

Submersible Borehole Pump

UPAchrom

Variant CN

Installation/Operating Manual



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Installation/Operating Manual UPAchrom

Original operating manual

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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.

1 General

1.1 Principles

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

The name plate indicates the type series and size, the main operating data, the order number and the order item number. The order number and order item number 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 centre 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 operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇒ Section 2.4, Page 8)

1.4 Symbols

Table 1: 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 2: 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.
	Explosion protection This symbol identifies information about avoiding explosions in potentially explosive atmospheres in accordance with Directive 2014/34/EU (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 operating manual contains general installation, operating and maintenance instructions that must be observed to ensure safe operation of the system and prevent personal injury and damage to property.

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

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

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

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

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

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

2.3 Intended use

- The pump (set) must only be operated within the operating limits described in the other applicable documents.
- Only operate pumps/pump sets which are in perfect technical condition.
- Do not operate the pump (set) in partially assembled condition.

- Only use the pump to handle the fluids described in the data sheet or product literature of the pump model or variant.
- Never operate the pump without the fluid to be handled.
- Observe the minimum flow rates indicated in the data sheet or product literature (to prevent overheating, bearing damage, etc.).
- Observe the maximum flow rates indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- Do not throttle the flow rate on the suction side of the pump (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.

Prevention of foreseeable misuse

- Never open the discharge-side shut-off elements further than permitted.
 - The maximum flow rates specified in the product literature or data sheet would be exceeded.
 - Risk of cavitation damage
- Never exceed the permissible operating limits specified in the data sheet or product literature regarding pressure, temperature, etc.
- Observe all safety information and instructions in this manual.

2.4 Personnel qualification and training

All personnel involved must be fully qualified to 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 this manual

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

2.6 Safety awareness

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

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

- 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 maintenance, inspection and installation 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.
- The maximum length of the riser is 2 metres so as not to exceed the max. permissible bending moment.
- Additionally secure the riser against loosening.
- 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.
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇒ Section 6.1, Page 26)

2.9 Unauthorised modes of operation

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

The warranty relating to the operating reliability and safety of the supplied pump (set) is only valid if the equipment is used in accordance with its intended use. (⇒ Section 2.3, Page 7)

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 and the insurer about the damage in writing immediately.

	NOTE
	The pump set is supplied by the manufacturer/supplier in packaging which largely prevents sagging or other damage during transport and/or storage.

3.2 Transport

	CAUTION
	<p>Pump set tipping over or slipping out of the suspension arrangement Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▸ Always make sure pump sets in upright position cannot tip over.

	NOTE
	Take into account the unequal weight distribution between pump and motor.

Select hoisting tackles suitable for the weight of the pump set.
Take care not to bend or damage the power supply cable during transport.

3.3 Storage/handling/preservation

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

	⚠ WARNING
	<p>Pump set tilting or rolling off Risk of personal injury!</p> <ul style="list-style-type: none"> ▸ Always secure vertically positioned pump sets against tipping over. ▸ Always secure horizontally positioned pump sets against rolling off.

	⚠ WARNING
	<p>Laying cables at temperatures below zero degrees Damage to the cables!</p> <ul style="list-style-type: none"> ▸ Observe the minimum permissible temperature at the cable surface of -25 °C for moving cables. ▸ Observe the minimum permissible temperature at the cable surface of -40 °C for stationary cables.

	CAUTION
	<p>Pump stored at wrong temperature Damage to the pump!</p> <ul style="list-style-type: none"> ▸ The pump must be stored at a temperature range of -20 °C to +60 °C.

	<p style="background-color: #FFD700; margin: 0;">CAUTION</p> <p>Ambient temperature below the specified minimum Danger of frost!</p> <ul style="list-style-type: none"> ▷ Never subject the pump set to ambient temperatures which are lower than those permitted for the drinking water/antifreeze mixture provided (see section on drinking water/antifreeze mixture / order documentation).
	<p style="background-color: #FFD700; margin: 0;">CAUTION</p> <p>Improper storage Damage to the power cables!</p> <ul style="list-style-type: none"> ▷ Support the power cables at the cable entries to prevent permanent deformation. Observe the minimum bending radius¹⁾ of the cables. ▷ Only remove the protective caps from the power cables at the time of installation.

For temporary storage, store the submersible borehole pumps as follows:

1. In the original packaging: in a **horizontal** position
2. Without packaging: in a **vertical** position (with the motor below)
3. In a dry environment
4. Protected against direct sunlight and heat
5. Protected against dirt and dust
6. Protected against freezing
7. Protected against vermin

3.4 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 pump set has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the pump set must also be neutralised, and anhydrous inert gas must be blown through the pump to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump (set).
 Always indicate any safety and decontamination measures taken.
 (⇒ Section 10, Page 36)

	<p style="background-color: #0070C0; color: white; margin: 0;">NOTE</p> <p>If required, a blank certificate of decontamination can be downloaded from the following web site: www.ksb.com/certificate_of_decontamination</p>
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1) See cable manufacturer's documentation or DIN VDE 0298-3.

3.5 Disposal

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

Verify the fluid composition against the data sheet.

Not approved for handling explosive fluids or for forming part of an explosion-proof system!

4.2 Designation

Example: UPAchrom 100-06/5 CN

Table 3: Designation key

Code	Description
UPAchrom	Pump type series DN 100
100	Well diameter [mm]
06	Flow rate at best efficiency point [m ³ /h]
5	Number of stages
C	Casing material AISI 304
N	Impeller material Noryl

4.3 Name plate

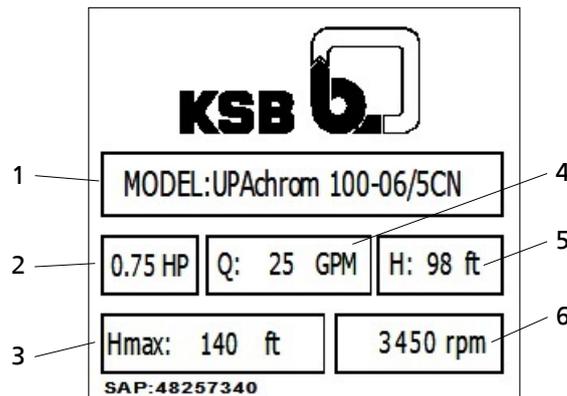


Fig. 1: Name plate

1	Type series, size	2	Rated power
3	Maximum head	4	Maximum flow rate
5	Head at Q_{opt}	6	Speed

4.4 Design details

Design

- Centrifugal pump
- Submersible motor in squirrel-cage design
- Rigid connection between pump and motor
- Shroud design

