

Submersible Motor Pump

Amarex KRT

Sizes DN 50 to DN 80

Motor Sizes

2-pole: 012 to 032

4-pole: 014 to 034

Material Variants H, C1, C2

Installation/Operating Manual



Mat. No.: 01047331

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Installation/Operating Manual Amarex KRT

Original operating manual

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Contents

	Glossary	5
1	General	6
1.1	Principles	6
1.2	Installation of partly completed machinery	6
1.3	Target group	6
1.4	Other applicable documents	6
1.5	Symbols	6
2	Safety	8
2.1	Key to safety symbols/markings	8
2.2	General	8
2.3	Intended use	8
2.4	Personnel qualification and training	10
2.5	Consequences and risks caused by non-compliance with these operating instructions	10
2.6	Safety awareness	10
2.7	Safety information for the operator/user	10
2.8	Safety information for maintenance, inspection and installation work	10
2.9	Unauthorised modes of operation	11
2.10	Explosion protection	11
3	Transport/Temporary Storage/Disposal	12
3.1	Checking the condition upon delivery	12
3.2	Transport	12
3.3	Storage/Preservation	13
3.4	Return to supplier	14
3.5	Disposal	14
4	Description of the Pump (Set)	15
4.1	General description	15
4.2	Designation	15
4.3	Name plate	15
4.4	Design details	15
4.5	Types of installation	16
4.6	Configuration and function	17
4.7	Scope of supply	17
4.8	Dimensions and weights	18
5	Installation at Site	19
5.1	Safety regulations	19
5.2	Checks to be carried out prior to installation	19
5.3	Installing the pump set	21
5.4	Electrical system	26

6	Commissioning/Start-up/Shutdown	32
6.1	Commissioning/start-up	32
6.2	Operating limits	33
6.3	Shutdown/storage/preservation	35
6.4	Returning to service	36
7	Servicing/Maintenance	37
7.1	Safety regulations	37
7.2	Servicing/inspection	38
7.3	Drainage/cleaning	41
7.4	Dismantling the pump set	41
7.5	Reassembling the pump set	43
7.6	Tightening torques	47
7.7	Spare parts stock	47
8	Trouble-shooting	49
9	Related Documents	50
9.1	General assembly drawings	50
9.2	Wiring diagram	53
9.3	Flamepaths on explosion-proof motors	54
9.4	Sectional drawings of the mechanical seal	55
10	EC Declaration of Conformity	56
11	Certificate of Decontamination	57
	Index	58

Glossary

Certificate of decontamination

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

Close-coupled design

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

Flamepath

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

Hydraulic system

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

1 General

1.1 Principles

This manual is supplied as an integral part of the type series and variants indicated on the front cover. It describes the proper and safe use of this equipment in all phases of operation.

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

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

1.2 Installation of partly completed machinery

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

1.3 Target group

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

1.4 Other applicable documents

Table 1: Overview of other applicable documents

Document	Contents
Data sheet	Description of the technical data of the pump set
General arrangement drawing/ outline drawing	Description of mating and installation dimensions for the pump set, weights
Hydraulic characteristic curve	Characteristic curves showing head, flow rate, efficiency and power input
General assembly drawing ¹⁾	Sectional drawing of the pump set
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 manuals ¹⁾	E.g. for special accessories


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

1.5 Symbols

Table 2: Symbols used in this manual

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

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

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








2 Safety

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



2.1 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

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

2.2 General

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

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

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

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

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

- Arrow indicating the direction of rotation
- Markings for connections
- Name plate

The operator is responsible for ensuring compliance with all local regulations not taken into account in this manual.




2.3 Intended use

The pump (set) must only be operated within the operating limits described in the other applicable documents.

- 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 model.

- Never operate the pump set without the fluid to be handled.
- Observe the limits for continuous operation specified in the data sheet or product literature ($Q_{min}^{2)}$ and $Q_{max}^{3)}$) (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 $1.2 \times Q_{opt}^{4)}$ to minimise the risk of clogging/hardening.
- Avoid duty points for continuous operation at very low speeds and small flow rates ($<0.7 \times Q_{opt}^{4)}$).
- Observe the maximum flow rates indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- Do not throttle the flow rate on the suction side of the pump set (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.
- Only use the respective impeller types in combination with the fluids indicated in the table below.

Table 4: Applications of impeller types

Impeller type		Suitable for the following fluids
	Free-flow impeller (impeller type F)	Fluids containing solids and stringy material as well as fluids with entrapped air or gas
	Closed multi-vane impeller (impeller type K)	Contaminated, solids-laden, non-gaseous fluids without stringy material
	Impeller with cutter (impeller type S)	Faeces, domestic sewage and waste water containing long fibres

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 specified in the data sheet and in the product literature regarding pressure, temperature, etc.
- Observe all safety information and instructions in this manual.

²⁾ Minimum permissible flow rate
³⁾ Maximum permissible flow rate
⁴⁾ Best efficiency point

2.4 Personnel qualification and training

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

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

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

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

2.5 Consequences and risks caused by non-compliance with 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

2.6 Safety awareness

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

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

2.7 Safety information for the operator/user

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

2.8 Safety information for maintenance, inspection and installation work

- Modifications or alterations of the pump are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts authorised by the manufacturer. The use of other parts can invalidate any liability of the manufacturer for resulting damage.

- The operator ensures that all maintenance, inspection and installation work is performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- The pump casing must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual. (⇒ Section 6.3 Page 35)
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work is completed, re-install and/or re-activate any safety-relevant and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇒ Section 6.1 Page 32)

2.9 Unauthorised modes of operation

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

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

2.10 Explosion protection

Always observe the information on explosion protection given in this section when operating an explosion-proof pump set.



Sections of the manual marked by the Ex symbol apply to explosion-proof pump sets also when temporarily operated outside potentially explosive atmospheres. Only pumps/pump sets marked as explosion-proof **and** identified as such in the data sheet must be used in potentially explosive atmospheres.

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

Especially adhere to the sections in this manual marked with the Ex symbol.

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

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

Prevent impermissible modes of operation at all times.

2.10.1 Repair

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


Repair work at the flameproof joints must only be performed in accordance with the manufacturer's instructions. Repair to the values in tables 1 and 2 of EN 60079-1 is not permitted.

3 Transport/Temporary Storage/Disposal

3.1 Checking the condition upon delivery

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

3.2 Transport

	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Improper transport Danger to life from falling parts! Damage to the pump set!</p> <ul style="list-style-type: none"> ➤ Use the attachment point provided (pump handle) for attaching lifting accessories. ➤ Never suspend the pump set by its power cable. ➤ Use the lifting chain/rope included in the scope of supply exclusively for lowering/lifting the pump set into/out of the pump sump. ➤ Securely attach the lifting chain/rope to the pump and crane. ➤ Use tested, marked and approved lifting accessories only. ➤ Observe any regional transport regulations. ➤ Observe the product literature supplied by the lifting accessory manufacturer. ➤ The load-carrying capacity of the lifting accessory must be higher than the weight indicated on the name plate of the pump set to be lifted. Take into account any additional system components to be lifted.
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Transport the pump set as shown.

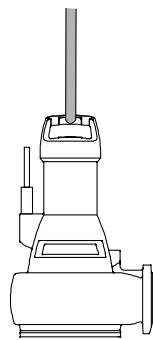




Fig. 1: Transporting the pump set

Setting down the pump set

	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Incorrect positioning Personal injury and damage to property!</p> <ul style="list-style-type: none"> ➤ Set the pump set down in a vertical position with the motor on top. ➤ Use appropriate means to secure the pump set against overturning and tipping over. ➤ Refer to the weights given in the data sheet/on the name plate.
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	⚠ WARNING
	<p>Improper handling when placing the pump set in vertical/horizontal position Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▸ Use appropriate means to secure the pump set against overturning or tipping over. ▸ Secure power cables against falling. ▸ Use additional supports for the transport holder to secure the pump set against overturning. ▸ Maintain adequate safety distance during lifting operations.

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

Table 5: Ambient conditions for storage

Ambient conditions	Value
Relative humidity	5 % to 85 % (non-condensing)
Ambient temperature	- 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
	<p>Observe the manufacturer's instructions for application/removal of the preservative.</p>

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇒ Section 7.3 Page 41)
2. Always flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the fluids handled by the pump set leave residues which might lead to corrosion damage when coming into contact with atmospheric humidity, or which might ignite when coming into contact with oxygen, the pump set must also be neutralised, and anhydrous inert gas must be blown through the pump for drying purposes.
4. Always complete and enclose a certificate of decontamination when returning the pump (set).
Always indicate any safety and decontamination measures taken. (⇒ Section 11 Page 57)



NOTE

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

3.5 Disposal



⚠ WARNING

Fluids, consumables and supplies which are hot or pose a health hazard
Hazard to persons and the environment!

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

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 fibres and solid substances, fluids containing air/gas as well as raw, activated and digested sludge.

