

## Submersible Motor Pump

# Amarex KRT

Sizes DN 100 to DN 700; 60 Hz, NEMA

4-pole: 35 4\_N to 350 4\_N

6-pole: 32 6\_N to 480 6\_N

8-pole: 26 8\_N to 400 8\_N

10 Poles: 40 10\_N to 350 10\_N

12-pole: 195 12\_N to 300 12\_N

## Installation/Operating Manual



Mat. No.: 01426370

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Installation/Operating Manual Amarex KRT

Original operating manual

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## Glossary

### **Back pull-out unit**

Pump without pump casing; partly completed machinery

### **Certificate of decontamination**

If a product is to be returned to the manufacturer, the customer declares in a certificate of decontamination that the product has been properly drained to eliminate any environmental and health hazards arising from components in contact with the fluid handled.

### **Close-coupled design**

Motor directly fitted to the pump via a flange or a drive lantern

### **Discharge line**

The pipeline which is connected to the discharge nozzle

### **Flamepath**

The surface of motor housing components which form flameproof joints when an explosion-proof motor is installed.

### **Hydraulic system**

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

### **Pump set**

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

### **Suction lift line/suction head line**

The pipeline which is connected to the suction nozzle

# 1 General

## 1.1 Principles

This operating manual is supplied as an integral part of the type series and variant indicated on the front cover (for details, please refer to the table below).

**Table 1:** Variants covered by this operating manual

Size	Impeller type	Material variant						
		Gray cast iron				Industrial materials		
		G	G1	G2	GH <sup>1)</sup>	H <sup>1)</sup>	C1 <sup>1)</sup>	C2 <sup>1)</sup>
100-400	K	K	K	-	-	-	K	K
100-401	E	E	-	-	-	-	-	-
100-401	F	F	F	F	F	F	F	F
100-401	K	K	K	-	K	K	K	K
100-403	D	D	D	D	-	-	-	-
150-400	K	K	-	-	-	-	-	-
150-401	E	E	-	-	-	-	-	-
150-401	F	F	F	F	F	F	F	F
150-403	D	D	D	D	-	-	-	-
150-403	K	K	K		K	K	K	K
150-503	K	K	K					
151-403	K	K	K		K	K	K	K
200-401	E	E	-	-	-	-	-	-
200-402	D	D	D	D	-	-	-	-
200-402	K	K	K		K	K	K	K
200-403	K	K	K		K	K	K	K
200-405	D	D	D	D	-	-	-	-
200-502	K	K	K			K	K	K
200-503	K	K	K					
250-401	K	K	K	-	K	K	K	K
250-402	D	D	D	D	-	-	-	-
250-403	K	K	K		K	K	K	K
250-632	K	K	K					
250-900	K	K	K	-	-	-	-	-
300-400	K	K	K	-	K	K	K	K
300-401	K	K	K	-	K	K	K	K
300-402	D	D	D	D	-	-	-	-
300-403	K	K	K		K	K	K	K
300-420	K	K	K	-	K	-	K	K
300-500	K	K	K	-	K	-	K	K
300-505	K	K	K					
350-500	K	K	K	-	K	-	K	K
350-503	K	K	-					
350-632	K	K	K				K	K
350-633	K	K	K					
350-710	K	K	K	-	-	-	K	K
350-713	K	K	K					
400-500	K	K	K	-	-	-	K	K
400-632	K	K	K					

<sup>1</sup> Not for pump sets with cooling system

Size	Impeller type	Material variant						
		Gray cast iron				Industrial materials		
		G	G1	G2	GH <sup>1)</sup>	H <sup>1)</sup>	C1 <sup>1)</sup>	C2 <sup>1)</sup>
400-900	K	K	K	-	-	-	-	-
401-710	K	K	K	-	-	-	-	-
401-713	K	K	K					
500-634	K	K	K				K	K
500-640	K	K	K	-	-	-	K	K
501-710	K	K	K	-	-	-	-	-
501-900	K	K	K	-	-	-	-	-
600-520	K	K	K	-	-	-	K	K
600-710	K	K	K	-	-	-	K	K
700-901	K	K	K	-	-	-	-	-
700-902	K	K	K	-	-	-	K	K

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 clearly identify the pump set and serve as identification for all further business processes.

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

### 1.2 Installation of partly completed machinery

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

### 1.3 Target group

This supplementary operating manual is aimed at the target group of trained and qualified specialist technical personnel.

### 1.4 Other applicable documents

Table 2: Overview of other applicable documents

Document	Contents
Data sheet	Description of the technical data of the pump set
General arrangement drawing / outline drawing	Mating dimensions, installation dimensions and weights of the pump set
Hydraulic characteristic curve	Characteristic curves showing head, flow rate, efficiency and power input
General assembly drawing <sup>2)</sup>	Sectional drawing of the pump set
Sub-supplier product literature <sup>2)</sup>	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists <sup>2)</sup>	Description of spare parts
Supplementary operating manual <sup>2)</sup>	Description of the proper and safe use of special accessories, for example

For accessories and/or integrated machinery components observe the product literature of the corresponding manufacturer.

<sup>2)</sup> If included in agreed scope of supply

### 1.5 Symbols

Table 3: 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. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

### 1.6 Key to safety symbols/markings

Table 4: 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>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 Safety

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

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

### 2.1 General

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

### 2.2 Intended use

- The pump set must only be operated within the operating limits described in the other applicable documents.
- Only operate pump sets which are in perfect technical condition.
- Do not operate partially assembled pump sets.
- Only use the pump set to handle the fluids described in the data sheet or product literature of the pump variant.
- Never operate the pump set without the fluid to be handled.
- Observe the limits for continuous duty specified in the data sheet or product literature ( $Q_{\min}$  and  $Q_{\max}$ ) (to prevent damage such as shaft fracture, bearing failure, mechanical seal damage, etc).
- When untreated waste water is handled, the duty points in continuous operation lie within  $0.7$  to  $1.2 \times Q_{\text{opt}}$  to minimize the risk of clogging/hardening.
- Avoid duty points for continuous operation at very low speeds and small flow rates ( $< 0.7 \times Q_{\text{opt}}$ ).
- Observe the minimum flow rate and maximum flow rate indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage).
- Do not throttle the flow rate on the suction side of the pump set (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.
- Only use the respective impeller types in combination with the fluids described below.

	Free-flow impeller (impeller type F)	<b>Suitable for the following fluids:</b> fluids containing solids and stringy material as well as fluids with entrapped air or entrapped gas
	Closed single-channel impeller (impeller type E)	<b>Suitable for the following fluids:</b> fluids containing solids and stringy material
	Open, radial multi-vane impeller (impeller type D-max)	<b>Suitable for the following fluids:</b> fluids containing solid substances and long fibers
	Closed multi-channel impeller (impeller type K)	<b>Suitable for the following fluids:</b> contaminated, solids-laden, non-gaseous fluids without stringy material

**Prevention of foreseeable misuse**

- Observe the minimum flow velocities required to fully open the swing check valves to prevent the reduction of pressure and risk of clogging. (Contact the manufacturer for the required minimum flow velocities/loss coefficients.)
- Never exceed the permissible operating limits and use limits specified in the data sheet or product literature regarding pressure, temperature, etc.
- Observe all safety information and instructions in this manual.

**2.2.1 Prevention of foreseeable misuse**

- Observe the minimum flow velocities required to fully open the swing check valves to prevent the reduction of pressure and risk of clogging. (Contact the manufacturer for the required minimum flow velocities/loss coefficients.)
- Never exceed the permissible operating limits and use limits specified in the data sheet or product literature regarding pressure, temperature, etc.
- Observe all safety information and instructions in this manual.

**2.3 Personnel qualification and personnel training**

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

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

Deficits in knowledge must be rectified by sufficiently trained specialist personnel training and instructing the personnel who will carry out the respective tasks. 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.

**2.4 Consequences and risks caused by non-compliance with these operating instructions**

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

- Hazard to the environment due to leakage of hazardous substances

### 2.5 Safety awareness

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

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

### 2.6 Safety information for the operator/user

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

### 2.7 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump (set) are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts/components authorized by the manufacturer. The use of other parts/components can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation is performed by authorized, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- Only perform work on the pump set when it has been disconnected from the power supply (de-energized).
- The pump (set) must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual. (⇒ Section 6.3, Page 66)
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇒ Section 6.1, Page 60)

### 2.8 Unauthorized modes of operation

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

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

## 2.9 Explosion protection

Special conditions apply to the operation of explosion-proof pumps.

- The explosion-proof status of the pump set is only assured if the pump set is used in accordance with its intended use.
- The limits stated in the data sheet and on the name plate must not be exceeded under any circumstances.
- Correct monitoring of the motor temperature is imperative to ensure explosion protection.
- Observe the wiring diagrams.
- Never operate an explosion-proof pump set without temperature monitoring.
- Modifications or alteration of the pump set could affect explosion protection and are only permitted after consultation with the manufacturer.
- Only original spare parts and accessories authorized by the manufacturer must be used for explosion-proof pumps.

### 2.9.1 Repair

Special regulations apply to repair work on explosion-proof pumps. Modifications or alterations of the pump set can affect explosion protection and are only permitted after consultation with the manufacturer.

### 3 Transport/Storage/Disposal

#### 3.1 Checking the condition upon delivery

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

#### 3.2 Transport

	 <b>DANGER</b>
	<p><b>Improper transport</b>            Danger to life from falling parts!            Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Attach any lifting accessories to the attachment point (pump handle) provided.</li> <li>▷ Use the eyebolts for vertical loads only. For lateral loads the eyebolts must be replaced by permissible lifting tackle for this direction of load.</li> <li>▷ Never suspend the pump set by its power cable.</li> <li>▷ Use the supplied lifting chain/rope exclusively to lower the pump set into or pull it out of the pump sump.</li> <li>▷ Securely attach the lifting rope/chain to the pump and crane.</li> <li>▷ Use tested, marked and approved lifting accessories only.</li> <li>▷ Observe the regional transport regulations.</li> <li>▷ Observe the documentation of the lifting accessory manufacturer.</li> <li>▷ The load-carrying capacity of the lifting accessories must exceed the weight indicated on the name plate of the pump set to be lifted. Take into account any additional system components to be lifted.</li> </ul>
	 <b>WARNING</b>
	<p><b>Incorrect handling of the electric cable</b>            Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Secure electric cables against falling down.</li> <li>▷ Avoid electric cables being laid on surfaces without fastening.</li> <li>▷ When moving the pump set keep at a safe distance to the electric cables.</li> </ul>

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

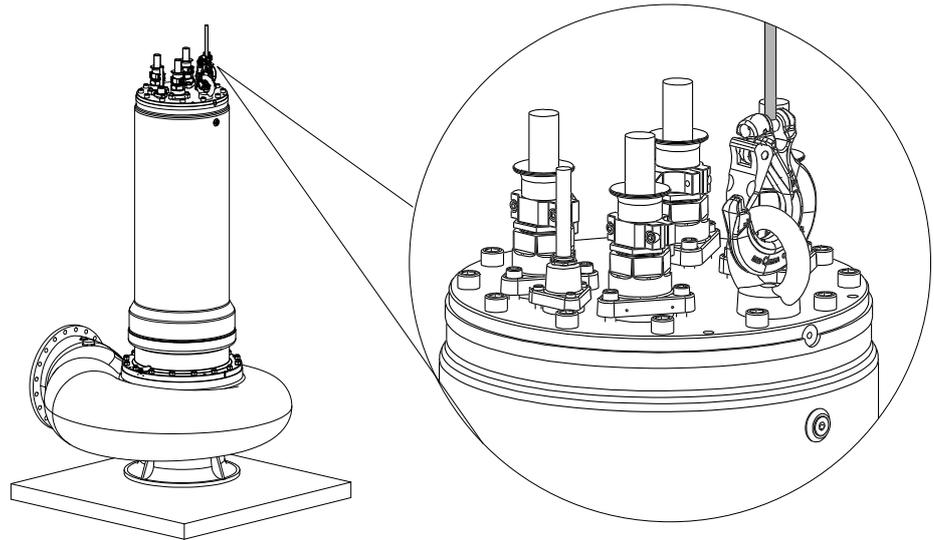


Fig. 1: Transporting the pump set with lifting accessories

3.2.1 Placing the pump set down in a horizontal position

	<p><b>! WARNING</b></p> <p><b>Incorrect positioning/placing down</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Position the pump set vertically with the motor on top.</li> <li>▷ Use appropriate means to secure the pump set against tilting and tipping over.</li> <li>▷ Refer to the weights given in the data sheet/on the name plate.</li> </ul>
	<p><b>! WARNING</b></p> <p><b>Improper placing of pump sets in a vertical/horizontal position</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use appropriate means to secure the pump set against tilting or tipping over.</li> <li>▷ If possible, use two pieces of lifting equipment when handling large pump sets (1st attachment point on the motor, 2nd attachment point at the discharge nozzle).</li> <li>▷ Secure electric cables against falling down.</li> <li>▷ Use additional supports for the transport holder to secure it against tilting.</li> <li>▷ Maintain adequate safety distance during lifting operations.</li> </ul>
	<p><b>! WARNING</b></p> <p><b>Improper lifting/moving of heavy assemblies or components</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.</li> </ul>

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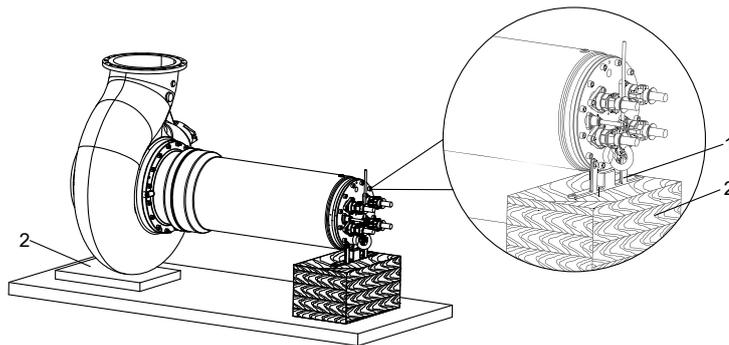
	<b>⚠ WARNING</b>
	<p><b>Placing the pump set on unsecured and uneven surfaces</b>          Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Always place the pump set on a solid and level surface with the pump set in a vertical position and the motor on top.</li> <li>▷ Only place the pump set on a surface of sufficient load-carrying capacity.</li> <li>▷ Use appropriate means to secure the pump set against tilting or tipping over.</li> </ul>

It may be necessary to place the pump set down in a horizontal position during maintenance or installation.

**Pump sets with cooling system (installation types D and K)**

	<b>CAUTION</b>
	<p><b>Improper transport / Improper positioning of pump sets with cooling system</b>          Damage to the cooling system!</p> <ul style="list-style-type: none"> <li>▷ Never place the pump set on the cooling jacket or fasten it by the cooling system.</li> </ul>

Pump sets equipped with a cooling system are delivered with a support foot as a transport lock.



**Fig. 2: Placing a pump set with support foot in a horizontal position**

1	Support foot	2	Wooden support
---	--------------	---	----------------

For placing the pump set down in a horizontal position observe the following:

- Support foot (1)
  - Fit the support foot (1) of the pump prior to placing the pump set down in a horizontal position.
  - Place the pump set down on the support foot (1) and the pump casing.
- Wooden support (2)
  - Use wooden supports (2) to prevent any damage to the coating.

**Pump sets without cooling system (installation types P and S)**

For placing the pump set down in a horizontal position observe the following:

- Place the pump set on the pump casing and directly on the edge of the motor housing cover.
- Use wooden supports to prevent any damage to the coating of the pump set.

**3.2.2 Placing the pump set in a vertical position**

To change the pump from a horizontal to a vertical position, attach lifting equipment to the attachment point provided.

When the pump is pulled upright, the pump casing will act as a pivot. Place wooden supports under the pivot points.

Pumps of installation types S and K with a nominal discharge nozzle diameter of DN 150 and above have a threaded hole in the claw. If two cranes are available, a swivel eyebolt can be screwed into the claw to pull the pump set upright. The direction of pull of the swivel eyebolt at an angle of 90° to the bolt axis should be approved for the entire pump set weight.

### 3.3 Storage/preservation

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

	<b>CAUTION</b>
	<p><b>Improper storage</b> Damage to the electric cables!</p> <ul style="list-style-type: none"> <li>▷ Support the electric cables at the cable entry to prevent permanent deformation.</li> <li>▷ Only remove the protective caps from the electric cables at the time of installation.</li> </ul>
	<b>CAUTION</b>
	<p><b>Damage during storage due to humidity, dirt or vermin</b> Corrosion/contamination of pump (set)!</p> <ul style="list-style-type: none"> <li>▷ For outdoor storage cover the pump (set) and accessories with waterproof material and protect against condensation.</li> </ul>
	<b>CAUTION</b>
	<p><b>Wet, contaminated or damaged openings and connections</b> Leakage or damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Clean and cover pump openings and connections as required prior to putting the pump into storage.</li> </ul>

**Table 5:** Ambient conditions for storage

Ambient condition	Value
Relative humidity	5 % to 85 % (non-condensing)
Ambient temperature	-4 °F to 158 °F [-20 °C to +70 °C]

- Store the pump set under dry and vibration-free conditions, if possible in its original packaging.
- 1. Spray-coat the inside wall of the pump casing, and in particular the impeller clearance areas, with a preservative.
- 2. Spray the preservative through the suction and discharge nozzles.  
It is advisable to then close the pump nozzles (e.g. with plastic caps or similar).

	<b>NOTE</b>
	Observe the manufacturer's instructions for application/removal of the preservative.

- 3. Rotate the impeller by hand once every three months.

### 3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇒ Section 7.3, Page 90)
2. Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump must also be neutralized, and anhydrous inert gas must be blown through the pump to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump.  
Indicate any safety measures and decontamination measures taken.  
(⇒ Section 10, Page 148)

	<b>NOTE</b>
	<p>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></p>

### 3.5 Disposal

	<b>! WARNING</b>
	<p><b>Fluids handled, consumables and operating supplies which are hot or pose a health hazard</b> Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▷ Collect and properly dispose of the flushing fluid and of 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

Horizontal or vertical single-stage submersible motor pump in close-coupled design, with various next-generation impeller types, for wet or dry installation, stationary or transportable version, with energy-saving motor and models for use in potentially explosive atmospheres.

Pump for handling untreated waste water containing long fibers and solid substances, liquids containing air/gas, and raw sludge, activated sludge and digested sludge.

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

For information as per European chemicals regulation (EC) No. 1907/2006 (REACH) see <https://www.ksb.com/en-global/company/corporate-responsibility/reach>.

### 4.3 Designation

**Example: Amarex KRT K 150-403/80 4 UN G-S IE3**

**Table 6:** Designation key

Code	Description	
Amarex KRT	Type series	
K	Impeller type (⇒ Section 2.2, Page 10)	
150	Nominal discharge nozzle diameter [mm]	
403	Maximum nominal impeller diameter [mm]	
80	Motor size	
4	Number of motor poles	
UN	Motor version	
	U/UN/UE	Non-explosion-proof, for fluid temperatures of up to 104 °F [40 °C]
	W/WN/WE	Non-explosion-proof, for fluid temperatures of up to 140 °F [60 °C]
	X/XN/XE	Explosion-proof, for fluid temperatures of up to 104 °F [40 °C]
	Z/ZN/ZE	Explosion-proof, for fluid temperatures of up to 140 °F [60 °C]
G	Material variant	
	G	Standard variant, gray cast iron
	G1	Like G, impeller made of duplex stainless steel
	G2	Like G, impeller made of white cast iron
	GH	Like G, impeller and discharge cover made of white cast iron
	H	Wetted components made of white cast iron
	C1	Wetted components made of duplex stainless steel, mechanical seal with elastomer bellows, screws/bolts made of A4/A 276 Type 316 Ti
	C2	Wetted components made of duplex stainless steel, mechanical seal with covered spring, screws/bolts made of 1.4462/A 182 F51
S	Installation type	
	D	Stationary dry installation, vertical (S1 duty)
	K	Stationary wet installation (S1 duty with motor outside of the fluid possible) with guide cable arrangement or guide rail arrangement

Code	Description	
S	S	Stationary wet installation (S1 duty with submerged motor) with guide cable arrangement or guide rail arrangement
	P	Wet installation of transportable model (S1 duty with submerged motor)
IE3	Motor efficiency classification to IEC 60034-30 <sup>3)</sup>	
	<sup>4)</sup>	No efficiency classification
	IE3	Premium Efficiency

4.4 Name plate

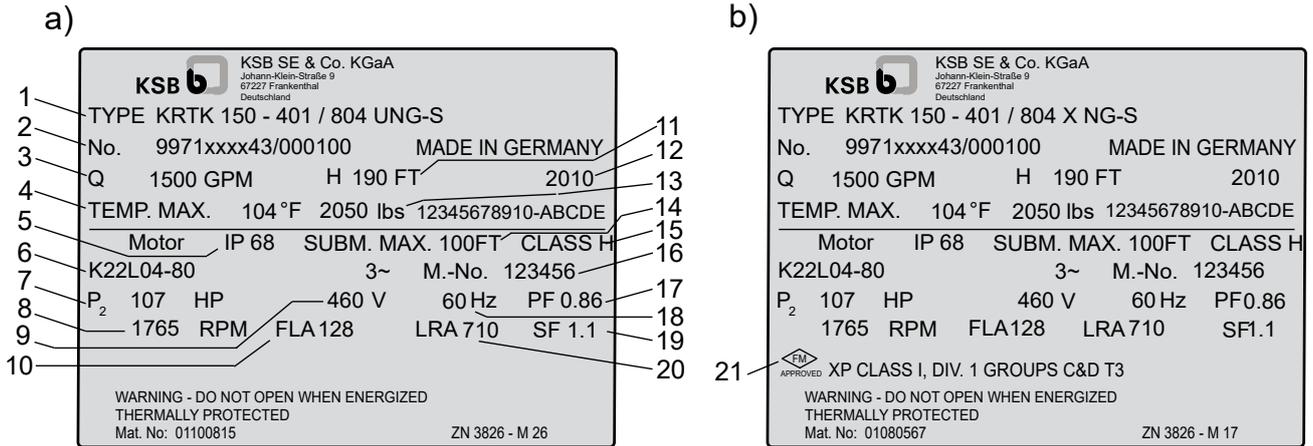


Fig. 3: Name plate (example) a) Standard pump set b) Explosion-proof pump set

1	Designation	2	KSB order number
3	Flow rate	4	Maximum fluid and ambient temperature
5	Enclosure	6	Motor type
7	Rated power	8	Rated speed
9	Rated voltage	10	Rated current
11	Head	12	Year of construction
13	Total weight	14	Maximum submergence
15	Thermal class of winding insulation	16	Motor number
17	Power factor at rated operating point	18	Rated frequency
19	Duty cycle	20	Starting current
21	Explosion protection marking		

<sup>3)</sup> The IEC 60034-30 standard is not binding for submersible motor pumps. Efficiencies are calculated / determined by analogy with the measurement method specified in IEC 60034-2. The marking is used for submersible motors that achieve efficiency levels similar to those of standardized motors acc. to the IEC 60034-30 standard.

<sup>4)</sup> Blank

## 4.5 Design details

### Design

- Fully floodable submersible motor pump
- Not self-priming
- Close-coupled design

### Impeller type

- Various application-oriented impeller types

### Shaft seal

- Two bi-directional mechanical seals in tandem arrangement, with liquid reservoir
- Leakage chamber

### Standard bearings

#### Motor-end bearing:

- Grease-packed bearings sealed for life
- Maintenance-free

#### Pump-end bearings:

- Can be re-lubricated

### Drive

- Three-phase asynchronous squirrel-cage motor
- Motors integrated in explosion-proof pump sets are supplied in Explosionproof Class I Division 1, Groups C&D, T3.

## 4.6 Types of installation

Four design variants are available, depending on the installation type:

- **Installation type D**  
Stationary dry installation with cooling system
- **Installation type K**  
Stationary wet installation with cooling system
- **Installation type P**  
Transportable model for wet installation without cooling system
- **Installation type S**  
Stationary wet installation without cooling system

### Pump sets of installation types P and S

are designed for continuously submerged operation. The motor is cooled by the fluid handled on the motor surface. Operation with the motor outside the fluid handled is possible for short periods.

### Pump sets of installation types D and K

are suitable for continuous operation with the motor outside the fluid. The motor is cooled by the integrated cooling system.

4.7 Configuration and function

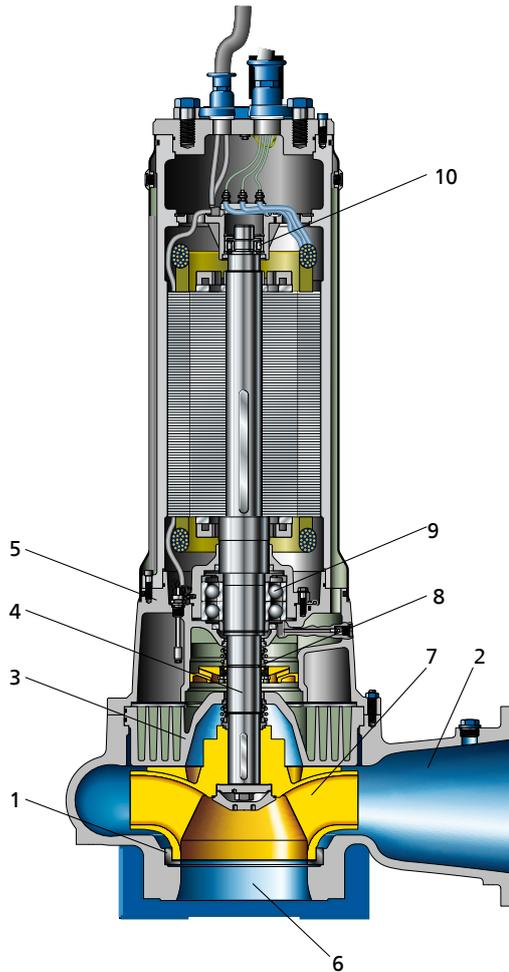


Fig. 4: Sectional drawing

1	Casing wear ring	2	Discharge nozzle
3	Discharge cover	4	Shaft
5	Bearing bracket	6	Suction nozzle
7	Impeller	8	Shaft seal
9	Bearing, pump-end	10	Bearing, motor-end

**Design** The pump is designed with an axial fluid inlet and a radial outlet. The hydraulic system sits on the extended motor shaft. The shaft runs in common bearings.

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

**Sealing** The pump is sealed by two bi-directional mechanical seals in tandem arrangement. A lubricant chamber in-between the seals ensures cooling and lubrication of the mechanical seals.

**Cooling system** Pump sets of installation types K and D feature an integrated motor cooling system. The heat generated by the motor is transferred via the discharge cover to the fluid handled by internal circulation. The coolant serves as anti-corrosive and antifreeze agent, and as a lubricant for the mechanical seals.

4.8 Noise characteristics (only for dry installation – installation type D)

Table 7: Surface sound pressure level  $L_{pA}$ <sup>5)</sup>

Rated power $P_2$		1500 1rpm	1000/750 rpm	600/500 rpm
[hp]	[kW]	[dB]	[dB]	[dB]
32	24	-	68	-
43	32	71	70	-
54/56	40/42	72	71	70
67/74/80	50/55/60	73	72	71
100	75	74	73	72
121	90	75	74	73
134/148	100/110	76	-	74
161/168/174	120/125/130	78	77	75
188/195	140/145	79	78	-
201/215/221	150/160/165	80	79	77
228/235/241	170/175/180	81	80	78
261/268/282	195/200/210	82	81	79
295/308/315	220/230/235	83	82	80
322/335	240/250	84	-	81
362/375	270/280	-	-	82
382/389	285/290	85	83	-
416/436	310/325	-	84	83
456/483	340/360	-	85	84
536/590	400/440	-	85	-

<sup>5)</sup> Measured at a distance of 3.28 ft [1 m] from the pump outline

### 4.9 Scope of supply

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

#### Stationary wet installation (installation types K and S)

- Pump set complete with electric cables
- Claw with sealing elements and mounting elements
- Lifting rope, lifting chain or lifting bail (optional)
- Mounting bracket with mounting elements
- Suction elbow with inspection hole<sup>6)</sup> (optional) and fastening elements
- Guide cable / guide rail  
(guide rails are not included in KSB's scope of supply)

#### Stationary dry installation (installation type D)

- Pump set complete with electric cables
- Suction elbow with inspection hole<sup>7)</sup> (optional) and fastening elements
- Optional: intake elbow with inspection hole

#### Transportable model for wet installation (installation type P)

- Pump set complete with electric cables
- Foot plate or pump stool with mounting elements
- Lifting rope, lifting chain or lifting bail (optional)

A separate name plate is included in KSB's scope of supply. Attach this name plate in a clearly visible position outside the place of installation, e.g. at the control panel, pipeline or mounting bracket.

### 4.10 Dimensions and weights

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

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<sup>6</sup> For nominal discharge nozzle diameter  $\geq$  DN100

<sup>7</sup> For nominal discharge nozzle diameter  $\geq$  DN100

## 5 Installation at Site

### 5.1 Safety regulations

	<p><b>⚠ DANGER</b></p> <p><b>Improper installation in potentially explosive atmospheres</b>          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 given in the data sheet and on the pump/motor name plates.</li> </ul>
	<p><b>⚠ DANGER</b></p> <p><b>Risk of falling when working at great heights</b>          Danger to life by falling from great heights!</p> <ul style="list-style-type: none"> <li>▷ Do not step onto the pump (set) during installation work or dismantling work.</li> <li>▷ Pay attention to safety equipment, such as railings, covers, barriers, etc.</li> <li>▷ Observe the applicable local occupational safety regulations and accident prevention regulations.</li> </ul>
	<p><b>⚠ DANGER</b></p> <p><b>Persons in the tank during pump operation</b>          Electric shock!          Risk of personal injury!          Danger of death from drowning!</p> <ul style="list-style-type: none"> <li>▷ Never start up the pump set when there are persons in the tank.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Hands, other body parts or foreign objects in the impeller or intake area</b>          Risk of injury! Damage to the submersible motor pump!</p> <ul style="list-style-type: none"> <li>▷ Never insert your hands, other body parts or foreign objects into the impeller and/or impeller intake area.</li> <li>▷ Always make sure that the electrical connections are disconnected before checking that the impeller can rotate freely.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Impermissible solid objects (tools, screws/bolts or similar) in the pump sump/inlet tank during pump start-up</b>          Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Check the pump sump/inlet tank for impermissible solid objects before flooding, and remove, if necessary.</li> </ul>

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

#### 5.2.1 Checking the operating data

Before installing the pump set, verify that the name plate data matches the data given in the purchase order and the system data.

5.2.2 Preparing the place of installation

Place of installation for stationary models

	 <b>WARNING</b>
	<p><b>Installation on a mounting surface which is unsecured and cannot support the load</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use a concrete with a minimum compressive strength of 3000 psi [Class C25/30 in exposure class XC1 to EN 206].</li> <li>▷ The mounting surface must be set, even, and level.</li> <li>▷ Observe the weights indicated.</li> </ul>

**Resonances** Any resonances at the usual excitation frequencies (1x and 2x rotational frequency, rotational noise) must be prevented both in the foundation and in the connected piping, as such frequencies may cause extreme vibrations.

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.

Place of installation for transportable models

	 <b>WARNING</b>
	<p><b>Incorrect positioning/placing down</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Position the pump set vertically with the motor on top.</li> <li>▷ Use appropriate means to secure the pump set against tilting and tipping over.</li> <li>▷ Refer to the weights given in the data sheet/on the name plate.</li> </ul>

**Resonances** Any resonances at the usual excitation frequencies (1x and 2x rotational frequency, rotational noise) must be prevented both in the foundation and in the connected piping, as such frequencies may cause extreme vibrations.

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

5.2.3 Removing the transport lock (installation types K and D)

Pump sets equipped with a cooling system are fitted with a support foot for transport to prevent in-transit damage to the cooling jacket.

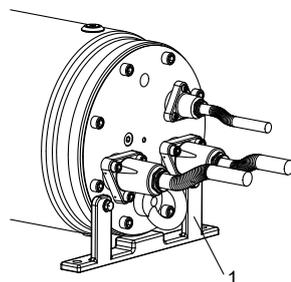


Fig. 5: Transport lock

1	Support foot
---	--------------

Remove the support foot (1) prior to commissioning and keep it for future servicing, temporary storage or decommissioning of the pump.

5.2.4 Checking the lubricant level (installation types S and P)

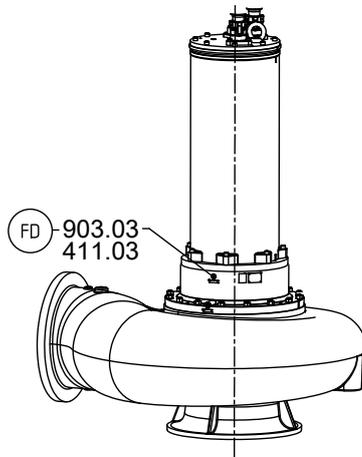
Check the lubricant level of pump sets without cooling system.

The lubricant chambers have been filled with an environmentally-friendly, non-toxic lubricant at the factory.

**Visual inspection for signs of oil leakage**

1. If no oil leakage is visible in the area of the pump casing or impeller, the lubricant chamber is filled properly.
2. If oil leakage is visible in the area of the pump casing or impeller, top up the lubricant chamber.

	<p><b>⚠ WARNING</b></p>
	<p><b>Incorrect positioning/placing down</b>                  Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Position the pump set vertically with the motor on top.</li> <li>▷ Use appropriate means to secure the pump set against tilting and tipping over.</li> <li>▷ Refer to the weights given in the data sheet/on the name plate.</li> </ul>



**Fig. 6:** Checking the lubricant level

- ✓ Signs of oil leakage have been detected.
  1. Place the pump set in a vertical position. (⇒ Section 3.2.2, Page 16)
  2. Secure the pump set against tipping over.
  3. Unscrew and remove screw plug 903.03 with joint ring 411.03.
  4. Check the lubricant level.
    - ⇒ If the lubricant level reaches the opening, fit and tighten screw plug 903.03 with joint ring 411.03 again.
    - ⇒ If the lubricant level is below the opening, top up the lubricant. (⇒ Section 7.2.3.1.4, Page 86)
  5. Fit and tighten screw plug 903.03 with a new joint ring 411.03.

**Table 8:** Key to the symbols

Symbol	Key
	Always apply a <b>liquid sealant</b> (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

	<p><b>NOTE</b></p>
	<p>If more than 1.59 quart [1.5 l] of lubricant are required for topping up, this suggests a defect of the mechanical seals.</p>

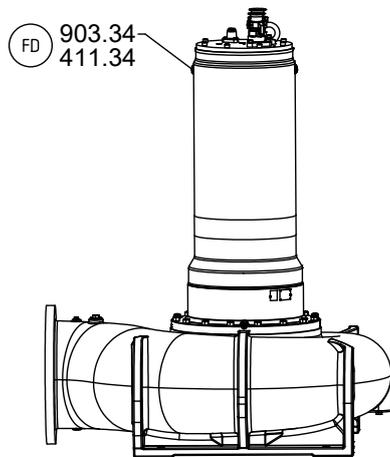
2553.8049/04-EN-US

5.2.5 Checking the coolant level (installation types D and K)

	<p><b>⚠ DANGER</b></p>
	<p><b>Operating a pump set with incomplete coolant fill</b>          Explosion hazard!          Damage to the pump set!</p> <p>▷ Never start up a pump set with incompletely filled cooling system.</p>

**Visual inspection for signs of coolant leakage**

1. No signs of coolant leakage visible in the area of the pump casing, impeller and transport support.
  - ⇒ The cooling system has been filled properly.
2. Signs of coolant leakage visible in the area of the pump casing, impeller and transport support.
  - ⇒ Check the coolant level.



**Fig. 7: Coolant filler opening**

- ✓ The pump set has been placed down in a vertical position.
  1. Position the pump set as shown.
  2. Unscrew and remove screw plug 903.34 with joint ring 411.34.
  3. Insert a paper test strip through the filler opening and read off the coolant level from the paper.
    - ⇒ The fluid level should not be more than 1.2 in. [3 cm] below the edge of the filler opening.
  4. If the fluid level is less than 1.2 in. [3 cm] below the edge of the filler opening, the cooling system is filled sufficiently.
  5. Screw in screw plug 903.34 with joint ring 411.34.
    - ⇒ If the fluid level is more than 1.2 in. [3 cm] below the edge of the filler opening, this suggests leakage of the cooling system.
  6. Remedy the cause.

**Table 9: Key to the symbols**

Symbol	Key
	Always apply a <b>liquid sealant</b> (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

	<p><b>NOTE</b></p>
	<p>If the fluid level is more than 1.2 in [3 cm] below the edge of the filler opening, this suggests a defect of the cooling system (at a coolant temperature of 68 °F [20 °C]).</p>

5.2.6 Checking the direction of rotation

	<p><b>⚠ DANGER</b></p>
	<p><b>Pump set running dry</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▸ Check the direction or rotation of explosion-proof pump sets outside potentially explosive atmospheres.</li> </ul>
	<p><b>⚠ WARNING</b></p>
	<p><b>Hands and/or foreign objects in the pump casing</b> 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> <li>▸ Take suitable precautions (e.g. wear safety goggles).</li> </ul>
	<p><b>⚠ WARNING</b></p>
	<p><b>Improper positioning of pump set when checking the direction of rotation</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▸ Use appropriate means to secure the pump set against tilting or tipping over.</li> </ul>
	<p><b>CAUTION</b></p>
	<p><b>Pump set running dry</b> Increased vibrations! Damage to mechanical seals and bearings!</p> <ul style="list-style-type: none"> <li>▸ Never operate the pump set without the fluid to be handled for more than 60 seconds.</li> </ul>

- ✓ The pump set is connected to the power supply.
- 1. Start the pump set and stop it again immediately to determine the motor's direction of rotation.
- 2. Check the direction of rotation.
  - ⇒ **Pump sets for wet installation (installation types K, S, P):** Impeller rotation must be anti-clockwise, seen from the suction-side opening of the pump (suction flange). (On some pump casings, the direction of rotation is marked by an arrow.)

