

Process Pump

RPH-RO

100-180
150-230
200-280 / 401
250-401 / 501
300-400
350-400

Installation/Operating Manual



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Installation/Operating Manual RPH-RO

Original operating manual

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Glossary

Back pull-out design

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

Back pull-out unit

Pump without pump casing; partly completed machinery

Certificate of decontamination

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

Discharge line

The line which is connected to the discharge nozzle

Hydraulic system

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

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 line which is connected to the suction nozzle

1 General

1.1 Principles

This operating manual is supplied as an integral part of the type series and variants indicated on the front cover. The 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 uniquely identify the pump (set) and serve as identification for all further business processes.

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

Noise characteristics see (⇒ Section 4.6, Page 16)

1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance.

1.3 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇒ Section 2.4, Page 9)

1.4 Other applicable documents

Table 1: Overview of other applicable documents

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

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









2 Safety

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

2.1 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

Symbol	Description
	DANGER This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
	WARNING This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
	CAUTION This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	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.

2.2 General

This manual contains general installation, operating and maintenance instructions that must be observed to ensure safe pump operation and prevent personal injury and damage to property.

The safety information in all sections of this manual must be complied with.

This manual must be read and completely understood by the specialist personnel/operators responsible prior to installation and commissioning.

The contents of this manual must be available to the specialist personnel at the site at all times.

Information attached directly to the pump must always be complied with and be 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 in this manual.

2.3 Intended use

The pump (set) must only be operated within the operating limits described in the other applicable documents. (⇒ Section 1.4, Page 6)

- 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 to handle the fluids described in the data sheet or product literature of the pump model.
- Never operate the pump without the fluid handled.
- Observe the minimum flow rates indicated in the data sheet or product literature (to prevent overheating, bearing damage, etc).

- Observe the maximum flow rates indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- 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.

Prevention of foreseeable misuse

- Never open discharge-side shut-off elements further than permitted.
 - The maximum flow rate specified in the data sheet or product literature would be exceeded.
 - Risk of cavitation damage
- Never exceed the permissible operating limits specified in the data sheet or product literature regarding pressure, temperature, etc.
- Observe all safety information and instructions in this manual.

2.4 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.

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

- Non-compliance with this operating manual 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

2.6 Safety awareness

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

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

2.7 Safety information for the operator/user

- The operator shall fit contact guards for hot, cold and moving parts and check that the guards function properly.
- Do not remove any 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 shutting down 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.

2.8 Safety information for maintenance, inspection and installation work

- Modifications or alterations of the pump are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts authorised by the manufacturer. The use of other parts can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that all maintenance, inspection and installation work is 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.
- The pump casing must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual. (⇒ Section 6.3, Page 32)
- Decontaminate pumps which handle fluids posing a health hazard. (⇒ Section 7.3, Page 38)
- As soon as the work has been completed, re-install and/or re-activate any safety-relevant and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇒ Section 6.1, Page 26)

2.9 Unauthorised modes of operation

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



The warranty relating to the operating reliability and safety of the supplied pump (set) is only valid if the equipment is used in accordance with its intended use. (⇒ Section 2.3, Page 8)

3 Transport/Temporary 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 (as applicable) and the insurer about the damage in writing immediately.

3.2 Transport

	<div style="background-color: #e67e22; color: white; padding: 5px; border: 1px solid black;">  DANGER </div> <p>The pump (set) could slip out of the suspension arrangement Danger to life from falling parts!</p> <ul style="list-style-type: none"> ▷ Always transport the pump (set) in the specified position. ▷ Never attach the suspension arrangement to the free shaft end or the motor eyebolt. ▷ Give due attention to the weight data and the centre of gravity. ▷ Observe the applicable local health and safety regulations. ▷ Use suitable, permitted lifting accessories, e.g. self-tightening lifting tongs.
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To transport the pump/pump set or back pull-out unit suspend it from the lifting tackle as shown.

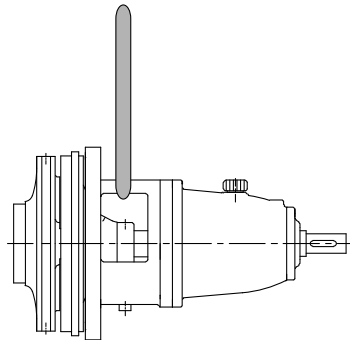


Fig. 1: Transporting the back pull-out unit

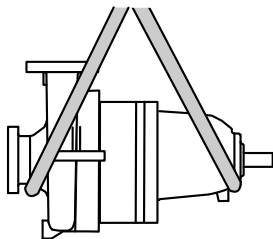


Fig. 2: Transporting the pump

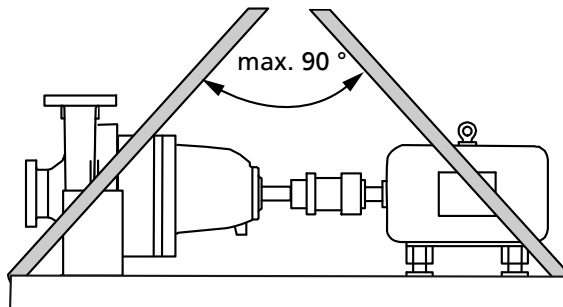


Fig. 3: Transporting the complete pump set

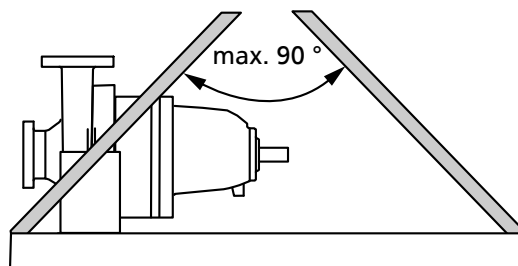




Fig. 4: Transporting the pump on the baseplate

3.3 Storage/preservation

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

	<p>CAUTION</p> <p>Damage during storage due to humidity, dirt, or vermin Corrosion/contamination of the pump (set)!</p> <ul style="list-style-type: none"> ▷ For outdoor storage cover the packed or unpacked pump (set) and accessories with waterproof material.
	<p>CAUTION</p> <p>Wet, contaminated or damaged openings and connections Leakage or damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Only remove caps/covers from the openings of the pump set at the time of installation.

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, observe the instructions in .

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇒ Section 7.3, Page 38)
2. Always flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump set has handled fluids whose residues could lead to corrosion in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump set 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 (set).
Always indicate any safety and decontamination measures taken.
(⇒ Section 11, Page 55)

	<p>NOTE</p> <p>If required, a blank certificate of decontamination can be downloaded from the following web site: www.ksb.com/certificate_of_decontamination</p>
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3.5 Disposal

	<div style="background-color: #f4a460; padding: 5px;"> WARNING</div> <p>Fluids, consumables and supplies which are hot and/or pose a health hazard Hazard to persons and the environment!</p> <ul style="list-style-type: none"> ▷ Collect and properly dispose of flushing fluid and any residues of the fluid handled. ▷ Wear safety clothing and a protective mask if required. ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.
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1. Dismantle the pump (set).
Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
 - Metals
 - Plastics
 - Electronic waste
 - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

4 Description of the Pump (Set)

4.1 General description

Pump for use in the high-pressure circuit of an isobaric energy recovery system of a seawater reverse osmosis plant.

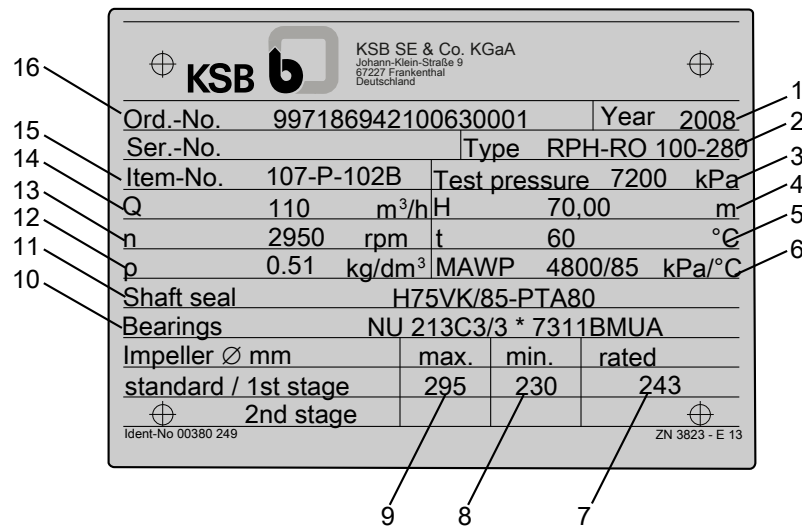
4.2 Designation

Example: RPH-RO 150-230

Table 4: Key to the designation

Code	Description
RPH	Type series
150	Nominal discharge nozzle diameter [mm]
230	Nominal impeller diameter [mm]
RO	Reverse osmosis

4.3 Name plate



KSB SE & Co. KGaA Johann-Klein-Straße 9 67227 Frankenthal Deutschland			
Ord.-No.	997186942100630001	Year	2008
Ser.-No.	Type RPH-RO 100-280		
Item-No.	107-P-102B	Test pressure	7200 kPa
Q	110 m ³ /h	H	70,00 m
n	2950 rpm	t	60 °C
p	0.51 kg/dm ³	MAWP	4800/85 kPa/°C
Shaft seal H75VK/85-PTA80			
Bearings NU 213C3/3 * 7311BMUA			
Impeller Ø mm	max.	min.	rated
standard / 1st stage	295	230	243
2nd stage			
Ident-No 00380 249		ZN 3823 - E 13	

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

4.4 Design details

Design

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

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
- Axial inlet nozzle, tangential discharge nozzle pointing vertically upwards.
(From DN 250 / from impeller diameter 500 / pump size 200-401: radial discharge nozzle pointing vertically upwards)
- Volute casing with casing wear ring

