S pumps, ranges 50-70

S1, S2, S3, ST, SV
10-208 hp

Installation and operating instructions

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GRUNDFOS

Original installation and operating instructions.

CONTENTS

Warning

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

1. Limited warranty

Products manufactured by GRUNDFOS PUMPS CORPORATION (Grundfos) are warranted to the original user only to be free of defects in material and workmanship for a period of 24 months from date of installation, but not more than 30 months from date of manufacture. Grundfos' liability under this warranty shall be limited to repairing or replacing at Grundfos' option, without charge, F.O.B. Grundfos' factory or authorized service station, any product of Grundfos' manufacture. Grundfos will not be liable for any costs of removal, installation, transportation, or any other charges which may arise in connection with a warranty claim. Products which are sold but not manufactured by Grundfos are subject to the warranty provided by the manufacturer of said products and not by Grundfos' warranty. Grundfos will not be liable for damage or wear to products caused by abnormal operating conditions, accident, abuse, misuse, unauthorized alteration or repair, or if the product was not installed in accordance with Grundfos' printed installation and operating instructions.

To obtain service under this warranty, the defective product must be returned to the distributor or dealer of Grundfos' products from which it was purchased together with proof of purchase and installation date, failure date, and supporting installation data. Unless otherwise provided, the distributor or dealer will contact Grundfos or an authorized service station for instructions.
Any defective product to be returned to Grundfos or a service station must be sent freight prepaid; documentation supporting the warranty claim and/or a Return Material Authorization must be included if so instructed.

GRUNDFOS WILL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, LOSSES, OR EXPENSES ARISING FROM INSTALLATION, USE, OR ANY OTHER CAUSES. THERE ARE NO EXPRESS OR IMPLIED WARRANTIES, INCLUDING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH EXTEND BEYOND THOSE WARRANTIES DESCRIBED OR REFERRED TO ABOVE.

Some jurisdictions do not allow the exclusion or limitation of incidental or consequential damages and some jurisdictions do not allow limit actions on how long implied warranties may last. Therefore, the above limitations or exclusions may not apply to you. This warranty gives you specific legal rights and you may also have other rights which vary from jurisdiction to jurisdiction.

2. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury.

Warning

The surface of the product may be so hot that it may cause burns or personal injury.

Warning

The sound pressure level is so high that hearing protection must be used.

Warning

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These instructions must be observed for explosion-proof pumps. It is advisable also to follow these instructions for standard pumps.

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.***

3. General description

This booklet includes instructions for installation, operation and maintenance of Grundfos submersible sewage and wastewater S pumps, range 50-70, fitted with motors of 10 to 210 hp (7.5 to 160 kW).

Special conditions for safe use of S pumps, range 50-70 FM:

1. Installation shall comply with the relevant requirements of the National Electrical Code® (ANSI/NFPA 70) and this manufacturer's installation and operating instructions.
2. Make sure the moisture switches and thermal switches are connected in two separate circuits and have separate alarm outputs (motor stop) in case of high humidity or high temperature in the motor.
3. Bolts used for replacement must be class A4-80 or A2-80 according to EN/ISO 3506-1.
4. During operation the cooling jacket, when fitted, must be filled with pumped liquid.

FM APPROVED

5. The level of pumped liquid must be controlled by level switches connected to the motor control circuit. The minimum level depends on the installation type and is specified in these installation and operating instructions.
6. Dry-running is not allowed.
7. Make sure the permanently attached cables are suitably mechanically protected and terminated in a suitable terminal board.
8. The sewage pumps have an ambient temperature range of 32 °F to 104 °F (0 °C to +40 °C) and a maximum process temperature 104 °F (+40 °C).

The thermal protector in the stator windings with a nominal switch temperature of 302 °F (150 °C) must guarantee the disconnection of the supply; resetting must be manual.

3.1 Applications

S pumps, range 50-70 are designed for the pumping of sewage and wastewater in a wide range of municipal, private and industrial applications.

Depending on the installation type, the pumps can be used for submerged or dry, horizontal or vertical installation.

Maximum solids size: 3- 6" (80-145 mm) depending on range.

3.2 Operating conditions

3.2.1 pH value

All pumps can be used for pumping liquids with a pH value between 4 and 10.

3.2.2 Liquid temperature

32 °F to 104 °F (0 °C to +40 °C).

FM APPROVED ***Warning***

Explosion-proof pumps must never pump liquids with a temperature higher than 104 °F (+40 °C).

3.2.3 Ambient temperature

-4 °F to 104 °F (-20 °C to +40 °C).

FM APPROVED ***Warning***

For explosion-proof pumps, the ambient temperature on the installation site must be in the range between 32 °F and +104 °F (0 °C and +40 °C).

3.2.4 Density and viscosity of pumped liquid

Density: 133.5 ounces / gallon (1000 kg/m^3).

Kinematic viscosity: 1 cSt (1 mm^2/s).

Note ***When pumping liquids with a density and/or a kinematic viscosity higher than the values stated above, use motors with correspondingly higher outputs.***

3.2.5 Flow velocity

It is advisable to keep a minimum flow velocity to avoid sedimentations in the piping system.

Recommended velocities:

In vertical pipes: 2.3 ft/s (0.7 m/s)

In horizontal pipes: 3.3 ft/s (1.0 m/s)

3.2.6 Level of pumped liquid

For a submerged pump, installation type C, the lowest stop level must always be above the pump housing.

Warning

Install an additional level switch to ensure that the pump is stopped in case the stop level switch is not operating.

Installation type	Description	Accessories
S	Sewage pump without cooling jacket for submerged installation on auto coupling.	Auto coupling
C	Sewage pump with cooling jacket for submerged installation on auto coupling.	Auto coupling
D	Sewage pump with cooling jacket for dry vertical installation.	Range 50, 54, 58 and 62: Base stand for vertical installation.
		Range 66 and 70: Base plate for vertical installation.
H	Sewage pump with cooling jacket for dry horizontal installation.	Base stand for horizontal installation
ST	Sewage pump without cooling jacket for installation in vertical column pipe.	Seat ring

To ensure adequate cooling of the motor during operation, the following minimum requirements must be met:

- **Installation type S:**
  The pump must always be covered by the pumped liquid to the top of the motor.

Warning

For FM-approved pumps of installation type S, the liquid level must always be to the top of the motor.

- **Installation type C:**
  The pump housing must always be covered by the pumped liquid.

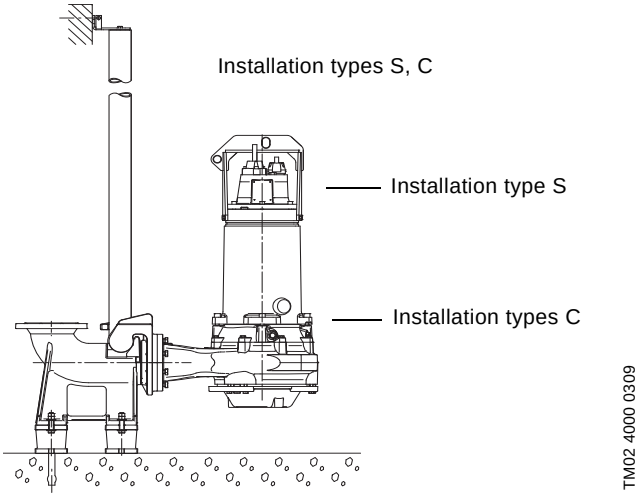


Fig. 1 Liquid level

- **Installation types D and H:**
  No special requirements.
- **Installation type ST:**
  The liquid level must be at least 14" (350 mm) above the pump inlet, see fig. 10.

3.2.7 Operating mode

The pumps are designed for continuous operation or for intermittent operation with the maximum number of starts per hour stated in the table below:

S pump, range	Starts per hour
50 54 58	20
62 66 70	15

3.2.8 Enclosure class

IEC IP68.

3.3 Sound pressure level

Warning

Depending on the installation type the sound pressure level of the pump can be higher than 70 dB(A).

When working nearby such an installation in operation, hearing protection must be used.

3.4 Type key

All S pumps, range 50-70, described in this booklet are identified by the type code stated in the confirmation of order and other documentation supplied with the pump.

Please note that the pump type described in this booklet is not necessarily available in all variants.

