Chapter 17 PROCESS PUMPS

MANUFACTURER/DISTRIBUTOR:

Real-Jean
A/S Hugo Porier
8165-75 Lafrenaie
Montréal, Qc, H1P 2B1
Email: hpoirier@real-jean.com
Tel:(514)279-8592
Fax: (514)279-8595

WOLSELEY Inc.
4200, Hickmore
St-Laurent, QC, H4T 1K2
Phone: (514) 344-9378
Fax :(514) 344-9341

17.1 **GRUNDFOS SUBMERSIBLE PUMP**

17.2 **GRUNDFOS SUBMERSIBLE PUMP MOTOR**

17.3 **ARMSTRONG COMPASS 20-20SS (P2 & P3)**

17.4 **Wilo Stratos Z 1.5 x 3 - 40 #2113420 (NSF61) (PS1 & PS2)**

WP-1 & WP-2

DIMENSIONS AND WEIGHTS

MODEL NO.	FIG.	HP	MOTOR SIZE	DISCH. SIZE	DIMENSIONS IN INCHES A	B	C	D	E	APPROX. SHIP WT.
300S30-1B	A	3	4"	3" NPT	38.1	23.6	14.5	3.8	5.7	65
300S50-1	A	5	4"	3" NPT	44.1	29.6	14.5	3.8	5.7	82
300S50-2BB	A	5	4"	3" NPT	49.1	29.6	19.5	3.8	5.7	87
300S75-2	A	7 1/2	4"	3" NPT	43.5	24.0	19.5	3.8	5.7	113
300S75-2*	A	7 1/2	6"	3" NPT	49.1	29.6	19.5	5.4	5.7	104
300S100-3A	A	10	4"	3" NPT	67.8	43.9	23.9	3.8	5.7	154
300S100-3A	A	10	6"	3" NPT	49.3	25.4	23.9	5.4	5.7	130
300S150-3	A	15	6"	3" NPT	51.9	28.0	23.9	5.4	5.7	146
300S150-4AA	A	15	6"	3" NPT	56.4	28.0	28.4	5.4	5.7	161
300S150-4	A	15	6"	3" NPT	56.4	28.0	28.4	5.4	5.7	161
300S200-5AA	A	20	6"	3" NPT	63.4	30.6	32.8	5.4	5.7	172
300S200-5	A	20	6"	3" NPT	63.4	30.6	32.8	5.4	5.7	172
300S200-6B	A	20	6"	3" NPT	67.9	30.6	37.3	5.4	5.7	177
300S250-6	A	25	6"	3" NPT	70.4	33.1	37.3	5.4	5.7	192
300S250-7AA	A	25	6"	3" NPT	74.8	33.1	41.7	5.4	5.7	201
300S300-7	A	30	6"	4" NPT	74.8	33.1	41.7	5.4	5.7	220
300S300-8	A	30	6"	4" NPT	81.9	35.7	46.2	5.4	5.7	241
300S300-9B	A	30	6"	4" NPT	81.9	35.7	46.2	5.4	5.7	246
300S400-9*	A	40	6"	4" NPT	91.4	40.8	50.6	5.4	5.7	281
300S400-10*	A	40	6"	4" NPT	95.9	40.8	55.1	5.4	5.7	286
300S500-11*	A	50	6"	4" NPT	117.3	57.8	59.5	5.4	5.7	292
300S500-12*	A	50	6"	4" NPT	116.8	57.8	63.9	5.4	5.7	396
300S500-13*	A	50	6"	4" NPT	126.2	57.8	68.4	5.4	5.7	402
300S600-14*	A	60	6"	4" NPT	135.3	61.3	74.0	5.4	7.1	447
300S600-15*	A	60	8"	4" NPT	120.3	41.8	78.5	7.5	7.1	484
300S750-16	A	75	8"	4" NPT	130.3	47.4	82.9	7.5	7.1	540
300S750-17	A	75	8"	4" NPT	134.8	47.4	87.4	7.5	7.1	544
300S750-18	A	75	8"	4" NPT	139.2	47.4	91.8	7.5	7.1	626

NOTES: Models 2-15 Stgs. are suitable for use in 6" wells, 16-18 Stgs. are suitable for use in 8" wells.
Weights include pump end with motor in lbs.
* Alternate motor sizes available.

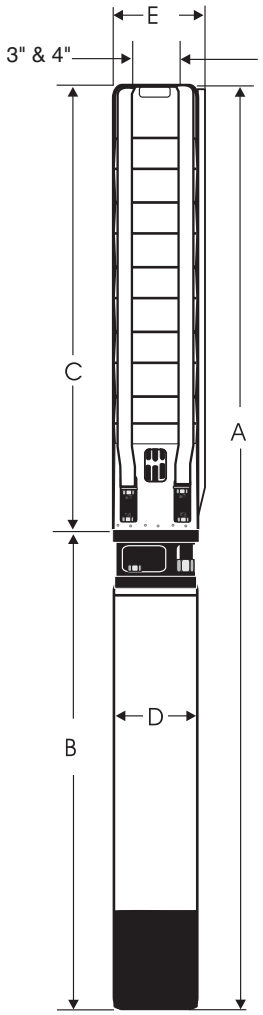


Fig. A

SHOP DRAWING

This review is solely for the verification of general design quality and does not alleviate the responsibility of the contractor for insuring that all specification, space and installation requirements are met.

Reviewed By: M.M.
Date: 20 June 2016

Reviewed ☒
Reviewed as noted ☐
Resubmit ☐

CHIARELLI ENGINEERING LTD.

SHOP DRAWING

Reviewed by: Samuel Charbonneau
Date: 14 Juin, 2016

Reviewed X
Reviewed as noted
Resubmit

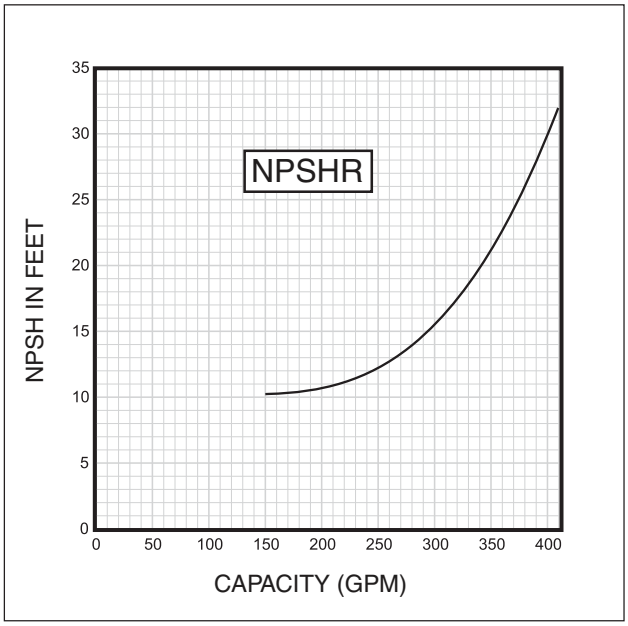
Out for approval

SIFEC NORTH INC.

MATERIALS OF CONSTRUCTION

COMPONENT	CYLINDRICAL SHAFT (2-18 Stgs.)
Check Valve Housing	304 Stainless Steel
Check Valve	304 Stainless Steel
Diffuser Chamber	304 Stainless Steel
Split Cone Nut	304 Stainless Steel
Split Cone	304 Stainless Steel
Impeller	304 Stainless Steel
Suction Interconnector	304 Stainless Steel
Inlet Screen	304 Stainless Steel
Straps	304 Stainless Steel
Cable Guard	304 Stainless Steel
Coupling	316/329 Stainless Steel**
Pump Shaft	431 Stainless Steel
Intermediate Bearings	NBR
Impeller Seal Ring	NBR/304 Stainless Steel
Check Valve Seat	NBR/316 Stainless Steel
Top/Lower Bearing	NBR/316 Stainless Steel
8" Motor Adaptor Plate	304 Stainless Steel
Upthrust Washer	Carbon/Graphite HY22
Upthrust stop ring	304 S.S./Tungsten Carbide

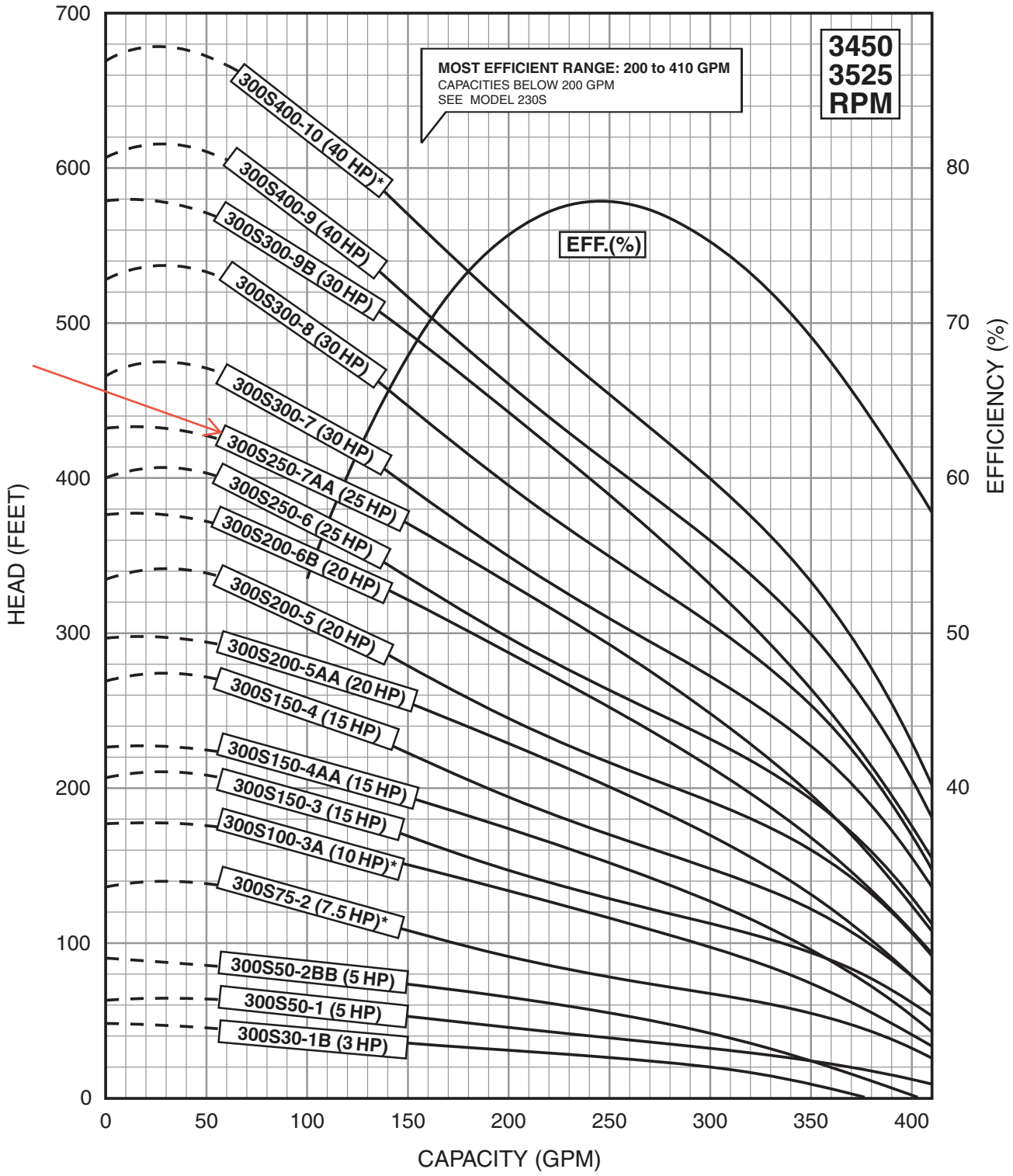
NOTES: Specifications are subject to change without notice.
***Stainless Steel options available.**
** 4" Coupling made of 316 Stainless Steel.



PERFORMANCE CURVES 300 GPM MODEL 300S

WP-1 & WP-2

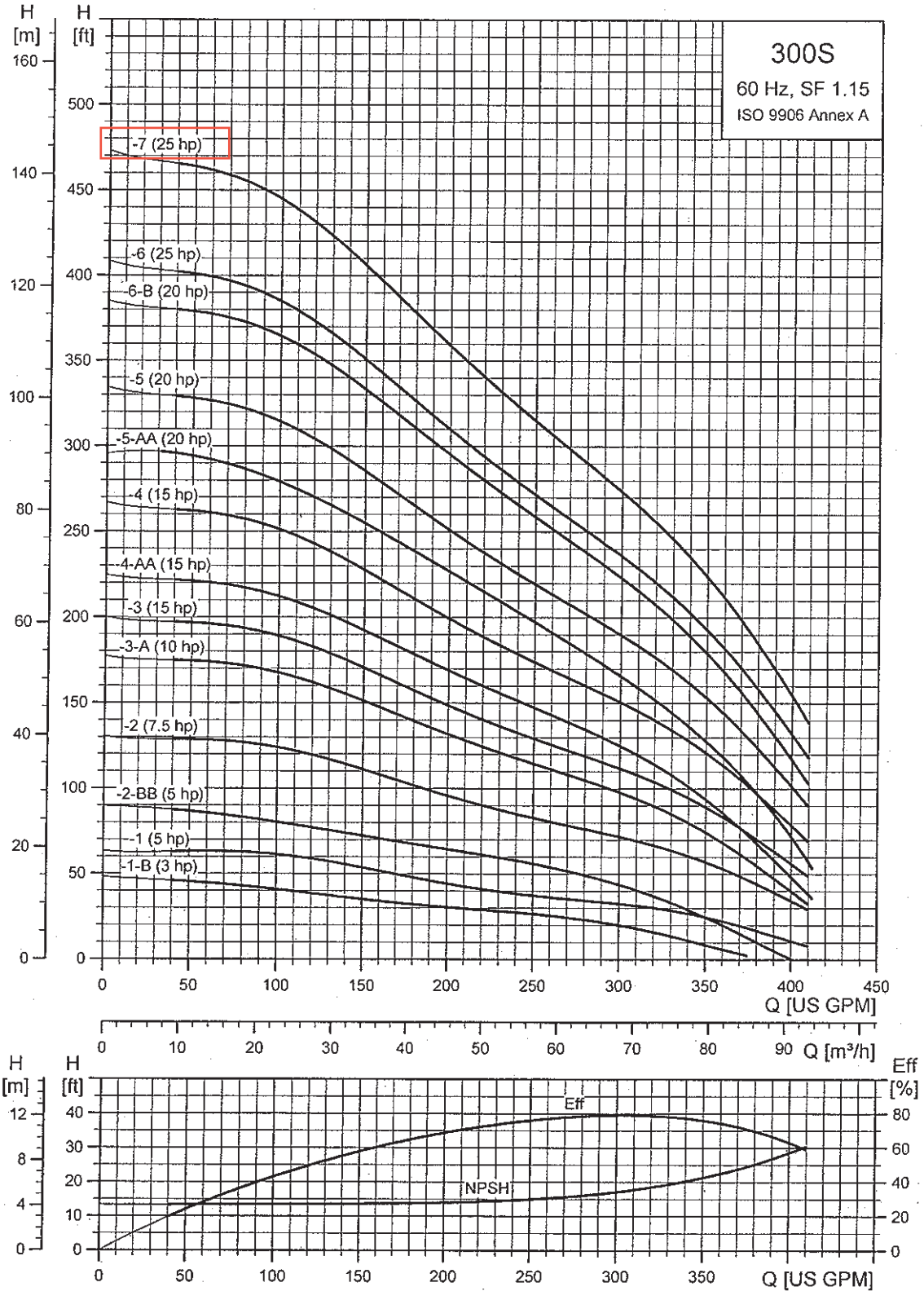
FLOW RANGE: 60 -410 GPM **OUTLET SIZE: 3"& 4" NPT*** **NOMINAL DIA. 6"**



SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE.
4" MOTOR STANDARD, 7.5 HP/3450 RPM.
6" MOTOR STANDARD,15-60 HP/3450 RPM.
8" MOTOR STANDARD, 75 HP/3525 RPM.
* 3" NPT 2-6 STAGES, 4" NPT 7-18 STAGES.

Performance conforms to ISO 9906 Annex A
@ 8 ft. min. submergence.

6" and larger wells - continued
SP 300S (300 gpm)

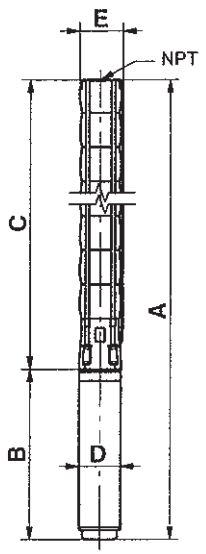


6" and larger wells - continued

SP 300S (300 gpm) / 6, 8 inch motor

Pump model	Nom. head [ft]	Ph	Volts [V]	Motor [Hp]		Dimensions A [in. (mm)]	B [in. (mm)]	C [in. (mm)]	D [in. (mm)]	E [in. (mm)]	Net weight (complete) [lb]
300S - Motor dia. 6 inch, 60 Hz, rated flow 300 gpm (4" NPT)											
300S250-7AA	249	3	230	25	▲	73.98 (1879)	31.78 (807)	42.21 (1072)	5.52 (140)	5.79 (147)	217.8
		3	460	25	▲	73.98 (1879)	31.78 (807)	42.21 (1072)	5.52 (140)	5.79 (147)	217.8
300S300-7	267	3	230	30	▲	76.34 (1939)	34.14 (867)	42.21 (1072)	5.52 (140)	5.79 (147)	217.8
		3	460	30	▲	76.34 (1939)	34.14 (867)	42.21 (1072)	5.52 (140)	5.79 (147)	217.8
300S300-8	307	3	230	30	▲	80.79 (2052)	34.14 (867)	46.66 (1185)	5.52 (140)	5.79 (147)	224.1
		3	460	30	▲	80.79 (2052)	34.14 (867)	46.66 (1185)	5.52 (140)	5.79 (147)	224.1
300S300-9B	329	3	230	30	▲	85.24 (2165)	34.14 (867)	51.11 (1298)	5.52 (140)	5.79 (147)	261.0
		3	460	30	▲	85.24 (2165)	34.14 (867)	51.11 (1298)	5.52 (140)	5.79 (147)	261.0
300S400-9	346	3	460	40	▲	90.36 (2295)	39.26 (997)	51.11 (1298)	5.52 (140)	5.79 (147)	296.0
300S400-10	385	3	460	40	▲	94.81 (2408)	39.26 (997)	55.56 (1411)	5.52 (140)	5.79 (147)	300.5
300S400-11	425	3	460	40	☼	99.26 (2521)	39.26 (997)	60.00 (1524)	5.52 (140)	5.79 (147)	352.0
300S500-12	464	3	460	50	☼	120.56 (3062)	56.11 (1425)	64.45 (1637)	5.67 (144)	5.79 (147)	348.8
300S500-13	504	3	460	50	☼	125.00 (3175)	56.11 (1425)	68.90 (1750)	5.67 (144)	5.79 (147)	355.1
300S600-14	543	3	460	60	*	-	-	73.35 (1863)	-	5.79 (147)	-
300S600-15	582	3	460	60	*	-	-	77.80 (1976)	-	5.79 (147)	-
SP 300S - Motor dia. 8 inch, 60 Hz, rated flow 230 gpm (4" NPT)											
300S600-14	543	3	460	60	*	125.12 (3178)	50.00 (1270)	75.12 (1908)	7.56 (192)	7.56 (192)	479.4
300S600-15	582	3	460	60	*	129.57 (3291)	50.00 (1270)	79.57 (2021)	7.56 (192)	7.56 (192)	519.4
300S750-16	622	3	460	75	*	137.17 (3484)	53.15 (1350)	84.02 (2134)	7.56 (192)	7.56 (192)	569.1
300S750-17	661	3	460	75	*	141.62 (3597)	53.15 (1350)	88.47 (2247)	7.56 (192)	7.56 (192)	575.4
300S750-18	701	3	460	75	*	146.07 (3710)	53.15 (1350)	92.92 (2360)	7.56 (192)	7.56 (192)	581.7

300S



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E = Maximum diameter of pump including cable guard and motor.

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
Performance conforms to ISO 9906 Annex A @ 8 ft. minimum submergence.

▲ MS 6000C motor.

☼ Takes MMS 6 motor; not available as complete.

* Takes MMS 8000 motor; not available as complete.

SP

Installation and operating instructions

Other languages

http://net.grundfos.com/qr/i/98074911

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. Symbols used in this document

Warning

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

Warning

If these instructions are not observed, it may lead to electric shock with consequent risk of serious personal injury or death.

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. Introduction

These instructions apply to Grundfos submersible pumps, type SP, with submersible motors, types Grundfos MS/MMS or Franklin 4"-8".

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

Note The USB stick supplied with the product contains installation and operating instructions in various languages.

3. Delivery and storage

3.1 Delivery

Caution The pump should remain in the packing until it is placed in vertical position during installation.

Handle the pump with care.

When the pump part and motor are supplied as separate units (long pumps), fit the motor to the pump as described in section *7.1 Fitting the motor to the pump*.

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

Do not expose the pump to unnecessary impact and shocks.

3.2 Storage

Storage temperature

Pump: -20 °C to +60 °C.
Motor: -20 °C to +70 °C.

The motors must be stored in a closed, dry and well ventilated room.

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

The pump should not be exposed to direct sunlight.

If the pump has been unpacked, it should be stored horizontally, adequately supported, or vertically to prevent misalignment of the pump. Make sure that the pump cannot roll or fall over.

During storage, the pump can be supported as shown in fig. 1.

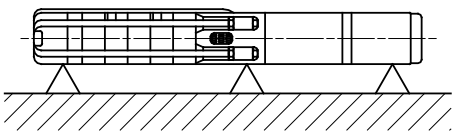

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Fig. 1 Pump position during storage

3.2.1 Frost protection

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

4. Applications

Grundfos SP submersible pumps are designed for a wide range of water supply and liquid transfer applications, such as the supply of fresh water to private homes or waterworks, water supply in horticulture and agriculture, drawdown of groundwater and pressure boosting, and various industrial jobs.

The pump must be installed so that the suction interconnector is completely submerged in the liquid. The pump can be installed horizontally or vertically. See section *5.2 Positional requirements*.

4.1 Pumped liquids

Clean, thin, non-explosive liquids without solid particles or fibres.

The maximum sand content of the water must not exceed 50 g/m^3. A larger sand content will reduce the life of the pump and increase the risk of blockage.

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, contact Grundfos.

The pump versions SP A N, SP A R, SP N, SP R and SPE are designed for liquids with higher aggressiveness than drinking water.

The maximum liquid temperature appears from section *5.4 Liquid temperatures/cooling*.

4.2 Sound pressure level

The sound pressure level has been measured in accordance with the rules laid down in the EC machinery directive 2006/42/EC.

Sound pressure level of pumps

The values apply to pumps submerged in water, without external regulating valve.

Pump type	$\overline{L}_{pA}$ [dB(A)]
SP 1A	< 70
SP 2A	< 70
SP 3A	< 70
SP 5A	< 70
SP 7	< 70
SP 9	< 70
SP 11	< 70
SP 14	< 70
SP 17	< 70
SP 30	< 70
SP 46	< 70
SP 60	< 70
SP 77	< 70
SP 95	< 70
SP 125	79
SP 160	79
SP 215	82

Sound pressure level of motors

The sound pressure level of Grundfos MS and MMS motors is lower than 70 dB(A).

Other motor makes: See installation and operating instructions for these motors.

5. Preparations before installation

Warning

Before starting work on the product, switch off the power supply. Make sure that the power supply cannot be accidentally switched on.

5.1 Checking the motor liquid

The motors are factory-filled with a special non-poisonous liquid which is frost-proof down to -20 °C.

Note Check the level of motor liquid and refill if required. Use clean water.

Caution If frost protection is required, special Grundfos liquid must be used to refill the motor. Otherwise clean water may be used for refilling (however, never use distilled water).

Refill liquid as described below.

5.1.1 Grundfos MS 4000 and MS 402 motors

The filling hole for motor liquid is placed in the following positions:

- MS 4000: in the top of the motor.
- MS 402: in the bottom of the motor.

1. Position the submersible pump as shown in fig. 2. The filling screw must be at the highest point of the motor.
2. Remove the screw from the filling hole.
3. Inject liquid into the motor with the filling syringe until the liquid runs back out of the filling hole. See fig. 2.
4. Replace the screw in the filling hole and tighten securely before changing the position of the pump.

Torques

- MS 4000: 3.0 Nm.
- MS 402: 2.0 Nm.

The submersible pump is now ready for installation.

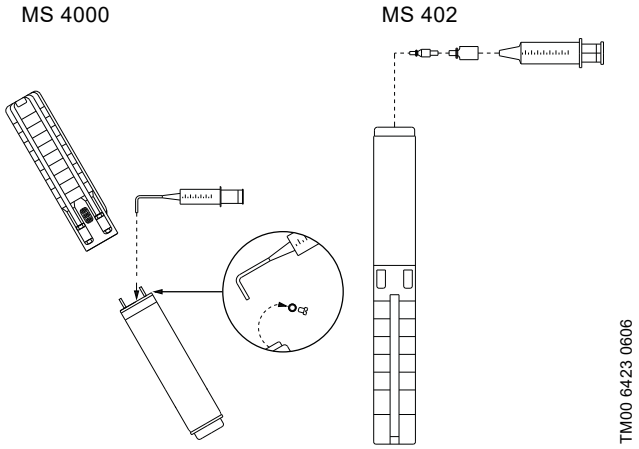

Fig. 2 Motor position during filling - MS 4000 and MS 402

5.1.2 Grundfos MS 6000 motors

- If the motor is delivered from stock, check the level of motor liquid before fitting the motor to the pump. See fig. 3.
- When pumps are delivered direct from Grundfos, the level has already been checked.
- Check the level in connection with service. See fig. 3.

The filling hole for motor liquid is placed at the top of the motor.

1. Position the submersible pump as shown in fig. 3. The filling screw must be at the highest point of the motor.
2. Remove the screw from the filling hole.
3. Inject liquid into the motor with the filling syringe until the liquid runs back out of the filling hole. See fig. 3.
4. Replace the screw in the filling hole and tighten securely before changing the position of the pump.

Torque: 3.0 Nm.

The submersible pump is now ready for installation.

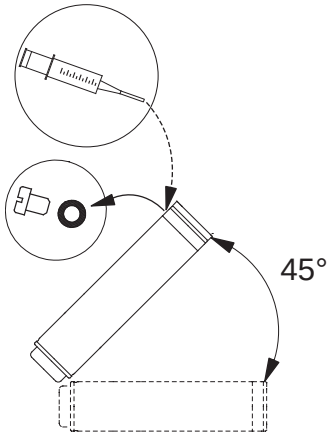

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Fig. 3 Motor position during filling - MS 6000

5.1.3 Grundfos MMS 6, MMS 8000, MMS 10000 and MMS 12000 motors

1. Place the motor at a 45 ° angle with the top of the motor upwards. See fig. 4.
2. Unscrew the plug A and place a funnel in the hole.
3. Pour tap water into the motor until the motor liquid inside the motor starts running out of A.

Caution Do not use motor liquid as it contains oil.

4. Remove the funnel and refit the plug A.

Caution Before fitting the motor to a pump after a long period of storage, lubricate the shaft seal by adding a few drops of water and turning the shaft.

The submersible pump is now ready for installation.

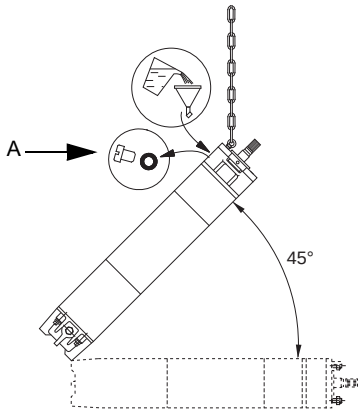

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Fig. 4 Motor position during filling - MMS

5.1.4 Franklin motors from 3 kW and up

Check the level of motor liquid in Franklin 4" and 6" motors by measuring the distance from the bottom plate to the built-in rubber diaphragm. The distance can be measured by inserting a rule or a small rod through the hole until it touches the diaphragm. See fig. 5.

Caution Take care not to damage the diaphragm.

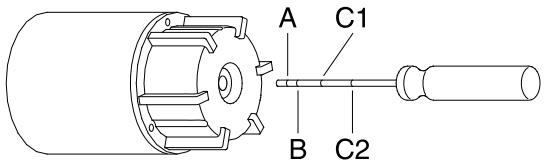

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Fig. 5 Measuring the distance from bottom plate to diaphragm

The table below shows the correct distance from the outside of the bottom plate to the diaphragm:

Motor	Dimension	Distance [mm]
Franklin 4", 0.25 - 3 kW (fig. 6a)	A	8
Franklin 4", 3 - 7.5 kW (fig. 6b)	B	16
Franklin 6", 4-45 kW (fig. 6c)	C1	35
Franklin 6", 4-22 kW (fig. 6d)	C2	59

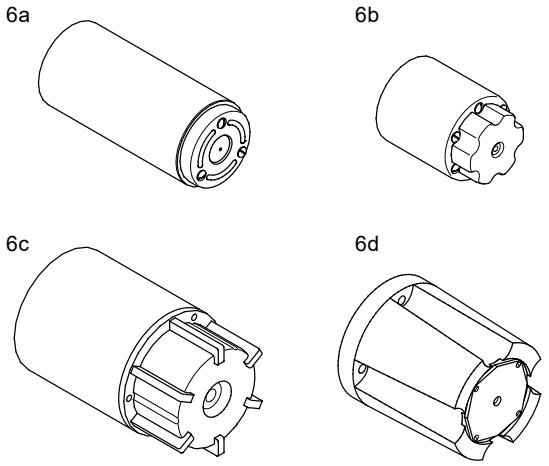

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Fig. 6 Franklin motors

If the distance is not correct, carry out an adjustment as described in section *5.1.5 Franklin motors*.

5.1.5 Franklin motors

Check the level of motor liquid in Franklin 8" motors as follows:

1. Press out the filter in front of the valve at the top of the motor using a screwdriver. If the filter is slotted, unscrew. Figure 7 shows the position of the filling valve.
2. Press the filling syringe against the valve and inject the liquid. See fig. 7. If the valve cone is depressed too far, it may be damaged thus causing the valve to leak.
3. Remove any air in the motor by pressing the point of the filling syringe lightly against the valve.
4. Repeat the process of injecting liquid and releasing air until the liquid starts running out or the diaphragm is in its correct position (Franklin 4" and 6").
5. Refit the filter.

The submersible pump is now ready for installation.

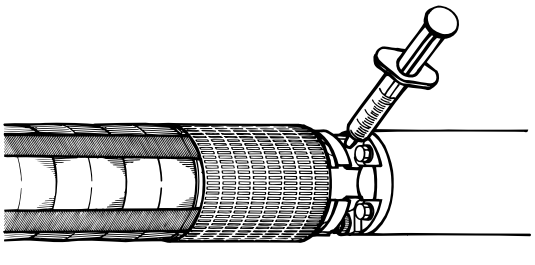

Fig. 7 Position of filling valve

5.2 Positional requirements

Warning

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 type, the pump can be installed either vertically or horizontally. A complete list of motor types suitable for horizontal installation is shown in section *5.2.1 Motors suitable for horizontal installation*.

If the pump is installed horizontally, the discharge port should never fall below the horizontal plane. See fig. 8.

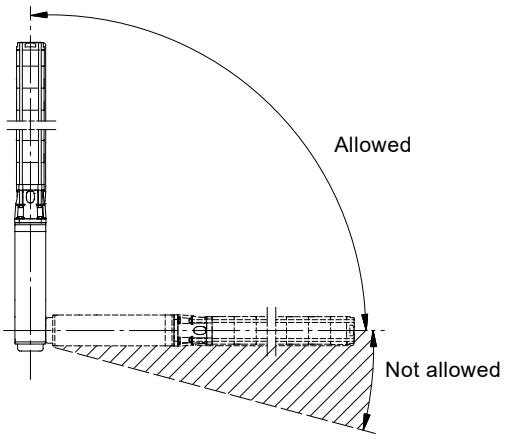

Fig. 8 Positional requirements

If the pump is installed horizontally, e.g. in a tank, we recommend that you fit it in a flow sleeve.

5.2.1 Motors suitable for horizontal installation

Motor	Output power 50 Hz	Output power 60 Hz
	[kW]	[kW]
MS	All	All
MMS 6	5.5 - 37	5.5 - 37
MMS 8000	22-110	22-110
MMS 10000	75-190	75-190
MMS 12000	147-250	147-250

When Franklin 4" motors up to and including 2.2 kW are started more than 10 times a day, we recommend that you incline the motor at least 15 ° above the horizontal plane in order to minimise wearing of the upthrust disc.

