# Submersible bore well pumps and Submersible rewindable motors

## 4", 6", 8", 10" -
## Stainless steel & Noryl series

### Installation and Operating Instructions

**60 Hz**

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**Contents**



**Warning**
Prior to installation, read these installation and operating instructions carefully. Installation and operation must comply with local regulations and accepted codes of good practice.

These instructions apply to SEI submersible motors and SEI submersible pumps type NP04, P04, P06, P08 and P10 fitted with SEI submersible motors.

If the pump is fitted with a motor of another motor make than SEI, please note that the motor data may differ from the data stated in these instructions.

### 1. Symbols used in this document

**Warning**
If these safety instructions are not observed, it may result in personal injury!

**Caution** If these safety instructions are not observed, it may result in malfunction or damage to the equipment!

**Note** Notes or instructions that make the job easier and ensure safe operation.

### 2. General description

This booklet provides instructions for installation, operation and maintenance of the submersible bore well pumps as well as rewindable submersible motors.

***STAINLESS STEEL SUBMERSIBLE PUMPS***

P04, P06, P08 and P10 series stainless steel submersible pumps are designed for 4" (DN 100 mm), 6" (DN 150 mm), 8" (DN 200mm) and 10" (DN 250 mm) bore well pumps applications.

They are available from 0.5 to 5 HP for single phase and from 0.5 to 250 HP for three phase power supply.

These pumps are constructed completely out of stainless steel AISI 304 (AISI 316 are also available on request).

Pumps are designed and sized for connection to the motor according to NEMA standards up to 8" motor joining.

All pumps are equipped with built-in non-return valve.

These pumps are available in two basic impellers design.

**Radial flow impellers**
- 4" pumps: P04-05, P04-07, P04-10, P04-16, P04-25,
- 6" pumps: P06-85

**Mixed flow impellers**
- 4" pumps: P04-40, P04-60, P04-75
- 6" pumps: P06-150, P06-230, P06-300
- 8" pumps: P08-385, P08-475
- 10" pumps: P10-625, P10-800, P10-1100

***NORYL SUBMERSIBLE PUMPS***

NP04 series Noryl submersible pumps are designed for 4" (DN 100 mm) bore well pumps applications.

They are available from 0.5 to 5 HP for single phase as well as three phase power supply.

Pumps are designed and sized for connection to the motor according to NEMA standards.

All pumps are equipped with built-in non-return valve.

***SUBMERSIBLE REWINDABLE MOTORS***

These are 2-pole induction motors, 60 Hz at rated speed 3450 rpm.

They are available from 0.5 to 5 HP for single phase and from 0.5 to 250 HP for three phase power supply.

SEI can supply a wide variety of submersible motors as per details below.

- 4" Oil Filled Standard
- 6" Water Filled Standard
- 6" Water Filled Stainless Steel (AISI 304/AISI 316)
- 8" Water Filled Standard
- 8" Water Filled Stainless Steel (AISI 304/AISI 316)
- 10" Water Filled Standard

These motors are Water Filled and Oil Filled submersible motors which can be easily rewound and repaired.

Motors are designed and sized for 4" diameter and larger sized water wells.

## 3. Delivery and handling

### 3.1 Delivery

SEI submersible pumps and/or motors are supplied from the factory in proper packing in which they should remain until they are to be installed.

Transportation and storing of pump and/or motor can be done in a vertical or a horizontal position. Make sure that it cannot roll or fall over.

Upon receiving the pump and/or motor, it should be inspected for possible damage during transit. If damage has occurred, please file a claim with the carrier who has delivered the pump and/or motor.

**Caution** The pumps and/or motors should remain in the packing until they are placed in vertical position during installation.

### 3.2 Handling

Pump and/or motor must be lifted by manually or by means of a hoist. Never lift the pump and/or motor by means of the motor cable.

**Caution** Do not use sharp tools when unpacking the motor. During unpacking and prior to installation, make sure that misalignment does not occur due to bending while handling the pump. Make sure that pump and/or motor are not dropped or mishandled. They must be handled carefully.

The pump and/or motor should not be exposed to unnecessary impact and shocks.

### 3.3 Storage

If the pump and/or motor are not to be installed and operated soon after arrival, store it in a closed, clean, dry and well ventilated room with slow, moderate changes in ambient temperature. Protect the pump and/or motor from moisture, heat, dust, dirt and foreign bodies. The pump and/or motor should not be exposed to direct sunlight.

**Storage temperature**

Pump: -4°F to +140°F
Motor: -4°F to +158°F.

**Caution** If the motors are stored, the shaft must be turned by hand at least once a month.

**Caution** If a motor has been stored for more than one year before installation, the rotating parts of the motor must be dismantled and checked before use.

**Caution** After a long period of storage, the pump should be inspected before it is put into operation. Make sure that the impeller can rotate freely.

If the pump has been unpacked, it should be stored horizontally, adequately supported. During storage, the pump can be supported as shown in fig. 1.

If the pump are stored in vertical position, make sure that it can not topple over.

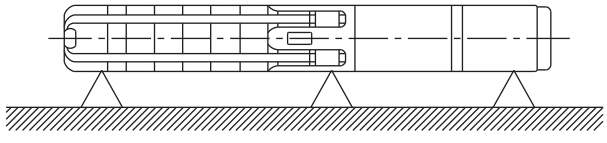


**Fig. 1** Pump position during storage

### 3.3.1 Frost protection

If the pump has to be stored after use, it must be stored on a frost-free location.

## 4. Applications

For water supply, irrigation, civil, industrial and fire fighting applications.

### 4.1 Pumped liquids

Pumps are designed for pumping clear and cold water that is free of air and gasses, thin, non-aggressive and non-explosive liquids without solid particles or fibers.

Decreased pump performance and life expectancy can occur if the water is not cold and clear or contains air and/or gasses.

The maximum sand content of the water must not exceed 50 g/m³. Higher sand content will increase the risk of blockage and reduce the pump life.

**Caution** When pumping liquids with a density higher than that of water, motors with correspondingly higher outputs must be used.

If liquids with a viscosity higher than that of water are to be pumped, please contact SEI.

The maximum liquid temperature is shown in section 7.3 “Liquid temperatures/cooling”.

## 5. Technical data

### 5.1 Pump data

| Description | | 60 Hz |
|---|---|---|
| Maximum flow range | Stainless steel | 1400 USgpm |
| | Noryl | 33 USgpm |
| Maximum head range | Stainless steel | 2220 feet |
| | Noryl | 1340 feet |
| Liquid temperature | | +32°F to +113°F |
| Installation depth | | 1148 feet |
| Maximum sand content | | 50 g/m³ |
| Duty rating | | Continuous |

### 5.2 Motor data

| Description | | 60 Hz |
|---|---|---|
| Ratings | 4" Oil Filled Standard | 1 ph. - 0.5 to 5 HP |
| | | 3 ph. - 0.5 to 10 HP |
| | 6" Water Filled Standard | 3 ph. - 5 to 60 HP |
| | 6" Water Filled Super Stainless steel | 3 ph. - 5 to 60 HP |
| | 8" Water Filled Standard | 3 ph. - 40 to 150 HP |
| | 8" Water Filled Super Stainless steel | 3 ph. - 40 to 150 HP |
| | 10" Water Filled Standard | 3 ph. - 150 to 250 HP |
| Rated speed | | 3450 rpm |
| Voltages | 1 phase | 115 V, 230 V |
| | 3 phase | 230 V, 380 V, 460 V |
| Voltage tolerance | | +6% / -10% |
| Enclosure class | | IP 68 |
| Insulation class | | F (Oil filled motors) |
| Duty rating | | Continuous |
| Ambient temperature | | +113°F |
| Rotation | 1 phase | CCW |
| | 3 phase | CCW and CW |
| Maximum nos. of starts/hour | 4" Oil Filled Standard | 0.5 to 3 HP - 30 |
| | | 4 to 10 HP - 20 |
| | 6" Water Filled Standard | 5 to 30 HP - 20 |
| | | 35 to 60 HP - 15 |
| | 6" Water Filled Super Stainless steel | 5 to 30 HP - 20<br>35 to 60 HP - 15 |
| | 8" Water Filled Standard | 40 to 75 HP - 25 |
| | | 90 to 150 HP - 20 |
| | 8" Water Filled Super Stainless steel | 40 to 75 HP - 25<br>90 to 150 HP - 20 |
| | 10" Water Filled Standard | 150 to 175 HP -20 |
| | | 200 to 250 HP - 15 |
| Water pH | | 6.5 - 8 |
| Minimum cooling flow along the motor | 4" Oil Filled Standard | 0.26 ft/sec |
| | 6" Water Filled Standard | 5 to 20 HP - 0.49 ft/sec |
| | | 25 to 60 - 0.98 ft/sec |
| | 6" Water Filled Super Stainless steel | 5 to 20 HP - 0.49 ft/sec |
| | | 25 to 60 - 0.98 ft/sec |
| | 8" Water Filled Standard | 40 to 50 HP - 0.98 ft/sec |
| | | 60 to 150 HP - 1.47 ft/sec |
| | 8" Water Filled Super Stainless steel | 40 to 50 HP - 0.98 ft/sec |
| | | 60 to 150 HP - 1.47 ft/sec |
| | 10" Water Filled Standard | 150 to 250 HP - 1.64 ft/sec |
| Maximum submerged depth | 4" | 1148 feet |
| | 6" | 820 feet |
| | 8" | 656 feet |
| | 10" | 656 feet |
| Mounting | | vertical/horizontal (horizontal allowed only if the pump size is identical to the motor size, e.g. 6" pump with 6" motor |

Please refer the motor nameplate for all electrical data.

