

MS, MMS

Installation and operating instructions



MS, MMS

Installation and operating instructions

Other languages

<http://net.grundfos.com/qr/i/98599768>

MS, MMS

English (GB)

Installation and operating instructions	4
Appendix A	30

English (GB) Installation and operating instructions

Original installation and operating instructions

Table of contents

1. General information	4
1.1 Hazard statements	4
1.2 Notes	5
2. Delivery and storage	5
2.1 Delivery	5
2.2 Unpacking	5
2.3 Storage and handling	5
3. General description	6
3.1 Applications	6
3.2 Pumped liquids	6
3.3 Sound pressure level	6
4. Installation requirements	6
4.1 Checking the motor liquid	6
4.2 Positional requirements	8
4.3 Liquid temperatures/cooling	8
4.4 Insulation resistance	9
5. Electrical connection	10
5.1 General	10
5.2 Motor protection	11
5.3 Cable sizing	13
5.4 Control of single-phase MS402	14
5.5 Connection of single-phase motors	14
5.6 Connection of three-phase motors	16
6. Setting up the CUE frequency converter in an SPE system	21
7. Motor installation	21
8. Mechanical installation	22
8.1 Removing and fitting the cable guard	22
8.2 Fitting of submersible drop cable and motor cable	22
8.3 Assembly of pump set on site	22
8.4 Fitting the pump to the motor	23
8.5 Maximum installation pressure [mWC]	24
8.6 Lowering the pump	24
8.7 Frequency of starts and stops	24
9. Servicing the product	25
9.1 MS6000P	25
10. Fault finding	26
10.1 MS6000P	26
11. Checking the motor and cable	27
11.1 Supply voltage	27
11.2 Current consumption	28
11.3 Winding resistance	28

11.4 Insulation resistance	29
----------------------------	----

12. Disposing of the product	29
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1. General information



Read this document before you install the product. Installation and operation must comply with local regulations and accepted codes of good practice.

These instructions apply to Grundfos MS and MMS submersible motors for submersible pumps.

These motors must not be put into service until the machine into which they are to be incorporated has been declared in conformity with the relevant directives.

1.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.



DANGER

Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.



WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.



CAUTION

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:



SIGNAL WORD

Description of the hazard

Consequence of ignoring the warning

- Action to avoid the hazard.

1.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.



Observe these instructions for explosion-proof products.



A blue or grey circle with a white graphical symbol indicates that an action must be taken.



A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.



If these instructions are not observed, it may result in malfunction or damage to the equipment.



Tips and advice that make the work easier.

2. Delivery and storage

2.1 Delivery

Grundfos submersible motors are supplied from the factory in proper packing in which they should remain until they are to be installed.

2.2 Unpacking



Be careful not to damage the motor cable with sharp tools when unpacking the motor.



The separate nameplate supplied with the motor is intended for being visible in electric panel during installation of the pump set.

Do not expose the motor to unnecessary impact and shocks.

2.3 Storage and handling

Storage temperature

-20 to +70 °C.



If an MMS motor is stored, the shaft must be turned at least once a month. If a motor is stored for more than one year before installation, the rotating parts of the motor must be dismantled and checked before use.

Do not expose the motor to direct sunlight.

Storage

WARNING

Crushing of feet

Death or serious personal injury

- Stack the pumps with the biggest at the bottom, and do not stack above 1 m.
- Use lifting equipment approved for the weight of the product.
- Wear personal protective equipment.

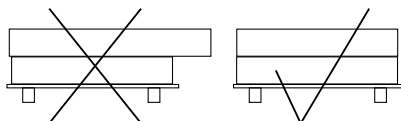


WARNING

Crushing of hands

Death or serious personal injury

- Stack the pumps with the biggest at the bottom, and do not stack above 1 m.
- Use lifting equipment approved for the weight of the product.
- Wear personal protective equipment.



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Guideline for stacking of boxes

2.3.1 Frost protection

If the motor is to be stored after use, it must be stored at a temperature above the freezing point, or the motor liquid must be frost-proof.



Special motors factory-filled with demineralised water must be stored at a temperature above the freezing point or emptied before storage.

3. General description

3.1 Applications

Grundfos MS and MMS submersible motors are designed according to market standards.

All Grundfos 4", 6" and 8" MS and MMS motors are designed to fit pump ends manufactured according to NEMA standards. The motors are ideally suited for water supply pumps for irrigation, groundwater regulation, pressure boosting, industrial water transfer and similar applications.

3.2 Pumped liquids

The motors are suited for use in clean, thin, non-flammable, non-combustible or non-explosive liquids not containing solid particles or fibres.

The maximum sand content of the pumped liquid must not exceed 50/100/150 g/m³.

The N, R and RE motor versions are designed for liquids with higher aggressiveness than that of drinking water.

Materials in contact with the liquid:

- MMS: cast iron DIN W.-Nr. 0.6025 and NBR rubber.
- MMS -N: stainless steel DIN W.-Nr. 1.4401 and NBR rubber.
- MS/MMS -R: stainless steel DIN W.-Nr. 1.4539 and NBR rubber.
- MS -RE: stainless steel DIN W.-Nr. 1.4539/1.4517 and FKM rubber.

The maximum liquid temperature is listed in section on liquid temperatures.

Related information

[4.3 Liquid temperatures/cooling](#)

3.3 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.

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

4. Installation requirements

DANGER

Electric shock

Death or serious personal injury



- Switch off the power supply before starting any work on the product.
- Make sure that the power supply cannot be accidentally switched on.

WARNING

Crushing of feet

Death or serious personal injury



- During handling, use lifting equipment which is approved for the weight of the product.
- Wear personal protective equipment

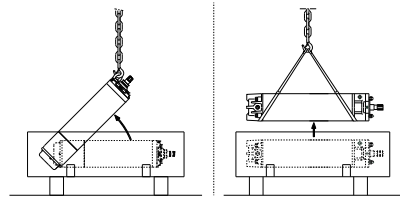
WARNING

Crushing of hands

Death or serious personal injury



- During handling, use lifting equipment which is approved for the weight of the product.
- Wear personal protective equipment



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Handling of the motor

4.1 Checking the motor liquid

The submersible motors are factory-filled with a special FDA-approved, non-toxic liquid which is frost-proof down to -20 °C.



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



If frost protection is required, a special Grundfos liquid must be used to refill the motor.

Refilling of liquid is carried out as described below.

4.1.1 Grundfos MS402 and MS4000 submersible motors

The filling hole for motor liquid can be found in the following positions:

MS 402: at the bottom of the motor.

MS 4000: on the top of the motor.

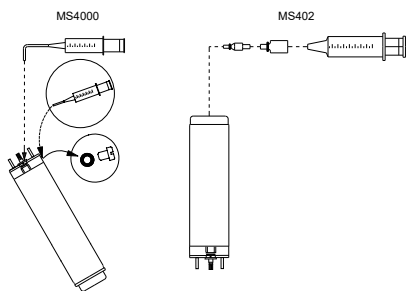
1. Position the submersible motor as shown in the figure below. The filling screw must be at the highest point of the motor.
2. Remove the screw from the filling hole.
3. Inject liquid into the motor with the filling syringe until the liquid overflows the filling hole.
4. Place the screw back in the filling hole and tighten securely before changing the position of the motor.

Torques:

MS402: 2.0 Nm.

MS4000: 5.0 Nm.

The submersible motor is now ready for installation.



