Parker-Hannifin

Mobile Water Treatment System

Model TW-60

Serial # 1, 2, 3

TW-60 Water Treatment System

table of contents:

1. INTRODUCTION
2. FUNCTIONAL DESCRIPTION
3. PROCESS DIAGRAM
4. DATA SHEETS
   - Viqua UVMax Pro30
   - Dosmatic SuperDos 45 0.3%
   - Grundfos CR 20-4 Service Pump
   - Grundfos 25 SQF-7 Submersible Well Pump
   - Grundfos CU 200 Pump Controller
   - Grundfos 75S100-16 Submersible Well Pump
   - Franklin Electric Submersible Pump Motor 234-595-8602
   - Grundfos MP 204 Motor Protector
   - Cycle Stop Valves CSV3B2T
   - Watts LF007M2QT, 1½″ Double-Check Valve
   - Pentair Wellmate Pressure Tank
   - Pentair Aqua Media Tank
   - Norwesco Storage Tank

MANUALS *

5. VIQUA UVMAX PRO30
6. DOSMATIC SUPERDOS 45 0.3%
7. GRUNDFOS CR 20-4 SERVICE PUMP
   - **7.1.** 50Hz Pump & Motor Data
   - **7.2.** 60Hz Pump & Motor Data & Service Parts List
   - **7.3.** CR 20-4 Pump Guide *
8. GRUNDFOS 25 SQF-7 SUBMERSIBLE WELL PUMP
9. GRUNDFOS CU 200 PUMP CONTROLLER *
10. GRUNDFOS 75S100-16 SUBMERSIBLE WELL PUMP
    - **10.1.** SP Pump 75S100-16 Guide *
    - **10.2.** SP Pump Installation & Maintenance *
11. FRANKLIN ELECTRIC SUBMERSIBLE PUMP MOTOR *
12. GRUNDFOS MP 204 MOTOR PROTECTOR
13. CYCLE STOP VALVES CSV3B2T
14. WATTS LF007M2QT, 1½″ DOUBLE-CHECK VALVE
15. ____

* Manuals have been abridged to include only data specific to this installation.

TW-60 Water Treatment System

section 1

Parker Hannifin Filtration Group Supplies Water Purification Equipment to SIM (ELWA) and The World's Largest Ebola Treatment Center

CLEVELAND, November 26, 2014 – Parker Hannifin Corporation (NYSE: PH), the global leader in motion and control technologies, has partnered with SIM, a Christian NGO based in Charlotte, NC, and Water Missions International, a Christian NGO based in North Charleston, South Carolina, to supply water purification equipment for the ongoing Ebola crisis in Monrovia, Liberia.

Water Treatment Systems as provided by Parker Hannifin will supply treated water to the ELWA Campus, new 80 bed hospital and those fighting the spread of this deadly disease at the world's largest Ebola Treatment Center in Monrovia.

SIM opened its ministry in Liberia in 1954 with a radio station to share the gospel. The original call letters were "ELWA" which stands for Eternal Love Winning Africa. Later, in 1965 SIM opened a hospital that has grown into the present ELWA facility. At present the 55 bed hospital is still housed in the original buildings. The hospital has an outpatient

TW-60
Mobile Water Treatment System

Photos courtesy of SIM

department that sees 150 to 200 patients per day. The hospital also includes obstetrics, surgery, an emergency room, pediatrics, family medicine, and an HIV unit.

Due to the rapid spread of the Ebola disease, the ELWA Hospital had to create a 100+ bed Ebola unit, separate from the hospital, to avoid cross infection. In addition to this, a 260 bed Ebola unit, operated by MSF (Doctors Without Borders) is located on the ELWA campus. For the last six months of 2014 fully one half of all the beds for Ebola patients in Liberia have been located on the ELWA campus.

SIM's partner organization, Samaritan's Purse, had started building a new 80 bed hospital on the ELWA property before the Ebola outbreak began. When complete, this will include a teaching hospital with an SIM-managed residency program to train Liberian doctors. SIM's 137-acre site in Monrovia is also home to a school, the ELWA Academy which teaches nursery school children to Grade 9, with future plans to add Grades 10 through 12.

Parker has donated three independent 20' containerized water purification systems. Each containerized system consists of filtration, two step disinfection process, water storage tanks and distribution pumps to ensure supply of safe water to those in need. Along with the water purification equipment Parker has supplied Water Missions International with thousands of feet of Parker hose and fittings to accompany and distribute the water.

The containerized water systems are scheduled to be delivered in January 2015. Parker's proven filtration and instrumentation technologies are able to support the entire process of collecting, purifying and testing water from local sources to assist relief efforts. Similar water purification systems have been deployed to assist in other recovery efforts in partnership with various relief efforts such as those supplied to assist the United States Army efforts in Biloxi, Mississippi following Hurricane Katrina in 2005 and the Philippines Red Cross in November, 2013 when Super Typhoon Haiyan (Yolanda) made landfall near the city of Tacloban.

Parker Hannifin Water Purification engineers, designs and fabricate standard catalogue and custom engineered solutions for a variety of applications including those serving the offshore Oil & Gas, Commercial Marine, Military and Land based installations.

To learn more about us visit:
www.parker/watermakers

Contact Information:

Parker Hannifin Corporation
Filtration Group-Water Purification
2630 E. El Presidio Street
Carson, CA 90810
Phone 310 608 5600
Fax 310 608 5692
waterpurification@parker.com
www.villagemarine.com
www.parker.com/watermakers

Photos courtesy of SIM

Print Reorder Number **WP-Ebola** 01-22-2015

ENGINEERING YOUR SUCCESS.

TW-60 Water Treatment System

section 2

TW-60 Water Treatment System

Overview:

Three TW-60 Mobile Water Treatment Systems supply water to the ELWA Hospital and Campus. They were specially built for ELWA by Parker Hannifin Filtration Group-Water Purification.

Unit 1 is behind the Academy and serves three wells.

Unit 2 is by the old hospital and serves two wells.

Unit 3 is at the corner of the Hospital campus entrance beside the old hospital pharmacy and serves the 52m borehole.

Each unit has sand filtration with backwash, ultraviolet disinfection and chlorination, contains storage for up to 1500 gallons of treated water, and can supply up to 80,000 gallons of treated water per day at up to 60PSI to the water system.

Functional Description:

Source pumps turn on/off based on float switch signal from atmospheric storage tank. Source pumps connect to 2″ inlet of TW-60 followed by throttling and shut-off valve. Filter operates at up to 60 GPM with manually adjusted throttling valve on discharge pipe. The 2″ discharge then splits into parallel trains through 30 GPM rated UV reactor. Trains recombine to flow through chlorination injection point, with Dosmatic mechanical chlorine injector and bypass with throttling valve. Atmospheric storage tanks provide required contact time for complete disinfection.

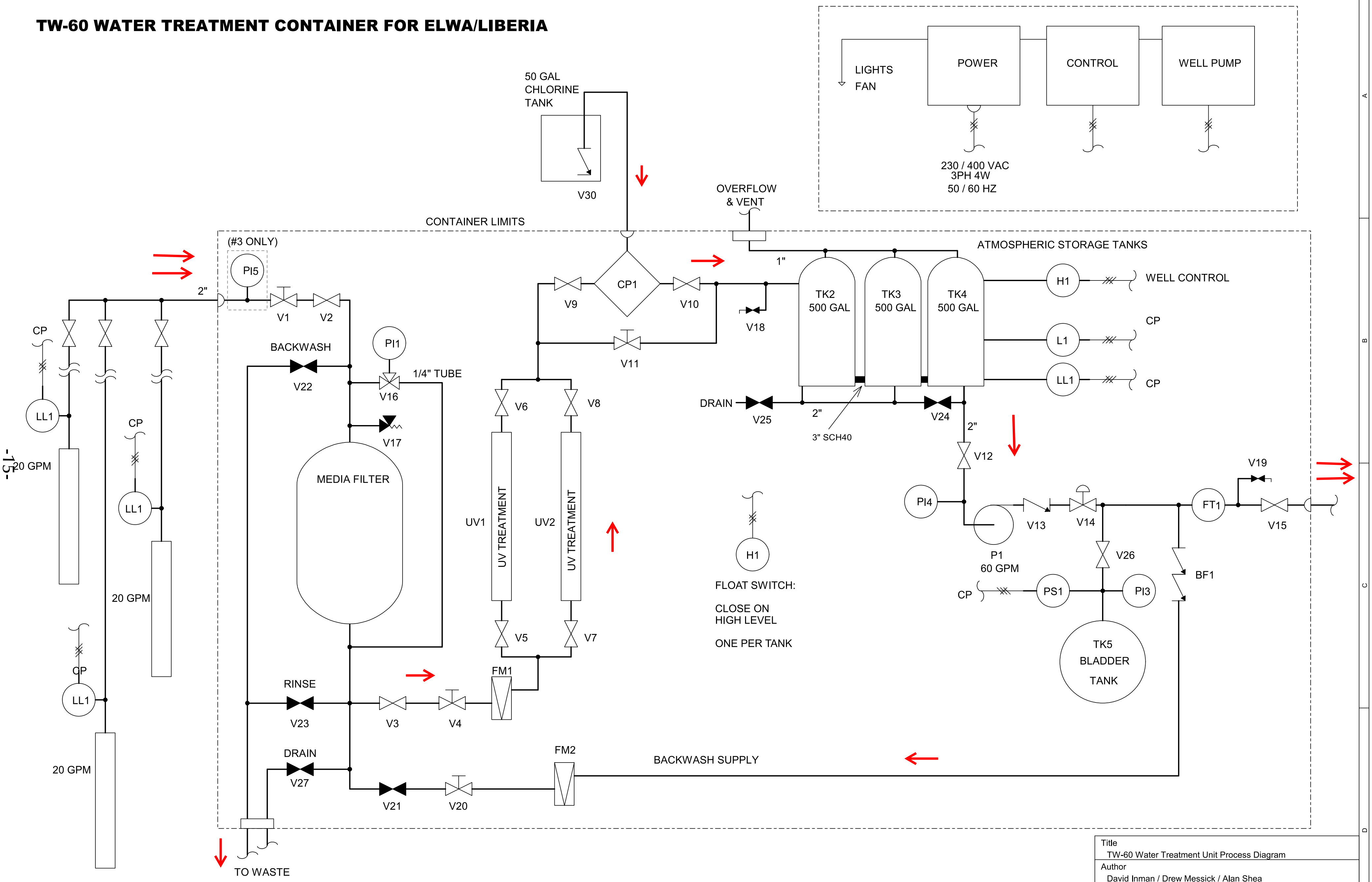
Booster pump draws from atmospheric storage tanks to pressurize water distribution system and is controlled by pressure switch (40/60 PSI) with Cycle Stop Valve and bladder tank. Backwash pipe connects downstream of bladder tank and can be routed to outlet of filter using dual check valves to prevent cross contamination, with manual valves to control backwash sequence.

Chlorine storage and mixing is provided from an external shed adjacent to each treatment unit.

TW-60 Water Treatment System

section 3

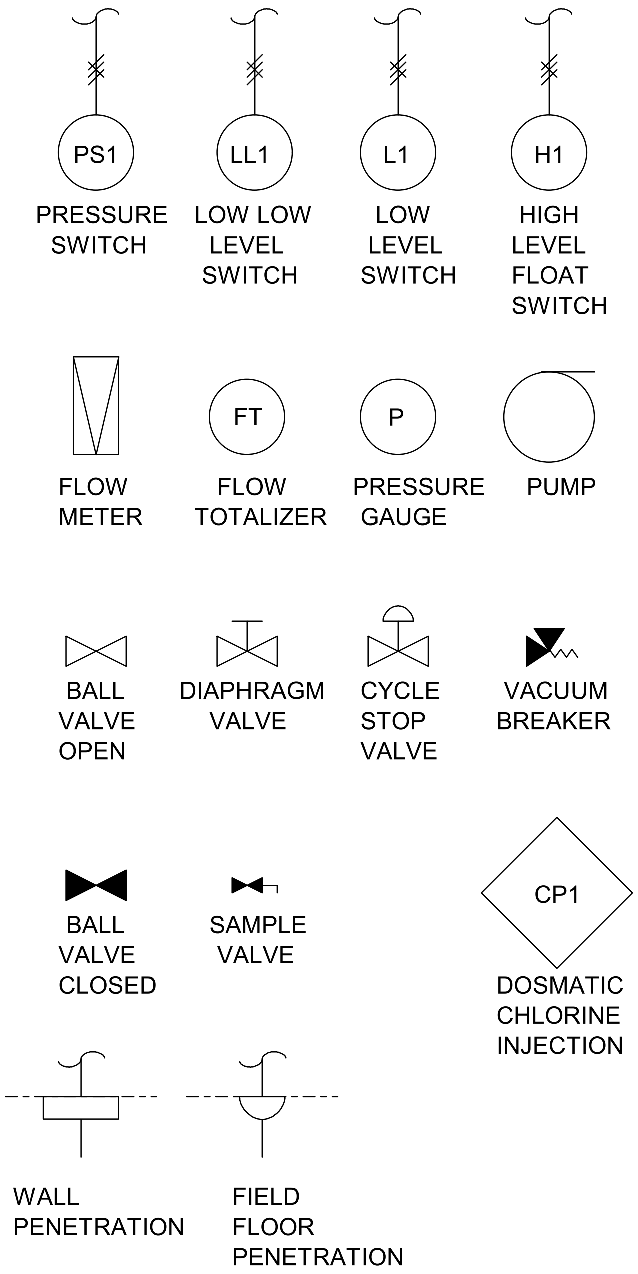
TW-60 WATER TREATMENT CONTAINER FOR ELWA/LIBERIA



PARKER VILLAGE MARINE
DWG NO. 25501

Title
TW-60 Water Treatment Unit Process Diagram
Author
David Inman / Drew Messick / Alan Shea
Water Missions / Parker Village Marine / ELWA Ministries
File
0 Water\M602 Water Treatment Unit Process.dsn
Document
M602-1
Revision
7
Date
2015-03-16
Sheets
1 of 2

WATER TREATMENT CONTAINER FOR ELWA/LIBERIA



Backwash, Overflow & Rinse to exit as wall penetrations 24" above floor level at corner by media filter.

All other well pump inputs, treated water outputs and electrical entrance to be field floor penetration at mid-joist as shown in accompanying drawing M601-1.

Dosmatic chlorine input line will be field floor penetration at Dosmatic installation location.

Title
Water Treatment Unit Process Diagram -- Key
Author
David Inman / Parker / Alan Shea
Water Missions / Parker Village Marine / ELWA Minist
File
0 Water\M602 Water Treatment Unit Process.dsn
Revision
4
Date
2014-10-28

TW-60 Valve Listing

Valve		Tag
1	Well Filtration Rate	🔵 DO NOT ADJUST
2	Well Shutoff	🔵
3	Feed Shutoff	🔵
4	Treatment Flow Rate	🔵 DO NOT ADJUST
5	UV 1 Isolation	🔵
6		🔵
7	UV 2 Isolation	🔵
8		🔵
9	Chlorine Pump Isolation	🔵
10		🔵
11	Chlorine Pump Bypass Flow Rate	🔵 DO NOT ADJUST
12	Storage Tank Shutoff	🔵

Valve		Tag
13	Pump Check Valve	🔵
14	Cycle Stop Valve	🔵 DO NOT ADJUST
15	Output Shutoff	🔵
16	Pressure Gauge Select	🔵
17	Media Filter Vacuum Breaker	🟦
18	Sample Valve: Post-Treatment	🟦
19	Sample Valve: Output	🟦

Key	**Normally-Open Valve**	**Normally-Closed Valve**
Water Treatment	🔵	🟦
Backwash	🔴	🟥
Drain		🟩

Valve		Tag
BF1A	Backflow Preventer	🔴
BF1B		🔴
20	Backwash Flow Rate	🔴 DO NOT ADJUST
21	Backwash Shutoff	🟥
22	Backwash Output	🟥
23	Filter Rinse Output	🟩
24	Storage Tank Isolation	🟩
25	Storage Tank Drain	🟩
26	Pressure Tank Shutoff	🔵
27	Filter Drain	🟩

TW-60 Water Treatment System

section 4

UVMax Pro30

PRODUCT FLOW RATES

DOSAGE	UV	RATE
40 mJ/cm²	75% UVT @ eoll	30 gpm

PRODUCT SPECIFICIATIONS

DIMENSIONS	
Length	41 inches
Diameter	4 inches
Power Supply	33cm x 16.5cm x 11.4cm (13" x 6.5" x 4.5")
Inlet/Outlet Port Size	1 1/4" NPT, 1" FNTP
Shipping Weight	15.6 kg
Reactor Chamber Material	316L SST
Electropolished & Passivated	Yes

ELECTRICAL	
Lamp Type	LPHO Amalgam lamp
Max. current	2.4 Amp
Lamp Power	200 W
Voltage	120-240V / 50-60Hz

OPERATING PARAMETERS	
Maximum iron	0.3 ppm
Maximum hardness	120 ppm (7 grains per gallon)
Ambient Temperature	0-40 °C (32-104 °F)
Maximum Operating Pressure	100 PSI (6.9 bar)
Minimum Operating Pressure	10 PSI (69 kPa)
Minimum UVT	75 %
Installation Orientation	Vertical

FEATURES	
UV Intensity Monitor	Yes
Visual "Power On"	Yes

VIQUA
A TROJAN TECHNOLOGIES COMPANY

Audible Lamp Failure	Yes
Audible alarm mute button	Yes
Visual Lamp Life Remaining	Yes
Lamp Replacement Indicator	Yes
Safety Interlock	Yes
Flow Restrictor	Yes
COMMcenter control package	Optional
CoolTouch fan	Yes
Colour-coded plug and play connections	Yes
Safety cap & special lamp plug	Yes
Solenoid operation indicator	Yes
Flow Pacing	Yes
Solenoid Valve	Optional
4-20 Interface	Optional
Dry Contact	Optional

CERTIFICATIONS	
NSF 55	Class A
CE	Yes
UL	Yes

SuperDos

Non-Electric, Fluid Driven Proportional Injectors

SuperDos operates without electricity to precisely inject liquid concentrates into a water supply line using fluid flow as the power source.

SuperDos is designed with a patented internal mixing chamber that promotes homogeneous mixing, while segregating harsh chemicals from critical internal components.

SuperDos comes in various models that easily satisfy the demands of your most challenging applications.

- Proprietary composite body for chemical compatibility and for mixing aggressive chemicals.
- Built-in on/off switch (30 and 45 models only), which allows user to stop the injection — but not the system.
- Separate internal mixing chamber to prevent chemical contact with motor piston — for longer life and uniform mixing.
- Interchangeable lower ends with the ability to adjust ratios while in operation.
- Highly-aggressive, chemical-resistant models available
- Diesel fuel-friendly models available

Injection range:
0.025% to 10%

Water flow range:
.04 gpm to 45 gpm*

Operating pressure:
3 psi to 100 psi*

*Depending on model

Principal applications

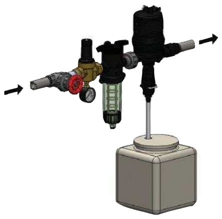
Chlorination, Cleaning, Cutting Fluids, Descaling, Decontamination, Degreasing, Disinfecting, Dispersants, Fertigation, Hydroponics, Inhibitors, Lubrication, Medication, Misting Systems, Odor Control, Pesticides, PH/TH Correction, Rinsing, Sanitizing, Soaps & Foams, Surfactants, Weed Control.

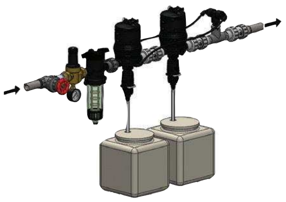
Often Used

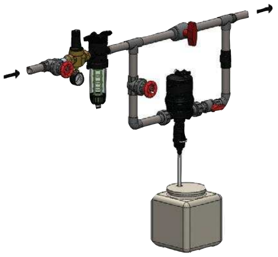
horticulture
animal health
irrigation
carwash & auto detailing
industrial
food processing

Further Information

Basic installation


inline installation


dual remote injection installation


bypass installation

General Specifications

Housing	Proprietary engineered composite material
Avg. dosing accuracy	+/- 5%
Repeatibility	+/-3 %
Fluid max. temp.	100ºF (38ºC)
Fluid min. temp.	34ºF (1ºC)
Max. vertical suction of concentrate	3.6 m
Max. horizontal suction of concentrate	15 m
Self-priming	Yes
Seal material available*:	Aflas- Alkaline concentrates Viton - Acids, oils & pesticides EPDM - Alkaline concentrates Kalrez

*Contact your representative for specific chemical information.

Model #	Description	Flow range		Operating pressure		Injection range	
		gpm	l/h	psi	bar	%	ratio
113227R	SuperDos 15TF 0.3%	0.04 - 15	10 - 3400	3 - 60	0.21 - 4.1	0.025 - 0.3	1:4000 - 1:333
113202	SuperDos 15TF 2.5%	0.04 - 15	10 - 3400	3 - 60	0.21 - 4.1	0.20 - 2.5	1:500 - 1:40
113203	SuperDos 15TF 5%	0.04 - 15	10 - 3400	3 - 60	0.21 - 4.1	0.40 - 5.0	1:250 - 1:20
113202WSP	SuperDos 15 2.5% WSP	0.04 - 15	10 - 3400	3 - 60	0.21 - 4.1	0.3 - 2.5	1:300 - 1:40
113228R	SuperDos 20 0.3%	0.05 - 20	11 - 4500	5 - 100	0.34 - 6.9	0.025 - 0.3	1:4000 - 1:333
113205	SuperDos 20 2.5%	0.05 - 20	11 - 4500	5 - 100	0.34 - 6.9	0.20 - 2.5	1:500 - 1:40
113206	SuperDos 20 5%	0.05 - 20	11 - 4500	5 - 100	0.34 - 6.9	0.40 - 5	1:250 - 1:20
113207	SuperDos 20 10%	0.05 - 20	11 - 4500	5 - 65	0.34 - 6.9	2 - 10	1:50 - 1:10
113205WSP	SuperDos 20 2.5% WSP	0.05 - 20	11 - 4500	3 - 60	0.21 - 4.1	0.3 - 2.5	1:300 - 1.40
113229R	SuperDos 30 0.3%	0.15 - 30	34 - 6800	5 - 100	0.34 - 6.9	0.025 - 0.3	1:4000 - 1:333
113209	SuperDos 30 2.5%	0.15 - 30	34 - 6800	5 - 100	0.34 - 6.9	0.20 - 2.5	1:500 - 1:40
113210	SuperDos 30 5%	0.15 - 30	34 - 6800	5 - 100	0.34 - 6.9	0.40 - 5	1:250 - 1:20
113209WSP	SuperDos 30 2.5% WSP	0.15 - 30	34 - 6800	5 - 100	0.34 - 6.9	0.3 - 2.5	1:300 - 1:40
113230R	SuperDos 45 0.3%	0.25 - 45	57 - 10,000	5 - 100	0.34 - 6.9	0.025 - 0.3	1:4000 - 1:333
113212	SuperDos 45 2.5%	0.25 - 45	57 - 10,000	5 - 100	0.34 - 6.9	0.20 - 2.5	1:500 - 1:40
113215	SuperDos 45 5%	0.25 - 45	57 - 10,000	5 - 80	0.34 - 6.9	0.04 - 5	1:250 - 1:20

WSP versions are available for use with Water Soluble Products.

North America 3798 Round Bottom Road, Cincinnati, Ohio, 45244 **Phone** 513.271.8800 **Toll Free** 800.543.7184 **Fax** 513.271.0160 **Web** hydrosystemsco.com
Europe Unit 3 The Sterling Centre, Eastern Road, Bracknell, Berkshire, RG12 2PW **Phone** +44 (0)1344 488880 **Fax** +44 (0)1344 488879 **Web** hydrosystemseurope.com
South America Rua Mogiana, 172 Chácaras Reunidas, São José Dos Campos,12238-420SP, Brasil **Phone** +55 12 3201 7707 **Web** hydronovabrasil.com
Australia Unit A, 1 Kellham Place, Glendenning, NSW 2761, Australia **Phone** +612 9625 8122 **Fax** +612 9625 8177
Asia Pacific Block #B, No. 51, Mindong Road, Pudong New Area, Shanghai, PRC 201209 **Phone** +86 21 61871037 **Fax** +86 21 68727775

Operations

Clicking Sound is Normal

Fluid flowing through the injector will automatically cause the injector to “click” and inject a set amount of solution into the fluid line. The higher the flow rate the more frequent the "clicking". The injector is designed to inject solution proportionally (at the same set ratio) regardless of fluid flow.

Service Fluid Flow

Fluid flow and pressure must be within the established specifications (see Specification on page 6) for your model.

Change Feed (Injection) Rate

The feed rate on the injector is adjustable **EVEN WHILE OPERATING AND UNDER PRESSURE**. To change feed rate see (Fig. 1 and Fig. 2). Do not remove #79 when injector is under pressure.

1. Remove Upper Interlock Pin (#65) (Fig. 1).
2. Rotate Ratio Adjuster Sleeve (#61) up or down to the desired setting (Fig. 2). Use the top of the Ratio Adjuster Sleeve to line up with the desired feed rate on the setting (Fig. 2a).
3. Re-insert Upper Interlock Pin (#65). Clip must be parallel with settings to be able to re-insert.

NOTE: Do not screw Ratio Adjuster Sleeve below lowest setting line. Measure outlet fluid to assure desired feed rate is being delivered.

Fig. 1

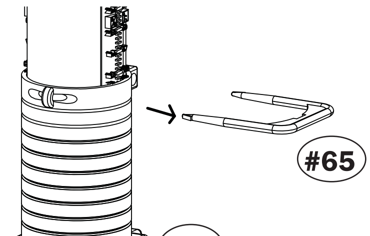


Fig. 2

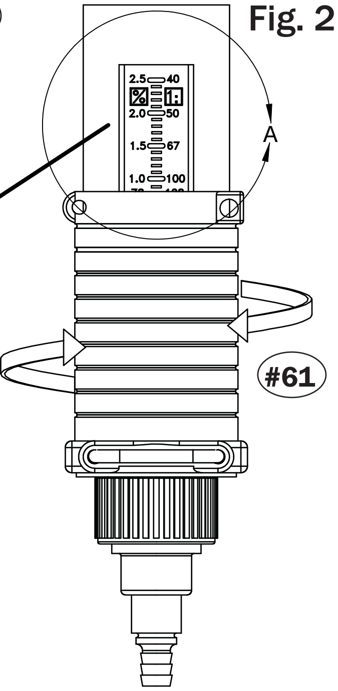
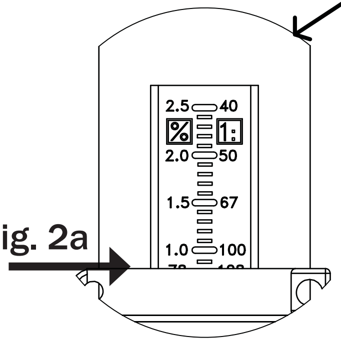


Fig. 2a



Bypass Operation

Injecting solution into the fluid line can be TEMPORARILY stopped with the On/Off feature (Fig. 3). Moving the On/Off Lever to the OFF position allows service fluid to pass through the injector without injecting chemical. No "clicking" will be heard.

With the On/Off lever set to the ON position the injector will operate as normal and “clicking” will be heard when fluid is flowing. It is recommended to use the three-valve bypass (see Fig. 5), for continued bypassing or servicing of the injector.

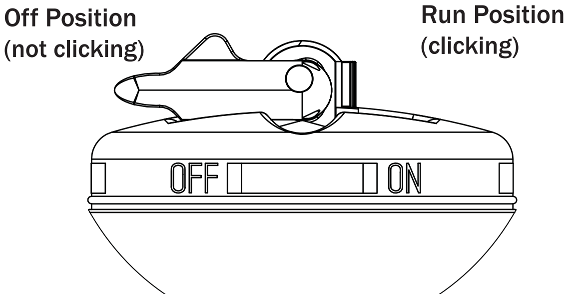
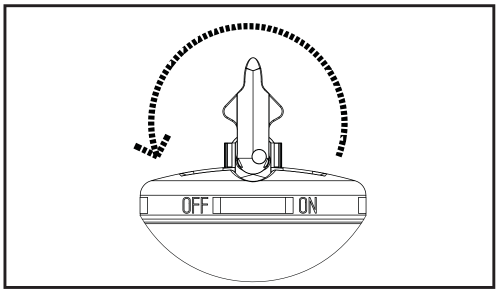


Fig. 3



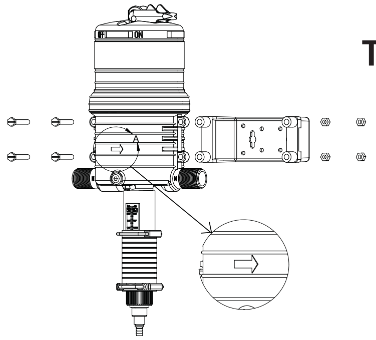


Fig. 4
Typical wall mounting

Maintenance

Reference numbers refer to Page 13 - 17

Perform these maintenance procedures to extend the life of your unit.

Refer to pages 14 & 15

SuperDos 45 (0.3%) Model (Including PAA)

Every 3 - 6 Months	Every 6 - 12 months	Replace as necessary
1. Clean seal areas (# 17, 14 & 13). 2. Check #17 O-ring, #7 Cylinder, clean and/or replace as necessary.	1. Replace #17 O-ring and #44 (0.3% - #51) Dosage Piston. 2. Clean and/or replace #13 Check Poppet, #11 Suction Tube Fitting.	1. #7 Cylinder 2. #14 O-ring 3. #51 Shaft Assembly Dosage Piston

CLEAN SOLUTION CONTAINER

Keep covered to prevent dirt, flies, feathers and other flying debris from entering the container. Rinse container thoroughly and often. Do not mix chemicals together that might react and cause a precipitate. Use **FILTERED** fluid when filling container.

CLEAN SUCTION TUBE FILTER SCREEN

Inspect each time new solution is added. Clean filter screen (#27) and suction tube (#25) as necessary by rinsing in fresh water. Replace if necessary. Keep filter screen off bottom of solution container to prevent dirt and precipitate from clogging filter.

CLEAN INLET FILTER

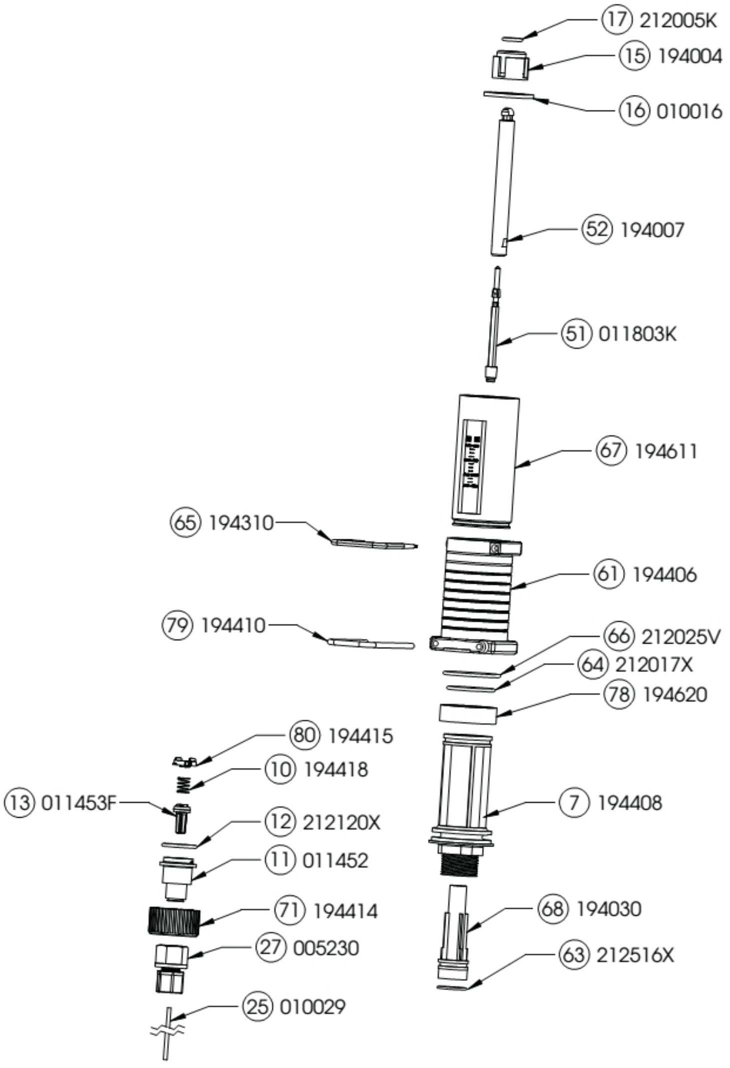
Clean or replace inlet filter as required to increase the life of the unit as well as reduce pressure loss.

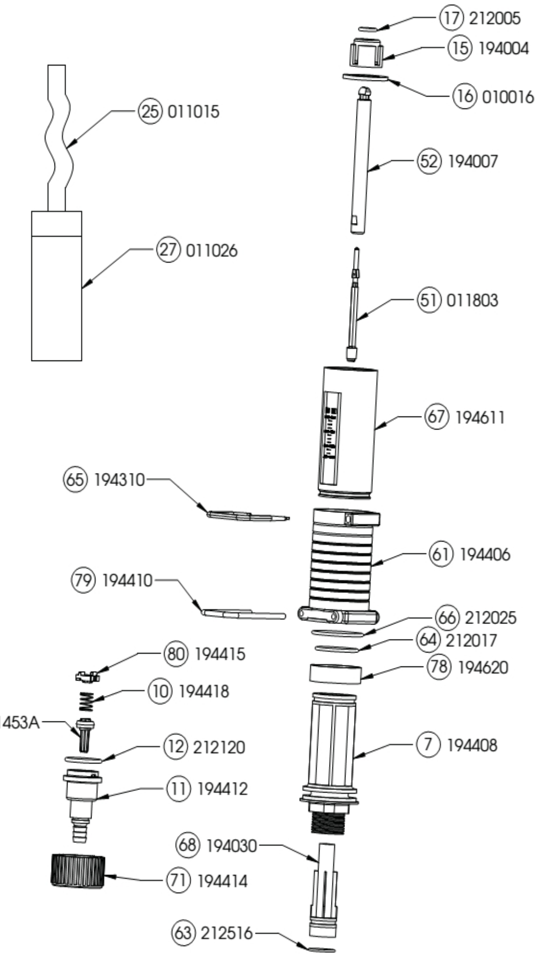
BYPASS INJECTOR

When not in use place the injector in bypass mode by using the three valve bypass (preferred) or turn the on/off lever on the top of the injector to the off position.

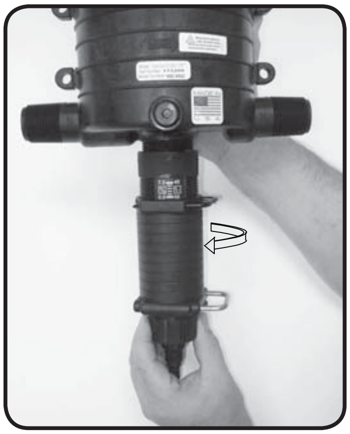
STORAGE

For extended storage, rinse injector (see "Rinse Injector After Each Use") and place underwater in a container. Apply monthly, <0.1 oz. (29 ml) of chlorine bleach to avoid algae growth. **KEEP FROM FREEZING**.

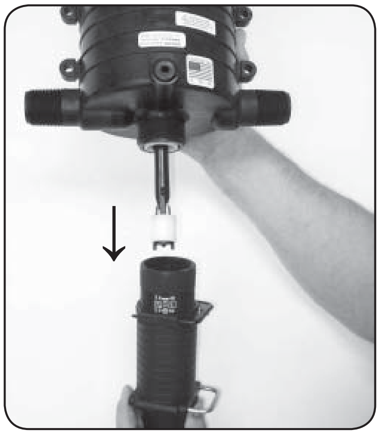




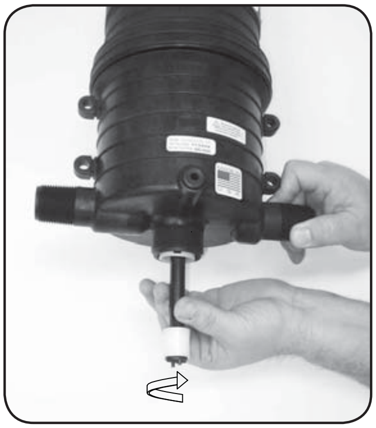
Routine Maintenance Instructions



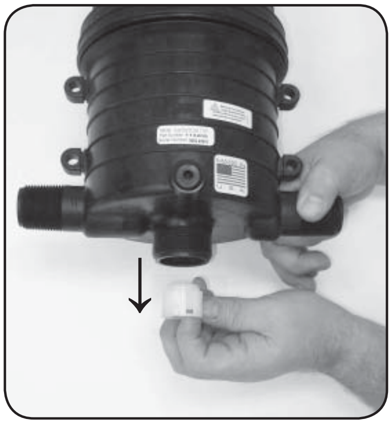
Step 1.
Unscrew LOWER END CYLINDER ASSEMBLY from body.



Step 2.
Remove LOWER END CYLINDER ASSEMBLY .

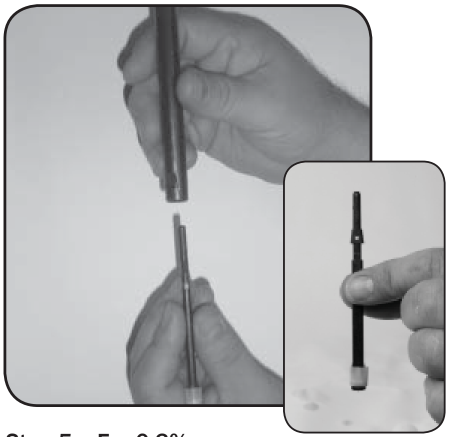


Step 3.
Rotate #51 SHAFT 90º and pull from body.



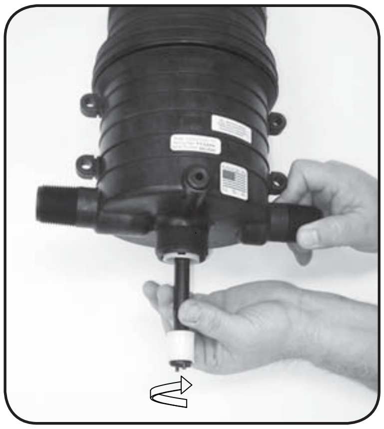
Step 4.
Pry the #15 SEAL RETAINER from the injector. Pry #17 O-ring from the unit. NOTE: O-ring may still be seated at the base of the unit.

Step 5. For 2.5% & 5%
Replace #44 DOSAGE PISTON flared-end up and #14 O-ring. 0.3% only: Replace # 51 SHAFT ASSEMBLY. See Step 5a.

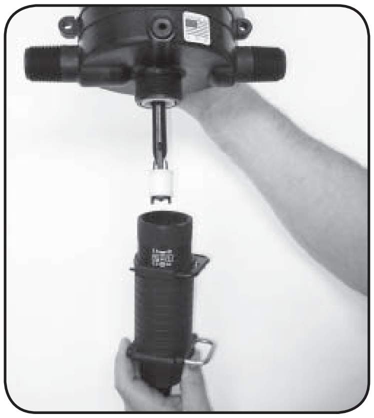


Step 5a. For 0.3%.
Replace LOWER SHAFT assembly into upper shaft.

Step 6.
Reinsert #15 SEAL RETAINER and #17 O-ring onto # 51 SHAFT ASSEMBLY.



Step 7.
Reinsert #51 SHAFT ASSEMBLY into body and rotate 90º to lock. Confirm the shaft is locked in by gently tugging on the shaft. Shaft should remain inserted.



Step 8.
Screw LOWER END CYLINDER ASSEMBLY onto body. Ensure #16 gasket is seated on the top of cylinder assembly.

Troubleshooting

New Install - Always Pressure Up Slowly (Follow start up on page 9)

Problem	Cause	Solution
No Clicking Sound	Fluid not flowing through unit	Are the red plugs at the inlet, outlet and suction tube fitting openings removed? Is the unit installed backward? The arrow on the unit must point in the direction of the fluid flow. Has the new injector been stored for an extended period. If so, submerge the injector in room temperature fluid for 24 hours so that the working parts can reabsorb fluid and swell back to the proper size. If still not clicking, do not open the upper body. Call Dosmatic Customer Service.
	Fluid flowing through unit	Fluid rate is below or exceeds rated service flow of injector. (see Specifications for maximum flow rate page 6). If below increase flow rate, if above, reduce flow rate. Operating pressure exceeds maximum limit. Install a pressure reducer valve. (see Specifications for maximum flow rate page 6). On/Off Lever in off position. Place the On/Off lever switch to the ON position. By-Pass Valve not closed. Check and set valve to the ON position.

Injector in Operation or After Scheduled Maintenance

Problem	Cause	Solution
No Clicking Sound	Main Piston Assembly #9 worn	Replace # 9 Main Piston Assembly. Clean fluid filter.
	Cover #1 or main body #40 worn or scored	Lightly sand inside diameter of bores to remove grooves. Install or clean fluid filter.
	On/Off Lever in off position	Place the On/Off lever switch to the ON position.
	By-Pass Valve not open	Set Valve to the closed position.
	Dirty or plugged inlet filter	Ensure mesh size is correct for proper filtration. Clean filter.
	#17 Worn or not seated properly	Re-seat #17 or replace.

Problem	Cause	Solution
Clicking Sound No Suction Of Solution	Cracked or loose Suction Hose	Check for proper fit and /or replace.
	Dosage piston #44 (0.3% model #51) worn or installed incorrectly	Replace. Ensure during maintenance replacement that #44 dosage piston was installed correctly flared-end up.
	O-ring retainer #15 installed incorrectly	Install correctly.
	O-ring seat #14 or dosage piston #44 (0.3% model #51) damaged	Replace.
	#17 O-ring worn and/or loose	Replace.
	Suction tube #25 or suction tube fitting #11 cracked, leaking or clogged suction tube filter	Replace and/or clean as necessary.
	Check valve #13 leaking	Clean & replace as necessary.

Problem	Cause	Solution
Clicking Sound. Under Injecting	#44 (0.3% model #51) Dosage Piston worn	Replace.
	#7 Inner Cylinder worn	Replace.
	Unit operates at high-flow and not at low flow	Replace #17 O-ring.
	Main Piston Assembly #9 worn	Replace # 9 Main Piston Assembly. Clean fluid filter.
	Cover #1 or main body #40 worn or scored	Lightly sand inside diameter of bores to remove O-ring grooves. Install or clean fluid filter.

Problem	Cause	Solution
Fluid Re-filling Solution Tank	Check valve #13 leaking	Check seat area on suction tube fitting #11. Check valve and seal must fit loose in the suction tube fitting. Clean seal and inside fitting for debris.
	Washer seal on #13 is swollen or chemical attack	Replace with new check valve assembly.

Submittal Data

PROJECT:	TW-60 Mobile Water Treatment System	UNIT TAG:	________	QUANTITY:	3
	________	TYPE OF SERVICE:	________		________
REPRESENTATIVE:	Water Missions Intl	SUBMITTED BY:	________	DATE:	________
ENGINEER:	Pat Haughney / David Inman	APPROVED BY:	________	DATE:	________
CONTRACTOR:	Parker Racor Village Marine	ORDER NO.:	________	DATE:	________

CR 20-4

Vertical, multistage centrifugal pump with suction and discharge ports on the same level. The pump head and base are in cast iron. All other wetted parts are in stainless steel (EN 1.4301)

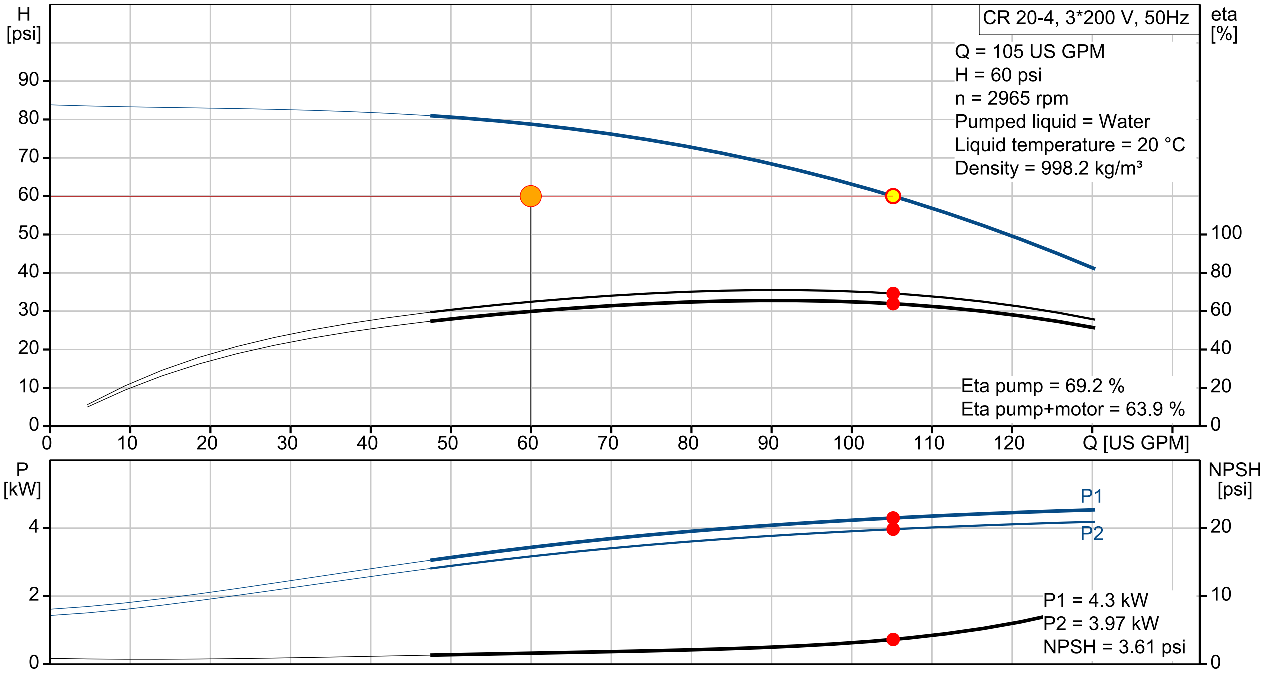
Note! Product picture may differ from actual product

50Hz Data

Conditions of Service	
Flow:	67.9 US GPM
Head:	76.8 psi
Efficiency:	62.3 %
Liquid:	0
Temperature:	20 °C
NPSH required:	1.85 psi
Viscosity:	1 mm2/s
Specific Gravity:	________

Pump Data	
Max pressure at stated temp:	16 bar / 120 °C
Liquid temperature range:	-20 .. 120 °C
Maximum ambient temperature:	60 °C
Approvals:	CE,TR
Shaft seal:	HQQE
Flange standard:	JIS
Pipe connection:	DN 50
Product number:	On request

Motor Data	
Rated power - P2:	7.5 kW
Rated voltage:	200-220 D/346-380 Y V
Mains frequency:	50 Hz
Enclosure class:	55
Insulation class:	F
Motor protection:	PTC
Motor type:	132SB
Motor_efficiency:	90,1-90,4 %



CR 20-4, 3*200 V, 50Hz

Q = 105 US GPM
H = 60 psi
n = 2965 rpm
Pumped liquid = Water
Liquid temperature = 20 °C
Density = 998.2 kg/m³

Eta pump = 69.2 %
Eta pump+motor = 63.9 %

P1 = 4.3 kW
P2 = 3.97 kW
NPSH = 3.61 psi

Submittal Data

PROJECT: ____________ UNIT TAG: ____________ QUANTITY: ____________

TYPE OF SERVICE: ____________

REPRESENTATIVE: ____________ SUBMITTED BY: ____________ DATE: ____________

ENGINEER: ____________ APPROVED BY: ____________ DATE: ____________

CONTRACTOR: ____________ ORDER NO.: ____________ DATE: ____________

Product photo could vary from the actual product

CR 20-4

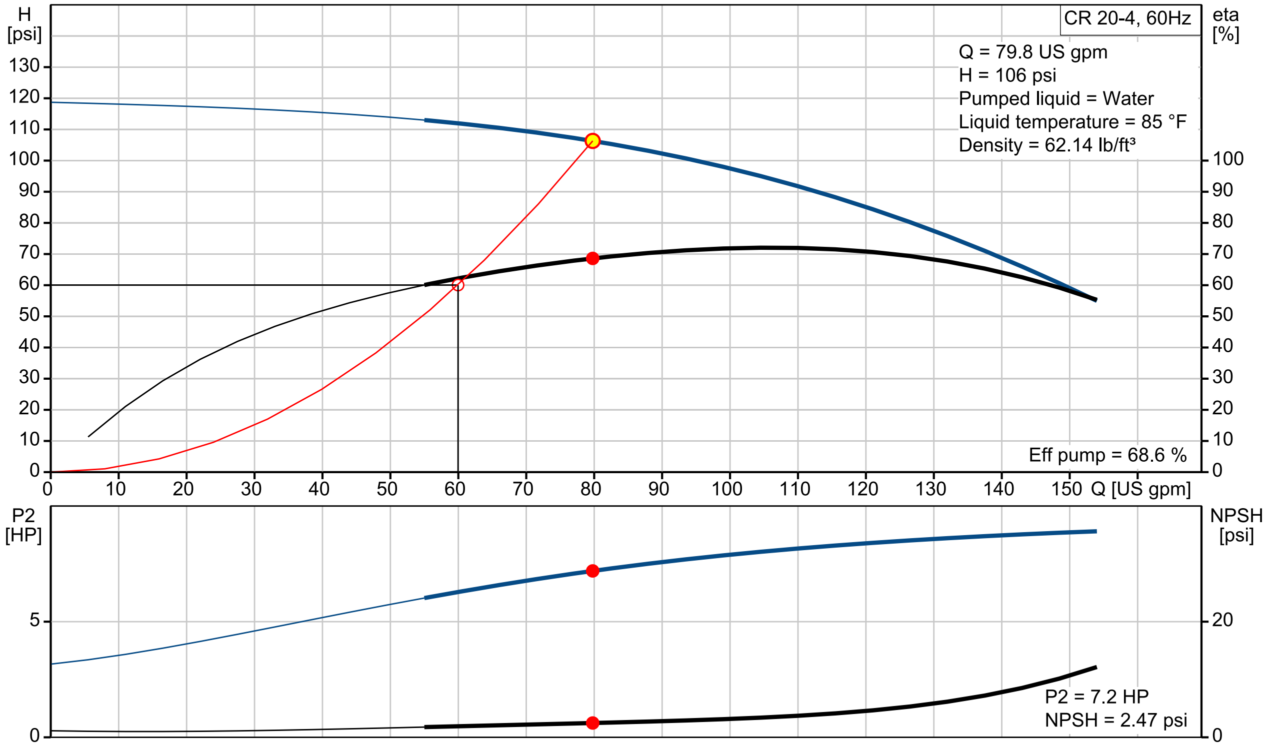
Vertical, multistage centrifugal pump with suction and discharge ports on the same level. The pump head and base are in cast iron. All other wetted parts are in stainless steel (EN 1.4301)(AISI 304)

60Hz Data

Conditions of Service	
Flow:	____________
Head:	____________
Efficiency:	____________
Liquid:	____________
Temperature:	____________
NPSH required:	____________
Viscosity:	____________
Specific Gravity:	____________

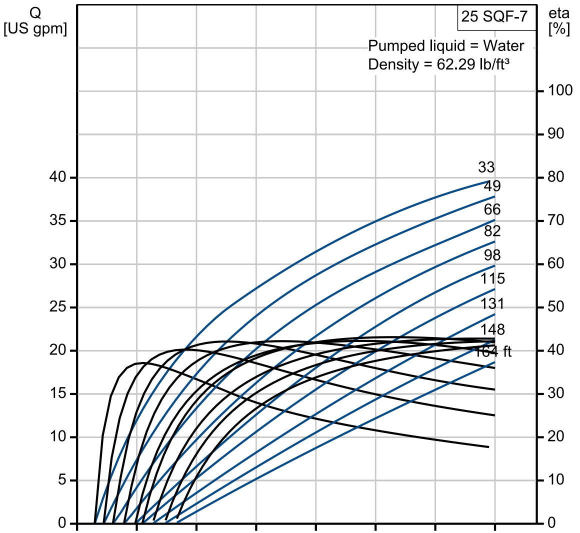
Pump Data	
Max pressure at stated temperature:	232 psi / 250 °F
Liquid temperature range:	-4 .. 248 °F
Maximum ambient temperature:	140 °F
Approvals:	ANSI/NSF61
Shaft seal:	HQQE
Flange standard:	ANSI
Pipe connection:	2"
Product number:	96524011

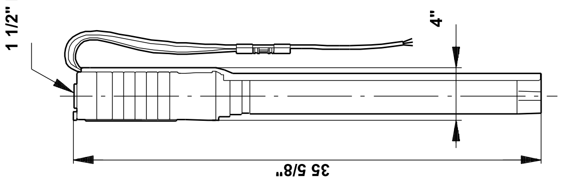
Motor Data	
Rated power - P2:	10 HP
Rated voltage:	208-230YY/460Y V
Main frequency:	60 Hz
Enclosure class:	55 Dust/Jetting
Insulation class:	F
Motor protection:	PTC
Motor type:	132FA
Motor_efficiency:	90,0-90,2 %

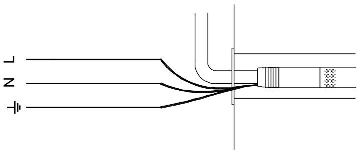


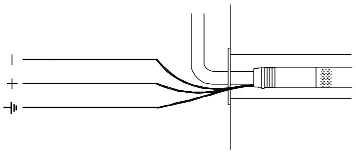
Company name: -
Created by: -
Phone: -
Fax: -
Date: -

Description	**Value**
Product name:	25 SQF-7
Product Number:	95027353
EAN number:	5700834760488
Technical:	
Approvals on motor nameplate:	CE,CTICK,TR_MARK
Pump Number:	95027395
Stages:	7
Valve:	pump with built-in non-return valve
Materials:	
Pump:	Stainless steel
	DIN W.-Nr. 1.4301
	AISI 304
Impeller:	Stainless steel
	DIN W.-Nr. 1.4301
	AISI 304
Rotor:	DIN W.-Nr. 1.4301
	AISI 304
Stator:	DIN W.-Nr. 1.4301
	AISI 304
Installation:	
Maximum ambient pressure:	218 psi
Pump outlet:	1 1/2 NPT"
Minimum borehole diameter:	4.02 in
Liquid:	
Pumped liquid:	Water
Maximum liquid temperature:	104 °F
Electrical data:	
Motor type:	MSF3
Power input - P1:	1.4 kW
Rated voltage AC:	1 x 90-240 V
Rated voltage DC:	30-300 V
Start. method:	direct-on-line
Rated current:	8.4 A
Power factor:	1,0
Rated speed:	500-3600 rpm
Enclosure class (IEC 34-5):	IP68
Insulation class (IEC 85):	F
Motor protection:	Y
Thermal protec:	internal
Length of cable:	6.56 ft
Motor Number:	98163731
Others:	
Net weight:	19.4 lb
Gross weight:	22.7 lb
Shipping volume:	1 ft³
Sales region:	North America









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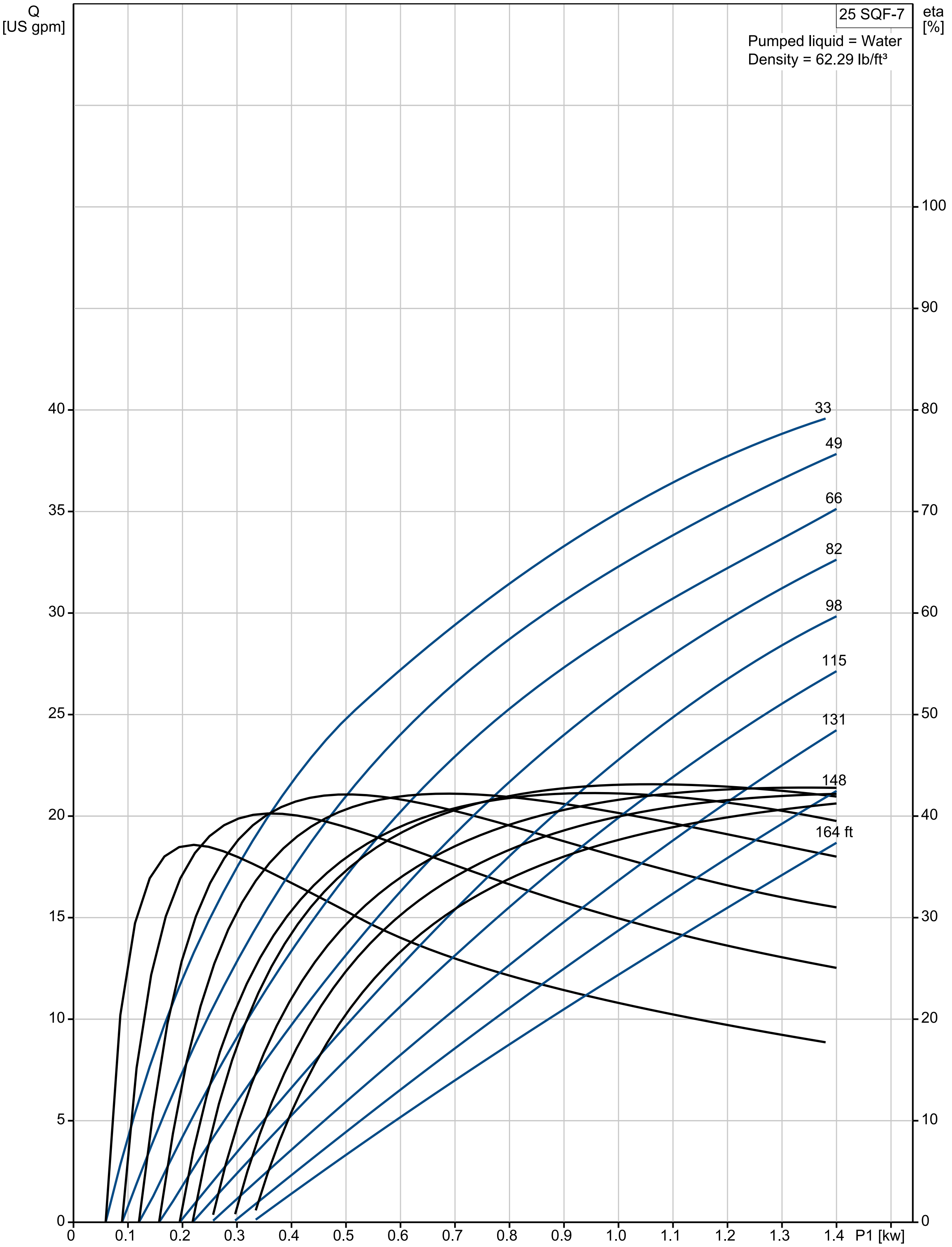
Created by: -
Phone: -
Fax: -
Date: -

95027353 25 SQF-7 60 Hz



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7. Accessories

CU 200 SQFlex control unit

Product	Product number
CU 200 SQFlex	96625360

The CU 200 is a combined status, control and communication unit especially developed for the SQFlex system. The CU 200 also enables connection of a level switch.

The CU 200 incorporates cable entries for

- power supply connection (pos. 6)
- pump connection (pos. 7)
- earth connection (pos. 8)
- level switch connection (pos. 9).

(The position numbers in brackets refer to fig. 24.)

Communication between the CU 200 and the pump takes place via the pump power supply cable. This is called mains borne signalling (or Power Line Communication), and this principle means that no extra cables between the CU 200 and the pump are required.

It is possible to start, stop and reset the pump with the on/off button (pos. 1). The CU 200 offers

- system monitoring
- alarm indication.

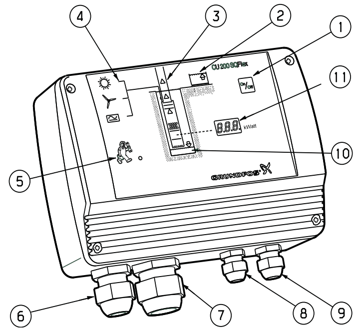
The following indications allow the operation of the pump to be monitored:

- water reservoir is full (level switch) (pos. 2)
- pump is running (pos. 3)
- input power (pos. 11).

The CU 200 offers the following alarm indications:

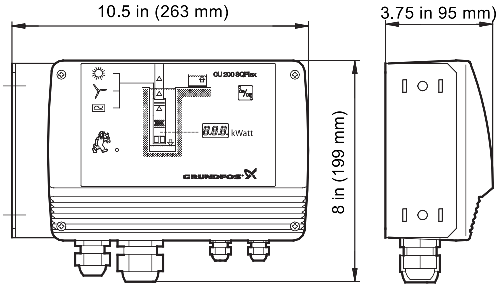
- Dry running (pos. 10)
- Service needed (pos. 5) in case of
  - – no contact to pump
  - – overvoltage
  - – overtemperature
  - – overload.

In addition, the CU 200 shows the symbols of the energy supply options (pos. 4).



TM02 2325 1206

Fig. 24 CU 200 elements



TM02 2323 1206

Fig. 25 CU 200, dimensional sketch

CU 200 SQFlex display and indicator lights

The front cover of CU 200 features a button and various indications:

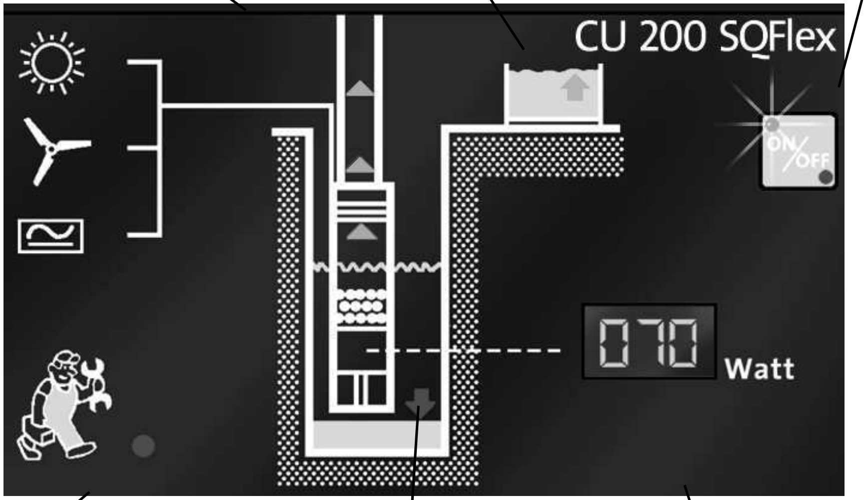
Pump operation
A running green light indicates that the pump is operating at more than 500 min^{-1}.

Full water reservoir

The yellow light indicates that the water reservoir is full.

ON/OFF button

- Green light on: The system has been switched on.
- Red light on: The system has been switched off.
- Both lights off: The system lacks the required power to light the display.
- Flashing green light: The system has adequate power to light the display but lacks sufficient power to start the pump.



Fault indicator

Red light indicates fault.

Dry running

Red light indicates lack of water.

Power and fault codes

The display indicates 0 Watt until the power supply is sufficient to run the pump at 500 rpm; upon startup, the power consumption of the pump is indicated in steps of 10 Watt, the maximum indication being 990 Watt.

When the fault indicator is on, the display indicates fault codes, see Trouble-shooting by means of CU 200 on page 8.

F1 = overvoltage

F2 = overtemperature

F3 = no contact to the pump

F4 = overload

Trouble-shooting by means of CU 200

Indication/Fault	Possible cause	Remedy
1. No light in front cover. Pump does not deliver water.	No voltage supply.	• Reestablish the voltage supply.
	Position of ribbon cable connector is wrong or cable is defective.	• Correct the position of the cable or replace it.
2. No light in front cover, and pump does not deliver water. But the LEDs inside CU 200 indicating 5 V, 10 V and 24 V internal supply voltage are on, and the 'CONTROL INDICATOR' LED is not flashing.	CU 200 is defective.	• Replace the CU 200.
3. Pump does not start. Green indicator light in ON/OFF button is on. No fault indicated.	CU 200 or pump is defective.	• Check that the 'CONTROL INDICATOR' LED is flashing. If not, replace the CU 200. • Check that there is sufficient voltage on the PUMP terminals. If no voltage can be measured, replace the CU 200. If a supply voltage to the pump can be detected, continue as follows: • Switch off the energy supply and wait for one minute. • Switch on the energy supply and observe what happens: If the green indicator light in the ON/OFF button is on and the pump still does not start, the pump or pump cable is defective. • Repair or replace pump or cable.
4. Off light in the ON/OFF button is on.	Pump has been stopped.	• Press the ON/OFF button on the CU 200 to start the pump.
5. CU 200 indicates 'F3 = no contact to pump'.	CU 200 defective.	• Check - the connection in the CU 200 - the pump cable - the end cover with socket on the pump.
	Pump cable or connections defective.	
	Pump is defective.	• Repair or replace the pump.
6. CU 200 indicates 'F1 = overvoltage'	Supply voltage is above permissible range.	• Disconnect the solar modules to allow the voltage to drop. • Reconfigure the modules and reconnect them. If a different supply source is used, check that the voltage is within the recommended voltage range. **Note:** As the voltage is detected at the motor, allow for the voltage drop in the pump cable.
7. CU 200 indicates 'F2 = overtemperature'.	Too high water temperature.	• Ensure that the water temperature is below the maximum permissible level.
	Incrustations on motor.	• Remove incrustations on the motor.
	Pump is defective.	• Repair or replace the pump.

Indication/Fault	Possible cause	Remedy
8. CU 200 indicates 'F4 = overload'.	Too low input voltage.	• Increase the supply voltage, to 30 VDC or higher.
	Pump is defective.	• Repair or replace the pump.
	Only helical rotor pumps. Pumped liquid is contaminated with oil or similar substance.	• Clean the liquid and replace the pump.
	Motor liquid low / Missing.	• Check or refill motor liquid.
9. Green indicator light in ON/OFF button is flashing.	Insufficient power supply.	• Increase the number of solar modules or connect an alternative energy supply, such as wind turbine, batteries or generator.
	Pump has seized up.	• Clean the pump.
10. Running light on CU 200 but low wattage.	System not grounded.	• Check system for adequate grounding
	Pump is defective.	• Repair or replace the pump. If a centrifugal pump is used: Check that the riser pipe is not blocked.
11. No light in front cover. Pump delivers water.	CU 200 is defective.	• Replace the CU 200.
	Ribbon cable not mounted.	• Mount the ribbon cable.
12. Pump does not stop when water reservoir is full. Fault indicator light on CU 200 is off.	Level switch is dirty or defective.	• Clean or replace the level switch.
	Cable on level switch is damaged.	• Replace the cable.
13. Pump does not stop when water reservoir is full. Fault indicator light on CU 200 is on.	CU 200 is defective.	• Replace the CU 200.
14. Pump does not start when water reservoir is empty. Water reservoir indicator is on.	Level switch is defective.	• Replace the level switch.
	Cable on level switch is damaged.	• Replace the cable.
	CU 200 is defective.	• Replace the CU 200.

