

Submersible Motor Pump

Amarex KRT

Sizes DN 200 to DN 700; 60 Hz
6 poles: 530 6_N to 850 6_N
8 poles: 460 8_N to 760 8_N
10 poles: 390 10_N to 660 10_N
12 poles: 340 12_N to 560 12_N

Installation/Operating Manual



Mat. No.: 01463269

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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

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 manual

Size	Impeller type	Material variant						
		Gray cast iron				Industrial materials		
		G	G1	G2	GH	H	C1	C2
200-631	K	K	K	-	-	-	-	-
250-630	K	K	K	-	-	-	-	-
250-632	K	K	K	-	-	-	-	-
250-900	K	K	K	-	-	-	-	-
350-632	K	K	K	-	-	-	-	-
350-633	K	K	K	-	-	-	-	-
350-636	K	K	K	-	-	-	-	-
350-710	K	K	K	-	-	-	-	-
350-713	K	K	K	-	-	-	-	-
400-900	K	K	K	-	-	-	-	-
401-710	K	K	K	-	-	-	-	-
401-713	K	K	K	-	-	-	-	-
500-632	K	K	K	-	-	-	-	-
500-634	K	K	K	-	-	-	-	-
500-640	K	K	K	-	-	-	-	-
501-710	K	K	K	-	-	-	-	-
501-900	K	K	K	-	-	-	-	-
600-710	K	K	K	-	-	-	-	-
700-901	K	K	K	-	-	-	-	-
700-902	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 center to maintain the right to claim under warranty.

1.2 Target group

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

1.3 Other applicable documents

Table 2: Overview of other applicable documents

Document	Contents
Data sheet	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

Document	Contents
General assembly drawing ¹⁾	Sectional drawing of the pump set with part numbers
Sub-supplier product literature ¹⁾	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists ¹⁾	Description of spare parts
Supplementary operating manual ¹⁾	E.g. for special accessories

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

1.4 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

1.5 Key to safety symbols/markings

Table 4: Definition of safety symbols/markings

Symbol	Description
	DANGER This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
	WARNING This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
	CAUTION This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	General hazard In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	Electrical hazard In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	Machine damage In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.

1) If agreed to be included in the scope of supply



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.

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

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.

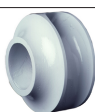
Information attached directly to the product must always be complied with and kept in a perfectly legible condition at all times. This applies to, for example:

- 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 $1.2 \times Q_{opt}$ to minimize the risk of clogging/hardening.
- Avoid duty points for continuous operation at very low speeds and small flow rates ($< 0.7 \times Q_{opt}$).
- Observe the minimum flow rates and maximum flow rates indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- Do not throttle the flow rate on the suction side of the pump 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 this pump for the fluids described below.



Closed multi-channel impeller
(impeller type K/K-max)

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 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 shutting down the pump does not increase potential risk, fit an emergency stop control device in the immediate vicinity of the pump (set) during pump set installation.

2.7 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 52)
- 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 47)

2.8 Unauthorized modes of operation

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

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

2.9 Information for use in Class I, Division 2, Hazardous (Classified) Locations

Only certified pump sets with FM-approved nonincendive submersible motors, with name plates marked accordingly, may be used in Class I, Division 2, Hazardous (Classified) Locations.

Special conditions apply to the operation of nonincendive pump sets:

- The explosion-proof status of the pump set is only assured if the pump set is used in accordance with its designated 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 a nonincendive pump set without temperature monitoring.
- Repairs or modifications of the pump set can affect explosion protection and may, therefore, only be made by the manufacturer or a repair shop certified by FM Approvals.

- Certified repair shops need to be audited by FM Approvals and need to have a copy of drawings as well as other rules and regulations to follow.
- Modifications always require the manufacturer's approval.
- Only original spare parts and accessories authorized by the manufacturer must be used for nonincendive pump sets.

3 Transport/Temporary Storage/Disposal

3.1 Checking the condition upon delivery

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

3.2 Transport

	 DANGER Improper transport Danger to life from falling parts! Damage to the pump set! ▷ Attach any lifting accessories to the attachment point (pump handle) provided. ▷ Use the eyebolts for vertical loads only. For lateral loads the eyebolts must be replaced by permissible lifting tackle for this direction of load. ▷ Never suspend the pump set by its power cable. ▷ Use the supplied lifting chain/rope exclusively to lower the pump set into or pull it out of the pump sump. ▷ Securely attach the lifting rope/chain to the pump and crane. ▷ Use tested, marked and approved lifting accessories only. ▷ Observe the regional transport regulations. ▷ Observe the documentation of the lifting accessory manufacturer. ▷ 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.
	 WARNING Improper placing of pump sets in a vertical/horizontal position Personal injury and damage to property! ▷ Use appropriate means to secure the pump set against tilting or tipping over. ▷ Use two sets of lifting equipment when handling large pump sets if possible (using the attachment point provided on the motor and the discharge nozzle). ▷ Secure power cables against falling down. ▷ Use additional supports for the transport holder to secure it against tilting. ▷ Maintain adequate safety distance during lifting operations.
	 WARNING Improper lifting/moving of heavy assemblies or components Personal injury and damage to property! ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

	⚠ WARNING Incorrect handling of the power cable Personal injury and damage to property! ▷ Secure power cables against falling down. ▷ Avoid power cables being laid on surfaces without fastening. ▷ When moving the pump set keep at a safe distance to the power cables.
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To transport the pump set suspend it from the lifting tackle as shown.

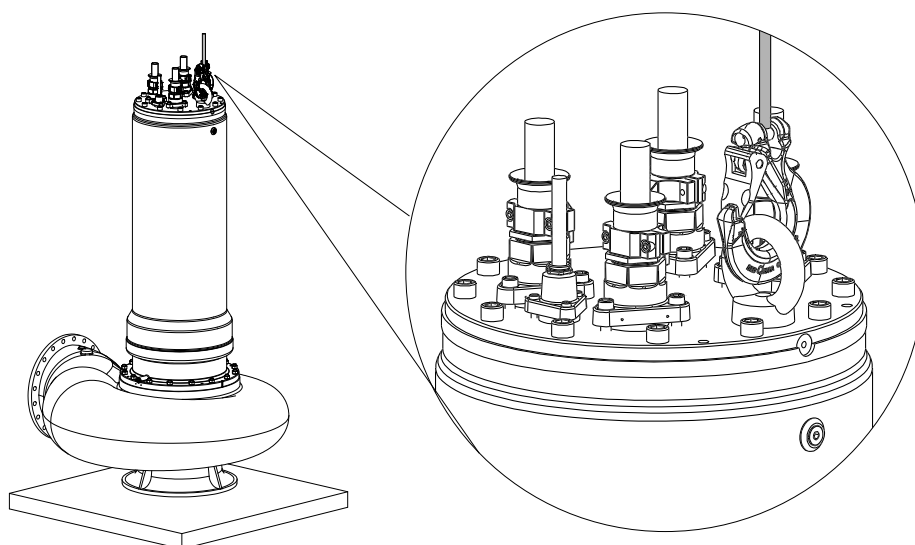


Fig. 1: Transporting the pump set with lifting accessories

3.2.1 Placing the pump set down

	⚠ WARNING Placing the pump set on unsecured and uneven surfaces Personal injury and damage to property! ▷ Always place the pump set on a solid and level surface with the pump set in a vertical position and the motor on top. ▷ Only place the pump set on a surface of sufficient load-carrying capacity. ▷ Use appropriate means to secure the pump set against tilting or tipping over.
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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)

	CAUTION Improper transport / Improper positioning of pump sets with cooling system Damage to the cooling system! ▷ Never place the pump set on the cooling jacket or fasten it by the cooling system.
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Pump sets equipped with a cooling system are delivered with a support foot as a transport lock.

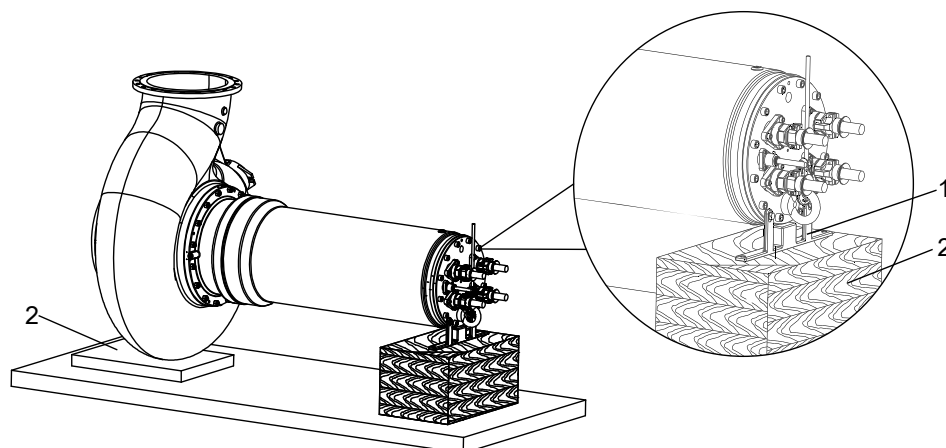


Fig. 2: Placing down a pump set with a support foot

1	Support foot	2	Wooden support
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For placing down the pump set 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 of the pump set.

Pump sets without cooling system (installation type S)

For placing down the pump set 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.



NOTE

The support foot can also be used for placing down the pump set. Place the pump set down as described for pump sets with cooling system (installation types D and K).

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:

	CAUTION Improper storage Damage to the power cables! ▷ Support the power cables at the cable entry to prevent permanent deformation. ▷ Only remove the protective caps from the power cables at the time of installation.
	CAUTION Damage during storage due to humidity, dirt or vermin Corrosion/contamination of the pump (set)! ▷ For outdoor storage cover the pump (set) or the packaged pump (set) and accessories with waterproof material.
	CAUTION Wet, contaminated or damaged openings and connections Leakage or damage to the pump! ▷ Clean and cover pump openings and connections as required prior to putting the pump into storage.

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).

	NOTE Observe the manufacturer's instructions for application/removal of the preservative.
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- 3. Rotate the impeller by hand once every three months.

3.4 Return to supplier

- Drain the pump as per operating instructions. (⇒ Section 7.3, Page 72)
- Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
- 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.
- Always complete and enclose a certificate of decontamination when returning the pump.
Always indicate any safety measures and decontamination measures taken.
(⇒ Section 10, Page 118)

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

	 WARNING Fluids handled, consumables and operating supplies which are hot or pose a health hazard Hazard to persons and the environment! ▷ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled. ▷ Wear safety clothing and a protective mask if required. ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.
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1. Dismantle the pump (set).
Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
 - Metals
 - Plastics
 - Electronic waste
 - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

4 Description of the Pump (Set)

4.1 General description

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

4.2 Designation

Example: Amarex KRT K 401-710 / 690 6 UN G-S IE3

Table 6: Designation key

Code	Description
Amarex KRT	Type series
K	Impeller type
K	Closed multi-channel impeller
401	Nominal discharge nozzle diameter [mm]
710	Maximum nominal impeller diameter [mm]
690	Motor size
6	Number of motor poles
UN	Motor version
UN	Non-explosion-proof, for fluid temperatures of up to 40 °C
G	Material variant
G	Standard variant, gray cast iron
G1	Like G with impeller made of duplex stainless steel
S	Installation type
S	Stationary wet installation with guide cable arrangement or guide rail arrangement (without cooling jacket)
D	Stationary dry installation, vertical
K	Stationary wet installation with guide cable arrangement or guide rail arrangement (with cooling jacket)
IE3	Motor efficiency classification ²⁾
³⁾	No efficiency classification
IE3	Premium Efficiency

2) IEC 60034-30 standard not binding for submersible motor pumps. Efficiencies calculated/determined according to 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.

3) Blank

4.3 Name plate

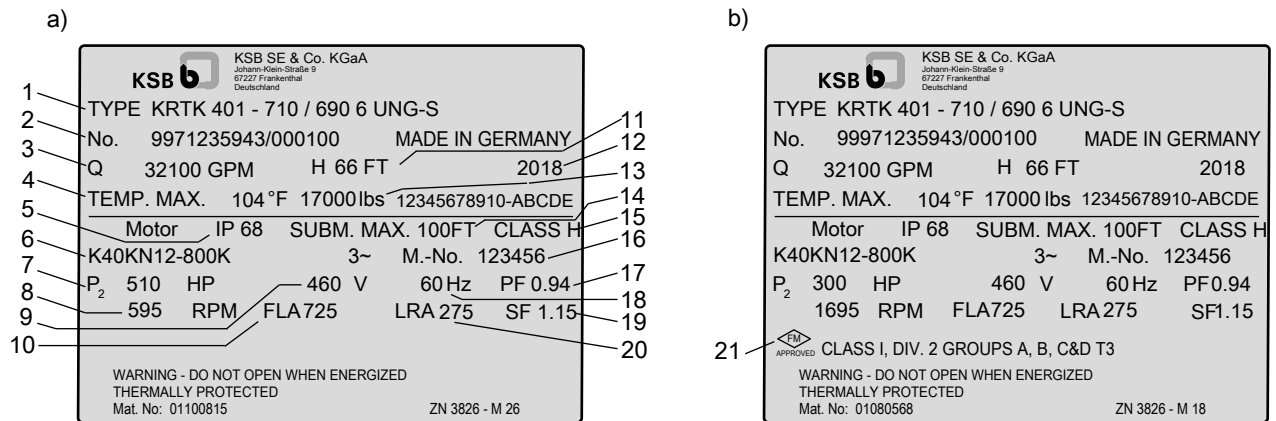


Fig. 3: Name plate (example) a) Standard pump set, b) Nonincendive pump set for use in Class I, Division 2, Hazardous (Classified) Locations

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	Service factor	20	Starting current
21	Explosion protection marking		

4.4 Design details

Design

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

Impeller type

- Application-oriented impeller type

Shaft seal

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

Bearings

Drive end:

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

Pump end:

- Can be re-lubricated

Drive

- Three-phase asynchronous squirrel-cage motor

4.5 Types of installation

Three 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 S**
Stationary wet installation without cooling system

Pump sets of installation type S

are designed for continuously submerged operation. The motor is cooled by the pumped fluid 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.

4.6 Configuration and function

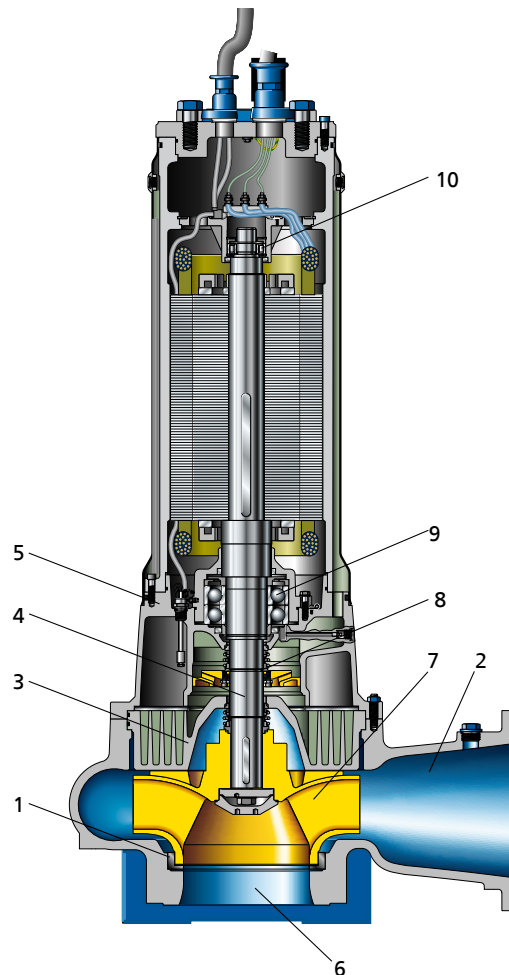


Fig. 4: Sectional drawing

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.

4.7 Noise characteristics (for dry installation only - installation type D)

The surface sound pressure level L_{pA} ⁴⁾ equals 85 dB max.

4.8 Scope of supply

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.

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 connection cables
- Claw with sealing elements and mounting elements
- Lifting rope, lifting chain or lifting bail (optional)
- Mounting bracket with mounting elements
- Base elbow with inspection hole⁵⁾ 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 connection cables
- Base elbow with inspection hole⁶⁾ and fastening elements
- Optional: intake elbow with inspection hole

4.9 Dimensions and weights

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

4) Surface sound pressure level to ISO 3744
 5) For nominal discharge nozzle diameter $\geq$ DN100
 6) For nominal discharge nozzle diameter $\geq$ DN100

5 Installation at Site

5.1 Safety regulations

	 DANGER Improper installation Damage to the pump set! ▷ Observe the information given in the data sheet and on the name plate of the pump set.
	 DANGER Risk of falling when working at great heights Danger to life by falling from great heights! ▷ Do not step onto the pump (set) during installation work or dismantling work. ▷ Pay attention to safety equipment, such as railings, covers, barriers, etc. ▷ Observe the applicable local occupational safety regulations and accident prevention regulations.
	 DANGER Persons in the tank during pump operation Electric shock! Risk of personal injury! Danger of death from drowning! ▷ Never start up the pump set when there are persons in the tank.
	 WARNING Hands, other body parts or foreign objects in the impeller or intake area Risk of personal injury! Damage to the submersible motor pump! ▷ Never insert your hands, other body parts or foreign objects into the impeller and/or impeller intake area. ▷ Check that the impeller can rotate freely.
	 WARNING Impermissible solid objects (tools, screws/bolts or similar) in the pump sump/inlet tank during pump start-up Personal injury and damage to property! ▷ Check the pump sump/inlet tank for impermissible solid objects before flooding, and remove, if necessary.

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

	 WARNING Installation on mounting surfaces which are unsecured and cannot support the load Personal injury and damage to property! ▷ Use a concrete with a minimum compressive strength of 3000 psi [Class C25/30 in exposure class XC1 to EN 206-1]. ▷ The mounting surface must have set and must be completely horizontal and even. ▷ Observe the weights indicated.
---	---

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

All pump sets are delivered with a support foot as a transport lock.

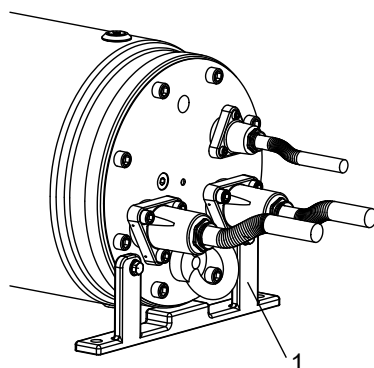


Fig. 5: Transport lock

1	Support foot
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1. Remove the support foot (1) prior to commissioning and keep it for future servicing, temporary storage or decommissioning of the pump.
2. Close the threaded holes with the two screw plugs supplied.

5.2.4 Checking the lubricant level (installation type S)

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 pump casing and/or impeller, the lubricant chamber is filled properly.
2. If oil leakage is visible in the area of pump casing and/or impeller, top up the lubricant chamber.

	⚠ WARNING Incorrect positioning/placing down Personal injury and damage to property! ▷ Position the pump set vertically with the motor on top. ▷ Use appropriate means to secure the pump set against tilting and tipping over. ▷ Refer to the weights given in the data sheet/on the name plate.
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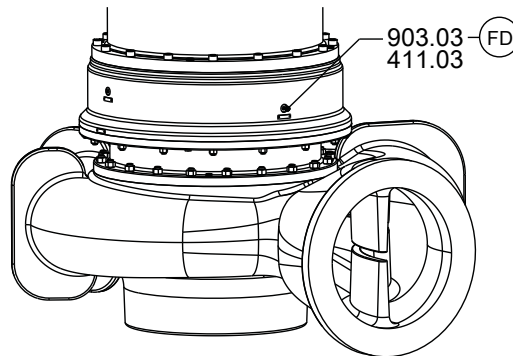


Fig. 6: Checking the lubricant level

Table 7: Key to the symbols and codes

Symbol	Description
(FD)	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

✓ Signs of oil leakage have been detected.

1. Place the pump set in a vertical position. (⇒ Section 3.2.2, Page 14)
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 66)

5. Fit and tighten screw plug 903.03 with a new joint ring 411.03.

	NOTE If more than 1.59 quart [1.5 l] of lubricant are required for topping up, this suggests a defect of the mechanical seals.
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5.2.5 Checking the coolant level (installation types K and D)

Check the coolant level of pump sets with cooling system.

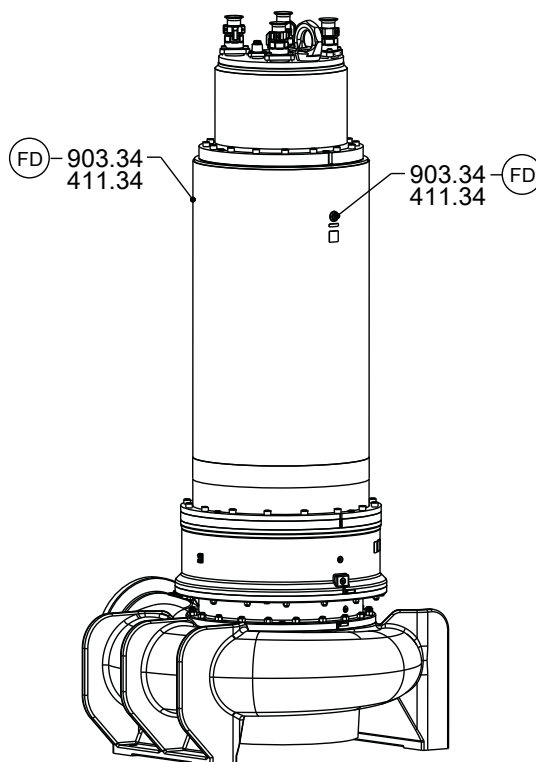


Fig. 7: Coolant filler opening

Table 8: Key to the symbols and codes

Symbol	Description
	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

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 1.18 inch [3 cm] below the edge of the filler opening.
4. If the fluid level is lower, top up clear water through the filler opening until it overflows.
5. Screw in screw plug 903.34 with joint ring 411.34.



NOTE

If more than 2.12 quarts [2 l] are required for topping up the coolant, this suggests a defect in the cooling system.

5.2.6 Checking the direction of rotation



DANGER

Pump set running dry

Explosion hazard!

- ▷ Check the direction of rotation of nonincendive pump sets outside potentially explosive atmospheres.

	! WARNING Hands and/or foreign objects in the pump casing Risk of injuries, damage to the pump! ▷ Never insert your hands or any other objects into the pump. ▷ Check that the inside of the pump is free from any foreign objects. ▷ Take suitable precautions (e.g. wear safety goggles).
	! WARNING Improper positioning of pump set when checking the direction of rotation Personal injury and damage to property! ▷ Use appropriate means to secure the pump set against tilting or tipping over.
	CAUTION Pump set running dry Increased vibrations! Damage to mechanical seals and bearings! ▷ Never operate the pump set for more than 60 seconds outside the fluid to be handled.