Caution During operation, the suction interconnector of the pump must always be completely submerged in the liquid. Make sure that the NPSH values are fulfilled.

Warning

If the pump is used for pumping hot liquids (40 to 60 °C), make sure that persons cannot come into contact with the pump and the installation, e.g. by installing a guard.

5.3 Pump/motor diameter

We recommend that you check the borehole with an inside calliper to ensure unobstructed passage.

5.4 Liquid temperatures/cooling

The maximum liquid temperature and the minimum flow velocity past the motor appear from the table below.

We recommend that you install the motor above the well screen in order to achieve proper motor cooling.

Caution In cases where the stated flow 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, use a flow sleeve in order to ensure proper cooling of the motor.

5.4.1 Maximum liquid temperature

Out of consideration for the rubber parts in pump and motor, the liquid temperature must not exceed 40 °C (~ 105 °F). See also the table below.

The pump can operate at liquid temperatures between 40 °C and 60 °C (~ 105 °F and 140 °F) provided that all rubber parts are replaced every third year.

Motor	Installation		
	Flow past the motor	Vertical	Horizontal
Grundfos MS 402 MS 4000 MS 6000	0.15 m/s	40 °C (~ 105 °F)	40 °C (~ 105 °F)
Grundfos MS 4000I*	0,15 m/s	60 °C (~ 140 °F) Flow sleeve recommended	60 °C (~ 140 °F) Flow sleeve recommended
Grundfos MS 6000I*	1.00 m/s		
Grundfos MMS	0.15 m/s	25 °C (~ 77 °F)	25 °C (~ 77 °F)
	0.50 m/s	30 °C (~ 86 °F)	30 °C (~ 86 °F)
Franklin 4"	0.08 m/s	30 °C (~ 85 °F)	30 °C (~ 85 °F)
Franklin 6" and 8"	0.16 m/s	30 °C (~ 85 °F)	30 °C (~ 85 °F)

* At an ambient pressure of minimum 1 bar (1 MPa).

Note 37 kW MMS 6, 110 kW MMS 8000 and 170 kW MMS 10000: The maximum operational liquid temperature is 5 °C lower than the values stated in the above table.

190 kW MMS 10000: The temperature is 10 °C lower.

5.5 Pipe connection

If noise may be transmitted to the building through the pipework, we recommend that you use plastic pipes.

Note We recommend plastic pipes for 4" pumps only.

When using plastic pipes, secure the pump by an unloaded straining wire.

Warning

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

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

6. Electrical connection

Warning

During electrical installation, make sure that the power supply cannot be accidentally switched on.

Warning

The electrical installation should be carried out by an authorised person in accordance with local regulations.

The supply voltage, rated maximum current and cos φ appear from the loose data plate which must be fitted close to the installation site.

The required voltage quality for MS and MMS motors, measured at the motor terminals, is - 10 %/+ 6 % of the nominal voltage during continuous operation (including variation in the supply voltage and losses in cables).

Check also that there is voltage symmetry in the power supply lines, i.e. same difference of voltage between the individual phases. See section *11. Checking motor and cable*, item 2.

Warning

The pump must be earthed.

The pump must be connected to an external mains switch with a minimum contact gap of 3 mm in all poles.

If MS motors with a built-in temperature transmitter (Tempcon) are not installed together with a MP 204 or similar Grundfos motor protection, they must be connected to a 0.47 µF capacitor approved for phase-phase operation (IEC 384-14) to meet the EC EMC directive (2004/108/EC). The capacitor must be connected to the two phases to which the temperature transmitter is connected. See fig. 9.

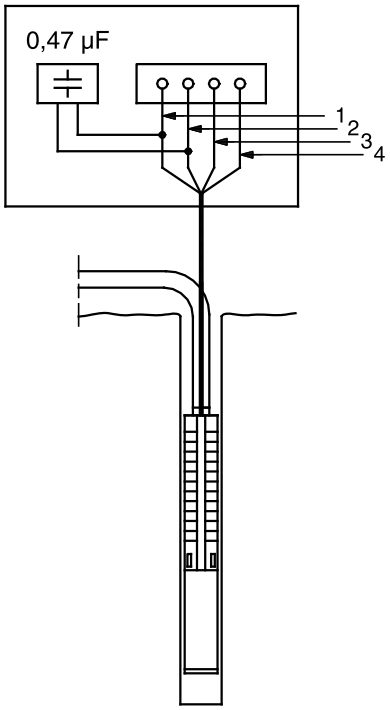

Fig. 9 Connection of capacitor

Colours of the leads		
Lead	**Flat cable**	**Single leads**
1 = L1	Brown	Black
2 = L2	Black	Yellow
3 = L3	Grey	Red
4 = PE	Yellow/green	Green

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

The run-up time of the pump is only about 0.1 second. Direct-on-line starting is therefore normally approved by the power supply company.

6.1 Frequency converter operation

6.1.1 Grundfos motors

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

Caution

If an MS motor with temperature transmitter is connected to a frequency converter, a fuse incorporated in the transmitter will melt and the transmitter will be inactive. The transmitter cannot be reactivated. This means that the motor will operate like a motor without a temperature transmitter.

If a temperature transmitter is required, Grundfos offers a Pt100 or Pt1000 sensor for the submersible motor.

Caution

The motor should not run at a frequency higher than the rated frequency (50 or 60 Hz) during frequency converter operation. In connection with pump operation, never 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, the motor must stop 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.

Warning

MS 402 motors for supply voltages up to and including 440 V (see motor nameplate) must be protected against voltage peaks higher than 650 V (peak value) between the supply terminals.

We recommend that you 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.

We recommend that you install an LC filter when using a frequency converter. See section *6.7.6 Frequency converter operation*.

For further details, contact your frequency converter supplier or Grundfos.

6.1.2 Other motor makes than Grundfos

Contact Grundfos or the motor manufacturer.

6.2 Motor protection

6.2.1 Single-phase motors

Single-phase MS 402 motors incorporate a thermal switch and require no additional motor protection.

Warning

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

Single-phase MS 4000 motors must be protected. A protective device can either be incorporated in a control box or be separate.

Franklin 4" PSC motors must be connected to a motor-protective circuit breaker.

6.2.2 Three-phase motors

MS motors are available with or without a built-in temperature transmitter.

The following motors must be protected by a motor-protective circuit breaker with thermal relay, or a MP 204 and contactor(s):

- motors with a built-in and intact temperature transmitter
- motors with or without a defective temperature transmitter
- motors with or without a Pt100 sensor.

MMS motors have no built-in temperature transmitter.
The Pt100 and the Pt1000 sensor are available as an accessory.

6.2.3 Required settings of motor-protective circuit breaker

For cold motors, the tripping time of the motor-protective circuit breaker must be less than 10 seconds at 5 times the rated maximum current of the motor. During normal operating conditions the motor must be running at full speed in less than 3 seconds.

Caution

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

In order to ensure optimum motor protection, the motor-protective circuit breaker should be set as follows:

1. Set the motor-protective circuit breaker 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 setting by 5 %.

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

For motors wound for star-delta starting, the motor-protective circuit breaker should be set as above, but the maximum setting should be rated maximum current x 0.58.

The highest permissible startup time for star-delta starting or autotransformer starting is 2 seconds.

6.3 Lightning protection

The installation can be fitted with a special overvoltage protective device to protect the motor from voltage surges in the power supply lines when lightning strikes somewhere in the area. See fig. 10.

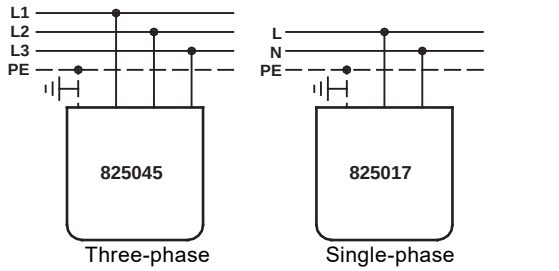

Fig. 10 Fitting an overvoltage protective device

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

The overvoltage protective device should be connected to the installation as close as possible to the motor and always in accordance with local regulations. Ask Grundfos for lightning protective devices.

MS 402 motors, however, require no further lightning protection as they are highly insulated.

A special cable termination kit with a built-in overvoltage protective device is available for Grundfos 4" motors (product No 799911 or 799912).

6.4 Cable sizing

Caution Submersible motor cables are dimensioned for submersion in liquid, and will not necessarily have sufficient cross-section to be in free air.

Make sure that the submersible drop cable can withstand permanent submersion in the actual liquid and at the actual temperature.

The cross-section (q) of the cable must meet the following requirements:

The submersible drop cable must be sized to the rated maximum current (I_n) of the motor.

The cross-section must be sufficient to make a voltage drop over the cable acceptable.

Grundfos supplies submersible drop cables for a wide range of installations. For correct cable sizing, Grundfos offers a cable sizing tool on the USB stick supplied with the motor.

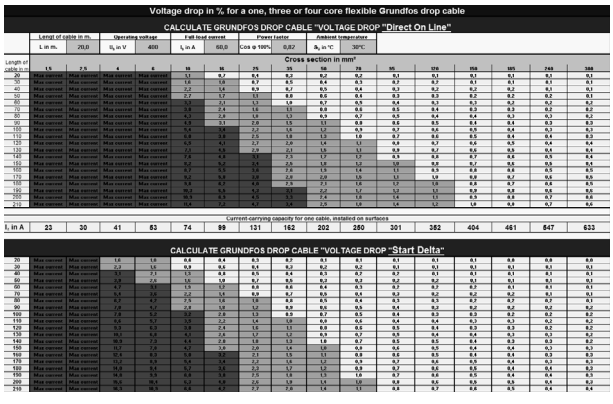

Fig. 11 Cable sizing tool

The sizing tool provides an accurate calculation of the voltage drop at a given cross-section on the basis of the following parameters:

- cable length
- operating voltage
- full-load current
- power factor
- ambient temperature.

You can calculate the voltage drop both for direct-on-line and star-delta starting.

In order to minimise operating losses, the cable cross-section may be increased. This is only cost-efficient if the borehole provides the necessary space, and if the operating time of the pump is long. The cable sizing tool also provides a power loss calculator that shows the potential savings of an increased cross-section.

As an alternative to the cable sizing tool, select the cross-section on the basis of the current values of the given cables.

The cross-section of the submersible drop cable must be large enough to meet the voltage quality requirements specified in section *6. Electrical connection*.

Determine the voltage drop for the cross-section of the submersible drop cable by means of the diagrams on pages 17 to 20.

Use the following formula:

I = Rated maximum current of the motor.

For star-delta starting, I = rated maximum current of the motor x 0.58.

Lx = Length of cable converted to a voltage drop of 1 % of the nominal voltage.

$$Lx = \frac{\text{length of drop cable}}{\text{permissible voltage drop in \%}}$$

q = Cross-section of submersible drop cable.

Draw a straight line between the actual I-value and the Lx-value. Where the line intersects the q-axis, select the cross-section that lies right above the intersection.

The diagrams are made on the basis of the formulas:

Single-phase submersible motor

$$L = \frac{U \times \Delta U}{I \times 2 \times 100 \times \left(\cos\varphi \times \frac{\rho}{q} + \sin\varphi \times XI\right)}$$

Three-phase submersible motor

$$L = \frac{U \times \Delta U}{I \times 1.73 \times 100 \times \left(\cos\varphi \times \frac{\rho}{q} + \sin\varphi \times XI\right)}$$

L = Length of submersible drop cable [m]
U = Rated voltage [V]
ΔU = Voltage drop [%]
I = Rated maximum current of the motor [A]
cos φ = 0.9
ρ = Specific resistance: 0.02 [Ωmm^2/m]
q = Cross-section of submersible drop cable [mm^2]
sin φ = 0.436
XI = Inductive resistance: 0.078 x 10^{-3} [Ω/m].

6.5 Control of single-phase MS 402 motors

Warning

The single-phase MS 402 motor incorporates motor protection which cuts out the motor in case of excessive winding temperatures while the motor is still supplied with voltage. Allow for this, when the motor forms part of a control system.

If a compressor is included in a control system together with an ochre filter, the compressor will run continuously once the motor protection has cut out the motor, unless other special precautions have been taken.

6.6 Connection of single-phase motors

6.6.1 2-wire motors

MS 402 2-wire motors incorporate motor protection and a starter device and can therefore be connected direct to the mains.
See fig. 12.

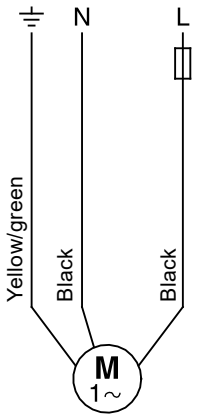

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Fig. 12 2-wire motors

6.6.2 PSC motors

The PSC motors are connected to the mains via a run capacitor which should be sized for continuous operation.

Select the correct capacitor size from the table below:

Motor [kW]	Capacitor [µF] 400 V, 50 Hz
0.25	12.5
0.37	16
0.55	20
0.75	30
1.10	40
1.50	50
2.20	75

MS 402 PSC motors incorporate motor protection and should be connected to the mains as shown in fig. 13.

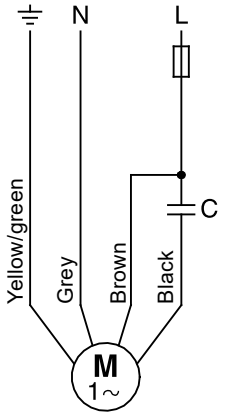

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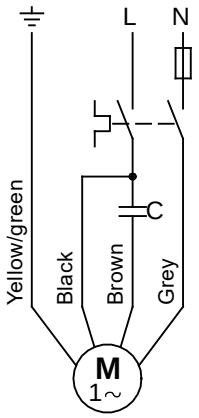
Fig. 13 PSC motors

See www.franklin-electric.com and fig. 14.



TM00 1361 1200

Fig. 14 Franklin motors

6.6.3 3-wire motors

MS 4000 3-wire motors must be connected to the mains via a Grundfos SA-SPM 5 (60 Hz), 7 or 8 (50 Hz) control box incorporating motor protection.

MS 402 3-wire motors incorporate motor protection and should be connected to the mains via a Grundfos control box SA-SPM 2, 3 or 5 (60 Hz), 7 or 8 (50 Hz) without motor protection.

6.7 Connection of three-phase motors

Three-phase motors must be protected.
See section *6.2.2 Three-phase motors*.

For electrical connection via the MP 204, see the separate installation and operating instructions for this unit.

When a conventional motor-protective circuit breaker is being used, the electrical connection should be carried out as described below.

6.7.1 Checking the direction of rotation

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

When the pump has been connected to the power supply, check the direction of rotation:

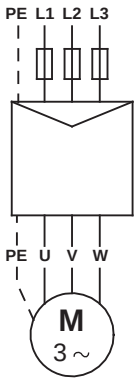
1. Start the pump and measure quantity of water and head.
2. Stop the pump and interchange two phases.
3. Start the pump and measure quantity of water and head.
4. Stop the pump.
5. Compare the two results. The connection giving the larger quantity of water and the higher head is the correct one.

6.7.2 Grundfos motors - direct-on-line starting

The connection of Grundfos motors wound for direct-on-line starting appears from the table below and fig. 15.

Mains	Cable/connection
	Grundfos 4" and 6" motors
PE	PE (yellow/green)
L1	U (brown)
L2	V (black)
L3	W (grey)

Check the direction of rotation as described in section *6.7.1 Checking the direction of rotation*.



TM03 2099 3705

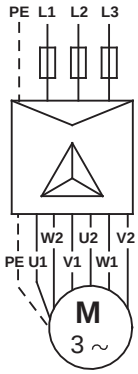
Fig. 15 Grundfos motors - direct-on-line starting

6.7.3 Grundfos motors - star-delta starting

The connection of Grundfos motors wound for star-delta starting appears from the table below and fig. 16.

Connection	Grundfos 6" motors
PE	Yellow/green
U1	Brown
V1	Black
W1	Grey
W2	Brown
U2	Black
V2	Grey

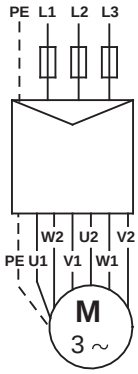
Check the direction of rotation as described in section *6.7.1 Checking the direction of rotation*.



TM03 2100 3705

Fig. 16 Grundfos motors wound for star-delta starting

If direct-on-line starting is required, the motors should be connected as shown in fig. 17.



TM03 2101 3705

Fig. 17 Grundfos motors wound for star-delta starting - direct-on-line starting

6.7.4 Connection in the case of unidentified cable marking/connection (Franklin motors)

If you do not know where the individual leads are to be connected to the mains in order to ensure the correct direction of rotation, proceed as follows:

Motors wound for direct-on-line starting

Connect the pump to the mains as is expected to be right.

Then check the direction of rotation as described in section *6.7.1 Checking the direction of rotation*.

Motors wound for star-delta starting

Determine the windings of the motor by means of an ohmmeter and name the lead sets for the individual windings accordingly: U1-U2, V1-V2, W1-W2. See fig. 18.

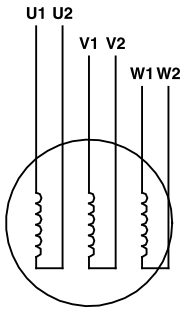


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Fig. 18 Unidentified cable marking/connection - motors wound for star-delta starting

If star-delta starting is required, connect the leads as shown in fig. 16.

If direct-on-line starting is required, connect the leads as shown in fig. 17.

Then check the direction of rotation as described in section *6.7.1 Checking the direction of rotation*.

6.7.5 Soft starter

We only recommend 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, contact your soft starter supplier or Grundfos.

6.7.6 Frequency converter operation

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

Note To enable the monitoring of the motor temperature, we recommend that you install a Pt100/Pt1000 sensor together with a PR5714 or CU 220 (50 Hz).

Permissible frequency ranges: 30-50 Hz and 30-60 Hz.

Ramp times: Maximum 3 seconds for start and stop.

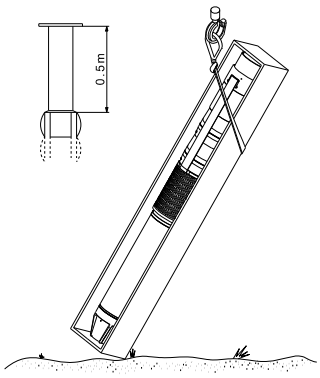
Depending on the type, the frequency converter may cause increased acoustic noise from the motor. Furthermore, it may expose the motor to detrimental voltage peaks. This can be abated by installing an LC filter between the frequency converter and the motor.

For further details, contact your frequency converter supplier or Grundfos.

7. Installation

We recommend that you first fit a 50 cm long pipe to the pump to facilitate handling of the pump during installation.

Caution Lift the pump to vertical position before removing it from the wooden box.



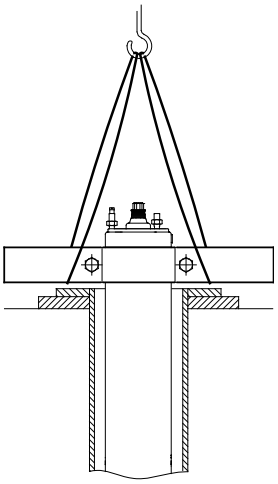
TM05 1617 3311

Fig. 19 Lifting the pump into vertical position

7.1 Fitting the motor to the pump

When the pump part and the motor are supplied as separate units (long pumps), fit the motor to the pump as follows:

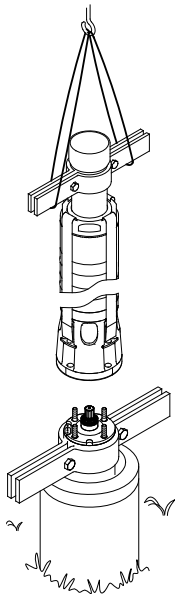
1. Use pipe clamps when handling the motor.
2. Place the motor in vertical position at the borehole seal. See fig. 20.



TM00 5259 2402

Fig. 20 Motor in vertical position

3. Lift the pump part by means of pipe clamps fitted to the extension pipe. See fig. 21.



TM02 5263 2502

Fig. 21 Lifting the pump into position

4. Place the pump part on top of the motor.
5. Fit and tighten the nuts. See table below.

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

The bolts and nuts securing the straps to the pump must be cross-tightened to the following torques:

Bolt/nut	Torque [Nm]
M8	18
M10	35
M12	45
M16	120
SP 215, 50 Hz, with more than 8 stages SP 215, 60 Hz, with more than 5 stages	150

When fitting the motor to the pump part, cross-tighten the nuts to the following torques:

Staybolt diameter	Torque [Nm]
5/16 UNF	18
1/2 UNF	50
M8	18
M12	70
M16	150
M20	280

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

7.2 Removing and fitting the cable guard

If the cable guard is screwed on to the pump, it 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.

7.3 Connecting the submersible drop cable

7.3.1 Grundfos motors

Before connecting the submersible drop cable to the motor, make sure that the cable socket is clean and dry.

To facilitate the connection of the cable, lubricate the rubber parts of the cable plug with non-conducting silicone paste.

Tighten the screws holding the cable to these torques [Nm]:

MS 402: 2.0
MS 4000: 3.0
MS 6000: 4.5
MMS 6: 20
MMS 8000: 18
MMS 10000: 18
MMS 12000: 15

7.4 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.

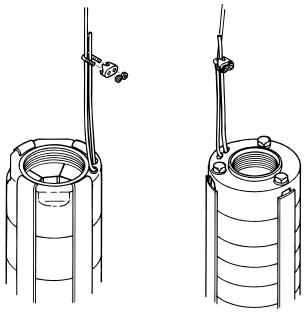
The threaded joints on the riser pipe must all be well cut and fit together to ensure that they do not work loose when subjected to torque reaction caused by the starting and stopping of the pump.

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, we recommend that you use plastic pipes.

Note We recommend plastic pipes for 4" pumps only.

When plastic pipes are used, secure the pump by an unloaded straining wire to be fastened to the discharge chamber of the pump. See fig. 22.



TM00 1368 2298

Fig. 22 Fixing the straining wire

When connecting plastic pipes, use a compression coupling 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.

7.5 Maximum installation depth below water level [m]

Grundfos MS 402: 150
Grundfos MS 4000: 600
Grundfos MS 6000: 600
Grundfos MMS: 600
Franklin motors: 350

7.6 Cable clips

Fit cable clips every 3 metres to fix the submersible drop cable and the straining wire, if fitted, to the riser pipe of the pump.

Grundfos supplies cable clip sets on request.

1. Cut off the rubber band so that the piece with no slit becomes as long as possible.
2. Insert a button in the first slit.
3. Position the wire alongside the submersible drop cable as shown in fig. 23.

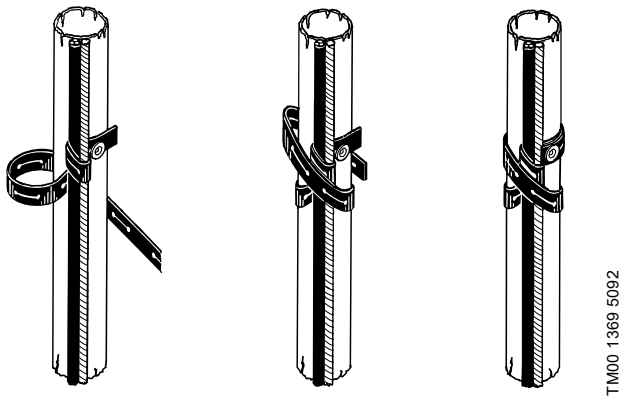


Fig. 23 Fitting the cable clips

4. Wind the band once around the wire and the cable. Then wind it tightly at least twice around the pipe, wire and the cable.
5. Push the slit over the button and cut off the band.

Where large cable cross-sections are used, it will be necessary to wind the band several times.

Where plastic pipes are used, some slackness must be left between each cable clip as plastic pipes expand when loaded.

When flanged pipes are used, the cable clips should be fitted above and below each joint.

7.7 Lowering the pump

We recommend that you 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 by means of the motor cable.

7.8 Installation depth

The dynamic water level should always be above the suction interconnector of the pump. See section *5.2 Positional requirements* and fig. 24.

Minimum inlet pressure is indicated in the NPSH curve for the pump. The minimum safety margin should be 1 metre head.

We recommend that you install the pump so that the motor part is above the well screen in order to ensure optimum cooling. See section *5.4 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.

Note For pumps fitted with plastic pipes, the expansion of the pipes when loaded should be taken into consideration, when deciding on the installation depth of the pump.

8. Startup and operation

8.1 Startup

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 approximately 1/3 of its maximum volume of water.

Check the direction of rotation as described in section *6.7.1 Checking the direction of rotation*.

If there are impurities in the water, open the valve gradually as the water becomes clearer. Do not stop the pump until the water is completely clean, as otherwise the pump parts and the non-return valve may become blocked.

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

The dynamic water level should always be above the suction interconnector of the pump. See section *5.2 Positional requirements* and fig. 24.

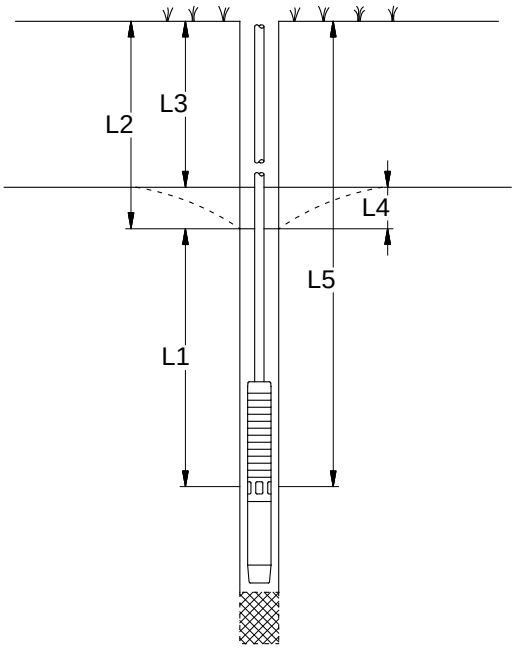


Fig. 24 Comparison of various water levels

L1: Minimum installation depth below dynamic water level. We recommend minimum 1 metre.

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 can pump more than yielded by the well, we recommend that you install the Grundfos MP 204 motor protector or some other type of dry-running protection.

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

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

8.2 Operation

8.2.1 Minimum flow rate

To ensure the necessary cooling of the motor, the pump flow rate should never be set so low that the cooling requirements in section *5.4 Liquid temperatures/cooling* cannot be met.

8.2.2 Frequency of starts and stops

Motor type		Number of starts
MS 402		• Minimum 1 per year is recommended. • Maximum 100 per hour. • Maximum 300 per day.
MS 4000		• Minimum 1 per year is recommended. • Maximum 100 per hour. • Maximum 300 per day.
MS 6000		• Minimum 1 per year is recommended. • Maximum 30 per hour. • Maximum 300 per day.
MMS6	PVC windings	• Minimum 1 per year is recommended. • Maximum 3 per hour. • Maximum 40 per day.
	PE/PA windings	• Minimum 1 per year is recommended. • Maximum 10 per hour. • Maximum 70 per day.
MMS 8000	PVC windings	• Minimum 1 per year is recommended. • Maximum 3 per hour. • Maximum 30 per day.
	PE/PA windings	• Minimum 1 per year is recommended. • Maximum 8 per hour. • Maximum 60 per day.
MMS 10000	PVC windings	• Minimum 1 per year is recommended. • Maximum 2 per hour. • Maximum 20 per day.
	PE/PA windings	• Minimum 1 per year is recommended. • Maximum 6 per hour. • Maximum 50 per day.
MMS 12000	PVC windings	• Minimum 1 per year is recommended. • Maximum 2 per hour. • Maximum 15 per day.
	PE/PA windings	• Minimum 1 per year is recommended. • Maximum 5 per hour. • Maximum 40 per day.

9. Maintenance and service

All pumps are easy to service.

Service kits and service tools are available from Grundfos.

The pumps can be serviced at a Grundfos service centre.

Warning

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

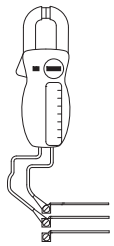
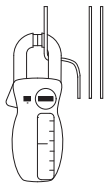
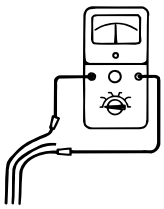
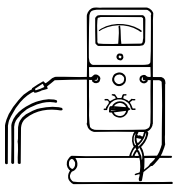
If Grundfos is requested to service the pump, Grundfos must be contacted with details about the pumped liquid, etc. before the pump is returned for service. Otherwise Grundfos can refuse to accept the pump for service.

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

10. Fault finding

Fault	Cause	Remedy
1. The pump does not run.	a) The fuses are blown.	Replace the blown fuses. If the new ones blow too, check the electric installation and the submersible drop cable.
	b) The ELCB or the voltage-operated ELCB has tripped.	Cut in the circuit breaker.
	c) No power supply.	Contact the power supply company.
	d) The motor-protective circuit breaker has tripped.	Reset the motor-protective circuit breaker (automatically or possibly manually). Check the voltage if it trips again. If the voltage is okay, see items 1e to 1h.
	e) The motor-protective circuit breaker/contactor is defective.	Replace the motor-protective circuit breaker/contactor.
	f) Starter device is defective.	Repair or 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 power supply to the pump due to low water level.	Check the water level. If it is okay, check the water level electrodes/level switch.
	i) The pump/submersible drop cable is defective.	Repair or 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 3a.
	c) The non-return valve is stuck in closed position.	Pull out the pump and clean or replace the valve.
	d) The suction strainer is blocked.	Pull out the pump and clean the strainer.
	e) The pump is defective.	Repair or replace the pump.
3. The pump runs at reduced performance.	a) The drawdown is larger than anticipated.	Increase the installation depth of the pump, throttle the pump or install a pump with a smaller performance.
	b) Wrong direction of rotation.	See section *6.7.1 Checking the direction of rotation*.
	c) The valves in the discharge pipe are partly closed/blocked.	Clean or replace the valves.
	d) The discharge pipe is partly blocked by impurities (ochre).	Clean or replace the pipe.
	e) The non-return valve of the pump is partly blocked.	Pull out the pump and clean or replace the valve.
	f) The pump and the riser pipe are partly blocked by impurities (ochre).	Pull out the pump and clean or replace it. Clean the pipes.
	g) The pump is defective.	Repair or replace the pump.
	h) Leakage in the pipework.	Check and repair the pipework.
	i) The riser pipe is defective.	Replace the 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. 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 electrodes/level switches. If the intervals between stop/start cannot be changed via the automatics, the pump performance 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 or replace the valve.
	d) The tank precharge pressure is too small.	Adjust the tank precharge pressure in accordance with its installation and operating instructions.
	e) The tank is too small.	Increase the capacity of the tank by replacing or supplementing with another tank.
	f) The diaphragm of the tank is defective.	Check the diaphragm tank.