Impeller type

- Radial or mixed flow versions

Bearings

- Radial and thrust bearings lubricated by the motor fill

Shaft seal

- In the motor

4.5 Configuration and function

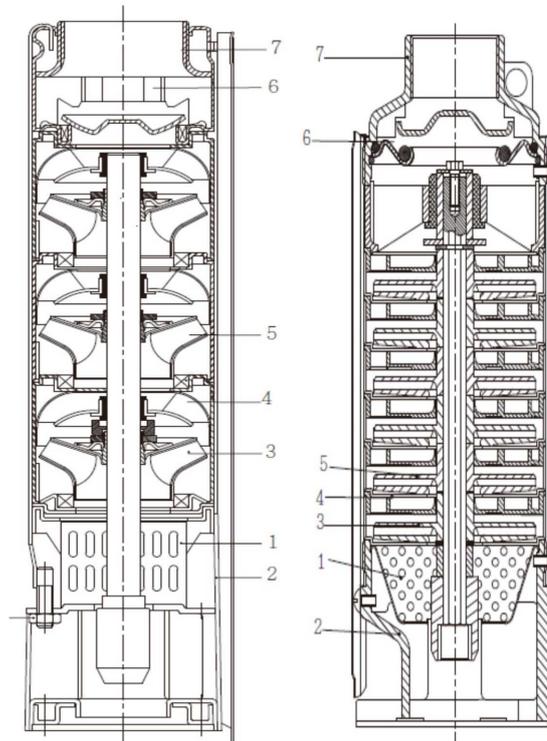


Fig. 2: Sectional drawing, example of an UPachrom

Design Pump and motor are connected by a rigid coupling. The stage casings are supported by a pump shroud, by straps or studs. A suction strainer at the suction casing protects the pump from coarse particles in the fluid. The pipe is connected via a lift check valve or connection branch, with either internal thread or flanged end.

Function The fluid flows along the motor and enters the suction casing (2) through the suction strainer (1). It is accelerated outward by the suction impeller (3). In the flow passage of the stage casing (4) the kinetic energy of the fluid is converted into pressure energy, and the fluid is routed to the next impeller (5). This process is repeated in all stages until the fluid has passed the last impeller (5). It is then guided through the integrated lift check valve (6) to the connection branch (7), where it leaves the pump. The integrated lift check valve prevents uncontrolled backflow of the fluid.

4.6 Scope of supply

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

- Pump set with motor lead
- Extension cable optional: connected or supplied but not fitted

4.7 Dimensions and weights

For dimensions and weights please refer to the data sheet of the pump (set).

5 Installation at Site

5.1 Checks to be carried out prior to installation

5.1.1 Checking the motor fill

The pump set can be installed directly in a vertical or horizontal ²⁾ position without any further preparations. The motors are filled at the factory with water and antifreeze agent. The loss of a few drops of liquid fill will not impair the motor function as the motor will self-prime with clean well water after it has been installed. If larger quantities of leakage are suspected, contact the manufacturer!

5.1.2 Checking the installation position

	WARNING
	<p>Impermissible installation position Damage to the machine! Damage to the bearings!</p> <p>▷ For angled installation, always install the pump set with a rising slope towards the discharge side.</p>

The pump set can be installed in a vertical or, depending on the number of stages, also in an angled or horizontal position. The pump set must not be installed with the pump as the lowest point.

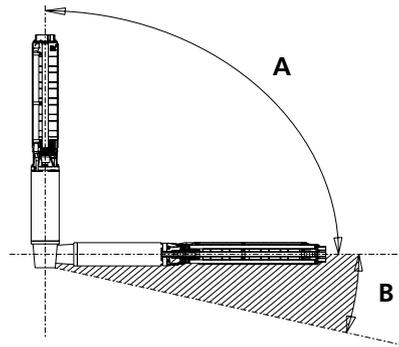


Fig. 3: Installation position

A	Permitted	B	Not permitted
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Particularities of horizontal installation

Check the following criteria before installing the pump set in a horizontal position:

- Has the pump set been ordered for horizontal installation?
- Has a sufficiently dimensioned cooling shroud or cooling hood been provided?

Pump sets originally selected for vertical installation must not be installed horizontally.

Only pump sets equipped with cooling shrouds may be installed horizontally.

5.1.3 Connecting the cables

	DANGER
	<p>Unqualified personnel connecting extension cables Installation in a well - electric shock!</p> <p>▷ The extension cable must be connected by a professional electrician only. ▷ The cable ends must be dry and clean.</p>

2) Only if equipped with a cooling shroud

	<div style="background-color: #e67e22; color: white; padding: 5px;">⚠ DANGER</div> <p>Earth conductor not properly connected Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▷ Never operate the motor without earth conductor. ▷ The earth conductor must be connected by a professional electrician only.
	<div style="background-color: #2980b9; color: white; padding: 5px;">NOTE</div> <p>The motor lead is selected for submerged operation and must be completely submerged, including the cable connector. See order documentation for any other use! For pump sets installed in VdS-approved sprinkler installations always refer to and observe the applicable requirements stipulated by VdS (German association of property insurance companies). In accordance with VdS 2025, the cable must be laid in such a way that it is protected against short circuit and earth fault.</p>
	<div style="background-color: #2980b9; color: white; padding: 5px;">NOTE</div> <p>Before fitting the submersible cable to the motor verify that the cable entry is clean and dry. Apply a non-conductive silicone paste to the rubber elements of the cable connector to facilitate assembly.</p>

Submersible motors are supplied fitted with a motor lead. The motor lead has been extended with a suitably sized extension cable to meet the length required for the specific installation. Unless otherwise indicated, the motor lead is designed for submerged operation only. To meet this condition the cable connector also has to be completely submerged.

Extension cables connected by KSB

If agreed with KSB, the extension cable can be supplied connected to the motor lead with a watertight cable connector.