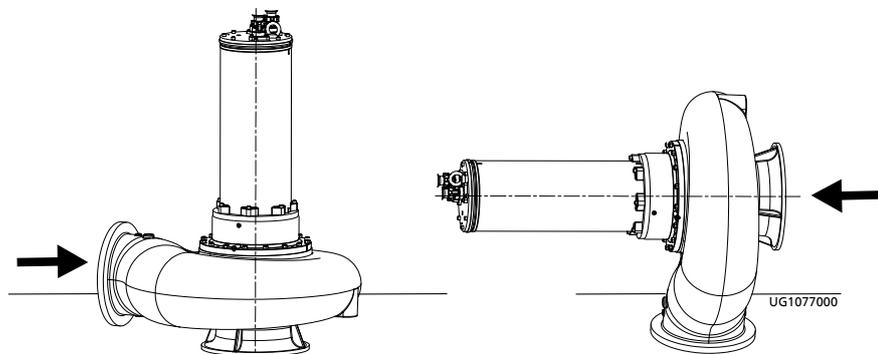
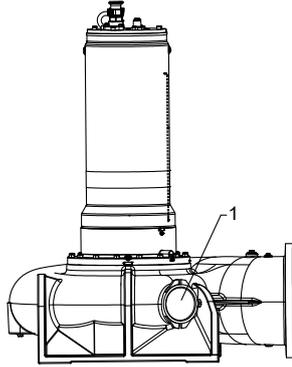


Fig. 8: Checking the direction of rotation

- ⇒ **Pump sets for dry installation (installation type D):** Viewed through the inspection hole of the pump set, impeller movement must be to the left. (On some pumps, the direction of rotation is marked by an arrow).



**Fig. 9:** Inspection hole

1	Inspection hole
---	-----------------

3. If the impeller is running in the wrong direction of rotation, check the electrical connection of the pump and the control system, if applicable.
4. Disconnect the pump set from the power supply and make sure it cannot be switched on unintentionally.

### 5.3 Installing the pump set

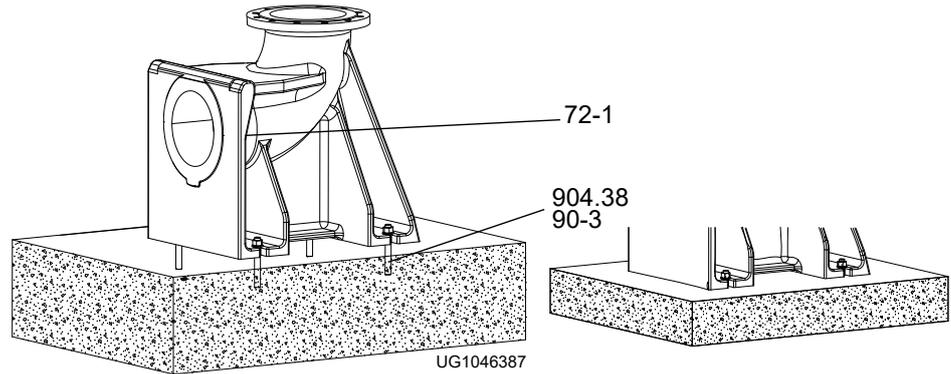
Always refer to and comply with the general arrangement drawing/outline drawing when installing the pump set.

#### 5.3.1 Stationary wet installation

##### 5.3.1.1 Fastening the base elbow

Depending on the pump size, the base elbow is either fastened with chemical anchors and/or foundation rails.

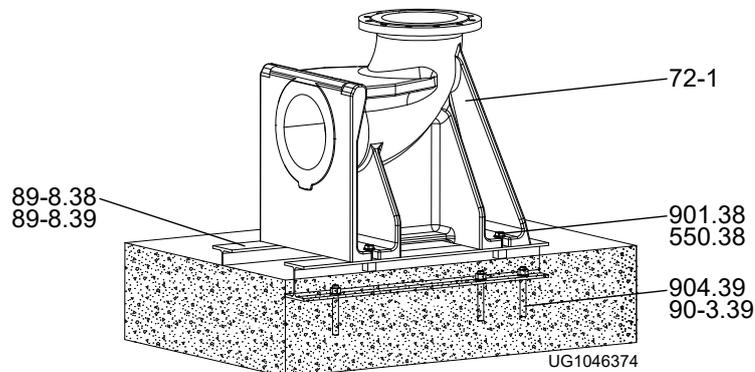
##### Fastening the base elbow with chemical anchors



**Fig. 10:** Fastening the base elbow with chemical anchors

1. Position base elbow 72-1 at the bottom of the tank/well.
2. Insert chemical anchors 904.38.
3. Bolt base elbow 72-1 to the floor using chemical anchors 904.38.

##### Fastening the base elbow with foundation rails and chemical anchors



**Fig. 11:** Fastening the base elbow with foundation rails and chemical anchors

1. Position base elbow 72-1 with foundation rails 89-8.38/39 at the bottom of the tank/well.
2. Insert chemical anchors 904.38.
3. Use chemical anchors 904.38 to bolt base elbow 72-1 with foundation rails 89-8.38/39 to the floor.
4. Set the foundation rails in concrete.

Chemical anchor dimensions

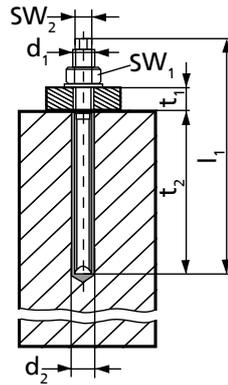


Fig. 12: Dimensions

Table 10: Chemical anchor dimensions

Size ( $d_1 \times l_1$ )	$d_2$	$t_1$	$t_2$	$SW_1^{8)}$	$SW_2^{8)}$	$M_{d1}$
	["]	["]	["]	["]	["]	[ft lb]
$\frac{3}{8} \times 5 \frac{1}{8}$ "	$\frac{7}{16}$	$\frac{7}{8}$	$3 \frac{9}{16}$	$\frac{11}{16}$	$\frac{1}{4}$	14,75
$\frac{7}{16} \times 6 \frac{5}{16}$ "	$\frac{9}{16}$	1	$4 \frac{5}{16}$	$\frac{3}{4}$	$\frac{5}{16}$	29,50
$\frac{5}{8} \times 7 \frac{1}{2}$ "	$\frac{11}{16}$	$1 \frac{3}{8}$	$4 \frac{15}{16}$	$\frac{15}{16}$	$\frac{7}{16}$	44,25
$\frac{13}{16} \times 10 \frac{1}{4}$ "	1	$2 \frac{9}{16}$	$6 \frac{11}{16}$	$1 \frac{3}{16}$	$\frac{9}{16}$	88,50
$\frac{15}{16} \times 11 \frac{13}{16}$ " <sup>9)</sup>	$1 \frac{1}{8}$	$2 \frac{9}{16}$	$8 \frac{1}{4}$	$1 \frac{7}{16}$	$\frac{11}{16}$	132,76
$1 \frac{3}{16} \times 14 \frac{15}{16}$ " <sup>9)</sup>	$1 \frac{3}{8}$	$2 \frac{9}{16}$	11	$1 \frac{13}{16}$	-	295,02

Size ( $d_1 \times l_1$ )	$d_2$	$t_1$	$t_2$	$SW_1^{8)}$	$SW_2^{8)}$	$M_{d1}$
	[mm]	[mm]	[mm]	[mm]	[mm]	[Nm]
M10 × 130	12	22	90	17	6	20
M12 × 160	14	25	110	19	8	40
M16 × 190	18	35	125	24	12	60
M20 × 260	25	65	170	30	14	120
M24 × 300 <sup>9)</sup>	28	65	210	36	17	180
M30 × 380 <sup>9)</sup>	35	65	280	46	-	400

Table 11: Curing times of mortar cartridge

Floor temperature		Curing time
[°F]	[°C]	[min]
23 to 32	-5 to 0	240
32 to 50	0 to +10	45
50 to 68	+10 to +20	20
> 68	> +20	10

<sup>8</sup> SW = Width across flats

<sup>9</sup> Mounting accessories of the respective manufacturer are required.

5.3.1.2 Connecting the piping, flanged bend

	<p><b>⚠ DANGER</b></p> <p><b>Impermissible loads acting on the flange of the base elbow</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 flange loads.</li> <li>▷ Take appropriate measures to compensate for thermal expansion of the piping.</li> </ul>
	<p><b>NOTE</b></p> <p>When the pump set is used for draining low-level building areas, fit a swing check valve into the discharge line to avoid backflow from the sewer system.</p>
	<p><b>CAUTION</b></p> <p><b>Critical speed of reverse rotation</b>                  Increased vibrations!                  Damage to mechanical seals and bearings!</p> <ul style="list-style-type: none"> <li>▷ If long risers are used, fit a swing check valve to prevent excessive rotational speed of the pump running in reverse after it has been stopped. Watch the venting function when arranging the swing check valve.</li> <li>▷ Observe the maximum permissible speed (depending on the mechanical seal and bearings) in the event of reverse rotation.</li> </ul>

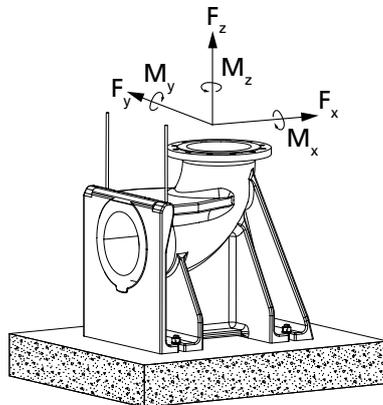


Fig. 13: Permissible flange loads

Table 12: Permissible flange loads

Nominal flange diameter	Forces [lbs]				Moments [ft lbs ]			
	F <sub>y</sub>	F <sub>z</sub>	F <sub>x</sub>	∑F	M <sub>y</sub>	M <sub>z</sub>	M <sub>x</sub>	∑M
100	610	757	678	1187	917	1063	1283	1907
150	916	1130	1017	1775	1283	1503	1833	2677
200	1221	1515	1356	2363	1687	1943	2383	3520
250	1526	1888	1684	2950	2310	2677	3263	4803
300	1820	2261	2023	3538	3153	3630	4437	6527
350	2125	2634	2363	4126	4033	4657	5683	8360
400	2430	3007	2702	4714	5060	5830	7113	10487
500	3041	3753	3380	5889	7517	8653	10597	15620
600	3651	4499	4058	7065	10560	12173	14813	21927

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Nominal flange diameter	Forces [lbs]				Moments [ft lbs ]			
	F <sub>y</sub>	F <sub>z</sub>	F <sub>x</sub>	∑F	M <sub>y</sub>	M <sub>z</sub>	M <sub>x</sub>	∑M
700	4318	5087	4702	8275	12613	15400	18847	27353
750	4318	5087	4702	8275	12613	15400	18847	27353

**Table 13:** Permissible flange loads

Nominal flange diameter	Forces [N]				Moments [Nm]			
	F <sub>y</sub>	F <sub>z</sub>	F <sub>x</sub>	∑F	M <sub>y</sub>	M <sub>z</sub>	M <sub>x</sub>	∑M
100	2700	3350	3000	5250	1250	1450	1750	2600
150	4050	5000	4500	7850	1750	2050	2500	3650
200	5400	6700	6000	10450	2300	2650	3250	4800
250	6750	8350	7450	13050	3150	3650	4450	6550
300	8050	10000	8950	15650	4300	4950	6050	8900
350	9400	11650	10450	18250	5500	6350	7750	11400
400	10750	13300	11950	20850	6900	7950	9700	14300
500	13450	16600	14950	26050	10250	11800	14450	21300
600	16150	19900	17950	31250	14400	16600	20200	29900
700	19100	22500	20800	36600	17200	21000	25700	37300
750	19100	22500	20800	36600	17200	21000	25700	37300

### 5.3.1.3 Fitting the cable wire arrangement

The pump set is guided into the sump or tank along two parallel, tightly stretched guide cables made of stainless steel. It attaches itself automatically to the base elbow which has been fitted to the floor.



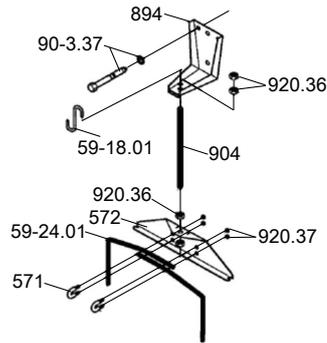
#### NOTE

Should site conditions/piping layout, etc., require the cable to run off the vertical, do not exceed a maximum angle of 5° to ensure reliable fitting and guiding of the pump set.

#### Fitting the mounting bracket

1. Fasten mounting bracket 894 to the edge of the sump opening with steel anchor bolts 90-3.37 and tighten the anchor bolts to a tightening torque of 10 Nm.
2. Insert clamping pieces 571 through the holes of suspension bracket 572 and fasten with nuts 920.37.
3. Fasten fully threaded stud 904 with the pre-assembled clamping arrangement to the mounting bracket with nut 920.36.  
Do not tighten nut 920.36 too much; allow sufficient play for subsequently tensioning the guide cable.

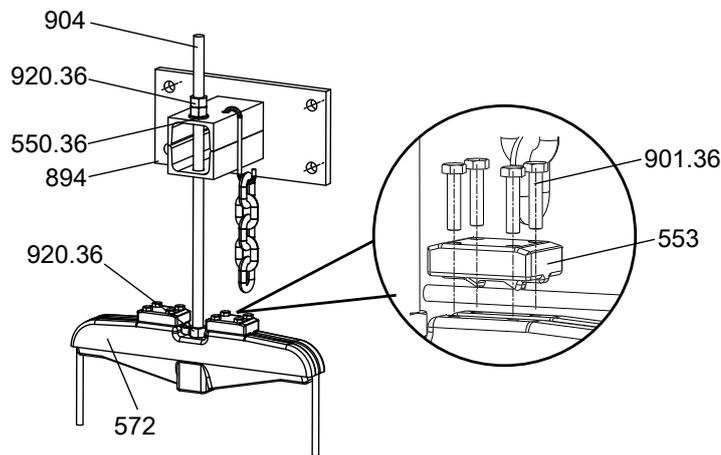
Mounting bracket variants:



**Fig. 14:** Mounting bracket variant for sizes 200-402, 200-403, and sizes with nominal discharge nozzle diameters DN 100 and DN 150

**Table 14:** List of components

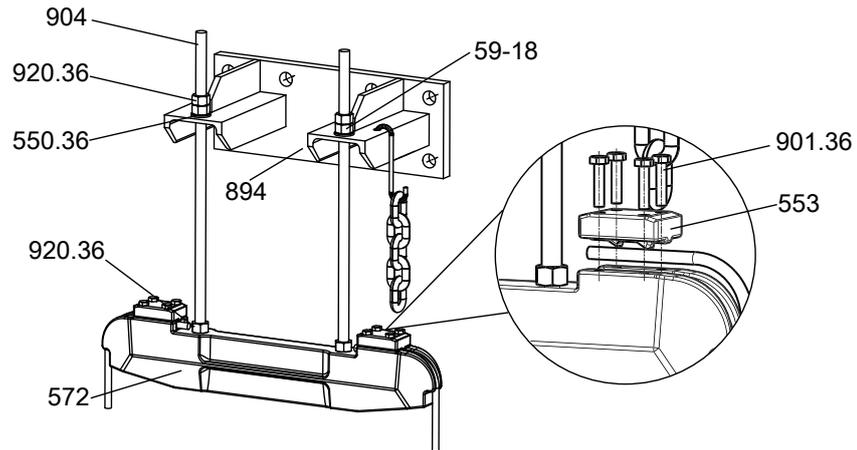
Part No.	Description	Part No.	Description
59-18	Hook	572	Guide cable suspension bracket
59-24.01	Guide cable	894	Mounting bracket
90-3.37	Anchor bolt	904	Grub screw
571	Clamping piece	920.36/.37	Nut



**Fig. 15:** Mounting bracket variant for sizes 200-502, 200-503 and sizes with nominal discharge nozzle diameters DN 250 and DN 300

**Table 15:** List of components

Part No.	Description	Part No.	Description
59-18	Hook	894	Mounting bracket
59-24.01	Guide cable	901.36	Hexagon head bolt
550.36	Disc	904	Grub screw
553	Thrust insert	920.36	Nut
572	Guide cable suspension bracket		

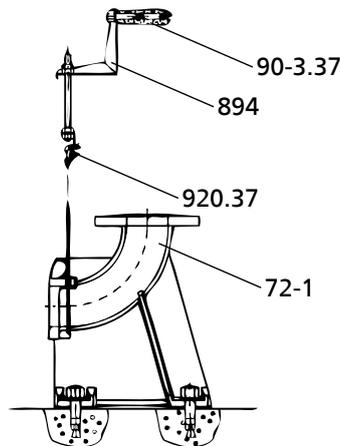


**Fig. 16:** Mounting bracket variant for sizes with nominal discharge nozzle diameters DN 350, DN 400, DN 500, DN 600 and DN 700

**Table 16:** List of components

Part No.	Description	Part No.	Description
59-18	Hook	572	Guide cable suspension bracket
59-24.01	Guide cable	901.36	Hexagon head bolt
550.36	Disc	904	Grub screw
553	Thrust insert	920.36	Nut

**Inserting the guide cable**



**Fig. 17:** Inserting the guide cable

1. Lift thrust insert 553, insert one end of the cable and secure it with bolts 901.36.
2. Run guide cable 59-24.01 around base elbow 72-1 and back again to guide cable suspension bracket 572. Insert it into thrust insert 553.
3. Manually tension guide cable 59-24.01 and secure it by means of bolts 901.36.
4. Pull the cable taut by tightening hexagon nuts 920.36 on the upper side of the mounting bracket.  
Refer to the "Guide cable tension" table.
5. Secure the nuts with a second hexagon nut.
6. The loose cable ends at guide cable suspension bracket 572 can either be twisted into a ring or the end can be cut off.  
After length adjustment, tape the ends to avoid fraying.
7. Attach hook 59-18 to mounting bracket 894 for attaching the lifting chain/rope at a later stage.

Table 17: Guide cable tension

Size	Tightening torque $M_A$		Guide cable tension	
	[lbf ft]	[Nm]	[lbf]	[N]
100-400	10,3	14	1349	6000
100-401	10,3	14	1349	6000
100-401	10,3	14	1349	6000
100-401	10,3	14	1349	6000
100-403	10,3	14	1349	6000
150-400	10,3	14	1349	6000
150-401	10,3	14	1349	6000
150-401	10,3	14	1349	6000
150-403	10,3	14	1349	6000
150-403	10,3	14	1349	6000
150-403	10,3	14	1349	6000
150-503	10,3	14	1349	6000
151-403	10,3	14	1349	6000
200-401	10,3	14	1349	6000
200-402	10,3	14	1349	6000
200-402	10,3	14	1349	6000
200-403	10,3	14	1349	6000
200-405	10,3	14	1349	6000
200-502	22,1	30	2248	10000
200-503	22,1	30	2248	10000
250-401	22,1	30	2248	10000
250-402	22,1	30	2248	10000
250-403	22,1	30	2248	10000
250-632	22,1	30	2248	10000
250-900	22,1	30	2248	10000
300-400	22,1	30	2248	10000
300-401	22,1	30	2248	10000
300-402	22,1	30	2248	10000
300-403	22,1	30	2248	10000
300-420	22,1	30	2248	10000
300-500	22,1	30	2248	10000
300-505	22,1	30	2248	10000
350-500	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
350-503	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
350-632	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
350-633	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
350-710	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
350-713	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
400-500	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
400-632	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
400-900	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
401-710	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
401-713	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
500-634	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
500-640	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
501-710	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000

<sup>10)</sup> 2 tensioning bolts, value indicated per bolt

Size	Tightening torque M <sub>A</sub>		Guide cable tension	
	[lbf ft]	[Nm]	[lbf]	[N]
501-900	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
600-520	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
600-710	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
700-901	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000
700-902	15,5 <sup>10)</sup>	21 <sup>10)</sup>	3372	15000

Table 18: Guide cable tension

Size	Tightening torque M <sub>A</sub>	Guide cable tension
	[Nm]	[N]
100-400	14	6000
100-401	14	6000
100-401	14	6000
100-401	14	6000
100-403	14	6000
150-400	14	6000
150-401	14	6000
150-401	14	6000
150-403	14	6000
150-403	14	6000
150-403	14	6000
150-503	14	6000
151-403	14	6000
200-401	14	6000
200-402	14	6000
200-402	14	6000
200-403	14	6000
200-405	14	6000
200-502	30	10000
200-503	30	10000
250-401	30	10000
250-402	30	10000
250-403	30	10000
250-632	30	10000
250-900	30	10000
300-400	30	10000
300-401	30	10000
300-402	30	10000
300-403	30	10000
300-420	30	10000
300-500	30	10000
300-505	30	10000
350-500	21 <sup>11)</sup>	15000
350-503	21 <sup>11)</sup>	15000
350-632	21 <sup>11)</sup>	15000
350-633	21 <sup>11)</sup>	15000
350-710	21 <sup>11)</sup>	15000
350-713	21 <sup>11)</sup>	15000

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<sup>11</sup> 2 tensioning bolts, value indicated per bolt

Size	Tightening torque M <sub>A</sub>	Guide cable tension
	[Nm]	[N]
400-500	21 <sup>11)</sup>	15000
400-632	21 <sup>11)</sup>	15000
400-900	21 <sup>11)</sup>	15000
401-710	21 <sup>11)</sup>	15000
401-713	21 <sup>11)</sup>	15000
500-634	21 <sup>11)</sup>	15000
500-640	21 <sup>11)</sup>	15000
501-710	21 <sup>11)</sup>	15000
501-900	21 <sup>11)</sup>	15000
600-520	21 <sup>11)</sup>	15000
600-710	21 <sup>11)</sup>	15000
700-901	21 <sup>11)</sup>	15000
700-902	21 <sup>11)</sup>	15000

### 5.3.1.4 Fitting the guide rail arrangement

The pump set is guided into the sump or tank along two vertical guide rails. It attaches itself automatically to the base elbow which has been fitted to the floor.

	<b>NOTE</b>
	<p>The guide rails are not included in the scope of supply. Select guide rail materials which are suitable for the fluid handled or as specified by the operator.</p>

Observe the following dimensions for the guide rails:

**Table 19:** Guide rail dimensions

Size of hydraulic system	Outside diameter		Wall thickness <sup>12)</sup>			
			Min.		Max.	
	[inch]	[mm]	[inch]	[mm]	[inch]	[mm]
DN 40 to DN 150	2,36	60	0,079	2	0,197	5
DN 200 to DN 300	3,5	89	0,118	3	0,236	6

#### Fitting the mounting bracket



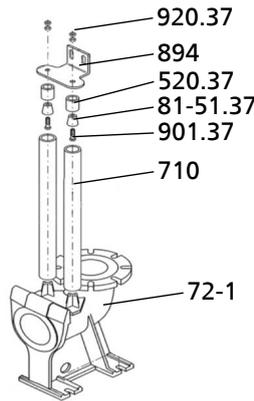
**Fig. 18:** Fitting the mounting bracket

1. Fasten mounting bracket 894 to the edge of the sump opening with suitable fasteners. Observe the hole pattern for the fasteners. See outline drawing. (⇒ Section 1.4, Page 8)

#### Fitting the guide rails

	<b>CAUTION</b>
	<p><b>Improper installation of guide rails</b>          Damage to the guide rail arrangement!</p> <p>▷ Always adjust the guide rails so that they are in a perfectly vertical position.</p>

<sup>12)</sup> To DIN 2440/2442/2462 or equivalent standards



**Fig. 19:** Fitting the guide rails

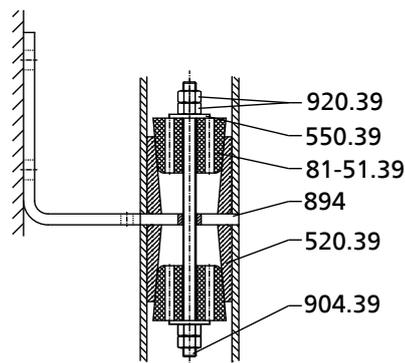
1. Place rails 710 onto the conical bosses provided on base elbow 72-1 and position them vertically.
2. Mark the length of rails 710 (up to the lower edge of the mounting bracket), taking into account the adjusting range of the slotted holes in mounting bracket 894.
3. Shorten rails 710 with a 90° cut to the pipe axis. Debur the rails inside and outside.
4. Insert mounting bracket 894 with elastic sleeves 520.37 into guide rails 710 until the mounting bracket rests on the rail ends.
5. Tighten nuts 920.37.  
This pulls clamping sleeves 81-51.37 upwards and expands sleeves 520.37 against the inside pipe diameter.
6. Lock nuts 920.37 with a second nut each and secure them with Loctite 243.



**NOTE**

For installation depths of more than 19.7 ft [6 m], the scope of supply may include brackets as a middle support for the guide rails. The mounting brackets also serve as spacers between the two guide rails.

**Fitting the middle support**



**Fig. 20:** Fitting the middle support

- ✓ The middle support has been properly fitted to the riser or to a cross-beam.
1. Measure the inside diameter of the guide rails.
  2. Expand elastic sleeves 520.39 with clamping sleeves 81-51.39 to the inside diameter of the guide rails by tightening nuts 920.39.
  3. Slip the guide rails onto the sleeves and verify that there is a tight fit between the guide rails and the sleeves.
  4. Fit and tighten the locknuts.

5.3.1.5 Preparing the pump set

Fitting the claw

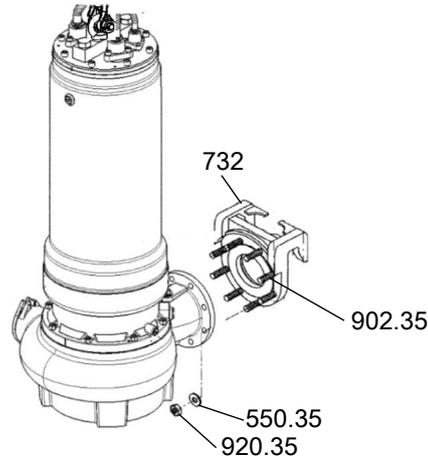


Fig. 21: Fitting the claw

1. Fasten claw 732 to the discharge flange with studs 902.35, discs 550.35 and nuts 920.35.  
Observe the tightening torques.
2. Fit profile seal 410 or round cord seal 99-6 into the groove of the claw.  
This will seal the base elbow/pump connection.

Attaching the lifting chain / lifting rope

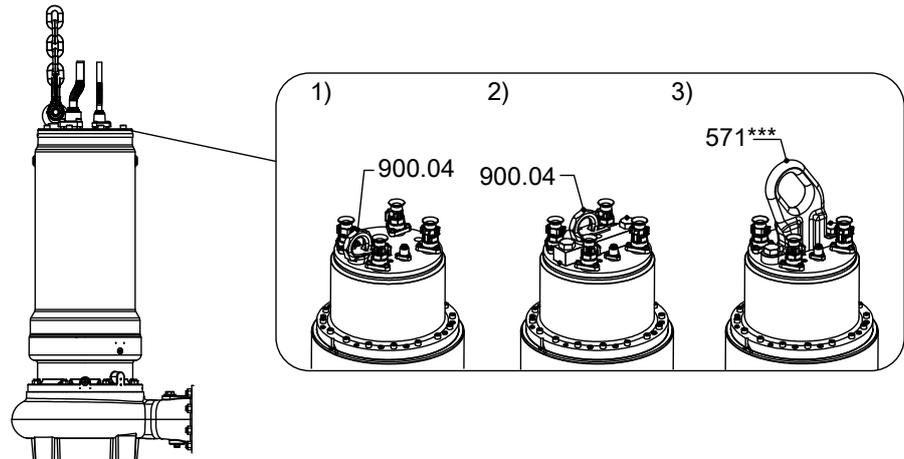


Fig. 22: Attaching the lifting chain / lifting rope – stationary wet installation

1	Standard for guide cable arrangement
2	Standard for guide rail arrangement
3	Optional bail

\*\*\*: Specific sizes only

1. Attach the lifting chain or lifting rope to the pump set at eyebolt 900.04 opposite the discharge nozzle or at bail 571.  
⇒ This attachment point achieves a forward inclination of the pump set towards the discharge nozzle, which allows the pump claw to hook onto the base elbow.

Types of attachment:

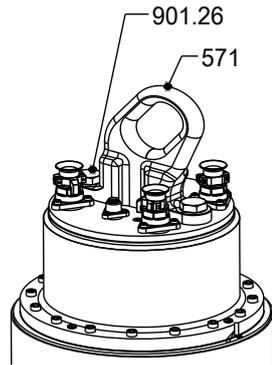


Fig. 23: Bail

Table 20: List of components

Part No.	Description	Part No.	Description
571	Bail	901.26	Hexagon head bolt

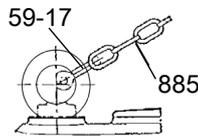


Fig. 24: Chain attached to the eyebolt with a shackle

Table 21: List of components

Part No.	Description	Part No.	Description
59-17	Shackle	885	Chain

### 5.3.1.6 Installing the pump set

	<b>NOTE</b>
<p>Make sure the pump set with the pre-assembled claw can easily be guided over the mounting bracket, threaded onto the guide cables and lowered down. If required, alter the position of the crane during installation.</p>	

1. Guide the pump set over the suspension brackets / mounting bracket, thread it onto the guide cable /guide rails and slowly lower it down.



Fig. 25: Attaching the claw

⇒ The pump set attaches itself to base elbow 72-1.

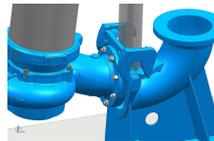


Fig. 26: Claw on base elbow

2. Attach the chain / lifting rope to hook 59-18 at the mounting bracket.

5.3.2 Stationary dry installation

5.3.2.1 Preparing the pump set

Attaching the lifting chain / lifting rope

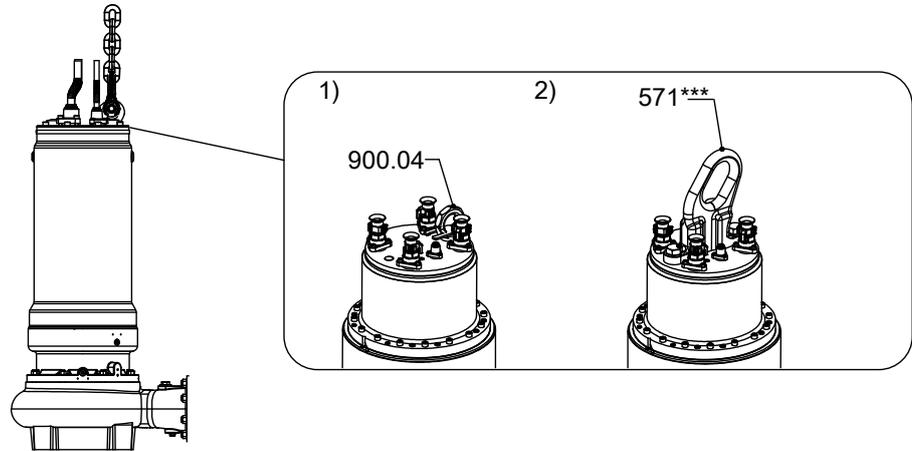


Fig. 27: Attaching the lifting chain / lifting rope – dry installation

1	Standard
2	Optional bail

\*\*\*: Specific sizes only

1. Attach the lifting chain or lifting rope to the pump set at eyebolt 900.04 on the discharge nozzle side or at bail 571.

⇒ This attachment point achieves a horizontal position of the pump feet, which allows the pump set to be placed down.

Types of attachment:

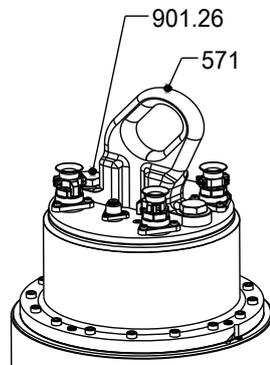


Fig. 28: Bail

Table 22: List of components

Part No.	Description	Part No.	Description
571	Bail	901.26	Hexagon head bolt

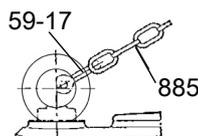


Fig. 29: Chain attached to the eyebolt with a shackle

Table 23: List of components

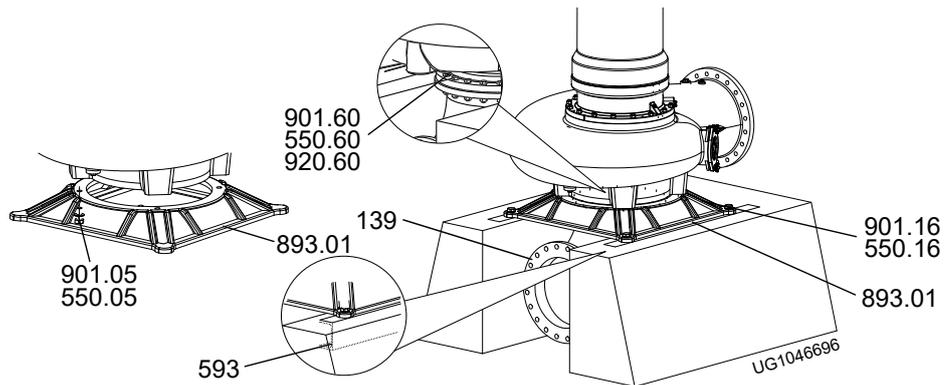
Part No.	Description	Part No.	Description
59-17	Shackle	885	Chain

5.3.2.2 Installing the pump set

	<b>NOTE</b>
<p>If rails 593 are included in the scope of supply, they must be set in concrete as shown in the general arrangement drawing / outline drawing.</p>	

5.3.2.2.1 Installing the pump set with a soleplate

Only for sizes 200-402, 200-403, 200-405, 200-501, 200-502, 200-503 and for sizes with a nominal discharge nozzle diameter of DN 100 and DN 150

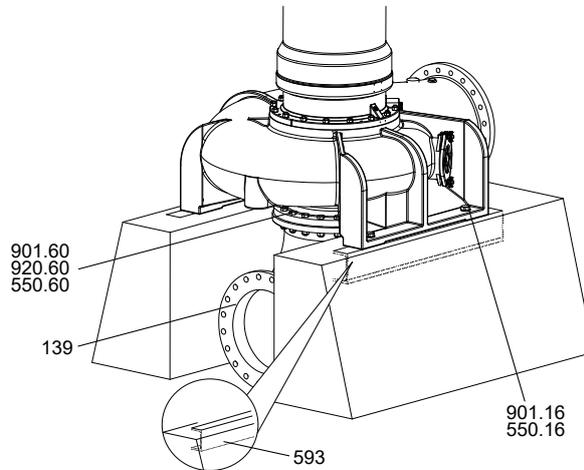


**Fig. 30:** Installing the pump set with a soleplate

1. Fasten suction elbow 139 to the suction nozzle with hexagon head bolts 901.60, discs 550.60 and nuts 920.60.
2. Fasten soleplate 893.01 to the pump set with hexagon head bolts 901.05 and discs 550.05.
3. Place the pump set in a vertical position. Attach lifting equipment to the attachment point on the discharge nozzle side (eyebolt or bail).
4. Place the pump set on the foundation.  
Make sure the pump casing is evenly seated; use shims if necessary.
5. Fasten the pump set with soleplate to the foundation with hexagon head bolts 901.16, discs 550.16 and rails 593.

### 5.3.2.2.2 Installing the pump set with integrally cast pump feet

Not for sizes 200-402, 200-403, 200-405, 200-501, 200-502, 200-503 and for sizes with a nominal discharge nozzle diameter of DN 100 and DN 150



**Fig. 31:** Installing the pump set with pump feet

1. Fasten suction elbow 139 to the suction nozzle with hexagon head bolts 901.60, discs 550.60 and nuts 920.60.
2. Place the pump set in a vertical position. Attach lifting equipment to the attachment point provided (eyebolt).
3. Place the pump set on the foundation.  
Make sure the pump casing is evenly seated; use shims if necessary.
4. Fasten the integrally cast pump feet of the pump set to rails 593 with hexagon head bolts 901.16 and discs 550.16.

5.3.2.3 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 properly 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 for thermal expansion of the piping.</li> </ul>

	<p><b>CAUTION</b></p>
	<p><b>Incorrect grounding during welding work on the piping</b>            Destruction of rolling element bearings (pitting effect)!</p> <ul style="list-style-type: none"> <li>▷ Never ground 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 has been laid with a rising slope, the suction head line with a downward slope towards the pump.
- ✓ A flow stabilization section having a length equivalent to at least twice the diameter of the suction flange has been provided upstream of the suction flange.
- ✓ The nominal sizes of the pipes are equal to or greater than the nominal sizes of the pump nozzles.
- ✓ To prevent excessive pressure losses, adapters to larger nominal diameters are designed with 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, pipes and connections (especially of new installations).
  2. Before installing the pump in the piping, remove the flange covers on the suction nozzle and discharge nozzle of the pump.
  3. Connect the pump nozzles to the piping.

	<p><b>CAUTION</b></p>
	<p><b>Pumps connected with unbraced expansion joints</b>            Machine damage by impermissible nozzle loads!</p> <ul style="list-style-type: none"> <li>▷ Never connect the pump with unbraced expansion joints.</li> </ul>

4. If the owner / operator supplies an expansion joint, it has to be braced with external tie rods to prevent impermissible nozzle loads.

5.3.2.3.1 Permissible forces and moments at the pump nozzles

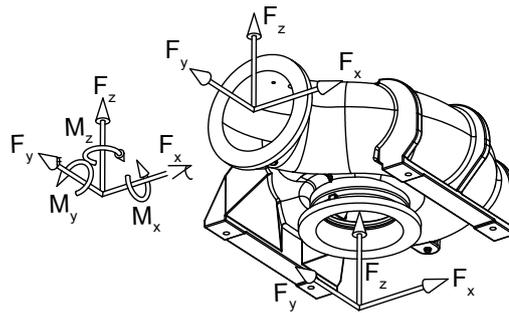


Fig. 32: Forces and moments at the pump nozzles

The values correspond with those specified in ISO 5199 for horizontal installation of pump family 1A for cast iron at 20 °C.