11. Checking motor and cable

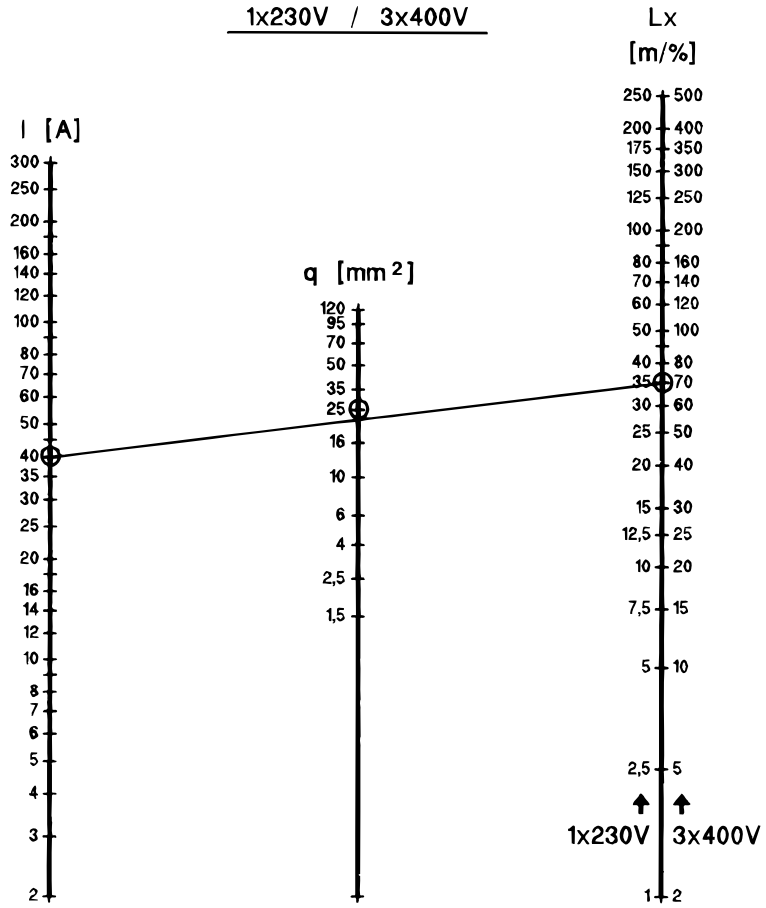
1. Supply voltage  TM00 1371 5092	Measure the voltage between the phases by means of a voltmeter. On single-phase motors, measure between phase and neutral or between two phases, depending on the type of supply. Connect the voltmeter to the terminals in the motor-protective circuit breaker.	The voltage should, when the motor is loaded, be within the range specified in section *6. Electrical connection*. The motor may burn if there are larger variations in voltage. Large variations in voltage indicate poor power supply, and the pump should be stopped until the defect has been remedied.
2. Current consumption  TM00 1372 5092	Measure the amps of each phase while the pump is operating at a constant discharge head (if possible, at the performance where the motor is most heavily loaded). 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: • The contacts of the motor-protective circuit breaker are burnt. Replace the contacts or the control box for single-phase operation. • Poor connection in leads, possibly in the cable joint. See item 3. • Too high or too low supply voltage. See item 1. • The motor windings are short-circuited or partly disjointed. See item 3. • Damaged pump is causing the motor to be overloaded. Pull out the pump for overhaul. • 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  TM00 1373 5092	Disconnect the submersible drop cable from the motor-protective circuit breaker. 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 %. If the deviation is higher, pull out the pump. Measure motor, motor cable and drop cable separately, and repair or replace defective parts. **Note:** The operating winding of single-phase 3-wire motors will assume the lowest resistance value.
4. Insulation resistance  TM00 1374 5092	Disconnect the submersible drop cable from the motor-protective circuit breaker. Measure the insulation resistance from each phase to earth (frame). Make sure that the earth connection was made carefully.	If the insulation resistance is less than 0.5 MΩ, the pump should be pulled out for motor or cable repair. Local regulations may specify other values for the insulation resistance.

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.

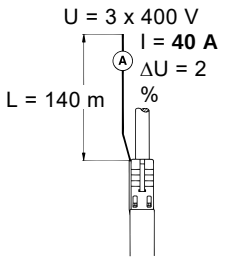


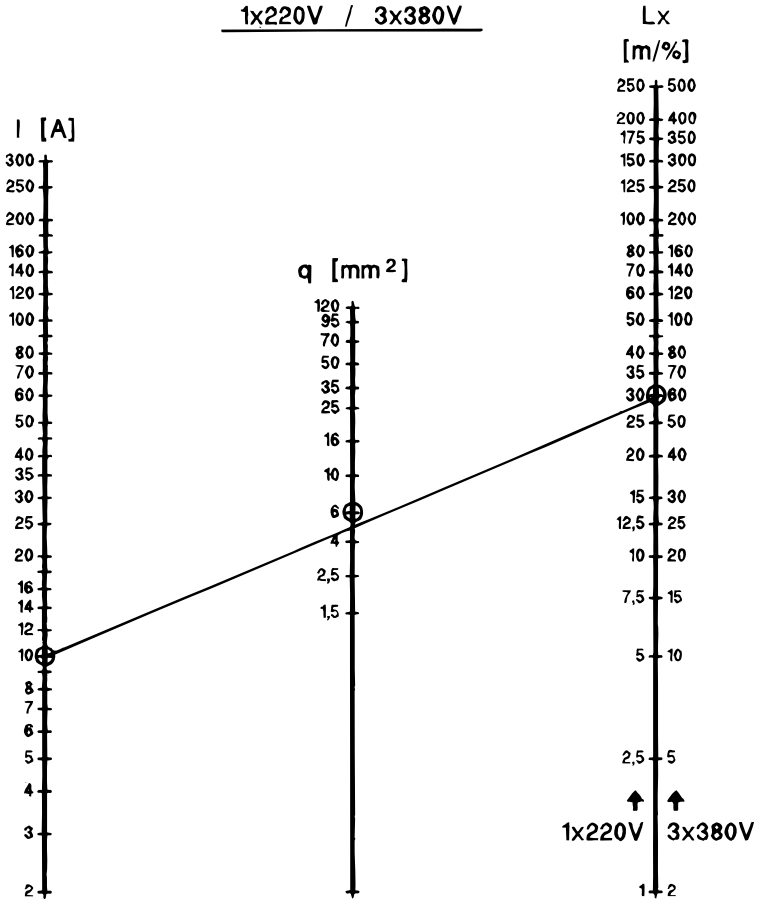
TM00 1346 5092

Example:

U = 3 x 400 V
I = **40 A**
L = 140 m
ΔU = 2 %

$Lx = \frac{L}{\Delta U} = \frac{140}{2\,\%} =$ **70 m** = q ⇒ 25 mm²



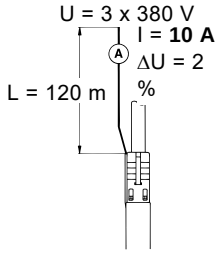


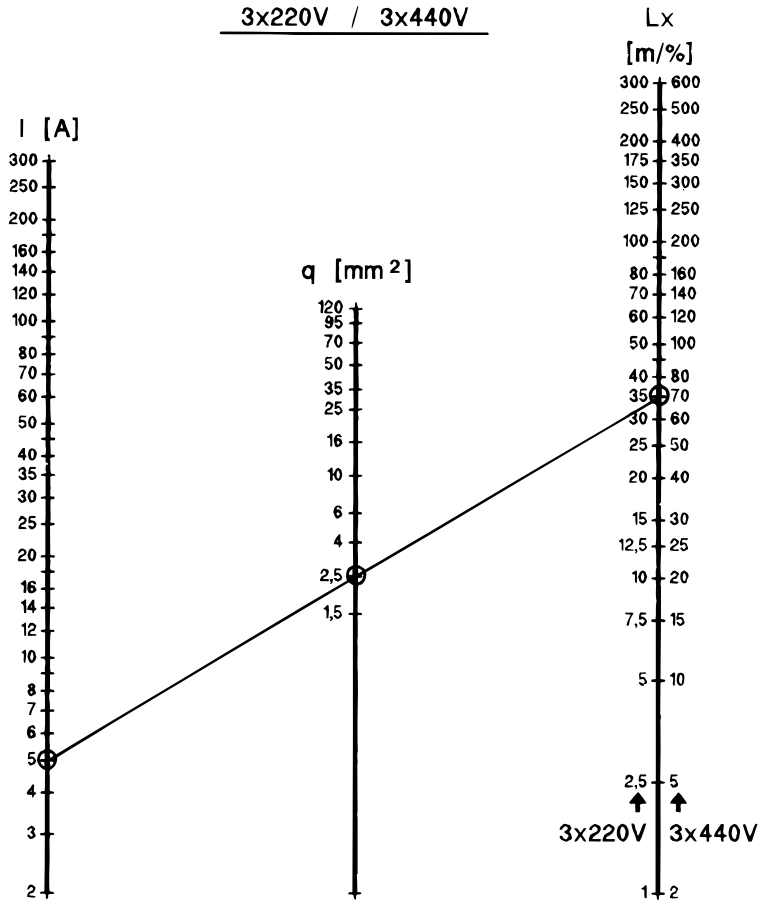
TM00 1345 5092

Example:

U = 3 x 380 V
I = **10 A**
L = 120 m
ΔU = 2 %

$Lx = \frac{L}{\Delta U} = \frac{120}{2\,\%} =$ **60 m** = q ⇒ 6 mm²



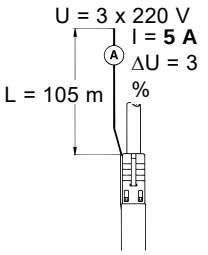


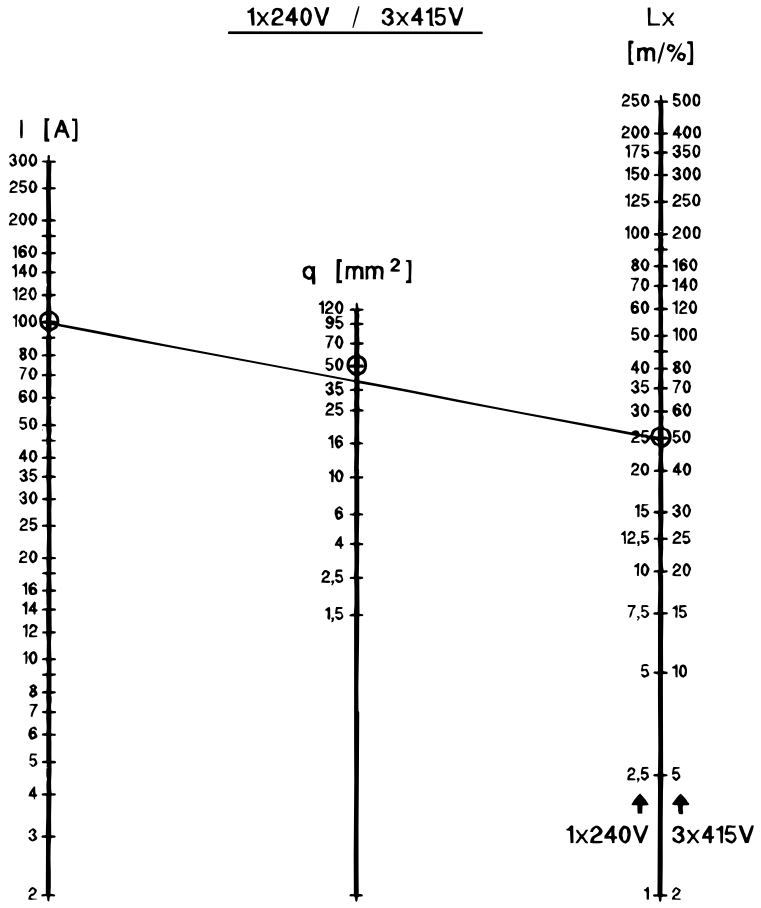
TM00 1348 5092

Example:

U = 3 x 220 V
I = **5 A**
L = 105 m
ΔU = 3 %

$Lx = \frac{L}{\Delta U} = \frac{105}{3\,\%} =$ **35 m** = q ⇒ 2,5 mm²



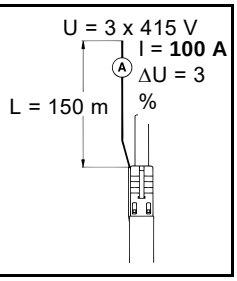


TM00 1347 5092

Example:

U = 3 x 415 V
I = **100 A**
L = 150 m
ΔU = 3 %

$$Lx = \frac{L}{\Delta U} = \frac{150}{3\ \%} = \mathbf{50\ m} = q \Rightarrow 50\ mm^2$$



SP1 - SP 2 - SP 3 - SP 5

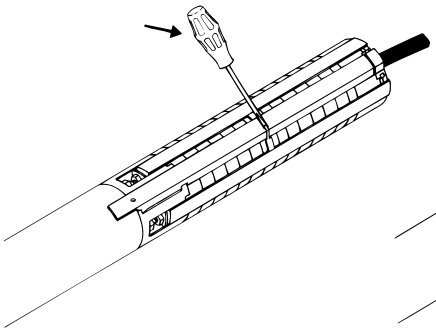


Fig. 1

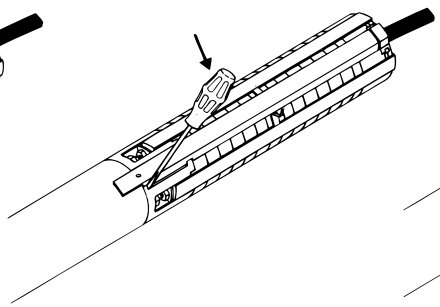


Fig. 2

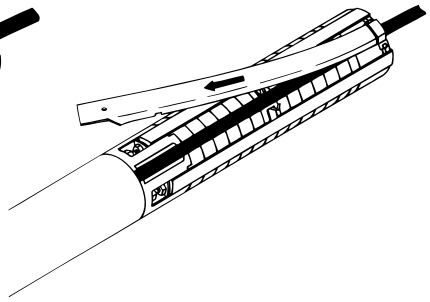


Fig. 3

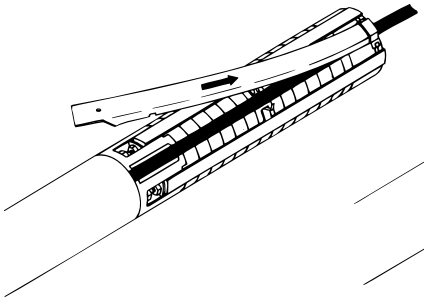


Fig. 1

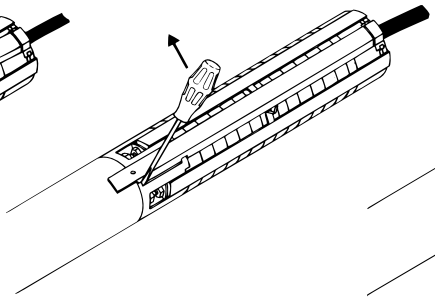


Fig. 2

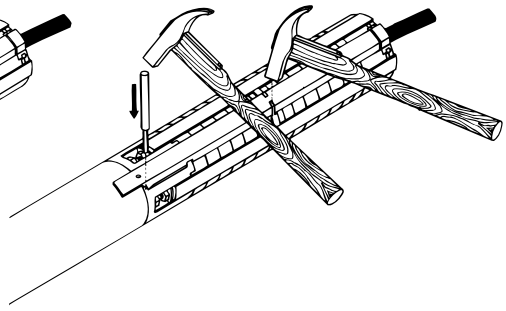


Fig. 3

TM00 1323 5092

SP 7 - SP 9 - SP 11 - SP 14 - SP 17 - SP 30 - SP 46 - SP 60

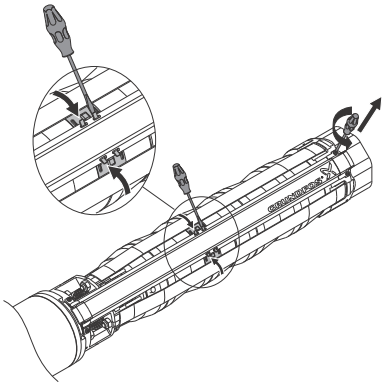


Fig. 1

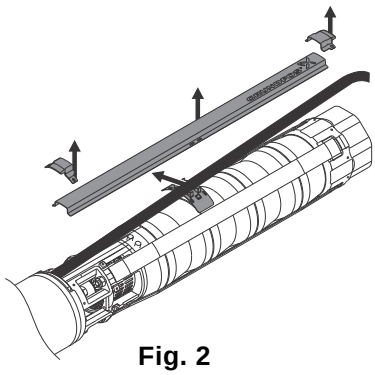


Fig. 2

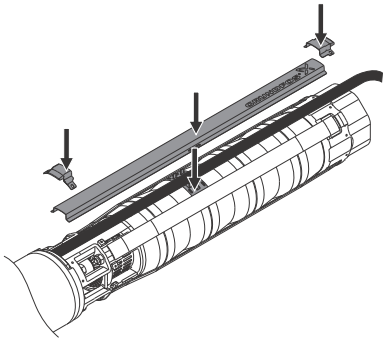


Fig. 1

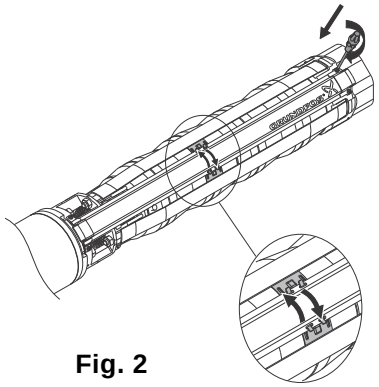


Fig. 2

TM06 0693 0814

SP 77 - SP 95 - SP 125 - SP 160 - SP 215

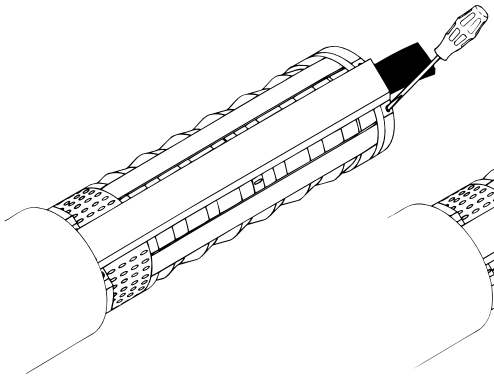


Fig. 1

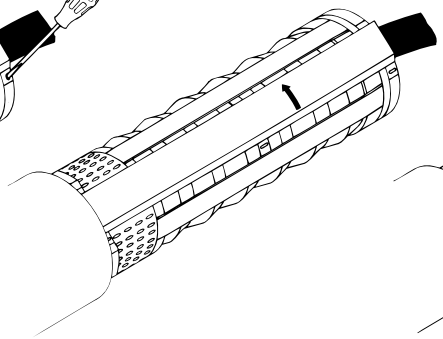


Fig. 2

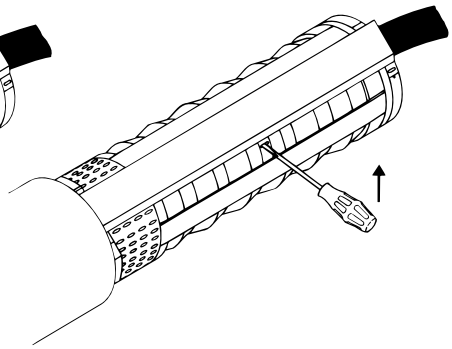


Fig. 3

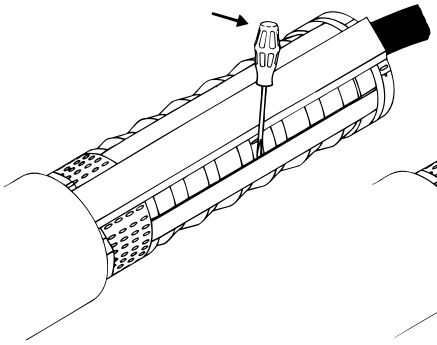


Fig. 1

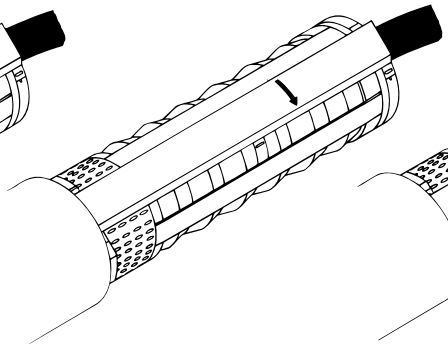


Fig. 2

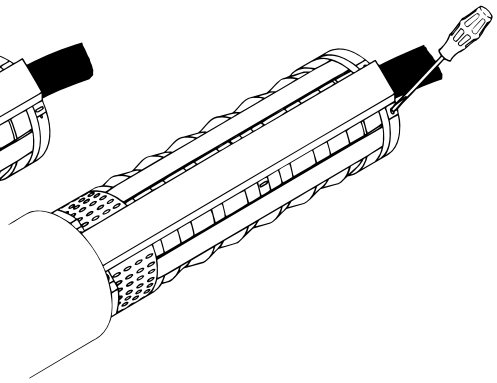


Fig. 3

TM00 1326 5092

Argentina
Bombas GRUNDFOS de Argentina S.A.
Ruta Panamericana km. 37.500 Centro Industrial Garin
1619 Garín Pcia. de B.A.
Phone: +54-3327 414 444
Telefax: +54-3327 45 3190

Australia
GRUNDFOS Pumps Pty. Ltd.
P.O. Box 2040
Regency Park
South Australia 5942
Phone: +61-8-8461-4611
Telefax: +61-8-8340 0155

Austria
GRUNDFOS Pumpen Vertrieb Ges.m.b.H.
Grundfosstraße 2
A-5082 Grödig/Salzburg
Tel.: +43-6246-883-0
Telefax: +43-6246-883-30

Belgium
N.V. GRUNDFOS Bellux S.A.
Boomsesteenweg 81-83
B-2630 Aartselaar
Tél.: +32-3-870 7300
Télécopie: +32-3-870 7301

Belarus
Представительство ГРУНДФОС в Минске
220125, Минск
ул. Шафарнянская, 11, оф. 56, БЦ «Порт»
Тел.: +7 (375 17) 286 39 72/73
Факс: +7 (375 17) 286 39 71
E-mail: minsk@grundfos.com

Bosna and Herzegovina
GRUNDFOS Sarajevo
Zmaja od Bosne 7-7A,
BH-71000 Sarajevo
Phone: +387 33 592 480
Telefax: +387 33 590 465
www.ba.grundfos.com
e-mail: grundfos@bih.net.ba

Brazil
BOMBAS GRUNDFOS DO BRASIL
Av. Humberto de Alencar Castelo Branco, 630
CEP 09850 - 300
São Bernardo do Campo - SP
Phone: +55-11 4393 5533
Telefax: +55-11 4343 5015

Bulgaria
Grundfos Bulgaria EOOD
Slatina District
Iztochna Tangenta street no. 100
BG - 1592 Sofia
Tel. +359 2 49 22 200
Fax. +359 2 49 22 201
email: bulgaria@grundfos.bg

Canada
GRUNDFOS Canada Inc.
2941 Brighton Road
Oakville, Ontario
L6H 6C9
Phone: +1-905 829 9533
Telefax: +1-905 829 9512

China
GRUNDFOS Pumps (Shanghai) Co. Ltd.
10F The Hub, No. 33 Suhong Road
Minhang District
Shanghai 201106
PRC
Phone: +86 21 612 252 22
Telefax: +86 21 612 253 33

Croatia
GRUNDFOS CROATIA d.o.o.
Buzinski prilaz 38, Buzin
HR-10010 Zagreb
Phone: +385 1 6595 400
Telefax: +385 1 6595 499
www.hr.grundfos.com

Czech Republic
GRUNDFOS s.r.o.
Čajkovského 21
779 00 Olomouc
Phone: +420-585-716 111
Telefax: +420-585-716 299

Denmark
GRUNDFOS DK A/S
Martin Bachs Vej 3
DK-8850 Bjerringbro
Tlf.: +45-87 50 50 50
Telefax: +45-87 50 51 51
E-mail: info_GDK@grundfos.com
www.grundfos.com/DK

Estonia
GRUNDFOS Pumps Eesti OÜ
Peterburi tee 92G
11415 Tallinn
Tel: + 372 606 1690
Fax: + 372 606 1691

Finland
OY GRUNDFOS Pumput AB
Trukkikuja 1
FI-01360 Vantaa
Phone: +358-(0) 207 889 500
Telefax: +358-(0) 207 889 550

France
Pompes GRUNDFOS Distribution S.A.
Parc d'Activités de Chesnes
57, rue de Malacombe
F-38290 St. Quentin Fallavier (Lyon)
Tél.: +33-4 74 82 15 15
Télécopie: +33-4 74 94 10 51

Germany
GRUNDFOS GMBH
Schlüterstr. 33
40699 Erkrath
Tel.: +49-(0) 211 929 69-0
Telefax: +49-(0) 211 929 69-3799
e-mail: infoservice@grundfos.de
Service in Deutschland:
e-mail: kundendienst@grundfos.de

Greece
GRUNDFOS Hellas A.E.B.E.
20th km. Athinon-Markopoulou Av.
P.O. Box 71
GR-19002 Peania
Phone: +0030-210-66 83 400
Telefax: +0030-210-66 46 273

Hong Kong
GRUNDFOS Pumps (Hong Kong) Ltd.
Unit 1, Ground floor
Siu Wai Industrial Centre
29-33 Wing Hong Street &
68 King Lam Street, Cheung Sha Wan
Kowloon
Phone: +852-27861706 / 27861741
Telefax: +852-27858664

Hungary
GRUNDFOS Hungária Kft.
Park u. 8
H-2045 Törökbálint,
Phone: +36-23 511 110
Telefax: +36-23 511 111

India
GRUNDFOS Pumps India Private Limited
118 Old Mahabalipuram Road
Thoraipakkam
Chennai 600 096
Phone: +91-44 2496 6800

Indonesia
PT. GRUNDFOS POMPA
Graha Intirub Lt. 2 & 3
Jln. Cililitan Besar No.454. Makasar,
Jakarta Timur
ID-Jakarta 13650
Phone: +62 21-469-51900
Telefax: +62 21-460 6910 / 460 6901

Ireland
GRUNDFOS (Ireland) Ltd.
Unit A, Merrywell Business Park
Ballymount Road Lower
Dublin 12
Phone: +353-1-4089 800
Telefax: +353-1-4089 830

Italy
GRUNDFOS Pompe Italia S.r.l.
Via Gran Sasso 4
I-20060 Truccazzano (Milano)
Tel.: +39-02-95838112
Telefax: +39-02-95309290 / 95838461

Japan
GRUNDFOS Pumps K.K.
Gotanda Metalion Bldg., 5F,
5-21-15, Higashi-gotanda
Shiagawa-ku, Tokyo
141-0022 Japan
Phone: +81 35 448 1391
Telefax: +81 35 448 9619

Korea
GRUNDFOS Pumps Korea Ltd.
6th Floor, Aju Building 679-5
Yeoksam-dong, Kangnam-ku, 135-916
Seoul, Korea
Phone: +82-2-5317 600
Telefax: +82-2-5633 725

Latvia
SIA GRUNDFOS Pumps Latvia
Deglava biznesa centrs
Augusta Deglava ielā 60, LV-1035, Rīga,
Tālr.: + 371 714 9640, 7 149 641
Fakss: + 371 914 9646

Lithuania
GRUNDFOS Pumps UAB
Smolensko g. 6
LT-03201 Vilnius
Tel: + 370 52 395 430
Fax: + 370 52 395 431

Malaysia
GRUNDFOS Pumps Sdn. Bhd.
7 Jalan Peguam U1/25
Glenmarie Industrial Park
40150 Shah Alam
Selangor
Phone: +60-3-5569 2922
Telefax: +60-3-5569 2866

Mexico
Bombas GRUNDFOS de México S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. 66600
Phone: +52-81-8144 4000
Telefax: +52-81-8144 4010

Netherlands
GRUNDFOS Netherlands
Veluwezoom 35
1326 AE Almere
Postbus 22015
1302 CA ALMERE
Tel.: +31-88-478 6336
Telefax: +31-88-478 6332
E-mail: info_gnl@grundfos.com

New Zealand
GRUNDFOS Pumps NZ Ltd.
17 Beatrice Tinsley Crescent
North Harbour Industrial Estate
Albany, Auckland
Phone: +64-9-415 3240
Telefax: +64-9-415 3250

Norway
GRUNDFOS Pumper A/S
Strømsveien 344
Postboks 235, Leirdal
N-1011 Oslo
Tlf.: +47-22 90 47 00
Telefax: +47-22 32 21 50

Poland
GRUNDFOS Pompy Sp. z o.o.
ul. Klonowa 23
Baranowo k. Poznania
PL-62-081 Przeźmierowo
Tel: (+48-61) 650 13 00
Fax: (+48-61) 650 13 50

Portugal
Bombas GRUNDFOS Portugal, S.A.
Rua Calvet de Magalhães, 241
Apartado 1079
P-2770-153 Paço de Arcos
Tel.: +351-21-440 76 00
Telefax: +351-21-440 76 90

Romania
GRUNDFOS Pompe România SRL
Bd. Biruintei, nr 103
Pantelimon county Ilfov
Phone: +40 21 200 4100
Telefax: +40 21 200 4101
E-mail: romania@grundfos.ro

Russia
ООО Грундфос Россия
109544, г. Москва, ул. Школьная, 39-41, стр. 1
Тел. (+7) 495 564-88-00 (495) 737-30-00
Факс (+7) 495 564 88 11
E-mail grundfos.moscow@grundfos.com

Serbia
Grundfos Srbija d.o.o.
Omladinskih brigada 90b
11070 Novi Beograd
Phone: +381 11 2258 740
Telefax: +381 11 2281 769
www.rs.grundfos.com

Singapore
GRUNDFOS (Singapore) Pte. Ltd.
25 Jalan Tukang
Singapore 619264
Phone: +65-6681 9688
Telefax: +65-6681 9689

Slovakia
GRUNDFOS s.r.o.
Prievozská 4D
821 09 BRATISLAVA
Phona: +421 2 5020 1426
sk.grundfos.com

Slovenia
GRUNDFOS LJUBLJANA, d.o.o.
Leskoškova 9e, 1122 Ljubljana
Phone: +386 (0) 1 568 06 10
Telefax: +386 (0)1 568 06 19
E-mail: tehnika-si@grundfos.com

South Africa
GRUNDFOS (PTY) LTD
Corner Mountjoy and George Allen Roads
Wilbart Ext. 2
Bedfordview 2008
Phone: (+27) 11 579 4800
Fax: (+27) 11 455 6066
E-mail: lsmart@grundfos.com

Spain
Bombas GRUNDFOS España S.A.
Camino de la Fuentecilla, s/n
E-28110 Algete (Madrid)
Tel.: +34-91-848 8800
Telefax: +34-91-628 0465

Sweden
GRUNDFOS AB
Box 333 (Lunnagårdsgatan 6)
431 24 Mölndal
Tel.: +46 31 332 23 000
Telefax: +46 31 331 94 60

Switzerland
GRUNDFOS Pumpen AG
Bruggacherstrasse 10
CH-8117 Fällanden/ZH
Tel.: +41-44-806 8111
Telefax: +41-44-806 8115

Taiwan
GRUNDFOS Pumps (Taiwan) Ltd.
7 Floor, 219 Min-Chuan Road
Taichung, Taiwan, R.O.C.
Phone: +886-4-2305 0868
Telefax: +886-4-2305 0878

Thailand
GRUNDFOS (Thailand) Ltd.
92 Chaloem Phrakiat Rama 9 Road,
Dokmai, Pravej, Bangkok 10250
Phone: +66-2-725 8999
Telefax: +66-2-725 8998

Turkey
GRUNDFOS POMPA San. ve Tic. Ltd. Sti.
Gebze Organize Sanayi Bölgesi
Ihsan dede Caddesi,
2. yol 200. Sokak No. 204
41490 Gebze/ Kocaeli
Phone: +90 - 262-679 7979
Telefax: +90 - 262-679 7905
E-mail: satis@grundfos.com

Ukraine
Бізнес Центр Європа
Столичне шосе, 103
м. Київ, 03131, Україна
Телефон: (+38 044) 237 04 00
Факс.: (+38 044) 237 04 01
E-mail: ukraine@grundfos.com

United Arab Emirates
GRUNDFOS Gulf Distribution
P.O. Box 16768
Jebel Ali Free Zone
Dubai
Phone: +971 4 8815 166
Telefax: +971 4 8815 136

United Kingdom
GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard/Beds. LU7 4TL
Phone: +44-1525-850000
Telefax: +44-1525-850011

U.S.A.
GRUNDFOS Pumps Corporation
17100 West 118th Terrace
Olathe, Kansas 66061
Phone: +1-913-227-3400
Telefax: +1-913-227-3500

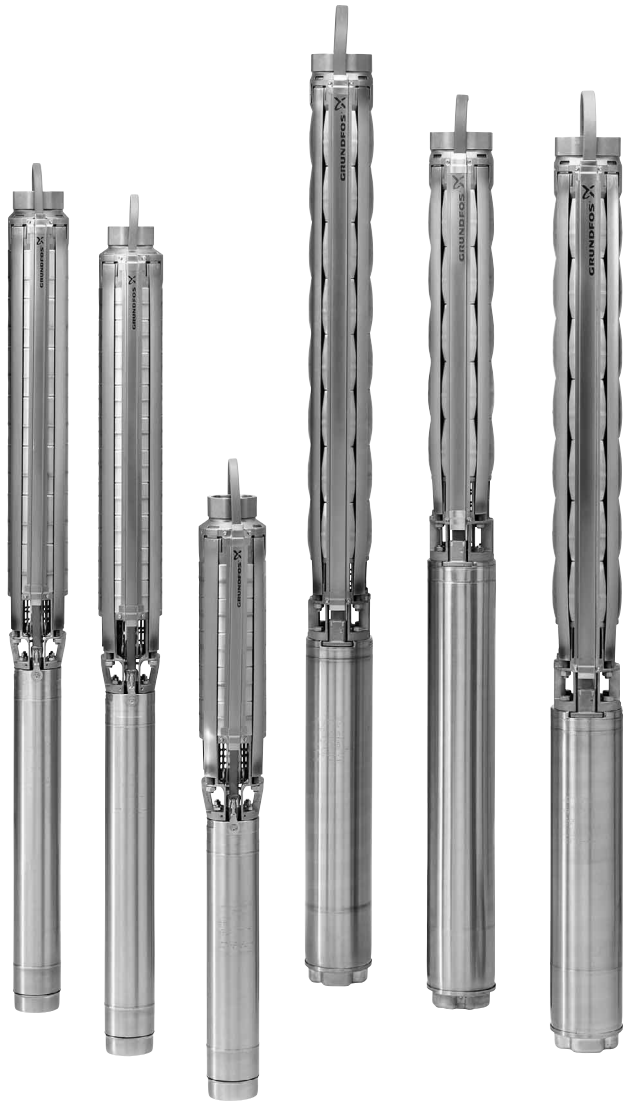
Uzbekistan
Grundfos Tashkent, Uzbekistan The Representative Office of Grundfos Kazakhstan in Uzbekistan
38a, Oybek street, Tashkent
Телефон: (+998) 71 150 3290 / 71 150 3291
Факс: (+998) 71 150 3292

Addresses Revised 25.01.2016

98074911 0616
ECM: 1157986

SP

Installation and operating instructions



Other languages

http://net.grundfos.com/qr/i/98074911

be
think
innovate

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. Symbols used in this document

Warning

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

Warning

If these instructions are not observed, it may lead to electric shock with consequent risk of serious personal injury or death.

