Installation/Operating Manual

Submersible Pumps 60 Hz

Contents

Glossary

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

Pump set

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

1 General

1.1 Principles

This manual is supplied as an integral part of the type series and variants indicated on the front cover (see details listed below).

Pump sizes

- URD 152
- UQH 193
- UQH 233
- BPD 271
- UQH 293
- UQN 345
- BPN 374
- BPH 384
- BPN 425
- BRTS 435
- BQTS 466
- BRVS 486

Motor sizes

- 6C
- 6E
- 7A
- 8A
- 9A
- 9B
- 10A
- 12A
- 14B

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 PUMPIRAN service centre to maintain the right to claim under warranty.

1.2 Target group

This manual is aimed at the target group of trained and qualified specialist technical personnel. (⇨ Section 2.4 Page 9)

1.3 Other applicable documents

Table 1: Overview of other applicable documents

Document	Contents
Data sheet	Description of the technical data of the pump(set)
General arrangement drawing/outline drawing	Description of mating and installation dimensions for the pump (set), weights
Hydraulic characteristic curve	Characteristic curves showing head, NPSH required, efficiency and power input
General assembly drawing[1)]	Sectional drawing of the pump Sectional drawing of the motor
Sub-supplier product literature[1)]	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists[1)]	Description of spare parts
Operating manual for accessories[1)]	Description of accessories, e.g. cable connector

1.4 Symbols

Table 2: Symbols used in this manual

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

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

2 Safety

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

2.1 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

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

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2.2 General

This manual contains general installation, operating and maintenance instructions that must be observed to ensure safe pump operation and prevent personal injury and damage to property.
The safety information in all sections of this manual must be complied with.
This manual must be read and completely understood by the specialist personnel/operators responsible prior to installation and commissioning.
The contents of this manual must be available to the specialist personnel at the site at all times.
Information attached directly to the pump/motor must always be complied with and be kept in a perfectly legible condition at all times. This applies to, for example:

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

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

2.3 Intended use

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

- Only operate 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.
- Never operate the pump without the fluid 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 discharge-side shut-off elements further than permitted.
  - The maximum flow rate specified in the data sheet or product literature 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 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.
- Do not remove any contact guards during operation.
- Provide the personnel with protective equipment and make sure it is used.
- Contain leakages (e.g. at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment Adhere to all relevant laws.

- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If shutting down the pump does not increase potential risk, fit an emergency stop control device in the immediate vicinity of the pump (set) during pump set installation.

2.8 Safety information for maintenance, inspection and installation work

- Modifications or alterations of the pump are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts authorised by the manufacturer. The use of other parts can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that all maintenance, inspection and installation work is performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- The pump casing must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual.
- Decontaminate pumps which handle fluids posing a health hazard.
- As soon as the work is completed, re-install and/or re-activate any safety-relevant and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇨ Section 6.1 Page 43)

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 8)

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 PUMPIRAN or the supplying dealer (as applicable) 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

	**WARNING**
	Improper transport Risk of squashing hands and feet! Damage to the pump set! • Always transport the pump set in horizontal position. • Do not use electrical cables for transport. • Gently set down the pump set. • Observe the centre of gravity of the pump set and the weights indicated

	**WARNING**
	Pump set tipping over or rolling off Risk of personal injury! • Always secure vertically positioned pump sets against tipping over. • Always secure horizontally positioned pump sets against rolling off.

	**WARNING**
	Ambient temperature below the specified minimum Danger of frost! • 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).

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

Transporting the transport boxes

Transport boxes Submersible borehole pumps are supplied in appropriate packaging, e.g. transport boxes, containing either the pump set or the pump and/or motor as individual components (depending on the design). Use suitable lifting equipment to transport the transport box to the place of installation or storage. Observe the marking on the long side of the transport box! This marking indicates the centre of gravity.

Unpacking the pump set / pump / motor

	**WARNING**
	Unsecured cable drum Risk of personal injury! • Always secure the cable drum against tipping over. • Always secure the cable drum against rolling off.

	**WARNING**
	Laying cables at temperatures below zero degrees Damage to the cables! • 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**
	Excessive bending stress on the pump set • Damage to the pump set! • Choose sling points which prevent excessive bending stress on the pump set.

Unpacking

Use suitable lifting equipment for lifting the pump set out of the packaging and transporting it (⇨ Section 4.7 Page 19) Use suitable lifting tackle for lifting the pump set out of the packaging and transporting it, e. g. lifting straps. Sling points: in the middle of the motor and at the upper end of the pump.

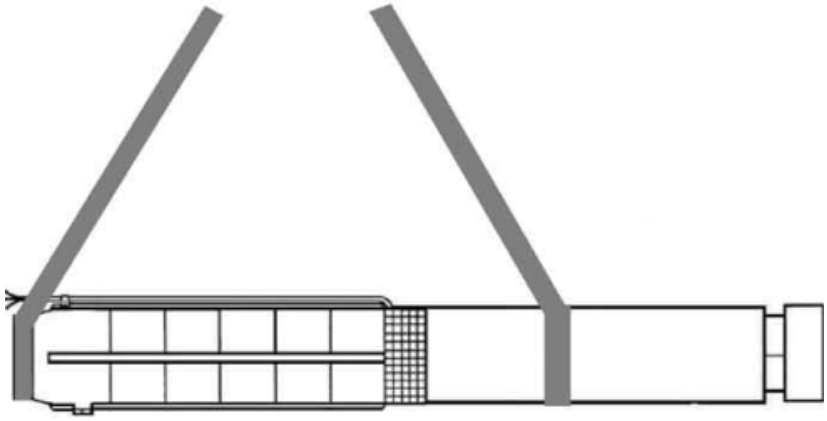


Fig. 1: Transporting the pump set by crane

- ✓ Suitable lifting equipment and lifting tackle are available.
- ✓ The surface on which the pump set is to be positioned is solid and level.
- ✓ Securing means, e.g. timber wedges are on hand.

1. Gently set down the transport box.
2. Open the transport box.
3. Take out the power cable and put it down.
4. Position the lifting tackle allowing for balanced lifting. Normally, the centre of gravity of the pump set will be in the motor area. Watch any add-on parts, such as piping and cables!
5. Use the lifting equipment to lift the pump set out and position it on a solid and level surface.
6. Use appropriate means to secure the pump set against rolling off.

3.3 Pulling the pump/motor/pump set upright

	WARNING
	Incorrect positioning Personal injury and damage to property! • Position the pump set vertically with the motor below. • Use appropriate means to secure the pump set against overturning and tipping over. • Refer to the weights given in the data sheet.

	WARNING
	Improper handling when setting the pump set down in a vertical/horizontal position Personal injury and damage to property! • Use appropriate means to secure the pump set against overturning, tipping over and rolling off. • Maintain adequate safety distance during lifting operations (load may swing when being lifted) • Use additional supports for the transport holder to secure the pump set against overturning.

	**WARNING**
	Improper handling of the power cable when placing the pump set in vertical position or transporting it Personal injury and damage to property! • Secure power cables against falling down.

	**CAUTION**
	Improper storage Damage to the power cables! • Support the power cables at the cable entries to prevent permanent deformation. Observe the minimum bending radius2) of the cables. • Only remove the protective caps from the power cables at the time of installation.

	**CAUTION**
	Excessive bending stress on the pump set Damage to the pump set! • Choose sling points which prevent excessive bending stress on the pump set.

✓ **Suitable lifting equipment for the total weight has been selected and is on hand.**

1. Fasten to a suitable lifting accessory, e.g. mounting plate.
2. Attach the lifting equipment, pull the pump/motor/pump set upright, and secure it against tipping over.

3.4 Storage and preservation

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

	**WARNING**
	Pump set tipping over or rolling off Risk of personal injury! • Always secure vertically positioned pump sets against tipping over. • Always secure horizontally positioned pump sets against rolling off.

	**WARNING**
	Ambient temperature below the specified minimum Danger of frost! • 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).

	**WARNING**
	Laying cables at temperatures below zero degrees Damage to the cables! • 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.

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

	**CAUTION**
	Improper storage Damage to the power cables! • Support the power cables at the cable entries to prevent permanent deformation. Observe the minimum bending radius3) of the cables. • Only remove the protective caps from the power cables at the time of installation.

Store the submersible borehole pumps as follows:

1. In its original packaging: horizontally
2. Without packaging: vertically (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

Further information on storing the pump set after use (⇨ Section 7.5 Page 58).

3.5 Return to supplier

	**WARNING**
	Ambient temperature below the specified minimum Danger of frost! · 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).

1. Clean the pump set properly from the outside.
2. Always flush and clean the pump, particularly if it has been used for handling noxious, explosive or other hazardous fluids.
3. If the fluids handled by the pump set leave residues which might lead to corrosion damage when coming into contact with atmospheric humidity, or which might ignite when coming into contact with oxygen, the pump set must also be neutralised, and anhydrous inert gas must be blown through the pump for drying purposes.
4. Always complete and enclose a certificate of decontamination when returning the pump (set).

Always indicate any safety and decontamination measures taken.

	**NOTE**
	If required, a blank certificate of decontamination can be downloaded from the PUMPIRAN web site at: www.pumpiran.com

3.6 Disposal

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

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

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

Submersible borehole pump

Example: UQH 193/12a

Table 4: Key to the designation

Code	Description
UQH	Pump type series
193	Nominal size [mm]
12	Number of stages
a	Trimmed impeller diameters

Submersible bore whole pump
Example: BQTS 466/10a

Table 5: Key to the designation

Code	Description
BQTS	Pump type series
466	Nominal size [mm]
10	Number of stages
A	Trimmed impeller diameters

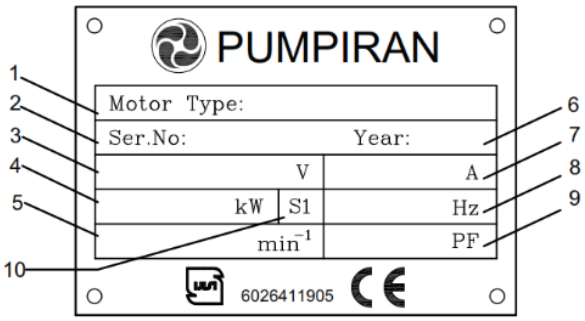
Submersible motor
Example: 4E 0.37 1/2
Table 6: Key to the designation

Code	Description
4E	Design status
0.37	Maximum rated power [kW] for 60 Hz
1	Number of phases
2	Number of poles

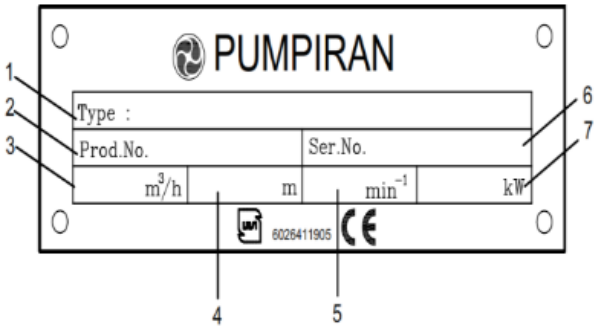
Submersible motor
Example: 9A45 3/2
Table 7: Key to the designation

Code	Description
9	Nominal size [inch]
A	Design status
45	Maximum rated power [kW] for 60 Hz
3	Number of phases
2	Number of poles

4.3 Name plate



1	Motor Designation
2	Serial No.
3	Voltage
4	Rated Power
5	Speed
6	Manufacturing date
7	Amperage
8	Frequency
9	Power Factor
10	Duty Cycle



1	Pump Designation
2	Production Code
3	Flow at Duty Point
4	Head at Duty Point
5	Speed
6	Serial No.
7	Rated Power

Fig. 2: Name plate (example)

4.4 Design details
Pump design

- Centrifugal pump
- Single-stage or multi-stage
- Radial or mixed flow versions
- Single-entry
- Ring-section or shroud design
- With non-return valve or connection branch
- Pump connection with threaded or flanged end
- Rigid connection between pump and motor

Motor design

- Submersible motor in squirrel-cage design
- Motor shaft[4)] protected by sealed sleeve coupling
- Rubber expansion diaphragm for pressure equalisation
- Thrust bearing with tilting pads to absorb the pump's hydraulic thrust
- Mechanical seal or shaft seal ring

4.5 Configuration and function

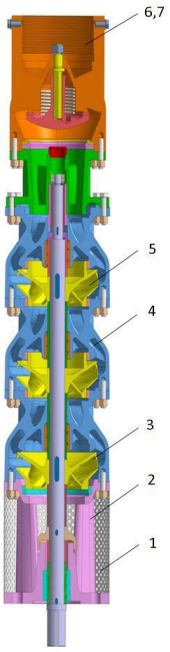


Fig. 3: Sectional drawing, example of a BPN 374

Design Pump and motor are connected by a rigid coupling. The stage casings are connected by means of stud bolts. A suction trainer at the suction casing protects the pump from coarse particles in the fluid. The pump set is connected to the piping via a non-return valve or connection branch with either internal thread or flanged end (optional).

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 non-return valve to the connection branch (6, 7), where it leaves the pump. The integrated non-return 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 Optional: pump and/or motor as individual units
- Electric cable Optional: connected or supplied loosely
- Tools for filling the motor
- Accessories, such as:
  - Cable connector
  - Cable ties
  - Cooling, suction or pressure shroud
  - Bearing pedestals
  - Electrical protection devices
  - Automatic control units

5) To be attached outside the place of installation, e.g. control panel, pipeline or mounting bracket.

4.7 Dimensions and weights

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

5 Installation at Site

5.1 General information/Safety regulations

	**DANGER**
	Using damaged cables in a well Electric shock! • Do not kink cables (observe the minimum bending radius [6)] 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

	**WARNING**
	Pump set falling into the well Personal injury or persons being dragged down by uncontrolled cable movements! Damage to the pump set and the well! • Securely store the cable with extension lead. Keep at a safe distance during installation. • 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.

	**WARNING**
	Persons could fall into unsecured wells/reservoirs/tanks Risk of personal injury! • During installation work, take suitable precautions to protect anyone from falling into an open well/reservoir/tank. • Suitably fence off the work area.

	**WARNING**
	Improper handling when setting the pump set down in a vertical/horizontal position Personal injury and damage to property! • Use appropriate means to secure the pump set against overturning, tipping over and rolling off. • Maintain adequate safety distance during lifting operations (load may swing when being lifted). • Use additional supports for the transport holder to secure the pump set against overturning.

