

Sprinkler Pump

## Multitec A SX

### Installation/Operating Manual



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Installation/Operating Manual Multitec A SX

Original operating manual

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## Glossary

### **Certificate of decontamination**

A certificate of decontamination certifies that the pump (set) 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

### **Drive**

Electric/hydraulic drive, diesel engine or turbine up to max. 4000 rpm

### **Hydraulic system**

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

### **Pool of pumps**

Pumps which are purchased and stored independently 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

### **Rotor**

Fully assembled unit of all rotating parts, without mechanical seal, rolling element bearings or plain bearings

### **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 18)

## 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 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)
Drawing of auxiliary connections	Description of auxiliary connections
Hydraulic characteristic curve	Characteristic curves showing head, NPSH required, efficiency and power input
General assembly drawing <sup>1)</sup>	Sectional drawing of the pump
Sub-supplier product literature <sup>1)</sup>	Operating manuals and other product literature of accessories and integrated machinery components
Spare parts lists <sup>1)</sup>	Description of spare parts
Piping layout <sup>1)</sup>	Description of auxiliary piping
List of components <sup>1)</sup>	Description of all pump components

## 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 to be included in the 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
 <b>DANGER</b>	<b>DANGER</b> This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
 <b>WARNING</b>	<b>WARNING</b> This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
<b>CAUTION</b>	<b>CAUTION</b> This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	<b>Explosion protection</b> This symbol identifies information about avoiding explosions in potentially explosive atmospheres in accordance with EC Directive 94/9/EC (ATEX).
	<b>General hazard</b> In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	<b>Electrical hazard</b> In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	<b>Machine damage</b> 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 install, operate, maintain and inspect the machinery this manual refers to.

The responsibilities, competence and supervision of all personnel involved in 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 or moving parts and check that the guards function properly.
- Do not remove any contact guards while the pump is running.
- Connect an earth conductor to the metal jacket if the fluid handled is electrostatically charged.
- 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.)

## 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 6.1.7, Page 33) (⇒ Section 6.3, Page 36)
- Decontaminate pumps which handle fluids posing a health hazard.
- 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 29)

## 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 9)

## 2.10 Explosion protection

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





Only pumps/pump sets marked as explosion-proof **and** identified as such in the data sheet may be used in potentially explosive atmospheres.

Special conditions apply to the operation of explosion-proof pump sets to EC Directive 94/9/EC (ATEX).

Especially adhere to the sections in this manual marked with the Ex symbol and the following sections (⇒ Section 2.10.1, Page 11) to (⇒ Section 2.10.4, Page 12) .

The explosion-proof status of the pump set is only assured if the pump set is used in accordance with its intended use.

Never operate the pump set outside the limits stated in the data sheet and on the name plate.

Prevent impermissible modes of operation at all times.

### 2.10.1 Marking

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

Example of such marking: II 2 G c TX

Refer to the Temperature Limits table for the temperatures permitted for the individual pump variants.

**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.

### 2.10.2 Temperature limits

In normal pump operation, the highest temperatures are to be expected on the surface of the pump casing, at the shaft seal and in the bearing areas. The surface temperature at the pump casing corresponds to the temperature of the fluid handled. If the pump is heated, the operator of the system is responsible for observing the specified temperature classes and fluid temperature (operating temperature). The table below lists the temperature classes and the resulting theoretical temperature limits of the fluid handled. (A possible temperature rise in the shaft seal area has already been taken into account).

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 as per EN 13463-1	Max. permissible fluid temperature
T1	200 °C
T2	200 °C
T3	185 °C
T4	120 °C
T5	85 °C
T6	on request only

**Temperature class T4** Based on an ambient temperature of 40°C, grease lubrication and proper maintenance and operation, compliance with temperature class T4 is warranted in the area of the rolling element bearings.

In the cases listed below, and if ambient temperatures exceed 40 °C, contact the manufacturer.

**Temperature classes T5 and T6** If temperature classes T5 and T6 have to be complied with, special measures may have to be taken with regard to bearing temperature.

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

A special design is required for compliance with temperature class T6.

If the pump is to be operated at a higher temperature, if there is no data sheet, or if the pump is part of a pool of pumps, contact KSB for the maximum permissible operating temperature.

### **2.10.3 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 on monitoring equipment.

### **2.10.4 Operating limits**

The minimum flows indicated in (⇒ Section 6.2.3, Page 35) 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 at the pump surface. However, if the physical properties of the fluids handled differ from those of 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, Page 35) (flow rate) can be used to check whether an additional heat build-up may lead to a dangerous temperature increase at the pump surface.

### 3 Transport/Temporary Storage/Disposal

#### 3.1 Transport

	<b>⚠ DANGER</b>
	<p><b>The pump (set) could slip out of the suspension arrangement</b>            Danger to life from falling parts!</p> <ul style="list-style-type: none"> <li>▷ Always transport the pump (set) in horizontal position.</li> <li>▷ Never attach the suspension arrangement to the free shaft end or the motor eyebolt.</li> <li>▷ Refer to the weights given in the general arrangement drawing.</li> <li>▷ Observe the local accident prevention regulations.</li> <li>▷ Use suitable, permitted lifting tackle, e.g. self-tightening lifting tongs.</li> </ul>

To transport the pump/pump set suspend it from the lifting tackle as shown.

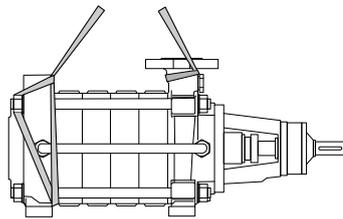


Fig. 1: Transporting the pump

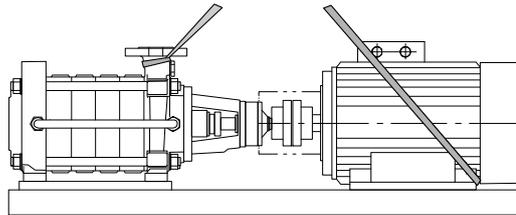


Fig. 2: Transporting the complete pump set

#### 3.2 Storage/preservation

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

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

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 three months (please refer to order or order confirmation).  
 New pumps/pump sets are supplied by our factory duly prepared for storage.  
 For storage periods exceeding three months, the pump set is preserved as specified in the purchase order (please refer to order or order confirmation).

### 3.3 Return to supplier

1. Drain the pump as per operating instructions.
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 fluids handled by the pump leave residues which might lead to corrosion damage when coming into contact with atmospheric humidity, or which might ignite when coming into contact with oxygen, the pump set must also be neutralised, and anhydrous inert gas must be blown through the pump for drying purposes.
4. Always complete and enclose a certificate of decontamination when returning the pump (set). (⇒ Section 11, Page 65)  
 Always indicate any safety and decontamination measures taken.

	<b>NOTE</b>
	If required, a blank certificate of decontamination can be downloaded from the KSB web site at: <a href="http://www.ksb.com/certificate_of_decontamination">www.ksb.com/certificate_of_decontamination</a>

### 3.4 Disposal

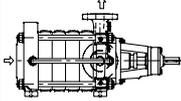
	<b>WARNING</b>
	<p><b>Fluids posing a health hazard and/or hot fluids</b>                  Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▷ Collect and properly dispose of flushing liquid and any residues of the fluid handled.</li> <li>▷ Wear safety clothing and a protective mask, if required.</li> <li>▷ Observe all legal regulations on the disposal of fluids posing a health hazard.</li> </ul>

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

- Sprinkler pump
- Multistage centrifugal pump in ring-section design with suction impeller for low NPSH value.

Type of installation	Drawing	Description
A		Horizontal design, baseplate mounted, one casing entry (drive end), rolling element bearings (drive end) and plain bearing (suction end), axial suction nozzle for the entire H/Q range

### 4.2 Designation

Example: Multitec A SX 100/3 - 8.1 25.65

Table 5: Key to the designation

Code	Description
Multitec	Type series
A	Type of installation
SX	Variant (SX = sprinkler pump)
100	Nominal discharge nozzle diameter [mm]
3	No. of stages / impeller combination
8.1	Hydraulic system
25	Material code
65	Seal code

### 4.3 Name plate

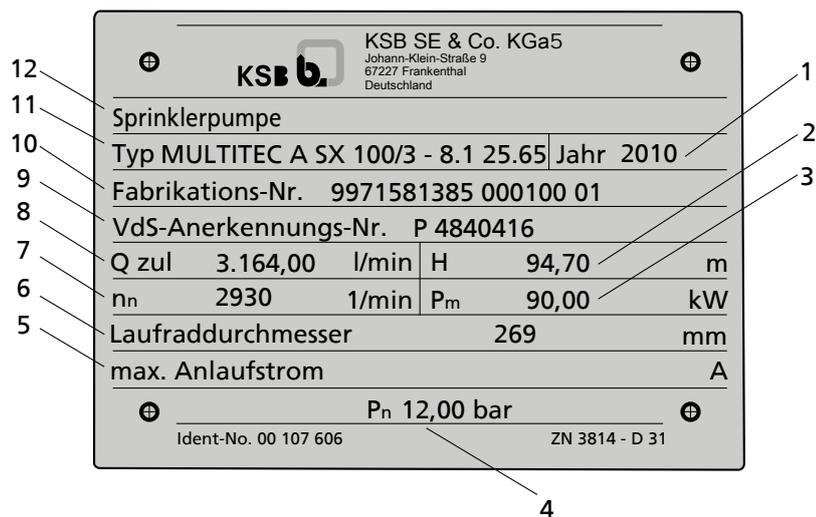


Fig. 3: Name plate

1	Year of construction	2	VdS approved head
3	Required motor rating at 15 m NPSH	4	Nominal pressure

5	Maximum starting current (only relevant for submersible borehole pumps)	6	Impeller diameter [mm]
7	Rated speed	8	VdS approved flow rate
9	VdS approval number	10	KSB order and order item number
11	Type series, size	12	Application

#### 4.4 Design details

##### Design

- Sprinkler pump
- High-pressure centrifugal pump
- Long-coupled (baseplate mounted) design
- Axial suction nozzle
- Radial discharge nozzle can be turned by 90°.
- Horizontal/vertical installation

##### Pump casing

- Radially split volute casing
- Casing in ring-section design

##### Impeller type

- Closed radial impeller with multiply curved vanes

##### Bearings

- Radial bearings are silicon carbide plain bearings.
- Self-aligning
- Plain bearing lubricated by fluid handled
- Fixed bearings are rolling element bearings.
- Grease or oil lubrication

##### Shaft seal

- Gland packing

	 <b>DANGER</b>
	<p><b>Excessive temperatures in the shaft seal area</b> Risk of explosion!</p> <ul style="list-style-type: none"> <li>▸ Never operate a pump (set) with gland packing in potentially explosive atmospheres.</li> </ul>

- Standardised mechanical seal to EN 12756

### 4.5 Configuration and function

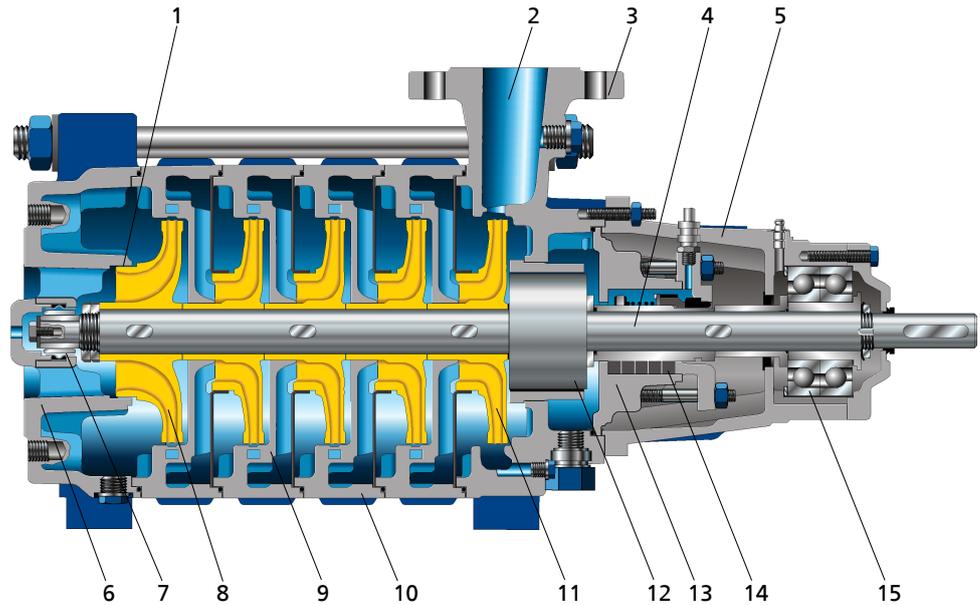


Fig. 4: Sectional drawing

1	Clearance gap	2	Discharge nozzle
3	Discharge casing	4	Shaft
5	Bearing housing	6	Suction casing
7	Plain bearing	8	(Suction) impeller
9	Diffuser	10	Stage casing
11	Impeller	12	Balance drum
13	Shaft seal housing	14	Shaft seal
15	Rolling element bearings		

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

**Function** The fluid enters the pump via the suction casing (6) and is accelerated outward in a cylindrical flow by the rotating (suction) impeller (8). In the flow passage of the stage casing (10) the kinetic energy of the fluid is converted into pressure energy and the fluid is routed to the next impeller (11) via the diffuser (9). This process is repeated in all stages until the fluid has passed the last impeller (11). It then passes through the discharge casing (3) to the discharge nozzle (2), from where it leaves the pump. The clearance gap (1) prevents any fluid from flowing back from the stage casing (10) into the suction range of the previous impeller. If required, a balance drum (12) is fitted behind the last impeller, providing axial thrust balancing by means of hydraulic forces. Behind the last impeller (11) and the balancing drum (12), the hydraulic system is closed off by a seal housing (13) through which the drive shaft (4) passes. The shaft passage through the seal housing (13) is sealed towards the atmosphere by a dynamic shaft seal (14). The drive shaft (4) is supported by rolling element bearings (15) and plain bearings (7) located in a bearing housing (5) and the suction casing (6), respectively. The bearing housing (5) is connected with the suction casing (6) and/or discharge casing (3).