Motor position during filling - MS 4000 and MS 402

4.1.2 Grundfos MS6000 and MS6000P submersible motors

- If the motor is delivered from stock, the liquid level must be checked before the motor is installed.
- In case of service, the liquid level must be checked.

Filling procedure:

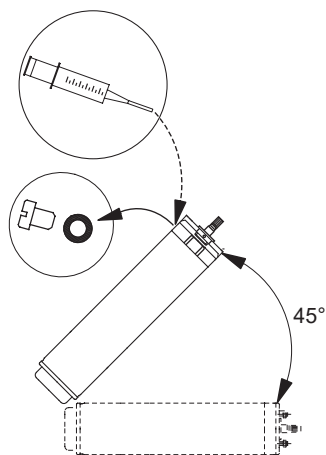
The filling hole for motor liquid is placed at the top of the motor.

1. Position the submersible motor as shown in the figure below. 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 overflows the filling hole.
4. Place the screw back in the filling hole and tighten securely before changing the position of the motor.

Torque: 3.0 Nm.

The submersible motor is now ready for installation.

TMO38128



Motor position during filling - MS 6000

TMO38129

4.1.3 Grundfos MMS6, MMS8000, MMS10000 and MMS12000 submersible motors

Filling procedure:

Place the motor at a 45° angle with the top of the motor upwards. See figure below.

1. Unscrew the plug (A) and place a funnel in the hole.
2. Pour tap water into the motor until the motor liquid inside the motor starts overflowing the plug (A).



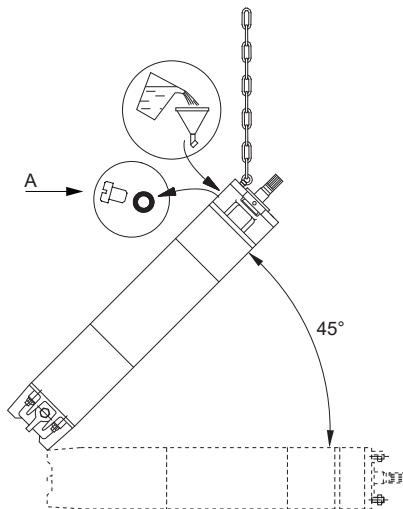
Do not use motor liquid that contains oil.

3. Remove the funnel and place back the plug (A).



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 motor is now ready for assembly with the pump and ready for installation.



Motor position during filling - MMS

4.2 Positional requirements

The motor can be installed either vertically or horizontally.

4.2.1 Motors suitable for horizontal installation

Motor type	Output power	Output power
	50 Hz	60 Hz
	[kW]	[kW]
MS	All sizes	All sizes
MMS6	5.5 - 37	5.5 - 37
MMS8000	22-92	22-92
MMS10000	75-170	75-170
MMS12000	147-190	-

CAUTION Hot surface

Minor or moderate personal injury



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



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

4.3 Liquid temperatures/cooling

The maximum liquid temperature and the minimum flow velocity past the motor are displayed in the following table.

Grundfos recommends that the motor be installed above the well screen in order to achieve proper motor cooling by liquid passing the motor.



In case the stated flow velocity cannot be achieved, a flow sleeve must be installed

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

Motor	Power range	Minimum flow past the motor [m/s]	Maximum liquid temperature
MS402			
MS4000 (T40)	All	0.15	40 °C (105 °F)
MS6000 (T40)			
MS6000P (T60)	All	0.15	60 °C (140 °F)
MS4000I (T60)			
¹⁾	All	1.00	60 °C (140 °F)
MS6000 (T60) ¹⁾			Flow sleeve recommended
MS6000 (T60) ²⁾	All	0.15	60 °C (140 °F) Flow sleeve recommended
MMS6	5.5 - 37	0.50	50 °C
	45	0.50	40 °C
MMS8000	22-92	0.50	45 °C
	110	0.50	40 °C
	75-147	0.50	45 °C
MMS10000	170	0.50	40 °C
	190	0.50	35 °C
MMS12000	147-190	0.50	45 °C
	220-250	0.50	35 °C

¹⁾ At an ambient pressure of minimum 1 bar (0.1 MPa).

²⁾ At an ambient pressure of minimum 2 bar (0.2 MPa).

4.4 Insulation resistance

The insulation resistance of the motor must be measured before the motor is spliced to the drop cable, after the splice is done and when the motor is installed in the borehole (wet motor).

The insulation resistance must be higher than the values stated in section on insulation resistance.

Record of the insulation resistance should be kept for troubleshooting, and periodic measurements are recommended. Sudden changes in the insulation resistance measurements may indicate the necessity of motor maintenance.

Related information

[11.4 Insulation resistance](#)

5. Electrical connection

DANGER

Electric shock

Death or serious personal injury



- Switch off the power supply before starting any work on the product.
- Make sure that the power supply cannot be accidentally switched on.

DANGER

Electric shock

Death or serious personal injury



- The pump must be earthed.
- The pump must be connected to an external main switch and must be provided with means to locking it in the OFF (isolated) position. Type and requirements are specified in EN 60204-1, 5.3.2



The electrical connection must be carried out by an authorised person in accordance with local regulations.

5.1 General

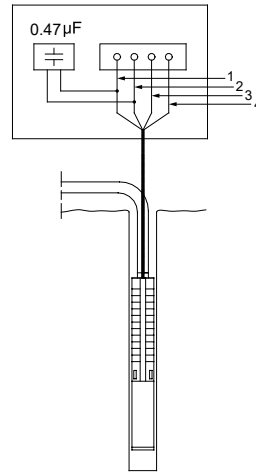
The electrical connection must be carried out by an authorised electrician in accordance with local regulations.

The supply voltage, rated maximum current and $\cos \phi$ are displayed on the separate nameplate that must be fitted close to the installation site.

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

Furthermore, make sure there is voltage symmetry in the power supply lines, that is, the difference of voltage between the individual phases is the same. See also item 2 in the section on checking the motor and cable.

If MS motors with a built-in temperature transmitter (Tempcon) are not installed together with an MP 204 motor protection unit, they must be connected to a 0.47 μF X2 capacitor (IEC 384-14) approved for the actual voltage. The capacitor must be connected to the two phases to which the temperature transmitter is connected. See figure below.



Connection of capacitor

Pos.	Description
1	L1: Brown
2	L2: Black
3	L3: Grey
4	PE: Yellow and green

The motors are wound for direct-on-line (DOL) 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 motor is only about 0.1 second. Direct-on-line starting is therefore normally approved by the power supply company.



If an MS motor with temperature transmitter is connected to a frequency converter, the fuse melts and the transmitter becomes inactive. The transmitter can no longer be reactivated, consequently, the motor thereafter operates like one without a temperature transmitter.



To enable monitoring of the motor temperature when running at frequency converter operation, Grundfos recommends that a Pt100 or a Pt1000 sensor be installed.

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During frequency converter operation, it is not advisable to run the motor at a frequency higher than the rated frequency (50 or 60 Hz). In connection with pump operation, it is important never to reduce the frequency (and consequently the speed) to such a level that the necessary flow of cooling liquid past the motor is no longer ensured.

To avoid damage to the pump part, make sure that the motor stops when the pump flow falls below 10 % of the rated flow.

Voltage peaks for Grundfos submersible motors should be limited according to the table below.