	**WARNING**
	Improper handling of the power cable when placing the pump set in vertical position or transporting it Personal injury and damage to property! • Secure power cables against falling down.

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

	**WARNING**
	Laying cables at temperatures below zero degrees Damage to the cables! • 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.

	**NOTE**
	Do not expose power cables to direct sunlight.

	**NOTE**
	The motor lead is selected for submerged operation and must be completely submerged, including the cable connector. See order documentation for any other use!

5.2 Preparing the installation

5.2.1 Checking the installation conditions

Prior to starting with the installation, check compliance with the particular
Framework conditions required for a trouble-free operation of the submersible borehole pump. To do so, verify the order data and/or delivery data against the constructional plans, the operating conditions and the operating limits of the pump set.

1. Has this pump set been ordered for the required installation position? (⇨ Section 5.2.2 Page 22)
2. Does the material variant of the pump set match the installation conditions?
3. Can the required flow velocity past the motor be guaranteed? (⇨ Section 6.2.4.4 Page 47)
4. Is the required minimum submergence met during operation? (⇨ Section 6.2.4.1 Page 45)
5. Is the sand content of the fluid to be handled below the specified maximum? (⇨Section 6.2.4.2 Page 47)
6. Is the temperature of the fluid to be handled below the specified maximum? (⇨Section 6.2.4.3 Page 47)
7. If fluids liable to form deposits are handled, is temperature monitoring provided? (⇨ Section 5.7.2 Page 40)
8. Will the motor lead and the cable connector be completely submerged? (⇨Section 5.2.7 Page 25)

General information on the system design

Well head select a pump set suspension arrangement whose design and dimensions allow for all static and dynamic forces to be absorbed. Tightly fasten the supporting clamps or flanges to the well head so that they cannot move or lift off the well head.

Vibrations System-induced vibrations must not be transmitted to the pump set. The system must be designed in such a way that vibrations are not amplified. Abrupt pressure equalisation processes (pressure surges), in particular, present a hazard for the pump set. Take suitable precautions (e.g. fit expansion joints, air vessels).

Sand deposits Do not install the pump set with the suction strainer exactly at the level of the well screen/filter. Excessive flow in the area of the well screen/filter entails the risk of large amounts of sand being transported, which will cause excessive wear in the pump.

Narrowing Verify the well dimensions.

Installation conditions

Pumps which are to be installed in a pump sump are always designed with a suction or cooling shroud. The pump set must not sit on the base of the well! The pump set must not touch the well and tank walls! Use a centering device, if required! Prevent adjacent pump sets from influencing each other. Provide an even approach flow in the suction area and do not obstruct it with any structural components or installations. Air intake from an inlet arranged above the water level is not permitted.

5.2.2 Checking the installation position

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

The submersible borehole pump can be installed in a vertical or, depending on the number of stages, also in an angled or horizontal position.

1. Never install horizontally a pump set which has been selected for vertical installation!
2. Never install the pump set with the pump at the lowest point.

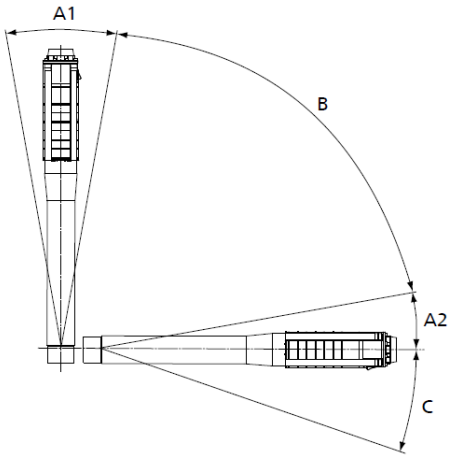


Fig. 4: Checking the installation position

A1, A2	Permissible installation position
B	Permissible installation position, if approved in the order documentation
C	Impermissible installation position

5.2.3 Checking the motor fill

	WARNING
	Unfilled or insufficiently filled motor Damage to the motor winding! • Never install and run the motor without sufficient motor fill. • Observe the information sticker on the motors and top up the motor fill as instructed.

	CAUTION
	Freezing of motor fill Damage to the motor! • Always protect motors filled with water against frost. • Provide frost-proof storage.

There are two methods for cooling motors:

1. 6C, 6E, 7A, 8A, 9A motors individually are filled with drinking water when installing.
2. 12A, 14B motors are filled with drinking water after coupling with related pumps.

Motor series	Supplied condition	Information sticker	Motor fill check required	See section
6C	Unfilled	-	Required if the motor has been stored or out of service for more than1 year	(⇨ Section 7.4.2 Page 53)
6E	Unfilled	-	Required if the motor has been stored or out of service for more than1 year	(⇨ Section 7.4.2 Page 53)
7A	Unfilled	-	Required if the motor has been stored or out of service for more than1 year	(⇨ Section 7.4.2 Page 53)
8A	Unfilled	-	Required if the motor has been stored or out of service for more than1 year	(⇨ Section 7.4.2 Page 53)
9A	Unfilled	-	Required if the motor has been stored or out of service for more than1 year	(⇨ Section 7.4.2 Page 53)
9B	Unfilled	-	Required if the motor has been stored or out of service for more than1 year	(⇨ Section 7.4.2 Page 53)
10A	Unfilled	-	Required if the motor has been stored or out of service for more than1 year	(⇨ Section 7.4.2 Page 53)
12A	Unfilled	-	Required	(⇨ Section 7.4.3 Page 56)
14B	Unfilled	-	Required	(⇨ Section 7.4.3 Page 56)

NOTE

The loss of a few drops of liquid fill will not impair the motor function. If any larger Amounts of leakage are suspected, the motor fill must definitely be checked.

5.2.4 Installing water storage tanks (6C to 14B)

If the pump set is intended for horizontal installation, motor **6C to 14B** must be fitted with water storage tanks.

- ✓ The motor has been set down in a horizontal position on a level and solid surface. It has been secured against rolling off.
- ✓ The motor has been positioned with the connections for the water storage tanks at the highest point.
- ✓ The water storage tanks are on hand.
- ✓ The motor fill has been checked with the motor in vertical position. (⇨ Section7.4.3 Page 56)
- ✓ Suitable liquid for topping up the motor fill has been prepared.

1. Remove the screw plugs from the top and bottom of the stator case. Remove the joint rings.
2. Insert the water storage tanks (59.33) with new joint rings (411.51) into the stator and screw them in tightly.
3. Fill the water storage tanks with the specified liquid fill until they overflow.
4. Close both water storage tanks with a screw plug with integrated vent valve(741) and joint ring (411.51).

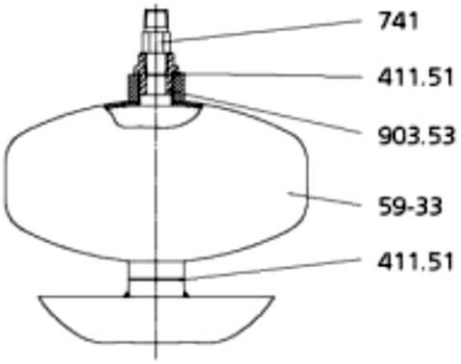


Fig. 5: Installing water storage tanks

5.2.5 Preventing backflow

	CAUTION
	**Uncontrolled backflow of the fluid from the riser** Damage to the pump set! • Prevent any uncontrolled backflow of the fluid handled with suitable means. • Make sure that backflow of the fluid handled is slow and controlled, so that the pump rotor does not start to rotate, e.g. by throttling the discharge-side gate valve accordingly

The submersible borehole pumps are generally fitted with an integrated non-return valve.
On pump sets without non-return valve the operator must prevent any uncontrolled backflow of the fluid, e.g. by structural means. Otherwise the pump could be operated in the wrong direction of rotation and critical speeds could be exceeded.

5.2.6 Calculating the total weight

Suitable lifting equipment (e.g. tripod, crane, etc.) is required for installing and removing submersible borehole pumps. The load-carrying capacity of the lifting equipment must be larger than the weight of the pump set + the riser[7)] + the water column [8)] in the riser + the power cable + the cable ties. For the weights refer to the order documentation, the product literature of the sub-suppliers and the following table.

7) See product literature of the riser used.

8) Applies to pumps with non-return valve if no other measures to drain the riser have been taken

Table 9: Weight of the water column per 1 metre of the riser

	Pipe diameter [mm], Pipe diameter [inch]									
	50 2”	80 3”	100 4”	125 5”	150 6”	200 8”	250 10”	300 --	350 --	400 --
Weight[kg]	2	5	8	12	18	32	49	72	98	125

	DANGER
	**Unqualified personnel connecting extension leads** Installation in a well - electric shock! • The extension lead must be connected by a professional electrician only. • The cable ends must be dry and clean.

	WARNING
	**Earth conductor not properly connected** Danger of death from electric shock! • Never operate the motor without earth conductor. • The earth conductor must be connected by a professional electrician only.

	NOTE
	**The motor lead is selected for submerged operation and must be completely** Submerged, including the cable connector. See order documentation for any other use!

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 PUMPIRAN

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

- Unless otherwise specified in the order documentation, PUMPIRAN's extension cables are designed for:
  - Being laid freely exposed to air
    - A voltage drop along the lead of $\Delta U \leqq 3\ \%$

For any other ways of laying cables, 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 points:

1. Observe the installation instruction 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 $\leqq$ 3%.The extension cable has to be approved for the applicable operating conditions.

If no earth conductor is provided, the operator shall be responsible for earthing the motor externally (core size corresponding to phase conductor, min. 4 mm^2).

3. 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.
4. 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 10: Core codes

Motors for DOL starting with 1 lead					
U	V	W			
Motors for star-delta starting with 2 leads					
U1	V1	W1	U2	V2	W2
Motors for DOL starting with 2 parallel leads					
U1 - 1	V1 - 1	W1 - 1	U1 - 2	V1 - 2	W1 - 2

5.2.8 Measuring the insulation resistance

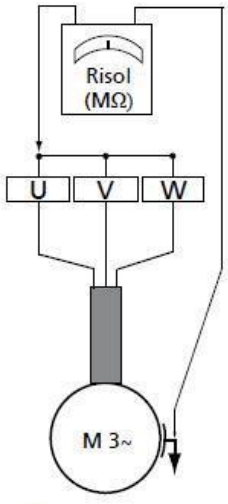
DANGER

Hazardous voltage during and after measurement Danger of death from electric shock!
• Do not touch the contact points during and immediately after measurement.
• Insulation resistance measurement must be effected by a trained electrician only.

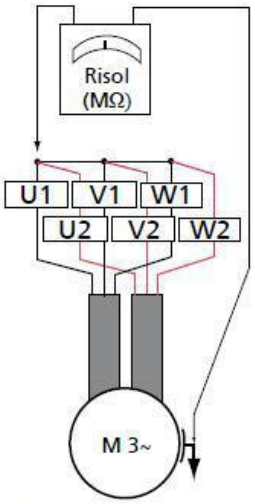
Measure the insulation resistance prior to installation and prior to connection to the power supply.
Insulation resistance measurement must be effected by a trained electrician only. Prior to the measurement, ensure compliance with the operating instructions of the device for measuring the insulation resistance.

✓ An insulation resistance measuring device with a measuring voltage of 660V DC is available.
✓ The contact points are clean and dry.

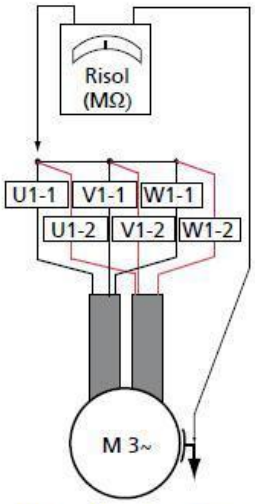
1. Measurement period: 1 minute[9)]
2. Minimum insulation resistance at **20 °C - 30 °C: > 50 MOhm**



1 lead



2 leads (for both star and delta operation)



2 leads (parallel)

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

5.3 Installing the pump set in a vertical position

	**NOTE**
	Observe all safety instructions contained in this manual for the following installation instructions. (⇨ Section 5.1 Page 20)

Suspend the submersible borehole pump from the riser to transport it to its actual place of installation/operation. The riser can differ in design and material. The installation and application options differ accordingly. Always observe the installation instructions of the respective riser when installing a submersible borehole pump! The riser always has to be designed for the maximum forces, torques and pressures in the system.

Table 11: Special features

Type of riser	Information
Flanged riser	Use a riser with a recess for the power cables in the flanges
Threaded riser	Fit an anti-rotation device to prevent the pump set from unscrewing itself from the threaded riser during start-up.
Riser hose	Especially observe the information on routing the power cable provided in the installation instructions of the riser. Any deformation of the riser hose could lead to small, light pump sets not being installed vertically and centred in the well. Take appropriate measures to ensure the correct installation position of the pump set

General information on lowering the pump set in to the well

- It is recommended to fit a centering device to prevent the pump set and the walls of the well from any damage during installation.
- Fit cable ties every three meters to protect the power cable against any damage. Cable ties are suitable for metal risers and/or thick-walled plastic risers. Also secure the power cable every three meters for all other types of risers. (⇨ Section 5.3.1 Page 29)
- Tighten the cable ties firmly to prevent the power cable from slipping downwards by its own weight! Otherwise, the cable could be affected by impermissibly high tensile stress.