4.2 Designation

Example: Amarex KRT F 80 - 210 / 02 4 Y H - S

Table 6: Key to the designation

Code	Description
Amarex KRT	Type series
K	Impeller type, e.g. F = free-flow impeller
80	Nominal discharge nozzle diameter [mm]
210	Maximum nominal impeller diameter [mm]
02	Motor size (kW)
4	Number of poles of electrical motor connection
Y	Motor version, e.g. Y = explosion-proof version
H	Casing material, e.g. H = white cast iron IN 3029
S	Installation type, e.g. stationary wet installation

4.3 Name plate

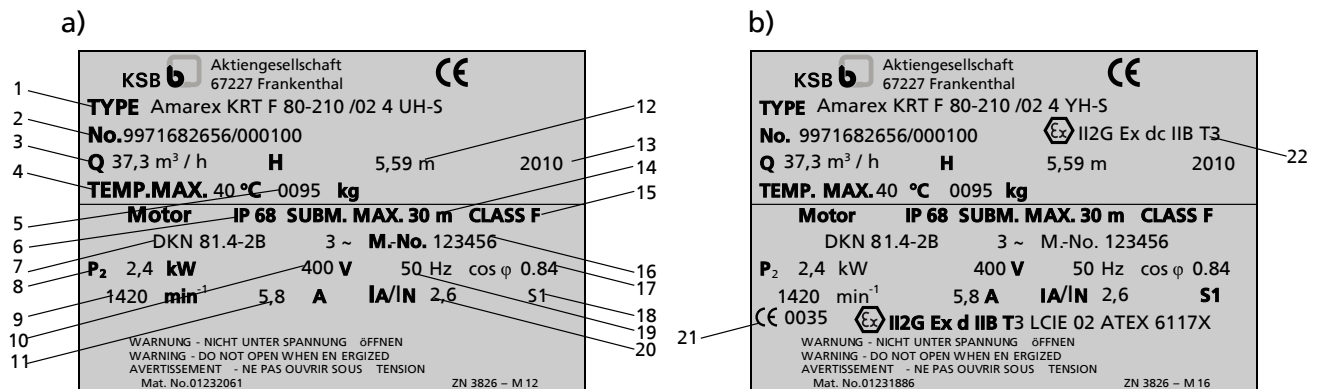


Fig. 2: Name plate a) for non-explosionproof model, b) for explosion-proof model

1	Designation	2	KSB order number
3	Flow rate	4	Maximum fluid and ambient temperature
5	Total weight	6	Enclosure
7	Motor type	8	Rated power
9	Rated speed	10	Rated voltage
11	Rated current	12	Head
13	Year of construction	14	Maximum submergence
15	Thermal class of winding insulation	16	Motor number
17	Power factor at design point	18	Mode of operation
19	Rated frequency	20	Starting current ratio
21	ATEX marking of submersible motor	22	ATEX marking of pump set

4.4 Design details

Design

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

Impeller type

- Various, application-based impeller types

Shaft seal

- Two bi-directional mechanical seals in tandem arrangement, with liquid reservoir
- Pumps with reinforced bearings: with leakage chamber

Standard bearing assembly

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

Drive

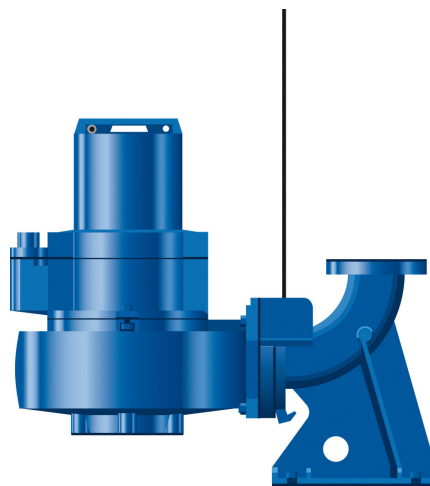
- Three-phase asynchronous squirrel-cage motor

Motors integrated in explosion-proof pump sets are supplied in Ex d IIB type of protection.

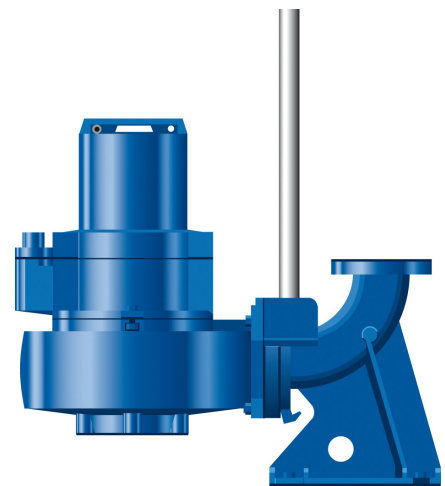
4.5 Types of installation

Installation types K and S

Table 7: Stationary wet installation



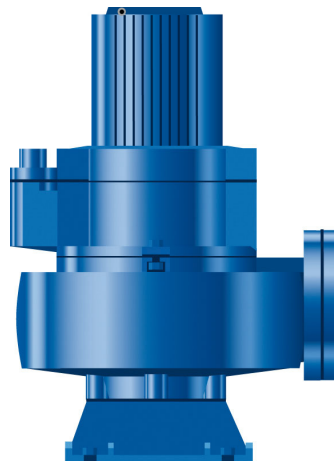
Guide wire arrangement



Guide rail arrangement

Installation type P

Table 8: Transportable wet-installed model



Pump sets of installation types P and S

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

Pump sets of installation type K

are suitable for continuous operation with the motor outside the fluid. Cooling is effected by means of air convection.

4.6 Configuration and function

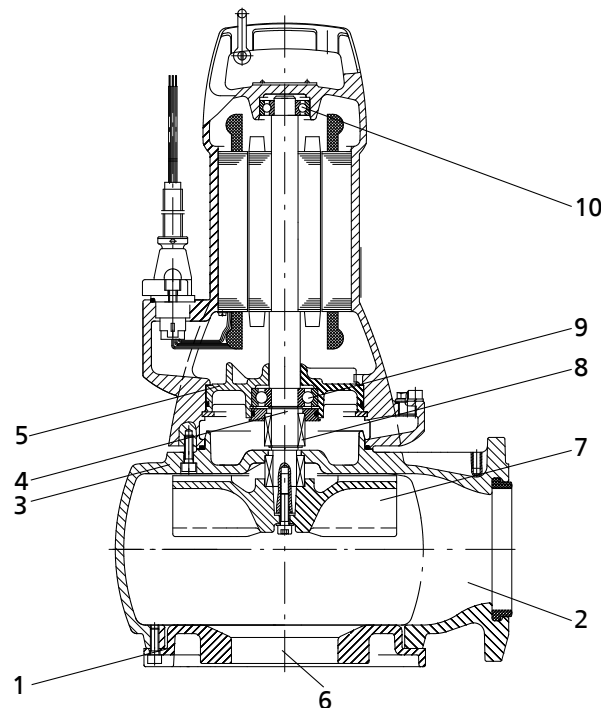


Fig. 3: Sectional drawing

1	Suction cover	2	Discharge nozzle
3	Pump casing	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 a suction nozzle (6) and is accelerated outward in a cylindrical flow 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 suction cover (1) prevents any fluid from flowing back from the casing into the inlet. At the rear side of the impeller, the shaft (4) enters the hydraulic system through the pump casing (3). The shaft passage through the pump casing is sealed towards the 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.

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

4.7 Scope of supply

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

Stationary wet installation (installation types S and K)

- Pump set complete with power cables
- Claw with sealing element (O-ring) and mounting elements
- Lifting rope, lifting chain or lifting bail (optional)

- Mounting bracket with mounting elements
- Duckfoot bend with mounting elements
- Guide wire
(guide rails are not included in KSB's scope of supply)

Transportable wet-installed model (installation type P)

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




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

4.8 Dimensions and weights

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

5 Installation at Site

5.1 Safety regulations

	<p>⚠ DANGER</p> <p>Improper installation in potentially explosive atmospheres Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ Comply with the applicable local explosion protection regulations. ▸ Observe the information given in the data sheet and on the name plate of the pump set.
	<p>⚠ DANGER</p> <p>Persons in the tank during pump operation Electric shock!</p> <ul style="list-style-type: none"> ▸ Never start up the pump set when there are persons in the tank.
	<p>⚠ WARNING</p> <p>Impermissible solid objects (tools, screws/bolts or similar) in the pump sump/inlet tank during pump start-up Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▸ 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 site system data.

5.2.2 Preparing the place of installation

Place of installation for stationary models


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

Place of installation for transportable models

	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Incorrect positioning Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▷ Set the pump set down in a vertical position with the motor on top. ▷ Use appropriate means to secure the pump set against overturning and tipping over. ▷ Refer to the weights given in the data sheet/on the name plate.
---	---

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 Checking the lubricant level

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

1. Position the pump set as shown.

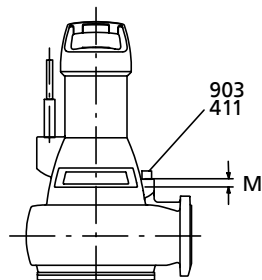






Fig. 4: Checking the lubricant level

2. Unscrew screw plug 903 with joint ring 411.
3. Top up lubricant in the lubricant reservoir through the lubricant filler opening until the lubricant reaches the given dimension $M = 15 \text{ mm}$.
4. Close screw plug 903 with joint ring 411.

5.2.4 Checking the direction of rotation

	<div style="background-color: #d9534f; padding: 5px;">⚠ DANGER</div> <p>Pump set running dry Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Check the direction of rotation of explosion-proof pump sets outside the potentially explosive atmosphere.
	<div style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Hands or objects inside the pump casing Risk of injuries, damage to the pump!</p> <ul style="list-style-type: none"> ▷ 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, etc).

	<p>⚠ WARNING</p> <p>Improper positioning of pump set when checking the direction of rotation Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▸ Use appropriate means to secure the pump set against overturning or tipping over.
	<p>CAUTION</p> <p>Pump set running dry Increased vibrations! Damage to mechanical seals and bearings!</p> <ul style="list-style-type: none"> ▸ 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. (⇒ Section 5.4.2 Page 29)

1. Start the pump set and stop it again immediately to determine the motor's direction of rotation.
2. Check the direction of rotation.
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.

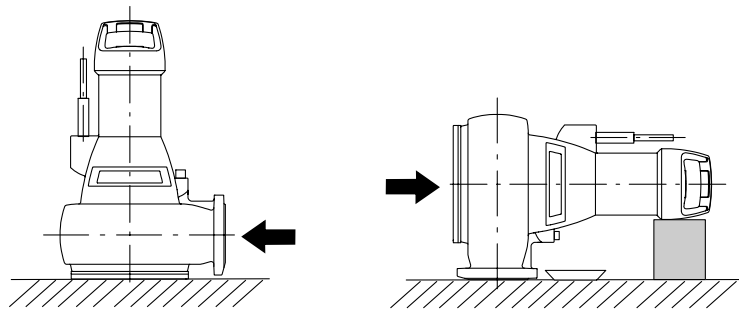


Fig. 5: Checking the direction of rotation

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

5.3 Installing the pump set

Always observe the general arrangement drawing/outline drawing when installing the pump set.