Impeller type

- Closed radial impeller
- Impeller with impeller wear ring on the suction side

Shaft seal

- KSB mechanical seal

Bearings

- Uncooled

Optional:

- Cooled bearing bracket

Drive-end bearing:

- Fixed bearing
- Paired angular contact ball bearing (triple bearing assembly)
- Axial movement of the rotor limited to 0.5 mm maximum
- Oil bath lubrication
- **Optional:** oil mist lubrication

Pump-end bearing:

- Radial bearing
- Cylindrical roller bearing
- Absorbs radial loads only
- Oil bath lubrication
- **Optional:** oil mist lubrication

Bearing bracket designation Example: B03

Table 5: Bearing bracket designation

Designation	Description
B	Back pull-out bearing bracket
03	Size code (based on dimensions of seal chamber, shaft end and bearings)

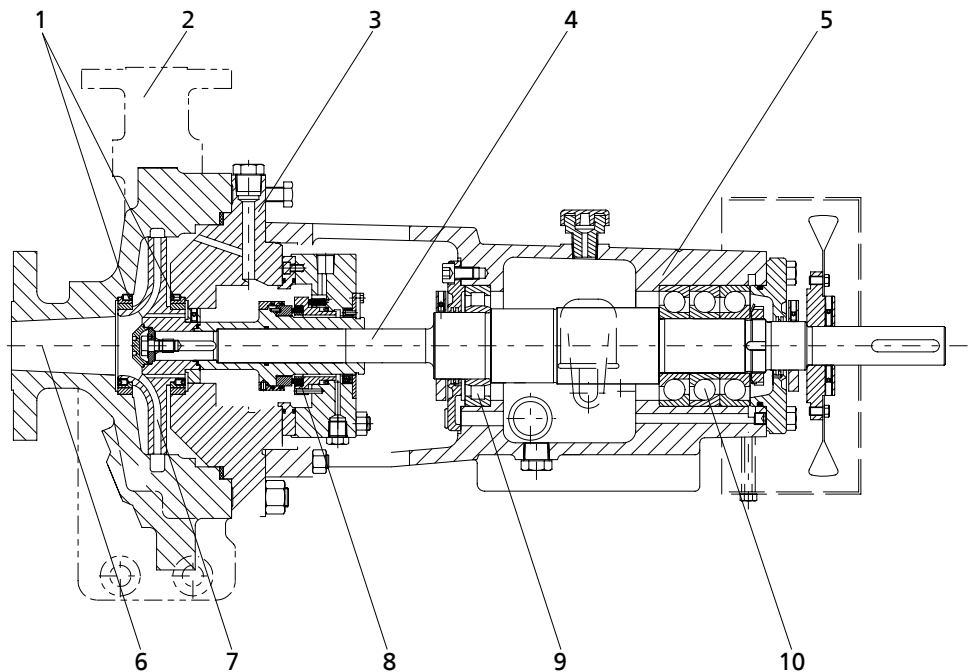
Bearings used Table 6: Bearing design

KSB designation	FAG designation	SKF designation
B.MUA	B-MP-UA	BECBM

Table 7: Reinforced bearing assembly (triple bearing assembly)

Bearing bracket	Rolling element bearings	
	Pump end	Motor end
B03	NU211EIC3	3 x 7311B-MUA
B05	NU211EIC3	3 x 7315B-MUA
B06	NU211EIC3	3 x 7224B-MUA
B07	NU211EIC3	3 x 7324B-MUA

4.5 Configuration and function



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

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

Function The fluid enters the pump axially via the suction nozzle (6) and is accelerated outward by the rotating impeller (7). In the flow passage of the 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 pump casing into the suction nozzle. At the rear side of the impeller, the shaft (4) enters the hydraulic system via the casing cover (3). The shaft passage through the cover is sealed 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) connected to the casing cover.

Sealing The pump is sealed by a KSB mechanical seal.

4.6 Noise characteristics

Table 8: Surface sound pressure level $L_{pA}^{2)3)}$

Rated power input P_N [kW]	Pump			Pump set		
	960 rpm 760 rpm [dB]	1450 rpm [dB]	2900 rpm [dB]	960 rpm 760 rpm [dB]	1450 rpm [dB]	2900 rpm [dB]
1,5	52	53	54	56	58	63
2,2	53	55	56	58	60	66
3	55	56	57	60	62	68

- 2) Spatial average; as per ISO 3744 and EN 12639; valid for pump operation in the $Q/Q_{opt} = 0.8 - 1.1$ range and for non-cavitating operation. If noise levels are to be guaranteed: Add +3 dB for measuring and constructional tolerance.
- 3) Increase for 60 Hz operation: 3500 rpm +3 dB, 1750 rpm +1 dB, 1160 rpm ± 0 dB

Rated power input P_N [kW]	Pump			Pump set		
	960 rpm 760 rpm [dB]	1450 rpm [dB]	2900 rpm [dB]	960 rpm 760 rpm [dB]	1450 rpm [dB]	2900 rpm [dB]
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
290	-	80	81	-	80	85
340	-	81	82	-	81	86
385	-	81	82	-	81	86
480	-	82	83	-	82	87

4.7 Scope of supply

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



- Pump
- Coupling** ▪ Torsion-resistant flexible disc coupling
- Contact guard** ▪ Coupling guard
- Baseplate** ▪ Welded baseplate for the complete unit (pump and motor), in torsion-resistant design
- Special accessories** ▪ As required

4.8 Dimensions and weights

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



5 Installation at Site

5.1 Safety regulations

	 DANGER
	<p>Installing electric equipment (motors) in potentially explosive atmospheres Risk of explosion!</p> <ul style="list-style-type: none"> ▸ Comply with the applicable local explosion protection regulations. ▸ Verify the test certificate of the motor. ▸ Keep the test certificate close to the location of operation (e.g. in the foreman's office).

5.2 Checks to be carried out prior to installation

Place of installation

	 WARNING
	<p>Installation on mounting surface which is unsecured and cannot support the load Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▸ Use a concrete of compressive strength class C12/15 which meets the requirements of exposure class XC1 to EN 206-1. ▸ The mounting surface must have set and must be completely horizontal and even. ▸ 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.

5.3 Installing the pump set

Always install the pump set in a horizontal position.

5.3.1 Installation on a foundation

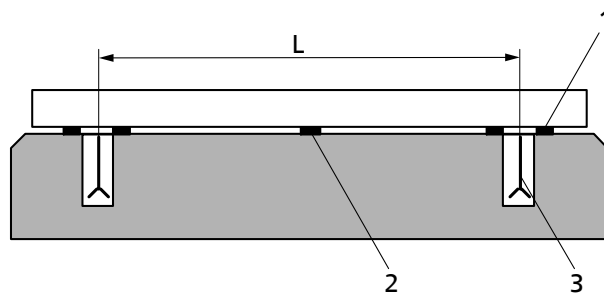




Fig. 6: Fitting the shims




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 DIN 1045.


	NOTE
	For low-noise operation the pump set can be mounted on vibration dampers upon confirmation by the manufacturer. In this case, only fasten the flexible elements at the baseplate after the piping has been connected.
	NOTE
	Expansion joints can be fitted between the pump and the suction/discharge line.

5.4 Piping

5.4.1 Connecting the piping

	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Impermissible loads acting on the pump nozzles Danger to life from leakage of hot, toxic, corrosive or flammable fluids!</p> <ul style="list-style-type: none"> ▷ Do not use the pump as an anchorage point for the piping. ▷ Anchor the pipelines in close proximity to the pump and connect them without transmitting any stresses or strains. ▷ Observe the permissible forces and moments at the pump nozzles. ▷ Take appropriate measures to compensate thermal expansion of the piping.
	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Incorrect earthing during welding work at the piping Destruction of rolling element bearings (pitting effect)!</p> <ul style="list-style-type: none"> ▷ Never earth the electric welding equipment on the pump or baseplate. ▷ Prevent current flowing through the rolling element bearings.
	<div style="background-color: #2980b9; color: white; padding: 5px;">NOTE</div> <p>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.</p>

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

	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Welding beads, scale and other impurities in the piping Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Remove any impurities from the piping. ▷ If necessary, install a filter. ▷ Observe the information in (⇒ Section 7.2.2.3, Page 36) .
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1. Thoroughly clean, flush and blow through all vessels, pipelines and connections (especially of new installations).
2. Before installing the pump in the piping, remove the flange covers on the suction and discharge nozzles of the pump.
3. Check that the inside of the pump is free from any foreign objects. Remove any foreign objects.

4. If required, install a filter in the piping (see figure: Filter in the piping).

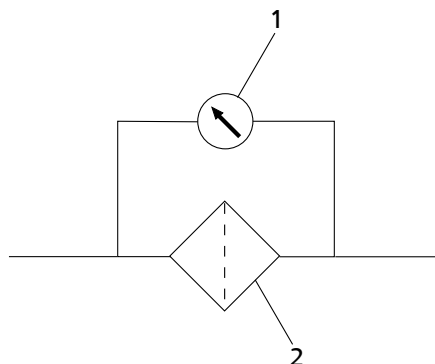


Fig. 7: Filter in the piping

1	Differential pressure gauge	2	Filter
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NOTE

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

5. Connect the pump nozzles to the piping.



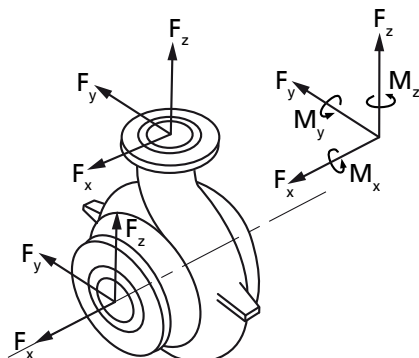
CAUTION

Aggressive flushing and pickling agents

Damage to the pump!

- Match the cleaning operation mode and duration for flushing and pickling service to the casing and seal materials used.