### 5.3 Dimensions and weights

See product catalogue for dimensions and weights.

## 6. General safety information

During installation, operation as well as servicing of the submersible pumps and/or submersible motors follow safety instructions as listed below.

- Check local codes and regulations before installation. The installation must in comply with these requirements.
- During installation, operation as well as servicing of the pump and/or motor, do not touch any electrical components when power supply is switched on.
- The pump and/or motor should be located in a non-explosive and non-flammable atmosphere.
- The pump and/or motor should be installed, connected and serviced by qualified personnel only. Ensure all power sources are disconnected when working on the pump and/or motor. Follow all appropriate electrical codes. Operators should be properly instructed on operating procedures & safety guidelines.
- Please wear protective clothes and safety glasses for personal protection.
- Make sure that the lifting apparatus is properly tightened before attempting to lift the pump and/or motor. Carelessness during lifting or transportation may cause injury to personnel or damage to the pump and/or motor.
- Pump must be installed in a vertical position. Horizontal installation allowed only if the pump size is identical to the motor size, e.g. 6" pump with 6" motor. Pump installed in any other position will void warranty.
- Motor must be completely submerged when it is used.
- It must be possible to lock the mains switch in "off" position when maintenance is progress.
- Never open the motor.
- Never use the motor in combination with damaged pump units or parts.
- Do not run pump dry. Dry running can overheat pump and will void warranty.
- Always use only an original genuine factory spare parts.
- Please keep out of the reach of children.

## 7. Installation

Before beginning the installation, switch off the power supply and lock the mains switch in "off" position.

Any external voltage connected to the pump must be switched off before working on the pump.

**Caution** Do not start the pump to check the direction of rotation until it has been immersed in liquid.

**Pre-installation checklist**
Before starting installation procedures, please carry out these checks:

- Condition of the well
- Condition of the water
- Liquid temperature/cooling
- Motor preparation
- Installation depth
- Pipework connection.

These checks are all critical for the proper installation of this submersible pump.

All safety regulations must be observed at the installation.

Pump should always be electrically grounded to a suitable electrical ground such as a grounded water pipe, grounded metallic pathway or a grounded wire system.

Do not put your hands or any tool into the pump suction or discharge port after the pump has been connected to the power supply, unless the pump has been switched off by removing the fuses or switching off the mains switch. It must be ensured that the power supply cannot be accidentally switched on.

**Caution** We recommend to always use SEI accessories to avoid malfunctions due to incorrect installation.

Do not lift the pump and/or motor by power cable. Only use the lifting apparatus for lifting the pump. Do not use it to hold the pump when in operation.

### 7.1 Condition of the well

If the pump is to be installed in a new well, the well should be fully developed by using compressed air to clean the sand from the well.

The stainless steel construction (P04, P06, P08 & P10) of the SEI submersible pump make it resistant to abrasion; however, no pump, made of any material, can forever withstand the destructive wear that occurs when constantly pumping sandy water.

If this pump is used to replace an oil-filled submersible or oil-lubricated line-shaft turbine in an existing well, the well must be blown or bailed clear of oil.

Determine the maximum depth of the well, and the draw-down level at the pump's maximum capacity. Pump selection and setting depth should be based on this data.

The inside diameter of the well casing should be checked to ensure that it is not smaller than the size of the pump and motor. The maximum diameter of the pump/motor is as shown in the catalogue.

### 7.2 Condition of the water

See section 4.1 "Pumped liquids" on page 5.

### 7.3 Liquid temperatures/cooling

The maximum liquid temperature and the minimum liquid velocity past the motor appear from the table as mentioned in section 7.3.1.

It is recommended to install the motor above the well screen in order to achieve proper motor cooling.

**Caution** In cases where the stated liquid velocity cannot be achieved, a flow sleeve must be installed.

If there is a risk of sediment build-up, such as sand, around the motor, a flow sleeve should be used in order to ensure proper cooling of the motor.

#### 7.3.1 Maximum liquid temperature and requirements of motor cooling

Out of consideration for the rubber parts in pump and motor, the liquid temperature must not exceed 113°F. See also the following table.

The pump can operate at liquid temperatures between 113°F to 140°F provided that all rubber parts are replaced every third year.

| Motor type | Flow velocity past the motor | Maximum liquid temperature | |
|---|---|---|---|
| | | Vertical installation | Horizontal installation |
| SEI 4" | See **Minimum cooling flow along the motor** in section 5.2 on page 5 "Motor data". | 113°F | 113°F |
| SEI 6" | | 113°F | 113°F |
| SEI 8" | | 113°F | 113°F |
| SEI 10" | | 113°F | 113°F |

### 7.4 Motor preparation

Before starting work on the pump, make sure that the electricity supply has been switched off and that it can not be accidentally switched on.

#### 7.4.1 Checking of liquid in WF (Water Filled) motor

The submersible motors are factory-filled with a special non-toxic liquid, which is frost-proof down to -4°F.

If there is any indication that cooling liquid has leaked from the motor then it would be desirable to check the motor if it has sufficient quantity of cooling liquid.

Follow the instructions to refill the motor with liquid as described below.

#### 7.4.2 Refilling of SEI 6" Water Filled submersible motors

To refill the SEI 6" WF (Water Filled) submersible motors as described below:

1. Place the motor in an upright position as shown in fig. 2.
2. Two water filling plugs are provided for refilling.
3. Open the plug from filling hole.
4. Carefully fill clean water into the motor, see fig. 2, until the water runs back out of the filling hole.
5. Tighten the water filling plug back.

**The pump is now ready for installation.**

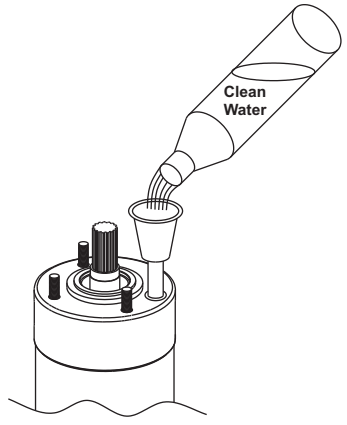



**Fig. 2** Location of water filling hole in 6" Water Filled motor

**7.4.3 Refilling of SEI 8" Water Filled submersible motors**
To refill the SEI 8" and 10" WF (Water Filled) submersible motors as described below:

1. Place the motor in an upright position as shown in fig. 3.
2. Two water filling plugs are provided for refilling.
3. Open the plug from filling hole.
4. Carefully fill clean water into the motor, see fig. 3, until the water runs back out of the filling hole.
5. Tighten the water filling plug back.

**The pump is now ready for installation.**

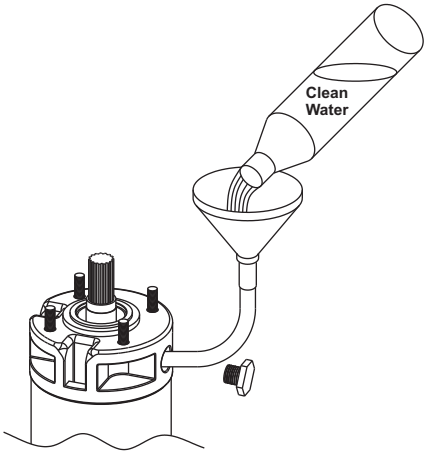



**Fig. 3** Location of water filling hole in 8" & 10" Water Filled motor

**7.4.4 Measuring the insulation resistance**
- The measurement is to be carried out using an insulation measuring unit (megger of 500 VDC).
- Before submerging the unit, connect a measuring cable to the ground conductor.
- Make sure that the contact points are clean.
- Connect the other measuring cable to every core of the connected motor cable in succession.
- Ensure that the insulation resistance as shown on the insulation measuring unit is a minimum of 20 megohm.