- Unless otherwise specified in the order documentation, KSB's **extension cables** are designed for:
 - Being laid freely exposed to air and in contact with surfaces
 - A voltage drop along the cable of $\Delta V \leq 3 \%$

For any other ways of laying the cable, e.g. in cable ducts, etc. observe the information on the maximum current-carrying capacity as per the applicable directives.

Extension cables connected by the operator

If the supplied extension cable is to be connected at the site, observe the following:

1. Observe the installation instructions of the cable connector to be used.
2. If the operator is responsible for connecting an extension cable, make sure the extension cable is selected and dimensioned for a maximum voltage drop of $\leq 3 \%$. The extension cable has to be approved for the applicable operating conditions.
3. In 4-core cables the earth conductor is part of the power cable and must also be connected in the cable connector when connecting an extension cable.
4. 3-core motor leads do not include an earth conductor. A separate earth conductor is connected on the outside of the motor. The earth conductor has to be extended and connected separately.

If no earth conductor is provided, the operator shall be responsible for earthing the motor externally. (Core cross-section corresponding to phase conductor, min. 4 mm²)

5. Connect the shield of shielded extension cables to the earth conductor. 3-core motor leads as described in paragraph 4 must be earthed externally; connect the shield of the extension cable to the earth conductor.
6. Transfer the core identification of the motor lead to the cores of the extension cable. Make sure the colour codes match when connecting the cores.

The core codes depend on the wiring type of the motor:

Table 4: Core codes

Motors for DOL starting with 1 cable					
U	V	W			
Motors for star/delta starting with 2 cables					
U 1	V 1	W 1	U 2	V 2	W 2
Motors for DOL starting with 2 parallel cables					
U1 - 1	V1 - 1	W1 - 1	U1 - 2	V1 - 2	W1 - 2

5.1.4 Measuring the insulation resistance

	 DANGER
	<p>Hazardous voltage during and after measurement Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▸ Do not touch the contact points during and immediately after measurement. ▸ Insulation resistance measurement must be effected by a trained electrician only.

Measure the insulation resistance prior to installation and prior to connection to the power supply.

Insulation resistance measurement must be effected by a trained electrician only.

Prior to the measurement, ensure compliance with the operating instructions of the insulation resistance measuring device.

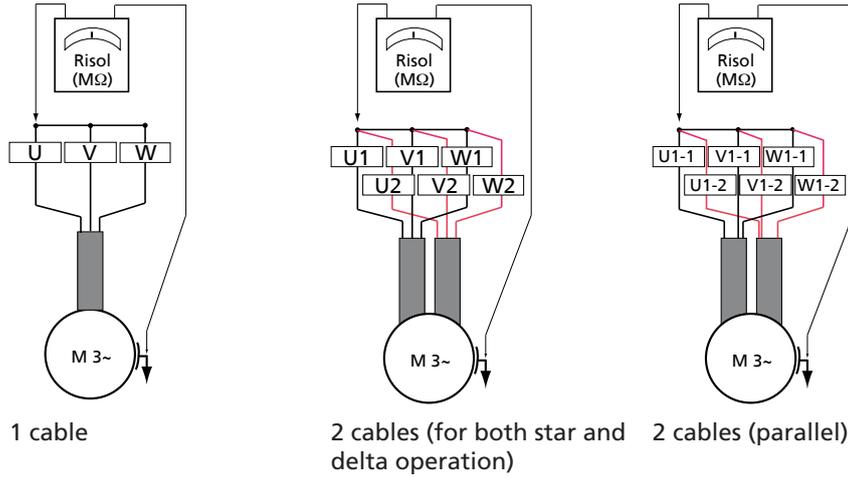
- ✓ An insulation resistance measuring device with a measuring voltage of 1000 V DC is available.
- ✓ The contact points are clean and dry.

1. Measurement period: 1 minute³⁾

2. Recommendation: insulation value at 20 °C - 30 °C: > 200 MOhm⁴⁾

3) The measured value must be steady; a longer measurement period might be needed for larger cable cross-sections.

4) The insulation resistance depends on the cable type and length.



5.2 Installing the pump set in a vertical position

	<p>⚠ DANGER</p> <p>Using damaged cables in a well Electric shock!</p> <ul style="list-style-type: none"> ▶ Do not kink cables (observe the minimum bending radius⁵⁾ of the cable) or drag the cables over sharp edges. ▶ Use cable ties or other suitable fasteners to fasten the power cables as well as any measuring and control cables to the riser or piping every three meters. ▶ Do not use any tools, equipment or accessories with sharp edges (e.g. sharp-edged pipe sockets) during installation.
	<p>⚠ WARNING</p> <p>Persons could fall into unsecured wells/reservoirs/tanks Risk of personal injury!</p> <ul style="list-style-type: none"> ▶ During installation work, take suitable precautions to protect anyone from falling into an open well/reservoir/tank. ▶ Suitably fence off the work area.
	<p>CAUTION</p> <p>Risk of the pump set falling into the well/reservoir/tank Damage to the pump set!</p> <ul style="list-style-type: none"> ▶ Secure the pump set during the entire installation procedure. ▶ Dimension any securing devices (supporting clamps, supports, etc.) so that they can carry all weights during the installation.

5) See cable manufacturer's documentation or DIN VDE 0298-3.

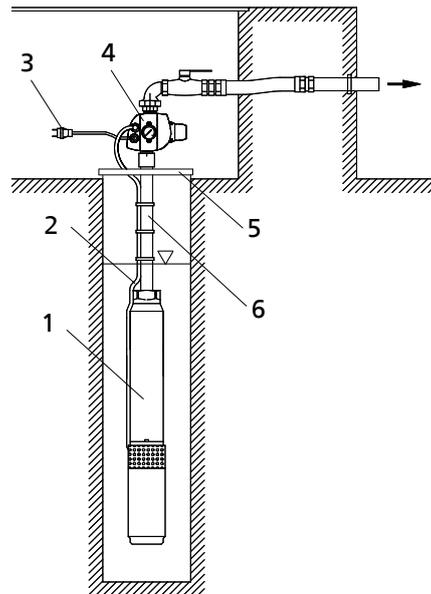


Fig. 4: Example of vertical installation

1	Pump set	2	Power cable
3	Connection to the mains	4	Control unit
5	Well head	6	Riser

Notes on installation

- Install the pump set in such a way that it does not sit on the base of the well.
- Install the pump set in such a way that sand or sludge deposits in the motor area are prevented.
- Install the pump set with the suction strainer above the well screen/filter.
- The use of hemp and hemp paste is recommended for connecting the pump to a threaded pipe connection.
- It is recommended to verify the well dimensions. This can be done, for example, by inserting a pipe of the same outer diameter as the pump set. Remove this pipe before starting with the installation.
- **Always observe the instructions of the pipe supplier!**

If the pump is to be installed with plastic risers, the pump set can be lowered and held in position with two suitably thick, rust-proof wires attached to the body of the lift check valve.