	**WARNING**
	Installing pipe sections of extensive length Impermissible bending of the pump set when pulling it upright! • The length of the first pipe section must not exceed two metres

Installation example with a metal riser (pipes)

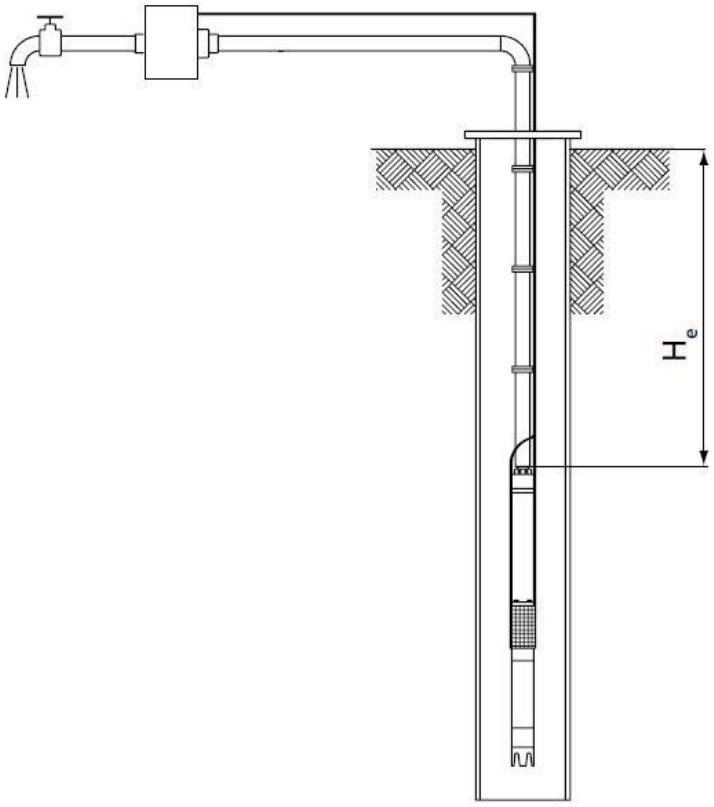
- ✓ Suitable lifting equipment for the total weight has been selected and is on hand.(⇨ Section 5.2.6 Page 24)
- ✓ The motor fill has been checked and topped up, if required.
- ✓ Any extension cables have been properly connected to the power cable as well as to the measuring and control cables.
- ✓ The pump set has been set down in a horizontal position in a level assembly area and is protected against rolling off.
- ✓ Cable ties to securely fasten the power cable and any measuring and control cables are on hand.
- ✓ A sealing agent is available.
- ✓ A mounting plate, pairs of supporting clamps and beams have been selected for the total weight (⇨ Section 5.2.6 Page 24) and are on hand.
- ✓ Risers with recesses in the flanges[10)] are available.

10) Applies to flanged risers only

1. For flanged risers:
   Bolt the first pipe section (max. length 2m) to the connection branch Fasten the mounting plate to this pipe section.
2. Fasten the first pair of supporting clamps below the upper flange.

	NOTE
	On threaded risers fit an anti-rotation device to prevent the pump set from unscrewing itself from the threaded riser during start-up.

1. For threaded risers:
   Apply a sealing agent and screw the first pipe section (max. length m) into the connection branch. Secure the connection with the two supplied securing screws.
   For this purpose, drill a shallow hole into the threaded end of the pipe section, taking care not to drill through the threaded end. Insert the securing screws with sealing agent in such a way that their tips rest lightly but do not press on the threaded pipe end! Allow time for the sealing agent to cure. The connection is now sufficiently secured against loosening.
2. Use cable ties to attach the power supply cable as well as any control and measuring cables to the riser approximately 0.5 m above the lower flange. (⇨Section 5.3.1 Page 29)
3. Place two sturdy beams across the well opening.
4. Pull the pump set into upright position with the lifting equipment.
5. Attach the pump set to the crane hook (e.g. mobile crane) by the mounting plate and lower it into the well until the first pair of supporting clamps rests on the beams.
6. Remove the mounting plate and fasten it to the second riser.
7. Fasten a second pair of supporting clamps to the second riser.
8. Use the lifting equipment to lower the second riser onto the first riser, and install it.
9. Undo the first pair of supporting clamps and lower the pump set until the second pair of supporting clamps rests on the beams.
10. Repeat these steps for every pipe section, lowering the pump set into the well until the installation depth He is reached.



5.3.1 Attaching the cable ties

	CAUTION
	Increased voltage drop along the lead Damage to the motor! • On motors with individual cables, the cables are arranged symmetrically in groups.

Fasten power cables to the riser with a cable tie each on both sides of the riser flange or socket. In the case of individual cables fasten the cables in groups. Attach a cable tie every 3 metres. Implement this arrangement over the entire length of the riser.
On motors with individual cables, lay the cables symmetrically. Arrange the cables in groups along the riser with the cables as close to each other as possible. If there are 2 groups, offset them by 90° or 180°.

- Group 1: U1-1, V1-1, W1-1 or U1, V1, W1
- Group 2: U1-2, V1-2, W1-2 or U2, V2, W2

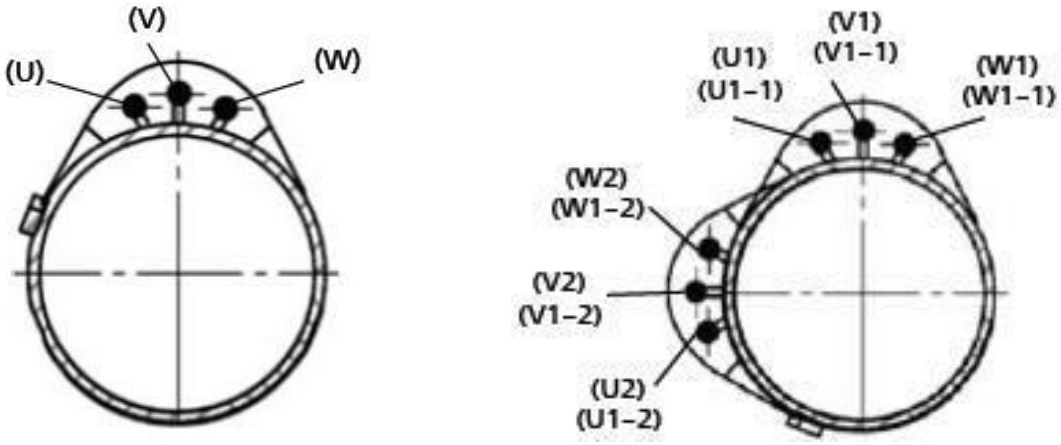


Fig. 6: Arrangement of 3 or 6 individual cables at the riser

5.3.1.1 Cable tie size 1 (rubber)

This cable tie (rubber strap + plastic studs) can be used for the following cables:

- flat, 3 and 4 cores, 1.5 mm^2 to 6 mm^2
- round, 4 cores, 1.5 mm^2 to 6 mm^2

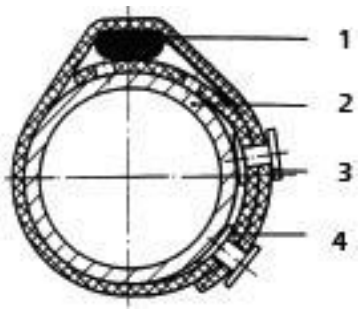


Fig.7: Cable tie size 1

1	Power cable	2	Riser
3	Plastic stud	4	Rubber strap

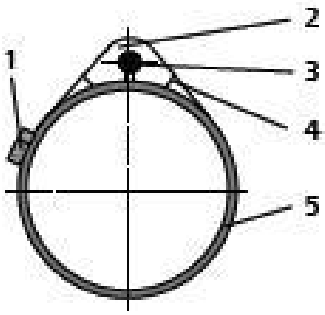
1. Cut the rubber strap (4) to size for the corresponding diameter of the riser (2) as indicated in the table below. Cut the strap half way between two holes.
2. Place one plastic stud (3) each into the third and fourth hole. Then wrap the rubber strap (4) around the riser (2) with one end beneath the power cable (1)
3. Wrap the other end around the riser (2) and the power cable and fasten it with the stud. Tighten the rubber strap (4) firmly to ensure that the power cable (1) cannot slip downwards by its own weight!

Table 12: Length of the rubber strap

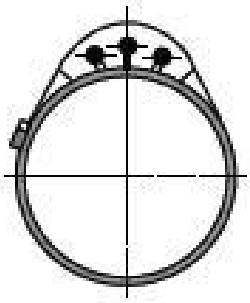
DN (mm)	50	80	100	125	150
R (inch)	2	3	4	5	6
L (mm)	320	400	450	500	600

5.3.1.2 Cable tie sizes 2 to 11 (metal)

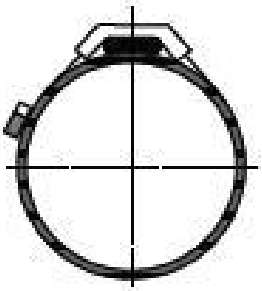
This type of cable tie (metal + rubber cable guard) is used for cables of large cross-section.



Sizes 2, 3, 3a, 3b, 4



Sizes 6 to 9



Size 11

1 = turnbuckle (reusable)
2 = cable guard
3 = power cable
4 = metal strap
5 = riser

1. Cut the metal strap (4) to size (length L = circumference of riser + approx. 200mm allowance) and bend approximately 100 mm of both strap ends inwards.
2. Fully open the turnbuckle (1) and attach it to one end of the metal strap (4).
3. Place the cable guard (2) around the power cable (3). Place it around the riser (5) together with the metal strap (4). Then attach the other end of the turnbuckle (1) to the metal strap (4).
4. Tighten the turnbuckle (1) with a screwdriver so that the power cable (3) cannot slip downwards by its own weight!

5.4 Installing the pump set in a horizontal position

	**NOTE**
	.Observe all safety instructions contained in this manual for the following installation instructions. (⇨ Section 5.1 Page 20)

	**WARNING**
	Installation on mounting surface which is unsecured and cannot support the load Personal injury and damage to property! • 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.

	**CAUTION**
	Temperature and pressure increase of the motor fill Damage to the motor! • Always protect non-flooded pump sets against direct exposure to sun.

	**NOTE**
	Only install pump sets in horizontal position if they have been approved for this type of installation.

Submersible borehole pumps can be installed in a horizontal position, provided the pump set has been approved for this type of installation. (See data sheet.)
The required accessories depend on the weight and the overall length of the pump set. If agreed with PUMPIRAN, the pump set is supplied with the accessories for the required installation type already fitted.
For assembly at the site:
It is imperative to use original accessories (bearing pedestals, supporting frames, pressure shroud).

5.4.1 Installing the pump set on bearing pedestals

Applicable for pump sets with the following motors:

6C, 6E, 7A, 8A

	**CAUTION**
	Deformation of the pump shroud Damage to the pump • For pumps in a pump shroud the pump-end bearing pedestal must be positioned at the very end of the pump, at the non-return valve.

	**NOTE**
	Fasten the power cable as well as any measuring and control cables to the piping at least every three metres as well as upstream and downstream of any pipe bends by means of cable ties or other suitable fasteners. Prevent any fluttering of the cables caused by the water flow. This applies especially to any other types of cable guide; use a protecting tube, if required

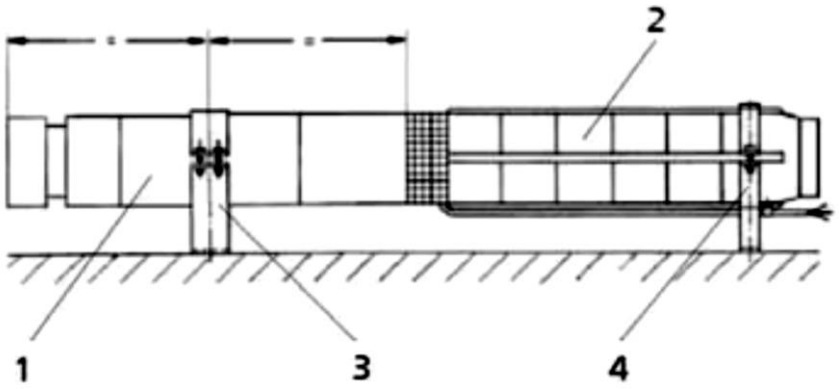


Fig. 8: Example: installation with bearing pedestals

1	Motor	2	Pump
3	Motor bearing pedestal	4	Pump bearing pedestal

Observe the following position of the bearing pedestals:
Motor bearing pedestal: middle of the motor
Pump bearing pedestal: last stage or non-return valve / connection branch.
The required foundation **bolts (M12 x 200)** shall be provided by the operator!

- ✓ The structural dimensions have been verified.
- ✓ The motor fill has been checked and topped up, if required.
- ✓ Any extension cables have been connected to the power cable as well as to the measuring and control cables.

1. Undo the ties holding the cable guard. Remove the cable guard.
2. Fasten the bearing pedestals to the pump set as shown in the illustration. Place the pump set on the foundation/floor and align it.
3. Mark and drill the holes for the fixing bolts on the foundation. Fasten the bearing pedestals of the pump set to the foundation.
4. Run the power cable through the foot of the pump bearing pedestal and secure it to the pump and the non-return valve / connection branch with cable ties. Make sure the cable is securely fastened to prevent it from fluttering in the water flow. Use a protective tube, if necessary!

	NOTE
	. Fit an expansion joint between the piping and the pump set to prevent any piping forces and vibrations from affecting the pump set.

5. Install the piping.
6. Fasten the power cable as well as any control and measuring cables to the riser with cable ties.

5.4.2 Installing the pump set on supporting frame and bearing pedestal

Applicable for pump sets with the following motors: **9A,9B ,10A,12A,14B**

	NOTE
	Fasten the power cable as well as any measuring and control cables to the piping at least every three metres as well as upstream and downstream of any pipe bends by means of cable ties or other suitable fasteners. Prevent any fluttering of the cables caused by the water flow. This applies especially to any other types of cable guide; use a protecting tube, if required.

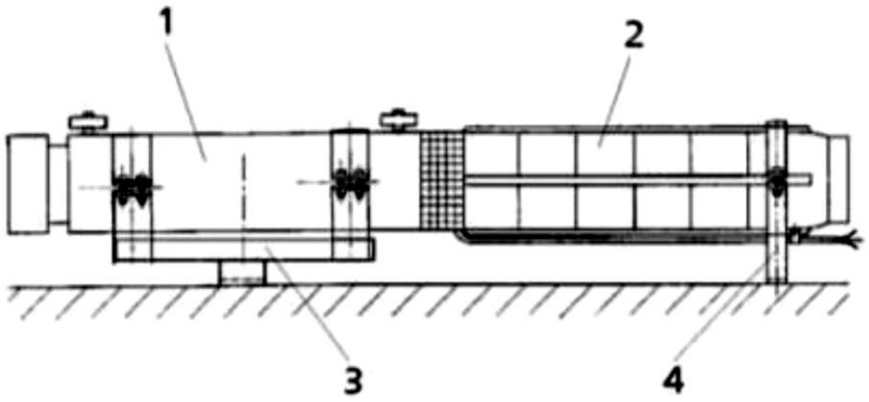


Fig. 9: Installation example with supporting frame and bearing pedestal

1	Motor	2	Pump
3	Supporting frame	4	Bearing pedestal

Observe the following position of the supporting frame and the bearing pedestal. Supporting frame for the motor: mounting clamps at the casing flanges bearing pedestal for the pump: last stage or non-return valve / connection branch.

