

Submersible Motor Pump

Amarex KRT

Dry Installation
60 Hz

Installation/Operating Manual



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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

A certificate of decontamination certifies that the pump (set) has been properly drained to eliminate any environmental and health hazards arising from components in contact with the fluid handled.

Close-coupled design

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

Discharge line

The line which is connected to the discharge nozzle

Hydraulic system

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

Suction lift line/suction head line

The line which is connected to the suction nozzle

1 General

1.1 Principles

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

Table 1: Variants covered by this manual

Sizes	Impeller types	Material variant			
		Cast iron			
		G	G1	G2	GH
80-250	F	F	F	F	F
80-251	E	E	-	-	-
80-315	D	D	D	-	-
100-250	F	F	F	F	F
100-251	E, D, K	E, D, K	D, K	-	-
100-315	D	D	D	-	-
150-251	D	D	D	-	-
150-315	D, E, F, K	D, E, F, K	D, F, K	F	F, K
200-316	K	K	K	-	K

The manual describes the proper and safe use of this equipment in all phases of operation.

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

In the event of damage, immediately contact your nearest KSB service center to maintain the right to claim 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 operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇒ Section 2.4 Page 10)

1.4 Other applicable documents

Table 2: Overview of other applicable documents

Document	Contents
Data sheet	Description of the technical data of the pump set
General arrangement drawing/ outline drawing	Description of mating and installation dimensions for the pump set
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 of accessories and integrated machinery components
Spare parts lists ¹⁾	Description of spare parts
Supplementary operating manuals ¹⁾	For example for special accessories

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

1.5 Symbols

Table 3: Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇒	Result of an action
⇔	Cross-references
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product

2 Safety

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



2.1 Key to safety symbols/markings

Table 4: Definition of safety symbols/markings

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

2.2 General

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

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

This manual must be read and completely understood by the responsible specialist personnel/operators 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

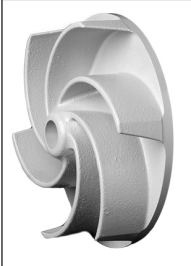
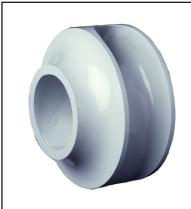
The operator is responsible for ensuring compliance with all local regulations which are not taken into account in this manual.

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 variant.
- 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 $1.2 \times Q_{\text{opt}}^{4)}$ to minimize the risk of clogging/hardening.
- Avoid duty points for continuous operation at very low speeds and small flow rates ($< 0.7 \times Q_{\text{opt}}^{4)}$).
- 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 described below.

	Free-flow impeller (impeller type F)	Suitable for the following fluids fluids containing solids and stringy material as well as fluids with entrapped air or gas
	Closed single-channel impeller (impeller type E)	Suitable for the following fluids Fluids containing solids and stringy material
	Closed multi-channel impeller (impeller type K)	Suitable for the following fluids Contaminated, solids-laden, non-gaseous fluids without stringy material
	Open, diagonal single-vane impeller (impeller type D)	Suitable for the following fluids Waste water with solid substances and long fibers

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.)

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

- Never exceed the permissible operating limits (pressure, temperature, etc.) specified in the data sheet or product literature.
- Observe all safety information and instructions in this manual.

2.4 Personnel qualification and training

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

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

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

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

2.5 Consequences and risks caused by non-compliance with 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.
- Never remove a contact guard while the pump is running.
- Connect a ground conductor to the metal jacket if the fluid handled is electrostatically charged.
- Provide the personnel with protective equipment and make sure it is used.
- Contain leakages (e.g. at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment. Adhere to all relevant laws.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)

2.8 Safety information for maintenance, inspection and installation work

- Modifications or alterations of the pump are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts authorized 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 authorized, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- The pump casing must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual. (⇒ Section 6.3 Page 32)
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work has been completed, re-install and/or re-activate any safety-relevant and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇒ Section 6.1 Page 29)

2.9 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.

2.10 Explosion protection

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

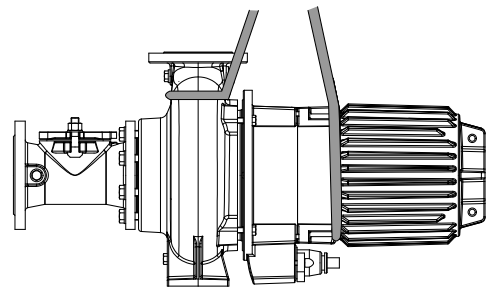
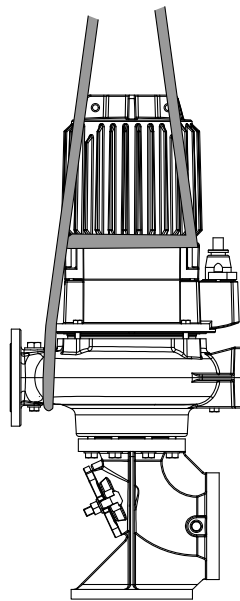
- The explosion-proof status of the pump set is only assured if the pump set is used in accordance with its intended use.
- The limits stated in the data sheet and on the name plate must not be exceeded under any circumstances.
- Correct monitoring of the motor temperature is imperative to ensure explosion protection.
- Observe the wiring diagrams. (⇒ Section 9.2 Page 54)
- Never operate an explosion-proof pump set without temperature monitoring.
- Modifications or alteration of the pump set may affect explosion protection and are only permitted after consultation with the manufacturer.
- Only original spare parts and accessories authorized by the manufacturer must be used for explosion-proof pumps.

3 Transport/Temporary Storage/Disposal

3.1 Transport

	⚠ DANGER
	Improper transport Danger to life from falling parts! Damage to the pump set! ▷ Use the attachment point provided (eyebolt, lifting lug or bail) for attaching lifting accessories. ▷ Never suspend the pump set by its power cable. ▷ Never use the chains or lifting ropes included in KSB's scope of supply for lifting loads other than the KSB product supplied. ▷ Securely attach the lifting ropes or chains to the pump and crane.

Transport the pump set as illustrated.



3.2 Storage/Preservation

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

	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 by 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 set! ▸ Only remove caps/covers from the openings of the pump set at the time of installation.
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Table 5: Ambient conditions for storage

Ambient conditions	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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3.3 Return to supplier

1. Drain the pump as per operating instructions.
2. Always flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the fluids handled by the pump (set) leave residues which might lead to corrosion when coming into contact with atmospheric humidity, or which might ignite when coming into contact with oxygen, the pump set must be neutralized, and anhydrous inert gas must be blown through the pump for drying purposes.
4. Always complete and enclose a certificate of decontamination when returning the pump (set). (⇒ Section 10 Page 56)
Always indicate any safety and decontamination measures taken.

	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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3.4 Disposal

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

4 Description of the Pump (Set)

4.1 General description

Pump for handling untreated sewage and all types of waste water.

- Close-coupled pump with shaft seal
- Directly flanged standardized motor
- Direct drive electric motor

4.2 Designation

Example: KRTK 100-251 / 74XKG-H

Table 6: Key to the designation

Code	Description
KRT	Type series
K	Impeller type, e.g. K = channel impeller
100	Nominal discharge nozzle diameter (DN) [mm]
251	Maximum nominal impeller diameter [mm]
7	Motor size
4	Number of poles
X	Motor version, e.g. X = explosion-proof version
K	Dry installation (convection in air)
G	Material variant, e.g. G = complete pump in grey cast iron
H	Installation type, e.g. H = horizontal installation

4.3 Name plate

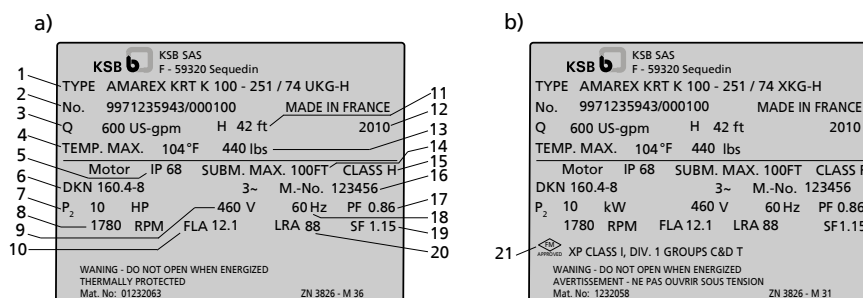


Fig. 1: Name plate a) Standard pump set b) Explosion-proof pump set

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

4.4 Design details

Design

- Fully floodable submersible motor pump

- Not self-priming
- Close-coupled design

Impeller type

- Various, application-oriented impeller types

Shaft seal

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

Standard bearing assembly

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

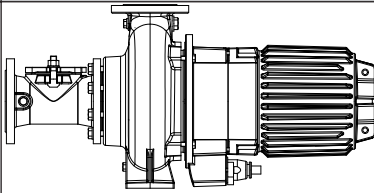
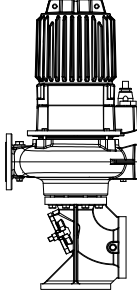
Drive

- Three-phase asynchronous squirrel-cage motor

Motors integrated in explosion-proof pump sets are supplied with a fire-proof housing suitable for use in Class I, Div. 1; Groups C&D classified hazardous environments.