✓ 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 and S):** Impeller rotation must be anti-clockwise, seen from the pump mouth end (on some pump casings, the direction of rotation is marked by an arrow).
- ⇒ **Pump sets for dry installation (installation type D):** Viewed through the inspection hole of the pump set, impeller rotation must be to the left (on some pumps, the direction of rotation is marked by an arrow).

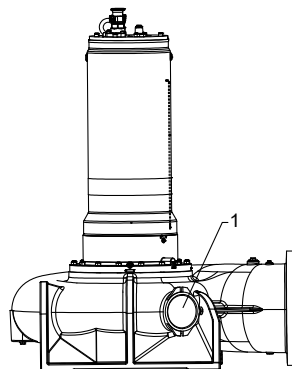


Fig. 8: Inspection hole

1	Inspection hole
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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 flanged elbow

Fastening the base elbow with foundation rails and chemical anchors

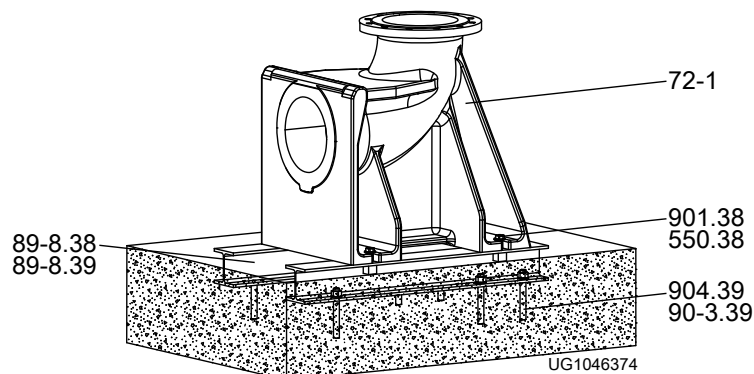


Fig. 9: Fastening the base elbow with foundation rails and chemical anchors

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

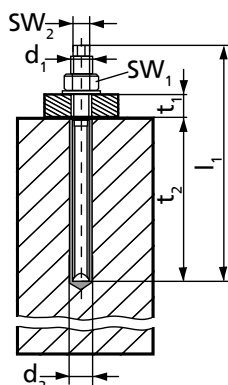


Fig. 10: Dimensions

Table 9: Chemical anchor dimensions ["]

Size ($d_1 \times l_1$)	d_2 ["]	t_1 ["]	t_2 ["]	$SW_1^{7)}$ ["]	$SW_2^{7)}$ ["]	M_{d1} [ft lb]
$1\frac{15}{16} \times 11\frac{13}{16}^{8)}$	$1\frac{1}{8}$	$2\frac{9}{16}$	$8\frac{1}{4}$	$1\frac{7}{16}$	$1\frac{11}{16}$	132,76
$1\frac{3}{16} \times 14\frac{15}{16}^{8)}$	$1\frac{3}{8}$	$2\frac{9}{16}$	11	$1\frac{13}{16}$	-	295,02

Table 10: Chemical anchor dimensions [mm]

Size ($d_1 \times l_1$)	d_2 [mm]	t_1 [mm]	t_2 [mm]	$SW_1^{7)}$ [mm]	$SW_2^{7)}$ [mm]	M_{d1} [Nm]
M24 $\times$ 300 ⁸⁾	28	65	210	36	17	180
M30 $\times$ 380 ⁸⁾	35	65	280	46	-	400

7) SW = Width across flats

8) Mounting accessories of the respective manufacturer are required.

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

5.3.1.2 Connecting the piping

	⚠ DANGER
	Impermissible loads acting on the flange of the base elbow Danger to life from leakage of hot, toxic, corrosive or flammable fluids! ▷ Do not use the pump as an anchorage point for the piping. ▷ Anchor the pipelines in close proximity to the pump and connect them without transmitting any stresses or strains. ▷ Observe the permissible flange loads. ▷ Take appropriate measures to compensate thermal expansion of the piping.
	NOTE
	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.
	CAUTION
	Critical speed Increased vibrations! Damage to mechanical seals and bearings! ▷ In the case of longer riser pipes, fit a swing check valve to prevent the pump from excessively running in reverse after it is switched off. Choose the position of the swing check valve to allow proper venting.

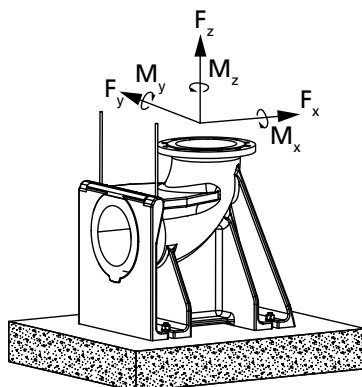

Fig. 11: Permissible flange loads

Table 12: Forces [lbs] and moments [ft lbs]

Nominal flange diameter	Forces [lbs]				Moments [lbs ft]			
	F_x	F_y	F_z	ΣF	M_x	M_y	M_z	ΣM
200	1356	1221	1515	2363	2383	1687	1943	3520
250	1684	1526	1888	2950	3263	2310	2677	4803
350	2363	2125	2634	4126	5683	4033	4657	8360
400	2702	2430	3007	4714	7113	5060	5830	10487

Nominal flange diameter	Forces [lbs]				Moments [lbs ft]			
	F _x	F _y	F _z	ΣF	M _x	M _y	M _z	ΣM
500	3380	3041	3753	5889	10597	7517	8653	15620
600	4058	3651	4499	7065	14813	10560	12173	21927
700	4702	4318	5087	8275	18847	12613	15400	27353

Table 13: Forces [N] and moments [Nm]

Nominal flange diameter	Forces [N]				Moments [Nm]			
	F _x	F _y	F _z	ΣF	M _x	M _y	M _z	ΣM
200	6000	5400	6700	10450	3250	2300	2650	4800
250	7450	6750	8350	13050	4450	3150	3650	6550
350	10450	9400	11650	18250	7750	5500	6350	11400
400	11950	10750	13300	20850	9700	6900	7950	14300
500	14950	13450	16600	26050	14450	10250	11800	21300
600	17950	16150	19900	31250	20200	14400	16600	29900
700	20800	19100	22500	36600	25700	17200	21000	37300

5.3.1.3 Fitting the guide cable 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. Use steel anchor bolts 90-3.37 to fasten mounting bracket 894 to the edge of the sump opening.
2. Pre-assemble the clamping arrangement consisting of guide cable suspension bracket 572, thrust insert 553 and hexagon head bolts 901.36.
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 in order to allow sufficient play for subsequently tensioning the guide cable.

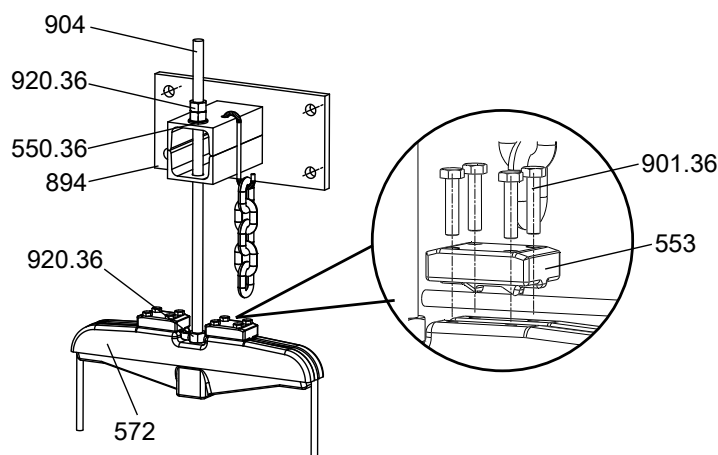


Fig. 12: Mounting bracket variants for pumps with a nominal discharge nozzle diameter of DN 250

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	Bail	920.36/.37	Nut

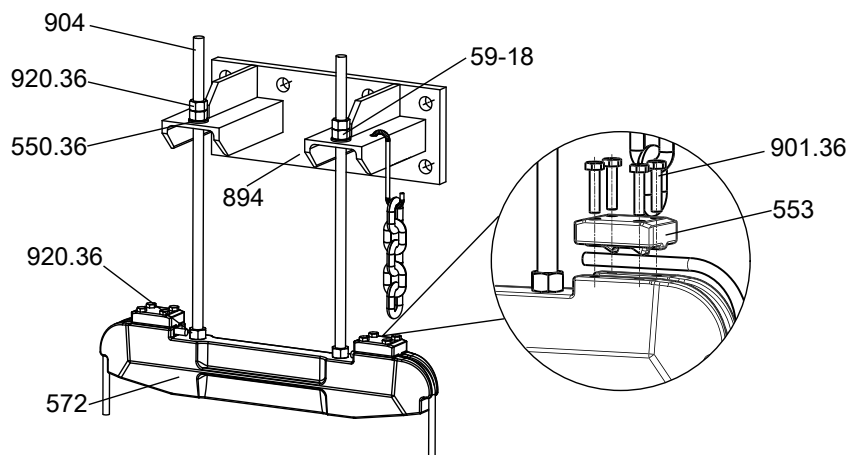

Fig. 13: Mounting bracket variants for pumps with a nominal discharge nozzle diameter of DN 350, 400, 500, 600, 700

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		

Inserting the guide cable

1. Lift thrust insert 533, insert one end of the cable and secure it with bolts 901.36.
2. Run cable 59-24.01 around base elbow 72-1 and back again to guide cable suspension bracket 572. Insert it into thrust insert 533.
3. Manually tension 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 / lifting rope at a later stage.

Table 16: Guide cable tension

Size	Tightening torque M_A	Guide cable tension P
	[ft lbf]	[lbf]
200-631	22,1	2248
250-630	22,1	2248
250-632	22,1	2248
250-900	22,1	2248

Size	Tightening torque M _A	Guide cable tension P
	[ft lbf]	[lbf]
350-632	15,5 ⁹⁾	3372
350-633	15,5 ⁹⁾	3372
350-636	15,5 ⁹⁾	3372
350-710	15,5 ⁹⁾	3372
350-713	15,5 ⁹⁾	3372
400-632	15,5 ⁹⁾	3372
400-900	15,5 ⁹⁾	3372
401-710	15,5 ⁹⁾	3372
401-713	15,5 ⁹⁾	3372
500-632	15,5 ⁹⁾	3372
500-634	15,5 ⁹⁾	3372
500-640	15,5 ⁹⁾	3372
501-710	15,5 ⁹⁾	3372
501-900	15,5 ⁹⁾	3372
600-710	15,5 ⁹⁾	3372
700-901	15,5 ⁹⁾	3372
700-902	15,5 ⁹⁾	3372

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.



NOTE

The guide rails are not included in KSB's scope of supply. Select guide rail materials which are suitable for the fluid handled or as specified by the operator.

Observe the following dimensions for the guide rails:

Table 17: Guide rail dimensions

Nominal discharge nozzle diameter	Outside diameter		Wall thickness ¹⁰⁾			
	[inch]	[mm]	Minimum [inch]	Minimum [mm]	Maximum [inch]	Maximum [mm]
200 to 700	3,5	89	0,118	3	0,236	6

Fitting the mounting bracket

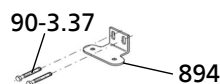


Fig. 14: Fitting the mounting bracket

1. Fasten mounting bracket 894 to the edge of the sump opening with steel anchor bolts 90-3.37. Tighten the anchor bolts to a tightening torque of 7.4 lbf ft [10 Nm].
Observe the hole pattern for the anchor bolts. (See outline drawing.)

9) 2 tensioning bolts, value indicated per bolt

10) To DIN 2440/2442/2462 or equivalent standards

Fitting the guide rails

	CAUTION Improper installation of the guide rails Damage to the guide rail arrangement! ► Always align the guide rails so that they are in a perfectly vertical position.
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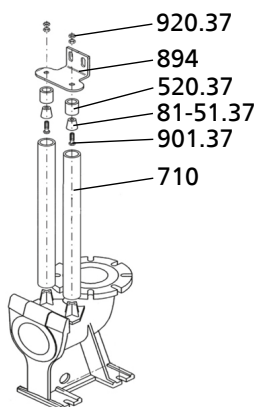


Fig. 15: Fitting the guide rails

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.
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Fitting the middle support

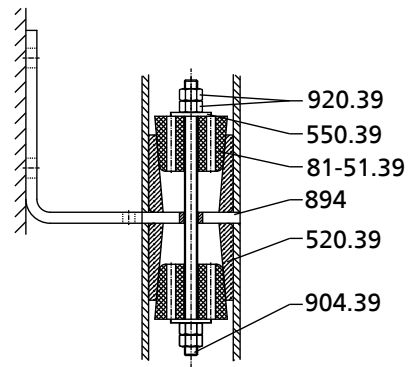


Fig. 16: Fitting the middle support

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. Slide the guide rails onto the sleeves. Verify that there is a tight fit between the guide rails and the sleeves.
4. Fit and tighten locknuts.
5. Continue fitting the guide rails.

5.3.1.5 Preparing the pump set

Fitting the claw

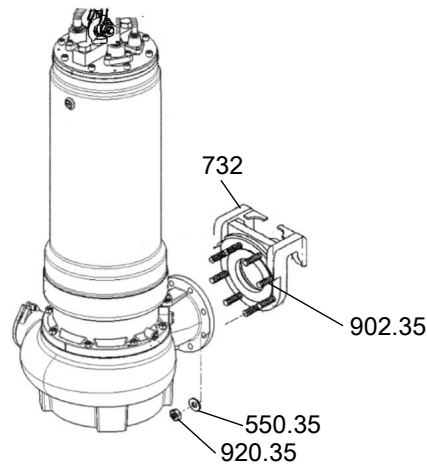


Fig. 17: Fitting the claw

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 joint 410 or round cord 99-6 into the groove of the claw. This will seal the base elbow/pump connection.

Attaching the lifting chain / lifting rope

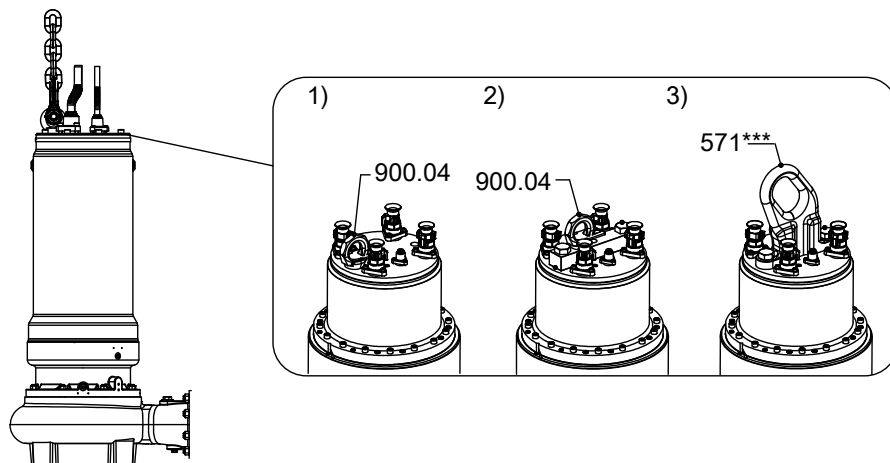


Fig. 18: Attaching the lifting chain / lifting rope – stationary wet installation

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:

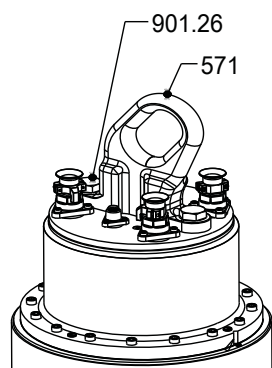


Fig. 19: Bail

Table 18: List of components

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

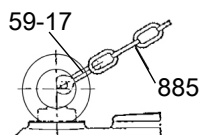


Fig. 20: Chain attached to the eyebolt with a shackle

Table 19: List of components

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

5.3.1.6 Installing the pump set



NOTE

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.

1. Guide the pump set over the suspension bracket/mounting bracket, thread it onto the guide cables/rails and slowly lower it down.
The pump set attaches itself to base elbow 72-1.
2. Attach the lifting chain/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

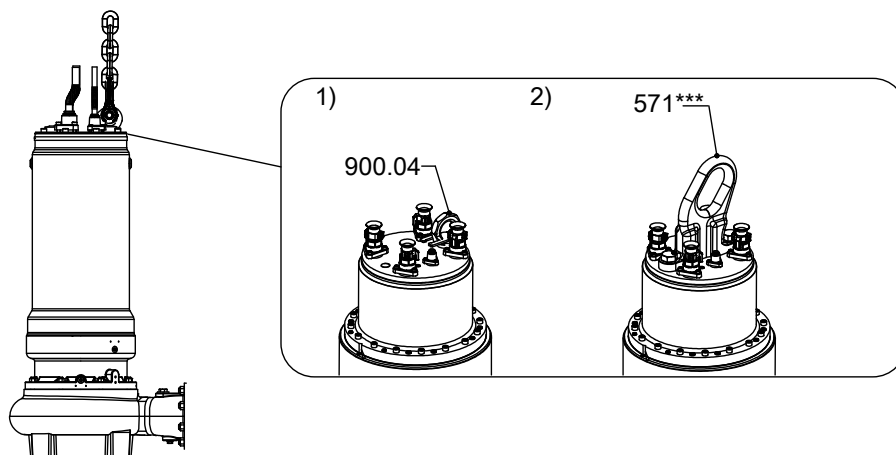


Fig. 21: Attaching the lifting chain / lifting rope – dry installation

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:

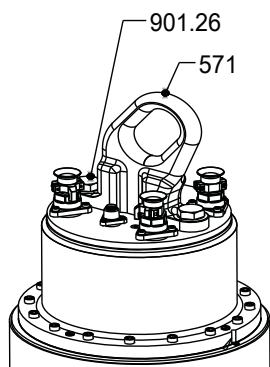


Fig. 22: Bail

Table 20: List of components

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

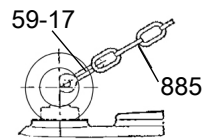


Fig. 23: Chain attached to the eyebolt with a shackle

Table 21: List of components

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

5.3.2.2 Installing the pump set



NOTE

If foundation rails 89-8 are included in KSB's scope of supply, they must be set in concrete as shown in the general arrangement drawing/outline drawing.

5.3.2.2.1 Installing the pump set with integrally cast pump feet

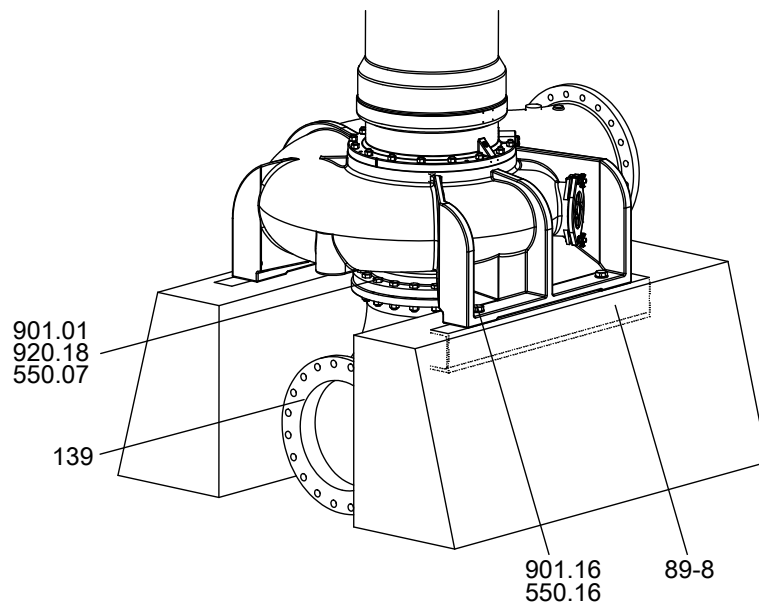


Fig. 24: Installing the pump set with pump feet

1. Fasten suction elbow 139 to the suction nozzle with hexagon head bolts 901.01, discs 550.07 and nuts 920.18.
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 foundation rails 89-8 with hexagon head bolts 901.16 and discs 550.16.

5.3.2.3 Connecting the piping

	! DANGER Impermissible loads acting on the pump nozzles Danger to life from hot, toxic, corrosive or flammable fluids escaping! ▷ Do not use the pump as an anchorage point for the piping. ▷ Anchor the pipelines in close proximity to the pump and connect them properly without transmitting any stresses or strains. ▷ Observe the permissible forces and moments at the pump nozzles. ▷ Take appropriate measures to compensate thermal expansion of the piping.
	CAUTION Incorrect grounding during welding work on the piping Destruction of rolling element bearings (pitting effect)! ▷ Never ground the electric welding equipment on the pump or baseplate. ▷ Prevent current flowing through the rolling element bearings.
	NOTE Installing check and shut-off elements in the system is recommended, depending on the type of plant and pump. However, such elements must not obstruct proper drainage or hinder disassembly of the pump.

- ✓ Suction lift lines have been laid with a rising slope, suction head lines with a downward slope towards the pump.
 - ✓ A flow 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 diameters of the pipelines are at least equal to the nominal diameters of the pump nozzles.
 - ✓ To prevent excessive pressure losses, adapters to larger diameters have a diffuser angle of approx. 8°.
 - ✓ The pipelines have been anchored in close proximity to the pump and connected without transmitting any stresses or strains.
1. Thoroughly clean, flush and blow through all vessels, pipelines and connections (especially of new installations).
 2. Before installing the pump in the piping, remove the flange covers on the suction and discharge nozzles of the pump.
 3. Connect the pump nozzles to the piping.

5.3.2.3.1 Permissible forces and moments at the pump nozzles

The permissible nozzle loads are given in the following table.

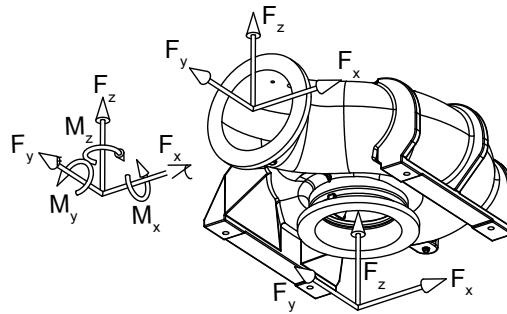


Fig. 25: Forces and moments at the pump nozzles

Table 22: Forces [lbs] and moments [lbs ft]

Nominal flange diameter	Forces [lbs]				Moments [lbs ft]			
	F_x	F_y	F_z	ΣF	M_x	M_y	M_z	ΣM
200	1356	1221	1515	2363	2383	1687	1943	3520
250	1684	1526	1888	2950	3263	2310	2677	4803
350	2363	2125	2634	4126	5683	4033	4657	8360
400	2702	2430	3007	4714	7113	5060	5830	10487
500	3380	3041	3753	5889	10597	7517	8653	15620
600	4058	3651	4499	7065	14813	10560	12173	21927
700	4702	4318	5087	8275	18847	12613	15400	27353

Table 23: Forces [N] and moments [Nm]

Nominal flange diameter	Forces [N]				Moments [Nm]			
	F_x	F_y	F_z	ΣF	M_x	M_y	M_z	ΣM
200	6000	5400	6700	10450	3250	2300	2650	4800
250	7450	6750	8350	13050	4450	3150	3650	6550
350	10450	9400	11650	18250	7750	5500	6350	11400
400	11950	10750	13300	20850	9700	6900	7950	14300
500	14950	13450	16600	26050	14450	10250	11800	21300
600	17950	16150	19900	31250	20200	14400	16600	29900
700	20800	19100	22500	36600	25700	17200	21000	37300

5.3.2.3.2 Auxiliary connections

	 WARNING
	Screw plugs subjected to pressure Risk of injuries by parts flying off and escaping fluid! ▷ Never use screw plugs for releasing pressure from the pump casing. ▷ Always use a suitable venting device (e.g. vent valve).