GRUNDFOS

Company name:	-
Created by:	-
Phone:	-
Fax:	-
Date:	-

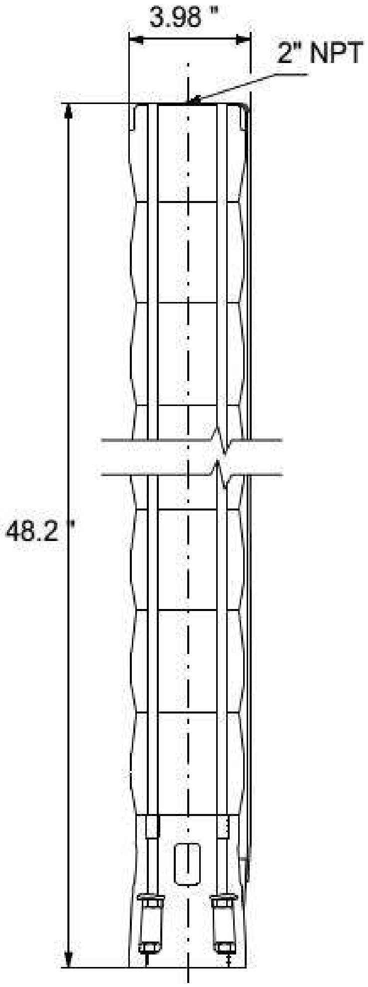
Position	Count	Description
	1	**75S100-16**

Product photo could vary from the actual product

Product No.: 07110016

Multi-stage submersible pump for raw water supply, groundwater lowering and pressure boosting. The pump is suitable for pumping clean, thin, non-agressive liquids without solid particles or fibers.

The pump is made entirely of Stainless steel DIN W.-Nr. DIN W.-Nr. 1.4301 and suitable for horizontal and vertical installation.
The pump is fitted with a built-in non-return valve.



Liquid:

Maximum liquid temperature:	104 °F

Technical:

Speed for pump data:	3450 rpm
Curve tolerance:	ISO 9906:2012 Grade 3B

Materials:

Pump:	Stainless steel DIN W.-Nr. 1.4301 AISI 304
Impeller:	Stainless steel DIN W.-Nr. 1.4301 AISI 304

Installation:

Pump outlet:	2" NPT
Motor diameter:	4 inch

Electrical data:

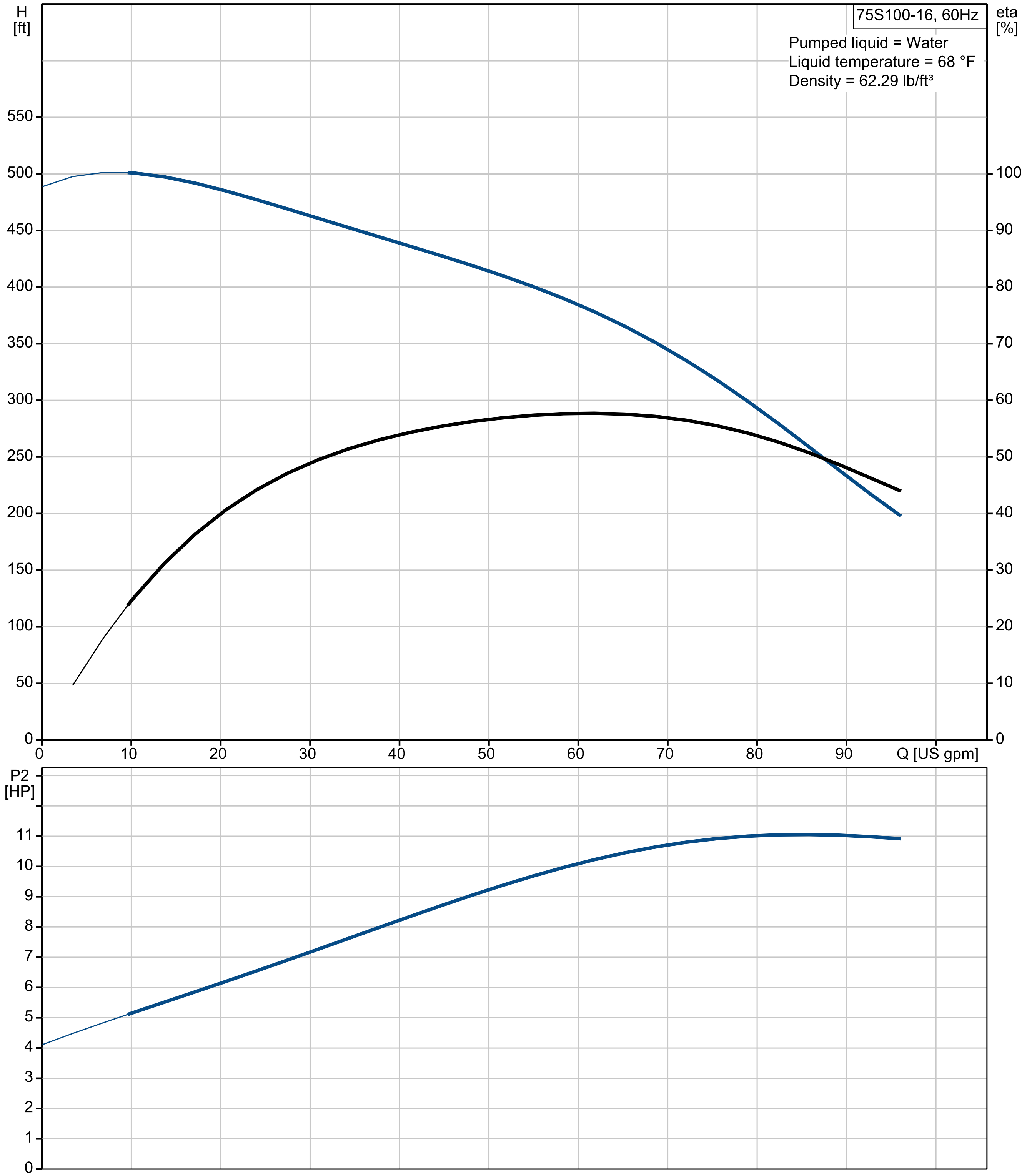
Power (P2) required by pump:	12 HP

Others:

Net weight:	28.4 lb
Gross weight:	39 lb

Company name: -
Created by: -
Phone: -
Fax: -
Date: -

07110016 75S100-16 60 Hz



Pumped liquid = Water
Liquid temperature = 68 °F
Density = 62.29 lb/ft³

Motors

4-Inch

- Super Stainless
- High Thrust

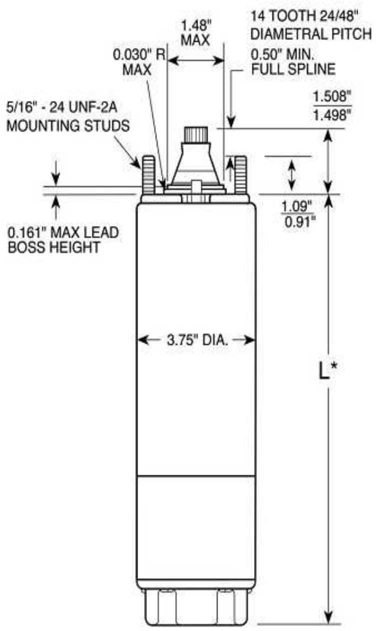
Model: 234 595 8602

4-inch Motors - High Thrust

Motor Specifications:	
Horsepower:	10
Voltage:	460/380-415
Frequency:	60/50
Phase:	Three-Phase
RPM:	3450
Service Factor:	1.15/1.00
Rotation:	CCW Facing Shaft End
Poles:	2
Downward Thrust (lbs):	1500 LBS (6500 N)
Max. Ambient Temp.:	86°F / 30°C
Duty Rating:	Continuous at 0.25 ft/sec flow past motor

Construction Materials:	
Construction:	Water Well
Length (inches):	32.18
Shipping Weight (lbs / kg):	77 / 34.9
Carton Size:	6 x 6 x 34
Stator Shell:	301 SS
Stator Ends:	Low Carbon Steel
Shaft Extension:	17-4 SS
Fasteners:	300 Series SS
Seal:	Nitrile Rubber Lip
Seal Cover:	Acetol
Slinger:	Nitrile Rubber
Lead in Motor:	YES
Lead Wire (or Cable):	XLPE*
Lead Potting:	Epoxy
Diaphragm:	Nitrile Rubber
Diaphragm Cover:	Gray Iron
Diaphragm Cup:	316 SS
Diaphragm Spring:	316 SS
Filter:	Delrin & Polyester

4" High Thrust — Dimensions
(Standard Water Well)



For specifications not included on this page, please contact Franklin's Technical Service Hotline at 800.348.2420

7. Accessories

MP 204

The MP 204 is an electronic motor protector, designed for the protection of an asynchronous motor or a pump.

The motor protector consists of:

- a cabinet incorporating transformers and electronics
- a control panel with operating buttons and display for reading of data.

The MP 204 operates with two sets of limits:

- a set of warning limits and
- a set of trip limits.

If one or more of the warning limits are exceeded, the motor continues to run, but the warnings will appear in the MP 204 display.

Some values only have a warning limit.

The warning can also be read out by means of the Grundfos R100 remote control.

If one of the trip limits is exceeded, the trip relay will stop the motor. At the same time, the signal relay is operating to indicate that the limit has been exceeded.

Applications

The MP 204 can be used as a stand-alone motor protector.

The MP 204 can be monitored via a Grundfos GENIbus.

The power supply to the MP 204 is in parallel with the supply to the motor. Motor currents up to 120 A are passed directly through the MP 204. The MP 204 protects the motor primarily by measuring the motor current by means of a true RMS measurement. The MP 204 disconnects the contactor if, for example, the current exceeds the preset value.

Secondarily, the motor is protected via temperature measuring by a Tempcon sensor, a Pt100/Pt1000 sensor and a PTC sensor/thermal switch.

The MP 204 is designed for single- and three-phase motors. In single-phase motors, the starting and run capacitors are also measured. Cos φ is measured in both single- and three-phase systems.

Benefits

The MP 204 offers these benefits:

- Suitable for both single- and three-phase motors
- Dry-running protection
- Overload protection
- Very high accuracy
- Made for submersible pumps.

Many monitoring options

The MP 204 monitors the following parameters:

- Insulation resistance before start-up
- Temperature (Tempcon, Pt sensor and PTC/thermal switch)
- Overload/underload
- Overvoltage/undervoltage
- Phase sequence
- Phase failure
- Power factor
- Power consumption
- Harmonic distortion
- Operating hours and number of starts.

TM03 1471 2205

Fig. 21 MP 204

Five sizes of single-turn transformers, 120-999 A.
Note: Monitoring of motor temperature is not possible when single-turn transformers are used.

TM03 2033 3505

Fig. 22 Single-turn transformers

Product numbers

Product	Product number
MP 204	96079927
R100	625333

Functions

- Phase-sequence monitoring
- Indication of current or temperature (user selection)
- Indication of temperature in °F or °C (user selection)
- 4-digit, 7-segment display
- Setting and status reading with the R100
- Setting and status reading via the GENIbus.

Tripping conditions

- Overload
- Underload (dry running)
- Temperature (Tempcon sensor, PTC/thermal switch and Pt sensor)
- Phase failure
- Phase sequence
- Overvoltage
- Undervoltage
- Power factor (cos φ)
- Current unbalance.

Warnings

- Overload
- Underload
- Temperature (Tempcon and Pt sensor)
- Overvoltage
- Undervoltage
- Power factor (cos φ)
  Note: In connection with single- and three-phase connection.
- Run capacitor (single-phase operation)
- Starting capacitor (single-phase operation)
- Loss of communication in network
- Harmonic distortion.

Learning function

- Phase sequence (three-phase operation)
- Run capacitor (single-phase operation)
- Starting capacitor (single-phase operation)
- Identification and measurement of Pt100/Pt1000 sensor circuit.

External current transformers

When fitted with external current transformers, the MP 204 unit can handle currents from 120 to 999 A. Grundfos can supply approved current transformers from stock (200/5A, 300/5A, 500/5A, 750/5A, 1000/5A).

Remote control R100

The R100 remote control from Grundfos allows for wireless infrared remote control of your MP 204 unit.

With the R100, you get access to a full range of options such as factory setting adjustment, service and fault finding.

Ready for bus communication

The MP 204 allows for monitoring and communication via GENIbus — a Grundfos-designed bus for exchange of pump data, alarms, status information, and setpoints. This enables users to connect the MP 204 to, for instance, SCADA systems.

Technical data - MP 204

Enclosure class	IP 20
Ambient temperature	–4 °F to +140 °F (–20 °C to +60 °C)
Relative air humidity	99%
Voltage range	100-480 VAC
Current range	3-999 A
Frequency	50 to 60 Hz
IEC trip class	1-45
Special Grundfos trip class	0.1 to 30 s
Voltage variation	–25 %/+15 % of nominal voltage
Approvals	EN 60947, EN 60335, UL/CSA 508
Marking	CE, cUL, C-tick
Consumption	Max. 5 W
Plastic type	Black PC / ABS

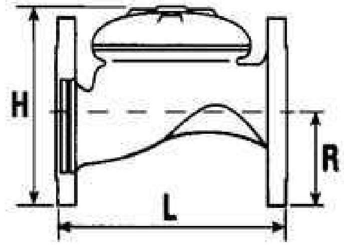
	Measuring range	**Accuracy**	**Resolution**
Current without external current transformers	3-120 A	±1 %	0.1 A
Current with external current transformers	120-999 A	±1 %	1 A
Phase-to-phase voltage	80-610 VAC	±1 %	1 V
Frequency	47-63 Hz	±1 %	0.5 Hz
Power	0-1 MW	±2 %	1 W
Power factor	0-0.99	±2 %	0.01
Energy consumption	0-4x10^9 kWh	±5 %	

Constant Pressure Pump Control Valves

Constant Pressure Experts for Over 20 Years!

CSV3B Specifications

Certified NSF/ANSI 372



Materials
- Body and cover; polyester coated cast iron
- Diaphragm retainer and spring: stainless steel
- Diaphragm: natural rubber, nylon fabric reinforced (Options -Nitrile, Buna N, EPDM)*
- Control piping: braided stainless steel
- Control fittings: brass and 304 stainless steel

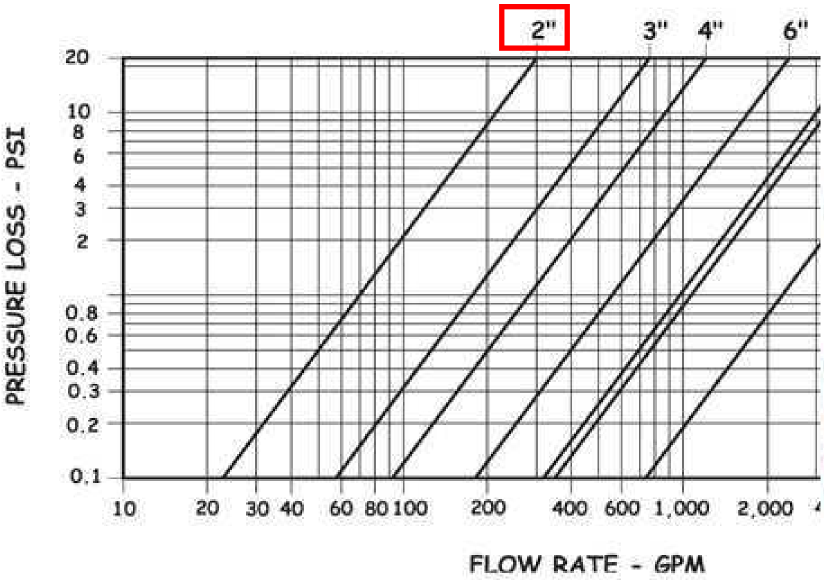
Pressure - Temperature

* Max temperature	100 degrees F
* Max shutoff head	225 PSI
* Pressure ranges	15-150 PSI
150-225 PSI available	
* Max differential pressure	125 PSI
* Min friction loss	14 PSI

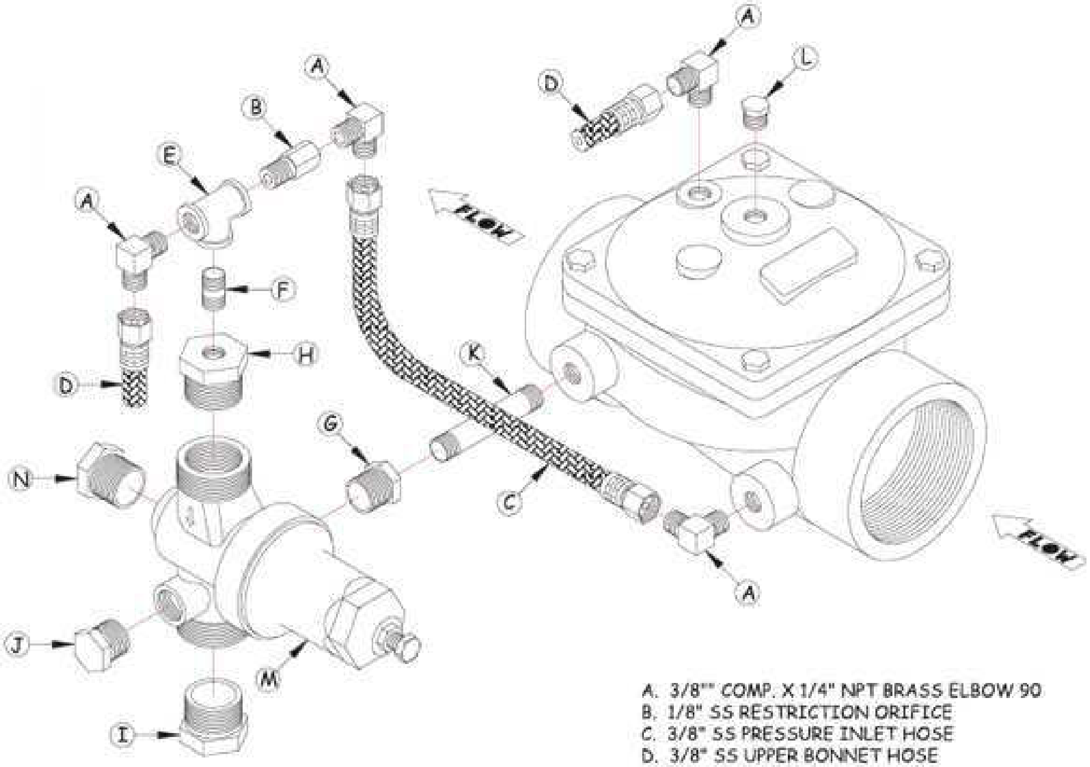
Features
- Sizes 2",3" threaded or flanged, 4",6",8", 10" and 12" flanged
- Flow ranges available between 5-5000 gpm
- Maintains constant outlet pressure
- Single chamber diaphragm operated
- Single one moving part design

Certified NSF ANSI/372 no lead

Size	2"	2"	3"	3"	4"	6"	8"	10"	12"
Type	Threaded	Flanged	Threaded	Flanged	Flanged	Flanged	Flanged	Flanged	Flanged
L	6 7/8	8 1/16	9 13/16	9 13/16	12 5/8	16 5/16	19 11/16	23 13/16	28 1/2
H	4 15/16	6	6 5/16	8 1/16	9 1/2	13 5/16	16 15/16	18 1/8	25
Width	4 3/4	6 1/8	6 7/8	7 7/8	8 3/4	12 3/8	15 3/8	15 15/16	22 7/8
R	1 1/2	3 1/16	2 3/16	3 15/16	4 7/16	5 1/2	6 11/16	7 15/16	9 7/16
Weight	18	25	35	45	65	150	309	329	680



CSV3B2TA Parts Breakdown



CSV3B2 A
VALVE PLUMBING

A. 3/8"" COMP. X 1/4" NPT BRASS ELBOW 90
B. 1/8" SS RESTRICTION ORIFICE
C. 3/8" SS PRESSURE INLET HOSE
D. 3/8" SS UPPER BONNET HOSE
E. 1/4" SS TEE
F. 1/4" x CLOSE SS NIPPLE
G. 1/2" X 1/4" SS REDUCER BUSHING
H. 1" X 1/4" SS REDUCER BUSHING
I. 1" PVC PLUG
J. 1/2" PVC PLUG
K. 1/4" X 2" SS NIPPLE
L. 1/4" PVC PLUG
M. CSV1A PILOT VALVE
N. 3/4" PVC PLUG

CSV3B Troubleshooting

Symptom	**Cause**	**Remedy**
Pump is cycling off and on	Pilot screen is stopped up	Clean screen (2003 or older models)
	Pressure switch is not set correctly	Cut off pressure must be at least 10 psi higher than valve set pressure.
	Valve is not set correctly	Reset valve to at least 10 PSI lower than cut off pressure
	Debri between diaphragm and seat	Clean out valve
	Waterlogged pressure tank	Replace tank
	Bad or torn diaphragm in main valve or pilot valve	Replace damaged diaphragm
Pressure modulates 10-15 PSI from set pressure	Air trapped in mainline-usually occurs on new start ups and spring start ups.	Release air from main line and reset CSV if necessary
Low Pressure	Valve is not set correctly	Reset valve
	Check colored (red on 2", orange on 3" and larger) restriction fitting on pilot for enlarged, missing, or wrong color orifice.	Replace worn orifice or get correct colored orifice.
	Demand is more than pump can provide at desired pressure	Reduce demand so it is within pump capabilities to maintain desired pressure.
Chattering valve	Pressure tank is located too far away from the valve	Relocate valve or tank to bring them closer together or add a second smaller tank to the system close to the valve.
	Too much air pressure in tank	Reduce air pressure in tank to 5-10 PSI below cut in pressure.
	Worn or defective diaphragm	Replace diaphragm

Pump rapid cycles at start up and then begins to function correctly	Pressure switch is located on the main line.	Move pressure switch to a small line at the base of the tank on a line no larger than 1 1/4" in diameter
	CSV setting is too close to cut off pressure	Set pressure switch cut off pressure at least 10 PSI higher than CSV setting
	Air pressure in tank too high	Reduce air pressure in tank to 5-10 PSI below cut in pressure
	Multiple check valves in system working against each other	Remove all but the check valve or foot valve on the pump itself
	Cut in pressure is not the same as CSV set pressure	Set pressure switch to come on at the same pressure the CSV is set to hold
	Air trapped in cover or bonnet	Loosen copper fitting on cover to release trapped air
	More than 125 psi differential between inlet and outlet pressure of valve	Reduce differential pressure or add a second valve

Cycle Stop Valves, Inc.
10221 CR 6900
Lubbock, Texas 79407
Send Email
800-652-0207
Fax: 806-885-1994

For Non-Health Hazard Applications

Job Name TW-60

Job Location ELWA Hospital Campus

Engineer

Approval

Contractor Parker Hannifin Village Marine

Approval

Contractor's P.O. No.

Representative Steve Aprill

LEAD FREE*

Series LF007

Double Check Valve Assemblies

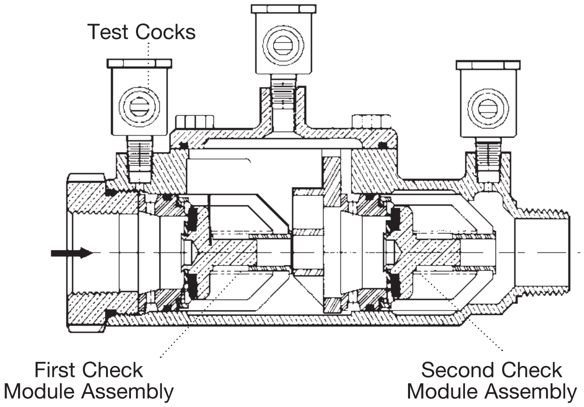
Sizes: ½" – 3" (15 – 80mm)

Series LF007 Double Check Valve Assemblies shall be installed at referenced cross-connections to prevent the backflow of polluted water into the potable water supply. Only those cross-connections identified by local inspection authorities as non-health hazard shall be allowed the use of an approved double check valve assembly. The LF007 features Lead Free* construction to comply with Lead Free* installation requirements.

Check with local authority having jurisdiction regarding vertical orientation, frequency of testing or other installation requirements.

The valve shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.

¾" (20mm) LF007M3QT



The LF007 Series features a modular design concept which facilitates complete maintenance and assembly by retaining the spring load.

Features

- Ease of maintenance — only one cover
- Top entry
- Replaceable seats and seat discs
- Modular construction
- Compact design
- Lead Free* cast copper silicon alloy body construction — ½" – 2" (15 – 50mm)
- Fused epoxy coated cast iron body — 2½" – 3" (65 – 80mm)
- Top mounted Lead Free* ball valve test cocks
- Low pressure drop
- No special tools required for servicing
- ½" – 1" (15 – 25mm) have tee handles

Specifications

A Double Check Valve Assembly shall be installed at each noted location. The assembly shall consist of two positive seating check modules with captured springs and rubber seat discs. The check module seats and seat discs shall be replaceable. Service of all internal components shall be through a single access cover secured with stainless steel bolts. The Double Check Valve Assemblies shall be constructed using Lead Free* cast copper silicon alloy. Lead Free* Double Check Valve Assemblies shall comply with state codes and standards, where applicable, requiring reduced lead content. The assembly shall also include two resilient seated isolation valves; four top mounted, resilient seated test cocks. The assembly shall meet the requirements of ASSE Std. 1015 and AWWA Std. C510. Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. Assembly shall be a Watts Series LF007.

NOTICE

Inquire with governing authorities for local installation requirements

***The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.**

WATTS®

Pressure — Temperature

½" – 2" (15 – 50mm)

Temperature Range: 33°F – 180°F (0.5°C – 82°C).

Maximum Working Pressure: 175psi (12.1 bar).

2½" – 3" (65 – 80mm)

Temperature Range: 33̊F – 110°F (0.5̊C – 43°C) continuous, 140°F (60°C) intermittent.

Maximum Working Pressure: 175psi (12.1 bar).

Standards

ASSE Std. 1015, AWWA Std. C510

IAPMO PS31, CSA B64.5

Approvals

- † ASSE, AWWA, IAPMO, CSA, UPC
- ▲ Approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California.
- • Models with suffix LF and S are not listed.
- ◆ UL Classified (without shutoff valves only) ¾" – 2" (20 – 50mm) (except 007M3LF)
- ◆ UL Classified with OSY gate valves (2½" and 3" horizontal only.)
- ▼ ½" - 2" models Lead Free* with strainer

Horizontal and vertical "flow up" approval on all sizes

Models

Sizes:

½" – 2" (15 – 50mm)

Suffix:

S - copper silicon alloy strainer

LF - without shutoff valves

Prefix:

U - Union connections

2½" – 3" (65 – 80mm)

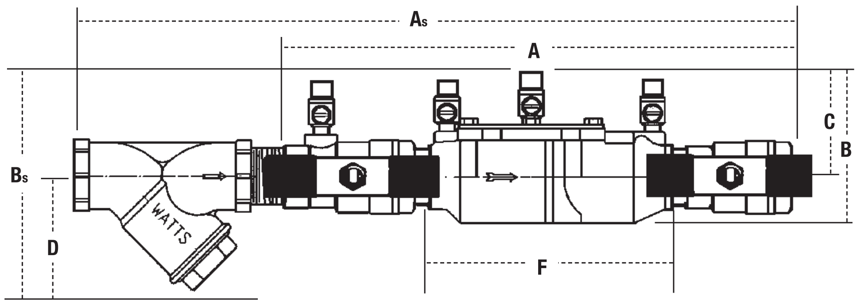
Suffix:

NRS - non-rising stem resilient seated gate valves

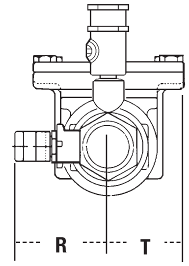
OSY - UL/FM outside stem and yoke resilient seated gate valves

LF - without shutoff valves

QT-FDA - FDA epoxy coated quarter-turn ball valves



Subscript 'S' = strainer model



Dimensions – Weights

MODEL	SIZE (DN)		DIMENSIONS																WEIGHT	
			A		B		C		D		F		G		R		T			
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lbs.	kgs.
†▲▼ LF007QT	½	15	10	254	4⅝	117	2 7/16	62	—	—	5	127	3⅜	85	2 5/16	59	2 1/16	52	4.5	2
†▲▼ LF007M3QT	¾	20	11⅛	282	4	102	3⅛	79	—	—	6 3/16	157	3 7/16	87	2⅛	54	15/16	33	5	2.3
†▲▼ LF007M1QT	1	25	13¼	337	5⅛	130	4	102	—	—	7½	191	3⅜	85	1 11/16	43	1 11/16	43	12	5.4
†▲▼ LF007M2QT	1¼	32	16⅜	416	5	127	3 5/16	84	—	—	9½	241	5	127	3	76	2	50	15	6.8
†▲▼ LF007M2QT	1½	40	16¾	425	4⅞	124	3½	89	—	—	9¾	248	5 13/16	148	3⅛	79	2 11/16	68	15.9	7.2
†▲▼ LF007M1QT	2	50	19½	495	6¼	159	4	102	—	—	13⅜	340	6⅛	156	3 7/16	87	2 11/16	68	25.7	11.7
•▼ LF007QT-S	½	15	13	330	6	152	2 7/16	62	3	76	5	127	3⅜	85	2 5/16	59	2 1/16	52	5.5	2.5
•▼ LF007M3QT-S	¾	20	14½	368	6⅛	156	3⅛	79	3	76	6 3/16	157	3 7/16	87	2⅛	54	15/16	33	6.7	3.1
•▼ LF007M1QT-S	1	25	17 15/16	157	7¾	197	4	102	3¼	83	7½	191	3⅜	85	1 11/16	43	1 11/16	43	14	6.4
•▼ LF007M2QT-S	1¼	32	21½	546	7 1/16	179	3 5/16	84	3½	83	9½	241	5	127	3	76	2	50	19	8.6
•▼ LF007M2QT-S	1½	40	25 1/16	637	7 1/16	179	3½	89	3¾	95	9¾	248	5 13/16	148	3⅛	79	2 11/16	68	19.6	8.9
•▼ LF007M1QT-S	2	50	27¼	692	8¾	222	4	102	4	102	13⅜	340	6⅛	156	3 7/16	87	2 11/16	68	33.5	15.2

WELLMATE® CLASSIC
RESIDENTIAL CAPTIVE AIR TANKS

TIME-TESTED RELIABILITY, PREFERRED BY PROS

MADE IN THE USA OF FOREIGN & DOMESTIC PARTS

High impact CPVC drain assembly – offers both flexibility and durability

The Pentair® Wellmate® Classic series of captive air tanks utilize a high impact CPVC service connection that allows for both installation flexibility and unmatched durability.

FEATURES/BENEFITS

100% composite construction is scratch, dent and corrosion resistant

Lightweight, high-strength construction – ease of installation and serviceability

High-impact CPVC drain assembly. Use the threads, or cut it off, the choice is yours!

Seamless, durable PEU aircell is fully replaceable and constructed of heavy-gauge engineered polymer

APPLICATIONS

Residential

Light Commercial

Agricultural

ORDERING INFORMATION

MODEL #	SPECIFICATIONS				DIMENSIONS			PALLET QTY
	CAPACITY GAL / LITRE	MAXIMUM OPERATING PRESSURE PSI / kPa / BAR	DRAWDOWN 30 / 50 SETTING GAL / LITRE	SYSTEM CONNECTION	DIAMETER INCH / CM	OVERALL HEIGHT INCH / CM	HEIGHT INLET / OUTLET TO FLOOR INCH / CM	
WM-4	14.5 / 55	125 / 862 / 8.5	4.5 / 17.0	1" MNPT	16 / 41	27.5 / 70	1.75 / 4.4	9
WM-6	19.8 / 75	125 / 862 / 8.5	6.1 / 23.1	1" MNPT	16 / 41	32.5 / 82.5	1.75 / 4.4	9
WM-9	29.5 / 112	125 / 862 / 8.5	9.1 / 34.4	1" MNPT	16 / 41	44.5 / 113	1.75 / 4.4	9
WM-12	40.3 / 153	125 / 862 / 8.5	12.5 / 47.3	1" MNPT	16 / 41	57.6 / 146.3	1.75 / 4.4	9
WM-14WB	47.1 / 178	125 / 862 / 8.5	14.6 / 55.3	1.25" MNPT	21 / 53	42 / 106.3	2.25 / 5.7	4
WM-20WB	60 / 227	125 / 862 / 8.5	18.5 / 70.0	1.25" MNPT	24 / 61	42.3 / 107.3	2.25 / 5.7	4
WM-23	79.6 / 301	125 / 862 / 8.5	24.6 / 93.1	1.25" MNPT	21 / 53	62.8 / 159.5	2.25 / 5.7	4
WM-25WB	86.7 / 328	125 / 862 / 8.5	26.8 / 101.5	1.25" MNPT	24 / 61	56 / 142.3	2.25 / 5.7	4
WM-35WB	119.7 / 453	125 / 862 / 8.5	37 / 140.1	1.25" MNPT	24 / 61	75 / 190	2.25 / 5.7	n/a

ACCESSORIES / REPLACEMENT PARTS

AIRCELL REPLACEMENT KITS	
PART #	DESCRIPTION
CH4989	WM Bag Kit WM-4/WM0060 / CPV-15T REPL
CH3133-2	WM Bag Kit WM-6/WM0075 / CPV-20T REPL
CH3134-2	WM Bag Kit WM-9/WM0120 / CPV-30T REPL
CH3135-2	WM Bag Kit WM-12/WM0150 / CPV-40T REPL
CH4466	WM Bag Kit WM-14WB/WM0180 / CPV-47T REPL
CH4846	WM Bag Kit WM-20WB/WM0235 / CPV-62T REPL
CH15304	WM Bag Kit WM-23
CH4467	WM Bag Kit WM-2WB/WM0330 / CPV-87T REPL
CH4468	WM Bag Kit WM-35WB/WM0450 / CPV-119T REPL
CH12762	WM Bag Kit WM-6LP/WMLP-075
CH12763	WM Bag Kit WM-10LP/WM-LP130 REPL

SERVICE PARTS	
PART #	DESCRIPTION
CH5484-1	WM Drain One PC BTM REPL WM-4/6/9/12
CH4233	WM Drain Kit BTM REPL WM-14/35WB
CH10795	Base WM 16" Modified (3) Side Holes
CH10798	Base WM 21"/24" Modified (3) Side Holes
CH11577-2	Base WM-14WB Black w/Grommets

Tested and Certified by the Water Quality Association (WQA) to NSF/ANSI-61, Section 8 and NSF/ANSI 372.

PENTAIR

FILTRATION & PROCESS
5730 NORTH GLEN PARK ROAD, MILWAUKEE, WI 53209
262.238.4400, CUSTOMER CARE: 800.279.9404, WWW.PENTAIRAQUA.COM

PENTAIR

STRUCTURAL®
COMPOSITE PRESSURE VESSELS

DESIGNED FOR COMMERCIAL SOFTENING AND FILTRATION APPLICATIONS

Pentair® Structural® Composite Pressure Vessels offer reinforced fiberglass construction for outstanding performance and durability. Available in capacities up to 1,600 gallons, composite vessels are available with a variety of different configurations. ASME code available.

FEATURES/BENEFITS

For commercial and industrial water treatment and storage

100% composite fiberglass construction

Outstanding performance and durability in harsh chemical environments

Absolutely will not – and cannot – rust

Requires little or no maintenance

Capacities up to 1,600 gallons

Factory-backed five-year warranty

Commercial softening and filtration

MATERIAL OF CONSTRUCTION

Polyethylene inner shell

INSTALLATION TIPS

Bolt base to floor

Calculate height for valve and base combined

COLOR OPTIONS

AL – Almond
BL – Blue
BK – Black
GR – Gray
NA – Natural

OPERATING PARAMETERS

Maximum operating pressure – 150 psi

Maximum operating temperature – 120° F (threaded); 150°F (flanged)

PENTAIR DESIGN PARAMETERS

Safety factor: 4:1

Minimum burst at 600 psi

Tested to 250,000 cycles without leakage

NSF DESIGN PARAMETERS

Safety factor: 4:1

Minimum burst at 600 psi

Tested to 100,000 cycles without leakage

ASME DESIGN PARAMETERS

Top/Bottom Flange
- Safety factor – 5:1
- Minimum burst at 750 psi
- Tested to 33,000 cycles without leakage

Side Flange
- Safety factor – 6:1
- Minimum burst at 900 psi
- Tested to 100,000 cycles without leakage

NSF® COMPONENT

Vessels Tested and Certified by NSF International to NSF/ANSI Standard 61 for material and structural integrity requirements.

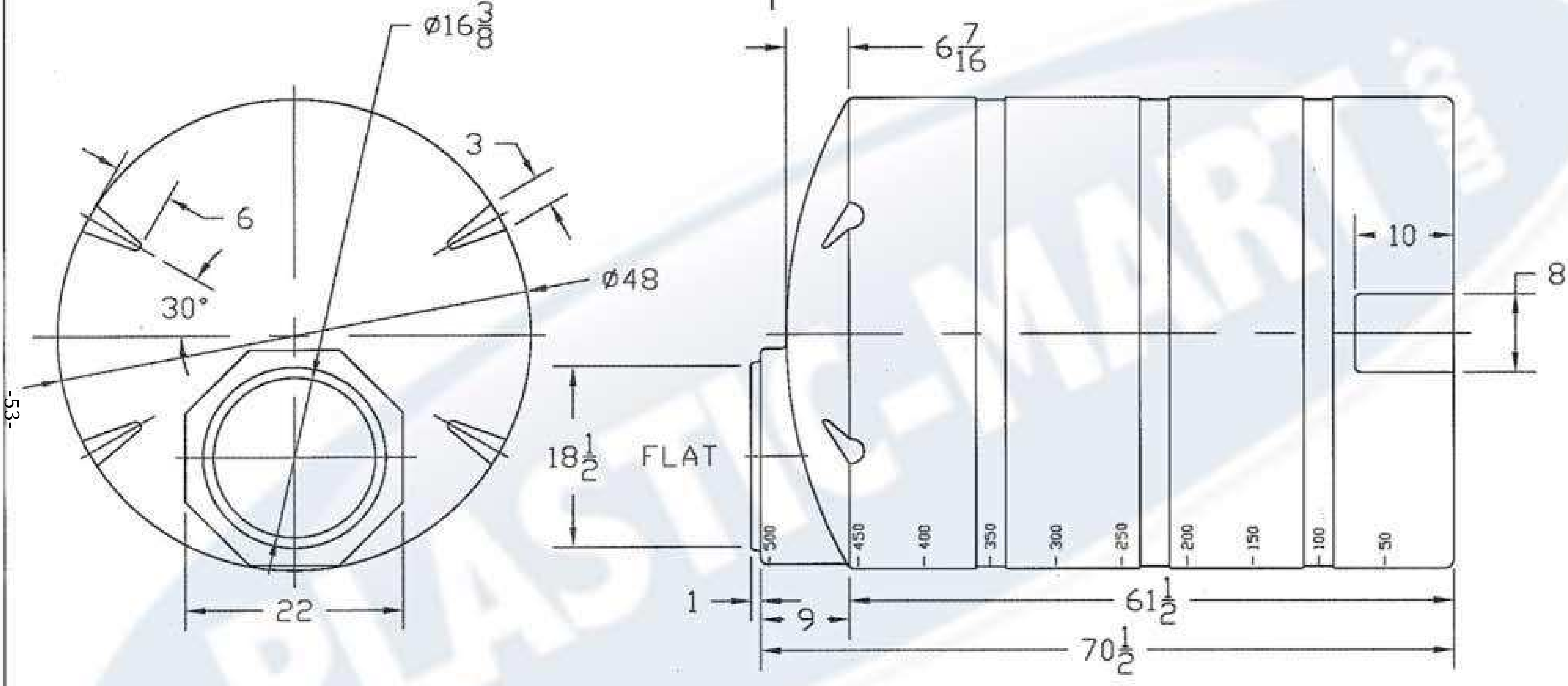
SPECIFICATIONS

VESSEL	PART NO.	DESCRIPTION	HEIGHT W/BASE INCHES / MM	HEIGHT W/O BASE INCHES / MM	CAPACITY GALLONS / LITERS	CUBIC FEET	BASE	SHIP WEIGHT LBS.
18" DIA.	CH30948	18X65 COMP 4"T	66.25 / 1683	65.07 / 1669	64 / 242	8.56	SMC	67
	CH31343	18X65 COMP 4"T 4"B	73.13 / 1858	65.6 / 1394	64 / 242	8.56	SMC EXT	67
	CH31693	18X65 COMP 6"TF 6"BF	84.12 / 2137	70.5 / 1791	62 / 234	8.29	SMC EXT	92
21" DIA.	CH30950	21X36 COMP 4"T	41.7 / 1059	38.2 / 970	45 / 171	6.06	SMC	46
	CH31573	21X36 COMP 4"T 4"B	47.5 / 1205	38.25 / 970	45 / 171	6.06	SMC EXT	53
	CH30953	21X62 COMP 4"T	67.0 / 1702	63.4 / 1610	84 / 318	11.23	SMC	95
	CH30954	21X62 COMP 4"T 4"B	72.8 / 1848	63.5 / 1613	84 / 318	11.23	SMC EXT	95
24" DIA.	CH31043	24X38 COMP 4"T	42.6 / 1081	38.5 / 978	61 / 231	8.15	SMC	65
	CH31053	24X50 COMP 4"T	55.6 / 1412	52.9 / 1343	83.5 / 316	11.16	SMC	90
	CH31611	24X50 COMP 4"T 4"B	63 / 1601	52.9 / 1343	83.5 / 316	11.16	SMC EXT	90
	CH32049	24X65 COMP 4"T	65.2 / 1655	61.1 / 1552	100 / 378	13.36	SMC	109
	CH32481	24X65 COMP 4"T 4"B	70.1 / 257	60 / 1524	100 / 378	13.36	SMC EXT	115
	CH32129	24X65 COMP 6"TF	65 / 1651	61.2 / 1556	100 / 378	13.36	SMC	114
	CH32139	24X65 COMP 6"TF 6"BF	79 / 2007	65 / 1651	100 / 378	13.36	TRIPOD	114
	CH31153	24X72 COMP 4"T	74.7 / 1897	70.12 / 1781	118 / 451	15.77	SMC	109
	CH31154	24X72 COMP 4"T 4"B	80.4 / 2043	70.3 / 1786	118 / 451	15.77	SMC EXT	124
	CH31155	24X72 COMP 6"TF	77 / 1956	73.4 / 1864	118 / 451	15.77	SMC	137
	CH31157	24X72 COMP 6"TF 6"BF	88.5 / 2248	74.5 / 1892	118 / 451	15.77	TRIPOD	137
30" DIA.	CH34177	30X60 COMP 6"TF	71.6 / 1819	64.3 / 1634	151 / 572	20.2	SMC EXT	195
	CH34178	30X60 COMP 6"TF 6"BF	82.5 / 2096	68.5 / 1740	151 / 572	20.2	TRIPOD	195
	CH33653	30X72 COMP 4"T	78.9 / 2004	69.8 / 1772	187 / 708	24.99	SMC EXT	198
	CH31161	30X72 COMP 4"T 4"B	77.2 / 1961	69.8 / 1772	187 / 708	24.99	SMC EXT	198
	CH31162	30X72 COMP 6"TF	83.7 / 2126	69.9 / 1778	187 / 708	24.99	SMC EXT	195
	CH31163	30X72 COMP 6"TF 6"BF	88.9 / 2258	74.9 / 1903	187 / 708	24.99	SMC EXT	211
36" DIA.	CH31209	36X36 COMP 6"TBF	55.3 / 1403	41 / 1041	118 / 447	15.8	TRIPOD	148
	CH31417	36X57 COMP 6"TF	68 / 1727	59.3 / 1505	205 / 776	27.4	SMC EXT	225
	CH31418	36X57 COMP 6"TF 6"BF	77.3 / 1962	63 / 1600	205 / 776	27.4	TRIPOD	225
	CH33652	36X72 COMP 4"T	80.5 / 2045	71.8 / 1823	264 / 999	35.2	SMC EXT	264
	CH31523	36X72 COMP 4"T 4"B	80.5 / 2045	70.5 / 1791	264 / 999	35.2	SMC EXT	285
	CH31214	36X72 COMP 6"TF	83 / 2108	74.3 / 1886	264 / 999	35.2	SMC EXT	285
	CH31217	36X72 COMP 6"TF 6"BF	90.4 / 2296	76.1 / 1934	264 / 999	35.2	TRIPOD	285
	CH31712	36X72 COMP 6"TF 6"BF 4"TBSF	89.6 / 2275	75.3 / 1913	264 / 999	35.2	TRIPOD	292
42" DIA.	CH31272	42X72 COMP 6"TF	72.5 / 1842	71.1 / 1807	345 / 1306	46.1	SMC	370
	CH31276	42X72 COMP 6"TF 6"BF	90.1 / 2289	73 / 1854	345 / 1306	46.1	TRIPOD	400
	CH34226	42X72 COMP 6"TF 6"BF 4"TBSF	94.6 / 2403	77.5 / 1969	345 / 1306	46.1	TRIPOD	415
48" DIA	CH31281	48X72 COMP 6"TF	81.5 / 2071	75.2 / 1909	463 / 1753	61.9	SMC	494
	CH31285	48X72 COMP 6"TF 6"BF	92.9 / 2360	76.9 / 1953	463 / 1753	61.9	TRIPOD	494
	CH31283	48X72 COMP 6"TF 6"BF 4"TBSF	96.75 / 2458	80.75 / 2051	463 / 1753	61.9	TRIPOD	504
63" DIA.	CH31390	63X67 COMP 6"TF 6"BF	81.4 / 2068	67.1 / 1704.3	600 / 2271	80.2	TRIPOD	680
	CH31326	63X86 COMP 6"TF 6"BF	98.5 / 2503	84.1 / 2136	900 / 3407	120.3	TRIPOD	950
	CH31327	63X86 COMP 16"TMWY 6"BF	99 / 2515	84.5 / 2146	900 / 3407	120.3	TRIPOD	950
	CH31292	63X86 COMP 16"TMWY 6"BF 4"TBSF	99 / 2515	85 / 2159	900 / 3407	120.3	TRIPOD	950
	CH34234	63X116 16"TMWY 6'BF 4"TBSF	130 / 3302	115.9 / 2945	1250 / 4732	167	TRIPOD	1190
	CH31607	63X144 16"TMWY 6'BF 4"TBSF	157.9 / 4012	143.9 / 3656	1600 / 6057	214	TRIPOD	1398

*Measurements are subject to change without notice and are for reference only.
NOTE: Flexible connections must be installed between hard piping and tank openings. Failure to install flex connection properly with the vessel will void the warranty.
NOTE: Different base options can be selected on different tank diameters. The bases selected above illustrate most common base selection.

REVISIONS

ZONE	REV	DESCRIPTION	DATE	APPROVED
	B	REDRAWN	02JAN97	



NORWESCO
ST. BONIFACIUS, MN

500 GALLON VERTICAL TANK

JTP 02JAN97

SIZE A
FSCM NO.
DWG NO.
REV B
SCALE 1/16
SHEET

TW-60 Water Treatment System

section 5

Owner's Manual

UVMAX™

Pro Series (Pro10, Pro10S, Pro20, Pro20S, Pro30, Pro 30S, Pro50)
Plus Series (G Plus, H Plus, J Plus, K Plus)
Basic Series (G, H, J, K)

Ultraviolet Water Purification System

Congratulations. By purchasing this system, you have taken the first step in ensuring safe drinking water. Designed using the most advanced UV technology available today, your UV system is designed to provide you with years of trouble free operation with minimal maintenance required.

Date of installation: _ _ _ _ _ _ _ _ _ _ _ _
Installed by: _ _ _ _ _ _ _ _ _ _ _ _
Installer phone #: _ _ _ _ _ _ _ _ _ _ _ _
Serial #: _ _ _ _ _ _ _ _ _ _ _ _
(Found on label on side of Power Supply)

KEY INFORMATION YOU SHOULD KNOW:

- A minimum of one 5-micron (nominal) sediment filter must be installed upstream of (before) any UV system.
- This product is for **indoor use only**. Keep all components clean and dry.
- Clean the sleeve regularly for optimum performance.
- Ensure all performance related water quality parameters have been tested and are within specifications (page 8).

NSF
C US

Pro10, Pro10S, Pro20, Pro20S, Pro30, Pro30S System Tested and Certified by NSF International against CSA B483.1 and NSF/ANSI 55 for Disinfection Performance, Class A

UVMAX™ Pro50 model is USEPA UVDGM 2006 validated.

VIQUA - a Trojan Technologies Company
425 Clair Road West, Guelph, Ontario N1L 1R1 Canada
t. (-1) 519 763 1032 • tf. 1 800 265 7246 (North America Only) • e-mail: info@viqua.com • www.viqua.com
t. +31 73 747 0144 (Europe Only)

602936_RevP

Potential Hazard	**Safety Measures**
UV Exposure	Never illuminate UV Lamp outside of the UV Chamber. Never look directly at illuminated UV Lamp, even when using protective gear. Always use protective gear, including gloves and UV safety glasses. If accidental exposure occurs, immediately cool affected area and consult physician.
Electrical Shock	Disconnect power to system before performing any maintenance or repair. There may be more than one source of power.
Impalement	Never perform any physical inspection, repair or maintenance on UV Chamber unless UV chamber has been isolated and depressurized. Never service UV Lamps, Sleeves or associated hardware until depressurization of UV chamber has been confirmed.
Hot chamber	Allow UV Lamps, UV Chamber to cool for a minimum of 10 minutes before handling.
Cut or ingestion	Ensure the quartz sleeve or lamp is not broken, cracked or damaged in any way when handling equipment.
Scald from water	When there is no water flow, the water in the chamber will become hot. To prevent scalding, allow the system to cool before draining the system.
Fire	Do not store any combustible or flammable material close to the system.
Hg Exposure	The UV lamp contains mercury. If the lamp breaks, then avoid inhalation or ingestion of the debris and avoid exposure to eyes and skin. Never use a vacuum cleaner to clean up a broken lamp as this may scatter the spilled mercury. Obey local regulations and guidelines for the removal and disposal of mercury waste.
Water leak	Use proper plumbing materials to avoid potential material degradation from UV exposure.

SAFETY INSTRUCTIONS

GROUNDING

This product must be grounded. If it should malfunction or breakdown, grounding provides a path of least resistance for electric current to reduce the risk of electrical shock. This system is equipped with a cord having an equipment-grounding conductor and a grounding plug. The plug must be plugged into an appropriate outlet that is properly installed and grounded in accordance with all local codes and ordinances.

DANGER – Improper connection of the equipment-grounding conductor can result in a risk of electrocution. Check with a qualified electrician or service personnel if you are in doubt as to whether the outlet is properly grounded. Do not modify the plug provided with this system – if it will not fit the outlet, have a proper outlet installed by a qualified electrician. Do not use any type of adapter with this system.

GROUND FAULT CIRCUIT INTERRUPTER PROTECTION

To comply with the National Electrical Code (NFPA 70) and to provide additional protection from the risk of electric shock, this system should only be connected to a properly grounded, grounding-type power supply receptacle that is protected by a Ground Fault Circuit Interrupter (GFCI). Inspect operation of GFCI as per manufacturers suggested maintenance schedule.

EXTENSION CORDS

If an extension cord is necessary, use only 3-wire extension cords that have 3-prong grounding-type plugs and 3-pole cord connectors that accept the plug from this system. Use only extension cords that are intended for outdoor use. Use only extension cords having an electrical rating not less than the rating of the system. A cord rated for less amperes or watts than this system rating may overheat. Exercise caution when arranging the cord so that it will not be tripped over or pulled. Do not use damaged extension cords. Examine extension cord before using and replace if damaged. Do not abuse extension cord. Keep extension cord away from heat and sharp edges. Always disconnect the extension cord from the receptacle before disconnecting this system from the extension cord. Never yank cord to pull plug from outlet. Always grasp the plug and pull to disconnect.

WARNING – *Always shut-off water flow and release water pressure before servicing.*
To guard against injury, basic safety precautions should be observed, including the following:

1. READ AND FOLLOW ALL SAFETY INSTRUCTIONS.
2. DANGER – To avoid possible electric shock, special care should be taken since water is employed in the use of this system. Unless a situation is encountered that is explicitly addressed by the provided maintenance and troubleshooting sections, do not attempt repairs yourself; refer to an authorized service facility.
3. CAUTION - Do not operate with broken or faulty parts as this may result in exposure to ultraviolet radiation. Contact supplier for replacement parts.
4. Do not operate the system if it has a damaged cord or plug, or if it is malfunctioning or if it has been dropped or damaged in any manner.
5. Always unplug the system, release water pressure before servicing or cleaning. Never yank cord to remove from outlet; grasp the wall plug and pull to disconnect.
6. Do not use the system for other than intended use. The use of attachments not recommended or sold by the manufacturer may cause an unsafe condition.
7. To prevent risk of electrical shock, connect this system only to a properly grounded, grounding-type power supply receptacle that is protected by a Ground Fault Circuit Interrupter (GFCI). Inspect performance of GFCI as per manufacturer's suggested maintenance schedule. If an extension cord is used, ensure it is of a sufficient rating and accepts the plug from this system; never use an adapter.
8. Visually inspect this system prior to installation. If the quartz sleeve or lamp is broken, cracked or damaged in any way, do not use. Contact the supplier for replacement parts
9. Keep all connections dry and off the ground. Do not touch plug with wet hands.
10. The light emitted by the lamp will cause serious eye damage and burn unprotected skin. Do not plug system into an electrical outlet without first properly securing the lamp into the chamber. Unplug the system prior to removing the lamp from the chamber.
11. If the UV system malfunctions or fails, water must be boiled prior to consumption until the UV system is operational and the water lines have been shocked. System failure is indicated by the system's audible and visual alarms or the absence of any indicator light.
12. Intended for indoor use only. System must not be exposed to weather elements. In seasonal applications, chamber must be drained to prevent freezing.
13. Installation of this system must be in accordance with local plumbing and electrical codes as well as any and all applicable regulations and laws.
14. The UV system is not to be used or played with by children. Persons with reduced physical, sensory or mental capabilities, or lack of experience and knowledge, are also not to handle the UV system unless they have been given supervision or instruction.
15. SAVE THESE INSTRUCTIONS.

WARNING – To prevent risk of electrical shock, connect this system only to a properly grounded, grounding-type power supply receptacle that is protected by a Ground Fault Circuit Interrupter. Pull plug before servicing or replacing lamp. Keep all connections dry and off the ground. Do not touch plug with wet hands.

WARNING – Do not look directly at UV lamp when it is operating. The light emitted by the lamp will cause serious eye damage and burn unprotected skin.

WARNING – Read manual before installing or servicing this system. Only authorized personnel possessing a strong understanding of this system should attempt to replace lamp or service this system.

WARNING – Always shut-off water flow and release water pressure before servicing.

NOTE – Maximum pressure rating is 100 PSI (6.89 bar)

TABLE OF CONTENTS

Overview 4
  Components 4
  Specifications 5
  Dimensions and layout 7

Installation 9
  Installing the UV system 9
  Disinfecting the water lines 11

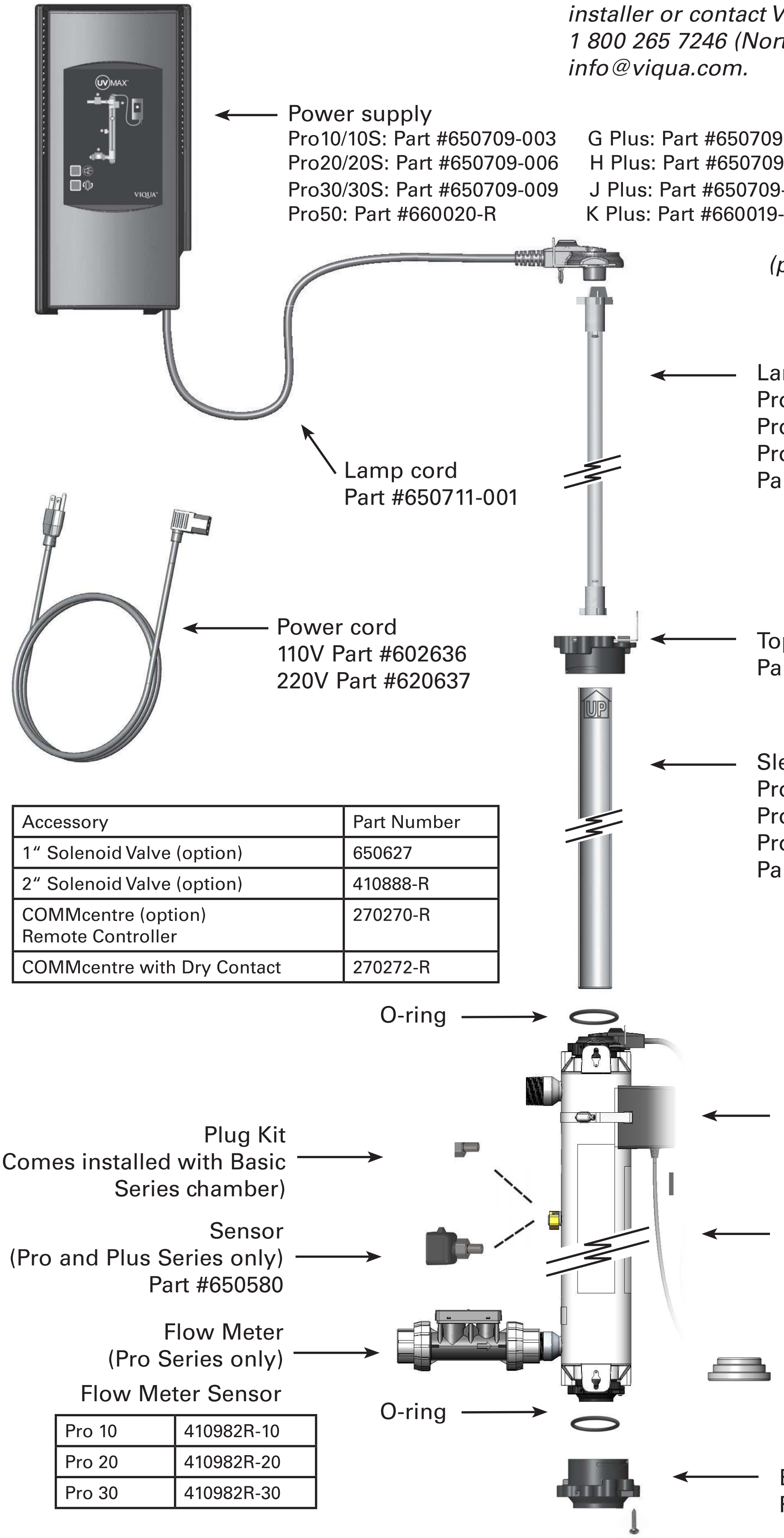
Operation 14
  Control panel 14
  Troubleshooting 15
  Low UV alarms 16

Maintenance 17
  Sleeve cleaning and lamp replacement 17
  Fuse replacement 22

Warranty 23

COMPONENTS

For replacement components please contact your installer or contact VIQUA directly for a referral: 1 800 265 7246 (North America), 519 763 1032, or info@viqua.com.



Power supply

Pro10/10S: Part #650709-003	G Plus: Part #650709-002	G: Part #650709-001
Pro20/20S: Part #650709-006	H Plus: Part #650709-005	H: Part #650709-004
Pro30/30S: Part #650709-009	J Plus: Part #650709-008	J: Part #650709-007
Pro50: Part #660020-R	K Plus: Part #660019-R	K: Part #660018-R

(power supply includes lamp cord)

Lamp
Pro10/10S, G Plus, G: Part #602854
Pro20/20S, H Plus, H: Part #602855
Pro30/30S/50, J/K Plus, J/K:
Part #602856

Lamp cord
Part #650711-001

Power cord
110V Part #602636
220V Part #620637

Top bolt & wireform
Part #602916 & 602896

Sleeve
Pro10/10S, G Plus, G: Part #602974
Pro20/20S, H Plus, H: Part #602975
Pro30/30S/50, J/K Plus, J/K:
Part #602976

Accessory	Part Number
1“ Solenoid Valve (option)	650627
2“ Solenoid Valve (option)	410888-R
COMMcentre (option) Remote Controller	270270-R
COMMcentre with Dry Contact	270272-R

O-ring

CoolTouch™ fan
Part #650630

Plug Kit
(Comes installed with Basic Series chamber)

Chamber

Sensor
(Pro and Plus Series only)
Part #650580

Flow Meter
(Pro Series only)

Sleeve removal tool
Part #602988
Note: keep this tool with system at all times.

Flow Meter Sensor

Pro 10	410982R-10
Pro 20	410982R-20
Pro 30	410982R-30

O-ring

Bottom bolt (includes screw)
Part #603053

SPECIFICATIONS

General (All Models)

Operating Parameters	
Maximum operating pressure	100 PSI (689 kPa)
Minimum operating pressure	15 PSI (103 kPa)
Maximum ambient air temperature	104^{0}F (40^{0}C)
Minimum ambient air temperature	32^{0}F (0^{0}C)
Maximum humidity	100%
Maximum hardness	120 ppm (7 grains per gallon)
Maximum iron	0.3 ppm
Minimum UVT	75% *
Installation	Vertical ONLY
Other	
Chamber material	316L SST
Rated service life of lamp	up to 2 years

* Pro50 has a minimum UVT rating of 85%

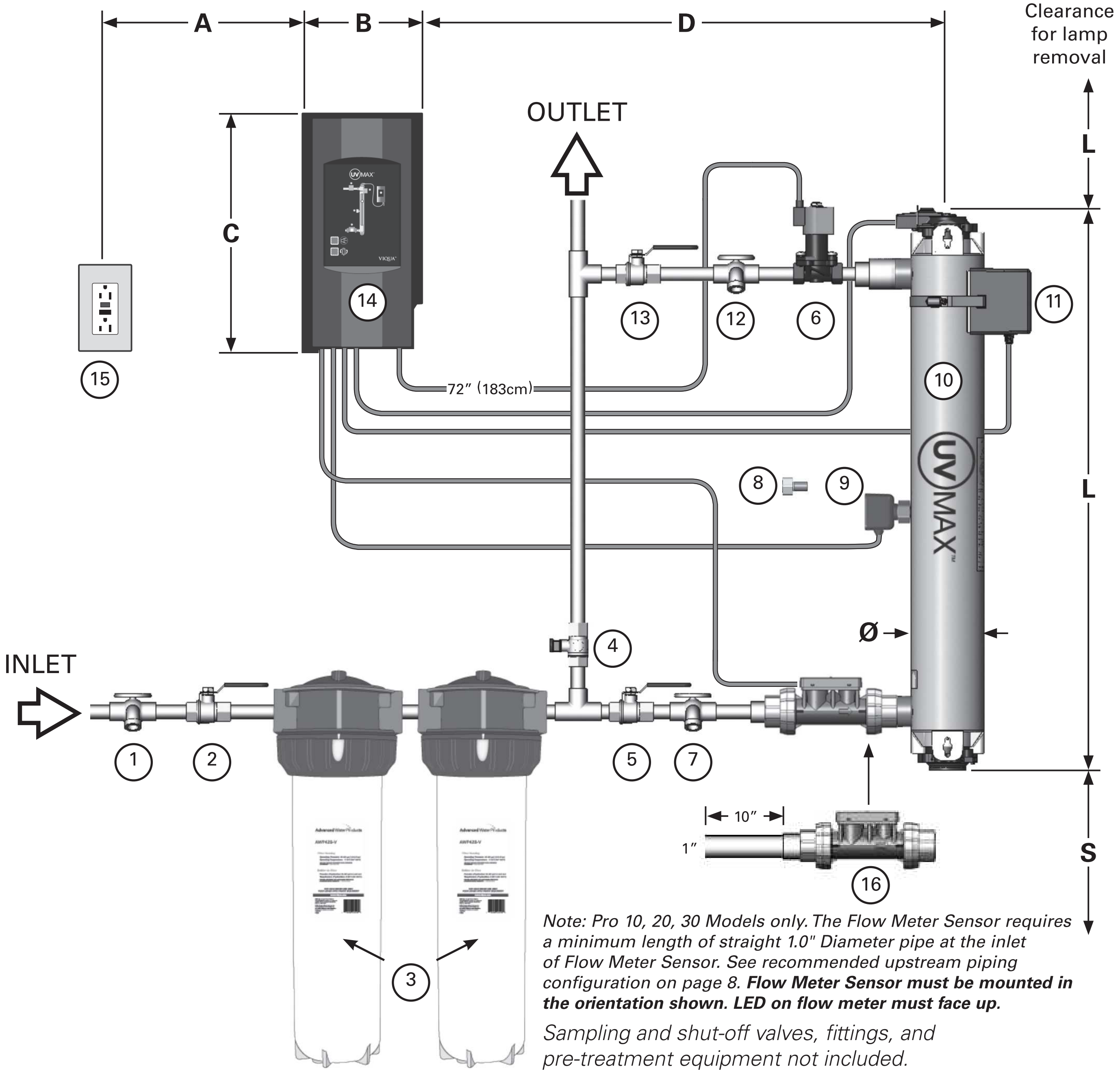
	Pro10/10S	Pro20/20S	Pro30/30S	Pro50*	G, G Plus*	H, H Plus*	J, J Plus*	K, K Plus**
Rated flow dose of 30 mJ/cm^2	--	--	--	--	up to 19 gpm (72 lpm)	20-39 gpm (76-148 lpm)	40-45 gpm (151-170 lpm)	80 gpm (303 lpm)
Rated flow dose of 40 mJ/cm^2	10 gpm (38 lpm)	20 gpm (76 lpm)	30 gpm (114 lpm)	50 gpm (189 lpm)	up to 15 gpm (57 lpm)	16-29 gpm (61-110 lpm)	30-44 gpm (114-167 lpm)	--
Electrical								
Voltage	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz	100-240V 50-60Hz
Max. current	1.2 Amp	1.6 Amp	2.4 Amp	2.4 Amp	1.2 Amp	1.6 Amp	2.4 Amp	2.4 Amp
Max. power consumption	120 Watts	160 Watts	230 Watts	230 Watts	120 Watts	160 Watts	230 Watts	230 Watts
Lamp power consumption	100 Watts	140 Watts	200 Watts	200 Watts	100 Watts	140 Watts	200 Watts	200 Watts
Port Size								
Inlet and outlet	Combo 1 ¼" NPT, 1" FNPT	Combo 1 ¼" NPT, 1" FNPT	Combo 1 ¼" NPT, 1" FNPT	2" MNPT	Combo 1 ¼" NPT, 1" FNPT	Combo 1 ¼" NPT, 1" FNPT	Combo 1 ¼" NPT, 1" FNPT	2" MNPT

*Flow rates shown are at 85% UVT.
** Flow rates show are at 95% UVT.