- ✓ The structural dimensions have been verified.
- ✓ The water storage tanks have been installed.
- ✓ The motor fill has been checked and topped up, if required.
- ✓ Any extension cables have been connected to the power cable as well as to the measuring and control cables.

1. Undo the ties holding the cable guard. Remove the cable guard.
2. Fasten the supporting frame and bearing pedestal to the pump set. Position and align the assembly on the foundation/floor.
3. Mark and drill the holes for the fixing bolts on the foundation and fasten the pump set to the foundation with the supporting frame and pedestal.
4. Run the power cable through the foot of the pump bearing pedestal and fasten it to the pump (approximately in the middle of the pump's overall length) and the non-return valve / connection branch with cable ties. Make sure the cable is securely fastened to prevent it from fluttering in the water flow. Use a protective tube, if necessary!

	NOTE
	Fit an expansion joint between the piping and the pump set to prevent any piping forces and vibrations from affecting the pump set.

5. Install the piping.
6. Securely fasten the power cable as well as any measuring and control cable to the piping with cable ties or use other suitable cable guides.

5.4.3 Installing the pump set in a suction, pressure or cooling shroud

For special operating conditions, submersible borehole pumps can be equipped with a suction, pressure or cooling shroud; see order documentation or data sheet. In such cases, always refer to the additional documentation supplied with the delivery. See the operating instructions of the accessory "Suction, pressure or cooling shroud".

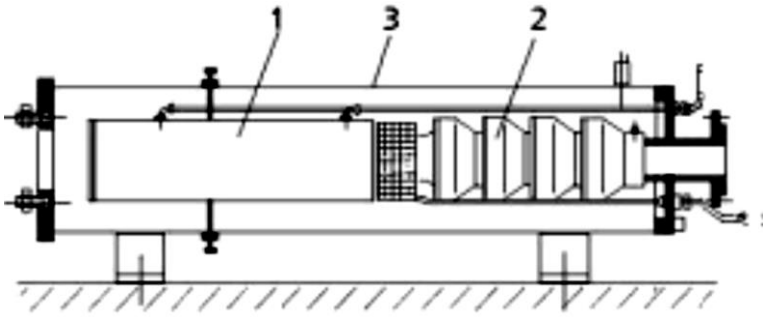


Fig. 10: Example: pressure shroud

1	Motor	2	Pump
3	Pressure shroud		

5.5 Installing the pump set in an angled position

	NOTE
	Observe all safety instructions contained in this manual for the following installation instructions. (⇨ Section 5.1 Page 20)

The pump sets are suitable for angled installation, provided they have been selected for this type of installation. See order documentation or data sheet. Angled installation of a submersible borehole pump always requires structural adjustments. For angled installation, always refer to the additional documentation supplied with the delivery.
Permissible installation positions:

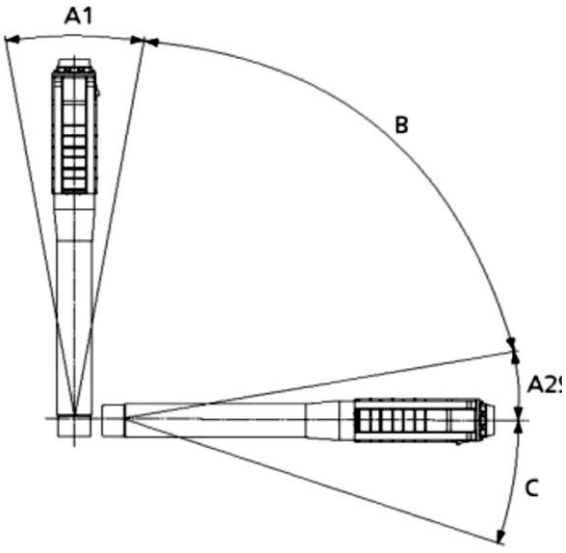


Fig. 11: Installation position

Table 13: Selection table

A1	Permissible up to maximum 3°	Installation see section: Installing the pump set in a vertical position
A2	Permissible up to maximum 3°	Installation see section: Installing the pump set in a horizontal position
B	Permissible installation position, if approved in the order documentation	
C	Impermissible	The pump set must not be installed in this position.

5.6 Notes on electrical connection

PUMPIRAN's submersible borehole pumps < 660 V are wired for DOL starting. During startup and run-up the voltage must not fall below the value specified in the order documentation.
If this starting method is not permitted in the mains, starting devices can be used to reduce starting currents (e.g. autotransformers, starting resistors or soft starters).

General information on 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 operation S1 to VDE 530T1 or IEC 60034-1.

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

Star-delta contactor The Y-phase or partial voltage period shall not exceed 4s. The switchover interval from Y to Δ must not be longer than 60ms. 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 4s. To operate the pump set with a starting transformer or starting resistor, choose a closed-transition switchover method.

5.6.2 Operation with soft starter

Submersible motors differ from ordinary standardised asynchronous motors in their slim design (low moments of inertia), their output, mechanical seal 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 indicated reference values may be exceeded.

Table 14: Reference values for soft starters

Parameter/function	Settings
Minimum starting voltage	40 % of the motor's rated voltage
Ramp time / acceleration (run-up) time	tH < 4 seconds
Current limitation	IA / IN approx. 3.5
Deceleration (run-down) time / stop ramp	tA < 4 seconds
All special functions, e.g. ▪ 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 d.c. 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 be ensured when the soft starter is bypassed by a contactor.

	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.

5.6.3 Operation with frequency inverter

When operating PUMPIRAN's submersible borehole pumps on a frequency inverter observe the following instructions based on the special design features of the pump set (small moment of inertia, high output, etc.):
Power reserve
If supplied by PUMPIRAN for operation with a frequency inverter, see data sheet, the motor has a power reserve of 5%.
To check whether a frequency inverter can be retrofitted, always contact the pump manufacturer!
Maximum permissible running-up/running-down times
The run-up process from standstill to the minimum frequency f_{min} must not exceed 2 seconds. The run-down process must also be limited to 2 seconds.

Minimum frequency

Observe the following minimum frequencies.

Table 15: Minimum frequency [Hz]

Motor size	Minimum frequency f_{min}	
	for vertical installation	for horizontal installation
6C	30	30
6E	30	30
7A	30	30
8A	30	30
9A	30	30
9B	30	30
10A	30	30
12A	30	30
14B	30	30

Maximum operating frequency

Do not exceed the maximum operating frequency of 60 Hz.

Maximum permissible voltage increase velocity and voltage peaks

Observe the following limits:
Maximum rate of voltage rise: du/dt ≤ 500 V/µs
Maximum voltage peaks against earth: J1 insulation ≤ 600 V

	**NOTE**
	An output filter must be fitted to observe the limits

Control principle of the frequency inverter

The control principle has to correspond with a linear U/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.

5.7 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 and qualified electrician. • Observe regulations IEC 60364 (DIN VDE 0100).

	**DANGER**
	Earth conductor not properly connected Danger of death from electric shock! • Never operate the motor without earth conductor. • The earth conductor must be connected by a professional electrician only.

	**WARNING**
	Incorrect connection to the mains Damage to the mains network, short circuit! • 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.
3. Check the starting method in the data sheet and select the corresponding circuit diagram.
4. Connect the power cable including the earth conductor

	**NOTE**
	Connect shielded motor leads 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 EMC[11]. Observe the EMC instructions given by the equipment manufacturers.

11) Electromagnetic compatibility

Three - phase (3 ~) motors with one lead for DOL starting

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

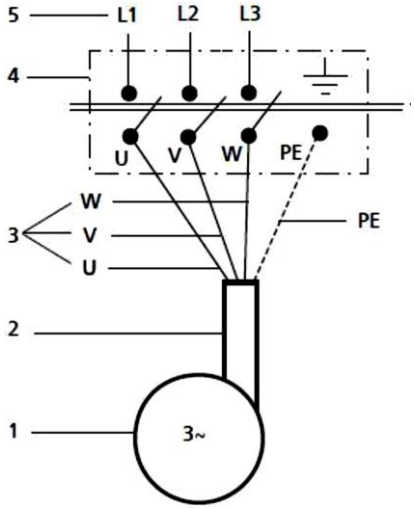


Fig.12: Circuit diagram: three-phase (3~) motors with one lead for DOL starting

1	Motor	2	Motor lead
3	Conductor marking	4	Control box
5	Phase conductor	PE	Earth conductor; conductor marking green-yellow

Three - phase (3 ~) motors with two leads for DOL starting

The 6 current-carrying conductors of the two leads are designated U1, V1, W1 and U2, V2, W2; the designation of the earth conductor is PE. (See circuit diagram.)

- ✓ The motors are wired for both delta and star operation, as shown on the name plate.

1. Depending on the winding voltage, wire the motors in delta (Δ) or star (Y) in the control unit. (e.g. 400 V / 660 V)

- ➢ For a supply voltage of 400 V, connect the motor in delta (Δ) configuration.
- ➢ For a supply voltage of 660 V, connect the motor in star (Y) configuration.

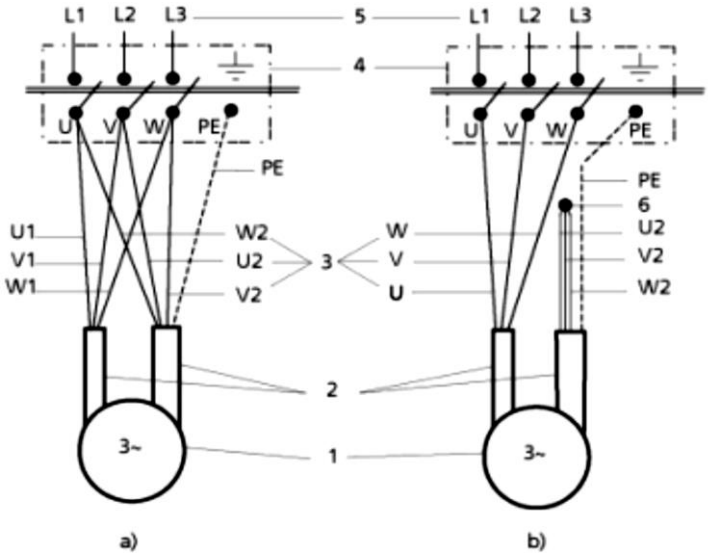


Fig. 13: Circuit diagram: motors with two leads for DOL starting; a) star, b) delta

1	Motor	2	Motor lead
3	Conductor marking	4	Control box
5	Phase conductor	6	Star point
PE	Earth conductor; conductor marking green-yellow		

Three - phase (3 ~) motors with two parallel leads for DOL starting

The 6 current-carrying conductors of the two parallel motor leads are designated U1-1, V1-1, W1-1 and U1-2, V1-2, W1-2; the designation of the earth conductor is PE.(See circuit diagram.)
The motors are wired in delta (Δ) or star (Y), as shown on the name plate, and are fitted with 2 parallel leads.

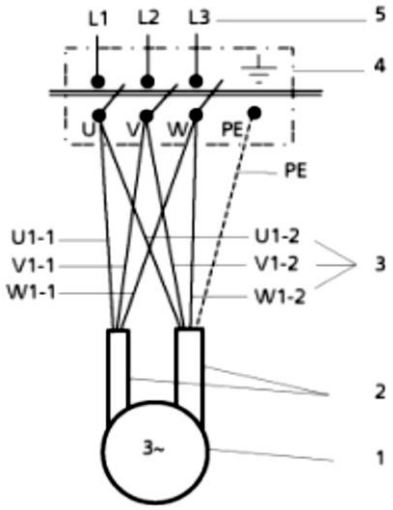


Fig. 14: Circuit diagram: motors with two parallel leads for DOL starting

1	Motor	2	Motor lead
3	Conductor marking	4	Control box
5	Phase conductor	PE	Earth conductor; conductor marking green-yellow

Three - phase (3 ~) motors with two leads for DOL starting

The 6 current-carrying conductors of the two leads are designated U1, V1, W1 and U2, V2, W2; the designation of the earth conductor is PE. (See circuit diagram.)The motors are wired for both delta and star operation, as shown on the name plate.

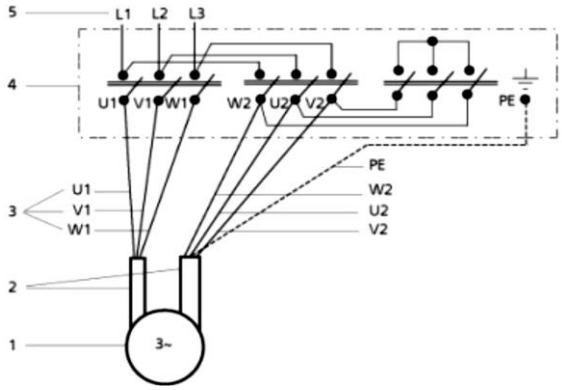


Fig. 15: Circuit diagram: motors with two leads for star-delta starting

1	Motor	2	Motor lead
3	Conductor marking	4	Control box
5	Phase conductor	PE	Earth conductor; conductor marking green-yellow

Set the overcurrent relay for the selected starting method:
- For DOL starting to the operating current or, at most, to the rated current I_N.
- For star-delta starting to the operating current or, at most, to the rated current x 0.58.

	NOTE
	It is recommended to fit an ammeter.

5.7.1 Recommended monitoring and protective equipment

The following monitoring and protective equipment is recommended to ensure a proper operation of the pump set:

Table 16: Monitoring options

To be monitored	If there is any risk of:	Monitoring options (examples)
Dry running	▪ Large water level fluctuations ▪ Wells with temporary low yields	▪Semi-automatic or fully automatic dry running protection equipment
Lightening/ Overvoltage	Although a lightning protection device cannot offer protection against direct lightning strikes, it will protect the pump unit from atmospheric overvoltage and any lightning strikes nearby.	▪Lightning protection with earthing terminal
Phase failure	▪ Failure of one phase, which will result in overloading of the remaining two phases	
Excessive temperature in the motor	▪ Permissible motor temperature exceeded by system conditions, e.g.: – Deposits on the stator – Installation in standing water – Dirt/sand deposits in the stator area – Major temperature rise in the fluid pumped – Frequency controlled motors	▪ PT 100 temperature monitoring with the corresponding analyzing device (⇨ Section 5.7.2 Page 40)

Also:
- Over current /undercurrent
- Earth fault / short circuit
- Current asymmetry
- Overvoltage/under voltage
- Vibrations

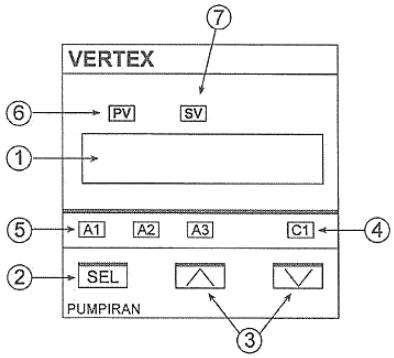
5.7.2 Connecting the temperature monitoring equipment

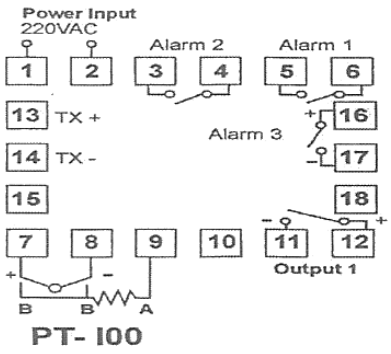
Submersible motors can be fitted with a temperature sensor for the motor fill temperature. This is necessary whenever the operating limits of the motor can be exceeded because of reduced cooling (e.g. ochre build up, increased temperature of the fluid pumped, etc).