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. Introduction

These instructions apply to Grundfos submersible pumps, type SP, with submersible motors, types Grundfos MS/MMS or Franklin 4"-8".

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

Note — The USB stick supplied with the product contains installation and operating instructions in various languages.

3. Delivery and storage

3.1 Delivery

Caution — The pump should remain in the packing until it is placed in vertical position during installation.

Handle the pump with care.

When the pump part and motor are supplied as separate units (long pumps), fit the motor to the pump as described in section *7.1 Fitting the motor to the pump*.

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

Do not expose the pump to unnecessary impact and shocks.

3.2 Storage

Storage temperature

Pump: -20 °C to +60 °C.
Motor: -20 °C to +70 °C.

The motors must be stored in a closed, dry and well ventilated room.

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

The pump should not be exposed to direct sunlight.

If the pump has been unpacked, it should be stored horizontally, adequately supported, or vertically to prevent misalignment of the pump. Make sure that the pump cannot roll or fall over.

During storage, the pump can be supported as shown in fig. 1.

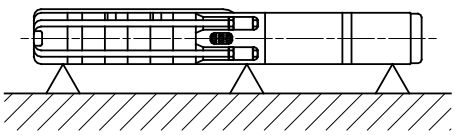


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Fig. 1 Pump position during storage

3.2.1 Frost protection

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

4. Applications

Grundfos SP submersible pumps are designed for a wide range of water supply and liquid transfer applications, such as the supply of fresh water to private homes or waterworks, water supply in horticulture and agriculture, drawdown of groundwater and pressure boosting, and various industrial jobs.

The pump must be installed so that the suction interconnector is completely submerged in the liquid. The pump can be installed horizontally or vertically. See section *5.2 Positional requirements*.

4.1 Pumped liquids

Clean, thin, non-explosive liquids without solid particles or fibres.

The maximum sand content of the water must not exceed 50 g/m^3. A larger sand content will reduce the life of the pump and increase the risk of blockage.

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, contact Grundfos.

The pump versions SP A N, SP A R, SP N, SP R and SPE are designed for liquids with higher aggressiveness than drinking water.

The maximum liquid temperature appears from section *5.4 Liquid temperatures/cooling*.

4.2 Sound pressure level

The sound pressure level has been measured in accordance with the rules laid down in the EC machinery directive 2006/42/EC.

Sound pressure level of pumps

The values apply to pumps submerged in water, without external regulating valve.

Pump type	$\overline{L}_{pA}$ [dB(A)]
SP 1A	< 70
SP 2A	< 70
SP 3A	< 70
SP 5A	< 70
SP 7	< 70
SP 9	< 70
SP 11	< 70
SP 14	< 70
SP 17	< 70
SP 30	< 70
SP 46	< 70
SP 60	< 70
SP 77	< 70
SP 95	< 70
SP 125	79
SP 160	79
SP 215	82

Sound pressure level of motors

The sound pressure level of Grundfos MS and MMS motors is lower than 70 dB(A).

Other motor makes: See installation and operating instructions for these motors.

5. Preparations before installation

Warning

Before starting work on the product, switch off the power supply. Make sure that the power supply cannot be accidentally switched on.

5.1 Checking the motor liquid

The motors are factory-filled with a special non-poisonous liquid which is frost-proof down to -20 °C.

Note Check the level of motor liquid and refill if required. Use clean water.

Caution If frost protection is required, special Grundfos liquid must be used to refill the motor. Otherwise clean water may be used for refilling (however, never use distilled water).

Refill liquid as described below.

5.1.1 Grundfos MS 4000 and MS 402 motors

The filling hole for motor liquid is placed in the following positions:

- MS 4000: in the top of the motor.
- MS 402: in the bottom of the motor.

1. Position the submersible pump as shown in fig. 2. The filling screw must be at the highest point of the motor.
2. Remove the screw from the filling hole.
3. Inject liquid into the motor with the filling syringe until the liquid runs back out of the filling hole. See fig. 2.
4. Replace the screw in the filling hole and tighten securely before changing the position of the pump.

Torques

- MS 4000: 3.0 Nm.
- MS 402: 2.0 Nm.

The submersible pump is now ready for installation.

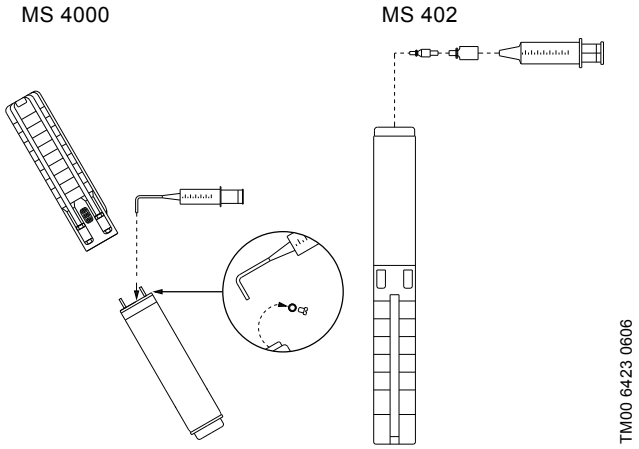

Fig. 2 Motor position during filling - MS 4000 and MS 402

5.1.2 Grundfos MS 6000 motors

- If the motor is delivered from stock, check the level of motor liquid before fitting the motor to the pump. See fig. 3.
- When pumps are delivered direct from Grundfos, the level has already been checked.
- Check the level in connection with service. See fig. 3.

The filling hole for motor liquid is placed at the top of the motor.

1. Position the submersible pump as shown in fig. 3. The filling screw must be at the highest point of the motor.
2. Remove the screw from the filling hole.
3. Inject liquid into the motor with the filling syringe until the liquid runs back out of the filling hole. See fig. 3.
4. Replace the screw in the filling hole and tighten securely before changing the position of the pump.

Torque: 3.0 Nm.

The submersible pump is now ready for installation.

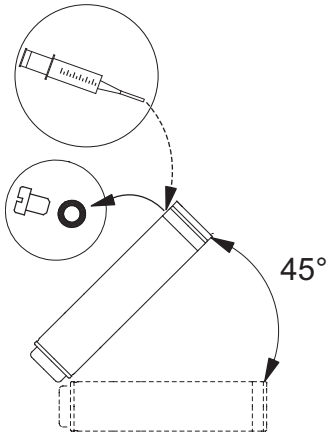

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Fig. 3 Motor position during filling - MS 6000

5.1.3 Grundfos MMS 6, MMS 8000, MMS 10000 and MMS 12000 motors

1. Place the motor at a 45 ° angle with the top of the motor upwards. See fig. 4.
2. Unscrew the plug A and place a funnel in the hole.
3. Pour tap water into the motor until the motor liquid inside the motor starts running out of A.

Caution Do not use motor liquid as it contains oil.

4. Remove the funnel and refit the plug A.

Caution Before fitting the motor to a pump after a long period of storage, lubricate the shaft seal by adding a few drops of water and turning the shaft.

The submersible pump is now ready for installation.

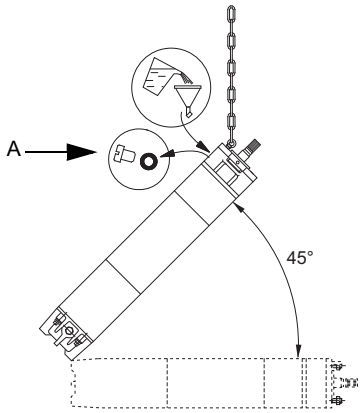

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Fig. 4 Motor position during filling - MMS

5.1.4 Franklin motors from 3 kW and up

Check the level of motor liquid in Franklin 4" and 6" motors by measuring the distance from the bottom plate to the built-in rubber diaphragm. The distance can be measured by inserting a rule or a small rod through the hole until it touches the diaphragm. See fig. 5.

Caution Take care not to damage the diaphragm.

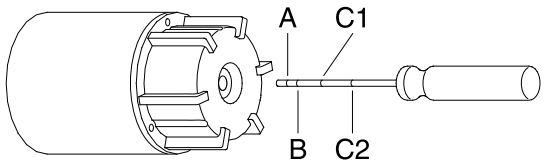

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Fig. 5 Measuring the distance from bottom plate to diaphragm

The table below shows the correct distance from the outside of the bottom plate to the diaphragm:

Motor	Dimension	Distance [mm]
Franklin 4", 0.25 - 3 kW (fig. 6a)	A	8
Franklin 4", 3 - 7.5 kW (fig. 6b)	B	16
Franklin 6", 4-45 kW (fig. 6c)	C1	35
Franklin 6", 4-22 kW (fig. 6d)	C2	59

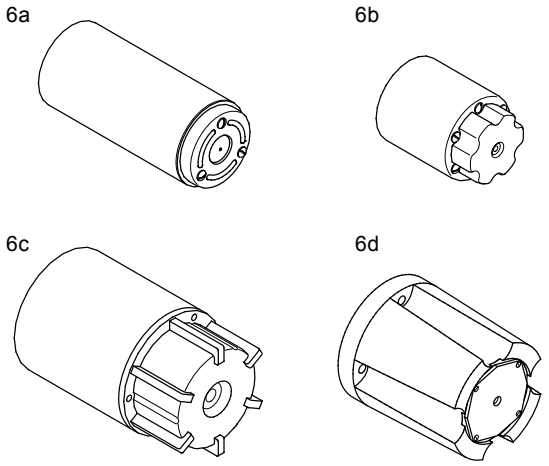

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Fig. 6 Franklin motors

If the distance is not correct, carry out an adjustment as described in section *5.1.5 Franklin motors*.

5.1.5 Franklin motors

Check the level of motor liquid in Franklin 8" motors as follows:

1. Press out the filter in front of the valve at the top of the motor using a screwdriver. If the filter is slotted, unscrew. Figure 7 shows the position of the filling valve.
2. Press the filling syringe against the valve and inject the liquid. See fig. 7. If the valve cone is depressed too far, it may be damaged thus causing the valve to leak.
3. Remove any air in the motor by pressing the point of the filling syringe lightly against the valve.
4. Repeat the process of injecting liquid and releasing air until the liquid starts running out or the diaphragm is in its correct position (Franklin 4" and 6").
5. Refit the filter.

The submersible pump is now ready for installation.

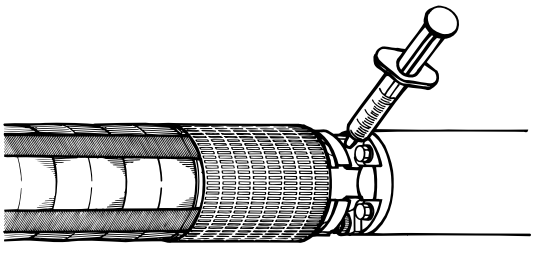

Fig. 7 Position of filling valve

5.2 Positional requirements

Warning

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 type, the pump can be installed either vertically or horizontally. A complete list of motor types suitable for horizontal installation is shown in section *5.2.1 Motors suitable for horizontal installation*.

If the pump is installed horizontally, the discharge port should never fall below the horizontal plane. See fig. 8.

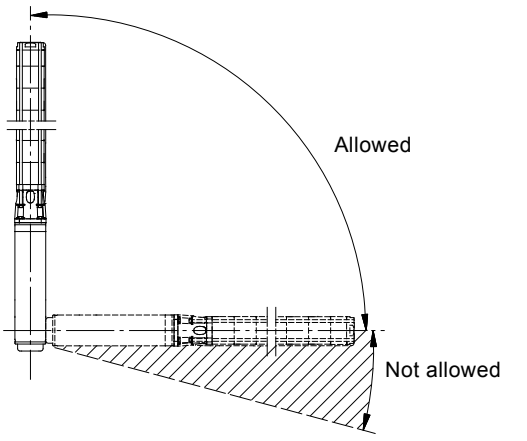

Fig. 8 Positional requirements

If the pump is installed horizontally, e.g. in a tank, we recommend that you fit it in a flow sleeve.

5.2.1 Motors suitable for horizontal installation

Motor	Output power 50 Hz	Output power 60 Hz
	[kW]	[kW]
MS	All	All
MMS 6	5.5 - 37	5.5 - 37
MMS 8000	22-110	22-110
MMS 10000	75-190	75-190
MMS 12000	147-250	147-250

When Franklin 4" motors up to and including 2.2 kW are started more than 10 times a day, we recommend that you incline the motor at least 15 ° above the horizontal plane in order to minimise wearing of the upthrust disc.

Caution During operation, the suction interconnector of the pump must always be completely submerged in the liquid. Make sure that the NPSH values are fulfilled.

Warning

If the pump is used for pumping hot liquids (40 to 60 °C), make sure that persons cannot come into contact with the pump and the installation, e.g. by installing a guard.

5.3 Pump/motor diameter

We recommend that you check the borehole with an inside calliper to ensure unobstructed passage.

5.4 Liquid temperatures/cooling

The maximum liquid temperature and the minimum flow velocity past the motor appear from the table below.

We recommend that you install the motor above the well screen in order to achieve proper motor cooling.

Caution In cases where the stated flow 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, use a flow sleeve in order to ensure proper cooling of the motor.

5.4.1 Maximum liquid temperature

Out of consideration for the rubber parts in pump and motor, the liquid temperature must not exceed 40 °C (~ 105 °F). See also the table below.

The pump can operate at liquid temperatures between 40 °C and 60 °C (~ 105 °F and 140 °F) provided that all rubber parts are replaced every third year.

Motor	Installation		
	Flow past the motor	Vertical	Horizontal
Grundfos MS 402 MS 4000 MS 6000	0.15 m/s	40 °C (~ 105 °F)	40 °C (~ 105 °F)
Grundfos MS 4000I*	0,15 m/s	60 °C (~ 140 °F) Flow sleeve recommended	60 °C (~ 140 °F) Flow sleeve recommended
Grundfos MS 6000I*	1.00 m/s		
Grundfos MMS	0.15 m/s	25 °C (~ 77 °F)	25 °C (~ 77 °F)
	0.50 m/s	30 °C (~ 86 °F)	30 °C (~ 86 °F)
Franklin 4"	0.08 m/s	30 °C (~ 85 °F)	30 °C (~ 85 °F)
Franklin 6" and 8"	0.16 m/s	30 °C (~ 85 °F)	30 °C (~ 85 °F)

* At an ambient pressure of minimum 1 bar (1 MPa).

Note 37 kW MMS 6, 110 kW MMS 8000 and 170 kW MMS 10000: The maximum operational liquid temperature is 5 °C lower than the values stated in the above table.

190 kW MMS 10000: The temperature is 10 °C lower.

5.5 Pipe connection

If noise may be transmitted to the building through the pipework, we recommend that you use plastic pipes.

Note We recommend plastic pipes for 4" pumps only.

When using plastic pipes, secure the pump by an unloaded straining wire.

Warning

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

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

6. Electrical connection

Warning

During electrical installation, make sure that the power supply cannot be accidentally switched on.

Warning

The electrical installation should be carried out by an authorised person in accordance with local regulations.

The supply voltage, rated maximum current and cos φ appear from the loose data plate which must be fitted close to the installation site.

The required voltage quality for MS and MMS motors, measured at the motor terminals, is - 10 %/+ 6 % of the nominal voltage during continuous operation (including variation in the supply voltage and losses in cables).

Check also that there is voltage symmetry in the power supply lines, i.e. same difference of voltage between the individual phases. See section *11. Checking motor and cable*, item 2.

Warning

The pump must be earthed.

The pump must be connected to an external mains switch with a minimum contact gap of 3 mm in all poles.

If MS motors with a built-in temperature transmitter (Tempcon) are not installed together with a MP 204 or similar Grundfos motor protection, they must be connected to a 0.47 µF capacitor approved for phase-phase operation (IEC 384-14) to meet the EC EMC directive (2004/108/EC). The capacitor must be connected to the two phases to which the temperature transmitter is connected. See fig. 9.

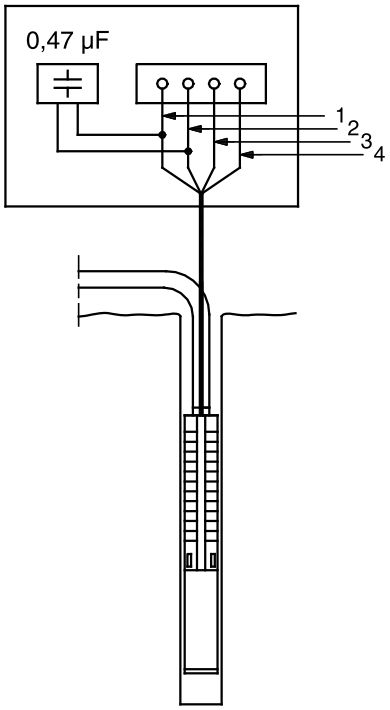

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Fig. 9 Connection of capacitor

Colours of the leads		
Lead	**Flat cable**	**Single leads**
1 = L1	Brown	Black
2 = L2	Black	Yellow
3 = L3	Grey	Red
4 = PE	Yellow/green	Green

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

The run-up time of the pump is only about 0.1 second. Direct-on-line starting is therefore normally approved by the power supply company.

6.1 Frequency converter operation

6.1.1 Grundfos motors

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

Caution

If an MS motor with temperature transmitter is connected to a frequency converter, a fuse incorporated in the transmitter will melt and the transmitter will be inactive. The transmitter cannot be reactivated. This means that the motor will operate like a motor without a temperature transmitter.

If a temperature transmitter is required, Grundfos offers a Pt100 or Pt1000 sensor for the submersible motor.

Caution

The motor should not run at a frequency higher than the rated frequency (50 or 60 Hz) during frequency converter operation. In connection with pump operation, never 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, the motor must stop 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.

Warning

MS 402 motors for supply voltages up to and including 440 V (see motor nameplate) must be protected against voltage peaks higher than 650 V (peak value) between the supply terminals.

We recommend that you 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.

We recommend that you install an LC filter when using a frequency converter. See section *6.7.6 Frequency converter operation*.

For further details, contact your frequency converter supplier or Grundfos.

6.1.2 Other motor makes than Grundfos

Contact Grundfos or the motor manufacturer.

6.2 Motor protection

6.2.1 Single-phase motors

Single-phase MS 402 motors incorporate a thermal switch and require no additional motor protection.

Warning

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

Single-phase MS 4000 motors must be protected. A protective device can either be incorporated in a control box or be separate.

Franklin 4" PSC motors must be connected to a motor-protective circuit breaker.

6.2.2 Three-phase motors

MS motors are available with or without a built-in temperature transmitter.

The following motors must be protected by a motor-protective circuit breaker with thermal relay, or a MP 204 and contactor(s):

- motors with a built-in and intact temperature transmitter
- motors with or without a defective temperature transmitter
- motors with or without a Pt100 sensor.

MMS motors have no built-in temperature transmitter.
The Pt100 and the Pt1000 sensor are available as an accessory.

6.2.3 Required settings of motor-protective circuit breaker

For cold motors, the tripping time of the motor-protective circuit breaker must be less than 10 seconds at 5 times the rated maximum current of the motor. During normal operating conditions the motor must be running at full speed in less than 3 seconds.

Caution

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

In order to ensure optimum motor protection, the motor-protective circuit breaker should be set as follows:

1. Set the motor-protective circuit breaker 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 setting by 5 %.

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

For motors wound for star-delta starting, the motor-protective circuit breaker should be set as above, but the maximum setting should be rated maximum current x 0.58.

The highest permissible startup time for star-delta starting or autotransformer starting is 2 seconds.

6.3 Lightning protection

The installation can be fitted with a special overvoltage protective device to protect the motor from voltage surges in the power supply lines when lightning strikes somewhere in the area. See fig. 10.

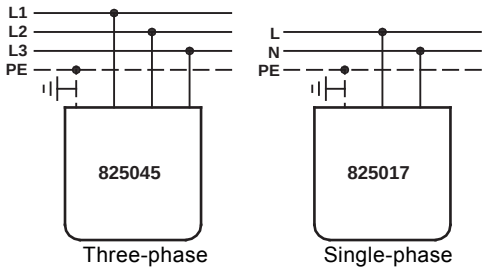

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Fig. 10 Fitting an overvoltage protective device

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

The overvoltage protective device should be connected to the installation as close as possible to the motor and always in accordance with local regulations. Ask Grundfos for lightning protective devices.

MS 402 motors, however, require no further lightning protection as they are highly insulated.

A special cable termination kit with a built-in overvoltage protective device is available for Grundfos 4" motors (product No 799911 or 799912).

6.4 Cable sizing

Caution Submersible motor cables are dimensioned for submersion in liquid, and will not necessarily have sufficient cross-section to be in free air.

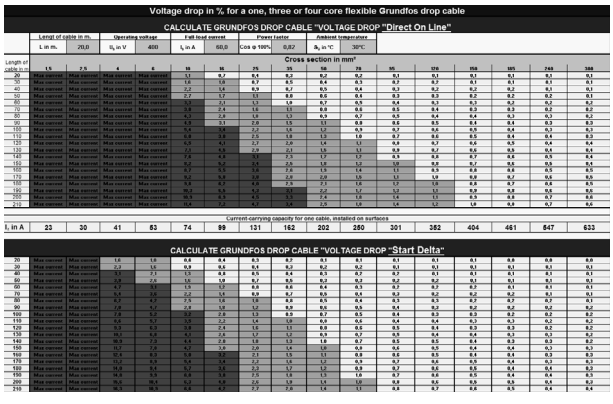
Make sure that the submersible drop cable can withstand permanent submersion in the actual liquid and at the actual temperature.

The cross-section (q) of the cable must meet the following requirements:

The submersible drop cable must be sized to the rated maximum current (I_n) of the motor.

The cross-section must be sufficient to make a voltage drop over the cable acceptable.

Grundfos supplies submersible drop cables for a wide range of installations. For correct cable sizing, Grundfos offers a cable sizing tool on the USB stick supplied with the motor.



TM05 8770 2613

Fig. 11 Cable sizing tool

The sizing tool provides an accurate calculation of the voltage drop at a given cross-section on the basis of the following parameters:

- cable length
- operating voltage
- full-load current
- power factor
- ambient temperature.

You can calculate the voltage drop both for direct-on-line and star-delta starting.

In order to minimise operating losses, the cable cross-section may be increased. This is only cost-efficient if the borehole provides the necessary space, and if the operating time of the pump is long. The cable sizing tool also provides a power loss calculator that shows the potential savings of an increased cross-section.

As an alternative to the cable sizing tool, select the cross-section on the basis of the current values of the given cables.

The cross-section of the submersible drop cable must be large enough to meet the voltage quality requirements specified in section *6. Electrical connection*.

Determine the voltage drop for the cross-section of the submersible drop cable by means of the diagrams on pages 17 to 20.

Use the following formula:

I = Rated maximum current of the motor.

For star-delta starting, I = rated maximum current of the motor x 0.58.

Lx = Length of cable converted to a voltage drop of 1 % of the nominal voltage.

$$Lx = \frac{\text{length of drop cable}}{\text{permissible voltage drop in \%}}$$

q = Cross-section of submersible drop cable.

Draw a straight line between the actual I-value and the Lx-value. Where the line intersects the q-axis, select the cross-section that lies right above the intersection.

The diagrams are made on the basis of the formulas:

Single-phase submersible motor

$$L = \frac{U \times \Delta U}{I \times 2 \times 100 \times \left(\cos\varphi \times \frac{\rho}{q} + \sin\varphi \times XI\right)}$$

Three-phase submersible motor

$$L = \frac{U \times \Delta U}{I \times 1.73 \times 100 \times \left(\cos\varphi \times \frac{\rho}{q} + \sin\varphi \times XI\right)}$$

L = Length of submersible drop cable [m]
U = Rated voltage [V]
ΔU = Voltage drop [%]
I = Rated maximum current of the motor [A]
cos φ = 0.9
ρ = Specific resistance: 0.02 [Ωmm^2/m]
q = Cross-section of submersible drop cable [mm^2]
sin φ = 0.436
XI = Inductive resistance: 0.078 x 10^{-3} [Ω/m].

6.5 Control of single-phase MS 402 motors

Warning

The single-phase MS 402 motor incorporates motor protection which cuts out the motor in case of excessive winding temperatures while the motor is still supplied with voltage. Allow for this, when the motor forms part of a control system.

If a compressor is included in a control system together with an ochre filter, the compressor will run continuously once the motor protection has cut out the motor, unless other special precautions have been taken.

6.6 Connection of single-phase motors

6.6.1 2-wire motors

MS 402 2-wire motors incorporate motor protection and a starter device and can therefore be connected direct to the mains. See fig. 12.

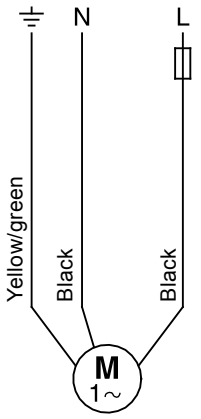


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Fig. 12 2-wire motors

6.6.2 PSC motors

The PSC motors are connected to the mains via a run capacitor which should be sized for continuous operation.

Select the correct capacitor size from the table below:

Motor [kW]	Capacitor [µF] 400 V, 50 Hz
0.25	12.5
0.37	16
0.55	20
0.75	30
1.10	40
1.50	50
2.20	75

MS 402 PSC motors incorporate motor protection and should be connected to the mains as shown in fig. 13.

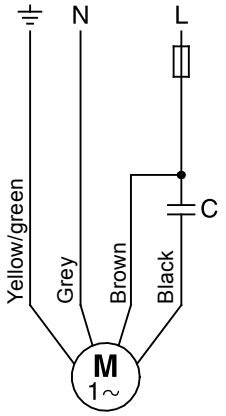

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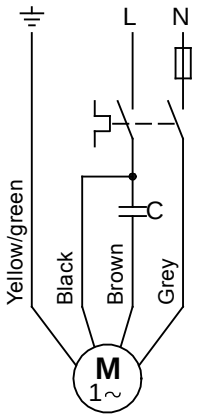
Fig. 13 PSC motors

See www.franklin-electric.com and fig. 14.



TM00 1361 1200

Fig. 14 Franklin motors

6.6.3 3-wire motors

MS 4000 3-wire motors must be connected to the mains via a Grundfos SA-SPM 5 (60 Hz), 7 or 8 (50 Hz) control box incorporating motor protection.

MS 402 3-wire motors incorporate motor protection and should be connected to the mains via a Grundfos control box SA-SPM 2, 3 or 5 (60 Hz), 7 or 8 (50 Hz) without motor protection.

6.7 Connection of three-phase motors

Three-phase motors must be protected.
See section *6.2.2 Three-phase motors*.

For electrical connection via the MP 204, see the separate installation and operating instructions for this unit.

When a conventional motor-protective circuit breaker is being used, the electrical connection should be carried out as described below.

6.7.1 Checking the direction of rotation

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

When the pump has been connected to the power supply, check the direction of rotation:

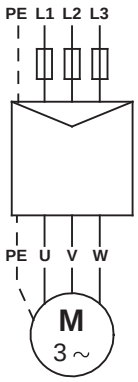
1. Start the pump and measure quantity of water and head.
2. Stop the pump and interchange two phases.
3. Start the pump and measure quantity of water and head.
4. Stop the pump.
5. Compare the two results. The connection giving the larger quantity of water and the higher head is the correct one.

6.7.2 Grundfos motors - direct-on-line starting

The connection of Grundfos motors wound for direct-on-line starting appears from the table below and fig. 15.

Mains	Cable/connection
	Grundfos 4" and 6" motors
PE	PE (yellow/green)
L1	U (brown)
L2	V (black)
L3	W (grey)

Check the direction of rotation as described in section *6.7.1 Checking the direction of rotation*.



TM03 2099 3705

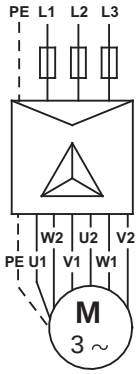
Fig. 15 Grundfos motors - direct-on-line starting

6.7.3 Grundfos motors - star-delta starting

The connection of Grundfos motors wound for star-delta starting appears from the table below and fig. 16.

Connection	Grundfos 6" motors
PE	Yellow/green
U1	Brown
V1	Black
W1	Grey
W2	Brown
U2	Black
V2	Grey

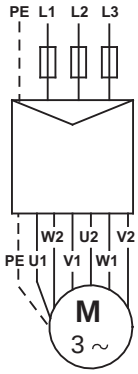
Check the direction of rotation as described in section *6.7.1 Checking the direction of rotation*.



TM03 2100 3705

Fig. 16 Grundfos motors wound for star-delta starting

If direct-on-line starting is required, the motors should be connected as shown in fig. 17.



TM03 2101 3705

Fig. 17 Grundfos motors wound for star-delta starting - direct-on-line starting

6.7.4 Connection in the case of unidentified cable marking/connection (Franklin motors)

If you do not know where the individual leads are to be connected to the mains in order to ensure the correct direction of rotation, proceed as follows:

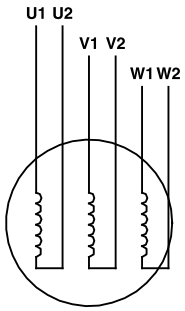
Motors wound for direct-on-line starting

Connect the pump to the mains as is expected to be right.

Then check the direction of rotation as described in section *6.7.1 Checking the direction of rotation*.

Motors wound for star-delta starting

Determine the windings of the motor by means of an ohmmeter and name the lead sets for the individual windings accordingly: U1-U2, V1-V2, W1-W2. See fig. 18.



TM00 1367 5092

Fig. 18 Unidentified cable marking/connection - motors wound for star-delta starting

If star-delta starting is required, connect the leads as shown in fig. 16.

If direct-on-line starting is required, connect the leads as shown in fig. 17.

Then check the direction of rotation as described in section *6.7.1 Checking the direction of rotation*.

6.7.5 Soft starter

We only recommend 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, contact your soft starter supplier or Grundfos.

6.7.6 Frequency converter operation

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

Note To enable the monitoring of the motor temperature, we recommend that you install a Pt100/Pt1000 sensor together with a PR5714 or CU 220 (50 Hz).

Permissible frequency ranges: 30-50 Hz and 30-60 Hz.

Ramp times: Maximum 3 seconds for start and stop.

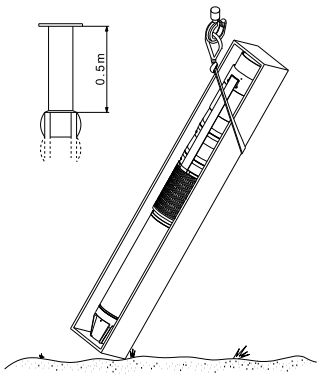
Depending on the type, the frequency converter may cause increased acoustic noise from the motor. Furthermore, it may expose the motor to detrimental voltage peaks. This can be abated by installing an LC filter between the frequency converter and the motor.

For further details, contact your frequency converter supplier or Grundfos.

7. Installation

We recommend that you first fit a 50 cm long pipe to the pump to facilitate handling of the pump during installation.

Caution Lift the pump to vertical position before removing it from the wooden box.