Lowering the pump set into the well

- ✓ The extension lead has been connected to the power cable.
 - ✓ Lifting equipment designed for the weight of the pump set is on hand.
1. Observe the installation instructions of the pipe suppliers.
 2. Lower the pump set into the well.
 3. Every three metres fasten the electric cable as well as any measuring and control cables to the riser with suitable fasteners (e.g. cable clips).

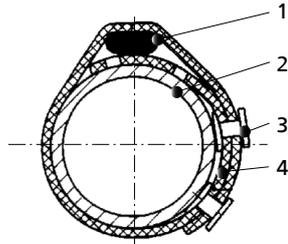


Fig. 5: Cable clip

1	Flat cable	2	Riser
3	Plastic stud	4	Rubber strap

5.3 Installing the pump set in a horizontal position

	<p>⚠ WARNING</p> <p>Persons could fall into unsecured wells/reservoirs/tanks Risk of personal injury!</p> <ul style="list-style-type: none"> ▷ During installation work, take suitable precautions to protect anyone from falling into an open well/reservoir/tank. ▷ Suitably fence off the work area.
	<p>⚠ WARNING</p> <p>Installation on mounting surface which is unsecured and cannot support the load Personal injury and 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. ▷ Observe the weights indicated.
	<p>CAUTION</p> <p>Temperature and pressure increase of the motor fill Damage to the motor!</p> <ul style="list-style-type: none"> ▷ Always protect non-flooded pump sets against direct exposure to sun.

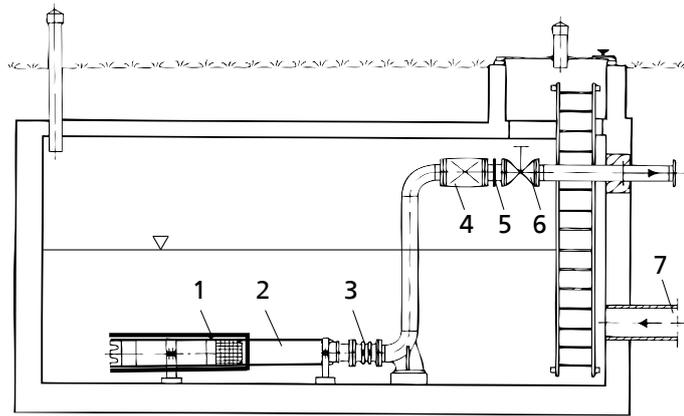


Fig. 6: Example of horizontal installation

1	Cooling shroud	2	Pump set
3	Expansion joint	4	Check valve ⁶⁾
5	Spacer	6	Shut-off valve
7	Inlet		

Installation instructions

- For horizontal installation, a device guiding the flow along the motor (cooling shroud, hood etc.) is required.
- For horizontal installation, install the pump set with the venting pointing upwards at an angle.
- Lay the pipe in such a way that no piping forces (weights, torsional forces, vibrations, etc.) can act on the pump set. To compensate such forces, we recommend fitting a tailored expansion joint between the pump set and the pipe.

Positioning the pump set

- ✓ The tank or well have been prepared in accordance with the instructions.
 - ✓ The concrete floor is of sufficient strength.
 - ✓ An extension cable of the specified length has been connected to the power cable.
1. Arrange the pedestals in accordance with the general arrangement drawing and fasten them to the foundation with the foundation bolts, anchor bolts, etc. provided by the operator.
 2. Position and fasten the pump set (including cooling shroud) on the pedestals.
 3. Fit the expansion joint, if any.
 4. Install the piping in accordance with the piping layout. **Observe the installation instructions of the pipe supplier.**
 5. Fasten the electric cable as well as any measuring and control cables to the pipe with suitable fasteners (e.g. cable clips). Attach them every three metres.

6) Only for pump sets without check valve.

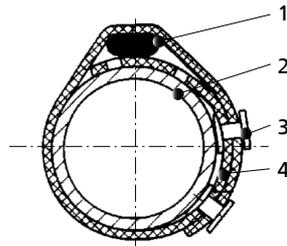


Fig. 7: Cable clip

1	Flat cable	2	Riser
3	Plastic stud	4	Rubber strap

5.4 Information on electrical connection

Asynchronous motors KSB's submersible borehole pumps with asynchronous motors < 1000 V are wired for DOL starting. During start-up and run-up the voltage must not fall below the value specified in the order documentation. If this starting method is not permitted by the power supply utility, starting devices to reduce starting currents must be provided (e.g. star-delta contactors, autotransformers, starting resistors, soft starters. etc).

Synchronous motors Submersible borehole pumps with synchronous motors < 1000 V must be controlled by a frequency inverter. They must not be operated directly on mains power.

General information for the motor

Motor protection

Provide a temperature-compensated overcurrent relay of tripping class 10 or 10 A as motor protection. If an earth leakage relay is used, it must be fitted in the motor power circuit.

Rating

The rating specified on the name plate and in the order confirmation applies to continuous duty S1 to DIN EN 60034-1.

5.4.1 Operation with star-delta contactor, autotransformer and starting resistors

Star-delta contactor The Y-phase or partial voltage period shall not exceed 4 s. The switchover interval from Y to Δ must not be longer than 60 ms. **Additional delays are not permitted.**

Starting devices Set up the starting devices for automatic operation, i.e. switchover from partial to full voltage must be automatic.

The partial voltage period shall not exceed 4 s. To operate the pump set with a starting transformer or starting resistor, choose a closed-transition switchover method (e.g. Korndorfer connection).