6C, 6E, 7A, 8A
The temperature sensor for motors of series **6C, 6E, 7A and 8A** is designed for insertion into the motor and can thus be retrofitted. As a standard, the sensor has a shielded 10 m connection cable (4-cores, 0.5 mm^2). If the connection cable is extended, the total length must not exceed 280 m.

9A to 14B

For motors of series **9A to 14B** two different types of temperature sensors are available: insertion sensors and sensors which are directly fastened to the end winding. Retrofitting options depend on the type and must be checked. The connection cable is usually (order-related variations possible) a shielded 4-core cable of 0.5 mm^2 or a 3-core cable of 1.5 mm^2. The maximum cable length for a cable of 1.5 mm^2 is 1400 m.
For analysing the temperature sensor, a separate analysing device is required.





1. Display monitor
2. SEL KEY. Press once to access the next programmable parameter. Press for 5 seconds to move from one programming level to next.
3. UP, DOWN KEY. Press to increase /decrease the set point or parameter value.
4. C1-Control output status indicator
5. A1,A2,A3- Alarm 1,2,3 output status indicator
6. PV-Proccess Value/Parameter indicator
7. SV-Setting Value indicator

WIRING PRECAUTIONS

1. Before wiring, verify the controller label for correct model number and option.
2. For thermocouple input, use the appropriate compensation wire. And note the polarity of input signal.
3. To avoid noise induction, keep input signal wire away from instrument power line, load lines and power lines of other electric equipment.

Function

Two temperature limits are important for submersible motors.

1. Alert temperature t_{Alert}

If the alert temperature t_{Alert} is exceeded, a malfunction has occurred (e.g. inadmissible contamination / ochre build up on the motor housing). Corrective action must be initiated.

Setting:
$t_{Alert} = t_{Operation} + (t_{Cut\text{-}out} - t_{Operation}) / 2$
$t_{Operation}$ = normal operating temperature after approx. 1.5 hours of operation

2. Cut-out temperature $t_{Cut\text{-}out}$

If the cut-out temperature $t_{Cut\text{-}out}$ is reached, the motor must be tripped. It must not be re-started until the malfunction has been remedied.

Setting:
Submersible motors with J1 winding (PVC): $t_{Cut\text{-}out}$ = 55 °C

	NOTE
	For the winding type refer to the motor designation. (⇨ Section 4.2 Page 16)

6 Commissioning/Start-up/Shutdown
6.1 Commissioning/start-up
6.1.1 Start-up

	**DANGER**
	Start-up with defective earth conductor Personal injury from electric shock! • Never switch on a pump set without an earth conductor or with a defective earth conductor

	**CAUTION**
	Starting up the pump set outside the fluid Damage to the motor! • Only start up pump sets when the motor is filled and the unit is fully submerged or flooded!

	**CAUTION**
	Operation with closed shut-off valve Damage to motor and bearings! • Never let the pump set run against a closed shut-off valve for more than five minutes.

	**CAUTION**
	Continuous operation against a throttled shut-off element Damage to pump and motor! • In continuous operation against a throttled shut-off element, the flow rate must not fall short of Q_{min} (see name plate).

- ✓ The pump set has been assembled as specified in this manual.
- ✓ The pump set has been installed as described in this manual.
- ✓ The power cables, including control and measuring cables, have been fastened and connected in the control box.
- ✓ The control box 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.

	**NOTE**
	When starting against an empty pipe, make sure that the air contained in the pipe can escape to the atmosphere.

	**NOTE**
	It is not necessary to delay the start-up of a shut-off element with electric actuator, as the running-up time of the pump is shorter than the dead time of the shut-off element.

6.1.1.1 Information on commissioning

	CAUTION
	Excessive sand content in the water Damage to the pump set! • If the sand content equals 25 g/m^3 or more, switch off the pump set. • Inform the well building company!

1. When commissioning pump sets in new boreholes, initially only operate the pump set for approximately 10 minutes with the shut-off element slightly open.
2. Check escaping water for any sand content.

- If the sand content equals 25 g/m^3 or more, switch off the pump set and inform the well building company.
- If the sand content decreases, slowly open the shut-off element until the duty point is reached.

6.1.2 Checking the direction of rotation

	CAUTION
	Wrong direction of rotation Damage to the motor! • Do not run the pump set for more than two minutes when checking the direction of rotation

	CAUTION
	Uncontrolled backflow of the fluid from the riser Damage to the pump set! • Prevent any uncontrolled backflow of the fluid handled with suitable means. • Make sure that backflow of the fluid handled is slow and controlled, so that the pump rotor does not start to rotate, e.g. by throttling the discharge-side gate valve accordingly

- ✓ The back-up name plate has been attached at the place of installation of the submersible borehole pump. (⇨ Section 4.6 Page 18)
- ✓ The pump set has been installed completely.
- ✓ The power cable and the measuring and control cables, if any, have been connected in the control cabinet.
- ✓ The shut-off element in the discharge line is slightly open.

1. Switch on the motor at the control cabinet. (⇨ Section 6.1.1 Page 43)
2. As soon as the system has reached a steady state, read off the pressure and/or flow rate from the pressure gauges.
3. Verify the read data against the data on the back-up name plate.
   - If the values are almost identical, the direction of rotation is correct.
   - If the read values are too low, the direction of rotation is incorrect.
4. If the direction of rotation is incorrect, switch the motor off at the control cabinet.
5. Have the phase sequence (U, V, W) corrected on the motor connection side in the control cabinet by a trained electrician.

6.2 Operating limits

	DANGER
	Non-compliance with the operating limits Damage to the pump set, especially to the motor! • Never operate the pump set outside the limits specified below

6.2.1 Frequency of starts

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

Table 18: Frequency of starts and standstill periods

Motor size	Maximum No. of starts per hour	Minimum standstill period [min]
6C	15	3
6E	15	3
7A	10	4
8A	10	4
9A	5	4
9B	5	4
10A	5	6
12A	5	6
14B	5	6

Do not exceed the maximum frequency of starts!
Observe the minimum standstill periods!

6.2.2 Supply voltage

Observe the permissible voltage and frequency fluctuations to DIN EN 60034-1 section A; U_N ± 5 %, f_N ± 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 x U_N and must be limited to one operating hour.

6.2.3 Immersion depth

Do not exceed the maximum immersion depth of 250 m.
For submergence or larger immersion depths refer to the data sheet or the order documentation.

6.2.4 Fluid handled

6.2.4.1 Minimum submergence

The submergence X of the pump sets must be ≥ 0.5 m for the following examples of vertical and horizontal installation.
A higher submergence may be required by the NPSH value specified in the order documentation or the value indicated in the following diagram.

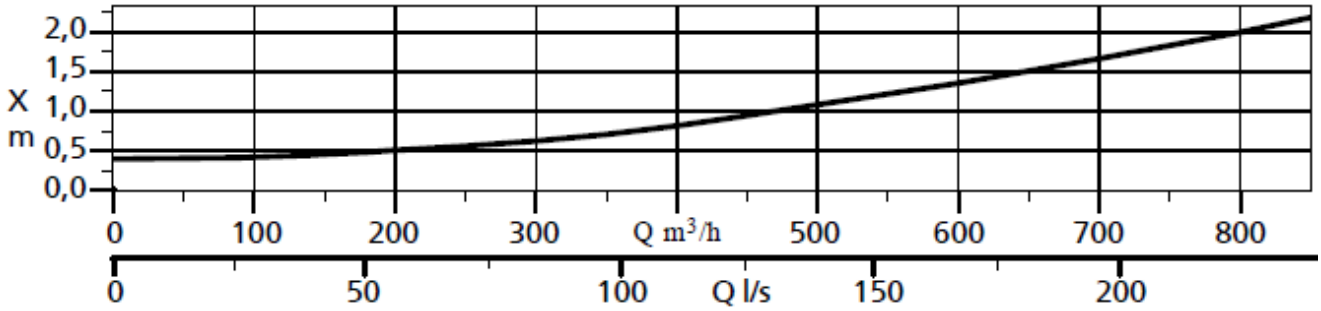


Fig. 16: Minimum submergence depending on the flow rate

The values in the above mentioned diagram apply to submersible borehole pumps up to size UQN 345.
For larger pump sets refer to the value X in the order documentation or the data sheet. Contact the manufacturer, if required.

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

Vertical Installation

Measurement for vertical installation:
Upper edge of the pump to lowest (dynamic) water level
$X = H_e - H_t$

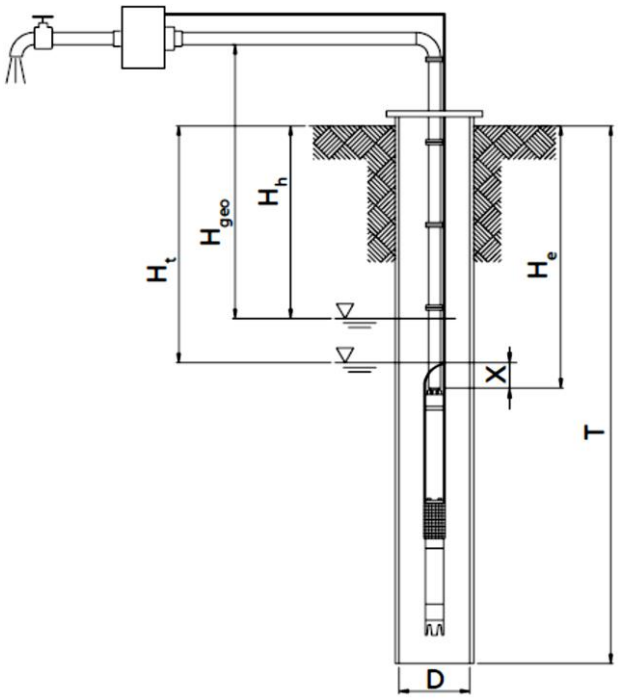


Fig. 17: Minimum submergence for vertical installation

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
X	Minimum submergence		

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

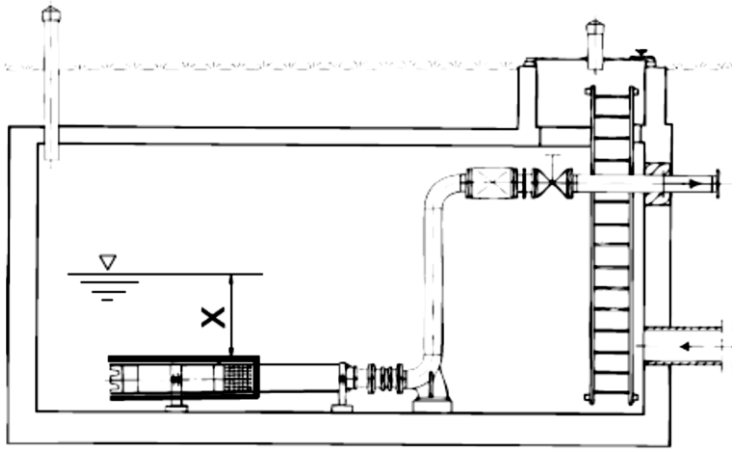


Fig. 18: Minimum submergence for horizontal installation

X	**Minimum submergence**

6.2.4.2 Sand content

Make sure the maximum sand content of 25 g/m³ is not exceeded.

6.2.4.3 Temperature of the fluid handled

	CAUTION
	Excessive temperature of the fluid pumped Damage to the pump set, especially to the motor! • Never operate the pump set at temperatures exceeding those specified in the data sheet or on the name plate. • Increase the flow past the motor.

The limits stated on the name plate or in the order documentation must not be exceeded.

6.2.4.4 Flow velocity past the motor

To ensure sufficient cooling of the motor, enforce the required flow velocity past the motor.
Refer to the name plate or order documentation for the required flow velocity v_{min}.
This minimum value must be ensured by providing suitable installation conditions or devices guiding the flow (e.g. cooling shroud, hood, etc.).