**Sealing** The pump is sealed by a shaft seal.  
Standardised mechanical seal or gland packing

#### 4.6 Noise characteristics

**Table 6:** Surface sound pressure level  $L_{pA}$ <sup>2)3)</sup>

Rated power input $P_N$ [kW]	Pump	Pump set
	2900 rpm [dB]	2900 rpm [dB]
2.2	57	65
3.0	60	67
4.0	61	68
5.5	63	70
7.5	65	71
9	66	73
11	67	73
15	68	75
18.5	69	76
22	70	77
30	71	78
37	72	79
45	73	79
55	74	80
75	74	82
90	75	82
110	75	83
132	76	83
160	76	84
200	77	85
250	78	--
315	78	--

Noise characteristics for higher power ratings on request.

#### 4.7 Scope of supply

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

- Pump
- Drive** ▪ Electric / hydraulic drives, Diesel engines or turbines up to max. 4000 rpm
- Shaft coupling** ▪ Flexible coupling with or without spacer
- Contact guard** ▪ Coupling guard to EN 294

	<b>DANGER</b>
	<p><b>Risk of ignition by frictional sparks</b> Risk of explosion!</p> <ul style="list-style-type: none"> <li>▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact (see DIN EN 13463-1).</li> <li>▷ If any coupling parts are made of aluminium, a brass coupling guard must be used.</li> </ul>

- Baseplate**
  - Channel section steel, welded
  - U-rail
- Special accessories**
  - As required

2) Measured at a distance of 1 m from the pump outline (as per DIN 45635 Parts 1 and 24)  
 3) Increase for 60 Hz operation: 3500 rpm +3dB; 1750 rpm 1dB

#### **4.8 Dimensions and weights**

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

## 5 Installation at Site

### 5.1 Safety regulations

	 <b>DANGER</b>
	<p><b>Improper installation in potentially explosive atmospheres</b> Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▸ Comply with the applicable local explosion protection regulations.</li> <li>▸ Observe the information in the data sheet and on the name plates of pump and motor.</li> </ul>

For positioning, installing and operating sprinkler pumps, generally comply with the following fire protection standards and directives:

- VDS CEA 4001
- CEA 4001
- EN 12845
- NFPA 20
- FM GLOBAL

### 5.2 Checks to be carried out prior to installation

#### Place of installation

	 <b>WARNING</b>
	<p><b>Installation on foundations which are unsecured and cannot support the load</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▸ Make sure the foundation concrete is of sufficient strength (min. C12/15 to DIN 1045).</li> <li>▸ Only place the pump set on a foundation whose concrete has set firmly.</li> <li>▸ Only place the duckfoot bend on horizontal and level surfaces.</li> <li>▸ Refer to the weight given in the general arrangement drawing.</li> </ul>

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

	<b>CAUTION</b>
	<p><b>Warped baseplate or pump</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▸ Align the baseplate and the pump accurately and carefully when installing the pump set.</li> </ul>

5.3.1 Installation on the foundation

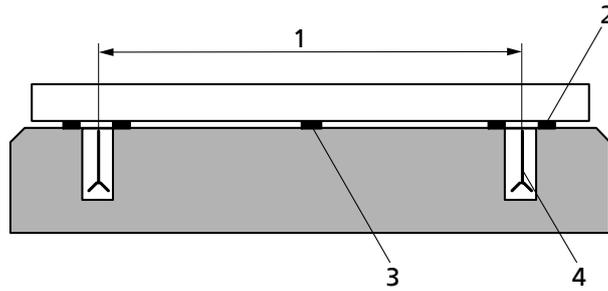


Fig. 5: Fitting the shims

1	Bolt-to-bolt clearance	2	Shim
3	Shim for bolt-to-bolt clearance > 800 mm	4	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 align it with the help of a spirit level placed on the shaft and discharge nozzle.  
Permissible deviation: 0.2 mm/m
  2. Use shims (2) for height compensation, if necessary.  
Always fit shims between the baseplate/foundation frame and the foundation itself; always insert them to the left and right of the foundation bolts (4) and in close proximity to these bolts.  
For a bolt-to-bolt clearance > 800 mm, fit additional shims (3) halfway between the adjoining holes.  
All shims must lie perfectly flush.
  3. Insert the foundation bolts (4) into the holes provided.
  4. Use concrete to set the foundation bolts (4) into the foundation.
  5. Wait until the concrete has set firmly, then align the baseplate.
  6. Tighten the foundation bolts (4) evenly and firmly.
  7. Grout baseplates > 400 mm using low-shrinkage concrete with a standard particle size and a water/cement ratio ≤ 0.5.  
Produce flowability with the help of a solvent.  
Perform secondary treatment of the concrete to DIN 1045.

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

	<b>NOTE</b>
	Expansion joints can be fitted between pump and suction/discharge line.

## 5.4 Piping

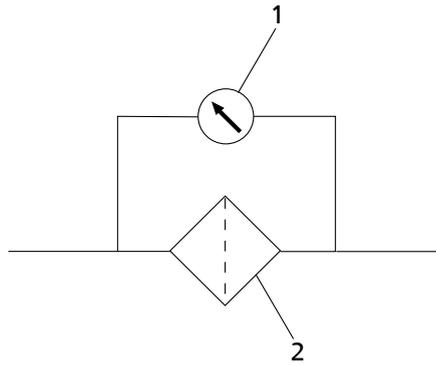
### 5.4.1 Connecting the piping

	<p><b>⚠ DANGER</b></p> <p><b>Impermissible loads acting on the pump nozzles</b>          Danger to life from leakage of hot, toxic, corrosive or flammable fluids!</p> <ul style="list-style-type: none"> <li>▷ Do not use the pump as an anchorage point for the piping.</li> <li>▷ Anchor the pipelines in close proximity to the pump and connect them without transmitting any stresses or strains.</li> <li>▷ Observe the permissible forces and moments at the pump nozzles.</li> <li>▷ Take appropriate measures to compensate thermal expansion of the piping.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Incorrect earthing during welding work at the piping</b>          Destruction of rolling element bearings (pitting effect)!</p> <ul style="list-style-type: none"> <li>▷ Never earth the electric welding equipment on the pump or baseplate.</li> <li>▷ Prevent current flowing through the rolling element bearings.</li> </ul>
	<p><b>NOTE</b></p> <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/suction head line has been laid with a rising/downward slope towards the pump.
- ✓ The nominal diameters of the pipelines are at least equal to the nominal diameters of the pump nozzles.
- ✓ To prevent excessive pressure losses, adapters to larger diameters have a diffuser angle of approx. 8°.
- ✓ 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.  
 Multitec A: Do not close the hole provided in the plain bearing cover.

	<p><b>CAUTION</b></p> <p><b>Welding beads, scale and other impurities in the piping</b>          Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Remove any impurities from the piping.</li> <li>▷ If necessary, install a filter.</li> <li>▷ Observe the information in (⇒ Section 7.2.2.3, Page 41) .</li> </ul>
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3. If required, install a filter in the piping (see illustration: Filter in the piping).



**Fig. 6:** Filter in the piping

1	Differential pressure gauge	2	Filter
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#### 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 with the piping.



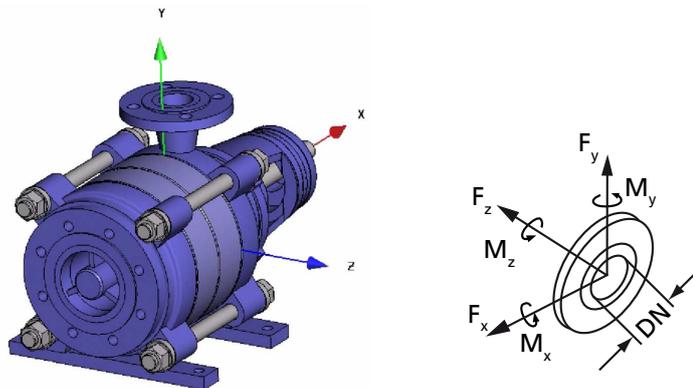
#### CAUTION

##### 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



**Fig. 7:** Forces and moments at the pump nozzles

Direction of forces	
$F_x$	horizontal, parallel to the pump axis
$F_y$	vertical to the pump axis
$F_z$	horizontal, at a right angle to the pump axis
Direction of moments	
$M_x$	around the horizontal axis, parallel to the pump axis
$M_y$	around the vertical nozzle axis
$M_z$	around the horizontal axis, at a right angle to the pump axis

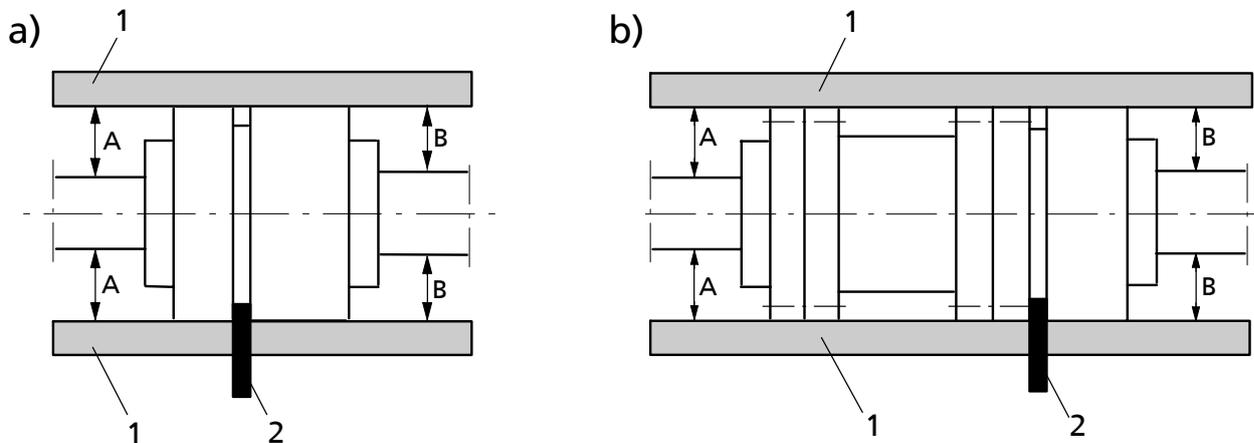
Suction and discharge nozzles must be regarded separately. Refer to the data sheet for the relevant suction and discharge nozzle diameters.