4.5 Types of installation

Table 7: Types of installation

Type of installation	Illustration	Description
Horizontal dry installation (installation type H)		Pump set with directly flanged motor, horizontal installation
Vertical dry installation (installation type D)		Pump set with directly flanged motor, vertical installation, with suction duckfoot bend

4.6 Configuration and function

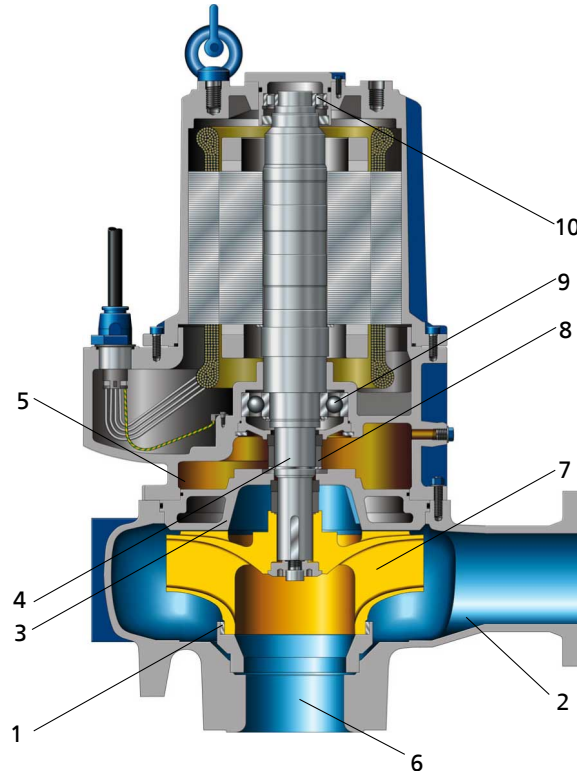


Fig. 2: Sectional drawing

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 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 casing wear ring (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 casing via the discharge cover (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 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.

4.7 Noise characteristics

Table 8: Surface sound pressure level L_{pA} ⁵⁾

Rated power P_2 [hp]	Pump set		
	3500 rpm [dB]	1750 rpm [dB]	1160 rpm [dB]
5.4	68.5	62.0	60.5
7.4	70.0	63.5	63.0
10.0	71.0	65.0	63.5

4.8 Scope of supply

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

- Pump set complete with power cables
- Foundation rails (for horizontal installation)
- Suction-side flanged taper piece or intake elbow with inspection hole
- Suction duckfoot bend (for vertical installation)



NOTE

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.

4.9 Dimensions and weights

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

⁵⁾ Measured at a distance of 1 m from the pump outline

5 Installation at Site

5.1 Safety regulations

	⚠ DANGER
	Improper installation in potentially explosive atmospheres Damage to the pump set! ▸ Comply with the applicable local explosion protection regulations. ▸ Observe the information given in the data sheet and on the pump/motor name plates.

5.2 Checks to be carried out prior to installation

Place of installation

	⚠ WARNING
	Installation on foundations which are unsecured and cannot support the load Personal injury and damage to property! ▸ Make sure the foundation concrete is of sufficient strength (min. 3000 psi [C12/15 to DIN 1045]). ▸ Only place the pump (set) on a foundation whose concrete has set firmly. ▸ Only place the pump set on a horizontal and level surface. ▸ Refer to the weights given in the general arrangement drawing.

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.

5.3 Checking the lubricant level

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

1. Position the pump set as shown.

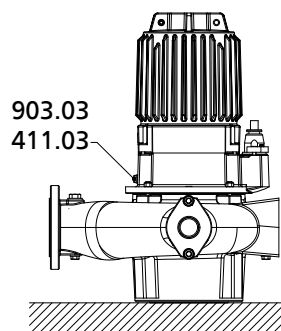


Fig. 3: Checking the lubricant level

2. Unscrew screw plug 903.03 with joint ring 411.03.
⇒ The lubricant level must reach the filler opening.
3. If the lubricant level is lower, top up lubricant through the filler opening until the lubricant reservoir overflows.
4. Close screw plug 903.03 with joint ring 411.03.

5.4 Checking the direction of rotation

	⚠ DANGER Pump set running dry Explosion hazard! ▶ Check the direction or rotation of explosion-proof pump sets outside potentially explosive atmospheres.
	⚠ WARNING Hands or objects inside the pump casing Risk of injury, 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.
	CAUTION Pump set running dry Increased vibrations! Damage to mechanical seals and bearings! ▶ Never operate the pump set without the fluid to be handled for more than 60 seconds.

- ✓ The pump set is positioned as illustrated below and secured against rolling off.
- ✓ 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.
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.

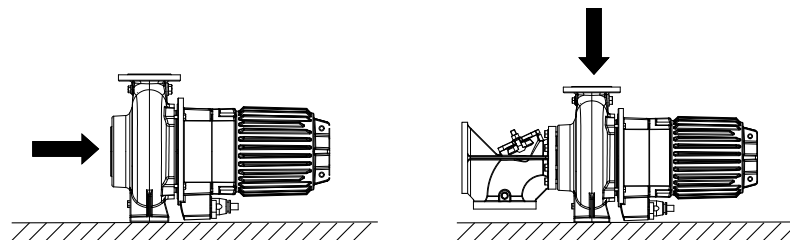


Fig. 4: Checking the direction of rotation

- 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.

5.5 Installing the pump set

Fastening

- Fasten the pump feet with or without foundation rails or the suction duckfoot bend to a concrete foundation with chemical anchors.

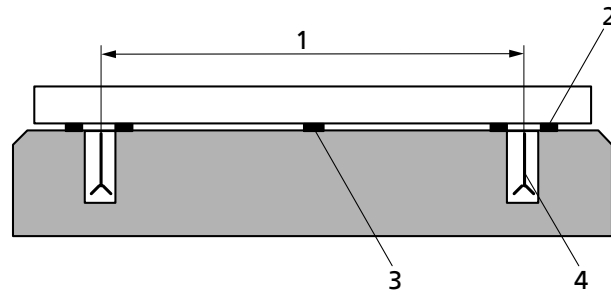


Fig. 5: Installation on a foundation with chemical anchors

1	Bolt-to-bolt clearance	2	Shim
3	Shim	4	Chemical anchor

- ✓ The foundation has the required strength and characteristics.
- ✓ The foundation has been prepared in accordance with the dimensions given in the outline drawing/general arrangement drawing.
- 1. Position the pump set on the foundation and align it with the help of a spirit level placed on the shaft and discharge nozzle.
Permissible deviation: 0.0079 $\frac{\text{inch}}{\text{m}}$ [0.2 $\frac{\text{mm}}{\text{m}}$].
- 2. Use shims (2) for height compensation, if necessary.
Always fit shims immediately to the left and right of the chemical anchors (4) between the baseplate/foundation frame and the foundation itself.
For a bolt-to-bolt clearance (1) ≥ 31.5 in. [800 mm] fit additional shims (3) halfway between the adjoining holes.
All shims must lie perfectly flush.
- 3. Drill the holes as specified in the table "Chemical anchor bolt dimensions". Then clean the holes.



⚠ WARNING

Improper handling of mortar cartridges
Skin sensitization or irritation!

- ▷ Wear suitable protective clothing.

- 4. Insert the mortar cartridges into the drilled holes.
Observe the curing times of the mortar cartridges!
- 5. Insert threaded rods into the corresponding drilled holes with an electric tool (e.g. impact drill, hammer drill).
- 6. After the curing time (see table), tighten the chemical anchors (4) evenly and tightly.
- 7. Grout the baseplate using low-shrinkage concrete.

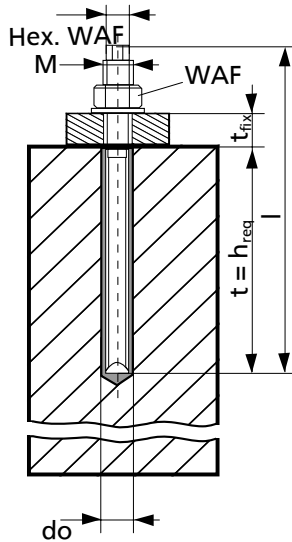


Fig. 6: Dimensions

Table 9: Chemical anchor bolt dimensions

Size	d _o [in.] [mm]	t=h _{req} [in.] [mm]	t _{fix} [in.] [mm]	WAF [in.] [mm]	M [in.] [mm]	Hex. head WAF [in.] [mm]	Torque assy. [ft lbs] [Nm]
0.39 x 5.12" M 10x130	0.47 12	3.54 90	0.79 20	0.67 17	0.39 10	0.27 7	14.75 20
0.47 x 6.30" M 12x160	0.55 14	4.53 110	0.98 25	0.75 19	0.47 12	0.31 8	29.5 40
0.63 x 7.48" M 16x190	0.71 18	4.92 125	1.38 35	0.94 24	0.63 16	0.47 12	44.25 60
0.79 x 10.24" M 20x260	0.98 25	6.69 170	2.56 65	1.18 30	0.79 20	0.47 12	88.50 120
0.94 x 11.81" M 24x300 ⁶⁾	1.10 28	8.27 210	2.56 65	1.41 36	0.94 24	-	110.63 150
1.18 x 14.96" M 30x380 ⁶⁾	1.38 35	11.0 280	2.56 65	1.81 46	1.18 30	-	221.26 300