5.4.2 Permissible forces and moments at the pump nozzles




The pumps are designed for handling large pipeline forces and moments.

Table 9: Forces and moments at the pump nozzles



Size	Suction nozzle								Discharge nozzle							
	Forces [N]				Moments [Nm]				Forces [N]				Moments [Nm]			
	F _x	F _y	F _z	F _{res}	M _x	M _y	M _z	M _{res}	F _x	F _y	F _z	F _{res}	M _x	M _y	M _z	M _{res}
100-180	6220	4980	4100	8960	4600	2360	3520	6260	2840	2320	3560	5120	2660	1360	2000	3600
150-230	9780	7560	6220	13840	7060	3520	5160	9420	4980	4100	6220	8960	4600	2360	3520	6260
200-280	13340	10680	8900	19260	10040	4880	7600	13500	7560	6220	9780	13840	7060	3520	5160	9420
200-401	13340	10680	8900	19260	10040	4880	7600	13500	7560	6220	9780	13840	7060	3520	5160	9420
250-401	16000	13340	10680	23400	12200	5960	9220	16420	10680	8900	13340	19260	10040	4880	7600	13500
250-501	16000	13340	10680	23400	12200	5960	9220	16420	10680	8900	13340	19260	10040	4880	7600	13500

Size	Suction nozzle								Discharge nozzle							
	Forces				Moments				Forces				Moments			
	[N]				[Nm]				[N]				[Nm]			
	F _x	F _y	F _z	F _{res}	M _x	M _y	M _z	M _{res}	F _x	F _y	F _z	F _{res}	M _x	M _y	M _z	M _{res}
300-400	17800	14240	11560	25560	12740	6240	9500	17080	13340	10680	16000	23400	12200	5960	9220	16420
350-500	17800	14240	11560	25560	12740	6240	9500	17080	14240	11560	17800	25560	12740	6240	9500	17080


5.4.3 Auxiliary connections

	WARNING
	<p>Failure to use or incorrect use of auxiliary connections (e.g. barrier fluid, flushing liquid, etc.)</p> <p>Risk of injury from escaping fluid!</p> <p>Risk of burns!</p> <p>Malfunction of the pump!</p> <ul style="list-style-type: none"> ▷ Refer to the general arrangement drawing, the piping layout and pump markings (if any) for the quantity, dimensions and locations of auxiliary connections. ▷ Use the auxiliary connections provided.

5.5 Enclosure/insulation

	WARNING
	<p>The volute casing and casing/discharge cover take on the same temperature as the fluid handled</p> <p>Risk of burns!</p> <ul style="list-style-type: none"> ▷ Insulate the volute casing. ▷ Fit protective equipment.
	CAUTION
	<p>Heat build-up in the bearing bracket</p> <p>Damage to the bearing!</p> <ul style="list-style-type: none"> ▷ Never insulate the bearing bracket, bearing bracket lantern and casing cover.

5.6 Checking the coupling alignment

	CAUTION
	<p>Misalignment of pump and motor shafts</p> <p>Damage to pump, motor and coupling!</p> <ul style="list-style-type: none"> ▷ 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.

Checking the coupling alignment with a dial gauge

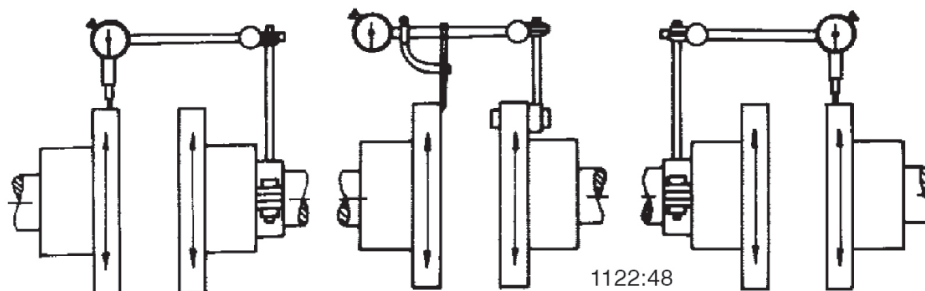


Fig. 8: Checking the spacer-type coupling with a dial gauge

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.

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 admissible run-out of the coupling face (axial) equals 0.1 mm.
The maximum admissible radial deviation, measured over the complete circumference, equals 0.2 mm.

5.7 Aligning the pump and motor

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

Any differences in shaft centre height between the pump and the motor are compensated by means of shims.

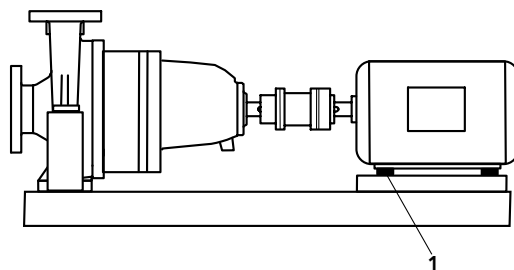



Fig. 9: Pump set with shim


- | | |
|---|------|
| 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! <ul style="list-style-type: none"> ▷ 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.


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

5.8 Electrical connection


	⚠ DANGER
	Work on the pump set by unqualified personnel Danger of death from electric shock! <ul style="list-style-type: none"> ▷ Always have the electrical connections installed by a trained and qualified electrician. ▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

	⚠ WARNING
	Incorrect connection to the mains Damage to the mains network, short circuit! <ul style="list-style-type: none"> ▷ Observe the technical specifications of the local energy supply companies.

1. Check the available mains voltage against the data on the name plate.
2. Select an appropriate start-up method.




	NOTE
	A motor protection device is recommended.

5.8.1 Connecting the motor

	NOTE
	In compliance with IEC 60034-8, three-phase motors are always wired for clockwise rotation (looking at the motor shaft stub). The pump's direction of rotation is indicated by an arrow on the pump.

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

5.9 Checking the direction of rotation

	<div>WARNING</div> <p>Hands inside the pump casing Risk of injuries, damage to the pump!</p> <ul style="list-style-type: none"> ▷ 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.
	<div>CAUTION</div> <p>Incorrect direction of rotation with non-reversible mechanical seal Damage to the mechanical seal and leakage!</p> <ul style="list-style-type: none"> ▷ Separate the pump from the motor to check the direction of rotation.
	<div>CAUTION</div> <p>Drive and pump running in the wrong direction of rotation Damage to the pump!</p> <ul style="list-style-type: none"> ▷ 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 motor and pump is clockwise (seen from the motor end).

1. Start the pump set 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 runs in the wrong direction of rotation, check the electrical connection of the motor and the control system, if necessary.

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 electric power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked.«
- 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 pump (set) to service have been carried out. (⇒ Section 6.4, Page 33)



6.1.2 Filling in lubricants

Oil-lubricated bearings Fill the bearing bracket with lubricating oil.

- Oil quality (⇒ Section 7.2.3.1.2, Page 37)
- Oil quantity (⇒ Section 7.2.3.1.3, Page 37)

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

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

	<p>NOTE</p> <p>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.</p>
	<p>CAUTION</p> <p>Insufficient quantity of lubricating oil in the reservoir of the constant level oiler</p> <p>Damage to the bearings!</p> <ul style="list-style-type: none"> ▷ Regularly check the oil level. ▷ Always fill the oil reservoir completely. ▷ Keep the oil reservoir properly filled at all times.

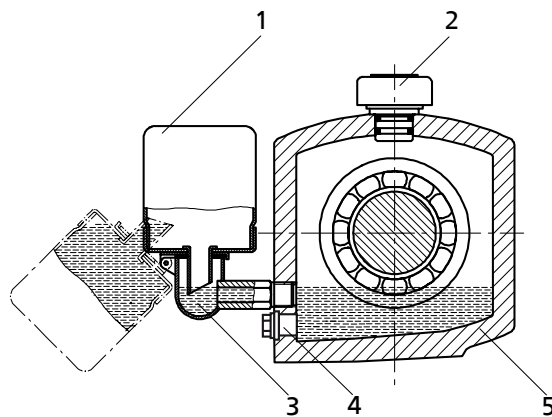


Fig. 10: Bearing bracket with constant level oiler

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

1. Remove the protective cage.
2. Unscrew the vent plug (2).
3. Hinge down the reservoir of the constant level oiler (1) from the bearing bracket (5) and hold it in this position.
4. Fill in oil through the hole for the vent plug until the oil reaches the connection elbow of the constant level oiler (3).
5. Completely fill the reservoir of the constant level oiler (1).
6. Snap the constant level oiler (1) back into its operating position.
7. Screw the vent plug (2) back in.
8. Fit the protective cage.
9. 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 - 8, if necessary.
10. 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.

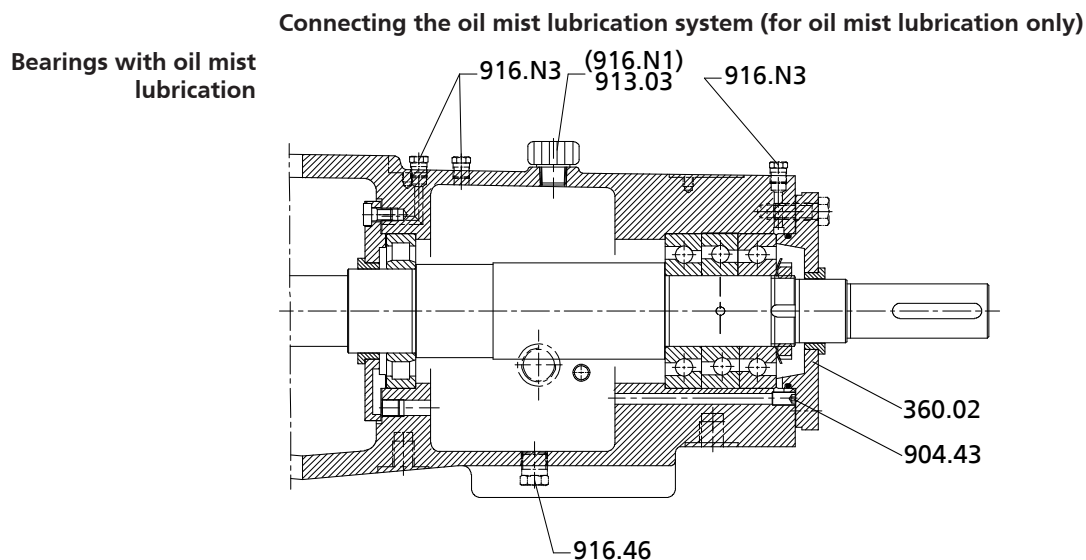


Fig. 11: Oil mist lubrication

✓ Always observe the instructions of the lubricating system manufacturer (especially on dosing and oil quantity).