**7.5 Installation depth**
- A check should be made to ensure that the installation depth of the pump will always be at least (5) five to (10) ten feet (1.5 to 3 m) below the maximum draw-down level of the well.

- The bottom of the motor should never be installed lower than the top of the well screen or within five feet of the well bottom.

- If the pump is to be installed in a lake, pond, tank or large diameter well, the water velocity passing over the motor must be sufficient to ensure proper motor cooling.

**7.5.1 Positional requirements**

If the pump is to be installed in a position where it is accessible, the coupling must be suitably isolated from human touch. The pump can for instance be built into a flow sleeve.

- Depending on motor joining size, the pump can be installed either vertically or horizontally (horizontal installation allowed only if the pump size is identical to the motor size, e.g. 6" pump with 6" motor), however, the pump shaft must never fall below the horizontal plane, see fig. 4.

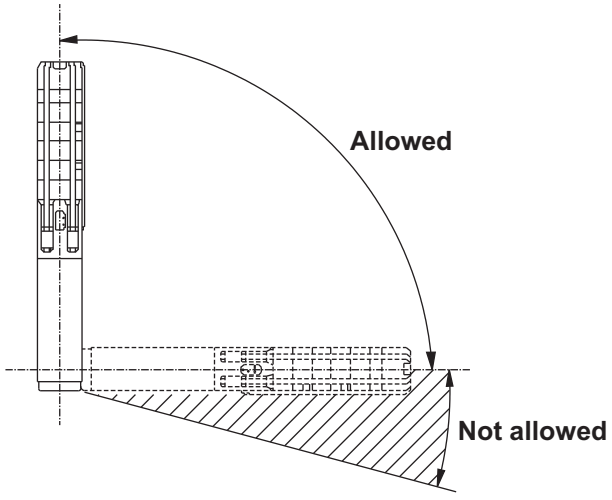



**Fig. 4** Pump position

**Caution** If the pump is to be installed horizontally, e.g. in a tank, and there is a risk that the pump might be covered by mud, it must be installed in a flow sleeve.

**Caution** During operation, the suction interconnector of the pump must always be completely submerged in the liquid.

If the pump is used for pumping hot liquids 113°F to 140°F, it must be ensured that persons cannot come into contact with the pump and the installation, e.g. by installing a guard.

**7.6 Pipework connection**
If noise may be transmitted to the building through the pipework, it is advisable to use plastic pipes.

**Note** Plastic pipes are recommended for 4" pumps only.

When plastic pipes are used, the pump should be secured by an unloaded straining wire.

Make sure that the plastic pipes to be used are suitable for the actual liquid temperature and the pump pressure.

When connecting plastic pipes, a compression coupling should be used between the pump and the first pipe section.

**8. Pump installation**

Before starting any work on the pump/motor, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on.

**8.1 Fitting the motor to the pump**
When the pump part & the motor are supplied as separate units (long pumps), fit the motor to the pump as follows:

1. Use pipe clamps when handling the motor.
2. Remove shaft protector. Place the motor in vertical position at the borehole seal.

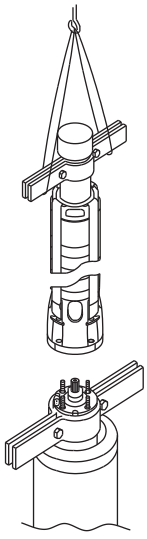


**Fig. 5** Lifting the pump into position

3. Lift the pump part by means of pipe clamps fitted to the extension pipe, see fig. 5.
4. Place the pump part on top of the motor.
5. Fit fully.

**Caution** Make sure that the coupling between the pump and motor engages properly.

**Caution** Make sure that the pump chambers are aligned when assembly has been completed.

**Note** After assembly ensure that the pump is moving axially by about 1.0 mm to 2.0 mm (0.039 inch to 0.078 inch).

**8.2 Removal and fitting of cable guard**
For removal and fitting of cable guard(s), see pages 18 and 19 (P04, P06, P08 & P10 series).

If the cable guard is screwed on to the pump, such as the P10-1100 and sleeved pumps, the cable guard should be removed and fitted by means of screws.

**Caution** Make sure that the pump chambers are aligned when the cable guard has been fitted.

**8.3 Splicing of submersible motor cable**

**Caution** At the time of joining motor cables with other cables precaution should be taken that no effect of water has to be there at the joints of cable.

**Note** This joint has to be made with the help of joint kit given with the pump set kit instructions of joining cables are given with this.

Cable joint can be done carefully with the tape as accordingly.

1. As shown in fig. 6 cut the cable slantingly.

2. Strip individual conductor of insulation only as far as necessary to provide room for a dowel type connector or a neatly twisted joint. If a twisted joint is used, It is essential that it be soldered. Tubular connectors of dowel are preferred (If connector o.d. is not as large as cable insulation build up with rubber electrical tape).

3. Tape individual joints with rubber electrical tape (Modistone heavy duty cushion gum or equivalent can also be used) using two layers, the first extending 25 mm beyond each end of the conductor insulation end, the second layer 25 mm beyond the ends of first layer. Wrap tightly, eliminating airspaces as much as possible.

4. Tape over the rubber electrical tape with PVC electrical tape (Steel grip self adhesive PVC electrical insulation tape or equivalent) using two layers as in step “3” & making each layer overlap the end or proceeding layer by at least 25 mm.

5. After joining the cables dip them in the bucket for 30 minutes. Dip the earthing wire of 500 volt, 100 megohm of megger.

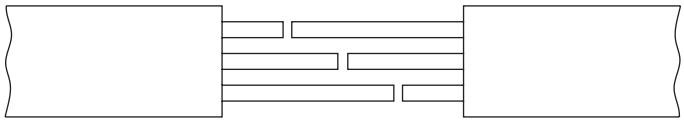


**Fig. 6** Slant cutting of cable for cable joining

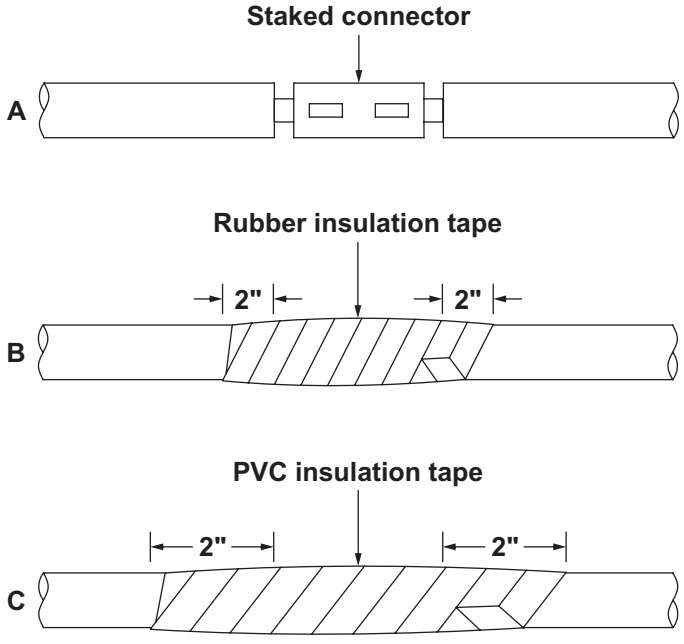



**Fig. 7** Joining of submersible cables

### 8.4 Riser pipe

If a tool, e.g. a chain pipe wrench, is used when the riser pipe is fitted to the pump, the pump must only be gripped by the pump discharge chamber.

The threaded joints on the riser pipe must all be well cut and fit together to ensure that they do not work loose when subjected to torque reaction caused by the starting and stopping of the pump. The thread on the first section of the riser pipe which is to be screwed into the pump should not be longer than the threads in the pump.

If noise may be transmitted to the building through the pipework, it is advisable to use plastic pipes.

**Note** Plastic pipes are recommended for 4" pumps only.

**Caution** When plastic pipes are used, the pump should be secured by an unloaded straining wire to be fastened to the discharge chamber of the pump, see fig. 8.