Table 10: Curing times of mortar cartridge

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

5.6 Piping

5.6.1 Connecting the piping

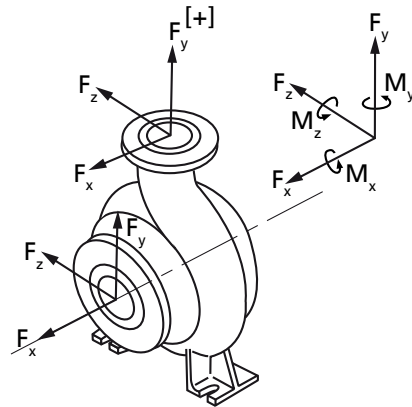
	⚠ DANGER Impermissible loads acting on the pump nozzles Danger to life from leakage of hot, toxic, corrosive or flammable fluids! ▷ Do not use the pump as an anchorage point for the piping. ▷ Anchor the pipelines in close proximity to the pump and connect them without transmitting any stresses or strains. ▷ Observe the permissible forces and moments at the pump nozzles. ▷ Take appropriate measures to compensate thermal expansion of the piping.
	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.

- ✓ The suction lift/suction head lines have been laid with a rising/downward slope towards the pump.
- ✓ The nominal diameters of the pipelines are at least equal to the nominal diameters of the pump nozzles.
- ✓ Adapters to larger nominal diameters are designed with a diffuser angle of approx. 8° to avoid excessive pressure losses.
- ✓ The pipelines have been anchored in close proximity to the pump and connected without transmitting any stresses or strains.

⁶⁾ Mounting accessories of respective manufacturer required

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.

5.6.2 Permissible forces and moments at the pump nozzles



The resulting permissible forces have been determined according to

$$F_{res D} \leq \sqrt{F_x^2 + F_z^2}$$

$$F_{res S} \leq \sqrt{F_y^2 + F_z^2}$$

Forces and moments at the pump nozzles

The data on forces and moments apply to static piping loads only. If the limits are exceeded, they must be checked and verified.

If a computerized strength analysis is required, please contact KSB.

The values are only applicable if the pump is installed on a completely grouted baseplate and bolted to a rigid and level foundation.

Table 11: Forces and moments at the pump nozzles

Pump sizes	Suction nozzle [lbs] [daN]				Discharge nozzle [lbs] [daN]					Suction nozzle [ft lbs] [daNm]			Discharge nozzle [ft lbs] [daNm]		
	F_x (+ -)	F_y (+ -)	F_z (+ -)	F_{res} (+ -)	F_x (+ -)	F_{yTens} (+)	F_{yPress} (-)	F_z (+ -)	F_{res} (+ -)	M_x (+ -)	M_y (+ -)	M_z (+ -)	M_x (+ -)	M_y (+ -)	M_z (+ -)
80 - 250	40	26	31	40	26	16	31	21	34	100	74	48	70	52	37
80 - 251	180	115	140	180	115	70	140	95	150	135	100	65	95	70	50
80 - 315															
100 - 250	40	26	31	40	31	20	40	26	40	100	74	48	100	74	48
100 - 251	180	115	140	180	140	90	180	115	180	135	100	65	135	100	65
100 - 315															
150 - 251	70	46	56	72	56	35	70	46	72	170	129	85	170	129	85
150 - 315	310	205	250	320	250	155	310	205	320	230	175	115	230	175	115
200 - 316	110	70	85	110	85	53	110	70	110	258	188	129	258	188	129
	490	310	380	490	380	235	490	310	490	350	255	175	350	255	175

5.6.3 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 in. [25 mm].
- The line extends above the highest permissible fluid level in the tank.

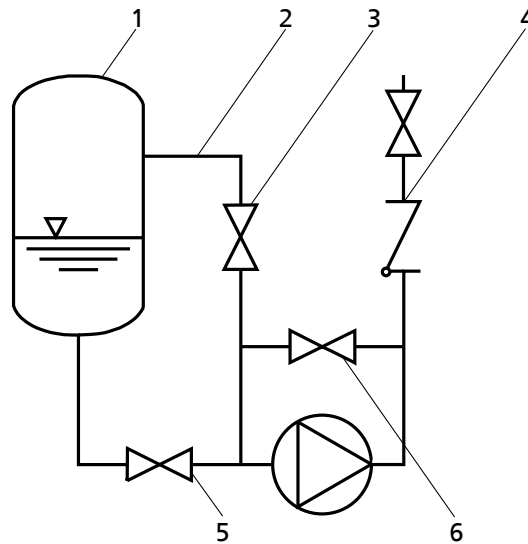


Fig. 7: Vacuum balance line

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.

5.7 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.

The following auxiliary connections are available:

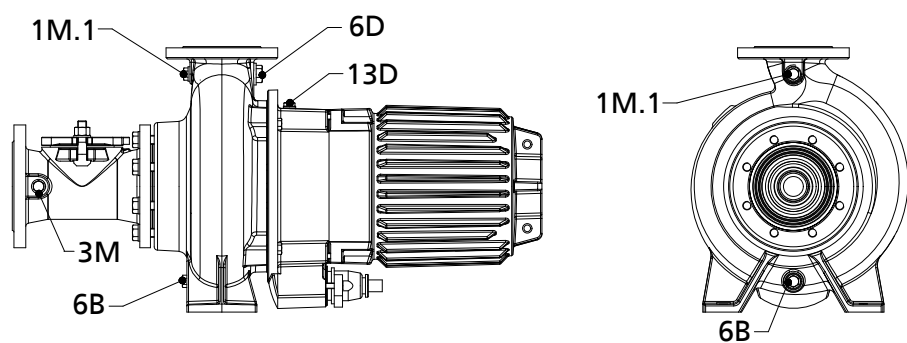


Fig. 8: Auxiliary connections

Table 12: Sizes of auxiliary connections

Connection	Description	Size	
		80-250 80-251 80-315 100-250 100-251 150-251 100-315	150-315 200-316
1 M.1	Pressure gauge	G 1/2	
6 D	Venting	G 1	
3 M	Pressure/vacuum gauge	G 1/2	
6 B	Casing drain	G 1/2	G 1
13 D	Oil filling	G 1/2	

5.8 Electrical system

5.8.1 Information for planning the control system

For the electrical connection of the pump set observe the wiring diagram contained in the Annex. (⇒ Section 9.2 Page 54)

The pump set is supplied with power cables; it is wired for DOL starting. Star-delta starting is also possible.



NOTE

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

The motors may be connected to electrical low-voltage grids with nominal voltages and voltage tolerances to IEC 38 or other grids or power supply facilities with maximum nominal voltage tolerances of ± 10 %.

5.8.1.1 Overload protection

1. Protect the pump set against overloading by 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.

5.8.1.2 Frequency inverter operation

The pump set is suitable for frequency inverter operation 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.



DANGER

Incorrect setting of frequency inverter current limit
Explosion hazard!

- ▷ Set the current limit to maximum 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

Start-up	- Electrical data of the pump set, particularly the rated current - Ensure short start ramps (maximum 5 seconds). - Only start speed-controlled operation after at least 2 minutes at the earliest. Pump start-up with long start ramps and low frequency may cause clogging.
Operation	For frequency inverter operation of the pump set observe the following limits: - Only utilize up to 95 % of the motor rating P_2 indicated on the name plate. - Frequency range 25-60 Hz
Electromagnetic compatibility	Frequency inverter operation produces RFI emissions of various extents, 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 instructions of the inverter manufacturer. If the inverter manufacturer recommends using a shielded power cable, make sure to use a pump set with a shielded power cable.
Generic immunity	The pump set generally meets the immunity requirements to EN 50082. To monitor the fitted sensors the operator is responsible for providing interference immunity by selecting suitable cables for the system and laying them properly. The power cable/ control cable of the pump set does not need to be modified. Suitable analysis equipment has to be selected. To monitor the leakage sensor inside the motor, it is recommended to use a special relay available from KSB.

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

	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.