1. Remove plugs 916.N3.
2. Connect the lines of the oil mist lubrication system.
3. Remove drain plug 916.46.
4. Connect the drain line (returning the oil back into the oil mist system).
5. Close with plug 916.N1.
6. Remove bearing cover 360.02 and replace grub screw 904.43 (M10x10) by grub screw (M10x25) to close the oil return bore if oil mist lubrication is used.

6.1.3 Shaft seal

Shaft seals are fitted prior to delivery.

Observe the instructions on dismantling or assembly (⇒ Section 7.5.3, Page 44) .

Reservoir of non-pressurised external fluid

If applicable, fill the reservoir of non-pressurised external fluid in accordance with the general arrangement drawing.

Double mechanical seal

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

External liquid feed

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

6.1.4 Priming and venting the pump


	<div style="background-color: #e67e22; color: white; padding: 5px; border: 1px solid black;"> DANGER </div> <p>Shaft seal failure caused by insufficient lubrication Hot or toxic fluid could escape! Damage to the pump!</p> <p>▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.</p>
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1. Vent the pump and suction line and prime both with the fluid to be handled.
2. Fully open the shut-off valve in the suction line.
3. Fully open all auxiliary connections (barrier fluid, flushing liquid, etc).


6.1.5 Final check

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


6.1.6 Start-up

	<div style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Abnormal noises, vibrations, temperatures or leakage Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Switch off the pump (set) immediately. ▷ Eliminate the causes before returning the pump set to service.
---	--

- ✓ The system piping has been cleaned.
- ✓ Pump, suction line and inlet tank, if any, have been vented and primed with the fluid handled.
- ✓ The filling and venting lines have been closed.

	<div style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Start-up against open discharge line Motor overload!</p> <ul style="list-style-type: none"> ▷ 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. Switch on the motor.
4. Immediately after the pump has reached full rotational speed, slowly open the shut-off valve in the discharge line and adjust it to comply with the duty point.

	<div style="background-color: #FF4500; padding: 5px;">! DANGER</div> <p>Seal leakage at operating temperature Hot or toxic fluid may escape!</p> <ul style="list-style-type: none"> ▷ Once the operating temperature has been reached, re-tighten the hexagon nuts at the casing/discharge cover. ▷ Check the coupling alignment. Re-align the coupling if required.
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5. When the operating temperature has been reached and/or in the event of leakage, switch off the pump set and let it cool down. Then re-tighten the bolts between lantern and casing.
6. Check the coupling alignment. Re-align the coupling if required.

6.1.7 Checking the shaft seal

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

6.1.8 Shutdown


- ✓ The shut-off element in the suction line is and remains open.
 - ✓ On pump sets with double mechanical seal, apply the required pressure specified in the general arrangement drawing to the mechanical seal chamber also during standstill.
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.
 3. Flush the pump using non-corrosive water with a low salt content.

	NOTE If the discharge line is equipped with a check valve, the shut-off element in the discharge line may remain open, provided the site's requirements and regulations are taken into account 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 periods of standstill (> 1 hour):

1. Close the shut-off element in the suction line.
2. Close any auxiliary lines.
If the fluid to be handled is fed in under vacuum, also supply the shaft seal with barrier fluid during standstill.
Only turn off the cooling liquid supply after the pump has cooled down.
3. Flush the pump using non-corrosive water with a low salt content (if necessary, customary preservation chemicals (e.g. hydrogen sulphite) can be used in SWRO plants).

In the case of prolonged shutdown periods (> 1 week), the pump should be drained and preserved. Furthermore, the instructions in the engineering contractor's operating manual for the SWRO plant must be observed.

	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


6.2.1 Ambient temperature

Observe the following parameters and values during operation:

Table 10: Permissible ambient temperatures

Permissible ambient temperature	Value
Maximum	55 °C ⁴⁾
Minimum	See data sheet

4) If ambient temperatures exceed 50 °C, a fully synthetic oil must be used.


	<div style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Operation outside the permissible ambient temperature Damage to the pump (set)!</p> <p>▷ Observe the specified limits for permissible ambient temperatures.</p>
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6.2.2 Frequency of starts

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

Table 11: Frequency of starts

Motor rating [kW]	Maximum number of start-ups [Start-ups/hour]
up to 12	15
up to 100	10
more than 100	5

	<div style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Re-starting while motor is still running down Damage to the pump (set)!</p> <p>▷ Do not re-start the pump set before the pump rotor has come to a standstill.</p>
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6.2.3 Fluid handled

6.2.3.1 Flow rate

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

Q_{\max} ⁵⁾ See characteristic curves.

Q_{\min} ⁶⁾ = $0.3 \times Q_{\text{opt}}$ ⁷⁾

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

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

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

Table 12: Key


Symbol	Description	Unit
c	Specific heat capacity	J/kg K
g	Gravitational constant	m/s ²
H	Pump discharge head	m

5) Maximum permissible flow rate
6) Minimum permissible flow rate
7) Best efficiency point

Symbol	Description	Unit
T_f	Fluid temperature	°C
T_o	Temperature at the casing surface	°C
η	Pump efficiency at duty point	-
$\Delta\vartheta$	Temperature difference	K

6.2.3.2 Density of the fluid handled

The pump input power changes in proportion to the density of the fluid handled.



	CAUTION
	Impermissibly high density of the fluid handled Motor overload! <ul style="list-style-type: none"> ▷ Observe the information on fluid density indicated 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

	! WARNING
	Pump under pressure after shutting down the reverse osmosis plant Fluid could spurt out! <ul style="list-style-type: none"> ▷ Release the pressure via appropriate devices (see also the engineering contractor's documented procedure).
	NOTE
	The pump must be flushed after shutdown using non-corrosive water with a low salt content until the process fluid (in this case: seawater) has been entirely eliminated. The instructions in the engineering contractor's documented procedure must be observed as this pump is usually part of the "isobaric energy recovery system".

The pump (set) remains installed.

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

1. The pump set should be started up regularly, i.e. weekly, for approx. 1 min. The start-up procedure should ensure that the aqueous preservative solution inside the pump is eliminated.

The start-up intervals must be checked by duly qualified personnel and reduced or increased if necessary.

In the case of prolonged shutdown periods (> 1 week), the pump should be drained and preserved. Furthermore, the instructions in the engineering contractor's operating manual for the SWRO plant must be observed.

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

- ✓ The pump has been properly drained (⇒ Section 7.3, Page 38) and the safety instructions for dismantling the pump have been observed. (⇒ Section 7.4.1, Page 38)
- 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 and discharge nozzles.
It is advisable to then close the pump nozzles (e.g. with plastic caps or similar).
- 3. Oil or grease all exposed machined parts and surfaces of the pump (with silicone-free oil and grease, food-approved if required) to protect them against corrosion.
Observe the additional instructions (⇒ Section 3.3, Page 12) .




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.

Observe any additional instructions and information provided. (⇒ Section 3, Page 11)

6.4 Returning to service

For returning the equipment to service, observe the sections on commissioning/start-up (⇒ Section 6.1, Page 26) and the operating limits.




In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇒ Section 7, Page 34)

	 WARNING
	<p>Failure to re-install or re-activate protective devices Risk of personal injury from moving parts or escaping fluid!</p> <ul style="list-style-type: none"> ▷ As soon as the work is complete, re-install and/or re-activate any safety-relevant and protective devices.
	NOTE
	<p>If the pump has been out of service for more than one year, replace all elastomer seals.</p>


7 Servicing/Maintenance

7.1 Safety regulations

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

	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Unintentional starting of pump set Risk of injury by moving parts!</p> <ul style="list-style-type: none"> ▷ Ensure that the pump set cannot be started up unintentionally. ▷ Always make sure the electrical connections are disconnected before carrying out work on the pump set.
	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Fluids handled and supplies posing a health hazard and/or hot fluids handled and supplies Risk of injury!</p> <ul style="list-style-type: none"> ▷ 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.
	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Insufficient stability Risk of crushing hands and feet!</p> <ul style="list-style-type: none"> ▷ During assembly/dismantling, secure the pump (set)/pump parts to prevent tipping or falling 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.


	<div style="background-color: #0070c0; color: white; padding: 5px;">NOTE</div> <p>All maintenance, service and installation work can be carried out by KSB Service or authorised workshops. Find your contact in the attached "Addresses" booklet or on the Internet at "www.ksb.com/contact".</p>
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Never use force when dismantling and reassembling the pump set.

7.2 Maintenance/inspection


7.2.1 Supervision of operation


	<div style="background-color: #ffd966; padding: 5px;">CAUTION</div> <p>Increased wear due to dry running Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ 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
	<p>Impermissibly high temperature of fluid handled Damage to the pump!</p> <ul style="list-style-type: none"> ▸ 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.

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

- The pump must run quietly and free from vibrations at all times.
- Check the shaft seal.
- Check the static seals for leakage.
- Check the rolling element bearings for running noise.
Vibrations, noise and an increase in current input occurring during unchanged operating conditions indicate wear.
- Monitor the stand-by pump.
To make sure that the stand-by pumps are ready for operation, start them up once a week.
- Monitor the bearing temperature.
The bearing temperature must not exceed 100 °C (measured on the outside of the bearing bracket).