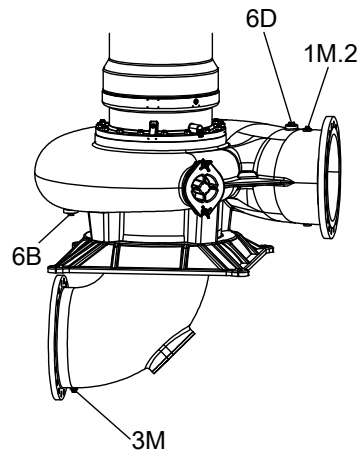


Fig. 26: Auxiliary connections

Table 24: Overview of auxiliary connections

Connection	Description	Thread
1M.2	Pressure gage	G 1/2
6D	Vent	G 1 1/4 ¹¹⁾
3M	Pressure/vacuum gage	G 1/2
6B	Casing drain	G 1

5.3.2.3.3 Vacuum balance line

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

The following rules apply to vacuum balance lines:

- Minimum nominal line diameter: 0.98 inch [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.

11) For sizes 500-632, 500-634, 500-640: G1 1/2

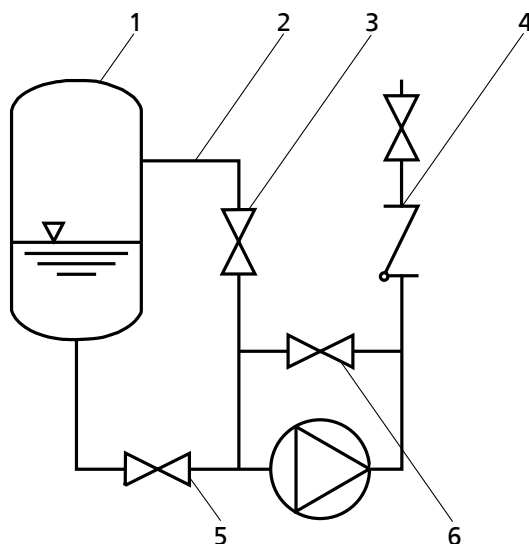


Fig. 27: Vacuum balance line

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.

5.4 Electrical system

5.4.1 Information for planning the control system

For the electrical connection of the pump set observe the wiring diagrams.

(⇒ Section 9.3, Page 108)

The pump set is supplied with power cables; it is wired for DOL starting.



NOTE

When laying a cable between the control system and the pump set's connection point, make sure the number of cores for the sensors is sufficient. A minimum cross-section of AWG 15 [1.5 mm²] is required.

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.

(⇒ Section 6.2.2, Page 50)

5.4.1.1 Overload protection

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

	! DANGER Pump set running dry Explosion hazard! ▷ Never allow a nonincendive pump set to run dry.
	CAUTION Fluid level below the specified minimum Damage to the pump set by cavitation! ▷ Never allow the fluid level to drop below the specified minimum.

Automatic pump set operation in a tank requires the use of level control equipment. Observe the specified minimum fluid level. (⇒ Section 6.2.4.2, Page 51)

5.4.1.3 Operation on a frequency inverter

The pump set is suitable for operation on a frequency inverter as per IEC 60034-17.

	! DANGER Operation outside the permitted frequency range Explosion hazard! ▷ Never operate an explosion-proof pump set outside the specified range.
	NOTE For pump sets with rated voltages exceeding 500 V, a dv/dt filter should be fitted at the output of the frequency inverter to reduce the rate of voltage rise to the limits specified in IEC 60034-17. Otherwise a considerably reduced service life of the insulation system has to be expected.
	! DANGER Incorrect selection and setting of the frequency inverter Explosion hazard! ▷ Observe the following information on selecting and setting a frequency inverter.

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

- Data provided by the manufacturer
- Electrical data of the pump set, particularly the nominal current
- Only voltage intermediate-circuit inverters (VSI) with pulse width modulation (PWM) and carrier frequencies between 1 and 16 kHz are suitable.

Setting Observe the following instructions for setting a frequency inverter:

- Set the current limit to max. 1.2 times the rated current. The rated current is indicated on the name plate.

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 motor rating 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. This applies in particular to the leakage sensor inside the motor.

5.4.1.4 Sensors

	! DANGER Operating an incompletely connected pump set Damage to the pump set! ▷ Never start up a pump set with incompletely connected power cables or non-operational monitoring devices.
	CAUTION Incorrect connection Damage to the sensors! ▷ Observe the limits stated in the following sections of this manual when connecting the sensors.

The pump set features sensors that avoid hazards and damage to the pump set. Measuring transducers are required for analyzing the sensor signals supplied. Suitable devices for 230 V~ can be supplied by KSB.

	NOTE 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.
---	--

All sensors are located inside the pump set and are connected to the power cable. For information on wiring and core identification please refer to the wiring diagrams. The individual sensors and the limit values to be set are described in the following sections.

5.4.1.4.1 Motor temperature

	! DANGER Insufficient cooling Explosion hazard! Winding damage! ▷ Never operate a pump set without operational temperature monitoring. ▷ For nonincendive pump sets use a thermistor tripping unit with manual reset.
---	---

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.

Pump sets without cooling system (installation type S)

The pump set features double monitoring of the winding temperature. Two bimetal switches (terminals 21 and 22, max. 30 V~/2 A) serve as temperature control devices which open when the winding temperature is too high. Tripping must result in the pump set cutting out. Automatic re-starting is permissible. For nonincendive pump sets, the three additional, series-connected (PTC) thermistors with terminals 10 and 11 must be used. They must be connected to a thermistor tripping unit with manual reset.

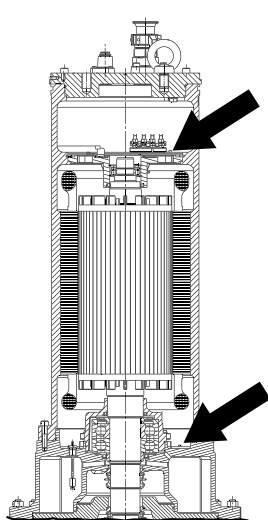
Resistance thermometer (Pt100)

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

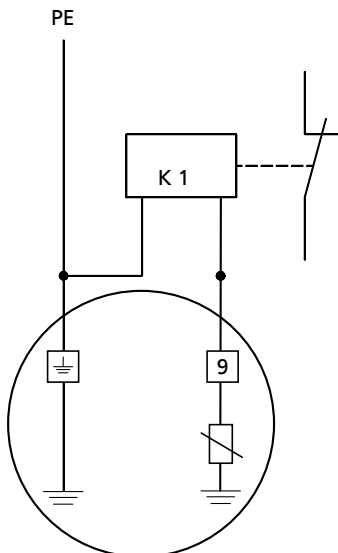
	CAUTION Temperature monitoring not properly connected Winding damage! ▷ Never use the resistance thermometers as a sole means of monitoring the motor temperature.
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5.4.1.4.2 Leakage inside the motor

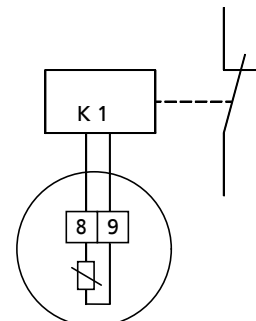
	! DANGER Incorrect monitoring of leakage electrode Explosion hazard! Danger of death from electric shock! ▷ Voltages must be < 30 V AC and tripping currents < 0.5 mA.
--	---



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 meet the following requirements:

- Sensor circuit 10 to 30 V AC
- Tripping current ≤ 0.5 mA

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

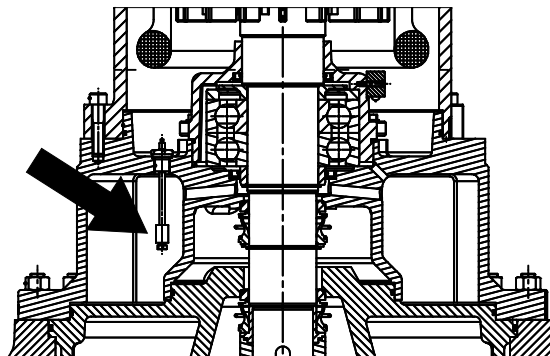


Fig. 28: Float switch

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 bearings of the pump set are equipped with bearing temperature sensors. The two sensors are Pt100 resistance thermometers. They each have to be connected to a temperature control device with a Pt100 input and 2 separate outputs for two different switching points (sensor circuit maximum 6 V / 2 mA).

Set the following limits:

- Alert at 226 °F [130 °C]
- Cut-out of the pump set at 302 °F [150°C]

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 25: Technical data of the sensor

Characteristic	Value
Measuring range	4 - 20 mA at 0 - 0.79 in/s RMS [0 - 20 mm/s]
Measuring 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

Connecting the vibration sensor

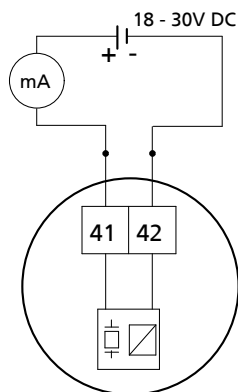


Fig. 29: Connecting the vibration sensor

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

- Alert triggered at $v_{\text{eff}} = 0.43 \text{ in/s}$ [11 mm/s] (impeller type E: $v_{\text{eff}} = 0.55 \text{ in/s}$ [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 $v_{\text{eff}} = 0.55 \text{ in/s}$ [14 mm/s] (impeller type E: $v_{\text{eff}} = 0.66 \text{ in/s}$ [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

	⚠ DANGER Electrical connection work by unqualified personnel Danger of death from electric shock! ▷ Always have the electrical connections installed by a trained electrician. ▷ Observe IEC 60364 regulations as well as any locally applicable regulations.
	⚠ WARNING Incorrect connection to the mains Damage to the mains network, short circuit! ▷ Observe the technical specifications of the local energy supply companies.
	CAUTION Improper routing of power cables Damage to the power cables! ▷ Never move the power cables at temperatures below -13 °F [-25 °C]. ▷ Never kink or crush the power cables. ▷ Never lift the pump set by the power cables. ▷ Adjust the length of the power cables to the site requirements.

	CAUTION
	Motor overload Damage to the motor! ▷ Protect the motor by a thermal time-lag overload protection device in accordance with IEC 60947 and local regulations.

For the electrical connection of the pump set observe the wiring diagrams (⇒ Section 9.3, Page 108) in the Annex and the information for planning the control system .

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

	⚠ DANGER
	Incorrect connection Explosion hazard! ▷ The connection point of the cable ends must be located outside hazardous areas or in an area approved for electrical equipment.

	⚠ DANGER
	Operating an incompletely connected pump set Explosion hazard! Damage to the pump set! ▷ Never start up a pump set with an incompletely connected power cable or non-operational monitoring devices.

	⚠ DANGER
	Connection of damaged power cables Danger of death from electric shock! ▷ Check the power cables for damage before connecting them. ▷ Never connect damaged power cables. ▷ Replace damaged power cables.

	CAUTION
	Flow-induced motion Damage to the power cable! ▷ Run the power cable upwards without slack.

1. Run the power cables directly upwards without slack, and fasten them.
2. Only remove the protective caps from the power cables immediately before connecting the cables.
3. If necessary, adjust the length of the power 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, S)

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

	⚠ DANGER Touching the pump set during operation Electric shock! ▷ Make sure that the pump set cannot be touched during operation.
---	---

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.

	⚠ DANGER Incorrect connection Danger of death from electric shock! ▷ Never operate the pump set without connecting the PE conductor.
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Connecting the potential equalization conductor

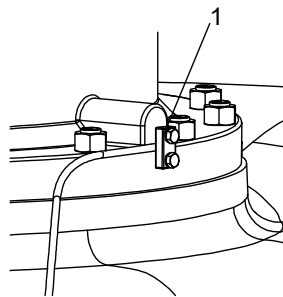


Fig. 30: Connecting the potential equalization conductor

1	Terminal for the potential equalization conductor
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 electric power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked.
- All auxiliary connections required are connected and operational.
- The lubricant has been checked.
- After prolonged shutdown of the pump (set), the activities required for returning the pump (set) to service have been carried out. (⇒ Section 6.4, Page 53)

	⚠ DANGER Persons in the tank during pump operation Electric shock! Risk of personal injury! Danger of death from drowning! ▷ Never start up the pump set when there are persons in the tank.
	⚠ DANGER Exceeding the operating limits Pump casing could burst/leak! Pressurized hot or toxic fluid could escape! Flying parts! ▷ Maintain an adequate safety distance from pump sets which are in operation.

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

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

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, S)

	CAUTION
	Re-starting while motor is still running down Damage to the pump set! ▷ Do not re-start the pump set before it has come to a standstill. ▷ Never start the pump set while the pump is running in reverse.

✓ The fluid level is sufficiently high.

	CAUTION
	Start-up against a closed shut-off element Increased vibrations! Damage to mechanical seals and bearings! ▷ Never start up the pump set against a closed shut-off element.

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

Dry installation (installation type D)

	! DANGER
	Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and discharge lines closed. Leakage of hot or toxic fluids! ▷ Never operate the pump with the shut-off elements in the suction line and/or discharge line closed. ▷ Only start up the pump set against a slightly or completely open discharge-side shut-off element.

	! DANGER
	Excessive temperatures due to dry running or excessive gas content in the fluid handled Damage to the pump set! ▷ Never operate the pump set without liquid fill. ▷ Prime the pump as per operating instructions. ▷ Always operate the pump within the permissible operating range.

	! WARNING
	Hot surface Risk of burns ▷ Never touch a pump set which is in operation.

	! WARNING
	Very high noise emission during operation Personal injury! ▷ Minimize exposure in the vicinity of the pump set. ▷ For required work near running pump sets use appropriate ear protection.

	WARNING
	Abnormal noises, vibrations, temperatures or leakage Damage to the pump! Risk of personal injury! ▷ Switch off the pump (set) immediately. ▷ Eliminate the causes before returning the pump set to service.

- ✓ 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.

	CAUTION
	Start-up against open discharge line Motor overload! ▷ Make sure the motor has sufficient power reserves. ▷ Use a soft starter. ▷ Use speed control.

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

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

For prolonged shutdown periods:

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

	CAUTION
	Danger of freezing! Damage to the pump set! ▷ Drain the pump set or protect it against freezing.

6.2 Operating limits

	⚠ DANGER
	Non-compliance with operating limits Damage to the pump set! ▸ Comply with the operating data indicated in the data sheet. ▸ Avoid operation against a closed shut-off element. ▸ Never operate the pump set at ambient or fluid temperatures exceeding those specified in the data sheet or on the name plate. ▸ Never operate the pump set outside the limits specified below.

6.2.1 Frequency of starts

	CAUTION
	Excessive frequency of starts Damage to the motor! ▸ Never exceed the specified frequency of starts.

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 start-ups per hour.

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

	CAUTION
	Re-starting while motor is still running down Damage to the pump set! ▸ Do not re-start the pump set before it has come to a standstill. ▸ Never start the pump set while the pump is running in reverse.

6.2.2 Operation on the power supply network

	⚠ DANGER
	Non-compliance with permissible supply voltage tolerances Explosion hazard! ▸ Never operate nonincendive pump sets outside the specified range.

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

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

	CAUTION Pumping solids-laden fluids at reduced speed Increased wear and clogging! ▷ 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.
---	---

Frequency inverter operation of the pump set is permitted in the frequency range from 30 to 60 Hz.

6.2.4 Fluid handled

6.2.4.1 Temperature of the fluid handled

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

	CAUTION Danger of freezing! Damage to the pump set! ▷ Drain the pump set or protect it against freezing.
---	---

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

	CAUTION Fluid level below the specified minimum Damage to the pump set by cavitation! ▷ Never allow the fluid level to drop below the specified minimum.
---	---

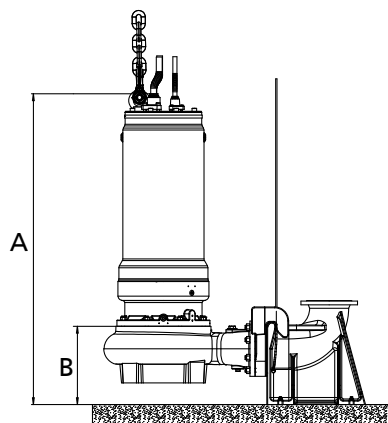


Fig. 31: Minimum level of fluid handled

Pump sets without cooling system (installation type 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 set can be operated at a lower fluid level for short periods until the temperature monitoring device of the motor trips. The fluid level must not drop below the specified minimum (dimension B). Exact dimensions 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.

	NOTE 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).
---	--

6.2.4.3 Density of the fluid handled

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

	CAUTION Impermissibly high density of fluid handled Motor overload! ▷ Observe the information on fluid density in the data sheet. ▷ Make sure the motor has sufficient power reserves.
---	---

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

	⚠ WARNING Unintentional starting of pump set Risk of injury by moving components and shock currents! ▷ Make sure that the pump set cannot be started up unintentionally. ▷ Always make sure the electrical connections are disconnected before carrying out work on the pump set.
	⚠ WARNING Fluids handled, consumables and operating supplies which are hot or pose a health hazard Risk of personal injury! ▷ Observe all relevant laws. ▷ When draining the fluid take appropriate measures to protect persons and the environment. ▷ Decontaminate pumps which handle fluids posing a health hazard.

	CAUTION Danger of frost/freezing Damage to the pump set! ▷ If there is any danger of frost/freezing, remove the pump set from the fluid handled and clean, preserve and store it.
---	--

- ✓ 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.
- 1. Clean the pump set.
- 2. Preserve the pump set.
- 3. Observe the information in (⇒ Section 3.2, Page 12) .

6.4 Returning to service

For returning the pump set to service, observe the items on commissioning/start-up. (⇒ Section 6.1, Page 47)

Refer to and comply with the operating limits. (⇒ Section 6.2, Page 50)

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

	! WARNING Failure to re-install or re-activate protective equipment/devices Risk of personal injury from moving parts or escaping fluid! ▷ As soon as the work is completed, re-install and/or re-activate any safety-relevant devices and protective devices.
	NOTE On pumps/pump sets older than 5 years we recommend replacing all elastomer seals.

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.

	 DANGER Sparks produced during maintenance work Explosion hazard! ▷ Always perform maintenance work on nonincendive pump sets outside potentially explosive atmospheres.
	 DANGER Electrical connection work by unqualified personnel Danger of death from electric shock! ▷ Always have electrical connection work carried out by a trained electrician. ▷ Observe the provisions of the EN 60079 standard.
	 DANGER Risk of falling when working at great heights Danger to life by falling from great heights! ▷ Do not step onto the pump (set) during installation work or dismantling work. ▷ Pay attention to safety equipment, such as railings, covers, barriers, etc. ▷ Observe the applicable local occupational safety regulations and accident prevention regulations.
	 WARNING Unintentional starting of pump set Risk of injury by moving components and shock currents! ▷ Make sure that the pump set cannot be started up unintentionally. ▷ Always make sure the electrical connections are disconnected before carrying out work on the pump set.
	 WARNING Hands, other body parts or foreign objects in the impeller or intake area Risk of personal injury! Damage to the submersible motor pump! ▷ Never insert your hands, other body parts or foreign objects into the impeller and/or impeller intake area. ▷ Check that the impeller can rotate freely.

	 WARNING Fluids handled, consumables and operating supplies which are hot or pose a health hazard Risk of personal injury! ▷ Observe all relevant laws. ▷ When draining the fluid take appropriate measures to protect persons and the environment. ▷ Decontaminate pumps which handle fluids posing a health hazard.
	 WARNING Hot surface Risk of personal injury! ▷ Allow the pump set to cool down to ambient temperature.
	 WARNING Improper lifting/moving of heavy assemblies or components Personal injury and damage to property! ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.
	 WARNING Insufficient stability Risk of crushing hands and feet! ▷ During assembly/dismantling, secure the pump (set)/pump parts against tilting or tipping over.
	NOTE Repairs or modifications of the pump set can affect explosion protection and may, therefore, only be made by the manufacturer or a repair shop certified by FM Approvals.
	NOTE 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 "www.ksb.com/contact".

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.

Never use force when dismantling and reassembling the pump set.

7.2 Maintenance/inspection

KSB recommends the following regular maintenance schedule:

Table 26: Overview of maintenance work

Maintenance interval	Maintenance work	For details see ...
Every 4000 operating hours ¹²⁾	Measuring the insulation resistance	(⇒ Section 7.2.1.4, Page 57)
	Checking the power cables	(⇒ Section 7.2.1.3, Page 56)
	Visual inspection of the lifting chain / lifting rope	(⇒ Section 7.2.1.1, Page 56)
	Visual inspection of lifting accessories	(⇒ Section 7.2.1.2, Page 56)
Every 8000 operating hours ¹³⁾	Checking the sensors	(⇒ Section 7.2.1.5, Page 57)
	Checking the mechanical seal leakage	(⇒ Section 7.2.1.6, Page 58)
	Changing the lubricant	(⇒ Section 7.2.3, Page 65)
	Changing the coolant	
Every five years	General overhaul (including coolant change for installation types K and D)	
Flexible maintenance interval ¹³⁾	Lubricating the bearings	(⇒ Section 7.2.3.2, Page 67)



NOTE

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.
 1. Inspect the lifting chain/rope as well as their fasteners for any visible damage.
 2. Replace any damaged components by original spare parts.

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 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.

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.

12) At least once per year

13) At least every two years

	 DANGER
	Defective ground conductor Electric shock! ▷ Never switch on a pump set with a defective ground conductor.

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.

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

	NOTE
	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.

7.2.1.5 Checking the sensors

	CAUTION
	Excessive test voltage Damage to the sensors! ▷ Use a commercially available ohmmeter to measure the resistance.

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 27: Resistance measurement

Measurement between terminals ...	Resistance [Ω]
21 and 22 ¹⁴⁾	< 1
10 and 11	200 to 1000
31 and 32 ¹⁵⁾	100 to 120
33 and 34 ¹⁵⁾	100 to 120
35 and 36 ¹⁵⁾	100 to 120

14) Only for pump sets without cooling system, installation type S

15) Optional

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 28: Resistance measurement of the leakage sensor in the motor

Measurement between terminals ...	Resistance
	[kΩ]
9 and ground conductor (PE)	> 60
8 and 9 ¹⁶⁾	> 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 29: 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 30: Resistance measurement bearing temperature

Measurement between terminals ...	Resistance
	[Ω]
15 and 16	100 to 120
16 and 17	100 to 120

If the measured value is within the permissible tolerance range and the tripping unit of the pump temperature sensor has tripped, the rolling element bearings must be checked and replaced, if required.