SPECIFICATIONS

	Pro Series	Plus Series	Basic Series
Sensor	Yes	Yes	No
CoolTouch fan	Yes	Yes	Yes
Dynamic flow restrictor	Yes (not Pro50)	No	No
Communications ports (two, RJ45)	Yes	Yes	Yes
COMMcenter control package	Optional	No	No
Solenoid valve	Optional	Optional	Optional
Flow Meter Sensor (Pro10, 20, 30 Models only)	Yes	No	No
Controls			
Audible alarm mute button	Yes	Yes	Yes
New lamp button	Yes	Yes	Yes
Lamp age indicator	Yes	Yes	Yes
Lamp operation indicator	Yes	Yes	Yes
Power supply operation indicator	Yes	Yes	Yes
Solenoid operation indicator	Yes	Yes	Yes
Fan operation indicator	Yes	Yes	Yes
Sensor reading indicator	Yes	Yes	No
NSF/ANSI certification Pro10/10S, 20/20S, 30/30S Models only)	NSF C US Standard 55 Class A	No	No
USEPA UVDGM 2006 (Pro50 model only)	Yes	No	No
Other certifications	c UL us LISTED CE	c UL us LISTED CE	c UL us LISTED CE

DIMENSIONS & LAYOUT



Note: Pro 10, 20, 30 Models only. The Flow Meter Sensor requires a minimum length of straight 1.0" Diameter pipe at the inlet of Flow Meter Sensor. See recommended upstream piping configuration on page 8. ***Flow Meter Sensor must be mounted in the orientation shown. LED on flow meter must face up.***

Sampling and shut-off valves, fittings, and pre-treatment equipment not included.

	L	S (min.)	Ø	A (max.)	B	C	D (max.)
Pro 10/10S, G Plus, G	21.4″ (55cm)	12″ (30cm)	4″ (10cm)	72″ (182cm)	6.5″ (16.5cm)	13″ (33cm)	48″ (122cm)
Pro 20/20S, H Plus, H	31" (78cm)	12" (30cm)	4" (10cm)	72" (182cm)	6.5" (16.5cm)	13" (33cm)	48" (122cm)
Pro30/30S, J Plus, J	41" (103cm)	12" (30cm)	4" (10cm)	72" (182cm)	6.5" (16.5cm)	13" (33cm)	48" (122cm)
Pro50, K Plus, K	41" (103cm)	12" (30cm)	4" (10cm)	72" (182cm)	6.5" (16.5cm)	13" (33cm)	48" (122cm)

Note: ***Prefilter should be sized to accommodate the UV systems maximum flow rate.***

① Sample valve: Allows for sampling of raw water.

② Shut-off valve: Required to allow maintenance of pre-treatment equipment.

③ Pre-treatment: For the UV system to operate effectively, the water should meet certain water quality parameters, as outlined below. To meet these, pre-treatment of the water may be required. Pre-treatment equipment must be installed BEFORE the UV chamber. Pre-treatment systems can be comprised of one or more of the following elements: sediment filters; carbon filters; iron removal systems; water softeners; cyst reduction filters, etc.

Water Quality Requirements:
Iron: < .3 PPM (.3 mg/L)
Hardness: < 120 PPM (7 Grains Per Gallon)
% UVT: > 75%
> 85% (Pro 50)

NOTE: These are minimum requirements. For optimum results treat all to ND (non detectable) levels if possible.

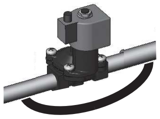
IMPORTANT: Minimum of one 5 micron (nominal) sediment filter must be installed before the UV system and after any water softening equipment.

④ Bypass shut-off valve: Bypass line and valve are optional. Intended to provide emergency water supply in the event that the UV system is unavailable.

⑤ Shut-off valve: Required to allow maintenance of UV system.

⑥ Solenoid valve: Optional piece of equipment supplied by VIQUA - a Trojan Technologies Company. Allows water supply to be shut-off when proper disinfection cannot be assured (1" & 2" SOLENOID available).

Note: If the ground from your electrical panel is tied to your copper water lines, and you are using a Plastic Body solenoid valve, installation of an approved ground strap is required. This ground strap will maintain continuity between the lines that have been cut to install the solenoid. Check your local electrical code for the correct clamp and cable size.



⑦ Sample valve: Allows for sampling of water entering UV chamber; necessary in order to confirm water being treated is of adequate quality.

⑧ Plug kit: A stopper provided and installed on Basic models.

⑨ Sensor: Monitors UV output to ensure proper dose (UV exposure) is being provided.

⑩ UV chamber: Provides disinfection of the water. MUST BE INSTALLED VERTICALLY.

⑪ CoolTouch™ fan: Removes excess heat from water in chamber during periods without water flow.

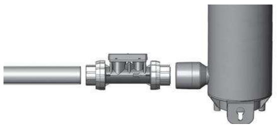
⑫ Sample valve: Allows for sampling of water immediately following UV treatment; necessary in order to confirm proper operation of UV system.

⑬ Shut-off valve: Required to allow maintenance of UV system.

⑭ Power supply: Powers and controls the UV lamp and other devices. Provides human interface, displaying information and allowing control inputs (such as muting the audible alarm).

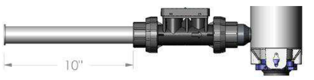
⑮ Power source: Provides power to the power supply. For safety reasons the outlet must be protected by a Ground Fault Circuit Interrupter (GFCI). NOTE: to protect the power supply, a UL1449 certified (or equivalent) transient voltage surge suppressor is required.

⑯ Flow Sensor: Monitors flow to provide real time dose (UV exposure) Flow Meter Sensor must be installed in this orientation with the LED facing up. (Pro10, Pro20, Pro30 only)

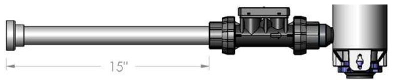


Recommended Minimum Straight Pipe Lengths for the Various piping configurations

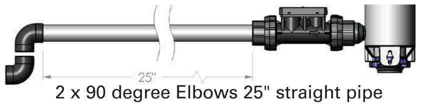
Note: Flow Meter Sensor must be mounted in the following orientation with the LED facing up. Ensure all air is purged from the piping and Flow Meter Sensor. All straight length to the Flow Meter Sensor must be 1.00" in diameter



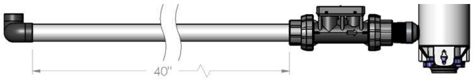
Straight Flange 10" straight pipe



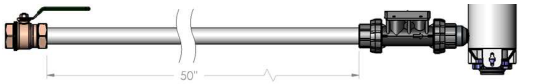
Reducing Flange 15" straight pipe



2 x 90 degree Elbows 25" straight pipe



2 x 90 degree Elbows 3 dimensions 40" straight pipe



Pump 50" straight pipe

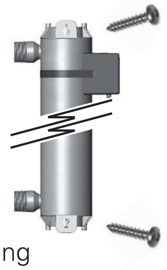
INSTALLING THE UV SYSTEM

① Determine appropriate indoor location of the power supply and chamber, referring to Dimensions and Layout drawing. Power supply should be installed higher than chamber away from all water sources. Ensure adequate clearance above chamber to allow for removal of the lamp and sleeve.

② Attach chamber to wall VERTICALLY ONLY.

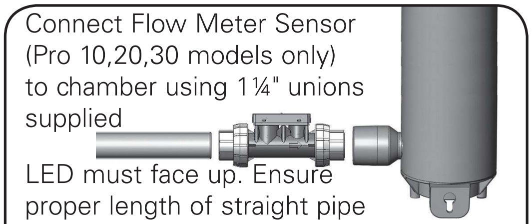
Install screws apart:

G, Pro10/10S: 18.5"
H, Pro20/20S: 27.5"
J, K, Pro30/30S/50: 37.5"



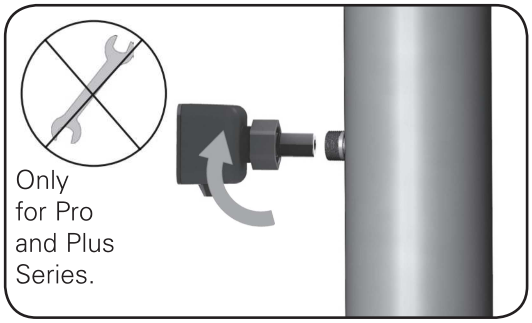
Make all necessary plumbing connections.

③ Connect Flow Meter Sensor (Pro 10,20,30 models only) to chamber using 1¼" unions supplied



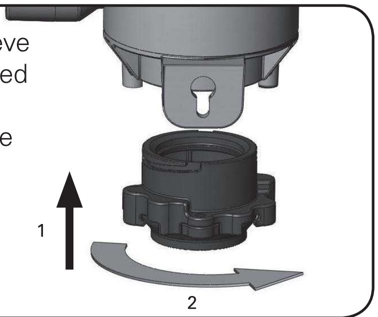
LED must face up. Ensure proper length of straight pipe 1.0" Diameter at inlet side of Flow Meter Sensor and use a 1¼" to 1" Reducing Coupler (not supplied)

④



Only for Pro and Plus Series.

⑤ Ensure sleeve bolt is rotated full 1/4 turn until positive stop.



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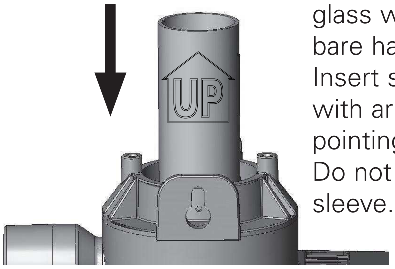
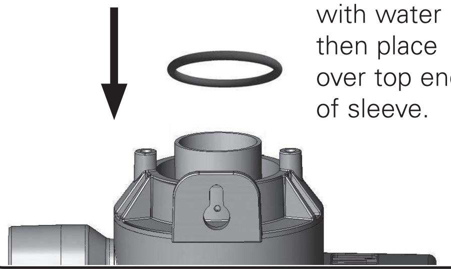


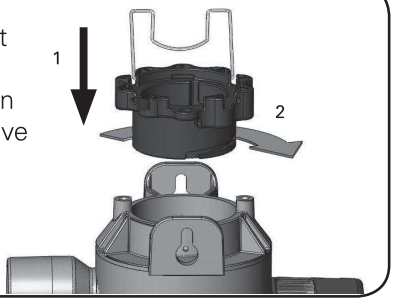
Do not touch glass with bare hands. Insert sleeve with arrow pointing up. Do not rotate sleeve.

⑦

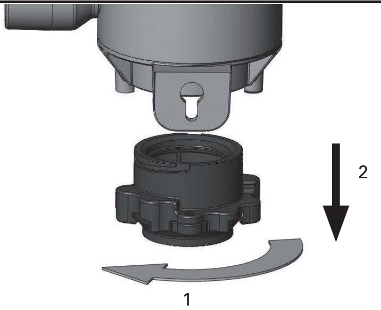


Wet O-ring with water then place over top end of sleeve.

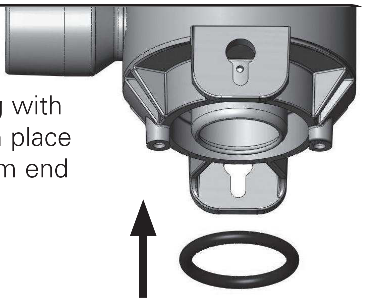
⑧ Ensure sleeve bolt is rotated full 1/4 turn until positive stop.



⑨



⑩ Wet O-ring with water then place over bottom end of sleeve.



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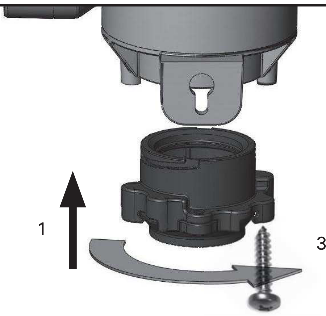
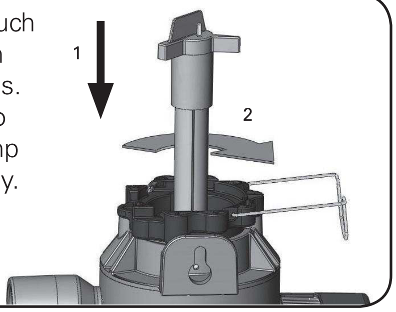


3 Install screw.

⑫

Do not touch glass with bare hands. Be sure to rotate lamp completely.



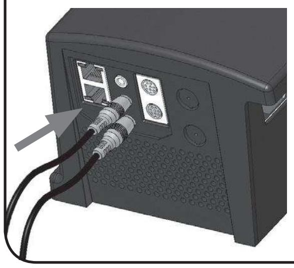
⑬

⑭

Plug UV sensor into blue jack.

(For Pro and Plus Series only).

⑮



Plug Flow Meter Sensor into green jack

(for Pro Plus series only)

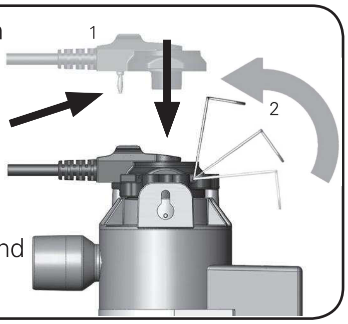
⑯

Plug CoolTouch fan into either receptacle.

⑰

Lock wireform into position.

Note: Ensure lamp harness ground is inserted into chamber ground terminal



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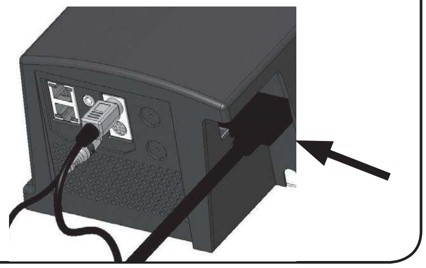
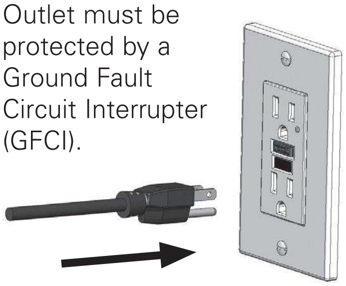


⑲

Outlet must be protected by a Ground Fault Circuit Interrupter (GFCI).



⑳

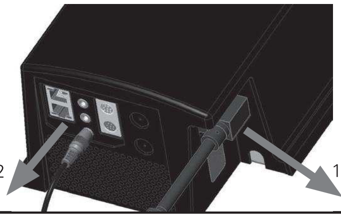
Let water flow to one faucet or other water outlet, then close the outlet and check for leaks.

Proceed to Disinfecting The Water Lines.

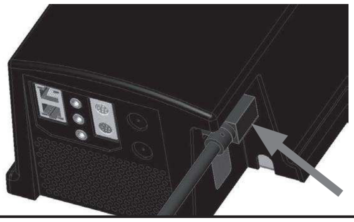
DISINFECTING THE WATER LINES

UV systems disinfect the water using ultraviolet light, treating the water as it passes through the system. When there is a risk that water downstream of the UV system has been contaminated it is critical that these water lines be chemically disinfected. Disinfection of the water lines is therefore required after initial system installation and following any period of time during which the system is inoperative, whether due to an alarm condition, a power failure, or for any other reason.

① Unplug power supply and then unplug UV sensor from blue jack.



② Make sure power supply is plugged in for entire disinfection process.



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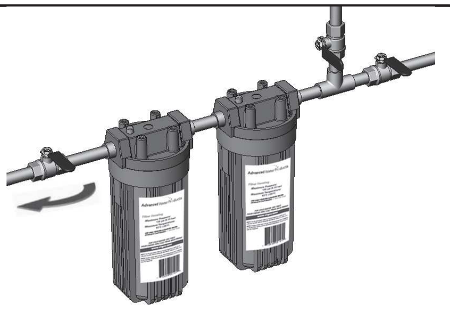

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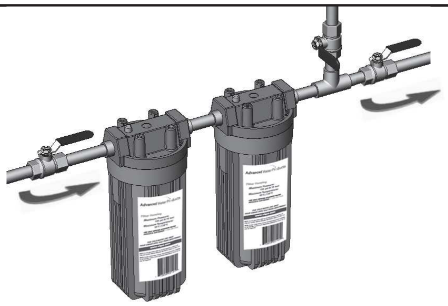
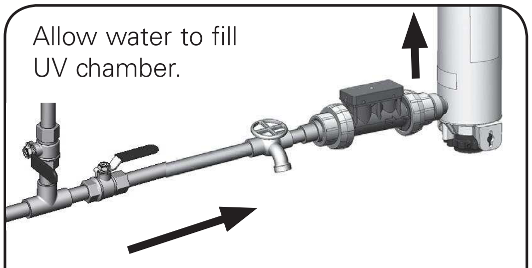


⑨ Allow water to fill UV chamber.



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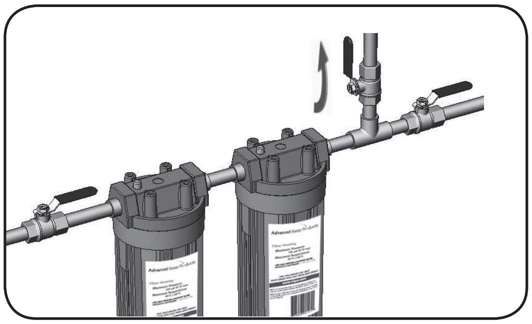
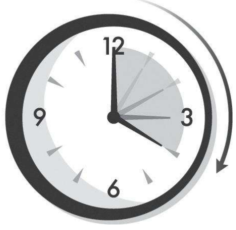


⑪ Go to a water outlet and allow the cold water to flow until you can smell bleach, then stop the flow. Allow hot water (if present) to flow until you can smell bleach, then stop the flow. Repeat procedure at all water outlets. Remember to include all faucets, washing machines, toilets, outside taps, and other water outlets. Note: You will likely run out of bleach; if you cannot smell bleach at a given outlet, turn off the main water supply, depressurize and add more bleach to the filter housing.

⑫ Let the bleach sit in the water lines for at least four hours.



⑬

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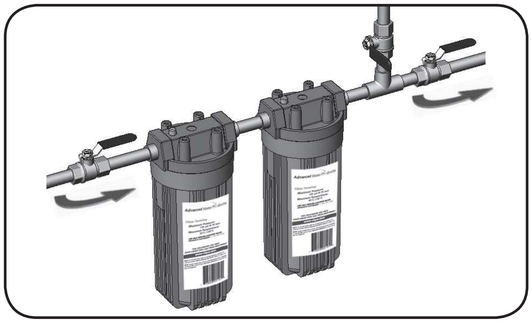
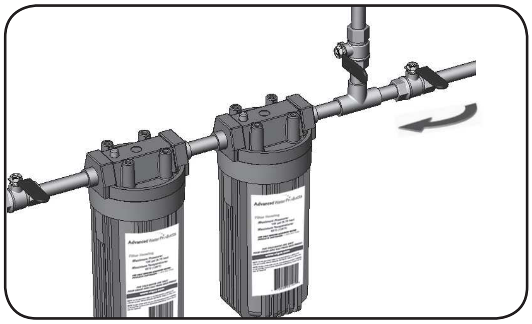


⑱ Flush all water outlets until bleach can no longer be smelled (at least 5 minutes).

⑲



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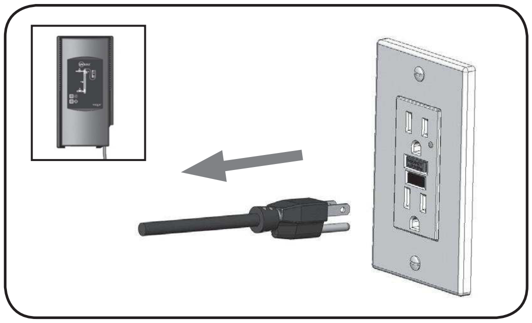
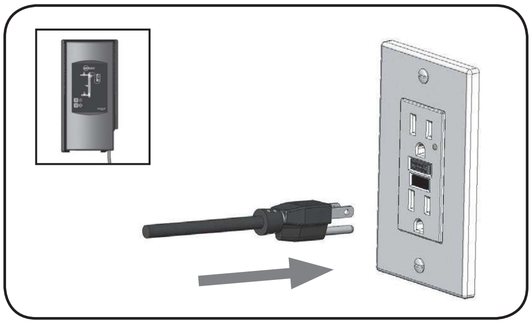


㉑ Plug UV sensor into blue jack.

㉒



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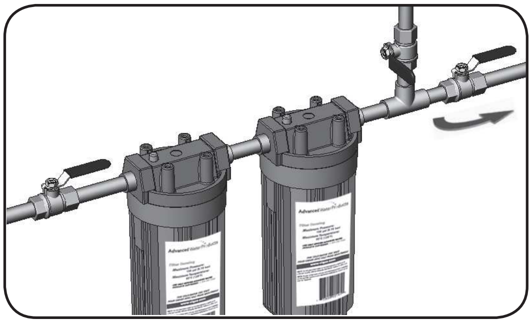


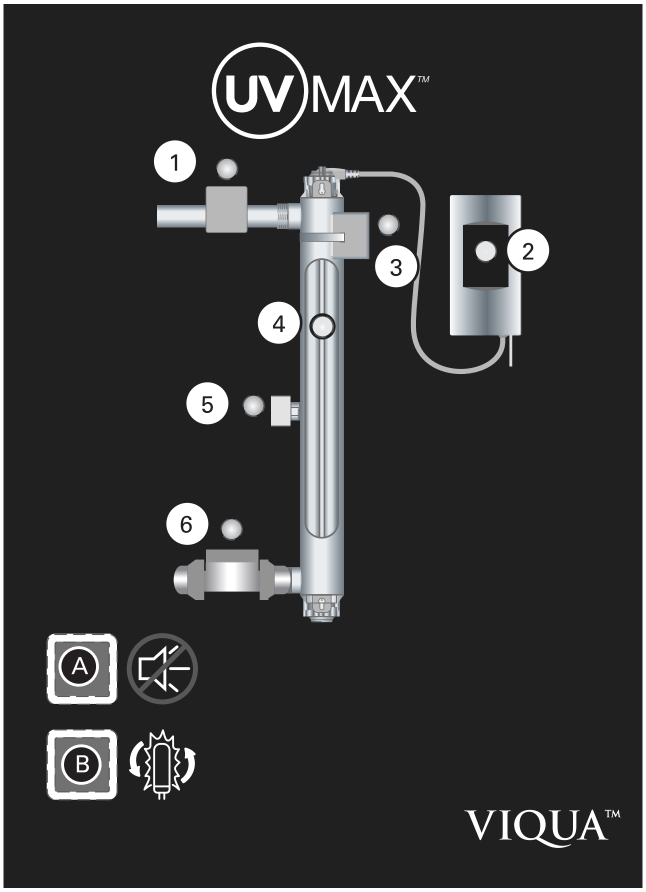
CONTROL PANEL

Buttons

	Button	Meaning
Ⓐ	Mute	For low UV alarms press mute button to silence alarm. If low UV is detected consecutively 5 times alarm will be locked, press the mute button to unlock the alarm. For end of lamp life alarm press the mute button to silence audible alarm for 7 days; this may be repeated up to a max. of 4 times.
Ⓑ	New Lamp	After installing a new lamp, press and hold this button until you hear a beep (about five seconds). This will reset the internal clock.

Indicator lights

Indicator lights only indicate a problem with the component when flashing red.



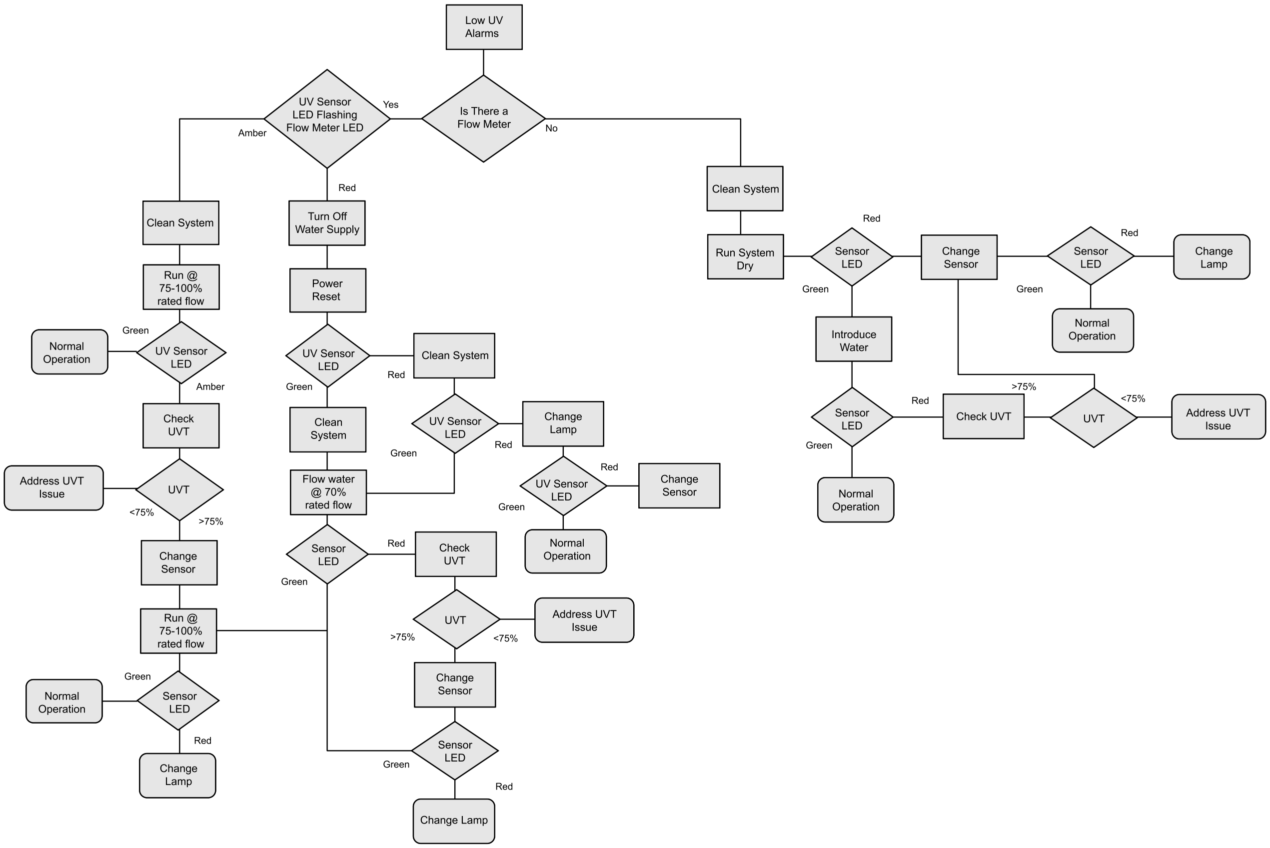
	Green	Yellow	Flashing Red	Solid Red
①	Solenoid valve open *(If equipped with solenoid)*	Not applicable	Solenoid valve disconnected; reconnect Solenoid coil damaged; replace coil *(not entire solenoid)*	Solenoid valve inactive (closed) due to failure of another component, in order to ensure safety of the water supply
②	Operating normally	Not applicable	Power supply failure; replace power supply	Power supply inactive due to lamp failure
③	Operating normally	Not applicable	Fan disconnected; reconnect Fan turning slower than required; unplug system, clean blades using a Q-tip Fan damaged; replace fan	Not applicable
④	Operating normally **NOTE**: During the lamp warm up, the indicator will flash	Warning; lamp will require replacement shortly	Lamp disconnected; unplug system, reconnect lamp and plug-in system again Lamp failure; replace lamp	Lamp inactive due to power supply failure
⑤	UV dose is adequate and sensor is operating normally *(Pro & Plus models only)*	UV dose is near the minimum required	Sensor disconnected; unplug system, reconnect sensor and plug-in system again Sensor failure UV dose is below minimum required, see Low UV Alarm section	Sensor inactive due to lamp or power supply failure
⑥	Flow Meter operating normally	High flow uv dose inadequate, reduce flow to achieve higher dose levels *(Pro10, Pro20, and Pro30 only)*	Flow meter sensor failure; service or replace sensor	Low flow uv dose inadequate, service required

TROUBLESHOOTING

The table below is a list of *possible* causes and solutions.

Symptom	Possible Cause	Possible Solution
No power	GFCI and/or breaker tripped	Reset GFCI and/or breaker
	Power supply fuse has blown	Replace power supply fuse - see Fuse Replacement section
	Transient voltage surge suppressor (TVSS) damaged	Replace TVSS
	Power supply damaged	Replace power supply and use a TVSS
GFCI or breaker repeatedly trips	Connection between lamp and lamp plug is wet	Clean and dry the lamp plug and lamp end, check unit for leaks or condensation
	Short-circuit in the electrical assembly	Replace power supply
Leak at inlet or outlet	Threaded pipe fittings are leaking	Clean threads, reseal with Teflon tape and retighten
Leak detected from area of chamber	Condensation of moist air on cold chamber (slow accumulation)	Control humidity or relocate unit
	O-ring damaged, deteriorated or incorrectly installed	Inspect and replace if deteriorated
	Sleeve bolt not tight enough	Ensure nut is turned completely (to stops)
Alarm	See Control Panel section	See Control Panel section
System is operating but water tests reveal bacterial contamination	Equipment downstream of UV system is acting as a breeding ground for pathogens	Ensure UV is the last piece of treatment equipment
	Pathogens are residing in the distribution lines post-UV	Ensure all distribution lines have been disinfected with chlorine - see Disinfecting the Water Lines section
	Recontamination from pipe dead-ends	Remove any pipe dead-ends and flush with chlorine - see Disinfecting the Water Lines section
Flow Meter Sensor red status LED	Detect Flow Sensor not detecting flow	Increase Flow rate through meter
	Flow Meter Sensor not functioning (Pro10, Pro20, and Pro30 only)	Flow Meter requires maintanence or replacement

LOW UV ALARMS (Pro & Plus Series Only)



1. In some cases, short-term flows of low ultraviolet transmittance (UVT) water can be created following and during the regeneration cycle of a water softener, resulting in a sensor alarm. Flushing the UV system alleviates this condition until the softener goes through another regeneration cycle. In the longer term, the softener's settings must be modified. To flush the UV system, unplug the sensor, then open a tap downstream and let water run for two (2) minutes. Disinfect the water lines following the procedures outlined under "Disinfecting The Water Lines" in the Installation section.
2. Refer to Sleeve Cleaning And Lamp Replacement section of the Owner's Manual.
3. Contact your water treatment dealer to inquire about testing the UVT of your water.

SLEEVE CLEANING & LAMP REPLACEMENT

Sleeve cleaning

Minerals in the water slowly form a coating on the sleeve. This coating must be removed because it reduces the amount of UV light reaching the water, thereby reducing disinfection performance. The need to clean the sleeve will be indicated by a low UV alarm (flashing red indicator light beside the sensor on control panel - see Control Panel section for details).

Note: Low UV alarms are for Pro & Plus Series only. If you own a Basic model, please clean the sleeve regularly (3-4 times per year, or more often depending on water quality).

When only cleaning is required, follow the instructions below and re-install the current lamp.

Lamp replacement

The amount of UV light created by the lamp decreases over time, requiring that the lamp be replaced. The system will automatically notify you when it is time to replace the lamp (the lamp should last up to 24 months). If the lamp requires replacement, follow the instructions below and install a new lamp.

NOTE: The UV system is designed to operate continuously and should not be shut off for short periods of time, such as over a period of less than three weeks.

<u>Equipment required:</u>

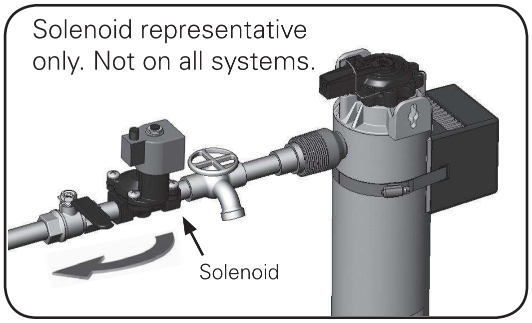
#2 Phillips screw driver

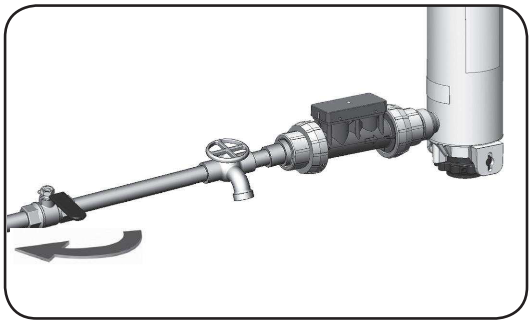
Clean cotton, latex or plastic gloves are preferred.

Scale remover such as vinegar or a citrus-based product.

Cloth must be soft, lint-free, and chemical-free. No clean-wipes.

Cotton swab.

①

Solenoid representative only. Not on all systems.

②


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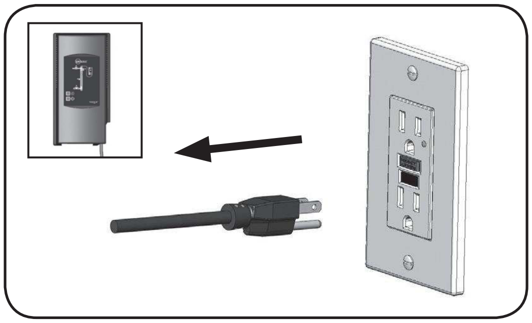

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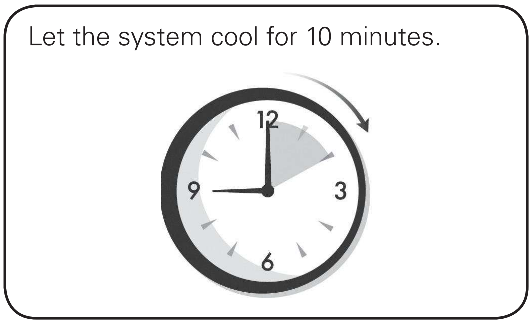
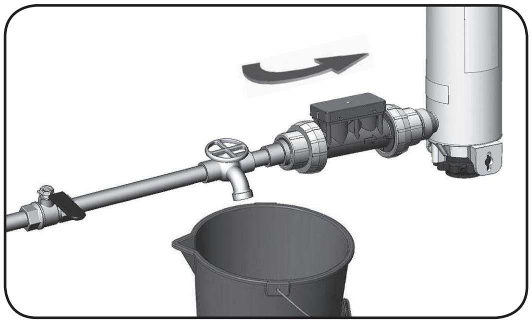

Let the system cool for 10 minutes.

⑤


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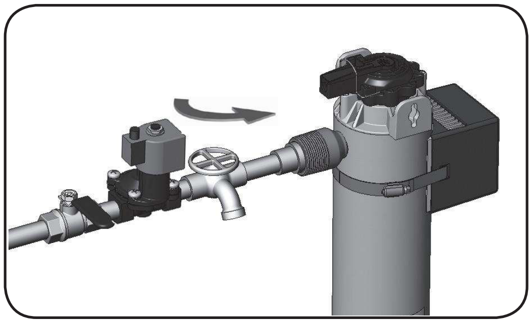
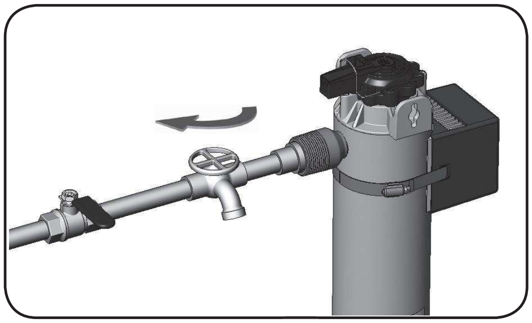


⑦

Close after all water has drained.

⑧


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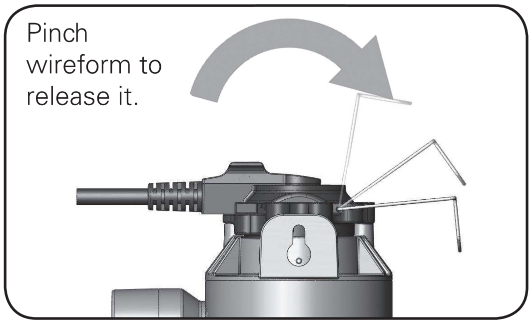
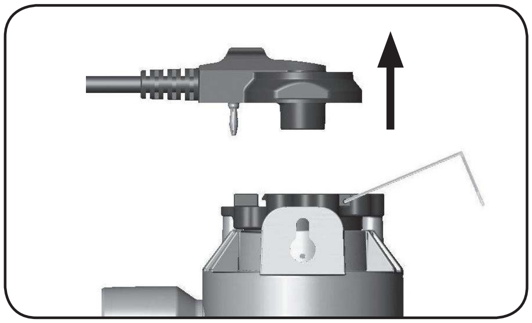

Pinch wireform to release it.

⑩


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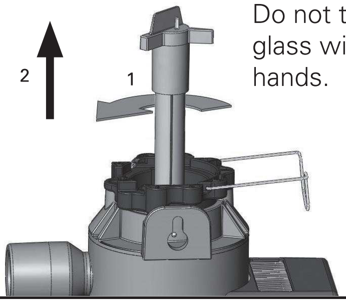
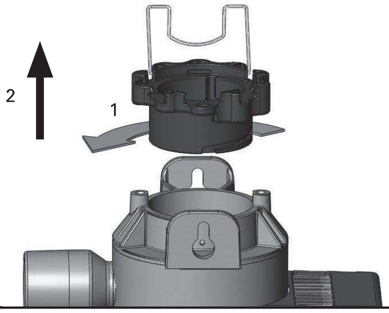


Do not touch glass with bare hands.

⑫



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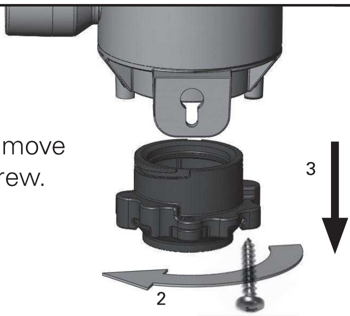
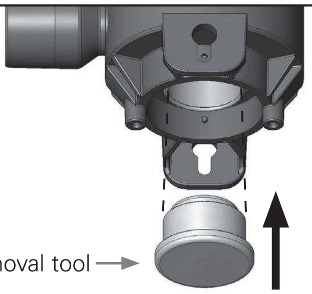


1 Remove screw.

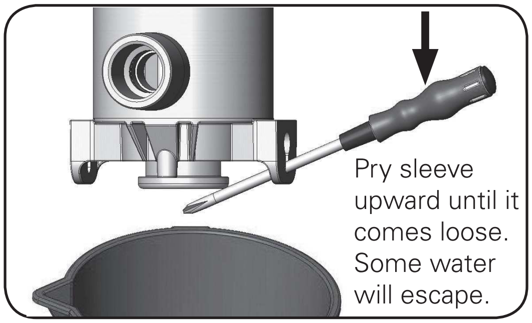
⑭



Insert sleeve removal tool into bottom of sleeve

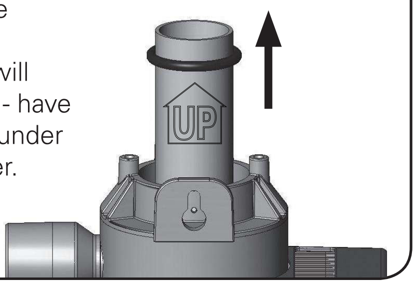
Sleeve removal tool

⑮



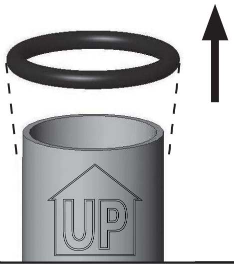
Pry sleeve upward until it comes loose. Some water will escape.

⑯



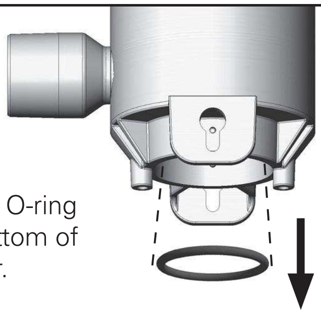
Remove sleeve. Water will escape - have bucket under chamber.

⑰



Remove O-ring from top of sleeve.

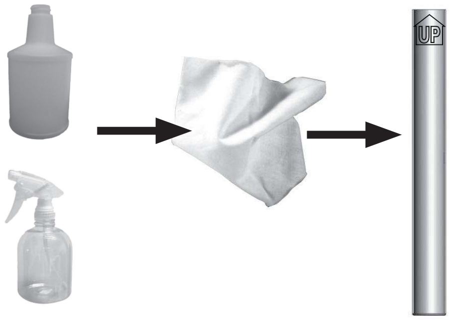
⑱



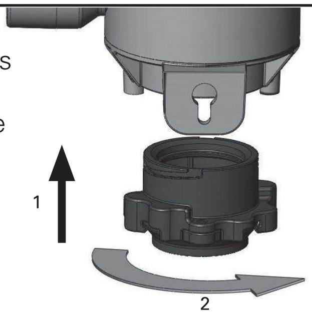
Remove O-ring from bottom of chamber.

⑲

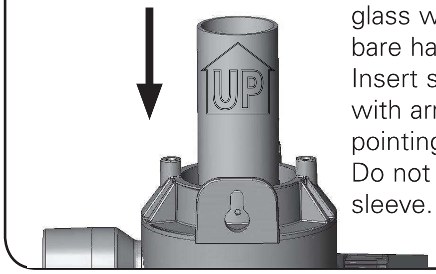
Ensure cloth used to clean the sleeve is soft, lint-free, and contains no chemicals (no clean-wipes). **Sleeve must be replaced if it cannot be completely cleaned or if it appears scratched or cracked.**



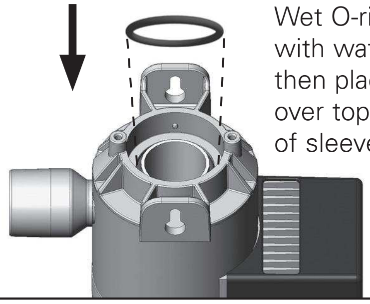
⑳ Ensure sleeve bolt is fully rotated until positive stop.



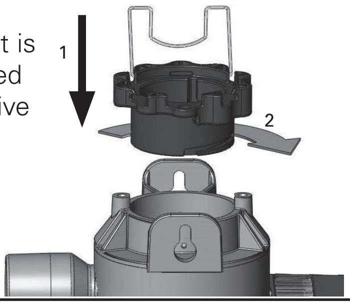
㉑ Do not touch glass with bare hands. Insert sleeve with arrow pointing up. Do not rotate sleeve.



㉒ Wet O-ring with water then place over top end of sleeve.



㉓ Ensure sleeve bolt is fully rotated until positive stop.



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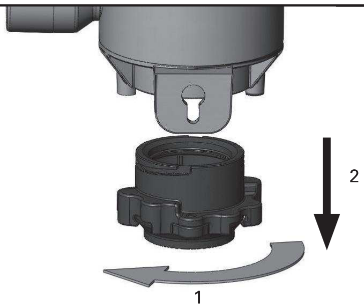
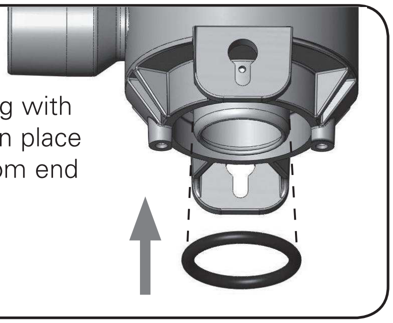
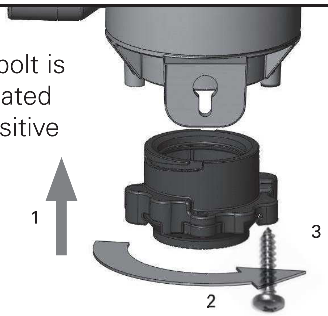


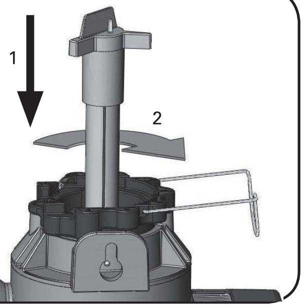
㉕ Wet O-ring with water then place over bottom end of sleeve.



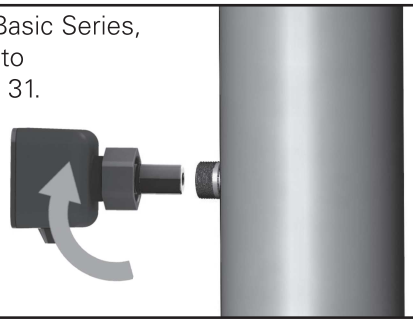
㉖ Ensure sleeve bolt is fully rotated until positive stop.



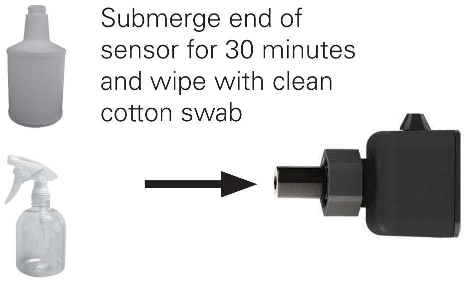
㉗ Re-install current lamp if it does not need replacement. Be sure to rotate lamp completely. Do not touch glass with bare hands.



㉘ For Basic Series, skip to Step 31.



㉙ Submerge end of sensor for 30 minutes and wipe with clean cotton swab



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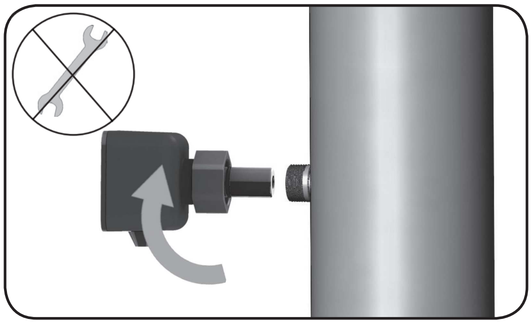
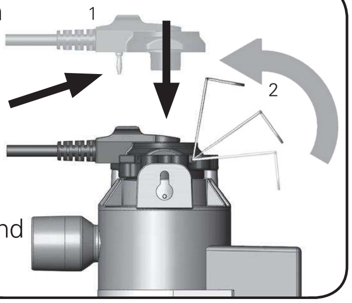


㉛

Lock wireform into position.

Note: Ensure lamp harness ground is inserted into chamber ground terminal



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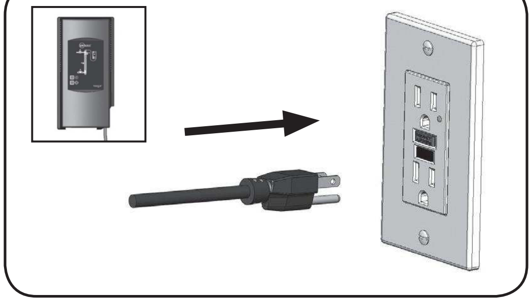

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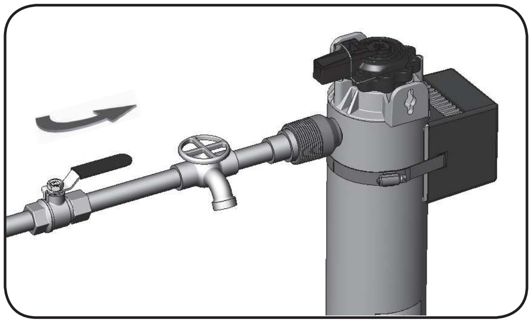
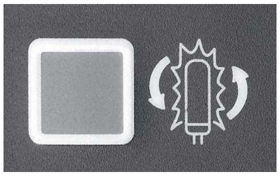


㉞

If lamp was replaced:
Press and hold "New Lamp" button for 5 seconds until you hear a "beep".

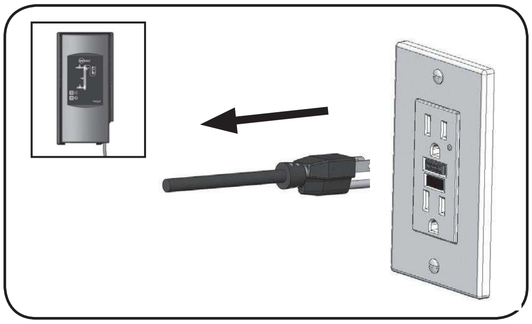


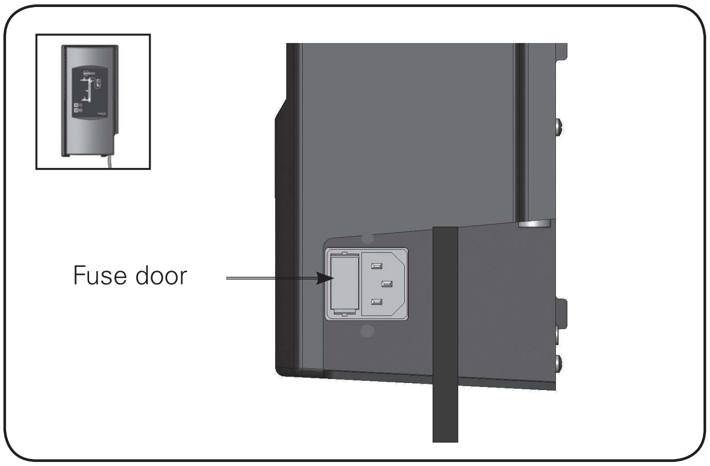
㉟

Disinfect the water lines. Refer to Disinfecting the Water Lines in Installation section.

FUSE REPLACEMENT

The system comes equipped with one functioning and one spare 250V 2.5A fuse. To access the fuses, first unplug system and disconnect the power cord from the power supply. Remove the fuse door by pushing in the tab on one side using a knife or other tool and gently prying outwards. Repeat on the other side.





Flow Meter Sensor Maintenance
Inspect Flow Meter Sensor periodically to ensure that there is no fouling and the paddle wheel spins freely with no resistance.

If Paddle wheel does not spin freely or is loose the sensor should be returned for service and calibration. It is recommended that the Flow Meter Sensor be returned for calibration every two years to ensure accurate system operation.

WARRANTY

Our Commitment

VIQUA is committed to ensuring your experience with our products and organization exceeds your expectations. We have manufactured your UV purification system to the highest quality standards and value you as our customer. Should you need any support, or have questions about your system, please contact our Technical Support team at 1.800.265.7246 or technicalsupport@viqua.com and we will be happy to assist you.

We sincerely hope you enjoy the benefits of clean, safe drinking water after the installation of your UVMAX® purification system.

How to Make a Warranty Claim

NOTE: To maximise the disinfection performance and reliability of your UVMAX® product, the system must be properly sized, installed and maintained. Guidance on the necessary water quality parameters and maintenance requirements can be found in your Owner's Manual.

In the event that repair or replacement of parts covered by this warranty are required, the process will be handled by your dealer. If you are unsure whether an equipment problem or failure is covered by warranty, contact our Technical Support team at 1.800.265.7246 or e-mail technicalsupport@viqua.com . Our fully trained technicians will help you troubleshoot the problem and identify a solution. Please have available the model number (system type), the date of purchase, the name of the dealer from whom you purchased your UVMAX® product ("the source dealer"), as well as a description of the problem you are experiencing.

To establish proof of purchase when making a warranty claim, you will either need your original invoice, or have previously completed and returned your product registration card via mail or online.

Specific Warranty Coverage

Warranty coverage is specific to the following UVMAX® products: Pro10/10S, Pro20/20S, Pro30/30S, Pro50, models G, H, J, K, and G+, H+, J+ and K+. Warranty coverage is subject to the conditions and limitations outlined under the heading "General Conditions and Limitations" below.

Ten-Year Limited Warranty for UV Chamber

VIQUA warrants the UV chamber on the UVMAX® product to be free from defects in material and workmanship for a period of ten (10) years from the date of purchase. During this time, VIQUA will repair or replace, at its option, any defective UVMAX® UV chamber. Please return the defective part to your dealer who will process your claim.

Five-Year Limited Warranty for Electrical and Hardware Components

VIQUA warrants the electrical (power supply) and hardware components to be free from defects in material and workmanship for a period of five (5) years from the date of purchase. During this time, VIQUA will repair or replace, at its option, any defective parts covered by the warranty. Please return the defective part to your dealer who will process your claim.

One-Year Limited Warranty for Lamps, Sleeves and UV Sensors

VIQUA warrants lamps, sleeves and UV sensors to be free from defects in material and workmanship for a period of one (1) year from the date of purchase. During this time, VIQUA will repair or replace, at its option, any defective parts covered by the warranty. Your dealer will process your claim and advise whether the defective item needs to be returned for failure analysis.

IMPORTANT NOTE: Use only genuine UVMAX® replacement lamps and sleeves in your system. Failure to do so may seriously compromise disinfection performance and affect warranty coverage.

General Conditions and Limitations

None of the above warranties cover damage caused by improper use or maintenance, accidents, acts of God or minor scratches or imperfections that do not materially impair the operation of the product. The warranties do not cover products that are not installed as outlined in the applicable Owner's Manual.

Parts repaired or replaced under these warranties will be covered under warranty up to the end of the warranty period applicable to the original part.

The above warranties do not include the cost of shipping and handling of returned items.

The limited warranties described above are the only warranties applicable to the UVMAX® products listed in the "Specific Warranty Coverage" section. These limited warranties outline the exclusive remedy for all claims based on a failure of or defect in any of these products, whether the claim is based on contract, tort (including negligence), strict liability or otherwise. These warranties are in lieu of all other warranties whether written, oral, implied or statutory. Without limitation, no warranty of merchantability or of fitness for a particular purpose shall apply to any of these products.

VIQUA does not assume any liability for personal injury or property damage caused by the use or misuse of any of the above products. VIQUA shall not in any event be liable for special, incidental, indirect or consequential damages. VIQUA's liability shall, in all instances, be limited to repair or replacement of the defective product or part and this liability will terminate upon expiration of the applicable warranty period.

Pro10, Pro10S, Pro20, Pro20S, Pro30, Pro30S System Tested and Certified by NSF International against CSA B483.1 and NSF/ANSI 55 for Disinfection Performance, Class A

NSF information pertains to UVMAX™ Pro Series models – Pro10/10S, Pro20/20S, Pro30/30S.

This Class A system conforms to NSF Standard 55 for the disinfection of microbiologically contaminated water that meets all other public health standards. The system is not intended to convert wastewater or raw sewage to drinking water. The system is intended to be installed on visually clear water (not colored, cloudy, or turbid water). If this system is used for the treatment of surface waters a prefilter found to be in compliance for cyst reduction under NSF/ANSI Standard 53: Drinking Water Treatment Units - Health Effects shall be installed upstream of the system.

NSF Standard 55 defines waste water to include human and/or animal body waste, toilet paper, and any other material intended to be deposited in a receptacle designed to receive urine and/or feces (black waste); and other waste materials deposited in plumbing fixtures (gray waste).

UVMAX™ Pro50 model is USEPA UVDGM 2006 validated.

A TROJAN TECHNOLOGIES BUSINESS

TW-60 Water Treatment System

section 6

SUPERDOS® 45

Operating Manual • Mode D'Emploi
Bediehnungs Handbuch • Manual de Operación
Manual de operação

Model 0.3%
Model 0.3% PAA
Model 2.5%
Model 5%

Fluid Flow Range:
Débit d'eau:
Durchflussmenge:
Caudal de trabajo:
Vazão Operativa:
0.50 gpm to 45 gpm
1,89 l/mn to 170 l/mn

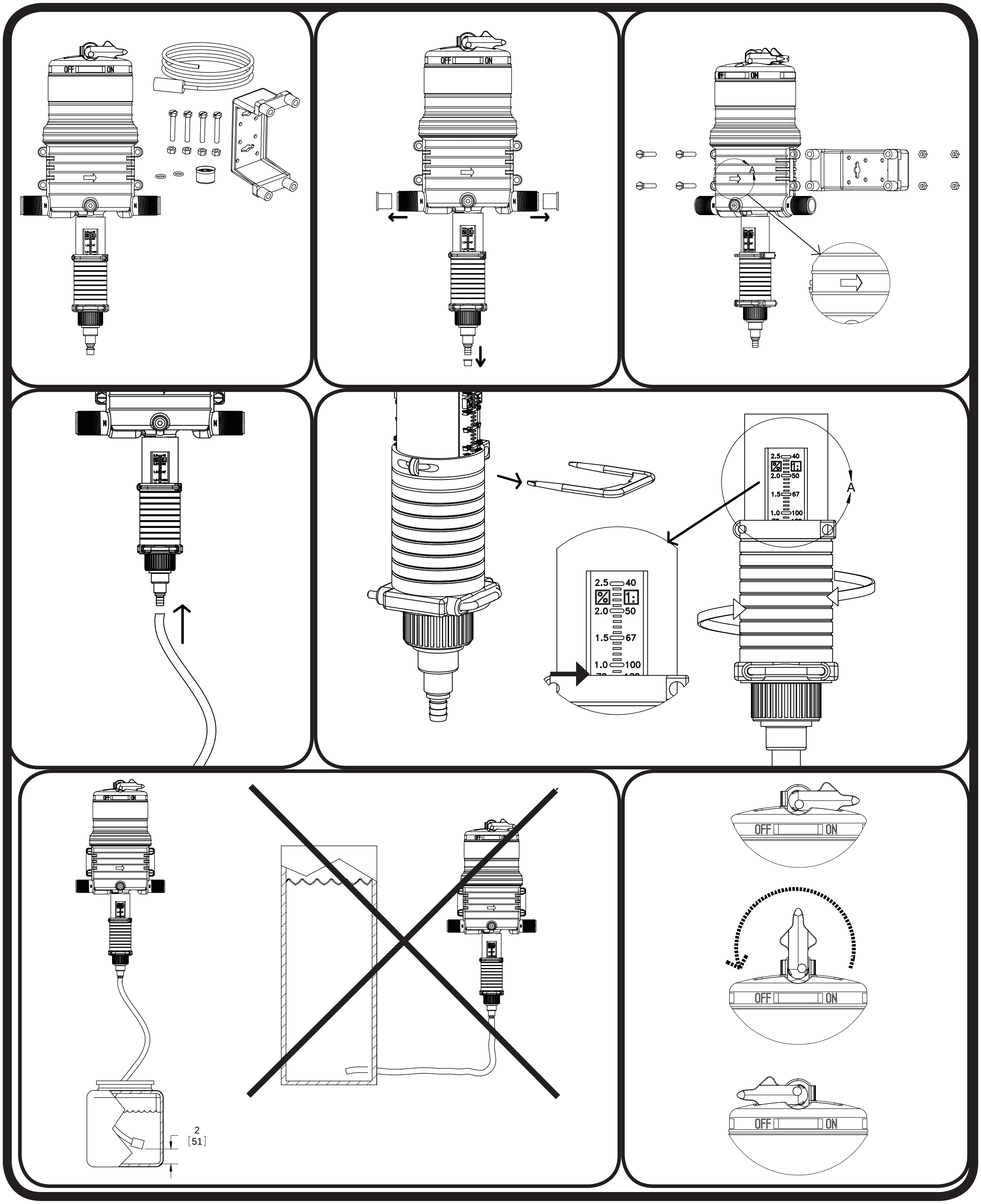
Injection Range
Dosage:
Dosierung:
Dosificación:
Injeção:
0.025% to 5%
1:4000 to 1:20

Operating Pressure:
Pression:
Druck:
Presión operativa:
Pressão operativa:
5 to 100* psi
0,34 to 6,9* bar

*Specifications vary by model.
*Les données techniques varient selon les modèles.
* Technische Daten sind je nach Modell unterschiedlich.
* Características técnicas varían según modelo.
* Características técnicas variam conforme o modelo.

Dosmatic®
a Hydro Systems Brand

Quick Start Up
Démarrage Rapide
Schnell Antrieb
Puesta en marcha rápida
Inicialização rápida



Part # 013827 Rev. F

Dosmatic®

a Hydro Systems Brand

English..3-18

Français..19-28

Deutsch...29-38

Español...39-48

Português...49-58

Hydro Systems Company Offices:

North America &
Global Headquarters:
Hydro Systems Company
3798 Round Bottom Road
Cincinnati, OH 45244
Phone: 513-271-8800
Fax: 513-271-0160
Toll Free: 800-543-7184

Europe, Middle East,
Africa, & India
Hydro Systems Europe
Unit 3, The Sterling Centre,
Eastern Road
Bracknell, Berkshire
RG12 2PW
Europe
Phone: +44 1344 488880
Fax: +44 1344 488879

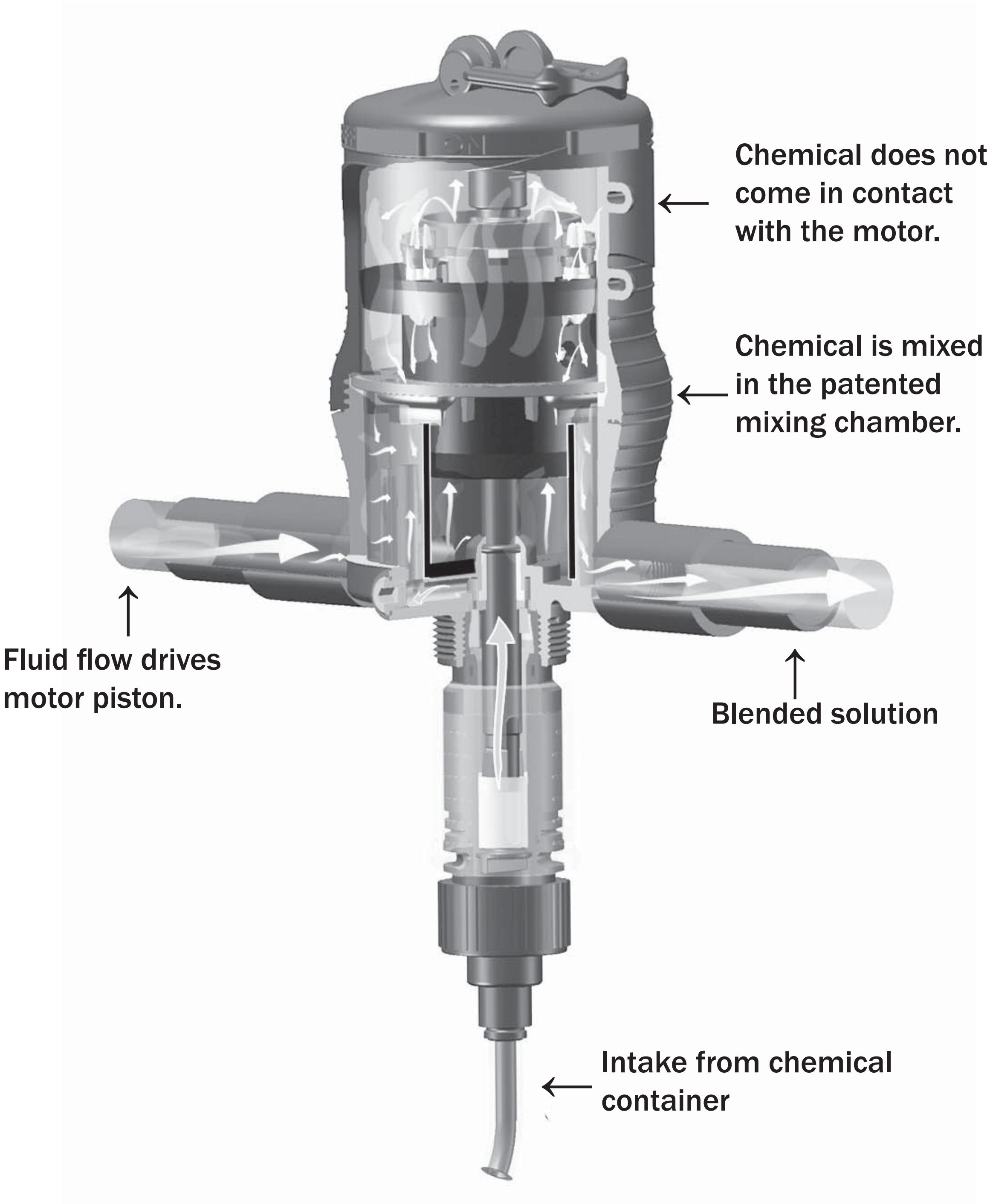
Asia Pacific:
Hydro Systems Asia Pacific
Unit A
1 Kelham Place
Glendenning, NSW 2761
Australia
Phone: 612-9625-8122
Fax: 612-9625-8177

South America:
Hydro Systems South America
Rua Mogiana, 172,
Chacarras Reunidas,
Sao Jose Dos Campos,
Brasil
Phone: +55-12-3201-7707
Fax: +55-12-3201-7739

Operating Principle

Accurate and Reliable

Installed directly in the fluid supply line, the injector operates without electricity, using fluid (water) pressure as the power source. The fluid drives the injector, which pulls the required percentage of concentrate directly from the chemical solution container. Inside the Dosmatic patented mixing chamber, the concentrate is mixed with the fluid, and the fluid pressure forces the mixed solution downstream. The amount of concentrate will be directly proportional to the volume of fluid entering the injector, regardless of variations in flow or pressure.



Contents

Operating Principle 4
Package Contents 6
Specifications 6
Safety Precautions 7
Warranty Compliance 7
General Tips 7
Operations 8
Installation and Start-up 9
Suggested Installation Diagram 9
Maintenance 10
Remote Injecting 10
Routine Maintenance Instructions 11
Troubleshooting 12
Injector Repair Parts 13
Lower end & wear parts kits 0.3% PAA (Rotating): 14
Lower end & wear parts kits 0.3% (Rotating): 15
Lower end & wear parts kits 2.5%: 16
Lower end & wear parts kits 5%: 17
Warranty 18

Please read this manual carefully before putting the Dosmatic injector into operation.
This booklet has the information you will need for the use and care of your new Dosmatic injector. If you have any further questions about your injector, the warranty, routine maintenance or proper usage, please contact your nearest distributor or Dosmatic customer service.

These models are designed to inject liquid concentrate or soluble powder that are recommended and approved for injection into fluid systems.

It is the responsibility of the operator to determine the correct dosage settings of the unit using the chemical manufacturers' recommendation for dispensing their product, and to assure that proper dosage is being maintained.

Maintenance and Warranty

Dosmatic offers a three year limited warranty from the original date of purchase for manufacturing or materials defects only. With proper use and care, your injector should provide you long-term performance. Please review the complete warranty information on page 18.

For Your Records
The serial number of your Dosmatic injector is located on the injector body. Please record this number in the space below and reference it when calling your distributor or Dosmatic for information, parts and service.

Serial #..

Date Purchased ....

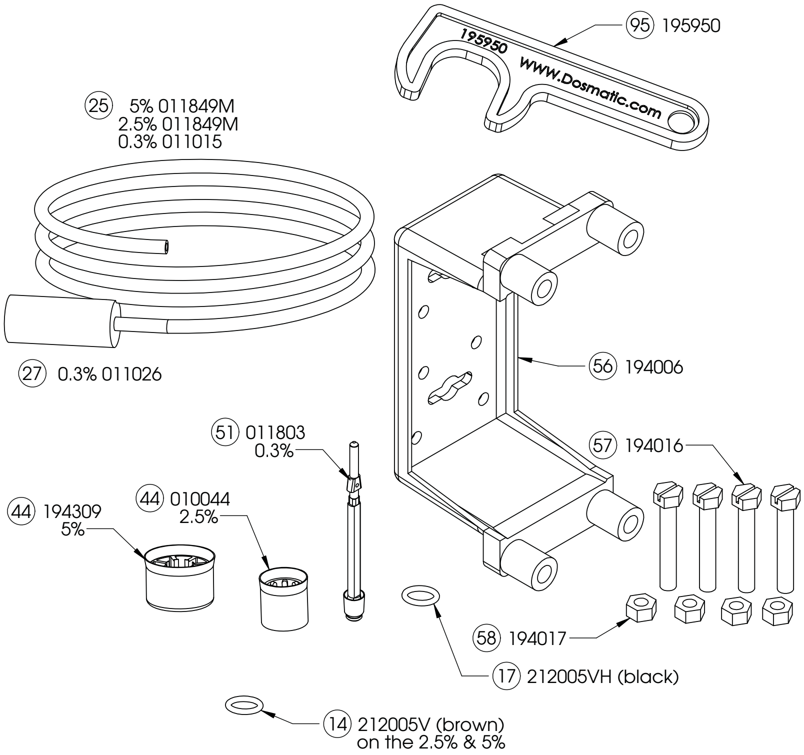
Important:
for product registration
visit our website
www.dosmatic.com
to fill out product
registration form!