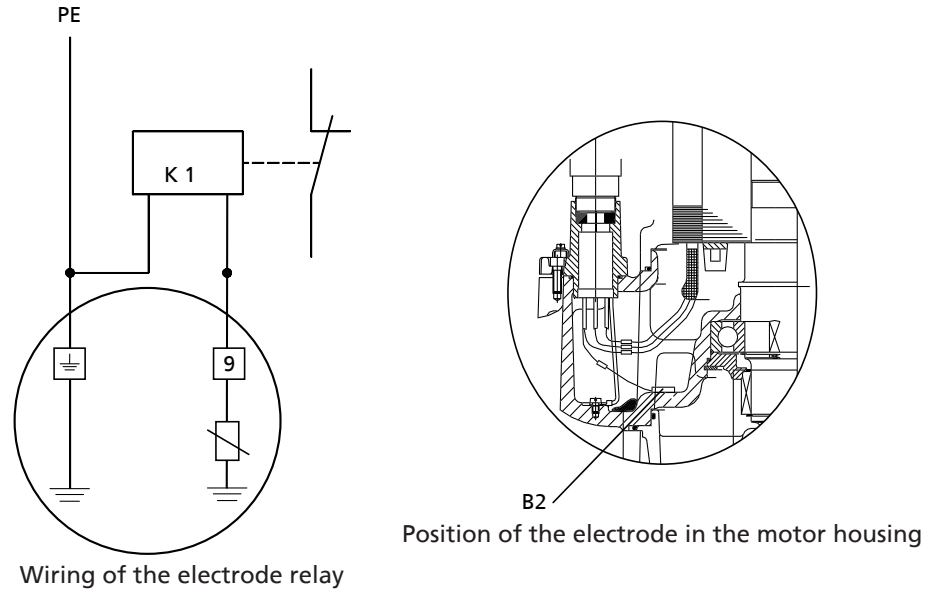
5.8.1.3.1 Motor temperature

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

The motor is monitored by three series-connected PTC thermistors with terminals 10 and 11.

They must be connected to a thermistor tripping unit with manual reset. Tripping must result in the pump set cutting out. Automatic re-start is not permitted.

5.8.1.3.2 Leakage inside the motor



Wiring of 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)

5.8.2 Connection to power supply

	⚠ 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 regulation IEC 30364 as well as any regional 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 cable 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 suspend the pump set by the power cables.

	CAUTION Motor overload Damage to the motor! Protect the motor by a thermal time-lag overload protection device in accordance with IEC 947 and local regulations.
---	---

For electrical connection observe the wiring diagrams in the Annex and the information on planning the control system. (⇒ Section 5.8.1 Page 25)

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

	DANGER Incorrect connection Explosion hazard! Damage to the pump set! 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 incompletely connected power cables or non-operational monitoring devices.
---	---

Potential equalization The pump set is fitted with an external PE connection terminal.

	DANGER Incorrect connection Danger of death from electric shock! Never operate the pump set without connecting the PE conductor.
---	---

5.9 Priming and venting the pump

	DANGER Formation of a potentially explosive atmosphere inside the pump Explosion hazard! - The pump internals in contact with the fluid to be handled, including the seal chamber and auxiliary systems must be filled with the fluid to be handled at all times. - Provide sufficient inlet pressure. - Provide an appropriate monitoring system.
---	---

	DANGER Shaft seal failure caused by dry running 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 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.
- All auxiliary connections required are connected and operational.
- The lubricant has been checked.
- After prolonged shutdown of the pump (set), the required activities have been carried out (⇒ Section 6.4 Page 32) .

6.1.2 Start-up

	 DANGER Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and discharge lines closed. Explosion hazard! 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 with the discharge side gate valve slightly or fully open.
	 DANGER Excessive temperatures due to dry running or excessive gas content in the fluid handled Explosion hazard! 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.

- ✓ The pump, suction line and discharge line have been vented and primed with the fluid to be handled.
- 1. Fully open the shut-off element in the suction head/suction lift line.
- 2. Close/slightly open the shut-off element in the discharge line; fully open the shut-off element if a check valve is installed.
- 3. Start up the motor.
- 4. Immediately after the pump has reached full rotational speed, swiftly open the shut-off element in the discharge line and adjust it to comply with the duty point.

6.1.3 Shutdown

1. Close the shut-off element in the discharge line.
If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open if there is back pressure.

Prolonged shutdown periods
Danger of frost/freezing

2. Switch off the motor.
Make sure that the pump set runs down smoothly to a standstill.
- For prolonged shutdown, close the shut-off element in the suction line.
- If there is any danger of frost/freezing, drain the pump and 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 an explosion-proof 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 Maximum operating pressure

	CAUTION
	Non-compliance with permissible operating pressure Damage to connections and seals! ▸ Never exceed the operating pressure specified in the data sheet.

Table 13: Maximum operating pressure

Size	Maximum operating pressure
80-315	145 psi [10 bar]
80-250/-251, 100-250/-251/-315, 150-251, 150-315, 200-316	87 psi [6 bar]

6.2.2 Temperature of the fluid handled

	CAUTION
	Impermissibly high temperature of fluid handled Damage to the pump! ▸ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid). ▸ Observe the temperature limits in the data sheet and in the section on Operating limits.

6.2.3 Density of the fluid handled

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

	CAUTION
	Impermissibly high density of the 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 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.

6.2.5 Frequency of starts

	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.
---	--

To prevent high temperature increases in the motor and excessive loads on the motor, seal elements and bearings, the maximum number of start-ups shall not exceed 10 per hour and 5000 per year. These values apply to mains start-up (DOL or with star-delta contactor, autotransformer, soft starter). These limits do not apply to frequency inverter operation.

6.2.6 Supply voltage

	⚠ DANGER Non-compliance with permissible supply voltage tolerances Explosion hazard! ▷ 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%.

6.2.7 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.
---	---

Frequency inverter operation of the pump set is permitted in the frequency range from 25 to 60 Hz.

	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.
---	--

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 parts! ▷ 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 posing a health hazard or hot fluids 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.

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

1. For prolonged shutdown periods, start up the pump (set) regularly between once a month and once every three months for approximately five minutes. 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

✓ The pump has been properly drained (⇒ Section 7.3 Page 40) and the safety instructions for dismantling the pump have been observed. (⇒ Section 7.4.1 Page 40)

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 close the pump nozzles (e.g. with plastic caps or similar).
3. Oil or grease all exposed machined parts and surfaces of the pump (with silicone-free oil and grease, food-approved, if required) to protect them against corrosion.
Observe the additional instructions

6.4 Returning to service after storage

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

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

	 WARNING Failure to re-install or re-activate protective 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 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, inspection and 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 explosion-proof pump sets outside potentially explosive atmospheres.
	⚠ WARNING Unintentional starting of pump set Risk of injury by moving parts! ▶ 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 posing a health hazard or hot fluids 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.
	NOTE Special regulations apply to repair work on explosion-proof pump sets. Modifications or alteration of the pump sets can affect explosion protection and are only permitted after consultation with the manufacturer.
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. Find your contact in the attached "Addresses" booklet or on the Internet under "www.ksb.com/contact".

Never use force when dismantling and reassembling the pump set.

7.2 Maintenance/inspection

KSB recommends the following schedule for pump set maintenance:

Table 14: Overview of maintenance work

Maintenance interval	Maintenance work	For details see ...
After 4,000 operating hours ⁷⁾	Insulation resistance test	(⇒ Section 7.2.2.2 Page 36)
	Check the power cables	(⇒ Section 7.2.2.1 Page 35)
After 10,000 operating hours ⁸⁾	Check the sensors	(⇒ Section 7.2.2.3 Page 36)
	Change the lubricant	(⇒ Section 7.2.3.1.4 Page 39)
Every five years	General overhaul	

7.2.1 Supervision of operation

	⚠ DANGER Formation of an explosive atmosphere inside the pump Explosion hazard! ▷ The pump internals in contact with the fluid to be handled, including the seal chamber and auxiliary systems, must be filled with the fluid to be handled at all times. ▷ Provide sufficient inlet pressure. ▷ Provide an appropriate monitoring system.
	CAUTION Increased wear due to dry running Damage to the pump set! ▷ Never operate the pump set without liquid fill. ▷ Never close the shut-off element in the suction line and/or supply line during pump operation.
	CAUTION Impermissibly high temperature of fluid handled Damage to the pump! ▷ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid). ▷ Observe the temperature limits in the data sheet and in the section on Operating limits.

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

- The pump must run quietly and free from vibrations at all times.
- Monitor the correct functioning of any auxiliary connections.
- Monitor the stand-by pump.
To make sure that the stand-by pumps are ready for operation, start them up once a week.
- Check the flexible elements of the coupling or belts and replace them, if required.

7.2.2 Inspection work

7.2.2.1 Checking the power cables

Visual inspection

- ✓ The pump set has been cleaned.
1. Inspect the power cable for visual damage.

⁷⁾ At least once a year

⁸⁾ At least every three years

Checking the ground conductor

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



DANGER

Defective ground conductor
Electric shock!

- Never switch on a pump set with a defective ground conductor.

7.2.2.2 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 max. measuring voltage is 1000 V.
- 1. Measure the winding against ground.
To do so, connect all winding ends together.
- 2. Measure the winding temperature sensor against ground.
To do so, connect all core ends of the winding temperature sensors together and connect all winding ends to ground.
- ⇒ The insulation resistance of the core ends against ground must not be lower than 1 M Ω .
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 one of the power cables is lower than 1 M Ω , the power 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.

7.2.2.3 Checking the sensors



CAUTION

Excessive test voltage
Damage to the sensors!

- Never test the sensors with voltages exceeding 30 V.

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 15: Resistance measurement

Measure between terminals ...	Resistance
10 and 11	200 Ω - 750 Ω

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.

Leakage sensor in the motor

Table 16: Resistance measurement of leakage sensor in the motor

Measurement between terminals ...	Resistance
9 and ground conductor (PE)	> 60 kΩ

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

7.2.2.4 Visual inspection through the inspection hole

If there are problems with clogging, the inside of the casing and the impeller can be checked via the inspection hole.