**Forces and moments at the pump nozzles**
**Table 7: Forces and moments at the pump nozzles (cast iron suction and discharge nozzles)**

DN	Vertical nozzle at a right angle to the shaft			Horizontal nozzle at a right angle to the shaft			Axial nozzle parallel to the shaft			Moments for all nozzles		
	$F_x$ [N]	$F_y$ [N]	$F_z$ [N]	$F_x$ [N]	$F_y$ [N]	$F_z$ [N]	$F_x$ [N]	$F_y$ [N]	$F_z$ [N]	$M_x$ [Nm]	$M_y$ [Nm]	$M_z$ [Nm]
100	1421	1778	1162	1421	1162	1778	-	-	-	1360	1000	686
150	1780	2220	1465	1780	1465	2220	2220	1465	1780	1640	1260	840

**5.5 Checking the coupling alignment**

	<b>⚠ DANGER</b>
	<b>Impermissible temperatures at the coupling or bearings caused by misalignment of the coupling</b> Explosion hazard! ▷ Make sure that the coupling is correctly aligned at all times.
	<b>CAUTION</b>
	<b>Misalignment of pump and motor shafts</b> Damage to pump, motor and coupling! ▷ Always check the coupling after the pump has been installed and connected to the piping. ▷ Also check the coupling of pump sets supplied with pump and motor mounted on the same baseplate.


**Fig. 8: a) Checking the coupling alignment and b) Aligning a spacer-type coupling**

1	Straight-edge	2	Wedge gauge
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- ✓ The coupling guard and step guard, if any, have been removed.
- 1. Loosen the support foot and re-tighten it without transmitting any stresses and strains.
- 2. Place the straight-edge axially on both coupling halves.

3. Leave the straight-edge in this position and turn the coupling by hand. The coupling is correctly aligned if the distances A) and B) to the respective shafts are the same at all points around the circumference. The radial and axial deviation of both coupling halves must not exceed 0.1 mm during standstill as well as at operating temperature and under inlet pressure.
4. Check the distance between the two coupling halves around the circumference. The coupling is correctly aligned if the distance between the two coupling halves is the same at all points around the circumference. The radial and axial deviation of both coupling halves must not exceed 0.1 mm during standstill as well as at operating temperature and under inlet pressure.

### 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 Motor with levelling screw

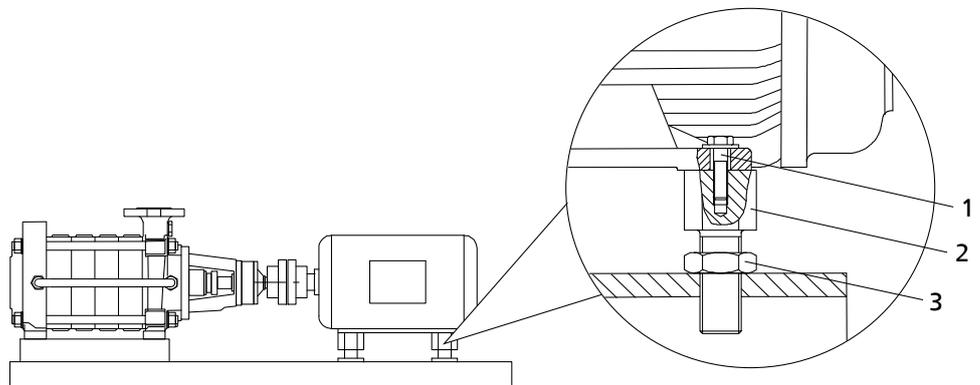


Fig. 9: Motor with levelling screw

1	Hexagon head bolt	2	Levelling screw
3	Lock nut		

- ✓ The coupling guard and step guard, 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 levelling screws (2) by hand or by means of an open-jawed wrench until the coupling alignment is correct.
- 4. Re-tighten the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
- 5. Check that the coupling and shaft can easily be rotated by hand.

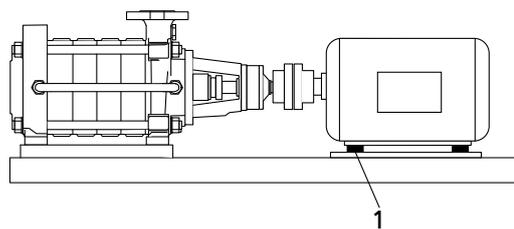
	<p><b>! WARNING</b></p>
	<p><b>Unprotected rotating coupling</b> Risk of injury by rotating shafts!</p> <ul style="list-style-type: none"> <li>▷ Always operate the pump set with a coupling guard. If the customer specifically requests not to include a coupling guard in KSB's delivery, then the operator must supply one!</li> <li>▷ Observe all relevant regulations for selecting a coupling guard.</li> </ul>

	<b>DANGER</b>
	<p><b>Risk of ignition by frictional sparks</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact (see DIN EN 13463-1).</li> </ul>

6. Re-install the coupling guard and step guard, if any.
7. Check the distance between coupling and coupling guard.  
The coupling guard must not touch the coupling.

**5.6.2 Motor without levelling screw**

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



**Fig. 10:** Pump set with shims

1	Shim	
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- ✓ The coupling guard and footboard, if any, have been removed.
1. Check the coupling alignment.
  2. Unscrew 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 that the coupling and shaft can easily be rotated by hand.

	<b>WARNING</b>
	<p><b>Unprotected rotating coupling</b> Risk of injury by rotating shafts!</p> <ul style="list-style-type: none"> <li>▷ 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!</li> <li>▷ Observe all relevant regulations for selecting a coupling guard.</li> </ul>

	<b>DANGER</b>
	<p><b>Risk of ignition by frictional sparks</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact (see DIN EN 13463-1).</li> </ul>

6. Re-install the coupling guard and footboard, if any.
7. Check the distance between coupling and coupling guard.  
The coupling guard must not touch the coupling.

### 5.7 Electrical connection

	<p><b>⚠ DANGER</b></p> <p><b>Incorrect electrical installation</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▸ For electrical installation, also observe the requirements of IEC 60079-14.</li> <li>▸ Always connect explosion-proof motors via a motor protection switch.</li> </ul>
	<p><b>⚠ DANGER</b></p> <p><b>Work on the pump set by unqualified personnel</b> Danger of death from electric shock!</p> <ul style="list-style-type: none"> <li>▸ Always have the electrical connections installed by a trained electrician.</li> <li>▸ Observe regulations IEC 30364 (DIN VDE 0100) and, for explosion-proof pump sets, EN 60079.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Incorrect connection to the mains</b> Damage to the mains network, short circuit!</p> <ul style="list-style-type: none"> <li>▸ Observe the technical specifications of the local energy supply companies.</li> </ul>
	<p><b>NOTE</b></p> <p>It is recommended to fit a motor protection device. However, this device must not trip the pump set; it must serve as an indicator only.</p>

#### 5.7.1 Setting the time relay

	<p><b>CAUTION</b></p> <p><b>Switchover between star and delta on three-phase motors with star-delta starting takes too long.</b> Damage to the pump (set)!</p> <ul style="list-style-type: none"> <li>▸ Keep switch-over intervals between star and delta as short as possible.</li> </ul>
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Time relay settings for star-delta starting: 3 seconds ± 30 %.

#### 5.7.2 Earthing

 	<p><b>⚠ DANGER</b></p> <p><b>Electrostatic charging</b> Explosion hazard! Fire hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▸ Connect the PE conductor to the earthing terminal provided.</li> </ul>
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## 5.7.3 Connecting the motor

	<b>NOTE</b>
	<p>In compliance with DIN VDE 0530 - Part 8, three-phase motors are always wired for clockwise rotation (looking at the motor shaft stub).</p> <p>The pump's direction of rotation is indicated by an arrow on the pump.</p>

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

## 5.8 Checking the direction of rotation

 	<b>⚠ DANGER</b>
	<p><b>Temperature increase resulting from contact between rotating and stationary components</b></p> <p>Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▸ Never check the direction of rotation by starting up the unfilled pump set.</li> <li>▸ Separate the pump from the motor to check the direction of rotation.</li> </ul>

	<b>⚠ WARNING</b>
	<p><b>Hands or objects inside the pump casing</b></p> <p>Risk of injuries, damage to the pump!</p> <ul style="list-style-type: none"> <li>▸ Never insert your hands or any other objects into the pump.</li> <li>▸ Check that the inside of the pump is free from any foreign objects.</li> </ul>

	<b>CAUTION</b>
	<p><b>Incorrect direction of rotation with non-reversible mechanical seal</b></p> <p>Damage to the mechanical seal and leakage!</p> <ul style="list-style-type: none"> <li>▸ Separate the pump from the motor to check the direction of rotation.</li> </ul>

	<b>CAUTION</b>
	<p><b>Motor and pump running in the wrong direction of rotation</b></p> <p>Damage to the pump!</p> <ul style="list-style-type: none"> <li>▸ Refer to the arrow indicating the direction of rotation on the pump.</li> <li>▸ Check the direction of rotation. If required, check the electrical connection and correct the direction of rotation.</li> </ul>

The correct direction of rotation of motor and pump is clockwise (seen from the motor 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 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 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 direction of rotation has been checked. (⇒ Section 5.8, Page 28)
- All auxiliary connections required are connected and operational.
- The lubricants have been checked.
- After prolonged shutdown of the pump (set), the activities described in (⇒ Section 6.4, Page 36) have been carried out.
- The quality of the concrete foundation complies with the regulations.
- The pump set has been installed and aligned in accordance with the tolerances specified.
- The pipelines have been connected without warping the pump nozzles.

#### 6.1.2 Filling in lubricants

##### Grease-lubricated bearings

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

##### Oil-lubricated bearings

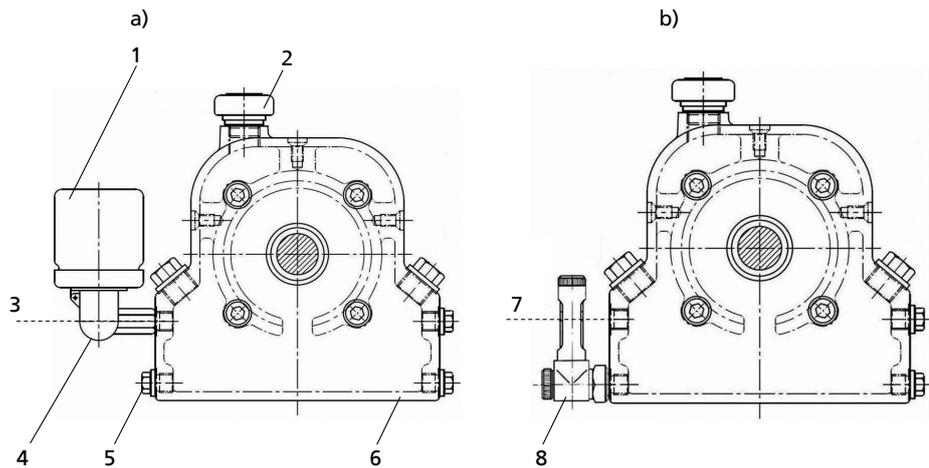
Fill the bearing bracket with lubricating oil.

Oil quality see (⇒ Section 7.2.3.1.2, Page 42)

Oil quantity see (⇒ Section 7.2.3.1.3, Page 42)

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

	<p style="background-color: #0070C0; color: white; padding: 5px;"><b>NOTE</b></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 style="background-color: #FFD700; padding: 5px;"><b>CAUTION</b></p> <p><b>Insufficient quantity of lubricating oil in the reservoir of the constant level oiler</b>  <b>Damage to the bearings!</b></p> <ul style="list-style-type: none"> <li>▷ Regularly check the oil level.</li> <li>▷ Always fill the oil reservoir completely.</li> <li>▷ Keep the oil reservoir properly filled at all times.</li> </ul>



**Fig. 11:** a) Bearing bracket with constant-level oiler - b) Bearing bracket with oil level sight glass

1	Constant-level oiler	2	Vent plug
3	Oil level Constant-level oiler	4	Connection elbow of the constant-level oiler
5	Screw plug	6	Bearing cover
7	Oil level Oil level sight glass	8	Oil level sight glass



#### NOTE

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

#### Bearing bracket with constant-level oiler

- ✓ The constant-level oiler has been fitted.
  - ✓ The screw plug has been fitted.
1. Pull out the vent plug (2).
  2. Pull the constant-level oiler (1) down away from the bearing cover (6) 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 (4).
  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 constant-level oiler (1).  
The oil reservoir must be properly filled at all times to provide an optimum 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 (5) until air bubbles can be seen in the oil reservoir.

#### Bearing bracket with oil level sight glass

Oil-lubricated pumps are standard supplied with a constant-level oiler mounted at the bearing cover. Alternatively, an oil level sight glass can be connected to the lower connection hole in the bearing cover.

On pumps with oil level sight glass the oil level must be visible between the two red marks on the oil level sight glass. Remove the vent plug and top up oil, if necessary.