Table 24: Permissible flange loads

Nominal flange diameter	Forces [lbs]				Moments [ft lbs]			
	F <sub>y</sub>	F <sub>z</sub>	F <sub>x</sub>	ΣF	M <sub>y</sub>	M <sub>z</sub>	M <sub>x</sub>	ΣM
100	610	757	678	1187	917	1063	1283	1907
125	723	893	803	1402	1100	1393	1540	2237
150	916	1130	1017	1775	1283	1503	1833	2677
200	1221	1515	1356	2363	1687	1943	2383	3520
250	1526	1888	1684	2950	2310	2677	3263	4803
300	1820	2261	2023	3538	3153	3630	4437	6527
350	2125	2634	2363	4126	4033	4657	5683	8360
400	2430	3007	2702	4714	5060	5830	7113	10487
500	3041	3753	3380	5889	7517	8653	10597	15620
600	3651	4499	4058	7065	10560	12173	14813	21927
700	4318	5087	4702	8275	12613	15400	18847	27353
750	4318	5087	4702	8275	12613	15400	18847	27353
800	4974	5652	5358	9473	14667	18627	22880	32780

Table 25: Permissible flange loads

Nominal flange diameter	Forces [N]				Moments [Nm]			
	F <sub>y</sub>	F <sub>z</sub>	F <sub>x</sub>	ΣF	M <sub>y</sub>	M <sub>z</sub>	M <sub>x</sub>	ΣM
100	2700	3350	3000	5250	1250	1450	1750	2600
125	3200	3950	3550	6200	1500	1900	2100	3050
150	4050	5000	4500	7850	1750	2050	2500	3650
200	5400	6700	6000	10450	2300	2650	3250	4800
250	6750	8350	7450	13050	3150	3650	4450	6550
300	8050	10000	8950	15650	4300	4950	6050	8900
350	9400	11650	10450	18250	5500	6350	7750	11400
400	10750	13300	11950	20850	6900	7950	9700	14300
500	13450	16600	14950	26050	10250	11800	14450	21300
600	16150	19900	17950	31250	14400	16600	20200	29900
700	19100	22500	20800	36600	17200	21000	25700	37300
750	19100	22500	20800	36600	17200	21000	25700	37300
800	22000	25000	23700	41900	20000	25400	31200	44700

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5.3.2.3.2 Auxiliary connections

	<p><b>⚠ WARNING</b></p>
	<p><b>Screw plugs subjected to pressure</b>                  Risk of injuries by parts flying off and escaping fluid!</p> <ul style="list-style-type: none"> <li>▷ Never use screw plugs for releasing pressure from the pump casing.</li> <li>▷ Always use a suitable venting device (e.g. vent valve).</li> </ul>

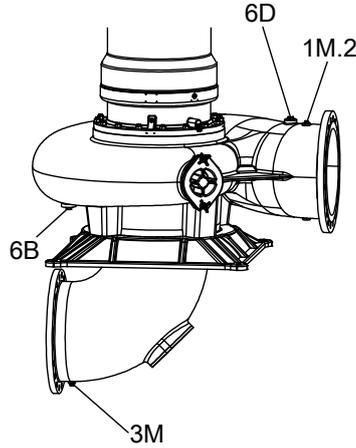


Fig. 33: Auxiliary connections

Table 26: Overview of auxiliary connections

Connection	Description	Thread
1 M.2	Pressure gage	G 1/2
6 D	Vent	G 1 1/4 <sup>13)</sup>
3 M	Pressure/vacuum gage	G 1 1/2
6 B	Casing drain	G 1

5.3.2.3.3 Vacuum balance line

	<p><b>NOTE</b></p>
	<p>Where fluid has to be pumped out of a vessel under vacuum, installing a vacuum balance line is recommended.</p>

The following rules apply to vacuum balance lines:

- Minimum nominal line diameter: 25 mm.
- The line extends above the highest permissible fluid level in the tank.
- The shut-off element in the vacuum balance line always stays open during pump operation; it is only closed when the pump is shut down.

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<sup>13</sup> For sizes: K600-520: G 2; K400-632, K500-634, K500-640: G 1 1/2

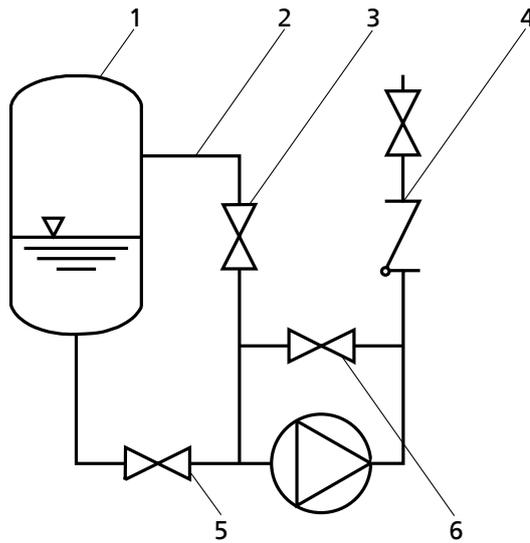


Fig. 34: Vacuum balance line

1	Vessel under vacuum	2	Vacuum balance line
3	Shut-off element	4	Swing check valve
5	Main shut-off element	6	Vacuum-tight shut-off element



**NOTE**

An additional line fitted with a shut-off valve (from the pump discharge nozzle to the balance line) facilitates venting of the pump before start-up.

**5.3.3 Wet installation of a transportable model**

**5.3.3.1 Fitting the foot plate or pump stool**

Fit the foot plate or pump stool before installing the pump.  
Tighten the screws/bolts as specified in the "Tightening torques" table.

**5.3.3.2 Preparing the pump set**

**Attaching the lifting chain / lifting rope**

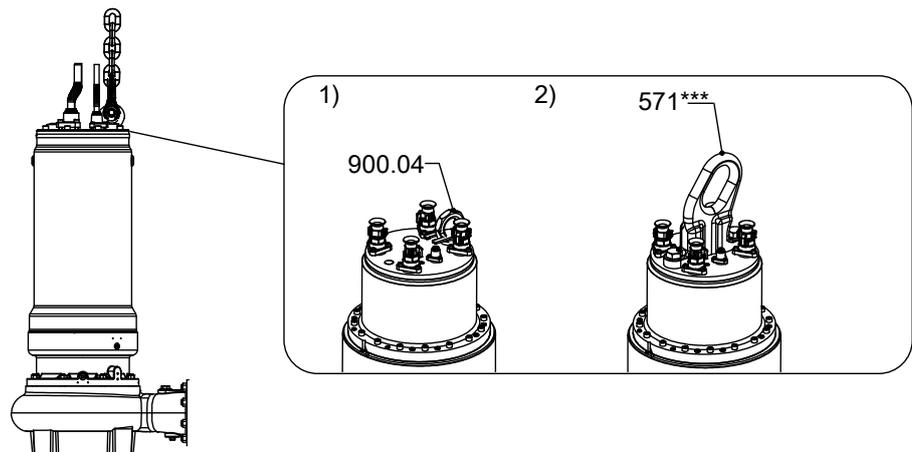


Fig. 35: Attaching the lifting chain / lifting rope – dry installation

1	Standard
2	Optional bail

\*\*\*: Specific sizes only

1. Attach the lifting chain or lifting rope to the pump set at eyebolt 900.04 on the discharge nozzle side or at bail 571.

⇒ This attachment point achieves a horizontal position of the pump feet, which allows the pump set to be placed down.

Types of attachment:

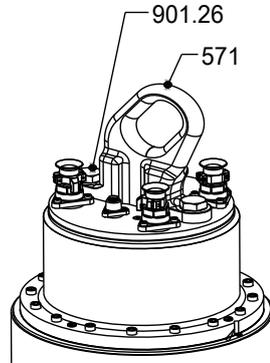


Fig. 36: Bail

Table 27: List of components

Part No.	Description	Part No.	Description
571	Bail	901.26	Hexagon head bolt

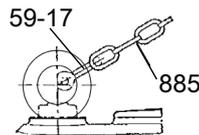


Fig. 37: Chain attached to the eyebolt with a shackle

Table 28: List of components

Part No.	Description	Part No.	Description
59-17	Shackle	885	Chain

### 5.3.3.3 Installing the pump set

#### Installing the pump set

1. Lift the completely assembled pump set with a lifting chain or lifting rope and position it vertically in its prepared place of installation.

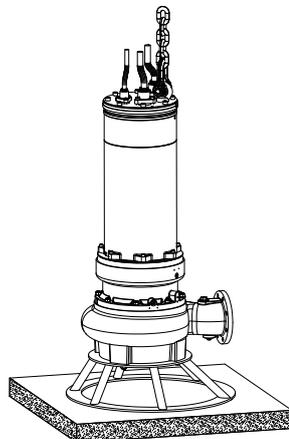


Fig. 38: Installing the pump set

5.3.3.4 Connecting the piping

The discharge nozzles can be connected to rigid or flexible pipes.

5.4 Electrical system

5.4.1 Information for planning the control system

For the electrical connection of the pump set observe the wiring diagram. The pump set is supplied with power cables; it is wired for DOL starting. Star-delta starting is possible.

	<b>NOTE</b>
	<p>When laying a cable between the control system and the pump set's connection point, make sure to have a sufficient number of cores for the sensors. A minimum cross-section of AWG 15 [1.5 mm<sup>2</sup>] is required.</p>

The motors can be connected to electrical low-voltage grids with rated voltages and voltage tolerances to IEC 60038. The permissible tolerances must be observed.

5.4.1.1 Setting the overload protection device

1. Protect the pump set against overloading by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations.
2. Set the overload protection device to the rated current specified on the name plate.

5.4.1.2 Level control

	<b>! DANGER</b>
	<p><b>Pump set running dry</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Never allow a pump set to run dry.</li> </ul>

	<b>CAUTION</b>
	<p><b>Fluid level below the specified minimum</b> Damage to the pump set by cavitation!</p> <ul style="list-style-type: none"> <li>▷ Never allow the fluid level to drop below the specified minimum.</li> </ul>

Automatic operation of the pump set in a sump / tank requires the use of level control equipment.

Observe the minimum fluid level indicated. (⇒ Section 6.2.4.2, Page 64)

5.4.1.3 Operation on a frequency inverter

The pump set is driven by an induction machine to IEC 60034-12 designed for fixed speed operation. In accordance with IEC 60034-25, Section 18, the pump set is suitable for operation on a frequency inverter.

	<b>! DANGER</b>
	<p><b>Operation outside the permitted frequency range</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Never operate an explosion-proof pump set outside the specified range.</li> </ul>

	<b>DANGER</b>
	<p><b>Incorrect selection and setting of the frequency inverter</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Observe the following information on selecting and setting a frequency inverter.</li> </ul>

**Selection** When selecting a frequency inverter, check the following details:

- Data provided by the manufacturer
- Electrical data of the pump set, particularly the rated current

**Start-up** Observe the following instructions for starting up a frequency inverter:

- Ensure short start ramps (maximum 5 seconds).
- Only start speed-controlled operation after 2 minutes at the earliest.  
Pump start-up with long start ramps and low frequency may cause clogging.

**Operation** Observe the following limits when operating the pump set on a frequency inverter:

- Only utilize up to 95 % of the rated power  $P_2$  indicated on the name plate.
- Frequency range 30 to 60 Hz

**Electromagnetic compatibility** Operation on a frequency inverter produces interference emissions whose level varies depending on the inverter used (type, interference suppression, make). To prevent the drive system, consisting of a submersible motor and a frequency inverter, from exceeding any given limits always observe the EMC information provided by the inverter manufacturer. If the inverter manufacturer recommends a shielded power cable, make sure to use a submersible motor pump with shielded power cables.

**Interference immunity** The submersible motor pump generally meets interference immunity requirements. For monitoring the sensors installed the operator must ensure sufficient interference immunity by appropriately selecting and laying the power cables in the plant. No modifications are required on the power/control cable of the submersible motor pump. Suitable analyzing devices must be selected. To monitor the leakage sensor inside the motor using a special relay available from KSB is recommended.

**5.4.1.4 Sensors**

	<b>DANGER</b>
	<p><b>Operating an incompletely connected pump set</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never start up a pump set with incompletely connected power cables or non-operational monitoring devices.</li> </ul>

	<b>CAUTION</b>
	<p><b>Incorrect connection</b> Damage to the sensors!</p> <ul style="list-style-type: none"> <li>▷ Observe the limits stated in the following sections of this manual when connecting the sensors.</li> </ul>

The pump set features sensors that avoid hazards and damage to the pump set.

	<b>NOTE</b>
	<p>Reliable and safe operation of the pump within the scope of our warranty is only possible if the sensor signals are properly analyzed as stipulated in this manual.</p>

All sensors are located inside the pump set and are connected to the sensor cable. For information on wiring and core marking see (⇒ Section 9.3, Page 133)

The individual sensors and the limit values to be set are described in the following sections.

**5.4.1.4.1 Motor temperature**

	<b>DANGER</b>
	<p><b>Insufficient cooling</b> Explosion hazard! Winding damage!</p> <ul style="list-style-type: none"> <li>▸ Never operate a pump set without operational temperature monitoring.</li> <li>▸ For explosion-proof pump sets use a thermistor tripping unit with manual reset.</li> </ul>

**Pump sets with cooling system (installation types D and K):**

Four series-connected thermistors (PTC) with terminals 10 and 11 monitor the winding and cooling liquid temperature. Use a thermistor tripping unit with manual reset. For explosion-proof pump sets use a thermistor tripping unit which is approved for monitoring the temperature of explosion-proof motors in "flameproof enclosure" Ex d type of protection.

**Pump sets without cooling system (installation types P and S):**

The pump set features double monitoring of the winding temperature. Two bimetal switches (terminals 21 and 22, max. 250 V AC/2 A) serve as temperature control devices which open when the winding temperature is too high. Opening of the contacts must result in the pump set cutting out. Automatic re-starting is permitted.

For explosion-proof pump sets, the three additional, series-connected (PTC) thermistors with terminals 10 and 11 must be used. They must be combined with a thermistor tripping unit with manual reset.

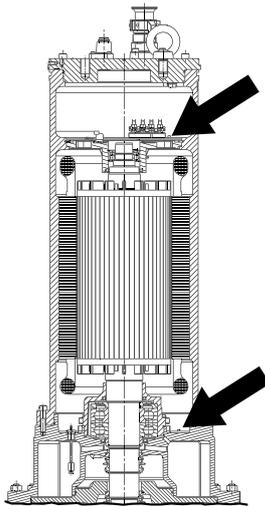
**Resistance thermometer (Pt100)**

As an option, in addition to the above, the motor can be fitted with Pt100 resistance thermometers in the winding. These can be used for reading the motor temperature (sensor circuit maximum 6 V/2 mA).

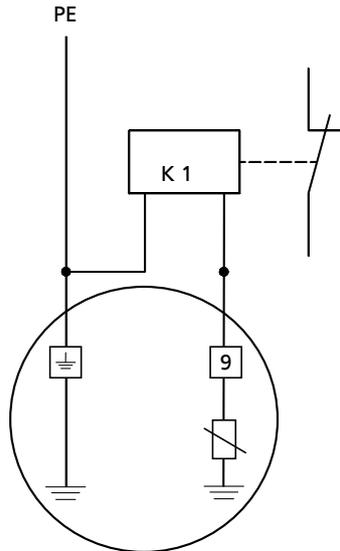
	<p style="text-align: center; margin: 0;"><b>CAUTION</b></p>
	<p><b>Temperature monitoring equipment not properly connected</b> Winding damage!</p> <ul style="list-style-type: none"> <li>▸ Never use the resistance thermometers as a sole means of monitoring the motor temperature.</li> </ul>

**5.4.1.4.2 Leakage inside the motor**

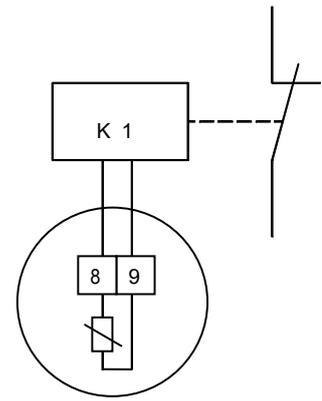
	<b>DANGER</b>
	<p><b>Incorrect monitoring of leakage electrode</b> Explosion hazard! Danger of death from electric shock!</p> <ul style="list-style-type: none"> <li>▸ Voltages must be &lt; 30 V AC and tripping currents &lt; 0.5 mA.</li> </ul>



Position of the electrodes in the motor housing



Wiring of the electrode relay (standard)



Wiring of the electrode relay (pump sets with vibration sensor only)

Electrodes fitted inside the motor monitor the winding and connection space for leakage. Both electrodes are connected in parallel (core identification 9). They must be connected to an electrode relay. Tripping of the electrode relay must result in the pump set cutting out.

The electrode relay (K1) must trip at a resistance between 3 and 60 kΩ.

**Pump sets with vibration sensors**

A different wiring system is used for the electrodes of pump sets with vibration sensors.

**5.4.1.4.3 Mechanical seal leakage**

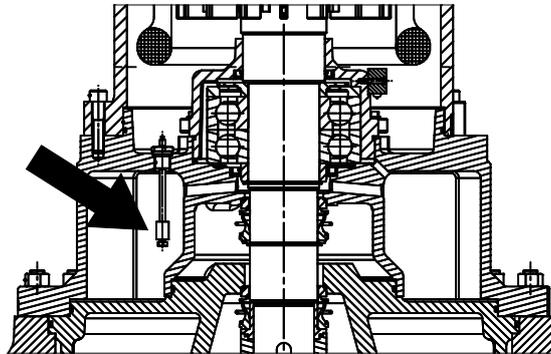


Fig. 39: Float switch

The chamber for mechanical seal leakage is equipped with a float switch (core identification 3 and 4). The contact (maximum 250 V~/2 A) opens when leakage is detected in the leakage chamber. Opening of the contact shall trigger an alarm signal.

**5.4.1.4.4 Bearing temperature**

The lower bearing of the pump set is equipped with a bearing temperature sensor. This sensor is a Pt100 resistance thermometer (core marking 15 and 16). It must be connected to a temperature control device with a Pt100 input and two separate outputs for two different switching points (sensor circuit maximum 6 V/2 mA).

Set the following limits:

- Alert at 266 °F (130 °C)
- Cut-out of the pump set at 302 °F (150 °C)

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As an option, the upper (drive-end) bearing can also be equipped with a temperature sensor (core marking 16 and 17). Its connection and settings are identical with the above. Check in the data sheet whether the pump set features temperature monitoring of the upper (drive-end) bearing.

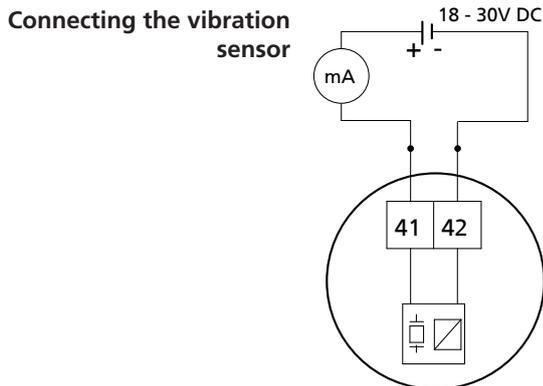
**5.4.1.4.5 Vibrations**

As an option, the pump set can be supplied with a vibration sensor in the area of the upper bearing assembly. The sensor is matched to KSB's diagnosis systems.

The vibration sensor measures the root-mean-square value of the radial vibration velocity at the upper bearing. The sensor has an integrated signal converter with a standardized output (4 to 20 mA). This allows simple integration into existing PLC systems or process control systems.

**Table 29:** Technical data of the sensor

Characteristic	Value
Measuring range	4 - 20 mA at 0 - 0.79 in/s RMS [0 - 20 mm/s]
Measurement error	< 5 %
Long-term stability	+/- 1 % in 10 years
Max. shock load	1.1 lb [500 g]
Frequency range	2 Hz - 1000 Hz
Resonant frequency	18 kHz
Output impedance	200 Ohm max.
Voltage supply	18 - 30 V (smoothed)
Working resistance	50 - 100 Ohm



**Fig. 40:** Connecting the vibration sensor

We recommend the following settings for vibration monitoring with the (optional) vibration sensor fitted at the factory:

- Alert triggered at  $v_{eff} = 0.43$  in/s [11 mm/s] (impeller types E and D:  $v_{eff} = 0.55$  in/s [14 mm/s])
  - This vibration limit requires remedial action.
  - In general, pump operation may continue until the causes of the change in vibration level have been detected and remedies have been determined.
- Cut-out at  $v_{eff} = 0.55$  in/s [14 mm/s] (impeller types E and D:  $v_{eff} = 0.66$  in/s [17 mm/s])
  - If this vibration velocity is exceeded, continued pump set operation may result in damage.
  - Suitable action to reduce vibrations should be taken immediately, or the pump set should be switched off.

5.4.2 Electrical connection

	<b>DANGER</b>
	<p><b>Electrical connection work 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 the IEC 61557 regulations as well as any locally applicable regulations.</li> </ul>

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

	<b>CAUTION</b>
	<p><b>Improper routing of power cables</b>            Damage to the power cables!</p> <ul style="list-style-type: none"> <li>▷ Never move the power cables at temperatures below -13 °F [-25 °C].</li> <li>▷ Never kink or crush the power cables.</li> <li>▷ Never lift the pump set by the power cables.</li> <li>▷ Adjust the length of the power cables to the site requirements.</li> </ul>

	<b>CAUTION</b>
	<p><b>Motor overload</b>            Damage to the motor!</p> <ul style="list-style-type: none"> <li>▷ Protect the motor by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations.</li> </ul>

For the electrical connection of the pump set observe the wiring diagrams (⇒ Section 9.3, Page 133) in the Annex and the information for planning the control system (⇒ Section 5.4.1, Page 52) .

The pump set is supplied complete with connection cables. Always use all cables provided and connect all marked cores of the control cable.

	<b>DANGER</b>
	<p><b>Incorrect connection</b>            Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ The connection point of the cable ends must be located outside hazardous areas or in an area approved for electrical equipment.</li> </ul>

	<b>DANGER</b>
	<p><b>Operating an incompletely connected pump set</b>            Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never start up a pump set with incompletely connected power cables or non-operational monitoring devices.</li> </ul>

	 <b>DANGER</b>
	<p><b>Connection of damaged electric cables</b>            Danger of death from electric shock!</p> <ul style="list-style-type: none"> <li>▷ Check the electric cables for any damage before connecting them.</li> <li>▷ Never connect damaged electric cables.</li> <li>▷ Replace damaged electric cables.</li> </ul>
	<b>CAUTION</b>
	<p><b>Flow-induced motion</b>            Damage to the electric cable!</p> <ul style="list-style-type: none"> <li>▷ If the pump is installed in a tank, run the electric cables directly upwards without slack.</li> </ul>

1. If the pump is installed in a tank, run the electric cables directly upwards without slack and fasten them.
2. Only remove the protective caps from the electric cables immediately before connecting the cables.
3. If necessary, adjust the length of the electric cables to the site requirements.
4. After shortening the cables, correctly re-affix the markings of the individual cores at the cable ends.

**5.4.2.1 Potential equalization**

**Wet installation (installation types K, P, S)**

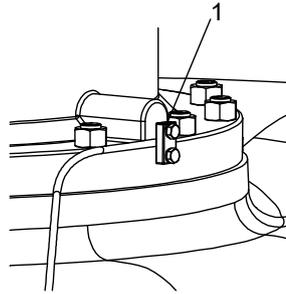
The pump set does not have an external PE connection (risk of corrosion).

	 <b>DANGER</b>
	<p><b>Touching the pump set during operation</b>            Electric shock!</p> <ul style="list-style-type: none"> <li>▷ Make sure that the pump set cannot be touched during operation.</li> </ul>

**Dry installation (installation type D)**

Pump sets for dry installation are provided with an external potential equalization connection. Potential equalization shall be provided for in compliance with IEC 60204.

	 <b>DANGER</b>
	<p><b>Incorrect connection</b>            Danger of death from electric shock!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump set without connecting the PE conductor.</li> </ul>

**Connecting the potential equalization conductor****Fig. 41:** Connecting the potential equalization conductor

1	Potential equalization
---	------------------------

1. Connect the potential equalization conductor to terminal 81-51 provided on the outside of bearing housing 350.
2. Fasten the conductor with hexagon head bolts 901.30 and spring washers 932.30.

## 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 power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked.
- All auxiliary feed lines required are connected and operational.
- The lubricant has been checked.
- After prolonged shutdown of the pump (set), the activities required for returning the equipment to service have been carried out. (⇒ Section 6.4, Page 67)

	 <b>DANGER</b>
	<p><b>Persons in the tank during pump operation</b>            Electric shock!            Risk of personal injury!            Danger of death from drowning!</p> <p>▷ Never start up the pump set when there are persons in the tank.</p>

	 <b>DANGER</b>
	<p><b>Exceeding the operating limits</b>            Pump casing could burst/leak!            Pressurized hot or toxic fluid could escape!            Flying parts!</p> <p>▷ Maintain an adequate safety distance from pump sets which are in operation.</p>

#### 6.1.2 Priming and venting the pump set (dry installation only - installation type D)

	 <b>DANGER</b>
	<p><b>Shaft seal failure caused by insufficient lubrication</b>            Hot or toxic fluid could escape!            Damage to the pump!</p> <p>▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.</p>

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.
3. Fully open all auxiliary connections (barrier fluid, flushing liquid, etc).

6.1.3 Start-up

Wet installation (installation types K, P, S)

	<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 it has come to a standstill.</li> <li>▸ Never start the pump set while the pump is running in reverse.</li> </ul>

✓ The fluid level is sufficiently high.

	<b>CAUTION</b>
	<p><b>Start-up against a closed shut-off element</b>          Increased vibrations!          Damage to mechanical seals and bearings!</p> <ul style="list-style-type: none"> <li>▸ Never start up the pump set against a closed shut-off element.</li> </ul>

1. Fully open the discharge line shut-off element, if any.
2. Start up the pump set.

Dry installation (installation type D)

	<b>⚠ DANGER</b>
	<p><b>Non-compliance with the permissible pressure limits and temperature limits due to pump being operated with the suction and discharge lines closed.</b>          Explosion hazard!          Hot or toxic fluids escaping!</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 against a slightly open discharge-side shut-off element.</li> </ul>

	<b>⚠ DANGER</b>
	<p><b>Excessive temperatures due to insufficient lubrication of shaft seal or excessive gas content in the fluid handled</b>          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>⚠ WARNING</b>
	<p><b>Hot surface</b>          Risk of burns</p> <ul style="list-style-type: none"> <li>▸ Never touch a pump set which is in operation.</li> </ul>

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	<b>⚠ WARNING</b>
	<p><b>Very high noise emission during operation</b>          Personal injury!</p> <ul style="list-style-type: none"> <li>▷ Minimize exposure in the vicinity of the pump set.</li> <li>▷ For required work near running pump sets use appropriate ear protection.</li> </ul>

	<b>⚠ WARNING</b>
	<p><b>Abnormal noises, vibrations, temperatures or leakage</b>          Damage to the pump!          Risk of personal injury!</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 pump, suction line and inlet tank, if any, have been vented and primed with the fluid to be 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 line / suction lift line.
2. Slightly open the shut-off element in the discharge line.
3. Start up the motor.
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.

**6.1.4 Shutdown (dry installation only - installation type D)**

- ✓ The shut-off element in the suction line is and remains open.
  1. Switch off the motor.
  2. Immediately after having switched off the motor, close the shut-off element in the discharge line.

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

**For prolonged shutdown periods:**

1. Close the shut-off element in the suction line.
2. Close any auxiliary lines.

	<b>CAUTION</b>
	<p><b>Danger of freezing!</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Drain the pump set or protect it against freezing.</li> </ul>

**6.2 Operating limits**

	<b>⚠ DANGER</b>
	<p><b>Non-compliance with operating limits</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Comply with the operating data indicated in the data sheet.</li> <li>▷ Never operate the pump set at ambient or fluid temperatures exceeding those specified in the data sheet or on the name plate.</li> <li>▷ Never operate the pump set outside the limits specified below.</li> </ul>

**6.2.1 Frequency of starts**

	<b>CAUTION</b>
	<p><b>Excessive frequency of starts</b> Damage to the motor!</p> <ul style="list-style-type: none"> <li>▷ Never exceed the specified frequency of starts.</li> </ul>

To prevent high temperature increases in the motor and excessive loads on the motor, sealing elements and bearings, the frequency of starts shall not exceed 10 starts per hour.

These values apply to mains start-up (DOL or with star-delta contactor, autotransformer, soft starter). These limits do not apply to operation on a frequency inverter.

	<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 it has come to a standstill.</li> <li>▷ Never start the pump set while the pump is running in reverse.</li> </ul>

**6.2.2 Operation on the power supply mains**

	<b>⚠ DANGER</b>
	<p><b>Non-compliance with permissible supply voltage tolerances</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Never operate an explosion-proof pump (set) outside the specified range.</li> </ul>

The maximum permissible deviation in supply voltage is  $\pm 10\%$  of the rated voltage. The voltage difference between the individual phases must not exceed 1 %.

6.2.3 Operation on a frequency inverter

	<b>⚠ DANGER</b>
	<p><b>Operation outside the permitted frequency range</b> Explosion hazard!</p> <p>▸ Never operate an explosion-proof pump set outside the specified range.</p>

	<b>CAUTION</b>
	<p><b>Pumping solids-laden fluids at reduced speed</b> Increased wear and clogging!</p> <p>▸ Never operate the pump set with flow velocities below approx. 25 in/s [0.7 m/s] in horizontal pipes and approx. 45 in/s [1.2 m/s] in vertical pipes.</p>

- Frequency range 30 to 60 Hz

6.2.4 Fluid handled

6.2.4.1 Fluid temperature

The pump set is designed for transporting liquids. The pump set is not operational under freezing conditions.

	<b>CAUTION</b>
	<p><b>Danger of freezing!</b> Damage to the pump set!</p> <p>▸ Drain the pump set or protect it against freezing.</p>

Refer to the maximum permissible fluid temperature and ambient temperature indicated on the name plate and/or in the data sheet.

6.2.4.2 Minimum level of fluid handled

	<b>⚠ DANGER</b>
	<p><b>Pump set running dry</b> Explosion hazard!</p> <p>▸ Never allow an explosion-proof pump set to run dry.</p>

	<b>CAUTION</b>
	<p><b>Fluid level below the specified minimum</b> Damage to the pump set by cavitation!</p> <p>▸ Never allow the fluid level to drop below the specified minimum.</p>

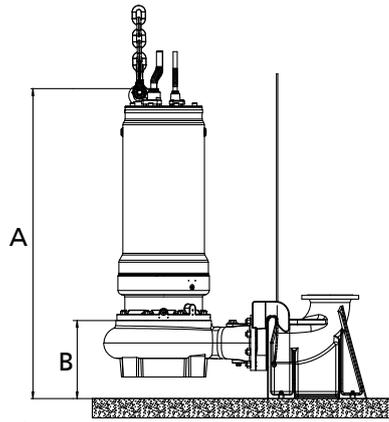


Fig. 42: Minimum level of fluid handled

**Pump sets without cooling system (installation types P and S)**

Pump sets without cooling system are designed for continuously **submerged** operation. This condition has to be fulfilled for the motor to be cooled sufficiently.

**Ready for operation** The pump set is ready for operation as soon as the motor is fully submerged (dimension A). Exact dimensions see general arrangement drawing / outline drawing.

The pump can be operated at a lower fluid level for short periods. If the motor is not sufficiently cooled, an internal temperature monitoring device will trip the pump set and automatically re-start it after the motor has cooled down. The fluid level must not drop below the specified minimum (dimension B). For the exact dimension see general arrangement drawing / outline drawing.

**Pump sets with cooling system (installation type K)**

Pump sets with cooling system are suitable for continuous operation with the motor **outside the fluid**.

**Ready for operation** The pump set is ready for operation when the minimum fluid level has been reached (dimension B). Exact dimensions see general arrangement drawing/outline drawing.

	<b>NOTE</b>
	<p>Compliance with dimension B does not guarantee trouble-free operation of the pump set. Depending on the pump's duty point, higher fluid levels may be required. Observe the NPSH values indicated in the characteristic curve (see hydraulic characteristic curves).</p>

**6.2.4.3 Density of the fluid handled**

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

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

**6.2.4.4 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 is to be expected. In this case, halve 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

	<p><b>⚠ WARNING</b></p> <p><b>Unintentional starting of pump set</b> Risk of injury by moving components and shock currents!</p> <ul style="list-style-type: none"> <li>▷ Make sure 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>
	<p><b>⚠ WARNING</b></p> <p><b>Fluids handled, consumables and operating supplies which are hot or pose a health hazard</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>
	<p><b>CAUTION</b></p> <p><b>Danger of frost/freezing</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ If there is any danger of frost/freezing, remove the pump set from the fluid handled and clean, preserve and store it.</li> </ul>

✓ Make sure sufficient fluid is available for the functional check run of the pump set.

1. For prolonged shutdown periods, start up the pump set regularly once every three months for approximately one minute.  
This will prevent the formation of deposits within the pump and the pump intake area.

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

✓ All safety regulations are observed. (⇒ Section 7.1, Page 68)

1. Clean the pump set.
2. Preserve the pump set.
3. Observe the information in (⇒ Section 3.2, Page 14) (⇒ Section 3.3, Page 17) .

**6.4 Returning to service**

For returning the pump set to service, observe the items on commissioning/start-up. (⇒ Section 6.1, Page 60)

Refer to and comply with the operating limits. (⇒ Section 6.2, Page 63)

For returning the equipment to service after pump set storage also follow the instructions for maintenance/inspection.

	<p style="background-color: #f4a460; padding: 2px;"><b>⚠ WARNING</b></p> <p><b>Failure to re-install or re-activate protective equipment/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 completed, re-install and/or re-activate any safety-relevant devices and protective devices.</li> </ul>
	<p style="background-color: #0070c0; color: white; padding: 2px;"><b>NOTE</b></p> <p>On pumps/pump sets older than 5 years we recommend replacing all elastomer seals.</p>

## 7 Servicing/Maintenance

### 7.1 Safety regulations

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

	<p><b>⚠ DANGER</b></p> <p><b>Sparks produced during maintenance work</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Observe the safety regulations in force at the place of installation.</li> <li>▷ Never open a pump set that is connected to the power supply.</li> <li>▷ Always perform maintenance work on pump sets outside potentially explosive atmospheres.</li> </ul>
	<p><b>⚠ DANGER</b></p> <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, electric cable, bearing assembly and shaft seal.</li> </ul>
	<p><b>⚠ DANGER</b></p> <p><b>Electrical connection work 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 the IEC 61557 regulations as well as any locally applicable regulations.</li> </ul>
	<p><b>⚠ DANGER</b></p> <p><b>Risk of falling when working at great heights</b> Danger to life by falling from great heights!</p> <ul style="list-style-type: none"> <li>▷ Do not step onto the pump (set) during installation work or dismantling work.</li> <li>▷ Pay attention to safety equipment, such as railings, covers, barriers, etc.</li> <li>▷ Observe the applicable local occupational safety regulations and accident prevention regulations.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Unintentional starting of pump set</b> Risk of injury by moving components and shock currents!</p> <ul style="list-style-type: none"> <li>▷ Make sure 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>

	<p><b>⚠ WARNING</b></p> <p><b>Hands, other body parts or foreign objects in the impeller or intake area</b> Risk of injury! Damage to the submersible motor pump!</p> <ul style="list-style-type: none"> <li>▷ Never insert your hands, other body parts or foreign objects into the impeller and/or impeller intake area.</li> <li>▷ Always make sure that the electrical connections are disconnected before checking that the impeller can rotate freely.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Fluids handled, consumables and operating supplies which are hot or pose a health hazard</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>
	<p><b>⚠ WARNING</b></p> <p><b>Hot surface</b> Risk of personal injury!</p> <ul style="list-style-type: none"> <li>▷ Allow the pump set to cool down to ambient temperature.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Improper lifting/moving of heavy assemblies or components</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Insufficient stability</b> Risk of crushing hands and feet!</p> <ul style="list-style-type: none"> <li>▷ During assembly/dismantling, secure the pump (set)/pump parts against tilting or tipping over.</li> </ul>
	<p><b>NOTE</b></p> <p>Special regulations apply to repair work on explosion-proof pump sets. Modifications or alteration of the pump sets can affect explosion protection and are only permitted after consultation with the manufacturer.</p>
<p>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.</p>	
	<p><b>NOTE</b></p> <p>All maintenance work, service work and installation work can be carried out by KSB Service or authorized workshops. 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 the pump set.

## 7.2 Servicing/inspection

KSB recommends the following regular maintenance schedule:

**Table 30:** Overview of maintenance work

Maintenance interval	Maintenance work	For details see ...
Every 4000 operating hours <sup>14)</sup>	Insulation resistance measurement	(⇒ Section 7.2.1.4, Page 71)
	Checking the power cables	(⇒ Section 7.2.1.3, Page 71)
	Visual inspection of lifting chain / lifting rope	(⇒ Section 7.2.1.1, Page 70)
	Visual inspection of lifting accessories	(⇒ Section 7.2.1.2, Page 70)
Every 8000 operating hours <sup>15)</sup>	Checking the sensors	(⇒ Section 7.2.1.5, Page 71)
	Checking the mechanical seal leakage	(⇒ Section 7.2.1.6, Page 73)
	Changing the lubricant	(⇒ Section 7.2.3.1.4, Page 86)
	Lubricating the bearings	(⇒ Section 7.2.3.2, Page 87)
Every five years	General overhaul (including coolant change on installation types K and D)	(⇒ Section 7.2.2.3, Page 79)

	<b>NOTE</b>
	Apply liquid sealant to all screw plugs.

### 7.2.1 Inspection work

#### 7.2.1.1 Checking the lifting chain/rope

- ✓ The pump set has been lifted out of the pump sump and cleaned. (Applies to installation type K only.)
  1. Inspect the lifting chain/rope as well as their fasteners (shackles) for any visible damage.
  2. Replace any damaged components by original spare parts.
  3. Assess the lifting chain / lifting rope / shackle in accordance with the locally applicable regulations for lifting tackle.
  4. In addition, observe the operating manual of the lifting accessories.

#### 7.2.1.2 Checking the lifting accessories

- ✓ The pump set has been lifted out of the pump sump and cleaned. (For installation types K, P and S only)
  1. Check the bail or eyebolt including fasteners (screws/bolts) for any visible damage.
  2. Replace any damaged components by original spare parts.
  3. If strongly corroded, the lifting accessory must be replaced by a lifting accessory made of a material suitable for the fluid handled.
  4. Assess the bail / eyebolt against the locally applicable regulations for lifting tackle.

<sup>14</sup> At least once a year

<sup>15</sup> At least every two years

**7.2.1.3 Checking the power cables**

**Visual inspection**

- ✓ The pump set has been lifted out of the pump sump and cleaned.
  1. Inspect the power cables for visible damage.
  2. Replace any damaged components by original spare parts.

**Checking the ground conductor**

- ✓ The pump set has been lifted out of the pump sump and cleaned.
  1. Measure the resistance between the ground conductor and chassis ground. The electrical resistance must be lower than 1 Ω.
  2. Replace any damaged components by original spare parts.

	 <b>DANGER</b>
	<p><b>Defective ground conductor</b> Electric shock!</p> <ul style="list-style-type: none"> <li>▷ Never switch on a pump set with a defective ground conductor.</li> </ul>

**7.2.1.4 Measuring the insulation resistance**

Measure the insulation resistance of the motor winding during annual maintenance work.

- ✓ The pump set has been disconnected in the control cabinet.
- ✓ Use an insulation resistance measuring device.
- ✓ The maximum measuring voltage is 500 V (maximum permissible voltage 1000 V).
  1. Measure the winding to chassis ground. To do so, connect all winding ends together.
  2. Measure the winding temperature sensor to chassis ground. To do so, connect all core ends of the winding temperature sensors together and connect all winding ends to chassis ground.
- ⇒ The insulation resistance of the core ends to chassis ground must not be lower than 1 MΩ.  
If the resistance measured is lower, power cable and motor resistance must be measured separately. Disconnect the power cable from the motor for this purpose.