This document does not form a contractual engagement on the part of Dosmatic and is for information only. Dosmatic reserves the right to alter product specifications or appearance without prior notice.

Package Contents

The injector is packaged
with the following items:

- **Injector (not shown)**
- **Dosage Piston**
- **O-ring**
- **Manual (not shown)**
- **Lower End Wrench (0.3% only)**
- **Mounting Bracket**
- **Mounting Nuts and Bolts**
- **Filter**
- **Suction Tube**



Model	NPT	BSP
0.3% Rotating	113230R	113730R
0.3% PAA Rotating	113230RK	113730RK
2.5%	113212	113712
5%	113215	113715

Specifications

SuperDos 45 gpm (100 max. psi)

Model 0.3% 0.025% - 0.3% (1:4000 - 1:333)

Model 2.5% 0.2% - 2.5% (1:500 - 1:40)

Model 5%* 0.4% - 5% (1:250 - 1:20)

Flow Rate: 0.50 - 45 gpm** (1,89 - 170 l/mn)

Operating Pressure: 5 - 100 psi (0,34 - 6,9 bar)

Pipe Coupling: 1 1/4" NPT/BSP

* 5% model with remote injection kit has maximum operating pressure of 80 psi (5,5 bar).

** 5% model with remote injection kit has maximum flow rate of 20 gpm (75 l/mn).

Housing	Proprietary Engineered Composite Material
Dosing Accuracy	+/- 10% of ratio
Repeatability	+/- 3% of ratio
Pressure Loss	Available upon request
Maximum Temp.	100°F (38°C)
Minimum Temp.	34°F (1°C)
Maximum vertical suction of concentrate	13 Feet (3.6 Meter)
Maximum horizontal suction of concentrate	49 Feet (15 Meter)
Self-Priming	Yes
Seal Material Available: *Contact your representative for specific chemical information	Aflas Viton EPDM FFKM
Maximum Viscosity	1,500 cP (Ex. Honey)
Recommended Accessories	140 mesh (104 micron) filter, check valve, pressure regulator, flow restrictor.

Safety Precautions
Warranty Compliance

⚠ Warning, **Please read precautions thoroughly before operation. Must meet all applicable local codes and regulations.**

Remove Red Caps Prior to Installation

Your injector is 100% factory tested before delivery and may contain a small amount of water. The three red plastic caps are fitted after testing to ensure cleanliness of the injector.

Before Applying Aggressive Chemicals

Please consult your distributor, chemical manufacturer or contact Dosmatic's customer service to confirm compatibility with your injector. Always wear proper safety protection as recommended by chemical supplier.

Label all Fluid Lines, Valves and Connections

If the solution that is being injected is not suitable for drinking, all fluid lines should be labeled:

Warning not for human consumption!

Monitor Outlet Flow

It is the user's responsibility to monitor the output of chemical injected.

A Filter is Recommended and Required

Install a filter of 140 mesh (104 micron) or finer depending on your fluid quality to prolong the working life of the injector and for the warranty to be valid. A filter is imperative since most fluid contains impurities or particles, especially if the fluid source comes from a well, pond or lake.

Avoid a Potentially Hazardous Chemical Accident

Select a safe location. Chemical container should be kept away from children and/or high usage areas and the location must also not be susceptible to freezing temperatures.

Avoid Solution Contamination

Use only clean FILTERED fluid. Do not allow contaminants to enter the solution container. They can be pumped into the fluid line and may cause the spread of disease. Dirt, debris and other contaminants in the solution container may cause excessive wear to the unit.

Fluid Temperature

Min: 34°F (1°C) **Max:** 100°F (38°C)

Maximum Fluid Pressure

0.3%, 2.5% - 100 psi (6,9 bar)
5% - 80 psi (5,5 bar)
5% model with remote injection kit has maximum operating pressure of 60 psi (4 bar).
Install a pressure regulator and/or pressure relief valve to ensure operating pressure does not exceed the maximum specification.

Before Removing An Injector From The System

Release fluid pressure. While the system is in operation, turn off the incoming fluid valve. Leave the out going valve open this will relieve the pressure at the injector and all parts of the system after the injector. Injector is now safe to remove.

General Tips

Please read this instruction manual thoroughly.
Following the procedures, will increase the life of your injector.

For A Long Service Life

Start with clean fluid by using an inline filter to reduce impurities. Keep the solution container covered and clean. Keep the suction tube filter 2" (5 cm) from the bottom of the container. Perform maintenance procedures as recommended (see Maintenance page 10).

Soluble Powder Use

Ensure the chemical is completely dissolved before starting the injector. If necessary, dissolve the chemical in hot water and allow to cool before using. Failure to thoroughly dissolve the chemical will cause premature wear to the dosage piston and the inner cylinder.

Keep From Extreme Temperature

Protect the injector from freezing temperatures or excessive heat.

Rinse Injector After Each Use

Additive allowed to remain in injector can dry out, foul or damage the lower end at the next start-up (see Maintenance page 10).

Injector Not in Use for an Extended Period

If the injector has not been stored properly deposits may have dried onto the motor (see Maintenance page 10). Before operation, soak entire unit into room temperature water approx. 72°F (22°C) for an eight hour period.

Operations

Clicking Sound is Normal

Fluid flowing through the injector will automatically cause the injector to “click” and inject a set amount of solution into the fluid line. The higher the flow rate the more frequent the "clicking". The injector is designed to inject solution proportionally (at the same set ratio) regardless of fluid flow.

Service Fluid Flow

Fluid flow and pressure must be within the established specifications (see Specification on page 6) for your model.

Change Feed (Injection) Rate

The feed rate on the injector is adjustable **EVEN WHILE OPERATING AND UNDER PRESSURE**. To change feed rate see (Fig. 1 and Fig. 2). Do not remove #79 when injector is under pressure.

1. Remove Upper Interlock Pin (#65) (Fig. 1).
2. Rotate Ratio Adjuster Sleeve (#61) up or down to the desired setting (Fig. 2). Use the top of the Ratio Adjuster Sleeve to line up with the desired feed rate on the setting (Fig. 2a).
3. Re-insert Upper Interlock Pin (#65). Clip must be parallel with settings to be able to re-insert.

NOTE: Do not screw Ratio Adjuster Sleeve below lowest setting line. Measure outlet fluid to assure desired feed rate is being delivered.

Bypass Operation

Injecting solution into the fluid line can be TEMPORARILY stopped with the On/Off feature (Fig. 3). Moving the On/Off Lever to the OFF position allows service fluid to pass through the injector without injecting chemical. No "clicking" will be heard.

With the On/Off lever set to the ON position the injector will operate as normal and “clicking” will be heard when fluid is flowing. It is recommended to use the three-valve bypass (see Fig. 5), for continued bypassing or servicing of the injector.

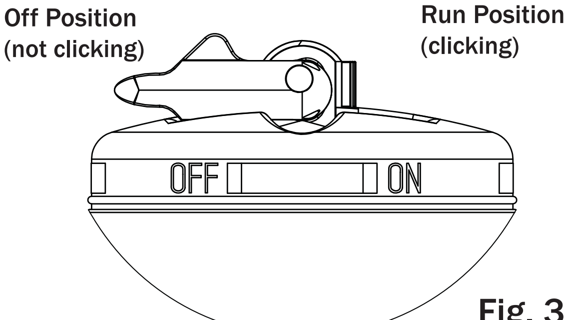
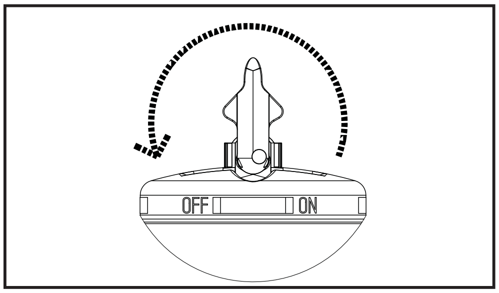


Fig. 3



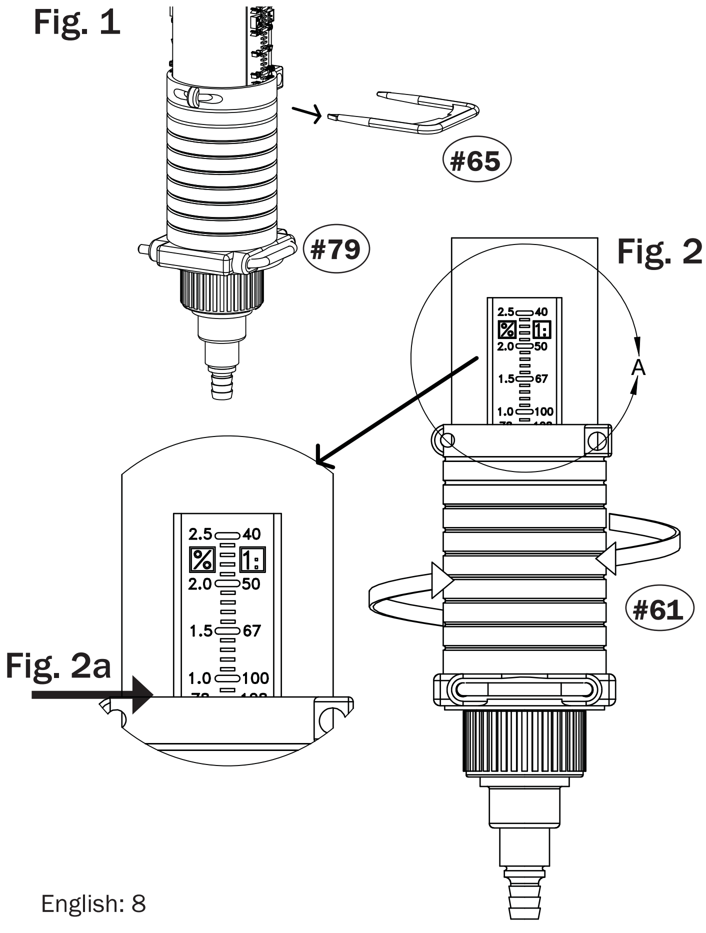


Fig. 1

Fig. 2

Fig. 2a

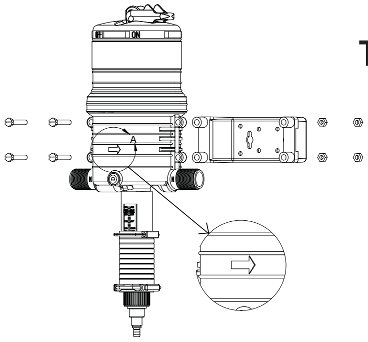


Fig. 4
Typical wall mounting

Installation and Start-up

Refer to Fig. 4 and Fig. 5

Fluid Filter (Required)

Install a filter of 140 mesh (104 micron) or finer depending on your fluid quality to prolong the working life of the injector and for the warranty to be valid. Dosmatic recommends a Twist II Clean® filter that can be ordered with your injector.

Mounting Injector

Securely fasten your injector to a solid object such as a wall or in a cold fluid line. Note arrow on injector indicates fluid flow.

Backflow Preventor (Recommended)

Install one that meets local code requirements.

Pressure Safety Release Device (Recommended)

Prevents pressure from exceeding specifications of the unit.

Bypass Valve Set-up (Recommended)

Allows the injector to be taken off-line for maintenance or storage when not in use.

Fluid-Hammer Arrester (Recommended)

Prevents fluid-hammer damage to the injector when operating quick closing solenoid, pneumatic or hand-operated ball valves on the fluid system.

Anti-Siphon Valve (Optional)

To prevent solution from being siphoned out (from the solution container) into the feed lines when the upstream valve is shut off. The anti-siphon valve must be installed on the downstream outlet.

Additional Siphoning Prevention

Place solution container on a level below the injector suction tube fitting. Using the inlet side as a shut-off valve could cause full strength solution to siphon into the feed line.

Solution Container

Use any size container. A lid or cover is recommended. To connect your solution container, gently push the end of the suction tube onto the bottom of the suction tube fitting assembly.
Place the filter into the solution container at least 2" (5cm) from the bottom and fill with at least 2" (5cm) of chemical solution.

Never Use Petroleum Based Lubricants

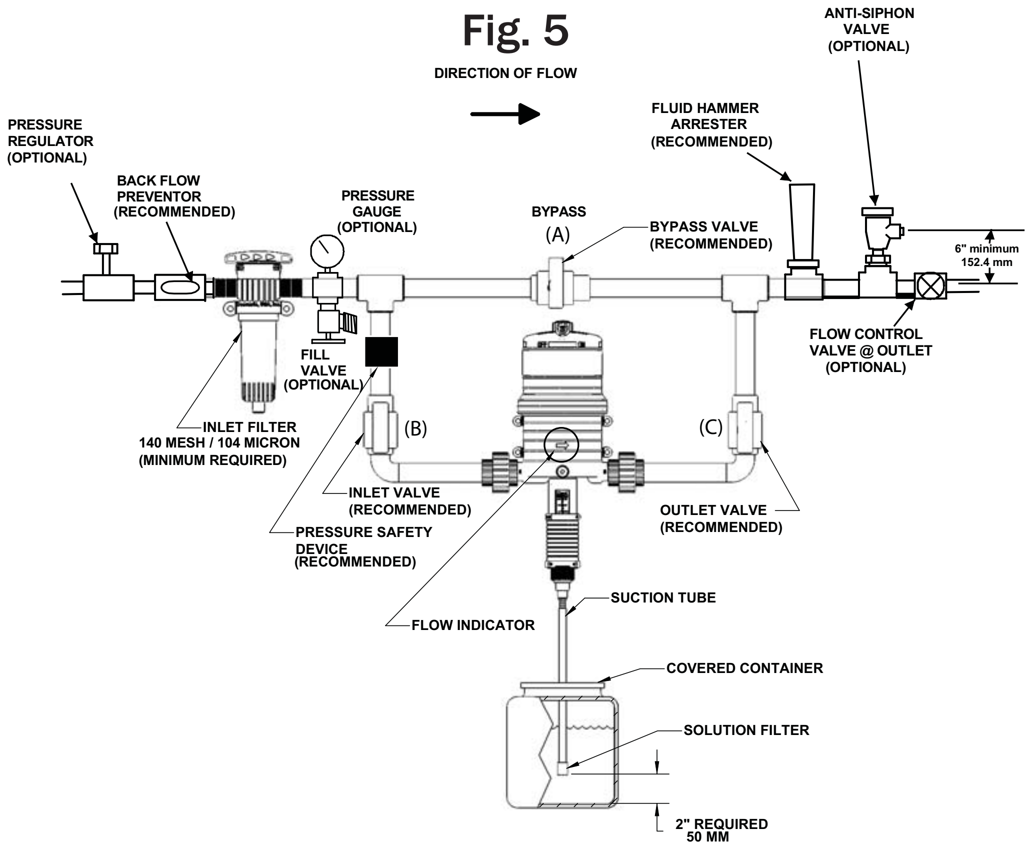
The injector is shipped with a thin coat of silicone around the seals for ease-of-assembly. Petroleum based lubricants such as Vaseline©, baby oil, WD40©, or motor oil on the O-rings or any part of the injector should never be used as this can cause particles to adhere and clog or damage the injector.

Check System for Leaks and Start-Up Procedures

Open the bypass valve (**A**), close inlet valve (**B**) and outlet valve (**C**) to prevent fluid flow into the injector. **SLOWLY** turn on the main fluid line. Run fluid flows between 5 -12 gpm (11-45 l/m) through the plumbing system. Turn on all of the valves located downstream from your injector to release trapped air. **SLOWLY** turn on the inlet valve (**B**). Open the outlet valve (**C**) and close valve (**A**). As fluid travels through the injector, you will hear a “clicking” sound. Check for leaks and correct if necessary.

Suggested Installation Diagram

Fig. 5



Remote Injecting

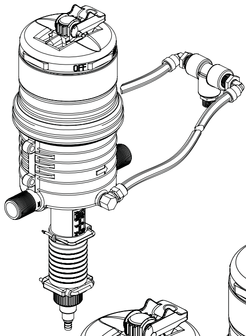


Fig. 6
Remote Injector Kit shown on a single injector.

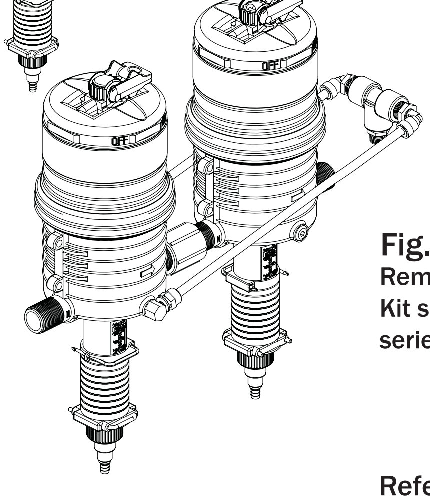


Fig. 7
Remote Injector Kit shown in a series.

Remote Injector Kit (not included)
Is recommended for the following:

Kit Part Numbers
012705

Single Injector:

To prevent mineral buildup within the body of the unit. Use when injecting chemicals that cause minerals to precipitate from fluid (see Fig. 6)

Injectors In a Series:

When injecting multiple chemical injections, using two or more injectors. Each injector adds chemical to the fluid(water) system, while bypassing the next injector and eliminating the potential damage to that injector (see Fig. 7).

NOTE: when mixing more than one chemical, always refer to your chemical manufacturer information guide for proper application. Contact your local distributor or Dosmatic customer service for information or to order.

Maintenance

Reference numbers refer to Page 13 - 17

RINSE INJECTOR AFTER EACH USE

Additive allowed to remain in injector can dry, foul or damage the lower end at the next start-up. Place suction tube into a 1 qt. (0.95 liters) or more container of fresh filtered water. Flow fresh water through the injector by operating until container is empty. This procedure is not needed for continuous operation.

CLEAN SOLUTION CONTAINER

Keep covered to prevent dirt, flies, feathers and other flying debris from entering the container. Rinse container thoroughly and often. Do not mix chemicals together that might react and cause a precipitate. Use **FILTERED** fluid when filling container.

CLEAN SUCTION TUBE FILTER SCREEN

Inspect each time new solution is added. Clean filter screen (#27) and suction tube (#25) as necessary by rinsing in fresh water. Replace if necessary. Keep filter screen off bottom of solution container to prevent dirt and precipitate from clogging filter.

CLEAN INLET FILTER

Clean or replace inlet filter as required to increase the life of the unit as well as reduce pressure loss.

BYPASS INJECTOR

When not in use place the injector in bypass mode by using the three valve bypass (preferred) or turn the on/off lever on the top of the injector to the off position.

STORAGE

For extended storage, rinse injector (see "Rinse Injector After Each Use") and place underwater in a container. Apply monthly, <0.1 oz. (29 ml) of chlorine bleach to avoid algae growth. **KEEP FROM FREEZING.**

Perform these maintenance procedures to extend the life of your unit.

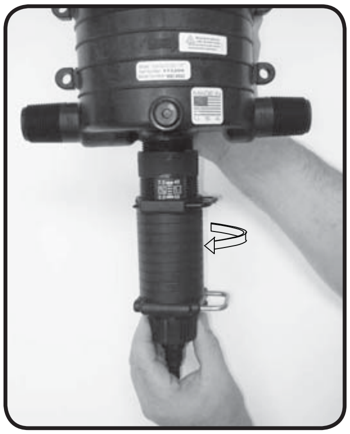
Refer to pages 14 & 15
SuperDos 45 (0.3%) Model (Including PAA)

Every 3 - 6 Months	Every 6 - 12 months	Replace as necessary
1. Clean seal areas (# 17, 14 & 13). 2. Check #17 O-ring, #7 Cylinder, clean and/or replace as necessary.	1. Replace #17 O-ring and #44 (0.3% - #51) Dosage Piston. 2. Clean and/or replace #13 Check Poppet, #11 Suction Tube Fitting.	1. #7 Cylinder 2. #14 O-ring 3. #51 Shaft Assembly Dosage Piston

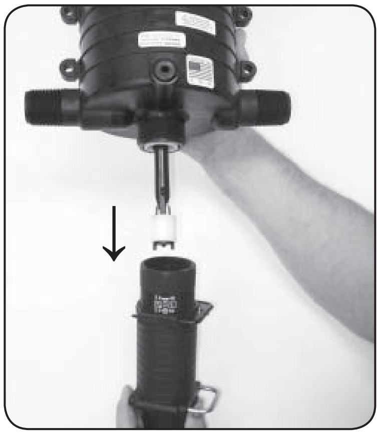
Refer to pages 16 & 17
SuperDos 45 (2.5%), (5%) Models

Every 3 - 6 Months	Every 6 - 12 months	Replace as necessary
1. Clean seal areas (# 17, 14 & 13). 2. Check #17 O-ring, #7 Cylinder, clean and/or replace as necessary.	1. Replace #17 O-ring and #44 Dosage Piston. Clean and/or replace. 2. #13 Check Poppet , #11 Suction Tube Fitting.	1. #7 Cylinder 2. #14 O-ring

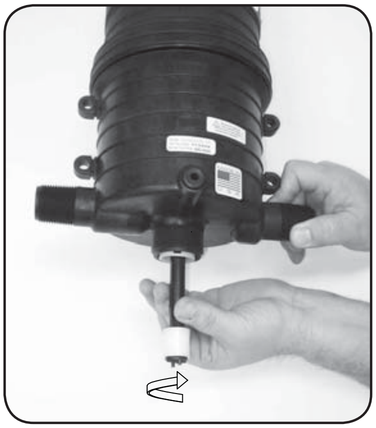
Routine Maintenance Instructions



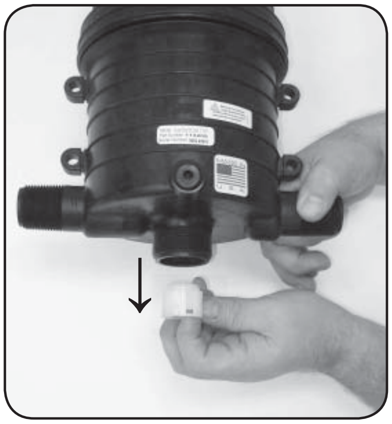
Step 1.
Unscrew LOWER END CYLINDER ASSEMBLY from body.



Step 2.
Remove LOWER END CYLINDER ASSEMBLY .

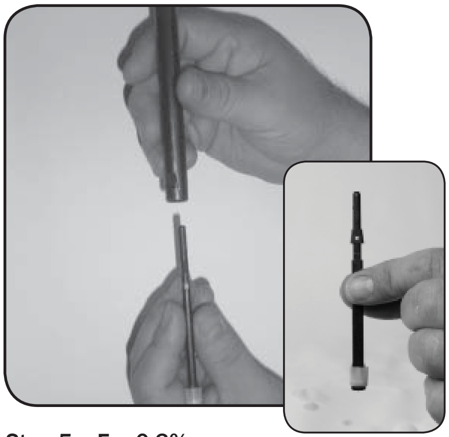


Step 3.
Rotate #51 SHAFT 90º and pull from body.



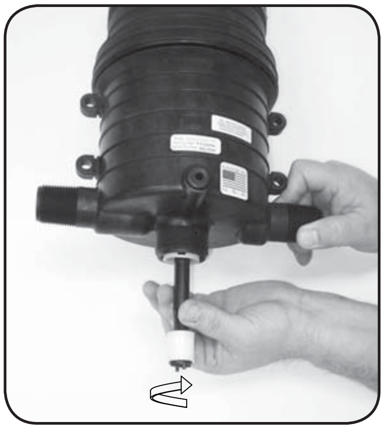
Step 4.
Pry the #15 SEAL RETAINER from the injector. Pry #17 O-ring from the unit. NOTE: O-ring may still be seated at the base of the unit.

Step 5. For 2.5% & 5%
Replace #44 DOSAGE PISTON flared-end up and #14 O-ring. 0.3% only: Replace # 51 SHAFT ASSEMBLY. See Step 5a.

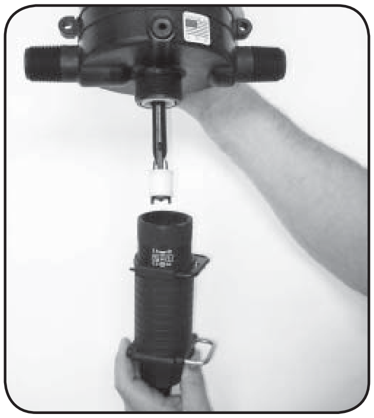


Step 5a. For 0.3%.
Replace LOWER SHAFT assembly into upper shaft.

Step 6.
Reinsert #15 SEAL RETAINER and #17 O-ring onto # 51 SHAFT ASSEMBLY.



Step 7.
Reinsert #51 SHAFT ASSEMBLY into body and rotate 90º to lock. Confirm the shaft is locked in by gently tugging on the shaft. Shaft should remain inserted.



Step 8.
Screw LOWER END CYLINDER ASSEMBLY onto body. Ensure #16 gasket is seated on the top of cylinder assembly.

Troubleshooting

New Install - Always Pressure Up Slowly (Follow start up on page 9)

Problem	Cause	Solution
No Clicking Sound	Fluid not flowing through unit	Are the red plugs at the inlet, outlet and suction tube fitting openings removed? Is the unit installed backward? The arrow on the unit must point in the direction of the fluid flow. Has the new injector been stored for an extended period. If so, submerge the injector in room temperature fluid for 24 hours so that the working parts can reabsorb fluid and swell back to the proper size. If still not clicking, do not open the upper body. Call Dosmatic Customer Service.
	Fluid flowing through unit	Fluid rate is below or exceeds rated service flow of injector. (see Specifications for maximum flow rate page 6). If below increase flow rate, if above, reduce flow rate. Operating pressure exceeds maximum limit. Install a pressure reducer valve. (see Specifications for maximum flow rate page 6). On/Off Lever in off position. Place the On/Off lever switch to the ON position. By-Pass Valve not closed. Check and set valve to the ON position.

Injector in Operation or After Scheduled Maintenance

Problem	Cause	Solution
No Clicking Sound	Main Piston Assembly #9 worn	Replace # 9 Main Piston Assembly. Clean fluid filter.
	Cover #1 or main body #40 worn or scored	Lightly sand inside diameter of bores to remove grooves. Install or clean fluid filter.
	On/Off Lever in off position	Place the On/Off lever switch to the ON position.
	By-Pass Valve not open	Set Valve to the closed position.
	Dirty or plugged inlet filter	Ensure mesh size is correct for proper filtration. Clean filter.
	#17 Worn or not seated properly	Re-seat #17 or replace.

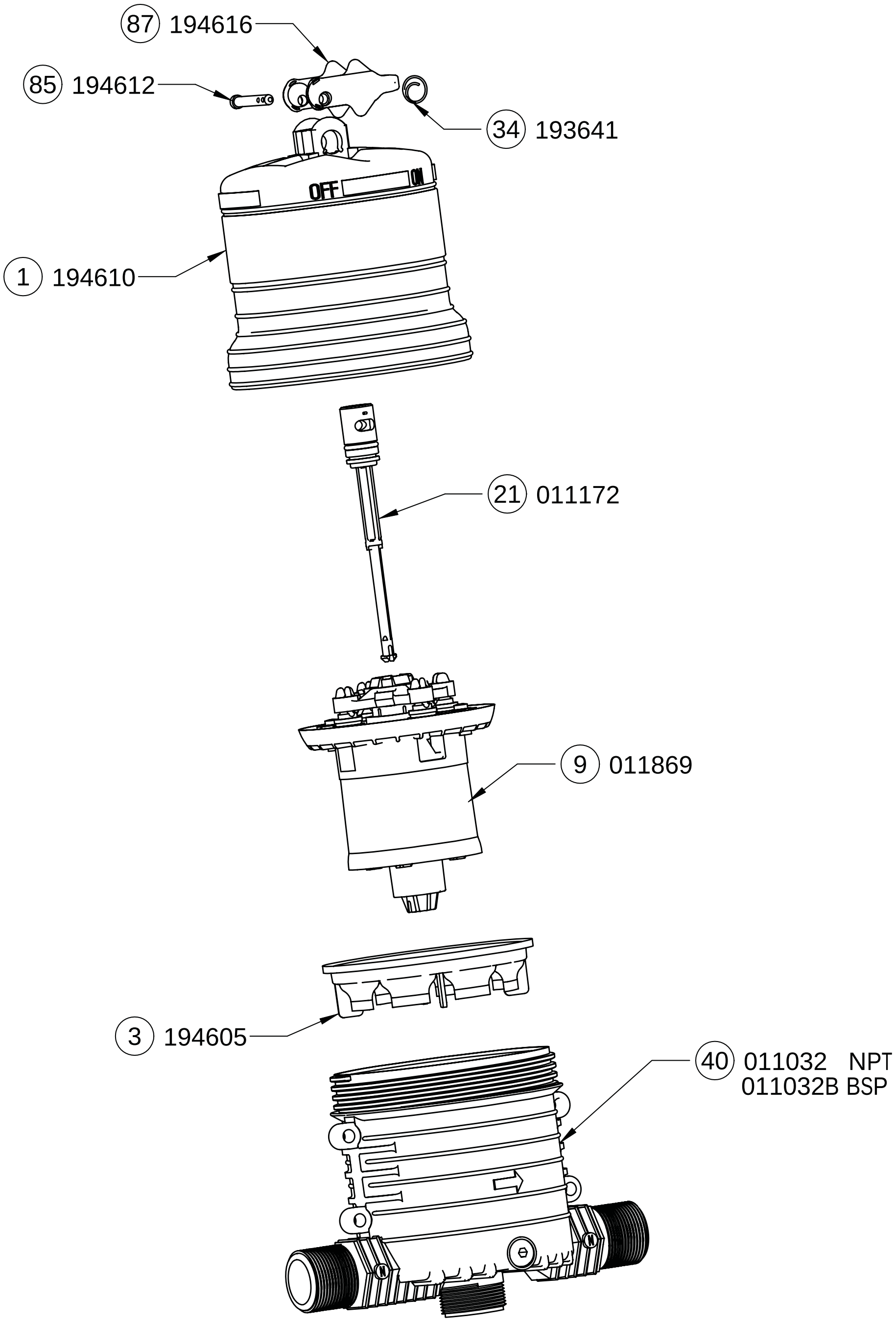
Problem	Cause	Solution
Clicking Sound No Suction Of Solution	Cracked or loose Suction Hose	Check for proper fit and /or replace.
	Dosage piston #44 (0.3% model #51) worn or installed incorrectly	Replace. Ensure during maintenance replacement that #44 dosage piston was installed correctly flared-end up.
	O-ring retainer #15 installed incorrectly	Install correctly.
	O-ring seat #14 or dosage piston #44 (0.3% model #51) damaged	Replace.
	#17 O-ring worn and/or loose	Replace.
	Suction tube #25 or suction tube fitting #11 cracked, leaking or clogged suction tube filter	Replace and/or clean as necessary.
	Check valve #13 leaking	Clean & replace as necessary.

Problem	Cause	Solution
Clicking Sound. Under Injecting	#44 (0.3% model #51) Dosage Piston worn	Replace.
	#7 Inner Cylinder worn	Replace.
	Unit operates at high-flow and not at low flow	Replace #17 O-ring.
	Main Piston Assembly #9 worn	Replace # 9 Main Piston Assembly. Clean fluid filter.
	Cover #1 or main body #40 worn or scored	Lightly sand inside diameter of bores to remove O-ring grooves. Install or clean fluid filter.

Problem	Cause	Solution
Fluid Re-filling Solution Tank	Check valve #13 leaking	Check seat area on suction tube fitting #11. Check valve and seal must fit loose in the suction tube fitting. Clean seal and inside fitting for debris.
	Washer seal on #13 is swollen or chemical attack	Replace with new check valve assembly.

Injector Repair Parts

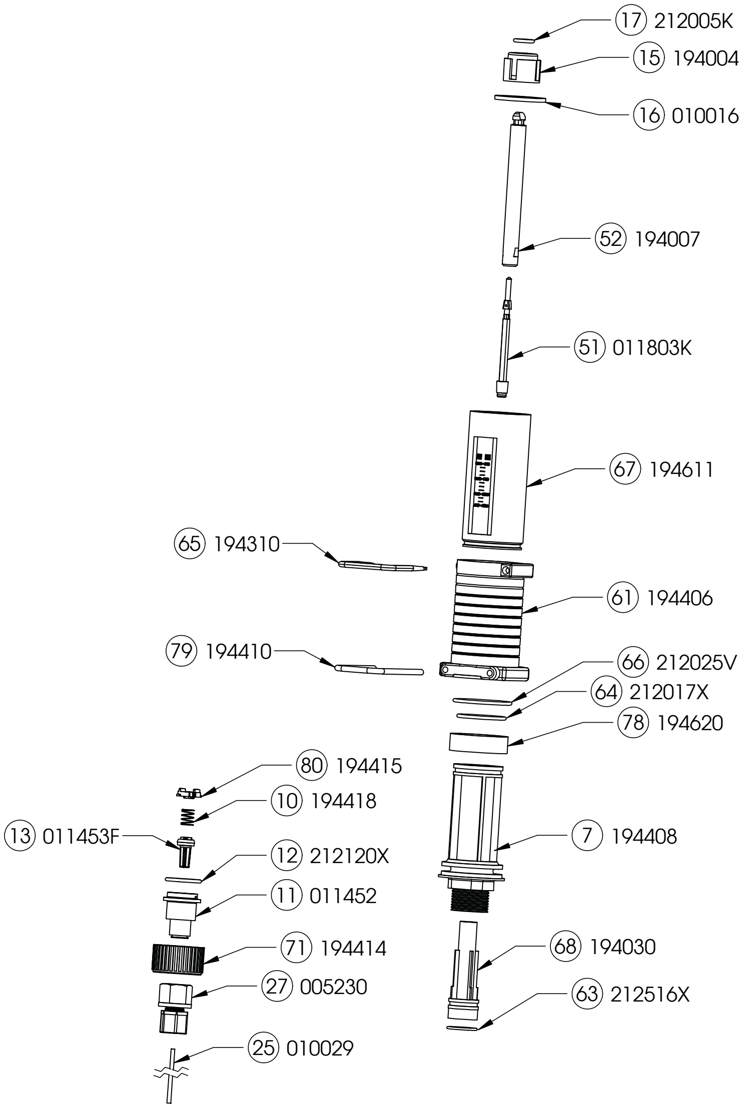
Reference #	Part #	Description
1	194610	Upper Body
3	194605	Mixing Chamber Gasket
9	011869	Piston Assembly
21	011172	Shaft Assembly
34	193641	Cotter ring
40	011032	Lower Body NPT 1 1/4"
	011032B	Lower Body BSP 1 1/4"
85	194612	Upper Shaft Pin
87	194616	On/Off Handle

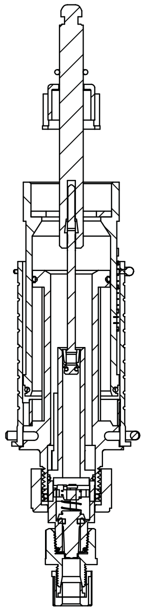


Lower end & wear parts kits 0.3% PAA (Rotating):

Kit A – Wear Parts Kit (dosage piston/shaft assy, O-ring)	012310K	17, 51
Kit C – Wear Parts Kit (Kit A, inner cylinder, O-ring)	012311RK	17, 51, 63, 68
Kit D – Suction Tube Fitting Assy (poppet, nut, washer, O-ring, spring, fitting)	011463RK	10, 11, 12, 13, 80
Kit E – Wear Parts Kit (Kits C & D, inner cylinder (2nd inner cylinder), shaft, pin, gasket)	012312RK	10, 11, 12, 13, 16, 17, 51, 63, 68, 80
Kit F – Lower End Cylinder Kit (inner & outer cylinder, ratio adjuster, O-ring, retainer clip, pin, gasket)	012313RK	7, 16, 61, 63, 64, 65, 66, 67, 68, 78,79
Kit G - Lower End Kit, complete (Kit E, outer cylinder, ratio adjuster, O-ring, retainer clip, pin, retainer, filter, solution tube)	012314RK	7, 11, 12, 13, 15, 16, 17, 25, 27, 51, 52, 61, 63, 64, 65, 66, 67, 68, 71, 78, 79
Kit H – Motor Piston Assy (upper end kit)	011861	9, 21
Kit M – Mounting Bracket Kit (mounting bracket, 4 hex caps & nuts)	011432	56, 57, 58

Manual Reference	**Part #**	**Description of Part**
7	194408P	Cylinder, inner
10	194418H	Spring
11	011452	Suction tube fitting
12	212120X	O-ring
13	011453F	Check poppet
15	194004	Seal retainer, O-ring
16	010016S	Gasket, inlet/outlet and cylinder
17	212005K	O-ring
25	010029	Suction tube, 1/4” ID x 5ft
27	005230	Compression fitting
51	011803K	Lower shaft
52	194007	Upper shaft
61	194406P	Ratio adjustment sleeve
63	212516X	O-ring
64	212017X	O-ring, inner cylinder, lower end
65	194310D	Pin, upper interlock
66	212025V	O-ring, outer cylinder, lower end
67	194611	Cylinder, outer
68	194030	Cylinder, inner for #7
71	194414	Nut, suction tube fitting
78	194620	Lower end stop
79	194410SS	Pin, narrow interlock
80	194415	Twistlock



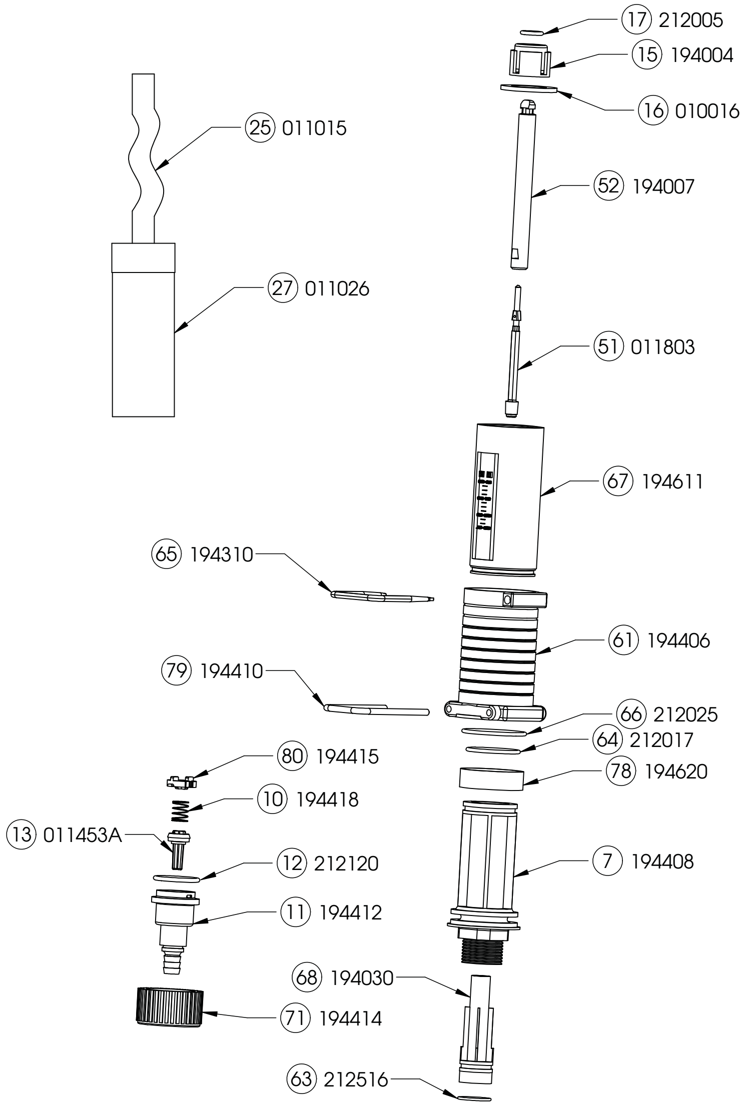


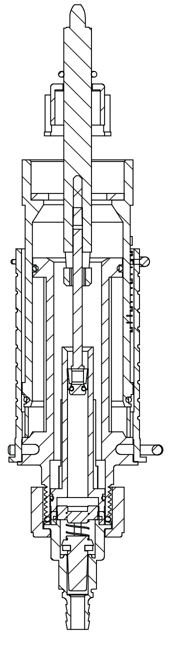
Lower End Assembly

Lower end & wear parts kits 0.3% (Rotating):

Kit A – Wear Parts Kit (dosage piston and O-ring)	012310	17, 51
Kit C – Wear Parts Kit (Kit A, inner cylinder and O-ring)	012311R	17, 51, 63,68
Kit D – Dip tube Fitting (poppet, O-ring, washer, spring, fitting	011461V	10, 11, 12, 13, 80
Kit E - Wear Parts (Kits C & D, inner cylinder (2nd inner cylinder), shaft, pin, gasket)	012315R	10, 11, 12, 13, 16, 17, 51, 63, 68, 80
Kit F – Lower End Cylinder Kit (inner & outer cylinder, ratio adjuster, O-rings, retainer clip, pin, gasket)	012313R	7, 16, 61, 63, 64, 65, 66, 67, 68, 78, 79
Kit G - Lower End Kit, complete (Kit E, outer cylinder, ratio adjuster, O-ring, retainer clip, pin, retainer, filter, solution tube)	012317R	7, 10, 11, 12, 13, 15, 16, 17, 25, 27, 51, 52, 61, 63, 64, 65, 66, 67, 68, 71, 78, 79, 80
Kit H - Motor Piston Assy (upper end kit)	011861	9, 21
Kit M – Mounting Bracket Kit (mounting bracket, 4 hex caps & nuts)	011432	56, 57, 58

Manual Reference	Part #	Description of Part
7	194408	Cylinder, Inner
10	194418H	Spring
11	194412	Fitting, Suction Tube, 3/8"
12	212120 *Must spedify material	O-ring
13	011453A	Check poppet
15	194004	Seal Retainer, O-ring
16	010016S	Gasket
17	212005 *Must specify material	O-ring
25	011015	Suction Tube, 3/8" X 5'
27	011026	Filter Suction Tube 3/8" Id
51	011803	Shaft, Assy With Dosage Piston
52	194007	Upper Shaft
61	194406P	Ratio Adjustment Sleeve
63	212516 *Must specify material	O-ring, Inner Cylinder (#68)
64	212017 *Must specify material	O-ring, Inner Cylinder, Lower End
65	194310D	Pin, Upper Interlock
66	212025 *Must specify material	O-ring, Outer Cylinder, Lower End
67	194611	Ratio Adjuster
68	194030	Cylinder, Inner For #7
71	194414	Nut, Suction Tube Fitting
78	194620	Lower End Stop
79	194410SS	Pin, Narrow Interlock
80	194415	Twistlock



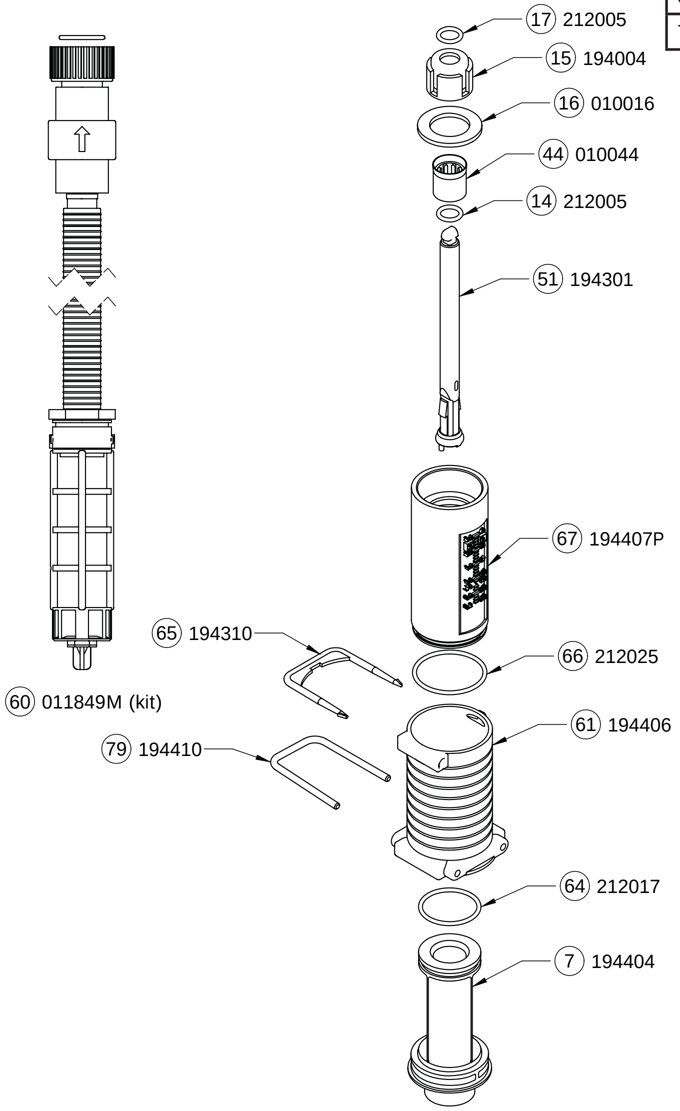


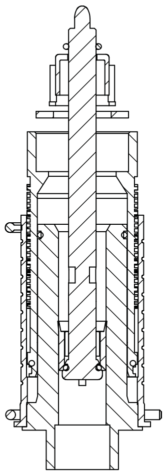
Lower End Assembly

Lower end & wear parts kits 2.5%:

Kit A – Wear Parts Kit (dosage piston and O-ring)	011850V	14, 17, 44
Kit B – Wear Parts Kit (Kit A, & shaft)	011945V	14, 17, 44, 51
Kit C – Wear Parts Kit (Kit A, inner cylinder and O-ring)	011850CV	7, 14, 17, 44, 64
Kit D – Hose Kit (O-ring, dip tube fitting, check valve, 2 adapters, clamp, hose, filter)	011849M	60
Kit F – Lower End Cylinder Kit (inner & outer cylinder, ratio adjuster, O-rings, retainer clip, pin, gasket)	011961V	7, 16, 61, 64, 65, 66, 67, 79
Kit H – Motor Piston Assy	011861	9, 21
Kit M – Mounting Bracket Kit (mounting bracket, 4 hex caps & nuts)	011432	56,57,58

Manual Reference	Part #	Description of Part
7	194404P	Cylinder, Inner
14	212005 *Must specify material	O-ring
15	194004	Seal Retainer, O-ring
16	010016S	Gasket
17	212005 *Must specify material	O-ring
44	010044P	Dosage Piston
51	194301F	Shaft
60	011849M	Hose Braid Kit
61	194406P	Ratio Adjustment Sleeve
64	212017 *Must specify material	O-ring, Inner Cylinder, Lower End
65	194310D	Pin, Upper Interlock
66	212025 *Must specify material	O-ring, Outer Cylinder, Lower End
67	194407P	Cylinder, Outer
79	194410SS	Pin, Narrow Interlock



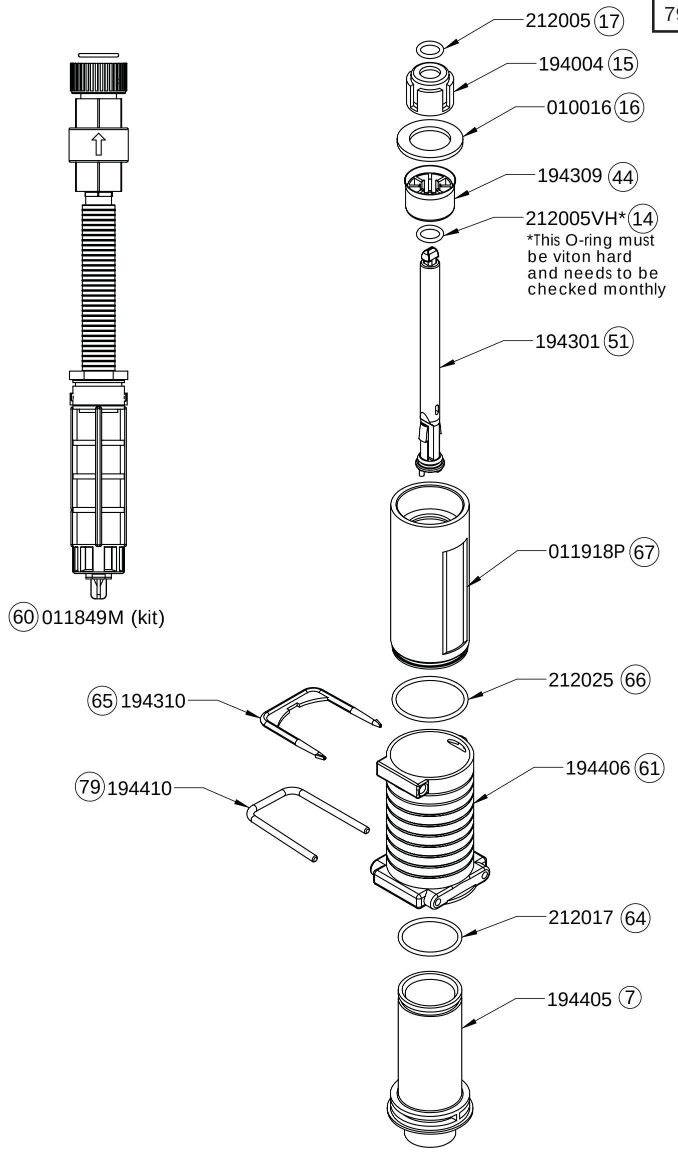


Lower End Assembly

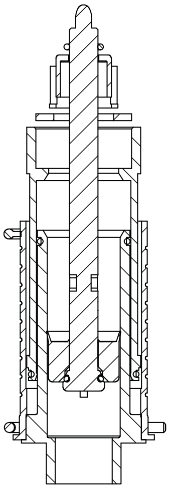
Lower end & wear parts kits 5%:

Kit A – Wear Parts Kit (dosage piston and O-ring)	011852PV	14, 17, 44
Kit B – Wear Parts Kit (Kit A, & shaft)	011950V	14, 17, 44, 51
Kit C – Wear Parts Kit (Kit A, inner cylinder and O-ring)	011856PV	7, 14, 17, 44, 64
Kit D – Hose Kit (O-ring, dip tube fitting, check valve, 2 adapters, clamp, hose, filter)	011849M	60
Kit F – Lower End Cylinder Kit (inner & outer cylinder, ratio adjuster, O-rings, retainer clip, pin, gasket)	011963PV	7, 16, 61, 64, 65, 66, 67, 79
Kit H – Motor Piston Assy	011861	9, 21
Kit M – Mounting Bracket Kit (mounting bracket, 4 hex caps & nuts)	011432	56, 57, 58

Manual Reference	Part #	Description of Part
7	194405P	Cylinder, Inner
14	212005 *Must specify material	O-ring
15	194004	Seal Retainer, O-ring
16	010016S	Gasket
17	212005 *Must specify material	O-ring
44	194309	Dosage Piston
51	194301F	Shaft
60	011849M	Hose Braid Kit
61	194406P	Ratio Adjustment Sleeve
64	212017 *Must specify material	O-ring, Inner Cylinder, Lower End
65	194310D	Pin, Upper Interlock
66	212025 *Must specify material	O-ring, Outer Cylinder, Lower End
67	011918P	Cylinder, Outer
79	194410SS	Pin, Narrow Interlock



*This O-ring must be viton hard and needs to be checked monthly



Lower End Assembly

Warranty

Congratulations on Your Purchase

We make the best and most reliable fluid-driven injectors available. Our warranty provides the best coverage in the industry. Dosmatic will provide for replacement of all parts proven to be defective in material or workmanship from the date of purchase for the following periods:

3 years	The cover and body
2 years	The motor piston assembly
1 year	The lower end (Chemical pump)

Dosmatic products are warranted to be free from defects in materials and workmanship for the above time frames. Dosmatic will at its sole option repair or replace any component that fails in normal use. Any repairs made under warranty shall not extend the initial warranty period.

To Maintain Your Warranty

Your only responsibility is ordinary maintenance - filtering incoming fluid, replacing the O-ring and dosage piston when worn. Seals and O-rings are not covered under the warranty.

This warranty is not valid if the defects are found to be due to the product's misuse, lack of maintenance, fluid impurities such as sand or iron, defective installation, freezing, fluid hammer, abuse, unwanted side effects due to the chemicals you choose to inject or service provided by anyone who is not an authorized service provider. Dosmatic declines any responsibility if the product is not used in compliance with the operating instructions and specifications as indicated in this owner's manual.

continued...

Warranty may be void if injector body is disassembled. If you suspect you are having a problem in the motor piston assembly or inside the body please contact Dosmatic or any authorized repair center to arrange to send the injector in to be evaluated and/or repaired.

IN NO EVENT SHALL Dosmatic BE LIABLE FOR ANY INCIDENTAL, SPECIAL; INDIRECT, OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE OR INABILITY TO USE THIS PRODUCT OR FROM DEFECTS IN THE PRODUCT.

There is no warranty expressed or implied relating in any way to products used in conjunction with Dosmatic.

Dosmatic or authorized distributor shall not be liable for incidental or consequential damage, such as any economic loss. Dosmatic retains the exclusive right to repair or replace the product. Such remedy shall be your sole and exclusive remedy for any breach of warranty. There are no warranties, expressed or implied, which extend beyond those described above.

To Return an injector for Warranty or Non-Warranty repair:

See page 3 for Dosmatic contact information.

1. Thoroughly flush the injector with water of any chemical and drain. Ensure proper packing for shipment.

2. To EXPEDITE warranty evaluation and repair or non-warranty product repair, please include the following: a copy of the original invoice, serial number of the unit, chemical used, contact information and a Return Authorization (RA) number, contact your country's Dosmatic Customer Service to obtain.

3. Send freight prepaid and ship to Dosmatic or your local distributor. For the name of your local distributor or if returning to Dosmatic, contact your country's Dosmatic Customer Service.

4. For a WARRANTED injector: upon inspection and determination that the unit has defects in materials or workmanship, the unit will be repaired or replaced at Dosmatic's option, free of charge and shipped back freight prepaid.

5. For a NON-WARRANTED injector: upon inspection Dosmatic or a local distributor will call the customer with a repair estimate.

TW-60 Water Treatment System

section 7

Submittal Data

PROJECT:	TW-60 Mobile Water Treatment System	UNIT TAG:	________	QUANTITY:	3
	________	TYPE OF SERVICE:	________		________
REPRESENTATIVE:	Water Missions Intl	SUBMITTED BY:	________	DATE:	________
ENGINEER:	Pat Haughney / David Inman	APPROVED BY:	________	DATE:	________
CONTRACTOR:	Parker Racor Village Marine	ORDER NO.:	________	DATE:	________

CR 20-4

Vertical, multistage centrifugal pump with suction and discharge ports on the same level. The pump head and base are in cast iron. All other wetted parts are in stainless steel (EN 1.4301)

Installed Unit

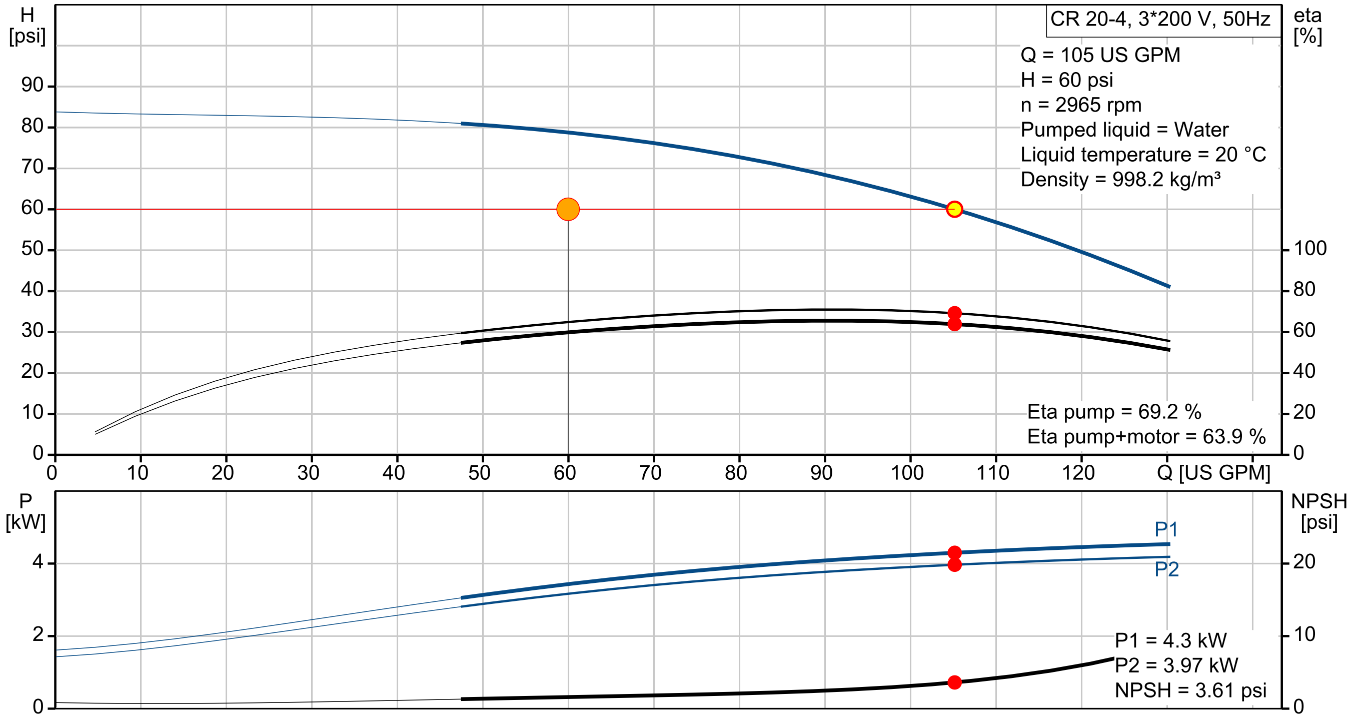
50 Hz Data

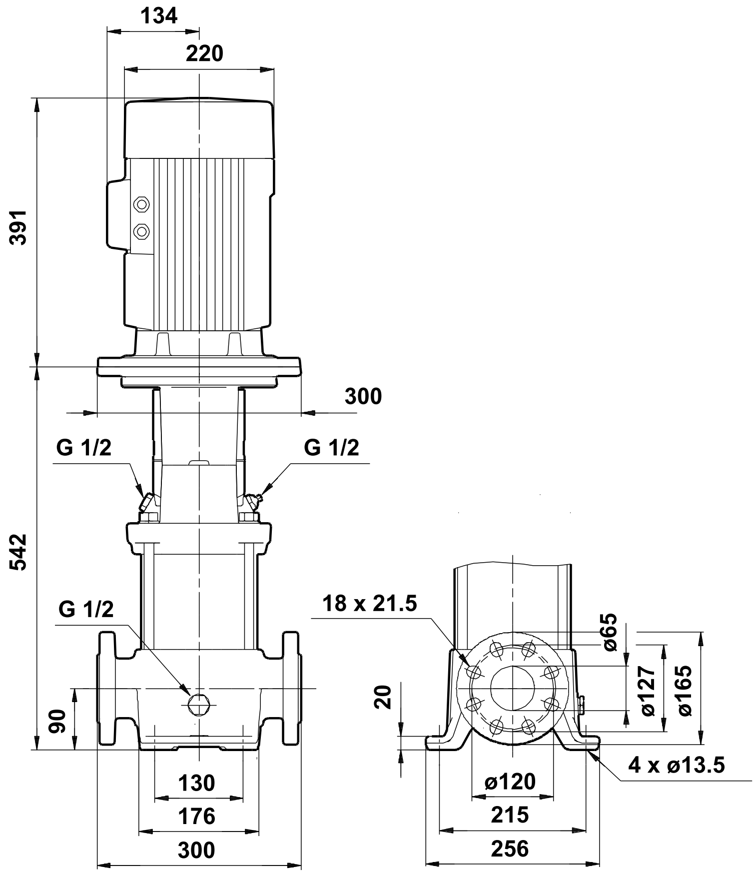
Note! Product picture may differ from actual product

Conditions of Service	
Flow:	67.9 US GPM
Head:	76.8 psi
Efficiency:	62.3 %
Liquid:	0
Temperature:	20 °C
NPSH required:	1.85 psi
Viscosity:	1 mm2/s
Specific Gravity:	________

Pump Data	
Max pressure at stated temp:	16 bar / 120 °C
Liquid temperature range:	-20 .. 120 °C
Maximum ambient temperature:	60 °C
Approvals:	CE,TR
Shaft seal:	HQQE
Flange standard:	JIS
Pipe connection:	DN 50
Product number:	On request

Motor Data	
Rated power - P2:	7.5 kW
Rated voltage:	200-220 D/346-380 Y V
Mains frequency:	50 Hz
Enclosure class:	55
Insulation class:	F
Motor protection:	PTC
Motor type:	132SB
Motor_efficiency:	90,1-90,4 %

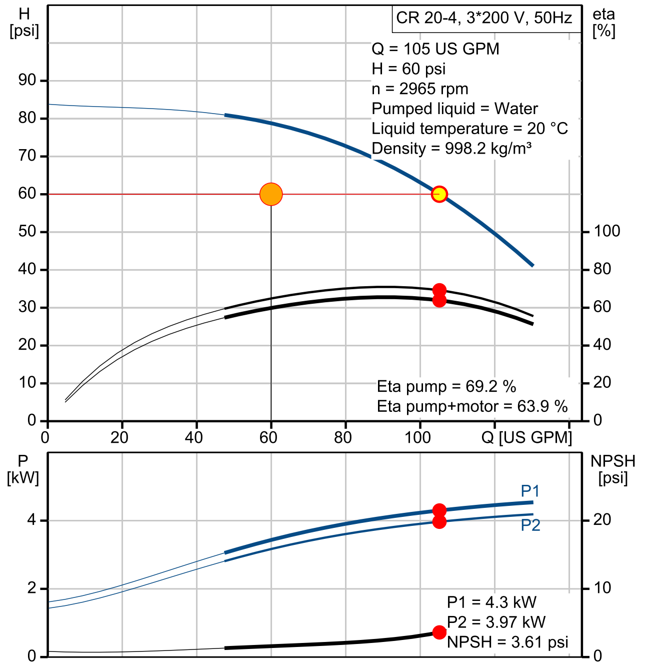


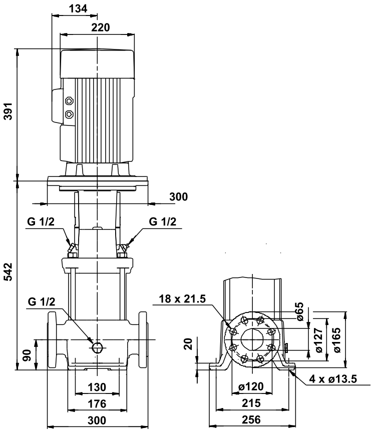


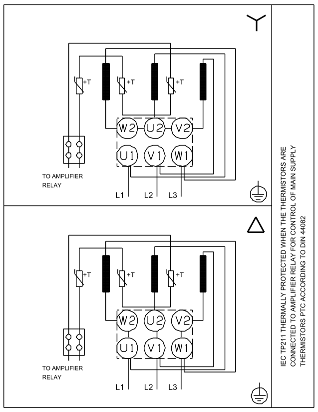
Materials:

Pump housing:	Cast iron EN-JL1030 ASTM A48-30 B
Impeller:	Stainless steel DIN W.-Nr. 1.4301 AISI 304
Material code:	A
Code for rubber:	E

Description	Value
General information:	
Product name:	CR 20-4 B-GJ-A-E-HQQE
Position	
Product No:	On request
EAN number:	On request
Price:	On request
Technical:	
Speed for pump data:	2897 rpm
Rated flow:	92.5 US GPM
Rated head:	65.5 psi
Head max:	83.2 psi
Impellers:	4
Shaft seal:	HQQE
Approvals on nameplate:	CE,TR
Curve tolerance:	ISO9906:2012 3B
Pump type:	CR 20
Stages:	4
Pump version:	B
Model:	A
Materials:	
Pump housing:	Cast iron
	EN-JL1030
	ASTM A48-30 B
Impeller:	Stainless steel
	DIN W.-Nr. 1.4301
	AISI 304
Material code:	A
Code for rubber:	E
Installation:	
Maximum ambient temperature:	60 °C
Max pressure at stated temp:	16 bar / 120 °C
	16 bar / -20 °C
Flange standard:	JIS
Connect code:	GJ
Pipe connection:	DN 50
Pressure stage:	20 K
Flange size for motor:	FF265
Liquid:	
Liquid temperature range:	-20 .. 120 °C
Kinematic viscosity:	1 mm2/s
Electrical data:	
Motor type:	132SB
IE Efficiency class:	IE3
Number of poles:	2
Rated power - P2:	7.5 kW
Power (P2) required by pump:	5.5 kW
Mains frequency:	50 Hz
Rated voltage:	3 x 200-220 D/346-380 Y V
Rated current:	27,5-26,5/15,8-15,4 A
Starting current:	780-910 %
Cos phi - power factor:	0,88-0,82
Rated speed:	2910-2920 rpm
Efficiency:	IE3 90,1%
Motor efficiency at full load:	90,1-90,4 %
Motor efficiency at 3/4 load:	90,8 %
Motor efficiency at 1/2 load:	90,8 %
Enclosure class (IEC 34-5)::	55
Insulation class (IEC 85):	F
Motor protec:	PTC
Motor No:	85904016
Others:	
Label:	Grundfos Blueflux
Minimum efficiency index, MEI ≥:	0.7
Net weight:	89 kg
Gross weight:	111 kg
Shipping volume:	0.43 m³