	⚠ WARNING Fluids posing a health hazard Hazard to persons and the environment! ▷ Collect and properly dispose of flushing liquid 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.
	⚠ WARNING Hands or objects inside the pump casing Risk of injury, 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.

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

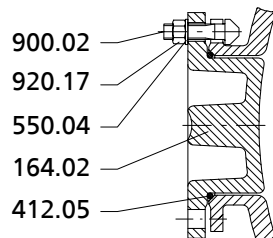


Fig. 9: Inspection hole in the casing

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.
- Unscrew 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. (⇒ Section 6.1.1 Page 29)

7.2.3 Lubrication and lubricant change

7.2.3.1 Lubricating the mechanical seal

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

7.2.3.1.1 Intervals

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

7.2.3.1.2 Lubricant quality

The lubricant reservoir has been filled with an environmentally friendly, non-toxic lubricant of medical quality (unless otherwise required by the customer) at the factory.

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

Recommended quality of lubricant

Alternative

- Thin-bodied paraffin oil; made by Merck, No.: 7174
- Merkur white oil Pharma 40; made by DEA
- Equivalent brand of medical quality, non-toxic
- Water-glycol mixture
- All non-doped and doped motor oils of classes SAE 10W to SAE 20W



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 17: Lubricant quantity

Motor sizes	5 4,7 4
Size	4 6, 6 6
80-250	2.1 l
80-251	
100-250	
100-251	
150-251	
80-315	4.6 l
100-315	
150-315	
200-316	

7.2.3.1.4 Changing the lubricant

	⚠ WARNING Placing the pump set on an unsecured and uneven assembly surface Personal injury and damage to property! ➤ Always place the pump set on a solid and level surface with the pump set in 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 overturning and tipping over. ➤ Refer to the weights given in the data sheet/on the name plate.
	⚠ WARNING Lubricants posing a health hazard Hazardous to persons and the environment! ➤ When draining the lubricant take appropriate measures to protect persons and the environment. ➤ 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

1. Position the pump set as shown.

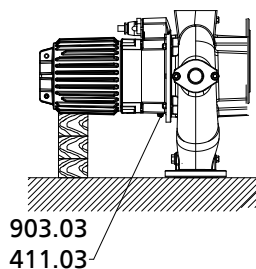


Fig. 10: Draining the lubricant

2. Place a suitable container under the screw plug.
3. Unscrew screw plug 903 or 903.03 with joint ring 411.03 and, if applicable, screw plug 903.04 with joint ring 411.05. Drain the lubricant.

Filling in the lubricant

1. Position the pump set as shown.

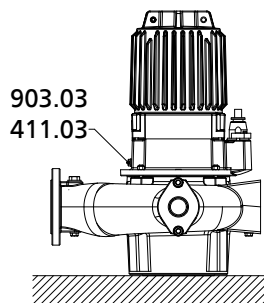


Fig. 11: Filling in the lubricant

2. Pour lubricant into the lubricant filler opening until the lubricant reservoir overflows.
3. Close screw plug 903.03 again, fitting a new joint ring 411.03.

7.2.3.2 Lubricating the rolling element bearings

The rolling element bearings of the pump sets are grease-packed and maintenance-free.

7.3 Drainage/disposal

	⚠ WARNING Fluids posing a health hazard Hazard to persons and the environment! ▸ Collect and properly dispose of flushing liquid and any residues of the fluid handled. ▸ Wear safety clothing and a protective mask, if required. ▸ Observe all legal regulations on the disposal of fluids posing a health hazard.
---	---

If the fluids handled by the pump (set) leave residues which might lead to corrosion when coming into contact with atmospheric humidity, or which might ignite when coming into contact with oxygen, the pump (set) must be flushed through, neutralized, and anhydrous inert gas must be blown through the pump for drying purposes.

Use connection 6B to drain the pump set.

7.4 Dismantling the pump set

7.4.1 General notes/Safety regulations

	⚠ WARNING Unqualified personnel performing work on the pump (set) Risk of personal injury! ▸ Always have repair and servicing work performed by specially trained, qualified personnel.
	⚠ WARNING Hot surface Risk of personal injury! ▸ Allow the pump set to cool down to ambient temperature.

Observe the general safety instructions and information. (⇒ Section 7 Page 34)

For any work on the motor, observe the instructions of the relevant motor manufacturer.

For dismantling and reassembly refer to the general assembly drawing.

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

	⚠ DANGER
	Insufficient preparation of work on the pump (set) Risk of personal injury! ▷ Properly shut down the pump set. ▷ Close the shut-off elements in the 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.

7.4.2 Separating the pump from the piping

- ✓ The pump set has been switched off properly.
 - ✓ The shut-off elements in the suction and discharge lines have been closed.
 - ✓ Any auxiliary connections have been closed.
 - ✓ The pump has been drained and the pump pressure has been released.
1. Separate any auxiliary connections.
 2. Remove the discharge and suction nozzles from the piping.

	NOTE
	After the pump set has been removed from the piping, the suction casing should be cleaned with water. Suitable protective clothing is recommended.

7.4.3 Removing the pump set from the piping

	⚠ WARNING
	Pump set tipping over Risk of squashing hands and feet! ▷ Suspend or support the pump set.

- ✓ The steps in (⇒ Section 7.4.2 Page 41) have been carried out.
1. Suspend the pump set as specified for transport.
 2. Depending on the type of installation, undo the fastening bolts at the pump foot or at the sole plate.
 3. Place the pump set in horizontal position.

7.4.4 Dismantling the pump section

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

7.4.4.1 Removing the back pull-out unit

1. Undo screwed connections 902.01 and 920.01 and pull the complete back pull-out unit out of pump casing 101.
2. Place the back pull-out unit in a safe and dry assembly area and secure it against tipping over or rolling off.

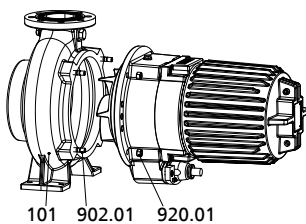


Fig. 12: Removing the back pull-out unit

7.4.4.2 Removing the impeller

1. Unscrew socket head cap screw 914.10 with disc 550.23.
2. Screw the grub screw fully into the shaft thread.
3. Pull off impeller 230 with a forcing screw.

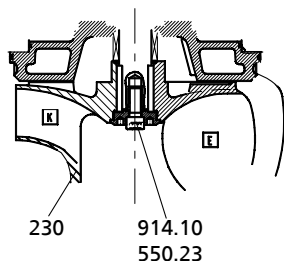


Fig. 13: Removing the impeller



NOTE

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

Table 18: Forcing screws for pulling off the impeller

Size	Impeller type	Forcing screw	
		Thread	Code
80-250	F	0.63" [M 16]	ADS 1
80-251	E		
100-250	F		
100-251	E, K	0.79" [M 20]	ADS 2
150-315	F, E, K		
200-316	K		
100-251	D	0.63" [M 16]	ADS 3
150-251		0.79" [M 20]	
80-315	D	0.79" [M 20]	ADS 4
100-315			
150-315			

7.4.4.3 Removing the mechanical seal

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

7.4.4.3.1 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 off shaft 210.
- 2. Remove discharge cover 163 from bearing bracket 330.
- 3. Press the stationary seat of mechanical seal 433.02 out of discharge cover 163.

7.4.4.3.2 Removing the drive-end mechanical seal

- ✓ The back pull-out unit and the impeller have been removed as described above.
- 1. Remove taper lock ring 515.
- 2. Pull the rotating assembly of mechanical seal 433.01 off shaft 210.

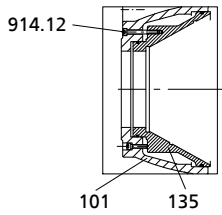


Fig. 14: Removing the wear plate

7.4.4.4 Removing the wear plate

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

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 sets can 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 could affect explosion protection, such as re-winding and repair work involving machining, must be inspected by an approved expert or performed by the motor manufacturer. No modifications must be made to the internal configuration of the motor space. Repair work at the flameproof joints must only be performed in accordance with the manufacturer's instructions.

When dismantling the motor section and the 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

	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.
	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 flamepath positions specified in the Annex.

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 glued together from material sold by the meter.
 - Assembly adhesives
 - Avoid the use of assembly adhesives, if possible.

Tightening torques

For reassembly, tighten all screws and bolts as specified in this manual. (⇒ Section 7.6 Page 47)

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 bellows-type mechanical seals, wet the inside diameter of the bellows with soapy water (not oil).
 - To prevent any damage to the rubber bellows, place a thin foil (of approximately 0.0039 to 0.0118 in. [0.1 to 0.3 mm] thickness) around the free shaft stub. Slip the rotating assembly over the foil into its installation position. Then remove the foil.
- ✓ The shaft and rolling element bearings have been properly installed in the motor.
1. Push drive-end mechanical seal 433.01 on shaft 210 and secure it with taper lock ring 515.
 2. Insert O-rings 412.04 and 412.15 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.

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 installed free from grease.