5.4.2 Operation with soft starter

Submersible motors differ from ordinary standardised asynchronous motors in their slim design (low moments of inertia), their output per size, plain bearing design and winding type.

The following reference values, based on our experience, ensure safe operation of submersible borehole pumps. The operator is responsible for checking with the manufacturer of the soft starter that the particular features of submersible borehole pumps have been taken into account. Depending on the make, the reference values provided might be exceeded.

Table 5: Reference values for soft starters

Parameter/function	Setting
Minimum starting voltage	40 % of the motor's rated voltage
Ramp time / acceleration (run-up) time	$t_H < 4$ seconds
Current limitation	I_A / I_N approx. 3.5

Parameter/function	Setting
Deceleration (run-down) time / stop ramp	$t_A < 4$ seconds
All special functions, e.g. <ul style="list-style-type: none"> ▪ Delayed starting ▪ Current control ▪ Speed control ▪ Kick-start / boost function 	OFF

1. After run-up, the soft starter must be bypassed by a contactor.
2. Always observe the manufacturer's operating instructions.
3. Soft starters for two-phase connection are only permitted if the starter's control algorithm eliminates the physically caused DC components.
4. If the soft starter fulfils motor protection functions, such as an over-current trip (tripping class 10 or 10A), phase failure, etc., these functions must also be ensured when the soft starter is bypassed.

	NOTE
Conspicuous noises or vibrations during run-up and run-down could indicate incorrect parameter settings on the soft starter, such as excessive ramp times, incorrect operating mode (control) or enabled special functions.	

5.4.3 Operation on a frequency inverter

If KSB's submersible borehole pumps are operated on a frequency inverter, the pumps' special design (low moment of inertia, high output per size, etc.) requires that the following points be observed.

Power reserve

If supplied by KSB for operation on a frequency inverter, see data sheet, the motor comes with a 5 % power reserve. If the submersible borehole pump is retrofitted with a frequency inverter, an electrical loss of 5 % has to be taken into account. To check whether a frequency inverter can be retrofitted, always contact the pump manufacturer.

Maximum permissible run-up and run-down time

The run-up time from standstill to the minimum frequency f_{min} must not exceed 2 seconds. The run-down time must also be limited to a maximum of 2 seconds.

Minimum frequency

The minimum frequency must not be below 30 Hz.

Maximum operating frequency

Do not exceed the maximum operating frequency of 50 Hz/60 Hz respectively.

Maximum permissible rate of voltage rise and voltage peaks

Observe the following limits:

- Maximum rate of voltage rise: $du/dt \leq 500$ V/ μ s
- Maximum peak voltages to earth: J1 insulation ≤ 600 V

	NOTE
Compliance with these limits can usually be assured by means of a sine filter or du/dt filter.	

Control principle of the frequency inverter

The control principle has to correspond with a linear V/f characteristic. If other control principles are employed, such as field-oriented inverters, inverters with DTC or NOF, the manufacturer of the frequency inverter must ensure that the special features of submersible motors (very small moment of inertia, electrical data) are taken into account.

5.5 Electrical connection

	<p>⚠ DANGER</p>
	<p>Electrical connection work 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.

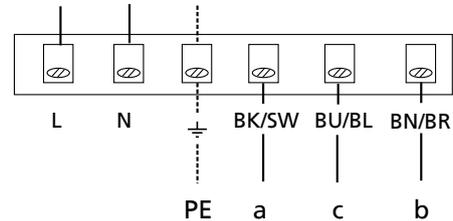
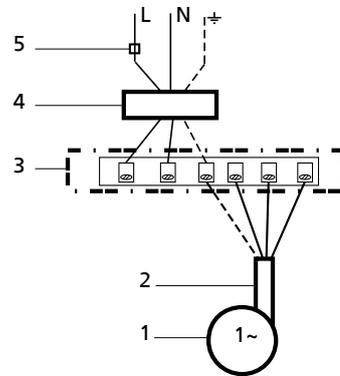
	<p>⚠ WARNING</p>
	<p>Incorrect connection to the mains Damage to the mains network, short circuit!</p> <ul style="list-style-type: none"> ▷ Observe the technical specifications of the local energy supply companies.

1. Check the available mains voltage against the data on the name plate.
2. Select an appropriate start-up method and observe the respective requirements.

	<p>NOTE</p>
	<p>Connect shielded motor connection cables with the exposed shield as short as possible and the shield ends having contact over a large area. Interruptions of the shield must be compliant with EMC⁷⁾. Observe the EMC instructions given by the equipment manufacturers.</p>

Connecting single-phase (1~) motors

For this motor type a starting device is required. The starting device is included in the scope of supply.



Circuit diagram: single-phase (1~) motors with one cable for DOL starting

- 1 = motor
- 2 = motor lead
- 3 = starting device
- 4 = switchgear
- 5 = fuse

Codes in the starting device

- L = phase conductor
- N = neutral conductor
- PE = earth conductor; core marking: green/yellow
- a = core marking: black
- b = core marking: brown
- c = core marking: grey (blue)

Connecting three-phase (3~) motors

The 3 current-carrying conductors are designated U, V, W; the designation of the earth conductor is PE.