	CAUTION
	<p>Operation outside the permissible bearing temperature Damage to the pump!</p> <ul style="list-style-type: none"> ▸ The bearing temperature of the pump (set) must never exceed 100 °C (measured on the outside of the bearing bracket).

	NOTE
	<p>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).</p>

7.2.2 Inspection work

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

For checking the clearances remove impeller 230, if required
(⇒ Section 7.4.5, Page 40) .


If the clearance is larger than permitted (see the following table), fit new casing wear ring 502.01 and/or impeller wear ring 503.02.

The clearances given refer to the diameter.

Table 13: Clearances between impeller and casing and/or between impeller and casing cover

Size	Inner nominal diameter of the suction-side casing wear ring (rounded) [mm]	Clearance (standard) [mm]
100-180	165	0,6 _{-0,05}
150-230	195	0,7 _{-0,08}
200-280	225	0,7 _{-0,08}
200-401	250	0,6 _{-0,05}
250-401	330	0,75 _{-0,08}
250-501	310	0,6 _{-0,08}
300-400	330	0,75 _{-0,08}
350-400A	380	0,85 _{-0,1}
350-400B	350	0,85 _{-0,1}

7.2.2.3 Cleaning filters

	CAUTION
	<p>Insufficient inlet pressure due to clogged filter in the suction line</p> <p>Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Monitor contamination of filter with suitable means (e.g. differential pressure gauge). ▷ Clean filter at appropriate intervals.


7.2.2.4 Periodic flushing of the mechanical seal

Residues will collect in the atmosphere-side seal area, depending on the contents of fluid to be sealed off. These residues must be removed by regular flushing with clean water with a low salt content (e.g. permeate or drinking water). This will ensure the necessary movement of the primary ring.

Prior to every flushing procedure, the gap between the rotating shaft sleeve and the thrust ring must be visually inspected. Any leakage or leakage residues/crystals must be reported to the responsible KSB service centre immediately.

- Recommended interval during continuous operation: every 4 weeks, 15 minutes at 10 l/minute
- Flushing fluid: clean water with a low salt content and free from particles (e.g. permeate or drinking water)
- Flushing pressure: 2 – 4 bar

7.2.3 Lubrication and lubricant change of rolling element bearings

	CAUTION
	<p>Excessive temperatures as a result of bearings running hot or defective bearing seals</p> <p>Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ 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 14: Oil change intervals

Temperature at the bearing	First oil change	All subsequent oil changes ⁸⁾
Up to 70 °C	After 300 operating hours	After 8500 operating hours
70 °C - 80 °C	After 300 operating hours	After 4200 operating hours
80 °C - 90 °C	After 300 operating hours	After 2000 operating hours
90 °C - 100 °C	After 300 operating hours	After 2500 operating hours ⁹⁾

7.2.3.1.2 Oil quality



Table 15: 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 mm²/s
		Flash point (to Cleveland)	+175 °C
		Solidification point (pour point)	-15 °C
		Application temperature ¹⁰⁾	Higher than permissible bearing temperature
Fully synthetic oil	-	Application temperature	Minimum 100 °C ¹¹⁾

7.2.3.1.3 Oil quantity

Bearing bracket	Oil quantity bearing bracket [l]
B03	1,8
B05	2,5
B06	5,7
B07	4,7

7.2.3.1.4 Changing the oil

	 WARNING
	<p>Lubricants posing a health hazard and/or hot lubricants</p> <p>Hazard to persons and the environment!</p> <ul style="list-style-type: none"> ▷ 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.

8) At least once a year

9) Only for fully synthetic oil

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

11) For ambient temperatures higher than 50 °C

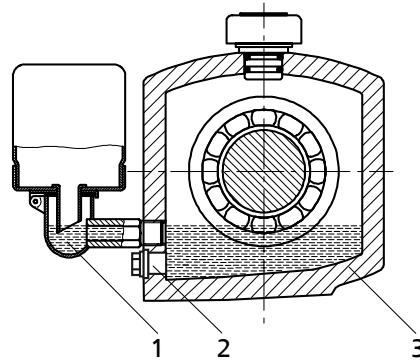


Fig. 12: Bearing bracket with constant level oiler

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.

7.3 Drainage/cleaning

	! WARNING
	Fluids, consumables and supplies which are hot and/or pose a health hazard Hazard to persons and the environment! <ul style="list-style-type: none"> ▷ Collect and properly dispose of flushing fluid and any residues of the fluid handled. ▷ 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 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! <ul style="list-style-type: none"> ▷ Always have repair and maintenance work performed by specially trained, qualified personnel.
	! WARNING
	Hot surface Risk of injury! <ul style="list-style-type: none"> ▷ 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 34)

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 staff.

	! DANGER
	Insufficient preparation of work on the pump (set) Risk of injury! ▷ Properly shut down the pump set. ▷ Close the shut-off elements in suction and discharge line. ▷ Drain the pump and release the pump pressure. (⇒ Section 7.3, Page 38) ▷ Close any auxiliary connections. ▷ Allow the pump set to cool down to ambient temperature.

7.4.2 Preparing the pump set

1. Interrupt the power supply and secure the pump against unintentional start-up.
2. Disconnect and remove all auxiliary pipework.
3. Remove the coupling guard.
4. Remove the coupling spacer, if any.
5. Drain the oil fill of oil-lubricated bearings. (⇒ Section 7.2.3.1.4, Page 37)


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 tilting Risk of crushing hands and feet! ▷ Suspend or support the motor to prevent it from tilting.

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

7.4.4 Removing the back pull-out unit

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

	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Back pull-out unit tilting Risk of crushing hands and feet!</p> <p>▷ Suspend or support the bearing bracket at the pump end.</p>
---	---

1. If required, suspend or support bearing bracket 330 to prevent it from tipping over.
2. Remove hexagon nut 920.01 at volute casing 102.
3. Use forcing screws 901.30 to pull the back pull-out unit out of volute casing 102.
4. Remove and dispose of O-ring 412.50.
5. Place the back pull-out unit on a clean and level surface.

7.4.5 Removing the impeller

7.4.5.1 Loosening the impeller – for bearing brackets B03 to B05

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 38) to (⇒ Section 7.4.4, Page 39) have been observed/carried out.
- ✓ The back pull-out unit is kept in a clean and level assembly area.
 1. Unscrew impeller nut 922.01 with threaded insert (right-hand thread).
 2. Remove and dispose of joint ring 411.31, if any.
 3. Remove lock washer 931.02.

7.4.5.2 Loosening the impeller – for bearing brackets B06 and B07

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 38) to (⇒ Section 7.4.4, Page 39) have been observed/carried out.
- ✓ The back pull-out unit is kept in a clean and level assembly area.
 1. Unscrew and remove impeller hub cap 260 (right-hand thread).
 2. Remove and dispose of joint ring 411.31.
 3. Bend open lock washer 931.02.
 4. Remove impeller screw 906 with lock washer 931.02 and disc 550.87.

7.4.5.3 Removing the impeller — for all bearing bracket sizes

- ✓ The notes and steps (⇒ Section 7.4.1, Page 38) stated in to (⇒ Section 7.4.4, Page 39) have been observed/carried out.
 1. Remove impeller 230 with an impeller removal tool.
 2. Place impeller 230 on a clean and level surface.
 3. Remove keys 940.01 from shaft 210.
 4. If throttling bush 542.02 is fitted, undo grub screws 904.38.
 5. Remove throttling bush 542.02, if any.


7.4.6 Removing the mechanical seal

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 38) to (⇒ Section 7.4.5.3, Page 40) have been observed/carried out.
- ✓ The back pull-out unit is kept in a clean and level assembly area.
 1. If assembling jigs are provided, loosen the hexagon head bolts for fitting the assembling jigs.
 2. Engage assembling jigs, if any, in the groove of shaft sleeve 523 and re-tighten the hexagon head bolts.
 3. Loosen hexagon head bolts 920.15 at casing cover 161.

4. Use forcing screws 901.31 to remove bearing bracket 330.
At the same time, pull shaft sleeve 523 (if any) with complete KSB mechanical seal 433 off shaft 210.
5. Undo hexagon nut 920.02 and remove seal cover 471.01 and/or the seal cartridge.
Observe the seal installation drawing of the mechanical seal.

7.4.7 Dismantling the bearings


- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 38) to (⇒ Section 7.4.6, Page 40) have been observed/carried out.
 - ✓ The bearing bracket has been placed in a clean and level assembly area.
1. Undo the hexagon socket head cap screw in the coupling hub.
 2. Pull the coupling half off the pump shaft with a puller.
 3. Remove key 940.02.
 4. Remove fan hood 882, fan hub 485.02 and fan wheel 831.02, if any.
 5. Undo hexagon nut 920.02 and remove seal cover 471.01 and/or the seal cartridge.
 6. Undo grub screws 904.41/42 and remove throwers 507.01/02.
 7. Undo hexagon socket head cap screws 914.01 and remove pump-end bearing cover 360.01 as well as joint ring 400.01.
 8. Undo hexagon head bolts 901.37 and remove motor-end bearing cover 360.02 as well as O-ring 412.22, if required.
 9. Carefully drive shaft 210 together with angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01, including oil thrower 508.01, if any, out of the bearing bracket towards the drive end.
 10. Remove cylindrical roller bearing 322.01 (roller cage) from bearing bracket 330.
 11. If oil thrower 508.01 is fitted, remove grub screw 904.20 and pull the oil thrower off the shaft.
 12. Bend open lock washer 931.01 behind slotted round nut 920.21 on shaft 210.
 13. Unscrew slotted round nut 920.21 (right-hand thread) and remove lock washer 931.01.


	<div style="background-color: #f4a460; padding: 5px;">! WARNING</div> <p>Hot surfaces due to heating of components for assembly/dismantling Risk of burns!</p> <ul style="list-style-type: none"> ▷ Wear heat-resistant protective gloves. ▷ Remove flammable substances from the danger zone.
---	--

14. 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.