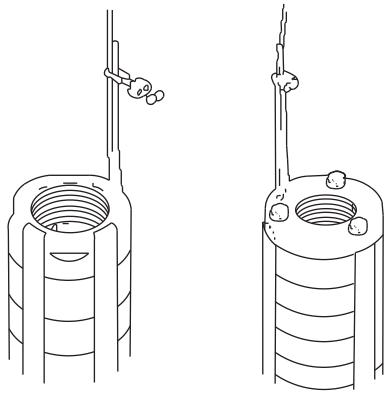


**Fig. 8** Fixing the straining wire

When connecting plastic pipes, a compression coupling should be used between the pump and the first pipe section.

Where flanged pipes are used, the flanges should be slotted to take the submersible drop cable and a water indicator hose, if fitted.

### 8.5 Maximum installation depth below water level

SEI 4" motors: 1148 feet (350 m)
SEI 6" motors: 820 feet (250 m)
SEI 8" motors: 656 feet (200 m)
SEI 10" motors: 656 feet (200 m)

### 8.6 Lowering the pump/motor

It is recommended to check the borehole by means of an inside calliper before lowering the pump to ensure unobstructed passage.

Lower the pump carefully into the borehole, taking care not to damage the motor cable and the submersible drop cable.

**Caution** Do not lower or lift the pump/motor by means of the motor cable.

### 8.7 Installation depth

The dynamic water level should always be above the suction interconnector of the pump, see section 7.5.1 “Positional requirements” and fig. 12.

Minimum inlet pressure is indicated in the NPSH curve for the pump.

The minimum safety margin should be 3.28 feet head.

It is recommended to install the pump so that the motor part is above the well screen in order to ensure optimum cooling, see section 7.3 “Liquid temperatures/cooling”.

When the pump has been installed to the required depth, the installation should be finished by means of a borehole seal. Slacken the straining wire so that it becomes unloaded and lock it to the borehole seal by means of wire locks.

## 9. Electrical connection

### 9.1 General

The electrical connections should be carried out by an authorised electrician in accordance with local regulations

Before making any connections in pump/motor, make sure that the electricity supply must be switched off and that it cannot be accidently switched on.

The pump must be grounded.

The pump must be connected to an external mains switch and control panel.

The operating voltage and frequency are stated on the nameplate.

The required voltage quality for SEI submersible motors, measured at the motor terminals, is +6% / -10% of the nominal voltage during continuous operation (including variation in the supply voltage and losses in cables). Furthermore, it must be checked that there is voltage symmetry in the electricity supply lines, i.e. same difference of voltage between the individual phases, see also section 13. “Checking of motor and cable”, point 2.

Make sure that the motor is suitable for the electricity supply at the installation site.

The motors are wound for direct-on-line starting or star-delta starting and the starting current is between 4 and 6 times the rated current of the motor.

The run-up time of the pump is only about 0.1 second. Direct-online starting is therefore normally approved by the electricity supply authorities.

### 9.2 Frequency converter operation

**SEI motors**

Three-phase SEI motors can be connected to a frequency converter.

**Caution** During frequency converter operation, it is not advisable to run the motor at a frequency higher than the rated frequency (60 Hz). In connection with pump operation, it is important never to reduce the frequency (and consequently the speed) to such a level that the necessary flow of cooling liquid past the motor is no longer ensured.

To avoid damage to the pump part, it must be ensured that the motor stops when the pump flow falls below 0.1 x nominal flow. Depending on the frequency converter type, it may expose the motor to detrimental voltage peaks.

Motors for supply voltages up to and including 415 V (see motor nameplate) must be protected against voltage peaks higher than 650 V (peak value) between the supply terminals.

It is recommended to protect other motors against voltage peaks higher than 850 V.

The above disturbance can be abated by installing an RC filter between the frequency converter and the motor.

Possible increased acoustic noise from the motor can be abated by installing an LC filter which will also eliminate voltage peaks from the frequency converter.

For further details, please contact your frequency converter supplier.

### 9.3 Motor protection

#### 9.3.1 OF (Oil Filled) single-phase motors

Oil Filled single-phase submersible motors, incorporate a thermal overload protector and require no additional motor protection.

When the motor has been thermally switched off, the motor terminals are still live.
When the motor has cooled sufficiently, it will restart automatically.

**WF (Water Filled) Single-phase submersible motors**, must be protected. A protective device can either be incorporated in a control box or be separate.

#### 9.3.2 Three-phase motors

SEI three-phase submersible motors must be protected by a motor starter with thermal overload relay.

SEI submersible motors can also be protected by PT 100 temperature sensor. Motors have to be ordered from factory with a PT 100 temperature sensor.

#### 9.3.3 Required motor starter settings

For cold motors, the tripping time for the motor starter must be less than 10 seconds at 5 times the rated maximum current of the motor.

**Caution** If this requirement is not met, the motor warranty will be invalidated.

In order to ensure the optimum protection of the submersible motor, the starter overload unit should be set in accordance with the following guidelines:

1. Set the starter overload to the rated maximum current of the motor.

2. Start the pump and let it run for half an hour at normal performance.

3. Slowly grade down the scale indicator until the motor trip point is reached.

4. Increase the overload setting by 5 %.

The highest permissible setting is the rated maximum current of the motor.

For motors wound for star-delta starting, the starter overload unit should be set as above, but the maximum setting should be as follows:

Starter overload setting = Rated maximum current x 0.58.

The highest permissible start-up time for star-delta starting or auto-transformer starting is 2 seconds.

### 9.4 Lightning protection

The installation can be fitted with a special over voltage protective device to protect the motor from voltage surges in the electricity supply lines when lightning strikes somewhere in the area, see fig. 9.

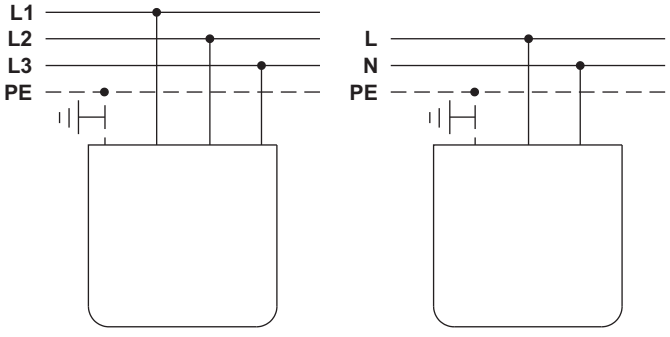



**Fig. 9** Fitting an overload voltage protective device

The over voltage protective device will not, however, protect the motor against a direct stroke of lightning.

The over voltage protective device should be connected to the installation as close as possible to the motor and always in accordance with local regulations.

### 9.5 Cable sizing

Cable for submersible motors must be suitable for submerged operation and adequate in size to operate within rated temperature and maintain adequate voltage at the motor.

The tables given here reflect cable size that will maintain at least 97% (for 3 phase) & 95% (for 1 phase) of supply voltage at maximum rated running Amps. and will also maintain adequate starting voltage and acceptable temperature.

If star/delta starting is used the current will be reduced by $\sqrt{3}$ (I x 0,58), meaning the cable length can be $\sqrt{3}$ longer (L x 1,73) then indicated in the tables.

Cable lengths are for copper twisted conductors with or without a jacket or flat molded type, not in magnetic enclosure. The portion of the cable from the service entrance to the 3 phase controller should not exceed 25% of table maximum length to assure reliable starter operation.

Maximum cable lengths from motor to service entrance, see following tables.

**Note**

If aluminum conductor is used, multiply lengths by 0.5. Maximum allowable length of aluminum is considerably shorter than copper wire of same size.

Cable #14 to #0000 are AWG sizes, and 250 to 300 are MCM sizes.