	<b>NOTE</b>
	<p>If the insulation resistance of the power cable is lower than 1 MΩ, the power cable is defective and must be replaced.</p>

	<b>NOTE</b>
	<p>If the insulation resistances measured on the motor are too low, the winding insulation is defective. The pump set must not be returned to service in this case.</p>

**7.2.1.5 Checking the sensors**

	<b>CAUTION</b>
	<p><b>Excessive test voltage</b> Damage to the sensors!</p> <ul style="list-style-type: none"> <li>▷ Use a commercially available ohmmeter to measure the resistance.</li> </ul>

The tests described below measure the resistance at the core ends of the control cable. The actual sensor function is not tested.

**Temperature sensors in the motor winding**

**Table 31:** Resistance measurement

Measurement between terminals ...	Resistance
	[Ω]
21 and 22 <sup>16)</sup>	< 1
10 and 11	100 to 1000
31 and 32 <sup>17)</sup>	100 to 120
33 and 34 <sup>17)</sup>	100 to 120
35 and 36 <sup>17)</sup>	100 to 120

If the specified tolerances are exceeded, disconnect the connection cable at the pump set and repeat the check inside the motor.

If the tolerances are exceeded here, too, the motor part must be opened and overhauled. The temperature sensors are fitted in the stator winding and cannot be replaced.

If the sensors are defective, use the back-up sensors provided at the same place in the stator winding.

**Leakage sensors in the motor**

**Table 32:** Resistance measurement of the leakage sensor in the motor

Measurement between terminals ...	Resistance
	[kΩ]
9 and ground conductor (PE)	> 60
8 and 9 <sup>18)</sup>	> 60

Lower resistance values would suggest water ingress into the motor. In this case the motor section must be opened and overhauled.

**Float switch (mechanical seal leakage)**

**Table 33:** Resistance measurement of the float switch

Measurement between terminals ...	Resistance
	[Ω]
3 and 4	< 1

If the readings suggest an open switch, check for mechanical seal leakage.

**Bearing temperature sensor**

**Table 34:** Resistance measurement of the bearing temperature sensors

Measurement between terminals ...	Resistance
	[Ω]
15 and 16	100 to 120
16 and 17 <sup>19)</sup>	100 to 120

**Vibration sensor**

**Table 35:** Current measurement at the vibration sensor

Measurement between terminals ...	Current value
41 and 42 <sup>20)</sup>	Constant 4 mA during standstill

**Functional test**

Connect the vibration sensor. Measure the current in the measuring circuit with a suitable ammeter. (⇒ Section 5.4.1.4.5, Page 56)

<sup>16)</sup> Only for pump sets without cooling system, installation type S

<sup>17)</sup> Optional

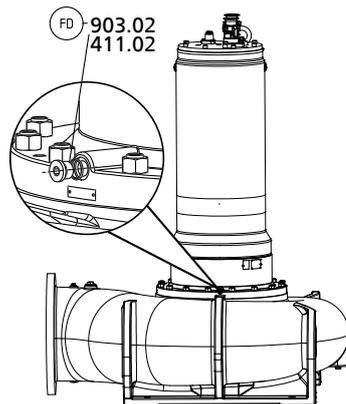
<sup>18)</sup> Only for pump sets with vibration sensor

<sup>19)</sup> Optional

<sup>20)</sup> Optional

7.2.1.6 Checking the mechanical seal leakage

	<p style="background-color: #f4a460; padding: 5px;"><b>⚠ WARNING</b></p> <p><b>Fluids handled, consumables and operating supplies which are hot or pose a health hazard</b> Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▷ Collect and properly dispose of the flushing fluid and of 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>
	<p style="background-color: #f4a460; padding: 5px;"><b>⚠ WARNING</b></p> <p><b>Excess pressure inside the pump set</b> Risk of personal injury when opening the pump set!</p> <ul style="list-style-type: none"> <li>▷ Be careful when opening the inner chambers.</li> </ul>
	<p style="background-color: #0070c0; color: white; padding: 5px;"><b>NOTE</b></p> <p>Slight wear of the mechanical seal is unavoidable. This will be aggravated by abrasive substances contained in the fluid handled.</p>



**Fig. 43:** Checking the mechanical seal leakage

- ✓ The pump set has been placed in a vertical position.
- 1. Place a suitable container under screw plug 903.02.
- 2. Remove screw plug 903.02 and joint ring 411.02.
- 3. Drain the leakage.

	<p style="background-color: #0070c0; color: white; padding: 5px;"><b>NOTE</b></p> <p>If more than 5.3 quart [5 liters] of leakage should escape we recommend to replace the mechanical seals.</p>
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- 4. Close screw plug 903.02, fitting joint ring 411.02 and applying liquid sealant.

**7.2.1.7 Visual inspection of the pump set through the inspection hole (dry installation only - installation type D)**

In the event of clogging the inside of the pump casing and the impeller can be checked via the inspection hole.

	<p><b>⚠ WARNING</b></p>
	<p><b>Fluids handled, consumables and operating supplies which are hot or pose a health hazard</b>  Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▷ Collect and properly dispose of the flushing fluid and of 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>
	<p><b>⚠ WARNING</b></p>
	<p><b>Hands inside the pump casing</b>  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 if the pump has not been de-energized and secured against unintentional start-up.</li> </ul>

If there is a problem which requires visual inspection, observe the following instructions:

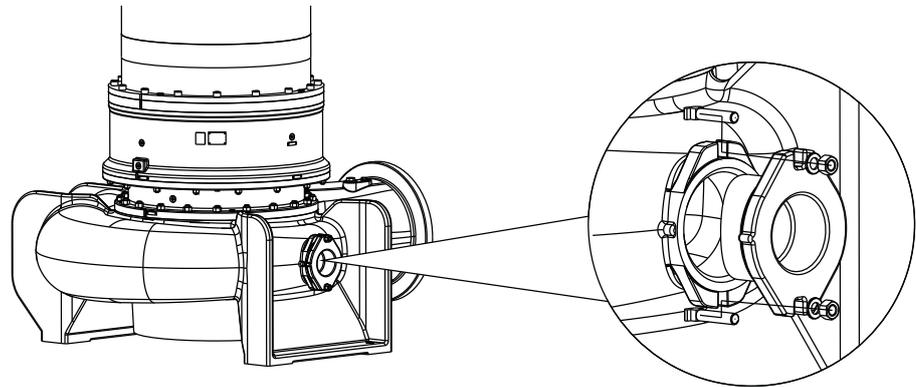


Fig. 44: Inspection hole at the casing

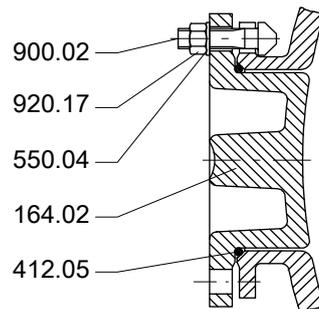


Fig. 45: Inspection hole in the casing

**Opening the inspection hole**

- Close the shut-off element on the suction side.
- Switch off the drive and make sure it cannot be re-started unintentionally.
- Close the shut-off element on the discharge side.
- Open the drain plug (auxiliary connection 6B). (⇒ Section 5.3.2.3.2, Page 49)
- Collect and dispose of any liquid residues.
- Loosen nuts 920.17 at the inspection hole and remove inspection cover 164.02.
- Perform a visual inspection with a lamp or similar.

**Closing the inspection hole**

- Fit new O-ring 412.05.
- Fit inspection cover 164.02.
- Place discs 550.04 and nuts 920.17 on screws 900.02 and tighten.
- Observe the instructions on commissioning/start-up.

**7.2.2 Coolant (pump sets with cooling system only - installation types D and K)**

The pump set's cooling system is filled with an environmentally friendly propylene glycol/water mixture. The coolant additive prevents corrosion in the cooling system and provides frost protection down to -4 °F [-20°C]. The coolant also lubricates the mechanical seals.

**7.2.2.1 Coolant quality**

	<b>CAUTION</b>
	<p><b>Incorrect coolant mixture</b> Corrosion of the cooling system</p> <p>▸ Always use the exact coolant mixture.</p>

Water/propylene glycol mixture with corrosion inhibitors for frost protection down to -4 °F [-20 °C]

(e.g. Tyfocor L<sup>21</sup>/water mixture, mixing ratio 62:38)

**7.2.2.2 Coolant quantity**
**Table 36:** Coolant quantity in liters

Size	Impeller type	Motor					
		35 4	95 4	130 4	200 4	320 6	400 6
		50 4	110 4	155 4	250 4	360 6	440 6
		65 4	80 6	175 4	300 4	260 8	480 6
		80 4	100 6	120 6	350 4	300 8	350 8
		32 6	75 8	140 6	190 6	230 10	400 8
		40 6		165 6	225 6	195 12	270 10
		50 6		90 8	260 6		310 10
		60 6		110 8	150 8		350 10
		26 8		130 8	185 8		265 12
		35 8		40 10	220 8		230 12
		50 8		60 10	110 10		300 12
				75 10	150 10		
				90 10	190 10		
					105 12		
					135 12		
					165 12		
		[quart]					
100-400	K	29,6	31,7	63,4	-	-	-
100-401	E	29,6	31,7	63,4	-	-	-
100-401	F	29,6	31,7	63,4	-	-	-
100-401	K	29,6	31,7	63,4	-	-	-
100-403	D	29,6	31,7	63,4	-	-	-
150-400	K	29,6	31,7	63,4	-	-	-
150-401	E	29,6	31,7	63,4	-	-	-
150-401	F	29,6	31,7	63,4	-	-	-
150-403	D	29,6	31,7	63,4	-	-	-

<sup>21</sup> Made by: Metasol Chemie, Magdeburg, Germany

Size	Impeller type	Motor					
		35 4	95 4	130 4	200 4	320 6	400 6
		50 4	110 4	155 4	250 4	360 6	440 6
		65 4	80 6	175 4	300 4	260 8	480 6
		80 4	100 6	120 6	350 4	300 8	350 8
		32 6	75 8	140 6	190 6	230 10	400 8
		40 6		165 6	225 6	195 12	270 10
		50 6		90 8	260 6		310 10
		60 6		110 8	150 8		350 10
		26 8		130 8	185 8		265 12
		35 8		40 10	220 8		230 12
		50 8		60 10	110 10		300 12
				75 10	150 10		
				90 10	190 10		
					105 12		
					135 12		
					165 12		
[quart]							
150-403	K	29,6	31,7	63,4	-	-	-
150-503	K	42,3	44,4	79,3	84,5	-	-
151-403	K	29,6	31,7	63,4	-	-	-
200-401	E	29,6	31,7	63,4	-	-	-
200-402	D	29,6	31,7	63,4	-	-	-
200-402	K	29,6	31,7	63,4	-	-	-
200-403	K	29,6	31,7	63,4	-	-	-
200-405	D	29,6	31,7	63,4	-	-	-
200-502	K	42,3	44,4	79,3	84,5	-	-
200-503	K	42,3	44,4	79,3	84,5	-	-
250-401	K	29,6	31,7	63,4	-	-	-
250-402	D	29,6	31,7	63,4	-	-	-
250-403	K	29,6	31,7	63,4	-	-	-
250-632	K	-	-	95,1	95,1	116,2	126,8
250-900	K	-	-	-	-	132,1	142,7
300-400	K	29,6	31,7	63,4	-	-	-
300-401	K	29,6	31,7	63,4	-	-	-
300-402	D	29,6	31,7	63,4	-	-	-
300-403	K	29,6	31,7	63,4	-	-	-
300-420	K	42,3	44,4	79,3	84,5	-	-
300-500	K	42,3	44,4	79,3	84,5	-	-
300-505	K	42,3	44,4	79,3	84,5	-	-
350-500	K	42,3	44,4	79,3	84,5	-	-
350-503	K	42,3	44,4	79,3	84,5	-	-
350-632	K	-	-	95,1	95,1	116,2	126,8
350-633	K	-	-	95,1	95,1	116,2	126,8
350-710	K	-	-	95,1	95,1	116,2	126,8
350-713	K	-	-	-	95,1	116,2	126,8
400-500	K	42,3	44,4	79,3	84,5	-	-
400-632	K	-	-	95,1	95,1	116,2	126,8
400-900	K	-	-	-	-	132,1	142,7
401-710	K	-	-	-	95,1	116,2	126,8
401-713	K	-	-	-	95,1	116,2	126,8
500-634	K	-	-	95,1	95,1	116,2	126,8
500-640	K	-	-	95,1	95,1	116,2	126,8
501-710	K	-	-	-	-	116,2	126,8

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Size	Impeller type	Motor					
		35 4	95 4	130 4	200 4	320 6	400 6
		50 4	110 4	155 4	250 4	360 6	440 6
		65 4	80 6	175 4	300 4	260 8	480 6
		80 4	100 6	120 6	350 4	300 8	350 8
		32 6	75 8	140 6	190 6	230 10	400 8
		40 6		165 6	225 6	195 12	270 10
		50 6		90 8	260 6		310 10
		60 6		110 8	150 8		350 10
		26 8		130 8	185 8		265 12
		35 8		40 10	220 8		230 12
		50 8		60 10	110 10		300 12
				75 10	150 10		
				90 10	190 10		
					105 12		
					135 12		
					165 12		
		[quart]					
501-900	K	-	-	-	-	132,1	142,7
600-520	K	-	-	95,1	95,1	-	-
600-710	K	-	-	-	95,1	116,2	126,8
700-901	K	-	-	-	-	132,1	142,7
700-902	K	-	-	-	-	132,1	142,7

Table 37: Coolant quantity in liters

Size	Impeller type	Motor					
		35 4	95 4	130 4	200 4	320 6	400 6
		50 4	110 4	155 4	250 4	360 6	440 6
		65 4	80 6	175 4	300 4	260 8	480 6
		80 4	100 6	120 6	350 4	300 8	350 8
		32 6	75 8	140 6	190 6	230 10	400 8
		40 6		165 6	225 6	195 12	270 10
		50 6		90 8	260 6		310 10
		60 6		110 8	150 8		350 10
		26 8		130 8	185 8		265 12
		35 8		40 10	220 8		230 12
		50 8		60 10	110 10		300 12
				75 10	150 10		
				90 10	190 10		
					105 12		
					135 12		
					165 12		
		[l]					
100-400	K	28,0	30,0	60,0	-	-	-
100-401	E	28,0	30,0	60,0	-	-	-
100-401	F	28,0	30,0	60,0	-	-	-
100-401	K	28,0	30,0	60,0	-	-	-
100-403	D	28,0	30,0	60,0	-	-	-
150-400	K	28,0	30,0	60,0	-	-	-
150-401	E	28,0	30,0	60,0	-	-	-
150-401	F	28,0	30,0	60,0	-	-	-
150-403	D	28,0	30,0	60,0	-	-	-
150-403	K	28,0	30,0	60,0	-	-	-
150-503	K	40,0	42,0	75,0	80,0	-	-
151-403	K	28,0	30,0	60,0	-	-	-
200-401	E	28,0	30,0	60,0	-	-	-

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Size	Impeller type	Motor					
		35 4 50 4 65 4 80 4 32 6 40 6 50 6 60 6 26 8 35 8 50 8	95 4 110 4 80 6 100 6 75 8	130 4 155 4 175 4 120 6 140 6 165 6 90 8 110 8 130 8 40 10 60 10 75 10 90 10	200 4 250 4 300 4 350 4 190 6 225 6 260 6 150 8 185 8 220 8 110 10 150 10 190 10 105 12 135 12 165 12	320 6 360 6 260 8 300 8 230 10 195 12	400 6 440 6 480 6 350 8 400 8 270 10 310 10 350 10 265 12 230 12 300 12
[!]							
200-402	D	28,0	30,0	60,0	-	-	-
200-402	K	28,0	30,0	60,0	-	-	-
200-403	K	28,0	30,0	60,0	-	-	-
200-405	D	28,0	30,0	60,0	-	-	-
200-502	K	40,0	42,0	75,0	80,0	-	-
200-503	K	40,0	42,0	75,0	80,0	-	-
250-401	K	28,0	30,0	60,0	-	-	-
250-402	D	28,0	30,0	60,0	-	-	-
250-403	K	28,0	30,0	60,0	-	-	-
250-632	K	-	-	90,0	90,0	110,0	120,0
250-900	K	-	-	-	-	125,0	135,0
300-400	K	28,0	30,0	60,0	-	-	-
300-401	K	28,0	30,0	60,0	-	-	-
300-402	D	28,0	30,0	60,0	-	-	-
300-403	K	28,0	30,0	60,0	-	-	-
300-420	K	40,0	42,0	75,0	80,0	-	-
300-500	K	40,0	42,0	75,0	80,0	-	-
300-505	K	40,0	42,0	75,0	80,0	-	-
350-500	K	40,0	42,0	75,0	80,0	-	-
350-503	K	40,0	42,0	75,0	80,0	-	-
350-632	K	-	-	90,0	90,0	110,0	120,0
350-633	K	-	-	90,0	90,0	110,0	120,0
350-710	K	-	-	90,0	90,0	110,0	120,0
350-713	K	-	-	-	90,0	110,0	120,0
400-500	K	40,0	42,0	75,0	80,0	-	-
400-632	K	-	-	90,0	90,0	110,0	120,0
400-900	K	-	-	-	-	125,0	135,0
401-710	K	-	-	-	90,0	110,0	120,0
401-713	K	-	-	-	90,0	110,0	120,0
500-634	K	-	-	90,0	90,0	110,0	120,0
500-640	K	-	-	90,0	90,0	110,0	120,0
501-710	K	-	-	-	-	110,0	120,0
501-900	K	-	-	-	-	125,0	135,0
600-520	K	-	-	90,0	90,0	-	-
600-710	K	-	-	-	90,0	110,0	120,0

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Size	Impeller type	Motor					
		35 4	95 4	130 4	200 4	320 6	400 6
		50 4	110 4	155 4	250 4	360 6	440 6
		65 4	80 6	175 4	300 4	260 8	480 6
		80 4	100 6	120 6	350 4	300 8	350 8
		32 6	75 8	140 6	190 6	230 10	400 8
		40 6		165 6	225 6	195 12	270 10
		50 6		90 8	260 6		310 10
		60 6		110 8	150 8		350 10
		26 8		130 8	185 8		265 12
		35 8		40 10	220 8		230 12
		50 8		60 10	110 10		300 12
				75 10	150 10		
				90 10	190 10		
					105 12		
					135 12		
					165 12		
[!]							
700-901	K	-	-	-	-	125,0	135,0
700-902	K	-	-	-	-	125,0	135,0

7.2.2.3 Changing the coolant

	<b>WARNING</b>
	<p><b>Coolants and supplies which pose a health hazard or are hot</b> Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▸ When draining the fluid take appropriate measures to protect persons and the environment.</li> <li>▸ Observe all legal regulations on the disposal of fluids posing a health hazard.</li> </ul>
	<b>WARNING</b>
	<p><b>Cooling liquid spurting out due to excess pressure in the cooling liquid chamber at operating temperature!</b> Risk of injuries by parts flying off and escaping cooling liquid!</p> <ul style="list-style-type: none"> <li>▸ Open the screw plug of the cooling liquid chamber very carefully.</li> </ul>

Draining the coolant

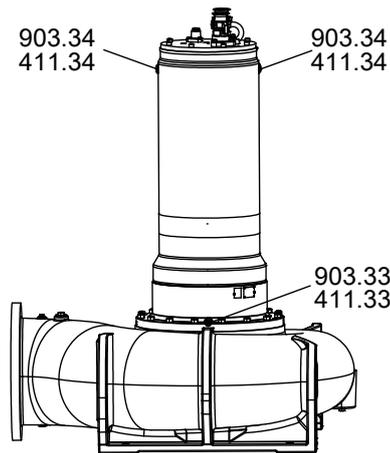


Fig. 46: Coolant filler openings

✓ The pump set has been placed down in a vertical position.

1. Place a suitable container under screw plug 903.33. (Coolant quantity (⇒ Section 7.2.2.2, Page 75) )
2. Unscrew both screw plugs 903.34 with joint rings 411.34 at the coolant filler openings (opposed by 180°).
3. Undo screw plug 903.33 with joint ring 411.33 and drain off the coolant.

	<b>NOTE</b>
<p>The drain plug is not located at the lowest point of the cooling system. To fully drain all coolant, proceed as follows:</p>	

4. **Option 1:** Insert a suction pump through the cooling liquid filler opening and pump off the remaining coolant.
- Option 2:** Change the position of the pump set from vertical to horizontal to fully drain the cooling system.

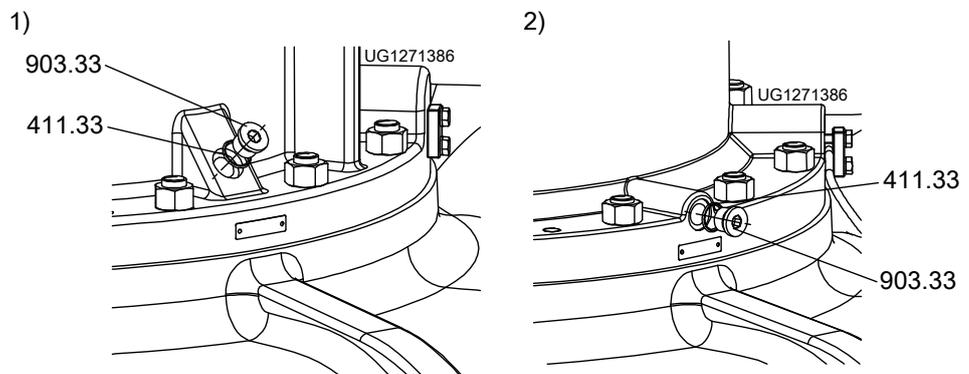


Fig. 47: Coolant draining options

	<b>NOTE</b>
<p>The coolant is bright and transparent in appearance. A slight discoloration, caused by the running-in process of new mechanical seals or small amounts of leakage from the fluid handled, has no detrimental effect. However, if the coolant is severely contaminated by the fluid handled, this suggests a defect at the mechanical seals.</p>	

Topping up the coolant

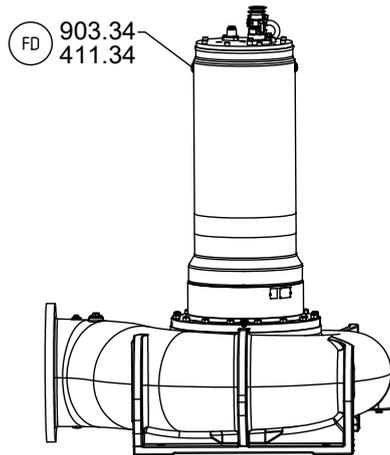


Fig. 48: Topping up the coolant

- ✓ The pump set has been placed down in a vertical position.
  1. Screw in screw plugs 903.33 with joint ring 411.33.
  2. Fill coolant through the filler opening (screw plug 903.34) until it overflows. (⇒ Section 7.2.2.2, Page 75)
  3. Pump off 1 liter of coolant with a suction pump or drain it via screw plug 903.33.
    - ⇒ The coolant level must be approximately 3 cm below the filler opening.
  4. Screw in screw plug 903.34 with a new joint ring 411.34.

Table 38: Key to the symbols

Symbol	Key
	Always apply a <b>liquid sealant</b> (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

7.2.3 Lubrication and lubricant change

7.2.3.1 Lubricating the mechanical seal (pump sets without cooling system only - installation types S and P)

	 <b>DANGER</b>
	<p><b>Excessive temperatures at the shaft seal</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Regularly check the condition of the lubricant in the lubricant chamber of the mechanical seal. Top it up if required.</li> </ul>

7.2.3.1.1 Intervals

Replace the lubricant every 8000 operating hours but at least every 2 years.

7.2.3.1.2 Lubricant quality

The lubricant chamber is filled at the factory with environmentally friendly, non-toxic lubricant (unless otherwise specified by the customer).

The following lubricants can be used to lubricate the mechanical seals:

**Recommended lubricant quality**

**Alternative**

- Environmentally friendly, non-toxic white oil of medical quality
- Thin-bodied paraffin oil, non-toxic
- Water / propylene glycol mixture with corrosion inhibitors for frost protection down to -4 °F [-20 °C].

**Table 39:** Lubricant quality

Description	Properties	
Paraffin oil or white oil	Kinematic viscosity at 104 °F [40 °C]	< 0.065 ft/s <sup>2</sup> [< 20 mm/s <sup>2</sup> ]
	Flash point (to Cleveland)	> 320 °F [> 160 °C]
	Solidification point (pour point)	< 5 °F [< -15 °C]

	<b>WARNING</b>
	<p><b>Contamination of fluid handled by lubricant</b> Hazard to persons and the environment!</p> <p>▸ Using machine oil is only permitted if the oil is disposed of properly.</p>

**7.2.3.1.3 Lubricant quantity**

**Table 40:** Lubricant quantity [quart] depending on the hydraulic system and motor

Size	Impeller type	Motor											
		35 4		95 4		130 4		200 4		320 6		400 6	
		G/G1/G2/GH/H	C1/C2										
[quart]													
100-400	K	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
100-401	E	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
100-401	F	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
100-401	K	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
100-403	D	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
150-400	K	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
150-401	E	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
150-401	F	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
150-403	D	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
150-403	K	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
150-503	K	5,0	5,0	5,0	5,0	7,4	7,4	7,9	4,2	-	-	-	-
151-403	K	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
200-401	E	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
200-402	D	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
200-402	K	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
200-403	K	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-

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Size	Impeller type	Motor											
		35 4		95 4		130 4		200 4		320 6		400 6	
		50 4		110 4		155 4		250 4		360 6		440 6	
		65 4		80 6		175 4		300 4		260 8		480 6	
80 4		100 6		120 6		350 4		300 8		350 8			
32 6		75 8		140 6		190 6		230 10		400 8			
40 6				165 6		225 6		195 12		270 10			
50 6				90 8		260 6				310 10			
60 6				110 8		150 8				350 10			
26 8				130 8		185 8				265 12			
35 8				40 10		220 8				230 12			
50 8				60 10		110 10				300 12			
				75 10		150 10							
				90 10		190 10							
						105 12							
						135 12							
						165 12							
		G/G1/G2/GH/H	C1/C2										
[quart]													
200-405	D	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
200-502	K	5,0	5,0	5,0	5,0	7,4	7,4	7,9	4,2	-	-	-	-
200-503	K	5,0	5,0	5,0	5,0	7,4	7,4	7,9	4,2	-	-	-	-
250-401	K	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
250-402	D	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
250-403	K	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
250-632	K	-	-	-	-	6,1	6,1	7,4	7,4	11,1	7,2	11,1	7,2
250-900	K	-	-	-	-	-	-	-	-	11,1	11,1	11,1	11,1
300-400	K	4,2	-	-	-	5,8	1,4	-	-	-	-	-	-
300-401	K	4,2	-	-	-	5,8	1,4	-	-	-	-	-	-
300-402	D	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
300-403	K	4,2	4,2	4,2	4,2	5,8	1,4	-	-	-	-	-	-
300-420	K	5,0	5,0	5,0	5,0	7,4	7,4	7,9	4,2	-	-	-	-
300-500	K	5,0	5,0	5,0	5,0	7,4	7,4	7,9	4,2	-	-	-	-
300-505	K	5,0	5,0	5,0	5,0	7,4	7,4	7,9	4,2	-	-	-	-
350-500	K	5,0	5,0	5,0	5,0	7,4	7,4	7,9	4,2	-	-	-	-
350-503	K	5,0	5,0	5,0	5,0	7,4	7,4	7,9	4,2	-	-	-	-
350-632	K	-	-	-	-	6,1	6,1	7,4	7,4	11,1	7,2	11,1	7,2
350-633	K	-	-	-	-	6,1	6,1	7,4	7,4	11,1	7,2	11,1	7,2
350-710	K	-	-	-	-	-	-	7,4	7,4	11,1	11,1	11,1	11,1
350-713	K	-	-	-	-	-	-	7,4	7,4	11,1	11,1	11,1	11,1
400-500	K	5,0	5,0	5,0	5,0	7,4	7,4	7,9	4,2	-	-	-	-
400-632	K	-	-	-	-	6,1	6,1	7,4	7,4	11,1	7,2	11,1	7,2
400-900	K	-	-	-	-	-	-	-	-	-	-	-	-
401-710	K	-	-	-	-	-	-	7,4	7,4	11,1	11,1	11,1	11,1
401-713	K	-	-	-	-	-	-	7,4	7,4	11,1	11,1	11,1	11,1
500-634	K	-	-	-	-	6,1	6,1	7,4	7,4	11,1	7,2	11,1	7,2
500-640	K	-	-	-	-	6,1	6,1	7,4	7,4	11,1	7,2	11,1	7,2
501-710	K	-	-	-	-	-	-	-	-	11,1	11,1	11,1	11,1
501-900	K	-	-	-	-	-	-	-	-	11,1	11,1	11,1	11,1
600-520	K	-	-	-	-	6,1	6,1	7,4	7,4	-	-	-	-

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Size	Impeller type	Motor											
		35 4		95 4		130 4		200 4		320 6		400 6	
		50 4		110 4		155 4		250 4		360 6		440 6	
		65 4		80 6		175 4		300 4		260 8		480 6	
80 4		100 6		120 6		350 4		300 8		350 8			
32 6		75 8		140 6		190 6		230 10		400 8			
40 6				165 6		225 6		195 12		270 10			
50 6				90 8		260 6				310 10			
60 6				110 8		150 8				350 10			
26 8				130 8		185 8				265 12			
35 8				40 10		220 8				230 12			
50 8				60 10		110 10				300 12			
				75 10		150 10							
				90 10		190 10							
						105 12							
						135 12							
						165 12							
		G/G1/G2/GH/H	C1/C2										
[quart]													
600-710	K	-	-	-	-	-	-	7,4	7,4	11,1	11,1	11,1	11,1
700-901	K	-	-	-	-	-	-	-	-	11,1	11,1	11,1	11,1
700-902	K	-	-	-	-	-	-	-	-	11,1	11,1	11,1	11,1

**Table 41:** Lubricant quantity [l] depending on the hydraulic system and motor

Size	Impeller type	Motor											
		35 4		95 4		130 4		200 4		320 6		400 6	
		50 4		110 4		155 4		250 4		360 6		440 6	
		65 4		80 6		175 4		300 4		260 8		480 6	
80 4		100 6		120 6		350 4		300 8		350 8			
32 6		75 8		140 6		190 6		230 10		400 8			
40 6				165 6		225 6		195 12		270 10			
50 6				90 8		260 6				310 10			
60 6				110 8		150 8				350 10			
26 8				130 8		185 8				265 12			
35 8				40 10		220 8				230 12			
50 8				60 10		110 10				300 12			
				75 10		150 10							
				90 10		190 10							
						105 12							
						135 12							
						165 12							
		G/G1/G2/GH/H	C1/C2										
[l]													
100-400	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
100-401	E	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
100-401	F	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
100-401	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
100-403	D	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
150-400	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-

Size	Impeller type	Motor											
		35 4		95 4		130 4		200 4		320 6		400 6	
		50 4		110 4		155 4		250 4		360 6		440 6	
		65 4		80 6		175 4		300 4		260 8		480 6	
80 4		100 6		120 6		350 4		300 8		350 8			
32 6		75 8		140 6		190 6		230 10		400 8			
40 6				165 6		225 6		195 12		270 10			
50 6				90 8		260 6				310 10			
60 6				110 8		150 8				350 10			
26 8				130 8		185 8				265 12			
35 8				40 10		220 8				230 12			
50 8				60 10		110 10				300 12			
				75 10		150 10							
				90 10		190 10							
						105 12							
						135 12							
						165 12							
		G/G1/G2/GH/H	C1/C2										
[I]													
150-401	E	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
150-401	F	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
150-403	D	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
150-403	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
150-503	K	4,7	4,7	4,7	4,7	7,0	7,0	7,5	4,0	-	-	-	-
151-403	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
200-401	E	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
200-402	D	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
200-402	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
200-403	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
200-405	D	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
200-502	K	4,7	4,7	4,7	4,7	7,0	7,0	7,5	4,0	-	-	-	-
200-503	K	4,7	4,7	4,7	4,7	7,0	7,0	7,5	4,0	-	-	-	-
250-401	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
250-402	D	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
250-403	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
250-632	K	-	-	-	-	5,8	5,8	7,0	7,0	10,5	6,8	10,5	6,8
250-900	K	-	-	-	-	-	-	-	-	10,5	10,5	10,5	10,5
300-400	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
300-401	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
300-402	D	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
300-403	K	4,0	1,4	4,0	4,0	5,5	1,3	-	-	-	-	-	-
300-420	K	4,7	4,7	4,7	4,7	7,0	7,0	7,5	4,0	-	-	-	-
300-500	K	4,7	4,7	4,7	4,7	7,0	7,0	7,5	4,0	-	-	-	-
300-505	K	4,7	4,7	4,7	4,7	7,0	7,0	7,5	4,0	-	-	-	-
350-500	K	4,7	4,7	4,7	4,7	7,0	7,0	7,5	4,0	-	-	-	-
350-503	K	4,7	4,7	4,7	4,7	7,0	7,0	7,5	4,0	-	-	-	-
350-632	K	-	-	-	-	5,8	5,8	7,0	7,0	10,5	6,8	10,5	6,8
350-633	K	-	-	-	-	5,8	5,8	7,0	7,0	10,5	6,8	10,5	6,8
350-710	K	-	-	-	-	-	-	7,0	7,0	10,5	10,5	10,5	10,5
350-713	K	-	-	-	-	-	-	7,0	7,0	10,5	10,5	10,5	10,5

Size	Impeller type	Motor											
		35 4		95 4		130 4		200 4		320 6		400 6	
		50 4		110 4		155 4		250 4		360 6		440 6	
		65 4		80 6		175 4		300 4		260 8		480 6	
		80 4		100 6		120 6		350 4		300 8		350 8	
		32 6		75 8		140 6		190 6		230 10		400 8	
		40 6				165 6		225 6		195 12		270 10	
		50 6				90 8		260 6				310 10	
		60 6				110 8		150 8				350 10	
		26 8				130 8		185 8				265 12	
		35 8				40 10		220 8				230 12	
		50 8				60 10		110 10				300 12	
						75 10		150 10					
						90 10		190 10					
								105 12					
								135 12					
								165 12					
		G/G1/G2/GH/H	C1/C2										
		[!]											
400-500	K	4,7	4,7	4,7	4,7	7,0	7,0	7,5	4,0	-	-	-	-
400-632	K	-	-	-	-	5,8	5,8	7,0	7,0	10,5	6,8	10,5	6,8
400-900	K	-	-	-	-	-	-	-	-	10,5	10,5	10,5	10,5
401-710	K	-	-	-	-	-	-	7,0	7,0	10,5	10,5	10,5	10,5
401-713	K	-	-	-	-	-	-	7,0	7,0	10,5	10,5	10,5	10,5
500-634	K	-	-	-	-	5,8	5,8	7,0	7,0	10,5	6,8	10,5	6,8
500-640	K	-	-	-	-	5,8	5,8	7,0	7,0	10,5	6,8	10,5	6,8
501-710	K	-	-	-	-	-	-	-	-	10,5	10,5	10,5	10,5
501-900	K	-	-	-	-	-	-	-	-	10,5	10,5	10,5	10,5
600-520	K	-	-	-	-	5,8	5,8	7,0	7,0	-	-	-	-
600-710	K	-	-	-	-	-	-	7,0	7,0	10,5	10,5	10,5	10,5
700-901	K	-	-	-	-	-	-	-	-	10,5	10,5	10,5	10,5
700-902	K	-	-	-	-	-	-	-	-	10,5	10,5	10,5	10,5

7.2.3.1.4 Changing the lubricant

	<p><b>⚠ WARNING</b></p>
	<p><b>Lubricants posing a health hazard and/or hot lubricants</b>  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>
	<p><b>⚠ WARNING</b></p>
	<p><b>Excess pressure in the lubricant chamber</b>  Liquid spurting out when the lubricant chamber is opened at operating temperature!</p> <ul style="list-style-type: none"> <li>▷ Open the screw plug of the lubricant chamber very carefully.</li> </ul>

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Draining the lubricant

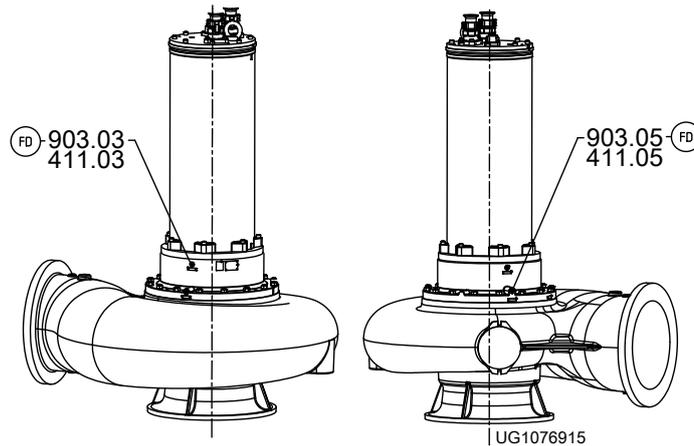


Fig. 49: Draining and re-filling the lubricant

- ✓ The pump set has been placed down in a vertical position.
  1. Place a suitable container under screw plug 903.05.
  2. Unscrew and remove screw plug 903.03 with joint ring 411.03.
  3. Unscrew and remove screw plugs 903.05 with joint ring 411.05. Drain off the lubricant.

Filling in the lubricant

- ✓ The pump set has been placed down in a vertical position.
  1. Position the pump set as shown.
  2. Screw in screw plugs 903.05 with joint ring 411.05.
  3. Pour lubricant into lubricant filler opening 903.03 until the lubricant chamber overflows. (⇒ Section 7.2.3.1.3, Page 82)
  4. Screw in screw plug 903.03 with a new joint ring 411.03.

Table 42: Key to the symbols

Symbol	Key
(FD)	Always apply a <b>liquid sealant</b> (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

7.2.3.2 Lubricating the rolling element bearings

The upper (radial) rolling element bearing of the pump set is grease-packed and maintenance-free. The lower bearings can be re-lubricated; they need to be re-lubricated as part of the maintenance work.

7.2.3.2.1 Grease quality

	<b>CAUTION</b>
	<p><b>Mix of different grease types</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Make sure to use the right type of grease.</li> <li>▷ Never mix different types of grease.</li> </ul>

The following greases can be used to lubricate the rolling element bearings:

**Table 43:** Lubricant characteristics

Type	Base oil	Thickener	NLGI grade (DIN 51518)	Worked penetration at 77 °F [25 °C], 0,1mm (DIN 51818)	Drop point (ISO 2176)	Application temperature range [°C]	Viscosity at 104°F [40°C] (DIN 51562)
A	Mineral oil	Lithium complex soap	2 or 3	220 to 295	> 527 °F [>275°C]	-4 °F to 320 °F [-20 °C to +160 °C]	≤120
B	Ester oil	Polyurea	2	265 to 295	>482 °F [>250 °C]	-40 °F to +356 °F [-40 °C to +180 °C]	100

The re-lubrication and maintenance intervals apply to the grease type originally used by the manufacturer (depending on the motor, see (⇒ Table 44) ):

- Type A
  - Multis Complex EP2, made by TOTAL
- Type B
  - Klüberquiet BQH 72-102, made by Klüber Lubrication München KG

7.2.3.2.2 Grease quantity for re-lubrication

	<b>NOTE</b>
	Always use grease type B for motors in stainless steel variant (..NC.. motors).