Vibration sensor

Table 31: Current measurement at the vibration sensor

Measurement between terminals ...	Current value
41 and 42	Constant 4 mA during standstill

Functional test

Connect the vibration sensor. Measure the current in the measuring circuit with a suitable ammeter.

7.2.1.6 Checking the mechanical seal leakage

	 WARNING
	Fluids handled, consumables and operating supplies which are hot or pose a health hazard Hazard to persons and the environment! ▷ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled. ▷ Wear safety clothing and a protective mask if required. ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

16) Only for pump sets with vibration sensor

	WARNING Excess pressure inside the pump set Risk of personal injury when opening the pump set! ► Be careful when opening the inner chambers.
	NOTE Slight wear of the mechanical seal is unavoidable. This will be aggravated by abrasive substances contained in the fluid handled.

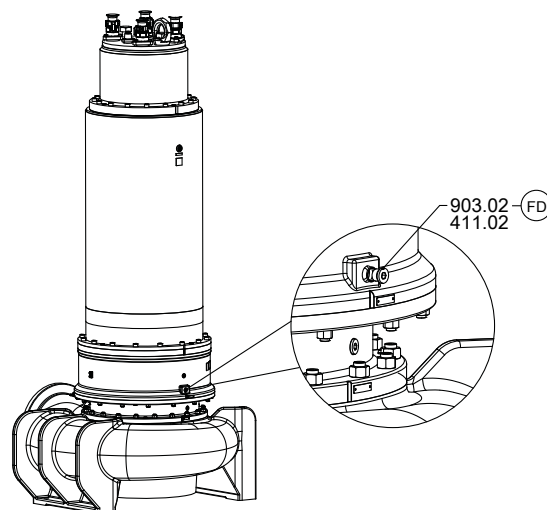


Fig. 32: Checking the mechanical seal leakage

Table 32: Key to the symbols and codes

Symbol	Description
(FD)	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

- ✓ The pump set has been placed down 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.

	NOTE If more than 3.2 quarts [3 liters] of leakage should escape we recommend replacing the mechanical seals.
---	--

4. Fit screw plug 903.02 with new joint ring 411.02.

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.

	⚠ WARNING Fluids handled, consumables and operating supplies which are hot or pose a health hazard Hazard to persons and the environment! ▷ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled. ▷ Wear safety clothing and a protective mask if required. ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.
	⚠ WARNING Hands inside the pump casing Risk of injuries, damage to the pump! ▷ 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.

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

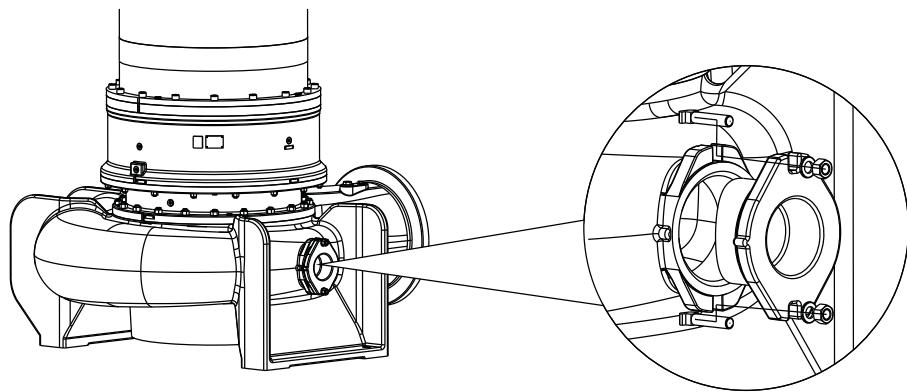


Fig. 33: Inspection hole at the casing

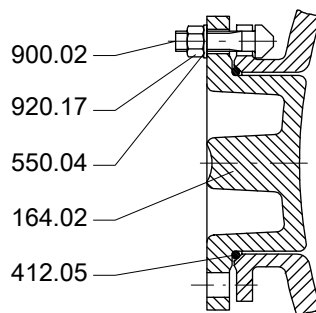


Fig. 34: Inspection hole in the casing

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).
- 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

	CAUTION
	Incorrect coolant mixture Corrosion of the cooling system ▷ Always use the exact coolant mixture.

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

(e.g. Tyfocor L¹⁷⁾ /water mixture, mixing ratio 38:62)

7.2.2.2 Coolant quantity

Table 33: Coolant quantity depending on the motor

Size	Motor							
	530 6 580 6 460 8 530 8 390 10 403 10 340 12		630 6 580 8 475 10 380 12		690 6 770 6 630 8 690 8 535 10 600 10 450 12 490 12		850 6 760 8 660 10 560 12	
	[liter]	[quart]	[liter]	[quart]	[liter]	[quart]	[liter]	[quart]
200-631	137	145	117	124	148	156	128	135
250-630	137	145	117	124	148	156	128	135
250-632	137	145	117	124	148	156	128	135
250-900	162	171	125	132	178	188	141	149
350-632	137	145	117	124	148	156	128	135
350-633	137	145	117	124	148	156	128	135
350-636	137	145	117	124	148	156	128	135
350-710	155	164	123	130	171	181	139	147
350-713	155	164	123	130	171	181	139	147
400-632	137	145	117	124	148	156	128	135
400-900	162	171	125	132	178	188	141	149
401-710	155	164	123	130	171	181	139	147
401-713	155	164	123	130	171	181	139	147
500-632	137	145	117	124	148	156	128	135
500-634	137	145	117	124	148	156	128	135

17) Manufacturer: Metalsol Chemie, Magdeburg, Germany

Size	Motor							
	530 6 580 6 460 8 530 8 390 10 403 10 340 12		630 6 580 8 475 10 380 12		690 6 770 6 630 8 690 8 535 10 600 10 450 12 490 12		850 6 760 8 660 10 560 12	
	[liter]	[quart]	[liter]	[quart]	[liter]	[quart]	[liter]	[quart]
500-640	137	145	117	124	148	156	128	135
501-710	155	164	123	130	171	181	139	147
501-900	162	171	125	132	178	188	141	149
600-710	155	164	123	130	171	181	139	147
700-901	162	171	125	132	178	188	141	149
700-902	162	171	125	132	178	188	141	149

7.2.2.3 Changing the coolant

	⚠ WARNING Coolants and supplies which pose a health hazard or are hot Hazard to persons and the environment! ▷ When draining the fluid take appropriate measures to protect persons and the environment. ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.
	⚠ WARNING Cooling liquid spurting out due to excess pressure in the cooling liquid chamber at operating temperature! Risk of injuries by parts flying off and escaping cooling liquid! ▷ Open the screw plug of the cooling liquid chamber very carefully.

Draining the coolant

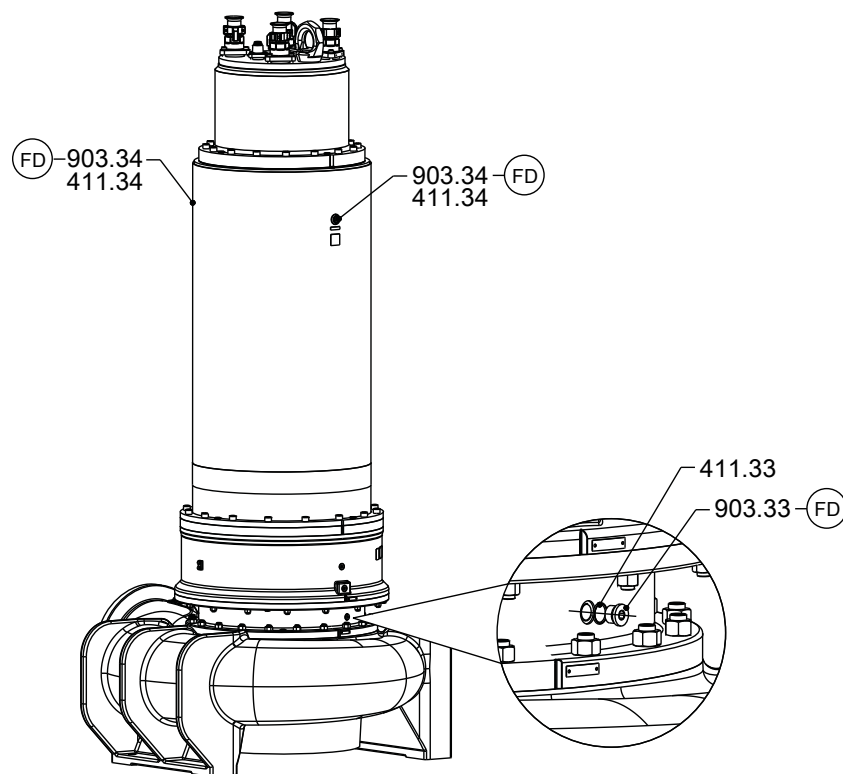


Fig. 35: Draining and filling in the coolant

411.33	Coolant drain
411.34	Coolant filler opening

Table 34: Key to the symbols and codes

Symbol	Description
(FD)	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

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

1. Place a suitable container under screw plug 903.33. (Coolant quantity.)
2. Unscrew and remove both screw plugs 903.34 with joint rings 411.34 at the filler openings (opposed by 180°).

3. Undo and remove screw plug 903.33 with joint ring 411.33. Drain off the coolant.



NOTE

The drain plug is not located at the lowest point of the cooling system. To fully drain all coolant, proceed as follows:

4. Change the pump set from a vertical to a horizontal position to drain the cooling system.



NOTE

Paraffin oil 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. If the coolant fill is severely contaminated by the fluid pumped, this will suggest a defect on the mechanical seals.

Filling in the coolant

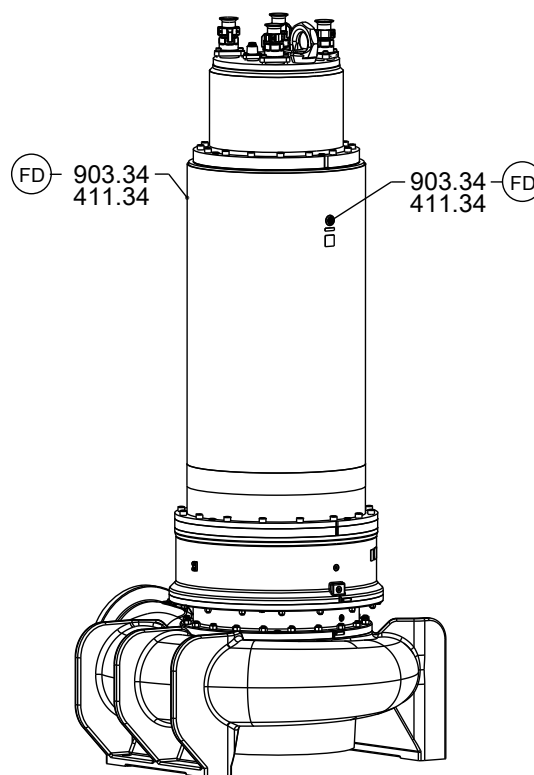


Fig. 36: Filling in the coolant

411.34	Coolant filler opening
--------	------------------------

Table 35: Key to the symbols and codes

Symbol	Description
	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

- ✓ 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.
 3. Screw in screw plug 903.34 with a new joint ring 411.34.

7.2.3 Lubrication and lubricant change

7.2.3.1 Lubricating the mechanical seal (pump sets without cooling system only — installation type 5)

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 of medicinal quality (unless otherwise specified by the customer).

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

Table 36: Lubricant quality

Description	Properties	
Paraffin oil or white oil. Alternative: motor oil grades SAE 10W to SAE 20W	Kinematic viscosity at 104 °F [40 °C]	< 0.065 ft/s ² [< 20 mm/s ²]
	Flash point (to Cleveland)	> 320 °F [> 160 °C]
	Solidification point (pour point)	< -5 °F [< -15 °C]

Recommended lubricants:

- Merkur WOP 40 PB, made by SASOL
- Merkur white oil Pharma 40, made by DEA
- Thin-bodied paraffin oil No. 7174, made by Merck
- Equivalent brands of medical quality, non-toxic
- Water-glycol mixture

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

7.2.3.1.3 Lubricant quantity

Table 37: Lubricant quantity depending on the motor

Size	Motor			
	530 6		690 6	
	580 6		770 6	
	630 6		850 6	
	460 8		630 8	
	530 8		690 8	
	580 8		760 8	
	390 10		535 10	
	430 10		600 10	
	475 10		660 10	
	340 12		450 12	
	380 12		490 12	
560 12				
Lubricant quantity				
[quart]	[l]	[quart]	[l]	
200-631	5,7	5,4	4,8	4,5
250-630	5,7	5,4	4,8	4,5
250-632	5,7	5,4	4,8	4,5
250-900	5,7	5,4	4,8	4,5

Size	Motor			
	530 6 580 6 630 6 460 8 530 8 580 8 390 10 430 10 475 10 340 12 380 12		690 6 770 6 850 6 630 8 690 8 760 8 535 10 600 10 660 10 450 12 490 12 560 12	
	Lubricant quantity			
	[quart]	[l]	[quart]	[l]
350-632	5,7	5,4	4,8	4,5
350-633	5,7	5,4	4,8	4,5
350-636	5,7	5,4	4,8	4,5
350-710	5,7	5,4	4,8	4,5
350-713	5,7	5,4	4,8	4,5
400-632	5,7	5,4	4,8	4,5
400-900	5,7	5,4	4,8	4,5
401-710	5,7	5,4	4,8	4,5
401-713	5,7	5,4	4,8	4,5
500-632	5,7	5,4	4,8	4,5
500-634	5,7	5,4	4,8	4,5
500-640	5,7	5,4	4,8	4,5
501-710	5,7	5,4	4,8	4,5
501-900	5,7	5,4	4,8	4,5
600-710	5,7	5,4	4,8	4,5
700-901	5,7	5,4	4,8	4,5
700-902	5,7	5,4	4,8	4,5

7.2.3.1.4 Changing the lubricant

	 WARNING
	Lubricants posing a health hazard and/or hot lubricants Hazard to persons and the environment! ▷ When draining the lubricant take appropriate measures to protect persons and the environment. ▷ Wear safety clothing and a protective mask if required. ▷ Collect and dispose of any lubricants. ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.
	 WARNING
	Excess pressure in the lubricant chamber Liquid spurting out when the lubricant chamber is opened at operating temperature! ▷ Open the screw plug of the lubricant chamber very carefully.

Draining the lubricant

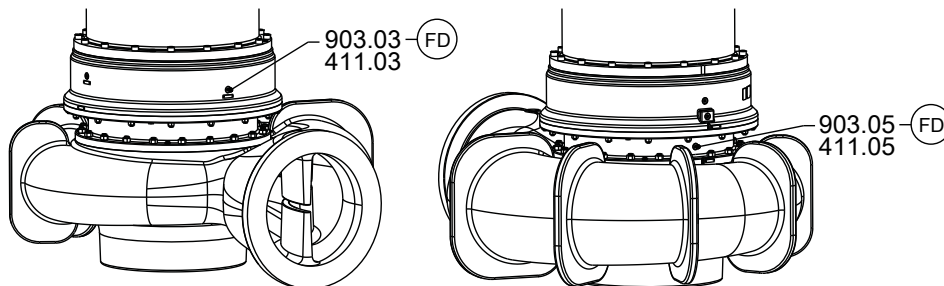


Fig. 37: Draining and filling in the lubricant

Table 38: Key to the symbols and codes

Symbol	Description
FD	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

- ✓ 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.
 4. Screw in screw plug 903.03 with a new joint ring 411.03.

7.2.3.2 Lubricating the rolling element bearings

The drive-end (radial) rolling element bearing of the pump set is grease-packed and maintenance-free. The pump-end (fixed) bearings must be re-lubricated as part of the maintenance work.

The maximum permissible re-lubrication interval for the pump-end bearings depends on the fluid temperature as indicated in the following diagram (the bearings must be re-lubricated at least every two years). Earlier re-lubrication as part of annual maintenance work is permissible. The chamber for used grease is designed for re-lubricating the bearings 9 times. The chamber for used grease is to be drained as part of the general overhaul.

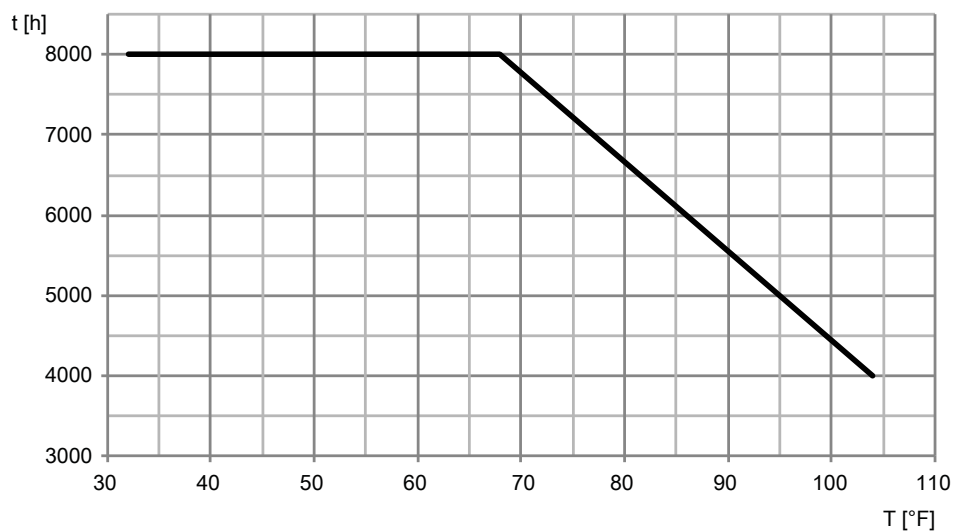


Fig. 38: Re-lubrication intervals for the bearings depending on the fluid temperature [°F]

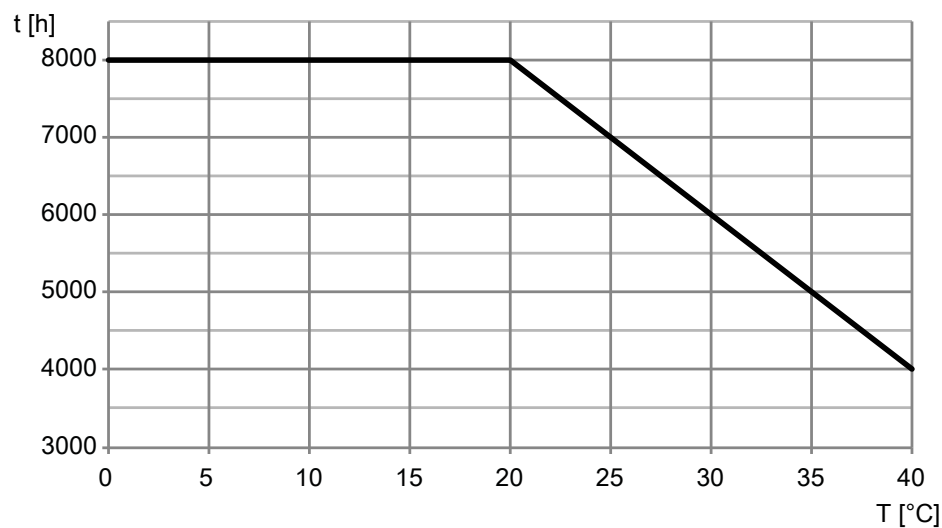


Fig. 39: Re-lubrication intervals for the bearings depending on the fluid temperature [°C]

7.2.3.2.1 Grease quality

	CAUTION
	Mix of different grease types Damage to the pump set! ▷ Make sure to use the right type of grease. ▷ Never mix different types of grease.

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

Table 39: Lubricant characteristics

Base oil	NLGI grade (DIN 51518)	Worked penetration at 77 °F [25 °C], 0.1 mm (DIN 51818)	Drop point (ISO 2176)	Application temperature range	Viscosity at 104 °F [40 °C] (DIN 51562)	Viscosity at 212 °F [100 °C] (DIN 51562)
Ester oil and perfluorinated polyether oil	2	240 to 270	≥ 482 ° F [250 °C]	-40 °F to 392 °F [-40 °C to 200 °C]	160	27

The re-lubrication and maintenance intervals apply to the grease type originally used by the manufacturer:

- Klüberquiet BMQ 72-162, made by Klüber Lubrication München KG

7.2.3.2.2 Grease quantity for re-lubrication

Table 40: Grease quantity depending on the motor

Size	Motor			
	530 6 580 6 630 6 460 8 530 8 580 8 390 10 430 10 475 10 340 12 380 12		690 6 770 6 850 6 630 8 690 8 760 8 535 10 600 10 660 10 450 12 490 12 560 12	
	[oz]	[g]	[oz]	[g]
200-631	6,0	170	7,4	210
250-630	6,0	170	7,4	210
250-632	6,0	170	7,4	210
250-900	6,0	170	7,4	210
350-632	6,0	170	7,4	210
350-633	6,0	170	7,4	210
350-636	6,0	170	7,4	210
350-710	6,0	170	7,4	210
350-713	6,0	170	7,4	210
400-632	6,0	170	7,4	210
400-900	6,0	170	7,4	210
401-710	6,0	170	7,4	210
401-713	6,0	170	7,4	210
500-632	6,0	170	7,4	210
500-634	6,0	170	7,4	210
500-640	6,0	170	7,4	210
501-710	6,0	170	7,4	210
501-900	6,0	170	7,4	210
600-710	6,0	170	7,4	210

Size	Motor			
	530 6		690 6	
	580 6		770 6	
	630 6		850 6	
	460 8		630 8	
	530 8		690 8	
	580 8		760 8	
	390 10		535 10	
	430 10		600 10	
	475 10		660 10	
	340 12		450 12	
	380 12		490 12	
			560 12	
	[oz]	[g]	[oz]	[g]
700-901	6,0	170	7,4	210
700-902	6,0	170	7,4	210

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.

	 DANGER
	Dry running Explosion hazard! ▸ Re-lubricate nonincendive pump sets outside potentially explosive atmospheres.
	 WARNING
	Hands inside the pump casing Risk of injuries, damage to the pump! ▸ 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.
	CAUTION
	Incomplete re-lubrication Bearing damage! ▸ Always re-lubricate the bearings with the pump set in operation.