Flow velocity past the motor v = 0 m/s

The flow velocity past the motor is not defined. The heat is dissipated freely. This heat dissipation must not be influenced or hindered by any structures, and a supply of fresh water must be provided at all times.
▪ Example: Pump set freely suspended in a large tank

Flow past the motor v > 0.2 m/s, v > 0.5 m/s

The flow past the motor is defined for the installation conditions, see table below. Decisive factors are the inner well diameter, the inner shroud diameter, the operating data and the outer dimensions of the pump.
▪ Example: Vertical installation in a well above the filter in accordance with the value indicated in the table below
▪ Example: Horizontal installation in a tank with cooling shroud, or vertical installation in a pump sump with cooling shroud in accordance with the values in the table below

Table 19: Maximum permissible inside diameter of the well or shroud in (m)

Flow rate	Flow velocity	Motor type						
Q[m³/h]	v [m/s]	6C / 6E	7A	8A	9A / 9B	10A	12A	14B
15	0.2	0.212	0.243	-	-	-	-	-
	0.5	0.171	0.207	-	-	-	-	-
25	0.2	0.250	0.277	-	-	-	-	-
	0.5	0.190	0.224	-	-	-	-	-
50	0.2	0.327	0.348	0.349	0.374	0.385	-	-
	0.5	0.232	0.260	0.262	0.294	0.309	-	-
75	0.2	0.389	0.406	0.408	0.429	0.439	0.461	-
	0.5	0.268	0.292	0.294	0.323	0.336	0.364	-
100	0.2	0.442	0.458	0.459	0.477	0.487	0.506	-
	0.5	0.299	0.321	0.323	0.349	0.362	0.388	-
125	0.2	0.490	0.504	0.505	0.522	0.530	0.548	-
	0.5	0.327	0.348	0.349	0.374	0.385	0.410	-
150	0.2	-	0.546	0.547	0.563	0.570	0.587	-
	0.5	-	0.372	0.374	0.397	0.408	0.431	-
175	0.2	-	0.585	0.586	0.601	0.608	0.624	-
	0.5	-	0.395	0.397	0.418	0.429	0.451	-
200	0.2	-	0.621	0.622	0.636	0.643	0.658	0.687
	0.5	-	0.417	0.418	0.439	0.449	0.470	0.509
250	0.2	-	-	0.690	0.702	0.709	0.722	0.748
	0.5	-	-	0.459	0.477	0.487	0.506	0.543
300	0.2	-	-	0.751	0.763	0.769	0.781	0.805
	0.5	-	-	0.496	0.513	0.522	0.540	0.574
350	0.2	-	-	-	0.819	0.824	0.836	0.858
	0.5	-	-	-	0.547	0.555	0.572	0.604
400	0.2	-	-	-	0.871	0.876	0.887	0.908
	0.5	-	-	-	0.578	0.586	0.602	0.633
500	0.2	-	-	-	0.967	0.972	0.982	1.001
	0.5	-	-	-	0.636	0.643	0.658	0.687
600	0.2	-	-	-	1.055	1.059	1.068	1.086
	0.5	-	-	-	0.690	0.696	0.710	0.736
800	0.2	-	-	-	-	1.215	1.223	1.238
	0.5	-	-	-	-	0.791	0.804	0.827
1000	0.2	-	-	-	-	-	1.360	1.374
	0.5	-	-	-	-	-	0.887	0.908
1200	0.2	-	-	-	-	-	1.484	1.497
	0.5	-	-	-	-	-	0.964	0.983
1400	0.2	-	-	-	-	-	-	1.611
	0.5	-	-	-	-	-	-	1.053
1600	0.2	-	-	-	-	-	-	1.717
	0.5	-	-	-	-	-	-	1.118

6.3 Shutdown

	**CAUTION**
	Surge pressure caused by sudden shutdown of the pump set Damage to the machinery right through to the pump set falling down! • Slowly close the shut-off element on the discharge side.

	**CAUTION**
	Uncontrolled backflow of the fluid from the riser Damage to the pump set! • 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.

1. Slowly close the shut-off element on the discharge side.
2. Switch off the motor immediately after closing the shut-off element.

	**NOTE**
	To make sure that the pump set is always ready for instant start-up, start up the pump set approximately every 2 weeks for approximately 5 minutes during prolonged shutdown periods.

7 Servicing/Maintenance

7.1 Servicing/inspection

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

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

Regular inspection does not require the submersible borehole pump to be removed from the well/tank.
For any queries and repeat orders, particularly when ordering spare parts, specify the following information (see name plate):

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

For information concerning repair jobs and spare parts please contact your nearest PUMPIRAN service center.

7.2 Removing the pump set

	**DANGER**
	Electrical connection work by unqualified personnel Danger of death from electric shock! • Always have the electrical connections installed by a trained and qualified electrician. • Observe regulations IEC 60364 (DIN VDE 0100) and HD 637 S1 (DIN VDE0101).

	**WARNING**
	Persons could fall into unsecured wells/reservoirs/tanks Risk of personal injury! • During installation work, take suitable precautions to protect anyone from falling into an open well/reservoir/tank. • Suitably fence off the work area

	**WARNING**
	Uncontrolled lifting of the pump/motor/pump set Risk of injury! • Maintain adequate safety distance during lifting operations (load may swing when being lifted).

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

- ✓ Suitable lifting equipment for the total weight has been selected and is on hand. (⇨ Section 5.2.6 Page 24)
- ✓ Suitable removing equipment, e.g. lifting clamps or mounting plate, is on hand.

1. Disconnect the pump set from the power supply and secure it against unintentional start-up.
2. For removing the pump set refer to the assembly/dismantling instructions of the corresponding riser.

	**Warning**
	Setting down pump sets with pipe sections of extensive length Impermissible bending of the pump set when setting it down in a horizontal position! • The length of the last pipe section flanged to the pump set must not exceed two meters.

3. Set the pump set down in a horizontal position on a solid and level surface. Secure it against rolling off.

7.3 Separating pump and motor

	**WARNING**
	Pump set tipping over or rolling off Risk of personal injury! • Always secure vertically positioned pump sets against tipping over. • Always secure horizontally positioned pump sets against rolling off.

- ✓ The power supply has been disconnected and the pump set has been secured against unintentional start-up.
- ✓ The pump set has been pulled out of the well or removed from the tank.
- ✓ The pump set has been disconnected from the piping.
- ✓ Lifting equipment of sufficient load-carrying capacity is on hand.

1. Attach the pump set to suitable lifting equipment.
2. Pull the pump set upright and make sure it cannot tip over.
3. Remove the cable guard. Observe the minimum bending radius for the cable[12].
4. Remove the suction strainer.
5. Remove the grub screw and the additional securing pin/bolt [13] from the sleeve coupling at the motor end.
6. Undo the assembly studs between pump and motor.
7. Use the lifting equipment to lift the pump off the motor in a vertical position.
Then place it on a clean and level surface and secure it against rolling off.
8. Secure the key in the shaft stub, e.g. with adhesive tape.
9. Place the motor on a clean and level surface. Secure it against tipping over and rolling off.

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

13) If any

7.4 Motor fill

	**DANGER**
	Unfilled or insufficiently filled motor Damage to the motor winding! • Never install and run the motor without sufficient motor fill. • Observe the information sticker on the motors and top up the motor fill as instructed.

	**DANGER**
	Incorrect motor fill Winding damage! Corrosion damage! • Fill the motor in accordance with the information sticker and the purpose of the motor fill.

	**WARNING**
	Drinking water/antifreeze mixture could escape Hazardous to persons and the environment! • Wear safety glasses and protective gloves when topping up, checking and draining the motor fill. • Observe the national health and safety regulations. • Observe all legal regulations on the disposal.

	**CAUTION**
	Freezing of motor fill Damage to the motor! • Select a suitable drinking water/antifreeze concentration for the temperatures to be expected. • Always protect motors filled with drinking water against frost. • Provide frost-proof storage.

Information sticker / motor fill

Submersible motors are filled with a liquid based on drinking water. A distinction is made between filled and unfilled motors, marked by colour-coded information stickers attached on the motor, depending on the motor type series. Motors which are supplied filled with a mixture of drinking water/antifreeze agent must not be filled with pure drinking water at a later stage. Pure drinking water can only be filled into motors which have not been filled before.

Table 20: Type of motor fill

Motor type series	Supplied condition	Sticker colour	Motor fill
6C	**Unfilled**	**-**	**Drinking water**
6E	**Unfilled**	**-**	**Drinking water**
7A	**Unfilled**	**-**	**Drinking water**
8A	**Unfilled**	**-**	**Drinking water**
9A	**Unfilled**	**-**	**Drinking water**
9B	**Unfilled**	**-**	**Drinking water**
10A	**Unfilled**	**-**	**Drinking water**
12A	**Unfilled**	**-**	**Drinking water**
14B	**Unfilled**	**-**	**Drinking water**

Mixing ratio / purpose

- The motors must only be filled with an antifreeze agent on a 1, 2 propylene glycol basis and approved by PUMPIRAN.
- The drinking water/antifreeze mixture supplied by the factory is intended for operation as well as storage/transport/preservation. It protects the motor up to temperatures of -15°C. For any deviations see order documentation / data sheet.
- The percentage of antifreeze agent must always be selected for the expected temperatures below 0°C at the place of installation/transport/storage.
- The motor fill must be prepared with clean drinking water. The mixing ratios and total quantity must be observed.

Table 21: Mixing ratios

Temperatures up to	Percentage of drinking water	Percentage of antifreeze agent	Purpose			
			Operation	Storage	Transport	preservation
- 10 °C	75 %	25 %	x	x	x	x
- 15 °C [14)]	66 % [14)]	34 % [14)]	x	x	x	x
- 20 °C	62 %	38 %	[15)]	x	x	x
- 25 °C	57 %	43 %	[15)]	x	x	x
- 30 °C	53 %	47 %	[15)]	x	x	x
Below - 30 °C	Contact PUMPIRAN.					

14) Drinking water/antifreeze mixture filled in at the factory

15) Operation only if clearly approved in the order confirmation.

Quantity of motor fill
Refer to the following table for the quantity of motor fill.

Table 22: Quantity of motor fill [liter]

Motor size		Quantity of motor fill
6C	0.15 3/2	3.2
	0.22 3/2	3.3
	0.30 3/2	3.4
6E	3 3/2	4.3
	5 3/2	4.5
	7 3/2	4.7
7A	9 3/2	10.0
	11 3/2	10.3
	13 3/2	10.7
	15 3/2	11.1
	18 3/2	11.4
	22 3/2	12.0
8A	24 3/2	19.7
	30 3/2	19.8
	38 3/2	20.0
9A	24 3/2	32
	30 3/2	32.5
	37 3/2	33
	45 3/2	33.2
	55 3/2	33.5
	62 3/2	33.8
	73 3/2	34
9B	24 3/2	32
	30 3/2	32.5
	37 3/2	33
	45 3/2	33.2
	55 3/2	33.5
	62 3/2	33.8
	73 3/2	34
	80 3/2	34.2
	92 3/2	34.4
	100 3/2	34.5
	110 3/2	34.7
10 A	92 3/2	38
	110 3/2	39
12A	130 3/2	41
	150 3/2	41.5
	185 3/2	42.5
14B	220 3/2	45
	260 3/2	45.5
	300 3/2	46
	350 3/2	47

7.4.1 Motor fill - 6C

All motors of series **6C** are supplied filled with antifreeze agent mixture, providing protection for temperatures up to -15°C. The motor fill generally does not need to be topped up or replaced. The loss of a few drops of liquid fill will not impair its function. If any larger amounts of leakage are suspected, or if the motor fill needs to be topped up or replaced, contact the manufacturer. Do not open the motor, as special tools are required to do so.

7.4.2 Motor fill – 6C, 6E, 7A, 8A, 9A, 9B, 10A

The motors of series **6C**, **6E, 7A, 8A, 9A, 9B, 10A** are supplied filled with drinking water/antifreeze agent mixture, providing protection for temperatures up
15°C. If motors have been stored or out of service for more than one year, check the motor fill.

7.4.2.1 Checking the motor fill of 6E, 7A and 8A

⚠	**WARNING**
	Pump set tipping over or rolling off Risk of personal injury! • Always secure vertically positioned pump sets against tipping over. • Always secure horizontally positioned pump sets against rolling off.

A special test pin is required to check the motor fill. This test pin is included in the scope of supply (filling kit with filling syringe).

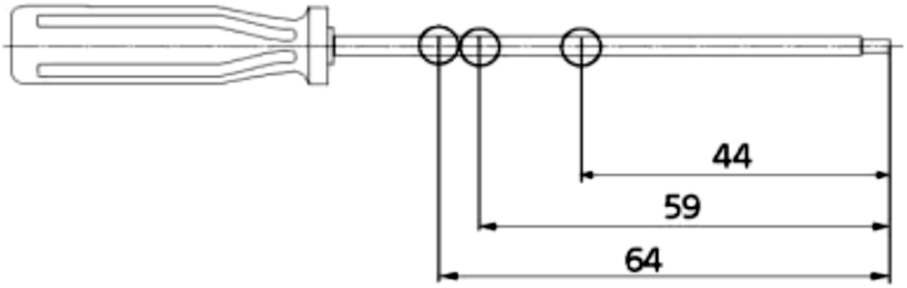
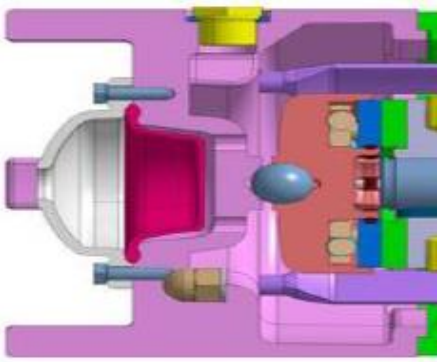


Fig. 19: Drawing of the test pin, dimensions in [mm]



To check the fill level measure the distance A between the diaphragm cover and the diaphragm position.

✓ The test pin is on hand.

1. Set down the pump set or motor in a horizontal position. Secure it against rolling off.
2. Carefully insert the test pin (1) through the hole in the diaphragm cover (3)[16)] until a resistance can be felt.
3. Measure the distance between the diaphragm and the edge of the hole in the diaphragm cover.
4. Compare the result with the required distance A given in the table.

⇒ If the measured value is not identical with the required value, top up (⇨Section 7.4.2.2 Page 55) or partly drain the motor fill. Then check it again.

16) The hole in the diaphragm cover of 7A and 8A is off centre.

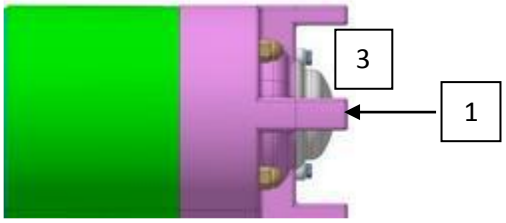
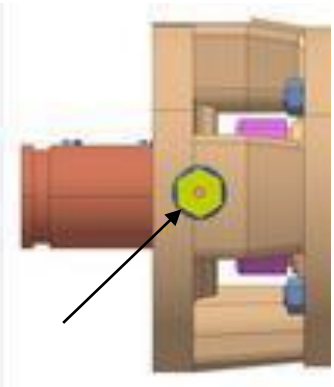


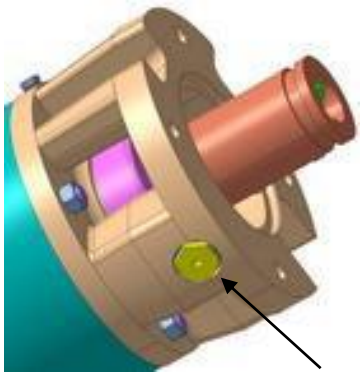
Fig. 20: Example of checking the motor fill with the test pin

7.4.2.2 Topping up the motor fill of 6E, 7A and 8A

The motor fill of motor series **6E, 7A and 8A** is pressurised, which means the pressure inside the motor is slightly over atmospheric pressure. The motors are fitted with valves (inlet valve and outlet valve) for controlling the pressure. They vary as follows:

Illustration of valves for motor size 6E to 12A





	WARNING
	Pump set tipping over or rolling off Risk of personal injury! • Always secure vertically positioned pump sets against tipping over. • Always secure horizontally positioned pump sets against rolling off.