5.3.1 Stationary wet installation

5.3.1.1 Fastening the duckfoot bend

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

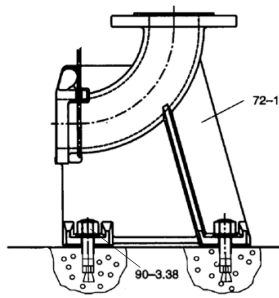


Fig. 6: Fastening the duckfoot bend

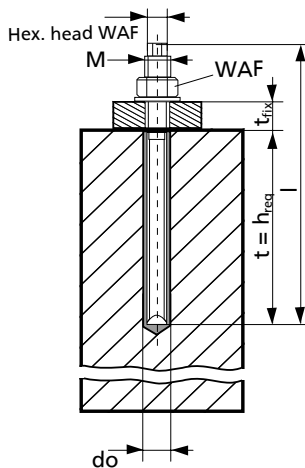


Fig. 7: Dimensions

Fastening the duckfoot bend with chemical anchors

1. Position duckfoot bend 72-1 on the floor of the tank/sump.
2. Insert chemical anchors 90-3.38.
3. Bolt duckfoot bend 72-1 to the floor with chemical anchors 90-3.38.

Table 9: Chemical anchor bolt dimensions

Bolt size	d _o [mm]	t=h _{req} [mm]	t _{fix} [mm]	WAF [mm]	M [mm]	Hex. head WAF [mm]	Torque _{as sy.} [Nm]
M 10x130	12	90	20	17	10	7	20
M 12x160	14	110	25	19	12	8	40
M 16x190	18	125	35	24	16	12	60

Table 10: Curing times of mortar cartridge

Floor temperature	Curing time [min]
-5 °C to 0 °C	240
0 °C to +10 °C	45
+10 °C to +20 °C	20
> +20 °C	10

5.3.1.2 Connecting the piping

	<p>⚠ DANGER</p> <p>Impermissible loads acting on the flange of the duckfoot bend Danger to life from leakage of hot, toxic, corrosive or flammable fluids!</p> <ul style="list-style-type: none"> Do not use the pump as an anchorage point for the piping. Anchor the pipelines in close proximity to the pump and connect them without transmitting any stresses or strains. Observe the permissible flange loads. Take appropriate measures to compensate thermal expansion of the piping.
	<p>NOTE</p> <p>When the pump set is used for draining low-level building areas, install a swing check valve in the discharge line to avoid backflow from the sewer system.</p>
	<p>CAUTION</p> <p>Critical speed Increased vibrations! Damage to mechanical seals and bearings!</p> <ul style="list-style-type: none"> Install a swing check valve in longer riser pipes to prevent the pump from excessive running in reverse. When fitting a swing check valve, make sure that the unit can still be vented properly.

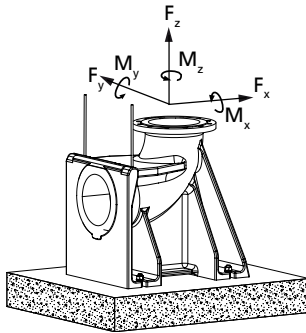


Fig. 8: Permissible flange loads

Table 11: Permissible flange loads

Nominal flange diameter	Forces [N]				Moments [Nm]			
	F_y	F_z	F_x	ΣF	M_y	M_z	M_x	ΣM
50/65	1350	1650	1500	2600	1000	1150	1400	2050
80	2050	2500	2250	3950	1150	1300	1600	2350
100	2700	3350	3000	5250	1250	1450	1750	2600

5.3.1.3 Fitting the guide wire arrangement

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



NOTE

Should site conditions/piping layout, etc. require the wire 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

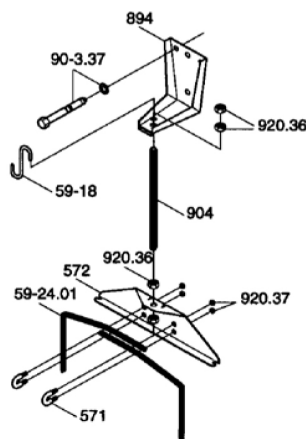


Fig. 9: Fitting the mounting bracket

1. Fasten mounting bracket 894 to the edge of the tank/sump opening with steel anchor bolts 90-3.37 and tighten the anchor bolts to a tightening torque of 10 Nm.
2. Push clamping pieces 571 through the holes of suspension bracket 572 and fasten with nuts 920.37.
3. Fasten threaded bolt 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 wire.

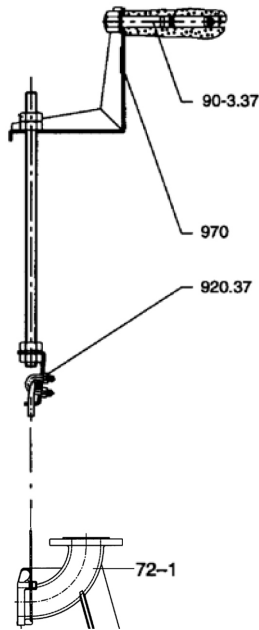


Fig. 10: Inserting the guide wire

Inserting the guide wire

1. Lift clamping piece 571 and insert one end of the guide wire.
2. Run wire 59-24.01 around duckfoot bend 72-1 and back again to suspension bracket 572 and insert it into clamping piece 571.
3. Manually tension wire 59-24.01 and secure it by means of hexagon nuts 920.37.
4. Pull the wire taut by tightening hexagon nut(s) 920.36 on the upper side of the mounting bracket to a torque $M_A=17 \text{ Nm}$ and a wire tensioning force $P= 6000\text{N}$.
5. Secure the nut(s) with a second hexagon nut.
6. The loose wire end at guide wire suspension bracket 572 can either be twisted into a ring or the end can be cut off.
After length adjustment, tape the ends to avoid fraying.
7. Attach hook 59-18 to mounting bracket 894 for attaching the lifting chain/rope at a later stage.

5.3.1.4 Preparing the pump set

Fitting the claw (50-210 / 65-210)

1. Place claw 732 onto the flange. The boss must rest against the back of the flange.
2. Fasten to the discharge flange using socket head cap screw 914.35 and disc 550.35.
3. Fit profile joint 410 in the groove of the claw.
This will seal the duckfoot bend/pump connection.

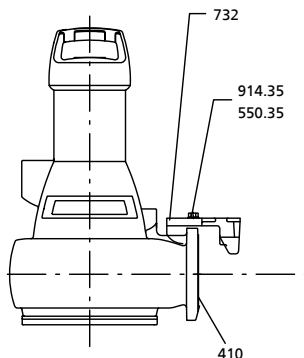


Fig. 11: Fitting the claw

Fitting the claw (80-210)

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 in the groove of the claw.
This will seal the duckfoot bend/pump connection.

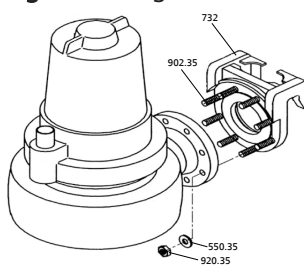


Fig. 12: Fitting the claw

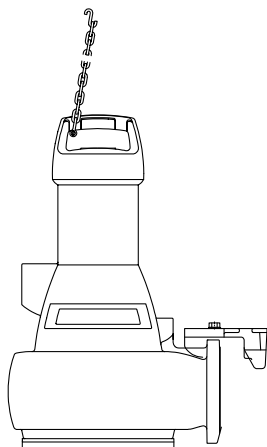


Fig. 13: Attaching the lifting chain/rope - stationary wet installation

Attaching the lifting chain/rope

1. Attach the lifting chain or rope to the bail at the pump set on the opposite side of the discharge nozzle.
This attachment point achieves a forward inclination of the pump set towards the discharge nozzle, which allows the pump claw to hook onto the duckfoot bend.

5.3.1.5 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 rails 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 wires/rails and slowly lower it down.
The pump set attaches itself to duckfoot bend 72-1.
2. Attach lifting chain/rope to hook 59-18 at the mounting bracket.

5.3.2 Transportable wet installation

Attaching the lifting chain/rope

1. Attach the lifting chain or rope to the bail opposite the discharge nozzle.
This attachment point achieves a forward inclination of the pump set towards the discharge nozzle, which allows the pump claw to hook onto the duckfoot bend.

Fitting the foot plate or pump stool

Fit the foot plate or pump stool before installing the pump.
Tighten the bolts as specified, see table "Tightening torques".

Connecting the piping

The DIN connection can be connected to rigid or flexible pipes.

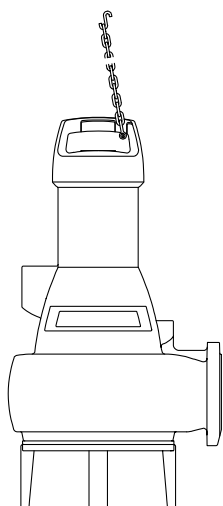


Fig. 14: Attaching the lifting chain/rope

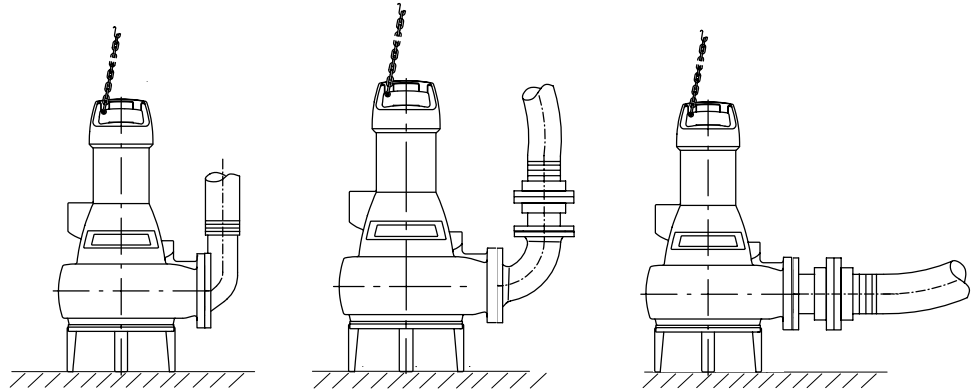


Fig. 15: Connection options

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 contained in the Annex.

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 that the number of cores is sufficient for the sensors. A minimum cross-section of 1.5 mm² is required.