Table 44: Grease quantity

<b>Motor</b>	35 4	95 4	130 4	155 4...-K	200 4	320 6	400 6
	50 4	110 4	155 4...-S	155 4...-D	250 4	360 6	440 6
	65 4	80 6	155 4...-P		300 4	260 8	480 6
	80 4	100 6	175 4		350 4	300 8	350 8
	32 6	75 8	120 6		190 6	230 10	400 8
	40 6		140 6		225 6	195 12	270 10
	50 6		165 6		260 6		310 10
	60 6		90 8		150 8		350 10
	26 8		110 8		185 8		265 12
	35 8		130 8		220 8		230 12
	50 8		40 10		110 10		300 12
			60 10		150 10		
			75 10		190 10		
			90 10		105 12		
				135 12			
				165 10			
Grease quantity	2,5 oz [70 g]	3,2 oz [90 g]	3,9 oz [110 g]	3,9 oz [110 g]	5,6 oz [160 g]	6,3 oz [180 g]	6,3 oz [180 g]
Grease type <sup>22)</sup>	Type A	Type A	Type A	Type B	Type B	Type B	Type B

7.2.3.2.3 Re-lubrication

**Lubricating nipple** An encapsulated water-tight lubricating nipple allows re-lubrication of the angular contact ball bearings without opening the pump.

	<b>⚠ DANGER</b>
	<p><b>Dry running</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Re-lubricate explosion-proof pump sets outside potentially explosive atmospheres.</li> </ul>
	<b>⚠ WARNING</b>
	<p><b>Hands inside the pump casing</b> 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 if the pump has not been de-energized and secured against unintentional start-up.</li> </ul>
	<b>CAUTION</b>
	<p><b>Incomplete re-lubrication</b> Bearing damage!</p> <ul style="list-style-type: none"> <li>▷ Always re-lubricate the bearings with the pump set in operation.</li> </ul>

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<sup>22)</sup> Also see the section on grease quality.

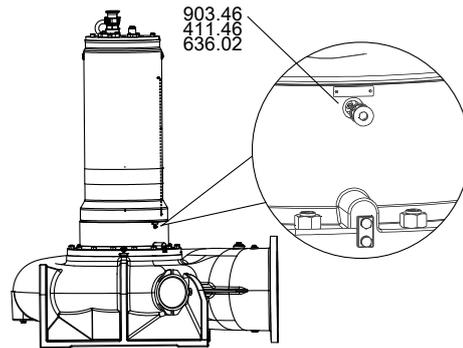


Fig. 50: Lubricating nipple

- ✓ The pump set has been positioned on a level surface.
  - ✓ The pump set is secured against tipping over.
1. Remove screw plug 903.46 and joint ring 411.46.
  2. Connect the pump set to the power supply.

	<b>CAUTION</b>
	<p><b>Pump set running dry</b> Increased vibrations! Damage to mechanical seals and bearings:</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump set without the fluid to be handled for more than 60 seconds.</li> </ul>

3. Secure the pump set against tilting.
4. Start up the pump set.
5. Fill in grease via lubricating nipple 636.02.
6. Disconnect the pump set from the power supply again and make sure it cannot be started up unintentionally.
7. Fit screw plug 903.46 with joint ring 411.46.

### 7.3 Drainage/cleaning

	<b>⚠ WARNING</b>
	<p><b>Fluids handled, consumables and operating supplies which are hot or pose a health hazard</b> Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▷ Collect and properly dispose of the flushing fluid and of 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. Always flush the pump if it has been used for handling noxious, explosive, hot or other hazardous fluids.
2. Always flush and clean the pump before transporting it to the workshop. Always complete and enclose a certificate of decontamination when returning the pump set. (⇒ Section 10, Page 148)

## 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 personal injury!</p> <ul style="list-style-type: none"> <li>▷ Always have repair work and maintenance work performed by specially trained, qualified personnel.</li> </ul>

	 <b>WARNING</b>
	<p><b>Hot surface</b>            Risk of personal injury!</p> <ul style="list-style-type: none"> <li>▷ Allow the pump set to cool down to ambient temperature.</li> </ul>

	 <b>WARNING</b>
	<p><b>Improper lifting/moving of heavy assemblies or components</b>            Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.</li> </ul>

Observe the safety instructions and information.

For dismantling and reassembly observe the general assembly drawing.

In the event of damage you can always contact KSB Service.

	 <b>DANGER</b>
	<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.</li> <li>▷ Close the shut-off elements in the suction line and discharge line.</li> <li>▷ Drain the pump and release the pump pressure.</li> <li>▷ Shut off any auxiliary feed lines.</li> <li>▷ Allow the pump set to cool down to ambient temperature.</li> </ul>

	 <b>WARNING</b>
	<p><b>Components with sharp edges</b>            Risk of cutting or shearing injuries!</p> <ul style="list-style-type: none"> <li>▷ Always use appropriate caution for installation and dismantling work.</li> <li>▷ Wear work gloves.</li> </ul>

#### 7.4.2 Preparing the pump set

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 91) have been observed/ carried out.
- 1. Interrupt the power supply and secure the pump against unintentional start-up.
- 2. On pump sets without cooling system (installation types S and P) drain the lubricant.
- 3. On pump sets with cooling system (installation types D and K) drain the cooling liquid.
- 4. Drain the leakage chamber and leave it open for the duration of the disassembly.

#### 7.4.3 Dismantling the pump section

Dismantle the pump section in accordance with the relevant general assembly drawing.

##### 7.4.3.1 Removing the back pull-out unit

###### Standard claw, guide cable arrangement / dry installation:

1. Remove screw plug 903.58. Screw a second eyebolt 900 or a suitable swivel eyebolt into motor housing cover 812.
2. Undo screwed connection 902.01 and 920.01 and pull the complete back pull-out unit out of pump casing 101.
3. Place the back pull-out unit in a safe and dry assembly area and secure it against tipping over or rolling off.

###### Standard claw, guide rail arrangement:

1. Unscrew and remove eyebolt 900.04 from strip 575.
2. Remove screw plug 903.56 from the middle of strip 575.
3. Screw eyebolt 900.04 into this threaded hole.
4. Undo screwed connection 902.01 and 920.01 and pull the complete back pull-out unit out of pump casing 101.
5. Place the back pull-out unit in a safe and dry assembly area and secure it against tipping over or rolling off.

###### Option with bail:

1. Undo nuts 920.13. Remove bail 571.
2. Screw suitable (swivel) eye nuts onto studs 902.13.
3. Undo screwed connection 902.01 and 920.01 and pull the complete back pull-out unit out of pump casing 101.
4. Place the back pull-out unit in a safe and dry assembly area and secure it against tipping over or rolling off.

##### 7.4.3.2 Removing the impeller

The procedures for removing the impeller differ depending on the hydraulic system and motor.

Table 45: Impeller fastening elements

Size	Impeller type	Tapered fit			Cylindrical fit					
		35 4	95 4	130 4	35 4	95 4	130 4	200 4	320 6	400 6
		50 4	110 4	155 4	50 4	110 4	155 4	250 4	360 6	440 6
		65 4	80 6	175 4	65 4	80 6	175 4	300 4	260 8	480 6
		80 4	100 6	120 6	80 4	100 6	120 6	350 4	300 8	350 8
		32 6	75 8	140 6	32 6	75 8	140 6	190 6	230 10	400 8
		40 6		90 8	40 6		165 6	225 6	195 12	270 10
		50 6			50 6		90 8	260 6		310 10
		60 6			60 6		110 8	150 8		350 10
		26 8			26 8		130 8	185 8		265 12
		35 8			35 8		40 10	220 8		230 12
		50 8			50 8		60 10	110 10		300 12
							75 10	150 10		
							90 10	190 10		
								105 12		
								135 12		
								165 12		
100-400	K	M20	M20	-	-	-	-	-	-	-
100-401	E	M20	M20	-	-	-	-	-	-	-
100-401	F	M20	M20	-	-	-	-	-	-	-
100-401	K	M20	M20	-	-	-	-	-	-	-
100-403	D	M20	M20	M20	-	-	-	-	-	-
150-400	K	M20	M20	M20	-	-	-	-	-	-
150-401	E	M20	M20	M20	-	-	-	-	-	-
150-401	F	M20	M20	-	-	-	-	-	-	-
150-403	D	M20	M20	M20	-	-	-	-	-	-
150-403	K	M20	M20	M20	-	-	-	-	-	-
150-503	K	-	-	-	M85 x 2	M85 x 2	M85 x 2	M100 x 2	-	-
151-403	K	M20	M20	M20	-	-	M85 x 2	-	-	-
200-401	E	M20	M20	M20	-	-	-	-	-	-
200-402	D	M20	M20	M20	-	-	-	-	-	-
200-402	K	M20	M20	M20	-	-	-	-	-	-
200-403	K	M20	M20	M20	-	-	-	-	-	-
200-405	D	M20	M20	M20	-	-	-	-	-	-
200-502	K	-	-	-	M100 x 2	M100 x 2	M100 x 2	M100 x 2	-	-
200-503	K	-	-	-	M100 x 2	M100 x 2	M100 x 2	M100 x 2	-	-
250-401	K	M20	M20	M20	-	-	-	-	-	-
250-402	D	M20	M20	M20	-	-	-	-	-	-
250-403	K	M20	M20	M20	-	-	-	-	-	-
250-632	K	-	-	-	-	-	M125 x 2	M125 x 2	M125 x 2	M125 x 2
250-900	K	-	-	-	-	-	M125 x 2	M125 x 2	M125 x 2	M125 x 2
300-400	K	M20	M20	-	-	-	M85 x 2	-	-	-
300-401	K	M20	M20	-	-	-	-	-	-	-
300-402	D	M20	M20	M20	-	-	-	-	-	-
300-403	K	M20	M20	M20	-	-	-	-	-	-
300-420	K	-	-	-	M100 x 2	M100 x 2	M100 x 2	M100 x 2	-	-
300-500	K	-	-	-	-	-	M125 x 2	M125 x 2	M125 x 2	M125 x 2
300-505	K	-	-	-	M100 x 2	M100 x 2	M100 x 2	M100 x 2	-	-
350-500	K	-	-	-	-	-	M125 x 2	M125 x 2	M125 x 2	M125 x 2
350-503	K	-	-	-	M85 x 2	M85 x 2	M85 x 2	M85 x 2	-	-
350-632	K	-	-	-	-	-	M125 x 2	M125 x 2	M125 x 2	M125 x 2
350-633	K	-	-	-	-	-	M125 x 2	M125 x 2	M125 x 2	M125 x 2
350-710	K	-	-	-	-	-	-	-	-	-

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Size	Impeller type	Tapered fit			Cylindrical fit					
		35 4	95 4	130 4	35 4	95 4	130 4	200 4	320 6	400 6
		50 4	110 4	155 4	50 4	110 4	155 4	250 4	360 6	440 6
		65 4	80 6	175 4	65 4	80 6	175 4	300 4	260 8	480 6
		80 4	100 6	120 6	80 4	100 6	120 6	350 4	300 8	350 8
		32 6	75 8	140 6	32 6	75 8	140 6	190 6	230 10	400 8
		40 6		90 8	40 6		165 6	225 6	195 12	270 10
		50 6			50 6		90 8	260 6		310 10
		60 6			60 6		110 8	150 8		350 10
		26 8			26 8		130 8	185 8		265 12
		35 8			35 8		40 10	220 8		230 12
		50 8			50 8		60 10	110 10		300 12
							75 10	150 10		
							90 10	190 10		
								105 12		
								135 12		
								165 12		
350-713	K	-	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
400-500	K	-	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	-	-
400-632	K	-	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
400-900	K	-	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
401-710	K	-	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
401-713	K	-	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
500-634	K	-	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
500-640	K	-	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	M100 × 2	M100 × 2
501-710	K	-	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
501-900	K	-	-	-	-	-	M160 × 3	M160 × 3	M160 × 3	M160 × 3
600-520	K	-	-	-	M100 × 2	M100 × 2	M100 × 2	M100 × 2	-	-
600-710	K	-	-	-	-	-	-	M125 × 2	M125 × 2	M125 × 2
700-901	K	-	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2
700-902	K	-	-	-	-	-	M125 × 2	M125 × 2	M125 × 2	M125 × 2


**NOTE**

Pull off the impeller using a special impeller removal tool or forcing screw.


**NOTE**

The special impeller removal tool and forcing screw are not included in the scope of supply. They can be ordered separately from KSB.

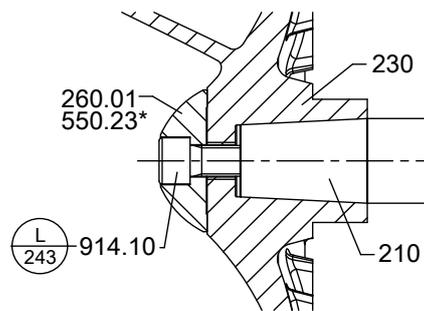
Table 46: Special impeller fitting and removal tool

Size	Impeller type	Tapered fit			Cylindrical fit					
		35 4	95 4	130 4	35 4	95 4	130 4	200 4	320 6	400 6
		50 4	110 4	155 4	50 4	110 4	155 4	250 4	360 6	440 6
		65 4	80 6	175 4	65 4	80 6	175 4	300 4	260 8	480 6
		80 4	100 6	120 6	80 4	100 6	120 6	350 4	300 8	350 8
		32 6	75 8	140 6	32 6	75 8	140 6	190 6	230 10	400 8
		40 6		90 8	40 6		165 6	225 6	195 12	270 10
		50 6			50 6		90 8	260 6		310 10
		60 6			60 6		110 8	150 8		350 10
		26 8			26 8		130 8	185 8		265 12
		35 8			35 8		40 10	220 8		230 12
		50 8			50 8		60 10	110 10		300 12
							75 10	150 10		
							90 10	190 10		
								105 12		
								135 12		
								165 12		
100-400	K	M24	ADS5	-	-	-	-	-	-	-
100-401	E	M24	ADS5	-	-	-	-	-	-	-
100-401	F	M24	ADS5	-	-	-	-	-	-	-
100-401	K	M24	ADS5	-	-	-	-	-	-	-
100-403	D	M24	ADS5	-	-	-	-	-	-	-
150-400	K	M24	ADS5	-	-	-	-	-	-	-
150-401	E	M24	ADS5	-	-	-	-	-	-	-
150-401	F	M24	ADS5	-	-	-	-	-	-	-
150-403	D	M24	ADS5	-	-	-	-	-	-	-
150-403	K	M24	ADS5	-	-	-	-	-	-	-
150-503	K	-	-	AV3	AV3	AV3	AV5	-	-	-
151-403	K	M24	ADS5	-	-	-	-	-	-	-
200-401	E	M24	ADS5	-	-	-	-	-	-	-
200-402	D	M24	ADS5	-	-	-	-	-	-	-
200-402	K	M24	ADS5	-	-	-	-	-	-	-
200-403	K	M24	ADS5	-	-	-	-	-	-	-
200-405	D	M24	ADS5	-	-	-	-	-	-	-
200-502	K	-	-	AV5	AV5	AV5	AV5	-	-	-
200-503	K	-	-	AV5	AV5	AV5	AV5	-	-	AV4
250-401	K	M24	ADS5	-	-	-	-	-	-	-
250-402	D	M24	ADS9	-	-	-	-	-	-	-
250-403	K	M24	ADS5	-	-	-	-	-	-	-
250-632	K	-	-	-	-	AV4	AV4	AV4	AV4	AV4
250-900	K	-	-	-	-	AV4	AV4	AV4	AV4	AV4
300-400	K	M24	ADS5	-	-	AV3	-	-	-	-
300-401	K	M24	ADS5	-	-	-	-	-	-	-
300-402	D	M24	ADS9	-	-	-	-	-	-	-
300-403	K	M24	ADS5	-	-	-	-	-	-	-
300-420	K	-	-	AV5	AV5	AV5	AV5	-	-	AV4
300-500	K	-	-	-	-	AV4	AV4	AV4	AV4	-
300-505	K	-	-	AV5	AV5	AV5	AV5	-	-	-
350-500	K	-	-	-	-	AV4	AV4	AV4	AV4	AV4
350-503	K	-	-	AV3	AV3	AV3	AV5	-	-	AV4
350-632	K	-	-	-	-	AV4	AV4	AV4	AV4	-
350-633	K	-	-	-	-	AV4	AV4	AV4	AV4	AV4
350-710	K	-	-	-	-	-	-	-	-	AV4

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Size	Impeller type	Tapered fit			Cylindrical fit					
		35 4	95 4	130 4	35 4	95 4	130 4	200 4	320 6	400 6
		50 4	110 4	155 4	50 4	110 4	155 4	250 4	360 6	440 6
		65 4	80 6	175 4	65 4	80 6	175 4	300 4	260 8	480 6
		80 4	100 6	120 6	80 4	100 6	120 6	350 4	300 8	350 8
		32 6	75 8	140 6	32 6	75 8	140 6	190 6	230 10	400 8
		40 6		90 8	40 6		165 6	225 6	195 12	270 10
		50 6			50 6		90 8	260 6		310 10
		60 6			60 6		110 8	150 8		350 10
		26 8			26 8		130 8	185 8		265 12
		35 8			35 8		40 10	220 8		230 12
		50 8			50 8		60 10	110 10		300 12
							75 10	150 10		
							90 10	190 10		
								105 12		
								135 12		
								165 12		
350-713	K	-	-	-	-	-	AV4	AV4	AV4	AV4
400-500	K	-	-	AV5	AV5	AV5	AV5	-	-	-
400-632	K	-	-	-	-	AV4	AV4	AV4	AV4	AV4
400-900	K	-	-	-	-	AV4	AV4	AV4	AV4	-
401-710	K	-	-	-	-	AV4	AV4	AV4	AV4	AV4
401-713	K	-	-	-	-	AV4	AV4	AV4	AV4	AV4
500-634	K	-	-	-	-	AV4	AV4	AV4	AV4	AV4
500-640	K	-	-	AV5	AV5	AV5	AV5	AV5	AV5	AV4
501-710	K	-	-	-	-	AV4	AV4	AV4	AV4	AV4
501-900	K	-	-	-	-	AV7	AV7	AV7	AV7	AV5
600-520	K	-	-	AV5	AV5	AV5	AV5	-	-	AV4
600-710	K	-	-	-	-	-	AV4	AV4	AV4	AV5
700-901	K	-	-	-	-	AV4	AV4	AV4	AV4	AV4
700-902	K	-	-	-	-	AV4	AV4	AV4	AV4	AV7

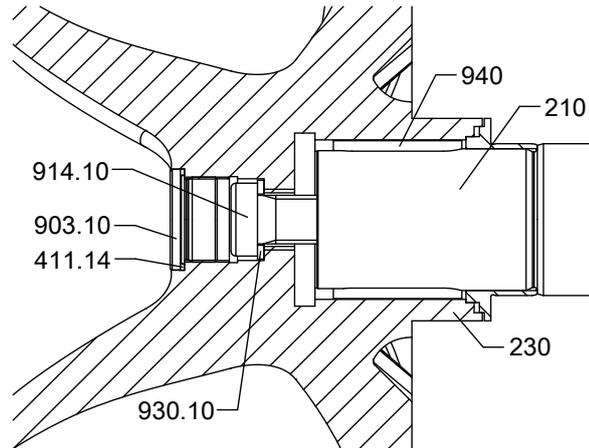
**Impeller fastening elements M20**



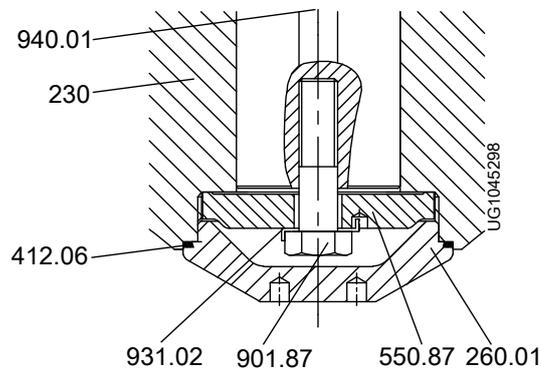
**Fig. 51: Removing the impeller**

\*: On specific designs only

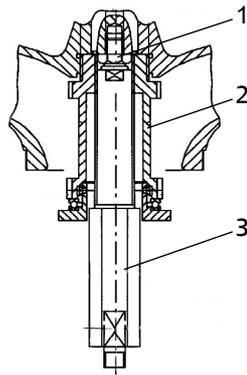
- ✓ The back pull-out unit has been placed in a horizontal position on wooden supports and secured against rolling off.
- ✓ The lubricant and any leakage have been drained.
- 1. Undo and remove hexagon socket head cap screw 914.10.
  - ⇒ The impeller/shaft connection is a tapered fit.
- 2. Remove impeller hub cap 260.01 or disc 550.23.
  - ⇒ For dismantling of the impeller, a jacking thread is provided at the impeller hub.
- 3. Screw in the forcing screw and remove impeller 230.

**Impeller fastening elements M42 × 1.5**

**Fig. 52:** Impeller fastening elements M42 × 1.5

1. Unscrew screw plug 903.10 (right-hand thread).
2. Remove joint ring 411.14.
3. Undo hexagon socket head cap screw 914.10. Remove it together with lock washer 930.10.
  - ⇒ For dismantling the impeller, a jacking thread is provided at the impeller hub.
4. Screw in the forcing screw and remove impeller 230.
5. Remove keys 940.01.

**Impeller fastening elements M85 × 2, M100 × 2, M125 × 2, M160 × 3**

**Fig. 53:** Impeller fastening elements

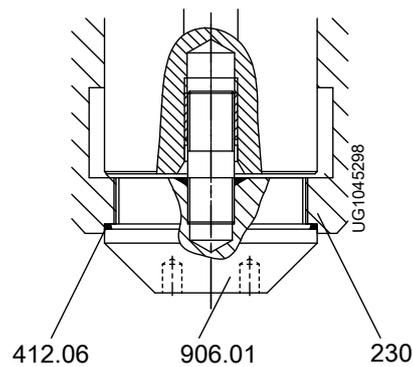
1. Unscrew impeller hub cap 260.01 using a special wrench (right-hand thread).
2. Remove O-ring 412.06.
3. Unbend lock washer 931.02, undo hexagon head bolt 901.87 and remove them together with disc 550.87.
4. Pull off impeller 230 with a special impeller fitting and removal tool.



**Fig. 54:** Special impeller fitting and removal tool

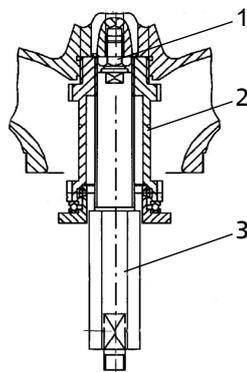
5. Screw hexagon head bolt 1 into the shaft end to prevent any damage to the shaft thread.
6. Screw part 2 into the impeller.
7. Screw fully threaded stud 3 into part 2 and pull off the impeller.
8. Remove key 940.01.

**Impeller fastening elements M75 × 2 (for hydraulic system E 200-401), M100 × 2 (for hydraulic system K 350-710)**



**Fig. 55:** Impeller fastening elements M75 × 2 (for hydraulic system E 200-401), M100 × 2 (for hydraulic system K 350-710)

1. Unscrew impeller screw 906.01 using a special wrench (right-hand thread).
2. Remove O-ring 412.06.
3. Pull off impeller 230 with a special impeller fitting and removal tool.

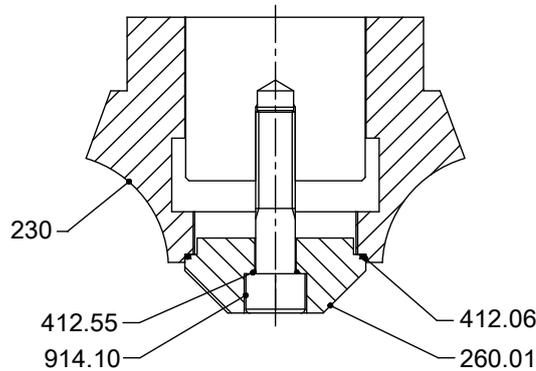


**Fig. 56:** Special impeller fitting and removal tool

4. Screw hexagon head bolt 1 into the shaft end to prevent any damage to the shaft thread.
5. Screw part 2 into the impeller.

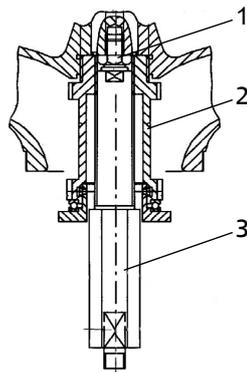
6. Screw fully threaded stud 3 into part 2 and pull off the impeller.
7. Remove key 940.01.

**Impeller fastening elements M100 × 2 (for hydraulic systems K 500-632, K 500-640)**



**Fig. 57:** Impeller fastening elements M100 × 2 (for hydraulic systems K 500-632, K 500-640)

1. Unscrew hexagon socket head cap screw 914.10 (right-hand thread).
2. Remove impeller hub cap 260.01 with O-ring 412.55 and O-ring 412.06.
3. Pull off impeller 230 with a special impeller fitting and removal tool.



**Fig. 58:** Special impeller fitting and removal tool

4. Screw hexagon head bolt 1 into the shaft end to prevent any damage to the shaft thread.
5. Screw part 2 into the impeller.
6. Screw fully threaded stud 3 into part 2 and pull off the impeller.
7. Remove keys 940.01.

**7.4.3.3 Removing the mechanical seal**

Remove the mechanical seal in accordance with the general arrangement drawings. (⇒ Section 9.5, Page 143)

**7.4.3.3.1 Removing the pump-end mechanical seal**

**Motor:** 35 4...110 4, 130 4...175 4, 200 4...350 4, 32 6...100 6, 120 6...165 6, 190 6...206 6, 26 8...75 8, 90 8...130 8, 150 8...220 8, 40 10...90 10, 110 10...190 10, 105 12...165 12

- ✓ The back pull-out unit and the impeller have been removed as described above.
1. Pull the rotating assembly of mechanical seal 433.02 and spacer sleeve 525 (if fitted) off shaft 210.
  2. Remove discharge cover 163 from bearing housing 350 if no seat lock is fitted.
  3. Press the stationary seat of mechanical seal 433.02 or the primary ring carrier out of discharge cover 163.

### 7.4.3.3.2 Removing the pump-end 4STC mechanical seal

**Motor: 320 6...480 6, 260 8...400 8, 230 10...350 10, 195 12...300 12**

- ✓ The back pull-out unit and the impeller have been removed as described above.
- 1. Undo grub screws 904. Pull mating ring carrier 476 and mating ring 475 off shaft 210. For the version with clamped mating ring carrier, pull the mating ring carrier together with the mating ring directly off the shaft.
- 2. On mechanical seals with axially secured primary ring carrier 473 undo screws 914.55.
- 3. Use the jacking threads to remove the primary ring carrier.
- 4. On mechanical seals without axially secured primary ring carrier, use assembly aids to remove the primary ring carrier. Another option of removing the primary ring carrier is to remove the discharge cover and apply pressure to the rear side of the primary ring carrier.

### 7.4.3.3.3 Removing the drive-end mechanical seal

- ✓ The back pull-out unit, impeller and pump-end mechanical seal have been removed as described.
- 1. Remove locking ring 515 or circlip 932.03 and support disc 550.05 or loosen grub screw 904.01.
- 2. Pull the rotating assembly of mechanical seal 433.01 off shaft 210.
- 3. Push the stationary seat of mechanical seal 433.01 out of bearing housing 350.

### 7.4.3.4 Removing the cooling jacket

	<b>CAUTION</b>
	<p><b>Removing the cooling jacket without using eyebolts</b>            Damage to the cooling jacket!</p> <p>▸ Always use eyebolts to pull off the cooling jacket.</p>

1. Screw two eyebolts (G 1/2 and R 1/2, respectively) into the filler openings.
2. Attach hoisting tackle to the eyebolts.
3. Use the hoisting tackle to pull the cooling jacket upwards and remove it from the pump set.

7.4.3.5 Removing the wear plate (for D impeller only)

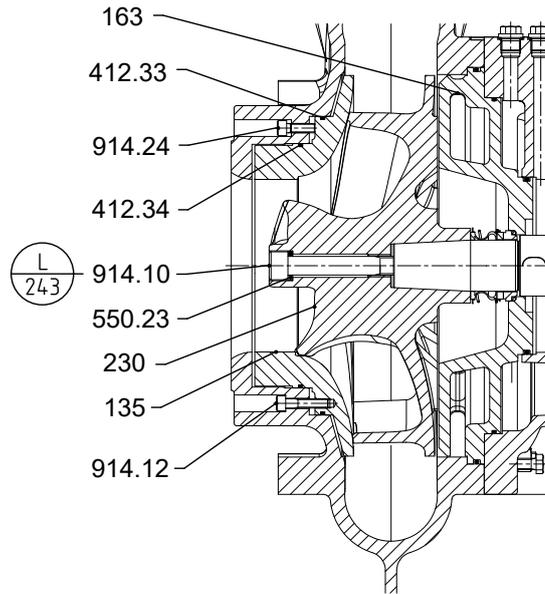


Fig. 59: Removing the wear plate

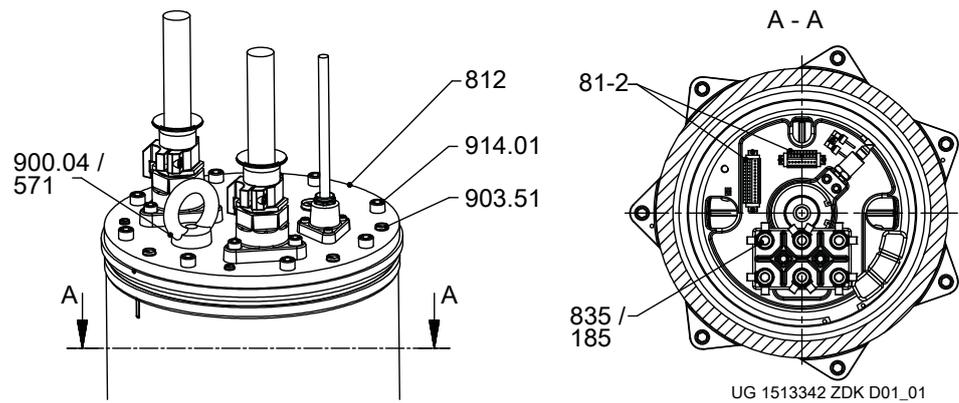
- ✓ The back pull-out unit has been separated from the pump casing.
  - ✓ The inside of the casing has been cleaned.
  - ✓ The wear plate needs to be replaced as a result of visual inspection.
1. Undo hexagon socket head cap screws 914.12.
  2. Remove wear plate 135 with O-rings 412.33/412.34.

7.4.4 Dismantling the motor section

	<b>NOTE</b>
	Special regulations apply to repair work on explosion-proof pump sets. Modifications or alteration of the pump sets can affect explosion protection and are only permitted after consultation with the manufacturer.
	<b>NOTE</b>
	The motors of explosion-proof pump sets are supplied in "flameproof enclosure" type of protection. Any work on the motor section which could affect explosion protection, such as re-winding and repair work involving machining, must be inspected by an approved expert or performed by the motor manufacturer. No modifications must be made to the internal configuration of the motor space. Repair work at the flameproof joints must only be performed in accordance with the manufacturer's instructions.

When dismantling the motor section and the electric cables make sure that the cores/terminals are clearly marked for future reassembly.

7.4.4.1 Removing the motor housing cover



**Fig. 60:** Removing the motor housing cover

- ✓ Suitable lifting equipment is on hand.
  - ✓ The pump set has been disconnected from the power supply. It has been securely placed on a level surface in a vertical position.
1. Attach lifting equipment to eyebolt 900.04 or bail 571.
  2. Undo hexagon socket head cap screws 914.01.
  3. Carefully lift off motor housing cover 812. If the motor housing cover cannot be lifted off, use the jacking threads located underneath caps 903.51.
  4. Remove the cable ties.
  5. Lift motor housing cover 812 up further until the power cables and control cable can be disconnected.
  6. Disconnect plug 81-2 of the control cable from the corresponding connector.
  7. Disconnect the power cable cores from terminal board 835 and terminal 185.
  8. Place motor housing cover 812 down and secure it against rolling off.

7.4.4.2 Removing the cable gland with connection cable

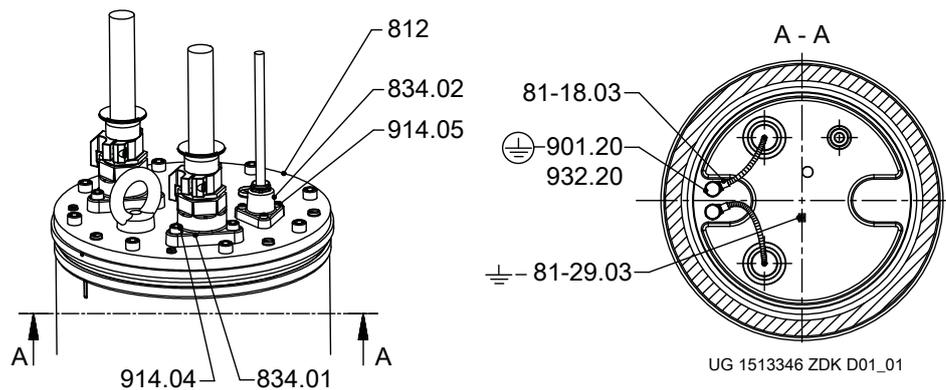


Fig. 61: Removing the connection cable and cable gland

**Removing the power cable**

- ✓ The motor housing cover has been removed, placed down and protected against rolling off.
- 1. Disconnect the ground conductor on the inside of motor housing cover 812. If a shielded cable is used, disconnect the shield as well.
- 2. Undo screws 914.04 of cable gland 834.01.
- 3. Pull cable gland 834.01 out of the centering seat in motor housing cover 812.

**Removing the control cable**

- ✓ The motor housing cover has been removed, placed down and protected against rolling off.
- 1. Disconnect the cores of the control cable from plug 81-2.
- 2. Undo screws 914.05 of cable gland 834.02.
- 3. Pull cable gland 834.02 out of the centering seat in motor housing cover 812.

	<b>NOTE</b>
	Noting down the marking and length of the cable cores to facilitate fitting the replacement cable gland is recommended.

## 7.5 Reassembling the pump set

### 7.5.1 General information/Safety regulations

	<p><b>! WARNING</b></p> <p><b>Improper lifting/moving of heavy assemblies or components</b>          Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.</li> </ul>
	<p><b>! WARNING</b></p> <p><b>Components with sharp edges</b>          Risk of cutting or shearing injuries!</p> <ul style="list-style-type: none"> <li>▷ Always use appropriate caution for installation and dismantling work.</li> <li>▷ Wear work gloves.</li> </ul>
	<p><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><b>NOTE</b></p> <p>Before reassembling the motor section, check that all joints relevant to explosion protection (flamepaths) are undamaged. Any components with damaged flamepaths must be replaced. Refer to the flamepath positions specified in the Annex.</p>

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

- Sealing elements**
- O-rings
    - Check O-rings for any damage and replace by new O-rings, if required.
    - Never use O-rings that have been made by cutting an O-ring cord to size and gluing the ends together.
  - Assembly adhesives
    - Avoid the use of assembly adhesives, if possible.

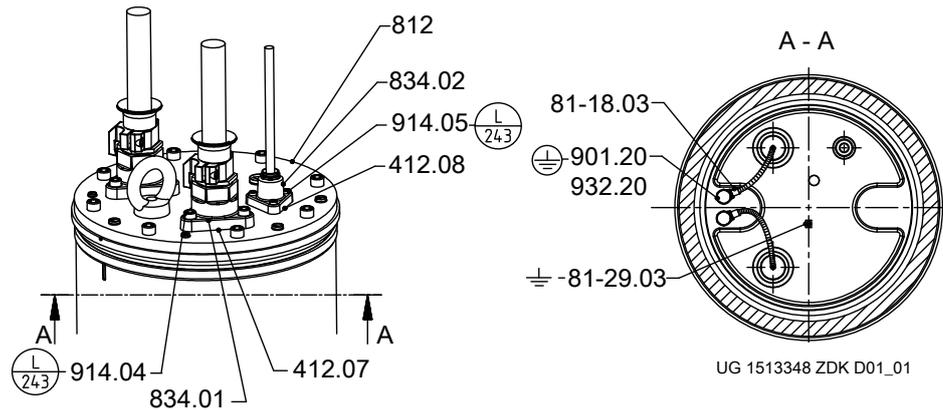
**Tightening torques** When reassembling the pump set, tighten all screws/bolts as indicated. In addition, secure all screwed connections closing off the flameproof enclosure with a thread-locking agent (Loctite type 243).

### 7.5.2 Reassembling the motor section

	<p><b>NOTE</b></p> <p>Before reassembling the motor section, check that all joints relevant to explosion protection (flamepaths) are undamaged. Any components with damaged flamepaths must be replaced. Only use original spare parts made by KSB for explosion-proof pump sets. Observe the flamepath positions specified in the Annex (Flamepaths on explosion-proof motors). Secure all screwed/bolted connections closing off the flameproof enclosure with a thread-locking agent (Loctite Type 243).</p>
--	---

	<p><b>⚠ DANGER</b></p>
	<p><b>Wrong screws/bolts</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Always use the original screws/bolts for assembling an explosion-proof pump set.</li> <li>▷ Never use screws/bolts of different dimensions or of a lower property class.</li> </ul>

**7.5.2.1 Installing the replacement cable gland**



**Fig. 62:** Installing the cable gland

**Table 47:** Key to the symbols

Symbol	Key
	Always secure screwed connections marked with this symbol with <b>Loctite 243</b> .

**Installing the power cable**

- ✓ The motor housing cover has been removed, placed down and protected against rolling off.
- 1. Adjust the lengths of the cable cores to the original cable gland.
- 2. Attach core identifications matching the original cable gland.
- 3. Slide O-ring 412.07 onto the core ends of the power cable and into the groove of the centering seat.
- 4. Insert cable gland 834.01 with the power cable and O-ring 412.07 into the opening provided.
- 5. Fasten cable gland 834.01 with hexagon socket head cap screws 914.04. Secure the screwed connection with Loctite 243.
- 6. Fit cable terminals to the core ends of the power cable.
- 7. Fasten the ground conductor (green/yellow) to the inside of motor housing cover 812 with bolt 901.20 and spring washer 932.20.
- 8. If shielded cables are used, connect the shield to terminal 81-29.03 on the inside of motor housing cover 812.