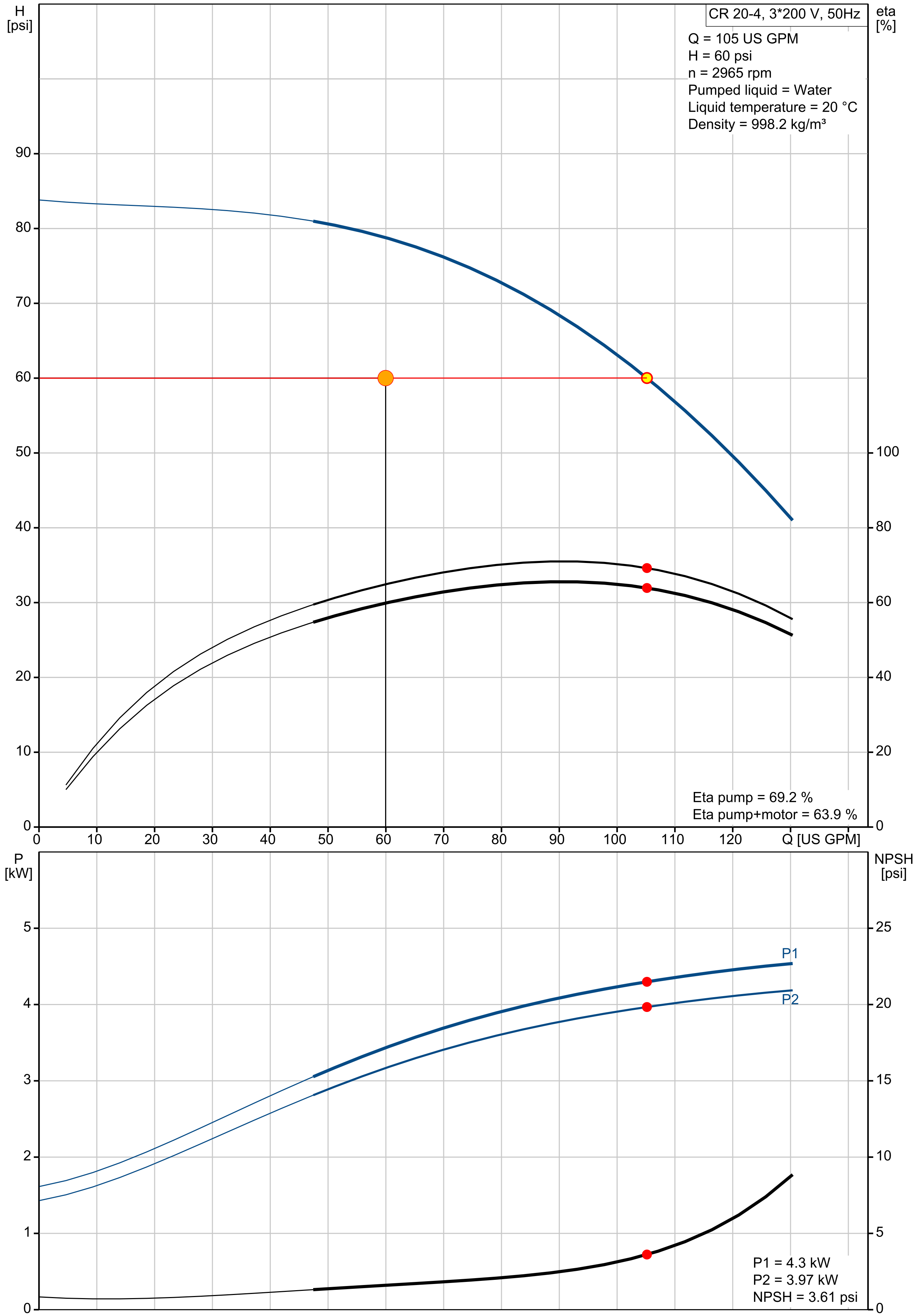






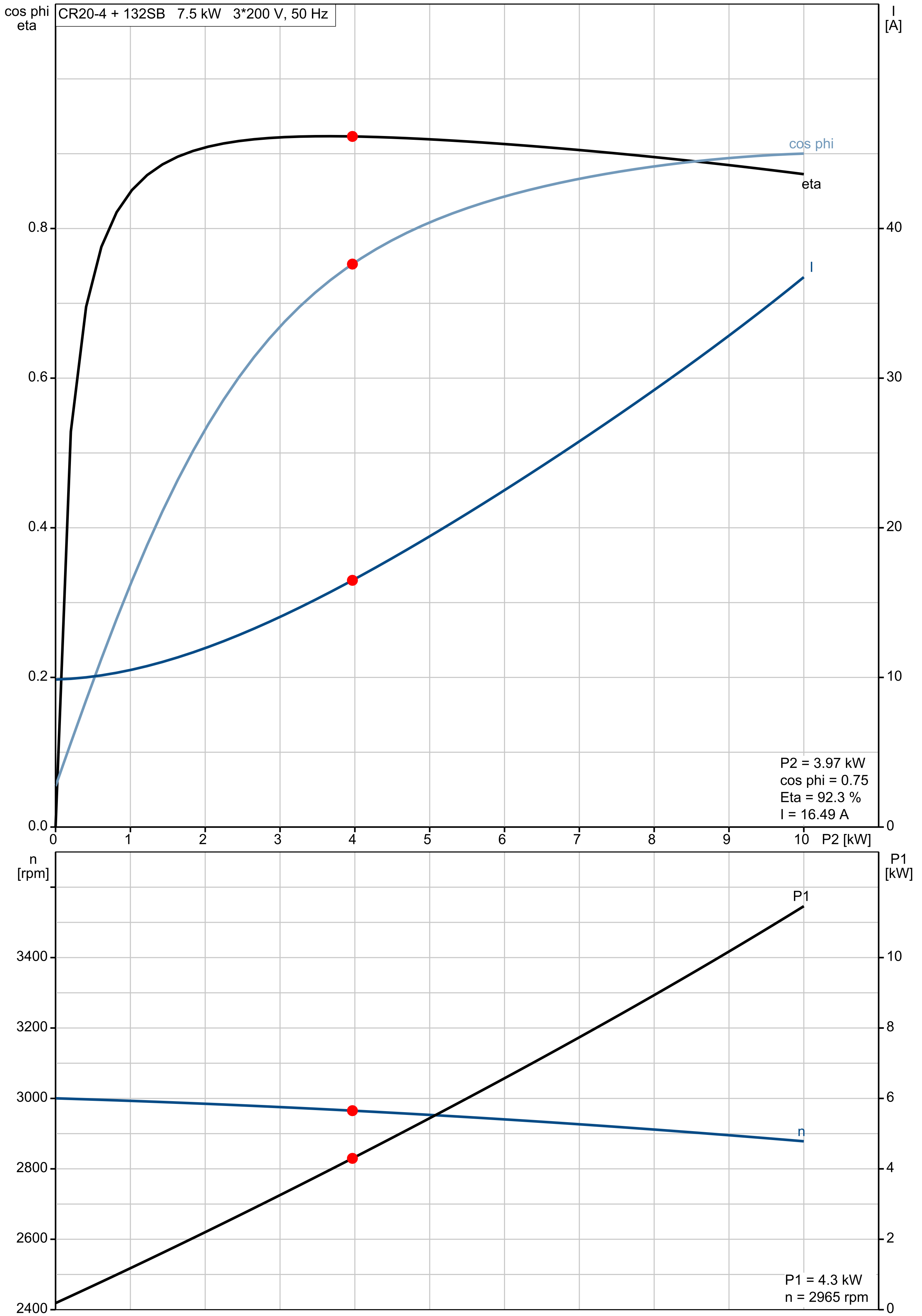
IEC TP211 THERMALLY PROTECTED WHEN THE THERMISTORS ARE CONNECTED TO AMPLIFIER RELAY FOR CONTROL OF MAIN SUPPLY THERMISTORS PTC ACCORDING TO DIN 44082

CR 20-4 50 Hz

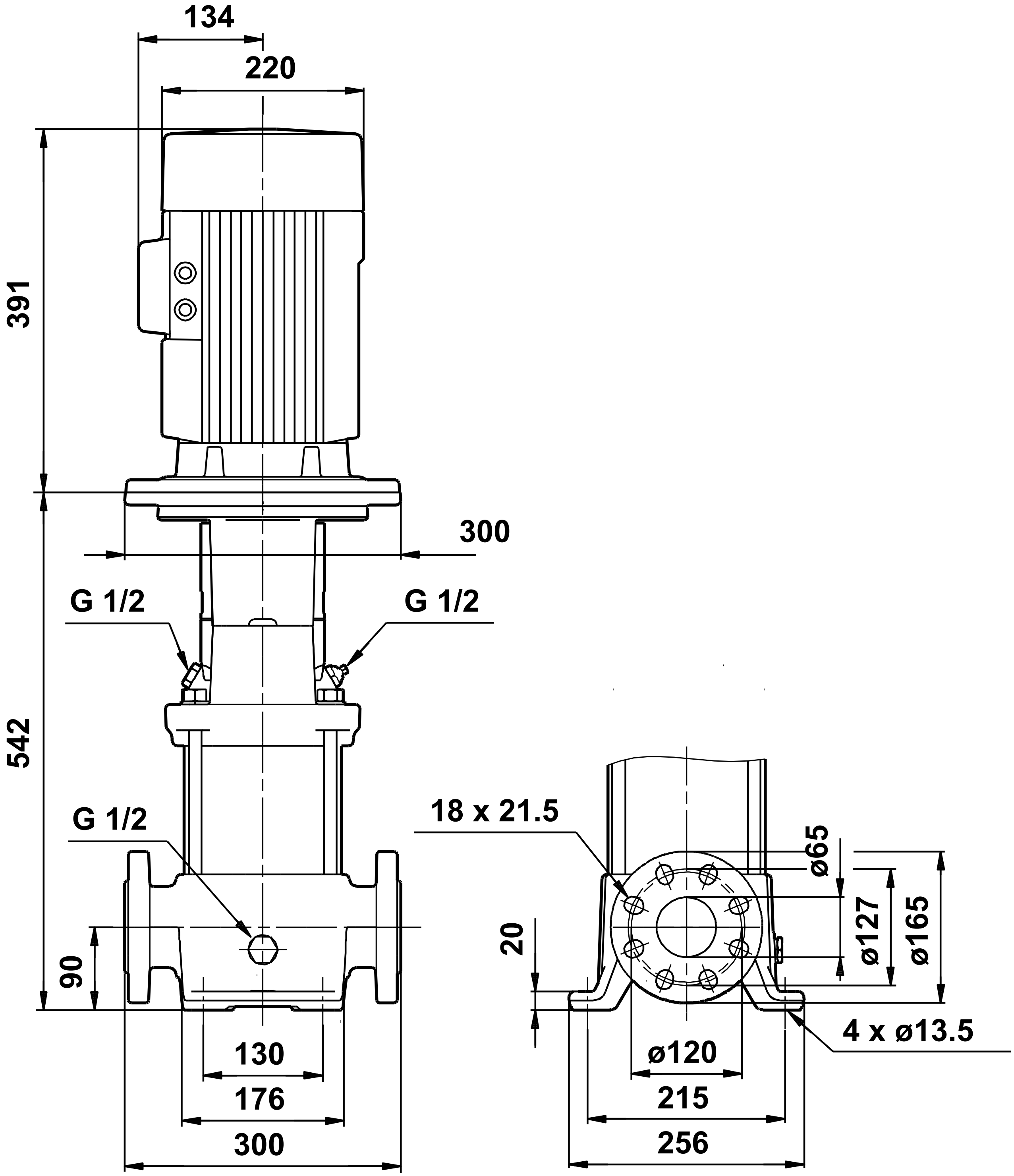


H [psi]
eta [%]
CR 20-4, 3*200 V, 50Hz
Q = 105 US GPM
H = 60 psi
n = 2965 rpm
Pumped liquid = Water
Liquid temperature = 20 °C
Density = 998.2 kg/m³
90
80
70
60
50
40
30
20
10
0
100
80
60
40
20
0
Eta pump = 69.2 %
Eta pump+motor = 63.9 %
0
10
20
30
40
50
60
70
80
90
100
110
120
Q [US GPM]
P [kW]
NPSH [psi]
5
4
3
2
1
0
25
20
15
10
5
0
P1
P2
P1 = 4.3 kW
P2 = 3.97 kW
NPSH = 3.61 psi

CR 20-4 50 Hz


CR20-4 + 132SB   7.5 kW   3*200 V, 50 Hz
cos phi
eta
I
[A]
cos phi
eta
I
0.0
0.2
0.4
0.6
0.8
0
10
20
30
40
0
1
2
3
4
5
6
7
8
9
10
P2 [kW]
P2 = 3.97 kW
cos phi = 0.75
Eta = 92.3 %
I = 16.49 A
n
[rpm]
P1
[kW]
P1
n
2400
2600
2800
3000
3200
3400
0
2
4
6
8
10
P1 = 4.3 kW
n = 2965 rpm

CR 20-4 50 Hz



Note! All units are in [mm] unless others are stated.
Disclaimer: This simplified dimensional drawing does not show all details.

GRUNDFOS

Submittal Data

PROJECT:		UNIT TAG:		QUANTITY:	
		TYPE OF SERVICE:			
REPRESENTATIVE:		SUBMITTED BY:		DATE:	
ENGINEER:		APPROVED BY:		DATE:	
CONTRACTOR:		ORDER NO.:		DATE:	

Product photo could vary from the actual product

CR 20-4

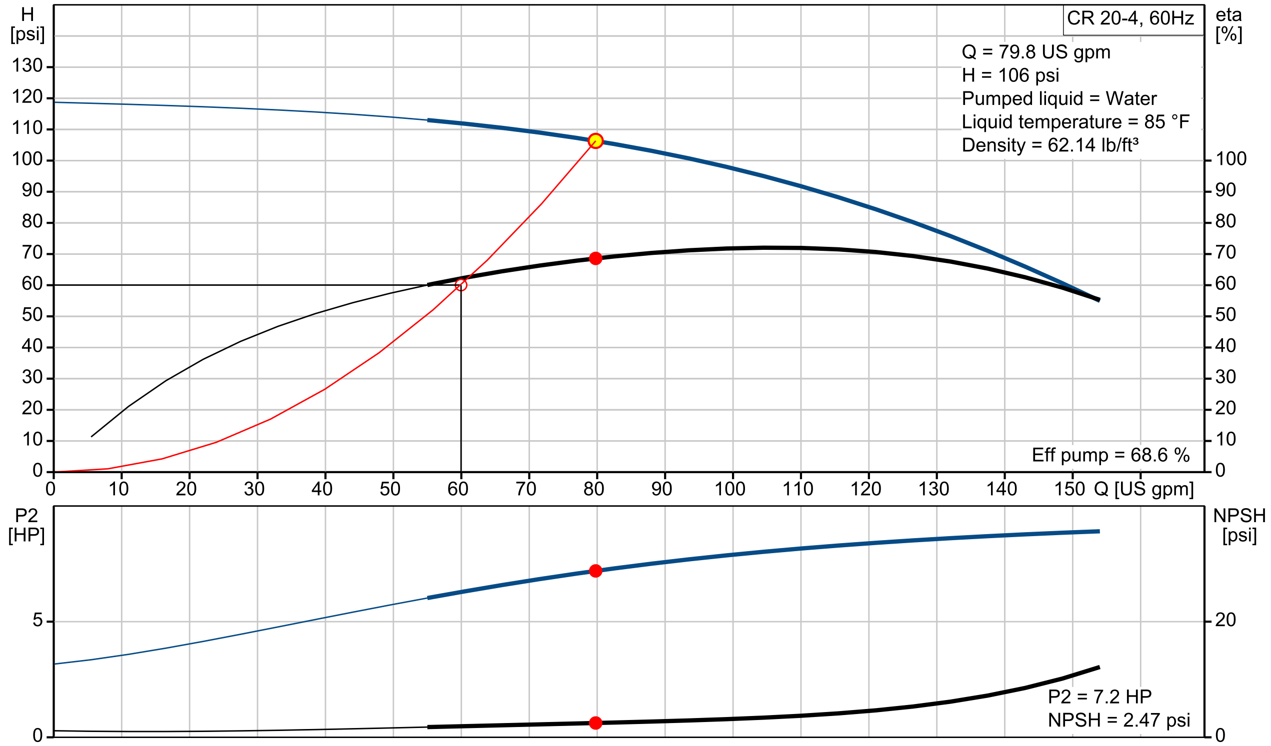
Vertical, multistage centrifugal pump with suction and discharge ports on the same level. The pump head and base are in cast iron. All other wetted parts are in stainless steel (EN 1.4301)(AISI 304)

60 Hz Data

Conditions of Service	
Flow:	
Head:	
Efficiency:	
Liquid:	
Temperature:	
NPSH required:	
Viscosity:	
Specific Gravity:	

Pump Data	
Max pressure at stated temperature:	232 psi / 250 °F
Liquid temperature range:	-4 .. 248 °F
Maximum ambient temperature:	140 °F
Approvals:	ANSI/NSF61
Shaft seal:	HQQE
Flange standard:	ANSI
Pipe connection:	2"
Product number:	96524011

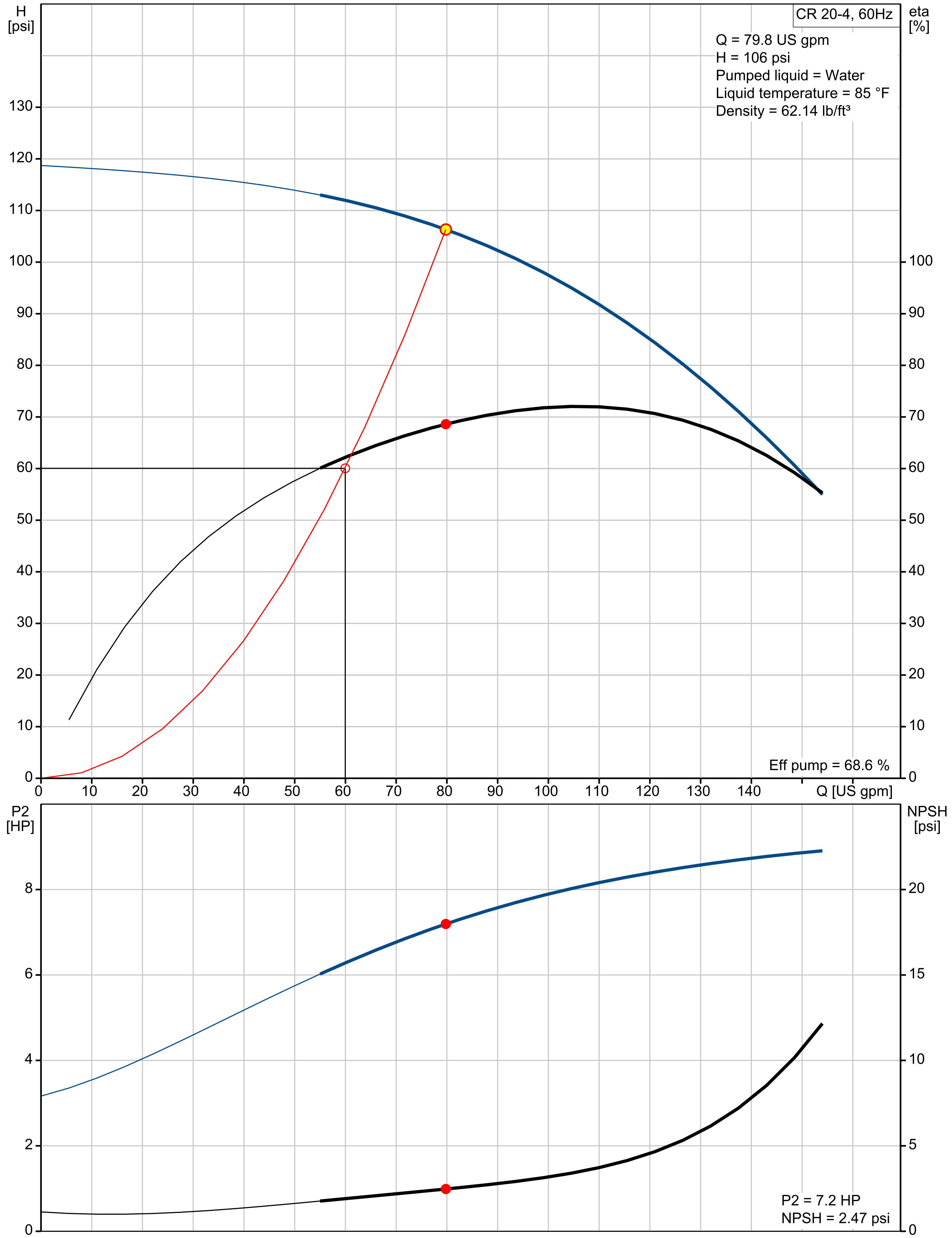
Motor Data	
Rated power - P2:	10 HP
Rated voltage:	208-230YY/460Y V
Main frequency:	60 Hz
Enclosure class:	55 Dust/Jetting
Insulation class:	F
Motor protection:	PTC
Motor type:	132FA
Motor_efficiency:	90,0-90,2 %



Company name:
Created by:
Phone:

Date:

96524011 CR 20-4 60 Hz

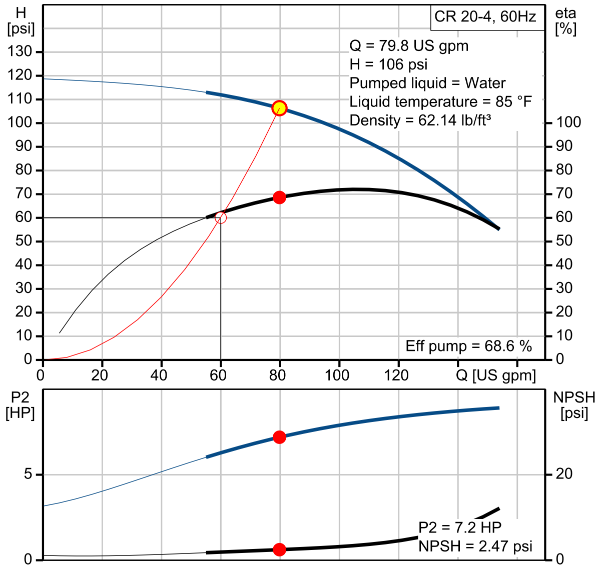


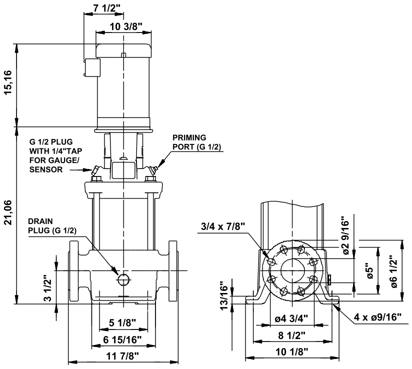
Printed from Grundfos Product Center [2015.01.034]

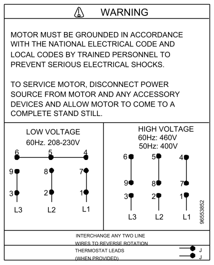
Company name:
Created by:
Phone:

Date:

Description	**Value**
General information:	
Product name:	CR 20-4 A-GJ-A-E-HQQE
Position	
Product No.:	96524011
EAN:	5700396915715
Price:	On request
Technical:	
Speed for pump data:	3470 rpm
Rated flow:	111 US gpm
Rated head:	90.8 psi
Head max:	118 psi
Impellers:	04
Shaft seal:	HQQE
Approvals on nameplate:	ANSI/NSF61
Curve tolerance:	ISO 9906:1999 Annex A
Stages:	4
Pump version:	A
Model:	A
Cooling:	TEFC
Materials:	
Pump housing:	Cast iron
	EN-JL1030
	ASTM A48-30 B
Impeller:	Stainless steel
	DIN W.-Nr. 1.4301
	AISI 304
Material code:	A
Code for rubber:	E
Installation:	
Maximum ambient temperature:	140 °F
Max pressure at stated temperature:	232 psi / 250 °F
	232 psi / -4 °F
Flange standard:	ANSI
Connect code:	GJ
Pipe connection:	2"
Pressure stage:	Class 250
Flange size for motor:	213TC
Liquid:	
Liquid temperature range:	-4 .. 248 °F
Electrical data:	
Motor type:	132FA
Number of poles:	2
Rated power - P2:	10 HP
Power (P2) required by pump:	10 HP
Main frequency:	60 Hz
Rated voltage:	3 x 208-230YY/460Y V
Service factor:	1.15
Rated current:	26,5-24,6/12,4 A
Starting current:	680-900 %
Cos phi - power factor:	0,87
Rated speed:	3480-3500 rpm
Motor efficiency at full load:	90,0-90,2 %
Motor efficiency at 3/4 load:	90,8 %
Motor efficiency at 1/2 load:	90,8 %
Enclosure class (IEC 34-5):	55 Dust/Jetting
Insulation class (IEC 85):	F
Motor protection:	PTC
Motor Number:	85903410
Others:	
Net weight:	216 lb






WARNING

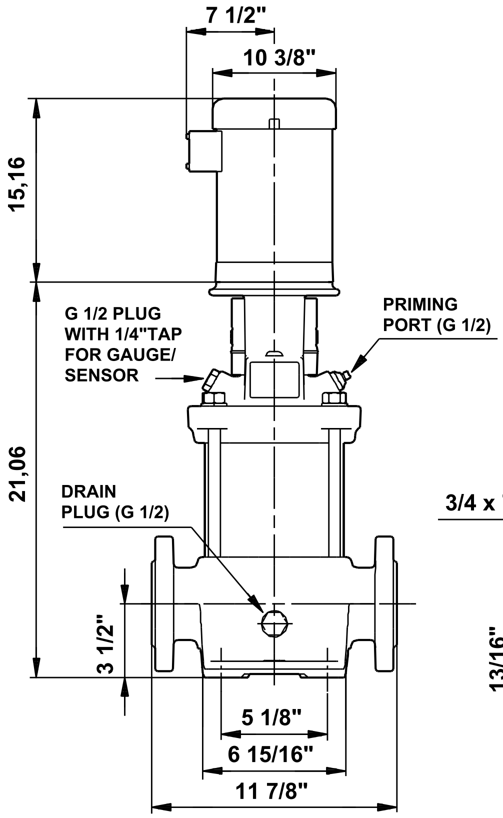
MOTOR MUST BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL CODES BY TRAINED PERSONNEL TO PREVENT SERIOUS ELECTRICAL SHOCKS.

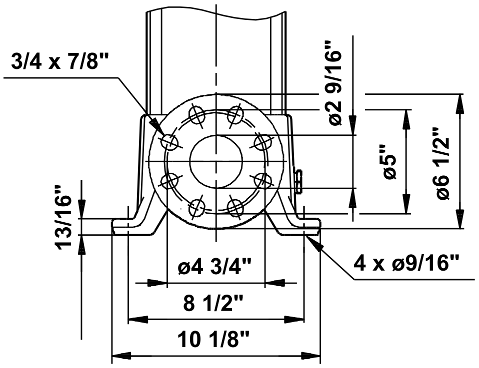
TO SERVICE MOTOR, DISCONNECT POWER SOURCE FROM MOTOR AND ANY ACCESSORY DEVICES AND ALLOW MOTOR TO COME TO A COMPLETE STAND STILL.

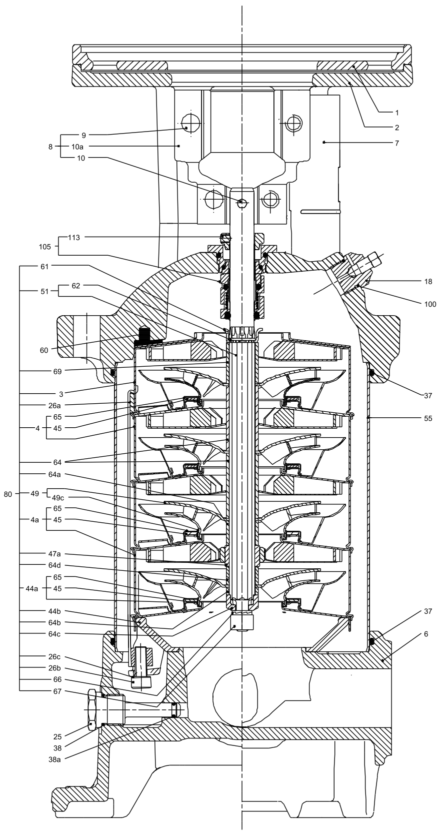
INTERCHANGE ANY TWO LINE WIRES TO REVERSE ROTATION

THERMOSTAT LEADS (WHEN PROVIDED)

Submittal Data







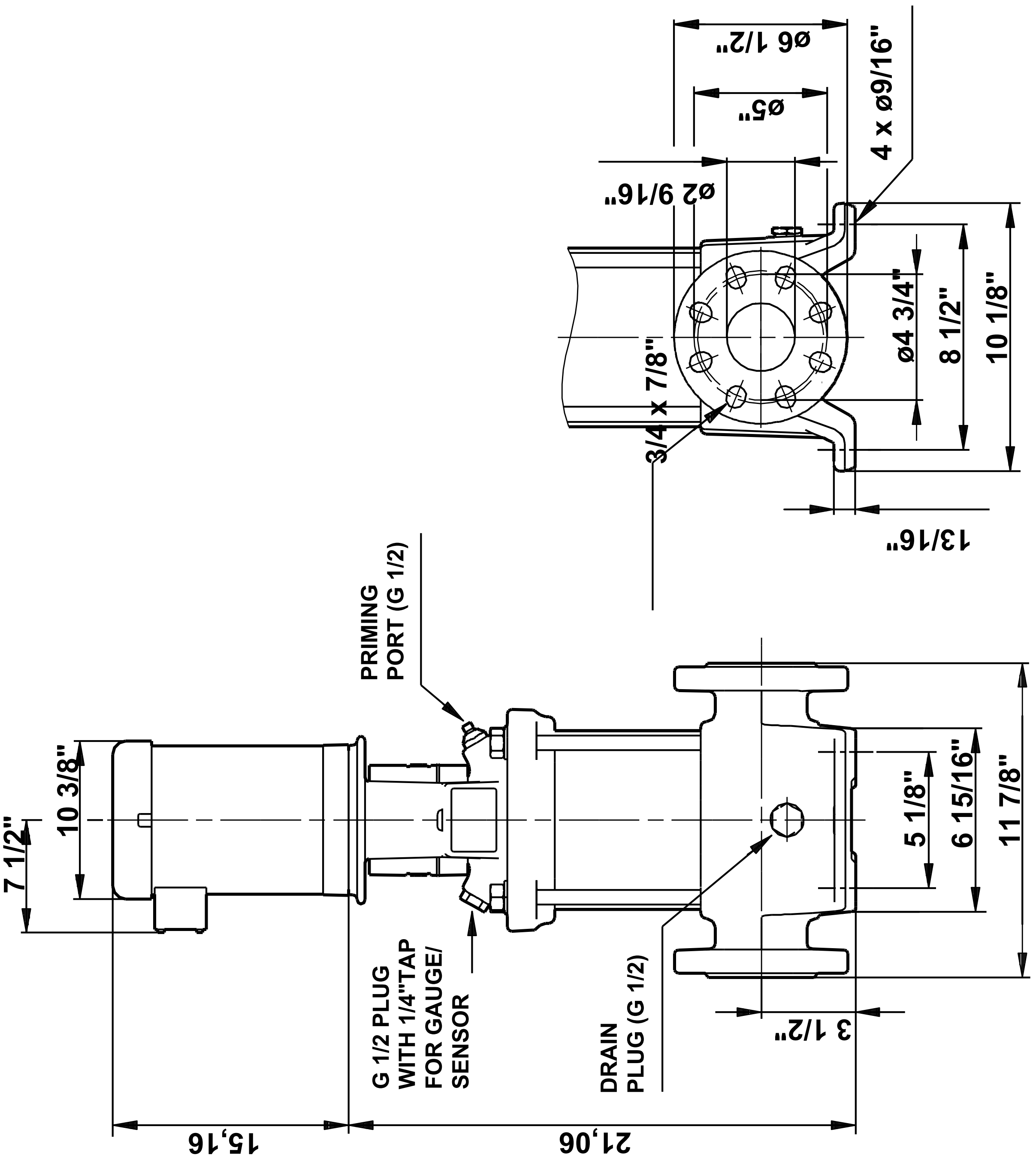
Materials:

Pump housing:	Cast iron EN-JL1030 ASTM A48-30 B
Impeller:	Stainless steel DIN W.-Nr. 1.4301 AISI 304
Material code:	A
Code for rubber:	E

Company name:
Created by:
Phone:

Date:

96524011 CR 20-4 60 Hz



Note! All units are in [mm] unless otherwise stated.
Disclaimer: This simplified dimensional drawing does not show all details.

Company name:
Created by:
Phone:

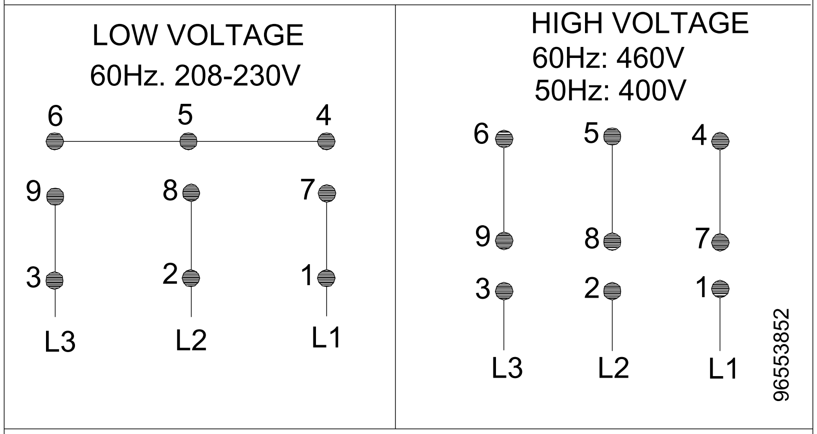
Date:

96524011 CR 20-4 60 Hz

WARNING

MOTOR MUST BE GROUNDED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE AND LOCAL CODES BY TRAINED PERSONNEL TO PREVENT SERIOUS ELECTRICAL SHOCKS.

TO SERVICE MOTOR, DISCONNECT POWER SOURCE FROM MOTOR AND ANY ACCESSORY DEVICES AND ALLOW MOTOR TO COME TO A COMPLETE STAND STILL.



INTERCHANGE ANY TWO LINE WIRES TO REVERSE ROTATION

THERMOSTAT LEADS (WHEN PROVIDED) — J, J

GRUNDFOS

Company name:
Created by:
Phone:

Date:

Service parts CR 20-4, Prod number 96524011
Valid from 20.10.2014 (1443)

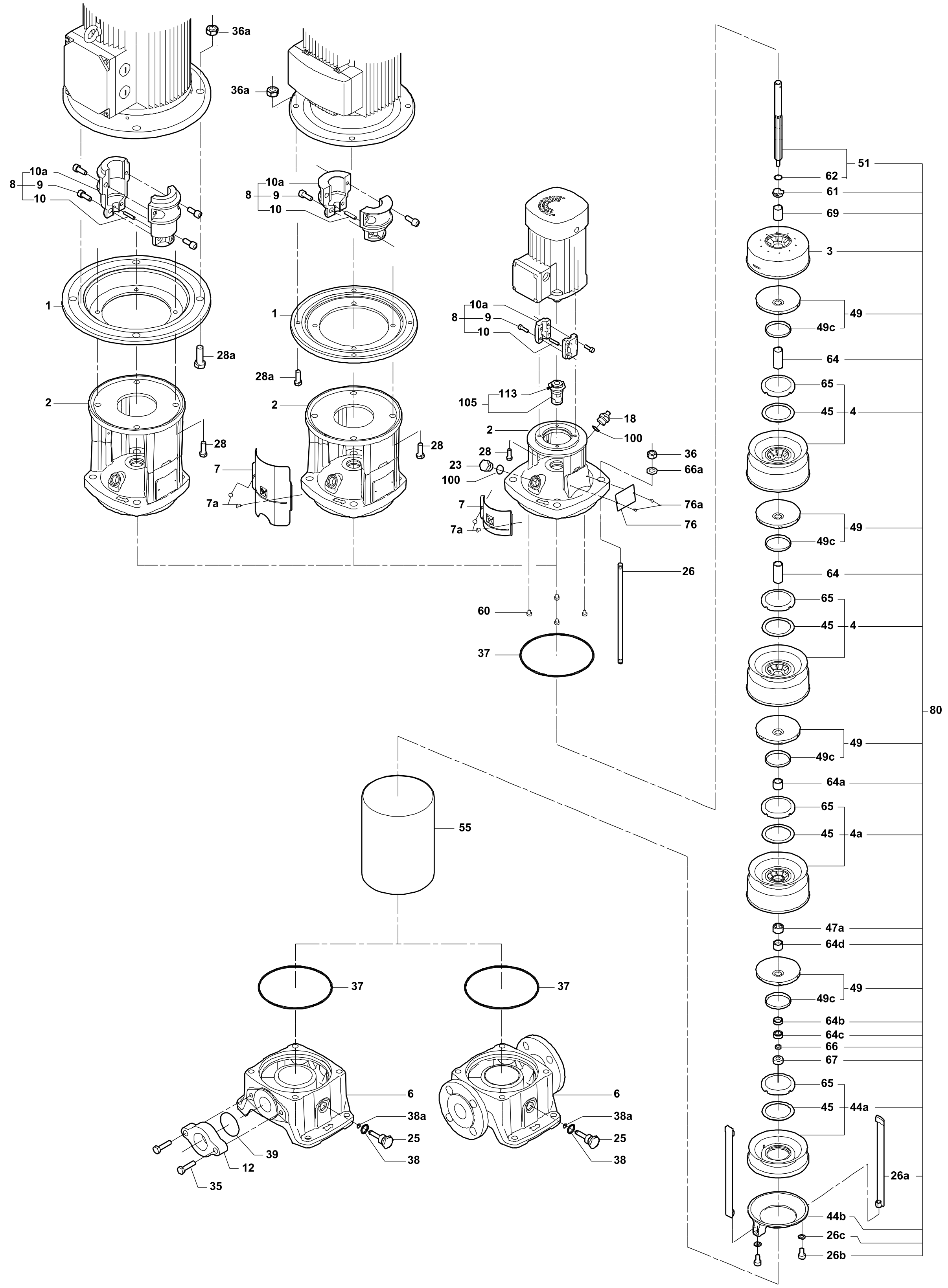
	Position	Description	Annotation	Classification data	Part No.	Count	Unit
-		Kit, chamber stack			96508544	1	pcs
-	80	Chamber stack				1	pcs
		Intermediate chamber cpl.				1	pcs
		Spacing bush				1	pcs
		Spacing bush				1	pcs
-	4a	Intermediate chamber cpl.				1	pcs
		Guide cup				1	pcs
		Lifter				1	pcs
		Bearing bush				1	pcs
		Bearing plate				1	pcs
		Guide vane				10	pcs
	3a	Intermediate chamber				1	pcs
	45	Neck ring cpl.				1	pcs
	65	Retainer for upper seal ring				1	pcs
-	4	Intermediate chamber cpl.				2	pcs
		Guide cup				1	pcs
		Lifter				1	pcs
		Intermediate chamber				1	pcs
		Front plate				1	pcs
		Guide vane				10	pcs
	45	Neck ring cpl.				1	pcs
	65	Retainer for upper seal ring				1	pcs
	26a	Strap cpl.				2	pcs
	26.c	Washer		Designation: DIN 125A Inner diameter: 8,4 Outer diameter: 16 Thickness: 1,6		2	pcs
	26.b	Hex cap screw		Length: 25,00 Thread: M08		2	pcs
	36	Lock nut		Thread: M8		1	pcs
	44b	Inlet part				1	pcs
-	44a	Inlet part cpl.				1	pcs
		Guide cup				1	pcs
		Lifter				1	pcs
		Inlet part				1	pcs
	45	Neck ring cpl.				1	pcs
	65	Retainer for upper seal ring				1	pcs
	47a	Bearing ring				1	pcs
-	49	Impeller cpl.				4	pcs
		Impeller blade				6	pcs
		Impeller plate				1	pcs
		Impeller plate				1	pcs
	49c	Wear ring				1	pcs
	51	Shaft, spline, cpl.				1	pcs
	64c	Spacing pipe				1	pcs
	64b	Spacing bush				1	pcs
	66	Washer				1	pcs
	69	Spacing pipe		Inner diameter: 17,5 Length: 17		1	pcs
	69	Spacing pipe				2	pcs
-	8	Kit, coupling			96511355	1	pcs
		Adjusting fork				1	pcs
	9	Hex socket head cap screw		Designation: DIN 912 Length: 25 Thread: M10		1	pcs
-	10.a	Coupling		Dimension: D35/D16		1	pcs
	9	Hex socket head cap screw		Designation: DIN 912 Length: 25 Thread: M10		4	pcs
	10a	Coupling				1	pcs

	Position	Description	Annotation	Classification data	Part No.	Count	Unit
	10	Shaft pin		Diameter: 5		1	pcs
				Length: 26			
	10	Shaft pin		Diameter: 5		1	pcs
				Length: 26			
-		Kit, gaskets			96509609	1	pcs
		O-ring				2	pcs
		Gasket				2	pcs
	20	Spring				4	pcs
	37	O-ring				2	pcs
	38a	O-ring		Diameter: 5,3		1	pcs
				Material type: EPDM			
				Thickness: 2,4			
	38	O-ring		Diameter: 16,3		1	pcs
				Material type: EPDM			
				Thickness: 2,4			
	39	Gasket		Inner diameter: 49		2	pcs
				Outer diameter: 92			
				Thickness: 2			
	100	O-ring		Diameter: 16,3		2	pcs
				Material type: EPDM			
				Thickness: 2,4			
-		Kit, plug			96511313	1	pcs
		Drain plug				1	pcs
-	18	Air vent screw				1	pcs
		Spindle				1	pcs
		Plug				1	pcs
	23.a	Drain plug				1	pcs
	23.a	Pipe plug				1	pcs
	38a	O-ring		Diameter: 5,3		1	pcs
				Material type: FKM			
				Thickness: 2,4			
	38a	O-ring		Diameter: 5,3		1	pcs
				Material type: EPDM			
				Thickness: 2,4			
	38	O-ring		Diameter: 16,3		1	pcs
				Material type: FKM			
				Thickness: 2,4			
	38	O-ring		Diameter: 16,3		1	pcs
				Material type: EPDM			
				Thickness: 2,4			
	100	O-ring		Diameter: 16,3		2	pcs
				Material type: FKM			
				Thickness: 2,4			
	100	O-ring		Diameter: 16,3		2	pcs
				Material type: EPDM			
				Thickness: 2,4			
-		Kit, shaft seal HQQE			96511844	1	pcs
		Emery cloth				1	pcs
		Grinding device				1	pcs
	105	Shaft seal		Material type: HQQE		1	pcs
-		Kit, wear parts			96511824	1	pcs
		Spacing bush				1	pcs
	4a	Intermediate chamber cpl.				1	pcs
	26.c	Washer		Designation: DIN 125A		2	pcs
				Inner diameter: 8,4			
				Outer diameter: 16			
				Thickness: 1,6			
	26.b	Hex cap screw		Length: 25,00		2	pcs
				Thread: M08			
	36	Lock nut		Thread: M8		1	pcs
	45	Neck ring cpl.				5	pcs
	47a	Bearing ring				1	pcs
	49c	Wear ring				6	pcs
	62	Retaining ring				1	pcs
	64c	Spacing pipe				1	pcs
	64b	Spacing bush				1	pcs

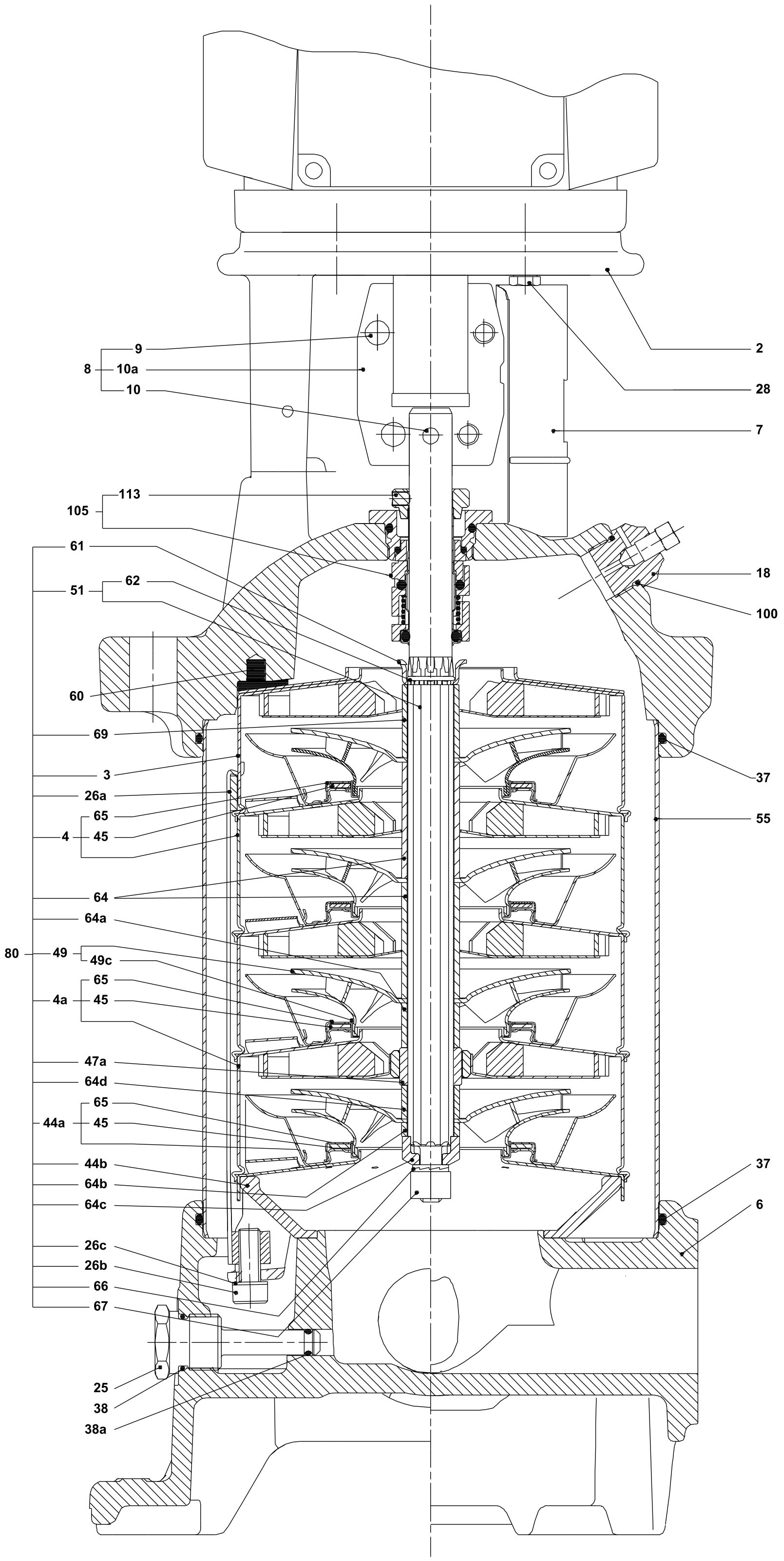
	Position	Description	Annotation	Classification data	Part No.	Count	Unit
	64.a	Spacing pipe		Inner diameter: 17,5		1	pcs
				Length: 17			
	65	Retainer				5	pcs
	66	Washer				1	pcs
		Bulk, Intermediate chamber cpl. (3 pcs)			96538971	1	pcs
		Intermediate chamber cpl.			98371105	1	pcs
		Bulk, Spacing bush (20 pcs)			96538949	1	pcs
		Bulk, Spacing bush (20 pcs)			96535098	1	pcs
		Bulk, Drain plug (10 pcs)			96535881	1	pcs
-		Motor			85903410	1	pcs
-		Kit, bearing cpl.			96796642	1	pcs
	153	Angular-contact bearing				1	pcs
	154	Ball bearing		Designation: 6206.2Z.C3.SYN		1	pcs
	157	O-ring		Diameter: 62		1	pcs
				Material type: NBR			
				Thickness: 3			
	158	Waved washer				2	pcs
	159.b	V-ring				1	pcs
	159	V-ring				1	pcs
-		Kit, eyebolt			96279874	1	pcs
	189	Eyebolt				1	pcs
-		Kit, fan			96796189	1	pcs
	156	Fan				1	pcs
-		Kit, fan cover			96796188	1	pcs
	151a	Label				1	pcs
	151	Fan cover				1	pcs
	152	Screw		Length: 12		4	pcs
				Thread: M5			
-		Kit, flange			96830887	1	pcs
	118a	Hex socket head screw				4	pcs
	156.b	Flange				1	pcs
	159.b	V-ring				1	pcs
	185.b	Nut		Thread: M8		4	pcs
-		Kit, gaskets			96798510	1	pcs
	184	O-ring				2	pcs
-		Kit, ND-end shield cpl.			96796598	1	pcs
	156.a	End shield, NDE				1	pcs
	157	O-ring		Diameter: 62		1	pcs
				Material type: NBR			
				Thickness: 3			
	158	Waved washer				1	pcs
	159	V-ring				1	pcs
	185.c	Nut		Thread: M8		4	pcs
	185.a	Hex socket head screw				4	pcs
-		Kit, shaft seal			96843458	1	pcs
	159.b	V-ring				1	pcs
	159	V-ring				1	pcs
-		Kit, terminal board			96030209	1	pcs
	176	Terminal board				1	pcs
	176	Terminal board				1	pcs
	178	Connecting bar				3	pcs
	179	Cable shoe				6	pcs
	180a	Slotted cheese head screw		Designation: COMBI TORX T25		6	pcs
				Length: 10			
				Thread: M5			
	180	Wire clamp				6	pcs
-		Kit, terminal box cover			96796215	1	pcs
	164	Terminal box cover w/gasket				1	pcs
	166	Screw				4	pcs
	2	Pump head			98770239	1	pcs
+	4a	Bulk, Intermediate chamber cpl. (10 pcs)			96538842	1	pcs
+	4a	Intermediate chamber cpl.			98371109	1	pcs
-	4	Bulk, Intermediate chamber cpl. (10 pcs)			96538817	2	pcs
		Bulk, Intermediate chamber (3 pcs)			96535086	1	pcs
	65	Bulk, Retainer for upper seal ring (20 pcs)			97699527	1	pcs
	65	Retainer for upper seal ring			96587913	1	pcs

	Position	Description	Annotation	Classification data	Part No.	Count	Unit
+	4	Intermediate chamber cpl.			98371107	2	pcs
	7.a	Bulk, Screw (1000 pcs)		Length: 8	96886324	4	pcs
				Thread: M4			
	10	Bulk, Shaft pin (10 pcs)		Diameter: 5	96536473	1	pcs
				Length: 26			
+	18	Bulk, Air vent screw (5 pcs)			96547461	1	pcs
	20	Bulk, Spring (20 pcs)			96538963	4	pcs
	26.c	Washer		Designation: DIN 125A	96586880	2	pcs
				Inner diameter: 8,4			
				Outer diameter: 16			
				Thickness: 1,6			
	36	Bulk, Lock nut (10 pcs)		Thread: M8	98277008	1	pcs
	36	Bulk, Nut (20 pcs)		Thread: M16	96620480	4	pcs
	37	Bulk, O-ring (20 pcs)			96538857	2	pcs
	44b	Inlet part			98814595	1	pcs
+	44a	Inlet part cpl.			98818924	1	pcs
	47a	Bulk, Bearing ring (10 pcs)			96538795	1	pcs
-	49	Bulk, Impeller cpl. (5 pcs)			98394308	4	pcs
	49c	Bulk, Wear ring (10 pcs)			96547340	1	pcs
+	49	Bulk, Impeller cpl. (10 pcs)			96538799	4	pcs
+	49	Impeller cpl.			98394458	4	pcs
	51	Shaft, spline, cpl.			98368609	1	pcs
	55	Sleeve			98812623	1	pcs
	64c	Bulk, Spacing pipe (5 pcs)			97980241	1	pcs
	64b	Bulk, Spacing bush (20 pcs)			96538947	1	pcs
	66	Bulk, Washer (10 pcs)			96536157	1	pcs
	69	Bulk, Spacing pipe (10 pcs)		Inner diameter: 17,5	98417487	1	pcs
				Length: 17			
	69	Bulk, Spacing pipe (20 pcs)			96535107	2	pcs
	105	Bulk, Shaft seal (11 pcs)		Material type: HQQE	96538914	1	pcs

Exploded view



Sectional drawing



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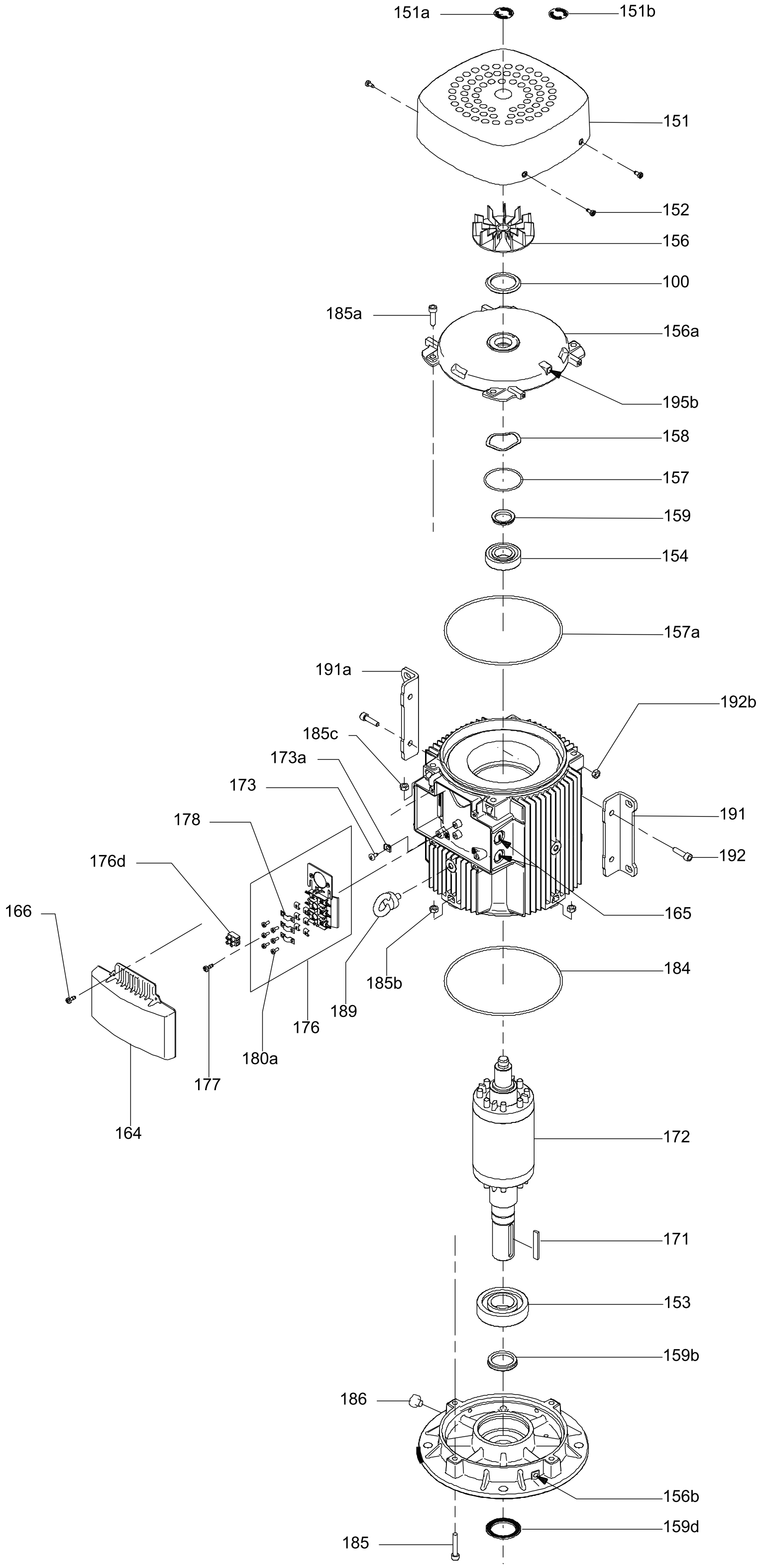
Exploded view



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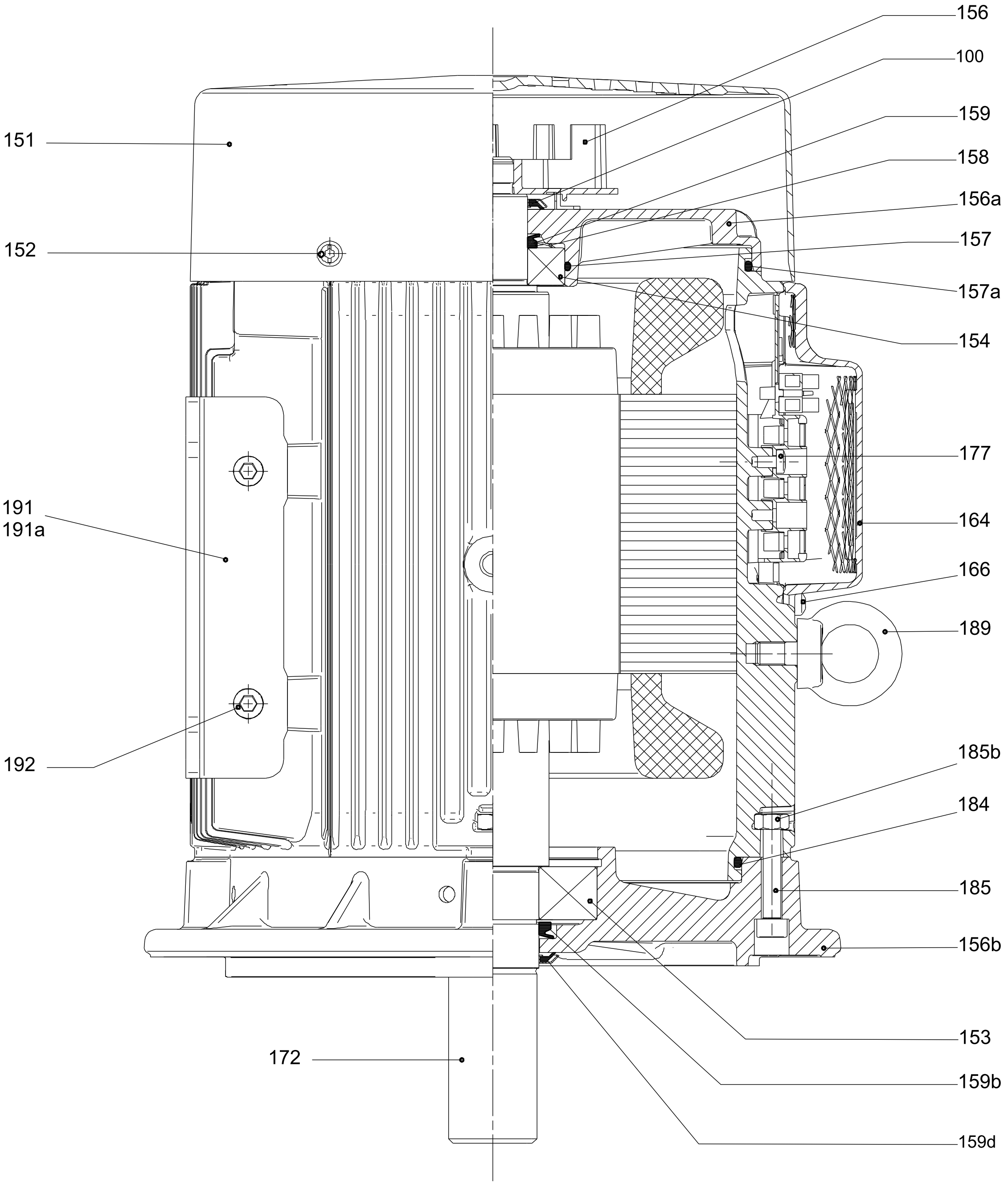
Sectional drawing



GRUNDFOS
PRODUCT GUIDE

CR, CRI, CRN
CRE, CRIE, CRNE
Vertical multistage centrifugal pumps
60 Hz

BE > THINK > INNOVATE >

GRUNDFOS®

Contents

Mission

3

Product data

Introduction 4
Performance range - CR, CRI, CRN 5
Performance range - CRE, CRIE, CRNE 5
Applications 6
Product range 7
Pump 8
Motor 8
Terminal box positions 8
Ambient temperature 9
Viscosity 9

Product data for E-pumps

Examples of E-pump applications 10

Control of E-pumps

Control options of E-pumps 11
Central management system 11
Control modes for E-pumps 11

Construction

CR(E) 1s, 1, 3, 5, 10, 15 and 20 13
CRI(E), CRN(E) 1s, 1, 3, 5, 10, 15 and 20 13
CR(E) 32, 45, 64 and 90 14
CRN(E) 32, 45, 64 and 90 14

Type keys and codes

Type keys 15
Codes 15

Operating and inlet pressure

Maximum operating pressure and temperature range 16
Operating range of the shaft seal 17
Maximum inlet pressure 18

Selection and sizing

Selection of pumps 19
How to read the curve charts 23
Guidelines to performance curves 23

Performance curves/ Technical data

CR, CRI, CRN 1s 24
CR(E), CRI(E), CRN(E) 1 28
CR(E), CRI(E), CRN(E) 3 32
CR(E), CRI(E), CRN(E) 5 36
CR(E), CRI(E), CRN(E) 10 40
CR(E), CRI(E), CRN(E) 15 44
CR(E), CRI(E), CRN(E) 20 48
CR(E), CRN(E) 32 52
CR(E), CRN(E) 45 55
CR(E), CRN(E) 64 58
CR, CRN 90 61

Motor data

TEFC motors 64
MLE motors 65
ODP motors 65

Pumped liquids

Pumped liquids 66
List of pumped liquids 66

Accessories

Pipework connection 69
Sensors for CRE, CRIE, CRNE 74
Gauges for CRE, CRIE, CRNE 74

Variants

Lists of variants - on request 75
Motors 75
Connections and other variants 75
Shaft seals 75
Pumps 75

Submittal data sheet

76

Quotation text

77

Further product documentation

Sources of product documentation 78
WinCAPS® 78
WebCAPS® 79

Introduction

This data booklet deals with CR, CRI and CRN as well as CRE, CRIE and CRNE pumps.

Fig. 1 CR, CRI and CRN pumps

CR, CRI, CRN pumps are vertical multistage centrifugal pumps. The in-line design enables the pump to be installed in a horizontal one-pipe system where the suction and discharge ports are in the same horizontal plane and have the same pipe dimensions. This design provides a more compact pump design and pipework.

Grundfos CR pumps come with various pump sizes and various numbers of stages to provide the flow and the pressure required.

CR pumps are suitable for a variety of applications from pumping of potable water to pumping of chemicals. The pumps are therefore used in a wide variety of pumping systems where the performance and material of the pump meet specific demands.

The CR pumps consist of two main components: the motor and the pump unit. The motor on a CR pump is a heavy-duty Grundfos specified motor.

The pump unit consists of optimized hydraulics, various types of connections, an outer sleeve, a top and various other parts.

CR pumps are available in various material versions according to the pumped liquid.

CRE, CRIE, CRNE pumps

Fig. 2 CRE, CRIE and CRNE pumps

CRE, CRIE, CRNE pumps are built on the basis of CR, CRI, CRN pumps.

CRE, CRIE, CRNE pumps belong to the so-called E-pump family and are referred to as E-pumps.

The difference between the CR and the CRE pump range is the motor. CRE, CRIE, CRNE pumps are fitted with an E-motor, i.e. a motor with built-in frequency control.

The motor of the CRE pump is a Grundfos MLE motor.

Frequency control enables continuously variable control of motor speed, which makes it possible to set the pump to operation at any duty point. The aim of continuously variable control of the motor speed is to adjust the performance to a given requirement.

CRE, CRIE and CRNE pumps are available with an integrated pressure sensor connected to the frequency control.

The pump materials are the same as those of the CR, CRI, CRN pump range.

Selection a CRE pump

Select a CRE pump if:

- controlled operation is required, i.e. consumption fluctuates;
- constant pressure is required,
- communication with the pump is required.

Adaptation of performance through frequency-controlled speed control offers obvious advantages:

- Energy savings.
- Increased comfort.
- Control and monitoring of the pump performance.

Pump

The CR and CRE pump is a non-self-priming, vertical multistage centrifugal pump. The pumps are available with a Grundfos standard motor (CR pumps) or a frequency-controlled motor (CRE pumps).

The pump consists of a base and a pump head. The chamber stack and the outer sleeve are secured between the pump head and the base by means of staybolts. The base has suction and discharge ports on the same level (in-line).

All pumps are equipped with a maintenance-free mechanical shaft seal of the cartridge type.

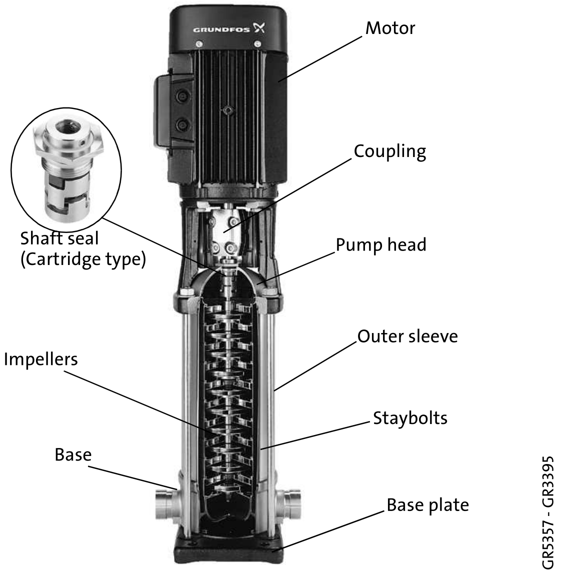


Fig. 3 CR pump

Motor

Grundfos standard motors - ML and Baldor® motors

CR, CRI and CRN pumps are fitted with a Grundfos specified motor. The motors are all heavy-duty 2-pole, NEMA C-face motors.

Frequency-controlled motors - MLE motors

CRE, CRIE and CRNE pumps are fitted with a totally enclosed, fan-cooled, 2-pole frequency-controlled motor.

From 0.5 Hp to 1.5 Hp Grundfos offers CRE pumps fitted with single-phase MLE motors (1 x 208-230 V).
From 1.0 Hp to 10 Hp Grundfos offers CRE pumps fitted with three-phase MLE motors (3 x 460-480 V).

Electrical data

Mounting designation	NEMA
Insulation class	F & B
Efficiency class*	Standard efficiency Energy efficient / EPAct - on request Premium efficiency - on request
Enclosure class	TEFC - Totally Enclosed Fan Cooled (Grundfos standard) ODP - Open Drip Proof - on request
60 Hz Standard voltages	1 x 115/208-230 V 3 x 208-230/460 V 3 x 575 V
Approvals	The motors are rated for:

* 1, 1.5 and 2 HP ML motors are premium efficiency as standard

Optional motors

The Grundfos standard range of motors covers a wide variety of application demands. However, for special applications or operating conditions, custom-built motor solutions can be provided.

For special applications or operating conditions, Grundfos offers custom-built motors such as:

- explosion proof motors,
- motors with anti-condensation heating unit,
- low-noise motors,
- energy efficient and premium efficiency motors,
- motors with thermal protection.

Motor protection

Single-phase Grundfos motors have a built-in thermal overload switch.

Three-phase motors **must** be connected to a motor starter in accordance with local regulations.

Terminal box positions

As standard the terminal box is mounted on the suction side of the pump.

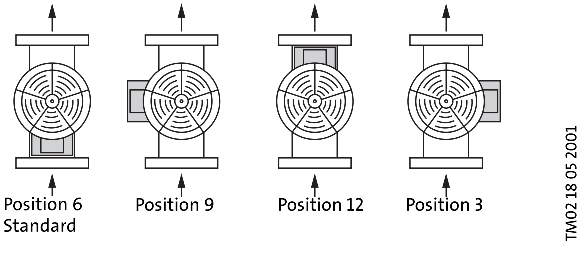


Fig. 4 Terminal box positions

Ambient temperature

Ambient temperature: Maximum +104°F.

If the ambient temperature exceeds +104°F or if the motor is located 3280 feet above sea level or higher, the motor output (P2) must be reduced due to the low cooling effect of the air. In such cases, it may be necessary to use a motor with a higher output.