The motors can be connected to electrical low voltage networks with nominal voltages and voltage tolerances as per IEC 38 or other networks or supply systems with rated voltage tolerances of max. ±10 %.

5.4.1.1 Overload protection

1. Protect the pump set against overloading by using a thermal time-lag overload protection device in accordance with IEC 947 and local regulations.
2. Set the overload protection device to the rated current specified on the name plate. (⇒ Section 4.3 Page 15)

5.4.1.2 Level control



DANGER

Pump set running dry
Explosion hazard!

- ▷ Never allow an explosion-proof 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 operation of the pump set in a tank requires the use of level control equipment.
Observe the minimum fluid level.

5.4.1.3 Frequency inverter operation

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

	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Operation outside the permitted frequency range Explosion hazard!</p> <ul style="list-style-type: none"> ▶ Never operate an explosion-proof pump set outside the specified range.
	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Incorrect setting of frequency inverter current limit Explosion hazard!</p> <ul style="list-style-type: none"> ▶ Set the current limit to max. 1.2 times the rated current indicated on the name plate.

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

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

Start-up

- Ensure short start ramps (max. 5 s)
- 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 via frequency inverter:

- Only utilise up to 95 % of the motor rating P_2 indicated on the name plate.
- Frequency range 25-50 Hz




Electromagnetic compatibility

Frequency inverter operation produces RFI 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 the limits stipulated in EN 50081 always observe the EMC information provided by the inverter manufacturer. If the inverter manufacturer recommends a shielded power cable, make sure to use a pump set with a shielded power cable.

Interference immunity

The pump set generally meets the interference immunity requirements to EN 50082. For monitoring the sensors installed the operator must ensure sufficient interference immunity by appropriately selecting and laying the cables in the plant. No modifications are required on the power/control cable of the pump set. Suitable analysing devices must be selected. To monitor the leakage sensor inside the motor, it is recommended to use a special relay available from KSB.

5.4.1.4 Sensors

 	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Operating an incompletely connected pump set Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> ▶ Never start up a pump set with incompletely connected power cables or non-operational monitoring devices.
	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Incorrect connection Damage to the sensors!</p> <ul style="list-style-type: none"> ▶ Observe the limits stated in the following sections of this manual when connecting the sensors.

The pump set is equipped with sensors designed to prevent hazards and damage to the pump set.

Measuring transducers are required for analysing the sensor signals supplied. Suitable devices for 230V~ 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 analysed as stipulated in these operating instructions.

All sensors are located inside the pump set and are connected to the power cable. For information on wiring and core marking 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 an explosion-proof pump set without operational temperature monitoring.

Standard pump sets (versions U and W):

Two bimetal switches (terminals 21 and 22, max. 250 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-start is permissible.



WARNING

Incorrect electrical connection
Electric shock!

- ▷ Adequately insulate core 20.

Core 20 has no function on standard pump sets.

However, it can be live and must, therefore, be insulated or connected to a dummy terminal.

Explosion-proof pump sets (version Y)

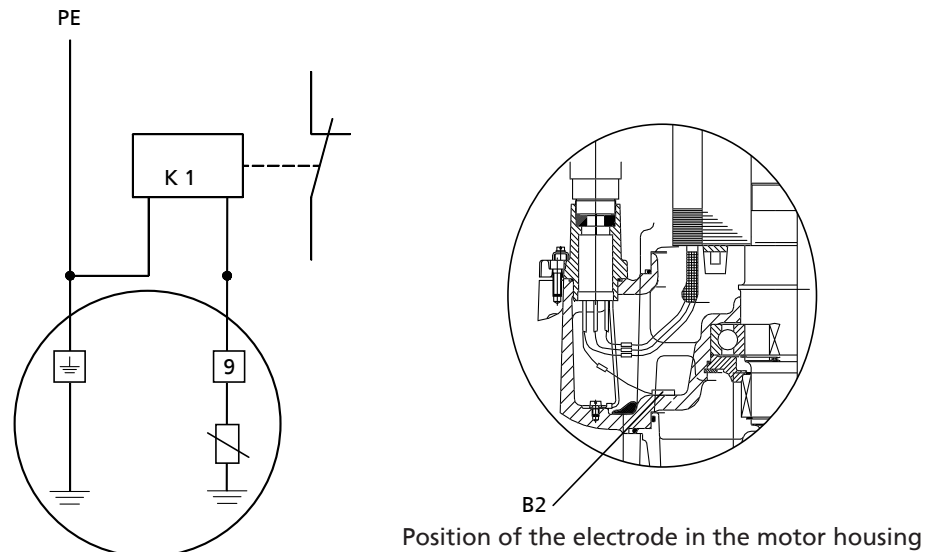
Explosion-proof pump sets are equipped with double monitoring of the winding temperature. Two bimetal switches (terminals 20 and 21, max. 250 V~/2 A) serve as temperature control devices which open when the winding temperature is too high.

Tripping must result in the pump set cutting out. Automatic re-start is permissible.

Two additional bimetal switches (terminals 21 and 22, max. 250 V~/2 A) serve as temperature limiters which open when the temperature limit is exceeded.

Tripping must result in the pump set cutting out. The pump set must not re-start automatically.

5.4.1.4.2 Leakage inside the motor






Connecting the electrode relay







An electrode fitted inside the motor monitors the winding and connection space for leakage. This electrode must be connected to an electrode relay (core identification 9). 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 ~
- Tripping current 0.5 to 3 mA
(equivalent to a tripping resistance of 3 to 60 kΩ)

5.4.2 Connection to power supply

	<p>⚠ DANGER</p> <p>Work on the pump set by unqualified personnel Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▸ Always have the electrical connections installed by a trained and qualified electrician. ▸ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.
	<p>⚠ WARNING</p> <p>Incorrect connection to the mains Damage to the mains network, short circuit!</p> <ul style="list-style-type: none"> ▸ Observe the technical specifications of the local energy supply companies.
	<p>CAUTION</p> <p>Improper routing of power cable Damage to the power cables!</p> <ul style="list-style-type: none"> ▸ Never move the power cables at temperatures below - 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! <ul style="list-style-type: none"> Protect the motor by a thermal time-lag overload protection device in accordance with IEC 947 and local regulations.
	DANGER Incorrect connection Explosion hazard! <ul style="list-style-type: none"> The connection point of the cable ends must be located outside the potentially explosive atmosphere or inside electrical equipment approved to equipment category II2G.
 	DANGER Operating an incompletely connected pump set Explosion hazard! Damage to the pump set! <ul style="list-style-type: none"> Never start up a pump set with incompletely connected power cables or non-operational monitoring devices.
	DANGER Connection of damaged power cables Danger of death from electric shock! <ul style="list-style-type: none"> Check the power cables for damage before connecting them to the power supply. Never connect damaged power cables.
	CAUTION Flow-induced motion Damage to the power cable! <ul style="list-style-type: none"> Run the power cable upwards without slack.

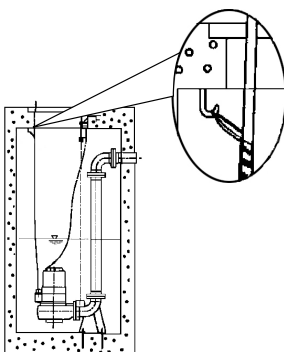






Fig. 16: Fastening the power cables

Potential equalisation

1. Run the power cables 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 on the individual cores at the cable ends.

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

	<div data-bbox="491 181 1453 232"> DANGER</div> <div data-bbox="491 232 1453 374"><p>Incorrect wiring Explosion hazard!</p><ul style="list-style-type: none">▸ Explosion-proof pump sets installed in a tank must never be retrofitted with an external potential equalisation connection!</div>
	<div data-bbox="491 394 1453 445"> DANGER</div> <div data-bbox="491 445 1453 560"><p>Touching the pump set during operation Electric shock!</p><ul style="list-style-type: none">▸ Make sure that the pump set cannot be touched during operation.</div>


6 Commissioning/Start-up/Shutdown

6.1 Commissioning/start-up


6.1.1 Prerequisites for commissioning/start-up


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

- The pump set has been properly connected to the power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled.
- The direction of rotation has been checked.
- The lubricant has been checked.
- After prolonged shutdown of the pump (set), the required activities have been carried out. (⇒ Section 6.4 Page 36)


	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Persons in the tank during pump operation Electric shock!</p> <ul style="list-style-type: none"> ▸ Never start up the pump set when there are persons in the tank.
---	---

6.1.2 Start-up

	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Persons in the tank during pump operation Electric shock!</p> <ul style="list-style-type: none"> ▸ Never start up the pump set when there are persons in the tank.
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	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Re-starting while motor is still running down Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ Do not re-start the pump set before it has come to a standstill. ▸ Never start up the pump set while the pump is running in reverse.
---	--

✓ The fluid level is sufficiently high.


	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Pump start-up against a closed shut-off element Increased vibrations! Damage to mechanical seals and bearings!</p> <ul style="list-style-type: none"> ▸ Never operate 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.

6.2 Operating limits



	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Non-compliance with operating limits Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ Comply with the operating data indicated in the data sheet. ▸ Avoid operation against a closed shut-off element. ▸ Never operate an explosion-proof pump set at ambient and 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 Supply voltage

	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Non-compliance with permissible supply voltage tolerances Explosion hazard!</p> <ul style="list-style-type: none"> ▸ Never operate an explosion-proof pump (set) 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 %.

6.2.2 Frequency inverter operation


	<div style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Operation outside the permitted frequency range Explosion hazard!</p> <ul style="list-style-type: none"> ▸ Never operate explosion-proof pump sets outside the specified range.
	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Pumping solids-laden fluids at reduced speed Increased wear and clogging!</p> <ul style="list-style-type: none"> ▸ Never operate the pump set with flow velocities below 0.7 m/s in horizontal pipes and 1.2 m/s in vertical pipes.

Frequency inverter operation of the pump set is permitted in the frequency range from 25 to 50 Hz.