Code	Example	S	1	.40	.A80	.980	4	.66	H	.S	.358	.G	.N	.D	.6	11	.Z

Pump type

S	Grundfos sewage and wastewater pump
ST	Multi-channel impeller pump installed in column pipe

Impeller type

1	Single-channel
2	Two-channel
3	Three-channel
V	SuperVortex

Pump passage

Maximum solids size = code number from type designation / 10 [inch]

40	4" (100 mm)

Pump discharge

Nominal diameter of pump discharge port = code number from type designation / 10 [inch]

A80	8" (200 mm)

Motor power, P2

P2 = code number from type designation / 10 [hp]

Number of poles

2	2-pole motor
4	4-pole motor
6	6-pole motor
8	8-pole motor

Pump range

50	Range 50
54	Range 54
58	Range 58
62	Range 62
66	Range 66
70	Range 70

Pressure version

H	High
M	Middle
L	Low
E	Extra low

Installation type

S	Submersible installation without cooling jacket
C	Submersible installation with cooling jacket
D	Dry, vertical installation
H	Dry, horizontal installation

Actual impeller diameter

[mm]

Material code for impeller, pump housing and motor housing

G	Cast iron impeller, pump housing and motor housing
Q	Stainless steel impeller, AISI 316 (DIN W.-Nr. 1.4408)

Pump version

N	Non-explosion-proof pump
Ex	Explosion-proof pump

Sensor version

B	S pump with built-in SM 113 module. PTC sensors are connected directly to IO 113 or other PTC relay.
C	Not in use
D	S pump without built-in SM 113 module

Frequency

6	60 Hz

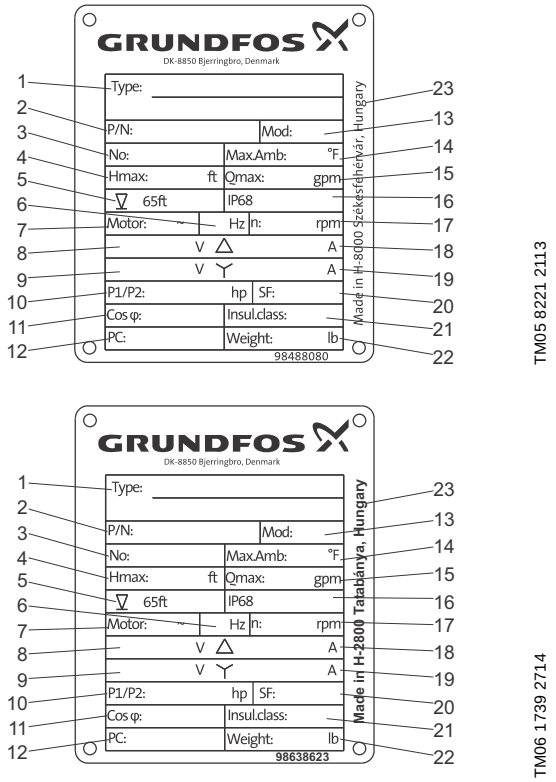
Voltage code and connection

11	3 x 460 / (797) V	Y/D
3A	3 x 460 V, factory wired	(Dual voltage, 230 V or 460 V)
3B	3 x 230 V, factory wired	(Dual voltage, 230 V or 460 V)

Z	Custom-built products

3.5 Nameplates

All pumps can be identified by means of the nameplate on the motor top cover, see fig. 2 and fig. 3. If the nameplate is missing or damaged, the pump can be identified by the serial number stamped under the nameplate.

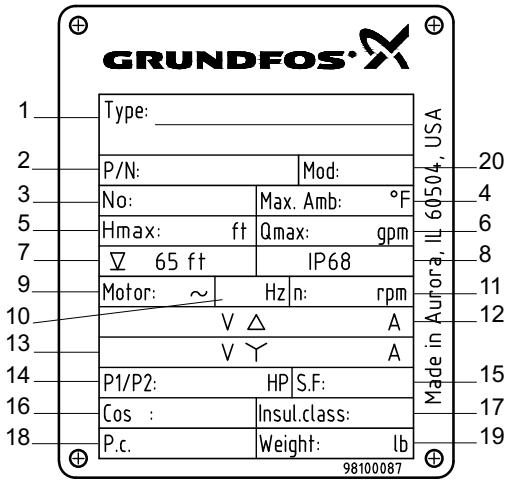


TM05 8221 2113

TM06 1739 2714

Fig. 2 Pump nameplate

Pos.	Description
1	Type designation
2	SAP code
3	Serial number
4	Maximum head (ft)
5	Maximum installation depth (ft)
6	Frequency (Hz)
7	Number of phases
8	Voltage, delta connection
9	Voltage, star connection
10	Power input/output (hp)
11	Cos φ, 1/1 load
12	Production code (YYWW)
13	Production number
14	Maximum liquid temperature (°F)
15	Maximum flow rate (gpm)
16	Enclosure class
17	Rated speed
18	Current, delta connection
19	Current, star connection
20	Motor safety factor
21	Insulation class
22	Weight (lb)
23	Production site

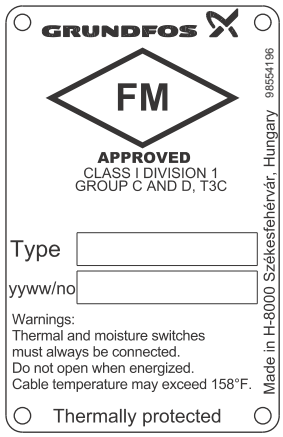


TM05 5094 3212

Fig. 3 Pump nameplate, YCC

Pos.	Description
1	Type designation
2	SAP code
3	Serial number
4	Maximum liquid temperature (°F)
5	Maximum head (ft)
6	Maximum flow rate (gpm)
7	Maximum installation depth (ft)
8	Enclosure class
9	Number of phases
10	Frequency (Hz)
11	Rated speed
12	Voltage/current, delta connection
13	Voltage/current, star connection
14	Power input/output (hp)
15	Motor service factor
16	Cos φ, 1/1 load
17	Insulation class
18	Production code (YYWW)
19	Weight (lb)
20	Production number

3.6 FM approval plate



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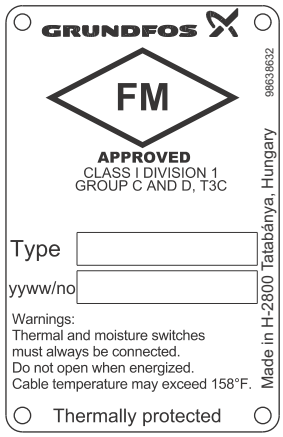


TM06 1740 2714

Fig. 4 Approval plate of explosion-proof pumps

According to NEC500 the following classification applies for this electrical equipment:

FM APPROVED	FM approval symbol.
Class I	Permitted for locations where flammable gases or vapors may be present.
Division 1	Permitted for locations where flammable or combustible gases can exist under normal operating conditions or because of repair, breakdown or faulty operation of equipment.
Group C and D	Permitted for specific gases or vapors of Group C and D that will be present.
T3C	Temperature class (T code). Surface temperature max. 320 °F (160 °C).
Type	FM listing code (e.g. S50X13.5/4.60).
yyww/no	Production year, week and serial number (e.g. 1052/123456).

3.6.1 FM certification and classification

Pump	Approval
50-70	Class I Division 1 Group C and D Hazardous (Classified) Locations. Temperature class T3C.

4. Safety

Warning

Pump installation in pits must be carried out by specially trained persons.

Warning

Persons must not enter the installation area when the atmosphere is explosive.

Warning

It must be possible to lock the mains switch in position 0. Type and requirements as specified in National Electrical Code and all local codes.

For safety reasons, all work in pits must be supervised by a person outside the pump pit.

Pits for submersible sewage and wastewater pumps contain sewage and wastewater with toxic and/or disease-causing substances. Therefore, all persons involved must wear appropriate personal protective equipment and clothing and all work on and near the pump must be carried out under strict observance of the hygiene regulations in force.

Warning

For some installation types, the surface temperature may be up to 194 °F (90 °C).

Warning

Make sure that the lifting eye bolts are tightened before attempting to lift the pump. Tighten if necessary. Carelessness during lifting or transportation may cause injury to personnel or damage to the pump.

Warning

Make sure the rated lifting capacity of the lifting equipment (lifting chain etc.) is adequate before attempting to lift the pump.

The rated lifting capacity of the lifting equipment is marked in the identification label. The weight of the pump is marked in the pump nameplate.