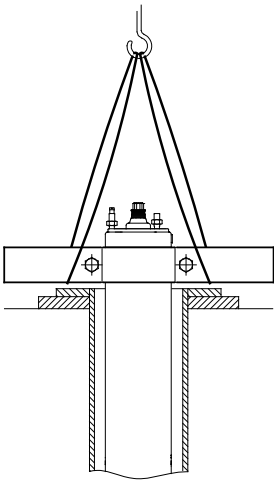
TM05 1617 3311

Fig. 19 Lifting the pump into vertical position

7.1 Fitting the motor to the pump

When the pump part and the motor are supplied as separate units (long pumps), fit the motor to the pump as follows:

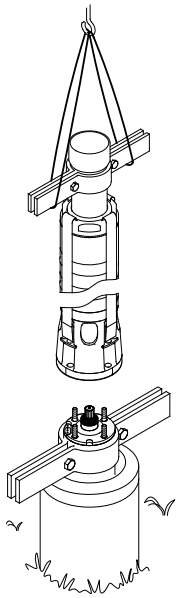
1. Use pipe clamps when handling the motor.
2. Place the motor in vertical position at the borehole seal. See fig. 20.



TM00 5259 2402

Fig. 20 Motor in vertical position

3. Lift the pump part by means of pipe clamps fitted to the extension pipe. See fig. 21.



TM02 5263 2502

Fig. 21 Lifting the pump into position

4. Place the pump part on top of the motor.
5. Fit and tighten the nuts. See table below.

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

The bolts and nuts securing the straps to the pump must be cross-tightened to the following torques:

Bolt/nut	Torque [Nm]
M8	18
M10	35
M12	45
M16	120
SP 215, 50 Hz, with more than 8 stages SP 215, 60 Hz, with more than 5 stages	150

When fitting the motor to the pump part, cross-tighten the nuts to the following torques:

Staybolt diameter	Torque [Nm]
5/16 UNF	18
1/2 UNF	50
M8	18
M12	70
M16	150
M20	280

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

7.2 Removing and fitting the cable guard

If the cable guard is screwed on to the pump, it 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.

7.3 Connecting the submersible drop cable

7.3.1 Grundfos motors

Before connecting the submersible drop cable to the motor, make sure that the cable socket is clean and dry.

To facilitate the connection of the cable, lubricate the rubber parts of the cable plug with non-conducting silicone paste.

Tighten the screws holding the cable to these torques [Nm]:

MS 402: 2.0
MS 4000: 3.0
MS 6000: 4.5
MMS 6: 20
MMS 8000: 18
MMS 10000: 18
MMS 12000: 15

7.4 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.

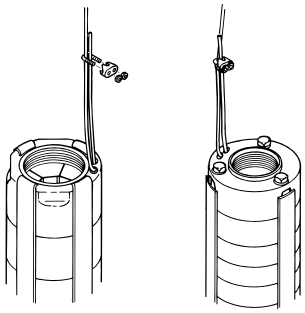
The threaded joints on the riser pipe must all be well cut and fit together to ensure that they do not work loose when subjected to torque reaction caused by the starting and stopping of the pump.

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, we recommend that you use plastic pipes.

Note We recommend plastic pipes for 4" pumps only.

When plastic pipes are used, secure the pump by an unloaded straining wire to be fastened to the discharge chamber of the pump. See fig. 22.



TM00 1368 2298

Fig. 22 Fixing the straining wire

When connecting plastic pipes, use a compression coupling 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.

7.5 Maximum installation depth below water level [m]

Grundfos MS 402: 150
Grundfos MS 4000: 600
Grundfos MS 6000: 600
Grundfos MMS: 600
Franklin motors: 350

7.6 Cable clips

Fit cable clips every 3 metres to fix the submersible drop cable and the straining wire, if fitted, to the riser pipe of the pump.

Grundfos supplies cable clip sets on request.

1. Cut off the rubber band so that the piece with no slit becomes as long as possible.
2. Insert a button in the first slit.
3. Position the wire alongside the submersible drop cable as shown in fig. 23.

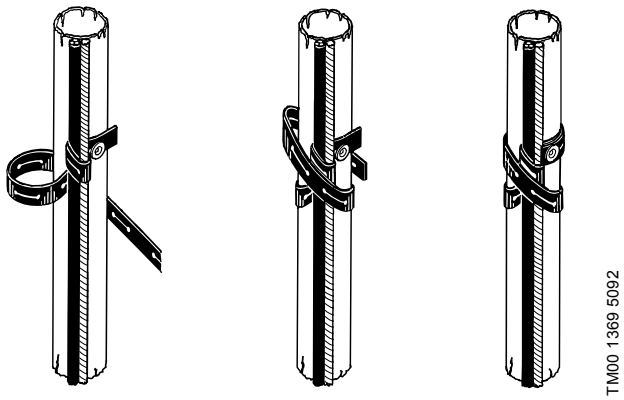


Fig. 23 Fitting the cable clips

4. Wind the band once around the wire and the cable. Then wind it tightly at least twice around the pipe, wire and the cable.
5. Push the slit over the button and cut off the band.

Where large cable cross-sections are used, it will be necessary to wind the band several times.

Where plastic pipes are used, some slackness must be left between each cable clip as plastic pipes expand when loaded.

When flanged pipes are used, the cable clips should be fitted above and below each joint.

7.7 Lowering the pump

We recommend that you 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 by means of the motor cable.

7.8 Installation depth

The dynamic water level should always be above the suction interconnector of the pump. See section *5.2 Positional requirements* and fig. 24.

Minimum inlet pressure is indicated in the NPSH curve for the pump. The minimum safety margin should be 1 metre head.

We recommend that you install the pump so that the motor part is above the well screen in order to ensure optimum cooling. See section *5.4 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.

Note For pumps fitted with plastic pipes, the expansion of the pipes when loaded should be taken into consideration, when deciding on the installation depth of the pump.

8. Startup and operation

8.1 Startup

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 approximately 1/3 of its maximum volume of water.

Check the direction of rotation as described in section *6.7.1 Checking the direction of rotation*.

If there are impurities in the water, open the valve gradually as the water becomes clearer. Do not stop the pump until the water is completely clean, as otherwise the pump parts and the non-return valve may become blocked.

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

The dynamic water level should always be above the suction interconnector of the pump. See section *5.2 Positional requirements* and fig. 24.

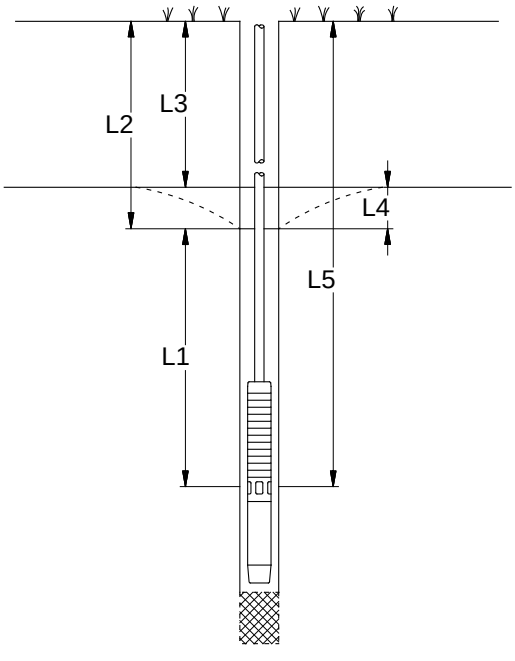


Fig. 24 Comparison of various water levels

L1: Minimum installation depth below dynamic water level. We recommend minimum 1 metre.

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 can pump more than yielded by the well, we recommend that you install the Grundfos MP 204 motor protector or some other type of dry-running protection.

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

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

8.2 Operation

8.2.1 Minimum flow rate

To ensure the necessary cooling of the motor, the pump flow rate should never be set so low that the cooling requirements in section *5.4 Liquid temperatures/cooling* cannot be met.

8.2.2 Frequency of starts and stops

Motor type		Number of starts
MS 402		• Minimum 1 per year is recommended. • Maximum 100 per hour. • Maximum 300 per day.
MS 4000		• Minimum 1 per year is recommended. • Maximum 100 per hour. • Maximum 300 per day.
MS 6000		• Minimum 1 per year is recommended. • Maximum 30 per hour. • Maximum 300 per day.
MMS6	PVC windings	• Minimum 1 per year is recommended. • Maximum 3 per hour. • Maximum 40 per day.
	PE/PA windings	• Minimum 1 per year is recommended. • Maximum 10 per hour. • Maximum 70 per day.
MMS 8000	PVC windings	• Minimum 1 per year is recommended. • Maximum 3 per hour. • Maximum 30 per day.
	PE/PA windings	• Minimum 1 per year is recommended. • Maximum 8 per hour. • Maximum 60 per day.
MMS 10000	PVC windings	• Minimum 1 per year is recommended. • Maximum 2 per hour. • Maximum 20 per day.
	PE/PA windings	• Minimum 1 per year is recommended. • Maximum 6 per hour. • Maximum 50 per day.
MMS 12000	PVC windings	• Minimum 1 per year is recommended. • Maximum 2 per hour. • Maximum 15 per day.
	PE/PA windings	• Minimum 1 per year is recommended. • Maximum 5 per hour. • Maximum 40 per day.

9. Maintenance and service

All pumps are easy to service.

Service kits and service tools are available from Grundfos.

The pumps can be serviced at a Grundfos service centre.

Warning

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

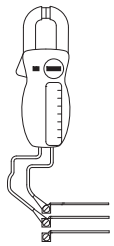
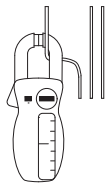
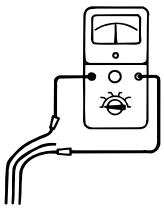
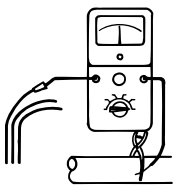
If Grundfos is requested to service the pump, Grundfos must be contacted with details about the pumped liquid, etc. before the pump is returned for service. Otherwise Grundfos can refuse to accept the pump for service.

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

10. Fault finding

Fault	Cause	Remedy
1. The pump does not run.	a) The fuses are blown.	Replace the blown fuses. If the new ones blow too, check the electric installation and the submersible drop cable.
	b) The ELCB or the voltage-operated ELCB has tripped.	Cut in the circuit breaker.
	c) No power supply.	Contact the power supply company.
	d) The motor-protective circuit breaker has tripped.	Reset the motor-protective circuit breaker (automatically or possibly manually). Check the voltage if it trips again. If the voltage is okay, see items 1e to 1h.
	e) The motor-protective circuit breaker/contactor is defective.	Replace the motor-protective circuit breaker/contactor.
	f) Starter device is defective.	Repair or 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 power supply to the pump due to low water level.	Check the water level. If it is okay, check the water level electrodes/level switch.
	i) The pump/submersible drop cable is defective.	Repair or 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 3a.
	c) The non-return valve is stuck in closed position.	Pull out the pump and clean or replace the valve.
	d) The suction strainer is blocked.	Pull out the pump and clean the strainer.
	e) The pump is defective.	Repair or replace the pump.
3. The pump runs at reduced performance.	a) The drawdown is larger than anticipated.	Increase the installation depth of the pump, throttle the pump or install a pump with a smaller performance.
	b) Wrong direction of rotation.	See section *6.7.1 Checking the direction of rotation*.
	c) The valves in the discharge pipe are partly closed/blocked.	Clean or replace the valves.
	d) The discharge pipe is partly blocked by impurities (ochre).	Clean or replace the pipe.
	e) The non-return valve of the pump is partly blocked.	Pull out the pump and clean or replace the valve.
	f) The pump and the riser pipe are partly blocked by impurities (ochre).	Pull out the pump and clean or replace it. Clean the pipes.
	g) The pump is defective.	Repair or replace the pump.
	h) Leakage in the pipework.	Check and repair the pipework.
	i) The riser pipe is defective.	Replace the 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. 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 electrodes/level switches. If the intervals between stop/start cannot be changed via the automatics, the pump performance 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 or replace the valve.
	d) The tank precharge pressure is too small.	Adjust the tank precharge pressure in accordance with its installation and operating instructions.
	e) The tank is too small.	Increase the capacity of the tank by replacing or supplementing with another tank.
	f) The diaphragm of the tank is defective.	Check the diaphragm tank.

11. Checking motor and cable

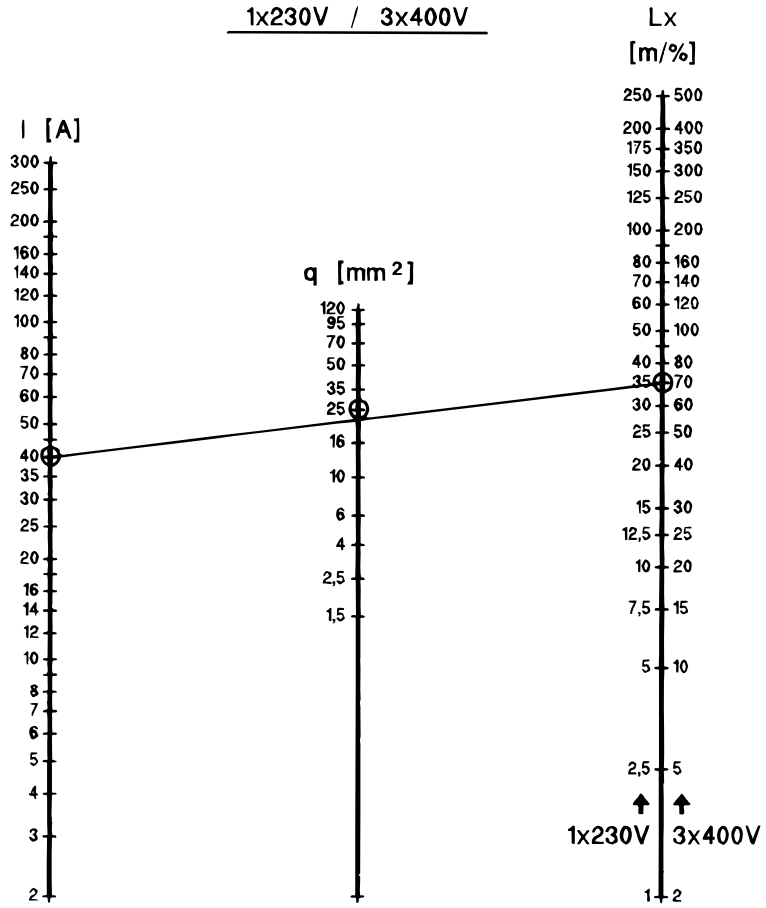
1. Supply voltage		
 TM00 1371 5092	Measure the voltage between the phases by means of a voltmeter. On single-phase motors, measure between phase and neutral or between two phases, depending on the type of supply. Connect the voltmeter to the terminals in the motor-protective circuit breaker.	The voltage should, when the motor is loaded, be within the range specified in section *6. Electrical connection*. The motor may burn if there are larger variations in voltage. Large variations in voltage indicate poor power supply, and the pump should be stopped until the defect has been remedied.
2. Current consumption		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: • The contacts of the motor-protective circuit breaker are burnt. Replace the contacts or the control box for single-phase operation. • Poor connection in leads, possibly in the cable joint. See item 3. • Too high or too low supply voltage. See item 1. • The motor windings are short-circuited or partly disjointed. See item 3. • Damaged pump is causing the motor to be overloaded. Pull out the pump for overhaul. • 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.
 TM00 1372 5092	Measure the amps of each phase while the pump is operating at a constant discharge head (if possible, at the performance where the motor is most heavily loaded). For maximum operating current, see nameplate.	
Items 3 and 4: Measurement is not necessary when the supply voltage and the current consumption are normal.		
3. Winding resistance		
 TM00 1373 5092	Disconnect the submersible drop cable from the motor-protective circuit breaker. 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 %. If the deviation is higher, pull out the pump. Measure motor, motor cable and drop cable separately, and repair or replace defective parts. **Note:** The operating winding of single-phase 3-wire motors will assume the lowest resistance value.
4. Insulation resistance		
 TM00 1374 5092	Disconnect the submersible drop cable from the motor-protective circuit breaker. Measure the insulation resistance from each phase to earth (frame). Make sure that the earth connection was made carefully.	If the insulation resistance is less than 0.5 MΩ, the pump should be pulled out for motor or cable repair. Local regulations may specify other values for the insulation resistance.

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.

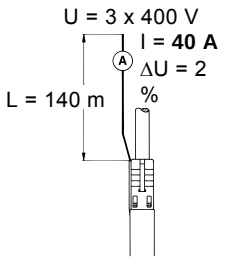


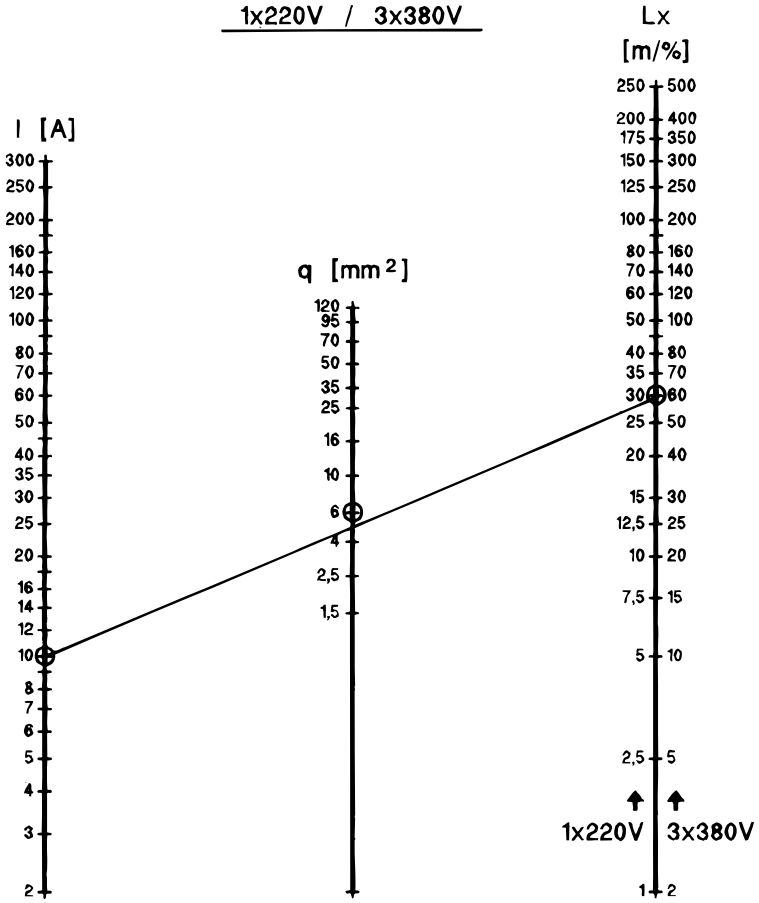
TM00 1346 5092

Example:

U = 3 x 400 V
I = **40 A**
L = 140 m
ΔU = 2 %

$Lx = \frac{L}{\Delta U} = \frac{140}{2\,\%} =$ **70 m** = q ⇒ 25 mm²



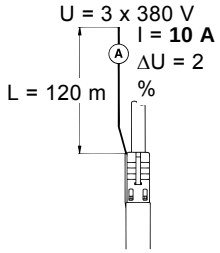


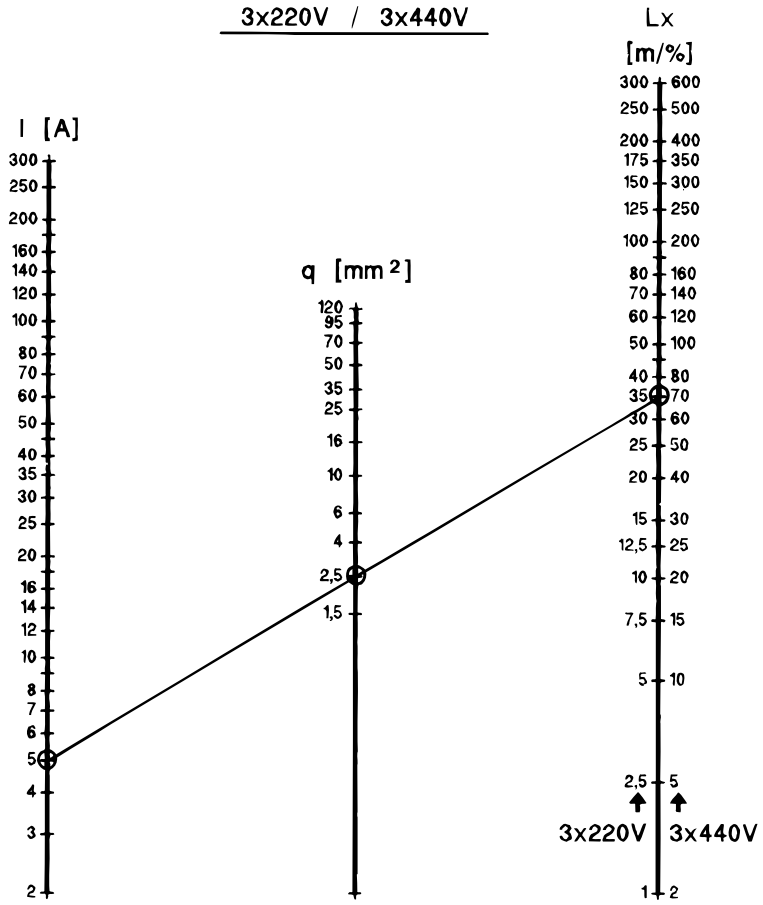
TM00 1345 5092

Example:

U = 3 x 380 V
I = **10 A**
L = 120 m
ΔU = 2 %

$$Lx = \frac{L}{\Delta U} = \frac{120}{2\,\%} = \mathbf{60\ m} = q \Rightarrow 6\ mm^2$$



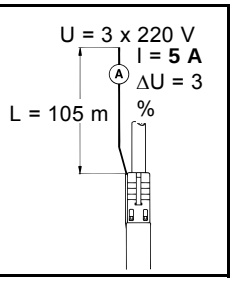


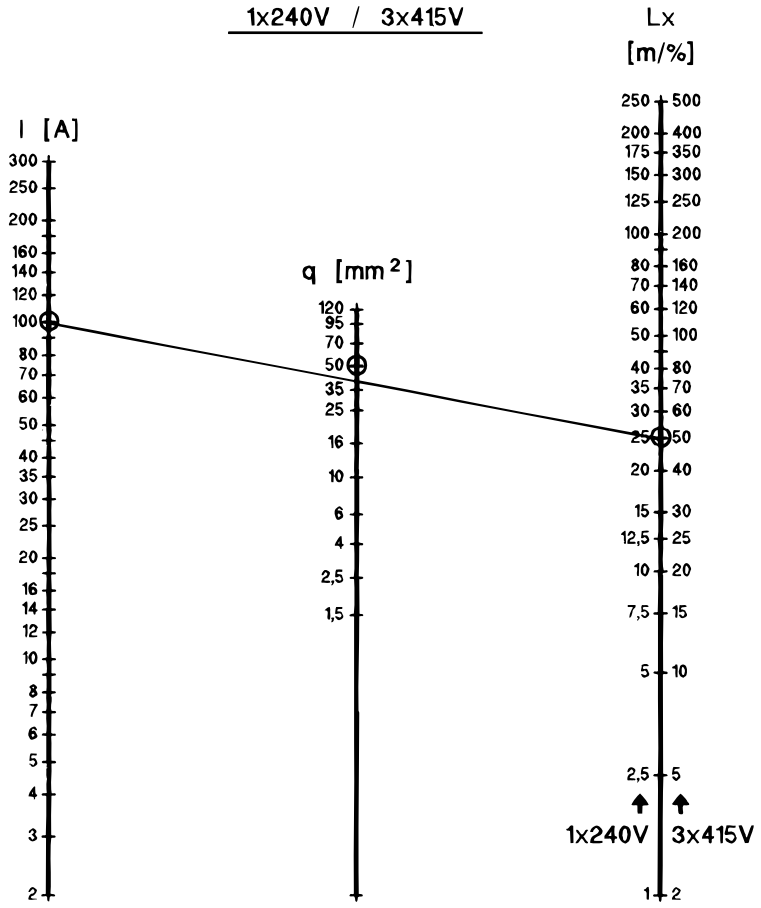
TM00 1348 5092

Example:

U = 3 x 220 V
I = **5 A**
L = 105 m
ΔU = 3 %

$$Lx = \frac{L}{\Delta U} = \frac{105}{3\,\%} = \mathbf{35\ m} = q \Rightarrow 2{,}5\ mm^2$$



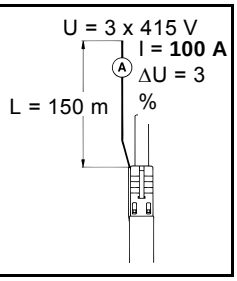


TM00 1347 5092

Example:

U = 3 x 415 V
I = **100 A**
L = 150 m
ΔU = 3 %

$$Lx = \frac{L}{\Delta U} = \frac{150}{3\,\%} = \mathbf{50\ m} = q \Rightarrow 50\ mm^2$$



SP1 - SP 2 - SP 3 - SP 5

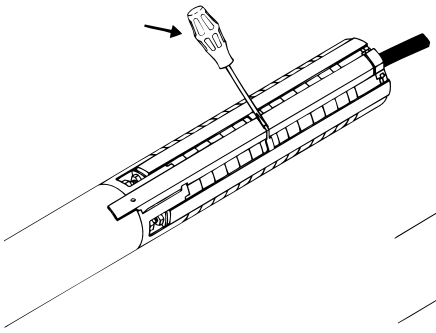


Fig. 1

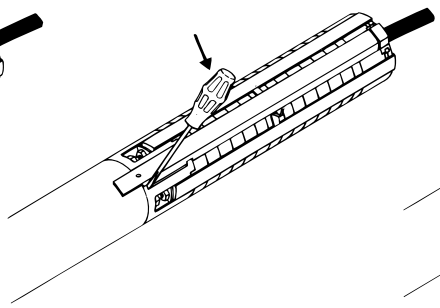


Fig. 2

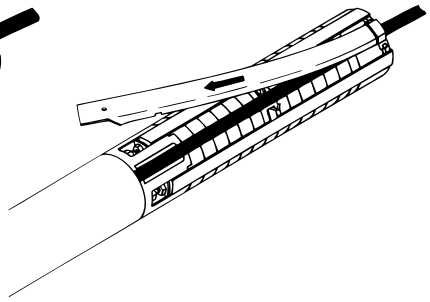


Fig. 3

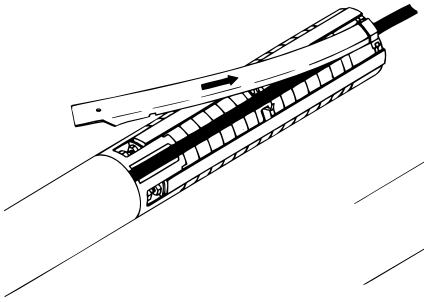


Fig. 1

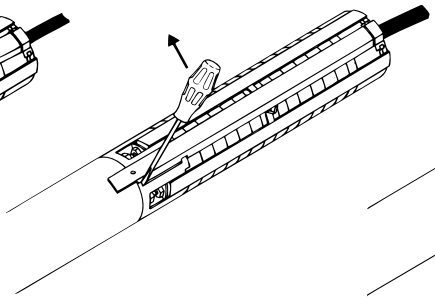


Fig. 2

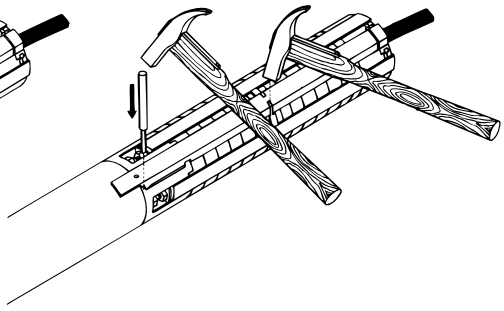


Fig. 3

TM00 1323 5092

SP 7 - SP 9 - SP 11 - SP 14 - SP 17 - SP 30 - SP 46 - SP 60

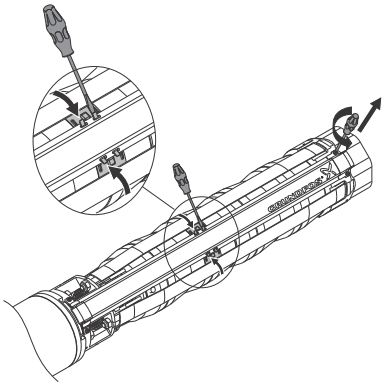
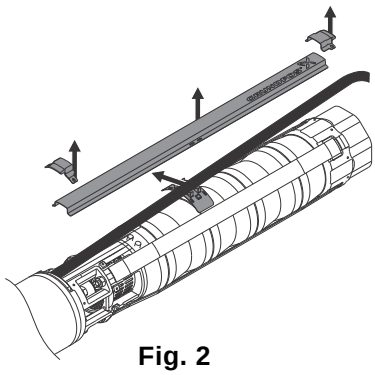


Fig. 1



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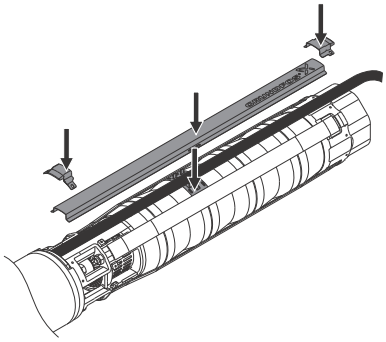


Fig. 1

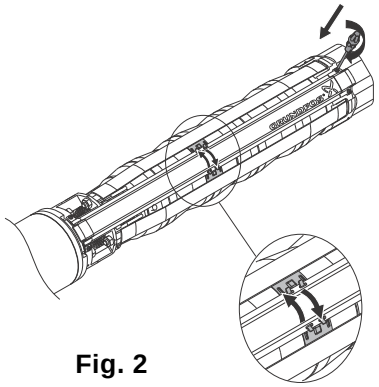


Fig. 2

TM06 0693 0814

SP 77 - SP 95 - SP 125 - SP 160 - SP 215

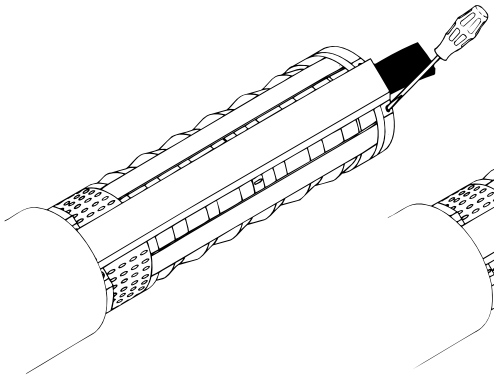


Fig. 1

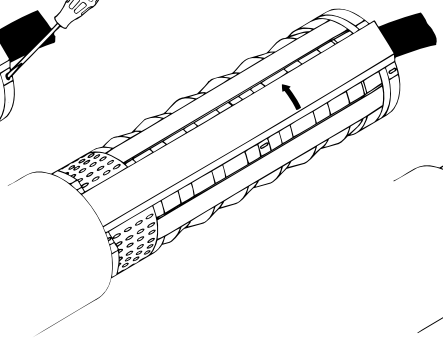


Fig. 2

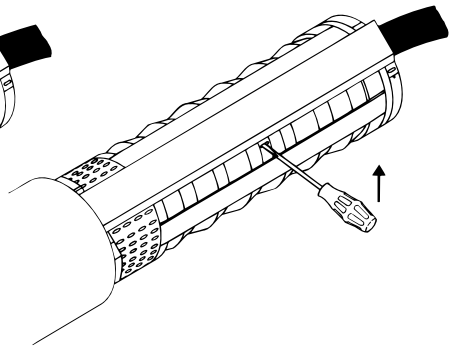


Fig. 3

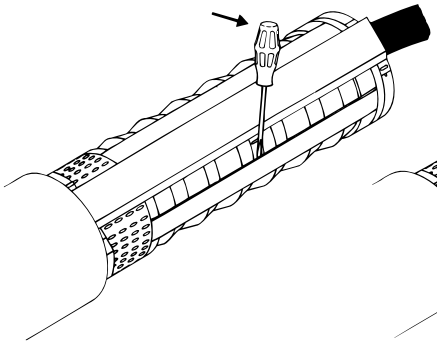
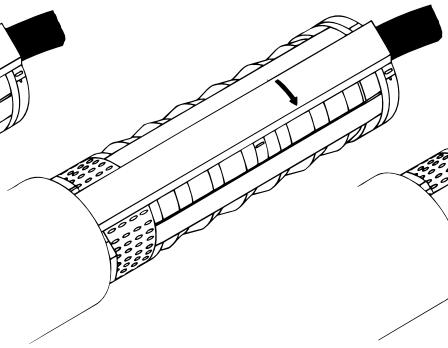