6.2.3 Fluid handled


6.2.3.1 Temperature of the fluid handled

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

	<div style="background-color: #f4d03f; padding: 5px;">CAUTION</div> <p>Danger of frost/freezing Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ Drain the pump set or protect it against freezing.
---	--


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

6.2.3.2 Frequency of starts


	<div style="background-color: yellow; padding: 5px;">CAUTION</div> <p>Excessive frequency of starts Risk of damage to the motor!</p> <ul style="list-style-type: none"> ▸ Never exceed the specified frequency of starts.
---	--


To prevent high temperature increases in the motor and excessive loads on the motor, seals and bearings, the frequency of starts shall not exceed 30 start-ups per hour and 5000 start-ups per year.

These values apply to mains start-up (DOL, with soft starter or with autotransformer). The limit does not apply to frequency inverter operation.

	<div style="background-color: yellow; padding: 5px;">CAUTION</div> <p>Re-starting while motor is still running down Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ Do not re-start the pump set before it has come to a standstill. ▸ Never start up the pump set while the pump is running in reverse.
---	---

6.2.3.3 Minimum level of fluid handled

	<div style="background-color: red; color: white; padding: 5px;">⚠ DANGER</div> <p>Pump set running dry Explosion hazard!</p> <ul style="list-style-type: none"> ▸ Never allow an explosion-proof pump set to run dry!
---	--

	<div style="background-color: yellow; padding: 5px;">CAUTION</div> <p>Fluid level below the specified minimum Damage to the pump set by cavitation!</p> <ul style="list-style-type: none"> ▸ Never allow the fluid level to drop below the specified minimum.
---	--

The pump set is 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.

The pump can be operated at a lower fluid level for short periods.

If the motor is not sufficiently cooled, an internal temperature monitoring device will trip the pump set and automatically re-start it after the motor has cooled down. The fluid level must not drop below the specified minimum (dimension B). Exact dimensions see general arrangement drawing/outline drawing.

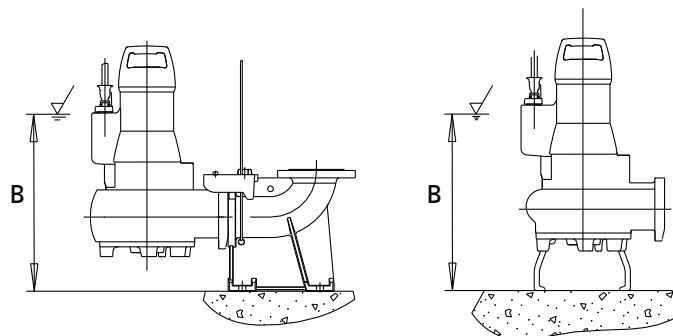




Fig. 17: Minimum fluid level

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

6.2.3.4 Density of the fluid handled


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


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


6.3 Shutdown/storage/preservation

6.3.1 Measures to be taken for shutdown

The pump set remains installed

	<p>⚠ WARNING</p> <p>Unintentional starting of pump set Risk of injury by moving parts!</p> <ul style="list-style-type: none"> ▸ 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.
--	--

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

	<p>CAUTION</p> <p>Danger of frost/freezing Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ 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 operation check run of the pump set.

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

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

✓ All safety regulations are observed. (⇒ Section 7.1 Page 37)



1. Clean the pump set.

2. Preserve the pump set.
3. Observe the instructions given in (⇒ Section 3.3 Page 13) .

6.4 Returning to service

For returning the pump set to service observe the sections on commissioning/start-up (⇒ Section 6 Page 32) and operating limits. (⇒ Section 6.2 Page 33)








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

	<p>⚠ WARNING</p> <p>Failure to re-install or re-activate protective devices Risk of personal injury from moving parts or escaping fluid!</p> <ul style="list-style-type: none"> ▸ As soon as the work is complete, re-install and/or re-activate any safety-relevant and protective devices.
	<p>NOTE</p> <p>On pumps/pump sets older than 5 years we recommend replacing all elastomer seals.</p>

7 Servicing/Maintenance

7.1 Safety regulations

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

	<div data-bbox="491 418 1452 465" style="background-color: #f4a460; padding: 5px;">⚠ DANGER</div> <p>Sparks produced during servicing work Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Observe the safety regulations in force at the place of installation! ▷ Never open an energised pump set. ▷ Always perform maintenance work on explosion-proof pump sets outside potentially explosive atmospheres only.
	<div data-bbox="491 705 1452 752" style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Unintentional starting of pump set Risk of injury by moving parts!</p> <ul style="list-style-type: none"> ▷ 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.
	<div data-bbox="491 956 1452 1003" style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Fluids and supplies posing a health hazard and/or hot fluids or supplies Risk of injury!</p> <ul style="list-style-type: none"> ▷ Observe all relevant laws. ▷ When draining the fluid take appropriate measures to protect persons and the environment. ▷ Decontaminate pumps which handle fluids posing a health hazard.
	<div data-bbox="491 1243 1452 1290" style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Hot surface Risk of injury!</p> <ul style="list-style-type: none"> ▷ Allow the pump set to cool down to ambient temperature.
	<div data-bbox="491 1426 1452 1473" style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Improper lifting/moving of heavy assemblies or components Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.
	<div data-bbox="491 1639 1452 1686" style="background-color: #f4a460; padding: 5px;">⚠ WARNING</div> <p>Insufficient stability Risk of crushing hands and feet!</p> <ul style="list-style-type: none"> ▷ During assembly/dismantling, secure the pump (set)/pump parts to prevent tipping or falling over.
	<div data-bbox="491 1852 1452 1899" style="background-color: #0072bc; color: white; padding: 5px;">NOTE</div> <p>Special regulations apply to repair work on explosion-proof pump sets. Modification or alteration of the pump set may affect explosion protection and are only permitted after consultation with the manufacturer.</p>

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



NOTE

All maintenance, service and installation work can be carried out by KSB Service or authorised workshops. Find your contact in the attached "Addresses" booklet or on the Internet at "www.ksb.com/contact".

Never use force when dismantling and reassembling the pump set.

7.2 Servicing/inspection

KSB recommends the following schedule for pump set maintenance:

Table 12: Overview of maintenance work

Maintenance interval	Maintenance work	For details see ...
Every 4,000 operating hours ⁵⁾	Measure the insulation resistance	(⇒ Section 7.2.1.3 Page 38)
	Check the power cables	(⇒ Section 7.2.1.2 Page 38)
	Visually inspect the lifting chain/rope	(⇒ Section 7.2.1.1 Page 38)
Every 10,000 operating hours ⁶⁾	Check the sensors	(⇒ Section 7.2.1.4 Page 39)
	Change the lubricant	
Every five years	General overhaul	

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 the attachment for any visible damage.
- 2. Replace any damaged components by original spare parts.

7.2.1.2 Checking the power cables

- Visual inspection**
- ✓ The pump set has been pulled out of the pump sump and cleaned.
 - 1. Inspect the power cable for any visual damage.
 - 2. Replace any damaged components by original spare parts.

- Checking the earth conductor**
- ✓ The pump set has been pulled out of the pump sump and cleaned.
 - 1. Measure the resistance between earth conductor and earth.
The resistance measured must be less than 1 Ω.
 - 2. Replace any damaged components by original spare parts.



DANGER

Defective earth conductor
Electric shock!

- ▷ Never switch on a pump set with a defective earth conductor.

7.2.1.3 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.

⁵⁾ At least once a year

⁶⁾ At least every three years

- ✓ Use an insulation resistance measuring device.
- ✓ The recommended measuring voltage equals 500 V (maximum permissible 1000 V).
- 1. Measure the winding against earth.
To do so, connect all winding ends together.
- 2. Measure the winding temperature sensors against earth.
To do so, connect all core ends of the winding temperature sensors together and connect all winding ends to earth.
- ⇒ The insulation resistance of the core ends against earth 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 for one of the power cables is below 1 MΩ, the cable is defective and must be replaced.



NOTE

If the insulation resistance values measured on the motor are too low, the winding insulation is defective. The pump set must not be returned to service in this case.

7.2.1.4 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.

Bimetal switches in the motor

Table 13: Resistance measurement of bimetal switch in the motor

Measurement between terminals ...	Resistance
20 and 21 and between 21 and 22	< 1 Ω

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

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

Leakage sensor in the motor

Table 14: Resistance measurement of the leakage sensor in the motor

Measurement between terminals ...	Resistance
9 and earth conductor (PE)	> 1 Ω

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

7.2.2 Lubrication and lubricant change

7.2.2.1 Lubricating the mechanical seal

The mechanical seal is supplied with lubricant from the lubricant reservoir.

7.2.2.1.1 Intervals

Replace the lubricant after every 10,000 operating hours but at least every 3 years.

7.2.2.1.2 Lubricant quality


The lubricant reservoir is filled at the factory with environmentally friendly, non-toxic lubricant of medicinal quality (if not requested otherwise by the customer). The following lubricants can be used to lubricate the mechanical seals:

Table 15: Oil quality

Description	Properties	
Paraffin oil or white oil Alternative: Motor oils of classes SAE 10 W to SAE 20 W	Kinematic viscosity at 40 °C	<20 mm ² /s
	Flash point (in accordance with Cleveland)	+160 °C
	Pour point	-15 °C

Recommended oil types:

- Merkur WOP 40 PB, SASOL
- Merkur white oil Pharma 40, DEA
- Liquid paraffin oil No. 7174, Merck
- Equivalent brands of medicinal quality, non-toxic
- Water-glycol mix



⚠ WARNING


Lubricant contaminating fluid handled
Hazard to persons and the environment!

- Using machine oil is only permitted if the oil is disposed of properly.

7.2.2.1.3 Lubricant quantity

Lubricant quantity required: 0.7 l.


7.2.2.1.4 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 reservoir
Liquid spurting out when the lubricant reservoir is opened at operating temperature!

- Open the screw plug of the lubricant reservoir very carefully.

Draining the lubricant

1. Position the pump set as shown.

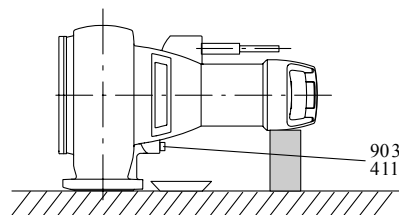


Fig. 18: Draining the lubricant

2. Place a suitable container under the screw plug.

Filling in the lubricant

3. Undo screw plug 903 with joint ring 411 and drain off the lubricant.
1. Position the pump set as shown.

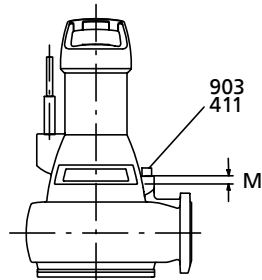


Fig. 19: Filling in the lubricant

2. Top up lubricant in the lubricant reservoir through the lubricant filler opening until the lubricant reaches the given dimension $M = 15 \text{ mm}$.
3. Close screw plug 903 again, fitting a new joint ring 411.