7) Electromagnetic compatibility

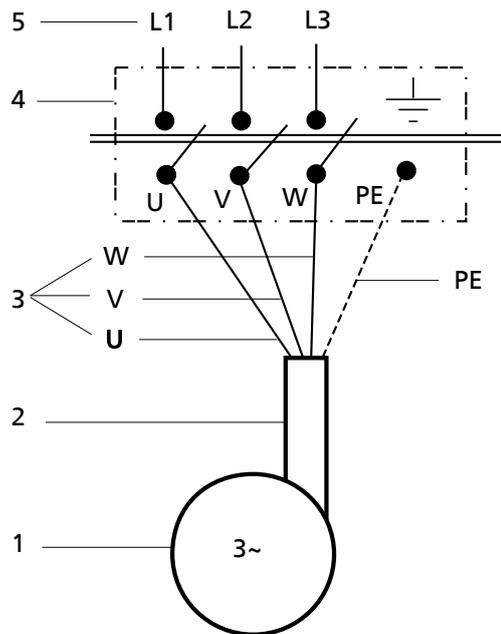


Fig. 8: Circuit diagram: three-phase (3~) motors with one cable for DOL starting

1	Motor	2	Motor cable
3	Core marking	4	Switchgear
5	Phase conductor	PE	Earth conductor Core marking: (green/yellow)

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/Start-up

6.1.1 Start-up

	<p>⚠ DANGER</p> <p>Start-up with defective earth conductor Personal injury from electric shock!</p> <ul style="list-style-type: none"> ▶ Never switch on a pump set without an earth conductor or with a defective earth conductor.
	<p>CAUTION</p> <p>Starting the pump set against an empty pipe Noise! Vibrations of the pump set and the connected piping!</p> <ul style="list-style-type: none"> ▶ During start-up make sure that any air contained can escape to the atmosphere.
	<p>CAUTION</p> <p>Starting up the pump set outside the fluid. Pump damage and motor damage!</p> <ul style="list-style-type: none"> ▶ Only start up the pump set when its motor is filled and the pump set is fully submerged or flooded!
	<p>CAUTION</p> <p>Operation with closed shut-off valve Damage to motor and bearings!</p> <ul style="list-style-type: none"> ▶ Never let the pump set run against a closed shut-off valve for more than five minutes.
	<p>CAUTION</p> <p>Continuous operation against a throttled shut-off element Damage to pump and motor!</p> <ul style="list-style-type: none"> ▶ In continuous operation against a throttled shut-off element, the flow rate must not fall short of Q_{min} (see name plate).

	NOTE
	<p>It is not necessary to delay the start-up of a shut-off element with electric actuator, as the run-up time of the pump is shorter than the dead time of the shut-off element.</p>

- ✓ The pump set has been assembled as described in this manual.
- ✓ The pump set has been installed as described in this manual.
- ✓ The power cables, control cables and measuring cables have been fastened and connected in the switchgear.
- ✓ The switchgear and protective equipment have been installed and set properly.
- ✓ The pump set is completely submerged or flooded.
 1. Slightly open the shut-off element on the discharge side.
 2. Start up the pump set.
 3. Slowly open the shut-off element until the duty point is reached.

6.1.2 Checking the direction of rotation

	CAUTION
	<p>Wrong direction of rotation Damage to the motor!</p> <ul style="list-style-type: none"> ▷ Do not run the pump set for more than two minutes when checking the direction of rotation.

	CAUTION
	<p>Uncontrolled backflow of the fluid from the riser Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Prevent any uncontrolled backflow of the fluid handled with suitable means. ▷ Control the fluid backflow, e.g. by throttling the gate valve in the discharge line.

For **single-phase a.c. units** the direction of rotation is fixed and cannot be changed.

For **three-phase units**, check the direction of rotation as described below:

- ✓ The back-up name plate is attached at the place of installation of the submersible borehole pump.
- ✓ The pump set has been installed completely and is sufficiently covered by the fluid to be handled. (⇒ Section 6.2.6.1, Page 28)
- ✓ The power supply cable and the measuring and control cables, if any, are connected to the control cabinet.
- ✓ The shut-off valve in the discharge line has been closed.
 1. Switch on the motor at the control cabinet.
 2. Read the pressure on the pressure gauge.
 3. Switch off the motor and interchange two phases of the power cable in the control cabinet.
 4. Start up the motor and read the pressure at the pressure gauge.
 5. Switch off the motor.
 - ⇒ The higher reading at the pressure gauge indicates the correct direction of rotation.
 - ⇒ On pumps with free discharge, the correct direction of rotation is indicated by the greater water volume produced, in fountains by the higher jet.
 6. Wire the motor for the correct result.

6.2 Operating limits

6.2.1 Frequency of starts

To prevent inadmissible heat build-up in the motor, the following max. number of starts or minimum standstill periods must be complied with:

- 20 start-ups per hour
- Minimum standstill periods of three minutes

6.2.2 Supply voltage

Observe the permissible voltage and frequency fluctuations to ANEEL No. 395 section A; $U_N \pm 5\%$, $f_N \pm 2\%$. The limits may differ if specified in the order, see order confirmation.

Star point displacement

Operation with displaced start point must not exceed the value $U_0 > 0.2 \times U_N$ and must be limited to one operating hour.

6.2.3 Voltage limits

Observe the following limits:

- Maximum rate of voltage rise $du/dt < 500 \text{ V}/\mu\text{s}$.
- Maximum voltage peaks - J1 insulation $< 600 \text{ V}$.

6.2.4 Operation on a frequency inverter

Do not operate the pump set outside the permissible frequency range of 30 to 50 Hz / 60 Hz.

6.2.5 Star point displacement

The motors are designed for short-time operation with displaced star point ($t < 1\text{h}$). For prolonged operation and $U_0 > 0.2 \times U_N$, consult the manufacturer.

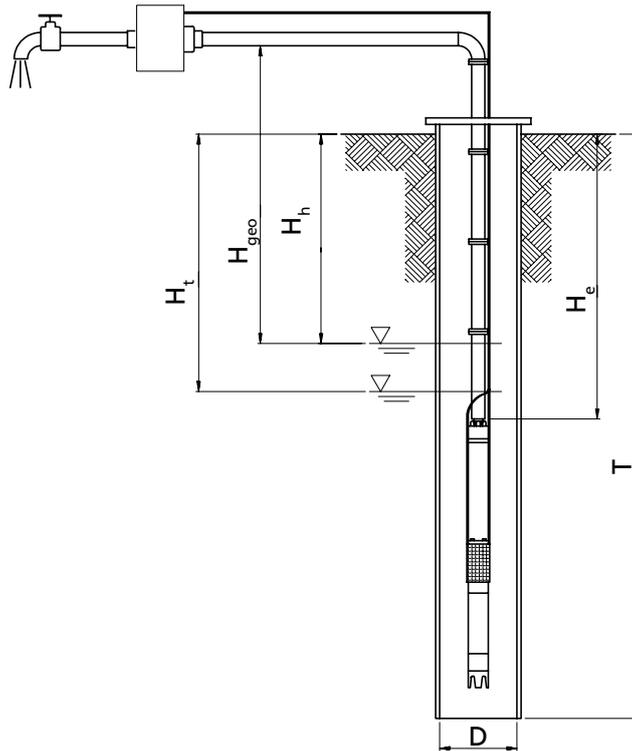
6.2.6 Fluid handled

6.2.6.1 Minimum submergence

Observe the minimum submergence of 0.5 metres.