Motor type	Max. Upeak voltage	Max. dU/dt
MS402	650 V phase-phase	2000 V/μs
MS4000	850 V phase-phase	2000 V/μs
MS6000	850 V phase-phase	2000 V/μs
MS6000P	850 V phase-phase	2000 V/μs
MMS6	850 V phase-ground	500 V/μs
MMS8000	850 V phase-ground	500 V/μs
MMS10000	850 V phase-ground	500 V/μs
MMS12000	850 V phase-ground	500 V/μs

Related information

11. Checking the motor and cable

5.2 Motor protection

5.2.1 Single-phase motors

Single-phase MS402 submersible motors incorporate a thermal switch and require no additional motor protection. As an exception, the 1.1 kW (1.5 hp) MS402 requires external current protection.

DANGER

Electric shock

Death or serious personal injury

- Switch off the power supply before starting any work on the product.
- Make sure that the power supply cannot be accidentally switched on.



DANGER

Electric shock

Death or serious personal injury

- The pump must be connected to protective earth.
- Switch off the power supply before starting any work on the product.
- Make sure that the power supply cannot be accidentally switched on.



DANGER

Electric shock

Death or serious personal injury

- 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 MS4000/MS6000 submersible motors are protected from overcurrent by a Grundfos starter box.

5.2.2 Three-phase asynchronous motors

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

Motors with a built-in and operational temperature transmitter must be protected by:

- a motor-protective circuit breaker with thermal relay or
- an MP 204 motor protection unit and contactor(s).

Motors with or without a non-operational temperature transmitter must be protected by:

- a motor-protective circuit breaker with thermal relay or
- an MP 204 motor protection unit and contactor(s).

MMS motors have no built-in temperature transmitter. A Pt100 sensor is available as an accessory.

Motors with a Pt100 sensor must be protected by the following:

- a motor-protective circuit breaker with thermal relay or
- an MP 204 motor protection unit and contactor(s).

Motors without a Pt100 sensor must be protected by the following:

- a motor-protective circuit breaker with thermal relay with max. trip class 10 according to IEC 60947-4-1 or
- an MP 204 motor protection unit and contactor(s).

5.2.3 Three-phase synchronous motors

Synchronous MS motors are a part of an SPE Pump system together with a suitable CUE frequency converter. The CUE has a built-in motor protection.

A suitable sine wave output filter may be required if the conditions stated in section on requirements for the MS6000P to operate without sine-wave filter are not met.

Related information

[5.6.7 Requirements for the MS6000P to operate without sine-wave filter](#)

5.2.4 Required settings of the motor-protective circuit breaker

For motors with an MP 204 motor protection unit, Grundfos recommends that a special trip curve with P-characteristics be used at a setting of U_n times 5 for 1 second.

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

For all Grundfos submersible MMS motors, the maximum start and stop ramp time is 3 seconds (minimum 30 Hz).



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

To ensure optimal protection of the submersible motor, set the motor-protective circuit breaker in accordance with the following guidelines:

1. Set the overload to the rated maximum current of the motor.
2. Start the motor and let it run for half an hour at normal performance.
3. Slowly grade down the scale indicator until the motor trip point is reached.
4. Increase the overload setting by 5 %.

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

For motors wound for star-delta starting, set the motor-protective circuit breaker as above, but the maximum setting must be 58 % of the rated maximum current.

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

5.3 Cable sizing



Submersible motor cables are dimensioned for submersion in the liquid, and will not necessarily have sufficient cross-section to be in the 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 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. A cable sizing tool is available on Grundfos Insite at: <https://product-selection-classicstest.grundfos.com> under Tools menu.

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

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

The voltage drop can be calculated for both direct-on-line and star-delta starting.

To minimise operating losses, the cable cross-section may be increased. This is cost-efficient only 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 based on 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 the general section on electrical connection.

Determine the voltage drop for the cross-section of the submersible drop cable with the help of the diagrams in the Appendix.

Use the following formula:

I: Rated maximum current of the motor.

For star-delta starting, I equals 58 % of the rated maximum current of the motor.

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 based on the following formulas:

Single-phase submersible motor

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

Three-phase submersible motor

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

L	Length of submersible drop cable [m]
U	Rated voltage [V]
ΔU	Voltage drop [%]
I	Rated maximum current of the motor [A]
$\cos \varphi$	0.9
ρ	Specific resistance: 0.02 [$\Omega\text{mm}^2/\text{m}$]
q	Cross-section of submersible drop cable [mm^2]
$\sin \varphi$	0.436
X_L	Inductive resistance: 0.078×10^{-3} [Ω/m].

Related information

[A.1. Appendix](#)

[5.1 General](#)

5.4 Control of single-phase MS402

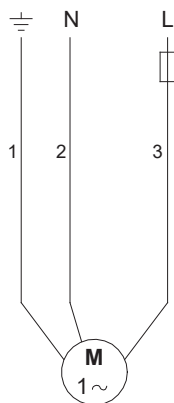


Single-phase MS402 submersible motors below 1.1 kW incorporate motor protection that cuts out the motor in case of excessive winding temperatures while the motor is still supplied with voltage. Allow for this when the motor forms part of a control system.

5.5 Connection of single-phase motors

5.5.1 2-wire motors

MS402 2-wire motors incorporate motor protection and a starter device, and can therefore be connected directly to the mains as shown below.



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2-wire motors

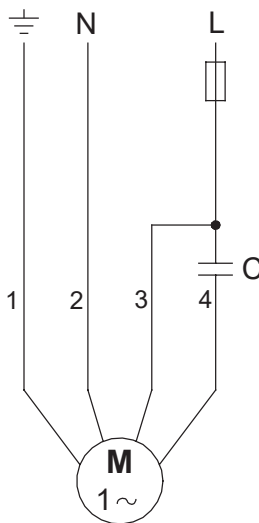
Pos.	Description
1	Yellow and green
2	Blue
3	Brown

5.5.2 PSC motors

PSC motors are connected to the mains via a run capacitor that must be sized for continuous operation. Select the correct capacitor size from the table below:

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

MS402 PSC motors with output power less than 1.1 kW incorporate motor protection and must be connected to the mains as shown below.



TM001359

PSC motors

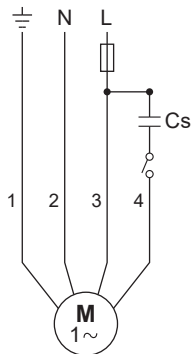
Pos.	Description
1	Yellow and green
2	Grey
3	Brown
4	Black

5.5.3 3-wire motors

MS402 3-wire motors incorporate motor protection and must be connected to the mains via a Grundfos SA-SPM 5, 7 or 8 control box without motor protection.

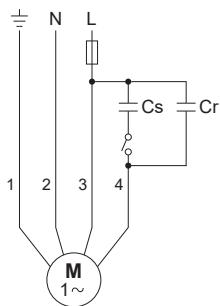
MS4000, MS6000 3-wire motors must be connected to the mains via a Grundfos SA-SPM 5, 7 or 8 control box incorporating motor protection.

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



TM074264

CSIR



TM074265

CSCR

Type of cable	Pos.	Colour
Single lead	1	green
	2	yellow
	3	black
	4	red
Blue jacketed	1	yellow-green
	2	grey
	3	brown
	4	black

This table is valid for both CSIR and CSCR.

5.5.4 Checking the direction of rotation of the motor

Once the motor is connected to the power supply, determine the correct direction of rotation as follows:

1. Add a few drops of water to the shaft seal before starting.
2. Start the motor and check the direction of rotation by watching the motor shaft. For Grundfos SP pumps, the direction of rotation must be counter-clockwise.
3. Interchange two of the phase connections if the direction of rotation is wrong. In case of motors wound for star-delta starting, exchange U1 by V1 and U2 by V2.