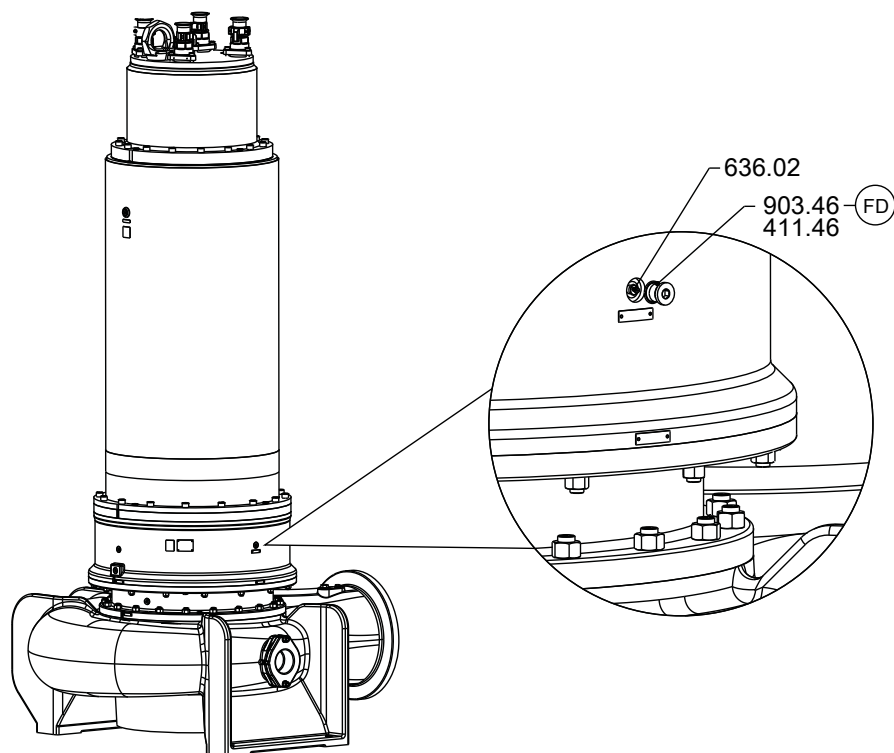


Fig. 40: Lubricating nipple

Table 41: Key to the symbols and codes

Symbol	Description
(FD)	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

- ✓ 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.

	CAUTION
	Pump set running dry Increased vibrations! Damage to mechanical seals and bearings! ▷ Never operate the pump set for more than 60 seconds outside the fluid to be handled.

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

7.3 Drainage/cleaning

	 WARNING
	Fluids handled, consumables and operating supplies which are hot or pose a health hazard Hazard to persons and the environment! ▷ Collect and properly dispose of the flushing fluid and of any residues of the fluid handled. ▷ Wear safety clothing and a protective mask if required. ▷ Observe all legal regulations on the disposal of fluids posing a health hazard.

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 118)

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations

	 WARNING
	Unqualified personnel performing work on the pump (set) Risk of personal injury! ▷ Always have repair work and maintenance work performed by specially trained, qualified personnel.
	 WARNING
	Hot surface Risk of personal injury! ▷ Allow the pump set to cool down to ambient temperature.
	 WARNING
	Improper lifting/moving of heavy assemblies or components Personal injury and damage to property! ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

Observe the general safety instructions and information.

For dismantling and reassembly observe the general assembly drawing.

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

	 DANGER
	Insufficient preparation of work on the pump (set) Risk of personal injury! ▷ Properly shut down the pump set. ▷ Close the shut-off elements in the suction line and discharge line. ▷ Drain the pump and release the pump pressure. ▷ Shut off any auxiliary feed lines. ▷ Allow the pump set to cool down to ambient temperature.

	 WARNING Components with sharp edges Risk of cutting or shearing injuries! ▷ Always use appropriate caution for installation and dismantling work. ▷ Wear work gloves.
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7.4.2 Preparing the pump set

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 72) have been observed/ carried out.
- 1. De-energize the pump set and secure it against unintentional start-up.
- 2. On pump sets without cooling system (installation type S) drain the lubricant.
- 3. On pump sets with cooling system (installation types D and K) drain the coolant.
- 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:

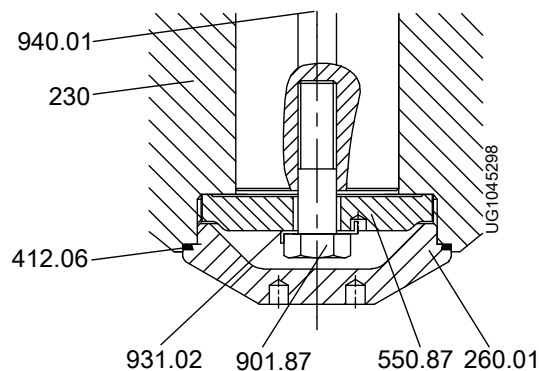
1. Undo nuts 920.13. Remove bail 571.
2. Screw suitable (swivel) eye nuts onto studs 902.13.
3. Undo screwed connection 902.01 and 920.01 and pull the complete back pull-out unit out of pump casing 101.
4. Place the back pull-out unit in a safe and dry assembly area and secure it against tipping over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

7.4.3.2 Removing the impeller

The procedures for removing the impeller differ depending on the pump size and motor in question.

Table 42: Impeller fastening elements depending on the motor

Size	Motor	
	530 6 580 6 630 6 460 8 530 8 580 8 390 10 430 10 475 10 340 12 380 12	690 6 770 6 850 6 630 8 690 8 760 8 535 10 600 10 660 10 450 12 490 12 560 12
200-631	N110	N110
250-630	N110	N110
250-632	N110	N110
250-900	N110	N140
350-632	N110	N110
350-633	N110	N110
350-636	N110	N110
350-710	N110X-2	N110X-2
350-713	N110X	N110X
400-632	N110	N110
400-900	N110	N140
401-710	N110	N140
401-713	N110	N140
500-632	N110-3	N110-3
500-634	N110	N110
500-640	N110-3	N110-3
501-710	N110X	N140
501-900	N110	N160
600-710	N110X	N110X
700-901	N110	N160
700-902	N110	N160

Impeller fastening elements N110, N110X

Fig. 41: Impeller fastening elements N110, N110X

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.
5. Remove key 940.01.

Impeller fastening elements N110X-2

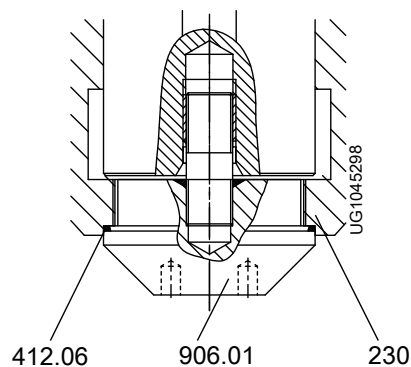


Fig. 42: Impeller fastening elements N110X-2

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.
4. Remove key 940.01.

Impeller fastening elements N110-3

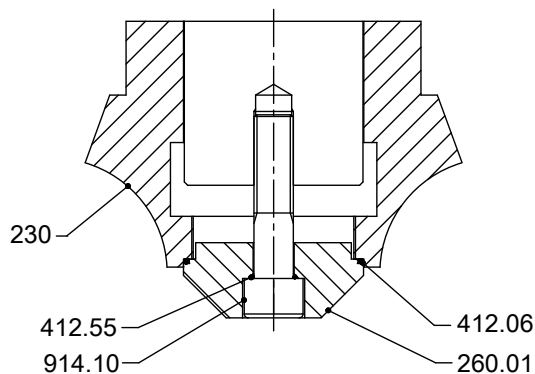


Fig. 43: Impeller fastening elements N110-3

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.
4. Remove keys 940.01.

Impeller fastening elements N140, N160

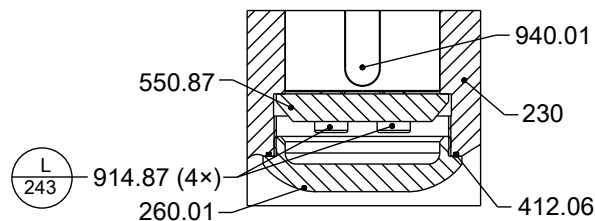


Fig. 44: Impeller fastening elements N140, N160

Table 43: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

1. Unscrew impeller hub cap 260.01 using a special wrench (right-hand thread).
2. Remove O-ring 412.06.
3. Undo (four) hexagon socket head cap screws 914.87. Remove them together with disc 550.87.
4. Pull off impeller 230 with a special impeller fitting and removal tool.
5. Remove key 940.01.

7.4.3.2.1 Using the special impeller fitting and removal tool

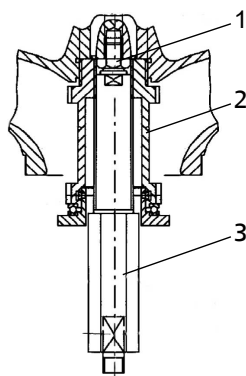


Fig. 45: Special impeller fitting and removal tool

1. Screw hexagon head bolt 1 into the shaft end to prevent any damage to the shaft thread.
2. Screw part 2 into the impeller.
3. Screw fully threaded stud 3 into part 2 and pull off the impeller.

Table 44: Special impeller fitting and removal tool

Size	Motor	
	530 6 580 6 630 6 460 8 530 8 580 8 390 10 430 10 475 10 340 12 380 12	690 6 770 6 850 6 630 8 690 8 760 8 535 10 600 10 660 10 450 12 490 12 560 12
200-631	AV4	AV4
250-630	AV4	AV4
250-632	AV4	AV4
250-900	AV4	AV6
350-632	AV4	AV4
350-633	AV4	AV4
350-636	AV4	AV4
350-710	AV5	AV5
350-713	AV4	AV4
400-632	AV4	AV4

Size	Motor	
	530 6 580 6 630 6 460 8 530 8 580 8 390 10 430 10 475 10 340 12 380 12	690 6 770 6 850 6 630 8 690 8 760 8 535 10 600 10 660 10 450 12 490 12 560 12
400-900	AV4	AV6
401-710	AV4	AV6
401-713	AV4	AV6
500-632	AV5	AV5
500-634	AV4	AV4
500-640	AV5	AV5
501-710	AV4	AV6
501-900	AV7	AV8
600-710	AV4	AV4
700-901	AV7	AV8
700-902	AV7	AV8

7.4.3.3 Removing the mechanical seal

Remove the mechanical seal in accordance with the general arrangement drawings.

7.4.3.3.1 Removing the pump-end mechanical seal

- ✓ 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, depending on the version also spacer sleeve 525, off shaft 210.
 2. Undo socket head cap screws 914.55.
 3. Push the stationary seat of mechanical seal 433.02 out of discharge cover 163. Use the extraction threads in the stationary seat, which are either M6 or M8, depending on the size of mechanical seal.

7.4.3.3.2 Removing the drive-end mechanical seal

- ✓ The back pull-out unit, impeller and pump-end mechanical seal have been removed as described
 1. Undo screwed connection 920.27 and pull the discharge cover out of the bearing housing.
 2. On installation types K and D remove the auxiliary impeller for coolant circulation. Remove pump-end circlip 932.32, pull the auxiliary impeller off the shaft, remove key 940.02 and drive-end circlip 932.32 (depending on the variant).
 3. Undo the grub screws of mechanical seal 433.01 and pull its rotating assembly off the shaft.
 4. Undo socket head cap screws 914.54.
 5. Push the stationary seat of mechanical seal 433.01 out of bearing housing 350. Use the extraction threads in the stationary seat, which are either M6 or M8, depending on the size of mechanical seal.

7.4.3.4 Removing the cooling jacket

	CAUTION Screwing eyebolts for removing the cooling jacket into the coolant filler openings or into the threaded holes for lifting the pump set Damage to the cooling jacket! ▷ Always use the forcing screw holes provided for pulling off the cooling jacket.
---	--

✓ Motor housing cover 812 has been removed.

1. Remove screw plug 903.50 at the lower flange as well as screw plug 903.51 at the upper flange of the cooling jacket.
2. Insert two M12 eyebolts into the threaded holes in the upper flange of the cooling jacket.
3. Attach the eyebolts to the lifting equipment.
4. Use the M20 extraction thread in the lower flange of the cooling jacket to move the cooling jacket up until it lifts off the centering seat of the motor housing. Then use the lifting equipment to pull the cooling jacket upwards and remove it from the pump set.

7.4.4 Dismantling the motor section

	NOTE Repairs or modifications of the pump set can affect explosion protection and may, therefore, only be made by the manufacturer or a repair shop certified by FM Approvals.
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	NOTE Motors of nonincendive pump sets: Any work on the motor section which could affect explosion protection, such as re-winding and repair work on the sensors, must be inspected by an approved expert or performed by the motor manufacturer. No modifications may be made to the internal configuration of the motor.
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When dismantling the motor section and the connection cable make sure that the cores/terminals are clearly marked for future reassembly.

7.4.4.1 Removing the motor housing cover

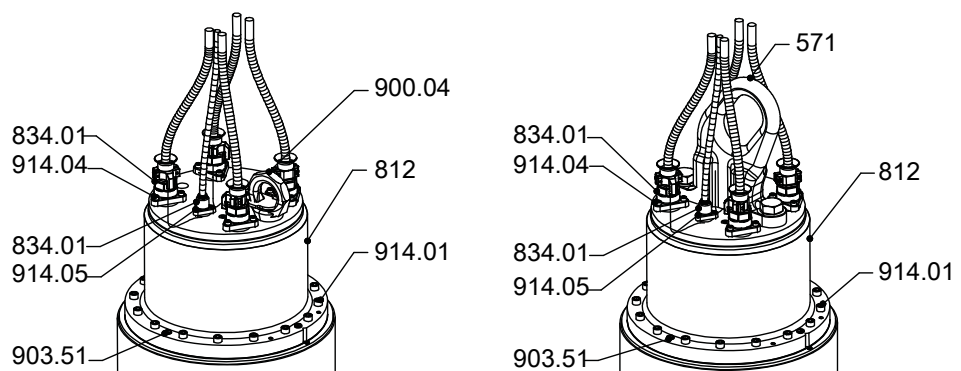


Fig. 46: Removing the motor housing cover

✓ 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 the motor housing cover up further until the power cable and control cables can be disconnected.
6. Inside the motor disconnect the individual cores of the power cable.

7.4.4.2 Removing the power cable

- ✓ Suitable lifting equipment is provided.
 - ✓ The pump set has been disconnected from the power supply. It has been securely placed on a level surface in a vertical position.
 - ✓ The motor housing cover has been removed.
1. Undo the screws 914.04 and 914.05 of cable glands 834.01 and 834.02.
 2. Pull the cable gland out of the centering seat in the motor housing cover.

7.5 Reassembling the pump set

7.5.1 General information/Safety regulations

	! WARNING Improper lifting/moving of heavy assemblies or components Personal injury and damage to property! ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.
	! WARNING Components with sharp edges Risk of cutting or shearing injuries! ▷ Always use appropriate caution for installation and dismantling work. ▷ Wear work gloves.
	CAUTION Improper reassembly Damage to the pump! ▷ Reassemble the pump (set) in accordance with the general rules of sound engineering practice. ▷ Use original spare parts only.

Sequence Always reassemble the pump 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 pump section

7.5.2.1 Installing the mechanical seal

Observe the following points 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 mechanical seals, wet the O-rings with soapy water (not oil).
 - Prevent the O-rings from sliding into any grooves in the shaft by lining the relevant grooves with suitable means.
 - To prevent any damage to the O-rings, cover the free shaft stub and any sharp edges of the shaft in thin foil (of approximately 0.1 to 0.3 mm thickness). Slip the rotating assembly over the foil into its installation position. Then remove the foil.
- ✓ The shaft and rolling element bearings have been properly installed in the motor.
1. Screw the stationary assembly of mechanical seal 433.01 to bearing housing 350 with screw 914.54. Secure screw 914.54 with a thread-locking agent (Loctite, type 243).
 2. Slide the rotating assembly of mechanical seal 433.01 onto the shaft and fasten it to the shaft with parallel pins. Secure the parallel pins with a thread-locking agent (Loctite, type 243).
 3. **On pump sets with cooling system (installation types K and D):** If applicable to the motor version, fasten drive-end circlip 932.32 to the shaft. Insert key 940.02 into the shaft keyway, slide auxiliary impeller 23-2 onto the shaft and fasten the auxiliary impeller with pump-end circlip 932.32.
 4. Insert O-ring 412.04 and O-ring 412.24 (depending on the variant) into the discharge cover. Fasten the discharge cover to the bearing housing with screwed connection 902.27/920.27.
 5. Screw the stationary assembly of mechanical seal 433.02 to discharge cover 163 with screw 914.55. Secure screw 914.55 with a thread-locking agent (Loctite, type 243).
 6. **N110 / N110X:** (see section 7.4.3.2) Slide the rotating assembly of mechanical seal 433.02 onto the spacer sleeve and fasten it with parallel pins. Secure the parallel pins with a thread-locking agent (Loctite, type 243). Slide the spacer sleeve with the mechanical seal onto the shaft.
N140 / N160: (see section 7.4.3.2) Slide the rotating assembly of mechanical seal 433.02 onto the shaft. The rotating assembly of the mechanical seal is fastened by fitting the impeller.

7.5.2.2 Fitting the impeller

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

Impeller fastening elements N110, N110X

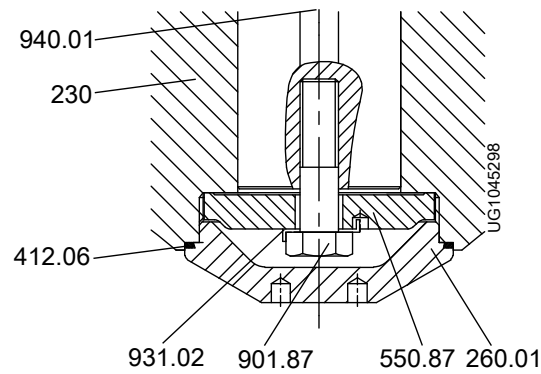


Fig. 47: Impeller fastening elements N110, N110X

1. Insert key 940.01.
2. Mount impeller 230 with a special impeller fitting and removal tool.
3. Screw in hexagon head bolt 901.87 with disc 550.87. Bend over lock washer 931.02.
4. Insert O-ring 412.06.
5. Screw in impeller hub cap 260.01 using a special wrench (right-hand thread).

Impeller fastening elements N110X-2

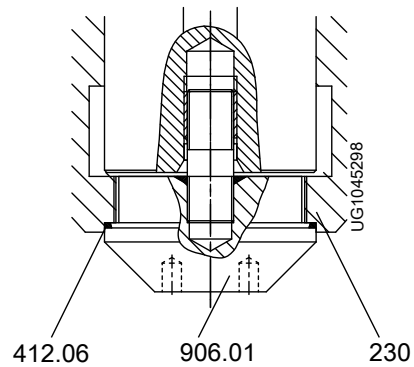


Fig. 48: Impeller fastening elements N110X-2

1. Insert key 940.01.
2. Mount impeller 230 with a special impeller fitting and removal tool.
3. Insert O-ring 412.06.
4. Screw in impeller screw 906.01 using a special wrench (right-hand thread).

Impeller fastening elements N110-3

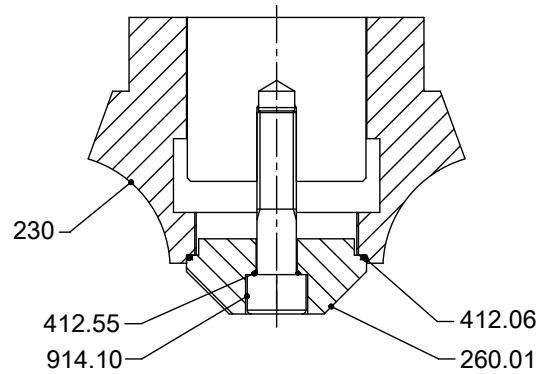


Fig. 49: Impeller fastening elements N110-3

1. Insert keys 940.01.
2. Fit impeller 230 using a special impeller fitting and removal tool.
3. Fit impeller hub cap 260.01 with O-ring 412.55 and O-ring 412.06.
4. Screw in hexagon socket head cap screw 914.10 (right-hand thread).

Impeller fastening elements N140, N160

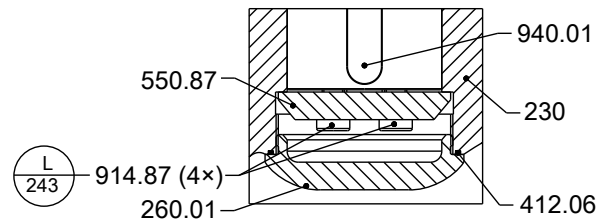


Fig. 50: Impeller fastening elements N140, N160

Table 45: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

1. Insert keys 940.01.
2. Fit impeller 230 using a special impeller fitting and removal tool.
3. Screw in hexagon socket head cap screws 914.87 with disc 550.87. Secure the hexagon socket head cap screws with a thread-locking agent (Loctite, type 243).
4. Insert O-ring 412.06.
5. Screw in impeller hub cap 260.01 using a special wrench (right-hand thread).

7.5.2.2.1 Fitting the impeller using the special impeller fitting and removal tool

1. Fit the impeller using the special impeller fitting and removal tool.
(⇒ Section , Page 83)
2. Fit the impeller fastening elements.

7.5.2.2.1.1 Using the special impeller fitting and removal tool

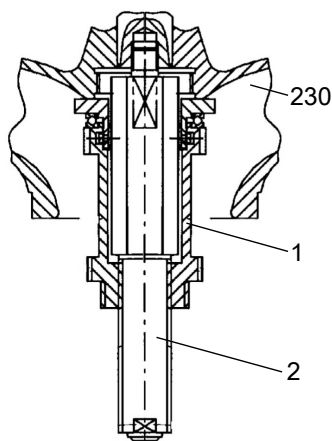


Fig. 51: Special impeller fitting and removal tool.

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

7.5.2.3 Installing the back pull-out unit

- ✓ The shaft, rolling element bearings, mechanical seal and impeller have been assembled properly.
1. Insert O-ring 412.12 into the discharge cover.
 2. Insert the complete back pull-out unit into the pump casing.
 3. Evenly tighten screwed connection 920.01 between pump casing and discharge cover 163.

7.5.3 Reassembling the motor section



NOTE

Before reassembling the motor section, verify that all parts are undamaged. Replace damaged parts. Only use original spare parts made by KSB for nonincendive pump sets. Secure all screwed connections closing off the motor with a thread-locking agent (Loctite type 243).

7.5.3.1 Fitting the cable gland

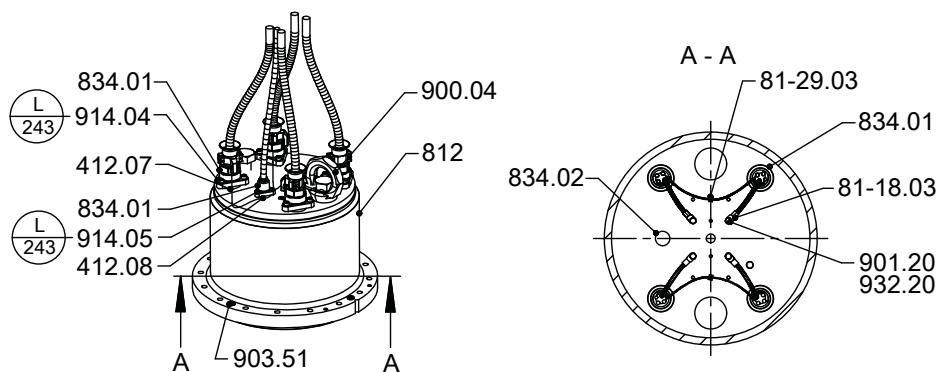


Fig. 52: Installing the cable gland

Table 46: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

- ✓ The core identification has been attached in a visible location
- ✓ The core identification has been verified against the wiring diagram.
- 1. Slide O-ring 412.07 onto the short end of the power cable and into the groove of the centering seat.
- 2. Insert cable gland 834.01 with the power cable and O-ring 412.07 into the opening provided.
- 3. Fasten cable gland 834.01 with hexagon socket head cap screws 914.04. Secure the screwed connection with Loctite 243.
- 4. Connect cable sockets to the ends of the individual cores of the power cable. Fasten the ground conductor (conductor identification green/yellow) of the power cable to motor housing cover 812 with bolt 901.20 and spring washer 932.20.
- 5. Connect the shield of shielded cables to terminal 81-29.03 on the motor housing cover.
- 6. Slide O-ring 412.08 over the short end of the control cable and into the groove of the centering seat.
- 7. Insert cable gland 834.02 with the control cable and O-ring 412.08 into the opening provided.
- 8. Fasten cable gland 834.02 with hexagon socket head cap screws 914.05. Secure the screwed connection with Loctite 243.