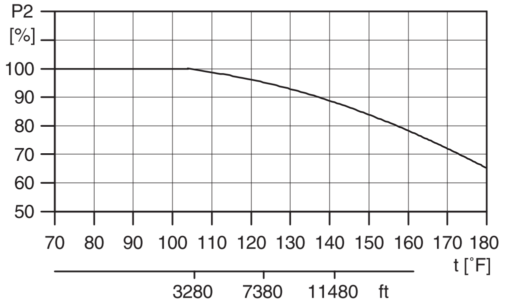


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Fig. 5 Relationship between motor output (P2) and ambient temperature

Viscosity

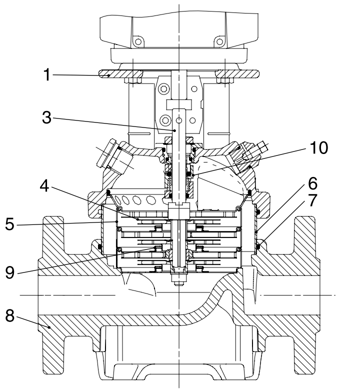
The pumping of liquids with densities or kinematic viscosities higher than those of water will cause a considerable pressure drop, a drop in the hydraulic performance and a rise in the power consumption.

In such situations the pump should be equipped with a larger motor. If in doubt, contact Grundfos.

CR(E) 1s, 1, 3, 5, 10, 15 and 20


TM02 1198 0601 - GR7377 - GR7379

Sectional drawing



TM02 1194 1403

Materials: CR(E)

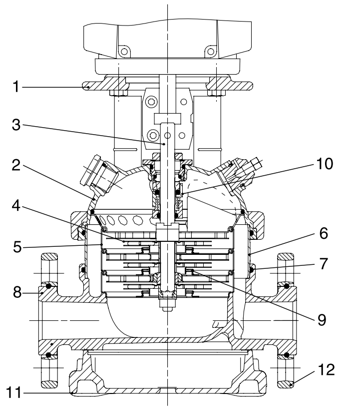
Pos.	Designation	Materials	AISI/ASTM
1	Pump head	Cast iron	A 48-30 B
3	Shaft	Stainless steel	AISI 316 1) AISI 431 2)
4	Impeller	Stainless steel	AISI 304
5	Chamber	Stainless steel	AISI 304
6	Outer sleeve	Stainless steel	AISI 304
7	O-ring for outer sleeve	EPDM or FKM	
8	Base	Cast iron	A 48-30 B
9	Neck ring	PTFE	
10	Shaft seal	Cartridge type	
	Bearing rings	Silicon carbide	
	Rubber parts	EPDM or FKM	

1) CR(E) 1s, 1, 3, 5
2) CR(E) 10, 15, 20
3) Stainless steel available on request.
4) CF 8M is cast equivalent of AISI 316 stainless steel.
5) CRI(E)/CRN(E) 1s, 1, 3, 5
6) CRN(E) 10, 15, 20
7) CRI(E) 10, 15, 20

CRI(E), CRN(E) 1s, 1, 3, 5, 10, 15 and 20


TM02 1808 2001 - GR7373 - GR7375

Sectional drawing



TM03 2156 3805

Materials: CRI(E), CRN(E)

Pos.	Designation	Materials	AISI/ASTM
1	Pump head	Cast iron 3)	A 48-30 B
2	Pump head cover	Stainless steel	CF 8M 4)
3	Shaft	Stainless steel	AISI 316 5) AISI 329 6) AISI 431 7)
8	Base	Stainless steel	CF 8M4)
9	Neck ring	PTFE	
10	Shaft seal	Cartridge type	
11	Base plate	Cast iron 3)	A 48-30 B
	Bearing rings	Silicon carbide	
	Rubber parts	EPDM or FKM	
		CRI(E)	
4	Impeller	Stainless steel	AISI 304
5	Chamber	Stainless steel	AISI 304
6	Outer sleeve	Stainless steel	AISI 304
7	O-ring for outer sleeve	EPDM or FKM	
12	FGJ flange ring	Ductile iron 3)	A 65-45-12
		CRN(E)	
4	Impeller	Stainless steel	AISI 316
5	Chamber	Stainless steel	AISI 316
6	Outer sleeve	Stainless steel	AISI 316
7	O-ring for outer sleeve	EPDM or FKM	
12	FGJ flange ring	Ductile iron 3)	A 65-45-12

Type keys and codes

Type keys

CR(E), CRI(E), CRN(E)

Example	CR E 32 (s) -4 -2 -A -G -G -E -HQQE
Type range: CR, CRI, CRN	
Pump with integrated frequency control	
Nominal flow rate [m^3/h]	
All impellers with reduced diameter (applys only to CR, CRI, CRN 1s)	
Number of impellers	
Number of reduced diameter impellers (CR(E), CRN(E) 32, 45, 64, 90)	
Code for pump version	
Code for pipe connection	
Code for materials	
Code for rubber parts	
Code for shaft seal	

Codes

	Example	A -F -A -E -H QQ E
Pump version		
A	Basic version [1]	
B	Oversize motor	
E	Cetificate/approval	
F	CR pump for high temperatures (air-cooled top assembly)	
H	Horizontal version	
HS	High-pressure pump with high speed MLE motor	
I	Different pressure rating	
J	Pump with different max speed	
K	Pump with low NPSH	
M	Magnetic drive	
N	Fitted with sensor	
P	Undersize motor	
R	Horizontal version with bearing bracket	
SF	High pressure pump	
T	Over size motor (two flange sizes bigger)	
U	NEMA version [1]	
X	Special version	
Pipe connection		
A	Oval flange	
B	NPT thread	
CA	FlexiClamp (CRI(E), CRN(E) 1, 3, 5, 10, 15, 20)	
CX	Triclamp (CRI(E), CRN(E) 1, 3, 5, 10, 15, 20)	
F	DIN flange	
G	ANSI flange	
J	JIS flange	
N	Changed diameter of ports	
P	PJE coupling	
X	Special version	
Materials		
A	Basic version	
D	Carbon-graphite filled PTFE (bearings)	
G	Wetted parts AISI 316	
GI	All parts stainless steel, wetted parts AISI 316	
I	Wetted parts AISI 304	
II	All parts stainless steel, wetted parts AISI 304	
K	Bronze (bearings)	
S	SiC bearings + PTFE neck rings	
X	Special version	
Code for rubber parts		
E	EPDM	
F	FXM	
K	FFKM	
V	FKM	
Shaft seal		
A	O-ring seal with fixed driver	
B	Rubber bellows seal	
E	Cartridge seal with O-ring	
H	Balanced cartridge seal with O-ring	
K	Metal bellows cartridge seal	
O	Double seal, back-to-back	
P	Double seal, tandem	
X	Special version	
B	Carbon, synthetic resin-impregnated	
H	Cemented tungsten carbide, embedded (hybrid)	
Q	Silicon carbide	
U	Cemented tungsten carbide	
X	Other ceramics	
E	EPDM	
F	FXM	
K	FFKM	
V	FKM	

[1] In August 2003 the NEMA version pump code was discontinued for all material numbers created by Grundfos manufacturing companies in North America. The NEMA version pump code will still remain in effect for existing material numbers. NEMA version pumps built in North America after this change will have either an A or U as the pump version code depending on the date the material number was created.

Operating range of the shaft seal

The operating range of the shaft seal depends on operating pressure, pump type, type of shaft seal and liquid temperature. The following curves apply to clean water and water with anti-freeze liquids. For selecting the right shaft seal, see ’List of pumped liquids’ page 66.

CR 1s - CR 20

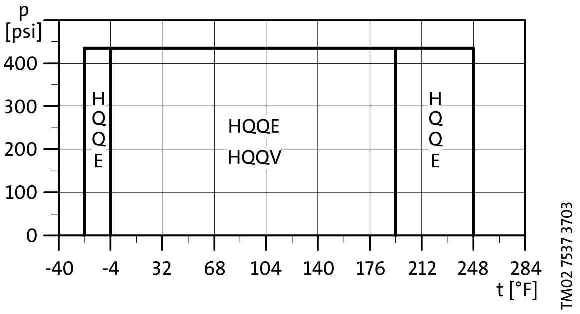


Fig. 14 Operating range of standard shaft seals for CR 1s - CR 20

CR 32 - CR 90

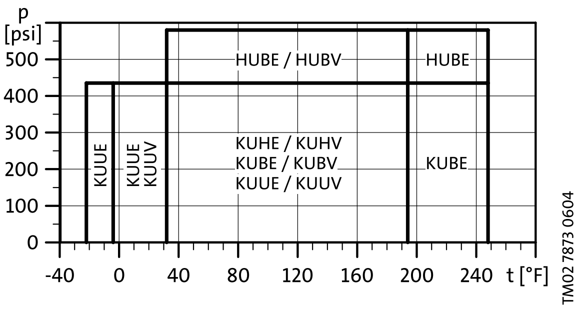


Fig. 15 Operating range of standard shaft seals for CR 32 - CR 90

Shaft seal	Description	Max. temp. range [°F]
HQQE	O-ring (cartridge) (balanced seal), SiC/SiC, EPDM	−22°F to +248°F
HQQV	O-ring (cartridge) (balanced seal), SiC/SiC, FKM	−4°F to +194°F
HUBE	O-ring (cartridge) (balanced seal), TC/carbon, EPDM	+32°F to +248°F
HUBV	O-ring (cartridge) (balanced seal), TC/carbon, FKM	+32°F to +194°F
KUBE	Bellows, metal (cartridge), TC/carbon, EPDM	+32°F to +248°F
KUBV	Bellows, metal (cartridge), TC/carbon, FKM	+32°F to +194°F
KUHE	Bellows, metal (cartridge), TC/Carbon with embedded TC, EPDM	+32°F to +194°F
KUHV	Bellows, metal (cartridge), TC/Carbon with embedded TC, FKM	+32°F to +194°F
KUUE	Bellows, metal (cartridge), TC/TC, EPDM	−22°F to +194°F
KUUV	Bellows, metal (cartridge), TC/TC, FKM	−4°F to +194°F

★ TC= tungsten carbide

In case of extreme temperatures, i.e.

- low temperatures down to −40°F or
- high temperatures up to +356°F,

see "List of variants - on request" page 75.

Operating and inlet pressure

Maximum inlet pressure

The following table shows the maximum permissible inlet pressure. However, the current inlet pressure + the pressure against a closed valve **must** always be lower than the maximum permissible operating pressure.

If the maximum permissible operating pressure is exceeded, the conical bearing in the motor may be damaged and the life of the shaft seal reduced.

CR, CRI, CRN 1s		
1s-2	→ 1s-27	145 [psi]
CR(E), CRI(E), CRN(E) 1		
1-2	→ 1-25	145 [psi]
1-27		218 [psi]
CR(E), CRI(E), CRN(E) 3		
3-2	→ 3-15	145 [psi]
3-17	→ 3-25	218 [psi]
CR(E), CRI(E), CRN(E) 5		
5-2	→ 5-9	145 [psi]
5-10	→ 5-24	218 [psi]
CR(E), CRI(E), CRN(E) 10		
10-1	→ 10-5	116 [psi]
10-6	→ 10-17	145 [psi]
CR(E), CRI(E), CRN(E) 15		
15-1	→ 15-2	116 [psi]
15-3	→ 15-12	145 [psi]
CR(E), CRI(E), CRN(E) 20		
20-1		116 [psi]
20-2	→ 20-10	145 [psi]
CR(E), CRN(E) 32		
32-1-1	→ 32-2	58 [psi]
32-3-2	→ 32-6	145 [psi]
32-7-2	→ 32-11-2	218 [psi]
CR(E), CRN(E) 45		
45-1-1	→ 45-1	58 [psi]
45-2-2	→ 45-3	145 [psi]
45-4-2	→ 45-8-1	218 [psi]
CR(E), CRN(E) 64		
64-1-1		58 [psi]
64-1	→ 64-2-1	145 [psi]
64-2	→ 64-5-2	218 [psi]
CR(E), CRN(E) 90		
90-1-1	→ 90-1	145 [psi]
90-2-1	→ 90-4-1	218 [psi]

Example of operating and inlet pressures

The values for operating and inlet pressures shown in the tables must not be considered individually but must always be compared, see the following examples:

Example 1:

The following pump type has been selected:
CR 3-10 A-A-A

Max. operating pressure: **232 psi**
Max. inlet pressure: **145 psi**

Discharge pressure against a closed valve: **139.2 psi,** see page 33.

This pump is **not** allowed to start at an inlet pressure of 145 psi, but at an inlet pressure of 232.0 – 139.2 **= 92.8 psi.**

Example 2:

The following pump has been selected:
CR 10-2 A-GJ-A

Max. operating pressure: **232 psi**
Max. inlet pressure: **116 psi**

Discharge pressure against a closed valve:
42 psi (97 H[ft]), see page 41.

This pump is allowed to start at an inlet pressure of 116 psi, as the discharge pressure is only 42 psi, which results in an operating pressure of 116 + 42 **= 158 psi.** On the contrary, the max. operating pressure of this pump is limited to 158 psi, as a higher operating pressure will require an inlet pressure of more than 116 psi.

In case the inlet or operating pressure exceeds the pressure permitted, see "Lists of variants - on request" page 75.

Selection of pumps

Selection of pumps should be based on

- The duty point of the pump (see section 1)
- Sizing data such as pressure loss as a result of height differences, friction loss in the pipework, pump efficiency etc. (see section 2)
- Pump materials (see section 3)
- Pump connections (see section 4)
- Shaft seal (see section 5).

1. Duty point of the pump

From a duty point it is possible to select a pump on the basis of the curve charts shown in the chapter of "Performance curves/Technical data" on pages 24-63.

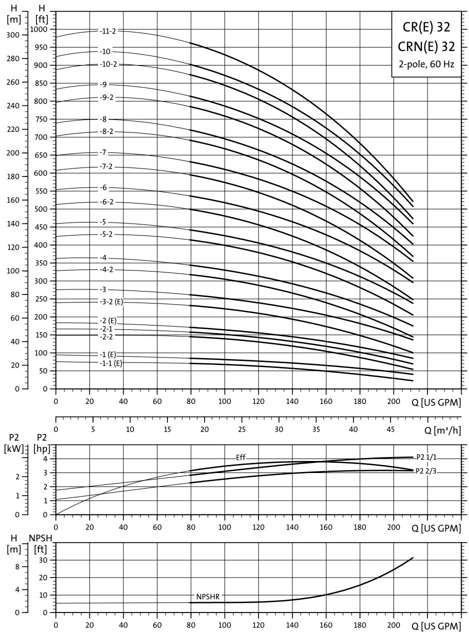


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Fig. 16 Example of a curve chart

2. Sizing data

When sizing a pump the following must be taken into account.

- Required flow and pressure at the point of use.
- Pressure loss as a result of height differences (H_{geo}).
- Friction loss in the pipework (H_f).
  It may be necessary to account for pressure loss in connection with long pipes, bends or valves, etc.
- Best efficiency at the estimated duty point.
- NPSH value.
  For calculation of the NPSH value, see "Minimum inlet pressure - NPSH" page 22.

Efficiency

Before determining the point of best efficiency the operation pattern of the pump needs to be identified. Is the pump expected to operate at the same duty point, then select a CR pump which is operating at a duty point corresponding with the best efficiency of the pump.

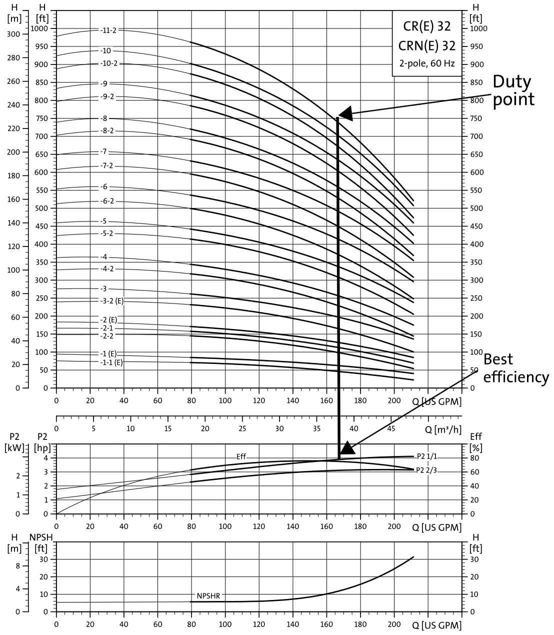

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Fig. 17 Example of a CR pump's duty point

As the pump is sized on the basis of the highest possible flow, it is important to always have the duty point to the right of the optimum efficiency point (see fig. 18, range with check mark). This must be considered in order to keep efficiency high when the flow drops.

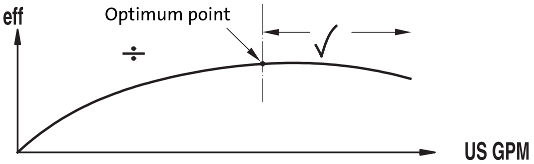

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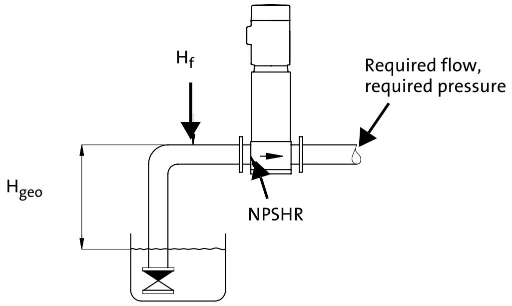
Fig. 18 Best efficiency



TM02 6711 1403

Fig. 19 Sizing data

Normally, E-pumps are used in applications characterized by a variable flow. Consequently, it is not possible to select a pump that is constantly operating at optimum efficiency.

In order to achieve optimum operating economy, the pump should be selected on the basis of the following criteria:

- The max. required duty point should be as close as possible to the QH curve of the pump.
- The required duty point should be positioned so that P_2 is close to the max. point of the 100% curve.

Between the min. and max. performance curve E-pumps have an infinite number of performance curves each representing a specific speed. Therefore it may not be possible to select a duty point close to the 100% curve.

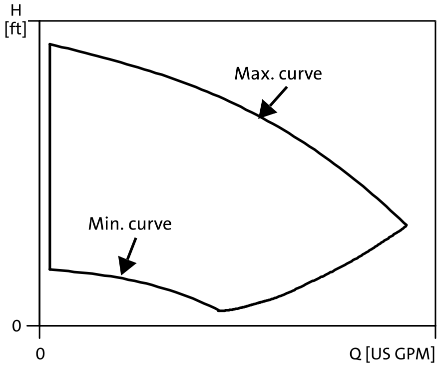


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Fig. 20 Min. and max. performance curves

In situations where it is not possible to select a duty point close to the 100% curve the affinity equations to the right can be used. The head (H), the flow (Q) and the input power (P) are all the appropriate variables for the motor speed (n).

Note:

The approximated formulas apply on condition that the system characteristic remains unchanged for n_n and n_x and that it is based on the formula $H = k \times Q^2$, where k is a constant.

The power equation implies that the pump efficiency is unchanged at the two speeds. In practice this is **not** quite correct.

Finally, it is worth noting that the efficiencies of the frequency converter and the motor **must** be taken into account if a precise calculation of the power saving resulting from a reduction of the pump speed is wanted.

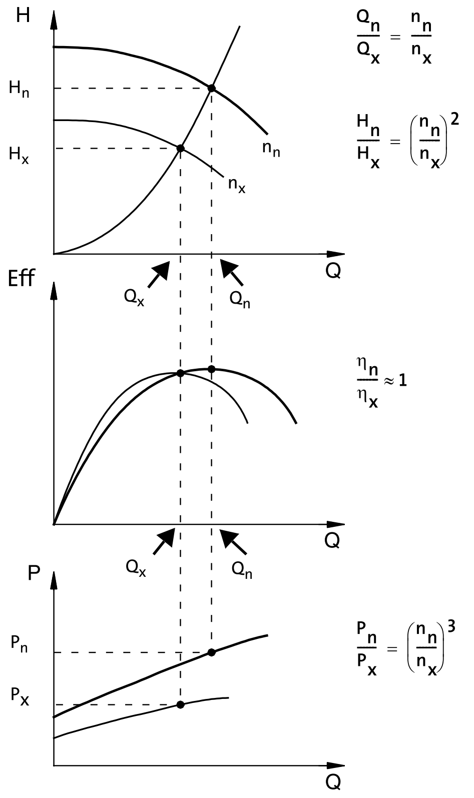

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Fig. 21 Affinity equations

Legend

H_n	Rated head in feet
H_x	Current head in feet
Q_n	Rated flow in US GPM
Q_x	Current flow in US GPM
n_n	Rated motor speed in min^{-1} (n_n = 3500 min^{-1})
n_x	Current motor speed in min^{-1}
η_n	Rated efficiency in %
η_x	Current efficiency in %

WinCAPS® and WebCAPS®

WinCAPS and WebCAPS are both selection programs offered by Grundfos.

The two programs make it possible to calculate an E-pump's specific duty point and energy consumption.

By entering the sizing data of the pump, WinCAPS and WebCAPS can calculate the exact duty point and energy comsumption. For further information see page 78 and page 79.

3. Material

The material variant (CR(E), CRI(E), CRN(E)) should be selected based of the liquid to be pumped. The product range covers three basic types.

- The CR(E), CRI(E) pump types are suitable for clean, non-aggressive liquids such as potable water, oils, etc.
- The CRN(E) pump type is suitable for industrial liquids and acids, see "List of pumped liquids" on page 66 or contact Grundfos.

For saline or chloride-containing liquids such as sea water, CRT(E) pumps of titanium are available.

4. Pump connection

Selection of pump connection depends on the rated pressure and pipework. To meet any requirement the CR(E), CRI(E) and CRN(E) pumps offer a wide range of flexible connections such as:

- Oval flange (NPT) - fig. 23
- ANSI flange - fig. 23
- PJE coupling - fig. 23
- Clamp coupling
- Union (NPT[M])
- Other connections on request.

5. Shaft seal

As standard, the CR(E) range is fitted with a Grundfos shaft seal (Cartridge type) suitable for the most common applications, see fig. 24.

The following three key parameters **must** be taken into account, when selecting the shaft seal:

- Type of pumped liquid
- liquid temperature and
- maximum pressure.

Grundfos offers a wide range of shaft seal variants to meet specific demands see "List of pumped liquids" on page 66.

Inlet pressure and operating pressure

The limit values stated on page 16 and page 18 must **not** be exceeded as regards ...

- maximum inlet pressure and
- maximum operating pressure.

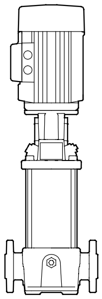
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Fig. 22 CR pump

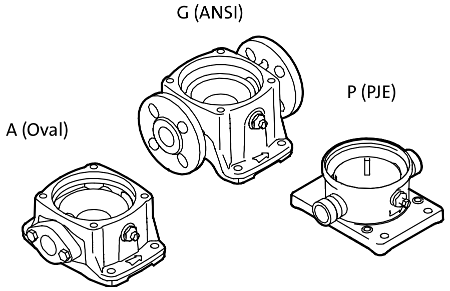

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Fig. 23 Pump connections

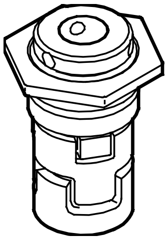
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Fig. 24 Shaft seal (Cartridge type)

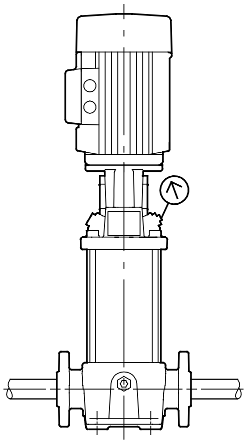
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Fig. 25 Inlet and operating pressure

Minimum inlet pressure - NPSHR

Calculation of the inlet pressure "H" is recommended when ....

- the liquid temperature is high,
- the flow is significantly higher than the rated flow,
- water is drawn from depths,
- water is drawn through long pipes,
- inlet conditions are poor.

To avoid cavitation, make sure that there is a minimum pressure on the suction side of the pump. The maximum suction lift "H" in feet can be calculated as follows:

$H = p_b - \text{NPSHR} - H_f - H_v - H_s$

p_b = Barometric pressure in feet absolute. (Barometric pressure can be set to 33.9 feet. at sea level. In closed systems, p_b indicates system pressure in feet.)

NPSHR = Net Positive Suction Head Required in feet. (To be read from the NPSHR curve at the highest flow the pump will be delivering).

H_f = Friction loss in suction pipe in feet. (At the highest flow the pump will be delivering.)

H_v = Vapor pressure in feet. (To be read from the vapor pressure scale. "H_v" depends on the liquid temperature "T_m").

H_s = Safety margin = minimum 2.0 feet.

If the "H" calculated is positive, the pump can operate at a suction lift of maximum "H" feet.

If the "H" calculated is negative, an inlet pressure of minimum "H" feet is required.

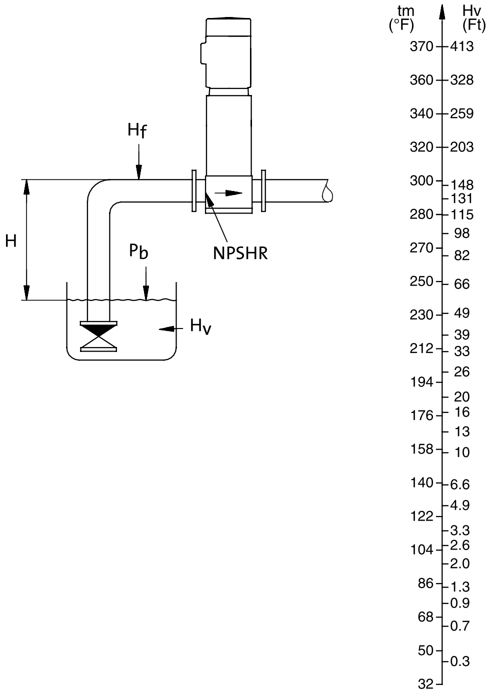

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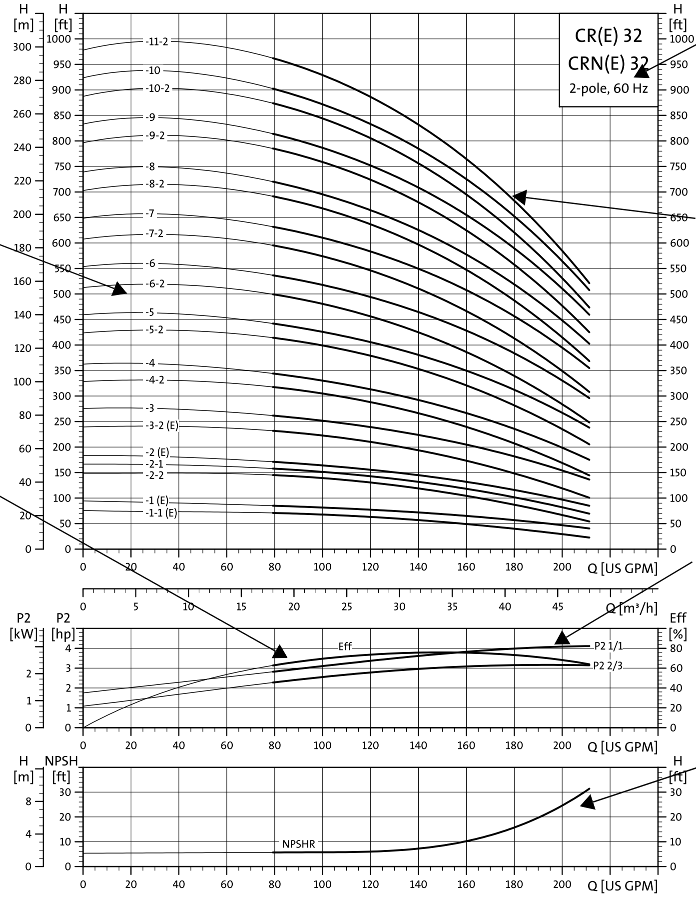
Fig. 26 Minimum inlet pressure - NPSHR

Note: In order to avoid cavitation **never**, select a pump whose duty point lies too far to the right on the NPSHR curve.

Always check the NPSHR value of the pump at the highest possible flow.

In case a lower NPSHR value is required, see "List of variants, on request" page 75.

How to read the curve charts



Pump type, number of poles and frequency.

Number of stages.
First figure: number of stages;
second figure: number of reduced-diameter impellers.

QH curve for the individual pump. The **bold** curves indicate the **recommended** performance range for best efficiency.

The eff curve shows the efficiency of the pump. The eff curve is an average curve of all the pump types shown in the chart.
The efficiency of pumps with reduced-diameter impellers is approx. 2% lower than the eff curve shown in the chart.

The power curves indicate pump input power **per stage.** Curves are shown for complete (1/1) and for reduced-diameter (2/3) impellers.

The NPSHR curve is an average curve for all the variants shown. When sizing the pumps, add a safety margin of at least 2.0 feet.

TM02 0039 1303

Fig. 27 How to read the curve charts

Guidelines to performance curves

The guidelines below apply to the curves shown on the following pages:

1. The motors used for the measurements are standard motors (ODP, TEFC or MLE).
2. Measurements have been made with airless water at a temperature of 68°F.
3. The curves apply to a kinematic viscosity of $\upsilon = 1\ mm^2/s$ (1 cSt).
4. Due to the risk of overheating, the pumps should not be used at a flow below the minimum flow rate.
5. The QH curves apply to actual speed with the motor types mentioned at 60 Hz.

The curve below shows the minimum flow rate as a percentage of the nominal flow rate in relation to the liquid temperature. The dotted line shows a CR pump fitted with an air-cooled top assembly.

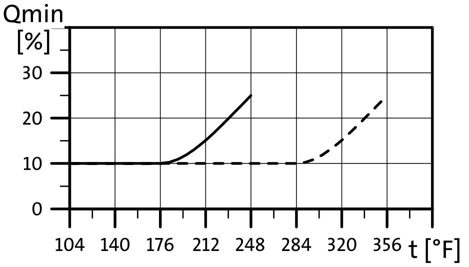


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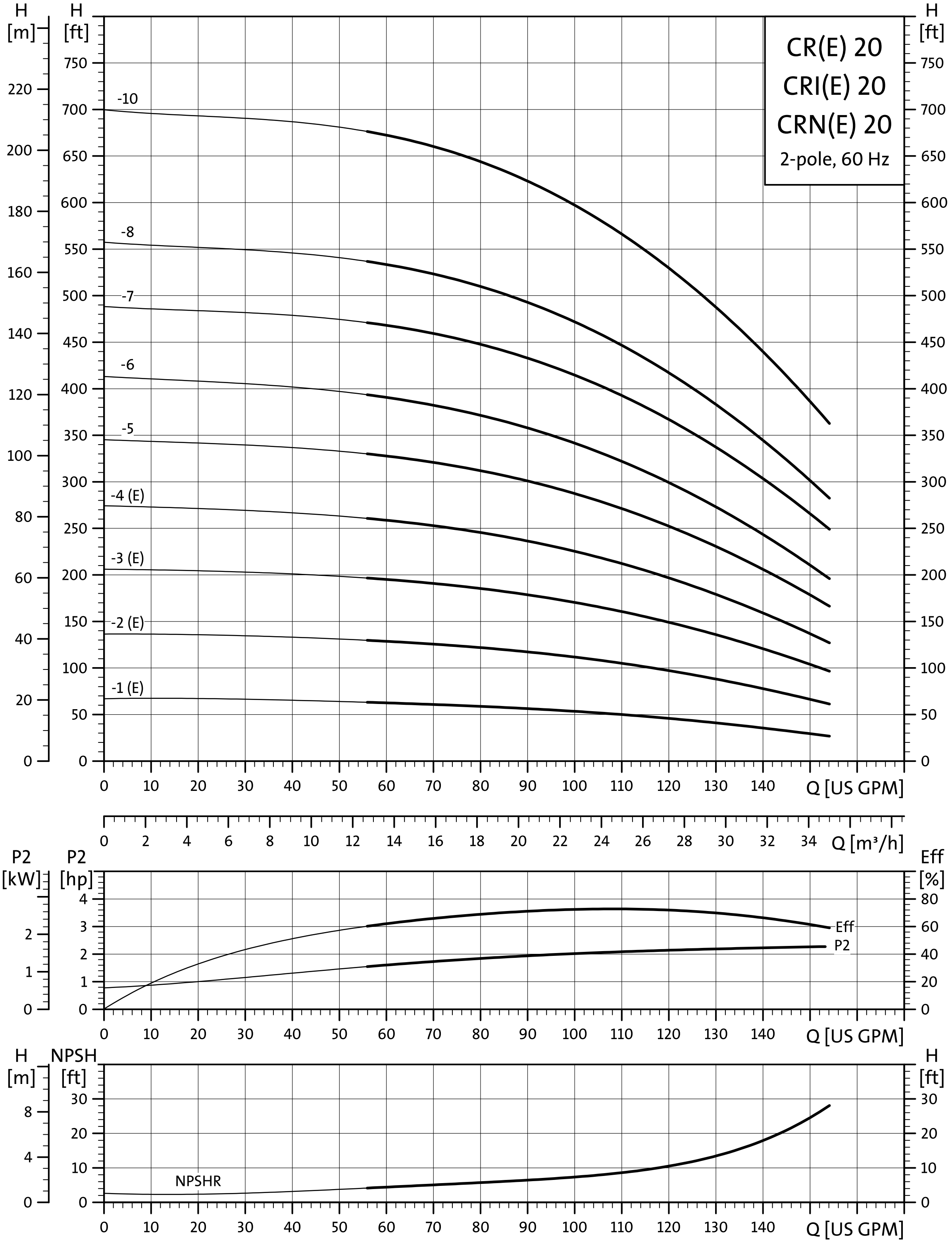
Fig. 28 Minimum flow rate



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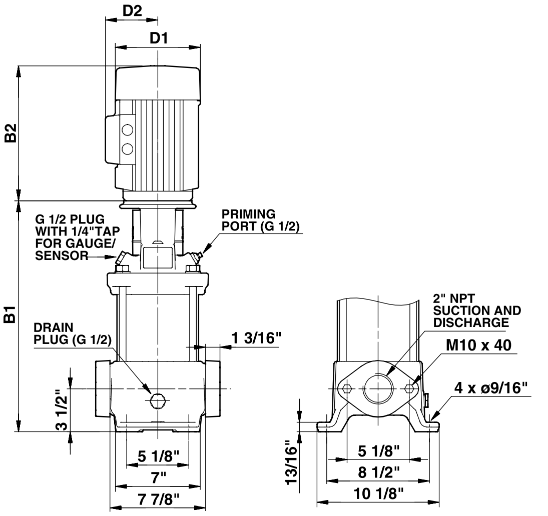
Dimensional sketches



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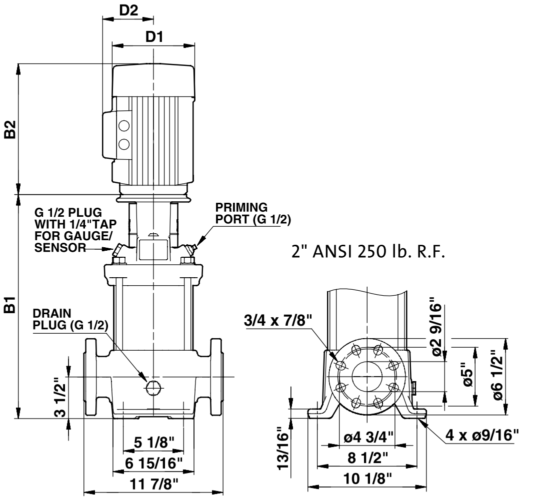


TM03 1461 2205

Dimensions and weights

							TEFC				ODP						MLE					
Pump type	Hp	Ph	Voltage	NEMA Frame size	Oval B1	ANSI B1	D1	D2	Oval B1+B2	ANSI B1+B2	D1	D2	Oval B1+B2	ANSI B1+B2	Oval Ship Wt.[1] [lbs.]	ANSI Ship Wt.[1] [lbs.]	D1	D2	Oval B1+B2	ANSI B1+B2	Oval Ship Wt.[1] [lbs.]	ANSI Ship Wt.[1] [lbs.]
CR(E) 20-1	3	1	115/208-230	56C	17 1/8	17 1/8	8 5/8	6 7/8	31 5/8	31 5/8	-	-	-	-	163	169	-	-	-	-	-	-
		3	208-230/460	56C	17 1/8	17 1/8	7 1/8	4 3/8	28 5/8	28 5/8	-	-	-	-	128	134	7	6 5/8	30 5/8	30 5/8	158	160
CR(E) 20-2	5	1	208-230	182TC	17 1/8	17 1/8	10 5/8	7 1/2	32 1/2	32 1/2	-	-	-	-	178	185	-	-	-	-	-	-
		3	208-230/460	182TC	17 1/8	17 1/8	7 1/8	4 3/8	30 3/8	30 3/8	-	-	-	-	135	141	8 3/4	7 1/2	32 3/4	32 3/4	190	192
CR(E) 20-3	7 1/2	1	208-230	213TC	19 1/4	19 1/4	10 1/4	7 1/2	34 5/8	34 5/8	-	-	-	-	200	207	-	-	-	-	-	-
		3	208-230/460	213TC	19 1/4	19 1/4	8 3/4	5 3/8	34 7/8	34 7/8	-	-	-	-	192	199	8 3/4	7 1/2	34 7/8	34 7/8	221	224
CR(E) 20-4	10	1	230	213TC	21	21	10 1/4	10 3/8	36 7/8	36 7/8	-	-	-	-	227	233	-	-	-	-	-	-
		3	208-230/460	213TC	21	21	8 3/4	5 3/8	36 5/8	36 5/8	-	-	-	-	176	183	8 3/4	7 1/2	36 5/8	36 5/8	229	231
CR 20-5	15	3	208-230/460	254TC	25 3/8	25 3/8	10 3/8	8 3/4	42	42	10 5/8	7 3/8	41 1/2	41 1/2	238	244	-	-	-	-	-	-
CR 20-6	15	3	208-230/460	254TC	27 1/8	27 1/8	10 3/8	8 3/4	43 3/4	43 3/4	10 5/8	7 3/8	43 1/4	43 1/4	240	246	-	-	-	-	-	-
CR 20-7	20	3	230/460	254TC	28 7/8	28 7/8	10 3/8	8 3/4	45 1/4	45 1/4	11 1/2	9	46 7/8	46 7/8	381	387	-	-	-	-	-	-
CR 20-8	20	3	230/460	254TC	-	30 5/8	10 3/8	8 3/4	-	47	11 1/2	9	-	48 5/8	-	392	-	-	-	-	-	-
CR 20-10	25	3	230/460	284TSC	-	33 1/2	13	9 1/2	-	53 1/4	11 1/2	9	-	54 1/2	-	381	-	-	-	-	-	-

Weights based on pump with TEFC motor (see price list for individual weights)
All dimensions in inches unless otherwise noted.

Motor data

TEFC motors

(Totally Enclosed Fan Cooled, constant speed)

HP	PH	Frame	S.F.	Voltage [V]	Mtr. Eff. [%]	Insul. class	KVA code	Full load current [A]	Service Factor current [A]	Start current [A]	Motor type
1/3	1	56C	1.35	115/230	55	B	K	6.0/3.0	7.6/3.8	28/14	Baldor
	3	56C	1.35	208-230/460	78.5/80	F	L	1.12-1.1/0.55	1.5-1.45/0.75	7.1-10.2/3.9	ML
1/2	1	56C	1.6	115/208-230	62	B	K	7.4/4.1-3.7	9.8/5.2-4.9	39/21.6-19.5	Baldor
	3	56C	1.25	208-230/460	78/79.5	F	K	1.64-1.55/0.78	2.0-1.9/0.95	9.7-10.1/5.1	ML
3/4	1	56C	1.25	115/208-230	66	B	K	9.6/5.3-4.8	11.4/6.0-5.7	56/31-28	Baldor
	3	56C	1.25	208-230/460	79/80	F	K	2.4-2.3/1.2	2.9-2.75/1.4	14.2-15/7.8	ML
1	1	56C	1.25	115/230	66	B	K	12/6.0	14.4/7.2	77/38.5	Baldor
	3	56C	1.25	208-230/460	81/81	F	J	3.25-3.35/1.68	4.0-3.9/1.95	19.2-21.8/10.9	ML
1 1/2	1	56C	1.3	115/208-230	71	B	K	17/9.5-8.6	20.4/11.3-10.2	106/58.6-53	Baldor
	3	56C	1.15	208-230/460	83/84	F	M	4.7-4.6/2.3	5.2-5.1/2.55	33.8-36.8/18.4	ML
2	1	56C	1.15	115/230	74	F	K	23/11.5	25.4/12.7	156/78	Baldor
	3	56C	1.15	208-230/460	84.5/85.5	F	G	5.7-5.4/2.7	6.55-6.1/3.05	46.2-48.6/24.3	ML
3	1	182TC	1.15	115/208-230	75	F	H	29/16-14.5	31.8/18-15.9	170/94-85	Baldor
	3	182TC	1.15	208-230/460	82.5/84	F	K	8.9-8.5/4.25	10.4-9.5/4.75	60.5-63.8/31.9	ML
5	1	213TC	1.15	208-230	80	F	J	24-22	27-25	188-170	Baldor
	3	184TC	1.15	208-230/460	84.5/86	F	S	14.2-14.0/7.0	16-15.4/7.7	109-119/59.5	ML
7 1/2	1	213TC	1.15	208-230	82	F	F	33.8-31	38.5-35.5	244-220	Baldor
	3	213TC	1.15	208-230/460	86/87.5	F	M	21-21.5/10.8	24-23.5/11.8	162-183/93	ML
10	1	213TC	1.15	230	85.5	F	F	40	46	284	Baldor
	3	213TC	1.15	208-230/460	89/89.5	F	L	28-28.5/14.4	32-31.5/16	241-271/137	ML
15	3	254TC	1.15	208-230/460	86.5	H	L	38-34/17	43.4-39/19.5	376-340/170	Baldor
20	3	254TC	1.15	230/460	88.5	F	K	46/23	52.4/26.2	420/210	Baldor
25	3	284TSC	1.15	230/460	91.7	F	J	57/28.5	66/33	498/249	Baldor
30	3	286TSC	1.15	230/460	91	F	G	68/34	78/39	450/225	Baldor
40	3	286TSC	1.15	230/460	90.2	F	H	90/45	104/52	644/322	Baldor
50	3	326TSC	1.15	230/460	93	F	G	110/55	128/64	746/393	Baldor
60	3	364TSC	1.15	230/460	93	F	G	134/67	154/77	918/459	Baldor

Baldor motor

TM02 7696 3803

ML motor

GR 7845

Notes:

1. The information in this chart applies to **Grundfos' ML motors and Grundfos specified Baldor® motors.**

   ML motors: Three-phase, 0.33-10 hp
   Baldor motors: Single-phase, 0.33-10 hp and
   Three-phase, 15-60 hp.

   Grundfos CR pumps are supplied with heavy-duty 2-pole, NEMA C-frame motors built or selected to our rigid specifications. All CR pump motors have heavy-duty bearings in them for maximum thrust requirements.
   It is not recommended that an off-the-shelf standard Baldor motor be used on a Grundfos pump. Ideally, the best motor choice would be the Grundfos specified motor.
2. Other motor types are available (i.e., Explosion proof, Mill and Chem duty, High Efficiency, etc.), consult local Grundfos company for more information.
3. Pumps supplied by Grundfos Canada are normally supplied with motors from other manufactures. 575 volt motors meet EPAct/NRC efficiency standards. Dimensions and data will vary, contact local Grundfos company for more information.
4. All values are subject to change without notice.

BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

L-CR-PG-001 10/05	US
Repl.: L-CR-PG-001 11/04	

Subject to alterations.

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

www.grundfos.com

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

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

GRUNDFOS®

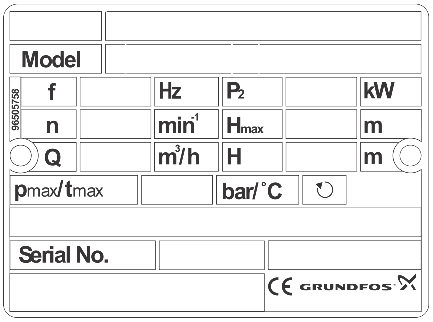
90. Recommended spare parts: CR, CRI, CRN 1 to 150

50/60 Hz

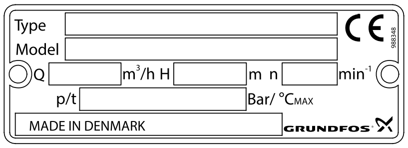
Customer Information

Project title:	Customer name:
Reference number:	Customer number:
Customer contact:	Customer phone number: ( )
	Fax number: ( )

Pump information



CR, CRI, CRN 1 to 20



CR, CRN 32 to 150

Quotation made by

Company name:

Prepared by:

Phone number: (   )

Fax number: (   )

Date:

Quote number:

Recommended spare parts

	Recommended service parts				
	CR, CRN 1,3 & 5		CR, CRI, CRN 10, 15 & 20		
Kits	2 years units per pump	5 years units per pump	2 years units per pump	5 years units per pump	Product number of part/kit
Wear part kit	1	1	1	1	
Shaft seal kit	1	2	1	2	
O-ring kit	1	2	1	2	
Chamber stack		1		1	
Motor bearings		1		1	

	Recommended service parts				
	CR, CRN 32, 45, 64 & 90		CR, CRN 120, 150		
Kits	2 years units per pump	5 years units per pump	2 years units per pump	5 years units per pump	Product number of part/kit
Wear part kit	1	1	1	1	
Shaft seal kit	1	2	1	2	
O-ring kit	1	2	1	2	
Chamber stack		1		1	
Bearing kit	1	1	1	1	
Motor bearings		1		1	

TW-60 Water Treatment System

section 8

Service instructions

SQFlex water supply systems

Table of contents

1. SQFlex components 2
1.1 Pumps 2
1.2 Motor 5
1.3 Control and switch boxes 6
1.4 Solar modules 13
1.5 Wind turbine 24
2. Start-up 28
3. Maintenance 29
3.1 Solar modules 29
3.2 Wind turbine 30
4. Trouble-shooting 32
4.1 Solar-powered system 34
4.2 Solar-powered system with CU 200 control unit and level switch 36
4.3 Solar-powered system with generator back-up 38
4.4 Wind-powered system 40
4.5 Wind-powered system with CU 200 control unit and level switch 42
4.6 Combined system 44
4.7 Combined system with CU 200 control unit and level switch 46
4.8 Options with generator as back-up source 49
5. Service of pump and motor 51
5.1 General information 51
5.2 Service tools 52
5.3 Torques and lubricants 54
5.4 Helical pump type 55
5.5 Centrifugal pump and motor 56
5.6 Centrifugal pump type with splined shaft 57
5.7 Centrifugal pump type with cylindrical shaft 58
5.8 Checking and replacing wear parts of centrifugal pumps 59
5.9 Testing the pump by means of CU 200 SQFlex control unit 60

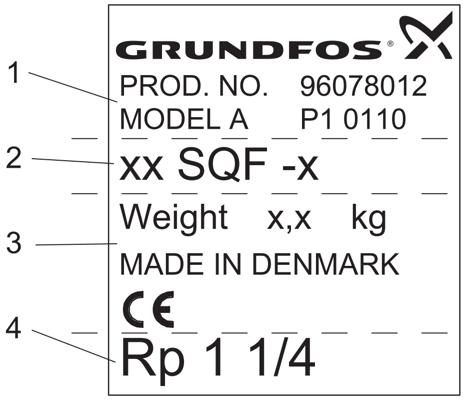
1. SQFlex components

1.1 Pumps

Two pump types are used, the helical rotor pump type and the centrifugal pump type.

Nameplate, helical rotor pump

The nameplate is engraved into the pump sleeve.



TM02 6973 2103

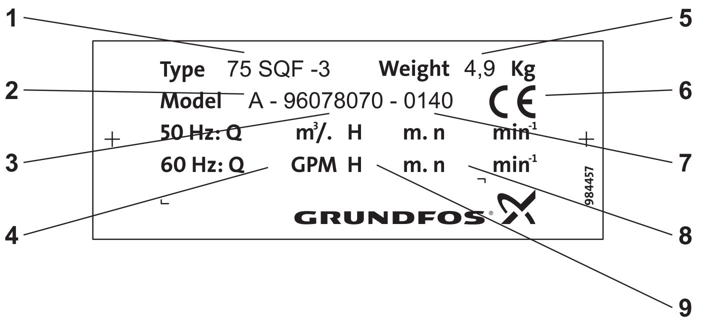
Fig. 1 Nameplate, helical rotor pump

Key to nameplate, helical rotor pump

Pos.	Code	Description
1	PROD. NO. 96078012	Product number
	MODEL A	Pump generation
	P1 0110	Production code - Bjerringbro (P1) + production year and week
2	xx SQF - x	Type designation, see section Type key on page 4
3	• Weight: x,x kg • MADE IN DENMARK • CE	• Pump net weight • Country of origin • Mark of approval.
4	Rp 1 1/4	Type and size of connecting thread

Nameplate, centrifugal pump

The nameplate is attached to the suction interconnector.



TM02 4149 5001

Fig. 2 Nameplate, centrifugal pump

Key to nameplate, centrifugal pump

Pos.	Code	Description
1	Type 75 SQF -3	Type designation, see section Type key on page 4
2	MODEL A	Pump generation
3	96078070	Product number
4	Q m^3	Rated flow rate (not indicated)
5	Weight 4.9 kg	Pump net weight in kg
6	CE	Mark of approval
7	0140	Production year and week
8	n min^{-1}	Speed (not indicated)
9	H	Head at rated flow rate (not indicated)

Type key

The type key is common for helical rotor pump and centrifugal pump.

X SQF - X

Rated flow rate in US GPM at 3000 min^{-1} (approximate value)
- 3 = helical rotor pump
- 6 = helical rotor pump
- 11 = helical rotor pump
- 25 = centrifugal pump
- 40 = centrifugal pump
- 75 = centrifugal pump

Type range

Number of stages

Centrifugal pumps come in two main types: with splined pump shaft and with cylindrical pump shaft. 25 SQF-3 and 25 SQF-6 have a splined pump shaft. 40 SQF-3 and 75 SQF-3 have a cylindrical shaft.

1.2 Motor

The MSF 3 motor is a sealed construction made of stainless steel. It is a brushles, electronically commutated DC-motor with a permanent-magnet rotor (PM-motor).

Nameplate, motor

The nameplate is engraved into the stator sleeve.

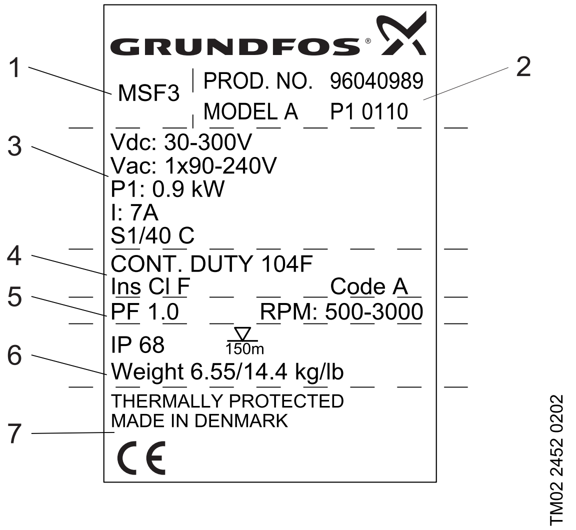


Fig. 3. Nameplate, motor

Key to nameplate, motor

Pos.	Code	Description
1	MSF 3	Type designation
2	PROD. NO. 96040989	Product number
	MODEL A	Pump generation
	P1 0110	Production code - Bjerringbro (P1) + production year and week
3	VDC: 30-300 V VAC: 1 x 90-240 V	The motor can be supplied with either DC or AC voltage: • DC: 30-300 V or • AC: 1 x 90-240 V
	P1: 0.9 kW	Maximum input power [kW]
	I: 7 A	Maximum input current [A]
	S1/40 C	Suitable for continuous operation up to 40°C
4	CONT. DUTY 104F	Suitable for continuous operation at 104°F
	Ins Cl F Code A	Insulation class F. Start-kVA is 0-3.15 per hp
5	PF 1.0 RPM 500 - 3000	Power factor = 1. Rated speed 500 - 3000 min^{-1}
6	IP 68 $\overset{\nabla}{\text{150 m}}$	Enclosure class: IP 68. Max submerged depth: 150 m
	Weight 6.55/14.4 kg/lb	Motor net weight in kg and pounds
7	THERMALLY PROTECTED	Temperature sensor built into the electronic unit
	MADE IN DENMARK	Country of origin
	CE	Mark of approval

1.3 Control and switch boxes

1.3.1 CU 200 SQFlex control unit

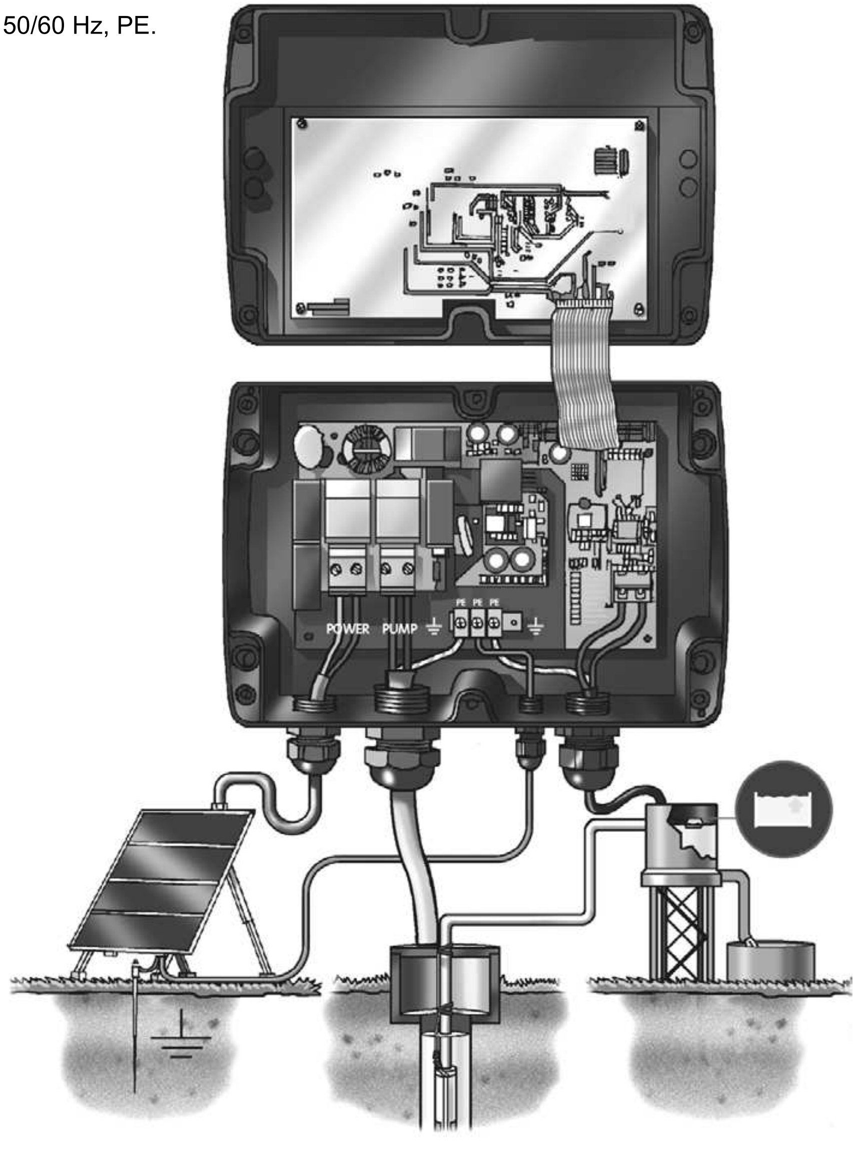
The CU 200 SQFlex control unit offers:

- system monitoring on the basis of sensor signals
- system control on the basis of sensor signals
- monitoring of pump operation and alarm indication.

Technical data

- 30-300 VDC, PE.
- 1 x 90-240 V –10%/+6%, 50/60 Hz, PE.

Maximum load: 100 mA.



Internal (and external) wiring of CU 200 SQFlex control unit

CU 200 SQFlex display and indicator lights

The front cover of CU 200 features a button and various indications:

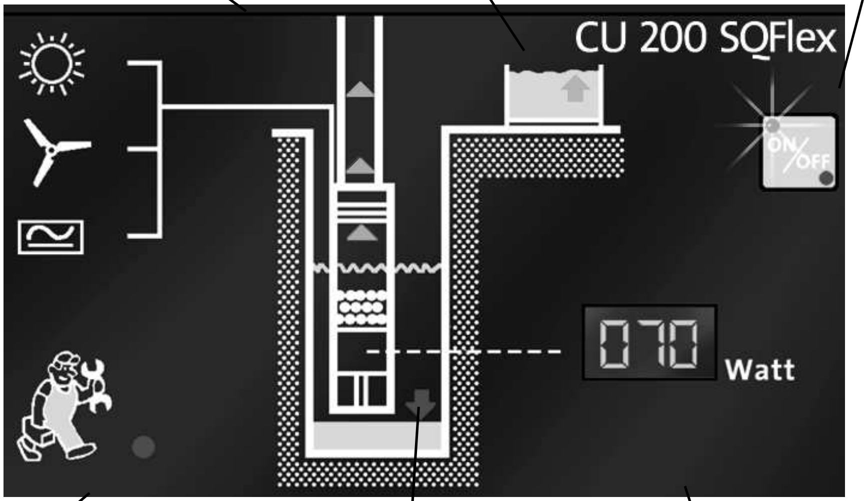
Pump operation
A running green light indicates that the pump is operating at more than 500 min^{-1}.

Full water reservoir

The yellow light indicates that the water reservoir is full.

ON/OFF button

- Green light on: The system has been switched on.
- Red light on: The system has been switched off.
- Both lights off: The system lacks the required power to light the display.
- Flashing green light: The system has adequate power to light the display but lacks sufficient power to start the pump.



Fault indicator

Red light indicates fault.

Dry running

Red light indicates lack of water.

Power and fault codes

The display indicates 0 Watt until the power supply is sufficient to run the pump at 500 rpm; upon startup, the power consumption of the pump is indicated in steps of 10 Watt, the maximum indication being 990 Watt.

When the fault indicator is on, the display indicates fault codes, see Trouble-shooting by means of CU 200 on page 8.

F1 = overvoltage

F2 = overtemperature

F3 = no contact to the pump

F4 = overload

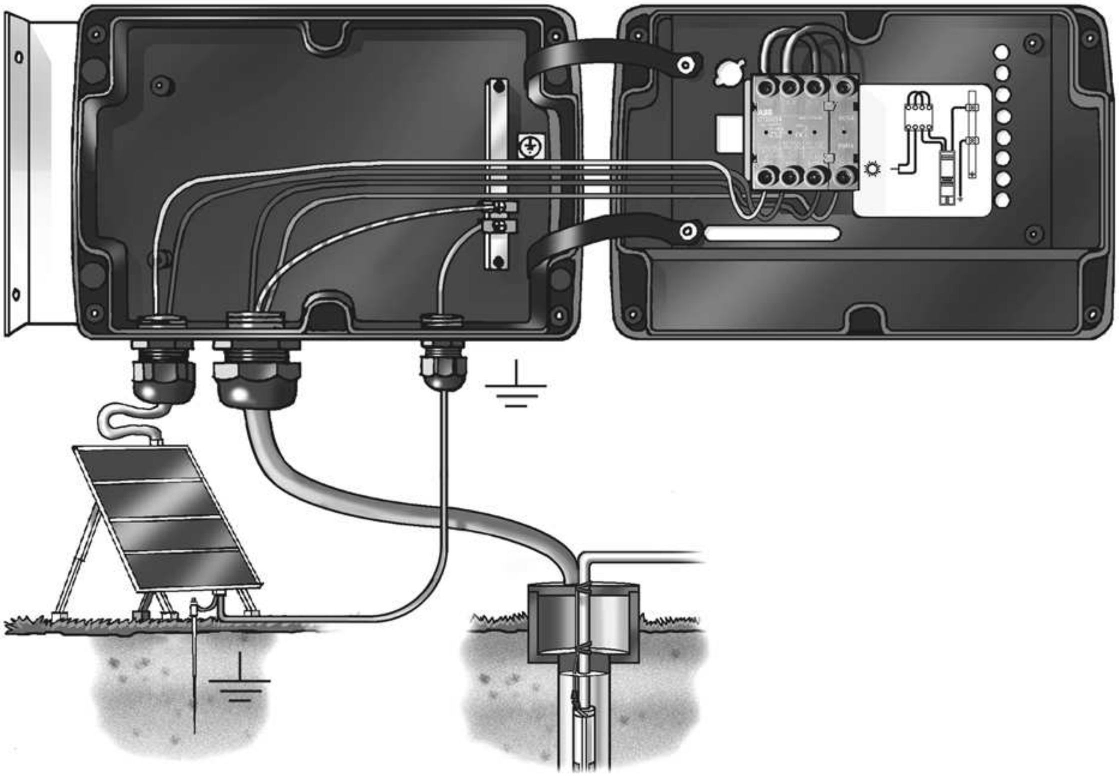
Trouble-shooting by means of CU 200

Indication/Fault	Possible cause	Remedy
1. No light in front cover. Pump does not deliver water.	No voltage supply.	• Reestablish the voltage supply.
	Position of ribbon cable connector is wrong or cable is defective.	• Correct the position of the cable or replace it.
2. No light in front cover, and pump does not deliver water. But the LEDs inside CU 200 indicating 5 V, 10 V and 24 V internal supply voltage are on, and the 'CONTROL INDICATOR' LED is not flashing.	CU 200 is defective.	• Replace the CU 200.
3. Pump does not start. Green indicator light in ON/OFF button is on. No fault indicated.	CU 200 or pump is defective.	• Check that the 'CONTROL INDICATOR' LED is flashing. If not, replace the CU 200. • Check that there is sufficient voltage on the PUMP terminals. If no voltage can be measured, replace the CU 200. If a supply voltage to the pump can be detected, continue as follows: • Switch off the energy supply and wait for one minute. • Switch on the energy supply and observe what happens: If the green indicator light in the ON/OFF button is on and the pump still does not start, the pump or pump cable is defective. • Repair or replace pump or cable.
4. Off light in the ON/OFF button is on.	Pump has been stopped.	• Press the ON/OFF button on the CU 200 to start the pump.
5. CU 200 indicates 'F3 = no contact to pump'.	CU 200 defective.	• Check - the connection in the CU 200 - the pump cable - the end cover with socket on the pump.
	Pump cable or connections defective.	
	Pump is defective.	• Repair or replace the pump.
6. CU 200 indicates 'F1 = overvoltage'	Supply voltage is above permissible range.	• Disconnect the solar modules to allow the voltage to drop. • Reconfigure the modules and reconnect them. If a different supply source is used, check that the voltage is within the recommended voltage range. **Note:** As the voltage is detected at the motor, allow for the voltage drop in the pump cable.
7. CU 200 indicates 'F2 = overtemperature'.	Too high water temperature.	• Ensure that the water temperature is below the maximum permissible level.
	Incrustations on motor.	• Remove incrustations on the motor.
	Pump is defective.	• Repair or replace the pump.

Indication/Fault	Possible cause	Remedy
8. CU 200 indicates 'F4 = overload'.	Too low input voltage.	• Increase the supply voltage, to 30 VDC or higher.
	Pump is defective.	• Repair or replace the pump.
	Only helical rotor pumps. Pumped liquid is contaminated with oil or similar substance.	• Clean the liquid and replace the pump.
	Motor liquid low / Missing.	• Check or refill motor liquid.
9. Green indicator light in ON/OFF button is flashing.	Insufficient power supply.	• Increase the number of solar modules or connect an alternative energy supply, such as wind turbine, batteries or generator.
	Pump has seized up.	• Clean the pump.
10. Running light on CU 200 but low wattage.	System not grounded.	• Check system for adequate grounding
	Pump is defective.	• Repair or replace the pump. If a centrifugal pump is used: Check that the riser pipe is not blocked.
11. No light in front cover. Pump delivers water.	CU 200 is defective.	• Replace the CU 200.
	Ribbon cable not mounted.	• Mount the ribbon cable.
12. Pump does not stop when water reservoir is full. Fault indicator light on CU 200 is off.	Level switch is dirty or defective.	• Clean or replace the level switch.
	Cable on level switch is damaged.	• Replace the cable.
13. Pump does not stop when water reservoir is full. Fault indicator light on CU 200 is on.	CU 200 is defective.	• Replace the CU 200.
14. Pump does not start when water reservoir is empty. Water reservoir indicator is on.	Level switch is defective.	• Replace the level switch.
	Cable on level switch is damaged.	• Replace the cable.
	CU 200 is defective.	• Replace the CU 200.

1.3.2 IO 100 SQFlex switch box

The IO 100 enables manual starting and stopping of the pump in a solar-powered SQFlex system. In addition, the IO 100 functions as a connection point for all necessary cables.



Internal (and external) wiring of IO 100 SQFlex switch box

Technical data:

DC: Max. 225 V, PE.

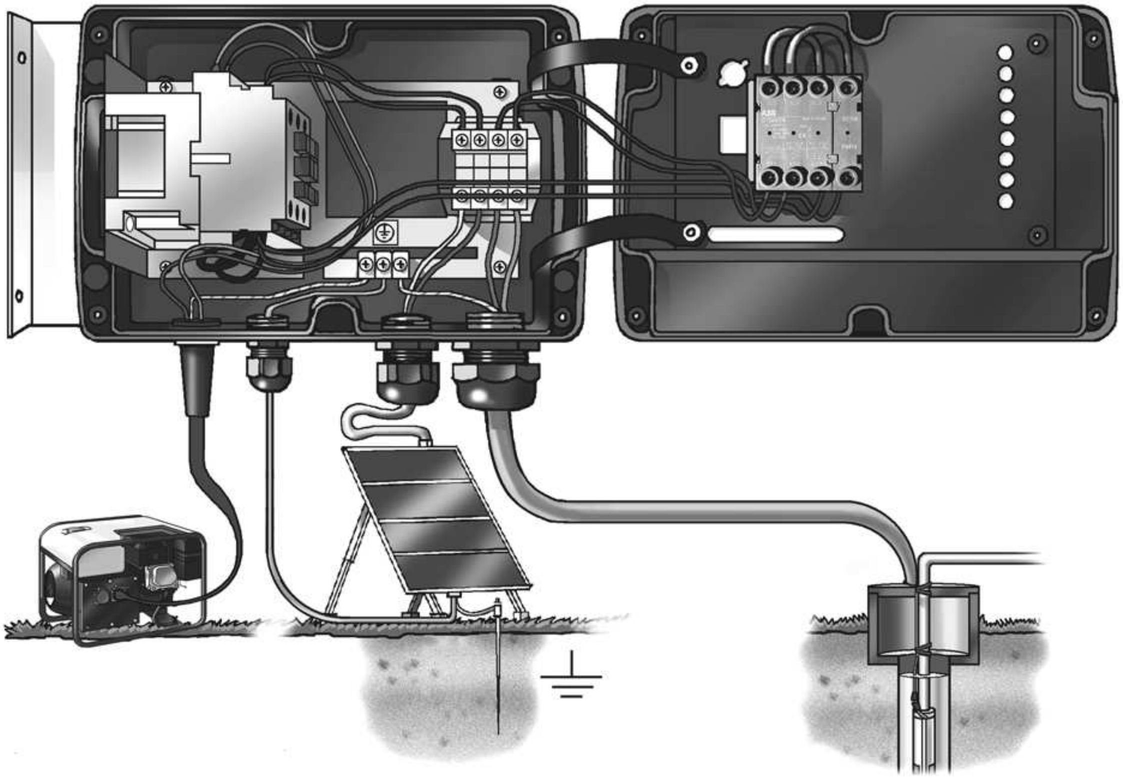
AC: Max. 265 V, 50/60 Hz, PE.