7.2.2.2 Lubricating the rolling element bearings

The pump set is equipped with grease-lubricated, maintenance-free rolling element bearings.

7.3 Drainage/cleaning




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

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 sending it to the workshop.
Make sure to add a certificate of decontamination. (⇒ Section 11 Page 57)

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations

	<p>⚠ WARNING</p>
	<p>Unqualified personnel performing work on the pump (set) Risk of injury!</p> <ul style="list-style-type: none"> ▸ Always have repair and maintenance work performed by specially trained, qualified personnel.
	<p>⚠ WARNING</p> <p>Hot surface Risk of injury!</p> <ul style="list-style-type: none"> ▸ Allow the pump set to cool down to ambient temperature.

	<p>⚠ WARNING</p> <p>Improper lifting/moving of heavy assemblies or components Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▶ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.
	<p>⚠ DANGER</p> <p>Insufficient preparation of work on the pump (set) Risk of injury!</p> <ul style="list-style-type: none"> ▶ Properly shut down the pump set. ▶ Close the shut-off elements in suction and discharge line. ▶ Drain the pump and release the pump pressure. ▶ Close any auxiliary connections. ▶ Allow the pump set to cool down to ambient temperature.
	<p>⚠ WARNING</p> <p>Components with sharp edges Risk of cutting or shearing injuries!</p> <ul style="list-style-type: none"> ▶ Always use appropriate caution for installation and dismantling work. ▶ Wear work gloves.

Observe the general safety instructions and information. (⇒ Section 7 Page 37)

For dismantling and reassembly observe the general assembly drawing.

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

7.4.2 Preparing the pump set

1. De-energise the pump set and secure it against unintentional start-up.
2. The pump set has been removed from the pump sump.
3. The pump set has been cleaned. (⇒ Section 7.3 Page 41)
4. The lubricant has been drained.

7.4.3 Dismantling the pump section

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

7.4.4 Removing the impeller

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

1. Remove suction cover 162.
2. Undo and remove the M8 impeller fastening screw.
The impeller/shaft connection is a tapered fit.
3. For removing the impeller, an M10 jacking thread is provided at the impeller hub.
Screw in the jack as shown in the drawing below and remove the impeller.

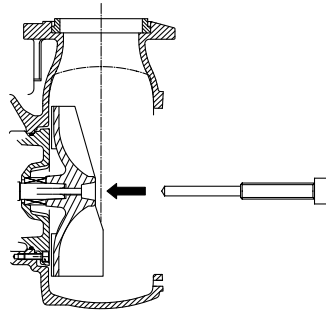


Fig. 20: Forcing screw



NOTE

The forcing screw is not included in the scope of supply. It can be ordered separately from KSB.

7.4.5 Dismantling the motor section



NOTE

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



NOTE

The motors of explosion-proof pump sets are supplied in "flameproof enclosure" type of protection. Any work on the motor section which may affect explosion protection, such as re-winding and machining repairs, must be inspected and approved by an approved expert or performed by the motor manufacturers. No modifications must be made to the internal configuration of the motor space. Repair work at the flameproof joints must only be performed in accordance with the manufacturer's instructions. Repair to the values in tables 1 and 2 of EN 60079-1 is not permitted.

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

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! <ul style="list-style-type: none"> ▸ Reassemble the pump (set) in accordance with the general rules of sound engineering practice. ▸ Use original spare parts only.
	NOTE Before reassembling the motor section, check that all joints relevant to explosion protection (flamepaths) are undamaged. Any components with damaged flamepaths must be replaced. Refer to the "Flamepaths" annex for the position of the flamepaths.

Sequence	Always reassemble the pump set in accordance with the corresponding general assembly drawing.
Sealing elements	<ul style="list-style-type: none"> ▪ O-rings <ul style="list-style-type: none"> – Check O-rings for any damage and replace by new O-rings, if required. – Never use O-rings that have been glued together from material sold by the metre. ▪ Assembly adhesives <ul style="list-style-type: none"> – 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.
 - Before the actual installation of the mechanical seal, wet the contact faces with a drop of oil.
 - For easier installation of bellows-type mechanical seals, wet the inside diameter of the bellows with soapy water (no oil).
 - To prevent any damage to the rubber bellows, place a thin foil (thickness approximately 0.1 to 0.3 mm) around the free shaft stub. Slip the rotating assembly over the foil into its installation position. Then remove the foil.
- ✓ The shaft and rolling element bearings have been properly installed in the motor.
1. Push drive-end mechanical seal 433.01 onto shaft 210 and secure it with taper lock ring 515 or circlip 932.03.
 2. Insert O-rings 412.04/412.35 and 412.15/412.11 into discharge cover 163, and press them into bearing bracket 330 as far as they will go.
 3. Push pump-end mechanical seal 433.02 onto shaft 210.

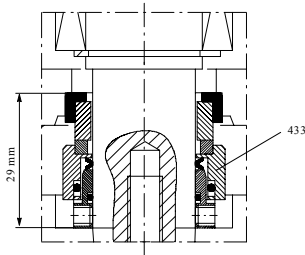


Fig. 21: Installation dimension of the mechanical seal

7.5.2.2 Fitting the impeller



NOTE

For bearing brackets with tapered fit make sure that the tapered fit of impeller and shaft is undamaged and assembled free from grease.

- ✓ The shaft and rolling element bearings have been properly installed.
- ✓ The mechanical seals have been properly installed.
- 1. Slide impeller 230 onto the shaft end.
- 2. Screw in impeller screw 914 and disc 550, if any. Tighten with a torque wrench.

7.5.2.2.1 Fitting the cutter

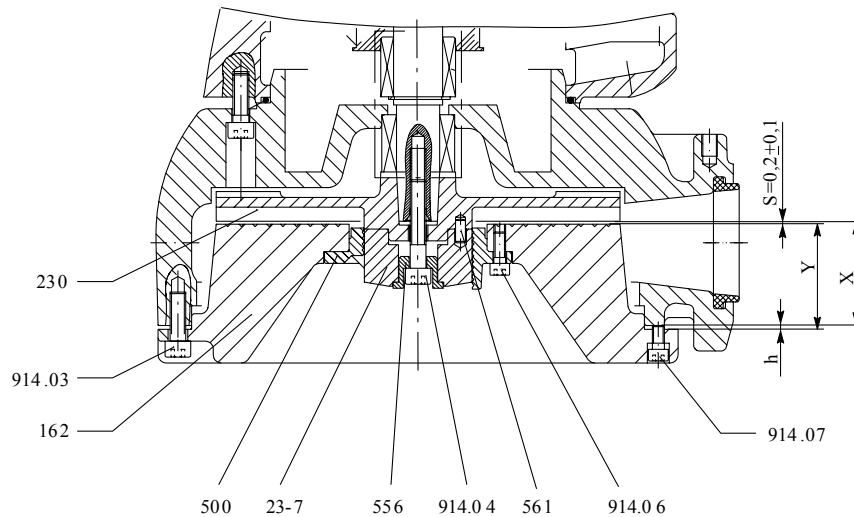


Fig. 22: Fitting the cutter

- ✓ Pump-end mechanical seal 433.02 has been installed.
- 1. Slide impeller 230 onto the conical shaft end.
- 2. Insert grooved pin 561.01 into the impeller and fit impeller body 23-7 on the centring hub.
- 3. Screw in impeller screw 914.10 and use a torque wrench to tighten the screw to a torque of 50 Nm.
- 4. Fit the pump casing including O-ring 412.15 using hexagon head bolts 901.14. Use a torque wrench to tighten the bolts to a tightening torque of 60 Nm.
- 5. Insert O-ring 412.16 in suction cover 162.
- 6. Fasten ring 500.02 with socket head cap screw 914.07 in the suction cover.

7. Insert the suction cover into the pump casing, making sure the suction cover touches the impeller vanes.
(Make sure that socket head cap screws 914.15 do not protrude from the threaded holes in the suction cover.)
8. Screw in hexagon head bolt 901.15 to hold the suction cover in place. Do not tighten the bolt yet.
9. Measure the distance between the impeller and the suction cover.
Distance S should measure approximately 0.2 ± 0.1 mm.
10. If required, adjust the position of the suction cover in relation to the pump casing using socket head cap screw 914.15.
11. Tighten hexagon head bolt 901.15 to a torque of 30 Nm.
12. Rotate the impeller body to check that the impeller turns smoothly.
Make sure that the suction cover and impeller do not touch each other.

7.5.2.3 Adjusting the casing wear ring (impeller type K)

1. Use a rubber mallet to push casing wear ring 502 into pump casing 101 as far as it will go.
2. Assemble the pump set as indicated. (⇒ Section 7.5.2 Page 44)



CAUTION

Axial displacement of the rotor
Damage to shaft seal and bearings!

- ▷ Always adjust and check the axial clearance with the pump set in vertical position.

3. Use a rubber mallet to push casing wear ring 502 in until it is close to impeller 230.
4. Suspend the pump set vertically, as illustrated.
5. Lift off the pump set and adjust the axial clearance to 0.3 ± 0.1 mm.

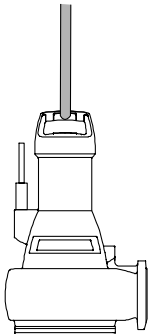


Fig. 23: Suspending the pump set

7.5.3 Leak testing

After reassembly, the mechanical seal area/lubricant reservoir must be tested for leakage. The leak test is performed using the lubricant filler opening.