7.5.3.2 Fitting the motor housing cover

	 DANGER Work on the pump set by unqualified personnel Danger of death from electric shock! ▷ Always have the electrical connections installed by a trained electrician. ▷ Observe the provisions of the IEC 60364 standard.
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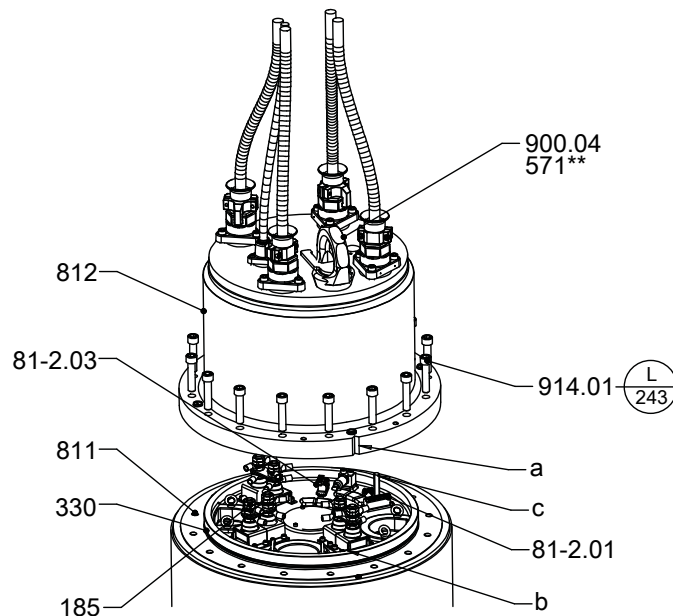


Fig. 53: Fitting the motor housing cover

a	Alignment groove on motor housing cover	b	Alignment groove on bearing bracket
c	Anti-rotation device on bearing bracket		

**: Optional

Table 47: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

✓ A new O-ring has been inserted into the groove of bearing bracket 330.

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 until only a gap remains which allows work to continue. Make sure that the alignment grooves on the motor housing and on the bearing bracket are correctly aligned. Only in this position will the anti-rotation device on the bearing bracket engage in the corresponding recess in the motor housing cover.
2. Connect the control cable properly to the terminals at the plug. Then plug it into connector block 81-2.01 (and 81-2.03, depending on the model) which is fastened to bearing bracket 330.
3. Fasten the power cable ends with cable terminal to terminal 185, using disc 550.23 and nuts.
4. Tie the control cable and power cables together with cable ties.
5. Carry out electrical tests of the cables and monitoring equipment.
6. If the test results are successful, slowly lower motor housing cover 812 onto motor housing 811.
Watch the alignment grooves in motor housing cover 812 and motor housing 811. The grooves must be aligned correctly.
7. Fasten motor housing cover 812 to motor housing 811 or motor unit 80-1 with hexagon socket head cap screws 914.01. Secure the screwed connection with Loctite 243.
Observe the tightening torque!
8. Cover the jacking threads with caps 903.51.
9. Perform a leak test on the motor.

7.5.4 Leak testing

After reassembly, always test the mechanical seal area (oil chamber or cooling system) and the motor for leakage.

7.5.4.1 Testing the mechanical seal area for leakage

Observe the following values for leak testing:

- **Test medium:** compressed air
- **Test pressure:** 15.4 psi [1.0 bar]
- **Test duration:** 5 minutes
- **Opening:**

Pump sets with cooling system (installation types D, K): coolant filler opening or drain

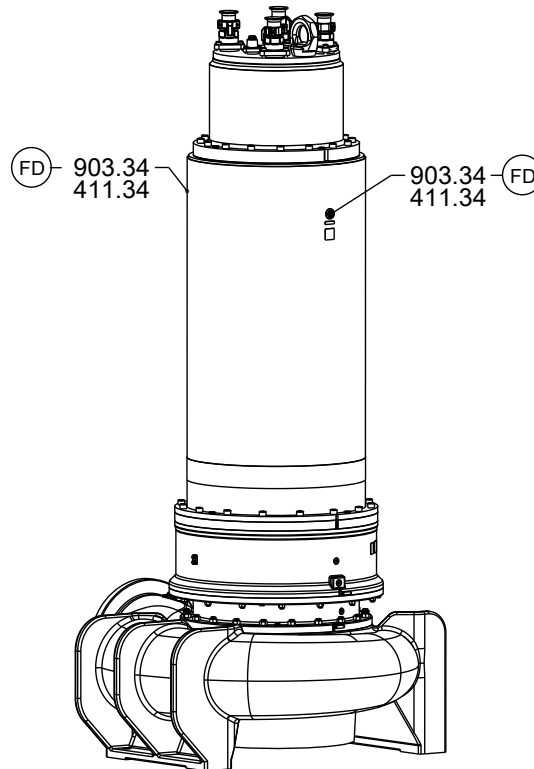


Fig. 54: Pump sets with cooling system

Table 48: Key to the symbols and codes

Symbol	Description
(FD)	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

Pump sets without cooling system (installation type S): lubricant filler opening or drain

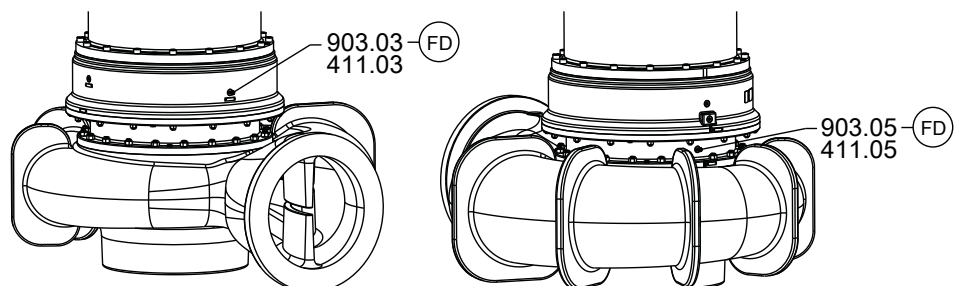


Fig. 55: Pump sets without cooling system

Table 49: Key to the symbols and codes

Symbol	Description
(FD)	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

1. Remove the screw plug and joint ring of the lubricant chamber and/or cooling system.
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 seals and screwed connections.
4. Repeat the leak test if required.
5. Remove the testing device.
6. After the leak test, top up coolant or 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

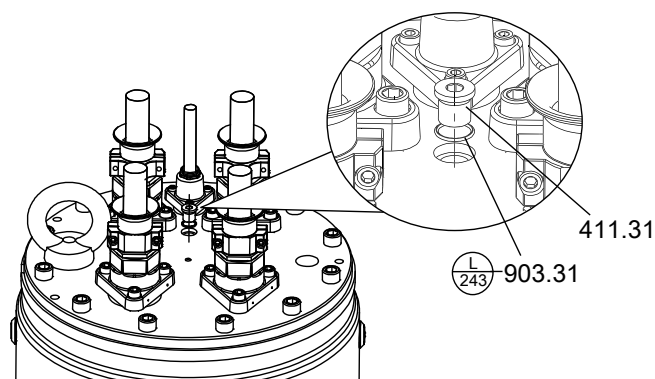


Fig. 56: Leak testing the motor

Table 50: Key to the symbols and codes

Symbol	Description
(L 243)	Always secure screwed connections marked with this symbol with Loctite 243 .

1. Undo and remove screw plug 903.31 with 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 seals and screwed connections.
4. Repeat the leak test if required.
5. Remove the testing device.

	 DANGER
	Screw plug leaking or missing Damage to the motor! ▷ Never start up a pump set without screw plug 903.31. ▷ Apply a thread-locking agent (Loctite 243) to screw plug 903.31.

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 power cables after reassembly. (⇒ Section 7.2.1, Page 56)

7.6 Tightening torques

Table 51: Tightening torques

Property class Rp 0.2 N/mm ²	A4-50		A4-70				1.4462		8.8	
	210		250		450		450		640	
Thread	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]	[lbf ft]	[Nm]
M8	-	-	-	-	12,5	17	12,5	17		25
M10	-	-	-	-	26	35	26	35	37	50
M12	-	-	-	-	44	60	44	60	63	85
M14	-	-	-	-	66	90	66	90	96	130
M16	-	-	-	-	110	150	110	150	155	210
M20	-	-	-	-	215	290	215	290	302	410
M24	170	230		278	-	-		500	515	700
M30	340	460	-	-	-	-		1000	1035	1400
M42	960	1300	-	-	-	-		2750	2875	3900
M48	1440	1950	-	-	-	-		4200	4425	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 92)
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

18) For two years of continuous operation or 17,800 operating hours

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

Table 52: Quantity of spare parts for recommended spare parts stock¹⁸⁾

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 %
321.01 / 322	Rolling element bearing, motor end	1	1	2	2	3	4	50 %
320 / 321.02	Rolling element 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 %

8 Trouble-shooting

	 WARNING
	Improper remedial work Risk of personal injury! ► 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.

If problems occur that are not described in the following table, consultation with KSB's customer 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

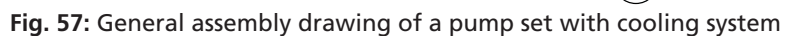
Table 53: Trouble-shooting

A	B	C	D	E	Possible cause	Remedy
-	X	-	-	-	Pump delivers against an excessively high discharge pressure.	Re-adjust to duty point.
-	X	-	-	-	Valve in discharge pipe not fully open	Open gate valve completely
-	-	X	-	X	Pump is running in the off-design range (part load/overload).	Check operating data of the pump
X	-	-	-	-	Pump or piping are not completely vented.	Dry installation: Vent and/or prime the pump and piping; fit a vent valve if required. Wet installation: Vent by lifting the pump off the base elbow and lowering it again.
X	X	-	X	X	Wet installation: Pump intake clogged by deposits Dry installation: Inlet line clogged by deposits	Clean inlet, pump parts 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 power cable. 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	-	-	-	-	Defective motor winding	Contact KSB.
-	X	-	-	-	Wet installation: Water level lowered too much during operation	Check level control equipment.

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

9.1 General assembly drawings with list of components

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



*: Installation type D only

***: Specific sizes only

①: Washers 550.06 eliminate axial play

Table 54: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .
	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

Table 55: List of components

Part No.	Description	Part No.	Description
101	Pump casing	66-2	Cooling jacket
163	Discharge cover	80-1	Motor unit
23-2	Auxiliary impeller	81-18.03	Cable terminal
230	Impeller	81-29.03	Terminal
260.01	Impeller hub cap	81-45	Float switch
320	Rolling element bearing	81-92.23	Cover plate
330	Bearing bracket	812	Motor housing cover
350	Bearing housing	818	Rotor
360	Bearing cover	900.04	Bolt/screw
411.01/.26/.34	Joint ring	901.20	Hexagon head bolt
412.01/.02/.03/.04/.06/.12/.15/.17/.45/.46/.47/.50/.51	O-ring	902.01/.27	Stud
421.02/.03	Lip seal	903.01/.34/.52	Screw plug
471.53	Seal cover	914.01/.02/.87	Hexagon socket head cap screw
500.05	Ring	920.01/.27	Nut
503	Impeller wear ring	932.02/.20/.32/.47	Circlip
512.02/.03	Wear ring	940.01/.02	Key
550.49/.87	Disc	950.02	Spring
647	Grease regulator		

9.1.2 Pump sets without cooling system (installation type S)

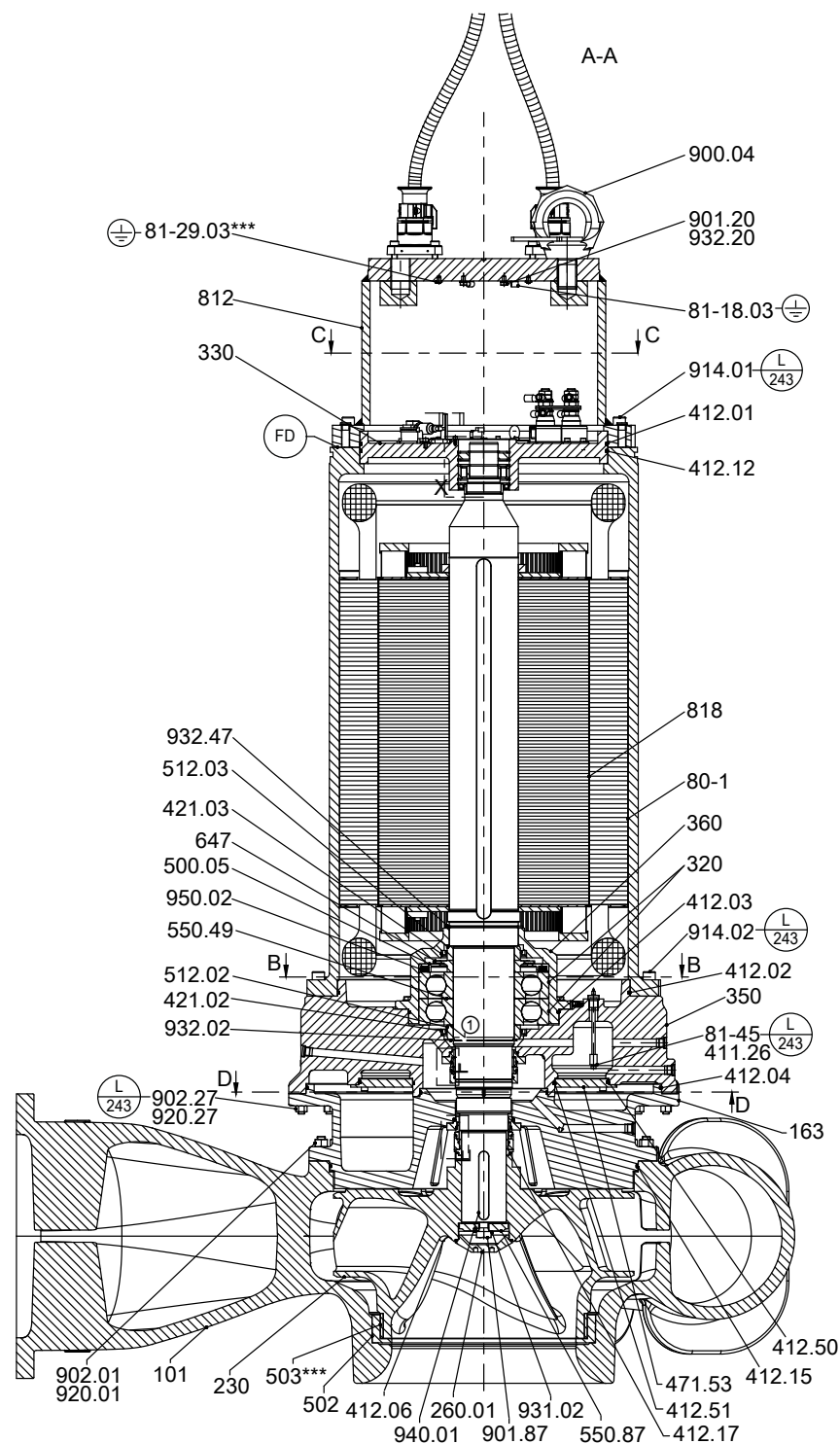


Fig. 58: General assembly drawing of a pump set without cooling system

***: Specific sizes only

①: Washers 550.06 eliminate axial play

Table 56: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .
	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

Table 57: List of components

Part No.	Description	Part No.	Description
101	Pump casing	647	Grease regulator
163	Discharge cover	80-1	Motor unit
230	Impeller	81-18.03	Cable terminal
260.01	Impeller hub cap	81-29.03	Terminal
320	Rolling element bearing	81-45	Float switch
330	Bearing bracket	812	Motor housing cover
350	Bearing housing	818	Rotor
360	Bearing cover	900.04	Bolt/screw
411.26	Joint ring	901.20/.87	Hexagon head bolt
412.01/.02/.03/.04/.06/.12/.15/.17/.50/.51	O-ring	902.01/.27	Stud
421.02/.03	Lip seal	914.01/.02	Hexagon socket head cap screw
471.53	Seal cover	920.01/.27	Nut
500.05	Ring	931.02	Lock washer
502	Casing wear ring	932.02/.20/.47	Circlip
503	Impeller wear ring	940.01	Key
512.02/.03	Wear ring	950.02	Spring
550.49/.87	Disc		

9.2 Detailed views

9.2.1 Side views

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

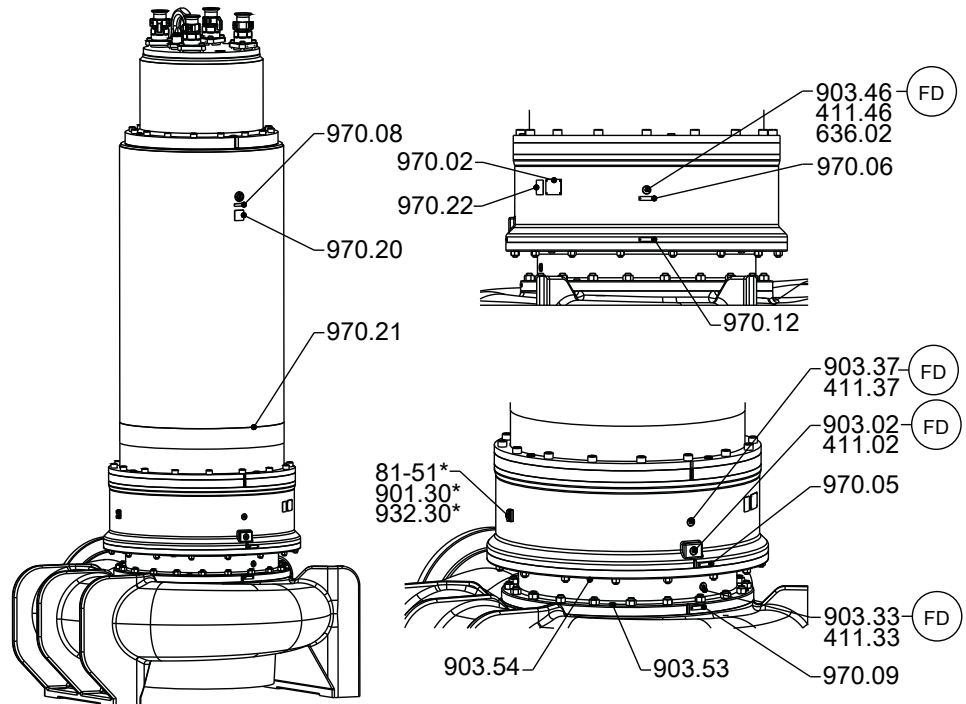


Fig. 59: Side views

*: Installation type D only

Table 58: Key to the symbols and codes

Symbol	Description
(FD)	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

Table 59: List of components

Part No.	Description	Part No.	Description
411.02/.33/.37/.46	Joint ring	903.02/.33/.37/.46/.53/.54	Screw plug
636.02	Lubricating nipple	932.30	Circlip
81-51	Clamping element	970.02/.05/.06/.08/.09/.12 /.20/.21/.22	Label/plate
901.30	Hexagon head bolt		

Pump sets without cooling system (installation type S)

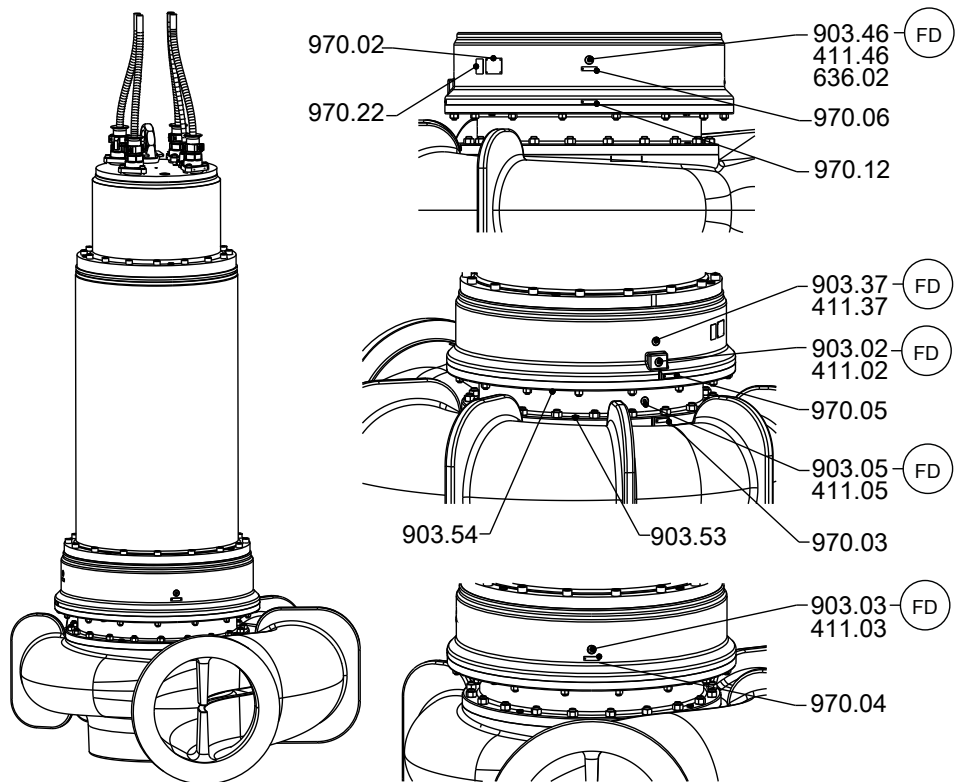


Fig. 60: Side views

Table 60: Key to the symbols and codes

Symbol	Description
(FD)	Always apply a liquid sealing agent (e.g. Hylomar SQ32M) to sealing surfaces marked with this symbol.