Fig. 1



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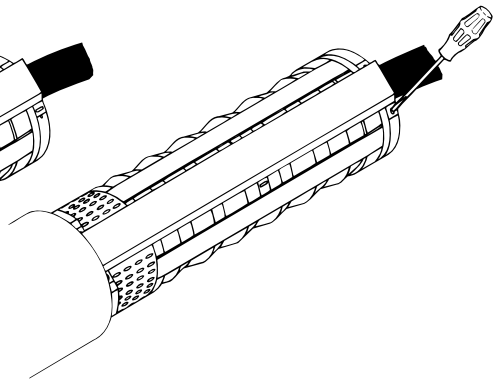

Fig. 3

TM00 1326 5092

Argentina
Bombas GRUNDFOS de Argentina S.A.
Ruta Panamericana km. 37.500 Centro Industrial Garin
1619 Garín Pcia. de B.A.
Phone: +54-3327 414 444
Telefax: +54-3327 45 3190

Australia
GRUNDFOS Pumps Pty. Ltd.
P.O. Box 2040
Regency Park
South Australia 5942
Phone: +61-8-8461-4611
Telefax: +61-8-8340 0155

Austria
GRUNDFOS Pumpen Vertrieb Ges.m.b.H.
Grundfosstraße 2
A-5082 Grödig/Salzburg
Tel.: +43-6246-883-0
Telefax: +43-6246-883-30

Belgium
N.V. GRUNDFOS Bellux S.A.
Boomsesteenweg 81-83
B-2630 Aartselaar
Tél.: +32-3-870 7300
Télécopie: +32-3-870 7301

Belarus
Представительство ГРУНДФОС в Минске
220125, Минск
ул. Шафарнянская, 11, оф. 56, БЦ «Порт»
Тел.: +7 (375 17) 286 39 72/73
Факс: +7 (375 17) 286 39 71
E-mail: minsk@grundfos.com

Bosna and Herzegovina
GRUNDFOS Sarajevo
Zmaja od Bosne 7-7A,
BH-71000 Sarajevo
Phone: +387 33 592 480
Telefax: +387 33 590 465
www.ba.grundfos.com
e-mail: grundfos@bih.net.ba

Brazil
BOMBAS GRUNDFOS DO BRASIL
Av. Humberto de Alencar Castelo Branco, 630
CEP 09850 - 300
São Bernardo do Campo - SP
Phone: +55-11 4393 5533
Telefax: +55-11 4343 5015

Bulgaria
Grundfos Bulgaria EOOD
Slatina District
Iztochna Tangenta street no. 100
BG - 1592 Sofia
Tel. +359 2 49 22 200
Fax. +359 2 49 22 201
email: bulgaria@grundfos.bg

Canada
GRUNDFOS Canada Inc.
2941 Brighton Road
Oakville, Ontario
L6H 6C9
Phone: +1-905 829 9533
Telefax: +1-905 829 9512

China
GRUNDFOS Pumps (Shanghai) Co. Ltd.
10F The Hub, No. 33 Suhong Road
Minhang District
Shanghai 201106
PRC
Phone: +86 21 612 252 22
Telefax: +86 21 612 253 33

Croatia
GRUNDFOS CROATIA d.o.o.
Buzinski prilaz 38, Buzin
HR-10010 Zagreb
Phone: +385 1 6595 400
Telefax: +385 1 6595 499
www.hr.grundfos.com

Czech Republic
GRUNDFOS s.r.o.
Čajkovského 21
779 00 Olomouc
Phone: +420-585-716 111
Telefax: +420-585-716 299

Denmark
GRUNDFOS DK A/S
Martin Bachs Vej 3
DK-8850 Bjerringbro
Tlf.: +45-87 50 50 50
Telefax: +45-87 50 51 51
E-mail: info_GDK@grundfos.com
www.grundfos.com/DK

Estonia
GRUNDFOS Pumps Eesti OÜ
Peterburi tee 92G
11415 Tallinn
Tel: + 372 606 1690
Fax: + 372 606 1691

Finland
OY GRUNDFOS Pumput AB
Trukkikuja 1
FI-01360 Vantaa
Phone: +358-(0) 207 889 500
Telefax: +358-(0) 207 889 550

France
Pompes GRUNDFOS Distribution S.A.
Parc d'Activités de Chesnes
57, rue de Malacombe
F-38290 St. Quentin Fallavier (Lyon)
Tél.: +33-4 74 82 15 15
Télécopie: +33-4 74 94 10 51

Germany
GRUNDFOS GMBH
Schlüterstr. 33
40699 Erkrath
Tel.: +49-(0) 211 929 69-0
Telefax: +49-(0) 211 929 69-3799
e-mail: infoservice@grundfos.de
Service in Deutschland:
e-mail: kundendienst@grundfos.de

Greece
GRUNDFOS Hellas A.E.B.E.
20th km. Athinon-Markopoulou Av.
P.O. Box 71
GR-19002 Peania
Phone: +0030-210-66 83 400
Telefax: +0030-210-66 46 273

Hong Kong
GRUNDFOS Pumps (Hong Kong) Ltd.
Unit 1, Ground floor
Siu Wai Industrial Centre
29-33 Wing Hong Street &
68 King Lam Street, Cheung Sha Wan
Kowloon
Phone: +852-27861706 / 27861741
Telefax: +852-27858664

Hungary
GRUNDFOS Hungária Kft.
Park u. 8
H-2045 Törökbálint,
Phone: +36-23 511 110
Telefax: +36-23 511 111

India
GRUNDFOS Pumps India Private Limited
118 Old Mahabalipuram Road
Thoraipakkam
Chennai 600 096
Phone: +91-44 2496 6800

Indonesia
PT. GRUNDFOS POMPA
Graha Intirub Lt. 2 & 3
Jln. Cililitan Besar No.454. Makasar,
Jakarta Timur
ID-Jakarta 13650
Phone: +62 21-469-51900
Telefax: +62 21-460 6910 / 460 6901

Ireland
GRUNDFOS (Ireland) Ltd.
Unit A, Merrywell Business Park
Ballymount Road Lower
Dublin 12
Phone: +353-1-4089 800
Telefax: +353-1-4089 830

Italy
GRUNDFOS Pompe Italia S.r.l.
Via Gran Sasso 4
I-20060 Truccazzano (Milano)
Tel.: +39-02-95838112
Telefax: +39-02-95309290 / 95838461

Japan
GRUNDFOS Pumps K.K.
Gotanda Metalion Bldg., 5F,
5-21-15, Higashi-gotanda
Shiagawa-ku, Tokyo
141-0022 Japan
Phone: +81 35 448 1391
Telefax: +81 35 448 9619

Korea
GRUNDFOS Pumps Korea Ltd.
6th Floor, Aju Building 679-5
Yeoksam-dong, Kangnam-ku, 135-916
Seoul, Korea
Phone: +82-2-5317 600
Telefax: +82-2-5633 725

Latvia
SIA GRUNDFOS Pumps Latvia
Deglava biznesa centrs
Augusta Deglava ielā 60, LV-1035, Rīga,
Tālr.: + 371 714 9640, 7 149 641
Fakss: + 371 914 9646

Lithuania
GRUNDFOS Pumps UAB
Smolensko g. 6
LT-03201 Vilnius
Tel: + 370 52 395 430
Fax: + 370 52 395 431

Malaysia
GRUNDFOS Pumps Sdn. Bhd.
7 Jalan Peguam U1/25
Glenmarie Industrial Park
40150 Shah Alam
Selangor
Phone: +60-3-5569 2922
Telefax: +60-3-5569 2866

Mexico
Bombas GRUNDFOS de México S.A. de C.V.
Boulevard TLC No. 15
Parque Industrial Stiva Aeropuerto
Apodaca, N.L. 66600
Phone: +52-81-8144 4000
Telefax: +52-81-8144 4010

Netherlands
GRUNDFOS Netherlands
Veluwezoom 35
1326 AE Almere
Postbus 22015
1302 CA ALMERE
Tel.: +31-88-478 6336
Telefax: +31-88-478 6332
E-mail: info_gnl@grundfos.com

New Zealand
GRUNDFOS Pumps NZ Ltd.
17 Beatrice Tinsley Crescent
North Harbour Industrial Estate
Albany, Auckland
Phone: +64-9-415 3240
Telefax: +64-9-415 3250

Norway
GRUNDFOS Pumper A/S
Strømsveien 344
Postboks 235, Leirdal
N-1011 Oslo
Tlf.: +47-22 90 47 00
Telefax: +47-22 32 21 50

Poland
GRUNDFOS Pompy Sp. z o.o.
ul. Klonowa 23
Baranowo k. Poznania
PL-62-081 Przeźmierowo
Tel: (+48-61) 650 13 00
Fax: (+48-61) 650 13 50

Portugal
Bombas GRUNDFOS Portugal, S.A.
Rua Calvet de Magalhães, 241
Apartado 1079
P-2770-153 Paço de Arcos
Tel.: +351-21-440 76 00
Telefax: +351-21-440 76 90

Romania
GRUNDFOS Pompe România SRL
Bd. Biruintei, nr 103
Pantelimon county Ilfov
Phone: +40 21 200 4100
Telefax: +40 21 200 4101
E-mail: romania@grundfos.ro

Russia
ООО Грундфос Россия
109544, г. Москва, ул. Школьная, 39-41, стр. 1
Тел. (+7) 495 564-88-00 (495) 737-30-00
Факс (+7) 495 564 88 11
E-mail grundfos.moscow@grundfos.com

Serbia
Grundfos Srbija d.o.o.
Omladinskih brigada 90b
11070 Novi Beograd
Phone: +381 11 2258 740
Telefax: +381 11 2281 769
www.rs.grundfos.com

Singapore
GRUNDFOS (Singapore) Pte. Ltd.
25 Jalan Tukang
Singapore 619264
Phone: +65-6681 9688
Telefax: +65-6681 9689

Slovakia
GRUNDFOS s.r.o.
Prievozská 4D
821 09 BRATISLAVA
Phona: +421 2 5020 1426
sk.grundfos.com

Slovenia
GRUNDFOS LJUBLJANA, d.o.o.
Leskoškova 9e, 1122 Ljubljana
Phone: +386 (0) 1 568 06 10
Telefax: +386 (0)1 568 06 19
E-mail: tehnika-si@grundfos.com

South Africa
GRUNDFOS (PTY) LTD
Corner Mountjoy and George Allen Roads
Wilbart Ext. 2
Bedfordview 2008
Phone: (+27) 11 579 4800
Fax: (+27) 11 455 6066
E-mail: lsmart@grundfos.com

Spain
Bombas GRUNDFOS Españ a S.A.
Camino de la Fuentecilla, s/n
E-28110 Algete (Madrid)
Tel.: +34-91-848 8800
Telefax: +34-91-628 0465

Sweden
GRUNDFOS AB
Box 333 (Lunnagårdsgatan 6)
431 24 Mölndal
Tel.: +46 31 332 23 000
Telefax: +46 31 331 94 60

Switzerland
GRUNDFOS Pumpen AG
Bruggacherstrasse 10
CH-8117 Fällanden/ZH
Tel.: +41-44-806 8111
Telefax: +41-44-806 8115

Taiwan
GRUNDFOS Pumps (Taiwan) Ltd.
7 Floor, 219 Min-Chuan Road
Taichung, Taiwan, R.O.C.
Phone: +886-4-2305 0868
Telefax: +886-4-2305 0878

Thailand
GRUNDFOS (Thailand) Ltd.
92 Chaloem Phrakiat Rama 9 Road,
Dokmai, Pravej, Bangkok 10250
Phone: +66-2-725 8999
Telefax: +66-2-725 8998

Turkey
GRUNDFOS POMPA San. ve Tic. Ltd. Sti.
Gebze Organize Sanayi Bölgesi
Ihsan dede Caddesi,
2. yol 200. Sokak No. 204
41490 Gebze/ Kocaeli
Phone: +90 - 262-679 7979
Telefax: +90 - 262-679 7905
E-mail: satis@grundfos.com

Ukraine
Бізнес Центр Європа
Столичне шосе, 103
м. Київ, 03131, Україна
Телефон: (+38 044) 237 04 00
Факс.: (+38 044) 237 04 01
E-mail: ukraine@grundfos.com

United Arab Emirates
GRUNDFOS Gulf Distribution
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Jebel Ali Free Zone
Dubai
Phone: +971 4 8815 166
Telefax: +971 4 8815 136

United Kingdom
GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard/Beds. LU7 4TL
Phone: +44-1525-850000
Telefax: +44-1525-850011

U.S.A.
GRUNDFOS Pumps Corporation
17100 West 118th Terrace
Olathe, Kansas 66061
Phone: +1-913-227-3400
Telefax: +1-913-227-3500

Uzbekistan
Grundfos Tashkent, Uzbekistan The Representative Office of Grundfos Kazakhstan in Uzbekistan
38a, Oybek street, Tashkent
Телефон: (+998) 71 150 3290 / 71 150 3291
Факс: (+998) 71 150 3292

Addresses Revised 25.01.2016

98074911 0616
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ARMSTRONG

DESIGN ENVELOPE

COMPASS high-efficiency wet-rotor circulators

NSF-372* | COMPLIES WITH EEI ≤ 0.22

3 YEAR WARRANTY

SOLUTION OUTLINE

FILE NO: 10.19
DATE: SEPTEMBER 2017

SUPERSEDES: 10.19
DATE: MAY 2016

Your choice of circulator has a surprisingly large effect on your building project.

Easy access for wiring the terminal block

The right circulator will generate energy savings for years. Advanced variable speed technology increases circulator efficiency; even though the circulator and motor are small, the energy savings can add up. Homeowners will appreciate the reduced operating costs and reduced carbon footprint.

For contractors, a well-designed circulator is easy to install and will reduce or eliminate customer complaints. For wholesalers and contractors, a circulator that covers a broad range of operating requirements makes the selection process easier, leaving more time for serving customers.

Inventory costs are also important. The right choice of circulator lets you serve more customers and installations with only one model. Keeping fewer circulator models on your shelf, or in your trucks, cuts your inventory investment and your operating costs.

ENERGY SAVINGS

UP TO 70%

FOR DETAILS ON

- Design Envelope selections
- Demand-based variable speed operation
- Sensorless technology

please see the Design Envelope solution outline
(FILE NO. 100.11)

kWh

DESIGN ENVELOPE

Design Envelope is a revolutionary technology pioneered by Armstrong that offers simplified circulator selection, lowest installed cost, expanded application flexibility and optimized energy efficiency. Armstrong Design Envelope technology, previously offered in Armstrong pumps from one horsepower to 450 hp, is now available in Armstrong circulators. Design Envelope technology augments the value of Armstrong circulators through increased operating range and sensorless, demand-based control.

KEY BENEFITS

Responding to the need for a better circulator, Armstrong offers COMPASS, an advanced solution that benefits everyone involved in a heating system project. By selecting the right circulator, wholesalers, homeowners, and contractors can all come out ahead.

COMPASS circulators incorporate advanced functionality to assist with your construction and service projects and improve the long-term enjoyment of the building spaces you help create.

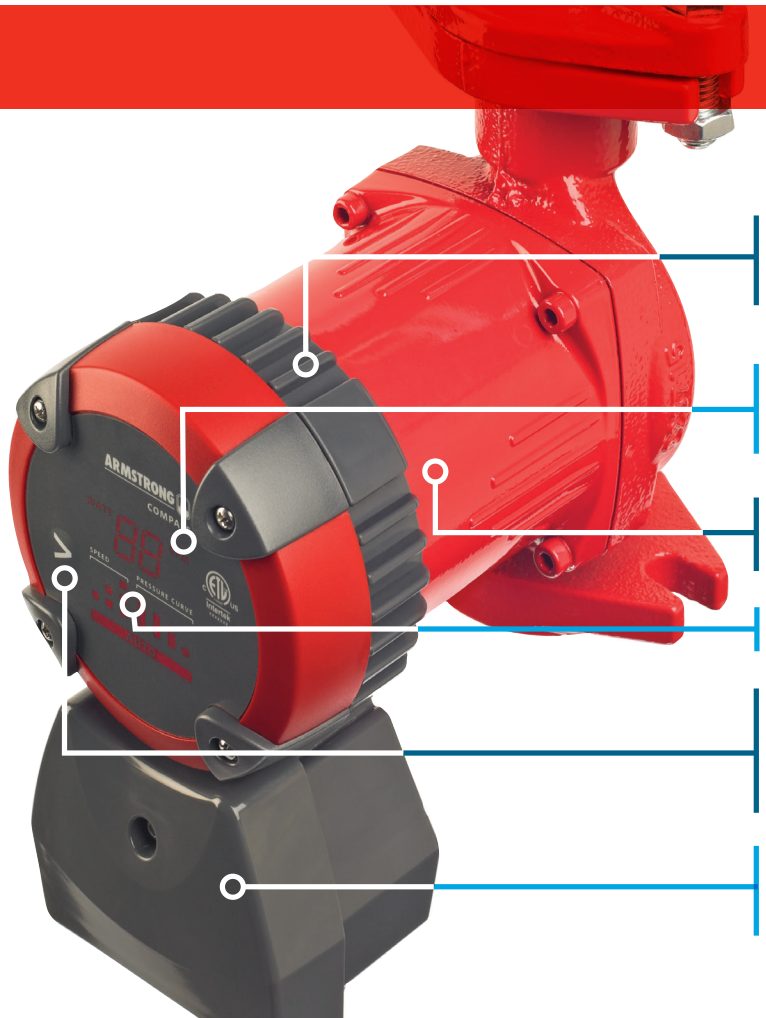
Easy sizing and selection of the COMPASS circulator simplifies your job as a wholesaler or contractor and reduces your inventory requirements.

In the field, the front mounted terminal block reduces installation time.

The COMPASS "auto" algorithm intelligently adapts to system demand, so you get the right setup every time and your customers enjoy comfortable room temperatures.

Ultimately, COMPASS circulators provide reliable performance, backed by a three-year warranty, with noticeable reductions in energy consumption and operating costs.

KEY FEATURES



Broad operating range, producing up to 20 feet of head and 20 USgpm flow

Design Envelope technology providing sensorless demand-based control

Efficient motor technology and intelligent variable speed operation

Easy to read display

Eight different modes of operation providing versatility to cover the performance of a wide range of fixed speed circulators

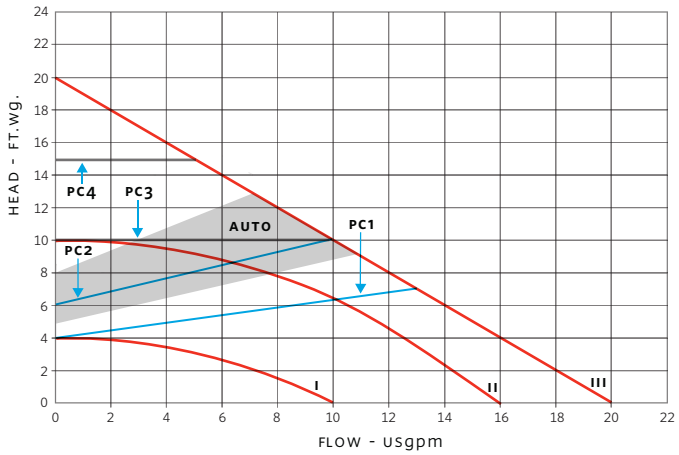
Large wiring chamber and front-mounted terminal block

PERFORMANCE

POWER RANGE	5W-45W
MAX FLOW RATE	20 USgpm
MAX HEAD PRESSURE	20 ft

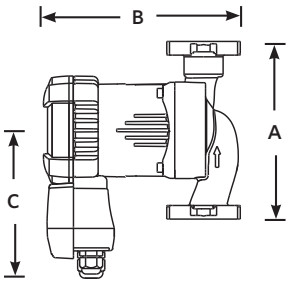
MODEL	ITEM NO.	
COMPASS 20 -20CI	180203-606	(flange)
*COMPASS 20-20SS	180203-607	(flange)
COMPASS 20-20SSU	180203-604	(union)

COMPASS PERFORMANCE CURVES

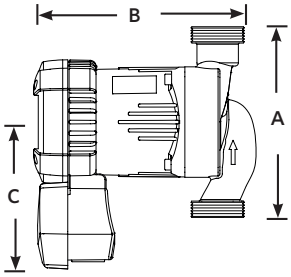


EIGHT MODE OPTIONS

AUTO	Circulator adapts to system demand over time.
PC1	Lowest proportional-pressure curve
PC2	Highest proportional-pressure curve
PC3	Lowest constant-pressure curve
PC4	Highest constant pressure curve
III	Highest constant speed
II	Medium constant speed
I	Lowest constant speed



A = 6.375"
B = 7.08"
C = 4.61"



A = 6"
B = 7.08"
C = 4.61"

ssu model

For more information, contact your Armstrong representative or visit us at:
ArmstrongFluidTechnology.com/ContactUs

TORONTO
+1 416 755 2291

BUFFALO
+1 716 693 8813

BIRMINGHAM
+44 (0) 8444 145 145

MANCHESTER
+44 (0) 8444 145 145

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ESTABLISHED 1934

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MAKING ENERGY MAKE SENSE™

COMPASS | HIGH-EFFICIENCY WET-ROTOR CIRCULATORS |
INSTALLATION AND OPERATING INSTRUCTIONS

File No: 10.895
Date: MARCH 28, 2014
Supersedes: 10.895
Date: DECEMBER 10, 2013

WARNING

- Prior to installation, read these installation and operating instructions. Installation and operation must comply with local regulations and accepted codes of good practice.
- The use of this product requires experience with and knowledge of the product. Only licensed or trained installers should install this product.
- For supply Connection, use wires acceptable for at least 90°C (194°F).
- **Risk of shock:** this pump has not been tested for use in swimming pools or marine areas.
- To reduce risk of electric shock: Unplug before servicing, see instructions for proper installation, connect to a properly grounded, grounding type receptacle only.
- For indoor use only.
- Use copper conductors only.
- Do not install with motor above or below pump body.
- Do not submerge.
- Do not run pump dry.

1.0 SYMBOLS USED IN THIS DOCUMENT

WARNING

The safety instructions must be followed to prevent potential personal injury.

CAUTION

The safety instructions must be followed to prevent potential malfunction or damage to the equipment.

HINT

Hints or instructions that make the setup easier and ensure safe operation

2.0 GENERAL INSTALLATION

2.1 THE ARMSTRONG COMPASS CIRCULATOR

The Armstrong Compass circulator is designed for circulating water in closed hydronic heating systems or potable water systems.

Model

- Compass 20-20 CI
- Compass 20-20 SS**

The Armstrong Compass includes operating modes suitable for systems with constant or variable flows, such as:

- Underfloor heating systems
- One-pipe (series) systems
- Two-pipe (parallel) systems

Armstrong Compass circulators incorporate Armstrong patented Design Envelope variable speed control technology with an ECM motor, enabling optimum energy efficiency and occupant comfort, with built-in control algorithms that can adapt to continuously changing system requirements.

The Armstrong Compass features a user-friendly front-mounted control panel (see section 6) and wiring box for ease of installation.

2.2 BENEFITS OF INSTALLING AN ARMSTRONG COMPASS CIRCULATOR

Eight different modes of operation to suit different system requirements:

- Easily selectable from the front mounted display.
- Modes include Sensorless demand-based control – Auto.
- Power consumption and flow rate clearly displayed.

Broad operating range, producing up to 20 feet of head and 20 US GPM of flow, provide versatility to cover the performance of a wide range of fixed speed or variable speed circulators.

- Flange to flange compatibility with existing Armstrong circulators and many competing models.

Front mounted wiring box for ease of installation and service.

3.0 INSTALLATION

3.1 MOUNTING

Note:
For convenience in future servicing, isolation flanges can be used in place of standard flanges.

CORRECT INSTALLATIONS **INCORRECT INSTALLATIONS**

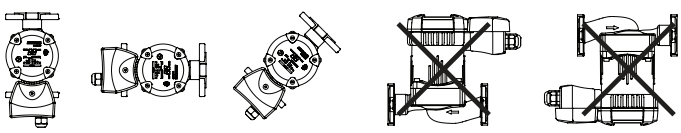


FIG. 2 Mounting the Armstrong compass

Arrows on the pump housing indicate the liquid flow direction through the pump.

1. Fit the two gaskets supplied when the pump is mounted in the pipe.
2. Install the pump with the motor shaft horizontal (see **FIG. 2**).

3.2 CONTROL BOX POSITIONS

The orientation of the display can be adjusted by removing four screws that attach the motor to the pump housing. Pump must be isolated from the system as this will open the system to the atmosphere.

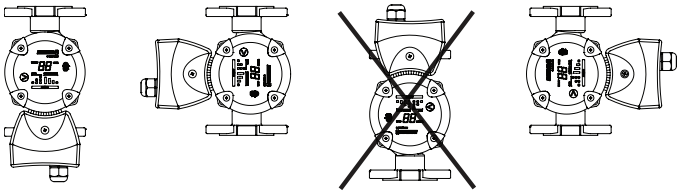


FIG. 3 Control box positions

WARNING

The pumped liquid may be scalding hot and under high pressure. Drain the system or close the isolating valves on either side of the pump before the screws are removed.

CAUTION

After the position of the control box has been rotated, refill the pump with system liquid before startup.

3.3 CHANGING THE WIRING BOX POSITION

Always install the circulator with the wiring box below or beside the motor. To change the wiring box position, remove the motor mounting screws and rotate the motor (see **FIG. 3**).

Ensure the gasket is intact and seated before evenly retightening the mounting screw to 4.5 - 5.5 lb/ft (6 - 7.5 Nm).

4.0 ELECTRICAL CONNECTION

The electrical wiring must be installed strictly in accordance with national electrical codes, local codes and regulations.

1. Electrical installation should be conducted by a qualified electrician.
2. Always make sure electric power is disconnected before wiring the circulator.

The motor is designed for 60 Hz, 1 phase, 115 volt power.

Wire shall be 14 to 16 gauge solid wire or 16 to 18 gauge stranded wire.

To wire, loosen the screw from the wiring box cover and remove the screw and cover.

Insert wires through supplied liquid-seal connector (installed) or other strain relief connector (not provided).

Select to use the installed liquid-seal connector or included ½" NPT connector. To install the NPT connector, loosen the existing connector and screw on the NPT connector using the existing lock nut.

(Connect other strain relief connector (not provided)to the NPT connector.)

Insert wires through the connector(s).

Strip 3⁄16" of insulation from the ends of the three wires to be connected.

To insert the wires into the terminal strip, press the terminal lever downward firmly. Insert the stripped wire into the opening and release the lever (see **FIG. 4**). Tug on the wire gently to ensure it is secured.

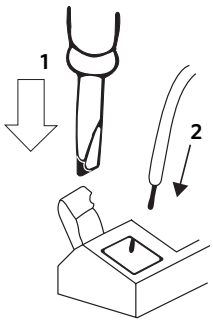


FIG. 4 Terminal strip

Connect the hot wire to terminal 'L', the neutral wire to terminal 'N', and the ground wire to terminal ⏚ (see **FIG. 5**).

Place the terminal box cover and tighten screw.

The motor is thermally protected so overload protection is not necessary. All that is required is a fused plug or circuit breaker in the power line. Electrical information can be found on the side of the terminal box.

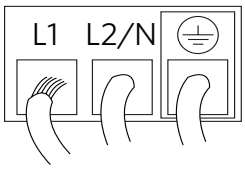


FIG. 5 Electrical connection

The electrical connections and protection must be carried out in accordance with local regulations.

WARNING

The pump must be connected to ground.

5.0 CONTROL PANEL

5.1 ELEMENTS ON THE CONTROL PANEL

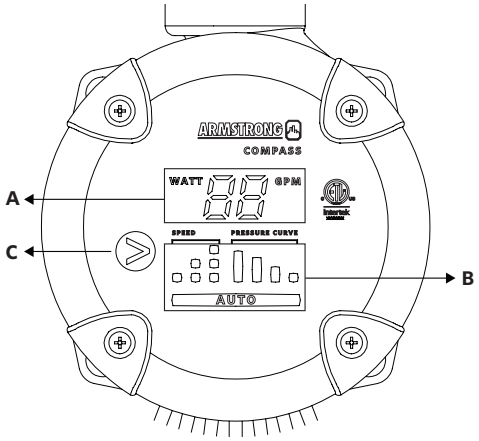


FIG. 6 Armstrong compass control panel

The control panel on the Armstrong compass includes:

POSITION	DESCRIPTION
A	Display showing the actual pump power consumption in Watt and reference flow in USgpm. Display alternates between Watt and GPM every 5 seconds.
B	Eight light fields indicating the pump setting
C	**Mode Select** button for changing pump setting

Note

GPM value is a flow indicator only, not calibrated.

5.2 FIRST POWER-UP

The display is on and in Auto mode (position 0 in **FIG. 7**) when the electricity has been switched on.

The display shows the actual pump power consumption in Watts and reference flow in USgpm during operation.

Note

Display shows "E#" when the pump is not operating properly (see section 10). (# is between 0 to 4)

5.3 DISPLAY

The Armstrong Compass has eight pump settings which can be selected with the press button.

Every time the Mode button is pressed (see **FIG. 6**, **C**) the pump setting is changed to the next option.

A full cycle is eight button presses.

The selected pump setting is indicated by one of eight different light fields (see **FIG. 7**).

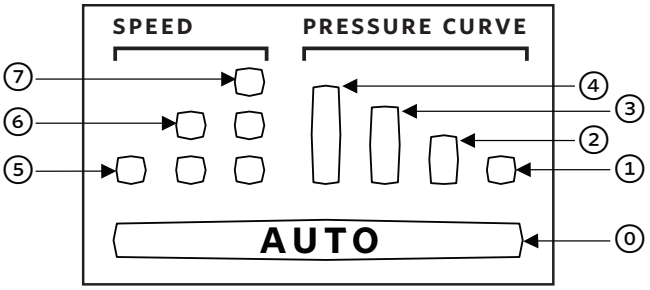


FIG. 7 Eight light fields

See section 9, Pump settings and pump performance, for information about the function of each setting.

POSITION	DESCRIPTION
⓪	AUTO (factory setting)
①	PC1 Lowest proportional-pressure curve
②	PC2 Highest proportional-pressure curve
③	PC3 Lowest constant-pressure curve
④	PC4 Highest constant-pressure curve
⑤	Constant curve, speed I
⑥	Constant curve, speed II
⑦	Constant curve, speed III

6.0 SETTING THE PUMP

6.1 PUMP SETTING FOR SYSTEM TYPE

Note
Optimum energy savings & comfort can be achieved by careful selection of the correct operation mode.

Recommended and alternative pump settings according to **FIG. 8**:

IMAGE	SYSTEM TYPE	RECOMMENDED SETTING	ALTERNATIVE SETTING
A	Underfloor heating	**AUTO**	Highest constant-pressure curve (PC4)* OR Lowest constant-pressure curve (PC3)*
B	Two-pipe (parallel) systems	**AUTO**	Highest proportional-pressure (PC2)*
C	One-pipe (series) systems	Lowest proportional-pressure curve (PC1)*	Highest proportional-pressure (PC2)*

* See pump settings and pump performance (section 9).

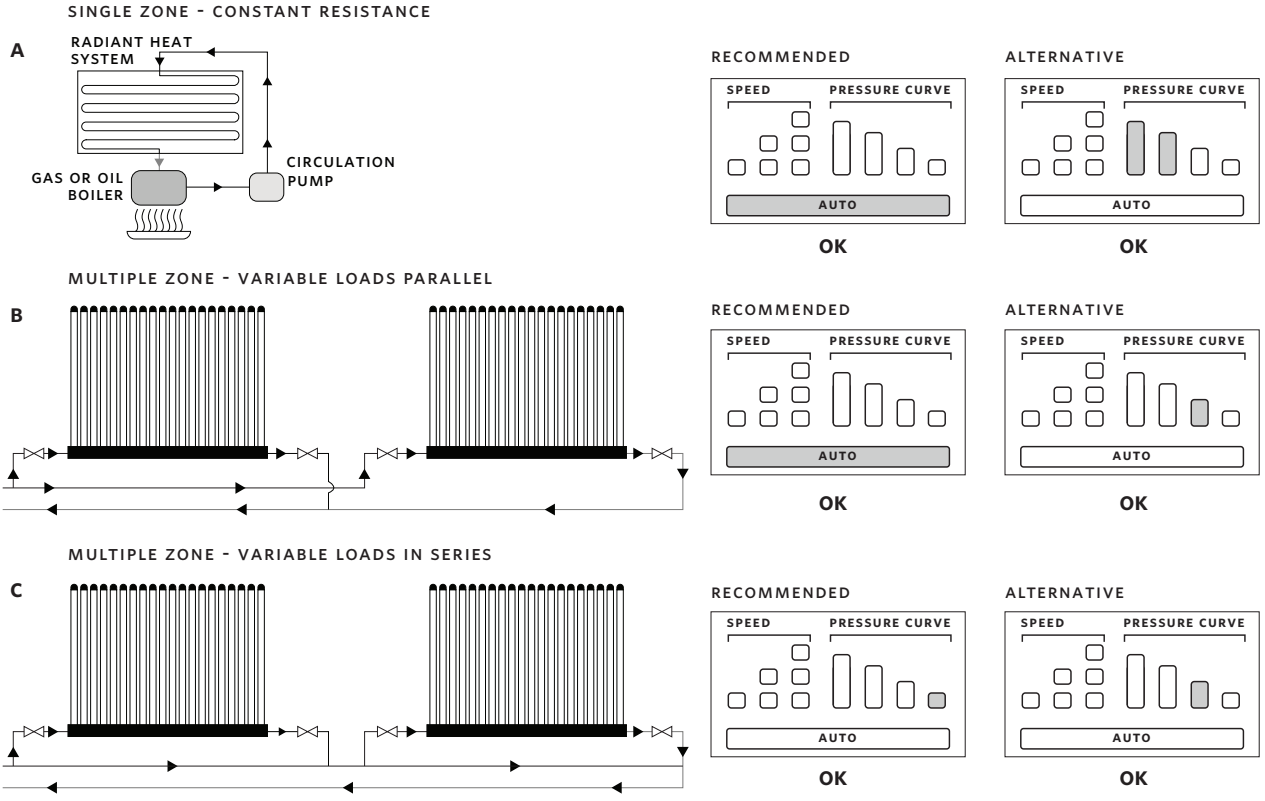


FIG. 8 Selection of pump setting for system type

AUTO (underfloor heating and two-pipe (parallel) systems)
AUTO function observes and adjusts the pump performance to satisfy the system requirement. The pump adapts to the system over time, it is recommended to leave the pump in the **AUTO** position at least one week before selecting other pump settings.