4.1 Lifting points for submerged and dry vertical installation (S/C/D)

When lifting the pump it is important to use the right lifting point to keep the pump balanced. S pumps model S/C/D are equipped with a bracket with liftting points ensuring that the pump can be lifted in a safe manner. See fig. 5 and table below to find the correct lifting point.

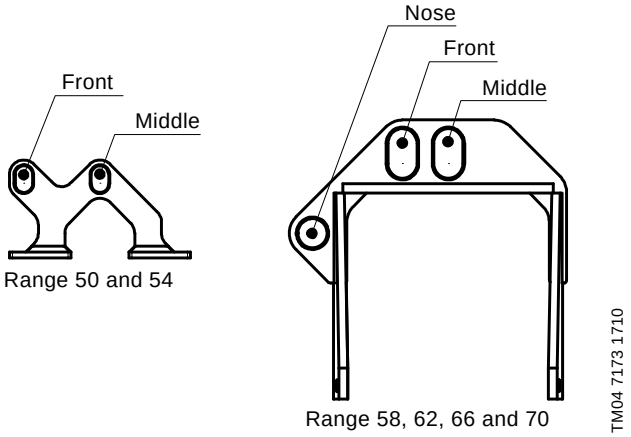


Fig. 5 Lifting points

Discharge flange size	Pump range					
	50	54	58	62	66	70
A30	Middle	Middle	-	-	-	-
A40	Middle	Middle	-	-	-	-
A50	Middle	Middle	Middle	Middle	-	-
A80	Front	Front	Front	Middle	Middle	Middle
A100	-	Front	-	-	Middle	Middle
A120	-	-	Front	Middle	Middle	Middle
A200	-	-	-	-	Nose	Front
A240	-	-	-	-	Nose	Front

5. Transportation and storage

The pump is supplied from the factory in proper packing in which it should remain until it is to be installed.

Make sure that the pump cannot roll or fall over.

All lifting equipment must be rated for the purpose and checked for damage before any attempt to lift the pump. The lifting equipment rating must under no circumstances be exceeded. The pump weight is stated on the pump nameplate.

Warning

Always lift the pump by its lifting bracket or by means of a fork-lift truck, never by means of the motor cable or the hose/pipe.

Caution

Do not remove the insulation from the free end of the supply cable until the electrical connection is to be made. Whether insulated or not, the free cable end must never be exposed to moisture or water. Non-compliance with this may cause damage to the motor.

For long periods of storage, the pump must be protected against moisture and heat.

Storage temperature: -22 °F to +140 °F (-30 °C to +60 °C).

Warning

If the pump is stored for more than one year or it will be a long time before it is put into operation after the installation, the impeller must be turned at least once a month.

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. Pay special attention to the condition of the shaft seals and the cable entry.

6. Installation

Warning

Before beginning the installation, switch off the power supply and lock the mains switch in position 0.

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

The extra nameplate supplied with the pump should be fixed at the installation site.

All safety regulations must be observed at the installation site, for instance the use of blowers for fresh-air supply to the pit.

Warning

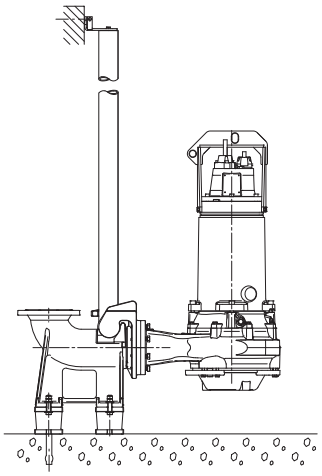
Do not put your hands or any tool into the pump suction or discharge port after the pump has been connected to the power supply, unless the pump has been switched off by removing the fuses or switching off the mains switch. It must be ensured that the power supply cannot be accidentally switched on.

Prior to installation, check the oil level in the oil chamber, see *10.1 Oil check and oil change*.

6.1 Installation types

S pumps, range 50-70 are designed for various installation types.
Figures 6 to 10 show the possible installation types.

Installation types S and C



TM02 4000 0309

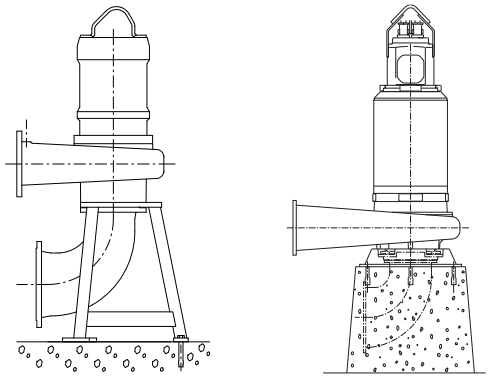
Fig. 6 Submerged installation on auto coupling

Caution ***Avoid pipe tension at flanges and bolts.***

Caution ***The exposed end of the cable must not be submerged as water may penetrate through the cable into the motor.***

Permanent installation in pit: The pump can easily be pulled out and lowered into the pit by means of the guide rails.
The liquid level can be set lower for type C than for type S.
See fig. 1.

Installation type D

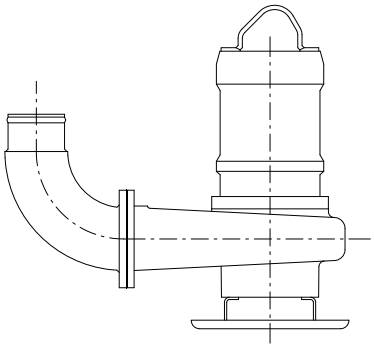


TM02 4001 4601 - TM02 4023 4701

Fig. 7 Dry, vertical installation with base stand (left) and base plate on two concrete pedestals (right)

Permanent installation in a pump room: The pump is bolted to the suction and discharge pipes by means of flange connections.
Range 66 or 70 pumps must always be installed on a concrete foundation (see the above figure to the right).

Installation types S and C

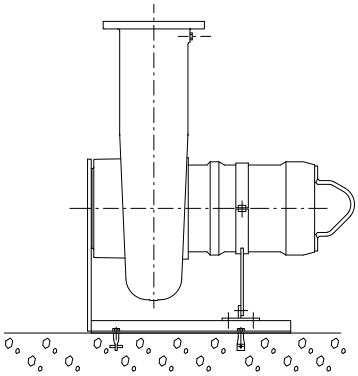


TM02 4002 4601

Fig. 8 Submerged, free standing installation

Free standing installation in a pit: The liquid level can be set lower for type C than for type S. See fig. 1.

Installation type H

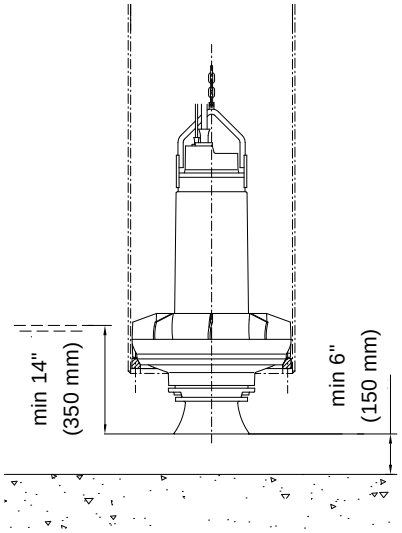


TM02 4003 4601

Fig. 9 Dry horizontal installation with base stand and bracket

Permanent installation in a pump room: The pump is bolted to the suction and discharge pipes by means of flange connections.

Pump type ST



TM02 2494 4401

Fig. 10 Column pipe installation

6.2 Submerged installation on auto coupling

Pumps for permanent installation can be installed on a stationary auto coupling and operated completely or partially submerged in the pumped liquid.