Observe the following values for leak testing:

- **Test medium:** compressed air
- **Test pressure:** 0.5 bar max.
- **Test duration:** 2 minutes

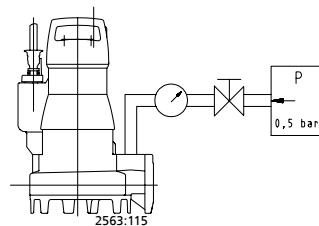


Fig. 24: Screwing in the testing device

1. Unscrew and remove the screw plug and joint ring of the lubricant reservoir.

2. Screw the testing device tightly into the lubricant filler opening.
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.
Then perform another leak test.
4. If the leak test has been successful, fill in the lubricant. (⇒ Section 7.2.2.1 Page 39)

7.5.4 Checking the connection of motor/power supply

Once reassembly has been completed, carry out the steps described in (⇒ Section 7.2.1 Page 38) .

7.6 Tightening torques

Table 16: Tightening torques

Thread	Torque [Nm]
M 5	4
M 6	7
M 8	17
M 10	35
M 12	60
M 16	150

7.7 Spare parts stock

7.7.1 Ordering spare parts

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

- Pump type
- KSB order number
- Motor number

Refer to the name plate for all data. (⇒ Section 4.3 Page 15)

Also supply the following data:

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

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

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

Table 17: Quantity of spare parts for recommended spare parts stock⁷⁾

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
230	Impeller	1	1	1	2	2	3	30 %
433.01	Mechanical seal, motor-end	2	3	4	5	6	7	90 %

⁷⁾ For two years of continuous operation or 17,800 operating hours

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
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	4	6	8	8	9	10	100 %

8 Trouble-shooting

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

Table 18: Trouble-shooting

A	B	C	D	E	Possible cause	Remedy
	X				Pump delivers against an excessively high pressure.	Re-adjust to duty point.
	X				Gate valve in the discharge line is not fully open.	Fully open the gate valve.
		X		X	Pump is running in the off-design range (low flow/overload).	Check the pump's operating data.
X					Pump or piping are not completely vented.	Vent by lifting the pump off the duckfoot bend and lowering it again.
X					Pump intake clogged by deposits	Clean the intake, pump components and non-return valve.
	X		X	X	Suction line or impeller clogged.	Remove deposits in the pump and/or piping.
		X		X	Dirt/fibres 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 of internal parts	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 switchgear, if any.
		X			Wrong supply voltage	Check the power cable. Check the cable connections.
X					Motor is not running because of lack of voltage.	Check the electrical installation. Contact the energy supplier.
X		X			Motor winding or power cable are defective.	Replace by new original KSB parts or contact KSB.
				X	Defective rolling element bearing	Contact KSB.
	X				Water level lowered too much during operation.	Check level control equipment.
X					The temperature control device for monitoring the winding has tripped due to excessive winding temperature.	The motor will restart automatically once it has cooled down.
X					Temperature limiter (explosion protection) has tripped the pump as a result of the permissible winding temperature being exceeded.	Have cause determined and eliminated by qualified and trained personnel.
X					Motor has been tripped by leakage monitor.	Have cause determined and eliminated by qualified and trained personnel.

9 Related Documents

9.1 General assembly drawings

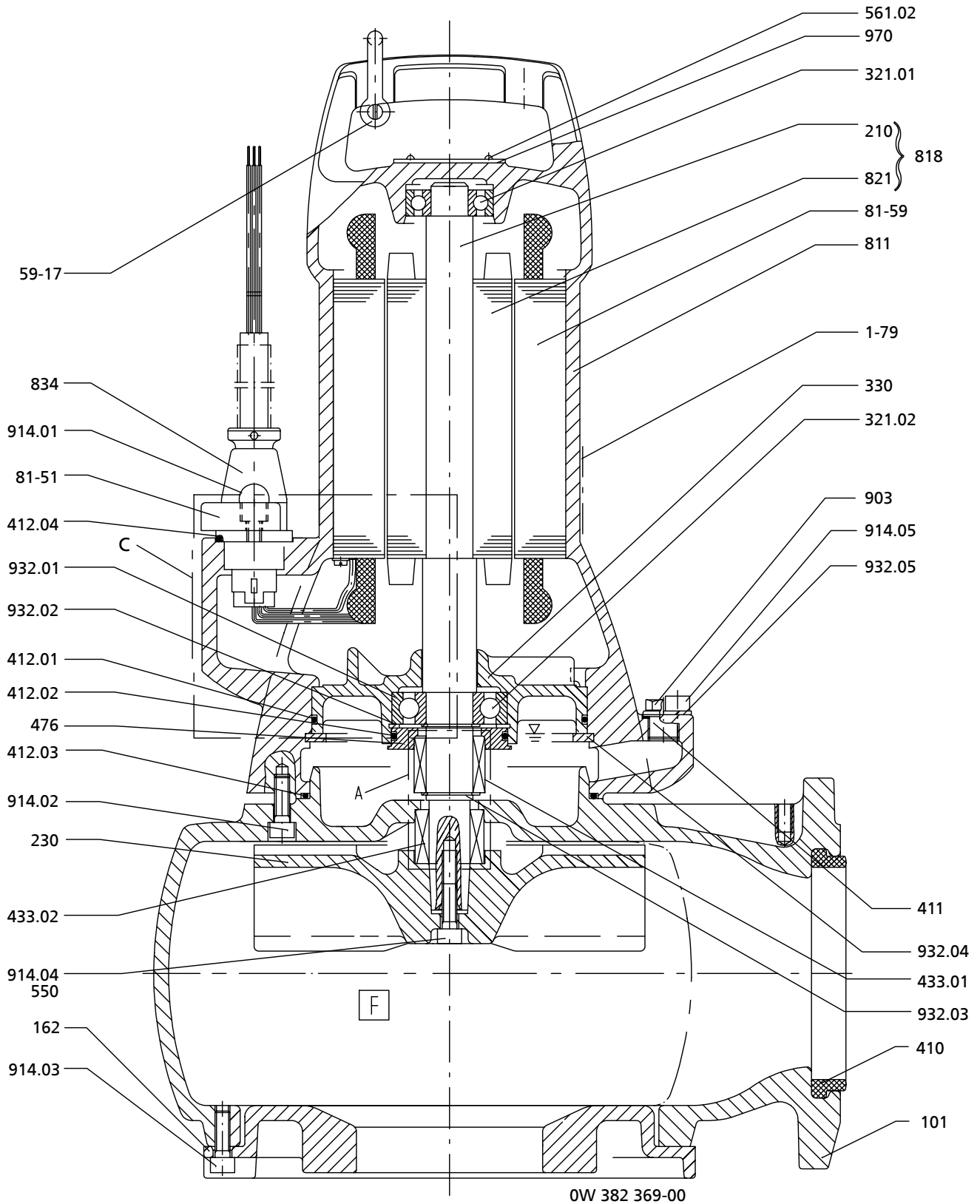
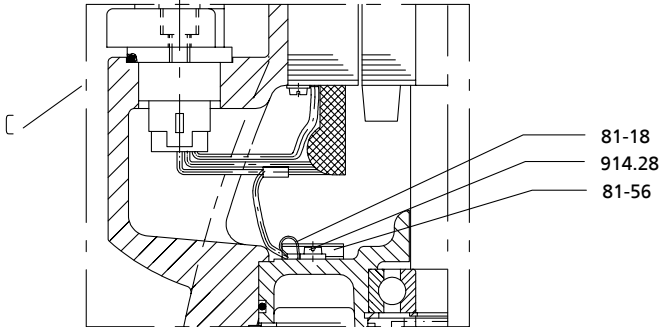
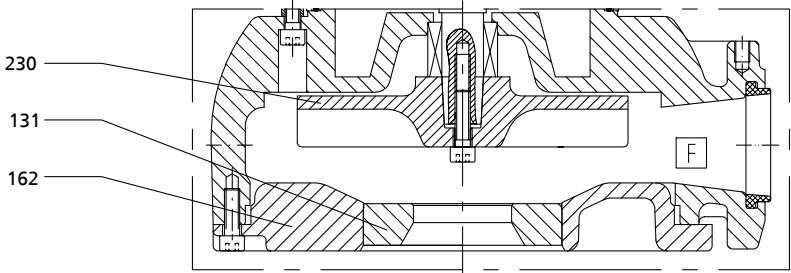
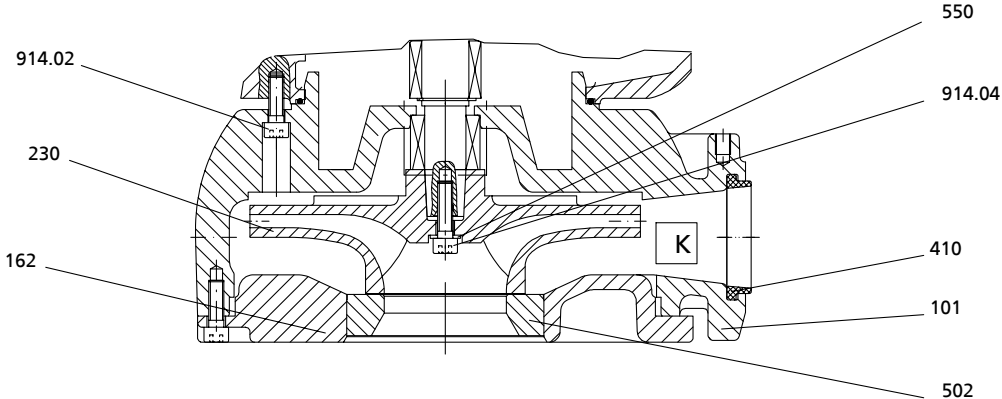
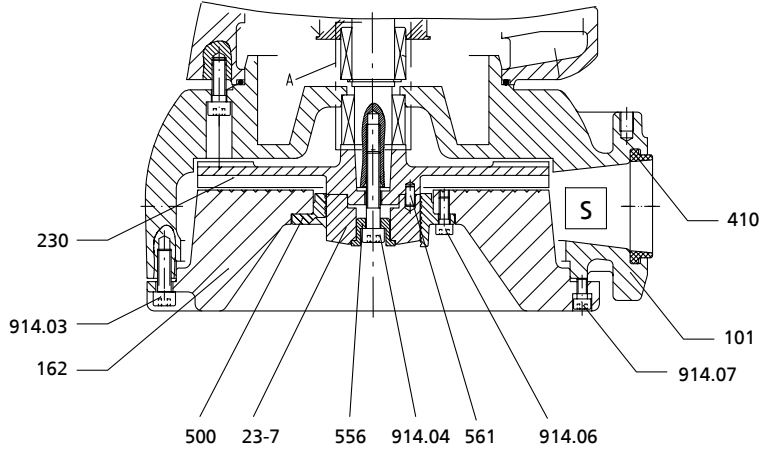