Changing from recommended (AUTO) to alternative pump setting:
Heating systems are 'slow' systems that cannot be set to the optimum operation within minutes or hours.

If the recommended pump setting does not give the desired comfort in some areas of the building, change the pump setting to the shown alternative.

See pump settings and pump performance (section 9) for more details.

7.0 SYSTEMS WITH BYPASS VALVE BETWEEN FLOW AND RETURN PIPES

7.1 PURPOSE OF BYPASS VALVE

The purpose of a differential pressure bypass valve is to ensure that the heat from the boiler can be distributed when all valves in the underfloor-heating circuits and/or thermostatic radiator valves are closed. These valves were commonly applied in multi zone systems with traditional fixed speed pumps.

A Compass circulator can eliminate the need for a differential bypass valve when used in Auto or proportional pressure modes, because the circulator will reduce speed when the valves in the system close and the heat demand is reduced.

If you are servicing an existing system with a bypass valve and you are replacing a fixed speed circulator with a Compass circulator, there is no need to remove the bypass valve.

8.0 START-UP

8.1 BEFORE START-UP

Fill the system with liquid and properly vent the system before starting the pump. The required minimum inlet pressure in relation to liquid temperature must be available at the pump inlet (see section 11).

8.2 VENTING THE PUMP

Even with system vented, air may be still be present in the pump. The air in the pump may cause noise but the noise should cease after a few minutes running.

The venting process can be shortened by setting the pump to run at speed III for a short period of time (20 seconds).

Once the pump is vented (the noise has ceased), set the pump mode according to the recommendations (see section 6).

CAUTION

The pump must not run dry.

9.0 PUMP SETTINGS AND PUMP PERFORMANCE

9.1 RELATION BETWEEN PUMP SETTING AND PUMP PERFORMANCE

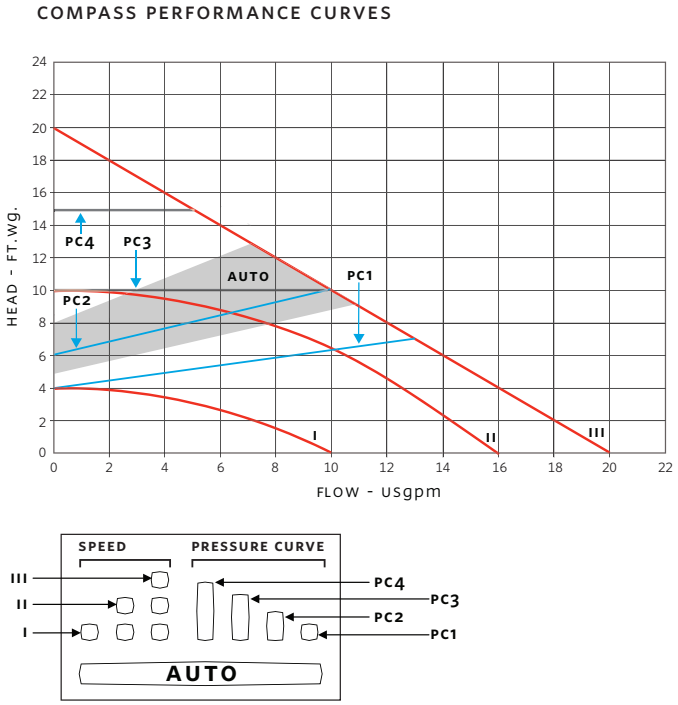


FIG. 10 Pump setting in relation to pump performance

Select the optimum setting:

The Compass circulator comes with 8 modes of operation.

There are three fixed speed curve options which will operate just like traditional fixed speed circulators, except that compass motor technology is far more energy efficient than traditional fixed speed circulators.

The proportional pressure curves operate as Sensorless differential pressure circulators. These curves follow pre-selected performance curves and will reduce flow and energy consumption when the valves in the system close and the flow requirements are reduced.

The constant pressure curves maintain pre-selected pressure ratings at the circulator.

AUTO mode operates on the sensorless differential pressure principle, but will **Learn** usage patterns and adjust circulator performance over time to optimize energy efficiency.

SETTING	PUMP CURVE	FUNCTION
AUTO (factory setting)	Operating within the defined range	The **AUTO** function controls the pump performance automatically within a defined performance range (see **FIG. 10**). • Adapt to the size of the system. • Adapt to system demand over time. In **AUTO**, Compass is set to proportional-pressure curve control.
PC1	Lowest proportional pressure curve	The operation point of the pump will follow the lowest proportional-pressure curve (see **FIG. 10**) depending on the load demand. The head (pressure) is reduced during low demand and increased during high demand until the maximum wattage is reached, then the pump will run on the speed III curve.
PC2	Highest proportional pressure curve	The operation point of the pump will follow the highest proportional-pressure curve (see **FIG. 10**) depending on the load demand. The head (pressure) is reduced during low demand and increased during high demand until the maximum wattage is reached, then the pump will run on the speed III curve.
PC3	Lowest constant pressure curve	The operation point of the pump will follow the lowest constant-pressure curve (see **FIG. 10**) depending on the load demand. The head (pressure) is kept constant, regardless of the load demand until the maximum wattage is reached, then the pump will run on the speed III curve.
PC4	Highest constant pressure curve	The operation point of the pump will follow the highest constant-pressure curve (see **FIG. 10**) depending on the load demand. The head (pressure) is kept constant, regardless of the load demand until the maximum wattage is reached, then the pump will run on the speed III curve.
III	Speed III	Speed III is the highest constant speed performance curve of Compass and it also presents the max performance capability of the pump (see **FIG. 10**). Speed III can also be used to vent the pump (see section 8.2).
II	Speed II	Speed II is the medium constant speed performance curve of Compass (see **FIG. 10**).
I	Speed I	Speed I is the lowest constant speed performance curve of Compass (see **FIG. 10**).

10.0 TROUBLESHOOTING

WARNING

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

FAULT	CONTROL PANEL	CAUSE	REMEDY
The pump does not run	Light off	A fuse in the installation is blown.	Replace the fuse.
		The circuit breaker has tripped out.	Switch the circuit breaker on.
		The pump is defective.	Replace the pump.
	Shows "E0" or "E1"	Electricity supply failure. Voltage may be too low or too high.	Check voltage level of the electricity supply.
	Shows "E2"	The impeller is locked.	Unlock the impeller/rotor.
	Shows "E3"	No liquid in system	Fill up the system
	Shows "E4"	Voltage may be too low	Check voltage level of the electricity supply.
		Control (internal circuit) is broken	Replace the pump.
Noise in the system	Shows wattage and gpm	Air in the system.	See section 8.2 Venting of the pump system.
		The flow is too high.	Select a lower speed or pressure curve (see section 9). Pump settings and pump performance.
		Pump may be running dry. No liquid in system	Fill up the system
Noise in the pump	Shows wattage and gpm	Air in the pump.	Let the pump run. It vents itself over time (see section 8.2) venting the pump.
		The inlet pressure is too low.	Increase the inlet pressure or check the air volume in the expansion tank, if installed.
Insufficient heat in space	Shows wattage and gpm	The pump performance setting may be too low.	Select a higher speed or pressure curve setting (see section 9). Pump settings and pump performance.
			Confirm that the system requirement can be met by this pump capacity or larger pump may be required.

11.0 TECHNICAL DATA AND INSTALLATION DIMENSIONS

11.1 TECHNICAL DATA

Supply voltage: 1 × 115 V – 10%/+ 6%, 60 Hz

	MINIMUM	MAXIMUM
Amp	0.05	0.65
Watt	5	45

Motor protection: The pump requires no external motor protection.

Maximum working temperature: 230°F (110°C) maximum

Maximum working pressure: 150 psi (10 bar).

Maximum relative air humidity (rh): 95%.

Enclosure class: Type 2

Insulation class: H

Certification: ETL listed for US and Canada (conforms to ULSTD.778 certified to CSA STD. C22.2 NO.108-01)

** NSF 372 (for stainless steel models)

INLET PRESSURE

Minimum inlet pressure in relation to liquid temperature:

LIQUID TEMPERATURE	MINIMUM INLET PRESSURE
150°F (65°C)	3.0 ft (0.91 m)
167°F (75°C)	4.4 ft (1.34 m)
194°F (90°C)	9.2 ft (2.8 m)
230°F (110°C)	36.1 ft (11.0 m)

Sound pressure level: The sound pressure level of the pump is lower than 43 dB(A).

Ambient temperature: 32°F (0°C) – 104°F (40°C)

Pumped liquids: Water or water Glycol mix.

WARNING

No flammable liquids such as diesel oil, petrol or similar liquids

Liquid temperature: 36°F (2°C) – 230°F (110°C)

To avoid condensation in the control box and stator, the liquid temperature must always be higher than the ambient temperature.

AMBIENT TEMPERATURE	LIQUID TEMPERATURE	
	MIN.	MAX.
32°F (0°C)	35.6°F (2°C)	230°F (110°C)
50°F (10°C)	50°F (10°C)	230°F (110°C)
68°F (20°C)	68°F (20°C)	230°F (110°C)
86°F (30°C)	86°F (30°C)	230°F (110°C)
95°F (35°C)	95°F (35°C)	194°F (90°C)
104°F (40°C)	104°F (40°C)	158°F (70°C)

CAUTION

Since water conditions can vary with geographical location (i.e. amount and type of dissolved solids) it is recommended that the operating temperature of the liquid for open (potable) systems be kept as low as possible (i.e. below 150°F or 65°C) to avoid precipitation of calcium.

VOLUTE MATERIAL

Cast iron: For closed systems (boiler loops)

Stainless steel:** Open or closed systems (potable hot water or boiler loops)

** Certified <0.25 weighted average percent lead (NSF 372) and complies with California Health and Safety code section 116875 (commonly known as AB1953).

SPARE PARTS

SPARE PART	ITEM NO.
Check valve 1"	810223–104

Pumpen Intelligenz.

Wilo Stratos Z

High Efficiency DHW Circulators

Product Brochure

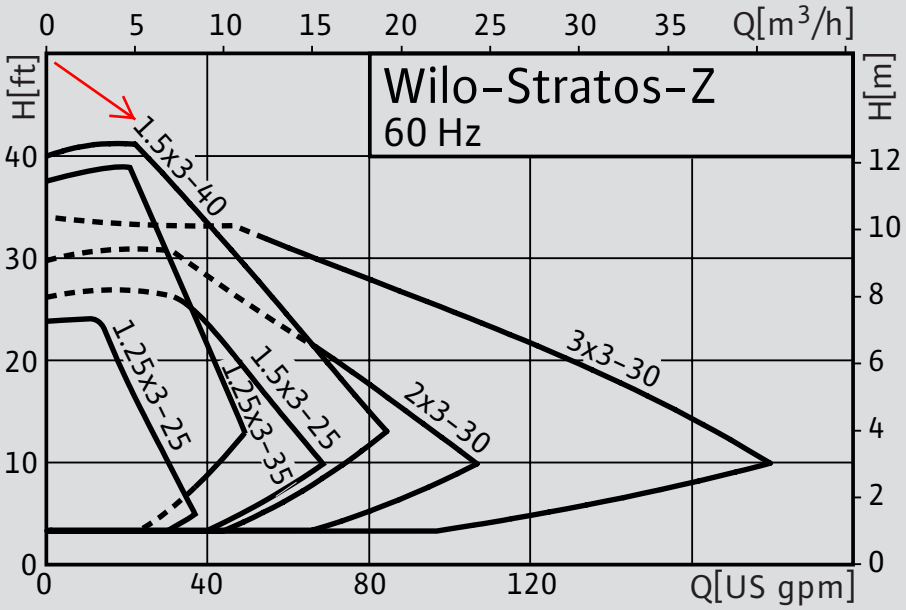
Wilo Stratos Z

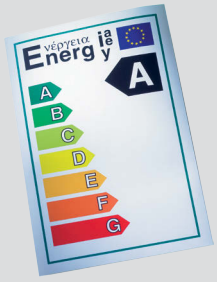
High Efficiency DHW Circulators

Applications Include:

- » **Domestic Hot Water**
- » **Closed Cooling Circuits**
- » **Solar**
- » **HVAC Systems**
- » **Industrial Circulation**
- » **Geothermal**

Wilo Stratos Z





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*Compared to an uncontrolled circulator.

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Wilo-Stratos

Installation and operating instructions

Notice de montage et de mise en service

Instrucciones de instalación y funcionamiento

2085563-Ed.01 / 2007-05-Kothes!

Fig. 1:

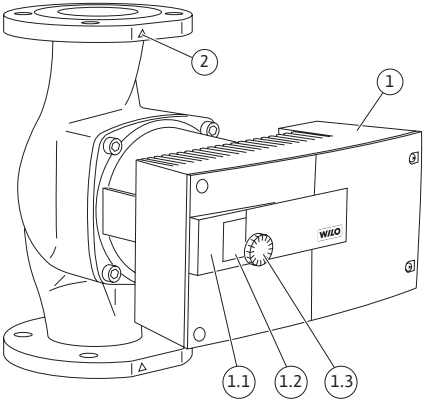


Fig. 2:

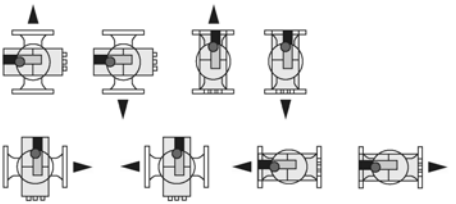


Fig. 3:

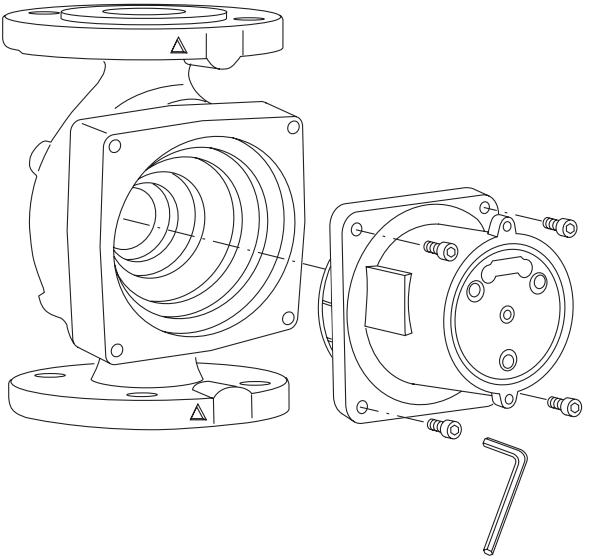


Fig. 4:

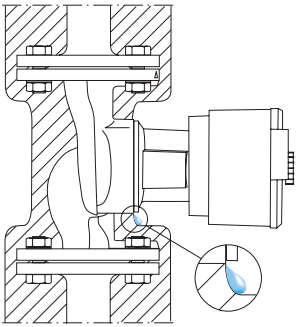


Fig. 5:

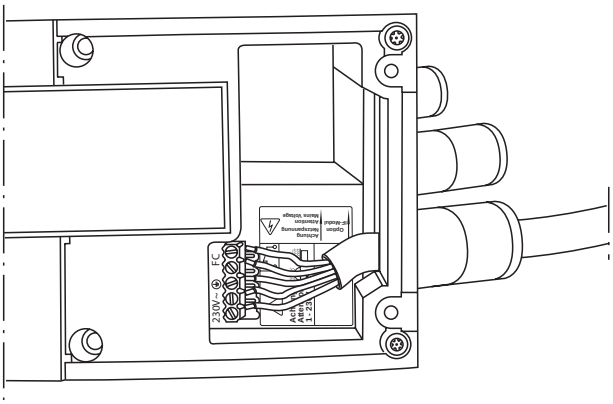


Fig. 6:

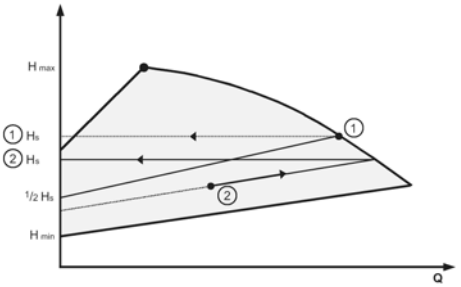


Fig. 7:

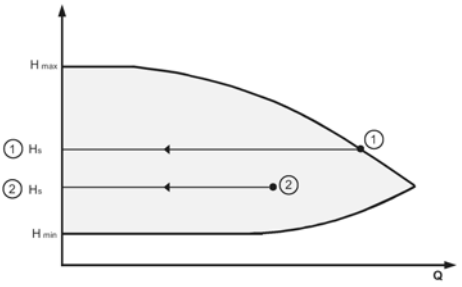


Fig. 8:

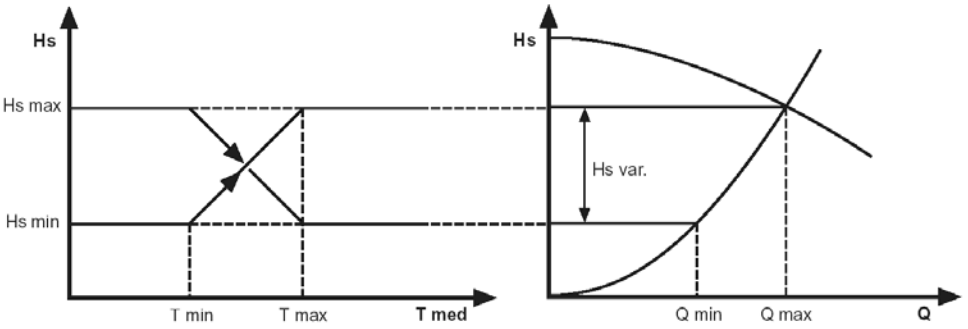


Fig. 9:

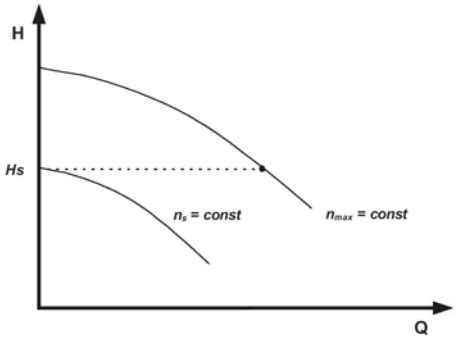
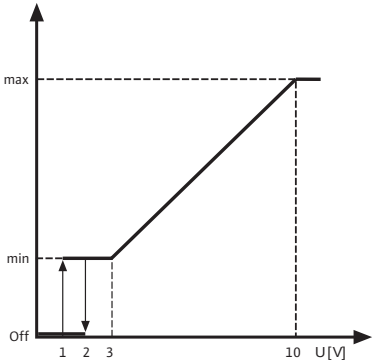


Fig. 10:



1 General

1.1 About this document

These Installation and Operating Instructions form an integral part of the product. They must be kept close to the product and in readiness whenever required. Precise observance of these instructions is a pre-condition for use of the product for the intended purpose and for its correct operation.
These Installation and Operating Instructions conform to the relevant version of the equipment and the underlying safety standards valid at the time of going to press.

2 Safety

These instructions contain important information which must be followed when installing and operating the pump. It is therefore imperative that they be read by both the installer and the operator before the circulator is installed or started up.
Both the general safety instructions in the 'Safety precautions' section and those in subsequent sections indicated by danger symbols should be carefully observed.

2.1 Symbols and signal words used in these operating instructions

Symbols:

General Safety symbol

Hazards from electrical causes

NOTE:

Signal words:

DANGER!
Imminently hazardous situation.
Will result in death or serious injury if not avoided.

WARNING!
The user can be exposed to (severe) injury. 'Warning' refers that harm to the user when the user is neglecting the procedure.

CAUTION!
The product is at risk of damage. 'Caution' refers to the product when the user is neglecting the procedures.

NOTE: A notice with useful information for the user in relation to the product. It attends the user to possible problems.

2.2 Qualified Personnel

The personnel installing the pump must have the appropriate qualifications for this work.

2.3 Risks incurred by failure to comply with the safety precautions

Failure to comply with the safety precautions could result in personal injury or damage to the pump or installation. Failure to comply with the safety precautions could invalidate warranty and/or damage claims.
In particular, failure to comply with these safety precautions could increase the possibility of the following risks:

- the failure of important parts of the pump or installation,
- personal injury due to electrical and mechanical causes,
- material damage.

2.4 Safety precautions for the operator

Existing regulations for the prevention of accidents must be observed.
National Electrical Codes, local codes and regulations must be followed.

2.5 Safety precautions for inspection and installation

The operator must ensure that all inspection and installation work is carried out by authorized and qualified specialists who have carefully reviewed these instructions.
Work on the pump/unit must be carried out only with the pump disconnected (locked out) from the electrical supply and at complete standstill.

2.6 Unauthorized alterations and manufacture of spare parts

Alterations to the pump or installation may only be carried out with the manufacturer's consent. The use of original spare parts and accessories authorized by the manufacturer will ensure safety. The use of any other parts

may invalidate claims involving the liability of the manufacturer for any consequences.

2.7 Improper use

The operational safety of the pump or installation supplied can only be guaranteed if it is used in accordance with paragraph 4 of the operating instructions. The limits given in the catalogue or data sheet must under no circumstances be exceeded.

3 Transport and interim storage

When receiving the material, check that there has been no damage during the transport. If shipping damage has occurred, take all necessary steps with the carrier within the allowed time.

CAUTION! Outside influences may cause damages

If the delivered material is to be installed later on, store it in a dry place and protect it from impacts and any outside influences (humidity, frost etc.).

Handle the pump carefully so as not to damage the unit prior to installation.

4 Intended use (Application)

CAUTION! Possible damage of the pump

This pump is intended for use with water and water/glycol only.

The circulating pumps are used to circulate liquids in

- Warm and hot water heating systems,
- Cooling and cold water circuits,
- Closed circulation systems.

WARNING! Health hazard

The materials are not designed for drinking water supply.

Permissible liquids and requirements:

- Heating water according the requirements of accepted standards of water quality in heating systems.
- Water and water/glycol mixtures in a maximum ratio up to 1:1. High glycol concentration and low temperature systems may require a reassessment of the hydraulic data to compensate for the increased viscosity (please contact your WILO representatives for more information). Use of additives (corrosion inhibitors, oxygen scavengers etc.) must be in compliance with the manufacturer instructions.
- If other fluids or additives are used, please contact WILO for proper authorization.

5 Specification about the product

5.1 Model identification

Example: Stratos 1.5x3-40	
Stratos	**High-efficiency pump** Wet-rotor circulating pump
1.5	Pipe connection [inch]
3-40	Infinitely variable nominal pump head 3 to 40 [ft] H_{min}: 3.3 ft, H_{max}: 39.4 ft

5.2 Technical Data	
Power supply	1~230 V ± 10%
Frequency	60 Hz
Degree of protection	Enclosure 2
Insulation class	H
Motor protection	Standard built-in full motor protection
Maximum sound pressure level	54 dB(A)
Liquid temperature	14°F (-10°C) to 230°F (+110°C)
Max. ambient temperature	104°F (40°C)
Max. working pressure at the pump	145 psi

Min. pump inlet pressure [psi] at the suction side during operation by Wilo-Stratos model:

	At these liquid temps T_{Med}		
	14°F...122°F (- 10°C...+50°C)	203°F (+95°C)	230°F (+110°C)
1.25 inch	4.4 (psi)	14.5 (psi)	23.2 (psi)
1.5 and 2 inch	7.3 (psi)	17.4 (psi)	26.1 (psi)
3 inch	10.2 (psi)	21.8 (psi)	33.4 (psi)

The values apply up to 984 ft above sea level, add-on for higher altitudes: 0.15 psi/328 ft increase in height

5.3 Scope of Supply

- Complete pump
- Installation and operating instructions
- 2 flange gaskets (only for 1.25, 1.5 and 2 inch flange pumps)

5.4 Accessories

- Accessories such as companion flanges must be ordered separately.
- Companion flanges (included bolts, nuts and gaskets) for flange-pipe connection.
- IR (infra-red) module for special setup and diagnostics.
- IF (interface) Module Stratos Ext. Off/SBM, Ext.Min

6 Description and function

6.1 Pump description (fig. 1)

The Wilo-Stratos high efficiency pump (fig. 1) is a series of glandless pumps with **E**lectronic **C**ommutated **M**otor (ECM) technology and built-in differential pressure control.
On the motor housing there is in axial mounting form a **control module** (fig. 1, pos. 1) which sets the pump's differential pressure to a set value that can be varied within the control range. Depending on the control system involved, the differential pressure is subject to different criteria. However, regardless of the control system the pump constantly adapts to changing system power requirements, as it is especially the case when using thermostatic valves or mixers.

The main benefits of electronic control are:

- it saves energy while reducing operating costs,
- it reduces noise caused by the excess flow,
- it does not require pressure bypass valves.

This wet rotor pump is designed to have all rotating parts surrounded by the liquid being pumped. The pump is maintenance free and requires no further maintenance after the air bleeding procedure during the initial start-up (no after start-up maintenance).

6.1.1 Differential-pressure control systems

The **control systems** which can be selected are:

- Δ**p-v**: (Factory default setting) The electronics increase the pump's differential pressure set point in a straight line between ½ Hs and Hs. The differential pressure set point Hs increases or decreases in accordance with the required flow rate (fig. 6).
- Δ**p-c**: The electronics keep the differential pressure generated by the pump at a constant differential pressure set point Hs over the entire operation range of the pump (fig. 7).
- Δ**p-T**: The electronics alter the nominal differential pressure set point dependant on the fluid temperature measured. This control system can only be adjusted with the IR module. There are two possible settings (fig. 8):
  - Positive control: As the system temperature rises, the nominal differential pressure set point is **increased** linearly between Hsmin and Hsmax. (setting on IR module: $Hs_{max} > Hs_{min}$).
    Used e.g. with standard boilers with sliding flow temperature.
  - Negative control: As the system temperature rises, the nominal differential pressure set point is **decreased** linearly between Hsmin and Hsmax (setting on IR module: $Hs_{max} < Hs_{min}$).
    Used e.g. with condensing boilers where a specific maxium return water temperature must be maintained to achieve as much condensing as possible to insure maxium boiler effeciency. To do this, the pump must be installed in the system's return flow section.

6.1.2 Other energy-saving operating modes

- Speed regulation mode operation: The speed of the pump is kept at an externally set constant speed between minimum and maximum speeds (fig. 9). The speed regulation mode deactivates the differential pressure control.
- In the "auto" operating mode (factory default setting) the pump is able to recognize a minimum system heat output requirement due to a sustained drop in the system temperature and then automitically switch to **"Autopilot" night setback mode**. If the heat output requirement rises, the pump automatically switches to standard mode. This setting ensures that the pump's energy consumption is reduced to a minimum and in most cases is the optimum setting.

6.1.3 General pump functions

- The pumps are fitted with an electronic **overload protection system** which switches the pump off should it become overloaded.
- The control module is equipped with a non-volatile memory for **data storage**. What this means is that data is saved, even during long periods of down time. Once the voltage returns the pump starts operating again with the values set before the power outage.
- **Pump kick**: If the pump has been switched off externally by the IF (interface) device (Ext.Off, 0...10 V) or IR module it will automatically run for a short time once every 24 hours to exercise the pump.

Connections to the building management system (BMS)

- **FC**: A collective fault contact FC (potential-free closed contact) can be connected to a control point (building management system) as standard. The internal contact is closed if the pump is turned off, or there are no problems or failures on the part of the control module. The faults are described in detail in chapter 10.
- **IF**(**I**nter**f**ace) **modules (accessory)**:
  Analog interfaces are available in the form of add-on IF modules for connecting to external control system (e.g. DDC/BMS).

6.1.4 Double pump mode

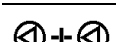
Two corresponding single pumps in a parallel pump installation can be fitted with built-in double-pump management.

- **Stratos IF module**: Two IF modules connected via the DP (double pump) interface are required for communication between pumps. In addition to double pump management, the IF modules provide other interfaces for the double pump.
  This double pump management has the following functions:
- **Master/Slave**: Both pumps are controlled by the master. All settings are made by the master.

- **Optimum-efficiency peak-load operation**: Two corresponding single pumps can be run in a low/high flow application where if the lead pump can not keep up with the flow demand the lag pump will operate automatically. At partial load, the hydraulic capacity is provided by one pump only. The second pump is switched on at optimum efficiency, when the sum of power consumptions P_1 of both pumps is less than the power consumptions P_1 of one pump. Both pumps are then adjusted upwards simultaneously to max. speed if necessary. In relation to the conventional peak load operation (load controlled switch on and off) a further energy saving is reached by this mode of operation.
- **Duty/Standby mode**: Each of the two pumps produces the design delivery rate. The other pump can be used in the event of the first pump malfunctioning or following a pump swap. Only one pump operates at a time.
- In the event that one pump experiences a **failure/problem**, the other will run as a single pump in standard mode as instructed by the master.
- In the event of a **break in communication**: The slave pump runs at the last set value of the master prior to the interruption.
- **Pump swap**: If only one pump is operational (duty/standby, peak- or low-load operation), the pumps are swapped after every 24 hrs' of actual operating time.
- **FC**: The collective fault contact (FC) of the master can be connected to a central control point. In this case, contact is only established with the master. The reading is valid for both pumps.
  As an option, the error message contacts of master and slave can be programmed as single fault signal with the IR module. For the single fault signals, contact must be established with each pump.