Note ***Make sure that the pipework is installed without the use of undue force. No loads from the pipework weight must be carried by the pump. We recommend the use of loose flanges to ease the installation and to avoid pipe tension at flanges and bolts.***

Note ***Do not use elastic elements or bellows in the pipework; these elements should never be used as a means to align the pipework.***

Note ***In some installations, a plinth is required beneath the auto coupling to ensure correct installation of the pump. This should be considered during the design of the installation.***

1. Drill mounting holes for the guide rail bracket on the inside of the pit and fasten the guide rail bracket provisionally with two screws.
2. Place the auto-coupling base unit on the bottom of the pit. Use a plumb line to establish the correct positioning. Fasten the auto coupling with expansion bolts. If the bottom of the pit is uneven, the auto-coupling base unit must be supported so that it is level when being fastened.
3. Assemble the discharge pipe in accordance with the generally accepted procedures and without exposing the pipe to distortion or tension.
4. Place the guide rails on the auto-coupling base unit and adjust the length of the rails accurately to the guide rail bracket at the top of the pit.
5. Unscrew the provisionally fastened guide rail bracket. Insert the expansion dowels into the guide rails. Fasten the guide rail bracket on the inside of the pit. Tighten the bolts in the expansion dowels.
6. Clean out debris from the pit before lowering the pump into the pit.
7. Fit the guide claw to the pump.
8. Slide the guide claw of the pump between the guide rails and lower the pump into the pit by means of a chain secured to the lifting bracket of the pump. When the pump reaches the auto-coupling base unit, the pump will automatically connect tightly.
9. Hang up the end of the chain on a suitable hook at the top of the pit and in such a way that the chain cannot come into contact with the pump housing.
10. Adjust the length of the motor cable by coiling it up on a relief fitting to ensure that the cable is not damaged during operation. Fasten the relief fitting to a suitable hook at the top of the pit. Make sure that the cables are not sharply bent or pinched.
11. Connect the motor cable and the control cable, if any.

Note ***The free end of the cable must not be submerged, as water may penetrate through the cable into the motor.***

6.3 Dry installation

Pumps in dry installation are installed permanently in a pump room.

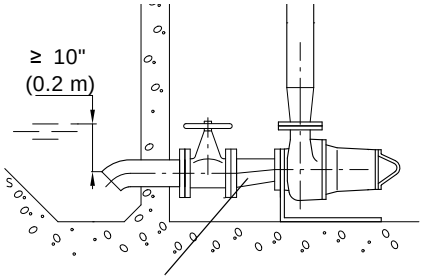
The pump motor is enclosed and watertight and will not be damaged if the installation site is flooded with water.

1. Mark and drill mounting holes in the concrete floor/concrete foundation.
2. Fit the bracket or base stand to the pump.
3. Fasten the pump with expansion bolts.
4. Check that the pump is vertical/horizontal.

In order to facilitate service on the pump, we recommend to use isolating valves on either side of the pump.

5. Fit the suction and discharge pipes and isolating valves, if used, and ensure that the pump is not stressed by the pipework.
6. Adjust the length of the motor cable by coiling it up on a relief fitting to ensure that the cable is not damaged during operation. Fasten the relief fitting to a suitable hook. Make sure that the cables are not sharply bent or pinched.
7. Connect the motor cable and the control cable, if any.

Caution ***We recommend to use a reducer between the suction pipe and the pump in horizontal installations. The reducer must be of the eccentric type and must be installed so that the straight edge is pointing upwards. In this way, the accumulation of air in the suction pipe is avoided and the risk of disturbance of operation is eliminated. See fig. 11.***



Reducer of the eccentric type

TM02 2396 4201

Fig. 11 Eccentric reducer

6.4 Submerged installation, portable

1. Fit the ring stand to the pump suction flange.
2. Fit a 90 ° elbow to the pump discharge port and connect the discharge pipe/hose.

If a hose is used, make sure that the hose does not buckle and that the inside diameter matches that of the discharge port.

3. Lower the pump into the liquid by means of a chain secured to the lifting bracket of the pump. It is recommended to place the pump on a plane, solid foundation. Make sure that the pump is hanging from the chain and **not** the cable.
4. Hang up the end of the chain on a suitable hook at the top of the pit and in such a way that the chain cannot come into contact with the pump housing.
5. Adjust the length of the motor cable by coiling it up on a relief fitting to ensure that the cable is not damaged during operation. Fasten the relief fitting to a suitable hook. Make sure that the cables are not sharply bent or pinched.
6. Connect the motor cable and the control cable, if any.

6.5 Column pipe installation

Pumps for column pipe installation are installed permanently in a column pipe. Grundfos does not normally supply the column pipe. Dimensioning of the column pipes is suggested in the pump specific dimensional drawings.

1. Fit the seat ring to the bottom of the column pipe.
2. Clean out debris from the pit.
3. Before lowering the pump into the column pipe, check the cables visually for cuts or ruptures which may have been caused by rough handling during transportation or installation.
4. Lower the pump into the column pipe by means of a certified chain secured to the lifting bracket of the pump. The pump will sit against the conical surface of the seat ring. Normally the friction between the conical surfaces will prevent the pump from rotating. As an extra precaution there are three guide pins on the seat ring which will limit the possible rotation to max. 60 °.
5. Hang up the end of the chain above or at the top of the column pipe in such a way that the chain cannot come into contact with the pump.
6. Adjust the length of the cables but remember to have enough cable length to be able to service the pump. Make sure that the cables are not sharply bent or pinched. Fix the cables in such a way that there is no extra slack in the column pipe. With long columns it may be necessary to arrange cable support for the cable inside the column pipe. If necessary, please contact Grundfos.
7. Connect the motor cables and the sensor cable.

6.6 Pump controller

S pumps, range 50-70 can be connected to a separate Grundfos pump controller for level control, which is available as an accessory:

- Grundfos Dedicated Controls (DC) for one to six pump installations.

The Dedicated Controls system starts/stops the S pumps by means of:

- float switches
- pressure sensor
- ultrasonic sensor.

Furthermore, it is possible to control the water level by both float switches and an analog pressure sensor or ultrasonic sensor.

Optionally, DC can control a mixer. The Dedicated Controls system can be extended with an IO 113 module per pump (for S pumps with built-in sensor).

When installing the level switches, the following points should be observed:

1. To prevent air intake and vibrations in submerged pumps, the **stop level switch** must be fitted in such a way that the pump is stopped before the liquid level is lowered below the top of the pump housing.
   As a principal rule for pumps in dry installation, the lowest stop level must be at least 8" (200 mm) above the opening of the suction pipe, see fig. 11.
2. The **start level switch** should be installed in such a way that the pump is started at the required level; however, the pump must always be started before the liquid level reaches the bottom inlet pipe to the pit.
3. The **high-level alarm switch**, if installed, should always be installed about 4" (100 mm) above the start level switch; however, alarm must always be given before the liquid level reaches the inlet pipe to the pit.

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Warning

The pump controller must not be installed in potentially explosive atmospheres.

FM APPROVED

Warning

Pumps installed in potentially explosive atmosphere must always be filled with the pumped liquid.

An additional level switch must be installed to ensure that the pump is stopped in case the stop level switch is not operating.

6.7 Galvanic separation

Double-insulated sensors for all measurements of high voltages ensure the electrical safety. Furthermore, there is a galvanic separation inside the IO 113.

6.8 IO 113

The IO 113 forms interface between a Grundfos sewage and wastewater pump with analogue and digital sensors and the pump controller. The most important sensor data are indicated on the front panel.

One pump can be connected to an IO 113 module.

Together with the sensors, the IO 113 forms a galvanic separation between the motor voltage in the pump and the controller connected.

6.8.1 Measurement of insulation resistance

The IO 113 measures the insulation resistance between a stator winding and earth:

- Resistance above 10 MΩ = ok.
- Resistance between 10 MΩ and 1 MΩ = warning.
- Resistance below 1 MΩ = alarm.

6.9 Thermal switches

Three bimetallic thermal switches are built into the stator windings, and a contact will open in case of over temperature, i.e. 302 °F (150 °C).

The supply voltage to the thermal switches must be 12-230 VAC.

The thermal switches are connected to the control cable, see *8. Electrical connection*, and must be connected to the safety circuit of the separate pump controller.

Caution

The motor-protective circuit breaker of the pump controller must include a circuit which automatically disconnects the power supply in case the protective circuit for the pump is opened.

FM APPROVED

Warning

The installer/user must install an automatic circuit breaker which disconnects the power supply in case the thermal switches or the moisture switches are not operating.

6.10 Moisture switches

Non-explosion-proof pumps have one moisture switch, which is fitted in the chamber below the motor top cover.

Ranges 50-58 and 66-70 explosion-proof-pumps have two moisture switches, one below the motor top cover and one in the stator housing in the bottom of the motor.

Range 62 has both moisture switches placed below the motor top cover. Moisture switches and thermal switches are motor protection devices which protect the motor from damage due to moisture or overheating. The moisture switches are non-reversing and must be replaced after use.