**Cable dimensions at 1 x 230V, 60 Hz (voltage drop: 5%)**

| Motor type | Power | | | Cable size [AWG] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HP | kW | | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 1 | 0 | 00 |
| 3" OF | 0.5 | 0.37 | Max. cable length [feet] | 1212 | 1933 | 2888 | 4773 | | | | | | |
| | 0.75 | 0.55 | | 867 | 1382 | 2065 | 3413 | 5395 | | | | | |
| | 1 | 0.75 | | 648 | 1034 | 1545 | 2554 | 4039 | 6202 | | | | |
| | 1.25 | 0.93 | | 533 | 850 | 1269 | 2099 | 3318 | 5095 | 6997 | | | |
| | 1.5 | 1.1 | | 459 | 732 | 1094 | 1809 | 2862 | 4397 | 6044 | | | |
| 4" OF | 0.5 | 0.37 | | 1413 | 2252 | 3362 | 5548 | | | | | | |
| | 0.75 | 0.55 | | 1036 | 1651 | 2465 | 4069 | 6418 | | | | | |
| | 1 | 0.75 | | 785 | 1251 | 1868 | 3085 | 4870 | | | | | |
| | 1.5 | 1.1 | | 569 | 908 | 1356 | 2242 | 3544 | 5439 | | | | |
| | 2 | 1.5 | | 436 | 696 | 1040 | 1721 | 2723 | 4184 | 5753 | | | |
| | 3 | 2.2 | | 306 | 489 | 731 | 1210 | 1917 | 2952 | 4069 | 5679 | 6200 | |
| | 5.5 | 4 | | 171 | 273 | 407 | 675 | 1069 | 1646 | 2269 | 3167 | 3457 | 4302 |
| 4" WF | 0.5 | 0.37 | | 1463 | 2332 | 3481 | 5744 | | | | | | |
| | 0.75 | 0.55 | | 984 | 1569 | 2342 | 3864 | 6091 | | | | | |
| | 1 | 0.75 | | 734 | 1170 | 1746 | 2879 | 4535 | 6926 | | | | |
| | 1.5 | 1.1 | | 569 | 907 | 1354 | 2236 | 3529 | 5404 | | | | |
| | 2 | 1.5 | | 424 | 676 | 1009 | 1668 | 2635 | 4042 | 5545 | | | |
| | 3 | 2.2 | | 306 | 488 | 730 | 1207 | 1910 | 2936 | 4038 | 5619 | 6128 | |
| | 5.5 | 4 | | 168 | 269 | 401 | 664 | 1052 | 1618 | 2227 | 3102 | 3384 | 4203 |

**Cable dimensions at 3 x 460V, 60 Hz (voltage drop: 3%)**

| Motor type | Power | | | Cable size [AWG] | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | HP | kW | | 14 | 12 | 10 | 8 | 6 | 4 | 2 | 1 | 0 | 00 | 000 | 0000 | 300 |
| 4" OF | 0.5 | 0.37 | Max. cable length [feet] | 4006 | | | | | | | | | | | | |
| | 0.75 | 0.55 | | 2737 | | | | | | | | | | | | |
| | 1 | 0.75 | | 2038 | 3245 | | | | | | | | | | | |
| | 1.5 | 1.1 | | 1472 | 2344 | 3493 | | | | | | | | | | |
| | 2 | 1.5 | | 1079 | 1719 | 2562 | | | | | | | | | | |
| | 3 | 2.2 | | 767 | 1222 | 1822 | 3002 | | | | | | | | | |
| | 4 | 3 | | 570 | 908 | 1353 | 2229 | 3505 | | | | | | | | |
| | 5.5 | 4 | | 428 | 681 | 1016 | 1674 | 2634 | | | | | | | | |
| | 7.5 | 5.5 | | 311 | 495 | 739 | 1218 | 1916 | 2922 | 3984 | | | | | | |
| | 10 | 7.5 | | 225 | 358 | 534 | 880 | 1383 | 2105 | 2865 | 3930 | | | | | |
| 4" WF | 0.5 | 0.37 | | 3944 | | | | | | | | | | | | |
| | 0.75 | 0.55 | | 2696 | | | | | | | | | | | | |
| | 1 | 0.75 | | 2007 | 3195 | | | | | | | | | | | |
| | 1.5 | 1.1 | | 1451 | 2309 | 3440 | | | | | | | | | | |
| | 2 | 1.5 | | 1064 | 1694 | 2524 | 4153 | | | | | | | | | |
| | 3 | 2.2 | | 746 | 1188 | 1771 | 2916 | | | | | | | | | |
| | 4 | 3 | | 555 | 884 | 1318 | 2170 | 3412 | | | | | | | | |
| | 5.5 | 4 | | 416 | 663 | 988 | 1628 | 2559 | 3897 | | | | | | | |
| | 7.5 | 5.5 | | 307 | 488 | 728 | 1199 | 1884 | 2867 | 3901 | | | | | | |
| 6" OF | 4 | 3 | | 562 | 896 | 1336 | 2201 | 3462 | | | | | | | | |
| | 5.5 | 4 | | 422 | 672 | 1003 | 1653 | 2603 | 3970 | | | | | | | |
| | 7.5 | 5.5 | | 327 | 522 | 779 | 1284 | 2023 | 3088 | | | | | | | |
| | 10 | 7.5 | | 240 | 383 | 572 | 943 | 1488 | 2275 | 3112 | | 3776 | | | | |
| | 12.5 | 9.3 | | | 312 | 466 | 769 | 1210 | 1848 | 2523 | 3474 | 3262 | | | | |
| | 15 | 11 | | | 268 | 399 | 659 | 1039 | 1589 | 2172 | 2999 | 2748 | | | | |
| | 17.5 | 13 | | | 226 | 338 | 557 | 878 | 1341 | 1833 | 2527 | 2450 | 3380 | | | |
| | 20 | 15 | | | 201 | 300 | 495 | 781 | 1194 | 1632 | 2253 | 1984 | 3018 | 3886 | | |
| | 25 | 18.5 | | | | 243 | 401 | 633 | 967 | 1322 | 1824 | 1691 | 2442 | 3144 | 3776 | |
| | 30 | 22 | | | | 207 | 342 | 539 | 823 | 1126 | 1554 | 1250 | 2082 | 2681 | 3222 | 3806 |
| | 40 | 30 | | | | | 251 | 396 | 606 | 830 | 1148 | 1018 | 1542 | 1992 | 2400 | 2843 |
| | 50 | 37 | | | | | 204 | 322 | 493 | 675 | 935 | | 1258 | 1627 | 1963 | 2329 |
| 6" WF | 5.5 | 4 | | 439 | 699 | 1043 | 1718 | 2704 | | | | | | | | |
| | 7.5 | 5.5 | | 323 | 515 | 769 | 1268 | 1998 | 3052 | | | | | | | |
| | 10 | 7.5 | | 240 | 383 | 571 | 942 | 1484 | 2267 | 3096 | | 3779 | | | | |
| | 12.5 | 9.3 | | | 312 | 466 | 769 | 1211 | 1849 | 2524 | 3477 | 3247 | | | | |
| | 15 | 11 | | | 268 | 399 | 658 | 1038 | 1585 | 2166 | 2986 | 2741 | 3995 | | | |
| | 17.5 | 13 | | | | 338 | 557 | 877 | 1340 | 1830 | 2522 | 2425 | 3371 | | | |
| | 20 | 15 | | | | 297 | 489 | 772 | 1180 | 1614 | 2229 | 1981 | 2987 | 3849 | | |
| | 25 | 18.5 | | | | 243 | 401 | 632 | 966 | 1321 | 1821 | 1677 | 2438 | 3136 | 3765 | |
| | 30 | 22 | | | | 205 | 338 | 533 | 815 | 1115 | 1541 | 1433 | 2067 | 2665 | 3207 | 3792 |
| | 35 | 26 | | | | | 289 | 456 | 697 | 954 | 1317 | 1252 | 1765 | 2274 | 2734 | 3231 |
| | 40 | 30 | | | | | 251 | 396 | 607 | 831 | 1150 | 1015 | 1545 | 1996 | 2407 | 2852 |
| | 50 | 37 | | | | | 204 | 321 | 492 | 674 | 932 | 834 | 1253 | 1619 | 1951 | 2312 |
| | 60 | 45 | | | | | | 264 | 404 | 554 | 767 | 1272 | 1030 | 1331 | 1604 | 1901 |
| 8" WF | 40 | 30 | | | | | | 398 | 611 | 840 | 1167 | 1018 | 1576 | 2048 | 2482 | 2958 |
| | 50 | 37 | | | | | | 321 | 493 | 675 | 935 | 849 | 1257 | 1626 | 1961 | 2326 |
| | 60 | 45 | | | | | | 268 | 411 | 563 | 780 | 701 | 1049 | 1357 | 1637 | 1942 |
| | 75 | 55 | | | | | | 221 | 339 | 465 | 643 | 591 | 865 | 1119 | 1350 | 1602 |
| | 90 | 66 | | | | | | | 286 | 392 | 542 | 523 | 729 | 943 | 1138 | 1350 |
| | 100 | 75 | | | | | | | 252 | 346 | 480 | 421 | 646 | 838 | 1013 | 1204 |
| | 125 | 93 | | | | | | | 204 | 279 | 386 | 675 | 519 | 672 | 811 | 961 |
| | 75 | 55 | | | | | | | 329 | 450 | 621 | 562 | 831 | 1070 | 1285 | 1517 |
| 10" WF | 90 | 66 | | | | | | | 274 | 375 | 517 | 497 | 691 | 889 | 1068 | 1260 |
| | 100 | 75 | | | | | | | 242 | 331 | 457 | 402 | 613 | 790 | 950 | 1124 |
| | 125 | 93 | | | | | | | | 267 | 369 | 341 | 495 | 639 | 768 | 909 |
| | 150 | 110 | | | | | | | | 227 | 314 | 285 | 420 | 540 | 648 | 765 |
| | 180 | 135 | | | | | | | | | 262 | 256 | 353 | 456 | 550 | 653 |
| | 200 | 150 | | | | | | | | | 235 | 232 | 316 | 408 | 491 | 581 |
| | 225 | 165 | | | | | | | | | 213 | 207 | 286 | 369 | 444 | 525 |
| | 250 | 185 | | | | | | | | | | | 255 | 328 | 395 | 467 |

### 9.6 Connection of single-phase motors

All single-phase motors should be connected using SEI control box.