5.5.5 Checking the direction of rotation of the pump set



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

Once the pump is connected to the power supply, check the direction of rotation:

1. Start the pump and measure the quantity of water and head.
2. Stop the pump and interchange two phases.
3. Start the pump and measure the 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.

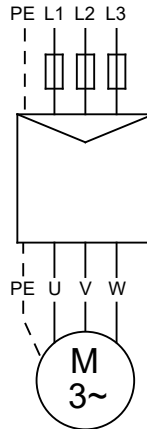
5.6 Connection of three-phase motors

5.6.1 Motors wound for direct-on-line starting

The connection of Grundfos submersible motors wound for direct-on-line starting is displayed in the table and figure below.

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

Check the direction of rotation as described in section on checking the direction of rotation of the motor.



Motors wound for direct-on-line starting

Related information

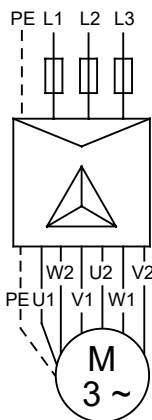
[5.5.4 Checking the direction of rotation of the motor](#)

5.6.2 Motors wound for star-delta starting

The connection of Grundfos submersible motors wound for star-delta starting is displayed in the table and figure below.

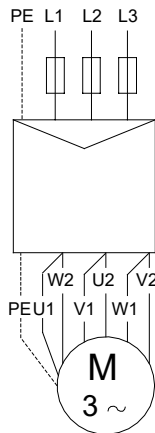
Connection	Grundfos 6" motors
PE	Yellow and green
U1	Brown
V1	Black
W1	Grey
W2	Brown
U2	Black
V2	Grey

Check the direction of rotation as described in section on checking the direction of rotation of the motor.



Motors wound for star-delta starting

If star-delta starting is not required, but direct-on-line starting is, the submersible motors must be connected as shown below.



Motors wound for direct-on-line starting

Related information

[5.5.4 Checking the direction of rotation of the motor](#)

TM032/100

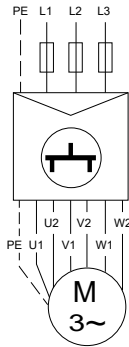
TM104/06/33

5.6.3 MS6000P motors with double-cable connection

MS6000P motors of 37 and 45 kW are supplied with double cabling per phase.

Connection		Colour
PE	PE	Yellow and green
L1	U1+U2	Brown
L2	V1+V2	Black
L3	W1+W2	Grey

Note: Grundfos recommendation is to join each motor cable to an individual drop cable using the Grundfos KM connection kits up to the borehole head. At the borehole head the two drop cables can be joined in a connection box.



Applicable to Grundfos MS6000P 37 kW and 45 kW

TM1040632

5.6.4 Connection in the case of unidentified cable marking/connection

If it is unknown where the individual leads are to be connected to the mains in order to ensure the correct direction of rotation, proceed as follows:

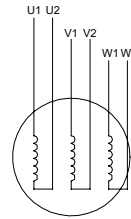
Motors wound for direct-on-line starting

Connect the motor to the mains as it is expected to be right.

Then check the direction of rotation as described in the section on checking the direction of rotation of the motor.

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 figure below.



TM1040635

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

If star-delta starting is required, connect the leads as shown in fig. *Motors wound for star-delta starting*.

If direct-on-line starting is required, connect the leads as shown in fig. *Motors wound for direct-on-line starting*.

Then check the direction of rotation as described in the section on checking the direction of rotation of the motor.

Related information

[5.5.4 Checking the direction of rotation of the motor](#)

[5.6.2 Motors wound for star-delta starting](#)

5.6.5 Soft starter

Grundfos only recommends the use of soft starters that control the voltage on all three phases and are provided with a bypass contact.

Ramp time: Maximum 3 seconds.

For further details, please contact your soft starter supplier or Grundfos.

5.6.6 Frequency converter

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

Three-phase MS6000P synchronous submersible motors must be connected to a frequency converter of VSI type and an IPM-ready sine wave filter. If the requirements stated in the section on requirements for the MS6000P to operate without sine-wave filter are not met, a sine wave filter must be installed between the frequency converter and the motor. MMS motors with PE/PA can be connected to a frequency converter.

To avoid EMC problems, it is required to use shielded cables between the frequency converter and the sine wave filter, and in EMC sensitive installations from the sine wave filter to the entrance of the borehole.

The cable shield must be connected to the sine wave filter and the borehole lining, if the latter is conductive.



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



To enable monitoring of the motor temperature, Grundfos recommends that a Pt100 or a Pt1000 be installed.

For asynchronous motors:

Permissible frequency ranges:

- 30-50 Hz
- 30 60 Hz.

Ramp time: Maximum 3 seconds from standstill to minimum frequency and vice versa.

For synchronous motors MS6000P:

Permissible frequency ranges:

- 55-100 Hz
- 55-120 Hz.

Ramp time: Maximum 3 seconds from standstill to minimum frequency and vice versa

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 prevented by installing an LC filter, or a sine wave filter between the frequency converter and the motor.

Grundfos recommends that a sine wave filter be used in all SP installations with asynchronous motors and voltages above 380 V. In installations with MS6000P motors a sine wave filter must be installed when the requirements stated in the section on requirements for the MS6000P to operate without sine-wave filter section are not met.

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

Related information

[5.6.7 Requirements for the MS6000P to operate without sine-wave filter](#)

5.6.7 Requirements for the MS6000P to operate without sine-wave filter

MS6000P

The MS6000P synchronous permanent magnet motor has been improved with upgraded insulation. As a result, sine-wave filter is not necessary if all requirements in the table below are fulfilled.

SPE

The SPE pump systems ³⁾ supplied by Grundfos meet the VFD and motor input requirements in the table below. When application and grid requirements are fulfilled, a sine-wave filter is not required.

SP pump + MS6000P + CUE

³⁾ SP pump + MS6000P + CUE

Requirements

	Value	Unit	Grundfos SPE systems
Application requirements			
Max. media temperature	60/140	[°C/°F]	Must be met
Max. cable length	300/1000	[m/ft]	Must be met
Grid requirements			
Max. line-line voltage	460	[V RMS]	Must be met
Phases	3	[-]	Must be met
VFD requirements			
Max. DC voltage	620	[V _{DC}]	✓
Max. peak voltage at inverter terminals	650	[V _{LL}]	✓
Min. rise time at VFD terminals (10-90 % V _{DC})	100	[ns]	✓
Max. dU/dt at VFD terminals	5	[V/ns]	✓
Max. switching frequency	4	[kHz]	✓
Grid voltage rectification	Passive rectifier bridge		✓
Motor input requirements			
Max. peak voltage at terminals	1500	[V _{LL}]	✓
Max. dU/dt at motor terminals	6	[V/ns]	✓



- Local and national requirements regarding safety, EMI etc., must always be followed and can demand filtering due to, for instance noise suppression.
- Cables and other system components must be properly rated for VFD use.
- If the cables are longer than 300 m/ 1000 ft and/or the grid voltage is higher than 460 V, a sine-wave filter must still be used

6. Setting up the CUE frequency converter in an SPE system

The SPE system consists of the following:

- SPE pump set
- CUE frequency converter.

The CUE has a start-up guide. Follow the instructions on the display.