- ✓ The fill level has been checked.
- ✓ A sufficient quantity of liquid of the specified concentration for the motor fill is available.
- ✓ A drain pan for any escaping liquid is on hand.

1. Set the pump set or motor down in a horizontal position. Support it in such a way that the inlet valve is at the highest point. Secure the pump set / motor against rolling off.
2. Remove the filter plug or screw plug[17)] from the inlet valve.
3. Gently insert the test pin into the inlet valve until air and some bubble-free liquid escape.
4. Press the filling syringe against the inlet valve and top up the motor fill until the diaphragm distance measured is smaller than the required distance A.
5. Adjust the diaphragm distance to the required distance A by draining (venting) or topping up the motor fill, as required.
6. Insert the filter plug or screw plug[17)] into the inlet valve

17) For 6E material variant C2, C3

7.4.3 Motor fill – 12A and 14B

	**NOTE**
	The motor fill must be checked prior to installation. If the motor needs to be filled completely, fill it 12 hours prior to mounting it.

The motors of series 8B and 14B are marked by a colour-coded information sticker which indicates the motor fill.
Key to the colour codes:
▪ Green information sticker (motor pre-filled): Check the fill level and top up the motor fill with liquid of the specified concentration.
▪ Red information sticker (motor unfilled): Completely fill the motor with liquid of the specified concentration or with drinking water.

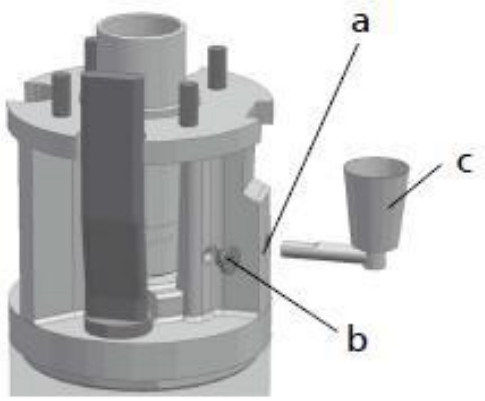
7.4.3.1 Checking the motor fill and topping up / filling motors 8B and 14B

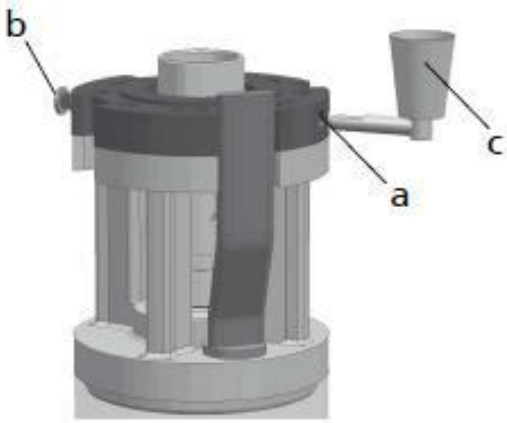
	**WARNING** Drinking water/antifreeze mixture could escape Hazardous to persons and the environment! • Wear safety glasses and protective gloves when topping up, checking and draining the motor fill. • Observe the national health and safety regulations. • Observe all legal regulations on the disposal.

	**WARNING** Internal pressure might have built up inside the motor. Risk of injury! • Comply with the applicable health and safety regulations. • Take care when opening the first screw plug. • Wear protective clothing.

	**WARNING** Pump set tipping over or rolling off Risk of personal injury! • Always secure vertically positioned pump sets against tipping over. • Always secure horizontally positioned pump sets against rolling off.

Checking the fill level / Topping up the pre - filled motor





Applies to motors

a. Screw plug of the filler opening
b. Screw plug of the vent opening
c. Filling funnel

- ✓ The information sticker has been checked.
- ✓ A drain pan for any escaping fill is on hand.

1. Set down the motor or pump set in a vertical position. Secure it against tipping over.
2. Undo the two screw plugs (a and b) and remove them together with the sealing elements.
- ➢ If the fill level is visible in one of the two openings, the motor is filled sufficiently.
- ➢ If the fill level is not visible, insert the filling funnel (c) horizontally into one of the two openings in the connecting piece. Top up the motor fill in accordance with the sticker colour until a continuous flow escapes from both openings.

3. Screw the screw plugs (a and b) back in together with the sealing elements.
Check the screw plugs for tightness. Make sure that the contact faces are clean and that the joint ring is inserted and free from damage.

Checking the screw plugs

1. Suspend the motor or pump set from a crane. Fasten the motor or pump set to the floor and secure it against slipping.
2. Carefully lower the crane to slightly tilt the motor or pump set.
3. Monitor the screw plugs for escaping fluid.
4. If required, fit new sealing elements.

Filling an unfilled motor

- ✓ The information sticker has been checked.
- ✓ A sufficient quantity of liquid of the specified concentration for the motor fill is available.
- ✓ A drain pan for any escaping fill is on hand.
- ✓ The motor or pump set is positioned vertically and secured against tipping over.

1. Undo the two screw plugs (a and b) and remove them together with the sealing elements. This results in a filler and a vent opening.
2. To fill the motor, insert the filling funnel (c) horizontally into one of the two adapter openings. Depending on the sticker colour, fill in or top up the motor fill until a continuous flow escapes from both openings.
3. Wait at least 12 hours to allow the air to escape. During this period, move the motor or pump set suspended from the crane slightly to and fro, if possible. Then continue filling it slowly. Wait another 30 minutes.
4. Then check the fill level again.
5. Screw the screw plugs (a and b) back in together with the sealing elements.

Check the screw plugs for tightness. Make sure that the contact faces are clean and that the joint ring is inserted and free from damage.

	**NOTE**
	Slowly fill in the liquid fill. Frequently interrupt the filling process to allow air to escape. Check the drain plugs at the bottom of the motor for tightness

Checking the screw plugs

1. Suspend the motor or pump set from a crane. Fasten the motor or pump set to the floor and secure it against slipping.
2. Carefully lower the crane to slightly tilt the motor or pump set.
3. Monitor the screw plugs for escaping fluid.
4. If required, fit new sealing elements.

7.5 Storage and preservation

	**WARNING**
	Pump set tipping over or rolling off Risk of personal injury! • Always secure vertically positioned pump sets against tipping over. • Always secure horizontally positioned pump sets against rolling off.

	**CAUTION**
	Improper storage Damage to the power cables! • Support the power cables at the cable entries to prevent permanent deformation. Observe the minimum bending radius[18)] of the cables. • Only remove the protective caps from the power cables at the time of installation

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

7.5.1 Storing new submersible borehole pumps

To store for a prolonged period pump sets / motors which have not been used yet ensure the following conditions are met:

1. Pump set / motor removed from packaging
2. Vertical (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

If the motors have been supplied filled with a drinking water/antifreeze mixture, store them in this filled condition. Store unfilled motors in unfilled condition.
If previously unfilled motors have been filled for functional testing, for example, the motor fill for storage must be equivalent to the drinking water/antifreeze mixture used by PUMPIRAN to provide protection up to -15 °C.

	**NOTE**
	As the antifreeze concentration gradually decreases over time the remaining antifreeze level must be checked with a spindle. If the anticipated temperature is below the antifreeze value, either increase the antifreeze concentration in the motor accordingly or store the pump set in a frost-free location.

7.5.2 Storing submersible borehole pumps which have been removed from a system

Pump sets / motors which have been operated must generally be overhauled by qualified specialist personnel, for example a service workshop authorised by PUMPIRAN.
After the pump set / motor has been overhauled, fill the motor with drinking water / antifreeze mixture providing protection up to -15 °C, and store it. Motors must only be stored in unfilled condition if, in addition to the above, the inside of the motor has been preserved against corrosion.
Store the pump set / motor as described in this manual. (⇨ Section 7.5.1 Page 58)

7.6 Reassembling the pump set

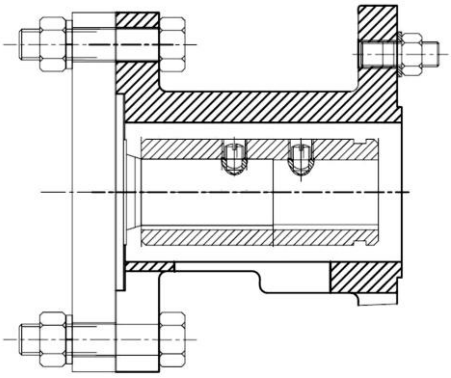
7.6.1 Mounting the motor

	CAUTION
	Pump set tipping over or slipping out of the suspension arrangement Personal injury and damage to property! • Always make sure pump sets in upright position cannot tip over.

	NOTE
	The shaft ends of all submersible motors, except motor type series 14B, are made of Cr-Ni steel and do not require any corrosion protection. The motors of type series 14B are supplied with a sealed sleeve coupling which protects the motor shaft from contact with the fluid handled. If motors are supplied without a pump, a sealed sleeve coupling must be used for mounting the pump on the motor. Make sure this protection is ensured also when the pump is serviced (dismantled) or replaced.

- ✓ Lifting equipment of sufficient load-carrying capacity is on hand. (⇨ Section 5.2.6 Page 24)
- ✓ A mounting flange or mounting guide hoop and lifting straps are provided.
- ✓ Loctite 242 has been prepared.
- ✓ The cleaning agent (e.g. Aceton made by Rhinix, or a similar agent) has been prepared.
- ✓ Grease (e.g. BIO-Chem Tech) is available.
- ✓ A torque wrench is on hand.
- ✓ Common assembly tools are on hand.
- ✓ The general assembly drawings are on hand.

1. If already installed, remove the suction strainer and cable guard from the pump.
2. Clean all locating surfaces, contact faces and threads with a cleaning agent. Thoroughly remove any residues of the preservative.
3. Grease the shaft stub of the motor and the sleeve coupling of the pump.
4. Apply a thin layer of grease to the locating surfaces and contact faces.
5. On new motors, remove the transport lock from the shaft.

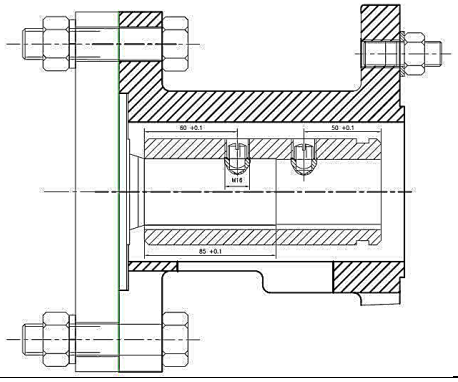


holding the shaft and pull off the protective cap.

6. Position the motor horizontally and secure it against tipping over.
7. Suspend the pump from the crane and align it so that the cable recess, coupling sleeve and screws/bolts are in the correct position.
8. Centre the pump, fit the sleeve coupling around the shaft stub, and lower the pump.

9. Fit nuts and assembly studs. Apply Loctite 242 and tighten the nuts by hand.

10. Insert the grub screw into the coupling sleeve and secure it with the corresponding securing pin/bolt, if any, to prevent the pump from lifting off the motor. Insert the securing screw into the coupling sleeve. Apply Loctite 242. Gently screw in the screw until flush, then turn it back by 1/8 of a turn. For shaft stubs with splining, turn the screw back by 1/2 of a turn.



	NOTE
	Make sure the fitted grub screw does not touch the rotor.

11. Use a torque wrench to tighten the assembly studs; alternate sides after each stud. Observe the tightening torque! (⇨ Section 7.6.2 Page 60)

12. Re-check the tightening torques!

13. Fasten the power cables to the pump set together with the suction strainer and the cable guard.

7.6.2 Tightening torques

Table 23: Maximum permissible tightening torques for the screws/bolts

Material/Property class		5.6	8.8	C3 - 80	A4 - 50	A4 - 70	A4 - 80	1.4462	CuAl10Ni	CuNi1,5Si
Rp 0.2 [N/mm²]		300	640	640	210	450	600	450	270	540
Metric thread										
Coarse pitch thread	Fine pitch thread	Tightening torque MA [N.m]								
M4	--	1.45	3.1	3.1	1.0	2.15	2.9	2.15	--	2.6
M5	--	2.85	6.1	6.1	2.0	4.25	5.7	4.25	--	5.1
M6	--	4.9	10.4	10.4	3.4	7.3	9.75	7.3	--	8.75
M8	--	11.8	25.2	25.2	8.3	17.7	23.7	17.7	--	21.3
--	M8x1	12.7	27.2	27.2	8.9	19.1	25.5	19.1	--	22.9
M10	--	23.2	49.5	49.5	16.2	34.8	46.4	34.8	--	41.8
--	M10x1.5	24.6	52.5	52.5	17.3	36.9	49.2	36.9	--	44.3
M12	--	39.9	85.2	85.2	28.0	59.9	79.8	59.9	--	71.9
--	M12x1.5	42.0	89.5	89.5	29.4	62.9	83.9	62.9	--	75.5
--	M12x1.25	44.0	93.9	93.9	30.8	66.0	88.0	66.0	--	79.2
M16	--	98.9	211.0	211.0	69.2	148.0	197.0	148.0	89.0	178.0
--	M16x1.5	106.0	226.0	226.0	74.3	159.0	211.0	159.0	95.5	191.0
M20		193.0	412.0	412.0	135.0	290.0	386.0	290.0	174.0	348.0
--	M20x1.5	216.0	461.0	461.0	151.0	324.0	432.0	324.0	194.0	389.0
M24		333.0	710.0	710.0	233.0	278.0	665.0	500.0	300.0	600.0
--	M24x2	365.0	780.0	780.0	256.0	305.0	731.0	548.0	329.0	658.0
M27		490.0	1050	1050	343.0	409.0	984.0	736.0	441.0	883.0
--	M27x2	532.0	1130	1130	372.0	443.0	1060	797.0	478.0	957.0
M30		665.0	1420	1420	466.0	554.0	1330	1000	599.0	1200
--	M30x2	741.0	1580	1580	519.0	618.0	1480	1110	667.0	1330
M33		908.0	1940	1940	636.0	--	1820	1360	817.0	1630
--	M33x2	1000	2130	2130	700.0	--	2000	1500	900.0	1800
M36		1160	2480	2480	812.0	--	2325	1740	1040	2090
--	M36x3	1230	2630	2630	863.0	--	2465	1850	1110	2220

8 Trouble-shooting

A. Pump is running but does not deliver
B. Pump delivers insufficient flow rate
C. Insufficient discharge head
D. Vibrations and noise during pump operation
E. Unit tripped by overcurrent relay
F. Fuses have blown
G. Pump set cannot be started u
H. Pump set cannot be switched off

Table 24: Trouble-shooting

A	B	C	D	E	F	G	H	Cause	Remedy[19)]
	x							Pump delivers against an excessively high discharge pressure.	Open the shut-off valve to readjust to duty point
		x						Pump delivers against an excessively low discharge pressure	Close the shut-off valve to readjust to duty point
		x	x					Deposits in the impellers Remove deposits.	Contact PUMPIRAN.
	x	x						Wrong direction of rotation (in case of 3 ~)	Interchange two of the phases of the power supply cable.
	x	x						Wear of internal components	Replace worn parts by new ones. Contact PUMPIRAN
	x			x		x		Motor is running on two phases only.	Replace defective fuse. Check cable connections.
x								No power supply	Check electrical installation, contact electric utility company
x				x	x	x		Pump clogged by sand	Clean suction casing, impellers, stage casings and check valve. Contact PUMPIRAN.
x				x				Motor winding or electric cable are defective	Contact PUMPIRAN
x	x	x						Defective or clogged riser (pipe and sealing elements).	Replace affected pipes. Replace sealing elements
	x							Water level lowered too much during operation.	Contact PUMPIRAN.
x		x	x					Impermissible air or gas content in the fluid handled	Contact PUMPIRAN
			x					Mechanical defect on pump or motor	Contact PUMPIRAN
			x					System-induced vibrations	Contact PUMPIRAN
	x		x					NPSH available (positive suction head) is too low.	Submerge pump deeper
	x	x						Speed is too low	Check voltage and increase, if necessary. Contact PUMPIRAN
					x			Wrong fuse size	Fit correct fuse size
				x		x	x	Defective over current relay	Check and replace, if necessary
				x				Motor winding not suitable for operating voltage available	Replace the pump set. Contact PUMPIRAN.