All single-phase motors require control box to operate. Connecting of single-phase motor must be made to the mains via the control box. All control boxes are provide with a connection diagram which have to be followed for proper connection.

### 9.7 Connection of three-phase motors

Three-phase submersible motors must be protected, see section 9.3.2 “Three-phase motors”.

When a conventional motor starter is being used, the electrical connection should be carried out as described below.

#### 9.7.1 Motors, direct-on-line starting

The connection of SEI submersible motors for direct-on-line starting as shown in below table and fig. 10.

| Mains | Cable/connection SEI 4" and 6" motor |
|---|---|
| | 60 Hz |
| PE | PE (Yellow/Green) |
| L1 | U (Black) |
| L2 | V (Yellow) |
| L3 | W (Red) |

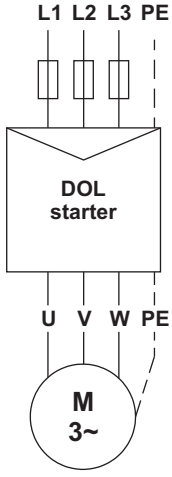



**Fig. 10** Wiring diagram for SEI direct-on-line starting motors

**Note** Check the direction of rotation as described in section 9.8 “Checking the direction of rotation”.

#### 9.7.2 Motors, star-delta starting

The connection of SEI submersible motors wound for star-delta starting appears from the table below and fig. 11.

| Connection | 60 Hz, SEI 4" & 6" motor |
|---|---|
| PE | Yellow/Green |
| U1 | Black |
| V1 | Yellow |
| W1 | Red |
| W2 | Black |
| U2 | Yellow |
| V2 | Red |

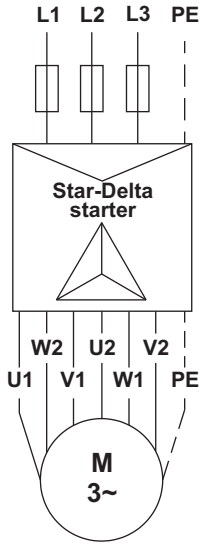



**Fig. 11** Wiring diagram for SEI star-delta starting motors

**Note** Check the direction of rotation as described in section 9.8 “Checking the direction of rotation”.

### 9.7.3 Soft starter

SEI only recommends the use of soft starters which control the voltage on all three phases and which are provided with a bypass switch.

Ramp times: Maximum 3 seconds.

For further details, please contact your soft starter supplier.

### 9.7.4 Frequency converter

Three-phase submersible motors can be connected to a frequency converter.

**Note** To enable the monitoring of the motor temperature, SEI recommends the installation of a PT100 sensor together with a suitable control panel.

Permissible frequency ranges: 30-60 Hz.
Ramp times: Maximum 3 seconds for start and stop.

Depending on the type, the frequency converter may cause increased acoustic noise from the motor. Furthermore, it may expose the motor to detrimental voltage peaks. This can be abated by installing an LC filter between the frequency converter and the motor.

For further details, please contact your frequency converter supplier.

### 9.8 Checking the direction of rotation

**Caution** The pump must not be started until the suction interconnector has been completely submerged in the liquid.

The direction of rotation should be checked in the following way every time the pump is connected to a new installation:

**Procedure:**

1. Start the pump and check the quantity of water and head developed.
2. Stop the pump and interchange two of the phase connections. In the case of motors wound for star-delta starting, exchange U1 by V1 and U2 by V2.
3. Start the pump and check the quantity of water and head developed.
4. Stop the pump.
5. Compare the results taken under points 1. and 3. The connection which gives the larger quantity of water and the higher head is the correct connection.

## 10. Start-up and operation

### 10.1 Start-up

When the pump has been connected correctly and it is submerged in the liquid to be pumped, it should be started with the discharge valve closed off to approx. 1/3 of its maximum volume of water.

Check the direction of rotation as described in section 9.8 “Checking the direction of rotation”.

If there are impurities in the water, the valve should be opened gradually as the water becomes clearer. The pump should not be stopped until the water is completely clean, as otherwise the pump parts and the non-return valve may choke up.

As the valve is being opened, the drawdown of the water level should be checked to ensure that the pump always remains submerged.

The dynamic water level should always be above the suction interconnector of the pump, see section 7.5.1 “Positional requirements” and fig. 12.

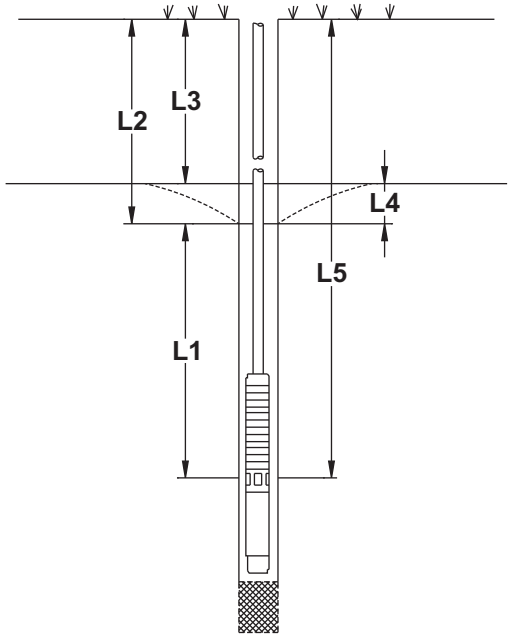



**Fig. 12** Comparison of various water levels

L1 = Minimum installation depth below dynamic water level. Minimum 1 metre is recommended
L2 = Depth to dynamic water level
L3 = Depth to static water level
L4 = Drawdown. This is the difference between the dynamic and the static water levels.
L5 = Installation depth.

If the pump is pumping more than the yield of water provided by the well it is recommended to provide dry running protection.

If no water level electrodes or level switches are installed, the water level may be drawn down to the suction inter-connector of the pump and the pump will then draw in air.

**Caution** Long time operation with water containing air may damage the pump and cause insufficient cooling of the motor.

### 10.2 Operation

#### 10.2.1 Minimum flow rate

To ensure the necessary cooling of the motor, the pump should never be set so low that the cooling requirements specified in section 7.3 “Liquid temperatures/cooling” cannot be met.

#### 10.2.2 Frequency of starts and stops

| Motor type | Number of starts |
|---|---|
| 4" motor | Minimum 1 in every 15 days is recommended. |
| | For maximum nos. of starts/hour see section 5.2 on page 5. |
| | Maximum 300 per day |
| 6" motor | Minimum 1 in every 15 days is recommended. |
| | For maximum nos. of starts/hour see section 5.2 on page 5. |
| | Maximum 300 per day |
| 8" motor | Minimum 1 in every 15 days is recommended. |
| | For maximum nos. of starts/hour see section 5.2 on page 5. |
| | Maximum 240 per day |
| 10" motor | Minimum 1 in every 15 days is recommended. |
| | For maximum nos. of starts/hour see section 5.2 on page 5. |
| | Maximum 190 per day |

### 11. Maintenance and service

The pumps/motors are maintenance-free.

All pumps/motors are easy to service.

Service kits and service tools are available from SEI.

The pumps/motors can be serviced at authorized SEI service centre.

If a pump has been used for a liquid which is injurious to health or toxic, the pump will be classified as contaminated.

If SEI is requested to service the pump, SEI must be contacted with details about the pumped liquid, etc. before the pump is returned for service. Otherwise SEI can refuse to accept the pump for service.