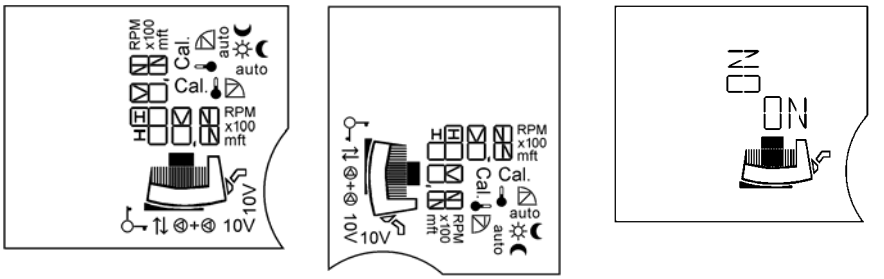
6.2 Operating the pump

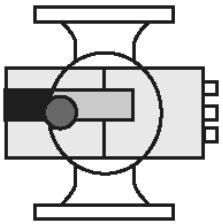
The electronic module (fig. 1, pos. 1) houses the **IR window** (infrared window, pos. 1.1) for communication with an **IR module** and the **LC display** (pos. 1.2) with the **tuning button** (pos. 1.3) for operating the pump. The IR receiver and sender surface must be located in such a way as to be able to communicate with the IR module. If the connection to the IR module has been made, the **green LED** lights up in the IR window to confirm the IR communication of all pumps that were connected to the IR module at the same time. The LED on the pump with which the IR module communicates blinks. It stops blinking 5 minutes after the connection to the IR module has been interrupted. A red **Error LED** in the IR window lights up when a fault is registered. Information on how to operate the IR module can be obtained in its installation and operating instructions.
LC display: The LC display shows the pump's setting parameters using symbols and numerical values. The display can be selected according to the position of the module, i.e. horizontal or vertical, at a readable angle (face to face).
The display is constantly lit up. The table below explains the meaning of the LC display's symbols:

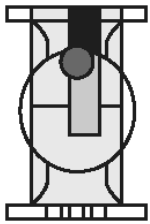
Symbol	Description of possible operating conditions
auto ☼	Standard mode; automatic switch-over to night setback mode is enabled. Night-time mode is activated at minimum heat output requirement (default).
auto ☾	Pump runs in night-time mode (night setback operation) at min. speed.
(no symb.)	Automatic switch-over to night setback mode blocked, i.e. pump runs in standard mode only.
☾	Night setback mode activated via interface Ext.Min, regardless of the system temperature.
	Pump switched on (default).
	Pump switched off.
	Differential pressure set value set to H = 18.0 ft. (example)
	Control system Δp-v, regulated to variable differential pressure set value (fig. 6) (default).
	Control system Δp-c, regulated to constant differential pressure set value (fig. 7).
	The regulator mode control system deactivates the module pressure variations. The speed of the pump is kept at a constant level. The speed is set internally using the tuning button (fig. 9).
	Pump set to a constant speed (2.600 rpm example shown) - regulator mode.
10 V	In regulator mode, the speed or nominal lift of operating mode Δp-c or Δp-v of the pump is set via input 0...10 V of the Stratos IF module Ext.Min. The button then has no set value input function. (fig. 10)
	Control system Δp-T, regulated to temperature dependent differential pressure set value (fig. 8). The maximum set value Hsmax is displayed. This control system can only be activated via the IR module.
	All settings on module except "acknowledge error" blocked. Settings locked out by IR module. Settings can only be altered using IR .
	Pump runs as slave pump. No changes can be made to the position setting of the display.
	Two single pumps as double pump running in peak load mode (master + slave)
	Two single pumps as double pump running in duty / standby mode (master or slave)

Operating the tuning button: (fig. 1, pos. 1.3) Starting from the basic setting, the setting menus are selected one after the other in a fixed order by pressing the button (in 1st menu: press for more than 1 second). The relevant symbol blinks. By turning the button to the left or to the right the parameters on the display can be altered up or down. The symbol which has just been set blinks. The new setting is stored by pressing the button. At the same time the system advances to the next setting option.
The set value (differential pressure or speed) in the basic setting can be altered by turning the tuning button. The new value blinks. The new setting is stored by pressing the button.
If the new setting is not confirmed, after 30 seconds the old value is restored and the display returns to the basic setting.
Settings of the display position: For the layout of the control module, whether installed horizontally or vertically, the position of the display can be rotated through 90°. The position setting can be entered in menu point 3. The display position specified by the basic setting flashes by “ON“ (for horizontal position). The display can be rotated by turning the selector button. “ON“ flashes for the vertical position. The setting is confirmed by pressing the selector button.

Display position:



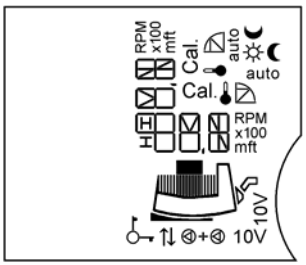
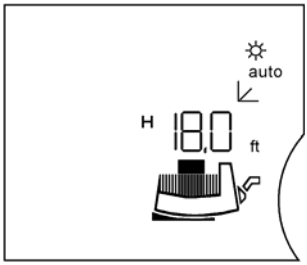


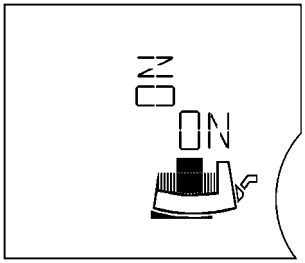
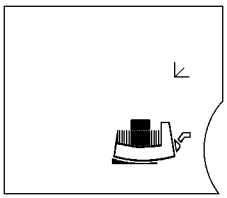
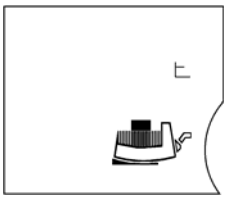
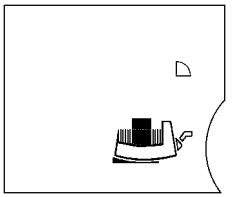
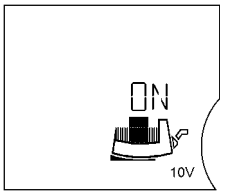
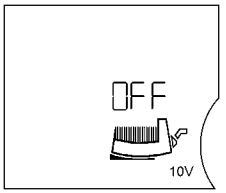


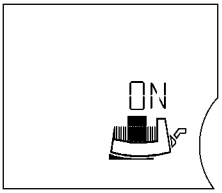
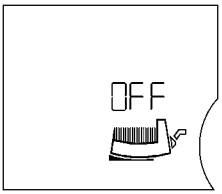
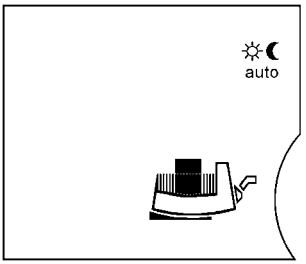
Position setting
in menu point 3

The following menus appear in succession on the pump display:
(horizontal representation of display)

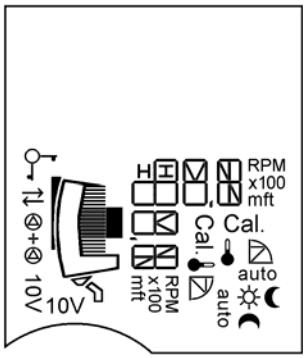
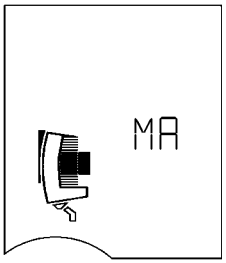
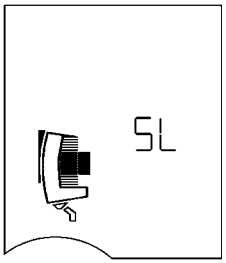
Single pump mode: Setting when first used / Menu order during standard use

	LC display	Setting
①		After switching on the module, **all symbols** appear on the display for 2 seconds. The current setting ② then engages.
②		**Current (basic) setting (factory default):** auto ☼ • automatic night setback enabled, Pump runs in standard mode e.g. **H 18.0 ft** • present differential pressure setpoint H_S = 18.0 ft at same time ½ H_S max (factory setting depending on pump type) • Control system Δp-v The differential pressure set point can be altered by turning the tuning button. The new differential pressure set point blinks. The new setting is stored by pressing the button briefly. If no button is pressed, the previously set blinking differential pressure set point returns to the previous value after 30 seconds. Press tuning button for > 1 second. The next menu point ③ appears.
	If no setting is made in the subsequent menus for 30s, the basic setting ② re-appears in the display.	

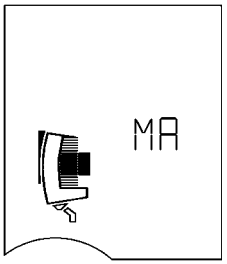
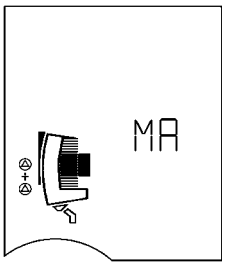
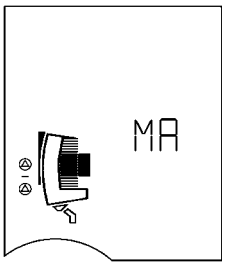
	LC display	Setting
③		Position setting of display vertical / horizontal The set position of the display is shown by the flashing “ON“. By turning the tuning button the other position can be selected. Setting stored.
④	  	The currently set **control system** blinks. By turning the tuning button other control systems can be selected. The new selected control system blinks. Pressing the button stores the new control system and switches to the next menu.
⑤	 	**Menu point ⑤ only appears if a Stratos IF module was inserted with input 0...10 V.** **Switch input 0...10 V on/off** **Activate input 0...10 V: “ON”** and the **“module motor symbol”** appears in the display. The setting can be altered by turning the tuning button. **Deactivate input 0...10 V: “OFF”** appears in the display and the **“motor symbol”** disappears. Setting stored. If the input was switched on, the menu manager jumps to menu point ⑦a.

	LC display	Setting
(6)		**Switch pump on/off.**
		Switch on pump, "**ON**" and the **"module motor symbol"** appear in the display
		The setting can be altered by turning the tuning button.
		**Switch off pump,** "**OFF**" appears in the display and the **"motor symbol"** disappears.
		Setting stored.
(7)		Menu point (6) is skipped if regulator mode was selected Either flash
		auto ☾ • **automatic night setback** Pump runs in standard mode Menu point (2) then shows "auto ☼" during autom. standard mode or "auto ☾" during automatic night-setback
		☼ • normal **standard mode**, automatic night-setback disabled**.** Menu point (2) does not contain any symbol.
		call up one of the two settings
		and store. Display jumps to the next menu.
		Menu point (7) is skipped if: • regulator mode was selected, • the input 0...10 V was activated
(7a)		In single-pump mode the display returns to basic setting (2). **In the event of an error the error menu (10) appears** before the basic setting (2). **In double pump mode (two single pumps) the display jumps to menu (8).**

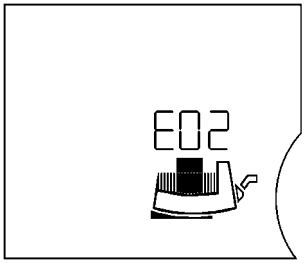
Double pump mode (as two single pump mode): Setting when starting up for the first time
(vertical display)

	LC display	Setting
①		When the module is switched on **all symbols** appear in the display for 2 seconds. Menu ⑴a then appears.
⑴a	 	The symbol **MA** = Master blinks on the display of both pumps. Should the settings not be altered, both pumps will run at a constant speed (HS = ½ Hmax. where Q = 0). By ↓ on the master pump tuning button the setting mode menu ⑨ appears on the display. **SL** = Slave appears automatically on the slave pump display. The configuration: left pump Master, right pump Slave is thus selected. The tuning button on the slave pump is deactivated. No more settings can be made here. A position setting for the display cannot be made on the slave pump. Position setting on the slave pump is taken over from the settings of the master pump.

Double pump mode: Menu order during normal use:
After switching on the module, **all symbols** (1) appear on the display for 2 seconds. The current setting (2) then sets itself. When "scrolling" in the MA display the same menu order (2)...(7) appears as for the single pump. Then the **MA** menu appears and remains on the screen permanently.

	LC display	Setting
(8)		**ATTENTION!** Use  to confirm MA at the left pump. No change must be made in this menu item. It is always: MA = left pump, SL = right pump.
(9)		Setting **Peak load and duty / standby mode**
		 The other setting blinks.
		 Setting stored. Display returns to basic setting (2).
		

Error display

	LC display	Setting
⑩		In the event of an error the current error is displayed by **E** = Error, the **code no.** and by the flashing of the error source motor, control module or mains connection. **For code numbers and their meaning see chapter 10**

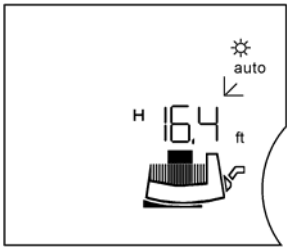
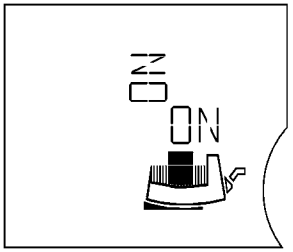
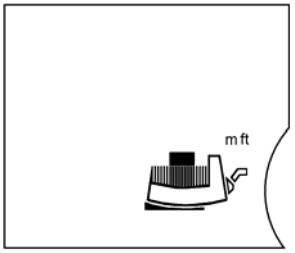
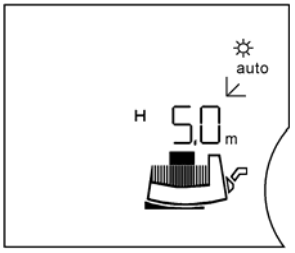
6.3 Priorities on the operation of the pump, IR module

The display of errors (menu 10) incl. error acknowledgment has the highest priority. This means that errors precedence on the pump's display and that they must be acknowledged and removed.

If settings are made on the control module or from the IR module and not confirmed by pressing the button, the setting will return to the previous position 30 seconds after the last entry.

- **Pump ↔ IR** without lockout function: The last command, whether from the IR monitor or control module, is stored by the pump.
- **Pump ↔ IR** with lockout function: When the "Key function on" command is received, the control module's current settings remain in place. The display shows  . The pump is now blocked and cannot be operated.

Changing the display setting from feet [ft] to meters [m]

	LC display	Setting
①		Press and hold in the red button at the initial start up menu (level one) for a period of approximately 6 seconds.
		During this time there will be access to the second menu level (menu item display orientation) after approximately 1 second.
		After another 5 seconds there will be access to the third menu level. The display "m ft" appears, with [ft] flashing (factory default is [ft]). By turning the red button the display can be changed over to [m]. (m is flashing)
②		By pressing the red button the selection is confirmed. The display immediately returns to the first menu display.

7 Installation and electrical connection

Installation and electrical work in compliance with any local codes and by qualified personnel only!

WARNING! Bodily injury

Existing regulations for the prevention of accidents must be observed.

WARNING! Electrical shock hazard

Dangers caused by electrical energy must be excluded.
National Electrical Codes, local codes and regulations must be followed.

7.1 Pump installation

- The pump must be installed in a dry, well-ventilated and frost-free place.

CAUTION! Possible damage of the pump

Dirt and solder drops in the pump body can effect the pump operation.

- **It is recommended that any welding and soldering work be done before installing the pump.**
- **Thoroughly flush the system prior to installing and operating the pump.**
- **Foreign material in the system resulting from construction may damage the pump and is not warrantable.**

- The pump must be installed in an easily accessible position to facilitate inspection or replacement.
- The pump should never be located at the lowest point of the piping system, where dirt and sediment collect. Nor should it be located at the highest point of the piping system, where air accumulates. Please ensure at least a minimum of three pipe diameters of straight on the suction side of the pump.
- It is recommended that isolation valves be installed on the suction and discharge side of the pump.
  This will save having to drain and refill the system if the pump / pump head needs exchange-service. The valves are to be installed so that any water that escape cannot drip onto the pump motor or terminal box.
- An arrow on the pump housing indicates the direction of water flow (fig.1, pos.2).
- Install the pump in an easily accessible place, so that subsequent servicing work can easily be carried out.
  Installation is to be carried out such that dripping water cannot drip onto the pump motor or control module.
- Pump must be installed with the shaft in the horizontal position in such a way that it is not stressed by the pipework. (Installation positions in fig. 2). When installing in confined spaces, for example in compact distributors, the control module can be placed in a vertical position by rotating the motor, see chapter 7.1.1.

- In order to obtain the correct terminal box position the motor housing can be turned after removing the four allen screws (fig. 3).

WARNING! Risk of scalding

If the pump is already installed in the system, the system must be drained or the isolating valves on both sides of the pump must be closed before the allen screws are removed as the pumped liquid may be scalding hot and/or under pressure.
Do not start the pump until the system has been filled with liquid and vented.

- Permitted terminal box positions see fig. 2

CAUTION! Possible damage of the pump

When rotating the motor housing, ensure the O-ring between the cartridge and pump housing (volute) does not become damaged.

- Carefully lift the pump head and rotate it so the terminal box is in the desired position. Replace the pump head onto the pump housing and thighten the allen screws evenly in a diagonal method.
  Torque to:
  - M6 ..... 7 ft lb
  - M10 ..... 22 ft lb

WARNING! Electrical shock hazard

If the pump is operated by means of a generator, a dangerous voltage is created at the motor terminals after the control module is removed. The motor terminals are designed as VDE-approved bushings, so that there is no danger if simply touched with the finger. However, there would be a danger if a pointed object (nail, screwdriver, wire) were poked into one of the bushings.

7.1.1 Removing/installing the motor head unit

If the control module is to be moved into a different position, the motor does not need to be completely removed from the pump housing. The motor can be turned to the desired position in the pump housing.

CAUTION! Possible damage of the pump

Be careful not to damage the O-ring situated between the motor head and the pump housing. The O-ring must lie untwisted in the bevel of the end shield pointing to the impeller.

CAUTION! Possible damage of the pump

The impeller is permemtantly attached to the shaft, the end shield and the rotor. As the rotor has extremely strong rare earth magnets, if the rotor is removed from the rotor can, it has a considerable potential for danger e.g. by suddenly attracting objects made from iron/steel, influencing electrical equipment (risk to people with pacemakers), destroying magnetic cards, etc.

To remove the motor, (4x) M6 or (4x) M10 hexagon socket screws must be loosened. These screws can be reached with the following tools (fig. 3):

- 90° offset socket-head screwdriver
- spherical head socket-head screwdriver
- ¼" reversing ratchet with suitable bit

7.1.2 Insulating the pump in refrigerating/air-conditioning systems

The Wilo-Stratos series is suitable for use in refrigeration and air-conditioning systems with flow medium temperatures down to 14°F (-10°C).
When using the pumps in refrigerating and air-conditioning systems, diffusion-proof insulation is to be provided by the customer.

CAUTION! Possible damage of the pump

The pump housing may only be insulated up to the interstice with the motor, so that the condensation vents remain free and any condensation produced in the motor can run off without hindrance (fig. 4).

To protect it from corrosion, the pump housing is cataphoretically coated.

7.2 Electrical connection

Warning! Electrical shock hazard

Dangers caused by electrical energy must be excluded.

- **Electrical work by a qualified electrician only!**
- **National Electrical Codes, local codes and regulations must be strictly followed.**
- **All electrical connections must be performed after the electrical supply has been switched off and secured against unauthorized switching.**
- **For safe installation and operation a proper grounding of the pump to the power supply's grounding terminals is required.**

- Suitable mains fuse is required to protect the motor per local electrical codes.
- The operating voltage and frequency are marked on the rating plate.
- The pump must be connected with a power supply equipped with a grounded plug-connection and a main power switch.
- A minimum cable size of 14 AWG should be used (refer to the local code for wiring restrictions).

CAUTION! Possible damage of the pump

All conductors must be for at least 167°F (75°C).

- The electrical cable must be installed so that it never touches the pipework and/or the pump and motor housing.
- The connecting cable can be fed through the cable entry below or beside the terminal box, depending on it's orientation. It is advisable to install the screwed cable glands with the entrance of the conduit pointing downwards. The cable entry which is not used must be closed by a blind plug (fig. 5).
- Watertight screwed cable glands and conduit connections must be used to prevent any entrance of water to the terminal box.
- Connect power as shown in fig. 5.
- Mains fuse: see rating plate
- Pump/installation must be grounded in compliance with regulations.

CAUTION! Possible damage of the pump

In insulation tests with a high-voltage generator the pump is to be disconnected on all poles from the mains in the control module. The free cable ends are to be insulated in accordance with the voltage of the high-voltage generator.

7.2.1 Electrical pump connection (fig. 5)

- **230 V~, ⏚ :** Mains voltage, single-phase current 1~230 V AC ±10%, 60 Hz
  Voltage across terminals “230V~” must be total 230 volt
  either
  - 230 volt “hot” lines and neutral line

  or
  - two 230 volt “hot” lines.
- **FC:** A built-in collective fault signal is available on the FC (fault contact) terminals as a potential-free closed contact.
  Permissible contact load:
  - minimum: 12 V DC, 10 mA,
  - maximum: 250 V AC, 1 A.

  Max. tightening torque of the connecting terminal screws (230 V~, ⏚, FC): 2.2 lb inch
- **Two single pumps as double pump:** Both motors in the parallel pump installation are to be provided with a separate mains cable and a separate mains fuse protection.

ⓘ NOTE: If a single motor in a parallel pump installation is switched off-load, the built-in double-pump management is deactivated.

- **Switching frequency:**
  - On-/Off switching by mains supply ≤ 20 times / 24 h
  - On-/Off switching by Ext. Off or 0...10 V Signal ≤ 20 times/ h
- **Assignment of supply terminals:** The following table shows the possibilities for which combinations of circuits the individual cable glands in a cable can be assigned.

	Cable gland ½”	Cable gland ¼”	Cable gland PG 7
Function Cable type	Mains cable FC 5x14 AWG		
Function Cable type	Mains cable 3x14 AWG 3x14 AWG	FC 2-core cable	
Function Cable type	Mains cable 3x14 AWG 3x14 AWG 3x14 AWG	FC / Ext.Off / SBM or FC / 0...10 V / Ext.Min multicore control cable, number of cores in acc. with number of circuits, if nec. shielded	DP-management 2-core cable (l ≤ 2.5 m)

8 Start up

8.1 System filling - Venting

- Proper fill and pressurize the system with liquid.

CAUTION! Possible damage of the pump

Never operate the pump dry.
The system must be filled before starting the pump. Ensure that all isolation valves are open.

- The pump is normally vented automatically after a short operational period.

WARNING! Risk of burning

Depending on the operating condition of the pump and/or installation (fluid temperature) the entire pump can become very hot.
Avoid touching the pump owing to the risk of burning.
The temperature at the heat sink can be up to 158°F (+70°C) within the permissible operating conditions.

8.2 Setting the pump power

The unit is set to a specific operating point (point of maximum load, calculated maximum heating requirements). When starting up for the first time, the pump capacity (delivery head) is to be set in accordance with the system operating point. The factory presetting does not correspond to the pumping capacity required for the system. It is calculated on the basis of the performance curve of the selected pump (from the catalogue/data sheet). See also figs. 6 to 8.

Control systems Δp-c, Δp-v and Δp-T:

	Δp-c (fig. 7)	Δp-v (fig. 6)	Δp-T (fig. 8)
Operating point on max. speed curve	Draw a line from the operating point to the left. Read set value Hs and set the pump in accordance with this value.		Settings are to be made by the infrared device.
Operating point in control range	Draw a line from the operating point to the left. Read set point Hs and set the pump in accordance with this value.	Continue the standard line until it meets the max. speed curve, then continue horizontally to the left, read set point Hs and set the pump in accordance with this value.	
Setting range	H_{min}, H_{max} see type key (chapter 5.1)		T_{min}: 68...212°F (+20...+100°C) T_{max}: 86...230°F (+30...+110°C) $\Delta T = T_{max} - T_{min} \geq$ 50°F (10°C) Increase: $\Delta HS/\Delta T \leq$ 3.3 ft/50°F (10°C) H_{min}, H_{max}

8.3 Selecting the control system

Unit type	System conditions	Recommended control system
Heating-/ventilation- and air conditioning systems with a system friction loss (heating radiator + thermostatic valve) ≤ 25% of the total resistance	1. Two-pipe systems with thermostatic/ zone valves • Flow head > 13.1 ft (high head systems) • Very long distribution lines • Heavily throttled branch shut-off valves • Branch differential pressure regulator • High pressure losses in those system parts through which the total volume flows (boilers/ refrigerating machines, poss. heat exchangers, distribution line) 2. Primary circuits with high pressure losses	**Δp-v**
Heating-/ventilation- and air conditioning systems with a system friction loss in the generator/distributor circuit ≤ 25% of the resistance in the transfer part (heating radiator + thermostatic valve)	1. Two-pipe systems with thermostatic/ zone valves and high consumer authority • Flow head ≤ 6.6 ft (low head systems) • Converted gravity systems • Retrofitting to large temperature spread (e.g. long-distance energy) • Low pressure losses in the system parts through which the total volume flows (boilers/refrigerating machines, poss. heat exchangers, distribution line) 2. Primary circuits with low pressure losses 3. Underfloor heating systems with thermostatic or zone valves 4. Single-pipe systems with thermostatic or branch shut-off valves	**Δp-c**

Unit type	System conditions	Recommended control system
Heating systems	1. Two-pipe systems • Pump installed in the supply pipe. • Flow temperature controlled by atmospheric conditions. With increasing flow temperature the flow rate will be increased. 2. Single-pipe systems • Pump installed in the return pipe. • Constant flow temperature. With increased return temperature the flow rate will be lowered. 3. Primary circuits with condensing boiler • Pump installed in the return pipe. With increased return temperature the flow rate will be lowered.	**Δp-T**
Heating-/ventilation- and air conditioning systems Circulation systems for drinking water	1. Constant flow rate	**Regulator mode**
Heating systems	1. All systems • Pump installed in the supply pipe. • Flow temperature will be lowered in light loads periods (e.g. night). • Pump runs 24h without external control.	**Night setback mode “Autopilot“**

9 Maintenance/service

All servicing should be performed by an authorized service representative!

Warning! Electrical shock hazard

Dangers caused by electrical energy must be avoided.
All electrical work must be performed after the electrical supply has been disconnected and secured against unauthorized switching.

WARNING! Risk of scalding

At high water temperatures and system pressure close isolating valves before and after the pump.
First allow pump to cool down.

These pumps are maintenance free, self-lubricated by the system fluid, and have no seals to leak or couplings to break.

CAUTION! Possible damage of the pump

If the motor head is separated from the pump housing for servicing or repair work, the O-ring situated between the motor head and pump housing must be replace by a new one. When refitting the motor head, make sure the O-ring is positioned correctly.

10 Faults, causes and remedies

For faults, causes, and remedies see "Error / Warning Messages" flow chart and the tables below.
The first column in the table lists the code numbers shown by the display in the event of an error.
Most error displays disappear automatically once the cause of the error has been remedied.

10.1 Error messages

An error has occurred. The pump shuts down, the error LED (red permanent light) comes on. After 5 minutes the pump switches on automatically. Only when the same error occurs for the 6th time within 24 hours does the pump shut down permanently, the FC relay opens. Manual reset is necessary.
NOTE: **Exception**: With blocking code no. "E10" and “E25” the unit immediately shuts down on the first occurrence.

10.2 Warning messages

The problem (only **W**arning) is displayed, but the FC relay does not come into action. The pump continues to run. The error can occur an infinite number of times. The indicated operating condition should not be ignored for long periods of time. The cause of the error must be removed.
NOTE: **Exception**: If errors "E04", and "E05" remain for more than 5 minutes, these are passed on as error readings (see diagram).

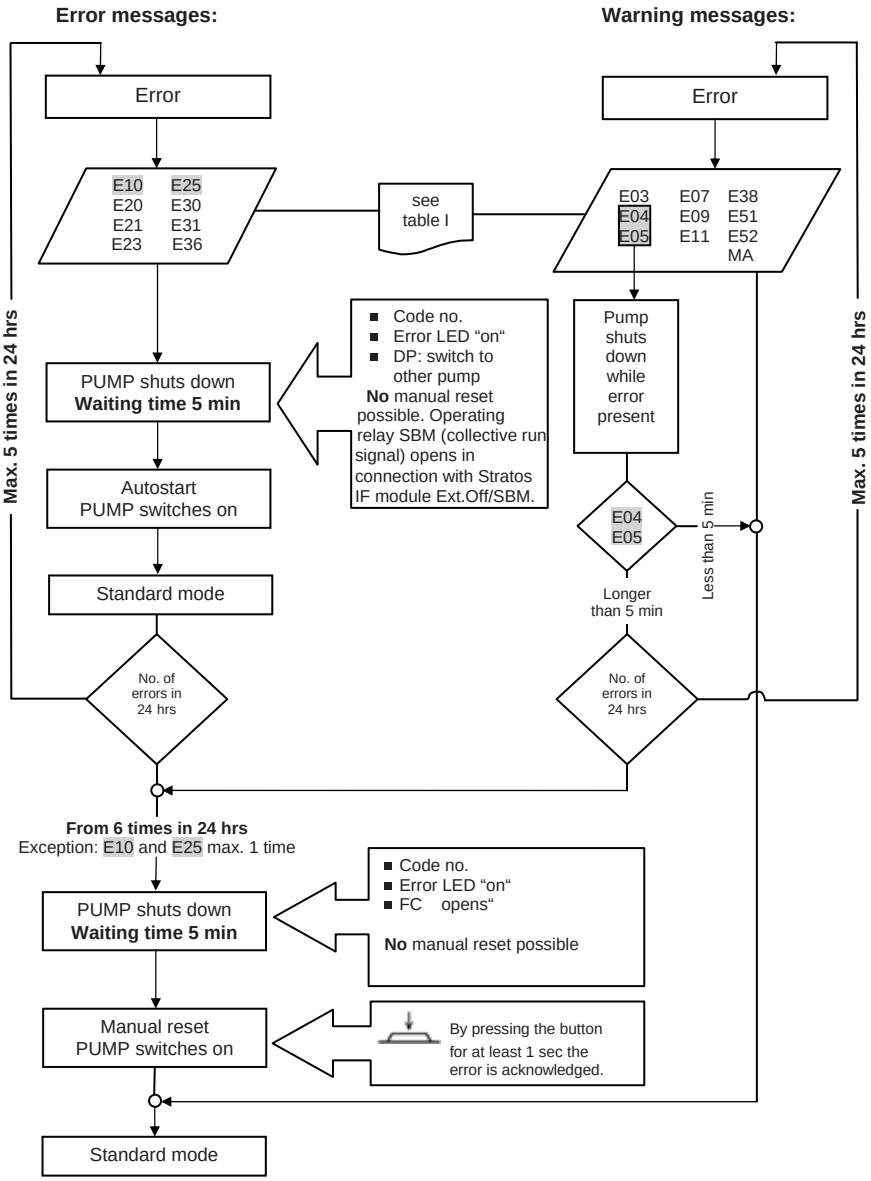

Error messages:
Warning messages:
Error
Error
E10 E25
E20 E30
E21 E31
E23 E36
see table I
E03 E07 E38
E04 E09 E51
E05 E11 E52
MA
Max. 5 times in 24 hrs
Max. 5 times in 24 hrs
Code no.
Error LED “on“
DP: switch to other pump
No manual reset possible. Operating relay SBM (collective run signal) opens in connection with Stratos IF module Ext.Off/SBM.
PUMP shuts down
Waiting time 5 min
Pump shuts down while error present
Autostart
PUMP switches on
E04
E05
Less than 5 min
Standard mode
Longer than 5 min
No. of errors in 24 hrs
No. of errors in 24 hrs
From 6 times in 24 hrs
Exception: E10 and E25 max. 1 time
Code no.
Error LED “on“
FC opens“
PUMP shuts down
Waiting time 5 min
No manual reset possible
Manual reset
PUMP switches on
By pressing the button for at least 1 sec the error is acknowledged.
Standard mode

Table I

Problem	cause	remedies
Pump does not run with switched on power	Electric fuse faulty,	Check fuse
	Pump has no power	Rectify interruption to power
Noisy pump operation	Cavitation due to insufficient admission pressure	Increase system admission pressure within permissible range

10.3 Error messages: Error LED “permanent light“

Code No.	Symbol flashing	Problem	cause	remedies
E04	Supply terminal	Mains undervoltage	Mains overloaded	Check electrical installation
E05	Supply terminal	Mains overvoltage		Check electrical installation
E10	Motor	Pump blocked	e.g. sedimentation	De-blocking routine starts automatically. Should this not remove the blockage, the pump switches off after 10 sec. Call customer services
E20	Motor	winding overheated	Motor overloaded	Let motor cool down, check the settings
			Ambient temperature to high	Reduce water temperature
E21	Motor	Motor overload	Sediment in the pump	Call customer services
E23	Motor	Short circuit/contact fault	Motor defect	Call customer services
E25	Motor	Contact error	Module not correctly installed	Reinstall module
E30	Module	Excess temperature module	Air intake to module heat sink is blocked	Free air intake
E31	Module	Excess temperature power component	Ambient temperature to high	Improve ventilation in room
E36	Module	Module faulty	Electronic components faulty	Call customer service / swap module

10.4 Warning messages: Error LED “off“

Code No.	Symbol flashing	Problem	cause	remedies
E03		Water temperature > 110°C	Heating control incorrectly set	Set to lower temperature
E04		Mains undervoltage	Mains overloaded	Check electrical installation
E05		Mains overvoltage		Check electrical installation
E07		Generator operation	Driven by admission pressure pump	Balance pump capacity regulation
E09		Generator operation	Driven by reverse flow through “off” pump	Check circulation direction. Fit a check valve at the pressure side
E11		Pump idling	Air in the pump	Vent pump and unit
E38	Motor	Temp. sensor medium faulty	Motor faulty (automatic night setback)	Call customer services
E51		non-permissible combination	Different pumps	
E52		Master/slave communication error Pump switches from standard mode to fixed characteristic (depending on chosen set value, see fig. 9)	Stratos IF module not correctly positioned, cable faulty	After 5 min. the modules switch to single-pump mode. Reinstall modules, check cable
MA		Master/slave not set		Specify master and slave

If the fault cannot be remedied, please contact your local heating specialist or Wilo customer services.