**Installing the control cable**

- ✓ The motor housing cover has been removed, placed down and protected against rolling off.
- 1. Adjust the lengths of the cable cores to the original cable gland.
- 2. Attach core identifications matching the original cable gland.
- 3. Slide O-ring 412.08 over the short core ends of the control cable and into the groove of the centering seat.
- 4. Insert cable gland 834.02 with the control cable and O-ring 412.08 into the opening provided.

5. Fasten cable gland 834.02 with hexagon socket head cap screws 914.05 and secure the screwed connection with Loctite 243.
6. Connect plug 81-2 to the control cable cores.

7.5.2.2 Fitting the motor housing cover

	<p><b>⚠ DANGER</b></p>
	<p><b>Electrical connection work by unqualified personnel</b>                  Danger to life from electric shock</p> <ul style="list-style-type: none"> <li>▷ Always have the electrical connections installed by an electrically qualified person.</li> <li>▷ Observe regulation IEC 60364 as well as the applicable regional regulations.</li> </ul>

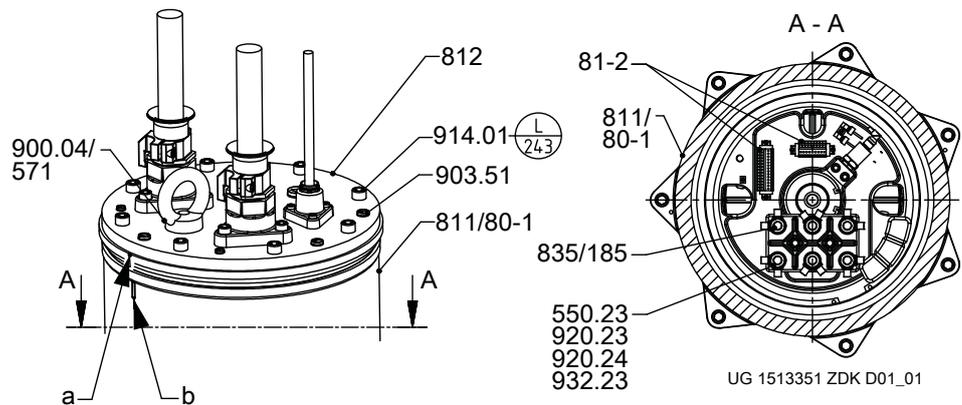


Fig. 63: Fitting the motor housing cover

a	Alignment grooves of motor housing cover 812
b	Alignment groove of motor housing 811

Table 48: Key to the symbols

Symbol	Key
	Always secure screwed connections marked with this symbol with <b>Loctite 243</b> .

- ✓ A new O-ring has been inserted into the groove of motor housing cover 812.
- 1. Attach lifting equipment to eyebolt 900.04 or bail 571 of motor housing cover 812. Lift up the motor housing cover and lower it down onto motor housing 811 or motor unit 80-1 until only a gap remains which allows work to continue. Align the alignment grooves in motor housing cover 812 and motor housing 811. The alignment grooves must be properly aligned.
- 2. Connect plug 81-2 of the control cable to the corresponding connector.
- 3. Connect the power cable cores to terminal board 835 with disc 550.23, circlip 932.23 and nuts 920.23/920.24 in accordance with the wiring diagram.
- 4. Tie the cores of the control cable and power cable together with cable ties.
- 5. Slowly lower motor housing cover 812 down onto motor housing 811. Align the alignment grooves in motor housing cover 812 and motor housing 811. The alignment grooves must be properly aligned.
- 6. Fasten motor housing cover 812 to motor housing 811 or motor unit 80-1 with socket head cap screws 914.01. Secure with Loctite 243. Observe the tightening torque!
- 7. Cover the jacking threads with caps 903.51.
- 8. Perform a leak test on the motor.

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### 7.5.3 Reassembling the pump section

#### 7.5.3.1 Fitting the drive-end mechanical seal

Observe the following to ensure trouble-free operation of the mechanical seal:

- Only remove the protective wrapping of the contact faces immediately before assembly takes place.
  - Make sure the surface of the shaft is absolutely clean and undamaged.
  - Immediately before installing the mechanical seal, wet the contact faces with a drop of oil.
  - For easier installation of bellows-type mechanical seals, wet the inside diameter of the bellows with soapy water (not oil).
  - To prevent any damage to the rubber bellows, place a thin foil (of approximately 0.0039 to 0.0118 inch [0.1 to 0.3 mm] thickness) around the free shaft stub. Slip the rotating assembly over the foil into its installation position. Then remove the foil.
- ✓ The shaft and rolling element bearings have been properly fitted in the motor.
1. Slide drive-end mechanical seal 433.01 with support disc 550.05 onto shaft 210. Press the primary ring carrier into the seat of bearing housing 350.
  2. Insert O-rings 412.04/412.35 and 412.15/412.11 into discharge cover 163, and press them into bearing housing 350 as far as they will go.

#### 7.5.3.2 Fitting the pump-end mechanical seal

**Motor: 35 4...110 4, 130 4...175 4, 200 4...350 4, 32 6...100 6, 120 6...165 6, 190 6...206 6, 26 8...75 8, 90 8...130 8, 150 8...220 8, 40 10...90 10, 110 10...190 10, 105 12...165 12**

Observe the following to ensure trouble-free operation of the mechanical seal:

- Only remove the protective wrapping of the seal faces immediately before assembly takes place.
  - Make sure the surface of the shaft is absolutely clean and undamaged.
  - Immediately before installing the mechanical seal, wet the seal faces with a drop of oil.
  - For easier installation of bellows-type mechanical seals, wet the inside diameter of the bellows with soapy water (not oil).
  - To prevent any damage to the rubber bellows, place a thin foil (of approximately 0.1 to 0.3 mm thickness) around the free shaft stub. Slide the rotating assembly over the foil into its installation position. Then remove the foil.
- ✓ The shaft, rolling element bearings and discharge cover have been properly fitted in the motor.
1. Press the stationary seat of mechanical seal 433.02 or the primary ring carrier into the seat of discharge cover 163.
  2. Slide pump-end mechanical seal 433.02 with spacer sleeve 525.04 (if applicable) onto shaft 210 until it reaches its installation position.

7.5.3.3 Fitting the pump-end 4STC mechanical seal

Motor: 320 6...480 6, 260 8...400 8, 230 10...350 10, 195 12...300 12

	<b>CAUTION</b>
	<p><b>Use of grease or other permanent lubricants</b></p> <p>Torque transmission impeded / overheating of and damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Never use grease or other permanent lubricants for fitting the torque-transmitting elements of a mechanical seal.</li> <li>▷ Use soft soap to reduce any friction caused during assembly.</li> <li>▷ Never coat the mechanical seal faces with grease or oil.</li> </ul>

- ✓ The relevant documentation for installing the mechanical seal is observed (⇒ Section 7.5.3.3, Page 108) .
- ✓ The back pull-out unit has been removed from the pump casing and safely positioned and secured in a horizontal position.
- ✓ The original KSB 4STC cartridge seal is fully assembled and undamaged.
- ✓ Assembly aids are available.
  1. Properly remove any corrosion or wear.
  2. Clean the seal faces with a suitable paper tissue and, if required, ethyl alcohol.
  3. Wet O-ring 412.54 and discharge cover 163 with a non-permanent lubricant (e.g. a water/soap mixture).
  4. Press the assembly consisting of primary ring carrier 473, primary ring 472, thrust ring 474, springs and O-rings 412 into the seat at discharge cover 163. If necessary, use a spacer sleeve and elastic intermediate element to protect the seal faces.

	<b>NOTE</b>
	<p>The seal faces must not be damaged (score mark, etc). The assembly must not be pressed into the seat by pressing on the primary ring (risk of fracture). The force for mounting it must be applied via the primary ring carrier.</p>

5. Fasten primary ring carrier 473 to discharge cover 163 with screws 914.55. Tighten the screws crosswise in several increments. Observe the tightening torques. This step does not apply to the version without axially secured primary ring carrier.
6. Check the seal face for any damage. Clean it again if required.
7. Check that primary ring 472 is correctly seated.
8. Wet O-ring 412.55 and the corresponding surface on shaft 210 with a suitable, non-permanent lubricant.
9. Slide the rotating assembly of the seal, comprising mating ring carrier 476, mating ring 475 and O-rings 412 onto shaft 210 as far as it will go.
10. Preload the rotating assembly with an assembly aid to match the installation dimension. This step does not apply to the version with clamped mating ring carrier. In this case, the installation dimension and torque transmission is ensured by mounting impeller 230.
11. Tighten grub screws 904, observing the installation dimension and tightening torques.

	<b>NOTE</b>
	<p>Do not re-use cup point grub screws! Used grub screws must be replaced by new cup point grub screws.</p>

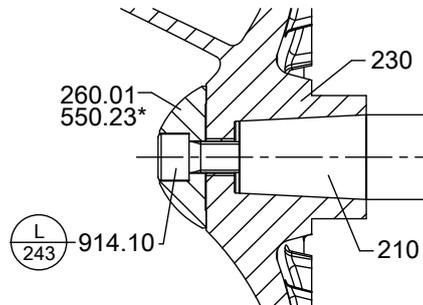
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⇒ Cup point grub screws must not be re-used. Repeated tightening can impair the reliability of force transmission.

### 7.5.3.4 Fitting the impeller

The procedures for fitting the impeller differ depending on the hydraulic system and motor. (⇒ Section 7.4.3.2, Page 92)

#### Impeller fastening elements M20



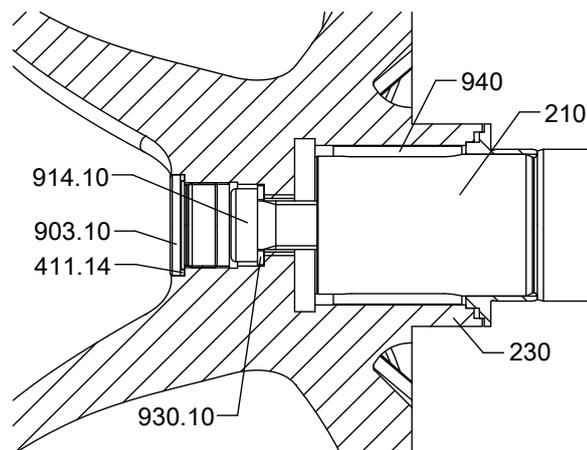
**Fig. 64:** Fitting the impeller

\*: On specific designs only

	<b>NOTE</b>
<p>For bearing brackets with tapered fit make sure that the tapered fit of impeller and shaft is undamaged and assembled free from grease.</p>	

- ✓ The shaft and rolling element bearings have been properly installed.
  - ✓ The mechanical seals have been properly installed.
1. Slide impeller 230 onto the shaft end.
  2. Apply thread-locking agent Loctite 243 to the thread of the impeller screw.
  3. Screw in impeller screw 914.10 and disc 550.23 if any. Tighten with a torque wrench. Observe the tightening torques depending on the bolt/screw materials (⇒ Section 7.6, Page 117)

#### Impeller fastening elements M42 × 1.5



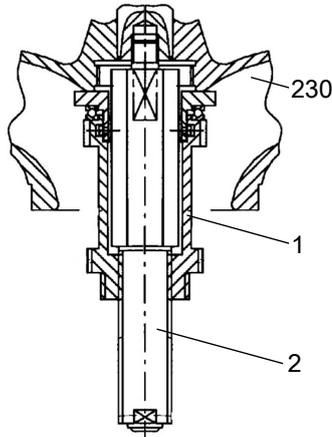
**Fig. 65:** Impeller fastening elements M42 × 1.5

1. Insert key 940.01.
2. Slide impeller 230 onto the shaft end.
3. Screw in hexagon socket head cap screw 914.10 including safety device 930.10 and tighten with a torque wrench. Observe the tightening torques.
4. Insert joint ring 411.14.
5. Screw in screw plug 903.10 (right-hand thread).

**Impeller fastening elements M85 × 2, M125 × 2, M100 × 2, M160 × 3**

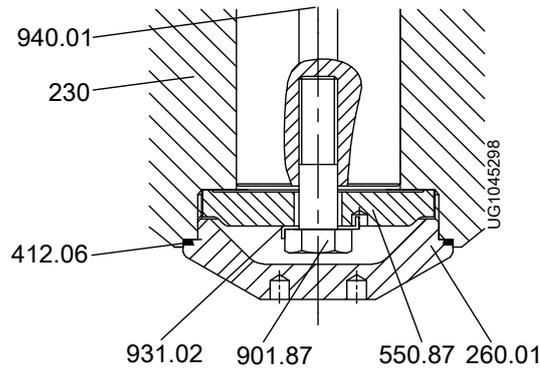
- ✓ The back pull-out unit has been placed in a horizontal position on wooden supports. It has been secured against rolling off.
- ✓ The mechanical seals and keys have been properly installed.

1. Insert key 940.01.
2. Mount impeller 230 with a special impeller fitting and removal tool.



**Fig. 66:** Special impeller fitting and removal tool

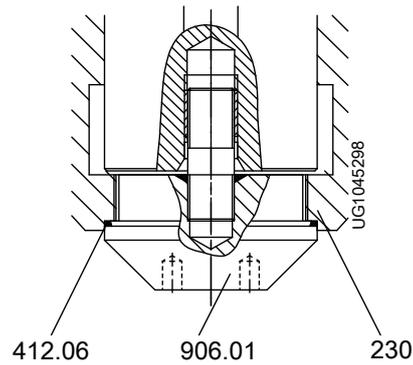
3. Screw part 2 of the special impeller fitting and removal tool into the shaft end of the pump set.
4. Screw part 1 to fully threaded stud part 2.



**Fig. 67:** Impeller fastening elements

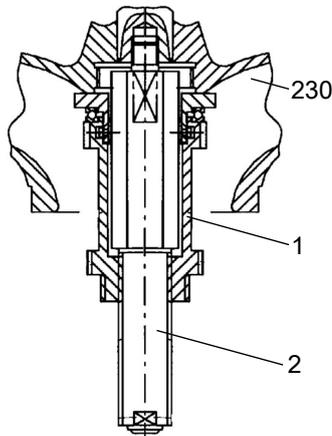
5. Screw in hexagon head bolt 901.87 with disc 550.87. Bend over lock washer 931.02.
6. Insert O-ring 412.06.
7. Screw in impeller hub cap 260.01 using a special wrench (right-hand thread).

**Impeller fastening elements M75 × 2 (for hydraulic system E 200-401), M100 × 2 (for hydraulic system K 350-710)**



**Fig. 68:** Impeller fastening elements M75 × 2 (for hydraulic system E 200-401), M100 × 2 (for hydraulic system K 350-710)

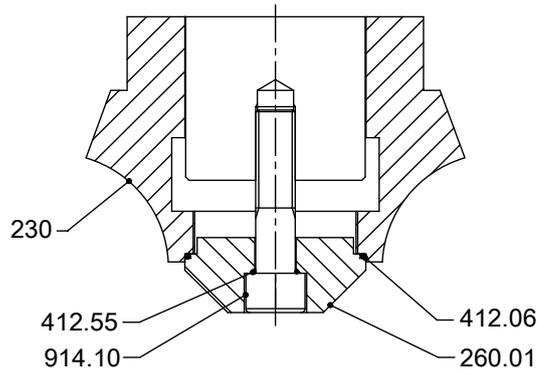
1. Insert key 940.01.
2. Mount impeller 230 with a special impeller fitting and removal tool.



**Fig. 69:** Special impeller fitting and removal tool

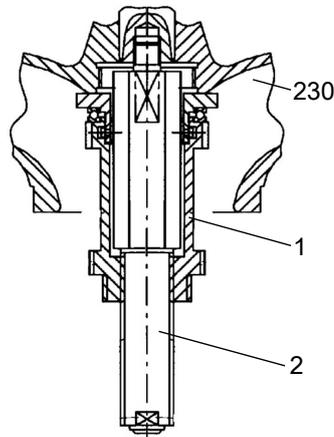
3. Screw part 2 of the special impeller fitting and removal tool into the shaft end of the pump set.
4. Screw part 1 to fully threaded stud part 2.
5. Insert O-ring 412.06.
6. Screw in impeller screw 906.01 using a special wrench (right-hand thread).

**Impeller fastening elements M100 × 2 (for hydraulic systems K 500-632, K 500-640)**



**Fig. 70:** Impeller fastening elements M100 × 2 (for hydraulic systems K 500-632, K 500-640)

1. Insert keys 940.01.
2. Fit impeller 230 using a special impeller fitting and removal tool.

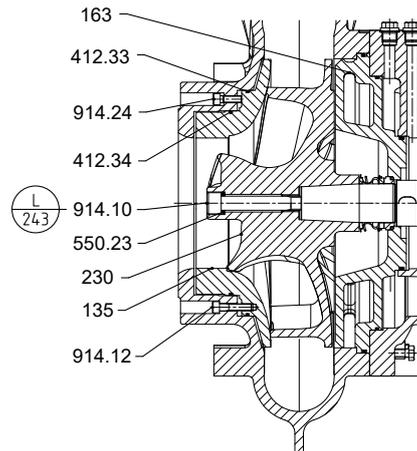


**Fig. 71:** Special impeller fitting and removal tool

3. Screw part 2 of the special impeller fitting and removal tool into the shaft end of the pump set.
4. Screw part 1 to fully threaded stud part 2.
5. Fit impeller hub cap 260.01 with O-ring 412.55 and O-ring 412.06.
6. Fasten hexagon socket head cap screw 914.10 (right-hand thread).

**7.5.3.5 Fitting the wear plate (for D impeller only)**

- ✓ The shaft, rolling element bearings, mechanical seal and impeller have been assembled properly.

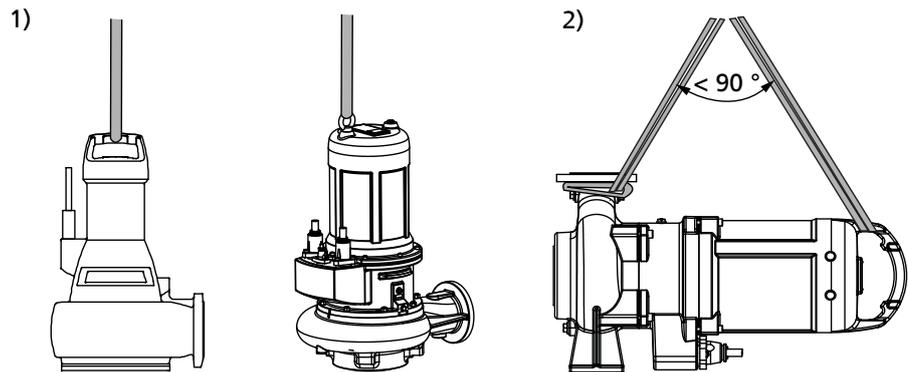


**Fig. 72:** Fitting the wear plate

1. Equip wear plate 135 with two new O-rings 412.33 and 412.34.
2. Insert wear plate 135 into pump casing 101.
3. Fasten wear plate 135 to pump casing 101 with hexagon socket head cap screws 914.12.
4. Adjust the clearance between impeller 230 and wear plate 135 by tightening and loosening screws 914.12 and 914.24.
  - ⇒ Screw 914.24 presses the wear plate in the direction of the impeller.
  - ⇒ The clearance equals  $0.3 \pm 0.1$  mm (measured on the suction side from the outer surface of the impeller vane to the wear plate).
5. Insert the complete back pull-out unit into the pump casing.
6. Evenly tighten bolted/screwed connection 920.01 and 902.01 and/or 914.74 between pump casing and bearing housing.

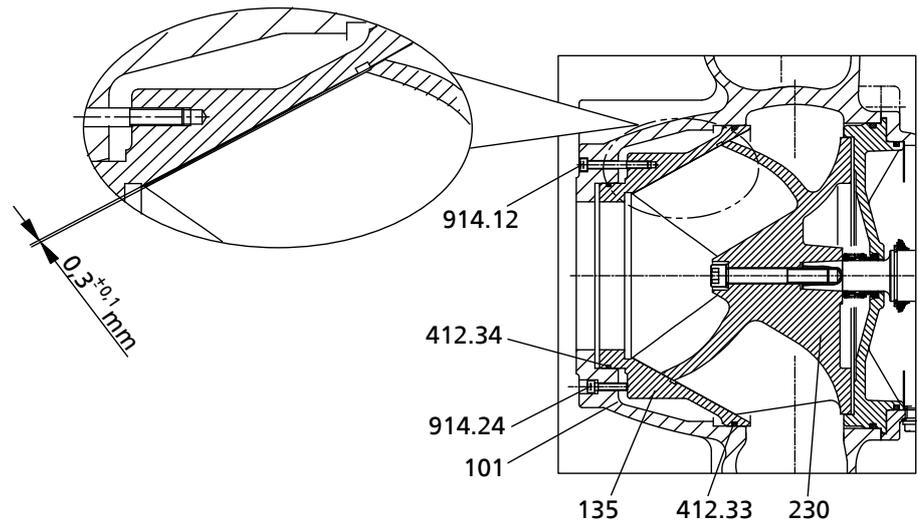
**7.5.3.6 Adjusting the wear plate**

1. Insert the complete back pull-out unit into the pump casing.
2. Evenly tighten bolted/screwed connection 920.01 and 902.01 and/or 914.74 between pump casing and bearing housing.



**Fig. 73:** Transporting the pump set 1) Vertical installation 2) Horizontal installation

✓ The pump set has been suspended and lifted as illustrated.



**Fig. 74:** Adjusting the wear plate

1. Adjust the clearance between impeller 230 and wear plate 135 by tightening and loosening screws 914.12 and 914.24.
  - ⇒ Screw 914.24 presses the wear plate in the direction of the impeller.
  - ⇒ The clearance equals  $0.3^{+0.1}$  mm (measured on the suction side from the outer surface of the impeller vane to the wear plate).

#### 7.5.3.7 Installing the back pull-out unit

- ✓ The shaft, rolling element bearings, mechanical seal and impeller have been assembled properly.
1. Insert the complete back pull-out unit into the pump casing.
  2. Evenly tighten screwed connection 920.01 between pump casing and bearing housing 350 or adapter 82-5, as applicable.

#### 7.5.4 Leak testing

##### 7.5.4.1 Testing the mechanical seal area for leakage

Observe the following values for leak testing:

- **Test medium:** compressed air
- **Test pressure:** 14.5 psi [1 bar]
- **Test duration:** 5 minutes
- **Opening:**
  - Pump sets with cooling system (installation types K and D): coolant filler opening or coolant drainage opening

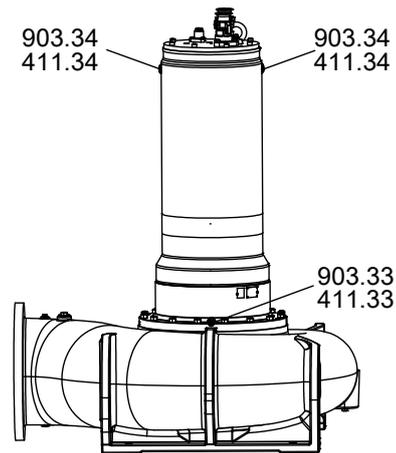


Fig. 75: Pump sets with cooling system

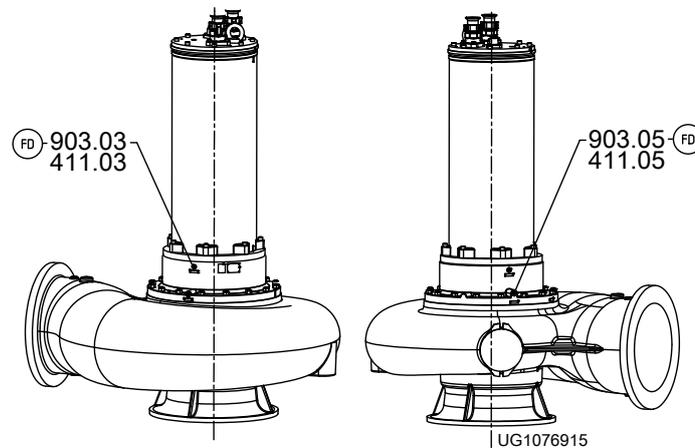


Fig. 76: Pump sets without cooling system

- Pump sets without cooling system (installation types S and P):  
lubricant filler opening or lubricant drainage opening

1. Remove the screw plug and joint ring of the lubricant chamber or cooling system.
2. Screw the testing device tightly into the G $\frac{1}{2}$  plug thread.
3. Carry out the leak test with the values specified above.
  - ⇒ The pressure must not drop during the test period.
  - ⇒ If the pressure does drop, check the sealing elements and screwed connections.
4. Repeat the leak test if required.
5. Remove the testing device.
6. After the leak test, top up coolant/lubricant.

#### 7.5.4.2 Testing the motor for leakage

Observe the following values for leak testing:

- **Test medium:** nitrogen
- **Test pressure:** 12.3 psi [0.8 bar]
- **Test duration:** 2 minutes
- **Opening:** hole of screw plug 903.31

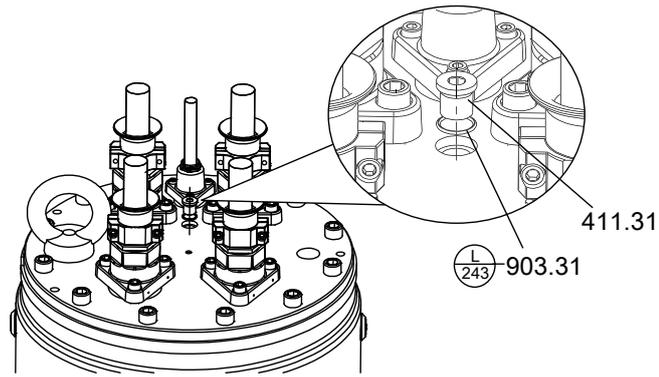


Fig. 77: Leak testing the motor

Table 49: Key to the symbols

Symbol	Key
	Always secure screwed connections marked with this symbol with <b>Loctite 243</b> .

1. Undo and remove screw plug 903.31 and joint ring 411.31.
2. Screw the testing device tightly into the G 1/2 plug thread.
3. Carry out the leak test with the values specified above.
  - ⇒ The pressure must not drop during the test period.
  - ⇒ If the pressure does drop, check the sealing elements and screwed connections.
4. Repeat the leak test if required.
5. Remove the testing device.

	<p><b>⚠ DANGER</b></p>
<p><b>Screw plug leaking or missing</b>                  Damage to the motor!</p> <ul style="list-style-type: none"> <li>▷ Never start up a pump set without screw plug 903.31.</li> <li>▷ Apply a thread-locking agent (Loctite 243) to screw plug 903.31.</li> </ul>	

6. Apply a thread-locking agent to screw plug 903.31.
7. Re-insert and tighten screw plug 903.31 with new joint ring 411.31.

**7.5.5 Checking the connection of motor/power supply**

Check the electric cables after reassembly. (⇒ Section 7.2.1, Page 70)

## 7.6 Tightening torques

**Table 50:** Tightening torques [lbf ft] depending on thread, material and property class

Thread	Material					
	A4-50	A4-70	A4-70	1.4462	D6-80	8.8 / C3-80
	Property class Rp 0.2 <sup>N</sup> / <sub>mm<sup>2</sup></sub>					
	210	250	450	450	600	640
M5	-	-	3	3	-	4
M6	-	-	5	5	-	7
M8	-	-	13	13	17	18
M10	-	-	26	26	34	37
M12	-	-	44	44	58	63
M14	-	-	66	66	89	96
M16	-	-	111	111	145	155
M20	-	-	214	214	283	302
M24	170	205	-	369	484	516
M30	339	-	-	738	968	1033
M42	959	-	-	2028	2696	2877
M48	1438	-	-	3097	4148	4425

**Table 51:** Tightening torques [Nm] depending on thread, steel grade and property class

Thread	Material					
	A4-50	A4-70	A4-70	1.4462	D6-80	8.8 / C3-80
	Property class Rp 0.2 <sup>N</sup> / <sub>mm<sup>2</sup></sub>					
	210	250	450	450	600	640
M5	-	-	4	4	-	6
M6	-	-	7	7	-	10
M8	-	-	17	17	23	25
M10	-	-	35	35	46	50
M12	-	-	60	60	79	85
M14	-	-	90	90	121	130
M16	-	-	150	150	196	210
M20	-	-	290	290	384	410
M24	230	278	-	500	656	700
M30	460	-	-	1000	1312	1400
M42	1300	-	-	2750	3656	3900
M48	1950	-	-	4200	5625	6000

## 7.7 Spare parts stock

### 7.7.1 Ordering spare parts

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

- Order number
- Order item number
- Type series
- Size
- Year of construction
- Motor number

Refer to the name plate for all data.

Also supply the following data:

- Part No. and description (⇒ Section 9.1, Page 121)
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

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

Table 52: Quantity of spare parts for recommended spare parts stock<sup>23)</sup>

Part No.	Description	Number of pump sets (including stand-by pump sets)						
		2	3	4	5	6 and 7	8 and 9	10 and more
80-1	Motor unit	-	-	-	1	1	2	30 %
834	Cable gland	1	1	2	2	2	3	40 %
818	Rotor	-	-	-	1	1	2	30 %
230	Impeller	1	1	1	2	2	3	30 %
502	Casing wear ring	2	2	2	3	3	4	50 %
433.01	Mechanical seal, motor end	2	3	4	5	6	7	90 %
433.02	Mechanical seal, pump end	2	3	4	5	6	7	90 %
322	Radial roller bearing, motor end	1	1	2	2	3	4	50 %
321	Radial ball bearing, pump end	1	1	2	2	3	4	50 %
99-9	Set of sealing elements for the motor	4	6	8	8	9	10	100 %
99-9	Set of sealing elements for the hydraulic system	4	6	8	8	9	10	100 %

<sup>23)</sup> For two years of continuous operation or 17,800 operating hours

## 8 Trouble-shooting

	<b>WARNING</b>
	<p><b>Improper remedial work</b> Risk of personal injury!</p> <p>▷ For any work performed in order to remedy faults observe the relevant information given in this operating manual and/or the product literature provided by the accessories manufacturers.</p>

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

- A Pump is running but does not deliver
- B Pump delivers insufficient flow rate
- C Excessive current/power input
- D Insufficient discharge head
- E Vibrations and noise during pump operation

Table 53: Trouble-shooting

A	B	C	D	E	Possible cause	Remedy
-	X	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point.
-	X	-	-	-	Gate valve in the discharge line is not fully open.	Fully open the gate valve.
-	-	X	-	X	Pump is running in off-design conditions (part load/overload).	Check the pump's operating data.
X	-	-	-	-	Pump or piping are not completely vented.	<b>Dry installation:</b> Vent and/or prime the pump and piping; fit a vent valve if required. <b>Wet installation:</b> Vent by lifting the pump off the base elbow and lowering it again.
X	X	-	X	X	<b>Wet installation:</b> Pump intake clogged by deposits	Clean the intake, pump components and lift check valve.
					<b>Dry installation:</b> Inlet line clogged by deposits	Clean the intake or inlet line, pump components and lift check valve.
-	-	X	-	X	Dirt/fibers in the clearance between the casing wall and impeller; sluggish rotor.	Check whether the impeller can be easily rotated. Clean the impeller, if required.
-	X	X	X	X	Wear	Replace worn parts by new ones.
X	X	-	X	-	Defective riser (pipe and sealing elements)	Replace defective riser pipes. Replace sealing elements.
-	X	-	X	X	Impermissible air or gas content in the fluid handled	Contact KSB.
-	-	-	-	X	System-induced vibrations	Contact KSB.
-	X	X	X	X	Wrong direction of rotation	Check the connection of the motor and control system, if any.
-	X	-	X	-	Wrong supply voltage	Check the mains power supply. Check the cable connections.
X	-	-	-	-	No voltage	Check the electrical installation. Contact the energy supplier.
-	-	-	-	X	Worn or defective rolling element bearings	Contact KSB.
-	X	-	X	-	In case of star-delta configuration: motor running in star configuration only	Check star-delta contactor.
X	-	-	-	-	Defective motor winding	Contact KSB.

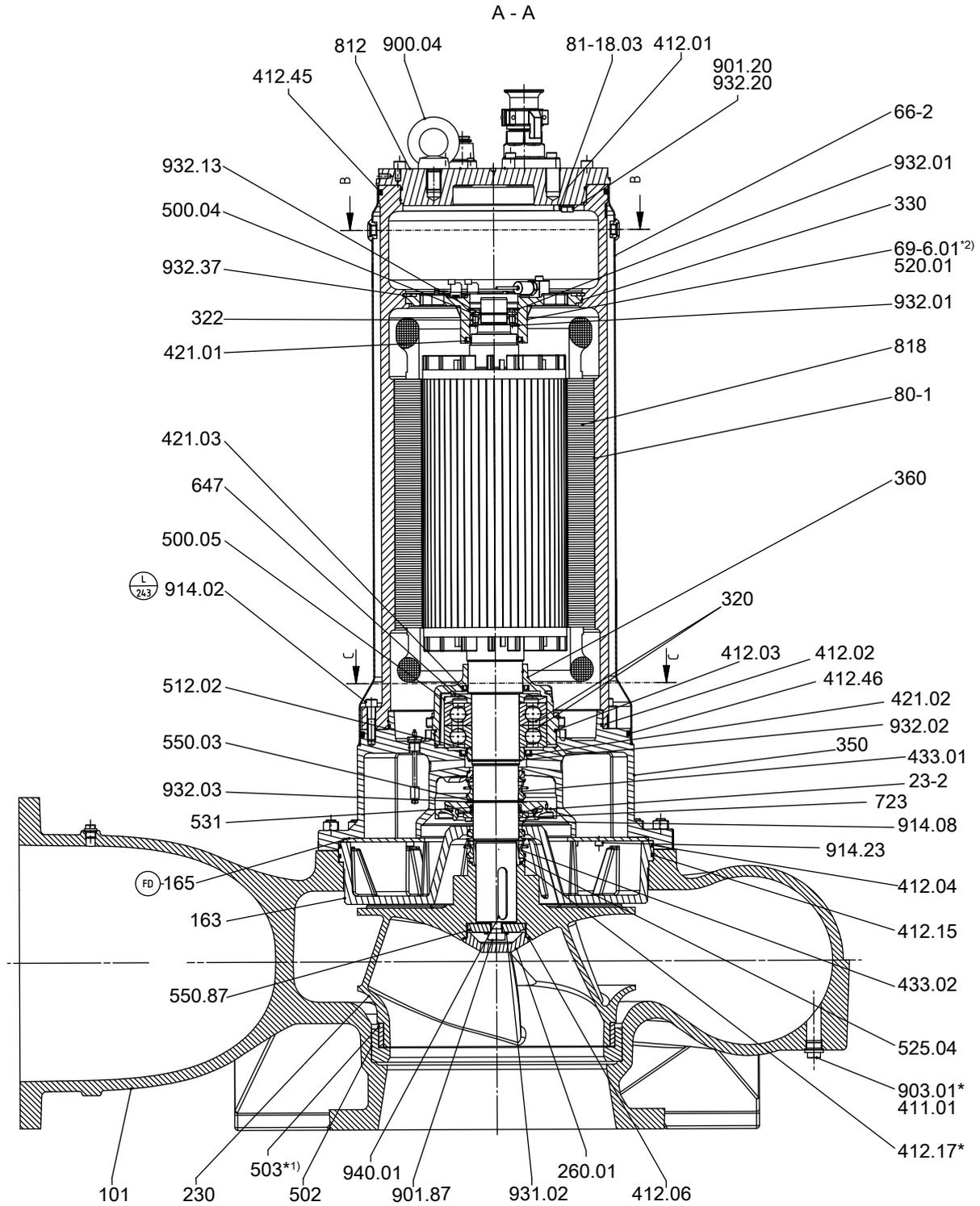
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A	B	C	D	E	Possible cause	Remedy
-	<b>X</b>	-	-	-	<p><b>Wet installation:</b> Water level lowered too much during operation</p> <p><b>Dry installation:</b> Suction lift is too high, NPSHavailable (positive suction head) is too low.</p>	<p>Check level control equipment.</p> <p>Check the inlet line for clogging, clean if necessary; fully open the shut-off element in the inlet line.</p>
<b>X</b>	-	-	-	-	<p><b>Pump sets without cooling system (installation types P and S):</b> The temperature control device for monitoring the winding has tripped due to excessive winding temperature.</p>	<p>The motor will restart automatically once it has cooled down.</p>
<b>X</b>	-	-	-	-	<p>The thermistor tripping unit with manual reset for temperature limiter has tripped the pump as a result of the permissible winding temperature being exceeded.</p>	<p>Have cause determined and eliminated by qualified and trained personnel.</p> <p><b>Pump sets with cooling system:</b> Check the coolant level.</p>
<b>X</b>	-	-	-	-	<p>Motor has been tripped by leakage monitor.</p>	<p>Have cause determined and eliminated by qualified and trained personnel.</p>
<b>X</b>	-	-	-	-	<p>Mechanical seal monitor has tripped.</p>	<p>Have cause determined and eliminated by qualified and trained personnel.</p>
<b>X</b>	-	-	-	-	<p>Bearing temperature monitor has tripped.</p>	<p>Have cause determined and eliminated by qualified and trained personnel.</p>

## 9 Related Documents

### 9.1 General assembly drawings with list of components

#### 9.1.1 Pump sets with cooling system (installation types K and D):



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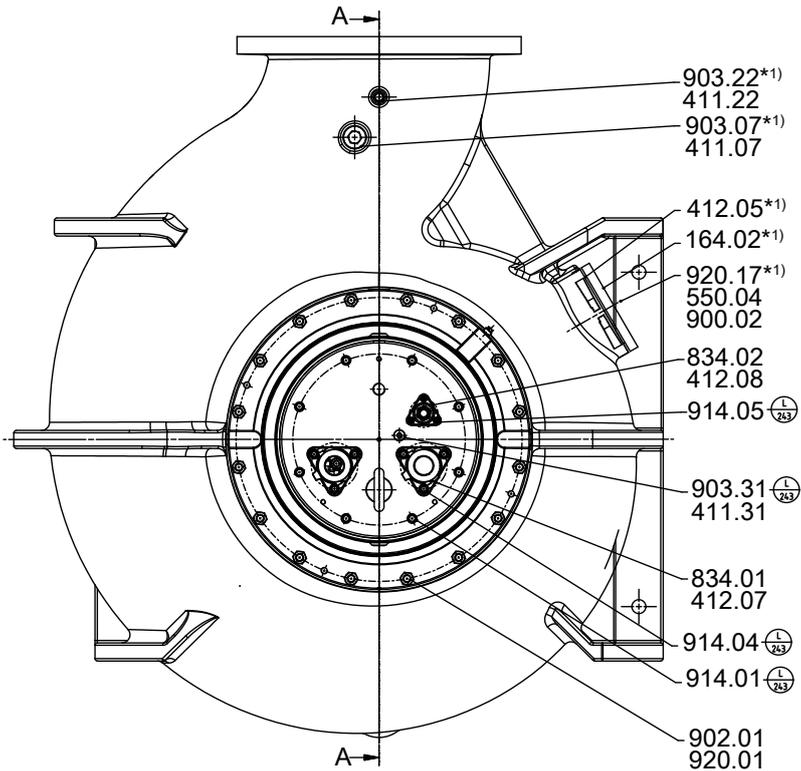