Fig. 25: General assembly drawing

Table 19: Detailed views of the general assembly drawing

Description	Detailed view		
Moisture protection device			
Impeller type F			
Impeller type K			
Impeller type S			
Part No.	Description	Part No.	Description
1-79	Coating	502	Casing wear ring
101	Pump casing	550	Disc

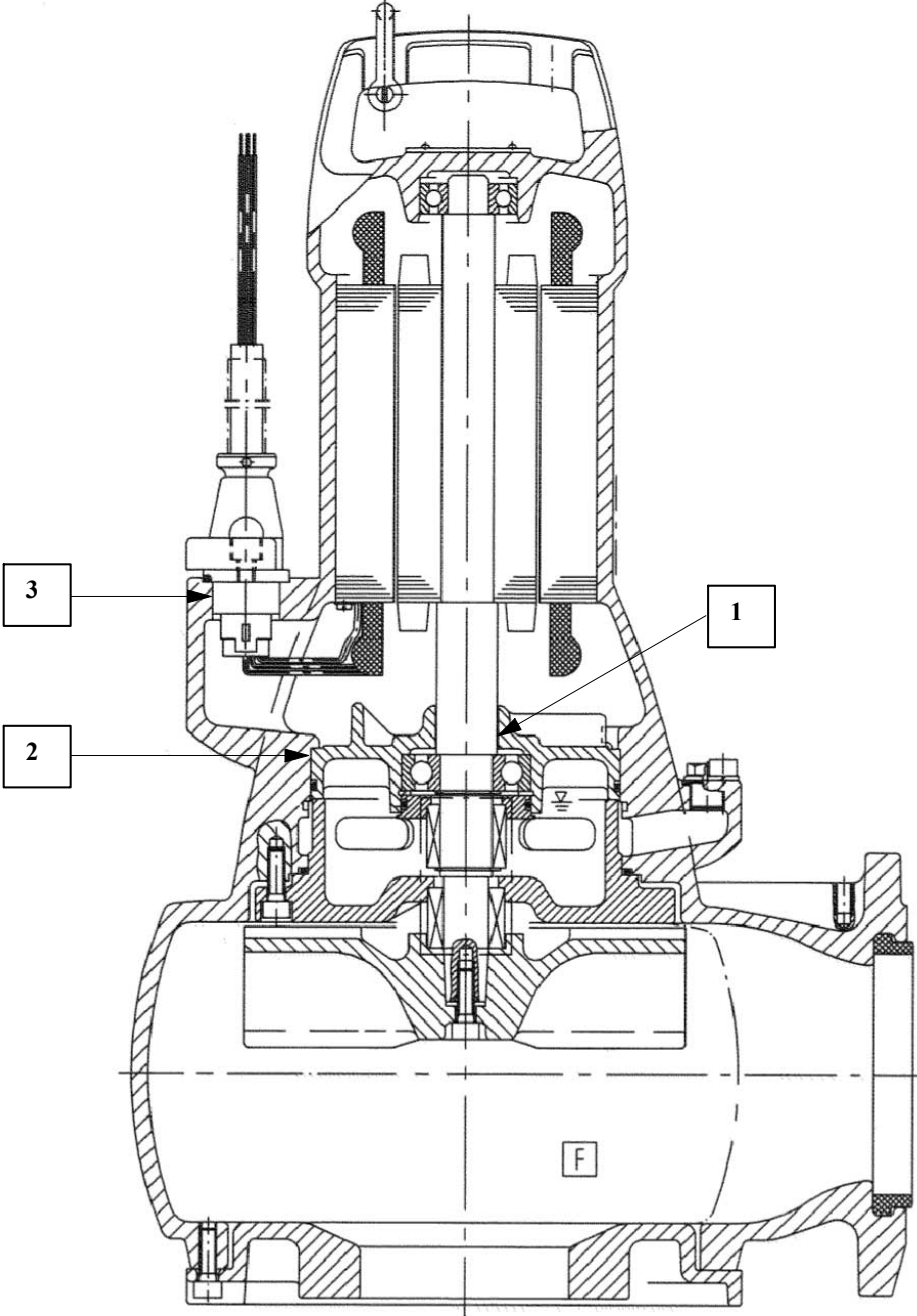
Part No.	Description	Part No.	Description
131	Inlet ring	556	Fitting piece
162	Suction cover	561/.02	Grooved pin
23-7	Impeller body	81-18	Cable terminal
210	Shaft	81-51	Clamping element
230	Impeller	81-56	Moisture protection device
321.01/.02	Radial ball bearing	81-59	Stator
330	Bearing bracket	811	Motor housing
410	Profile seal	818	Rotor
411	Joint ring	821	Rotor core pack
412.01/.02/.03/.04	O-ring	834	Cable gland
433.01/.02	Mechanical seal	903	Screw plug
476	Mating ring carrier	914.01/.02/.03/.04/.05/.06/.07/.28	Hexagon socket head cap screw
59-17	Shackle	932.01/.02/.03/.04/.05	Circlip
500	Ring	970	Name plate

_____ $8 \times \dots \text{mm}^2$



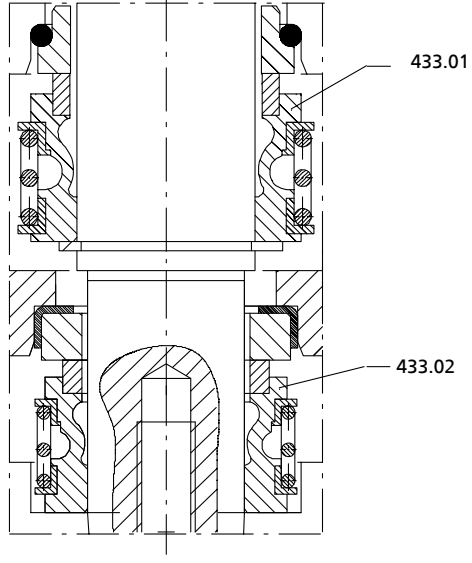
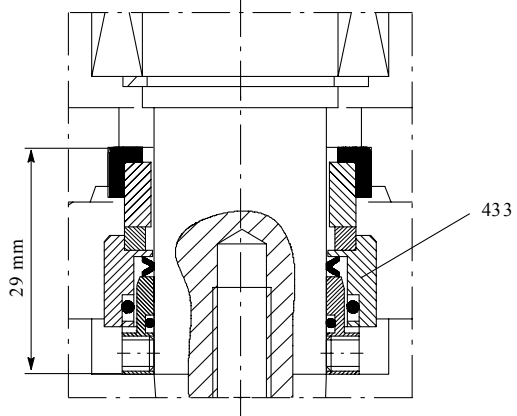
9.3 Flamepaths on explosion-proof motors

Table 20: Overview of flamepaths

Pump set	
	
1, 2, 3	Flamepaths

9.4 Sectional drawings of the mechanical seal

Table 21: Sectional drawings of the mechanical seal

		Sectional drawing	
Standard, material: C1	433.01	Mechanical seal (bellows- type mechanical seal)	 <p>433.01</p> <p>433.02</p>
	433.02	Mechanical seal (bellows- type mechanical seal)	
Standard H, C2 Standard variant C1	433.	Mechanical seal	 <p>29 mm</p> <p>433</p>

10 EC Declaration of Conformity

Manufacturer:

KSB Aktiengesellschaft
Johann-Klein-Straße 9
67227 Frankenthal (Germany)

The manufacturer herewith declares that the product:

Amarex KRT

KSB order number:

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

The manufacturer also declares that

- the following harmonised international standards have been applied:
 - ISO 12100
 - EN 809
 - EN 60034-1, EN 60034-5/A1

Person authorised to compile the technical file:

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

The EC Declaration of Conformity was issued in/on:

Place, date

.....⁸⁾.....

Name
Function
Company
Address

⁸⁾ A signed, legally binding declaration of conformity is supplied with the product.

11 Certificate of Decontamination

Type:
 Order number/
 Order item number⁹⁾:

Delivery date:

Field of application:

Fluid handled⁹⁾:

Please tick where applicable⁹⁾:



☐ Radioactive



☐ Explosive



☐ Corrosive



☐ Toxic



☐ Harmful



☐ Bio-hazardous



☐ Highly flammable



☐ Safe

Reason for return⁹⁾:

Comments:

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

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

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

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

.....

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

.....
 Place, date and signature

.....
 Address

.....
 Company stamp

⁹⁾ Required fields

Index

C

Certificate of decontamination 57
Commissioning/start-up 32
Connection to power supply 30
Cutter 45

D

Direction of rotation 21
Dismantling 42
Disposal 14

E

Electromagnetic compatibility 27
Explosion protection 11, 19, 20, 26, 27, 28, 30, 31, 33, 34, 37

F

Flamepaths 54
Fluid handled
 Density 35
Frequency inverter operation 27, 33
Function 17

G

General assembly drawing 50

I

Installation
 Transportable model 25
Insulation resistance measurement 38
Intended use 8
Interference immunity 27

L

Leakage monitoring 29
Level control 26
Lubricant 39
 Intervals 38
 Quality 40

M

Maintenance work 38

Mechanical seal 55
Minimum fluid level 34
Misuse 9

O

Oil lubrication
 Oil quality 40
Operating limits 8
Order number 6
Other applicable documents 6
Overload protection device 26

P

Partly completed machinery 6
Permissible flange loads 23
Piping 23
Place of installation 19
Preservation 13
Product description 15

R

Reassembly 42
Return to supplier 14
Returning to service 36

S

Safety 8
Safety awareness 10
Scope of supply 17
Sensors 28
Shutdown 35
Spare parts stock 47
Start-up 32
Storage 13, 35
Supply voltage 33

T

Tightening torques 47
Trouble-shooting 49



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