The moisture switches and thermal switches are connected in two separate circuits and to the control cable. See *8. Electrical connection*. They are also to be connected to the safety circuit of the separate pump controller.

Caution ***The safety circuit for the moisture switch must ensure that the pump cannot start if the moisture switch becomes wet due to water ingress.***

Caution ***The motor-protective circuit breaker of the pump controller must include a circuit which automatically disconnects the power supply in case the protective circuit for the pump is opened.***

6.11 Thermistors

Thermistors are available as an option.

The thermistors can be used as motor protection devices to monitor stator temperature instead of thermal switches and must be connected to the thermistor relay in the control cabinet.

6.11.1 Checking after installation of pump

1. Using a multimeter, check whether the circuit resistance is < 150 Ω / thermistor.
2. Using a multimeter, check whether the insulation between circuit and stator housing is outside the scale (not measurable ∞).
3. Carry out similar measurements at the end of the supply cable.

6.12 Pt100 temperature sensor

The Pt100 temperature sensor is available as an accessory or as an FPV (Factory Product Variant) option.

The Pt100 sensor is primarily used for the monitoring of bearing temperature, but it can also be used in the stator.

Note ***The bearing temperature monitoring is only available as an option. It is not available for range 50 and 54.***

The sensor resistance is

- 100 Ω at 32 °F (0 °C)
- 138.5 Ω at 212 °F (100 °C)
- approx. 108 Ω at room temperature.

The following temperature limits are used:

- 194 °F (90 °C) - alarm for bearing temperature
- 266 °F (130 °C) - pump stop caused by high bearing temperature
- 302 °F (150 °C) - pump stop caused by high stator temperature.

At room temperature, the PT100 temperature sensor resistance is approx. 100 Ω.

Warning

In case of overheating caused by wear, lack of lubricant etc., the Pt100 sensor trips an alarm and disconnects the power supply at a preset temperature. Max. acceptable alarm temperature in bearing sensors is 212 °F (100 °C) for the lower bearing (shaft end) and 248 °F (120 °C) for the upper bearing (range 58, 62, 66 and 70 only).

6.12.1 Checking after installation of pump

1. Using a multimeter, check whether the resistance at room temperature is approx. 108 Ω.
2. Using a multimeter, check whether the insulation between circuit and stator housing is outside the scale (not measurable ∞).
3. Carry out similar measurements at the end of the supply cable.
4. During pump check, the Pt100 sensor must be connected to a recording device.

7. Water-in-oil (WIO) sensor

7.1 WIO built-in version

Explosion proof pumps range 58-70 have a built-in WIO sensor in the pump housing. The sensor measures the water content in the oil chamber.

The sensor consists of a plate capacitor which is immersed in the oil and measures the electronic circuit, emitting a 4-20 mA proportional current signal.

A WIO sensor is not available for range 50 and 54 explosion proof pumps.

For more information about the WIO sensor, see *7.2 WIO as accessory*.

7.2 WIO as accessory

Warning

Lack of the lubricant may cause overheating and damage of the mechanical seals. The WIO sensor in the oil chamber trips the alarm if the oil quality is poor or there is no oil in the oil chamber.

The WIO sensor is available as an accessory for pumps with motor sizes of 7.5 to 210 hp (5.5 to 160 kW).

The sensor measures the water content in the oil chamber.

The sensor consists of a plate capacitor which is immersed in the oil and measures the electronic circuit, emitting a 4-20 mA proportional current signal.

Note ***The WIO sensor is not FM-approved as an accessory. It is FM-approved as a built-in sensor for frames 58-70 only.***

7.3 Fitting the WIO sensor

The WIO sensor is to be fitted in the filling hole of the oil chamber instead of the oil screw.

1. Remove the oil screw.
2. Push the sensor into the oil filling hole.
3. Push the sensor to a suitable depth in the oil chamber without letting it touch the rotating parts, but so deep that the sensor is completely covered by the oil. Recommended insertion depths for different pump types appear from the table below.
4. Screw the sensor bush into the thread for the oil screw.

Note ***Vertical installation: Always use the lowest oil screw hole.***

Horizontal installation: Always use the inspection screw hole.

Caution ***Before refitting the WIO sensor after oil change, clean it with white spirit.***

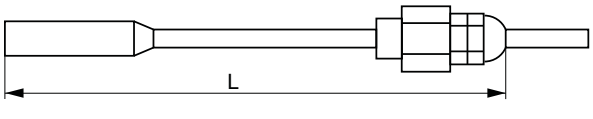


Fig. 12 Dimensions of WIO sensor

S pumps, range	Insertion depths L [inch (mm)]
50	3.15 (80)
54	3.54 (90)
58	3.94 (100)
62	3.94 (100)
66	3.94 (100)
70	3.94 (100)

For more detailed information, see installation instruction for the WIO sensor (96591899).

7.4 Electrical data, WIO sensor

Input voltage:	12-24 VDC
Output current:	3.4 - 22 mA
Power consumption:	0.6 W
Ambient temperature:	32 to 158 °F (0 to 70 °C)

7.5 Sensor signals

4-20 mA	=	0-20 % water in the oil: Accuracy better than 2 %.
22 mA	=	Warning: Water content far outside measuring range.
3.5 mA	=	Alarm: Air in the oil chamber.

Note ***The sensor signal is only valid when oil and water is mixed (when the pump is running).***

8. Electrical connection

Warning

The pump must be connected to an external mains switch with a contact separation according to local regulations.

The electrical connection must be carried out in accordance with local regulations.

The supply voltage and frequency are marked on the pump nameplate.

The voltage tolerance at the motor terminals must be within - 10 %/+ 10 % of the rated voltage.

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

The motor is effectively earthed via the power cable and pipework. The motor top cover is equipped with connections for external earthing or an equipotential bonding conductor.

Warning

For FM models in dry installation (version D), we recommend also to connect an external grounding.

Warning

Before installation and the first start-up of the pump, check the condition of the cable visually to avoid short circuits.

The pump must be connected to a motor protective circuit breaker.

The most commonly used starting methods are direct-on-line (DOL) start, star-delta (Y/D) start and soft start.

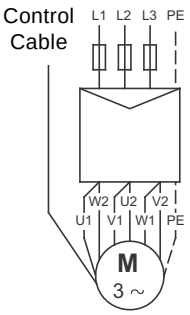
The pump can also be started via frequency converter according to frequency converter manufacturer's specifications.

The selection of a suitable method depends on several considerations on usage and mains supply conditions.

Note

When using star-delta starting it is important to keep switching transient time to a minimum to avoid high transient torques. We recommend to use a time relay with switching time max. 50 ms or according to the starter manufacturer's specifications.

The wiring diagrams for direct-on-line starting and star-delta starting are shown in fig. 13 and fig. 14, respectively.



TM05 1638 3311

Fig. 13 Direct-on-line starting

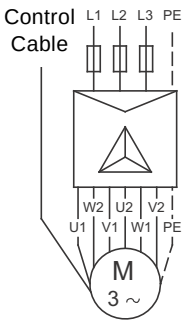


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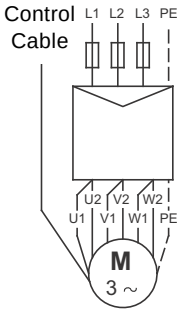
Fig. 14 Star-delta starting



TM05 1640 3311

Fig. 15 Dual voltage, direct-on-line-starting (ranges 50 and 54 only)

8.1 Frequency converter operation

In principle, all three-phase motors can be connected to a frequency converter.

However, frequency converter operation will often expose the motor insulation system to a heavier load and cause the motor to be more noisy than usual due to eddy currents caused by voltage peaks.

In addition, large motors driven via a frequency converter will be loaded by bearing currents.

For frequency converter operation, please observe the following information:

Requirements must be fulfilled.

Recommendations ought to be fulfilled.

Consequences should be considered.

8.1.1 Requirements

- The thermal protection of the motor must be connected.
- Peak voltage and dU/dt must be in accordance with the table below. The values stated are maximum values supplied to the motor terminals. The cable influence has not been taken into account. See the frequency converter data sheet regarding the actual values and the cable influence on the peak voltage and dU/dt.

Maximum repetitive peak voltage [V]	Maximum dU/dt U_N 400 V [V/µ sec.]
850	2000

- Set the frequency converter U/f ratio according to the motor data.
- Local regulations/standards must be fulfilled.