19) Pump set pressure must be released before attempting to remedy faults on parts which are subjected to pressure.

9 Related Documents

9.1 General assembly drawing with list of components

The general assembly drawings are examples only. Refer to the documentation supplied with the delivery for the general assembly drawings with lists of components applicable for this order.

9.1.1 General assembly drawing: BRVS 486 submersible borehole pump

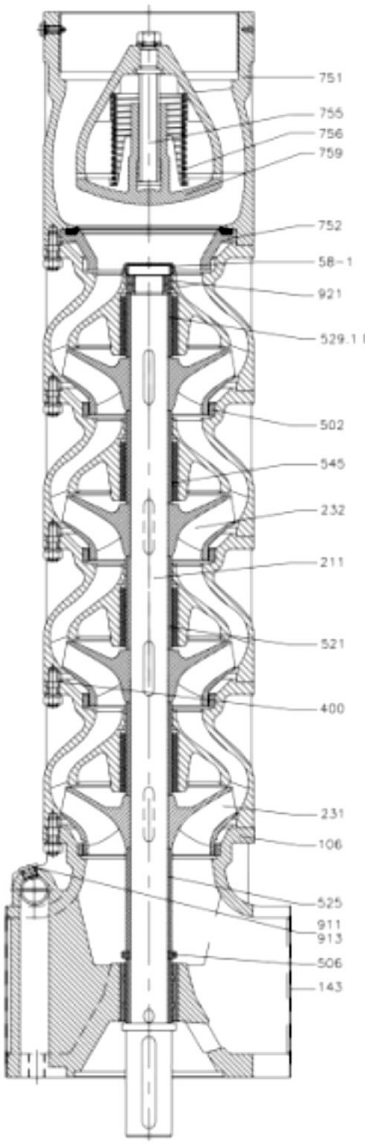


Fig. 21: General assembly drawing: BRVS 486 submersible borehole pump

Table 25: List of components

Part No.	Denomination
58-1	Protecting plug
106	Suction casing
108	Sage casing
143	Suction strainer
211	Pump shaft
231	Suction shaft
232	Clockwise impeller
400	Gasket
506	Retaining ring
502	Casing wear ring
521	Stage sleeve
525	Spacer sleeve
529	Bearing sleeve
545	Bearing bush
545.3	Bearing bush
751	Valve body
752	Valve seat
755	Valve spindle
756	Valve spring
759	Valve plate
911	Priming plug
913	Vent plug
921	Shaft nut

9.1.2 14B general assembly drawing

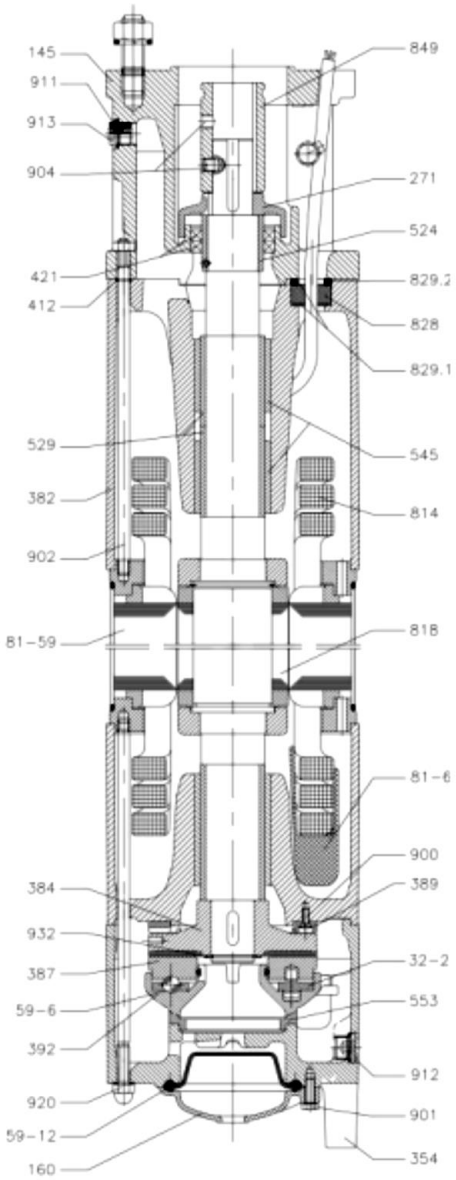


Fig. 22: 14B submersible borehole motor

Table 26: List of components

Part No.	Denomination
32-2	Ball/Retainer
59-6	Ball
59-12	Diaphragm
81-6	Windings protection
81-59	Stator
145	Adaptor
160	Cover
271	Sand guard
354	Thrust bearing housing
382	Bearing body
384	Thrust bearing plate
387	Thrust bearing segment
389	Counter thrust bearing ring
392	Bearing segment carrier
412	O- Ring
421	Shaft protecting sleeve
524	Shaft protecting sleeve
529	Bearing sleeve
545	Bearing bush
553	Thrust insert
814	windings
818	Rotor
828	Cable rubber ring
829.1	Cable gland ring
829.2	Cable gland ring
849	Sleeve coupling
900	screw
901	Hexagon head bolt
902	Stud
904	Slatted set screw with cone end
911	Priming plug
912	Drain plug
913	Vent plug
920	Hexagon domed cap nut
932	Circlip

9.2 Connecting dimensions for the motors
9.2.1 6E connecting dimensions
Observe the following dimensions:

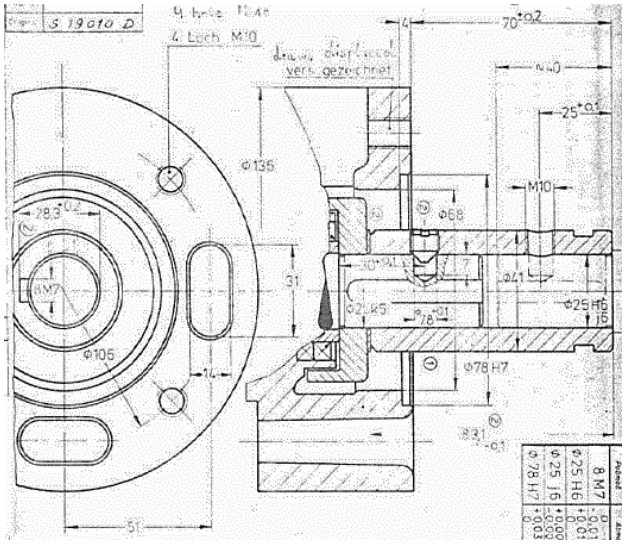


Fig. 23: 6E connecting dimensions
Dimensions in mm

	NOTE
	The pump shaft must rest on the motor shaft

9.2.2 12A connecting dimensions
Observe the following dimensions:

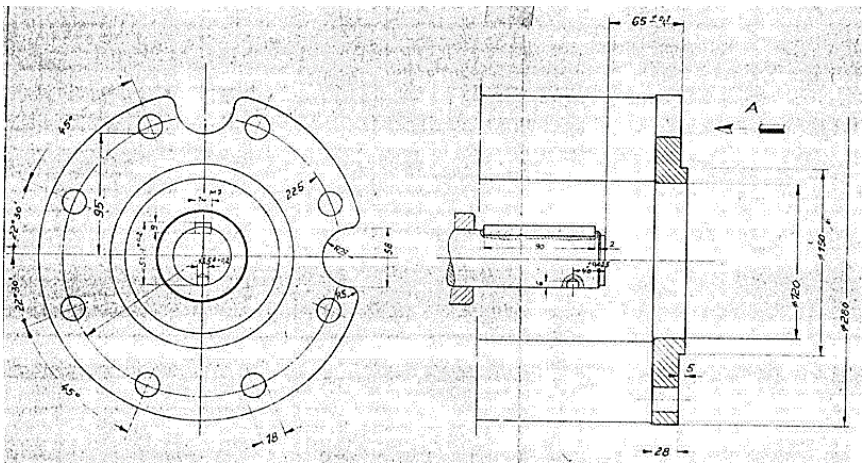


Fig. 24: 12A connecting dimensions
Dimensions in mm

	NOTE
	The pump shaft must rest on the motor shaft.

9.2.3 Connecting dimensions 14B

Observe the following dimensions:

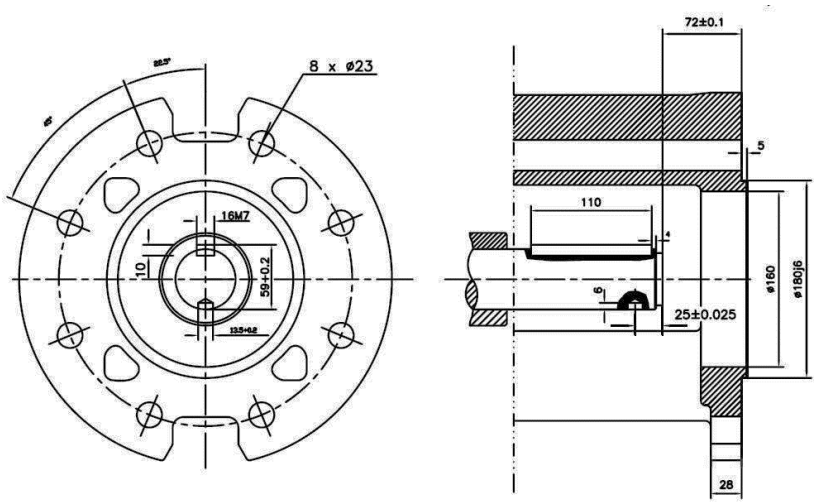


Fig. 25: Connecting dimension 14B

10 EC Declaration of Conformity

Manufacturer: **PUMPIRAN** – P.O.Box 51845-135 Tabriz-IRAN

The manufacturer herewith declares that the product:

URD152 to BRVS 486
6C to14B

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

The manufacturer also declares that

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

Person authorised to compile the technical file:
Name
Function
Address (company)
Address (Street, No.)
Address (post or ZIP code, city) (country)
The EC Declaration of Conformity was issued in/on:
Place, date

.....20).....
Name
Function
Company
Address
Address

.

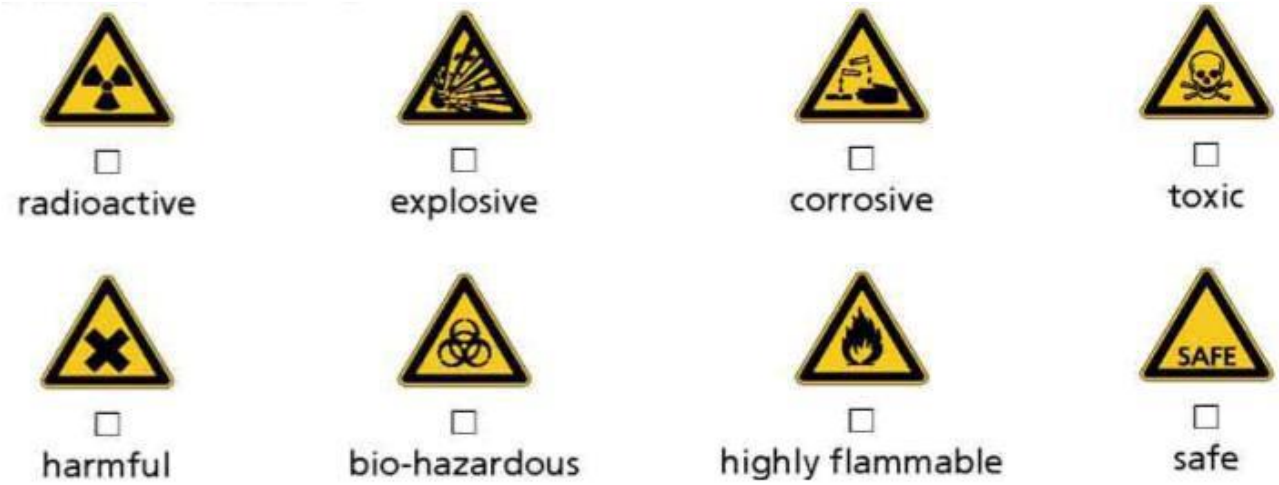
11 Certificate of Decontamination

Type.....
Order number/
Order item number[21)].....
Delivery date.....
Field of application: .....
Fluid handled[21)]: .....

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

21) Required fields

Please tick where applicable [21]:



Reason for return[21]: .....
Comments: .....
.....

The product/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

21) Required fields

Index

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WATER . OIL . ENERGY

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