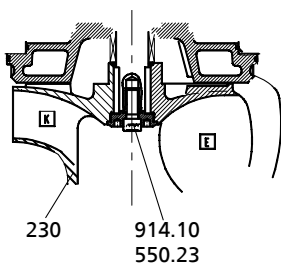


Fig. 15: Fitting the impeller

- ✓ 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 914.10 and disc 550.23. Tighten them with a torque wrench.

Table 19: Tightening torque for the impeller screw

Size	Thread	Tightening torque [ft lbs] [daNm]
80-250, 100-250, 150-251, D 100-251	0.39" M 10	25.81 35
E, K 80-251, 100-251, 80-315, 100-315, 150-315, 200-316	0.63" M 16	110.63 150

7.5.2.3 Installing the back pull-out unit

7.5.2.3.1 Design with axial clearance



NOTE

After casing wear rings with a radial clearance have been fitted in pump casing 101 they have the required inner diameter and do not need to be readjusted.

1. Use a rubber mallet to push casing wear ring 502 into pump casing 101 as far as it will go.
2. Insert the complete back pull-out unit into the pump casing.
3. Evenly tighten screwed connection 902.01 and 920.01 between pump casing and bearing bracket.



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.

4. Use a rubber mallet to push casing wear ring 502 in until it is close to impeller 230.
5. Suspend the pump set vertically, as illustrated.

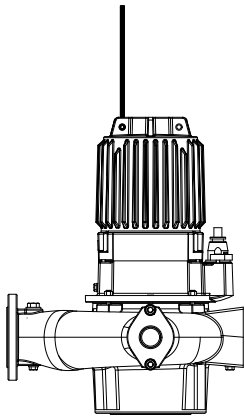


Fig. 16: Suspending the pump set

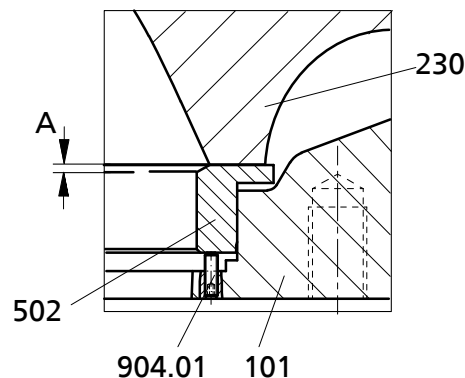


Fig. 17: Fitting the casing wear ring

A	Clearance of 0.012 ± 0.04 in. [0.3 ± 0.1 mm]
---	---

6. Lift off the pump set and adjust the axial clearance.

7.5.2.3.2 Design with wear plate

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

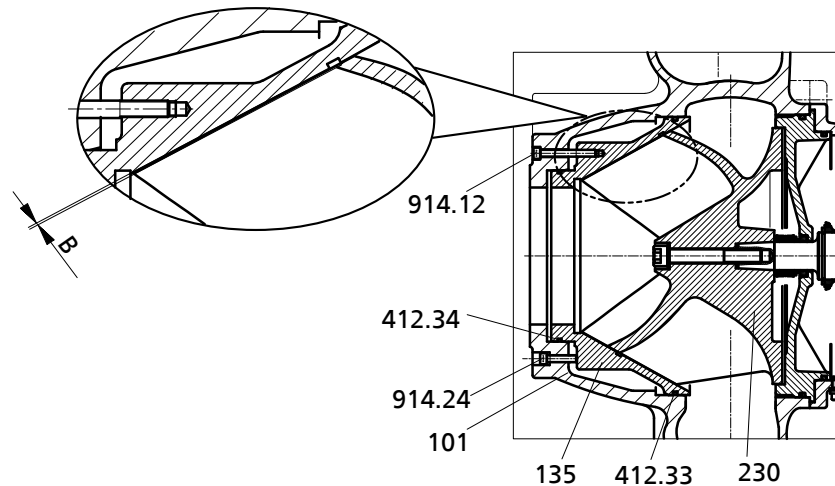


Fig. 18: Fitting the wear plate

B	Clearance
1.	Equip wear plate 135 with two new O-rings 412.33 and 412.34.
2.	Insert wear plate 135 into pump casing 101.
3.	Fasten wear plate 135 to pump casing 101 with hexagon socket head cap screws 914.12.
4.	Adjust the clearance between impeller 230 and wear plate 135 by tightening and loosening screws 914.12 and 914.24.
	⇒ Screw 914.24 pushes the wear plate in the direction of the impeller.
	⇒ The clearance B equals 0.016 ^{+0.079} in. [0.4 ^{+0.2} mm] (measured on the suction side from the outer surface of the impeller vane to the wear plate).
5.	Insert the complete back pull-out unit into the pump casing.
6.	Evenly tighten screwed connection 902.01 and 920.01 between pump casing and bearing bracket.

7.5.3 Reassembling the motor section

	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. Only use original spare parts made by KSB for explosion-proof pumps. Observe the flamepath positions specified in the Annex. Secure all screwed connections closing off the flameproof enclosure with a thread-locking agent (Loctite type 243).
	⚠ DANGER Incorrect screws/bolts Explosion hazard! ▶ Always use the original screws/bolts for assembling an explosion-proof pump set. ▶ Never use screws/bolts of different dimensions or of a lower property class.

7.5.4 Leak testing

After reassembly, always test the mechanical seal area/lubricant chamber 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:** 11.6 psi [0.8 bar] max.
- **Test period:** 2 minutes

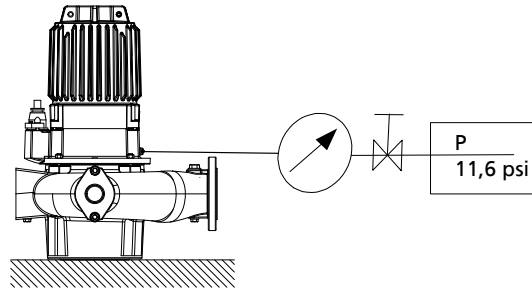


Fig. 19: Screwing in the testing device

1. Unscrew and remove the screw plug and joint ring of the lubricant chamber.
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 7.2.3.1 Page 38)

7.5.5 Checking the connection of motor/power supply

Once reassembly has been completed, carry out the steps described in (⇒ Section 7.2.2 Page 35) .

7.6 Tightening torques

7.6.1 Tightening torques

Table 20: Tightening torques

Thread	Tightening torque ⁹⁾ [ft lbs] [Nm]
0.24" M 6	5.16 7
0.31" M 8	12.54 17
0.39" M 10	25.81 35
0.47" M 12	44.25 60
0.63" M 16	110.63 150

7.7 Spare parts stock

7.7.1 Ordering spare parts

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

⁹⁾ Property class: A4-70

- Pump type
- KSB order number
- Motor number

Refer to the name plate for all data.

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.

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

Table 21: Quantity of spare parts for recommended spare parts stock¹⁰⁾

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 %

¹⁰⁾ For two years of continuous operation or 17,800 operating hours

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 22: 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				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 and/or prime the pump and piping; fit a vent valve if required.
X	X		X	X	Inlet line clogged by deposits	Clean the intake or inlet line, pump components and non-return valve.
		X		X	Dirt/fibers in the clearance between the casing wall and impeller of a 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 switchgear, 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		X		In case of star-delta configuration: motor running in star configuration only.	Check star-delta contactor.
X					Defective motor winding	Contact KSB.
	X				Suction head is too high, NPSH _{available} (positive suction head) is too low.	Check the inlet line for clogging, clean if necessary; fully open the gate valve in the inlet line.
X					Motor has been tripped by leakage monitor.	Assign qualified and trained personnel to determine and remedy the cause of failure.
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.	Assign qualified and trained personnel to determine and remedy the cause of failure.