**6.1.3 Priming and venting the pump**

	<b>CAUTION</b>
	<p><b>Shaft seal failure caused by dry running</b>            Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.</li> </ul>

1. Vent the pump and suction line and prime both with the fluid to be handled.
2. Fully open the shut-off element in the suction line.

**6.1.4 Final check**

1. Remove the coupling guard and footboard, if any.
2. Check the coupling alignment; re-align the coupling if required.  
(⇒ Section 5.5, Page 24)
3. Check that the coupling and shaft can easily be rotated by hand.
4. Re-install the coupling guard and footboard, if any.
5. Check the distance between the coupling and coupling guard.  
The coupling and coupling guard must not come into contact.

**6.1.5 Start-up**

	<b>⚠ DANGER</b>
	<p><b>The permissible pressure and temperature limits will be exceeded if the pump is operated with the suction and discharge lines closed.</b>            Explosion hazard!            Leakage of hot or toxic fluids!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump with the shut-off elements in the suction line and/or discharge line closed.</li> <li>▷ Only start up the pump set with the discharge-side gate valve slightly or fully open.</li> </ul>

	<b>⚠ DANGER</b>
	<p><b>Excessive temperatures due to dry running or excessive gas content in the fluid handled</b>            Explosion hazard!            Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump set without liquid fill.</li> <li>▷ Prime the pump as per operating instructions.</li> <li>▷ Always operate the pump within the permissible operating range.</li> </ul>

	<b>CAUTION</b>
	<p><b>Abnormal noises, vibrations, temperatures or leakage</b>            Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Switch off the pump (set) immediately.</li> <li>▷ Eliminate the causes before returning the pump set to service.</li> </ul>

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

	<b>CAUTION</b>
	<p><b>Start-up against open discharge line</b>            Motor overload!</p> <ul style="list-style-type: none"> <li>▷ Make sure the motor has sufficient power reserves.</li> <li>▷ Use a soft starter.</li> <li>▷ Use speed control.</li> </ul>

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.  
 Start-up must proceed without abnormal vibrations or noises.
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.  
 An automatic check valve installed must open steadily when the operating speed has been reached, without abnormal noise, vibrations or increased power consumption of the pump set.
5. After the duty point has been reached, check motor input power and bearing temperature.
6. After the operating temperature has been reached and/or in the event of leakage, switch off the pump set and re-tighten the bolts between lantern and casing.
7. Check the coupling alignment. Re-align the coupling if required.

**6.1.6 Checking the shaft seal**

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

**Gland packing** The gland packing must drip slightly during operation.  
 (approx. 20 drops per minute)

	<b>NOTE</b>
	<p>On variable speed pumps, the necessary gland packing leakage must be set for the minimum fluid pressure; higher leakage rates are to be expected for other operating conditions.</p>

**Adjusting the leakage**

- Prior to commissioning**
1. Only lightly tighten the nuts of the gland follower by hand.
  2. Use a feeler gauge to verify that the gland follower is mounted centred and at a right angle to the shaft.
- ⇒ The gland must leak after the pump has been primed.

**After five minutes of operation**

The leakage can be reduced.

1. Tighten the nuts of the gland follower by 1/6 turn.
2. Monitor the leakage for another five minutes.

**Excessive leakage:**

Repeat steps 1 and 2 until the minimum value has been reached.

**Not enough leakage:**

Slightly loosen the nuts at the gland follower.

**No leakage:**

Switch off the pump set immediately!

Loosen the gland follower and repeat start-up.

**Checking the leakage**

After the leakage has been adjusted, monitor the leakage for about two hours at maximum fluid temperature.

Check that enough leakage occurs at the gland at minimum fluid pressure.

**6.1.7 Shutdown**

	<b>CAUTION</b>
	<p><b>Heat build-up inside the pump</b> Damage to the shaft seal!</p> <ul style="list-style-type: none"> <li>▷ Depending on the type of installation, the pump set requires sufficient after-run time – with the heat source switched off – until the fluid handled has cooled down.</li> </ul>

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

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

	<b>NOTE</b>
	<p>If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open as long as there is some back pressure.</p>

For prolonged shutdown periods:

1. Close the shut-off element in the suction line.
2. Close the auxiliary connections.  
If the fluid handled is fed in under vacuum, also supply the shaft seal with barrier fluid during standstill.

	<b>CAUTION</b>
	<p><b>Risk of freezing during prolonged pump shutdown periods</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Drain the pump and the cooling/heating chambers (if any) or otherwise protect them against freezing.</li> </ul>

## 6.2 Operating limits

	 <b>DANGER</b>
	<p><b>Non-compliance with operating limits for pressure, temperature and speed</b> Explosion hazard! Hot or toxic fluid may escape!</p> <ul style="list-style-type: none"> <li>▸ Comply with the operating data indicated in the data sheet.</li> <li>▸ Avoid prolonged operation against a closed shut-off element.</li> <li>▸ Never operate the pump at temperatures exceeding those specified in the data sheet or on the name plate unless the written consent of the manufacturer has been obtained.</li> </ul>

### 6.2.1 Ambient temperature

Observe the following parameters and values during operation:

**Table 8:** Permissible ambient temperatures

Permissible ambient temperature	Value
Maximum	40 °C
Minimum	on request

	<b>CAUTION</b>
	<p><b>Operation outside the permissible ambient temperature</b> Damage to the pump (set)!</p> <ul style="list-style-type: none"> <li>▸ Observe the specified limits for permissible ambient temperatures.</li> </ul>

### 6.2.2 Frequency of starts

	 <b>DANGER</b>
	<p><b>Excessive surface temperature of the motor</b> Explosion hazard! Damage to the motor!</p> <ul style="list-style-type: none"> <li>▸ In case of explosion-proof motors, observe the frequency of starts specified in the manufacturer's product literature.</li> </ul>

	<b>CAUTION</b>
	<p><b>Re-starting while motor is still running down</b> Damage to the pump (set)!</p> <ul style="list-style-type: none"> <li>▸ Do not re-start the pump set before the pump rotor has come to a standstill.</li> </ul>

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 start-ups are evenly spaced over the period indicated, the following limits can be used for orientation for start-up with the discharge-side gate valve slightly open:

**Table 9:** Frequency of starts

Motor rating [kW]	Maximum No. of start-ups [Start-ups/hour]
up to 45	10
more than 45	5

Overloading of the motor may generally result in:

- an abnormal temperature increase leading to the motor temperature exceeding the temperature limit of the winding or bearing grease
- premature coupling wear
- reduced service life of the pump components
- irregularities or malfunctions in the system

### 6.2.3 Flow rate

The minimum flow rates indicated below are for single-pump operation and will prevent thermal or mechanical overloading of the pump. In case of parallel operation with pumps of identical or different design, higher flow rates may be required to guarantee a stable operating behaviour.

**Table 10:** Flow rate

Size	Temperature range (t)	Minimum flow rate	Maximum flow rate
100	independent of temperature	≈ 35 % of $Q_{opt.}^{4)}$	See hydraulic characteristic curves.

A temporary minimum flow rate of 25 % of  $Q_{opt.}^{4)}$  has been defined. This temporary flow rate shall be limited to one hour's uninterrupted operation and approx. 200 hours/year.

The calculation formula below can be used to check if an additional heat build-up could lead to a dangerous temperature increase at the pump surface.

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

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

**Table 11:** Key

Symbol	Description	Unit
c	Specific heat capacity	J/kg K
g	Gravitational constant	m/s <sup>2</sup>
H	Pump head	m
$T_f$	Temperature of the fluid handled	°C
$T_o$	Temperature at the casing surface	°C
$\eta$	Pump efficiency at duty point	-
$\Delta \vartheta$	Temperature difference	°C

### 6.2.4 Density of the fluid handled

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

	<b>CAUTION</b>
	<p><b>Impermissibly high density of the fluid handled</b> Motor overload!</p> <ul style="list-style-type: none"> <li>▷ Observe the information on fluid density indicated in the data sheet.</li> <li>▷ Make sure the motor has sufficient power reserves.</li> </ul>

4) Best efficiency point

### 6.2.5 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 the shaft seal are to be expected. In this case, reduce the intervals commonly recommended for servicing and maintenance.

## 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 operation check run of the pump.
  1. Start up the pump (set) regularly between once a month and once every three months for approximately five minutes during prolonged shutdown periods. This will prevent the formation of deposits within the pump and the pump intake area.

	<b>NOTE</b>
	Prolonged shutdown periods should be avoided in the case of pumps in material variants 10, 13, 17, 20, 21 and 27 (cast-iron hydraulics), particularly if the pumps are handling aggressive water qualities (high oxygen content). In such cases, the pump should remain filled, and the operation check run should be performed at least every other day.

	<b>NOTE</b>
	The stage casings of horizontal pumps can only be drained completely through the drain plugs provided on the stage casings (optional). If this is not possible we recommend to proceed as described in the following section.

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

- ✓ The pump has been properly drained and the safety instructions for dismantling the pump have been observed.
  1. Fill the pump with a water-repellent preservative (e.g. RUSTELO DEWATERING 924, producer: CASTROL; OSYRIS DW, producer: TOTAL; or equivalent).
  2. Turn the pump rotor by hand several times, to ensure even distribution of the preservative.

	<b>CAUTION</b>
	<p><b>Glycol-base preservatives (e.g. KLÜBERTOP K 01-601)</b> Corrosion damage on surfaces not treated with preservative</p> <ul style="list-style-type: none"> <li>▷ Do not drain the preservative if the pump is stored for a longer period.</li> <li>▷ Completely fill the pump with preservative for storage.</li> <li>▷ Do not drain the preservative until immediately before the pump is returned to service. (The preservative can be re-used if water content &lt; 20%.)</li> </ul>

3. Drain the pump and close the suction and discharge nozzle, respectively.
4. Oil or grease all blank parts and surfaces of the pump (with silicone-free oil or grease) to protect them against corrosion.  
Observe any additional instructions and information provided.  
(⇒ Section 3.2, Page 13)

### 6.4 Returning to service

For returning the pump to service observe the sections on commissioning/start-up (⇒ Section 6.1, Page 29) and the operating limits (⇒ Section 6.2, Page 34) .

In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇒ Section 7, Page 38)

	<p style="background-color: #f4a460; padding: 2px;"><b>⚠ WARNING</b></p> <p><b>Failure to re-install or re-activate protective devices</b>          Risk of personal injury from moving parts or escaping fluid!</p> <ul style="list-style-type: none"> <li>▷ As soon as the work is complete, re-install and/or re-activate any safety-relevant and protective devices.</li> </ul>
	<p style="background-color: #0070c0; color: white; padding: 2px;"><b>NOTE</b></p> <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

	 <b>DANGER</b>
	<p><b>Improperly serviced pump set</b> Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Service the pump set regularly.</li> <li>▷ Prepare a maintenance schedule with special emphasis on lubricants, shaft seal and coupling.</li> </ul>

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

	 <b>WARNING</b>
	<p><b>Unintentional starting of pump set</b> Risk of injury by moving parts!</p> <ul style="list-style-type: none"> <li>▷ Ensure that the pump set cannot be started up unintentionally.</li> <li>▷ Always make sure the electrical connections are disconnected before carrying out work on the pump set.</li> </ul>

	 <b>WARNING</b>
	<p><b>Fluids posing a health hazard and/or hot fluids</b> Risk of personal injury!</p> <ul style="list-style-type: none"> <li>▷ Observe all relevant laws.</li> <li>▷ When draining the fluid take appropriate measures to protect persons and the environment.</li> <li>▷ Decontaminate pumps which handle fluids posing a health hazard.</li> </ul>

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

	<b>NOTE</b>
	<p>All maintenance, service and installation work can be carried out by KSB Service. Find your contact in the attached "Addresses" booklet or on the Internet at <a href="http://www.ksb.com/contact">www.ksb.com/contact</a>.</p>

Never use force when dismantling and reassembling a pump set.