Note that to compensate for the impact from long cable length, Automatic Motor Adaptation (AMA) is highly recommended to be set as described below:

After completing the installation and settings, go to parameter 1-29 "Automatic Motor Adaptation (AMA)" and select [2] Enable Reduced AMA. Then press [Hand on] to start AMA.

For further information regarding safety and advanced settings see the CUE Installation and operating instruction.



Installation and operating instructions

<http://net.grundfos.com/qr/i/98870684>

7. Motor installation

Valid for all MS/MMS

DANGER

Electric shock

Death or serious personal injury



- Switch off the power supply before starting any work on the product.
- Make sure that the power supply cannot be accidentally switched on.

Valid for MS6000P only.

DANGER

Electric shock

Death or serious personal injury



- Make sure that motor cable ends are not live before starting any work on the product.
- Make sure that the power supply cannot be accidentally switched on.

In case of unintended flow of water through a non-energized pump, there is a risk that the moving parts of the pump and the motor will start rotating, thereby generating voltage over the terminals. The size of the voltage depends on the speed of rotation. Consequently, the motor terminals must be considered as live until proven otherwise.

8. Mechanical installation

8.1 Removing and fitting the cable guard

The cable guard is screwed onto the pump, it must be removed and fitted by means of screws. See pump installation and operating instructions.



Once the cable guard is fitted, make sure that the pump chambers are aligned.

8.2 Fitting of submersible drop cable and motor cable

Before fitting the motor cable to the motor, make sure that the cable socket is clean and dry.

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

Tighten the cable connector screws alternately in several steps until the below product-specific torque is reached:

MS402:	3.1 Nm
MS4000 model B:	3.0 Nm
MS4000 model C:	4.0 Nm
MS6000:	4.5 Nm
MS6000P:	4.5 Nm
MMS6:	20 Nm
MMS8000:	18 Nm
MMS10000:	18 Nm
MMS12000:	15 Nm

Connect the motor cable to the drop cable by original Grundfos cable termination kits, such as shrink tube type KM or cable termination kit type M0 to M4.

If necessary, shorten the motor cable to ensure that it is always covered with pump medium prior to making the cable termination as described above.

If the motor is delivered with the motor cable mounted, make sure that the screws are re-tightened to the torques specified in the table above.

8.3 Assembly of pump set on site

DANGER

Electric shock

Death or serious personal injury



- Switch off the power supply before starting any work on the product.
- Make sure that the power supply cannot be accidentally switched on.
- Do not lower or lift the product by means of the motor cable.

WARNING

Crushing of hands

Death or serious personal injury



- When the motor is to be assembled with the pump at the borehole, make sure to use suitable pipe clamps.
- Stay clear of the wire and cable while placing the motor in the borehole.

WARNING

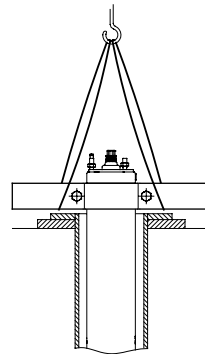
Crushing of feet

Death or serious personal injury



- When the motor is to be assembled with the pump at the borehole, make sure to use suitable pipe clamps.
- Stay clear of the wire and cable while placing the motor in the borehole.

1. Use pipe clamps when handling the motor.
2. Place the motor in vertical position at the borehole. See figure below.



Motor in vertical position

8.4 Fitting the pump to the motor

WARNING

Sharp element

Death or serious personal injury



- When mounting the facilitating pipe, wear personal protective equipment to avoid cutting on sharp edges.

WARNING

Crushing of hands

Death or serious personal injury



- Make sure to use suitable pipe clamps.
- Stay clear of the wire and cable while placing the motor in the borehole.

WARNING

Crushing of feet

Death or serious personal injury



- Make sure to use suitable pipe clamps.
- Stay clear of the wire and cable while placing the motor in the borehole.

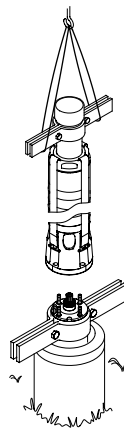


Be careful not to bend or damage long pump sets when moving them from horizontal to vertical positions.



Grundfos recommends that a maximum 30 cm long facilitating pipe be fitted to the pump to facilitate handling of the pump during installation.

1. Lift the pump part by means of pipe clamps fitted to the facilitating pipe. See figure below.



Lifting the pump into position

2. Place the pump part on top of the motor.
3. Fit and cross-tighten the nuts to the torques stated below.



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

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

TM025263

8.5 Maximum installation pressure [mWC]

Grundfos MS402:	150
Grundfos MS4000:	600
Grundfos MS6000:	600
Grundfos MS6000P:	600
Grundfos MMS:	600

8.6 Lowering the pump

DANGER

Electric shock

Death or serious personal injury



- Switch off the power supply before starting any work on the product.
- Make sure that the power supply cannot be accidentally switched on.
- Do not lower or lift the product by means of the motor cable.

WARNING

Crushing of hands

Death or serious personal injury



- When the motor is to be assembled with the pump at the borehole, make sure to use suitable pipe clamps.
- Stay clear of the wire and cable while placing the motor in the borehole.

WARNING

Crushing of feet

Death or serious personal injury



- When the motor is to be assembled with the pump at the borehole, make sure to use suitable pipe clamps.
- Stay clear of the wire and cable while placing the motor in the borehole.

Grundfos recommends that the borehole be checked by an inside calliper before lowering the pump so as to ensure unobstructed passage.

Carefully lower the pump assembly into the borehole, being cautious not to damage the motor cable and the submersible drop cable.

8.7 Frequency of starts and stops

Motor type	Number of starts
MS402	We recommend minimum 1 per year.
	Maximum 100 per hour. Maximum 300 per day.
MS4000	We recommend minimum 1 per year.
	Maximum 100 per hour. Maximum 300 per day.
MS6000	We recommend minimum 1 per year.
	Maximum 30 per hour. Maximum 300 per day.
MS6000P	We recommend minimum 1 per year.
	Maximum 120 per hour. Maximum 360 per day.
MMS6	We recommend minimum 1 per year.
	Maximum 10 per hour. Maximum 70 per day.
MMS8000	We recommend minimum 1 per year.
	Maximum 8 per hour. Maximum 60 per day.
MMS10000	We recommend minimum 1 per year.
	Maximum 6 per hour. Maximum 50 per day.
MMS12000	We recommend minimum 1 per year.
	Maximum 5 per hour. Maximum 40 per day.

9. Servicing the product

The motors are maintenance-free.

All motors are easy to service.

Service kits and service tools are available from Grundfos.

The motors can also be serviced at a Grundfos service centre.

DANGER

Electric shock

Death or serious personal injury



- Switch off the power supply before starting any work on the product.
- Make sure that the power supply cannot be accidentally switched on.

DANGER

Toxic material

Death or serious personal injury



- If a pump is used for a liquid injurious to health, the pump will be classified as contaminated.

WARNING

Sharp element

Death or serious personal injury



- For service, see the service instructions. Service must be performed by qualified personnel.

9.1 MS6000P

The following three warnings are only valid for MS6000P/SPE pump sets.

DANGER

Magnetic field

Death or serious personal injury



- The rotor dismantled from the motor must never be handled by anyone with a pacemaker.

WARNING

Crushing of fingers

Death or serious personal injury



- Keep the surroundings of the dismantled rotor free of magnetic objects, and be careful when placing the rotor on a magnetic surface.

DANGER

Electric shock

Death or serious personal injury



- Before starting any work on the product, make sure that motor cable ends are not live.
- Make sure that the power supply cannot be accidentally switched on.