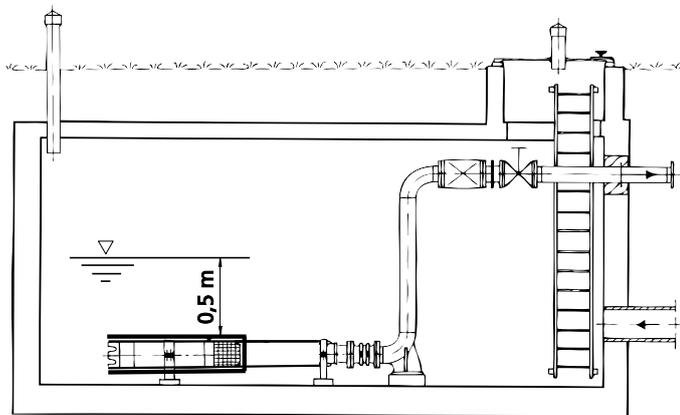
	NOTE
<p>The water level in the well is usually measured with a water level contact meter (well dipper).</p>	

Vertical installation Measurement for vertical installation:
Upper pump edge to lowest (dynamic) water level.
 $H_e - H_t \geq 0.5 \text{ metres!}$


Fig. 9: Minimum submergence for vertical installation

T	Well depth	H_h	Static water level
D	Well diameter	H_t	Dynamic water level
H_e	Installation depth of the pump set	H_{geo}	Height of control box above the static water level in the well

Horizontal installation Measurement for horizontal installation:
Upper pump edge of suction strainer to lowest (dynamic) water level.


Fig. 10: Minimum submergence for horizontal installation

6.2.6.2 Sand content

Make sure the maximum sand content of 50 g/m^3 is not exceeded.

6.2.6.3 Temperature of the fluid handled

Make sure the maximum water temperature $T = + 30 \text{ }^\circ\text{C}$ is not exceeded.



NOTE

The minimum flow velocity in the motor area has to equal 0.08 m/s . For inner well diameters $> 150 \text{ mm}$ always install a cooling jacket.

6.3 Shutdown

	<p style="background-color: #FFD700; margin: 0;">CAUTION</p> <p>Work on the pump with the power cables connected Risk of injury from unintentional start-up!</p> <ul style="list-style-type: none"> ▸ Always make sure the electrical cables are disconnected before carrying out work on the equipment.
	<p style="background-color: #FFD700; margin: 0;">CAUTION</p> <p>Surge pressure caused by sudden stopping of the pump set Damage to the machinery right through to the pump set falling down!</p> <ul style="list-style-type: none"> ▸ Slowly close the shut-off element on the discharge side.
	<p style="background-color: #FFD700; margin: 0;">CAUTION</p> <p>Uncontrolled backflow of the fluid from the riser Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ Prevent any uncontrolled backflow of the fluid handled with suitable means. ▸ Control the fluid backflow, e.g. by throttling the gate valve in the discharge line.
<ol style="list-style-type: none"> 1. Slowly close the shut-off element on the discharge side. 2. Switch off the motor immediately after closing the shut-off element. 	
	<p style="background-color: #0070C0; color: white; margin: 0;">NOTE</p> <p>To make sure that the pump is always ready for instant start-up, start up the pump set approximately every 2 weeks for approx. 5 minutes during prolonged shutdown periods.</p>

7 Servicing/inspection

7.1 Servicing/inspection

The submersible borehole pumps are generally maintenance-free. In order to detect indications of potential damage at an early stage, regular checks are required.

Possible indications of potential damage:

- Temperature rise in the fluid handled
- Increased sand content of the fluid handled
- Change in current consumption
- Change in head / flow rate
- Change in frequency of starts
- Increase in noise and vibration levels

The submersible borehole pump need not be removed from the well/tank regularly for inspection.

For any queries and repeat orders, particularly when ordering spare parts, specify the following information given on the name plate:

- Pump and/or motor type series and size
- Operating data
- Order number and/or material number

For information concerning repair jobs and spare parts please contact your nearest KSB service centre.

8 Trouble-shooting

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

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

- A** Pump is running, but does not deliver
- B** Insufficient flow rate
- C** Insufficient discharge head
- D** Vibrations and noise during pump operation
- E** Overcurrent relay has tripped
- F** Fuses have blown
- G** Pump set cannot be switched on
- H** Pump set cannot be switched off

Table 6: Trouble-shooting

A	B	C	D	E	F	G	H	Possible cause	Remedy ⁸⁾
-	X	-	-	-	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point by opening the shut-off element accordingly.
-	-	X	-	-	-	-	-	Pump delivers against an excessively low pressure.	Re-adjust to duty point by closing the shut-off element accordingly.
-	-	X	X	-	-	-	-	Deposits in the impellers	Remove deposits. Contact the manufacturer.
-	X	X	-	-	-	-	-	Wrong direction of rotation (three-phase units)	Interchange two of the phases of the power cable.
-	X	X	-	-	-	-	-	Wear of internal components	Replace worn components by new ones. Contact the manufacturer.
-	X	-	-	X	-	-	-	Two-phase operation	Replace defective fuse. Check cable connections.
X	-	-	-	-	-	X	-	No power supply	Check electrical installation. Inform electric utility company.
X	-	-	-	X	-	-	-	Pump clogged by sand	Clean suction casing, impellers, stage casings and check valve. Contact the manufacturer.
X	-	-	-	X	X	X	-	Motor winding or power cable are defective.	Contact the manufacturer.
X	X	X	-	-	-	-	-	Defective or clogged riser pipe (pipe and sealing elements)	Replace defective riser pipes. Replace sealing elements.
-	X	-	-	-	-	-	-	Water level lowered too much during operation	Contact the manufacturer.
X	-	X	X	-	-	-	-	Impermissible air/gas content in the fluid handled	Contact the manufacturer.
-	-	-	X	-	-	-	-	Mechanical defect of pump or motor	Contact the manufacturer.
-	-	-	X	-	-	-	-	System-induced vibrations	Contact the manufacturer.
-	X	-	X	-	-	-	-	NPSHavailable (positive suction head) is too low.	Submerge pump deeper.