## 7.2 Maintenance/inspection

### 7.2.1 Supervision of operation

	<p><b>⚠ DANGER</b></p> <p><b>Risk of potentially explosive atmosphere inside the pump</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ 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.</li> <li>▷ Provide sufficient inlet pressure.</li> <li>▷ Provide an appropriate monitoring system.</li> </ul>
	<p><b>⚠ DANGER</b></p> <p><b>Incorrectly serviced shaft seal</b> Explosion hazard! Fire hazard! Leakage of hot, toxic fluids! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Regularly service the shaft seal.</li> </ul>
	<p><b>⚠ DANGER</b></p> <p><b>Excessive temperatures as a result of bearings running hot or defective bearing seals</b> Explosion hazard! Fire hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Regularly check the lubricant level.</li> <li>▷ Regularly check the rolling element bearings for running noises.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Increased wear due to dry running</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump set without liquid fill.</li> <li>▷ Never close the shut-off element in the suction line and/or supply line during pump operation.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Impermissibly high temperature of fluid handled</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid).</li> <li>▷ Observe the temperature limits in the data sheet and in the section on operating limits. (⇒ Section 6.2, Page 34)</li> </ul>

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 29)
- Check the shaft seal. (⇒ Section 6.1.6, Page 32)

- Check the static seals for any leakage.
- Check the rolling element bearings for running noises.  
Vibrations, noise and an increase in current input occurring during unchanged operating conditions indicate wear.
- Check the correct functioning of any auxiliary connections.
- 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 90 °C (measured on the outside of the bearing bracket).
- On oil-lubricated models the bearing temperature can be measured in the oil sump. The alert limit is 100 °C. Never exceed 110 °C (pump trip).

	<b>CAUTION</b>
	<p><b>Operation outside the permissible bearing temperature</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▸ The bearing temperature of the pump (set) must never exceed 90 °C (measured on the outside of the bearing bracket).</li> </ul>
	<b>NOTE</b>
	<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>

Please note the following when checking the bearing temperature:

- **Manual temperature checks are not sufficient !**
- If the bearing temperature exceeds 100 °C during start-up, switch off the pump and check the following:
  - Check the alignment of the pump set.
  - Verify bearing type and arrangement.
  - Remove the rolling element bearings.
  - Check the grease quantity in the rolling element bearings (grease-lubricated bearings only).  
Excessive amounts of grease will cause increased temperatures.
  - After reassembly, ensure a tight press fit of the outer bearing ring via the cover (fixed bearing).
  - A temperature rise may also occur after replacement of the bearings or dismantling of the hydraulic system.

### 7.2.2 Inspection work

	<b>⚠ DANGER</b>
	<p><b>Excessive temperatures caused by friction, impact or frictional sparks</b> Explosion hazard! Fire hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▸ Regularly check the coupling guard, plastic components and other guards of rotating parts for deformation and sufficient distance from rotating parts.</li> </ul>

### 7.2.2.1 Checking the coupling

Check the flexible elements of the coupling. Replace these parts in due time if there is any sign of wear.

### 7.2.2.2 Checking the clearances

Excessive clearances will affect pump performance. Losses in efficiency and discharge head will occur.

#### Max. clearances

The clearances given refer to the diameter.

**Table 12:** Max. permissible clearances

Diameter	Clearance [mm]
Impellers 230 and 231	
Suction-side clearance	0.8
Clearance at the hub	0.8
Balance drum 59.4	0.8

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

### 7.2.2.3 Cleaning filters

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

### 7.2.2.4 Checking the bearing seals

	<b>⚠ DANGER</b>
	<p><b>Excessive temperatures caused by mechanical contact</b>            Risk of explosion!            Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Check correct seating of axial seal rings mounted on the shaft. Only gentle contact of the sealing lip shall be established.</li> </ul>

**7.2.3 Lubrication and lubricant change of rolling element bearings**

 	 <b>DANGER</b>
	<p><b>Excessive temperatures as a result of bearings running hot or defective bearing seals</b></p> <p>Explosion hazard! Fire hazard! Damage to the pump set!</p> <p>▷ Regularly check the condition of the lubricant.</p>

**7.2.3.1 Oil lubrication**

The rolling element bearings are usually lubricated with mineral oil.

**7.2.3.1.1 Intervals**
**Table 13: Oil change intervals**

Temperature at the bearing	First oil change	All subsequent oil changes <sup>5)</sup>
up to 70 °C	After 300 operating hours	Every 8500 operating hours
70 °C - 80 °C	After 300 operating hours	Every 4200 operating hours
80 °C - 90 °C	After 300 operating hours	Every 2000 operating hours

**7.2.3.1.2 Oil quality**

Quality: ISO VG 46

**7.2.3.1.3 Oil quantity**
**Table 14: Oil quantity**

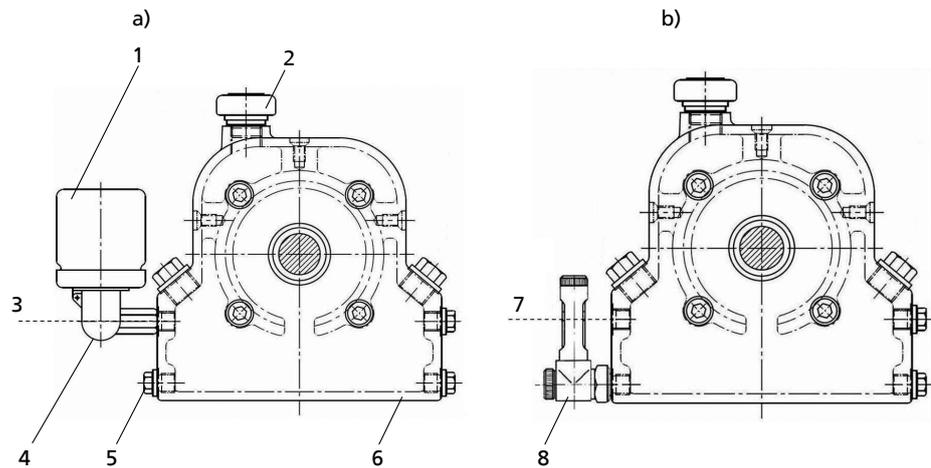
Oil quantity (approx.) <sup>6)</sup> [ml]	
Drive end	Non-drive end
880	920

**7.2.3.1.4 Changing the oil**

	 <b>WARNING</b>
	<p><b>Lubricants posing a health hazard and/or hot lubricants</b></p> <p>Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▷ When draining the lubricant take appropriate measures to protect persons and the environment.</li> <li>▷ Wear safety clothing and a protective mask, if required.</li> <li>▷ Collect and dispose of any lubricants.</li> <li>▷ Observe all legal regulations on the disposal of fluids posing a health hazard.</li> </ul>

5) At least once a year

6) Oil quantity without oil fill in the reservoir of the constant-level oiler



**Fig. 12:** a) Bearing bracket with constant-level oiler - b) Bearing bracket with oil level sight glass

1	Constant-level oiler	2	Vent plug
3	Oil level Constant-level oiler	4	Connection elbow of the constant-level oiler
5	Screw plug	6	Bearing cover
7	Oil level Oil level sight glass	8	Oil level sight glass

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

1. Place the container underneath the screw plug.
2. Undo the screw plug (5) at the bearing cover (6) and drain the oil.
3. Once the bearing housing (3) has been drained, re-insert and re-tighten the screw plug (5).
4. Re-fill with oil. (⇒ Section 6.1.2, Page 29)

### 7.2.3.2 Grease lubrication

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

#### 7.2.3.2.1 Intervals

Size	Rotational speed in rpm		
	< 1800	≈ 2950	≈ 3550
100	9000 h	5700 h	3900 h



#### NOTE

If re-lubrication intervals are short, we recommend that the grease be completely replaced once a year. Otherwise, the grease fill must be replaced completely every two years. To do so, remove the rolling element bearings, clean and pack with new grease.

#### 7.2.3.2.2 Grease quality

##### Optimum grease properties for rolling element bearings

- High melting point lithium soap base grease
- Free of resin and acid
- Not liable to crumble

- With good rust-preventive characteristics
- Penetration number between 2 and 3 (corresponding to a worked penetration of 220 to 295 mm/10)
- Drop point  $\geq 175$  °C

If required, the bearings may be lubricated with greases of other soap bases. Make sure to remove any old grease and rinse the bearings thoroughly.

#### 7.2.3.2.3 Grease quantity

Use a grease quantity of 25 grams per bearing.

#### 7.2.3.2.4 Changing the grease

	<b>CAUTION</b>
	<p><b>Mixing greases of differing soap bases</b>            Changed lubricating qualities!</p> <ul style="list-style-type: none"> <li>▸ Thoroughly clean the bearings.</li> <li>▸ Adjust the re-lubrication intervals to the grease used.</li> </ul>

1. Only half-fill the bearing cavities with grease.

### 7.3 Drainage/disposal

	<b>! WARNING</b>
	<p><b>Fluids posing a health hazard and/or hot fluids</b>            Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▸ Collect and properly dispose of flushing liquid and any residues of the fluid handled.</li> <li>▸ Wear safety clothing and a protective mask, if required.</li> <li>▸ Observe all legal regulations on the disposal of fluids posing a health hazard.</li> </ul>

#### Horizontal pumps

Remove the drain plugs in the stage casing (optional), suction casing (if any) and discharge casing.

1. Use a crane to bring the pump into a vertical position, with the suction nozzle pointing downwards.
2. Turn the rotor by hand.
3. Remove the drain plugs at the seal housing, suction casing and discharge casing.

If the pump cannot be drained completely, we recommend to dismantle it and dry the individual components.

### 7.4 Dismantling the pump set

#### 7.4.1 General information/Safety regulations

	<b>! WARNING</b>
	<p><b>Unqualified personnel performing work on the pump (set)</b>            Risk of injury!</p> <ul style="list-style-type: none"> <li>▸ Always have repair and maintenance work performed by specially trained, qualified personnel.</li> </ul>

	<p><b>WARNING</b></p> <p><b>Hot surface</b> Risk of injury!</p> <ul style="list-style-type: none"> <li>▷ Allow the pump set to cool down to ambient temperature.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Protruding plain bearings</b> Damage to plain bearings when dismantling the suction line!</p> <ul style="list-style-type: none"> <li>▷ When separating the suction line from the suction nozzle, make sure to shift the suction line axially away from the pump by at least 20 mm before removing it.</li> </ul>
<p>Observe the general safety instructions and information. (⇒ Section 7.1, Page 38)</p> <p>For any work on the motor, observe the instructions of the relevant motor manufacturer.</p> <p>For dismantling and reassembly observe the exploded views and the general assembly drawing.</p>	
	<p><b>NOTE</b></p> <p>All maintenance, service and installation work can be carried out by KSB Service. Find your contact in the attached "Addresses" booklet or on the Internet at <a href="http://www.ksb.com/contact">www.ksb.com/contact</a>.</p>
	<p><b>DANGER</b></p> <p><b>Insufficient preparation of work on the pump (set)</b> Risk of injury!</p> <ul style="list-style-type: none"> <li>▷ Properly shut down the pump set. (⇒ Section 6.1.7, Page 33)</li> <li>▷ Close the shut-off elements in suction and discharge line.</li> <li>▷ Drain the pump and release the pump pressure.</li> <li>▷ Close any auxiliary connections.</li> <li>▷ Allow the pump set to cool down to ambient temperature.</li> </ul>
	<p><b>NOTE</b></p> <p>After a prolonged period of operation the individual components may be hard to pull off the shaft. If this is the case, use a brand name penetrating agent and/or - if possible - an appropriate puller.</p>

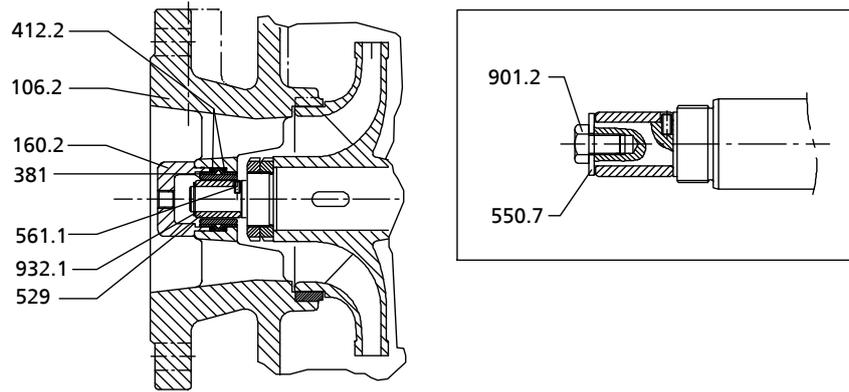
#### 7.4.2 Preparing the pump set

1. Disconnect the power supply (e.g. at the motor).
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.

#### 7.4.3 Dismantling the bearings

##### 7.4.3.1 Dismantling the plain bearing (non-drive end)

The plain bearing is removed without dismantling the hydraulic section of the pump.