8.1.2 Recommendations

Before installing a frequency converter, calculate the lowest allowable frequency in the installation in order to avoid zero flow.

- Do not reduce the motor speed to less than 30 % of rated speed.
- Keep the flow velocity above 1 m/sec.
- Let the pump run at rated speed at least once a day in order to prevent sedimentation in the piping system.
- Do not exceed the frequency indicated on the nameplate. In this case there is risk of motor overload.
- Keep the motor cable as short as possible. The peak voltage will increase with the length of the motor cable. See data sheet for the frequency converter used.
- Use input and output filters on the frequency converter. See data sheet for the frequency converter used.
- Use screened motor cable if there is a risk that electrical noise can disturb other electrical equipment. See data sheet for the frequency converter used.

8.1.3 Consequences

When operating the pump via a frequency converter, please be aware of these possible consequences:

- The locked-rotor torque will be lower. How much lower will depend on the frequency converter type. See the installation and operating instructions for the frequency converter used for information on the locked-rotor torque available.
- The working condition of bearings and shaft seal may be affected. The possible effect will depend on the application. The actual effect cannot be predicted.
- The acoustic noise level may increase. See the installation and operating instructions for the frequency converter used for advice as to how to reduce the acoustic noise.

8.2 Cable data

Standard H07RN-F

S pump, range	Cable type [mm^2]	Outer cable diameter [Inch (mm)]		Bending radius [Inch (cm)]
		Min.	Max.	
50	7 x 1.5	0.57 (14.4)	0.65 (16.4)	3.94 (10)
	4 x 2.5	0.66 (16.7)	0.74 (18.7)	4.72 (12)
	4 x 6	0.62 (15.7)	0.68 (17.2)	4.33 (11)
54	4 x 6	0.62 (15.7)	0.68 (17.2)	14.33 (11)
	4 x 10	0.82 (20.9)	0.92 (23.4)	5.51 (14)
58	4 x 6	0.62 (15.7)	0.68 (17.2)	4.33 (11)
	4 x 10	0.82 (20.9)	0.92 (23.4)	5.51 (14)
62	4 x 6	0.62 (15.7)	0.68 (17.2)	4.33 (11)
	4 x 10	0.82 (20.9)	0.92 (23.4)	5.51 (14)
	4 x 16	0.94 (23.8)	1 (26.3)	6.3 (16)
66	4 x 10	0.82 (20.9)	0.92 (23.4)	5.51 (14)
	4 x 16	0.94 (23.8)	1 (26.3)	6.3 (16)
	4 x 25	1.1 (28.9)	1.2 (31.4)	7.48 (19)
70	4 x 25	1.1 (28.9)	1.2 (31.4)	7.48 (19)
	4 x 35	1.3 (32.5)	1.4 (34.7)	8.66 (22)
	4 x 50	1.5 (37.7)	1.6 (40.4)	9.84 (25)
	4 x 70	1.7 (42.7)	1.8 (45.4)	11 (28)

EMC

S pump, range	Cable type [mm^2]	Outer cable diameter [Inch (mm)]		Bending radius [Inch (cm)]
		Min.	Max.	
50	3 x 6	0.54 (13.6)	0.6 (15.2)	3 (7.6)
54	3 x 6	0.54 (13.6)	0.6 (15.2)	3 (7.6)
	3 x 10	0.7 (17.8)	0.78 (19.8)	3.9 (9.9)
58	3 x 6	0.54 (13.6)	0.6 (15.2)	3 (7.6)
	3 x 10	0.7 (17.8)	0.78 (19.8)	3.9 (9.9)
62	3 x 6	0.54 (13.6)	0.6 (15.2)	3 (7.6)
	3 x 10	0.7 (17.8)	0.78 (19.8)	3.9 (9.9)
	3 x 16	0.82 (20.9)	0.9 (22.9)	4.5 (11.5)
66	3 x 10	0.7 (17.8)	0.78 (19.8)	3.9 (9.9)
	3 x 16	0.82 (20.9)	0.9 (22.9)	4.5 (11.5)
	3 x 35	1.1 (28.3)	1.2 (31.3)	6.2 (15.7)
70	3 x 35	1.1 (28.3)	1.2 (31.3)	6.2 (15.7)
	3 x 70	1.5 (38.7)	1.6 (41.7)	8.2 (20.9)

Control cables

Cable type [mm^2]	Outer cable diameter [Inch (mm)]		Bending radius [Inch (cm)]
	Min.	Max.	
7 x 1.5	0.57 (14.4)	0.63 - 0.64 (16.0 - 16.4)	3.9 (10)
10 x 1.5	0.71 (18)	0.79 (20)	4.7 (12)

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Warning

The top cover of explosion-proof pumps is provided with an external earth terminal to ensure the connection to earth. The electrical installation must include an external connection from this terminal to earth. The earth conductor must fulfil all electrical safety regulations in force.

Cross section of phase conductor (S) of the installation [$Inch^2$ (mm^2)]	Minimum cross section of earth conductor [$Inch^2$ (mm^2)]
S ≤ 0.025 (16)	S
0.025 (16) < S ≤ 0.054 (35)	0.025 (16)
S > 0.054 (35)	0.5 *S, max. 0.11 (70)

9. Startup

Warning

Before manual starting or changeover to automatic control, make sure that no persons are working on or near the pump.

Warning

Before the first start-up and after a long standstill period, make sure that the pump has been filled with pumped liquid.

In dry installed versions the cooling jacket must always be filled with pumped liquid when operating. Ensure this by venting before the first start-up.

Proceed as follows:

1. Remove the fuses or switch off the mains switch.
2. Check the oil level in the oil chamber. See *10.1 Oil check and oil change*.
3. Check whether the impeller can rotate freely.
4. Check whether the monitoring units, if used, are operating satisfactorily.
5. For pumps in submerged installation, make sure that the pump is submerged in the liquid.
6. For pumps in dry installation, make sure that there is liquid in the pit from which the supply of liquid comes.

Warning

Make sure that the pump has been filled with pumped liquid.

Pumps in dry installation must be vented via the vent hole in the pump housing.

7. Open the isolating valves, if fitted.
8. Check whether the system has been filled with liquid and vented.
9. Check the setting of the level switches.
10. Start the pump and check the pump operation for abnormal noise or vibrations.

Caution ***In case of abnormal noise or vibrations from the pump or other pump or liquid supply failures, stop the pump immediately. Do not attempt to restart the pump until the cause of the fault has been found and the fault corrected.***

11. After start-up, the actual pump duty point must be established as accurately as possible so that it can be checked whether the operating conditions are as desired.

Note ***The pump may only be started for a very short period without being submerged for checking of direction of rotation.***

The operation of the pump should always take place in accordance with established routines with scheduled checks of pump monitoring equipment and accessories (valves, etc.). Make sure that the pump and equipment settings cannot be changed by unauthorized persons.

9.1 Checking the direction of rotation

An arrow cast in the pump housing indicates the correct direction of rotation. The pump must rotate **clockwise** when seen from the drive end. Observe the movement of the pump (jerk) when started. If the pump jerks counter-clockwise, the direction of rotation is correct.

As an alternative, the direction of rotation can be checked as follows:

1. Start the pump and check the quantity of liquid or the discharge pressure.
2. Stop the pump and interchange two of the phases to the motor.
3. Restart the pump and check the quantity of liquid or the discharge pressure.
4. Stop the pump.
5. Compare the results taken under points 1 and 3.
   The connection which gives the larger quantity of liquid or the higher pressure is the correct direction of rotation.

Caution ***The pump must only run for a short period when suspended from a chain.***

10. Maintenance and service

Warning

Before starting work on the pump, make sure that the fuses have been removed or the mains switch has been switched off. It must be ensured that the power supply cannot be accidentally switched on.

All rotating parts must have stopped moving.

Maintenance and service must be carried out by specially trained persons.

Warning

The maintenance and service work on explosion-proof pumps must be carried out by Grundfos or a service workshop authorized by Grundfos.

Warning

Do not open the motor in hazardous classified location.

Warning

The explosion proof series of submersible motors must be provided with flexible cables, HD516, rated for extra hard usage, which are approved by the manufacturer and suitable for the cable entry as to diameter, number of leads, conductor cross section and sheath material.

Before carrying out maintenance and service, make sure that the pump has been thoroughly flushed with clean water. Rinse the pump parts in water after dismantling.