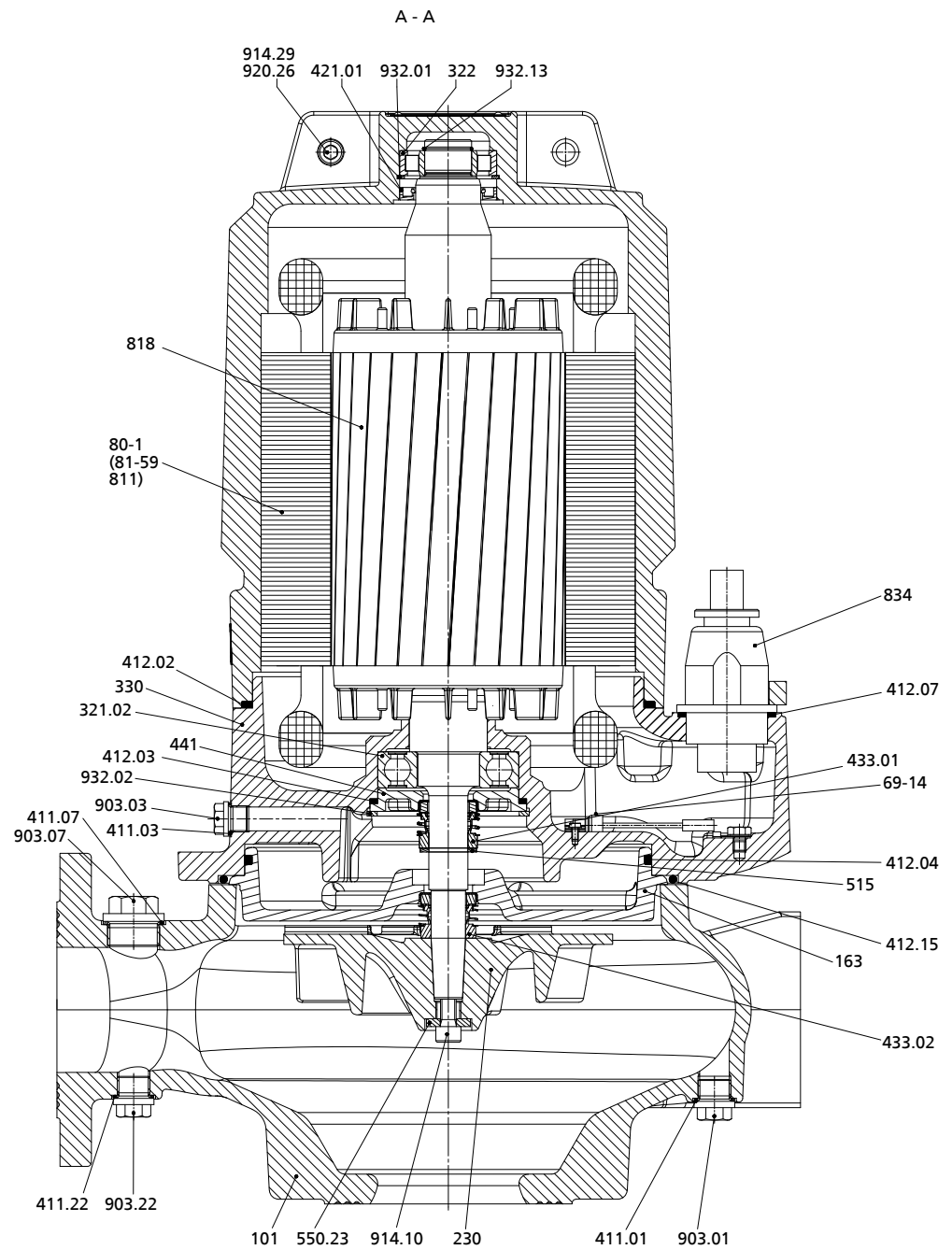
9 Related Documents

9.1 General assembly drawing

Motor sizes

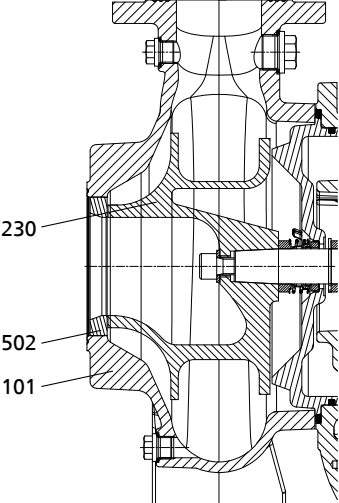
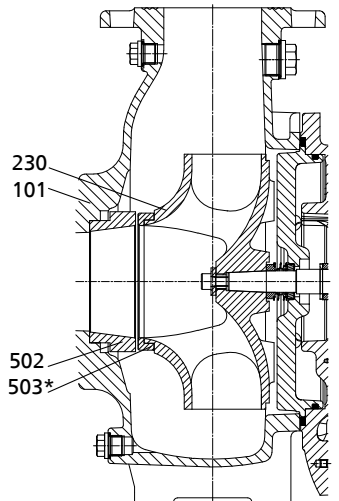
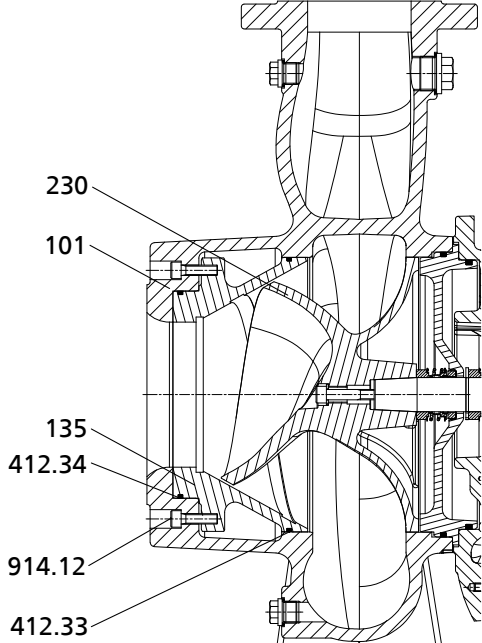
5 4, 7 4,

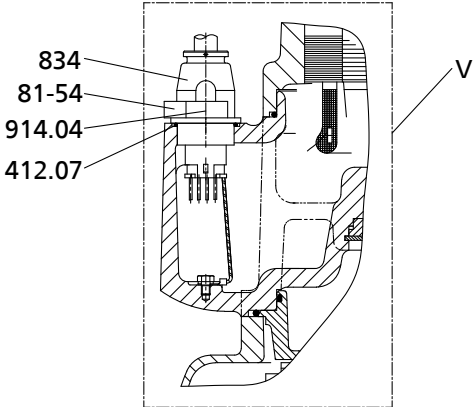
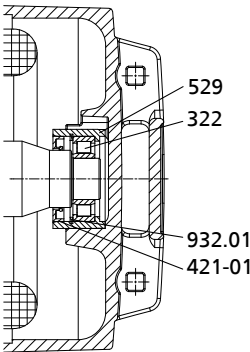
4 6, 6 6



General assembly drawing (impeller type F)

Table 23: Detailed views of the general assembly drawing

Section	Detailed view
Impeller type E	 Technical drawing showing a cross-section of the impeller assembly for Impeller type E. The drawing includes the following labeled components: 230: Impeller 502: Impeller nut 101: Impeller lock washer
Impeller type K	 Technical drawing showing a cross-section of the impeller assembly for Impeller type K. The drawing includes the following labeled components: 230: Impeller 101: Impeller lock washer 502: Impeller nut 503*: Impeller lock nut * If applicable
Impeller type D	 Technical drawing showing a cross-section of the impeller assembly for Impeller type D. The drawing includes the following labeled components: 230: Impeller 101: Impeller lock washer 135: Impeller nut 412.34: Impeller lock nut 914.12: Impeller lock nut 412.33: Impeller lock nut

Section	Detailed view
Cable gland	
Upper bearing Motor sizes 5 4, 4 6	

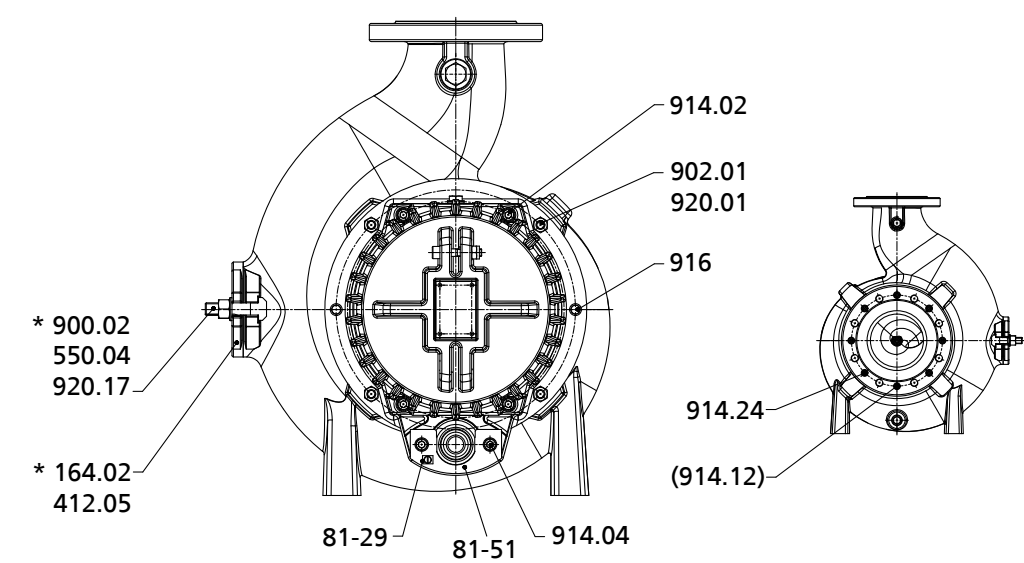
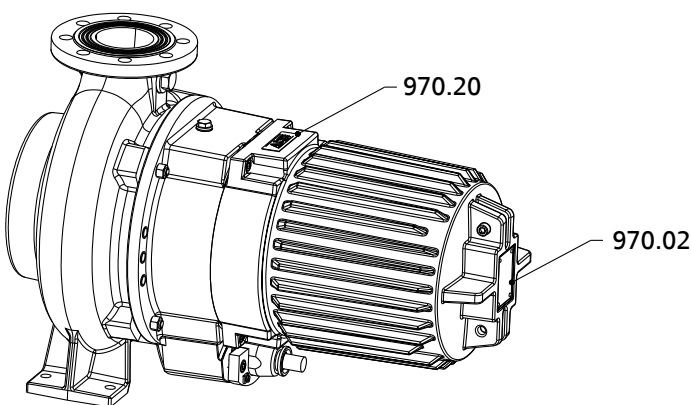
Section	Detailed view
Connections	 * 900.02 550.04 920.17 * 164.02 412.05 81-29 81-51 914.04 914.02 902.01 920.01 916 914.24 (914.12) * Not for impeller type F 80-250 impeller type D 80-315
Plates	 970.20 970.02