Table 61: List of components

Part No.	Description	Part No.	Description
411.02/03/05/37/46	Joint ring	903.02/03/05/37/46/53/54	Screw plug
636.02	Lubricating nipple	970.02/03/04/05/06/12/22	Label/plate

9.2.2 Top views

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

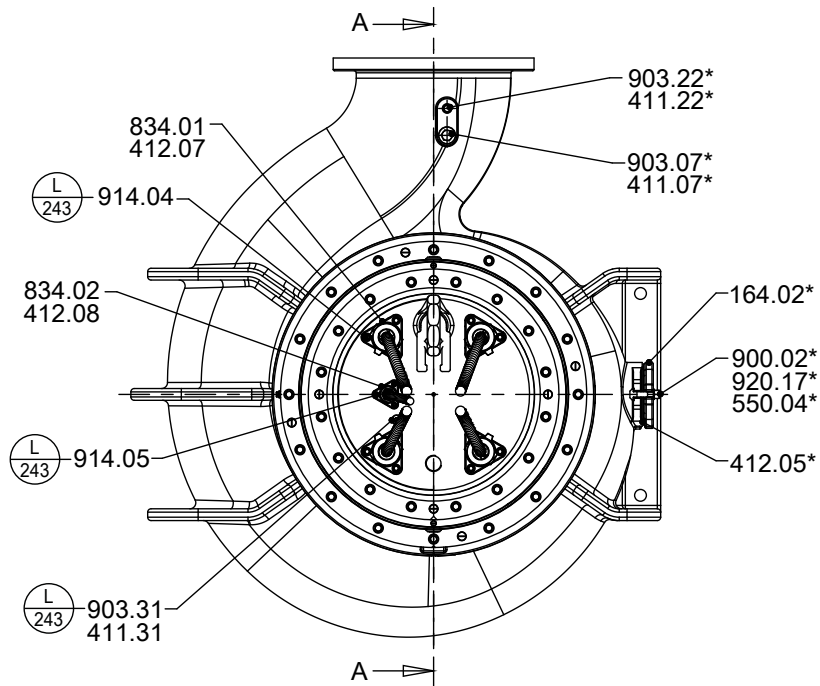


Fig. 61: Pump sets with cooling system (installation types K and D)

*: Installation type D only

Table 62: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243.

Table 63: List of components

Part No.	Description	Part No.	Description
164.02	Inspection cover	900.02	Bolt/screw
411.07/.22/.31	Joint ring	903.07/.22/.31	Screw plug
412.05/.07/.08	O-ring	914.04/.05	Hexagon socket head cap screw
550.04	Disc	920.17	Nut
834.01/.02	Cable gland		

Pump sets without cooling system (installation type S)

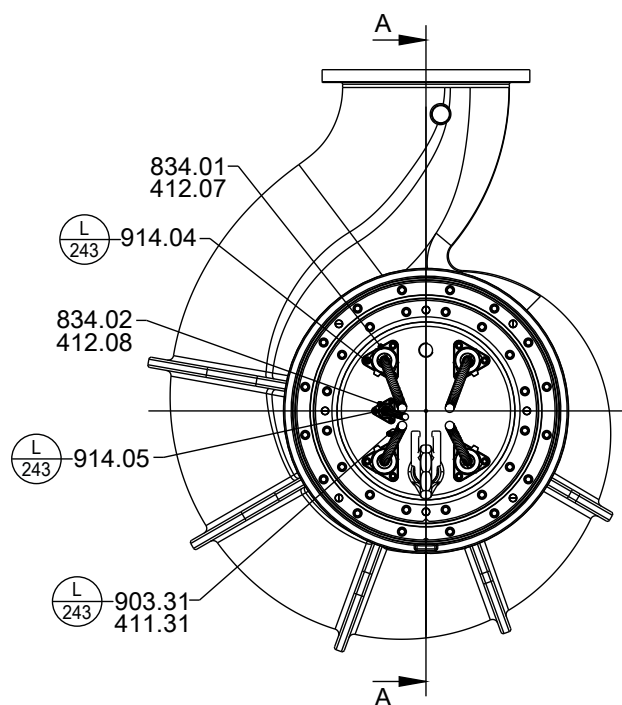


Fig. 62: Pump sets without cooling system (installation type S)

Table 64: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

Table 65: List of components

Part No.	Description	Part No.	Description
411.31	Joint ring	903.31	Screw plug
412.07/08	O-ring	914.04/05	Hexagon socket head cap screw
834.01/02	Cable gland		

9.2.3 Attachment points

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

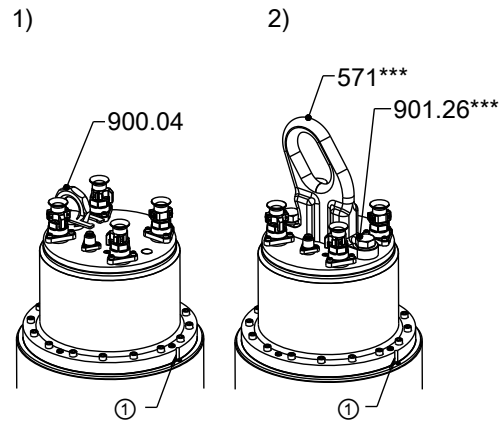


Fig. 63: Attachment points, installation type D

1)	Installation type D
2)	Installation type D with bail (optional)

***: Specific sizes only

①: Alignment groove

Table 66: List of components

Part No.	Description	Part No.	Description
571	Bail	901.26	Hexagon head bolt
900.04	Bolt/screw		

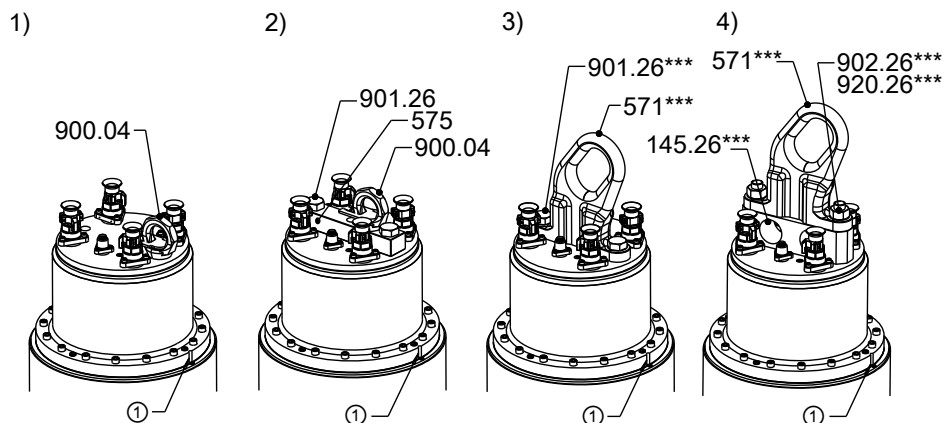


Fig. 64: Attachment points, installation type K

1)	Installation type K with guide cable arrangement
2)	Installation type K with guide rail arrangement
3)	Installation type K with bail (optional)
4)	Installation type K with lifting system (optional)

***: Specific sizes only

①: Alignment groove

Table 67: List of components

Part No.	Description	Part No.	Description
145.26	Adapter	901.26	Hexagon head bolt
571	Bail	902.26	Stud
575	Strip	920.26	Nut
900.04	Bolt/screw		

Pump sets without cooling system (installation type S)

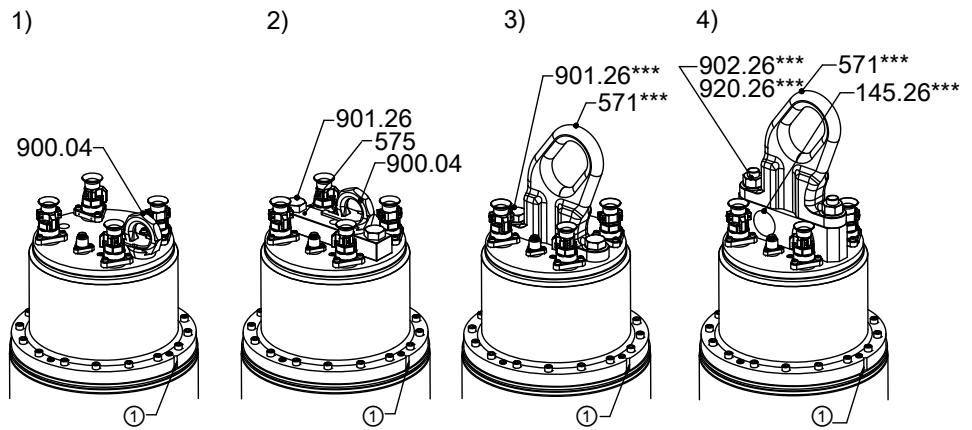


Fig. 65: Attachment points, installation type S

1)	Installation type S with guide cable arrangement
2)	Installation type S with guide rail arrangement
3)	Installation type S with bail (optional)
4)	Installation type S with lifting system (optional)

***: Specific sizes only

①: Alignment groove

Table 68: List of components

Part No.	Description	Part No.	Description
145.26	Adapter	901.26	Hexagon head bolt
571	Bail	902.26	Stud
575	Strip	920.26	Nut
900.04	Bolt/screw		

9.2.4 Sensors and terminals

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

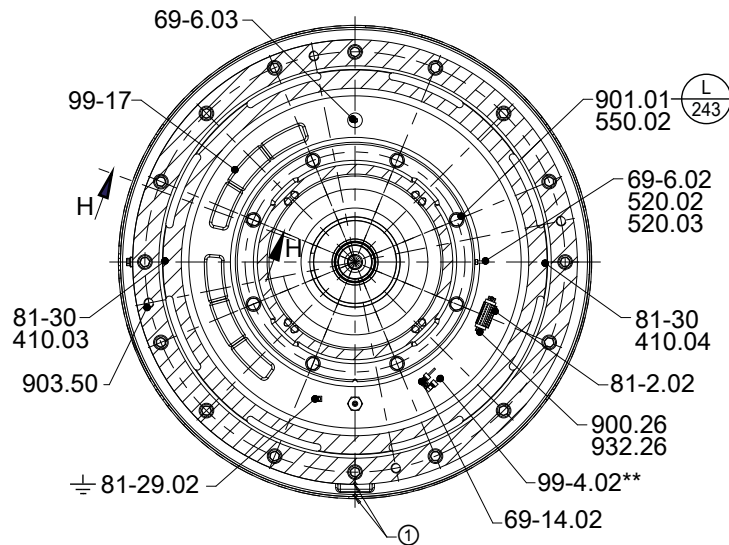


Fig. 66: Section B-B, pump sets with cooling system (installation types K and D)

①: Alignment groove

Table 69: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

Table 70: List of components

Part No.	Description	Part No.	Description
410.03/04	Profile seal	81-30	Guide rail
520.02/03	Sleeve	900.26	Bolt/screw
550.02	Disc	901.01	Hexagon head bolt
69-14.02	Leakage sensor	903.50	Screw plug
69-6.02/03	Temperature sensor	932.26	Circlip
81-2.02	Plug	99-17	Desiccant
81-29.02	Terminal	99-4.02	Conversion kit

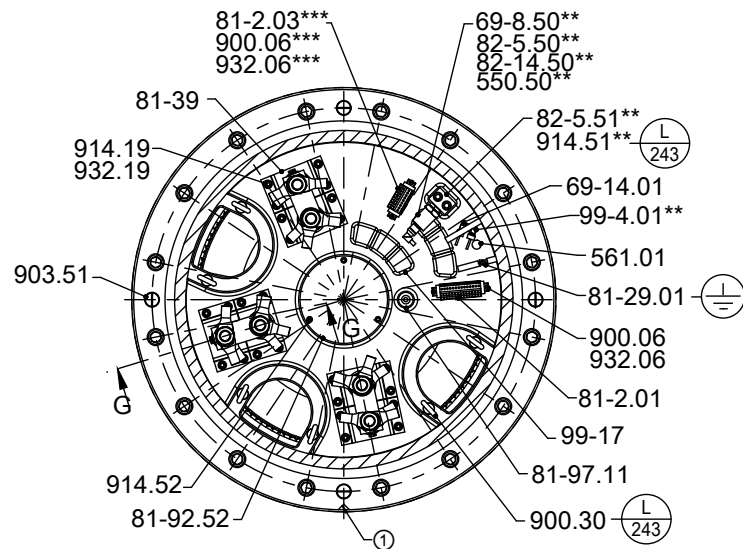


Fig. 67: Section C-C, pump sets with cooling system (installation types K and D)

** : Pump sets with vibration monitoring only

*** : Specific sizes only

① : Alignment groove

Table 71: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

Table 72: List of components

Part No.	Description	Part No.	Description
550.50	Disc	82-5.50/.51	Adapter
561.01	Grooved pin	82-14.50	Cable with plug
69-14.01	Leakage sensor	900.06/.30	Bolt/screw
69-8.50	Measurement transmitter	903.51	Screw plug
81-2.01/.03	Plug	914.19/.51/.52	Hexagon socket head cap screw
81-29.01	Terminal	932.06/.19	Circlip
81-39	Clamp	99-17	Desiccant
81-92.52	Cover plate	99-4.01	Conversion kit
81-97.11	Cable protector		

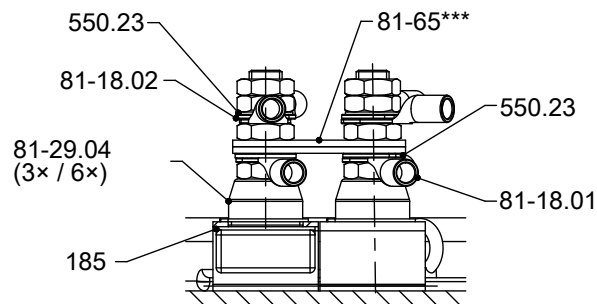


Fig. 68: Section G-G, pump sets with cooling system (installation types K and D)

*** : Specific sizes only

Table 73: List of components

Part No.	Description	Part No.	Description
185	Plate	81-29.04	Terminal
550.23	Disc	81-65	Star connector
81-18.01/02	Cable terminal		

Pump sets without cooling system (installation type S)

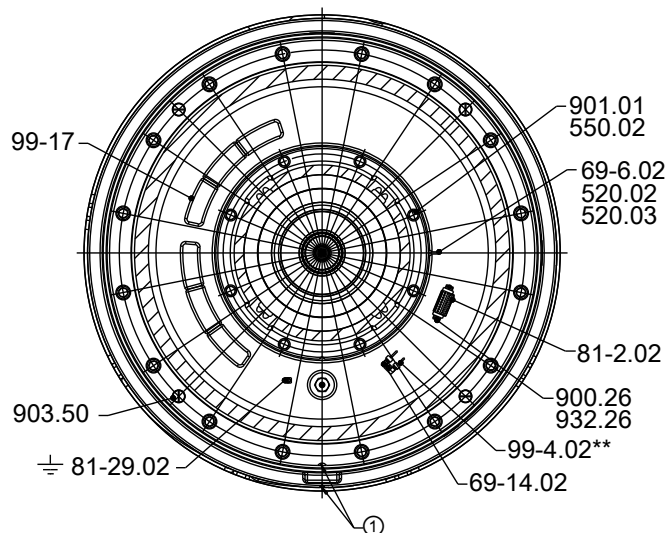


Fig. 69: Section B-B, pump sets without cooling system (installation type S)

** : Pump sets with vibration monitoring only

① : Alignment groove

Table 74: List of components

Part No.	Description	Part No.	Description
520.02/03	Sleeve	900.26	Bolt/screw
550.02	Disc	901.01	Hexagon head bolt
69-14.02	Leakage sensor	903.50	Screw plug
69-6.02	Temperature sensor	932.26	Circlip
81-2.02	Plug	99-17	Desiccant
81-29.02	Terminal	99-4.02	Conversion kit

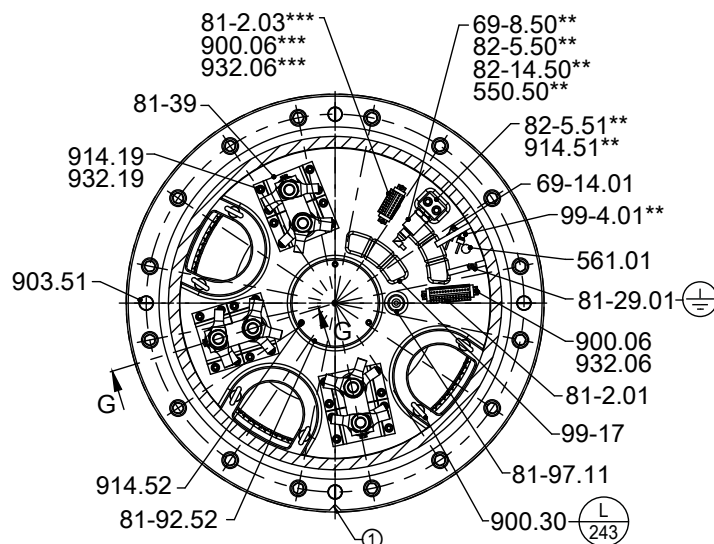


Fig. 70: Section C-C, pump sets without cooling system (installation type S)

** : Pump sets with vibration monitoring only

*** : Specific sizes only

① : Alignment groove

Table 75: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

Table 76: List of components

Part No.	Description	Part No.	Description
550.50	Disc	82-14.50	Cable with plug
561.01	Grooved pin	82-5.50/.51	Adapter
69-14.01	Leakage sensor	900.06/.30	Bolt/screw
69-8.50	Measurement transmitter	903.51	Screw plug
81-2.01/.03	Plug	914.19/.51/.52	Hexagon socket head cap screw
81-29.01	Terminal	932.06/.19	Circlip
81-39	Clamp	99-17	Desiccant
81-92.52	Cover plate	99-4.01	Conversion kit
81-97.11	Cable protector		

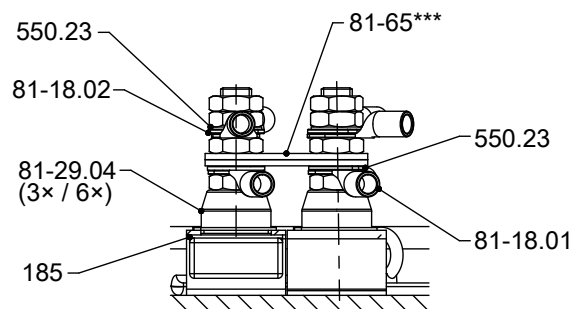


Fig. 71: Section G-G, pump sets without cooling system (installation type S)

*** : Specific sizes only

Table 77: List of components

Part No.	Description	Part No.	Description
185	Plate	81-29.04	Terminal
550.23	Disc	81-65	Star connector
81-18.01/.02	Cable terminal		

9.2.5 Drive-end bearing assembly

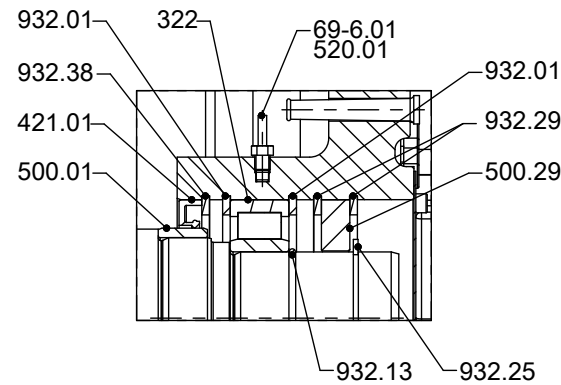


Fig. 72: Drive-end bearing assembly

Table 78: List of components

Part No.	Description	Part No.	Description
322	Radial roller bearing	520.01	Sleeve
421.01	Lip seal	69-6.01	Temperature sensor
500.01/.29	Ring	932.01/.13/.25/.29/.38	Circlip

9.2.6 Further details

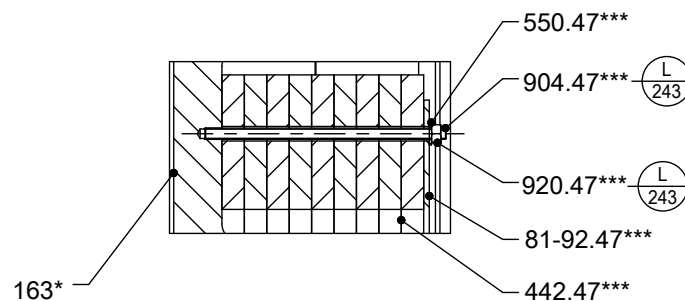


Fig. 73: Section H-H

*: Installation type D only

***: Specific sizes only

Table 79: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243.

Table 80: List of components

Part No.	Description	Part No.	Description
163	Discharge cover	81-92.47	Cover plate
442.47	Cooling insert	904.47	Grub screw
550.47	Disc	920.47	Nut

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

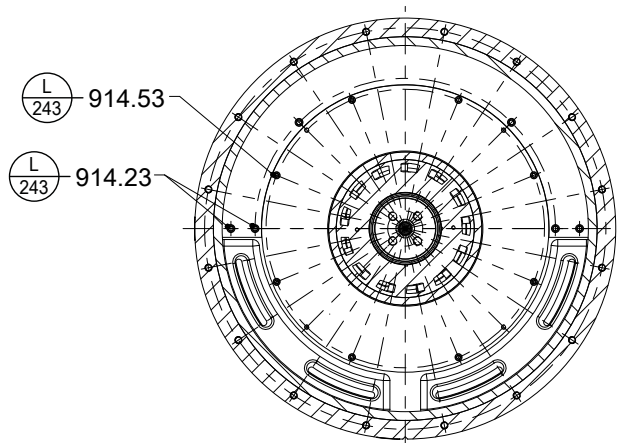


Fig. 74: Section D-D

Table 81: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243.

Table 82: List of components

Part No.	Description	Part No.	Description
914.23/.53	Hexagon socket head cap screw		

Pump sets without cooling system (installation type S)

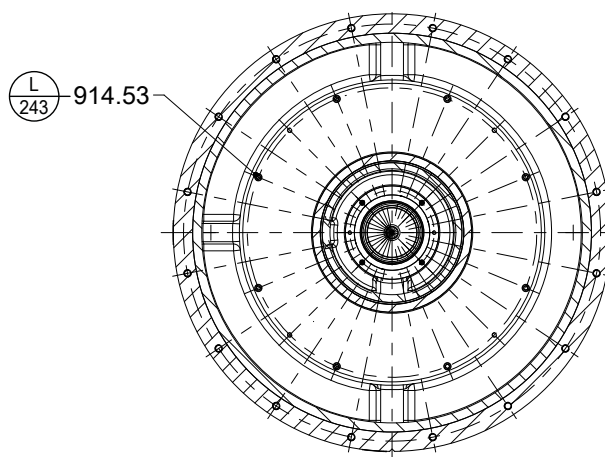


Fig. 75: Section D-D

Table 83: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243.