Fig. 79: Top view

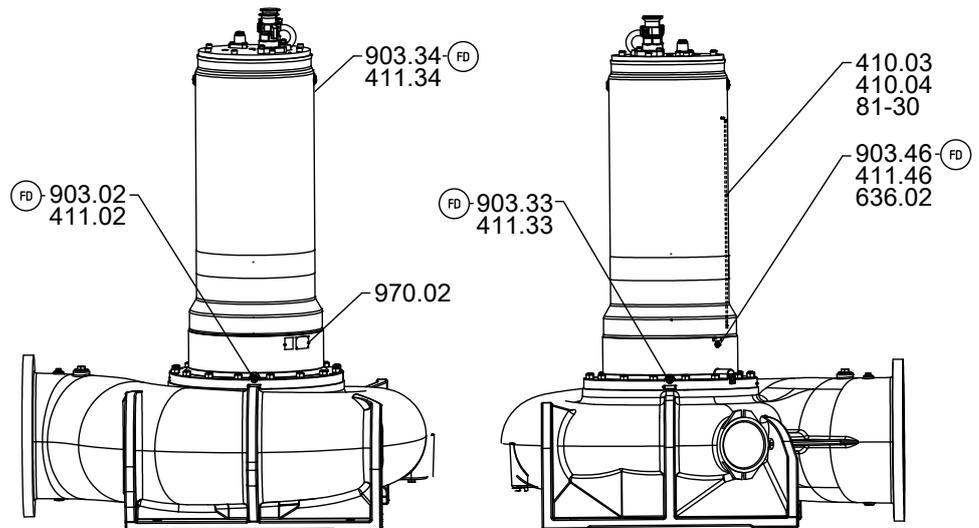


Fig. 80: Side views

\*: For dry installation only

\*1): If fitted

\*2): Optional

Table 54: Key to the symbols

Symbol	Key
	Always secure screwed connections marked with this symbol with <b>Loctite 243</b> .
	Always apply a <b>liquid sealant</b> (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

**Table 55:** List of components

Part No.	Description	Part No.	Description
23-2	Auxiliary impeller	502	Casing wear ring
66-2	Cooling jacket	503	Impeller wear ring
69-6.01	Temperature sensor	512.02	Wear ring
80-1	Motor unit	520.01	Sleeve
81-18.03	Cable terminal	525.04	Spacer sleeve
81-30	Guide rail	531	Locking sleeve
101	Pump casing	550.03/.04/.87	Disc
163	Discharge cover	636.02	Lubricating nipple
164.02	Inspection cover	647	Grease regulator
165	Cooling chamber cover	723	Flange
230	Impeller	812	Motor housing cover
260.01	Impeller hub cap	818	Rotor
320	Rolling element bearing	834.01/.02	Cable gland
322	Radial roller bearing	900.02/.04	Bolt/screw
330	Bearing bracket	901.20/.87	Hexagon head bolt
350	Bearing housing	902.01	Stud
360	Bearing cover	903.01/.02/.07/.22/.31/.33/.34/.46	Screw plug
410.03/.04	Profile seal	914.01/.02/.04/.05/.08/.23	Hexagon socket head cap screw
411.01/.02/.07/.22/.31/.33/.34/.46	Joint ring	920.01/.17	Nut
412.01/.02/.03/.04/.05/.06/.07/.08/.15/.17/.45/.46	O-ring	931.02	Lock washer
421.01/.02/.03	Lip seal	932.01/.02/.03/.13/.20/.37	Circlip
433.01/.02	Mechanical seal	940.01	Key
500.04/.05	Ring	970.02	Label/plate

9.1.2 Pump sets without cooling system (installation types S and P)

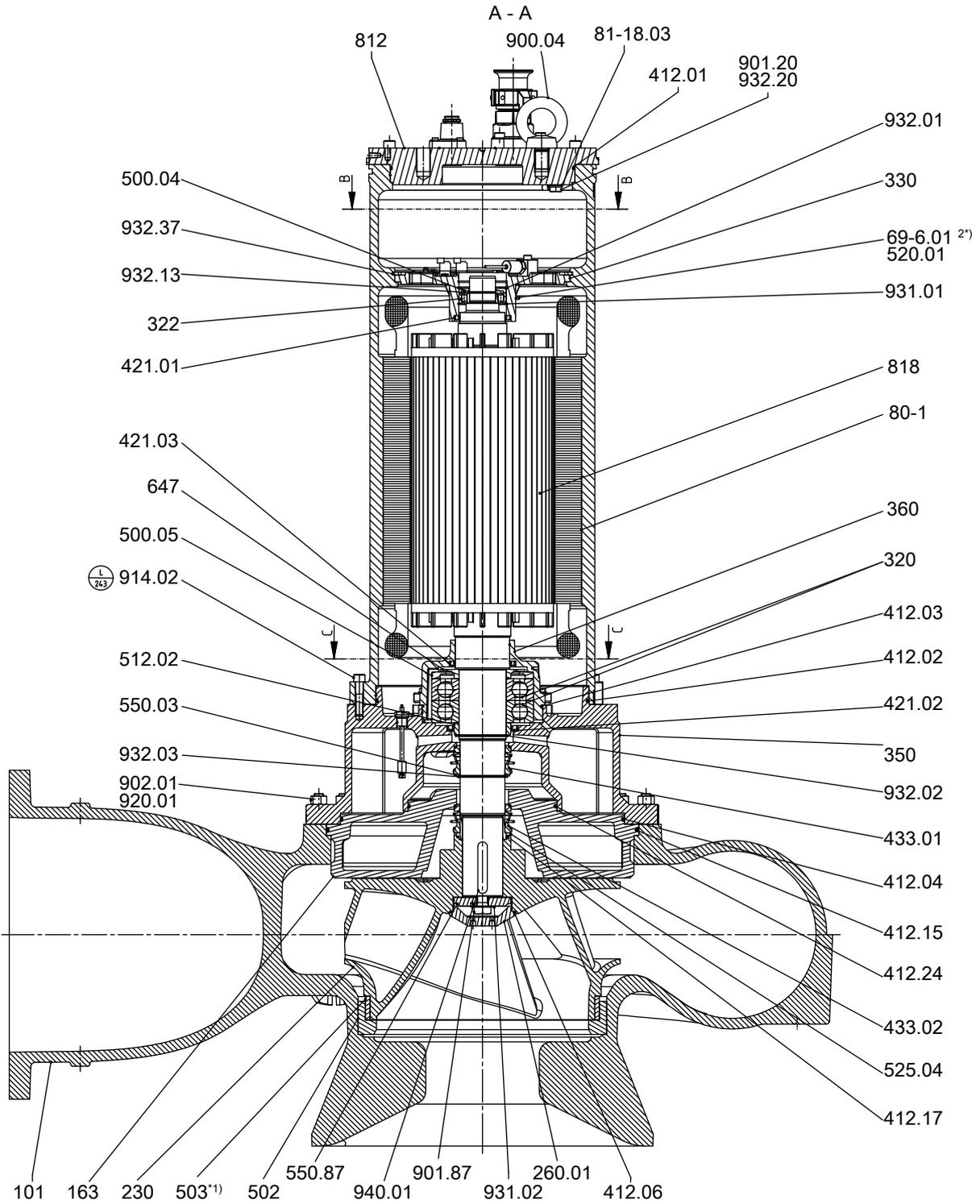


Fig. 81: General assembly drawing

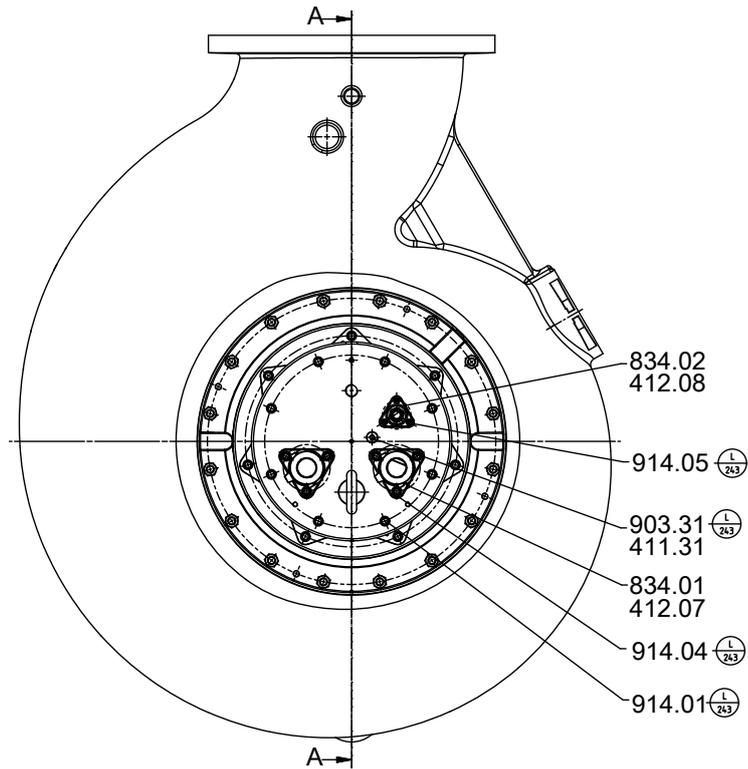


Fig. 82: Top view

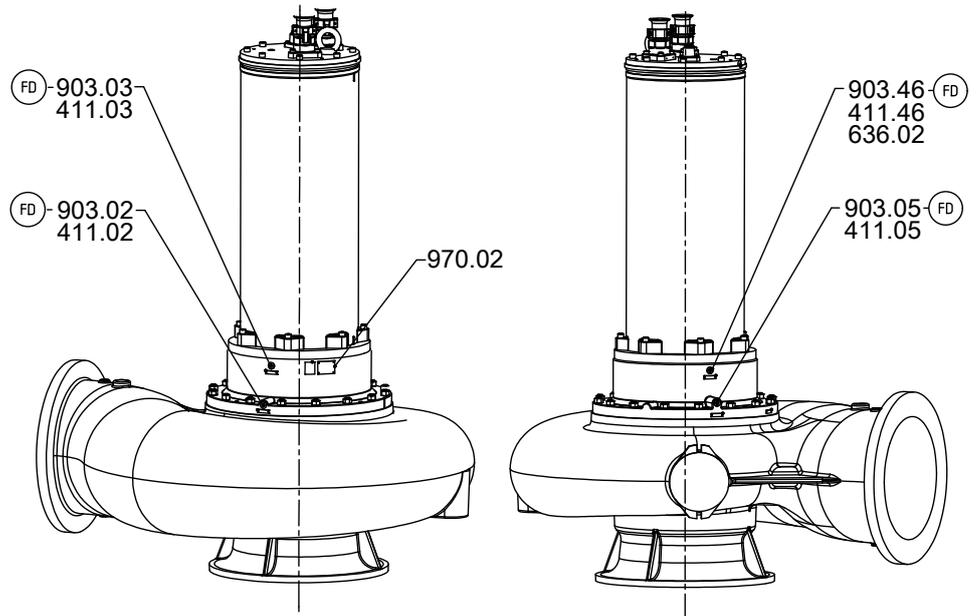


Fig. 83: Side view

\*1) If fitted (⇒ Section 9.5, Page 143)

\*2) Optional

Table 56: Key to the symbols

Symbol	Key
	Always secure screwed connections marked with this symbol with <b>Loctite 243</b> .
	Always apply a <b>liquid sealant</b> (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

**Table 57:** List of components

Part No.	Description	Part No.	Description
69-6.01	Temperature sensor	512.02	Wear ring
80-1	Motor unit	520.01	Sleeve
81-18.03	Cable terminal	525.04	Spacer sleeve
101	Pump casing	550.03/.87	Disc
163	Discharge cover	636.02	Lubricating nipple
230	Impeller	647	Grease regulator
260.01	Impeller hub cap	812	Motor housing cover
320	Rolling element bearing	818	Rotor
322	Radial roller bearing	834.01/.02	Cable gland
330	Bearing bracket	900.04	Bolt/screw
350	Bearing housing	901.20/.87	Hexagon head bolt
360	Bearing cover	902.01	Stud
411.02/.03/.05/.31/.46	Joint ring	903.02/.03/.05/.31/.46	Screw plug
412.01/.02/.03/.04/.06/.07/.08/.15/.17/.24	O-ring	914.01/.02/.04/.05	Hexagon socket head cap screw
421.01/.02/.03	Lip seal	920.01	Nut
433.01/.02	Mechanical seal	931.01/.02	Lock washer
500.04/.05	Ring	932.01/.02/.03/.13/.20/.37	Circlip
502	Casing wear ring	940.01	Key
503	Impeller wear ring	970.02	Label/plate

## 9.2 Detailed views

### 9.2.1 Sensors and terminals - pump set with cooling system

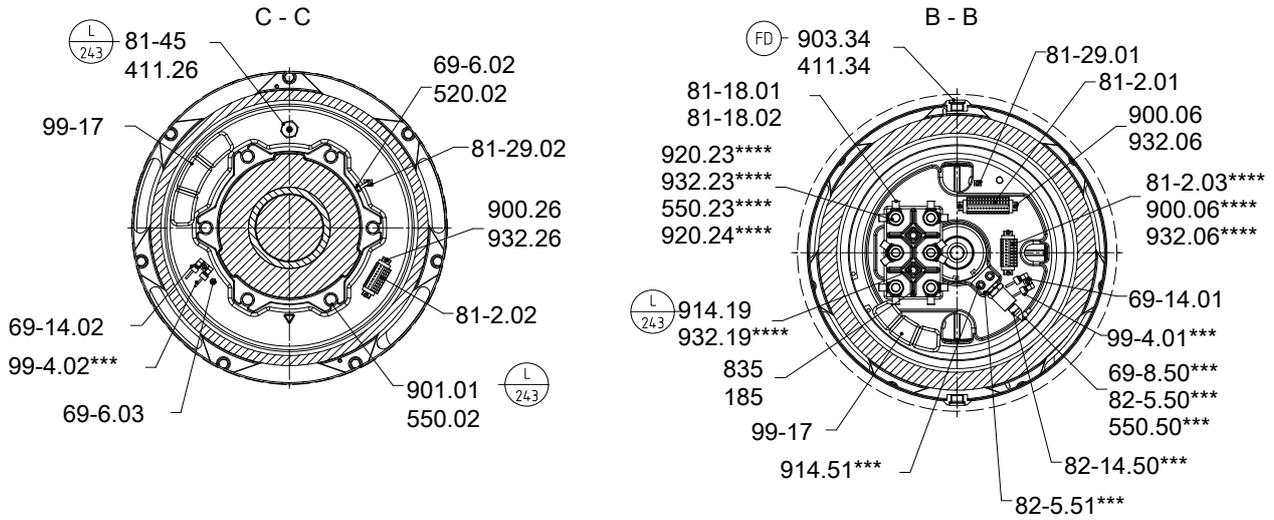


Fig. 84: Sensors and terminals – pump set with cooling system

\*\*\*: Pump sets with vibration monitoring only

\*\*\*\*: Specific sizes only

Table 58: Key to the symbols

Symbol	Key
	Always secure screwed connections marked with this symbol with <b>Loctite 243</b> .

Table 59: List of components

Part No.	Description	Part No.	Description
69-14.01/.02	Leakage sensor	185	Plate
69-6.02/.03	Temperature sensor	411.26/.34	Joint ring
69-8.50	Measurement transmitter	520.02	Sleeve
81-18.01/.02	Cable terminal	550.02/.23/.50	Disc
81-2.01/.02/.03	Plug	835	Terminal board
81-29.01/.02	Terminal	900.06/.26	Bolt/screw
81-45	Float switch	901.01	Hexagon head bolt
82-14.50	Cable with plug	903.34	Screw plug
82-5.50/.51	Adapter	914.19/.51	Hexagon socket head cap screw
99-17	Desiccant	920.23/.24	Nut
99-4.01/.02	Conversion kit	932.06/.19/.23/.26	Circlip

9.2.2 Sensors and terminals - pump set without cooling system

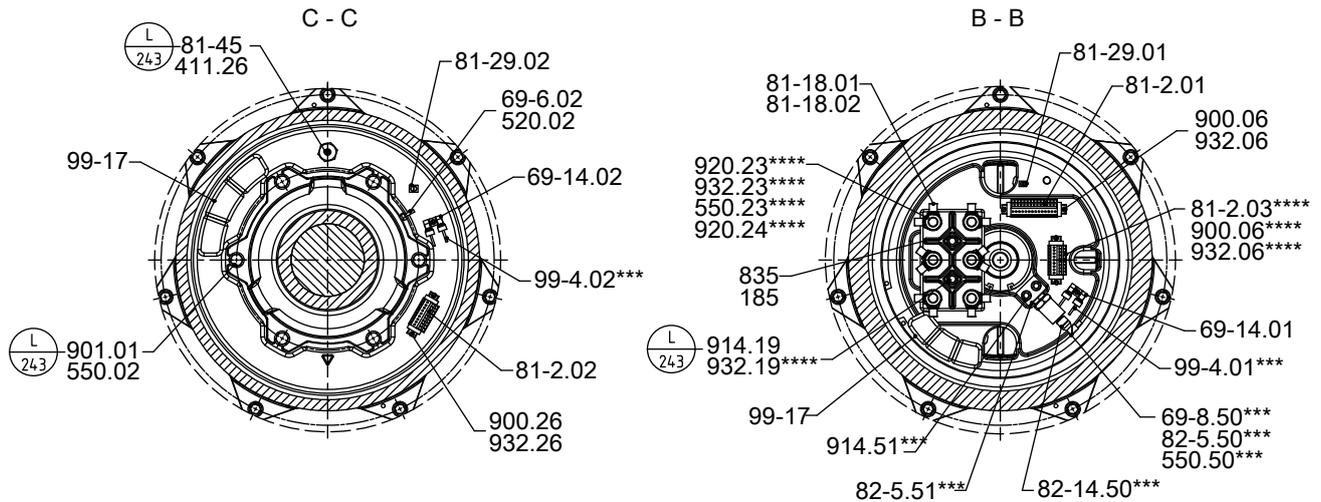


Fig. 85: Sensors and terminals – pump set without cooling system

\*\*\*: Variants with vibration monitoring only

\*\*\*\*: Specific sizes only

Table 60: Key to the symbols

Symbol	Key
	Always secure screwed connections marked with this symbol with <b>Loctite 243</b> .

Table 61: List of components

Part No.	Description	Part No.	Description
69-14.01/.02	Leakage sensor	185	Plate
69-6.02	Temperature sensor	411.26	Joint ring
69-8.50	Measurement transmitter	520.02	Sleeve
81-18.01/.02	Cable terminal	550.02/.23/.50	Disc
81-2.01/.02/.03	Plug	835	Terminal board
81-29.01/.02	Terminal	900.06/.26	Bolt/screw
81-45	Float switch	901.01	Hexagon head bolt
82-14.50	Cable with plug	914.19/.51	Hexagon socket head cap screw
82-5.50/.51	Adapter	920.23/.24	Nut
99-17	Desiccant	932.06/.19/.23/.26	Circlip
99-4.01/.02	Conversion kit		

9.2.3 Bearings - pump set with cooling system

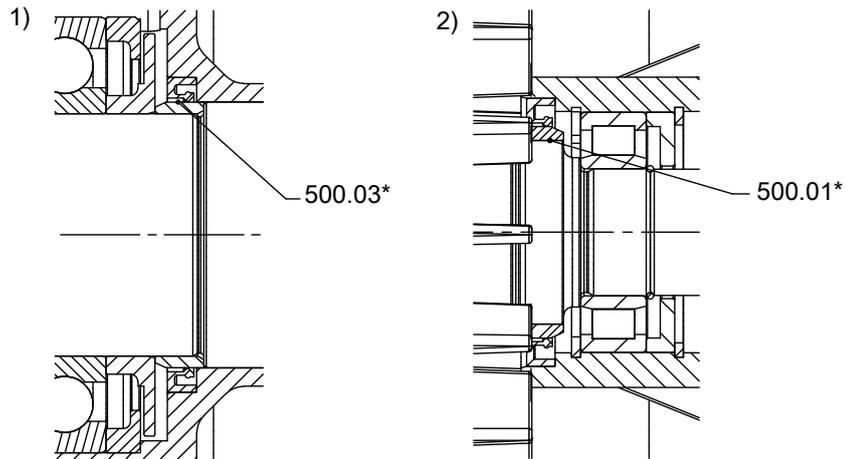


Fig. 86: Bearings - pump set with cooling system

1)	Motors: 65 4, 80 4, 50 6, 60 6, 35 8, 50 8
2)	Motors: 65 4, 80 4, 95 4, 110 4, 50 6, 60 6, 80 6, 100 6, 35 8, 50 8, 75 8

\*: Additional

Table 62: List of components

Part No.	Description	Part No.	Description
500.01/03	Ring		

9.2.4 Bearings - pump set without cooling system

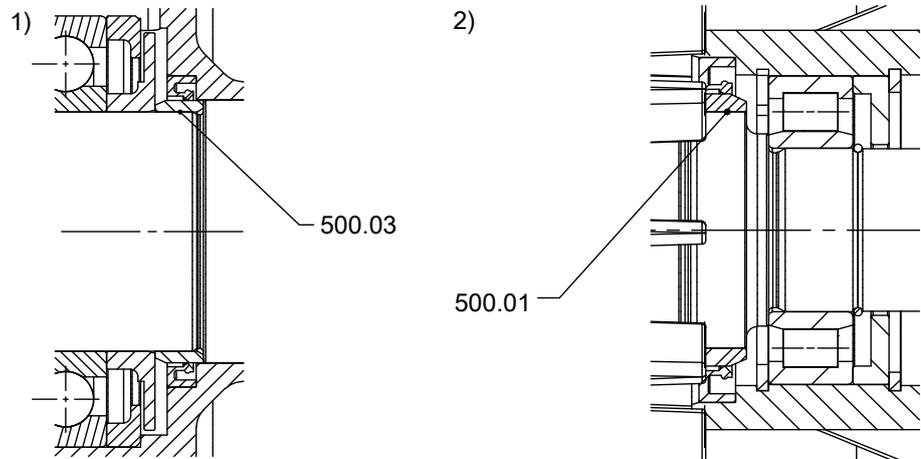


Fig. 87: Bearings - pump set without cooling system

1	Motors: 35 4...80 4, 32 6...60 6, 26 8...50 8
2	Motors: 35 4...110 4, 32 6...100 6, 26 8...75 8

\*: Additional

Table 63: List of components

Part No.	Description	Part No.	Description
500.01/03	Ring		

2553.8049/04-EN-US

9.2.5 Bearing housing made of stainless steel

..NC..motors  
and hydraulic systems  
155 4 ...-K  
155 4 ...-D

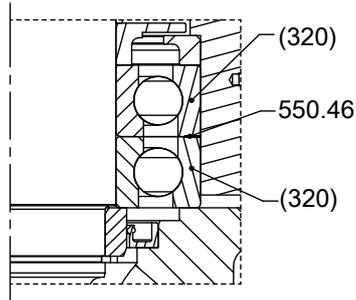


Fig. 88: Bearing housing made of stainless steel

Table 64: List of components

Part No.	Description	Part No.	Description
320	Rolling element bearing	550.46	Disc

9.2.6 Bearing bracket fastening

Motors:  
35 4...175 4  
32 6...165 6  
26 8...130 8  
40 10...90 10

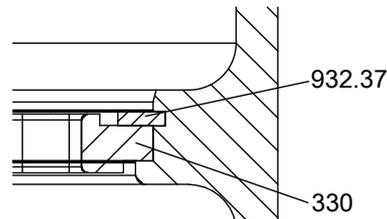


Fig. 89: Bearing bracket fastening

Table 65: List of components

Part No.	Description	Part No.	Description
330	Bearing bracket	932.37	Circlip

Motors:  
200 4...350 4  
190 6...480 6  
150 8...400 8  
110 10...350 10  
105 12...300 12

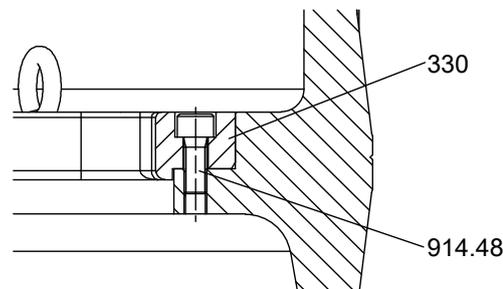


Fig. 90: Bearing bracket fastening

Table 66: List of components

Part No.	Description	Part No.	Description
330	Bearing bracket	914.48	Hexagon socket head cap screw

9.2.7 Special feature of hydraulic system - pump set with cooling system

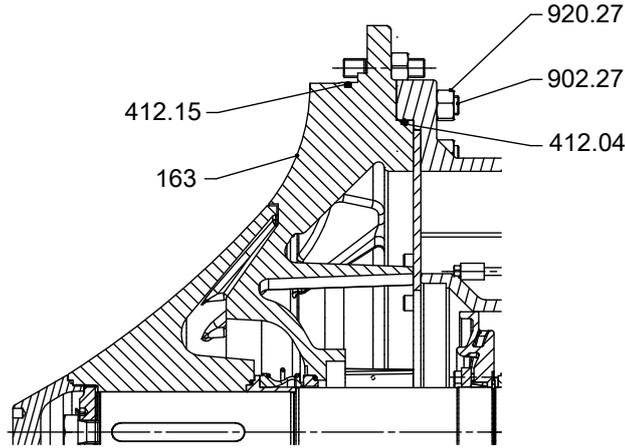


Fig. 91: Special feature of hydraulic system - pump set with cooling system

Table 67: List of components

Part No.	Description	Part No.	Description
163	Discharge cover	902.27	Stud
412.04/.15	O-ring	920.27	Nut

9.2.8 Special feature of hydraulic system - pump set without cooling system

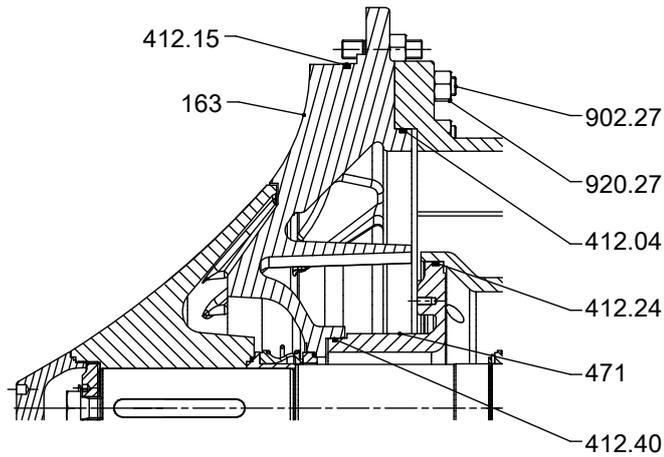
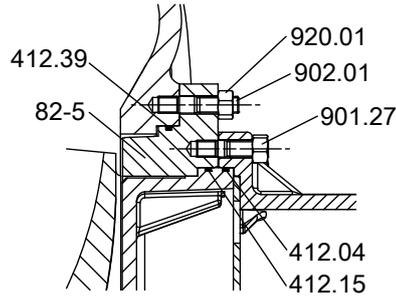


Fig. 92: Special feature of hydraulic system - pump set without cooling system

Table 68: List of components

Part No.	Description	Part No.	Description
163	Discharge cover	902.27	Stud
412.04/.15/.24/.40	O-ring	920.27	Nut
471	Seal cover		

**9.2.9 Special feature of hydraulic system - K 350-710, K 350-713, K 401-710, K 401-713, K 501-710, K 600-710**



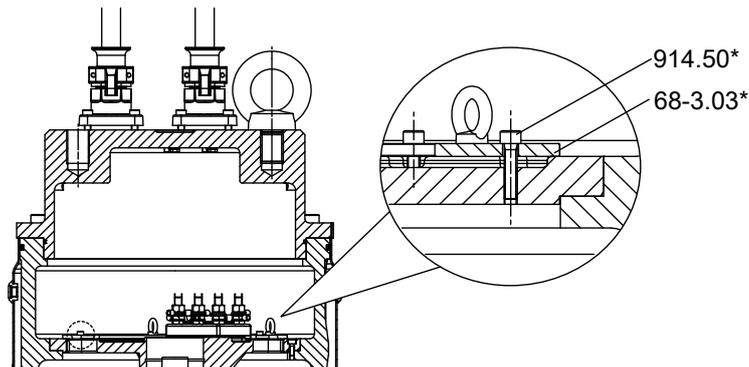
**Fig. 93:** Special feature of hydraulic system - K 350-710, K 350-713, K 401-710, K 401-713, K 501-710, K 600-710

**Table 69:** List of components

Part No.	Description	Part No.	Description
82-5	Adapter	902.01	Stud
412.04/.15/.39	O-ring	920.01	Nut
901.27	Hexagon head bolt		

**9.2.10 Connection space of K35 motors**

320 6...480 6  
 260 8...400 8  
 230 10...350 10  
 195 12...300 12



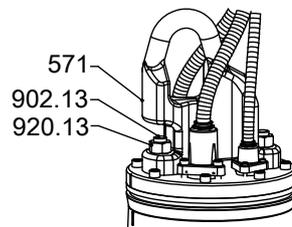
**Fig. 94:** Connection space of K35 motors

\*: Explosion-proof versions only

**Table 70:** List of components

Part No.	Description	Part No.	Description
68-3.03	Cover plate	914.50	Hexagon socket head cap screw

**9.2.11 Bail**



**Fig. 95:** Bail

**Table 71:** List of components

Part No.	Description	Part No.	Description
571	Bail	920.13	Nut
902.13	Stud		

9.3 Wiring diagrams

9.3.1 Wiring diagram for power cable

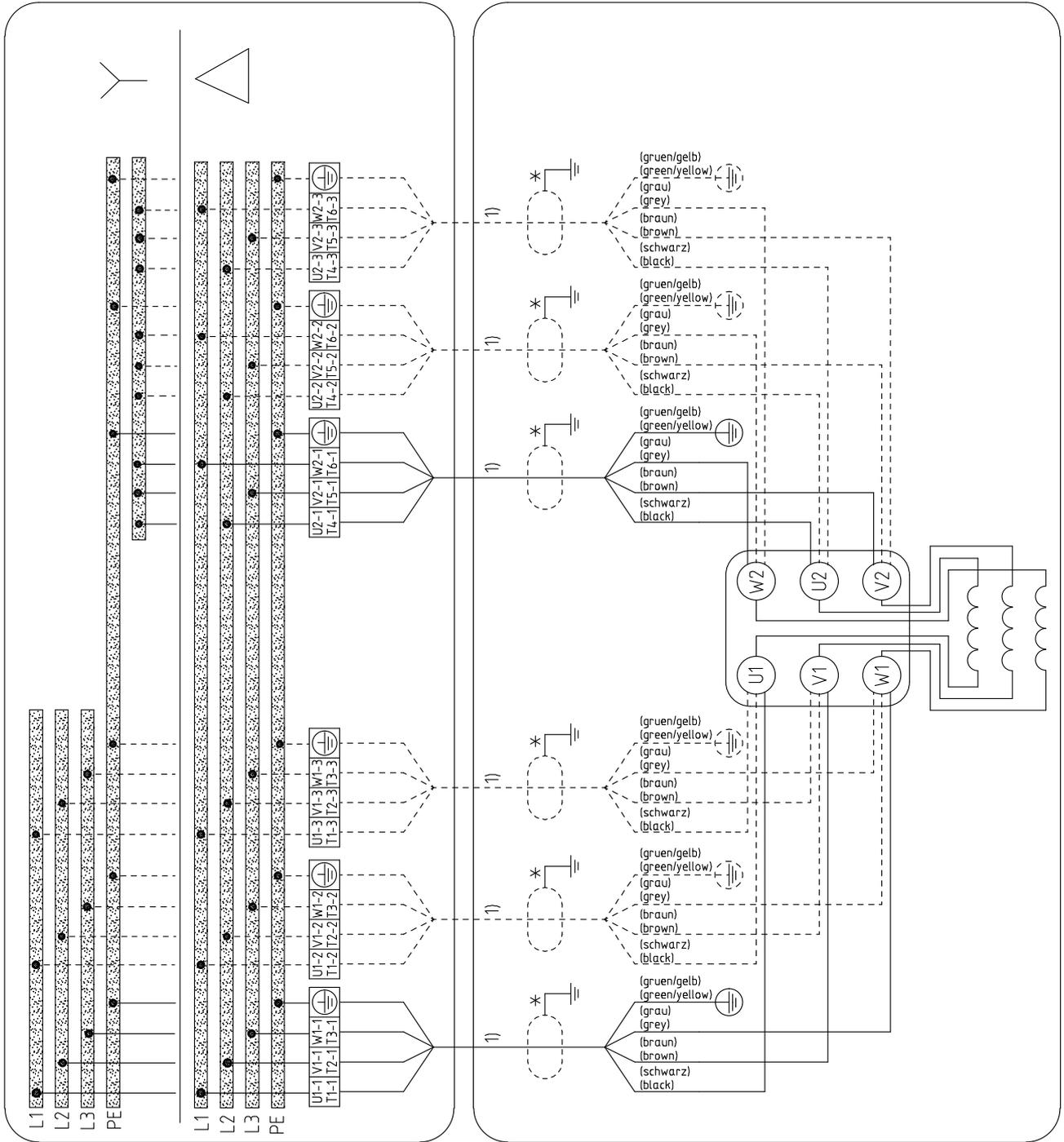


Fig. 96: Wiring diagram for power cable

\* Shielded cable option

<sup>1)</sup> Up to 3 parallel cable pairs possible

9.3.2 Wiring diagrams for the sensors

9.3.2.1 Pump sets with cooling system, installation types D and K

Standard pump set,  
installation types D and K

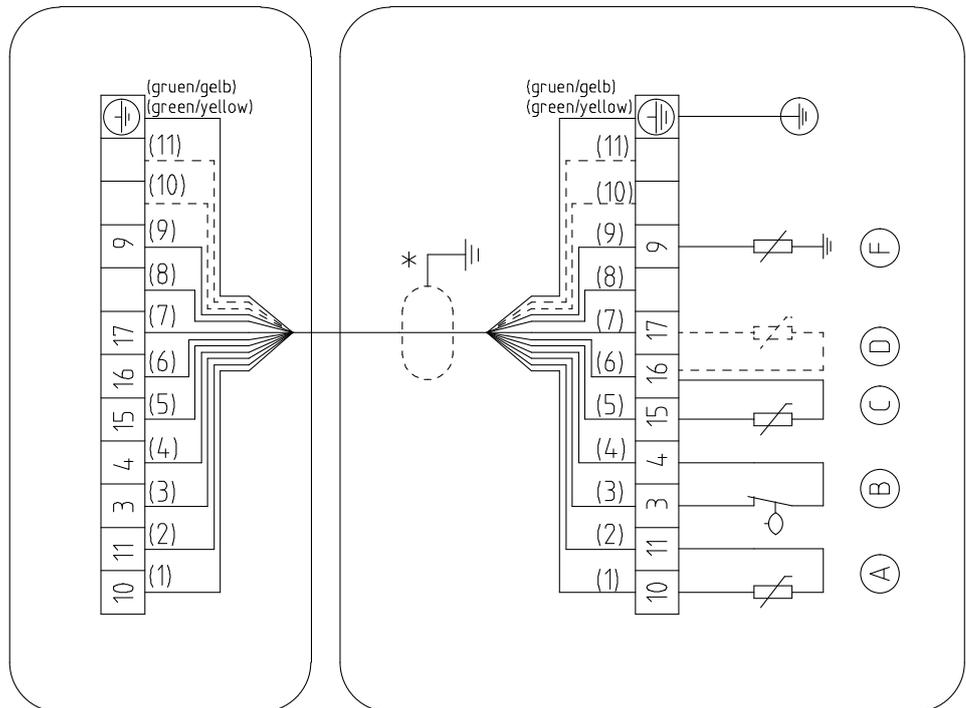


Fig. 97: Sensor wiring diagram for standard pump sets, installation types D and K

*	Shielded cable option
Ⓐ	Motor temperature (PTC)
Ⓑ	Mechanical seal leakage
Ⓒ	Bearing temperature (lower bearings)
Ⓓ	Bearing temperature (upper bearing, optional)
Ⓕ	Leakage inside the motor

Pump sets with additional monitoring by vibration sensor, installation types D and K

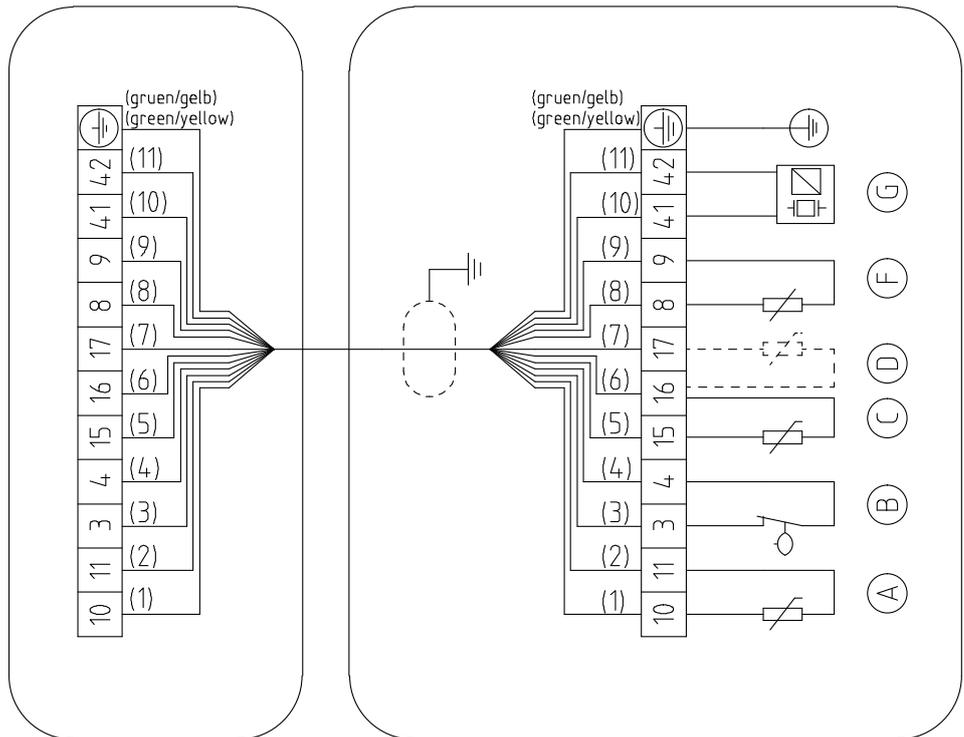


Fig. 98: Sensor wiring diagram for pump sets with additional monitoring by vibration sensor, installation types D and K