Pumps running normal operation should be inspected every 2000 operating hours or at least once a year. If the pumped liquid is very muddy or sandy, the pump should be inspected every 1000 operating hours or every six months.

The following points should be checked:

- Power consumption
- **Oil level and oil condition**
  When the pump is new or after replacement of the shaft seals, check the oil level and water content after one week of operation. If there is more than 20 % of water in the oil, the shaft seal may be defective. See *10.1 Oil check and oil change*.

Note ***Used oil must be disposed of in accordance with local regulations.***

The oil chamber contains 2 to 13.2 quarts (1.9 to 12.5 litres) of oil depending on pump size. See table below.

Quantity of oil

S pump, range	Installation type	No of poles	Quantity of oil [qt (l)]
50	S	All	2.75 (2.6)
	C-D-H	All	2 (1.9)
54	S	All	3.7 (3.5)
	C-D-H	All	2.7 (2.5)
58	S	All	4.9 (4.6)
	C-D-H	All	4 (3.8)
62	S	All	9.5 (9.0)
	C-D-H	All	7.5 (7.1)
66	S	All	13.2 (12.5)
	C-D-H	All	9.7 (9.2)
70	S	All	13.1 (12.4)
	C-D-H	All	9.5 (9.0)

- **Cable entry**
  Make sure that the cable entry is waterproof and that the cables are not sharply bent or pinched.
- **Impeller clearance**
  Check the impeller clearance. See *10.2 Inspection and adjustment of impeller clearance*.
- **Pump parts**
  Check the pump housing, etc. for possible wear.
  Replace defective parts.
- **Ball bearings**
  Check the shaft for noisy or heavy operation (turn the shaft by hand). Replace defective ball bearings.
  A general overhaul of the pump is usually required in case of defective ball bearings or poor motor function. This work must be carried out by an authorized service workshop.

Warning

The ball bearings must be replaced at least every 25,000 operating hours.

Caution ***Clean the outside of the pump at regular intervals in order to retain the heat conductivity.***

10.1 Oil check and oil change

Caution ***Change the oil every four years to prevent oxidation.***

The oil chamber has two screws, A and B, for oil drainage, oil filling and level control.

In pumps with 8- or 10-pole motors of 30-67 hp (22-50 kW) and pumps with motors larger than 67 hp (50 kW), the oil can be changed while the pump is standing upright. The screw B is used for the indication of the oil level in the oil chamber, see fig. 16.

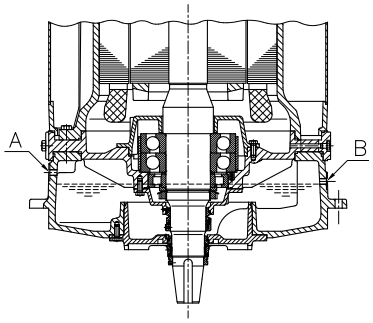

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Fig. 16 Oil level, vertical installation

Horizontally installed pumps (installation type H) have a third screw, C, for oil drainage.

On horizontally installed pumps (installation type H), the oil screws are always positioned as shown in fig. 17.

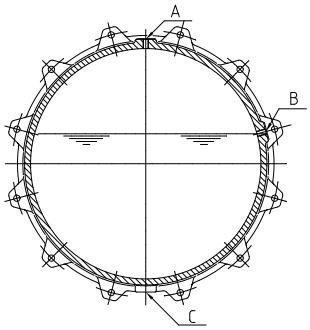

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Fig. 17 Oil level, horizontal installation

Proceed as follows:

1. Place the pump in such a position that the screw A is pointing upwards.

Warning

When slackening the screw A of the oil chamber, note that pressure may have built up in the chamber. Do not remove the screw until the pressure has been fully relieved.

2. Place a clean container under the pump to collect all the drained-off oil. Slacken the screw B pointing to the side and observe the oil level. The drained-off quantity of oil indicates whether the lower mechanical shaft seal is leaking, which may be normal.
3. Turn the pump or remove the screw C and allow all the oil to drain from the chamber into the container. Pour an oil sample into a glass container and observe the condition of the oil. Clear oil can be reused.
   Emulsified oil must be changed and disposed of.

Note ***Used oil must be disposed of in accordance with local regulations.***

Low oil level may indicate that the upper mechanical shaft seal is defective. Contact an authorized service workshop for further overhaul of the pump and repair, if required.

4. Fill the oil chamber with oil through the top hole A until the oil level reaches the hole B. Replace the O-rings with new rings, insert the screws and tighten securely.

Warning

Use viscosity grade SAE 10 W 30 or ONDINA X420.

10.2 Inspection and adjustment of impeller clearance

Warning

Check impeller clearance every time service is carried out to prevent hot surfaces in the hydraulic parts.

All S1, S2 and S3 pumps have an axial impeller clearance between 0.020 and 0.035 inches (0.5 and 0.9 mm).

If the clearance is 0.047 inches (1.2 mm) or more, adjust it to between 0.020 and 0.035 inches (0.5 and 0.9 mm) at all points.

Note ***It is not possible to adjust the impeller clearance of SV pumps.***

The impeller clearance of installation types S and C can be inspected directly through the pump inlet.

Warning

Before inspection make sure that the motor is switched off and that the mains switch is locked in position 0.

Installation versions D and H can be inspected and adjusted with the pump installed on the stand and connected to the pipework. Inspect and adjust the impeller clearance as described in section *10.2.2 Installation types D and H, range 50-54* and section *10.2.3 Installation types D and H, range 58-70*.

10.2.1 Installation types S and C, all ranges

Adjust the clearance between the impeller and the pump housing by following these steps:

1. Slacken the set screws by two full turns each.
2. Close the impeller clearance by lightly tightening the fastening screws diagonally until the impeller touches the pump housing.

Warning

Do not use too much force when tightening the fastening screws as this may damage the bearings. The movement is usual 0.039 to 0.118 inch (1 to 3 mm).

3. Slacken the fastening screws to make an 0.027 inches (0.7 mm) gap under the head of the fastening screws. See fig. 18.
4. Tighten the set screws tightly.
5. Tighten the fastening screws diagonally.

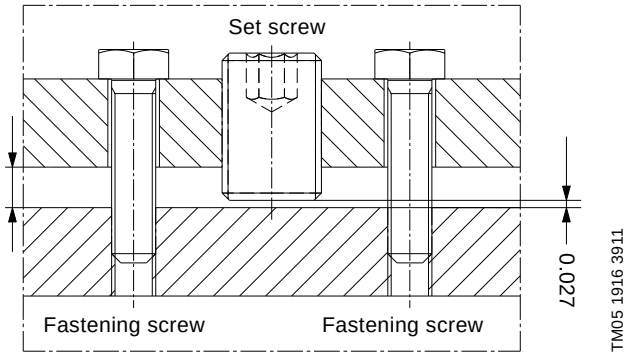

Fig. 18 Impeller clearance adjustment

10.2.2 Installation types D and H, range 50-54

Adjust the clearance between the impeller and the pump housing by following these steps:

1. Slacken the set screws by two full turns each.
2. Close the impeller clearance by lightly tightening the fastening screws diagonally until the impeller touches the pump housing.

Warning

Do not use too much force when tightening the fastening screws as this may damage the bearings. The movement is usual 0.039 to 0.118 inch (1 to 3 mm).

3. Slacken the fastening screws to make an 0.027 inches (0.7 mm) gap under the head of the fastening screws. See fig. 18.
4. Tighten the set screws tightly
5. Tighten the fastening screws diagonally.

10.2.3 Installation types D and H, range 58-70

Adjust the clearance between the impeller and the pump housing by following these steps:

1. Slacken the six fastening screws and close the impeller clearance by tightening the three set screws. Tighten the screws diagonally to move the suction cover evenly.

Warning

Do not use too much force when tightening the fastening screws as this may damage the bearings. The movement is usual 0.039 to 0.118 inch (1 to 3 mm).

2. Measure the distance "L" between suction cover and pump housing at three points next to the set screws, using feeler gauges or callipers, and make a note of the distance.
3. Slacken the set screws and draw back the suction cover by between 0.020 and 0.035 inches (0.5 and 0.9 mm). using the six fastening screws (approx. one 270 ° turn of an M12 fastening screw) and the distance "L" as reference. See fig. 19.

Tighten all set screws and check that the distance "L" at the three reference points is stable at the new value.