**Axial suction nozzle**

**Fig. 13:** Dismantling the plain bearing - axial suction nozzle

1. Pull off cover 160.2 with a forcing screw (M12).
2. **Shaft in C45**  
Remove circlip 932.1.  
**Shaft in 1.4021**  
Remove bolt 901.2 and disc 550.7.
3. Take out SiC bearing sleeve 529.
4. Pull out bearing cartridge 381 with both O-rings 412.2.

**Note:**

Half round head grooved pin 561.1 remains in position.

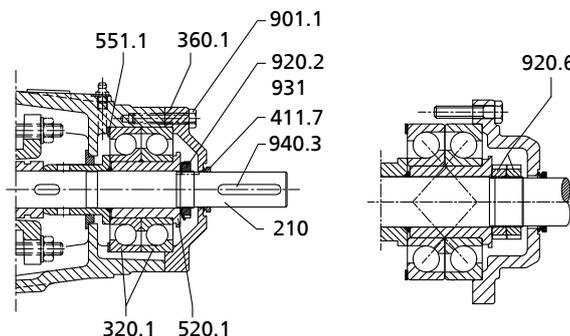
**7.4.3.2 Dismantling the rolling element bearing (drive end)**

The drive-end rolling element bearing are removed without dismantling the plain bearing located at the opposite end of the shaft.

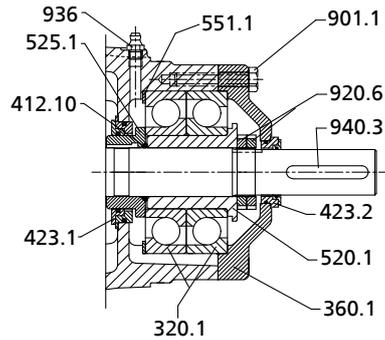
**Removing the coupling half**

The coupling half must be removed before the drive-end rolling element bearing can be dismantled.

1. Undo the grub screw in the coupling hub.
2. Pull off the coupling half.
3. Pull out key 940.3.

**Preparations for dismantling the rolling element bearing**
**Grease lubrication**

**Fig. 14:** Grease lubrication

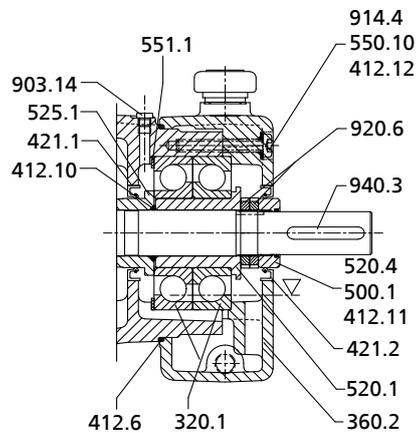
1. Remove joint ring (V-ring) 411.7.
2. Undo hexagon head bolts 901.1.
3. Remove bearing cover 360.1.



**Fig. 15: Grease lubrication of labyrinth seal**

1. Remove labyrinth ring 423.2.
2. Undo hexagon head bolt 901.1.
3. Remove bearing cover 360.1.

**Oil lubrication of lip seal**

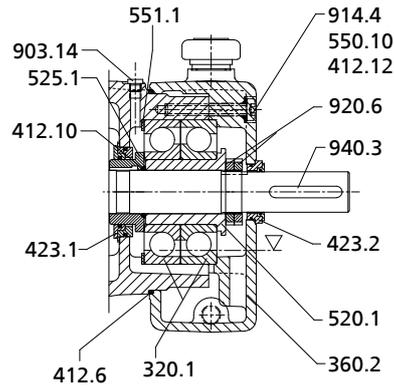


**Fig. 16: Oil lubrication of lip seal**

✓ For oil lubrication: The oil has been drained.

1. Undo socket head cap screws 914.4 and remove them together with disc 550.10 and O-ring 412.12.
2. Remove bearing cover 360.2.
3. Pull off sleeve 520.4 with ring 500.1 (tolerance ring) and O-ring 412.11.

**Oil lubrication of labyrinth seal**


**Fig. 17: Oil lubrication of labyrinth seal**

✓ For oil lubrication: The oil has been drained.

1. Pull out labyrinth ring 423.2.
2. Undo socket head cap screws 914.4 and remove them together with disc 550.10 and O-ring 412.12.
3. Remove bearing cover 360.2.

#### Removing the rolling element bearing



#### NOTE

When dismantling keywaded nut 920.6, mark all relevant positions such as sequence and orientation of the contact face to ensure identical reassembly.

1. Undo nut 920.2 with lockwasher 931 or nuts 920.6, holding onto shaft 210.
2. Pull off sleeve 520.1 with rolling element bearing(s) 320.1. (The shaft is centered in the sleeve without locking device.)



#### CAUTION

##### Incorrect axial adjustment of rotor

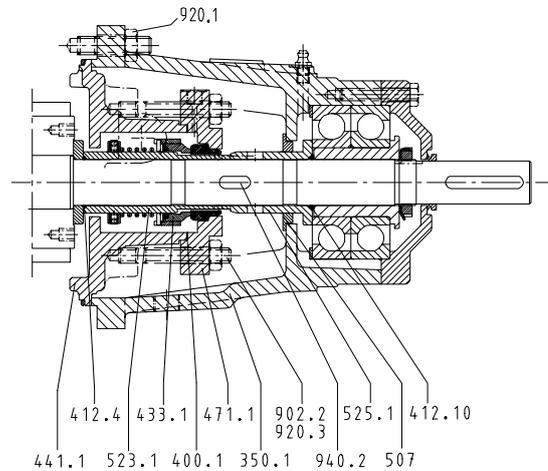
- ▷ After bearing or seal replacement, fit the same spacer discs on the bearing side.
- ▷ Always reproduce the original rotor adjustment.

3. Take out spacer disc 551.1.

## 7.4.4 Removing the shaft seal

### 7.4.4.1 Removing the mechanical seal

#### Removing the standard mechanical seal



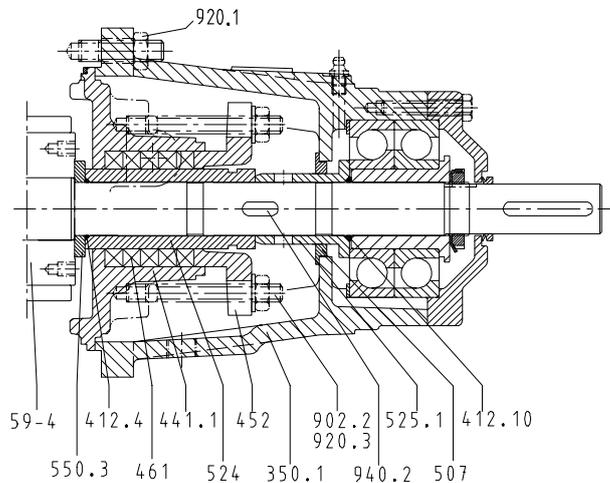
**Fig. 18: Removing the mechanical seal**

✓ The pump has been drained.

✓ The bearings have been removed.

1. Remove O-ring 412.10.
2. Dismantle any auxiliary piping (circulation, etc., depending on model).
3. Loosen nut 920.3 on seal cover 471 until the spring of the mechanical seal is relaxed.
4. Undo nut 920.1 and remove bearing housing 350.1.
5. Pull off spacer sleeve 525.1.
6. Remove seal cover 471.1 with the mating ring and gasket 400.1.
7. Remove primary ring (not in case of bellows-type seals).
8. Remove key 940.2.
9. Pull off shaft sleeve 523.1 with the rotating assembly of mechanical seal 433.1.  
Two holes are provided in the shaft sleeve for engaging a puller.
10. Take off seal housing 441.1.
11. Remove O-ring 412.4.

### 7.4.4.2 Dismantling the gland packing



**Fig. 19: Dismantling the gland packing**

### Removing the packing rings

The packing rings can be removed without dismantling the bearing section.

1. Undo nuts 920.3.
2. Pull gland follower 452 out of seal housing 441.1.
3. Remove packing rings 461 and lantern ring, if any.

### Removing the shaft protecting sleeve

- ✓ The bearings have been removed.
  - ✓ The packing rings 461 have been removed.
1. Remove O-ring 412.10.
  2. Undo nut 920.1 and remove bearing housing 350.1.
  3. Pull off spacer sleeve 525.1.
  4. Pull out seal housing 441.1 with gland follower 452.
  5. Remove key 940.2.
  6. Use a puller to remove shaft protecting sleeve 524. Use the groove provided in the shaft protecting sleeve for this purpose.
  7. Remove O-ring 412.4.

#### Note:

If shaft protecting sleeve 524 is hard to remove, the balance drum 59-4, if fitted, can be used for leverage.

1. The puller can be engaged in the threaded holes provided in the balance drum.
2. Pull out balance drum 59-4, disc 550.3 and shaft protecting sleeve 524.

## 7.4.5 Dismantling the hydraulic system

### Removing the discharge casing

- ✓ Rolling element bearings 320.1 have been removed.
  - ✓ The shaft seal has been removed.
  - ✓ The hydraulic system is in vertical position (if possible)
1. Remove the plain bearing.
  2. Place the pump in a vertical position, with the bare shaft end pointing upwards.
  3. Support the opposite pump end (suction side).
  4. Start dismantling from the top (discharge side).
  5. Number and match-mark the casing faces to ensure identical reassembly.
  6. Remove balancing line (pipe) 710.1 (if fitted).
  7. Attach discharge casing 107 to lifting gear to hold it safely in position.
  8. Undo the four tie bolts 905.
  9. Lift discharge casing 107 slightly and separate it by gently tapping the last stage of the suction casing with a mallet.
  10. Pull off discharge casing 107.
  11. Remove balance drum 59-4 (or spacer sleeve 525.4) and disc 550.3.
  12. Remove key 420.2.
  13. Pull off impeller 230.3 or 230.1 and remove the respective key.
  14. Remove and dispose of O-ring 412.1.

### Dismantling the individual stages

#### Dismantling the stage casing

1. Remove disc 550.1.
2. Pull off stage casing 108.1 and diffuser 171.1.  
Use the raised areas at the outside diameter or the groove provided for this purpose. If necessary, separate them by tapping gently with a mallet.

3. Pull off impeller 230.1 and remove the respective key.
4. Remove and dispose of O-ring 412.1.
5. Hold the shaft in vertical position, if possible.
6. Repeat steps 1-5 up to and including the suction impeller (231).

## 7.5 Reassembling the pump set

### 7.5.1 General information/Safety regulations

	<p style="background-color: #FFD700; margin: 0;"><b>CAUTION</b></p> <p><b>Improper reassembly</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Reassemble the pump (set) in accordance with the general rules of sound engineering practice.</li> <li>▷ Use original spare parts only.</li> </ul>
	<p style="background-color: #FFD700; margin: 0;"><b>CAUTION</b></p> <p><b>Elastomers in contact with oil/grease</b> Shaft seal failure!</p> <ul style="list-style-type: none"> <li>▷ Use water as assembly lubricant.</li> <li>▷ Never use oil or grease as assembly lubricant.</li> </ul>

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

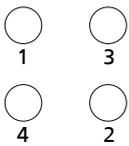
- Seal elements**
- **Gaskets**
    - Always use new gaskets, making sure that they have the same thickness as the old ones.
    - Always fit gaskets of asbestos-free materials or graphite without using lubricants (e.g. copper grease, graphite paste).
  - **O-rings**
    - Never use O-rings that have been glued together from material sold by the metre.
    - Always use new O-rings.
  - **Assembly adhesives**
    - For gaskets, avoid the use of assembly adhesives, if possible.
    - Should assembly adhesives be required after all, 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.

**Tightening torques** For reassembly, tighten all screws as specified in this manual. (⇒ Section 7.6, Page 56)

### 7.5.2 Reassembling the hydraulic system

- ✓ Start reassembly from the suction end.
- ✓ Reassemble the pump in vertical position, if possible.
- ✓ The clearance between the last impeller 230.1 or 230.3 and the balance drum 59-4 (or spacer sleeve 525.4) is between 0.7 and 1.2 mm.