7.5 Reassembling the pump set


7.5.1 General information/Safety regulations

	<div style="background-color: #f4a460; padding: 5px;">! WARNING</div> <p>Improper lifting/moving of heavy assemblies or components Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.
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	<div style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Improper reassembly Damage to the pump!</p> <ul style="list-style-type: none"> ▷ 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.

	<div style="background-color: #FFD700; padding: 5px;">CAUTION</div> <p>Contact of O-ring with graphite or similar material Fluid could escape!</p> <ul style="list-style-type: none"> ▷ Do not coat O-ring with graphite or similar material. ▷ Use animal fats or lubricants based on silicone or PTFE.
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- **Assembly adhesives**
 - For gaskets, avoid the use of assembly adhesives, if possible.
 - If assembly adhesives are required, use a commercially available contact adhesive (e.g. "Pattex").
 - Only apply adhesive at selected points and in thin layers.
 - Never use quick-setting adhesives (cyanoacrylate adhesives).
 - Coat the locating surfaces of the individual components and screwed connections with graphite or similar before reassembly.
- **Plug 916.01 / 916.16 (if any)**
 - To prevent corrosion damage, the plugs 916.01 and 916.16 must be glued in place with Loctite 567.

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

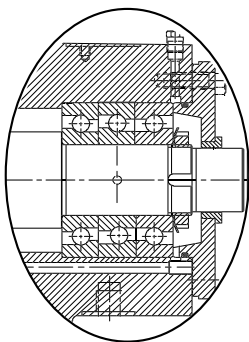




Fig. 13: Arrangement of the triple bearing assembly

7.5.2 Installing the bearings

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

	WARNING
	<p>Hot surfaces due to heating of components for assembly/dismantling</p> <p>Risk of burns!</p> <ul style="list-style-type: none"> ▷ Wear heat-resistant protective gloves. ▷ Remove flammable substances from the danger zone.

1. Heat up angular contact ball bearing 320.02 and the inner ring of cylindrical rolling element bearing 322.01 to approximately 80 °C in an oil bath.
2. Slide angular contact ball bearing 320.02 onto shaft 210 as far as it will go.
3. For bearing brackets B03 and B05 make sure that disc 550 is positioned correctly.
4. Slide the inner ring of cylindrical roller bearing 322.01 onto shaft 210 as far as it will go.

	NOTE
	<p>Angular contact ball bearings installed in pairs must always be from the same manufacturer.</p>

5. Use a C-spanner to tighten slotted round nut 920.21 (right-hand thread) without lock washer 931.01.
6. Let angular contact ball bearing 320.01 cool down to approximately 5 °C above ambient temperature.
7. Re-tighten slotted round nut 920.21, then unscrew it again.
8. 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.
9. Fit lock washer 931.01.
10. Tighten slotted round nut 920.21.
11. Bend back lock washer 931.01.
12. If provided, slide oil thrower 508.01 on shaft 210.
13. Screw grub screw 904.20 into oil thrower 508.01.
14. Slide cylindrical roller bearing 322.01 (roller cage) into bearing bracket 330.
15. Carefully insert shaft 210 together with angular contact ball bearing 320.02 and the inner ring of cylindrical roller bearing 322.01, including oil thrower 508.01 (if any) into bearing bracket 330 towards the pump end.
16. Insert O-ring 412.22 into the groove of motor-end bearing cover 360.02.
17. Insert motor-end bearing cover 360.02 with O-ring 412.22 into bearing bracket 330 from the motor end.
18. Screw hexagon head bolts 901.37 with bearing cover 360.02 into bearing bracket 330 from the motor end.
19. Fit pump-end bearing cover 360.01 with joint ring 400.01.
20. Screw socket head cap screws 914.01 into bearing bracket 330.
21. Slide thrower 507.01 onto shaft 210 from the pump end, leaving a 2 mm gap between the thrower and pump-end bearing cover 360.01.
22. Screw grub screw 904.41 into pump-end thrower 507.01.
23. Slide thrower 507.02 onto shaft 210 from the motor end, leaving a 2 mm gap between the thrower and motor-end bearing cover 360.02.
24. Screw grub screw 904.41 into motor-end thrower 507.02.
25. Fit fan hood 882, fan hub 485.02 and fan wheel 831.02, if any.
26. From the motor end, insert key 940.02 into the keyway at the shaft end.
27. Pull the coupling half onto the shaft end.
28. Screw the socket head cap screw into the coupling hub.

7.5.3 Fitting the shaft seal

7.5.3.1 Fitting the mechanical seal

Always observe the following points when installing the mechanical seal:

- Install the mechanical seal as described in the seal installation drawing.
 - Work cleanly and accurately.
 - Prevent any damage to the sealing surfaces or O-rings.
 - ✓ The notes and steps stated in to have been observed/carried out.
1. Fit seal cover 471 and/or the seal cartridge and tighten hexagon head bolts 920.02.
 2. Slide casing cover 161 with mechanical seal 433 onto shaft 210 from the pump end.
 3. Carefully slide complete pre-assembled bearing bracket 330 on studs 902.15 which have been screwed into casing cover 161.
 4. Screw casing cover 161 to complete bearing cover 330 with hexagon nuts 920.15.

7.5.4 Fitting the impeller

7.5.4.1 Fitting the impeller — for all bearing bracket sizes

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 41) to have been observed and carried out.
 - ✓ The back pull-out unit has been placed in a clean and level assembly area.
 - ✓ The pre-assembly (motor, shaft, bearing bracket, casing cover) has been placed in a clean and level assembly area.
 - ✓ All dismantled parts have been cleaned and checked for wear.
 - ✓ Any damaged or worn parts have been replaced by original spare parts.
 - ✓ The sealing surfaces have been cleaned.
1. If applicable, slide throttling bush 542.02 onto impeller 230.
 2. Screw grub screws 904.38 into throttling bush 542.02.
 3. Slide joint ring 411.32, if any, onto shaft 210.
 4. Place key 940.01 into the keyway of shaft 210.
 5. Slide impeller 230 onto shaft 210.


7.5.4.2 Fastening the impeller – for bearing brackets B03 to B05

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 41) to (⇒ Section 7.5.3, Page 44) have been observed/carried out.
 - ✓ The sealing surfaces have been cleaned.
1. Insert lock washer 931.02.
 2. Insert new joint ring 411.31, if applicable.
 3. Screw impeller nut 922.01 with threaded insert (right-hand thread) onto shaft 210.
Observe the tightening torques.
 4. Bend back the lock washer.

7.5.4.3 Fastening the impeller – for bearing brackets B06 and B07


- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 41) to (⇒ Section 7.5.4, Page 44) have been observed/carried out.
- ✓ The sealing surfaces have been cleaned.
 1. Insert disc 550.87 and lock washer 931.02.
 2. Screw impeller screw 906 into shaft 210.
 3. Observe the tightening torques.
 4. Bend back lock washer 931.02.
 5. Insert new joint ring 411.31 into impeller 230.
 6. Screw impeller hub cap 260 into impeller 230 (right-hand thread).

7.5.5 Installing the back pull-out unit

	<div style="background-color: #f4a460; padding: 5px;">! WARNING</div> <p>Back pull-out unit tilting Risk of crushing hands and feet!</p> <p>▷ Suspend or support the bearing bracket at the pump end.</p>
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- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 41) to (⇒ Section 7.5.4, Page 44) 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 without coupling, fit the coupling in accordance with the manufacturer's instructions.
 1. If required, prevent the back pull-out unit from tipping over, e.g. by suspending or supporting it. Then slide it into volute casing 102 with new O-ring 412.50.
 2. Tighten nut 920.01 at volute casing 102. Observe the tightening torques.

7.5.6 Mounting the motor

	<div style="background-color: #0070c0; color: white; padding: 5px;">NOTE</div> <p>Steps 1 and 2 do not apply to versions with spacer-type coupling.</p>
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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.
4. Connect the motor to the power supply (refer to manufacturer's product literature).

7.6 Tightening torques

Use a torque wrench to tighten the screwed connections (902.01/920.01) between the volute casing and the casing cover.

-
- 13) These values are determined on the basis of a friction coefficient of $\mu = 0.12$.
 14) After repeated tightening of the threads and in case of good lubrication the values shall be reduced by 15 % to 20 %.
 15) Re-tighten impeller nut 922.01 or impeller screw 906 some 20 to 30 minutes after assembly. Bend back lock washer 931.02.
 12) Stud to DIN 938/DIN 939 with hexagon nuts to ISO 4032.
 16) Values for 1.7709/A 193 Grade B7/B16/
 17) Values for 1.6772 (Monix 3K)/A 540 Grade B24
 18) Values for 1.4571/A 276 Type 316Ti