8) Release pump set pressure before attempting to remedy faults on parts which are subjected to pressure.

A	B	C	D	E	F	G	H	Possible cause	Remedy ³⁾
-	X	X	-	-	-	-	-	Speed is too low.	Check electrical voltage and increase if necessary. Contact the manufacturer.
-	-	-	-	-	X	-	-	Wrong fuse size	Fit correct fuse size.
-	-	-	-	X	-	X	X	Defective overcurrent relay	Check and replace if necessary.
-	-	-	-	X	-	-	-	Motor winding not suitable for operating voltage available	Replace the pump set. Contact the manufacturer.

9 Related Documents

9.1 General assembly drawing of UPachrom CN

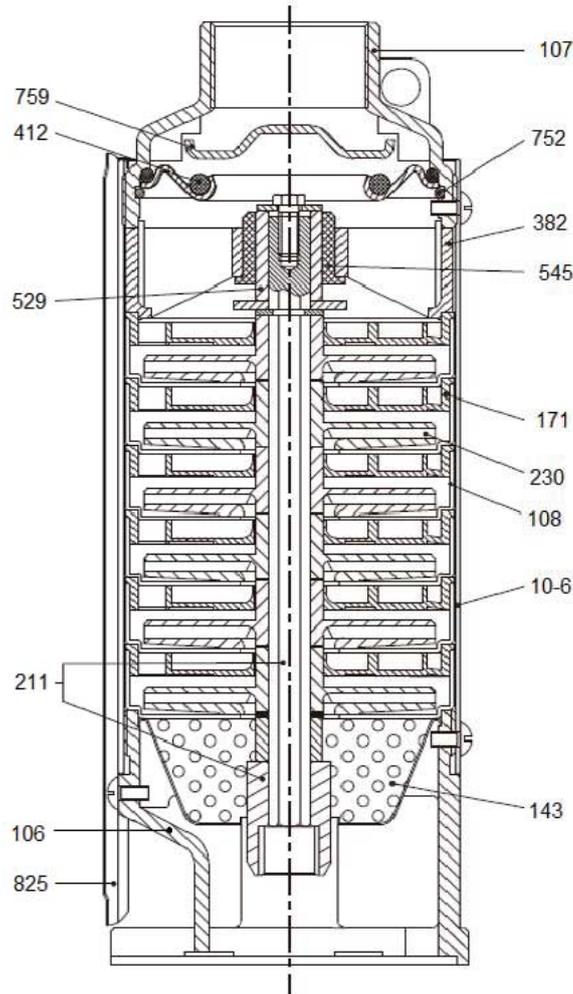


Fig. 11: Sectional drawing of pump type UPachrom CN

Table 7: List of components of UPachrom CN

Part No.	Description	Part No.	Description
10-6	Pump shroud	382	Bearing carrier
106	Suction casing	412	O-ring
107	Discharge casing	529	Bearing sleeve
108	Stage casing	545	Bearing bush
143	Suction strainer	752	Valve seat
171	Diffuser	759	Valve disc
211	Pump shaft with coupling	825	Cable guard
230	Impeller		

9.2 General assembly drawing of motor DN 100

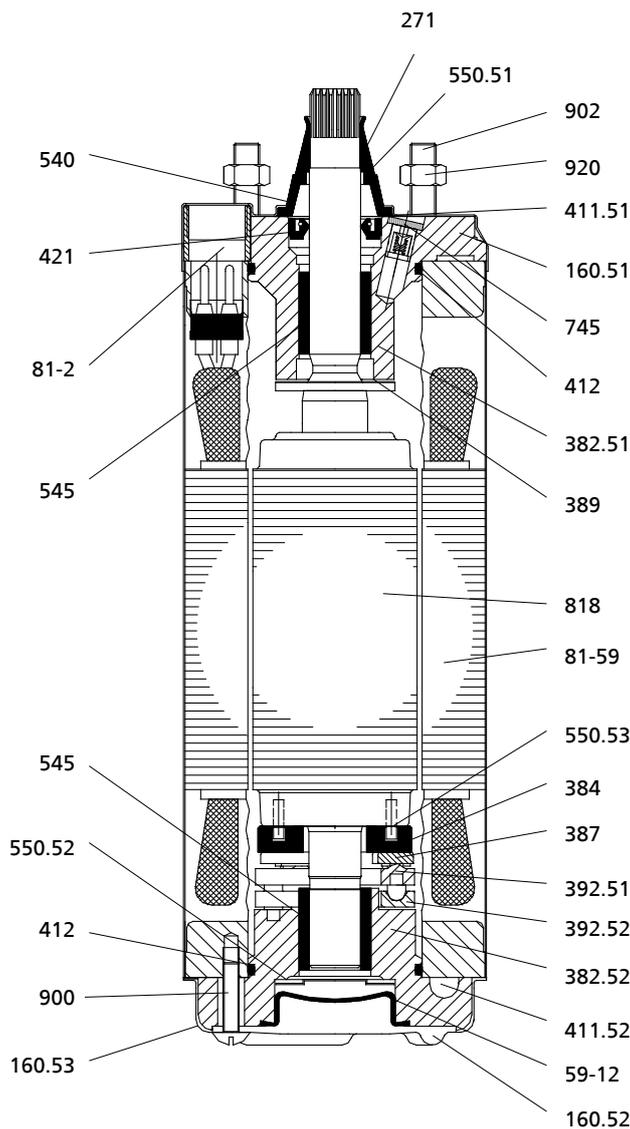


Fig. 12: Example of a DN 100 motor < 3.0 kW

Table 8: List of components DN 100

Part No.	Description	Part No.	Description
59-12	Diaphragm	412	O-ring
81-2	Plug	421	Lip seal
81-59	Stator	540	Bush
160.51/.52/.53	Cover	545	Bearing bush
271	Sand guard	550.51/.52/.53	Disc
382.51/.52	Bearing carrier	745	Filter
384	Thrust collar	818	Rotor
387	Thrust bearing segment	900	Screw
389	Counter thrust bearing ring	902	Stud
392.51/.52	Bearing segment carrier	920	Hexagon nut
411.51/.52	Joint ring		

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