1.3.3 IO 101 SQFlex switch box

The IO 101 SQFlex switch box makes it possible to

- switch off the voltage supply to the pump and
- connect a back-up generator.

A back-up generator is useful in periods of insufficient solar energy or in case of an immediate requirement for water supply or a need for water at night.



Internal (and external) wiring of IO 101 SQFlex switch box

Technical data:

- DC: Max. 225 V, PE.
- AC: Max. 265 V, 50/60 Hz, PE.

The internal relay in the IO 101 has the following rated voltage:

- 115 V –15%/+10%, 50/60 Hz, PE.

1.3.4 IO 102 SQFlex breaker box

The IO 102 is applicable in SQFlex systems powered exclusively by a wind turbine

The IO 102 SQFlex breaker box makes it possible to

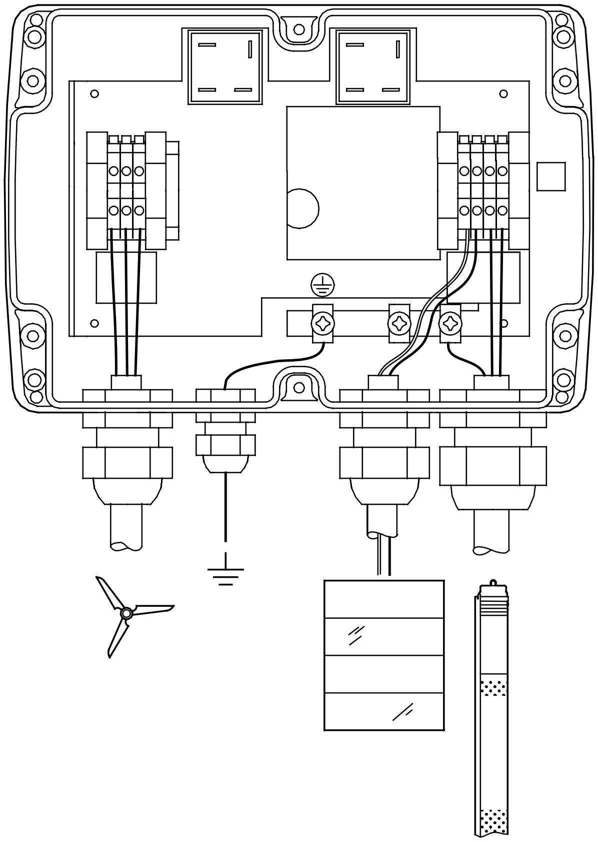
- switch off the voltage supply to the pump, and
- Stop the wind turbine blades
- connect solar modules as well as a wind turbine.

The IO 102 is applicable in SQFlex systems provided the system voltages mentioned below are not exceeded.

Technical data:

- DC: Max. 225 V, PE
- AC: Max. 265 V, 50/60 Hz, PE.

IO 102



Internal (and external) wiring of IO 102 SQFlex breaker box

1.4 Solar modules

Positioning

Solar modules located in the **northern hemisphere** should face south. Use a compass to position the modules as precisely as possible. Due to the magnetic declination it may be necessary to turn the modules some degrees away from the direction of the compass. In case of positive declination, turn the modules some degrees to the west, in case of negative declination, turn the modules some degrees to the east. See *Fig. 4*.

Solar modules located in the **southern hemisphere** should face north. Use a compass to position the modules as precisely as possible. Due to the magnetic declination it may be necessary to turn the modules some degrees away from the direction of the compass. In case of positive declination, turn the modules some degrees to the east, in case of negative declination, turn the modules some degrees to the west. See *Fig. 4*.

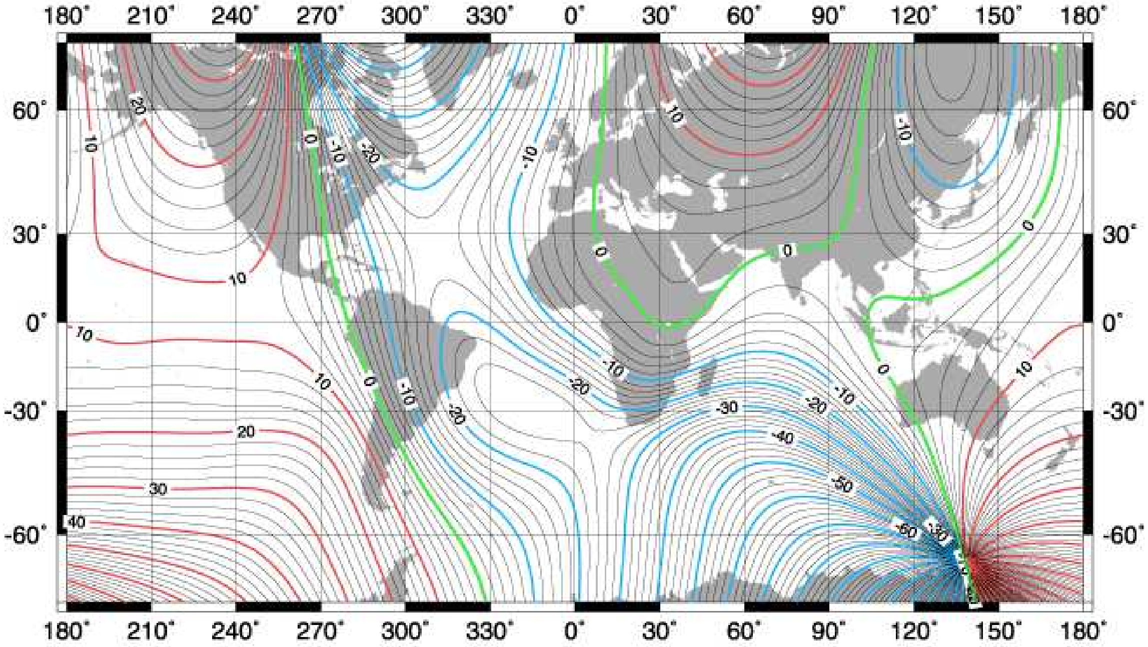


Fig. 4. The map illustrates the differences in magnetic declination in different parts of the world. Declination is caused by the fact that the geographic north pole and the magnetic north pole are not located in the same place. Depending on your location on the globe you must turn the solar modules away from the direction of the compass. How much appears from the map.

Mounting

The solar modules must be mounted on a support structure.

When mounting the solar modules, make sure that the module frames overlap in order to allow for rain water to run off.

For further information on the installation of solar modules, see installation and operating instructions for the modules.

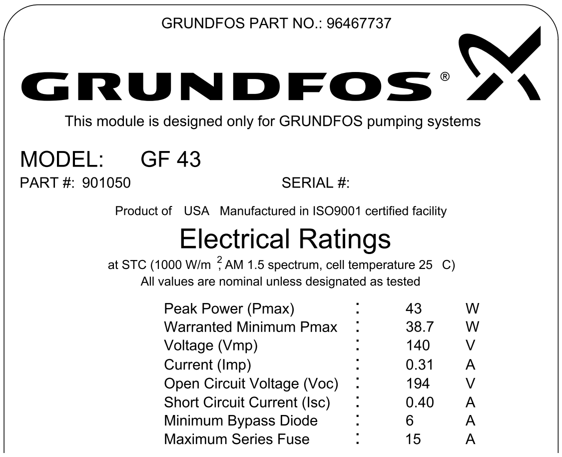
Tilt angle

For maximum utilisation of the solar radiation the tilt angle of the support structure can normally be adjusted from 15° to 45°.

1.4.1 GF 43, GF 50 solar modules

The GF solar modules consist of amorphous silicon thin-film solar cells.

Each solar module is equipped with plugs and sockets for easy connection of several modules in parallel. The solar panels are mounted on a support structure, tilted at an angle ensuring optimum utilisation of the solar energy.



GRUNDFOS PART NO.: 96467737

GRUNDFOS®

This module is designed only for GRUNDFOS pumping systems

MODEL: GF 43

PART #: 901050 SERIAL #:

Product of USA Manufactured in ISO9001 certified facility

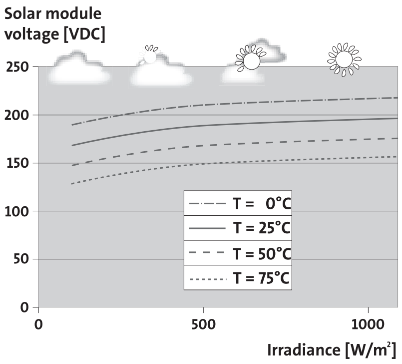
Electrical Ratings

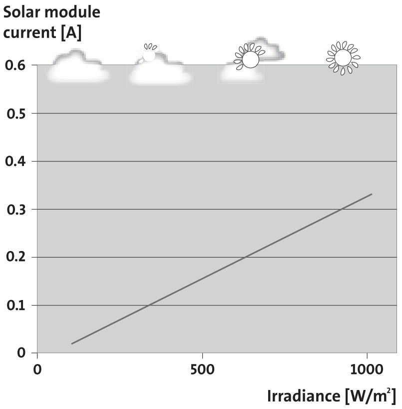
at STC (1000 W/m ^{2}, AM 1.5 spectrum, cell temperature 25 C)

All values are nominal unless designated as tested

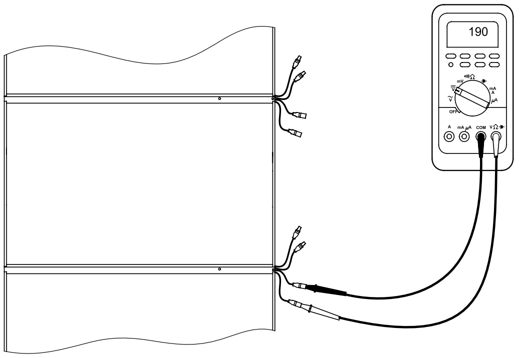
Peak Power (Pmax)	:	43	W
Warranted Minimum Pmax	:	38.7	W
Voltage (Vmp)	:	140	V
Current (Imp)	:	0.31	A
Open Circuit Voltage (Voc)	:	194	V
Short Circuit Current (Isc)	:	0.40	A
Minimum Bypass Diode	:	6	A
Maximum Series Fuse	:	15	A

Example of GF 43 nameplate

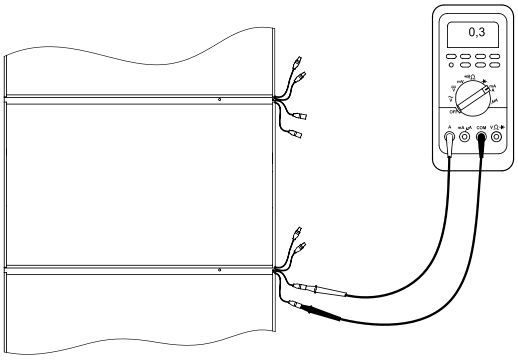




A = current read on the graph must be multiplied by the number of solar modules.



Measurement of voltage by means of multimeter



Measurement of current by means of multimeter

Visual inspection of solar modules

- Check that the solar modules are intact.
- Make sure that trees, grass, bushes, buildings, etc. do not cast a shadow on the solar modules.

Electrical connections GF 43, GF 50 solar modules

Note: Before making any electrical connections, make sure that the solar modules are covered with a non-transparent covering material to ensure that the modules are dead.

- The cover **must be** removed before measuring is made.
- Measurements must be made when the solar modules are not connected.
- The current to be measured is the short-circuit current I_{SC}.

Note: The Grundfos GF solar modules must not be connected in series.

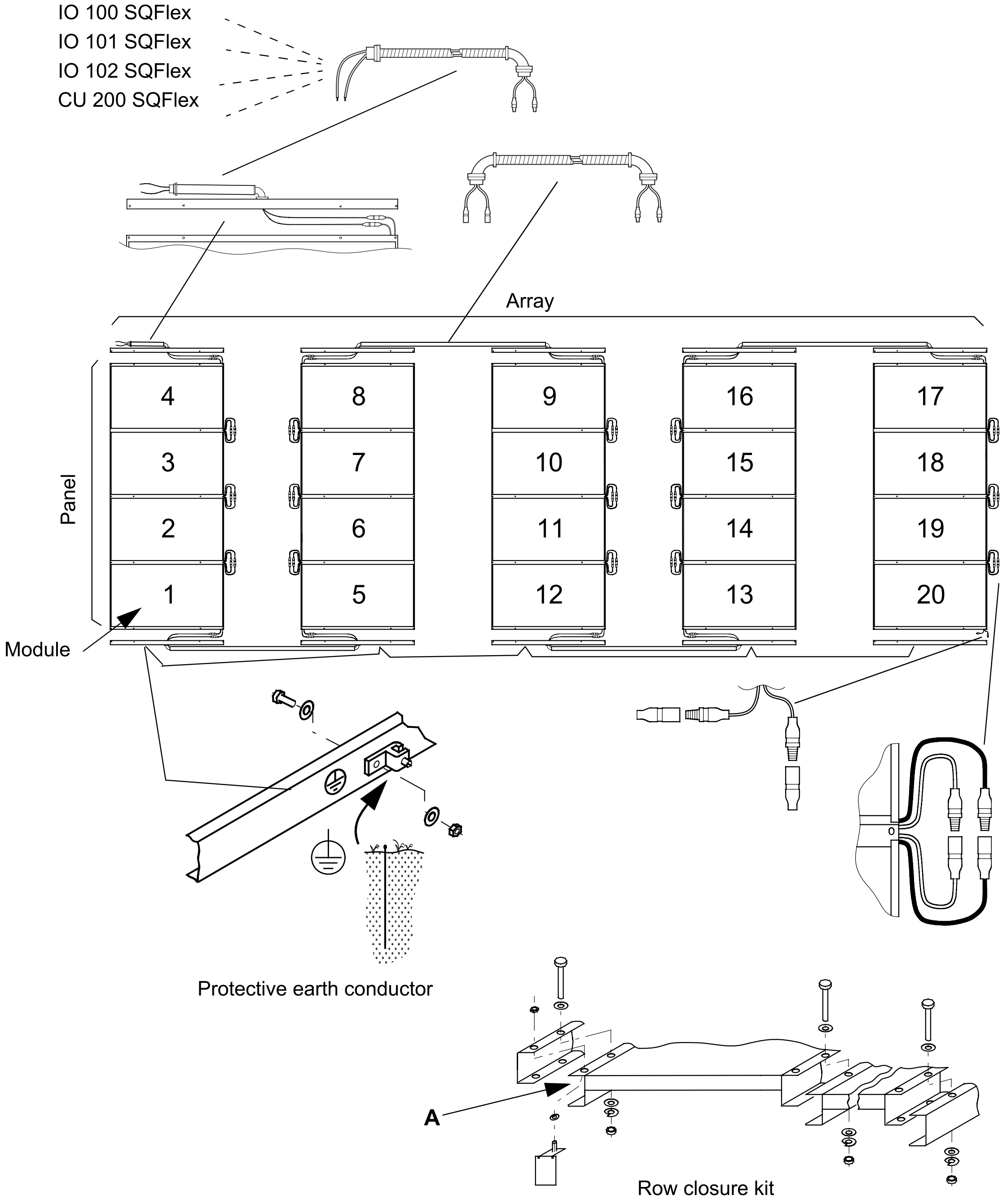


Fig. 5. Accessories needed to connect a PE conductor

The solar panels must be connected to earth via the **P**rotective **E**arth (PE) conductor supplied with the row closure kit. The PE conductor is connected to the row closure by means of a screw terminal.

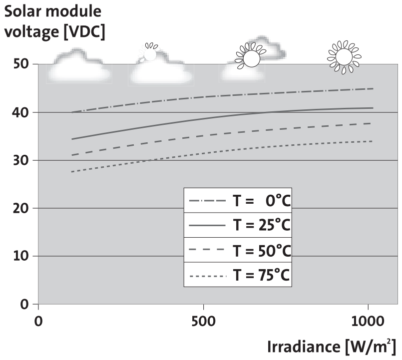
Note: To achieve good earth connection and thus to protect persons, it is of decisive importance to fit the earth clips (pos. A) and earth terminals supplied with the row closure kit.

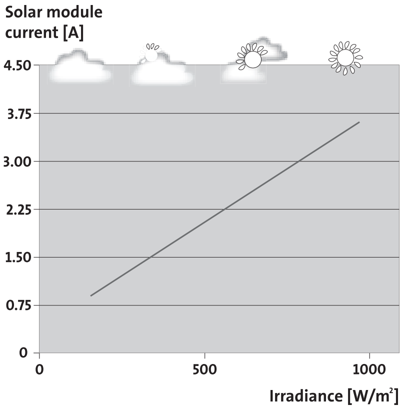
1.4.2 SX-110 solar modules

The SX-110 solar modules consist of 72 multicrystalline silicon solar cells in series with bypass diodes installed. The solar modules are equipped with plugs and sockets for easy connection of several modules in parallel or series. The solar modules must be mounted on a support structure, tilted at an angle ensuring optimum utilisation of the solar energy.

This module is UL, Tüv, CE and IEC 61215 approved.

Peak power (P_{Max})	110	W
Voltage ($V_{mp)}$	32.9	V
Current (I_{mp})	3.34	A
Open circut voltage (V_{oc})	41.2	V
Short circut current (I_{sc})	3.69	A
Reference cell temperature (T_{cref})	25	˚C
Solar irradiation at reference cell temperatue (I_{tref})	1000	W/m^2





Visual inspection of solar modulesmodules

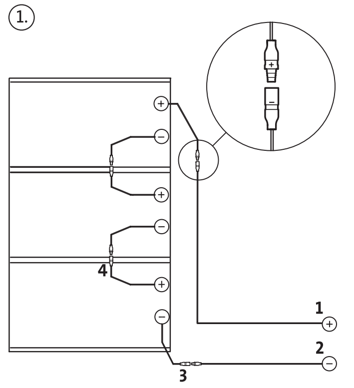
- Check that the solar modules are intact.
- Make sure that trees, grass, bushes, buildings, etc. do not cast a shadow on the solar modules.

Electrical connection SX-110 solar modules

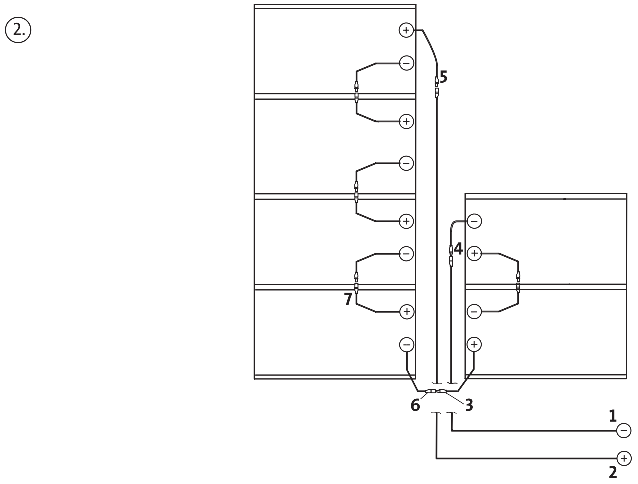
Note: Before making any electrical connections, make sure that the solar modules are covered with a non-transparent covering material to ensure that the modules are dead.

- The cover **must be** removed before measuring is made.
- Measurements must be made when the solar modules are not connected.
- The current to be measured is the short-circuit current I_{SC}.

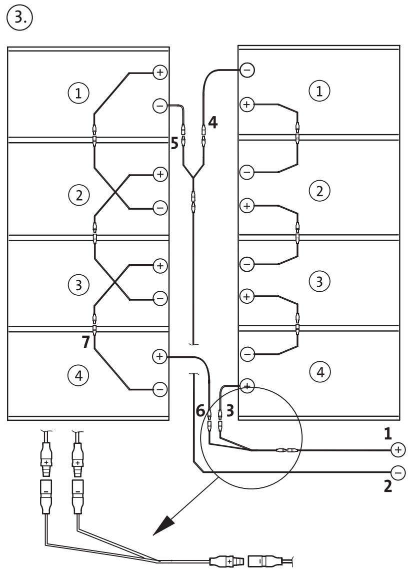
Electrical connection SX-110 solar modules (continued)



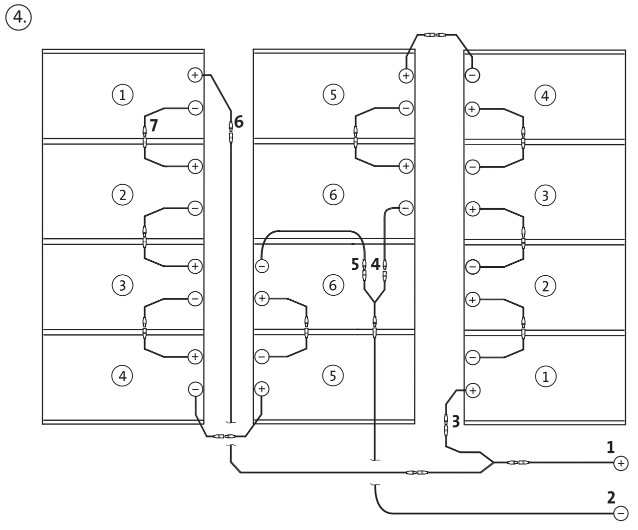
Plug	Modules	Voltage [v]	Current [A]
1 - 2	4 3 2 1	164 123 82 41	3,7 3,7 3,7 3,7
3 - 4	1	41	3,7



Plug	Modules	Voltage [v]	Current [A]
1 - 2	7 6 5	288 247 206	3,7 3,7 3,7
3 - 4	2 1	82 41	3,7
5 - 6	4	165	3,7
6 - 7	1	41	3,7



Plug	Modules	Voltage [v]	Current [A]
1 - 2	8	165	7,4
3 - 4 **5 - 6**	4	165	3,7
6 - 7	1	41	3,7

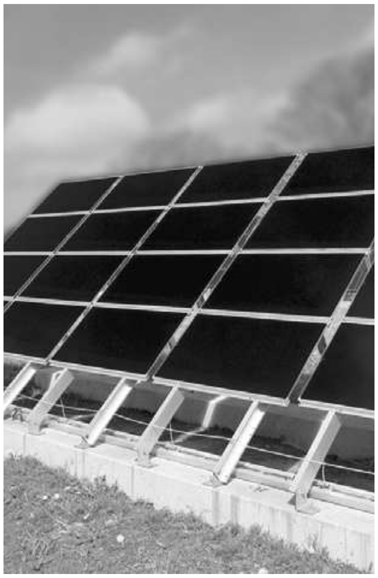


Plug	Modules	Voltage [v]	Current [A]
1 - 2	12	247	7,4
3 - 4 **5 - 6**	6	247	3,7
6 - 7	1	41	3,7

TM02 6875 1903

The solar panels must be connected to earth via a **P**rotective **E**arth (PE) conductor

1.4.3 FS-50-D solar modules

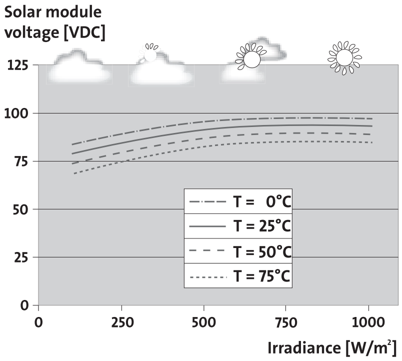


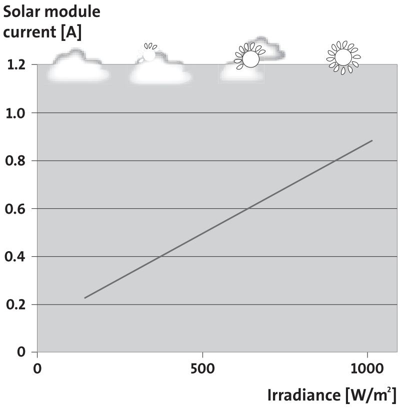
The FS-50-D solar modules consist of thin-film of semiconductor material on glass.

The solar modules are equipped with plugs and sockets for easy connection of several modules in parallel or series. The solar modules must be mounted on a support structure, tilted at an angle ensuring optimum utilisation of the solar energy.

This module is UL and IEC 61646 approved.

Peak power (P_{Max})	50	W
Voltage (V_{mp})	65	V
Current (I_{mp})	0.77	A
Open circut voltage (V_{oc})	90	V
Short circut current (I_{sc})	1	A
Max. series fuse rating	2	A
Reference cell temperature (T_{cref})	25	°C
Solar irradiation at reference cell temperatue (I_{tref})	1000	W/m^2





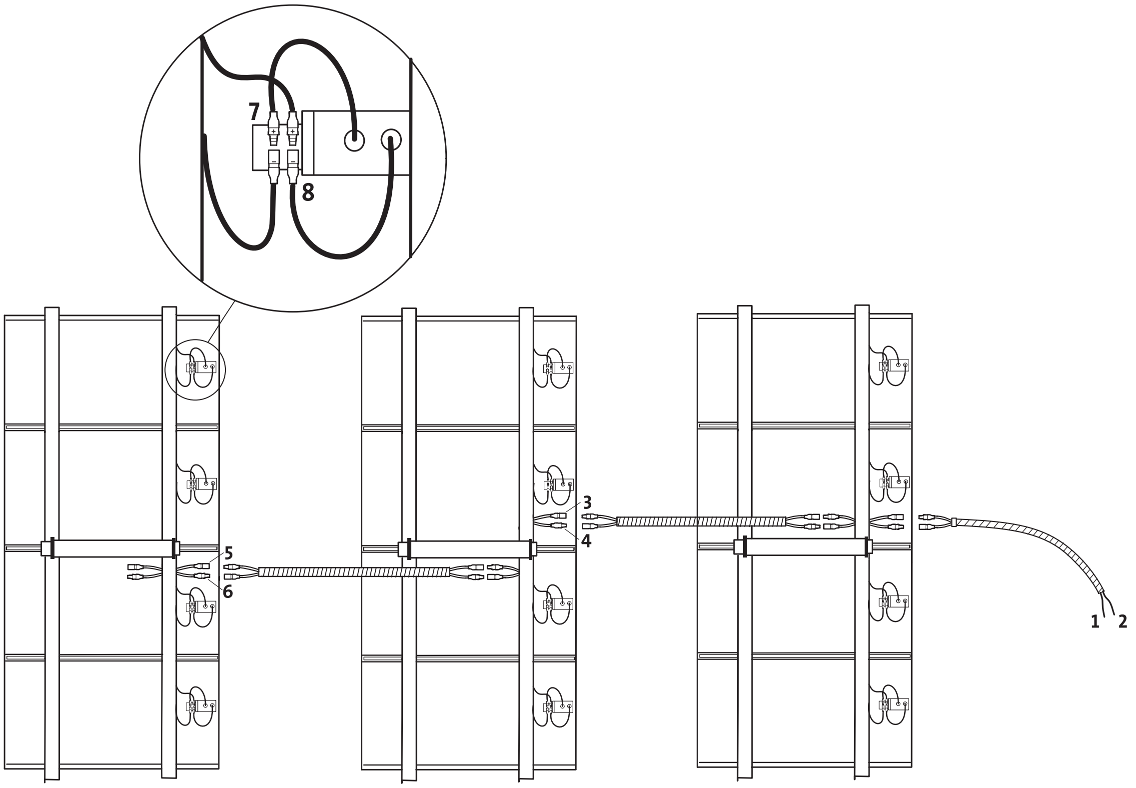
Visual inspection of solar modules

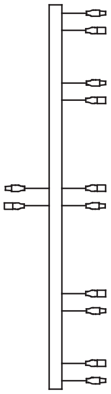
- Check that the solar modules are intact.
- Make sure that trees, grass, bushes, buildings, etc. do not cast a shadow on the solar modules.

Electrical connection of FS-50-D solar modules.

Note: Before making any electrical connections, make sure that the solar modules are covered with a non-transparent covering material to ensure that the modules are dead.

- The cover **must be** removed before measuring is made.
- Measurements must be made when the solar modules are not connected.
- The current to be measured is the short-circuit current I_{SC}.





Plug	Modules	Voltage [v]	Current [A]
1 - 2	20	180	10
	18	180	9
	16	180	8
	14	180	7
	12	180	6
	10	180	5
3 - 4	8	180	4
	6	180	3
5 - 6	4	180	2
	2	180	1
7 - 8	1	90	1

TM02 6874 1903

The solar panels must be connected to earth via a **P**rotective **E**arth (PE) conductor

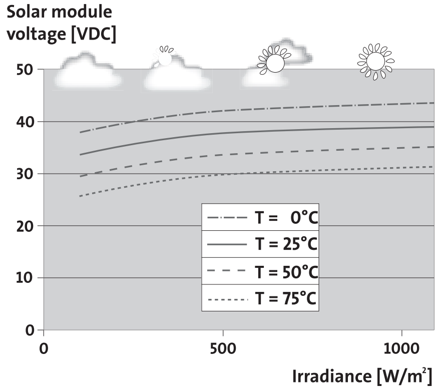
1.4.4 GF 55C and GF 65C solar modules

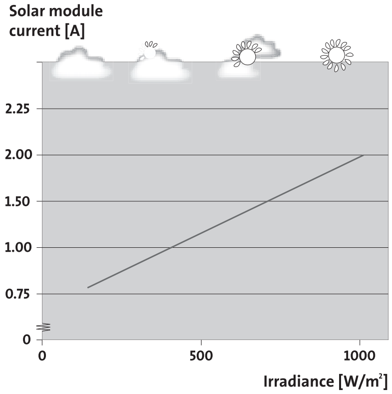
The GF 55C and GF65C solar modules consist of 68 multicrystalline silicon cells in series. The solar modules are equipped with plugs and sockets for easy connection of several modules in parallel or series. The solar modules must be mounted on a support structure, tilted at an angle ensuring optimum utilisation of the solar energy.

This module is UL, Tüv, CE and IEC 61215 approved.

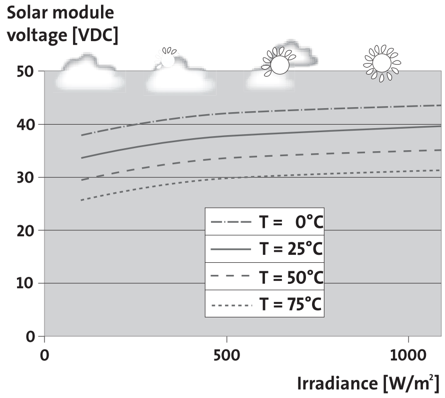
	GF 55C	GF 65C	
Peak power (P_{Max})	55	65	W
Voltage ($V_{mp)}$	30.6	31.4	V
Current (I_{mp})	1.8	2.1	A
Open circut voltage (V_{oc})	39.0	39.7	V
Short circut current (I_{sc})	2.0	2.3	A
Reference cell temperature (T_{cref})	25	25	°C
Solar irradiation at reference cell temperatue (I_{tref})	1000	1000	W/m^2

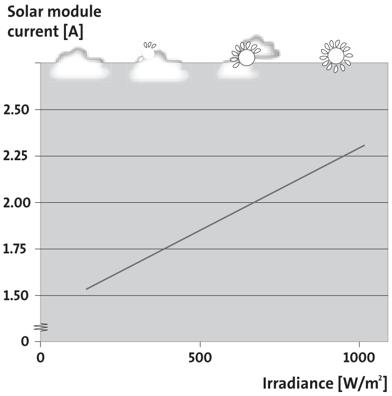
GF 55C





GF 65C





Visual inspection of solar modulesmodules

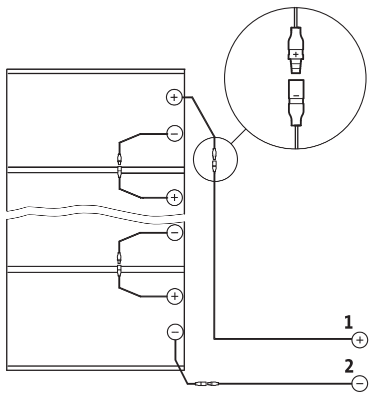
- Check that the solar modules are intact.
- Make sure that trees, grass, bushes, buildings, etc. do not cast a shadow on the solar modules.

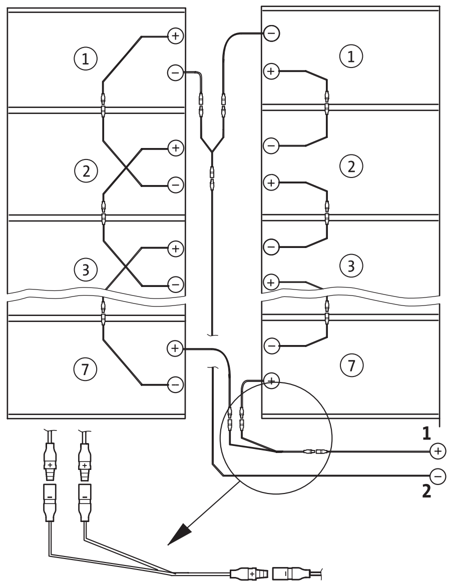
Electrical connection GF 55C and GF 65C solar modules

Note: Before making any electrical connections, make sure that the solar modules are covered with a non-transparent covering material to ensure that the modules are dead.

- The cover must be removed before measuring is made.
- Measurements must be made when the solar modules are not connected.
- The current to be measured is the short-circuit current I_{SC}.

Electrical connection GF 55C and GF 65C solar modules (continued)





TM02 8643 0604

The solar panels must be connected to earth via a Protective Earth (PE) conductor

Note: To achieve good earth connection and thus to protect persons, it is of decisive importance to fit the earth clips and earth terminals

Modules	**Seriel**	**Parrallel**	**GF 55C**		**GF 65C**	
			V_{OC} [V]	**I_{SC} [A]**	**V_{OC} [V]**	**I_{SC} [A]**
2	2	1	78	2	79.4	2.3
3	3	1	117	2	119.1	2.3
4	4	1	156	2	158.8	2.3
5	5	1	195	2	198.5	2.3
6	6	1	234	2	238.2	2.3
7	7	1	273	2	277.9	2.3
8	4	2	156	4	158.8	4.6
9	3	3	117	6	119.1	6.9
10	5	2	195	4	198.5	4.6
12	6	2	234	4	238.2	4.6
14	7	2	273	4	277.9	4.6
15	5	3	195	6	198.5	6.9
16	4	4	156	8	158.8	9.2
18	6	3	234	6	238.2	6.9
20	5	4	195	8	198.5	9.2

1.4.5 GTF 55

GTF 55 solar modules consist of thin-film of semiconductor material on glass substrates. The module is equipped with cost effective aluminium mounting frame.

Low temperature coefficients provide more power at actual operating conditions.

Proven durability eliminates the need for expensive frames to prevent delamination in the field.

Architecturally aesthetic uniform black appearance.

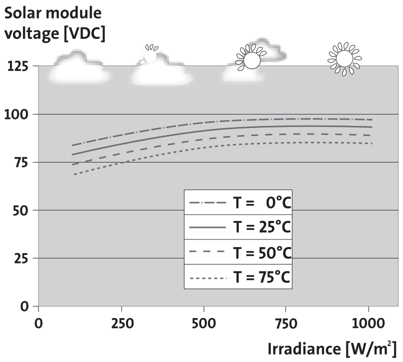
Weatherproof connectors and cordplate elimate the need for a junction box and module to module field wiring.

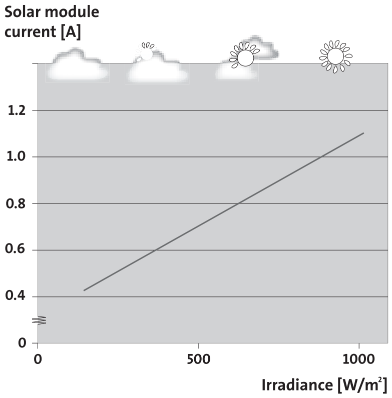
The solar modules are equipped with plugs and sockets for easy connection of several modules in parallel or series. The solar modules **must** be mounted on a support structure, tilted at an angle ensuring optimum utilisation of the solar energy

This module is UL and IEC 61646 approved.

Peak power (P_{Max})	55	W
Voltage (V_{mp})	63	V
Current (I_{mp})	0.87	A
Open circut voltage (V_{oc})	89	V
Short circut current (I_{sc})	1.1	A
Reference cell temperature (T_{cref})	25	°C
Solar irradiation at reference cell temperatue (I_{tref})	1000	W/m^2

Visual inspection of solar modules



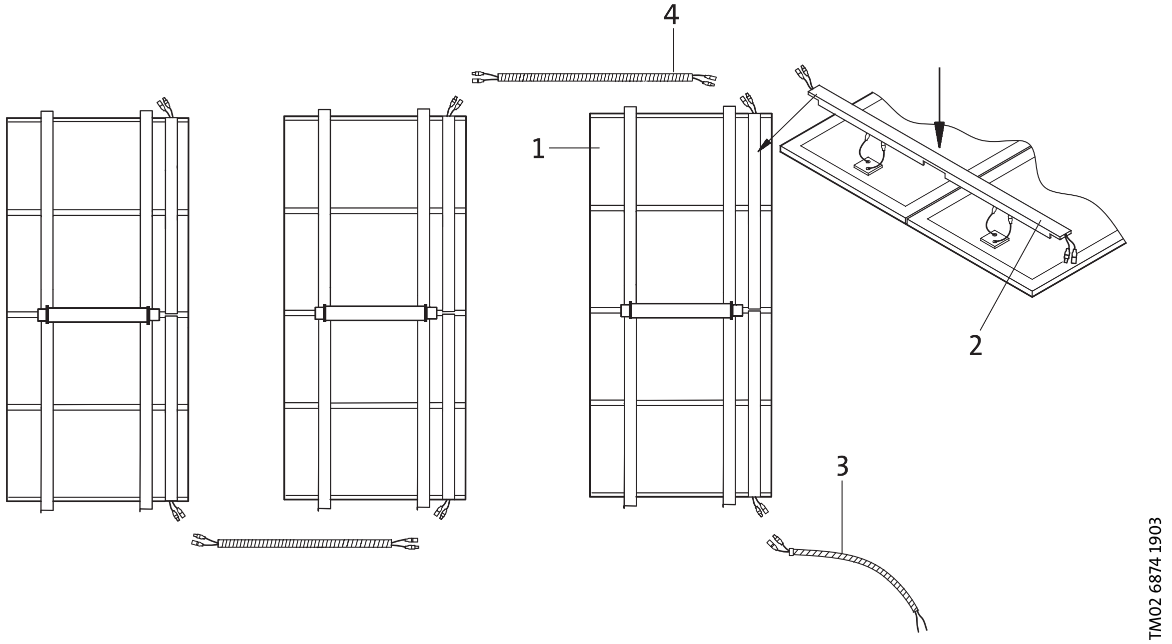


- Check that the solar modules are intact.
- Make sure that trees, grass, bushes, buildings, etc. do not cast a shadow on the solar modules.

Electrical connection of GTF 55 solar modules.

Note: Before making any electrical connections, make sure that the solar modules are covered with a non-transparent covering material to ensure that the modules are dead.

- The cover must be removed before measuring is made.
- Measurements must be made when the solar modules are not connected.
- The current to be measured is the short-circuit current I_{SC}.



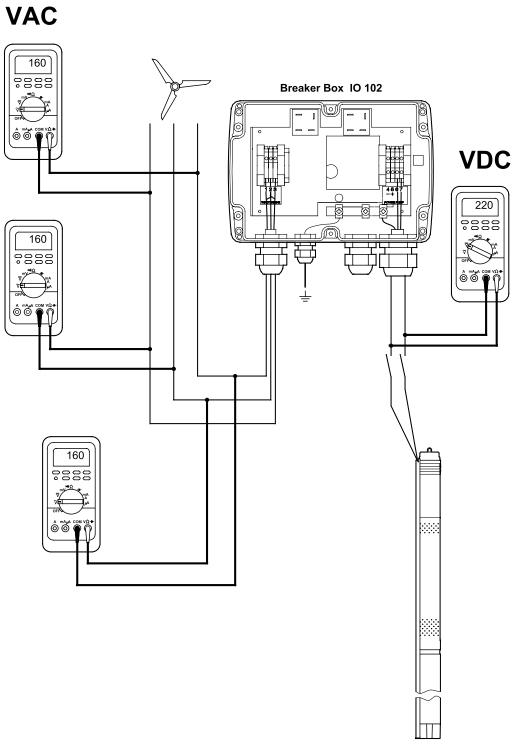
Pos.	Product
1	Solar module GTF 55
2	Cable guards and connection wire kit
3	Array-to-controller wire kit
4	Array-to-array wire kit

The solar panels must be connected to earth via a Protective Earth (PE) conductor

Note: To achieve good earth connection and thus to protect persons, it is of decisive importance to fit the earth clips and earth terminals

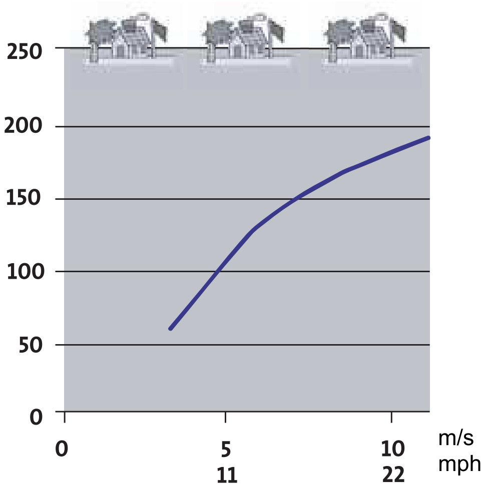
Modules	Seriel	Parrallel	GTF 55	
			V_{OC} [V]	I_{SC} [A]
4	2	2	126	1.7
6	2	3	126	2.6
8	2	4	126	3.5
10	2	5	126	4.4
12	2	6	126	5.2
14	2	7	126	6.1
16	2	8	126	7.0
18	2	9	126	7.8
20	2	10	126	8.7

1.5 Wind turbine

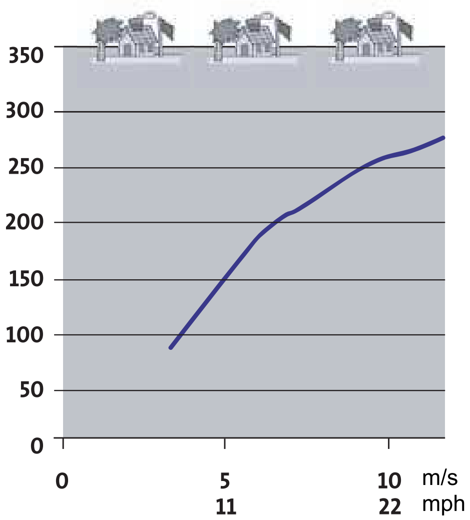


Measurement of VAC and VDC

Wind turbine
voltage [VAC]



IO 102
voltage [VDC]



Values measured between the three phases must be identical.

1.5.1 Trouble-shooting

1. Find out if the problem is mechanical or electrical.
   - Propeller cannot turn = Mechanical problem, see Mechanical problems on page 26.
   - Propeller turns slowly = Electrical problem, see Electrical problems on page 27.
     Electrical problems may be in the wind turbine or the IO 102 breaker box. Determine which as follows:
2. Disconnect the three wires from the wind turbine one at a time at the IO 102 breaker box. If the propeller starts, the wire that allowed it to start leads to a defective rectifier in the IO 102 breaker box. Replace the breaker box, see Overview of possible system combinations on page 33.
3. If the propeller still does not start, the problem is in the tower wiring or the wind turbine.
4. The propeller is running, but may have an electrical problem. Using a voltmeter, read the voltage across the leads and see the list below as a guide to possible problems.
   - The voltage increases and decreases slowly with wind speed and equally across all wires = Everything OK.
   - No voltage across two wires = One wire from wind turbine is not carrying power. Check in order:
     -the tower wiring to ensure it is properly wired.
     -slip rings and brushes,
     -stator connections and stator windings for obvious damage.
   - The voltage is significantly higher across two wires than the others = Contact the distributor or the factory.
   - Voltage is produced even after ON/OFF switch is activated = Possibly a faulty ON/OFF switch or a wire has been short circuited to the other two wires or an internal fault has occurred in the IO 102 breaker box.
   - The voltage is significantly lower across two wires than the others = Bad connection at the wind turbine voltage connections or faulty stator winding.
5. Should these steps not solve the problem, proceed directly to Electrical problems on page 27.

Mechanical problems

Fault	Cause	Remedy
1. Propeller is stationary, even in high winds.	• Ice in wind turbine, or uneven ice on propeller. • Debris between rotor and stator. • Loose magnet. • Worn-out bearing.	• Remove ice, or wait for warm weather. • Turn propeller gently by hand and blow or use piece of paper to dislodge debris. • Contact distributor. • Contact distributor.
2. a) Propeller will not turn at all except in high wind b) Scraping or rubbing sound at low rpm c) Propeller always stops in the same position.	• Same as above. • Swelled wire keepers due to high moisture.	• Same as above. • Contact distributor.
3. a) Propeller is difficult to start b) Output is low c) more propeller noise than usual. d) Propeller seems out of balance.	• Ice on blade. • Dirty blade. • Split, warped or damaged blade. • One or more blades fitted wrongly.	• Remove ice, or wait for warm weather. • Clean with soap or bug cleaner. • Replace broken or damaged blade. • Fit blade(s) correctly.
4. Propeller turns a little, but never starts properly.	• Blades fitted wrongly.	• Fit blades correctly. Leading edge should move clockwise when viewing propeller from the front.
5. Tail, wind turbine and tower vibrate.	• Blade out of balance. • Blade not tracking.	• Contact distributor.
6. Rattling or clunking sound from wind turbine.	• wind turbine loose in tower. • Loose rotor (magnet can) on shaft, loose tail, missing rubber bumper, wires slapping inside of mast, governor pivot bolt loose. • Worn bearings. • Shaft broken.	• Retighten mounting screws. Use Loctite or equivalent thread-locking compound. • Repair as required. • Contact distributor. • Contact distributor.

Electrical problems

Note: Always be aware of the danger of high voltage. Do not directly touch the wires.

Fault	Possible cause	Remedy
1. Pump does not operate and propeller do not turn or turns slowly even in high winds.	• The wind speed is too slow.	• Wait for the wind speed to increase.
	• The IO 102 ON/OFF switch is set to OFF.	• Set the IO 102 ON/OFF switch to ON.
	• Pump defective or pump cable short circuit.	• Set IO 102 ON/OFF switch to OFF. Disconnect the pump from IO 102. Set ON/OFF switch to ON. If the propeller starts to turn, either the pump or the pump cable is defective. Set IO 102 ON/OFF switch to OFF. Replace the defective part and reconnect to IO 102. Set ON/OFF switch to ON.
	• IO 102 is defective.	• Set IO 102 ON/OFF switch to ON. Disconnect the three wires from the wind turbine one at the time at the IO 102. if the proppeler starts to turn the IO 102 is defective. Replace the IO 102.
2. Pump does not operate and propeller turns fast.	• Wires between IO 102 and pump may be disconnected.	• Set IO 102 ON/OFF switch to OFF. Reconnect the wires. Set IO 102 ON/OFF switch to ON.
	• Pump defective.	• Set IO 102 ON/OFF switch to OFF. Replace the pump. Set IO 102 ON/OFF switch to ON.
3. Pump does not operate. Propeller turns fast and are not alowing down when IO 102 ON/OFF switch is set to OFF.	• One or more wires between wind turbine and IO 102 may be disconnected.	• Set IO 102 ON/OFF switch to OFF. Reconnect the wires. Set IO 102 ON/OFF switch to ON.
	• Wind turbine defective.	• Set IO 102 ON/OFF switch to OFF. Replace wind turbine. Set IO 102 ON/OFF switch to ON.
	• IO 102 defective.	• Try to disconnect the three wires from the wind turbine in the IO 102 and short circute them. If the propeller slows down or stops, the IO 102 is defective. Replace the IO 102.

2. Start-up

The starting sequence has three steps:

1. Charging the capacitor
2. positioning of the rotor
3. start.

Consequently, during start-up the motor will make small rotations in order to bring the rotor into the correct starting position. These rotations also ensure that there is water in the pump and that the pump parts are lubricated.

During start-up current consumption will be uneven but when the motor has started, current consumption will be constant.

Helical rotor pumps:

- If sufficient energy is available the pump will normally be running within one minute.
- If sufficient energy is available and the motor does not start within 15 minutes, the pump rotor may be stuck due to dryness. This situation can arise if the pump has been stocked for some time. Dismantle the pump and loosen the rotor, or add water to the pump rotor/stator assembly.
- If sufficient energy is not available the starting sequence will be repeated.

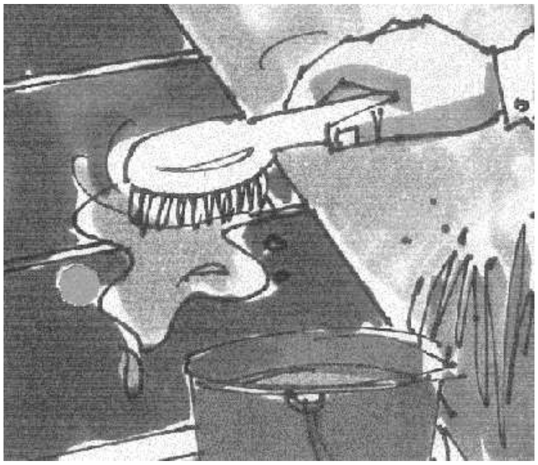
Please note that after the pump has started running, it will take a while to fill the riser pipe. How long depends on the energy available, the installation depth and the dimensions of the riser pipe. At moderate energy supply and high head, it may take up to one hour.

3. Maintenance

This section describes how to maintain solar modules and wind turbines. Under normal operating conditions the pumps and the controls are maintenance-free.

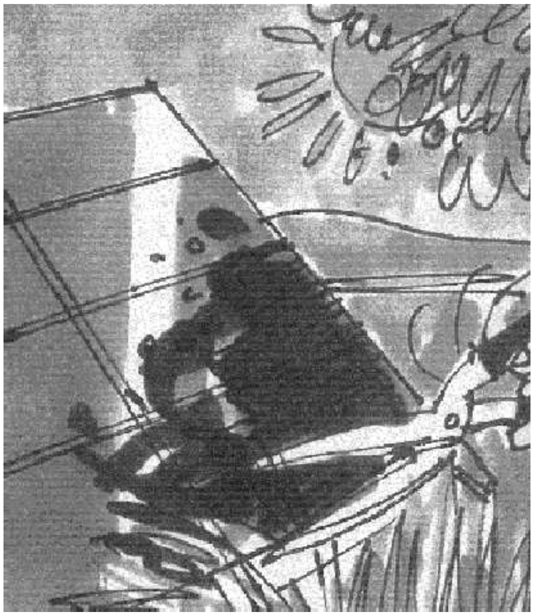
3.1 Solar modules

Routine maintenance



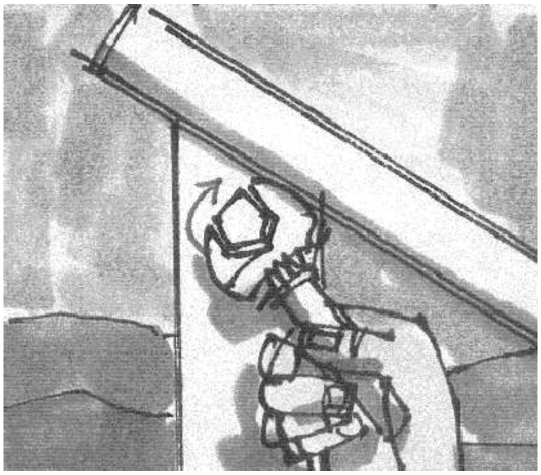
Cleaning

- The solar modules must be cleaned when they are dirty. Use only clean water without soap and a soft brush or cloth. Make sure there is no sand or other abrasive particles in the water.
- There is no need to clean the modules underneath.



Clearing

- Make sure that the sun can shine directly on the modules.
- Cut down grass or trees that cast a shadow on the solar modules.

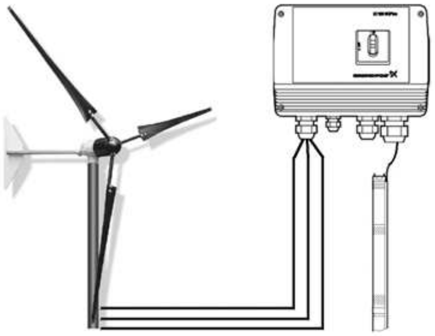


Tighten

- Tighten screws and nuts on the support structure if they have loosened.

3.2 Wind turbine

Monthly maintenance

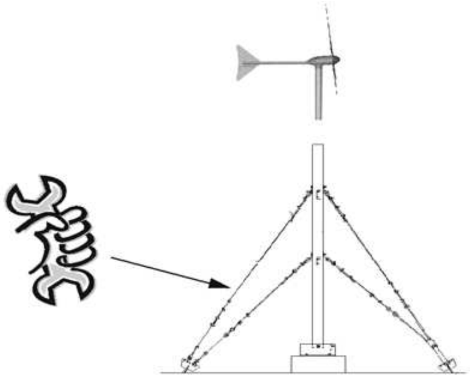


Test brake

(This checks electrical wiring.)
Stop the wind turbine in a moderate wind (charging but not furling). No unusual difficulty or noise should be experienced in stopping the propeller. A noise during braking can indicate a disconnected wire.

Check mechanical condition

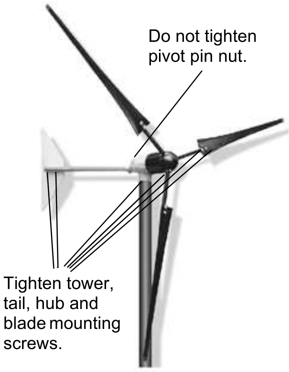
Watch and listen from the tower base.
Use binoculars. The propeller and tail must not wobble. There should be no mechanical noise, rattle or vibration.
Lower or climb the tower for inspection, if required.
There should be no buzzing either heard or felt with your hand on the tower mast. Go to section Electrical problems on page 27, if required.



Inspect the tower

Follow all inspection and maintenance requirements of the tower manufacturer. Tighten all nuts and screws, especially wire clips. Check for cracks and bent or broken parts at the anchors and base structure. Check for broken wire strands and tighten guys.

Annual maintenance



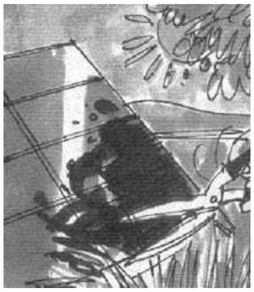
Complete mechanical check

- Lower the tower
- Repair or replace any worn or loose parts.
- Check tightness of all tower mounting nuts and screws and propeller mounting screws.
- Check all bearings. Just perceptible play is acceptable.
- Clean the propeller with mild detergent to remove all dirt and debris. Replace blades if they are cracked or damaged.

4. Trouble-shooting

Visual/general inspection of main components

Before starting specific Trouble-shooting, go through these simple visual inspections first.

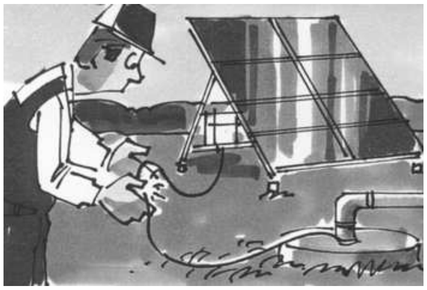


Visual inspection of solar modules

- Check that the solar modules are intact.
- Make sure that trees, grass, bushes, buildings, etc. do not cast a shadow on the solar modules.

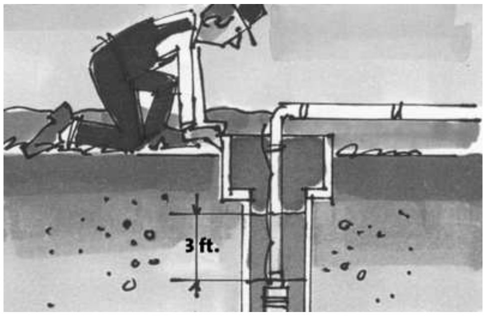
Visual inspection of the wind turbine,

see Check mechanical condition on page 30



Visual inspection of cables

- Check that the cables are intact.

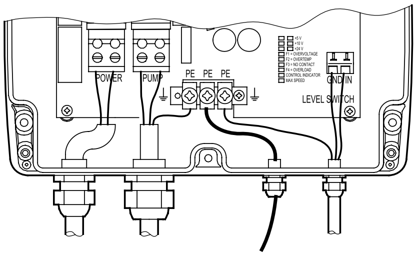


Visual inspection of the water level

The water level must be at least 3 ft. above the pump.
The dry running sensor must be under water.

Visual inspection of pipes and hoses

- Check that hoses or pipes are intact.

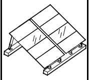
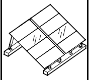
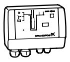
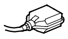
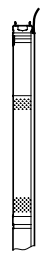
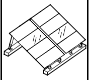
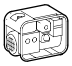
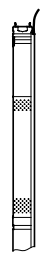
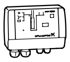
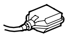
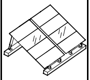
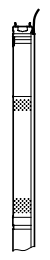
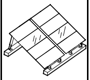
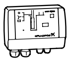
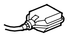
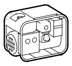
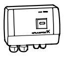


Test by means of a service CU 200

If available, a CU 200 can be used for testing systems without a CU 200. Connect the CU 200 and proceed according to the instructions in section 1.3.1 CU 200 SQFlex control unit on page 6.

Overview of possible system combinations

1. In the table below find the system corresponding to your system.
2. Follow the Trouble-shooting instructions for your system.
   In systems with solar modules Trouble-shooting must be carried out in the middle of an unclouded day.
   In systems with wind turbine Trouble-shooting must be carried out at a wind speed of minimum 3.5 m/s (8 mph).
3. Find the faulty component and repair/replace it or contact the Grundfos Service Centre stating the data from the component's nameplate.

System	System components						
	Pump	Solar panel	Wind turbine with IO 102	Generator/ supply network	Switch box	CU 200 control unit	Level switch
4.1 Solar-powered system on page 34					 IO 100		
4.2 Solar-powered system with CU 200 control unit and level switch on page 36							
4.3 Solar-powered system with generator back-up on page 38					 IO 101		
4.4 Wind-powered system on page 40							
4.5 Wind-powered system with CU 200 control unit and level switch on page 42							
4.6 Combined system on page 44							
4.7 Combined system with CU 200 control unit and level switch on page 46							
4.8 Options with generator as back-up source on page 49		*	*		 IO 101	*	*

* May be a component in the system.

4.1 Solar-powered system

Pos.	Component
1.	SQF pump
2.	Submersible drop cable
3.	Cable clips
4.	Straining wire
5.	Wire clamps
6.	Solar modules
7.	Support structure
12.	IO 100 SQFlex switch box

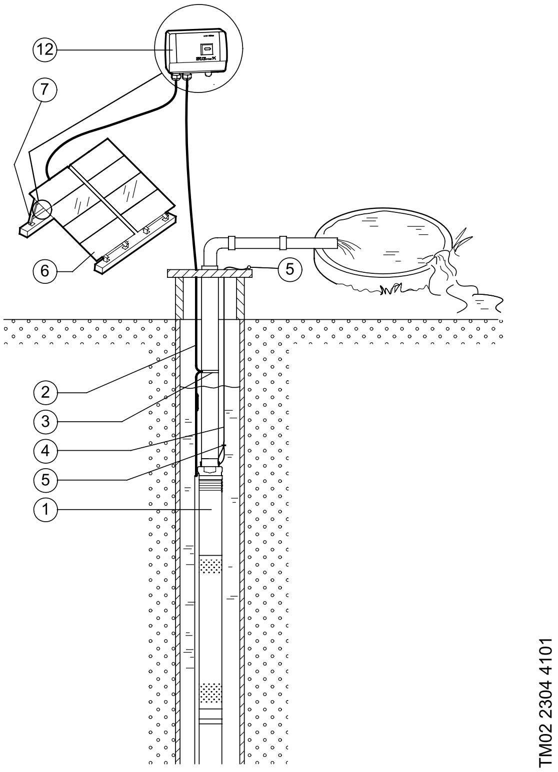


Fig. 6. Solar-powered system and its main components

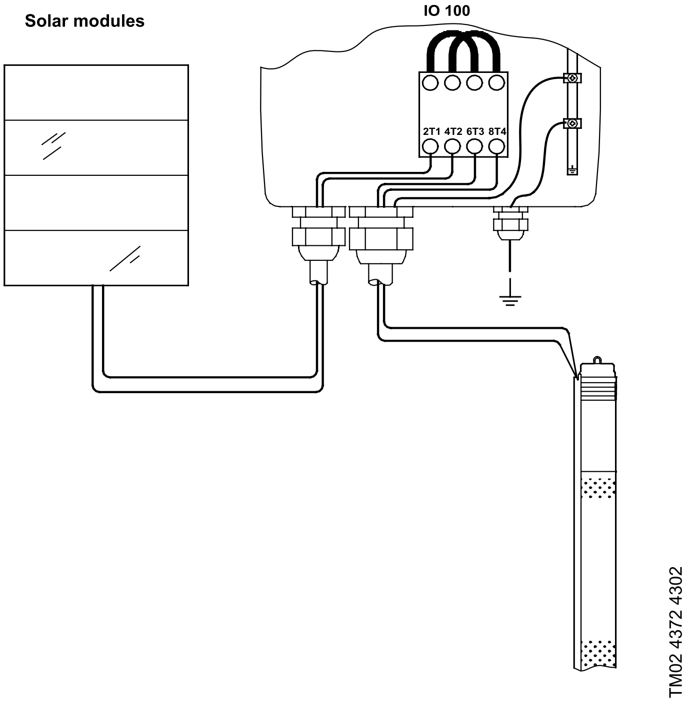


Fig. 7. Internal (and external) wiring of IO 100 SQFlex switch box.

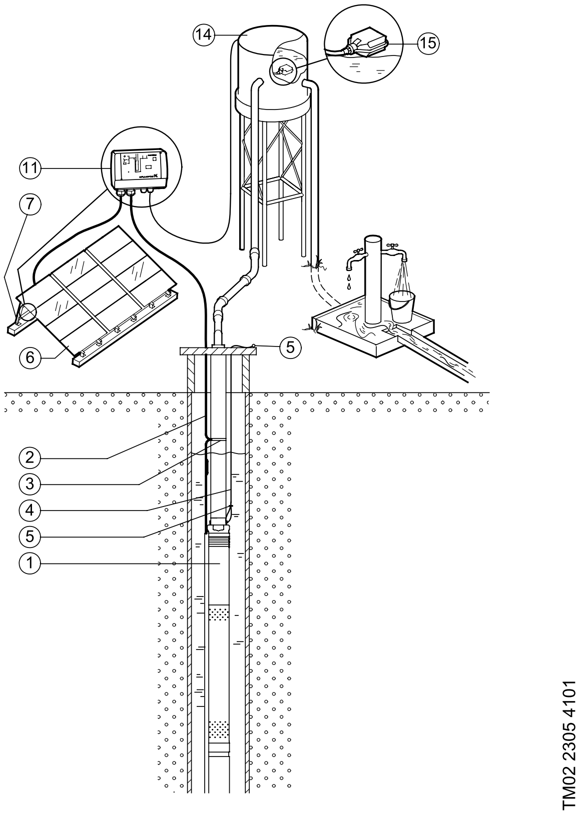
If the system does not work properly, follow the instructions in section 4.1.1 Trouble-shooting of a solar-powered system on page 35.

4.1.1 Trouble-shooting of a solar-powered system

1. **Disconnect the pump**
   - Set the IO 100 switch to off.
   - Disconnect the pump cable from the terminals (6T3, N, 8T4).
2. **Check the solar modules**
   - Measure the voltage and short-circuit current across the terminals (2T1, 4T2).
     See electrical connection:
     1.4.1 GF 43, GF 50 solar modules on page 14
     1.4.2 SX-110 solar modules on page 16
     1.4.3 FS-50-D solar modules on page 18
     1.4.4 GF 55C and GF 65C solar modules on page 20
     1.4.5 GTF 55 on page 22

   If the DC voltage or DC current is outside the range, one or more of the solar modules is faulty.
   Replace the faulty solar module/s.
3. **Check the IO 100 box**
   - Set the IO 100 switch to on.
   - Measure the DC voltage across the terminals (6T3, N, 8T4) using a voltmeter.
   - Measure the DC current across the terminals (6T3, N, 8T4) using an ammeter.
     If the values differ from the values measured under step 2, the IO 100 is defective.
     Replace the IO 100 box.
4. **Check the pump**
   - Set the IO 100 switch to Off.
   - Reconnect the pump cable to the terminals (6T3, N, 8T4).
   - Switch on the pump by setting the IO 100 switch to On.
     Note that the dry running sensor is covered with water.
     If the pump starts, it was stopped due to dry running and has now been reset.
     - Wait five minutes.
       If the pump does not start, it is defective. Repair or replace the pump.

4.2 Solar-powered system with CU 200 control unit and level switch



Pos.	Component
1.	SQF pump
2.	Submersible drop cable
3.	Cable clips
4.	Straining wire
5.	Wire clamps
6.	Solar modules
7.	Support structure
11.	CU 200 control unit
14.	Water reservoir
15.	Level switch (optional)

Fig. 8. Solar-powered system with CU 200 and level switch

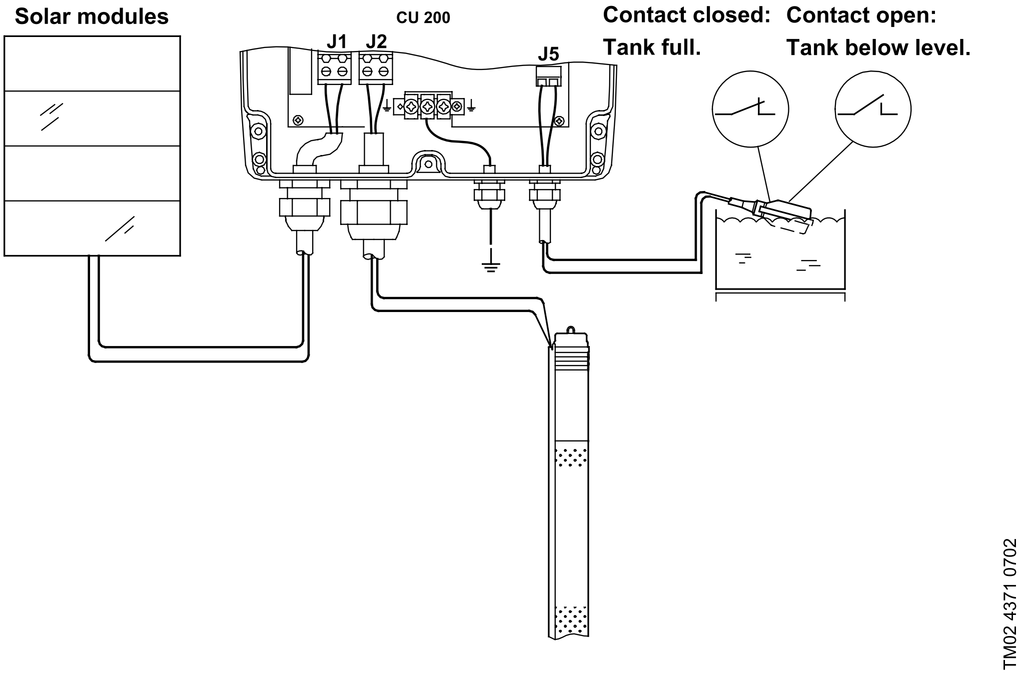


Fig. 9. Internal (and external) wiring of CU 200 SQFlex control unit

If the system does not work properly, follow the instructions in section 4.2.1 Trouble-shooting of a solar-powered system with CU 200 control unit and level switch on page 37.