Table 16: Tightening torques of screwed connections

Material (Asia and Americas)		A 193 Grade B7/ B16/ A 540 Grade B24			A 193 Grade B7/ B16			10.9			--			CF6M/Type 316		
Material (Europe)		1.7709/1.6772 (Monix 3K)			C35E+QT			8.8			A4-70			1.4571/1.4021		
Bearing bracket	Size	Stud ¹⁵⁾ 902.01			Stud ¹²⁾ 902.15			Hexagon head bolt 901.37			Stud ¹²⁾ 902.02			Impeller nut 922.01 or impeller screw 906		
		Quantity	Thread	Tightening torque ^{13/14)} [Nm]	Quantity	Thread	Tightening torque ^{13/14)} [Nm]	Quantity	Thread	Tightening torque ¹³⁾ [Nm]	Quantity	Thread	Tightening torque ^{13/14)} [Nm]	Quantity	Thread	Tightening torque ^{13/15)} [Nm]
B03	100-180	12	M 16	163 ¹⁶⁾ / 280 ¹⁷⁾	4	M 20	168	4	M 12	77	4	M 16	133	1	M 20x1.5	250 ¹⁸⁾
	150-230	12	M 20	330 ¹⁶⁾ / 565 ¹⁷⁾	4	M 20	168	4	M 12	77	4	M 16	133	1	M 20x1.5	250 ¹⁸⁾
B05S	200-280	12	M 24	565 ¹⁶⁾ / 970 ¹⁷⁾	4	M 24	290	4	M 16	190	4	M 16	133	1	M 24x1.5	350 ¹⁸⁾
B05L	200-401	24	M 16	163 ¹⁶⁾ / 280 ¹⁷⁾	4	M 24	290	4	M 16	190	4	M 16	133	1	M 30x1.5	600 ¹⁸⁾
	250-401	24	M 16	163 ¹⁶⁾ / 280 ¹⁷⁾	4	M 24	290	4	M 16	190	4	M 16	133	1	M 30x1.5	600 ¹⁸⁾
	250-501	24	M 20	330 ¹⁶⁾ / 565 ¹⁷⁾	4	M 24	290	4	M 16	190	4	M 16	133	1	M 30x1.5	600 ¹⁸⁾
	300-400	24	M 20	330 ¹⁶⁾ / 565 ¹⁷⁾	4	M 24	290	4	M 16	190	4	M 16	133	1	M 30x1.5	600 ¹⁸⁾
B07	350-400	16	M 24	565 ¹⁶⁾ / 970 ¹⁷⁾	4	M 24	290	8	M 16	190	4	M 20	270	1	M 30x1.5	300 ¹⁸⁾ / 400

7.7 Spare parts stock

7.7.1 Ordering spare parts

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

- Type series
- Size
- KSB order number
- Material variant
- Year of construction

Refer to the name plate for all data. (⇒ Section 4.3, Page 14)

Also specify the following data:

- Description
- Part No.
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

Refer to the general assembly drawing for part numbers and descriptions.
(⇒ Section 9.1, Page 50)

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

Table 17: Quantity of spare parts for recommended spare parts stock

Part No.	Description	Number of pumps (including stand-by pumps)						
		2	3	4	5	6 and 7	8 and 9	10 and more
210	Shaft	1	1	1	2	2	2	20 %
230	Impeller	1	1	1	2	2	2	20 %
320.02	Angular contact ball bearing (set)	1	1	2	2	2	3	25 %
322.01	Cylindrical roller bearing	1	1	2	2	2	3	25 %
330	Bearing bracket	--	--	--	--	--	1	2
502.01	Casing wear ring	2	2	2	3	3	4	50 %
503.01	Impeller wear ring	2	2	2	3	3	4	50 %
542.02	Throttling bush	1	1	2	2	2	3	30 %
-	Sealing elements	4	6	8	8	9	10	100 %
433	Mechanical seal, complete	1	1	2	2	2	3	25 %



7.7.3 Interchangeability of pump components

Components featuring the same number in a column are interchangeable.

Table 18: Interchangeability of pump components

Bearing bracket	Size	Description																				
		Part No.																				
		102	161	210	230	260	320.02	322.01	330	360.01	360.02	412.50	433	471.01	502.01	503.01	507.01	507.02	508.01	542.01	906	922.01
B03	100-180	19	15	3	19	-	2	2	2	2	2	5	2	2	7	7	2	2	2	3	-	3
	150-230	22	20	3	22	-	2	2	2	2	2	2	2	2	9	9	2	2	2	3	-	3
B05S	200-280	28	24	4	28	-	3	3	3	3	3	5	3	3	11	11	3	3	3	4	-	4
B05L	200-401	33	28	5	33	-	3	3	3	3	3	7	3	3	14	14	3	3	3	5	-	5
	250-401	35	30	5	35	-	3	3	3	3	3	7	3	3	16	16	3	3	3	5	-	5
	250-501	36	31	5	36	-	3	3	3	3	3	6	3	3	17	17	3	3	3	5	-	5
	300-400	41	36	5	41	-	3	3	3	3	3	7	3	3	21	21	3	3	3	5	-	5
B07	350-400	44	37	7	44	1	4	4	4	4	4	7	4	4	29	27	4	4	4	6	1	-

8 Trouble-shooting

	<div style="background-color: #f4a460; padding: 5px; margin-bottom: 5px;">  WARNING </div> <p>Improper work to remedy faults Risk of injury!</p> <p>▷ For any work to remedy faults observe the relevant information in this manual or in the relevant accessory manufacturer's product literature.</p>
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If problems occur that are not described in the following table, consultation with KSB's customer service is required.

- A Pump delivers insufficient flow rate
- B Motor is overloaded
- C Excessive discharge pressure
- D Increased bearing temperature
- E Leakage at the pump
- F Excessive leakage at the shaft seal
- G Vibrations during pump operation
- H Impermissible temperature increase in the pump

Table 19: Trouble-shooting

A	B	C	D	E	F	G	H	Possible cause	Remedy ¹⁹⁾
X								Pump delivers against an excessively high pressure.	Re-adjust to duty point. Check system for impurities. Fit a larger impeller. ²⁰⁾ Increase the speed (turbine, I.C. engine).
X						X	X	Pump or piping are not completely vented or primed.	Vent and/or prime.
X								Supply line or impeller clogged	Remove deposits in the pump and/or piping.
X								Formation of air pockets in the piping	Alter piping layout. Fit vent valve.
X						X	X	Suction lift is too high/NPSH _{available} (positive suction head) is too low.	Check/alter fluid level. Install pump at a lower level. Fully open the shut-off element in the suction line. Change suction line, if the friction losses in the suction line are too high. Check any strainers installed/suction opening. Observe permissible speed of pressure fall.
			X					Increased axial thrust ²⁰⁾	Correct rotor adjustment.
X								Air intake at the shaft seal	Clean barrier fluid duct, supply external barrier fluid, if necessary, or increase barrier fluid pressure. Replace shaft seal.
X								Wrong direction of rotation	Check the electrical connection of the motor and the control system, if any.
X								Speed is too low. ²⁰⁾ - Operation with frequency inverter - Operation without frequency inverter	- Increase voltage/frequency at the frequency inverter in the permissible range. - Check voltage.
X						X		Impeller	Replace worn components by new ones.
	X					X		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. ²⁰⁾

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

20) Contact KSB.

A	B	C	D	E	F	G	H	Possible cause	Remedy ¹⁹⁾
	X							Density or viscosity of fluid handled higher than stated in purchase order	Contact KSB.
	X	X						Speed is too high.	Reduce speed. ²⁰⁾
				X				Defective gasket	Fit new gasket between volute casing and discharge cover.
					X			Worn shaft seal	Fit new shaft seal. Check flushing liquid/barrier fluid.
					X			Vibrations during pump operation	Correct suction conditions. Re-align the pump. Re-balance the impeller. Increase pressure at the pump suction nozzle.
			X		X	X		The pump set is misaligned.	Re-align.
			X		X	X		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.
			X			X		Insufficient or excessive quantity of lubricant or unsuitable lubricant.	Top up, reduce or change lubricant.
			X					Non-compliance with specified coupling distance	Correct distance according to general arrangement drawing.
X	X							Motor is running on two phases only.	Replace the defective fuse. Check the electric cable connections.
						X		Rotor out of balance	Clean the impeller. Re-balance the impeller.
						X		Defective bearing(s)	Replace.
						X	X	Flow rate is too low.	Increase the minimum flow rate.
					X			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 brackets B03 to B05