If a flow of water unintendedly goes through a non-energized pump, there is a risk that the moving parts of the pump and the motor will start rotating, thereby generating voltage over the terminals. The size of the voltage depends on the speed of rotation. Consequently, the motor terminals must be considered as live until proven otherwise.

If Grundfos is requested to service a 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

DANGER

Electric shock

Death or serious personal injury



- Before starting any work on the product, make sure that motor cable ends are not live.
- Make sure that the power supply cannot be accidentally switched on.

DANGER

Toxic material

Death or serious personal injury



- If a product is used for a liquid injurious to health, the pump will be classified as contaminated.

10.1 MS6000P

The following three warnings are only valid for MS6000P/SPE pump sets.

DANGER

Magnetic field

Death or serious personal injury



- The rotor dismantled from the motor must never be handled by anyone with a pacemaker.

WARNING

Crushing of hands

Death or serious personal injury



- Keep the surroundings of the dismantled rotor free of magnetic objects and be careful when placing the rotor on a magnetic surface.

DANGER

Electric shock

Death or serious personal injury



- Before starting any work on the product, make sure that motor cable ends are not live.
- Make sure that the power supply cannot be accidentally switched on.

If a flow of water unintendedly goes through a non-energized pump there is a risk that the moving parts of the pump and the motor will start rotating, thereby generating voltage over the terminals. The size of the voltage depends on the speed of rotation. Consequently, the motor terminals must be considered as live until proven otherwise.

10.1.1 Troubleshooting chart

Operational problem: the motor does not run.

Cause	Remedy
The fuses are blown.	Replace the blown fuses. If the new ones blow too, check the electrical installation and the submersible drop cable.
The ELCB or the voltage-operated ELCB has tripped.	Cut in the circuit breaker.
No power supply.	Contact the power supply company.
The motor-protective circuit breaker has tripped.	Reset the motor-protective circuit breaker (automatically or possibly manually). If it trips again, check the voltage. If the voltage is OK, see the next four items.
Motor-protective circuit breaker/contactors is defective.	Replace the motor-protective circuit breaker/contactors.
Starter device is defective.	Repair or replace the starter device.
The control circuit has been interrupted or is defective.	Check the electrical installation.
The pump/submersible drop cable is defective.	Repair or replace the pump/cable.

11. Checking the motor and cable

DANGER

Electric shock

Death or serious personal injury



- Switch off the power supply before starting any work on the product.
- Make sure that the power supply cannot be accidentally switched on.

The following warning is only valid for MS6000P/SPE pump sets.

DANGER

Electric shock

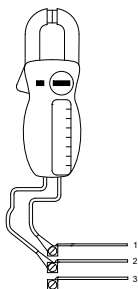
Death or serious personal injury



- Before starting any work on the product, make sure that motor cable ends are not live.
- Make sure that the power supply cannot be accidentally switched on.

If a flow of water unintentionally goes through a non-energized pump there is a risk that the moving parts of the pump and the motor will start rotating, thereby generating voltage over the terminals. The size of the voltage depends on the speed of rotation. Consequently, the motor terminals must be considered as live until proven otherwise.

11.1 Supply voltage



TM001371

Measure the voltage between the phases by a voltmeter. On single-phase motors, complete measurement 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.

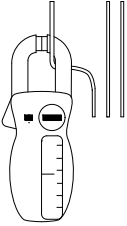
For the MS6000P, the supply voltage must be measured between the sine wave filter and the motor.

When the motor is loaded, the voltage should be within the range specified in the general section on electrical connection. The motor may burn if there are larger variations in voltage. Large variations in voltage indicate poor power supply, and the motor must be stopped until the defect has been corrected.

Related information

5.1 General

11.2 Current consumption



TM001372

Measure the amps of each phase while the pump is operating at a constant discharge head (if possible, at the capacity where the motor is most heavily loaded). For maximum operating current, see nameplate.

For the MS6000P, the current consumption must be measured between the sine wave filter and the motor.

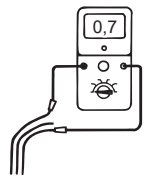
On three-phase motors, the difference between the current in the phase with the highest consumption and that with the lowest consumption must not exceed 5 %. Otherwise, or if the current exceeds the rated current, the following faults may occur:

- The contacts of the motor-protective circuit breaker burn.
 - Replace the contacts or the control box for single-phase operation.
- There is poor connection in leads, possibly in the cable joint.
 - See section on winding resistance.
- The mains voltage is too low or too high.
 - See section on supply voltage.
- The motor windings are short-circuited or partly disjointed.
 - See section on winding resistance.
- Damaged pump is causing the motor to be overloaded.
 - Pull out the pump assembly for overhaul.
- The resistance value of the motor windings deviates too much (three-phase operation).
 - Move the phases in phase order to a more uniform load. If this does not help, see section on winding resistance.

Related information

[11.1 Supply voltage](#)

[11.3 Winding resistance](#)



TM001373

Disconnect the submersible drop cable from the motor-protective circuit breaker or sine wave filter. Measure the winding resistance between the leads of the drop cable.

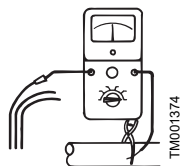
Three-phase motors: The deviation between the highest and lowest value must not exceed 10 %. If the deviation is higher, pull out the pump assembly. Measure motor, motor cable and drop cable separately, and repair/replace the defective parts.

Note: On single-phase, 3-wire motors, the operating winding will assume the lowest resistance value.

Measurement is not necessary when the supply voltage and the current consumption are normal.

11.4 Insulation resistance

a) Insulation resistance, MS

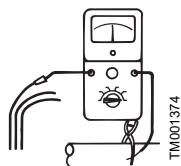


TM001374

Disconnect the submersible drop cable from the motor-protective circuit breaker or the sine wave filter. Measure the insulation resistance from each phase to earth (frame). Earth connection has to be established carefully.

If the insulation resistance is below $0.5\text{ M}\Omega$, pull out the pump assembly for motor, cable or cable termination repair. Local regulations may specify other values for the insulation resistance.

b) Insulation resistance, MMS



TM001374

Motors outside a well:

Clean the motor cable end.

Installed motors:

Disconnect the submersible drop cable from the motor-protective circuit breaker and clean the cable end (contact points).

Measure the insulation resistance from each phase to earth (frame) using an insulation tester (500 VDC, 2 min.).

Earth connection has to be established carefully.

Check the value on the instrument.

If the insulation resistance is lower than the values below, pull out the pump assembly for checking and repair.

The values apply to an ambient temperature of $20\text{ }^{\circ}\text{C}$ ($68\text{ }^{\circ}\text{F}$).

With drop cable:

new motor: $4\text{ M}\Omega$.

used motor: $2\text{ M}\Omega$.

Without drop cable:

new motor: $200\text{ M}\Omega$.

used motor: $20\text{ M}\Omega$.

Measurement is not necessary when the supply voltage and the current consumption are normal.

12. Disposing of the product

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.
3. Dispose of the waste battery through the national collective schemes. If in doubt, contact your local Grundfos company.