- ✓ Use assembling aids for components made of stainless steel (impellers, drum). Verify suitability for drinking water applications.
- ✓ The assembly consisting of suction casing 106.1 or 106.2 with casing wear ring 502.1 and foot (if any) is on hand.
- ✓ The assembly consisting of shaft 210, half round head grooved pin 561.1 and shaft nuts 920.5 has been installed.
  1. Fit key 940.1 and suction impeller 231 on the shaft.
  2. Fit the assembly of shaft and suction impeller in suction casing 106.1 or 106.2.
  3. Fit key 940.1.
  4. Mount stage casing 108.1 with diffuser 171.1 and O-ring 412.1 on the shaft.
  5. Fit disc 550.1.
  6. Fit stage impeller 230.1 on the shaft.
  7. Repeat steps 3-6 up to the last impeller.
  8. If an intermediate bearing 540.3 is fitted: The intermediate bearing is located in diffuser 171.1. Make sure to re-install the stages in the correct order as indicated by the stage numbers applied during dismantling.  
On the 9.2, 10.2, 11.1 and 12.1 hydraulics, impeller 230.3 is the last impeller.
  9. Fit key 940.2, balance drum 59-4 (or spacer sleeve 525.4) and disc 550.3 on the shaft.
  10. Fit discharge casing 107 (with O-ring 412.1, foot (if any), drum bush 540.1 (if any) and four studs 902.1).
  11. Insert tie bolts 905 with discs 550.4 and nuts 920.4.
  12. Slightly tighten tie bolts 905.
  13. Move the pump into horizontal position, setting the pump feet down on a level surface (e.g. workbench).
  14. Tighten tie bolts 905 in two steps.  
First step: tighten to 50 % of tightening torque; second step: tighten to 100 % of tightening torque.  
Observe the tightening sequence given.
  15. Connect balancing line 710.1 (if balance drum is fitted).



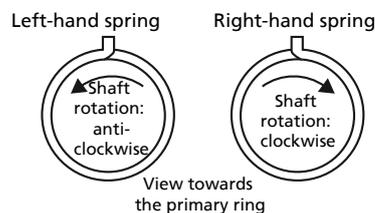
**Fig. 20:** Tie bolts — tightening sequence

### 7.5.3 Fitting the shaft seal

#### 7.5.3.1 Installing the mechanical seal

For drawings and part numbers refer to the section on the mechanical seal.

##### Uni-directional mechanical seal



**Fig. 21:** Uni-directional spring of mechanical seal

### Installing the mechanical seal

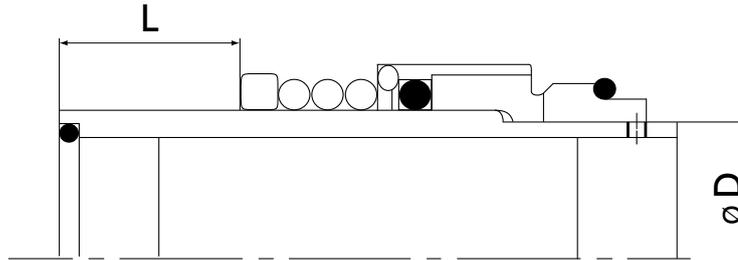


Fig. 22: Adjusting dimension L for mechanical seal

Table 15: Adjusting dimension L for mechanical seal, seal codes 55, 62, 63, 67, 68

Size	Seal code	Diameter D mechanical seal [mm]	Adjusting dimension L [mm]
	62		
100	H12N	50	28

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 seal faces immediately before installation takes place.
- Prevent any damage to the sealing surfaces or O-rings.
- After inserting the mating ring, 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.
- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 51) to (⇒ Section 7.5.2, Page 51) have been observed/carried out.
- ✓ The bearing assembly and the individual parts of the mechanical seal 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. Depending on the mechanical seal design, proceed as follows:

#### Installing the standard mechanical seal

1. Fit O-ring 412.4 on the shaft.
2. Fit seal housing 441.1 with O-ring 412.5 and two studs 902.2 on the shaft.
3. Fit the rotating assembly (primary ring) of mechanical seal 433.1 on shaft protecting sleeve 523.1 (observing adjusting dimension L).
4. Slip shaft protecting sleeve 523.1 with the pre-assembled rotating assembly of mechanical seal 433.1, or shaft sleeve 523.2 with the rotating assembly of mechanical seal 433.2 (depending on seal code) onto the shaft.
5. Fit key 940.2.
6. Carefully press the stationary mating ring of mechanical seal 433.1 or 433.2 into seal cover 471.1.
7. Fit seal cover 471.1 with gasket 400.1.
8. Insert and tighten nuts 920.3.
9. Connect circulation line 710.2 (depending on seal code).

### 7.5.3.2 Packing the gland

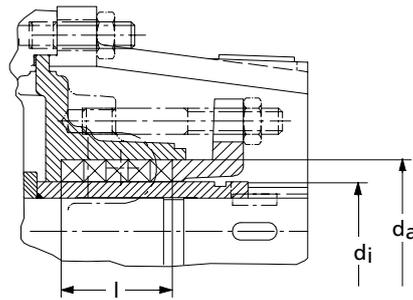


Fig. 23: Gland packing chamber

Table 16: Gland packing dimensions

Size	Gland packing chamber			Packing cross-section	Length of packing cord	Number of packing rings
	$\varnothing d_i$	$\varnothing d_a$	l			
100	56	80	60	□ 12.5	≈ 223	5

If the inlet pressure at the suction nozzle is below 1 bar absolute, the gland packing needs to be fitted with a lantern ring.

The barrier fluid is a clean fluid supplied from an external source.

Requirements:

- Flow rate: 1 l/min
- The barrier fluid pressure must be 0.5 bar higher than the inlet pressure of the fluid handled at the suction nozzle.
- The barrier fluid pressure must always correspond to at least 0.1 bar relative.

#### Packing ring cut to size

Pure graphite packings see supplementary operating instructions.



Fig. 24: Packing ring cut to size

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 51) to (⇒ Section 7.5.2, Page 51) have been observed/carried out.
- ✓ The assembled bearing 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. Clean the packing chamber.
  2. Slip the pre-stressed packing ring onto shaft protecting sleeve 524 and press it home with the help of gland follower 452. Insert each subsequent packing ring into the packing chamber with its joint displaced by approx. 90° in relation to the previous one. Insert each packing ring separately, using gland follower 452.
  3. On gland packings with lantern ring (for vacuum operation), fit the lantern ring instead of the next to last packing ring. The last packing ring is located in the seal housing on the pump side.
  4. Place gland follower 452 on studs 902.2. Tighten it gently and evenly with hexagon nuts 920.2, so that the packing rings are not compressed yet.
  5. Use a feeler gauge to verify that gland follower 452 is fitted centred and at a right angle to the shaft.
  6. Tighten gland follower 452 lightly and evenly. It must be easy to rotate the rotor.

7.5.4 Fitting the bearings

	NOTE
	<p>If a cylindrical coupling guard is fitted:</p> <ul style="list-style-type: none"> <li>- Grease-lubricated bearings: The adapter is fastened to the bearing cover by means of hexagon head bolt 901.1.</li> <li>- Oil-lubricated bearings: The bearing cover is fitted using socket head cap screws 914.4. The adapter is fastened to the bearing cover by three additional hexagon head bolts 901.15.</li> </ul>

Rolling element bearing sizes

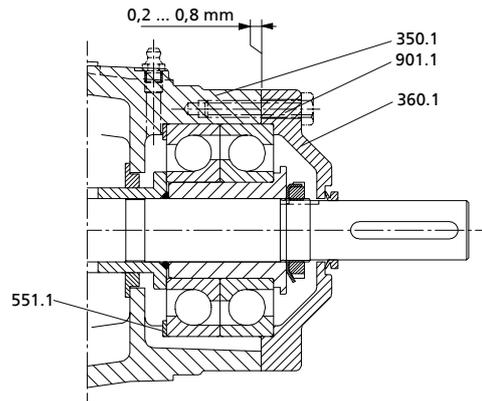


Fig. 25: Grease-lubricated bearings

Table 17: Rolling element bearing sizes — grease-lubricated bearings

Size	Fixed bearing 320.1
100	2 x 7312 BUA

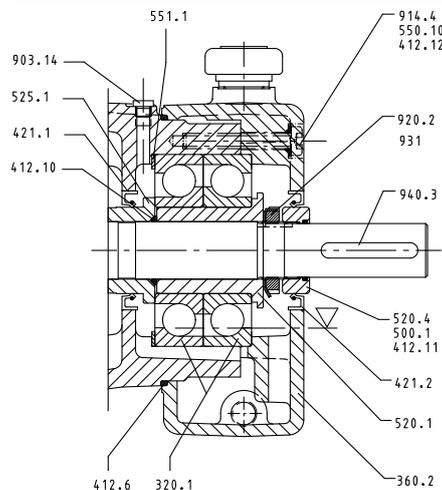


Fig. 26: Oil-lubricated bearings

Table 18: Rolling element bearing sizes — oil-lubricated bearings

Size	Fixed bearing 320.1
100	2 x 7312 BUA

**Fixed bearing**

The fixed bearing is located at the drive end.  
 The pump is fitted with angular contact ball bearings in "X" arrangement.  
 Spacer discs 551.1 provide axial positioning of the rotor.

**Axial position of rotor** Axial adjustment of the rotor is not required. The correct axial position of the rotor is achieved by inserting spacer discs 551.1 on the side of the bearing (or angular contact ball bearings) in bearing housing 350.1. The total thickness of the spacer sleeves is 1.6 mm.

**Cover bolt tightening torques** Cover bolts 901.1 (or 914.4 on oil-lubricated bearings) must be tightened crosswise to the following torques:

**Table 19:** Cover bolt tightening torques

Size	Torque [Nm]
100	40

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 51) to (⇒ Section 7.5.3, Page 52) have been observed/carried out.
- 1. Apply grease to both sides of grease-lubricated bearings. (Not applicable to type 6309 and oil-lubricated bearings!)
- 2. Use a press to push the rolling element bearings onto bearing sleeve 520.1 or 520.2 in "X" arrangement.  
If no press is at hand, place the rolling element bearings on a soft surface and insert the bearing sleeve into the bearing bore with a soft striking tool, taking care not to tilt the sleeve.
- 3. Place spacer discs 551.1 into bearing housing 350.1. (Total thickness of spacer discs = 1.6 mm)
- 4. Slip O-ring 412.10 onto the shaft.
- 5. Slip the pre-assembled bearing assembly into bearing housing 350.1. Lift the shaft slightly, if necessary.
- 6. Secure the rolling element bearings with shaft nuts 920.2/6/7.  
On models with two shaft nuts, firmly tighten the inner shaft nut first, then slightly loosen it again, before locking it with the outer shaft nut.
- 7. Bend lockwasher 931, if any, to engage it in the groove provided.

**Final check** After installation of the bearings, check the following:

**Grease-lubricated bearings**

- ✓ Hexagon head bolts 901.1 have been tightened.
- 1. Check the clearance between cover 360.1 and bearing housing 350.1.  
The cover must not rest against the bearing housing.  
The clearance shall measure between 0.2 mm and 0.8 mm.

**Oil-lubricated bearings**

- 1. Check the clearance between cover 360.2 and bearing housing 350.1.

## 7.6 Tightening torques

### 7.6.1 Tie bolt tightening torques

**Table 20:** Tie bolt tightening torques (in Nm)

Max. permissible pressure [bar]	MTC material code	
	25	27
40	680	-
63	680	-
80	-	865

- 7) Loosen again after first tightening.
- 8) Final tightening torque of first nut
- 9) Tightening torque of second nut (if any)
- 10) Block first nut when tightening.

## 7.6.2 Shaft nut tightening torques

**Table 21:** Shaft nut tightening torques (in Nm)

Size	Drive end				Non-drive end			
	Nut	M1 <sup>7)</sup>	M2 <sup>8)</sup>	M3 <sup>9)10)</sup>	Nut	M1 <sup>7)</sup>	M2 <sup>8)</sup>	M3 <sup>9)10)</sup>
100	M 42x1.5 (2x)	150	50	150	M 42x1.5	--	50	150

### Procedure for tightening the shaft nuts with a torque wrench

#### Nut with lockwasher

1. Tighten the nut to torque M1, then loosen it again.
2. Tighten the nut to torque M2 and bend back the lockwasher.

#### Nut with locknut — drive end

1. Tighten the first nut to torque M1, then loosen it again.
2. Tighten the first nut to torque M2.
3. Tighten the locknut to torque M3 while blocking the first nut

#### Nut with locknut — non-drive end

1. Tighten the first nut to torque M1.
2. Tighten the locknut to torque M2 while blocking the first nut.

### Procedure for tightening the shaft nut without a torque wrench

If there is no suitable torque wrench available for tightening the shaft nuts, proceed as follows, depending on the pump version:

#### Nut with lockwasher — drive end

1. Tighten the shaft nut firmly.
2. Loosen the shaft nut again.
3. Tighten the shaft nut moderately.
4. Bend back the lockwasher.