Table 84: List of components

Part No.	Description	Part No.	Description
914.53	Hexagon socket head cap screw		

9.3 Wiring diagrams

9.3.1 Wiring diagram for the power cables

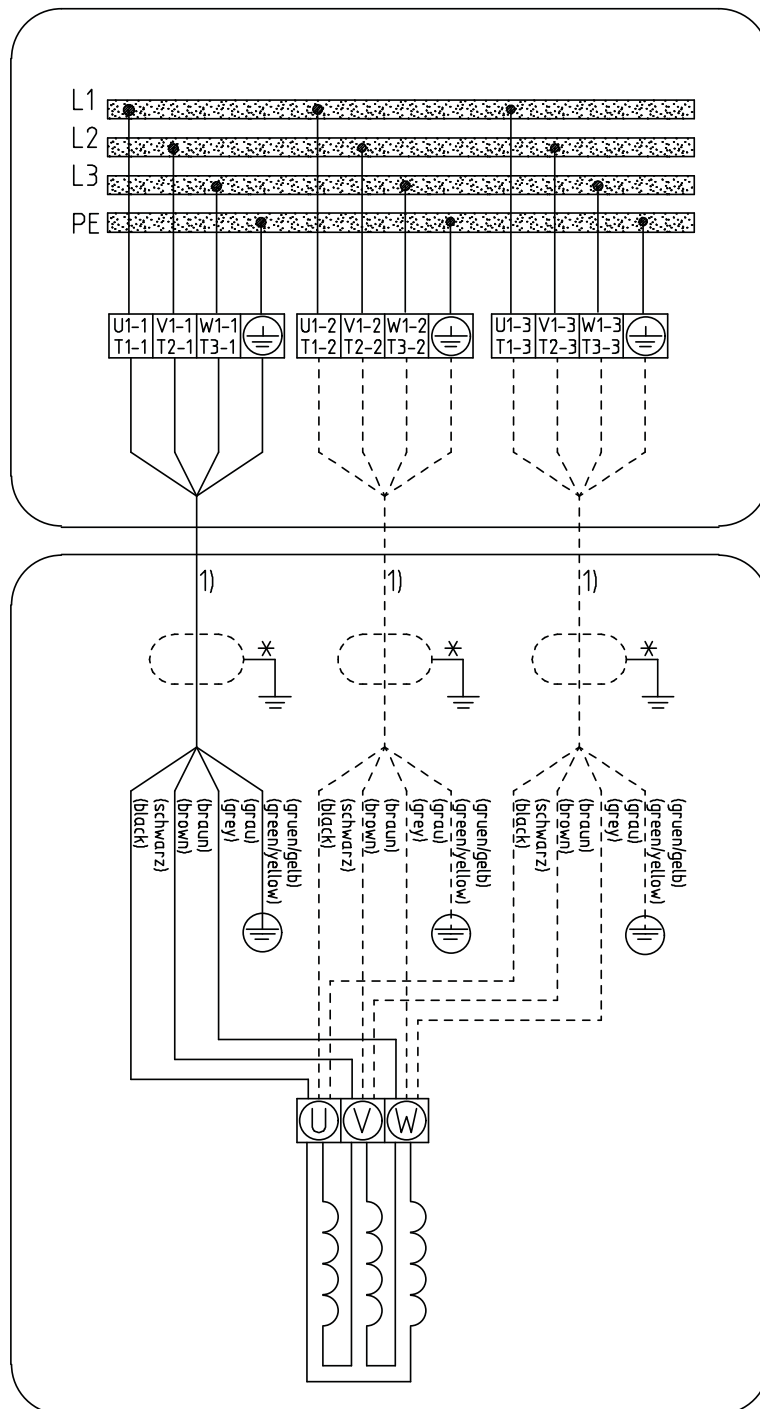


Fig. 76: Wiring diagram for the power cables

* Shielded cable optional

¹⁾ Up to 8 parallel cables possible

9.3.2 Wiring diagram for the sensors

Installation types D and K

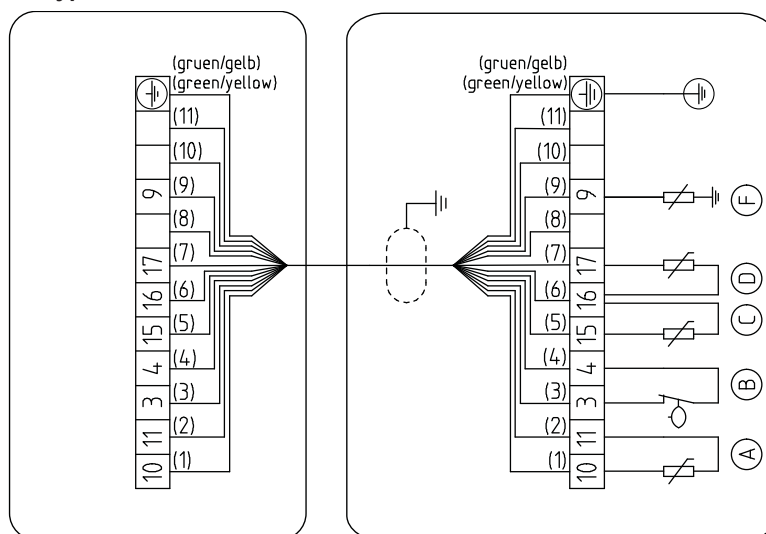


Fig. 77: Sensor wiring diagram for installation types D and K

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

Pump sets with vibration sensor

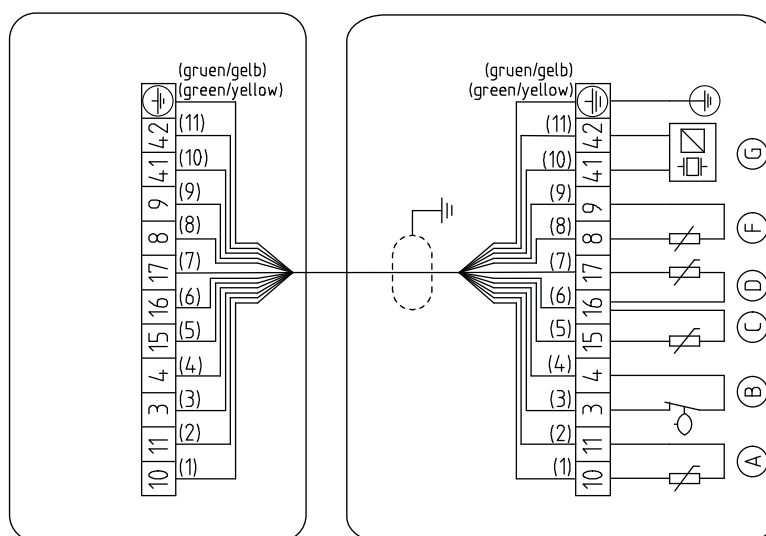


Fig. 78: Sensor wiring diagram for installation types D and K, pump sets with vibration sensor

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

Pump sets
with additional Pt100
motor temperature
monitoring

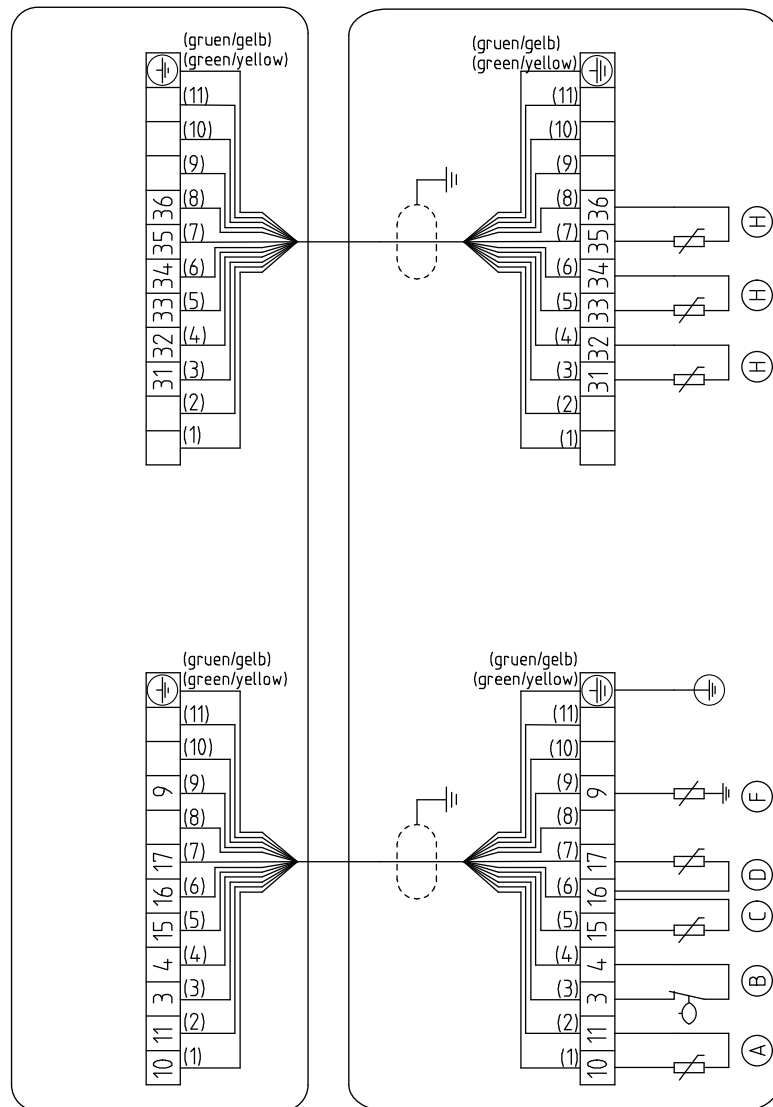


Fig. 79: Sensor wiring diagram for installation types D and K, pump sets with additional Pt100 motor temperature monitoring

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

Pump sets
with additional Pt100
motor temperature
monitoring and vibration
sensor

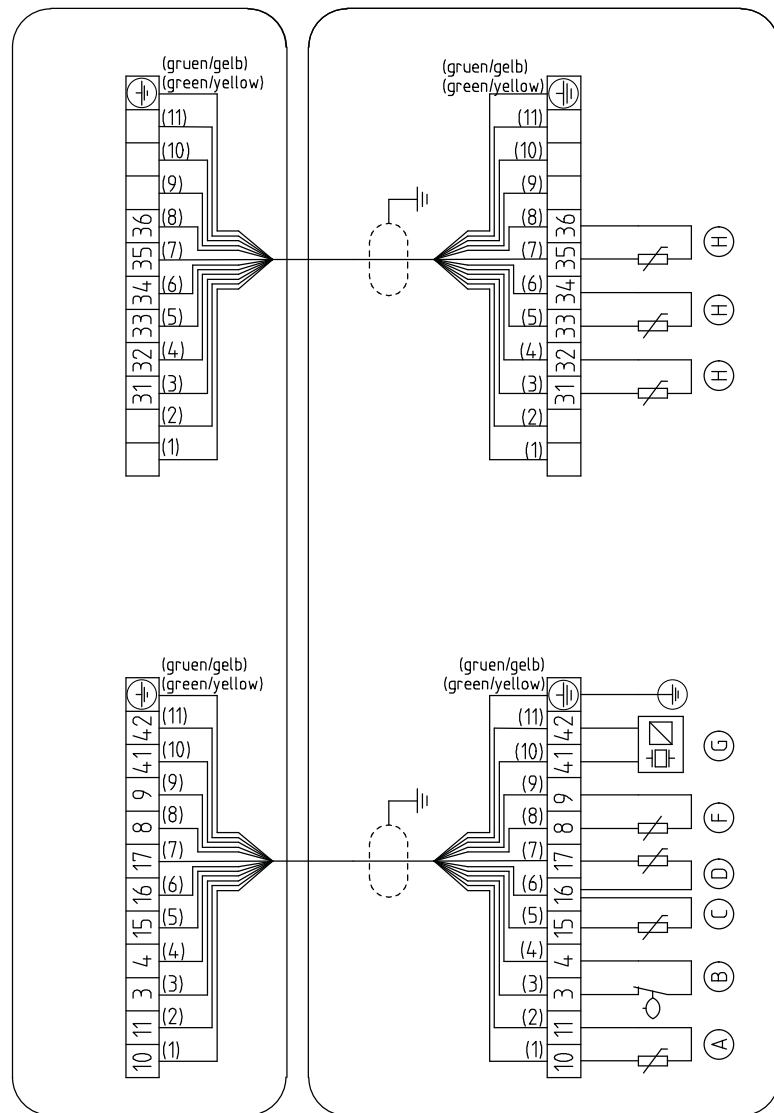


Fig. 80: Sensor wiring diagram for installation types D and K, pump sets with additional Pt100 motor temperature monitoring and vibration sensor

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

Installation type S

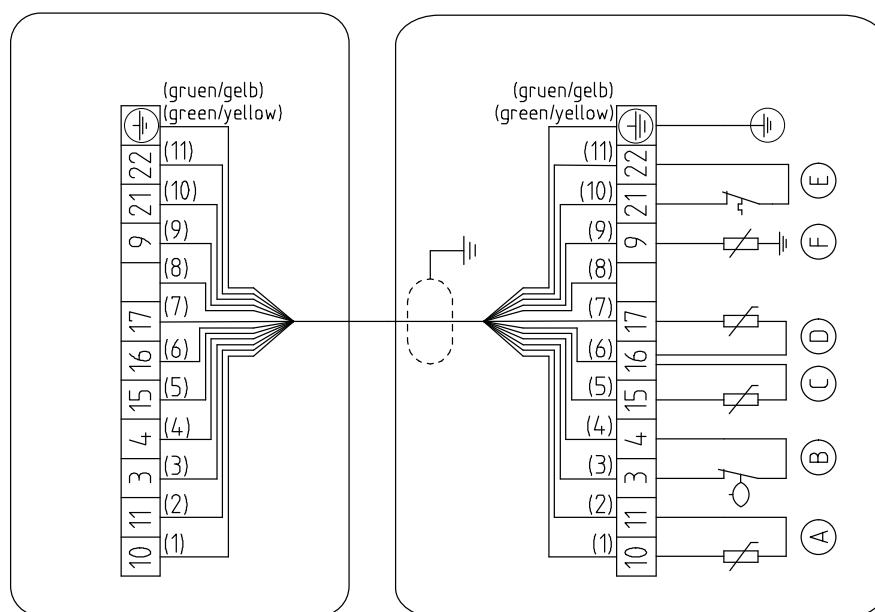


Fig. 81: Sensor wiring diagram for installation type S

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

Pump sets
with vibration sensor

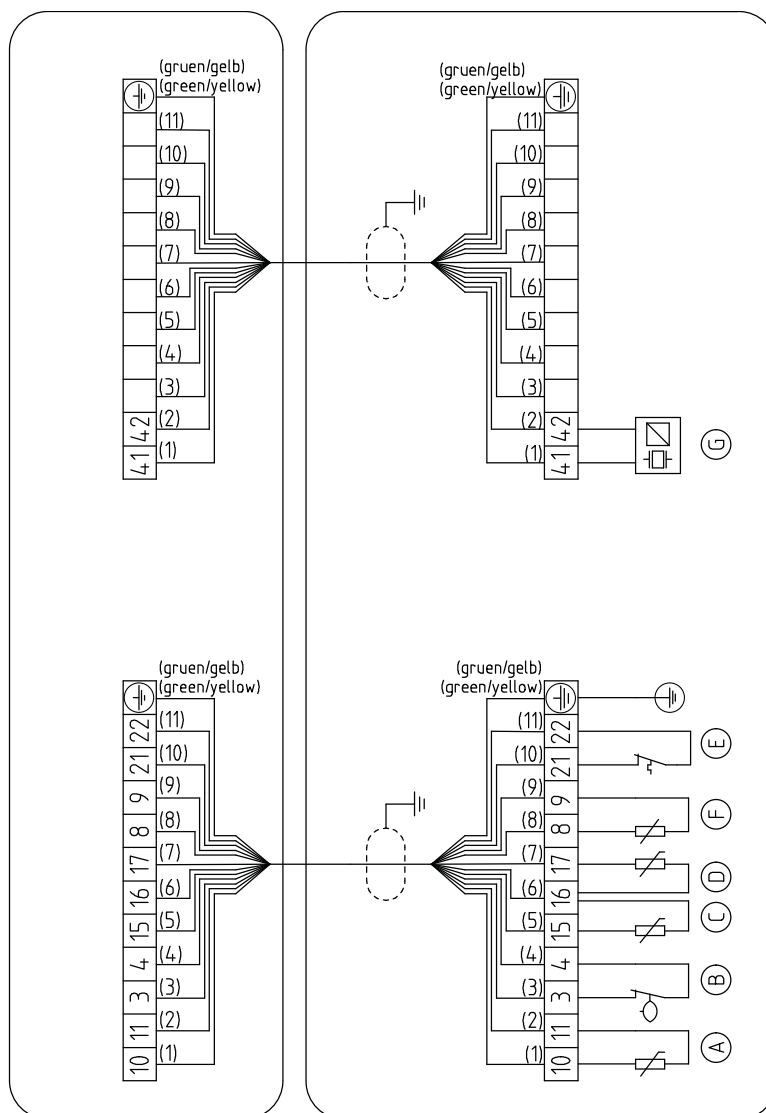


Fig. 82: Sensor wiring diagram for installation type S, pump sets with vibration sensor

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

The diagram illustrates a 4-core cable with 36 conductors. The left side shows a standard configuration where the 11th and 12th conductors are connected to the 11th and 12th positions of the cable. The right side shows an alternative configuration where the 11th and 12th conductors are connected to the 11th and 12th positions of the cable, but with different internal wiring for the 11th and 12th conductors, indicated by a dashed line and a ground symbol.

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

Pump sets
with additional Pt100
motor temperature
monitoring and vibration
sensor

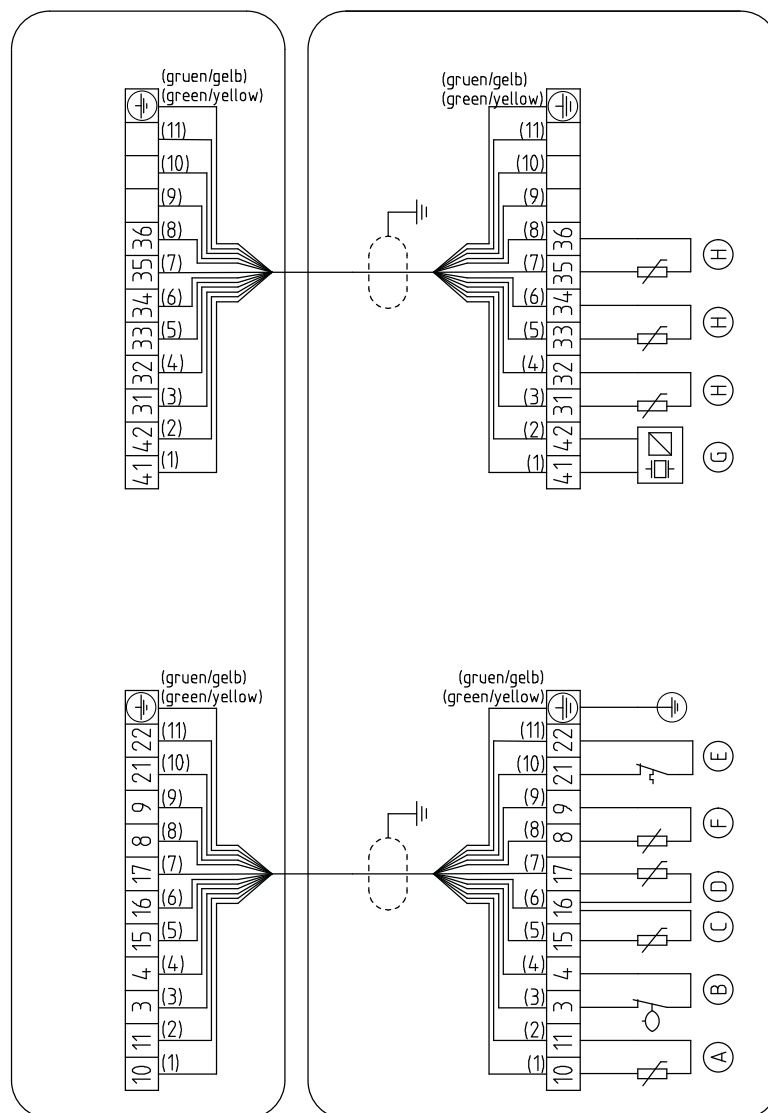


Fig. 84: Sensor wiring diagram for installation type S, pump sets with additional Pt100 motor temperature monitoring and vibration sensor

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

9.4 Sectional drawings of the mechanical seal

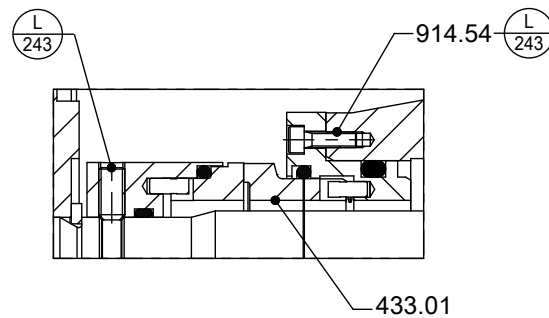


Fig. 85: Mechanical seal (drive end)

Table 85: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

Table 86: List of components

Part No.	Description	Part No.	Description
433.01	Mechanical seal	914.54	Hexagon socket head cap screw

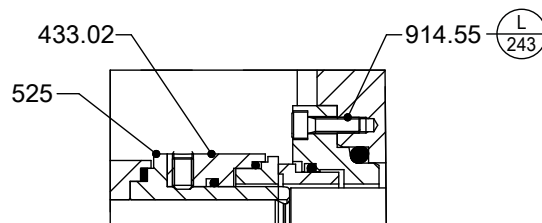


Fig. 86: Mechanical seal (pump end) for impeller fastening elements N110/N110X

Table 87: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

Table 88: List of components

Part No.	Description	Part No.	Description
525	Spacer sleeve	914.55	Hexagon socket head cap screw
433.02	Mechanical seal		

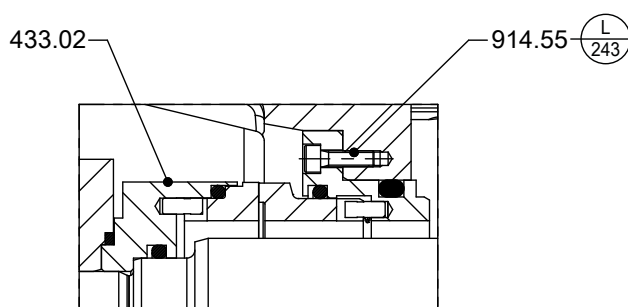


Fig. 87: Mechanical seal (pump end) for impeller fastening elements N140/N160X

Table 89: Key to the symbols and codes

Symbol	Description
	Always secure screwed connections marked with this symbol with Loctite 243 .

Table 90: List of components

Part No.	Description	Part No.	Description
433.02	Mechanical seal	914.55	Hexagon socket head cap screw

10 Certificate of Decontamination

Type:
 Order number/
 order item number¹⁹⁾:
 Delivery date:
 Field of application:
 Fluid handled¹⁹⁾:

Please check where applicable¹⁹⁾:



Radioactive



Explosive



Corrosive



Toxic



Harmful



Bio-hazardous



Highly flammable



Safe

Reason for return¹⁹⁾:
 Comments:

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

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

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

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

- ☐ No special safety precautions are required for further handling.
☐ The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....

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

.....
 Place, date and signature

.....
 Address

.....
 Company stamp

¹⁹⁾ Required fields

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