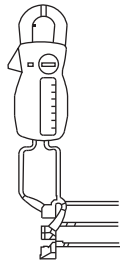
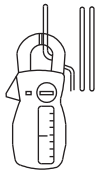
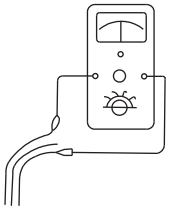
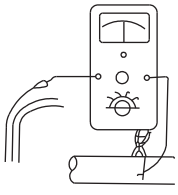
Possible costs of returning the pump are to be paid by the customer.

## 12. Fault finding chart

Before removal/dismantling of the pump, make sure that the electricity supply has been switched off and that it cannot be accidentally switched on. All rotating parts must have stopped moving.

| Fault | Cause | Remedy |
|---|---|---|
| 1. The pump/motor does not run. | a) The fuses are blown. | Replace the blown fuses. If the new ones blow too, the electric installation and the submersible drop cable should be checked. |
| | b) The ELCB or the voltage-operated ELCB has tripped out. | Cut in the circuit breaker. |
| | c) No electricity supply. | Contact the electricity supply company. |
| | d) The motor starter overload has tripped out. | Reset the motor starter overload (automatically or possibly manually). If it trips out again, check the voltage. Is the voltage OK, see items e) - h). |
| | e) Motor starter/contactor is defective. | Replace the motor starter/contactor. |
| | f) Starter device is defective. | Repair/replace the starter device. |
| | g) The control circuit has been interrupted or is defective. | Check the electric installation. |
| | h) The dry-running protection has cut off the electricity supply to the pump, due to low water level. | Check the water level. If it is OK, check the water level electrodes/level switch. |
| | i) The pump/submersible drop cable is defective. | Repair/replace the pump/cable. |
| 2. The pump runs but gives no water. | a) The discharge valve is closed. | Open the valve. |
| | b) No water or too low water level in borehole. | See item 3 a). |
| | c) The non-return valve is stuck in its shut position. | Pull out the pump and clean or replace the valve. |
| | d) The inlet strainer is choked up. | Pull out the pump and clean the strainer. |
| | e) The pump is defective. | Repair/replace the pump. |
| 3. The pump runs at reduced capacity. | a) The drawdown is larger than anticipated. | Increase the installation depth of the pump, throttle the pump or replace it by a smaller model to obtain a smaller capacity. |
| | b) Wrong direction of rotation. | See section 9.8 “Checking the direction of rotation”. |
| | c) The valves in the discharge pipe are partly closed/blocked. | Check and clean/replace the valves, if necessary. |
| | d) The discharge pipe is partly choked by impurities (ochre). | Clean/replace the discharge pipe. |
| | e) The non-return valve of the pump is partly blocked. | Pull out the pump and check/replace the valve. |
| | f) The pump and the riser pipe are partly choked by impurities (ochre). | Pull out the pump. Check and clean or replace the pump, if necessary. Clean the pipes. |
| | g) The pump is defective. | Repair/replace the pump. |
| | h) Leakage in the pipework. | Check and repair the pipework. |
| | i) The riser pipe is defective. | Replace the riser pipe. |
| 4. Frequent starts and stops. | a) The differential of the pressure switch between the start and stop pressures is too small. | Increase the differential. However, the stop pressure must not exceed the operating pressure of the pressure tank, and the start pressure should be high enough to ensure sufficient water supply. |
| | b) The water level electrodes or level switches in the reservoir have not been installed correctly. | Adjust the intervals of the electrodes/level switches to ensure suitable time between the cutting-in and cutting-out of the pump. See installation and operating instructions for the automatic devices used. If the intervals between stop/start cannot be changed via the automatics, the pump capacity may be reduced by throttling the discharge valve. |
| | c) The non-return valve is leaking or stuck half open. | Pull out the pump and clean/replace the non-return valve. |
| | d) The volume of air in the pressure/diaphragm tank is too small. | Adjust the volume of air in the pressure/diaphragm tank in accordance with its installation and operating instructions. |
| | e) The pressure/diaphragm tank is too small. | Increase the capacity of the pressure/diaphragm tank by replacing or supplementing with another tank. |
| | f) The diaphragm of the diaphragm tank is defective. | Check the diaphragm tank. |

## 13. Checking of motor and cable

| | | |
|---|---|---|
| 1. Supply voltage  | Measure the voltage between the phases by means of a voltmeter.<br>On single-phase motors, measure between phase and neutral or between two phases, depending on the type of supply.<br>Connect the voltmeter to the terminals in the motor starter. | The voltage should, when the motor is loaded, be within the range specified in section 9.1 “General”.<br>The motor may burn if there are larger variations in voltage. Large variations in voltage indicate poor electricity supply, and the pump should be stopped until the defect has been remedied. |
| 2. Current consumption  | Measure the amps of each phase while the pump is operating at a constant discharge head (if possible, at the capacity where the motor is most heavily loaded).<br>For maximum operating current, see nameplate. | On three-phase motors, the difference between the current in the phase with the highest consumption and the current in the phase with the lowest consumption should not exceed 5 %. If so, or if the current exceeds the rated current, there are the following possible faults:<br>• The contacts of the motor starter burnt. Replace the contacts or the control box for single-phase operation.<br>• Poor connection in leads, possibly in the cable joint. See item 3.<br>• Too high or too low supply voltage. See item 1.<br>• The motor windings are short-circuited or partly disjointed. See item 3.<br>• Damaged pump is causing the motor to be overloaded. Pull out the pump for overhaul.<br>• The resistance value of the motor windings deviates too much (three-phase). Move the phases in phase order to a more uniform load. If this does not help, see item 3. |
| Items 3 and 4: Measurement is not necessary when the supply voltage and the current consumption are normal. | | |
| 3. Winding resistance  | Disconnect the submersible drop cable at the motor starter.<br>Measure the winding resistance between the leads of the drop cable. | For three-phase motors, the deviation between the highest and the lowest value should not exceed 10 %.<br>If the deviation is higher, pull out the pump.<br>Measure motor, motor cable and drop cable separately, and repair/replace defective parts.<br>**Note**: On single-phase, 3-wire motors, the operating winding will assume the lowest resistance value. |
| 4. Insulation resistance  | Disconnect the submersible drop cable at the motor starter.<br>Measure the insulation resistance from each phase to earth (frame).<br>Make sure that the earth connection is made carefully. | If the insulation resistance is less than 0.5 MO, the pump should be pulled out for motor or cable repair.<br>Local regulations may specify other values for the insulation resistance. |

## 14. Disposal

Disposal of this product or parts of it must be carried out according to the following guidelines:

1. Use the local public or private waste collection service.

**Removal and fitting of cable guard: P04, P06, P08 & P10**

**Pump type: P04-05, P04-07, P04-10, P04-16, P04-25**

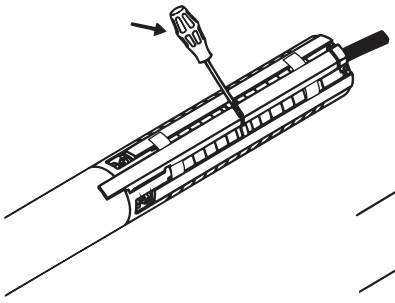


Fig. 1

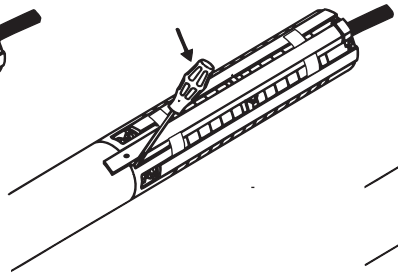


Fig. 2

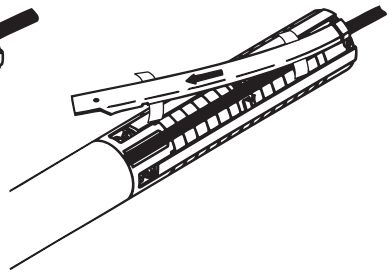


Fig. 3

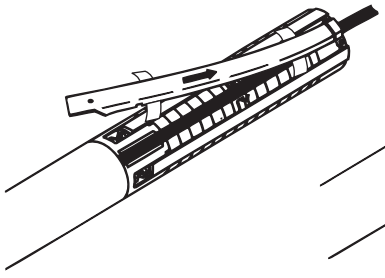


Fig. 1

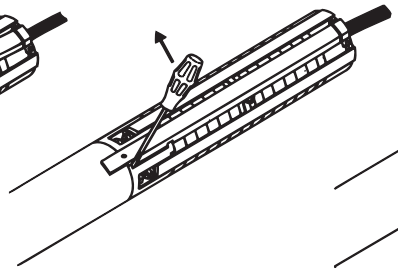


Fig. 2

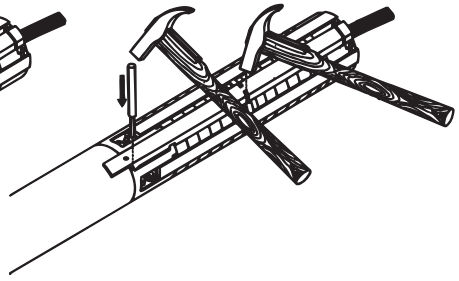


Fig. 3

**Pump type: P04-40, P04-60, P04-75**

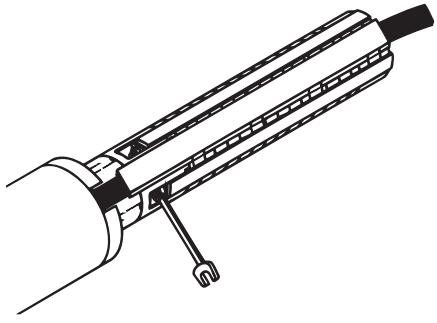


Fig. 1

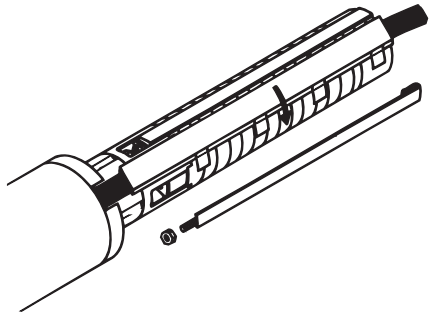


Fig. 2

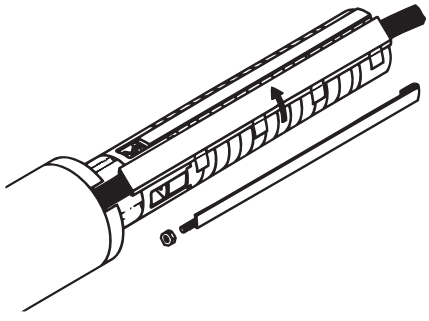


Fig. 1

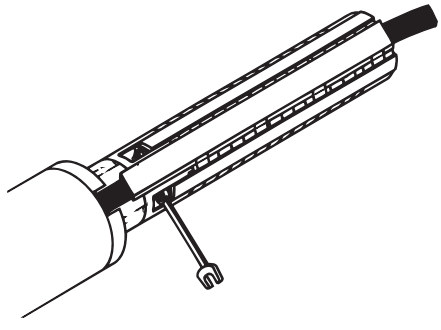


Fig. 2

**Removal and fitting of cable guard: P04, P06, P08 & P10**

**Pump type: P06-85, P06-150, P06-230, P06-300**

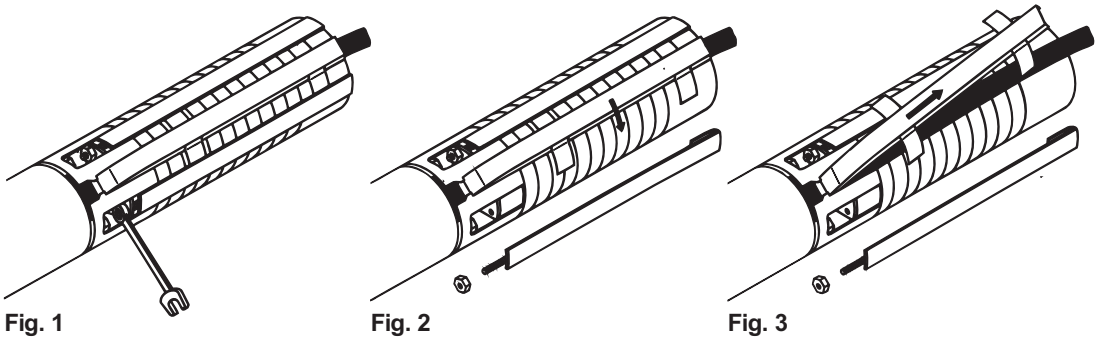


Fig. 1 Fig. 2 Fig. 3

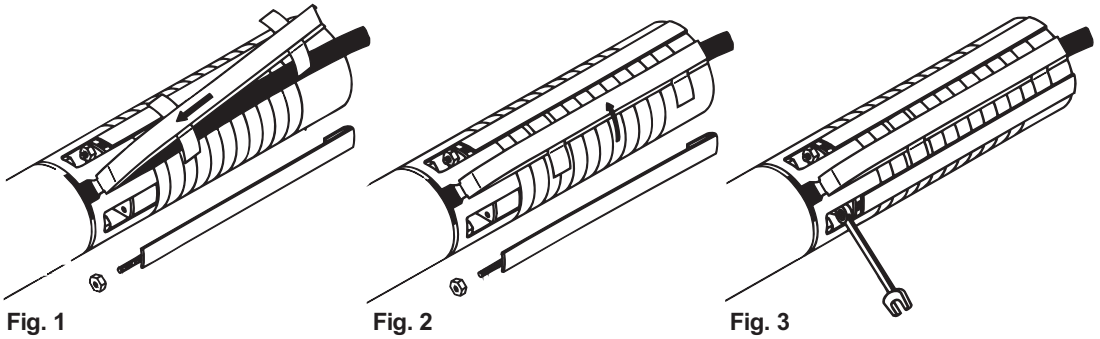


Fig. 1 Fig. 2 Fig. 3

**Pump type: P08-385, P08-475, P10-625, P10-800, P10-1100**

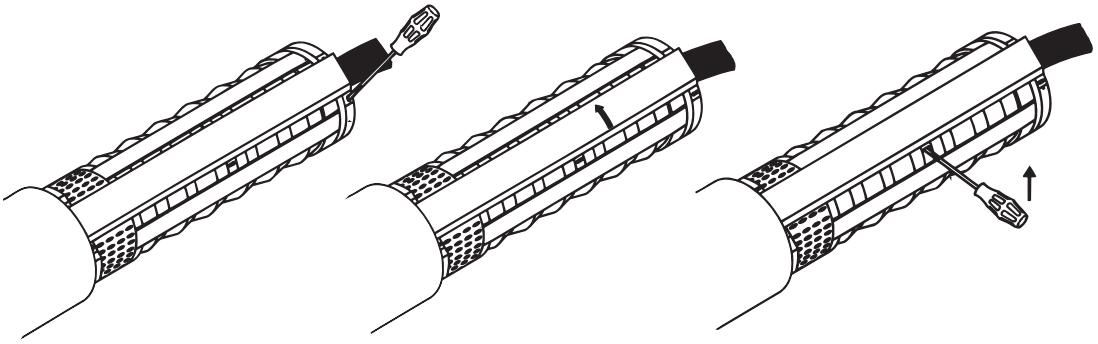


Fig. 1 Fig. 2 Fig. 3

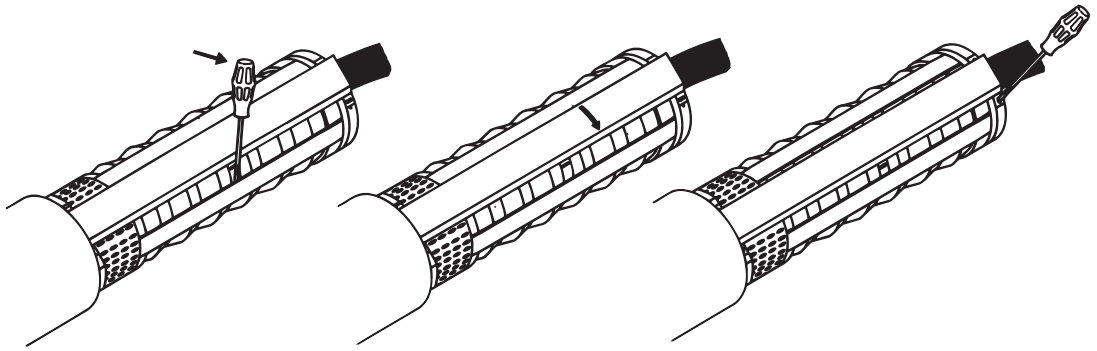


Fig. 1 Fig. 2 Fig. 3

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