#### Nut with locknut — drive end

1. Tighten the first shaft nut firmly.
2. Loosen the first shaft nut again.
3. Tighten the first shaft nut moderately.
4. Tighten the locknut firmly against the first shaft nut while blocking the first nut.

#### Nut with locknut — non-drive end

1. Tighten the first shaft nut moderately.
2. Tighten the locknut firmly against the first shaft nut while blocking the first nut.

## 7.7 Spare parts stock

### 7.7.1 Ordering spare parts

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

- Type series
- Material variant
- Size
- Seal code
- KSB order number
- Order item number
- Consecutive number
- Year of construction

Refer to the name plate for all data.

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 exploded view or general assembly drawing for part numbers and descriptions.

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

	NOTE
	We recommend to replace various wear parts such as rolling element bearings, sealing elements, circlips, etc. (see spare parts list below) whenever the hydraulic system has been completely dismantled.

Table 22: 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
<b>For grease-lubricated pump sets</b>								
210	Shaft (complete with small parts)	1	1	2	2	2	3	30 %
230	Impeller (set)	1	1	1	2	2	3	30 %
231	Suction impeller	1	1	1	2	2	3	30 %
412.1	O-ring (set)	4	8	8	8	9	12	150 %
433	Mechanical seal (complete)	2	3	4	5	6	7	90 %
461 <sup>11)</sup>	Gland packing (set)	4	6	8	8	9	12	150 %
502 <sup>12)</sup>	Casing wear ring (set)	2	2	2	3	3	4	50 %
523	Shaft sleeve	2	2	2	3	3	4	50 %
524 <sup>11)</sup>	Shaft protecting sleeve	2	2	2	3	3	4	50 %
525	Spacer sleeve	2	2	2	3	3	4	50 %
550.1 <sup>13)</sup>	Disc (set)	2	2	2	3	3	4	50 %
99-20.1 <sup>14)</sup>	Plain bearing repair kit (incl. parts No. 381, 412.2/.3, 529, 550.7, 561.1, 901.2, 931.1)	1	1	2	2	3	4	50 %
99-20.2	Balance drum repair kit (incl. parts No. 540.1, 59-4, 940.2)	1	1	1	2	2	3	30 %
99-20.4 <sup>14)</sup>	Drive-end ball bearing repair kit (incl. parts No. 320.1, 412.10, 520.1, 551.1)	1	1	2	2	3	4	50 %
99-20.4 <sup>15)</sup>	Non-drive end ball bearing repair kit (incl. parts No. 320.2, 412.10, 520.2)	1	1	2	2	3	4	50 %
99-9.1	Set of sealing elements (incl. parts No. 400.1, 411.7, 412.2/.3/.4/.5/.10, 507)	4	8	8	8	9	12	150 %
<b>Additional parts required for oil lubrication</b>								
421 <sup>16)</sup>	Lip seal	4	8	8	8	9	12	150 %

- 11) For seal codes 65 and 66 (gland packing); parts No. 433 and 523 not fitted  
 12) On pump sizes 125 and 150 only; on pump sizes 32 to 100 with material codes 20 to 30  
 13) On pump sizes 32 to 100 only  
 14) On installation types A and B  
 15) Additional parts on installation types C and D; part No. 99-20.1 not fitted  
 16) Depending on version

Part No.	Description	Number of pumps (including stand-by pumps)						
		2	3	4	5	6 and 7	8 and 9	10 and more
423 <sup>16)</sup>	Labyrinth ring	2	3	4	5	6	7	90 %
99-9.2	Set of sealing elements (incl. parts No. 411.10/.11, 412.6/.10/.11/.12)	4	8	8	8	9	12	150 %

## 8 Trouble-shooting

- A Pump delivers insufficient flow rate
- B Motor is overloaded
- C Pump is running, but does not deliver
- D Increased bearing temperature
- E Leakage at the pump
- F Excessive leakage at the shaft seal
- G Vibrations during pump operation
- H Impermissible rise of temperature inside the pump

**Table 23: Trouble-shooting**

A	B	C	D	E	F	G	H	Possible cause	Remedy <sup>17)</sup>
X		X					X	Pump delivers against an excessively high discharge pressure.	Re-adjust to duty point. Check system for impurities.
X		X				X	X	Pump and/or piping are not completely vented or primed.	Vent and/or prime.
X		X						Supply line or impeller clogged	Remove deposits in pump and/or piping.
X		X						Formation of air pockets in the piping	Alter piping layout. Fit vent valve.
X		X			X	X	X	Suction head is too high, NPSH <sub>available</sub> (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 suction strainer/foot valve and suction line for clogging.
X		X						Air intake at the shaft seal	Replace shaft seal.
X		X			X			Wrong direction of rotation	Interchange two phases of the power cable.
X								Speed too low <sup>18)</sup>	Increase speed. <sup>18)</sup>
X	X		X			X		Wear of internal parts	Replace worn parts by new ones.
	X					X		Pump back pressure lower than specified in purchase order	Re-adjust to duty point.
X	X							Density or viscosity of fluid handled higher than stated in purchase order	<sup>18)</sup>
	X				X	X		Gland follower too tight or askew	Correct. Increase leakage slightly.
	X							Speed of I.C. engine too low	Increase speed. <sup>18)</sup>
	X							Speed too high	Reduce speed. <sup>18)</sup>
				X				Tie bolts/seal element defective	Fit new seal element. Re-tighten tie bolts.
					X			Worn shaft seal	Replace shaft seal.
					X			Score marks or roughness on shaft protecting sleeve / shaft sleeve	Replace shaft protecting sleeve / shaft sleeve. Fit new shaft seal.
					X			Pump runs rough.	Correct suction conditions. Re-align the pump set. Re-balance the impeller. Increase pressure at the pump suction nozzle.
			X	X	X			The pump set is misaligned.	Re-align the pump set.
			X	X	X			Pump warped or resonant vibrations in piping	Check pipeline connections and secure fixing of pump; if required, reduce distances between pipe clamps. Fix the pipelines using anti-vibration material.

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

18) Consult installation contractor or KSB customer service.

A	B	C	D	E	F	G	H	Possible cause	Remedy <sup>17)</sup>
			X					Outer bearing rings of fixed bearing are loose.	Clamp outer bearing rings axially.
			X					Increased axial thrust <sup>18)</sup>	Check rotor clearances, axial adjustment and clearance on throttling bush/balance drum.
			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 running on two phases only	Replace the defective fuse. Check the electric cable connections.
			X	X	X			Rotor out of balance	Clean the impeller. Re-balance the impeller.
			X	X	X			Defective bearing	Fit new bearing.
			X			X	X	Insufficient flow rate	Increase minimum flow rate.
				X				Incorrect inflow of circulation liquid	Increase the free cross-section
X	X	X				X		In case of parallel operation, check valve defective or not installed.	Check.
				X				Gland not packed correctly. Packing material not suitable	Check.
X			X	X				Change in the free cross-section of the balancing liquid return line. Wear in balancing device.	Check the balancing line. Check throttling bush/balance drum clearances.

## 9 Related Documents

### 9.1 General assembly drawing with list of components

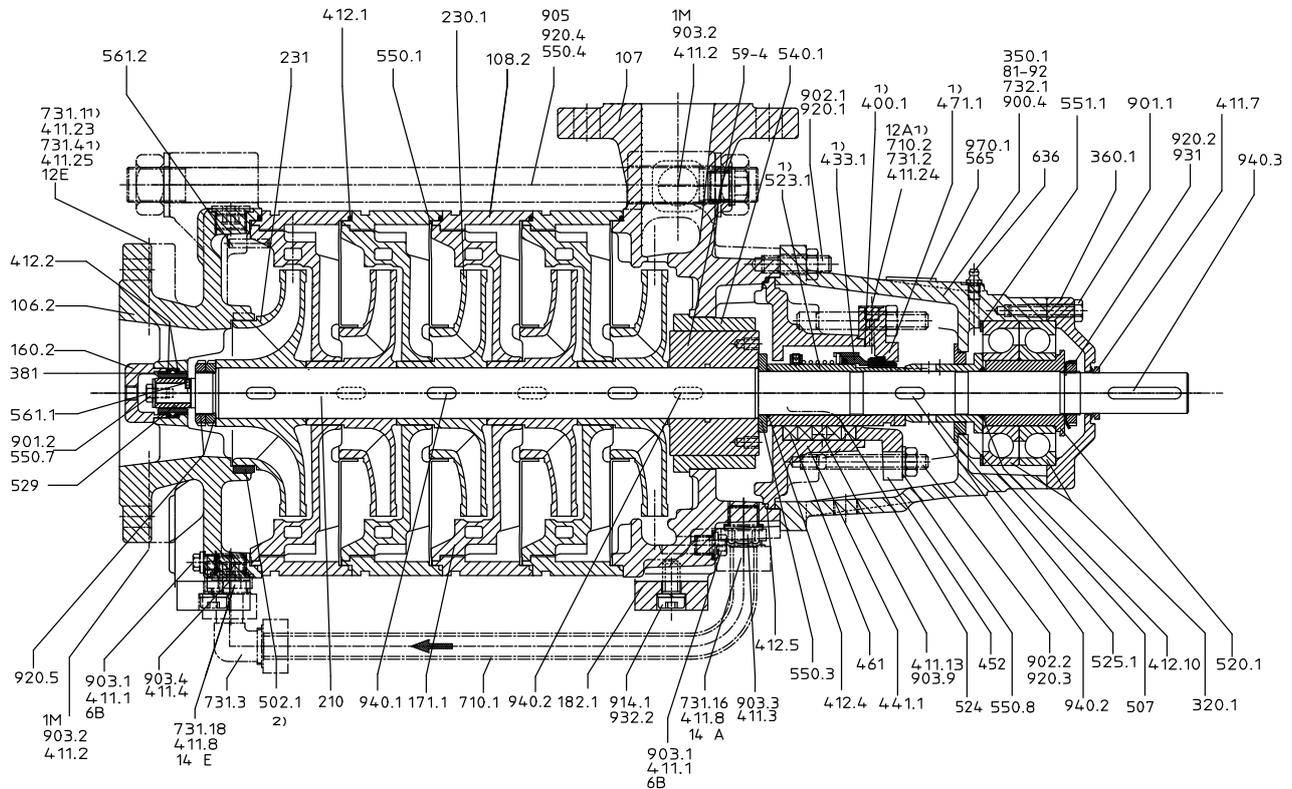


Fig. 27: Multitec A SX general assembly drawing

Table 24: List of components

Part No.	Description	Part No.	Description
106.2	Suction casing	524	Shaft protecting sleeve
107	Discharge casing	525.1	Spacer sleeve
108.2	Stage casing	529	Bearing sleeve SiC
160.2	Cover	540.1	Bush
171.1	Diffuser	550.1/.3/.4/.7/.8	Disc
182.1	Foot	551.1	Spacer disc
210	Shaft	561.1/.2	Half round head grooved pin
230.1	Impeller	565	Rivet
231	Suction impeller	59-4	Balance drum
320.1	Rolling element bearing	636	Lubricating nipple
350.1	Bearing housing	710.1/.2	Pipe
360.1	Bearing cover	731.1/.2/.3/.4/.16/.18	Pipe union
381	Bearing cartridge	81-92	Cover plate
400.1	Gasket	900.4	Screw
411.1/.2/.3/.4/.7/.8/.13/.24/.25	Joint ring	901.1/.2	Hexagon head bolt
412.1/.2/.4/.5/.10	O-ring	902.1/.2	Stud
433.1 <sup>19)</sup>	Mechanical seal	903.1/.2/.3/.4/.9	Screw plug
441.1	Shaft seal housing	905	Tie bolt
452	Gland follower	914.1	Hexagon socket head cap screw

19) For mechanical seal only

Part No.	Description	Part No.	Description
461	Gland packing	920.1/.2/.3/.4/.5	Nut
471.1	Seal cover	931	Lockwasher
502.1 <sup>20)</sup>	Casing wear ring	932.2	Circlip
507	Thrower	940.1/.2/.3	Key
520.1	Sleeve	970.1	Plate
523.1	Shaft sleeve <sup>19)</sup>		

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20) Except for Multitec 65, material code 12

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## 10 EC Declaration of Conformity

Manufacturer:

**KSB S.A.S.**  
**Allée de Sagan**  
**36004 Châteauroux (France)**

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

### Multitec A SX

KSB order number: .....

KSB order item 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

.....<sup>21)</sup>.....

Name  
Function  
Company  
Address

---

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

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