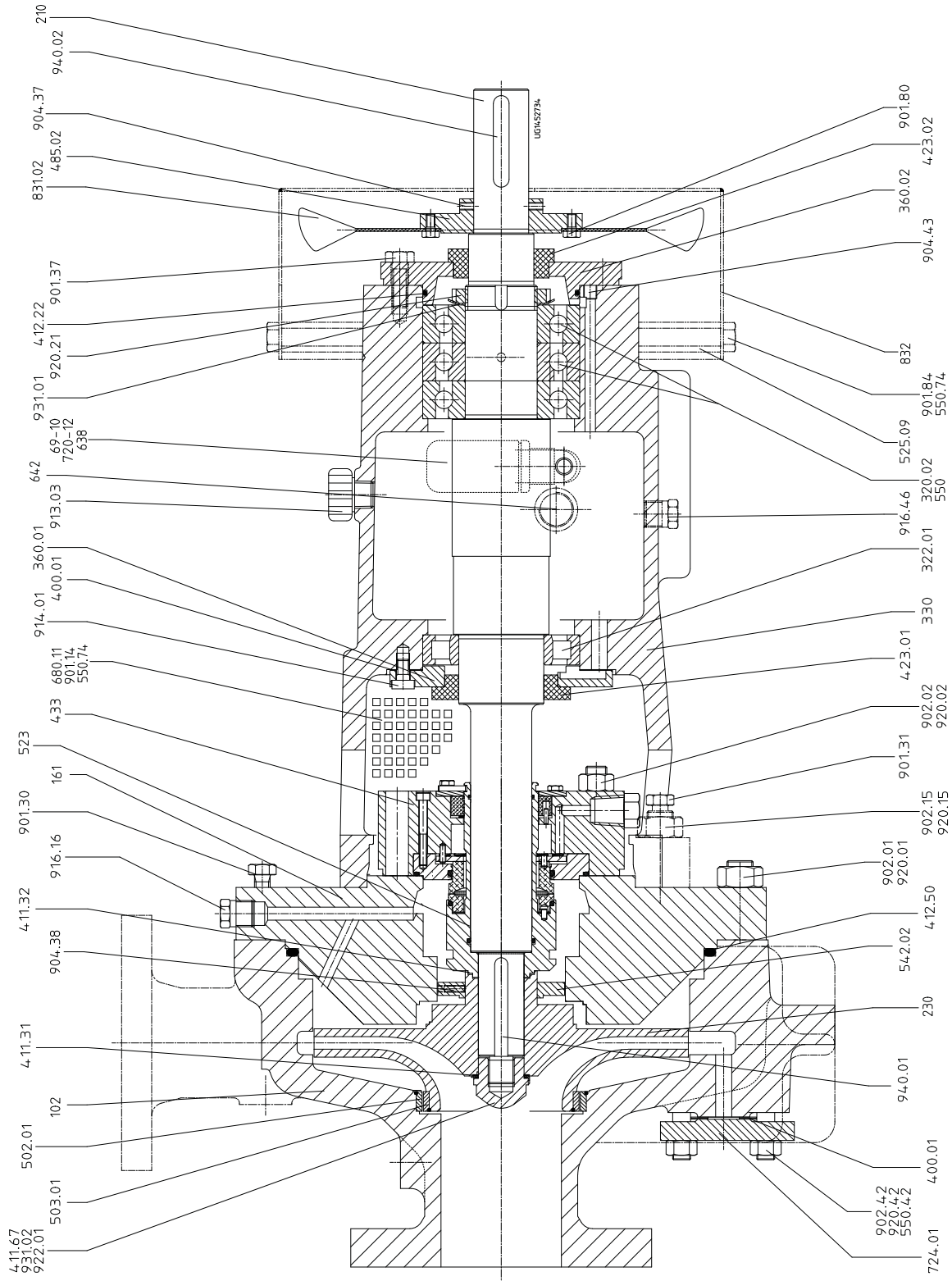


Fig. 14: Bearing brackets B03 to B05

9.1.2 Bearing brackets B06 and B07

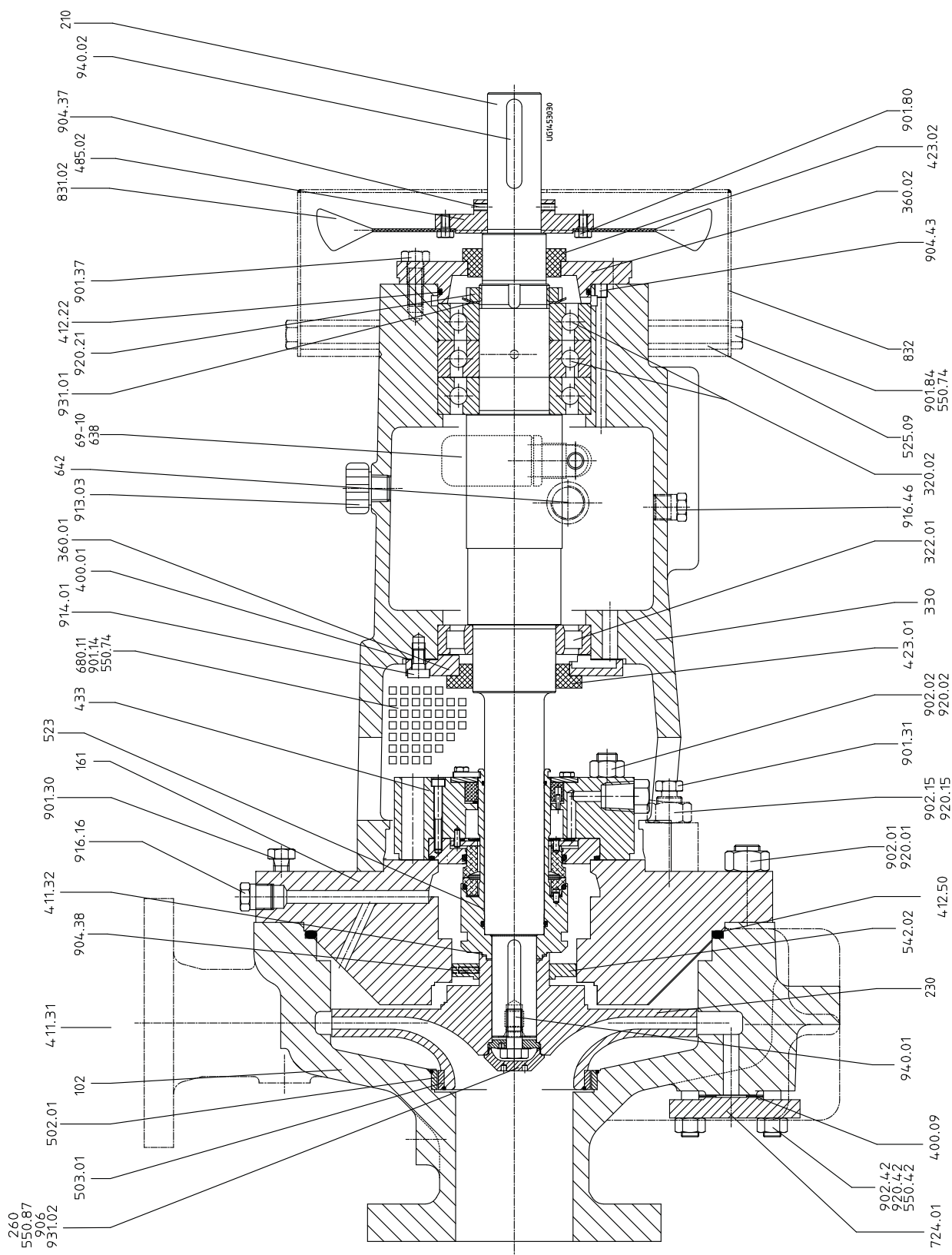


Fig. 15: Bearing brackets B06 and B07

Table 20: List of components

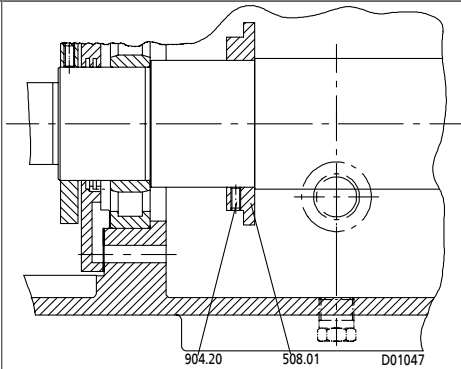
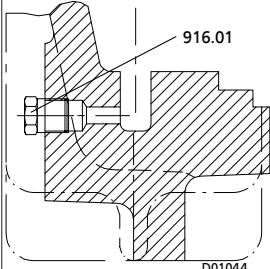
Part No.	Comprising	Description
102	102	Volute casing
	412.50	O-ring
	502.01	Casing wear ring
	902.01	Stud
	916.01	Plug
	920.01	Hexagon nut
161	161	Casing cover
	412.50	O-ring
	901.30	Hexagon head bolt
	902.15	Stud
	916.16	Plug
	920.15	Hexagon nut
210	210	Shaft
	920.21	Slotted round nut
	931.01	Lock washer
	940.01/.02	Key
230	230	Impeller
	411.31/.32/.67	Joint ring
	503.01	Impeller wear ring
	931.02	Lock washer
260 ²¹⁾	260	Impeller hub cap
	550.87	Disc
	906	Impeller screw
320.02	320.02	Angular contact ball bearing
	550	Adjusting washer
322.01	322.01 ²²⁾	Cylindrical roller bearing
330	330	Bearing bracket
	69.10	Protective cage
	360.01/.02	Bearing cover
	400.01	Gasket
	412.22	O-ring
	638	Constant level oiler
	642	Oil level sight glass
	710.21	Pipe
	901.31/.37	Hexagon head bolt
	913.03	Vent plug
	916.46	Plug
	914.01	Hexagon socket head cap screw
360.01/.02	360.01/.02	Bearing cover
	400.01	Gasket
	412.22	O-ring
	914.01	Hexagon socket head cap screw
400.09	400.09	Gasket
423.01/.02 ²³⁾	423.01/.02	Labyrinth ring
433	433	Mechanical seal
	523	Shaft sleeve

- 21) For bearing brackets B06 and B07 only
22) For bearing brackets B03 to B05 only
23) On pumps with fan only

Part No.	Comprising	Description
502.01	502.01	Casing wear ring
503.01	503.01	Impeller wear ring
507.01/.02 ²⁴⁾	507.01/.02 ²⁴⁾	Thrower
	904.41/.42 ²⁴⁾	Grub screw
542.02	542.02	Throttling bush
	904.38	Grub screw
550.42	550.42	Disc
638	638	Constant level oiler
680.11	680.11	Guard
	901.14	Hexagon head bolt
	550.74	Disc
724.01	724.01	Blind flange
831.02 ²⁵⁾	831.02	Fan impeller
	832	Fan hood
	485.02	Fan hub
	904.37	Grub screw
902.42	902.42	Stud
920.42	920.42	Hexagon nut
922.01 ²²⁾	922.01	Impeller nut
	931.02	Lock washer
99-9	99-9	Set of sealing elements, complete

9.1.3 Design variants

Table 21: Design variants

Design	Detailed view
Design with thrower	
Design with plug	

24) On pumps without fan only

25) Optional

10 EC Declaration of Conformity

Manufacturer:

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

The manufacturer herewith declares that the product:

RPH-RO

KSB order number:

- is in conformity with the provisions of the following Directives as amended from time to time:
 - Pump (set): Machinery Directive 2006/42/EC

The manufacturer also declares that

- the following harmonised international standards 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 EU Declaration of Conformity was issued in/on:

Place, date

.....²⁶⁾.....
Name
Function
Company
Address

26) A signed, legally binding EU Declaration of Conformity is supplied with the product.

11 Certificate of Decontamination

Type:
Order number/
Order item number²⁷⁾:
Delivery date:
Field of application:
Fluid handled²⁷⁾:

Please tick where applicable²⁷⁾:


☐

Radioactive


☐

Explosive


☐

Corrosive


☐

Toxic


☐

Harmful


☐

Bio-hazardous


☐

Highly flammable


☐

Safe

Reason for return²⁷⁾:
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, biological and radioactive substances.

On seal-less pumps, the rotor has been removed from the pump for cleaning.

- ☐ 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

27) Required fields

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