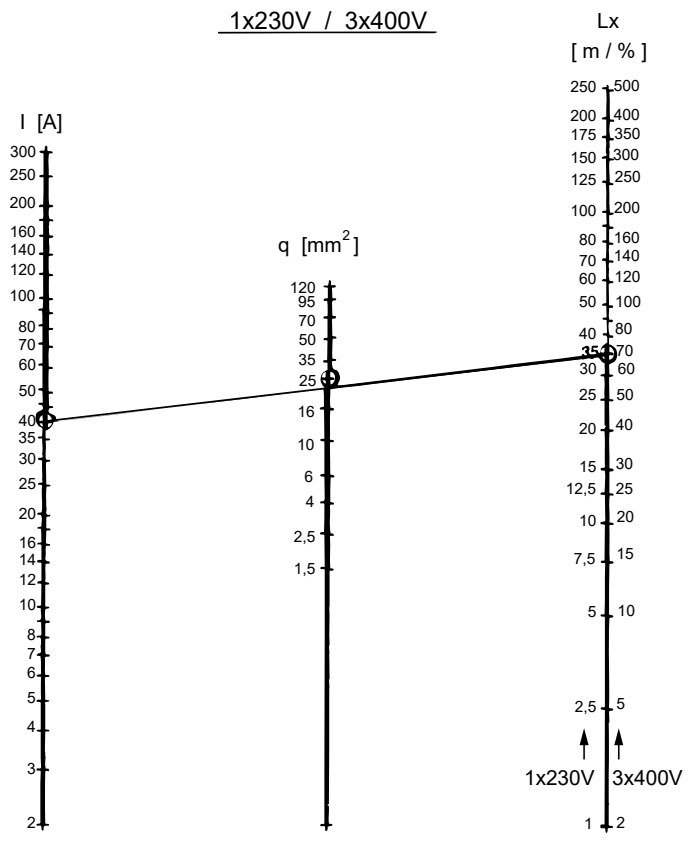
The crossed-out wheellie bin symbol on a product means that it must be disposed of separately from household waste. When a product marked with this symbol reaches its end of life, take it to a collection point designated by the local waste disposal authorities.

The separate collection and recycling of such products will help protect the environment and human health.

See also end-of-life information at www.grundfos.com/product-recycling.

Appendix A

A.1. Appendix



Example:

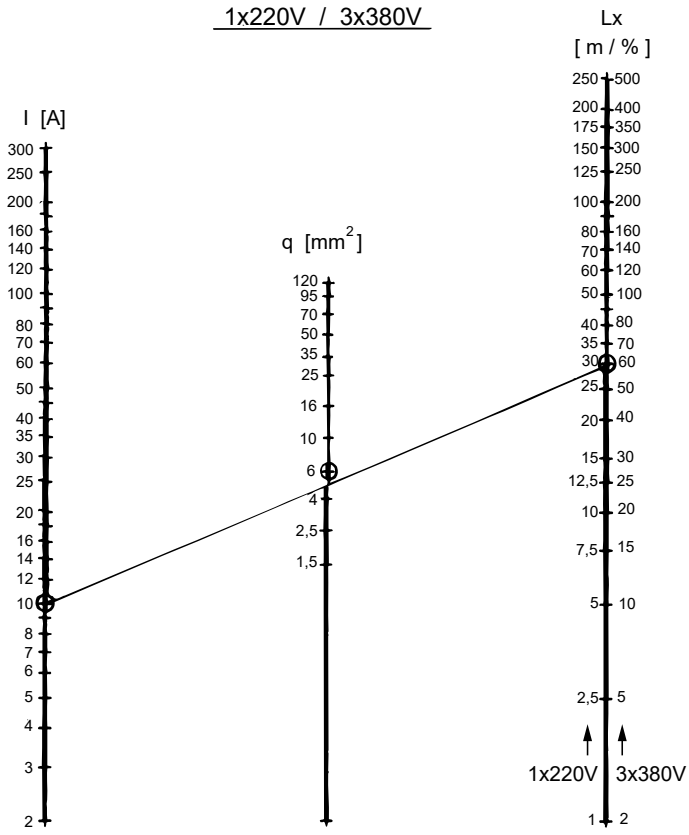
$U = 3 \times 400 \text{ V}$
 $I = 40 \text{ A}$
 $L = 140 \text{ m}$
 $\Delta U = 2 \%$

$$Lx = \frac{L}{\Delta U} = \frac{140}{2\%} = 70 \text{ m} = q \Rightarrow 25 \text{ mm}^2$$

TM001346

TM076394

1x220V / 3x380V



TM001345

Example:

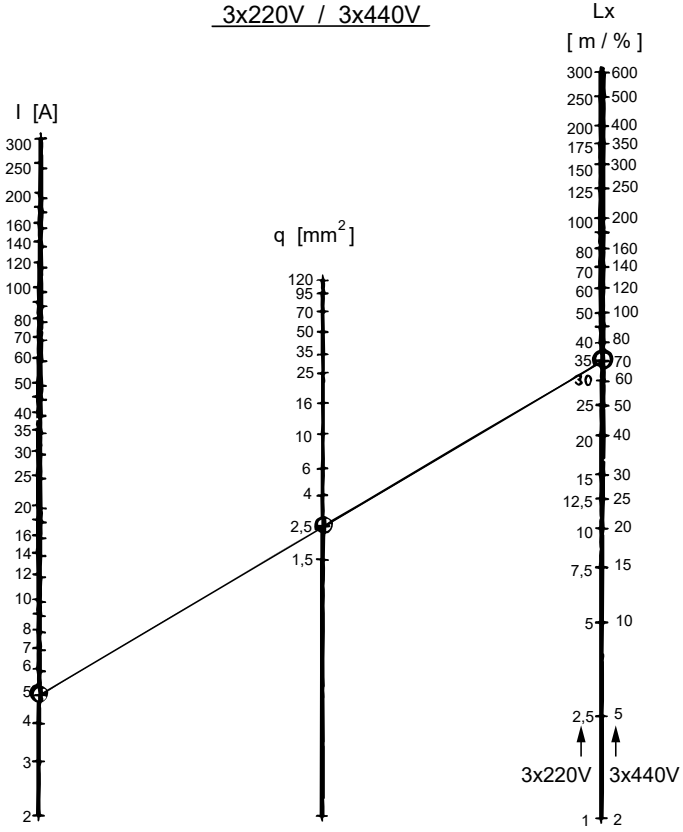
$U = 3 \times 380 \text{ V}$
 $I = 10 \text{ A}$
 $L = 120 \text{ m}$
 $\Delta U = 2 \%$

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

$U = 3 \times 380 \text{ V}$
 $I = 10 \text{ A}$
 $\Delta U = 2 \%$

TM078395

3x220V / 3x440V



Example:

$U = 3 \times 220 \text{ V}$
 $I = 5 \text{ A}$
 $L = 105 \text{ m}$
 $\Delta U = 3 \%$