Table 24: List of components

Part No.	Description	Part No.	Description
69-14	Leakage sensor	433.01/.02	Mechanical seal
80-1	Motor unit	441	Shaft seal housing
81-29	Terminal	502	Casing wear ring
81-51	Shim	503 ¹¹⁾	Impeller wear ring
101	Pump casing	515	Taper lock ring
135	Wear plate	529	Bearing sleeve
163	Discharge cover	550.04/.23	Disc
164.02 ¹²⁾	Inspection cover	818	Rotor
230	Impeller	834	Cable gland
321.02	Radial ball bearing	900.02 ¹²⁾	Screw
322	Radial roller bearing	902.01	Stud
330	Bearing bracket	903.01/.03/.07/.22	Screw plug
411.01/03/07/22/	Joint ring	914.02/.04/.10/.12/.24/.26	Hexagon socket head cap screw

¹¹⁾ If any

¹²⁾ Not for F,E 80-250; D 80-315

Part No.	Description	Part No.	Description
412./02/03/04/05/07/15/33/34	O-ring	916	Plug
421.01	Lip seal	920.01/17/26	Nut
		932.01/02/13	Circlip

9.2 Wiring diagram

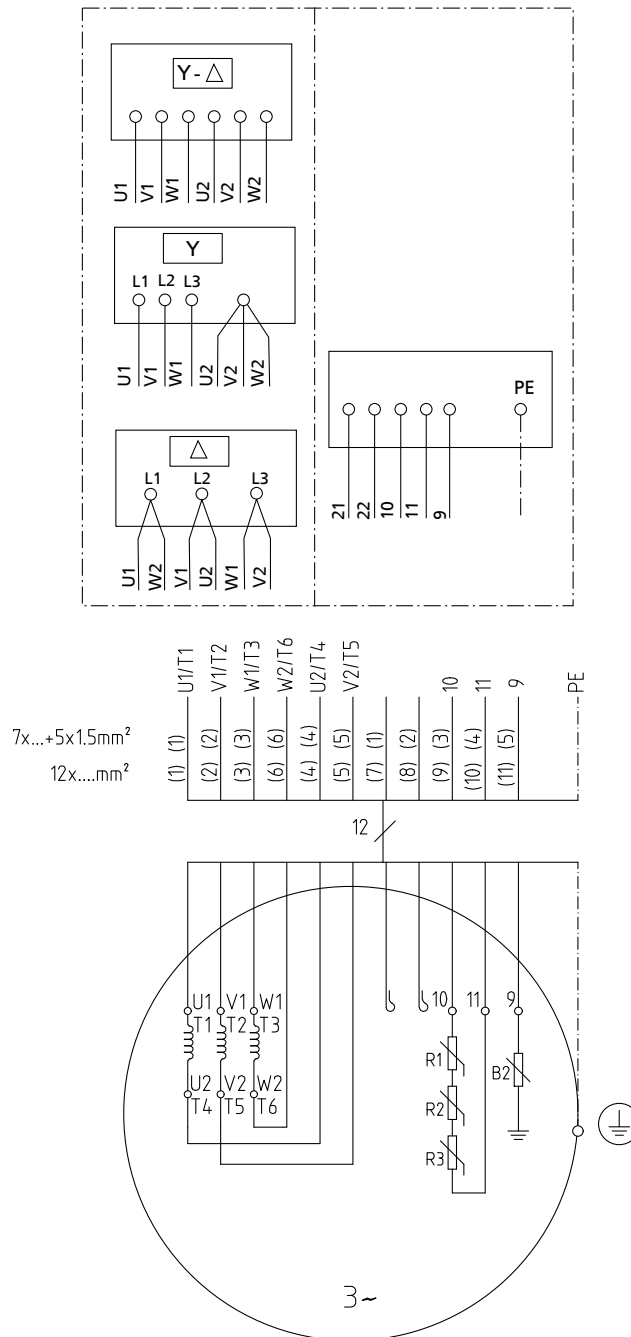
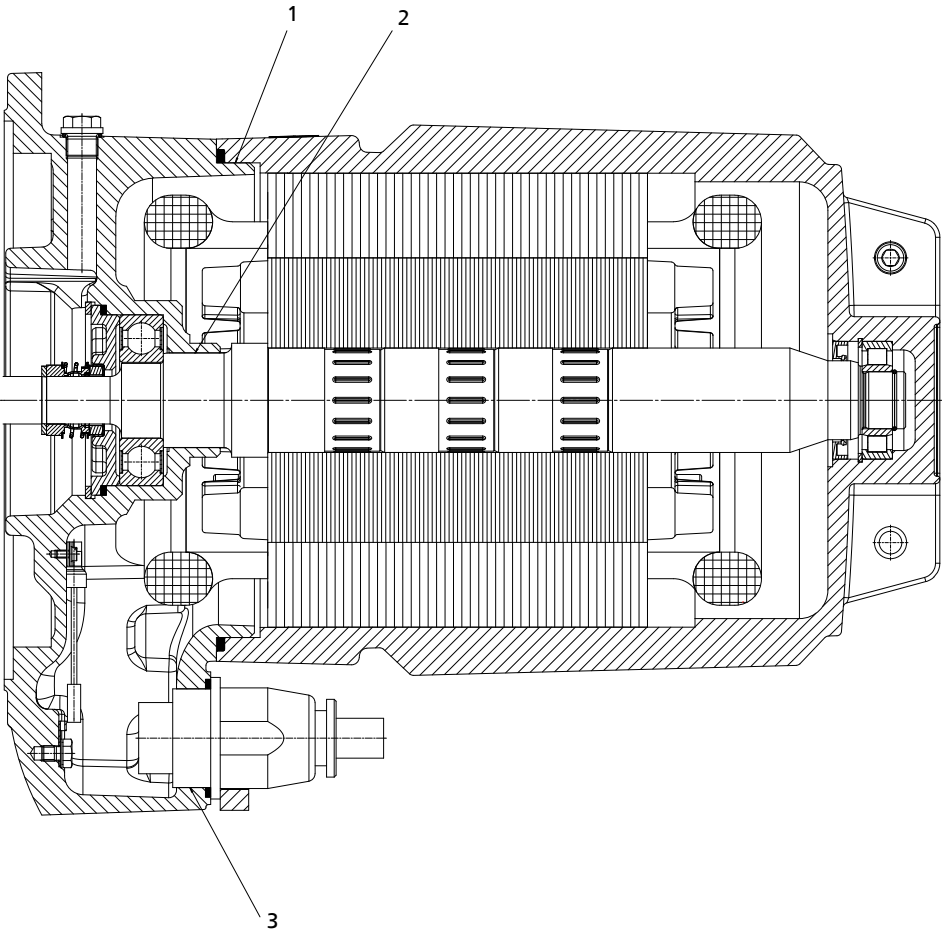


Fig. 20: Wiring diagram

R1-R3	Temperature sensor	B2	Leakage sensor
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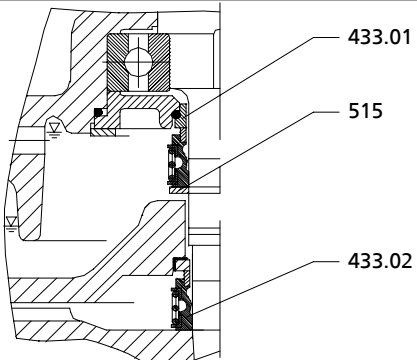
9.3 Flamepaths on explosion-proof motors

Table 25: Overview of flamepaths

Motor sizes	Pump set
5 4, 7 4, 4 6, 6 6	
	1,2, 3 Flamepaths

9.4 Sectional drawings of the mechanical seal

Table 26: Sectional drawings of the mechanical seal

Sizes	Sectional drawing	
Motor sizes 5 4, 7 4, 4 6, 6 6	433.01	Mechanical seal (bellows-type mechanical seal)
	515	Taper lock ring
	433.02	Mechanical seal (bellows-type mechanical seal)
		

10 Certificate of Decontamination

Type
Order number/
Order item number¹³⁾

Delivery date

Field of application:

Fluid handled¹³⁾:

Please tick where applicable¹³⁾:



☐ radioactive



☐ explosive



☐ corrosive



☐ toxic



☐ harmful



☐ bio-hazardous



☐ highly flammable



☐ safe

Reason for return¹³⁾:

Comments:

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

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

¹³⁾ Required fields

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KSB SE & Co. KGaA

67225 Frankenthal • Johann-Klein-Str. 9 • 67227 Frankenthal (Germany)

Tel. +49 6233 86-0 • Fax +49 6233 86-3401

www.ksb.com