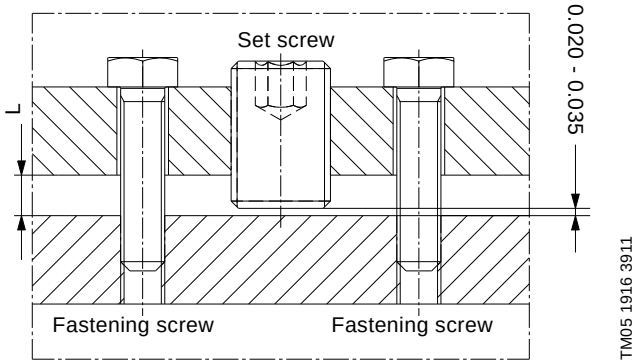

Fig. 19 Impeller clearance adjustment

10.3 Contaminated pumps

Warning

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

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

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

However, any application for service (no matter to whom it may be made) must include details about the pumped liquid if the pump has been used for liquids which are injurious to health or toxic.

11. Fault finding chart

Warning

Before attempting to diagnose any fault, make sure that the fuses have been removed or the mains switch has been switched off. It must be ensured that the power supply cannot be accidentally switched on. All rotating parts must have stopped moving.

The safety instructions in section 4. Safety must be read and observed.

Fault	Cause	Remedy
1. Pump does not start or stops without visible cause.	a) No power supply.	Reestablish power supply. Start the pump manually and check contactor operation.
2. Pump does not start or stops. The control panel of the controller indicates that the motor protective circuit breaker or protection equipment has tripped out.	a) Missing phase.	Reestablish all phases.
	b) Pump momentarily overloaded.	If the fault does not disappear automatically, find the cause and remedy the fault.
	c) Impeller clogged by impurities.	Clean impeller as required.
	d) Motor protective circuit breaker not set correctly.	Set the motor protective circuit breaker as required according to rated current.
	e) Thermal switches tripped out. Insufficient motor cooling.	Reestablish motor cooling.
	f) Moisture switch in motor tripped out.	Contact an authorized service workshop.
	g) Motor cable defective.	Contact an authorized service workshop.
	h) Fluctuating voltage.	Reestablish correct voltage supply. Permissible deviation is - 10 %/+ 10 %.
3. Pump runs but does not deliver the rated flow.	a) Wrong direction of rotation.	Interchange two phases to the motor.
	b) Impeller loose or worn.	Tighten or replace the impeller.
	c) Pump or pipework blocked by impurities.	Clean as required.
	d) Pump head too high.	Measure the differential pressure and compare the value with the pump curve. Remove the blockage in the discharge pipe.
	e) Valves closed or blocked. Non-return valve not operating.	Clean or replace valves as required.
	f) Air in pump or suction pipe.	Vent the pump and suction pipe. Increase the stop level in the pit.
	g) Pumped liquid too dense.	Dilute the liquid.
	h) Pump not properly connected to auto coupling.	Pump down the liquid level in pit. Lift out the pump and relocate the pump on the auto coupling.
	i) Leakage in pipework.	Repair the pipework.
	j) Pump pit flushing system inadvertently activated.	Check function and repair as required.
4. Pump starts, but stops immediately.	a) Clogged pump causes motor-protective circuit breaker to trip out.	Clean the pump.
	b) Overheated motor causes thermal switches to trip out.	Allow pump to cool. Clean the pump.
	c) Level switch out of adjustment or defective.	Clean or set level switch or replace as required.
5. Pump vibrating or emitting excessive noise.	a) Pump partly choked by impurities.	Clean the pump.
	b) Wrong direction of rotation.	Interchange two phases to the motor.
	c) Pump operates outside specified operating range.	Reestablish proper operating conditions.
	d) Pump defective.	Repair the pump or contact an authorized workshop, if necessary.
	e) Pump not properly connected to auto coupling.	Pump down the liquid level in pit. Lift out the pump and relocate the pump on the auto coupling.
	f) Pump cavitates.	Clean the suction pipe.
	g) Base stand, auto coupling, ring stand or guide rails not installed correctly.	Install the components correctly.
6. Oil watery or emulsified.	a) Lower mechanical seal leaking.	Contact an authorized service workshop.
7. Low oil level.	a) Upper mechanical seal leaking.	Contact an authorized service workshop.

12. Disposal

This product or parts of it must be disposed of in an environmentally sound way:

1. Use the public or private waste collection service.
2. If this is not possible, contact the nearest Grundfos company or service workshop.

Subject to alterations.

1. Wiring diagrams

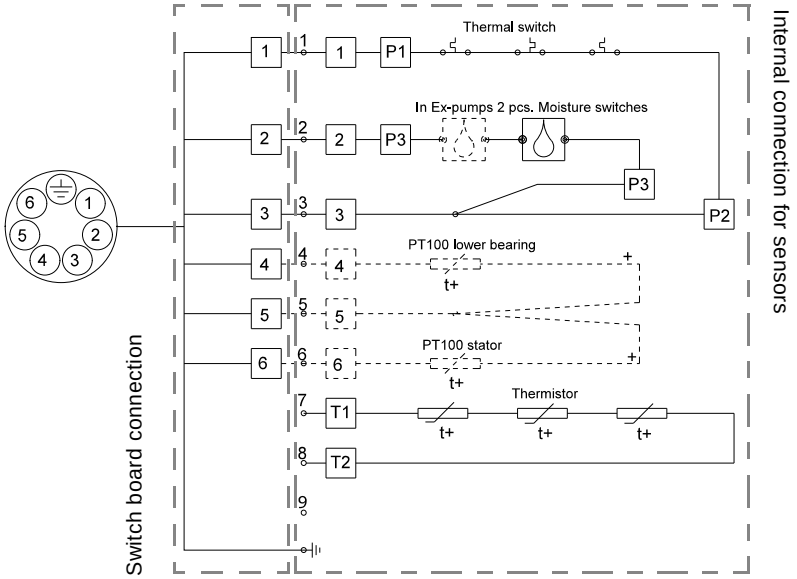

Fig. 1 Wiring diagram for sensor cable 7-lead wires

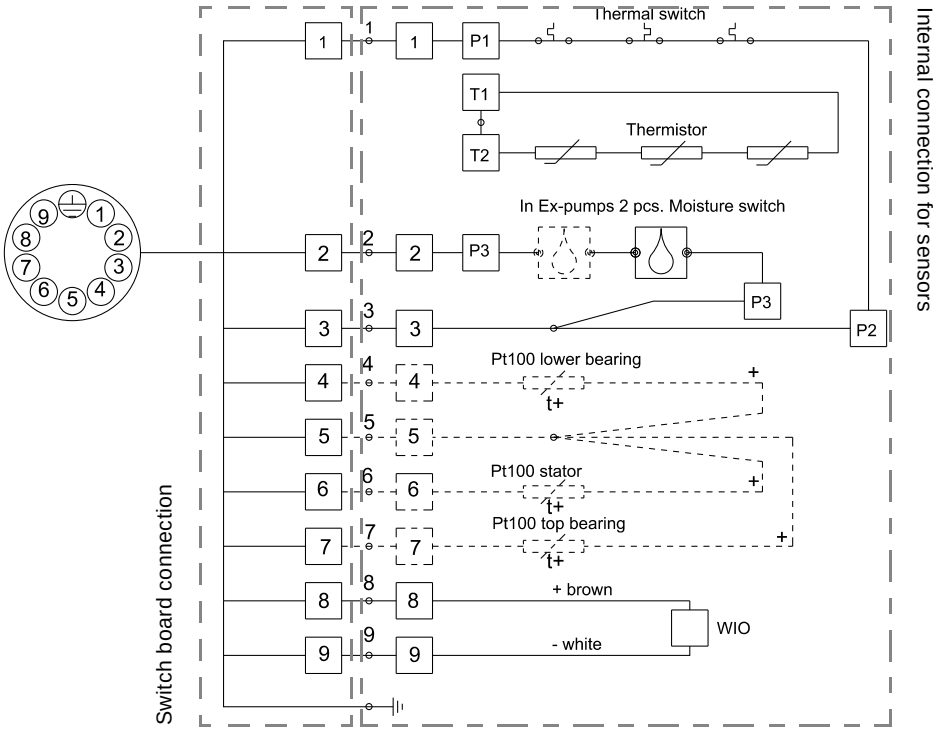

Fig. 2 Wiring diagram for sensor cable 10-lead wires

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