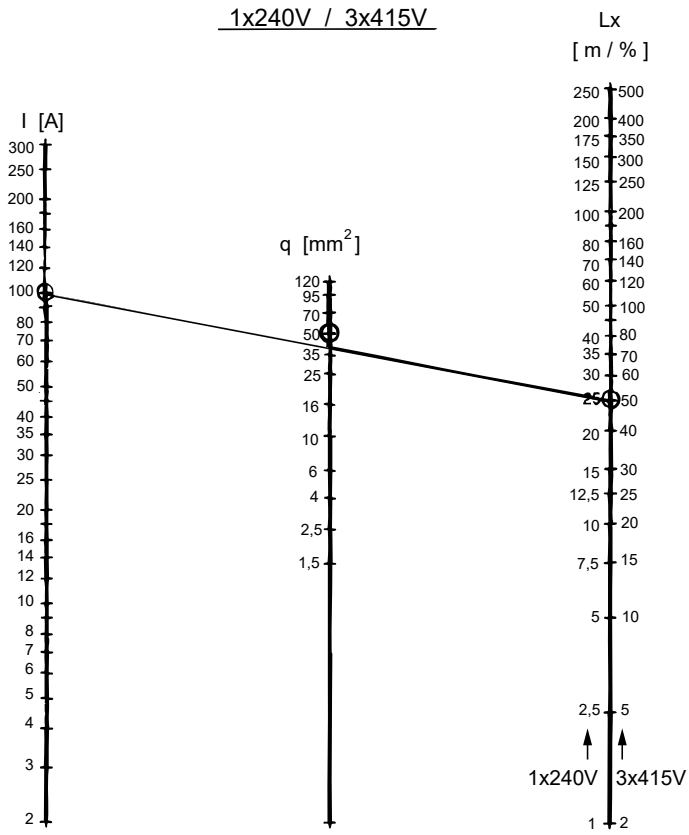
$L_x = \frac{L}{\Delta U} = \frac{105}{3\%} = 35 \text{ m} = q \Rightarrow 2,5 \text{ mm}^2$

The schematic shows a cable of length $L = 105 \text{ m}$ connected to a 3-phase 220V source. An ammeter (A) is placed in the line, showing a current $I = 5 \text{ A}$. The voltage drop is indicated as $\Delta U = 3 \%$.

TM001348

TM078396

1x240V / 3x415V



$U = 3 \times 415 \text{ V}$

Example:

$U = 3 \times 415 \text{ V}$
 $I = 100 \text{ A}$
 $L = 150 \text{ m}$
 $\Delta U = 3 \%$

$I = 100 \text{ A}$
 $\Delta U = 3 \%$
 $L = 150 \text{ m}$

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

TM001347

TM078397

Argentina

Bombas GRUNDFOS de Argentina S.A.
Ruta Panamericana km. 37.500 Industrias
1619 - Garin Pcia. de B.A.
Tel.: +54-3327 414 444
Fax: +54-3327 45 3190

Australia

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

Austria

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

Belgium

N.V. GRUNDFOS Bellux S.A.
Boomssesteenweg 81-83
B-2630 Aartselaar
Tel.: +32-3-870 7300
Fax: +32-3-870 7301

Bosnia and Herzegovina

GRUNDFOS Sarajevo
Zmajia od Bosne 7-7A
BiH-71000 Sarajevo
Tel.: +387 33 592 480
Fax: +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
Tel.: +55-11 4393 5533
Fax: +55-11 4343 5015

Bulgaria

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

Canada

GRUNDFOS Canada inc.
2941 Brighton Road
Oakville, Ontario
L6H 6C9
Tel.: +1-905 829 9533
Fax: +1-905 829 9512

China

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

Columbia

GRUNDFOS Colombia S.A.S.
Km 1.5 vía Siberia-Cota Conj. Potrero
Chico,
Parque Empresarial Arcos de Cota Bo. 1A.
Cota, Cundinamarca
Tel.: +57(1)-2913444
Fax: +57(1)-8764586

Croatia

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

Czech Republic

GRUNDFOS Sales Czechia and Slovakia
s.r.o.
Čajkovského 21
779 00 Olomouc
Tel.: +420-585-716 111

Denmark

GRUNDFOS DK A/S
Martin Bachs Vej 3
DK-8850 Bjerringbro
Tel.: +45-87 50 50 50
Fax: +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
Trukkikujua 1
FI-01360 Vantaa
Tel.: +358-(0) 207 889 500

France

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

Germany

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

Greece

GRUNDFOS Hellas A.E.B.E.
20th km. Athinon-Markopoulou Av.
P.O. Box 71
GR-19002 Peania
Tel.: +0030-210-66 83 400
Fax: +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
Tel.: +852-27861706 / 27861741
Fax: +852-27858664

Hungary

GRUNDFOS Hungária Kft.
Tópark u. 8
H-2045 Törökbalint
Tel.: +36-23 511 110
Fax: +36-23 511 111

India

GRUNDFOS Pumps india Private Limited
118 Old Mahabalipuram Road
Thoraipakkam
Chennai 600 097
Tel.: +91-44 2496 6800

Indonesia

PT GRUNDFOS Pompa
Graha intrub Lt. 2 & 3
Jln. Cililitan Besar No.454. Makasar,
Jakarta Timur
ID-Jakarta 13650
Tel.: +62 21-469-51900
Fax: +62 21-460 6910 / 460 6901

Ireland

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

Italy

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

Japan

GRUNDFOS Pumps K.K.
1-2-3, Shin-Miyakoda, Kita-ku
Hamamatsu
431-2103 Japan
Tel.: +81 53 428 4760
Fax: +81 53 428 5005

Kazakhstan

Grundfos Kazakhstan LLP
7' Kyz-Zhibek Str., Kok-Tobe micr.
KZ-050020 Almaty Kazakhstan
Tel.: +7 (727) 227-98-55/56

Korea

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

Latvia

SIA GRUNDFOS Pumps Latvia
Deglava biznesa centrs
Augusta Deglava ielā 60
LV-1035, Rīga,
Tel.: + 371 714 9640, 7 149 641
Fax: + 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
Tel.: +60-3-5569 2922
Fax: +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
Tel.: +52-81-8144 4000
Fax: +52-81-8144 4010

Netherlands

GRUNDFOS Netherlands
Veluwezoom 35
1326 AE Almere
Postbus 22015
1302 CA ALMERE
Tel.: +31-88-478 6336
Fax: +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
Tel.: +64-9-415 3240
Fax: +64-9-415 3250

Norway

GRUNDFOS Pumper A/S
Strømsveien 344
Postboks 235, Leirdal
N-1011 Oslo
Tel.: +47-22 90 47 00
Fax: +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
Fax: +351-21-440 76 90

Romania

GRUNDFOS Pompe România SRL
S-PARK BUSINESS CENTER, Clădirea
A2, etaj 2
Str. Tipografilor, Nr. 11-15, Sector 1, Cod
013714
București, Romania
Tel.: 004 021 2004 100
E-mail: romania@grundfos.ro

Serbia

Grundfos Srbija d.o.o.
Ormladinskih brigada 90b
11070 Novi Beograd
Tel.: +381 11 2258 740
Fax: +381 11 2281 769
www.rs.grundfos.com

Singapore

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

Slovakia

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

Slovenia

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

South Africa

GRUNDFOS (PTY) LTD
16 Lascelles Drive, Meadowbrook Estate
1609 Germiston, Johannesburg
Tel.: (+27) 10 248 6000
Fax: (+27) 10 248 6002
E-mail: lgradidge@grundfos.com

Spain

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

Sweden

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

Switzerland

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

Taiwan

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

Thailand

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

Turkey

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

Ukraine

ТОВ "ГРУНДФОС УКРАЇНА"
Бізнес Центр Європа
Столичне шосе, 103
м. Київ, 03131, Україна
Tel.: (+38 044) 237 04 00
Fax: (+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
Tel.: +971 4 8815 166
Fax: +971 4 8815 136

United Kingdom

GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard/Beds. LU7 4TL
Tel.: +44-1525-850000
Fax: +44-1525-850011

U.S.A.

Global Headquarters for WU
856 Koomey Road
Brookshire, Texas 77423 USA
Phone: +1-630-236-5500

Uzbekistan

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

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ECM: 1383186

www.grundfos.com

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