Ⓐ	Motor temperature (PTC)
Ⓑ	Mechanical seal leakage
Ⓒ	Bearing temperature (lower bearings)
Ⓓ	Bearing temperature (upper bearing, optional)
Ⓔ	Leakage inside the motor
ⓐ	Vibration sensor

Pump sets with additional Pt100 motor temperature monitoring, installation types D and K

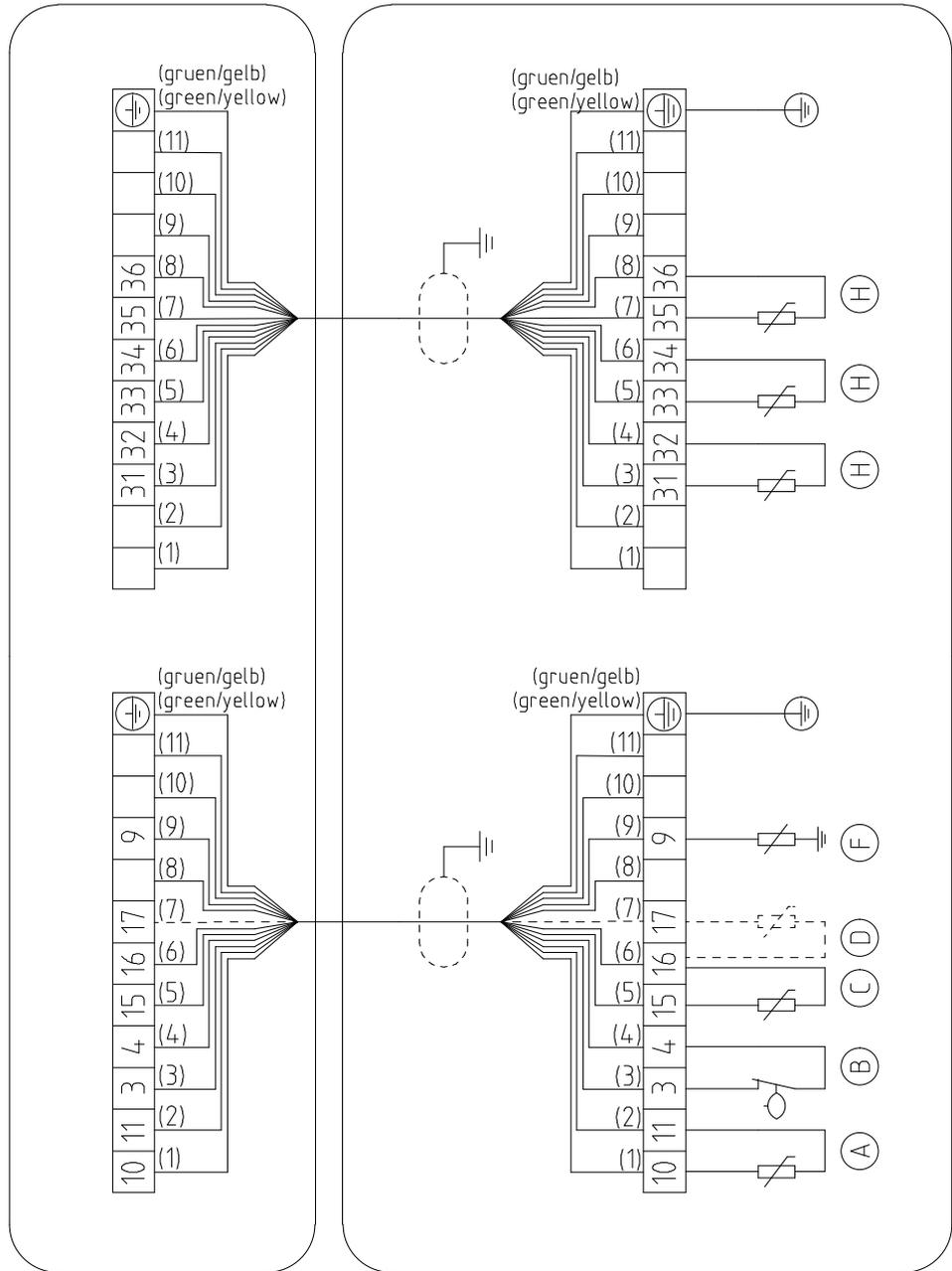
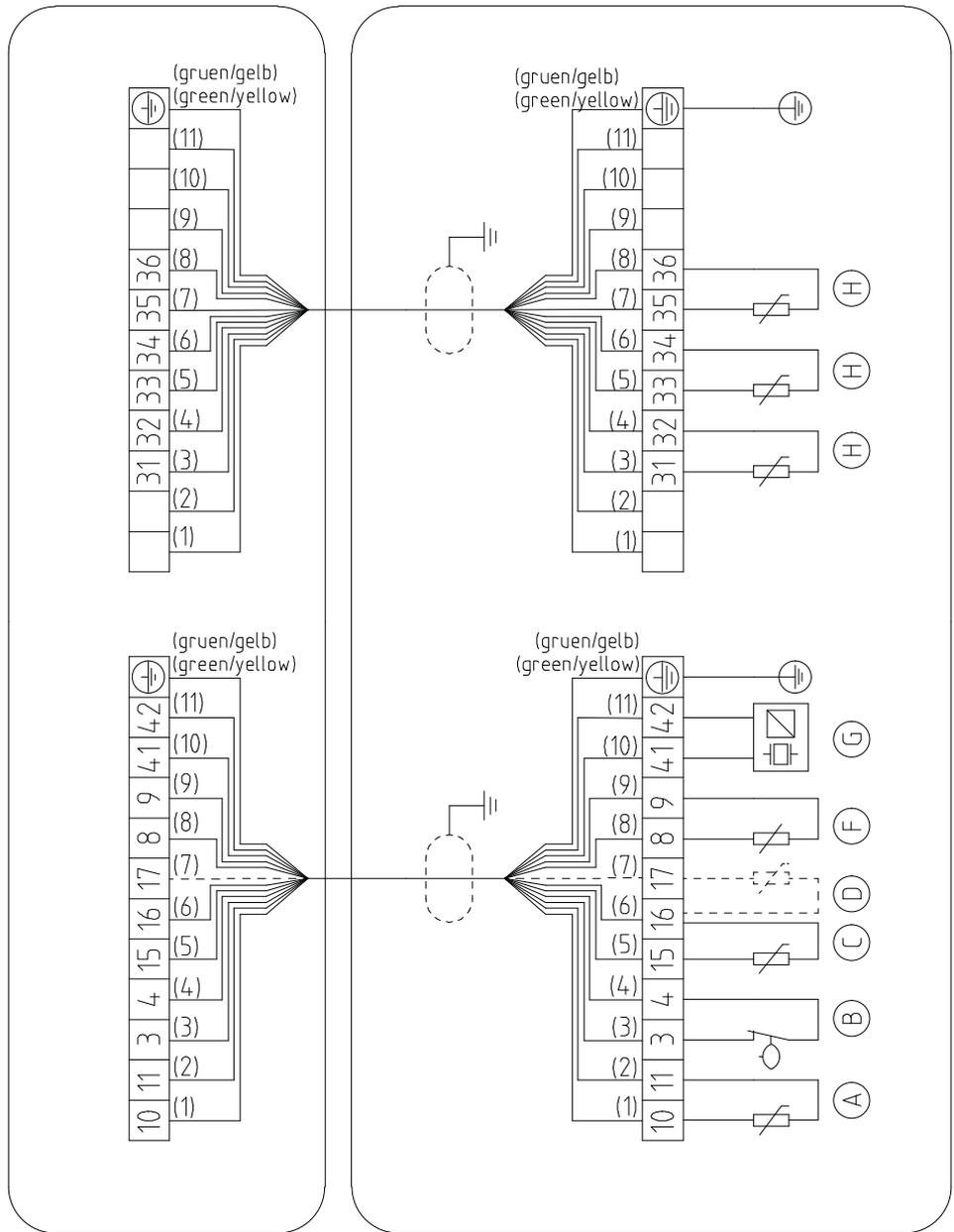


Fig. 99: Sensor wiring diagram for pump sets with additional Pt100 motor temperature monitoring, installation types D and K

(A)	Motor temperature (PTC)
(B)	Mechanical seal leakage
(C)	Bearing temperature (lower bearings)
(D)	Bearing temperature (upper bearing, optional)
(E)	Leakage inside the motor
(H)	Motor temperature (Pt100)

Pump sets with additional monitoring equipment Pt100 for the motor temperature and vibration sensor, installation types D and K



**Fig. 100:** Sensor wiring diagram for pump sets with additional monitoring equipment Pt100 for the motor temperature and vibration sensor, installation types D and K

Ⓐ	Motor temperature (PTC)
Ⓑ	Mechanical seal leakage
Ⓒ	Bearing temperature (lower bearings)
Ⓓ	Bearing temperature (upper bearing, optional)
Ⓕ	Leakage inside the motor
Ⓖ	Vibration sensor
Ⓗ	Motor temperature (Pt100)

9.3.2.2 Pump sets without cooling system, installation types P and S

Standard pump sets,  
installation types P and S

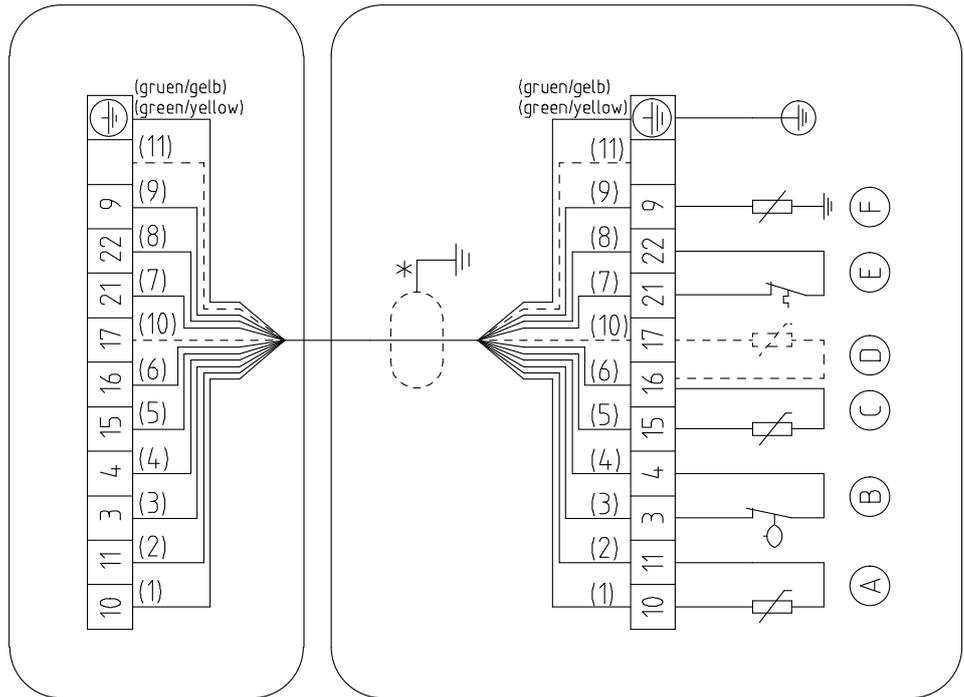
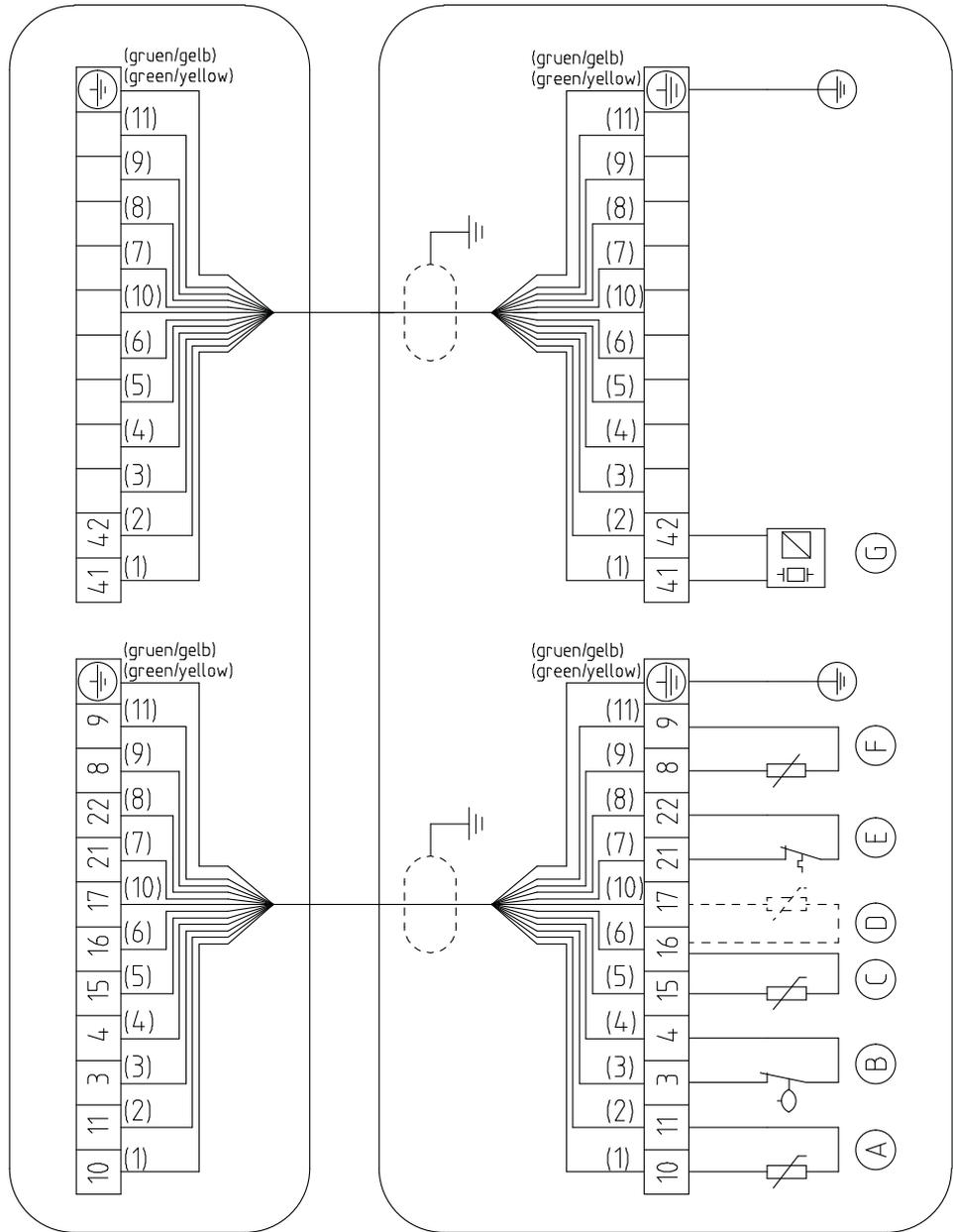


Fig. 101: Sensor wiring diagram for standard pump sets, installation types P and S

*	Shielded cable option
Ⓐ	Motor temperature (PTC thermistor)
Ⓑ	Mechanical seal leakage
Ⓒ	Bearing temperature (lower bearings)
Ⓓ	Bearing temperature (upper bearings, optional)
Ⓔ	Motor temperature
Ⓕ	Leakage inside the motor

Pump sets with additional monitoring equipment vibration sensor, installation types P and S



**Fig. 102:** Sensor wiring diagram for pump sets with additional monitoring equipment vibration sensor, installation types P and S

Ⓐ	Motor temperature (PTC thermistor)
Ⓑ	Mechanical seal leakage
Ⓒ	Bearing temperature (lower bearings)
Ⓓ	Bearing temperature (upper bearings, optional)
Ⓔ	Motor temperature
Ⓕ	Leakage inside the motor
Ⓖ	Vibration sensor

Pump sets with additional monitoring equipment  
Pt100 resistance thermometer for the motor temperature, installation types P and S

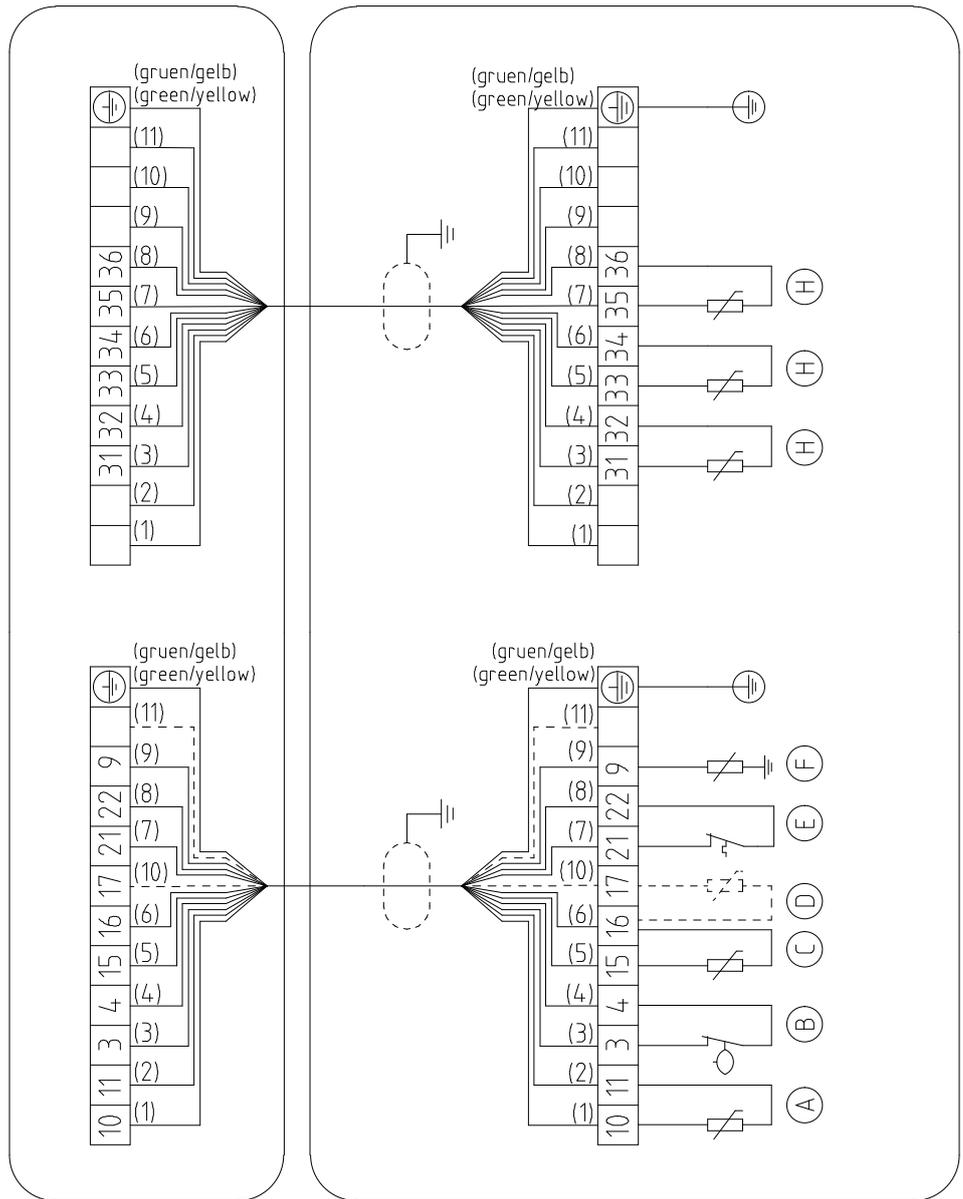
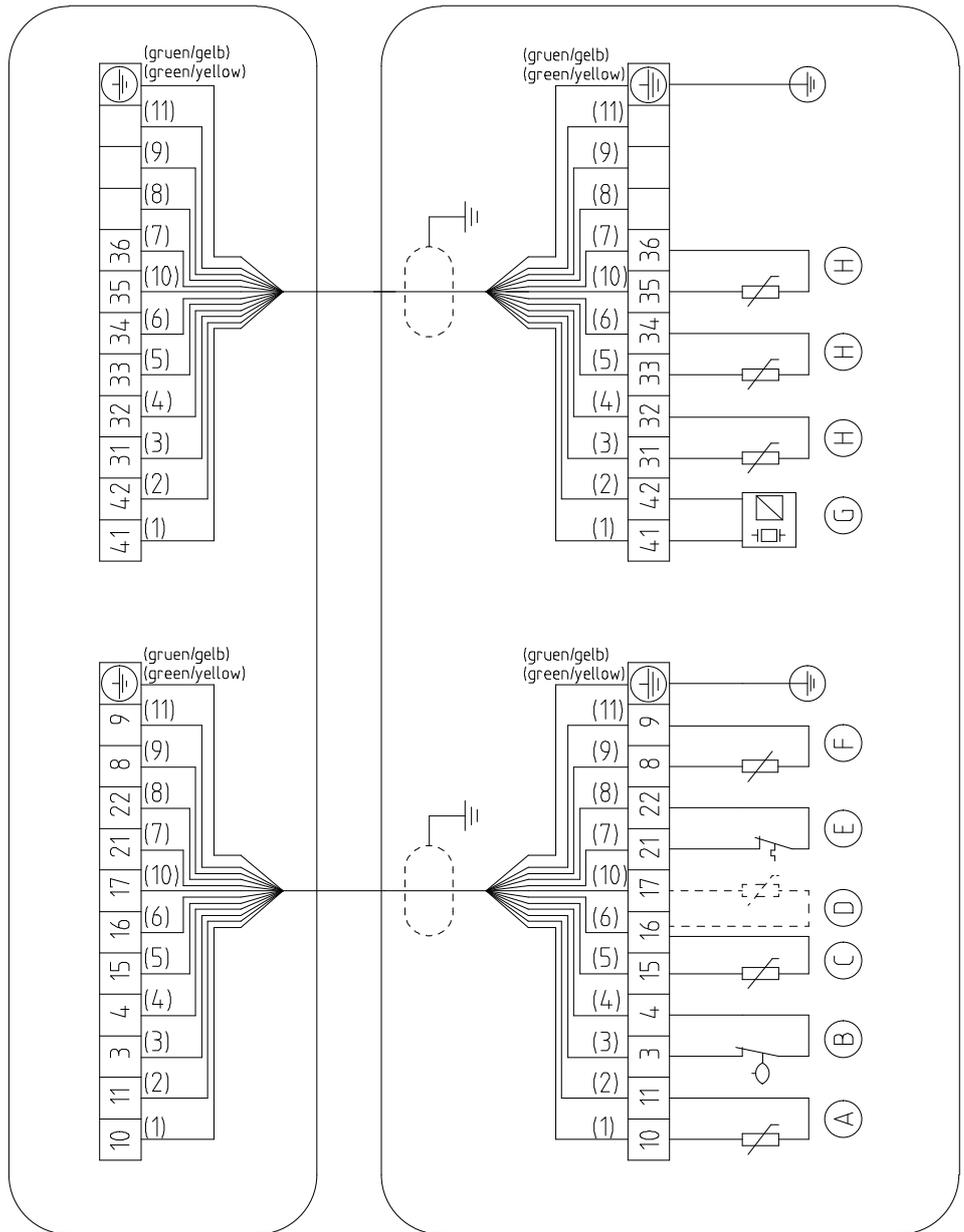


Fig. 103: Sensor wiring diagram for pump sets with additional monitoring equipment Pt100 resistance thermometer for the motor temperature, installation types P and S

Ⓐ	Motor temperature (PTC thermistor)
Ⓑ	Mechanical seal leakage
Ⓒ	Bearing temperature (lower bearings)
Ⓓ	Bearing temperature (upper bearings, optional)
Ⓔ	Motor temperature
Ⓕ	Leakage inside the motor
Ⓖ	Motor temperature (Pt100 resistance thermometer)

Pump sets with additional monitoring equipment  
Pt100 resistance thermometer for the motor temperature and vibration sensor, installation types P and S



**Fig. 104:** Sensor wiring diagram for pump sets with additional monitoring equipment Pt100 resistance thermometer for the motor temperature and vibration sensor, installation types P and S

Ⓐ	Motor temperature (PTC thermistor)
Ⓑ	Mechanical seal leakage
Ⓒ	Bearing temperature (lower bearings)
Ⓓ	Bearing temperature (upper bearings, optional)
Ⓔ	Motor temperature
Ⓕ	Leakage inside the motor
Ⓖ	Vibration sensor
Ⓗ	Motor temperature (Pt100 resistance thermometer)

9.4 Flamepaths on explosion-proof motors

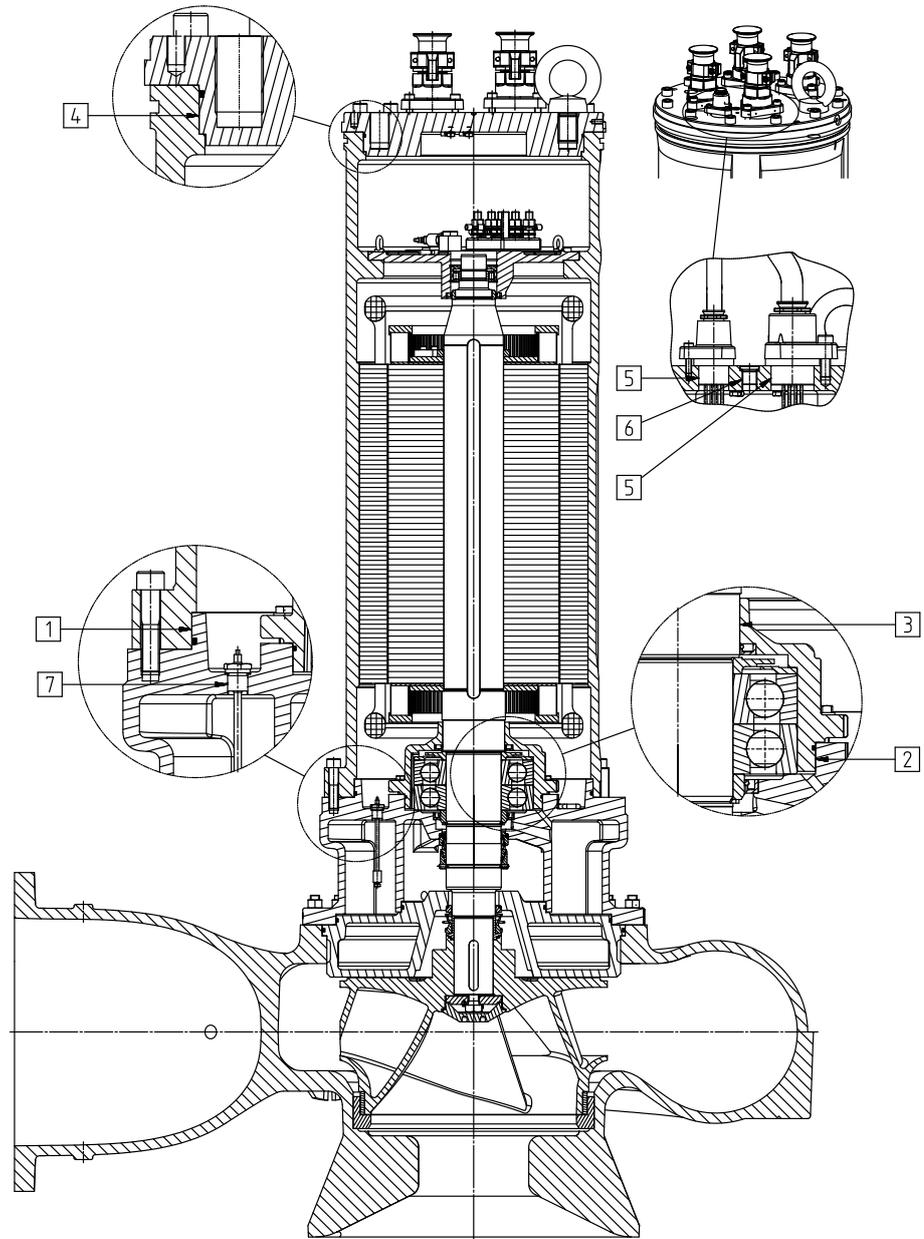
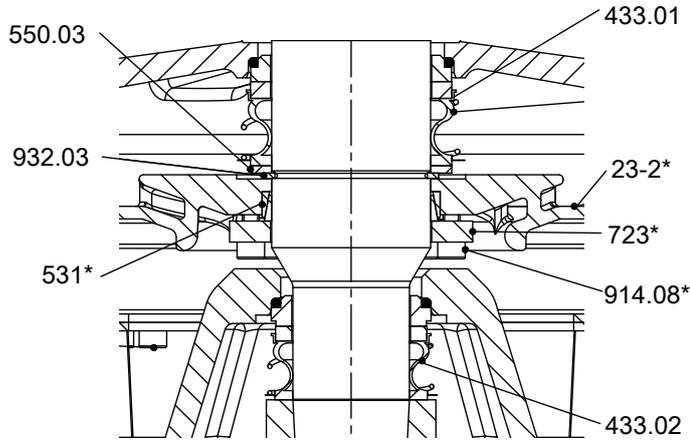


Fig. 105: Flamepaths on explosion-proof motors

1, 2, 3, 4, 5, 6, 7	Flamepaths
---------------------	------------

### 9.5 Sectional drawings of the mechanical seal

Motors: 35 4...110 4, 32 6...100 6, 26 8...75 8



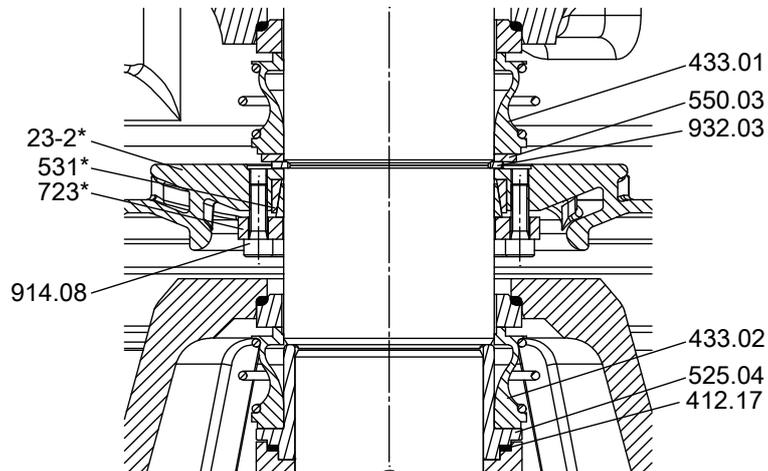
**Fig. 106:** Mechanical seal for motors: 35 4...110 4, 32 6...100 6, 26 8...75 8

\*: Only for pump sets with cooling system

**Table 72:** List of components

Part No.	Description	Part No.	Description
23-2	Auxiliary impeller	723	Flange
433.01/02	Mechanical seal	914.08	Hexagon socket head cap screw
531	Locking sleeve	932.03	Circlip
550.03	Disc		

Motors: 130 4...175 4, 120 6...165 6, 90 8...130 8, 40 10...90 10



**Fig. 107:** Mechanical seal for motors: 130 4...175 4, 120 6...165 6, 90 8...130 8, 40 10...90 10

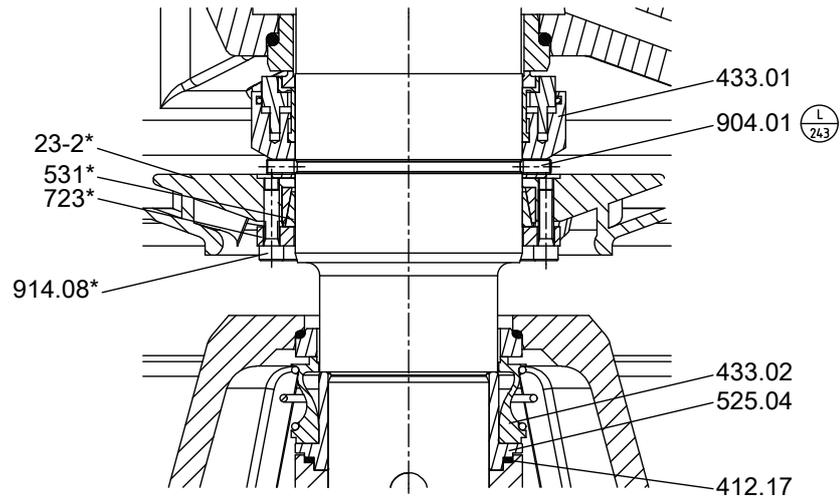
\*: Only for pump sets with cooling system

**Table 73:** List of components

Part No.	Description	Part No.	Description
23-2	Auxiliary impeller	550.03	Disc
412.17	O-ring	723	Flange
433.01/02	Mechanical seal	914.08	Hexagon socket head cap screw
525.04	Spacer sleeve	932.03	Circlip
531	Locking sleeve		

2553.8049/04-EN-US

Motors: 200 4...350 4, 190 6...206 6, 150 8...220 8, 110 10...190 10, 105 12...165 12



**Fig. 108:** Mechanical seal for motors: 200 4...350 4, 190 6...206 6, 150 8...220 8, 110 10...190 10, 105 12...165 12

\*: Only for pump sets with cooling system

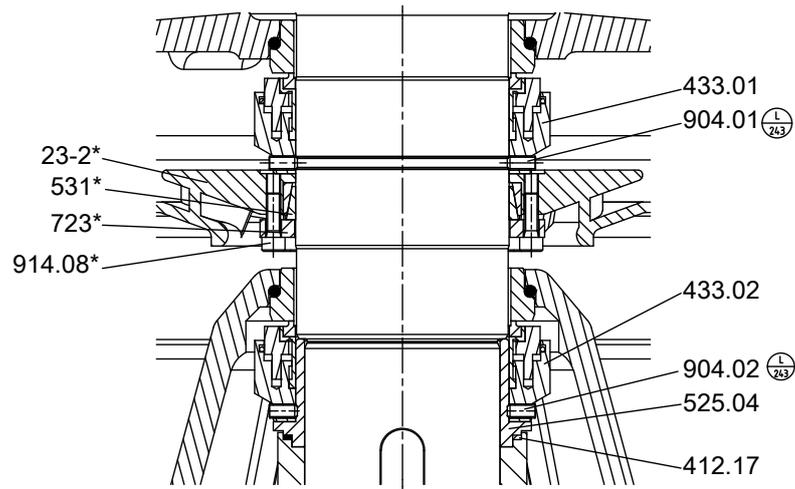
**Table 74:** Key to the symbols

Symbol	Key
	Always secure screwed connections marked with this symbol with <b>Loctite 243</b> .

**Table 75:** List of components

Part No.	Description	Part No.	Description
23-2	Auxiliary impeller	531	Locking sleeve
412.17	O-ring	723	Flange
433.01/02	Mechanical seal	904.01	Grub screw
525.04	Spacer sleeve	914.08	Hexagon socket head cap screw

Motors: 320 6...480 6, 260 8...400 8, 230 10...350 10, 195 12...300 12



**Fig. 109:** Mechanical seal for motors: 320 6...480 6, 260 8...400 8, 230 10...350 10, 195 12...300 12

\*: Only for pump sets with cooling system

**Table 76:** Key to the symbols

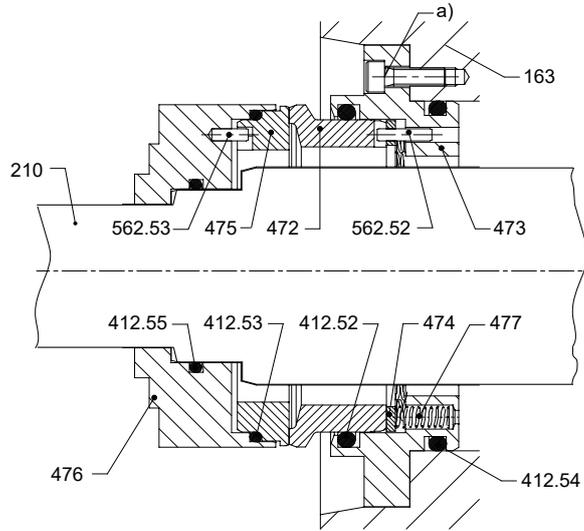
Symbol	Key
	Always secure screwed connections marked with this symbol with <b>Loctite 243</b> .

**Table 77:** List of components

Part No.	Description	Part No.	Description
23-2	Auxiliary impeller	531	Locking sleeve
412.17	O-ring	723	Flange
433.01/.02	Mechanical seal	904.01/.02	Grub screw
525.04	Spacer sleeve	914.08	Hexagon socket head cap screw

**9.5.1 Pump-end mechanical seal (4STC, version with clamped mating ring carrier and secured primary ring carrier)**

Motors: 320 6...480 6, 260 8...400 8, 230 10...350 10, 195 12...300 12<sup>24)</sup>



**Fig. 110:** Sectional drawing

a)	Screws ISO 4762-M6
----	--------------------

**Table 78:** List of components

Part No.	Description	Part No.	Description
163	Discharge cover	474	Thrust ring
210	Shaft <sup>25)</sup>	475	Mating ring
412.52/.53/.54/.55	O-ring	476	Mating ring carrier
472	Primary ring	477	Spring for mechanical seal
473	Primary ring carrier	562.52/.53	Parallel pin

<sup>24)</sup> For installation types K and D; without axially secured primary ring carrier

<sup>25)</sup> Illustration not to scale

9.5.2 Drive-end mechanical seal (4STC, version without axially secured primary ring carrier)

Motors: 320 6...480 6, 260 8...400 8, 230 10...350 10, 195 12...300 12

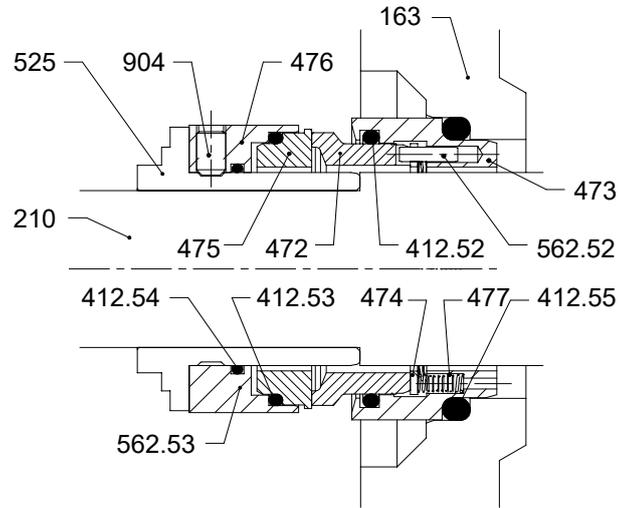


Fig. 111: Sectional drawing

Table 79: List of components

Part No.	Description	Part No.	Description
163	Discharge cover	475	Mating ring
210	Shaft	476	Mating ring carrier
412.52/.53/.54/.55	O-ring	477	Spring for mechanical seal
472	Primary ring	525	Spacer sleeve
473	Primary ring carrier	562.52/.53	Parallel pin
474	Thrust ring	904	Grub screw



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