4.2.1 Trouble-shooting of a solar-powered system with CU 200 control unit and level switch

All measuring points/terminal designations in the following refer to the CU 200 control unit.

1. **Check the system by means of the CU 200**
   If the CU 200 indicates fault, proceed according to section Trouble-shooting by means of CU 200 on page 8.
2. **Disconnect the pump**
   - Switch off the pump by pressing the ON/OFF button at the CU 200. The OFF light must be on.
   - Disconnect the pump cable from the terminal J2.
3. **Check the solar modules**
   - Measure the voltage and short-circuit current across the terminals (2T1, 4T2).
     See electrical connection:
     1.4.1 GF 43, GF 50 solar modules on page 14
     1.4.2 SX-110 solar modules on page 16
     1.4.3 FS-50-D solar modules on page 18
     1.4.4 GF 55C and GF 65C solar modules on page 20
     1.4.5 GTF 55 on page 22
     If the DC voltage or DC current is outside the range, one or more of the solar modules is faulty. Replace the faulty solar module/s.
4. **Check the level switch in the water reservoir**
   - Disconnect the level switch cable from the terminal J5.
   - Measure the disconnected level switch cable with an ohmmeter.
   - Turn the level switch upwards => the contact in the level switch is closed. The measured value must be approx. 0 Ω.
   - Turn the level switch downwards => the contact in the level switch is open. The measured value must be ∞ Ω.
     If one of the two values is not correct, the level switch is defective. Replace the level switch.
5. **Check the CU 200 control unit**
   - Let the level switch remain disconnected.
   - Measure the voltage and current across the terminals for the pump (J2).
     If the values measured differ from the values measured under step 3, the CU 200 is defective. Replace the CU 200.
6. **Check the pump**
   - Make sure that CU 200 is set to off by pressing ON/OFF button. The OFF light must be on.
   - Reconnect the pump cable to the terminal J2.
   - Reconnect lewel switch to J5.
     the lewel switch must point downwards to send a starting signal to the CU 200.
   - Switch on the pump by pressing the ON/OFF button. The on light must be on.
     Note that the dry running sensor is covered with water.
     If the pump starts, it was stopped due to dry running and has now been reset.
     - Wait five minutes.
       If the pump does not start, it is defective. Repair or replace the pump.

4.3 Solar-powered system with generator back-up

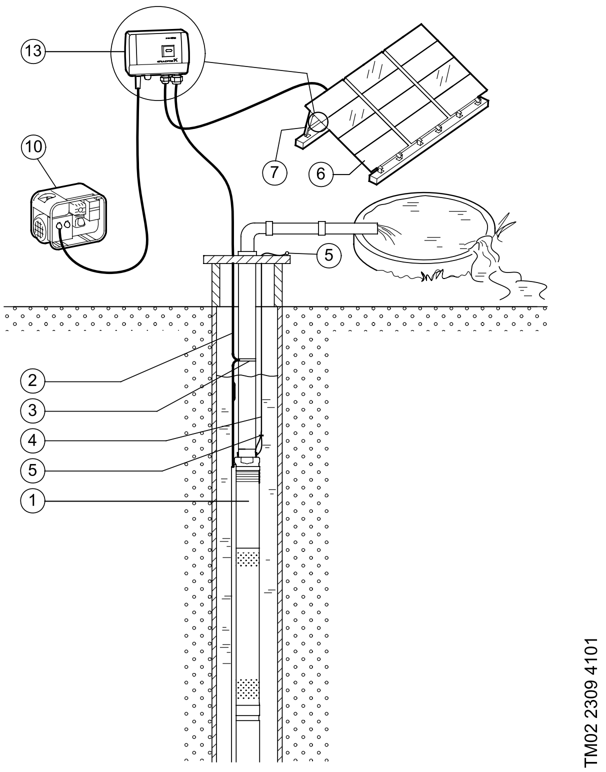


Fig. 10. Solar-powered system with IO 101 and generator

Pos.	Component
1	SQF pump
2	Submersible drop cable
3	Cable clips
4	Straining wire
5	Wire clamps
6	Solar modules
7	Support structure
10	Diesel or petrol powered generator
13	IO 101 switch box

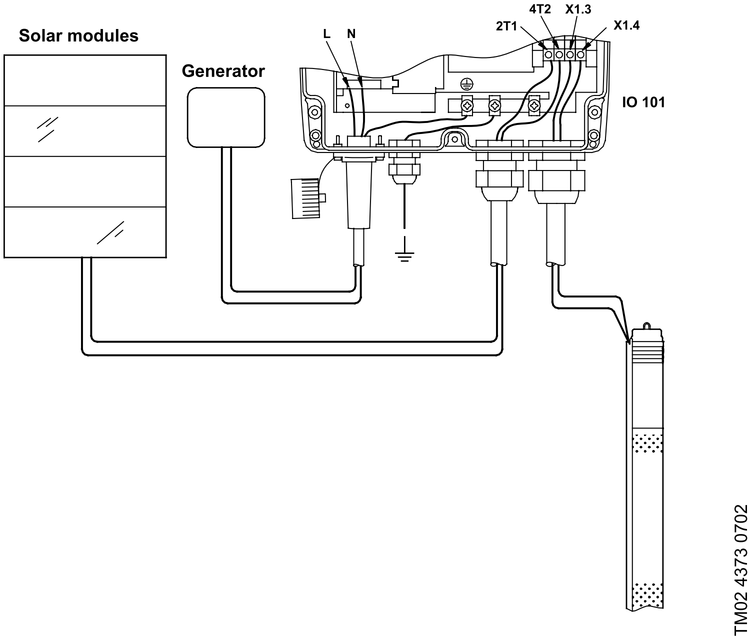


Fig. 11. Internal (and external) wiring of IO 101 SQFlex switch box

If the system does not work properly, follow the instructions in section 4.3.1 Trouble-shooting of a solar-powered system with generator back-up.

4.3.1 Trouble-shooting of a solar-powered system with generator back-up

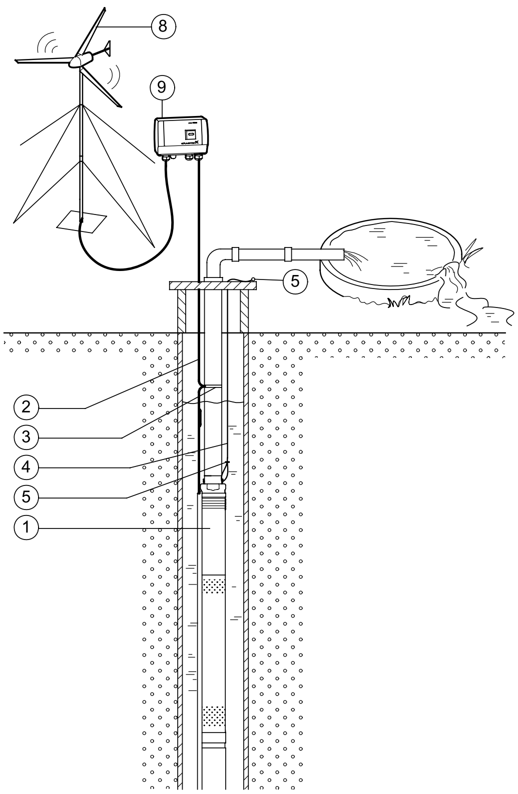
All measuring points/terminal designations in the following refer to the IO 101 switch box

1. **Disconnect the pump**
   - Make sure that the generator has been turned off.
   - Set the IO 101 switch to Off.
   - Disconnect the pump cable from the terminals (X1.3, X1.4).
2. **Check the solar modules**
   - Measure the DC voltage and short-circuit DC current across the terminals (2T1, 4T2). See electrical connection:

     1.4.1 GF 43, GF 50 solar modules on page 14
     1.4.2 SX-110 solar modules on page 16
     1.4.3 FS-50-D solar modules on page 18
     1.4.4 GF 55C and GF 65C solar modules on page 20
     1.4.5 GTF 55 on page 22

     If the DC voltage or DC current is outside the range, one of the solar modules is faulty. Replace the solar module.
3. **Check the IO 101 box**
   - Set the IO 101 switch to on.
   - Measure the DC voltage and DC current across the terminals (X1.3, X1.4). If the values differ from the values measured under step 2, the IO 101 is defective. Replace the IO 101.
4. **Check the generator**
   - Set the IO 101 switch to off.
   - Turn on the generator.
   - Measure the AC voltage across the terminals (L, N).
     The voltage (U) = rated generator voltage (see generator nameplate).
     If the value is not correct, the generator is faulty. Repair or replace the generator.
5. **Check the IO 101 box during generator operation**
   - The generator must be running. Set the IO 101 switch to on.
   - Measure the AC voltage across the terminals (X1.3, X1.4).
     The voltage (U) = rated generator voltage (see generator nameplate).
     If the value is not correct, the IO 101 is faulty. Replace the IO 101.
6. **Check the pump**
   - Set the IO 101 switch to off.
   - Reconnect the pump cable to the terminals (X1.3, X1.4).
   - Set the IO 101 switch to on.
     Note that the dry running sensor is covered with water.
     If the pump starts, it was stopped due to dry running and has now been reset.
     - Wait five minutes.
       If the pump does not start, it is defective. Repair or replace the pump.

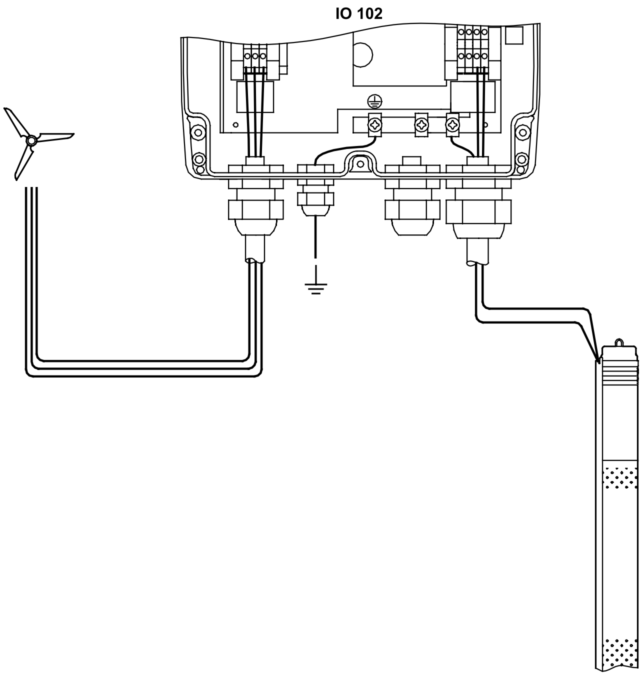
4.4 Wind-powered system



TM02 2306 4101

Pos.	**Component**
1.	SQF pump
2.	Submersible drop cable
3.	Cable clips
4.	Straining wire
5.	Wire clamps
8.	Wind turbine
9.	IO 102 breaker box

Fig. 12. The wind-powered system main components.



TM02 4374 0702

Fig. 13. Internal (and external) wiring of IO 102 SQFlex breaker box

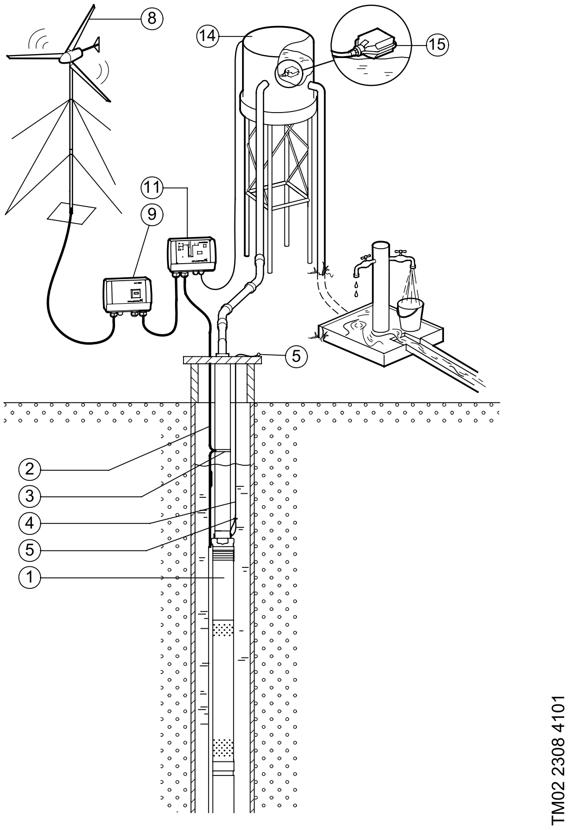
If the system does not work properly, follow the instructions in section 4.4.1 Trouble-shooting of a wind-powered system on page 41.

4.4.1 Trouble-shooting of a wind-powered system

All measuring points/terminal designations in the following refer to the IO 102 breaker box.

1. **Disconnect the pump**
   - Stop the wind turbine and turn off the pump, by turning the ON/OFF switch to off.
   - Disconnect the pump cable from the terminals in the IO 102 breaker box.
   - Release the wind turbine by turning the ON/OFF switch to on.
2. **Check the wind turbine**
   - Measure the AC voltage across the terminals for the wind turbine, i.e. one measurement between each of the three phases.
     The voltage (U) = 0-250 VAC. The voltage depends on the wind speed, see Wind turbine on page 24.
     The three values measured must be identical. If they differ, or if no voltage is measured and the propeller is turning, the wind turbine is faulty. Repair or replace the wind turbine.
3. **Check the IO 102 breaker box**
   - Measure the DC voltage across the terminals for the pump.
     The voltage (U) = 0-300 VDC. The voltage depends on the wind speed, see Wind turbine on page 24.
     If no voltage is measured and the Propeller is turning, the breaker box is faulty. Replace the breaker box.
4. **Check the pump**
   - Stop the wind turbine by turning the ON/OFF switch to off.
   - Reconnect the pump cable to the terminals.
   - Release the wind turbine and turn on the pump, by turning the ON/OFF switch to on.
     Note that the dry running sensor is covered with water.
     If the pump starts, it was stopped due to dry running and has now been reset.
     - Wait five minutes.
       If the pump does not start, it is defective. Repair or replace the pump.

4.5 Wind-powered system with CU 200 control unit and level switch



Pos.	Component
1.	SQF pump
2.	Submersible drop cable
3.	Cable clips
4.	Straining wire
5.	Wire clamps
8.	Wind turbine
9.	IO 102 breaker box
11.	CU 200 control unit
14.	Water reservoir
15.	Level switch

Fig. 14. Wind-powered system with CU 200 and level switch

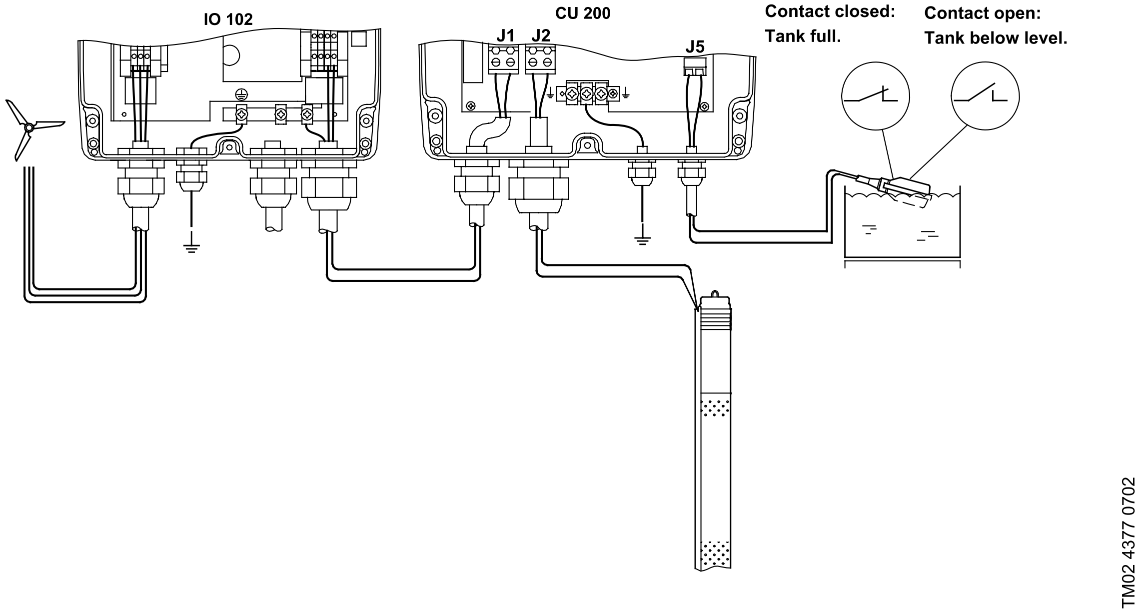


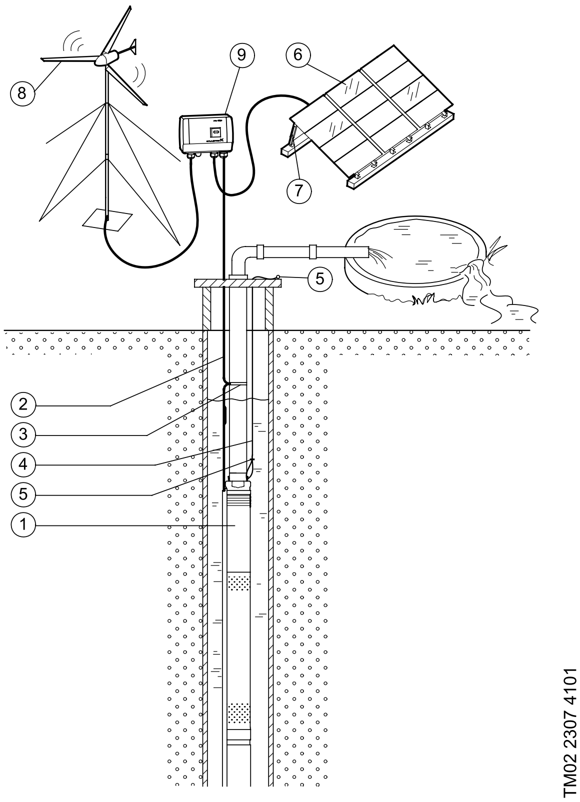
Fig. 15. Internal (and external) wiring of IO 102 breaker box and CU 200 SQFlex control unit

If the system does not work properly, follow the instructions in section 4.5.1 Trouble-shooting of a wind-powered system with CU 200 control unit and level switch on page 43.

4.5.1 Trouble-shooting of a wind-powered system with CU 200 control unit and level switch

1. **Check the system by means of the CU 200**
   If the CU 200 indicates fault, proceed according to section Trouble-shooting by means of CU 200 on page 8.
2. **Disconnect the pump**
   - Switch off the pump by pressing the ON/OFF button at the CU 200. The OFF light must be on.
   - Disconnect the pump cable from the terminal J2.
3. **Check the wind turbine**
   - Measure the AC voltage across the terminals for the wind turbine, i.e. one measurement between each of the three phases.
     U = 0-250 VAC. The voltage depends on the wind speed, see Wind turbine on page 24.
     The three values measured must be identical. If they differ, or if no AC voltage is measured and the Propeller is turning, the wind turbine is faulty. Repair or replace the wind turbine.
4. **Check the IO 102 breaker box**
   - Measure the DC voltage across the terminals for the CU 200 in the breaker box.
     U = 0-300 VDC. The voltage depends on the wind speed, see Wind turbine on page 24.
     If no DC voltage is measured and the Propeller is turning, the breaker box is faulty. Replace the breaker box.
5. **Check the level switch in the water reservoir**
   - Disconnect the level switch cable from the terminal J5 in CU 200.
   - Measure the disconnected level switch cable with an ohmmeter.
   - Turn the level switch upwards => the contact in the level switch is closed. The measured value must be approx. 0 Ω.
   - Turn the level switch downwards => the contact in the level switch is open. The measured value must be ∞ Ω.
     If one of the two values is not correct, the level switch is defective. Replace the level switch.
6. **Check the CU 200 control unit**
   - Let the level switch remain disconnected.
   - Measure the DC voltage across the terminal for the pump (J2) in CU 200.
     The value must correspond to the value measured under step 4.
     If the value differs, the CU 200 is defective. Replace the CU 200.
7. **Check the pump**
   - Make sure that CU 200 is set to off by pressing ON/OFF button. The OFF light must be on.
   - Reconnect the pump cable to the terminal J2.
   - Connect the level switch cable to the terminal J5.
     The level switch must point downwards to send a starting signal to the CU 200.
   - Switch on the pump by pressing the ON/OFF button. The on light must be on.
     Note that the dry running sensor is covered with water.
     If the pump starts, it was stopped due to dry running and has now been reset.
     - Wait five minutes.
       If the pump does not start, it is defective. Repair or replace the pump.

4.6 Combined system



Pos.	Component
1.	SQF pump
2.	Submersible drop cable
3.	Cable clips
4.	Straining wire
5.	Wire clamps
6.	Solar modules
7.	Support structure
8.	Wind turbine
9.	IO 102 breaker box

Fig. 16. Combined system main components

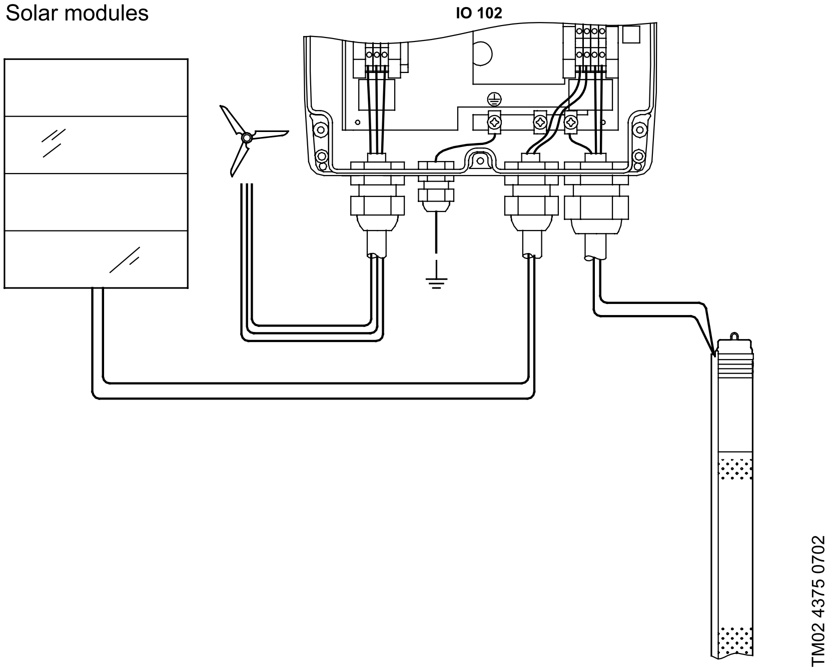


Fig. 17. Internal (and external) wiring of IO 102 SQFlex breaker box

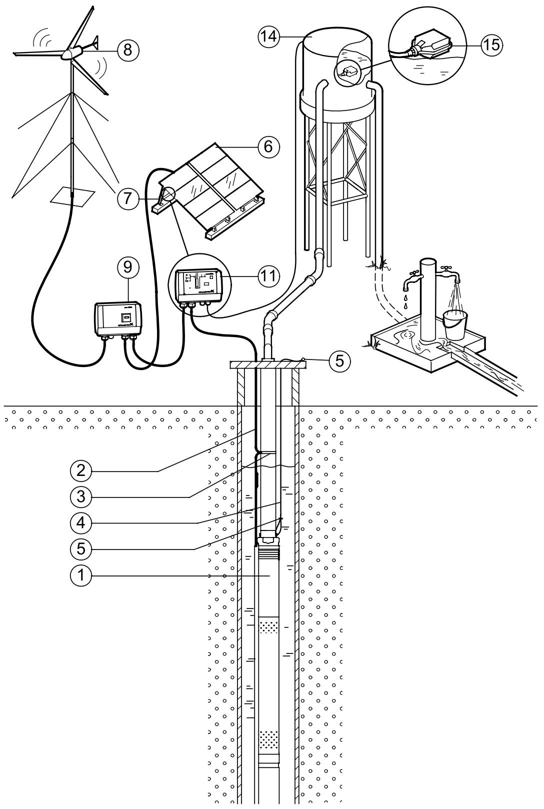
If the SQFlex system does not work properly, follow the instructions in section 4.5.1 Trouble-shooting of a wind-powered system with CU 200 control unit and level switch on page 43.

4.6.1 Trouble-shooting of a combined system

All measuring points/terminal designations in the following refer to the IO 102 breaker box.

1. **Disconnect the pump**
   - Set the IO 102 switch to off.
   - Disconnect the pump cable from the terminals.
   - Disconnect plus or minus from the solar modules.
     WARNING: Do not touch the wire due to high voltage.
     Release the wind turbine by setting the IO 102 switch to on.
2. **Check the wind turbine**
   - Measure the AC voltage across the terminals for the wind turbine, i.e. one measurement between each of the three phases.
     U = 0-250 VAC. The voltage depends on the wind speed, see Wind turbine on page 24.
     The three values measured must be identical. If they differ (more than 10 V), or if no voltage is measured and the wind turbine is turning, the wind turbine is faulty. Repair or replace the wind turbine.
3. **Check the IO 102 breaker box with wind turbine connected**
   - Measure the DC voltage across the terminals for the CU 200 in the breaker box.
     U = 0-300 VDC. The voltage depends on the wind speed, see Wind turbine on page 24.
     If no DC voltage is measured and the wind turbine is turning, the breaker box is faulty. Replace the breaker box.
4. **Check the solar modules**
   - Disconnect the three wires from the wind turbine one by one and short-circuit all three wires to each other in order to stop the turbine.
     WARNING: Do not touch the wire due to high voltage.
   - Reconnect the wire from the solar panel which was disconnected under step 1.
   - Measure the DC voltage and short-circuit DC current across the terminals (2T1, 4T2).
     See electrical connection:
     1.4.1 GF 43, GF 50 solar modules on page 14
     1.4.2 SX-110 solar modules on page 16
     1.4.3 FS-50-D solar modules on page 18
     1.4.4 GF 55C and GF 65C solar modules on page 20
     1.4.5 GTF 55 on page 22
     If the DC voltage or DC current is outside the range, one ore more of the solar modules is faulty.
     Replace the faulty solar module/s.
5. **Check the IO 102 breaker box with solar modules connected**
   - Connect the solar modules by setting the IO 102 switch to on.
   - Measure the DC voltage and short circuit DC current, across the terminals for the pump.
     The values must correspond to the values measured under step 4.
     If the values differ, the breaker box is defective. Replace the breaker box.
6. **Reset of dry-running alarm**
   - Set the IO 102 switch to off.
   - Reconnect the pump cable to the terminals.
   - Set the IO 102 switch to on.
     Note that the dry running sensor is covered with water.
     If the pump starts, it was stopped due to dry running and has now been reset.
     - Wait five minutes.
       If the pump does not start, it is defective. Repair or replace the pump.

4.7 Combined system with CU 200 control unit and level switch



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Pos.	Component
1.	SQF pump
2.	Submersible drop cable
3.	Cable clips
4.	Straining wire
5.	Wire clamps
6.	Solar modules
7.	Support structure
8.	Wind turbine
9.	IO 102 breaker box
11.	CU 200 control unit
14.	Water reservoir
15.	Level switch

Fig. 18. Combined system with CU 200 and level switch

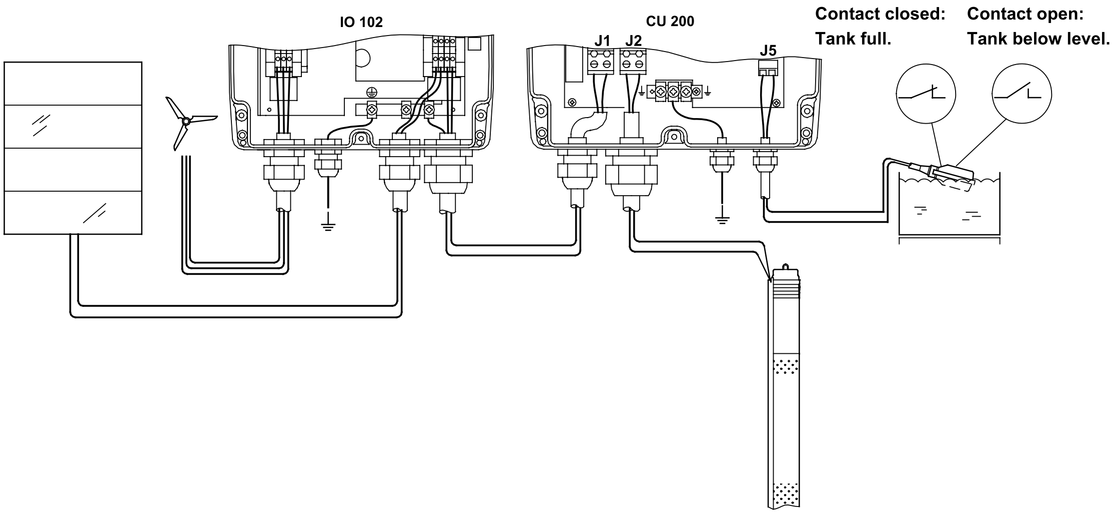

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Fig. 19. Internal (and external) wiring for IO 102 SQFlex breaker box and CU 200 SQFlex control unit

If the system does not work properly, follow the instructions in section 4.7.1 Trouble-shooting of a combined system with CU 200 control unit and level switch on page 47.

4.7.1 Trouble-shooting of a combined system with CU 200 control unit and level switch

Measuring points/terminal designations in the following refer to the IO 102 breaker box or the CU 200.

1. **Disconnect the pump**
   - Set the IO 102 switch to off.
   - Disconnect plus or minus from the solar modules.
     WARNING: Do not touch the wire due to high voltage.
   - Disconnect the pump cable from the terminal J2.
   - Release the wind turbine by setting the IO 102 switch to on.
2. **Check the wind turbine**
   - Measure the AC voltage across the terminals for the wind turbine, i.e. one measurement between each of the three phases.
     U = 0-250 VAC. The voltage depends on the wind speed, see Wind turbine on page 24.
     The three values measured must be identical. If they differ, or if no voltage is measured and the wind turbine is turning, the wind turbine is faulty. Repair or replace the wind turbine.
3. **Check the IO 102 breaker box with wind turbine connected**
   - Measure the DC voltage across the terminals for the CU 200 in the breaker box.
     U = 0-300 VDC. The voltage depends on the wind speed, see Wind turbine on page 24.
     If no voltage is measured and the wind turbine is turning, the breaker box is faulty. Replace the breaker box.
4. **Check the solar modules**
   - Disconnect the three wires from the wind turbine one by one and short-circuit all three wires to each other in order to stop the turbine.
     WARNING: Do not touch the wire due to high voltage.
   - Reconnect the wire from the solar panel which was disconnected under step 1.
   - Measure the DC voltage and short-circuit DC current across the terminals (2T1, 4T2).
     See electrical connection:
     1.4.1 GF 43, GF 50 solar modules on page 14
     1.4.2 SX-110 solar modules on page 16
     1.4.3 FS-50-D solar modules on page 18
     1.4.4 GF 55C and GF 65C solar modules on page 20
     1.4.5 GTF 55 on page 22
     If the DC voltage or DC current is outside the range, one or more of the solar modules is faulty.
     Replace the faulty solar module/s.
5. **Check the IO 102 breaker box with solar modules**
   - Connect the solar modules by setting the IO 102 switch to on.
   - Measure the DC voltage and short circuit DC current, across the terminals for the pump.
     The values must correspond to the values measured under step 4.
     If the values differ, the breaker box is defective. Replace the breaker box.
6. **Check level switch in the water reservoir**
   - Release the wind turbine by setting the IO 102 switch to on.
   - Disconnect the level switch cable from the terminal J5.
   - Measure the disconnected level switch cable with an ohmmeter.
   - Turn the level switch upwards => the contact in the level switch is closed. The measured value must be approx. 0 Ω.
   - Turn the level switch downwards => the contact in the level switch is open. The measured value must be ∞ Ω.
     If one of the two values is not correct, the level switch is defective. Replace the level switch.
7. **Check the CU 200 control unit**
   - Let the level switch remain disconnected.
   - Measure the DC voltage across the terminals for the pump (J2).
     The value must correspond to the value measured under step 3 or 5.
     Note: The sun and wind conditions may have changed since the measurements in point 3 or 5 were made
     If the value differs, the CU 200 is defective. Replace the CU 200.

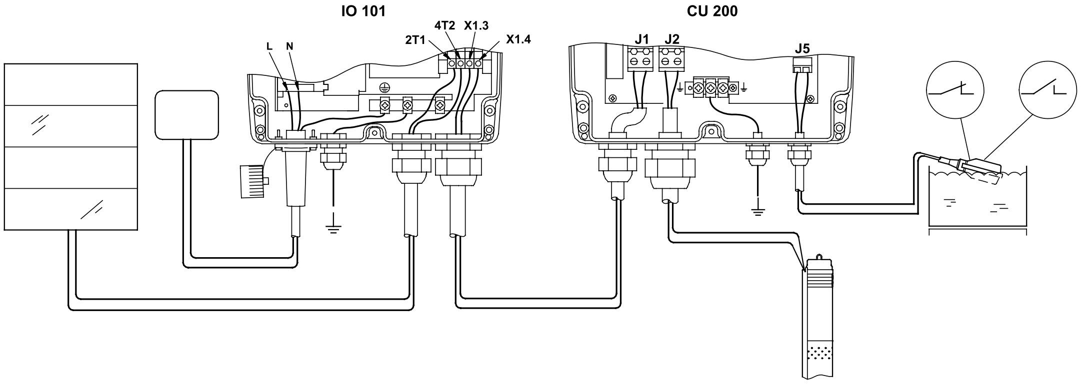
8. **Check the pump**
   - Make sure that CU 200 is set to off by pressing ON/OFF button. The OFF light must be on.
   - Reconnect the pump cable to the terminal J2.
   - Connect the level switch cable to the terminal J5.
     The level switch must point downwards to send a starting signal to the CU 200.
   - Press the ON/OFF button the on light must be on.
     Note that the dry running sensor is covered with water.
     If the pump starts, it was stopped due to dry running and has now been reset.
     - Wait five minutes.
       If the pump does not start, it is defective. Repair or replace the pump.

4.8 Options with generator as back-up source

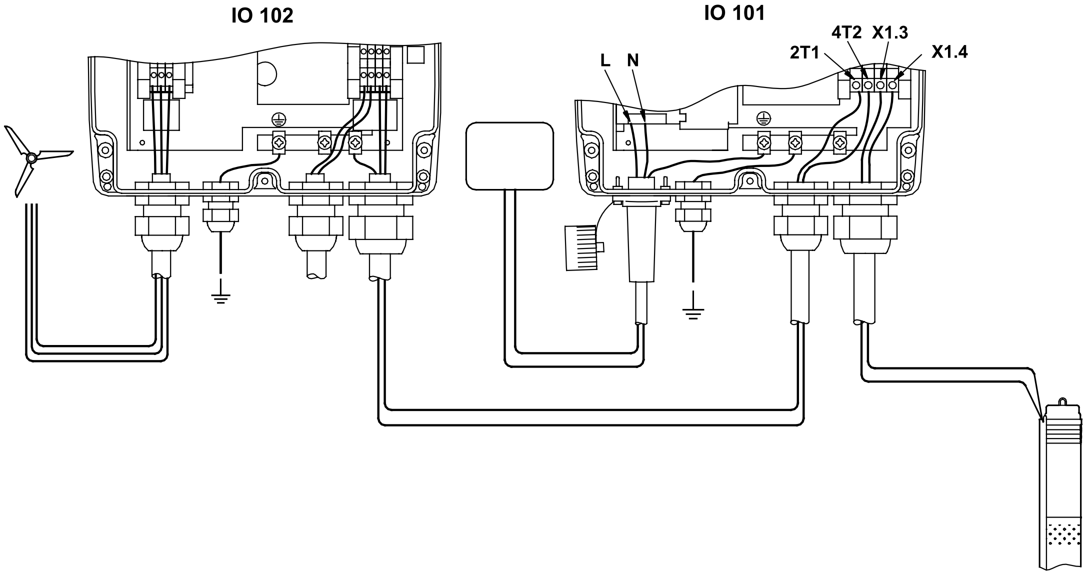
Below are wiring diagrams for options with generator as a power supply back-up source.

For Trouble-shooting of the individual components see sections 3.1 to 3.7.
For application overview see section Overview of possible system combinations on page 33.

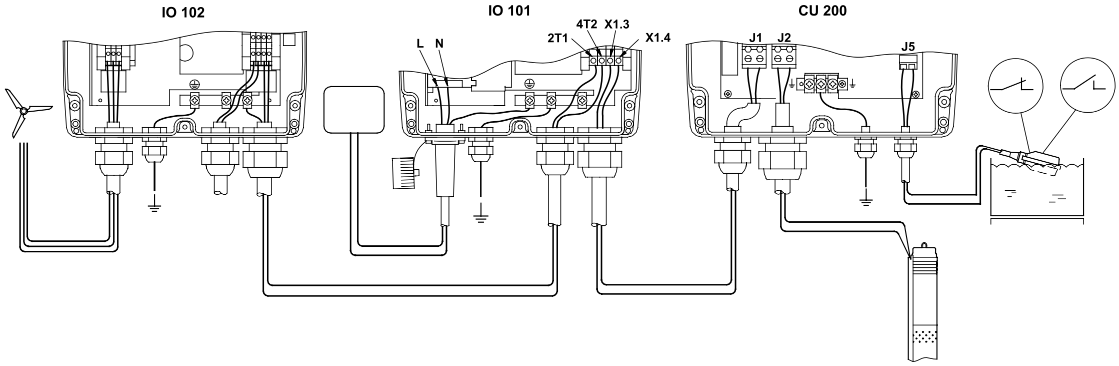
Solar-powered system with CU 200 control unit and level switch



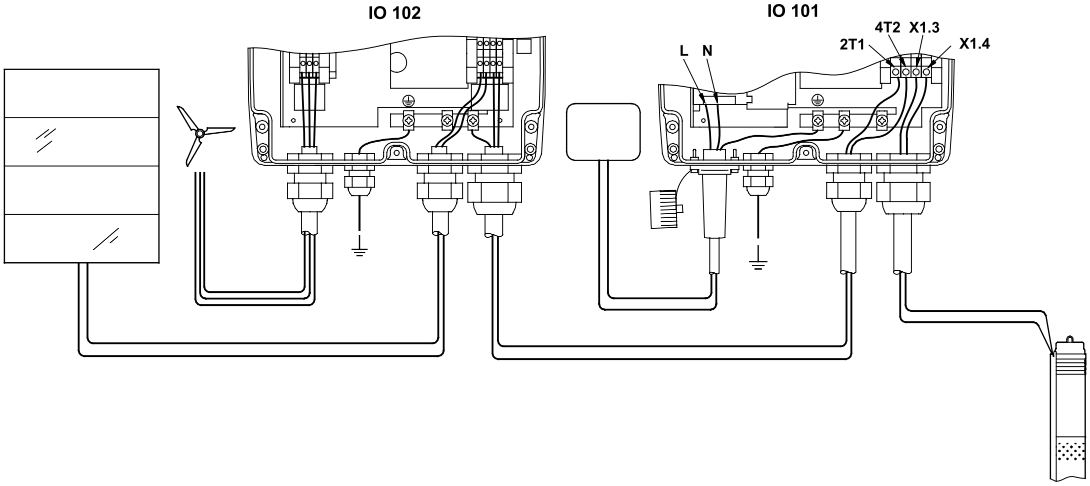
Wind-powered system



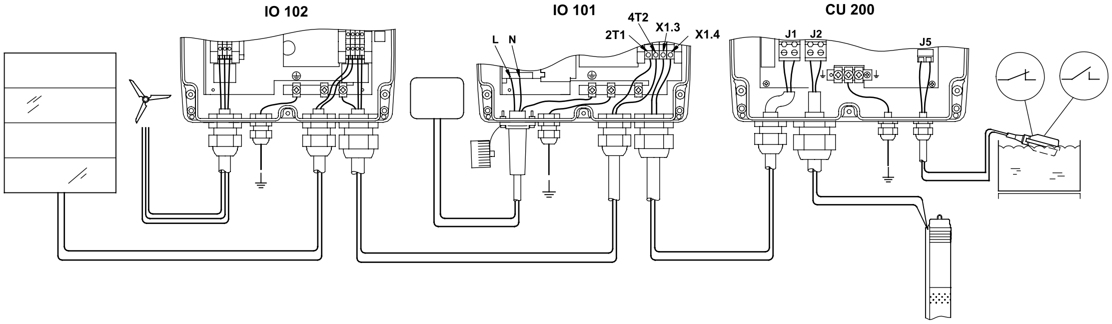
Wind-powered system with CU 200 control unit and level switch



Combined system



Combined system with CU 200 control unit and level switch



5. Service of pump and motor

5.1 General information

Helical rotor pumps cannot be separated from the motor as a unit. If the motor or the pump has to be replaced, the pump must be dismantled, see section 5.4 Helical pump type on page 55.

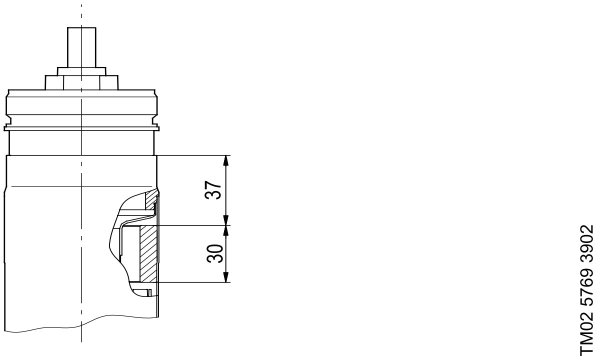


Fig. 20. When fixing the motor in a vice, tighten only on the 30 mm wide area starting 37 mm from the upper edge of the motor sleeve.

Position numbers refer to exploded views, sectional drawings and parts lists; tool letters refer to section 5.2 Service tools on page 52.

5.1.1 Before dismantling

- Disconnect the electricity supply to the motor.

5.1.2 Before assembly

- Clean all parts and check them for fractures and wear.
- Order the necessary service kits and/or parts.
- Replace defective parts by new parts.
- Moisten rubber parts with soapy water before fitting them.

5.1.3 During assembly

- Lubricate and/or tighten screws and rubber parts according to section 5.3 Torques and lubricants on page 54.
- Before connecting the pump to the motor, fill the motor with GRUNDFOS motor liquid SML 2.

Filling of motor liquid

1. Place the motor in vertical position with an inclination of approx. 10°.
2. Remove the filling plug using a screwdriver or a similar tool.
3. Inject motor liquid SML 2, into the motor with a filling syringe or the like.
4. To allow possible air to escape, move the motor from side to side.
5. Refit the filling plug and make sure that it is tight.

Fit the pump to the motor, see section 5.5.2 Fitting pump to motor on page 56 (centrifugal pump) or section 5.4.2 Assembly on page 55 (helical pumps)

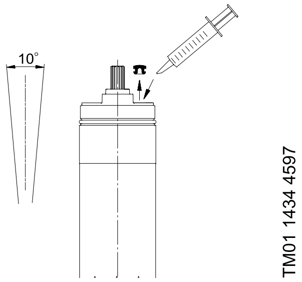


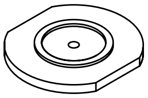
Fig. 21. Filling of motor

5.1.4 After assembly

- Test the head and flow according to the test specifications, see section 5.9 Testing the pump by means of CU 200 SQFlex control unit on page 60.

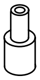
5.2 Service tools

A



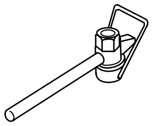
B

C

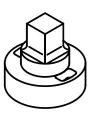


D

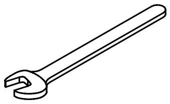
E



F



G



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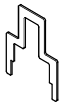
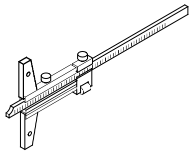


I



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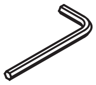
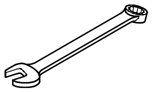
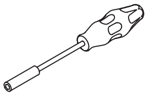


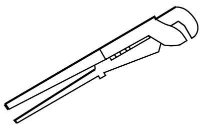
K



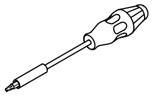
L



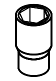
M



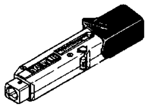
N



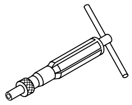
O



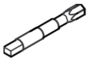
P



Q



R



S

T

Special tools

	Designation	To be used for	Supplementary information	Helical pump	25 SQF	40 SQF	75 SQF
A	Mounting plate				SV0049		
B	Spline pin with screw				SV0226		
C	Spacing pipe		∅13 / ∅8.5 x 39.5		SV0006[a]		
			∅13 / ∅8.5 x 39.0			SV0008	SV0008
D	Hexagon socket head screw with washer	K	M8 x 65		SV0074		
E	Key for split cone nut	11-12	22 mm		SV0182	SV0187	
			27 mm				SV0217
F	Key for discharge chamber	1a		SV0064			
G	Open-end spanner	1a	62 mm	SV2080			
H	Measuring template	24			96079961		
I	Depth gauge	14-16			Standard		

[a] Only for 25 SQF N

Standard tools

Pos.	Designation	To be used for	Supplementary information	Helical pump	25 SQF	40 SQF	75 SQF
J	Hexagon key	E	6 mm		SV1204		
K	Ring/open-end spanner	16-24	10 mm (two pcs. needed for pos.16)	SV0083			
		19-19a	13 mm		SV0055		
L	Nut driver with socket	250	7 mm	SV0065			
M	Pipe wrench	13	1"	standard			
		14a	4"		standard		
N	Screwdriver (torx)	18a	T10	SV0066			
O	Socket for hexagon head screws	250-S	7 mm 1/4"	SV0457			

Torque tools

Pos.	Designation	To be used for	Supplementary information	Helical pump	25 SQF	40 SQF	75 SQF
P	Torque wrench	S-U	4-20 Nm 9x12		SV0292		
		G	40-200 Nm14x18	SV0400			
Q	Torque screwdriver	S	1-6 Nm 1/4"	SV0438			
R	Adapter for torque screwdriver	O-P	1/4"	SV0437			
S	Ring insert tool	Q-19-19a	13 mm 9x12		SV0294		
T	Open-end spanner	F-Q-11-12	22 mm 9x12			SV0622	
		Q-16	10 mm 9x12	SV0610			

5.3 Torques and lubricants

This section shows the screws and nuts that must be tightened to a certain torque and the lubricants to be used.

Pos.	Description	Pump type	Torque [Nm]	Lubricant
	Pump / motor	Helical	55	
1a	Discharge chamber*	Helical	100	Rocol
13/16	Pump rotor / torsion shaft	Helical	18	
14a	Connecting piece	Centrifugal		
16	Torsion shaft / motor shaft	Helical	18	
19	Screw	Centrifugal, splined shaft	18	Gardolube
	Nut	Centrifugal, cylindrical shaft		
19a	Nut	Centrifugal	18	Gardolube
19b	Nut	Centrifugal, splined shaft	11	Gardolube
24	Shaft end (nut)	Centrifugal	18	
	End cover with cable	All		Rocol
	Nut	All	1,5	

Rocol Sapphire Aqua-Sil, part no. RM2924 (0.5 l).

Gardolube L 6034, part no. SV9995 (1 l).

It is not necessary to lubricate screws and nuts treated with "Delta Seal", as this coat is anti-corrosive and lubricating.

* The thread of the discharge chamber **must** be lubricated.

5.4 Helical pump type

Helical pumps cannot be separated from the motor as a unit. If the motor or the pump must be replaced, the pump must be dismantled.

5.4.1 Dismantling

1. Fix the motor in a vice.
   Note: Tighten only on the area shown in fig. 20.
2. Unscrew the screws pos. 18a and 18b and remove them together with the cable guard pos. 18.
3. If the motor is intact, the cable need not to be removed. If the motor is defective, remove the nuts for end cover with socket at the bottom of the motor and pull the end cover with cable and socket out of the motor.
4. Remove the discharge chamber pos. 1a with valve casing complete using the key for discharge chamber G. Hold the pump by means of the pipe wrench N on the weld just above the upper strainer.
5. Loosen the outer sleeve pos. 55 with pump stator pos. 9 from the motor using the pipe wrench N on the weld just above the upper strainer. Hold the motor with the open-end spanner H.
6. Pull the outer sleeve pos. 55 with pump stator pos. 9 free of the pump rotor pos. 13 and torsion shaft pos. 16 with a bump.
7. Remove the pump stator pos. 9 and flange pos. 6 by knocking the discharge end of the outer sleeve hard against a solid wooden surface such as a workbench or table.
8. Remove the torsion shaft pos. 16 from the motor shaft using two ring/open-end spanners L.
9. Remove the pump rotor pos. 13 from the torsion shaft pos. 16 using the pipe wrench N. Hold the torsion shaft with the ring/open-end spanner L.
10. If the parts of the valve casing complete are defective, replace these parts. Prise the retaining ring pos. 7a out of the recess of the discharge chamber pos. 1a and press the parts down and out of the discharge chamber.

5.4.2 Assembly

1. Fill the motor with liquid, see Filling of motor liquid on page 51
2. Fit the pump rotor pos. 13 to the torsion shaft pos. 16 and tighten to correct torque, see 5.3. Hold the pump rotor using the pipe wrench N on the cylindrical part below the pump rotor.
3. Fit the torsion shaft to the motor shaft and tighten to the correct torque, see 5.3.
4. Fit the pump stator pos. 9 with the conical stator inlet against the strainer into the outer sleeve pos. 55 .
5. Fit the flange pos. 6 into the outer sleeve and press it on the upper part of the stator, fixing the stator in the centre of the outer sleeve.

   11SQF-2: Turn the flange pos. 6 with the even surface against the stator pos. 9.
6. Assemble the valve and discharge chamber if it has been dismantled.
   - Place the valve casing complete on a plane surface with the bearing pos. 6 downwards.
   - Lubricate the O-ring pos. 1d with grease and fit it in the outside recess of the valve casing.
   - Press the discharge chamber pos. 1a over the valve casing. Turn the discharge chamber and fit the retaining ring pos. 7a in the recess of the discharge chamber.
   - Grease the thread of the discharge chamber with valve casing complete and screw it into the top of the sleeve.
7. Fit the discharge chamber pos. 1a with valve casing complete and tighten to the correct torque by means of the key for discharge chamber G. Hold the pump using the pipe wrench N or fix it in a vice. The jaws must be placed on the weld just above the upper strainer.
8. Moisten the pump rotor pos. 13 with clean water and fit the pump on the motor. Tighten to the correct torque, see 5.3 by means of the key for discharge chamber G.
9. Push the end cover with socket and cable into the motor if it has been removed. Fit and tighten the nuts using the socket for hexagon head screws P, the adapter for torque screwdriver S and the torque screwdriver R.
10. Fit the cable guard pos. 18. Press the two upper flaps under the outer sleeve and fit the screws pos. 18a and 18b. If the accessible holes in the outer sleeve at the lower strainer are not threaded, they must be tapped using the tapping screw included in the cable guard service kit and the assembly kit or by means of an M3 set screw.
11. Test the pump performance using a CU 200 control unit, if available. See section 5.9 Testing the pump by means of CU 200 SQFlex control unit on page 60
12. Install the pump. See section 2. Start-up on page 28.

5.5 Centrifugal pump and motor

5.5.1 Detaching pump from motor

1. Fix the motor in a vice.
   Note: Tighten only on the area shown in fig. 20.
2. Unscrew the screws pos. 18a and remove them together with the cable guard pos. 18c.
3. Unscrew the screws pos. 18b and remove them (if any) together with the cable guard pos. 18.
4. If the motor is intact, the cable need not be removed. If the motor is defective, remove the nuts for the end cover with socket and pull the end cover with cable and socket out of the motor.
5. Remove the nuts pos. 19a and lift the pump off the motor
6. Remove the spline protector pos. 24b and supporting ring pos. 24a from the pump shaft.
7. Remove the shaft end pos. 24 from the motor shaft.
8. Remove the connecting piece pos. 14a from the motor by means of the pipe wrench N. Hold the motor using the open-end spanner H.

5.5.2 Fitting pump to motor

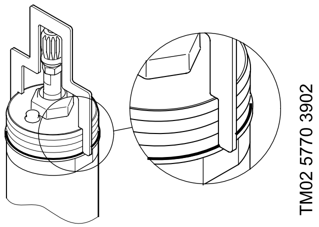


Fig. 22.

1. Fill the motor with liquid, see Filling of motor liquid on page 51.
2. Screw the shaft end pos. 24 on to the motor shaft and push it home. Adjust the height to 88.15 mm ±0.2 mm by means of the measuring template I, see fig. 22.
3. Tighten the nut to the correct torque, see 5.3. Check that the height is still 88.15 mm ±0.2 mm.
4. Fit the supporting ring pos. 24a and the spline protector pos. 24b.
5. Fit the connecting piece pos. 14a and tighten using the pipe wrench N.
6. Fit the pump to the motor. The cable recesses in the suction interconnector pos. 14 and the connecting piece pos. 14a must be next to each other. Fit the four nuts pos. 19a and tighten diagonally to the correct torque, see 5.3.
7. Push the end cover with cable into the motor if it has been removed. Fit and tighten the nuts, see 5.3 using the socket for hexagon head screws P, the adapter for torque screwdriver S and the torque screwdriver R.
8. Fit the cable guard pos. 18c and secure it with screws pos. 18a.
9. Fit the cable guard pos. 18 and secure with screws pos. 18b (25 SQF).
10. Test the pump performance using a CU 200 control unit, if available. See section 5.9 Testing the pump by means of CU 200 SQFlex control unit on page 60.
11. Install the pump, see section 2. Start-up on page 28.

5.6 Centrifugal pump type with splined shaft

5.6.1 Dismantling

1. Fit the and tighten the spline pin with screw B on the mounting plate A.
   Note: Make sure that the mounting plate is positioned correctly so that the recess of the mounting plate and the suction interconnector pos. 14 fit into each other.
2. Place the pump on the mounting plate A.
3. Unscrew and remove the screws pos. 19 together with the washers pos. 71. Remove the strap pos. 17.
4. Dismantle the pump in the following order until the last chamber has been removed:
   - discharge piece pos. 1b
   - valve casing complete pos. 1
   - nut pos. 19b
   - washer pos. 76
   - impeller pos. 13
   - chamber pos. 9.
5. Pull the pump shaft pos. 16 with priming disc pos. 64 up and out of the suction interconnector pos. 14 and the bottom chamber pos. 10.
6. Lift the suction interconnector pos. 14 and the bottom chamber pos. 10 free of the mounting plate A.
7. Replace worn wear parts, if any, see section 5.8 Checking and replacing wear parts of centrifugal pumps on page 59

5.6.2 Assembly

1. Fit the suction interconnector pos. 14 to the mounting plate A.
2. Press the bottom chamber pos. 10 into the suction interconnector pos. 14.
3. Slide the priming disc pos. 64 over the pump shaft pos. 16 and push until it touches the coupling.
   Note: The dogs of the priming disc must point upwards.
4. Fit the pump shaft to the spline pin with screw B.
5. Fit the first impeller pos. 13 and press it until it engages with the neck ring pos. 7 in the bottom chamber pos. 10.
6. Fit the chamber pos. 9 and the impeller pos. 13 until the last impeller has been fitted.
7. Fit the washer pos. 76 (with the three grooves upwards) and the nut pos. 19b.
8. Make sure that the top impeller engages with the splined shaft and tighten the nut pos. 19b to the correct torque, see 5.3.
   Note: Check that the impellers can be raised and lowered, as it is important that the nut is tightened against the impellers.
9. Fit the valve casing complete pos. 1 and the discharge piece pos. 1b.
   Note: Turn the discharge piece so that the slots for the cable guard are located above the screw holes for the screws pos. 18b in the suction interconnector pos. 14.
10. Lubricate the threads of the screws pos. 19, and fit the straps pos. 17, washers pos. 71 and screws pos. 19. Tighten diagonally to the correct torque, see 5.3.
11. Remove the pump from the mounting plate A and fit the pump to the motor, see section 5.5.2 Fitting pump to motor on page 56.

5.7 Centrifugal pump type with cylindrical shaft

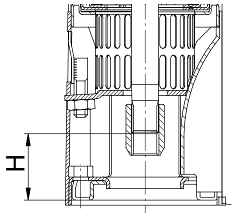
5.7.1 Dismantling

1. Fit the mounting plate A to the suction interconnector pos. 14 by means of the spacing pipe D and the hexagon socket head screw with washer E.
   Note: Make sure that the mounting plate is positioned correctly so that the recess of the mounting plate and the projection of the suction interconnector pos. 14 fit into each other.
   Fix the mounting plate in a vice.
2. Slacken and remove the nuts pos. 19. Remove the strap pos. 17.
3. Remove the valve housing complete pos. 1 and the top chamber pos. 4 (25 SQF N chamber pos. 9.)
   Remove the stop ring pos. 85 of 25 SQF N.
4. Loosen the split cone nut pos. 11 using the key for split cone nut F. Knock the split cone pos. 12 down through and out of the impeller pos. 13 using the key for split cone nut F.
5. Remove the impeller pos. 13, split cone pos. 12, split cone nut pos. 11 and chamber pos. 9.
6. Repeat steps 4. and 5. until all impellers and chambers have been removed.
   Remove the stop ring pos. 85 of 75 SQF.
7. Loosen the guide pos. 25 from the recess of the suction interconnector pos. 14 (only 75 SQF). Lift the suction interconnector off the mounting plate A.
8. Remove the hexagon socket head screw with washer E, spacing pipe D and pump shaft pos. 16.
9. Check and replace wear parts, see section 5.8 Checking and replacing wear parts of centrifugal pumps on page 59.

5.7.2 Assembly

1. Fit the shaft pos. 16 to the mounting plate A by means of the spacing pipe D and hexagon socket head screw with washer E.
   Note: Make sure that the mounting plate is positioned correctly so that the recess of the mounting plate and the projection of the suction interconnector pos. 14 fit into each other.
   Fix the mounting plate in a vice.
2. Slide the suction interconnector pos. 14 over the shaft so that the projection of the suction interconnector engages with the recess of the mounting plate. Press the bottom chamber pos. 10 / guide pos. 25 home in the suction interconnector.
3. Fit the split cone pos. 12, impeller pos. 13 (the impeller collar must point downwards) and split cone nut pos. 11. Give the split cone nut a few turns. Press the impeller home against the chamber pos. 10 / guide pos. 25 using the key for split cone nut F and tighten to the correct torque, see 5.3.
4. Fit the chamber pos. 9.
5. Repeat steps 3. and 4. until all impellers and chambers have been fitted.
   Note: For each section, make sure that the chamber and the impeller are fitted correctly before the split cone nut is tightened.
   Note: Fit the stop ring pos. 85 after the middle impeller of 25 SQF and 75 SQF. In 75 SQF the small recess of the stop ring must be downwards.
   Note: The top chamber of 40 SQF and 75 SQF is pos. 4.
6. Fit the valve housing pos. 1 so that the holes for the straining wire are opposite the motor cable (cable opening in the suction interconnector) and that the slots for the straps are aligned to the points where the straps are attached to the suction interconnector.
7. Fit the strap pos. 17 and nuts pos. 19. Tighten diagonally to the correct torque, see 5.3.
8. Remove the pump from the mounting plate A and fit it on the motor, see section 5.5.2 Fitting pump to motor on page 56.
9. Check the axial clearance of the pump shaft by measuring the distance between the contact surface of the suction interconnector and the shaft end using a slide gauge or depth gauge. Measure with the shaft in its top and bottom position, see below.

	25 SQF	75 SQF	40 SQF
Bottom position H_{max}	37.5	37.15	37.15
Top position H_{min}	38.4	39.15	40.15

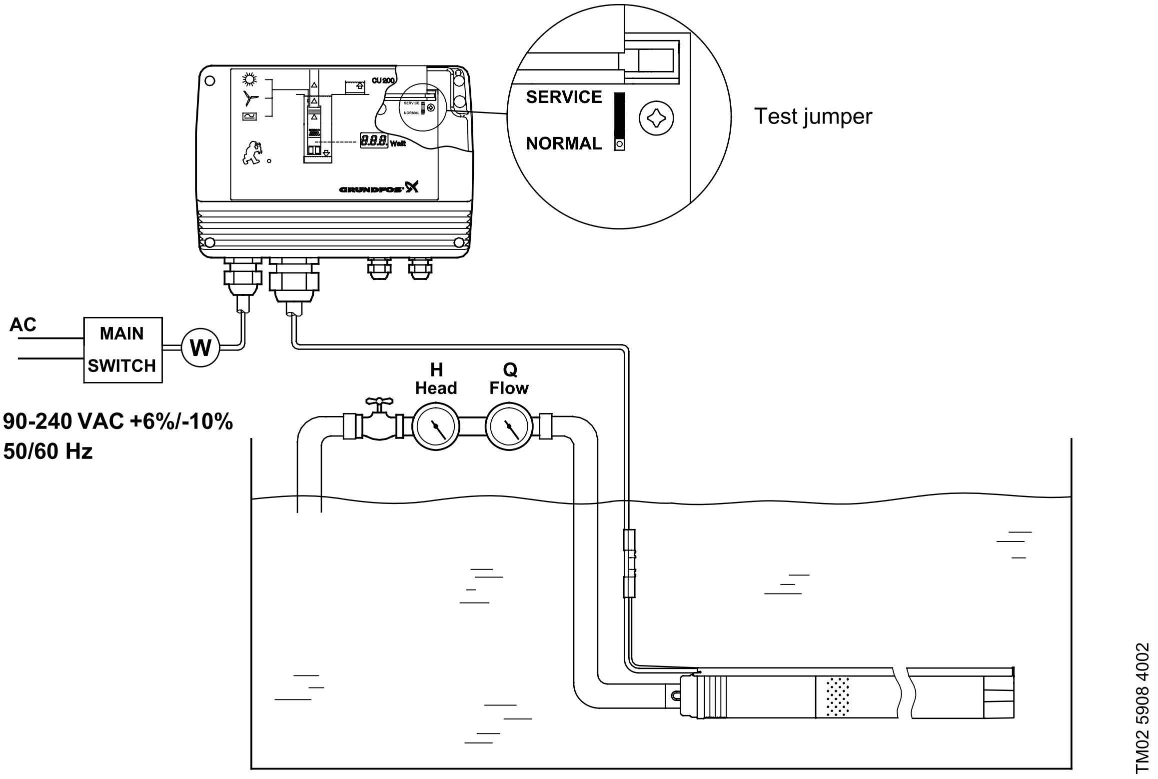


5.8 Checking and replacing wear parts of centrifugal pumps

<table>
<tr><th colspan="2">Bearing pos. 8</th></tr>
<tr><th>Check</th><th>Replace</th></tr>
<tr><td>• Check whether the bearings are defective due to sand or dry running.</td><td>• Remove the bearing pos. 8 by pressing it out of the chamber pos. 9.
• Press a new bearing into the chamber from the bottom side with the largest bearing diameter against the bottom side of the chamber.</td></tr>
<tr><th colspan="2">Top bearing pos. 6</th></tr>
<tr><th>Check</th><th>Replace</th></tr>
<tr><td>• Check whether the bearing is defective.</td><td>• Press the bearing pos. 6 out of the valve housing (cylindrical shaft).
25 SQF (splined shaft): Press the bearing out using a screwdriver, if necessary.
• Press the new bearing into the valve housing from the bottom side.</td></tr>
<tr><th colspan="2">Valve seat pos. 3 (only in 25 SQF)</th></tr>
<tr><th>Check</th><th>Replace</th></tr>
<tr><td>• Check whether the rubber is hard or compressed so that the valve cup pos. 2 touches the metal.</td><td>• Free the valve guide pos. 70 where it is positioned under the recess of the valve casing. Pull the guide and the valve cup pos. 2 out of the valve housing.
• Push the valve seat pos. 3 out of the valve housing by inserting a screwdriver between the valve seat and the valve housing.
• Press the valve seat home in the valve housing with the flat side downwards.</td></tr>
<tr><th colspan="2">Neck ring pos. 7</th></tr>
<tr><th>Check</th><th>Replace</th></tr>
<tr><td>• Check whether the rubber is hard or worn as this may reduce the head or flow rate.</td><td>• Prize the neck ring pos. 7 free of the chamber pos. 9/10 or guide pos. 25 by inserting a screwdriver between the neck ring and the chamber/guide.
• Press the neck ring home in the chamber pos. 9/10 or guide pos. 25. The following side of the neck ring must be up:
• 25 SQF smooth surface
• 40 SQF "This side up"
• 75 SQF lip</td></tr>
</table>

5.9 Testing the pump by means of CU 200 SQFlex control unit

The pump must deliver a flow rate (m³/h) at a given power consumption and head. The “Test value curves ‘ on page 61 apply to the head stated for each pump. The curve values are minimum values.

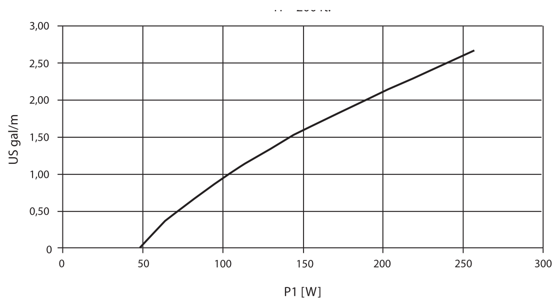


1. Open the discharge valve completely to reduce the counter-pressure to a minimum.
2. Disconnect the power supply to the pump.
3. Remove the front cover of the CU 200, and set the test jumper to service position, see illustration. Refit the front cover.
4. Connect the power supply.
5. Make sure that the system is off. The red indicator light of the ON/OFF button must be on. If the system is not off, press the ON/OFF button once.
6. Press the ON/OFF button for at least four seconds. Release the button. The CU 200 is now in test mode. (The bottom flow indicator is permanently on, and the pump is running slowly.)
7. Press the ON/OFF button twice (the upper flow indicator is permanently on). The pump now adjusts its speed.
8. Adjust the counter-pressure to the value stated for each pump in the curves in section 5.9.1 Test value curves on page 61.
9. Read the flow rate Q [m³/h] using a flowmeter or a similar device and the power consumption P1 [W] using a wattmeter.
10. In the relevant curve chart, find the intersection point of the values read for flow (Q) and power consumption P1 [W].
    - If the intersection is above the minimum curve, the flow rate is sufficient.
    - If the intersection is below the minimum curve, the flow rate is insufficient, and the pump should be checked and defective parts replaced.
11. Press the ON/OFF button once. The CU 200 is no longer in test mode.
12. Disconnect the power supply, and disconnect the pump and the CU 200.
13. Move the test jumper from service to normal position.

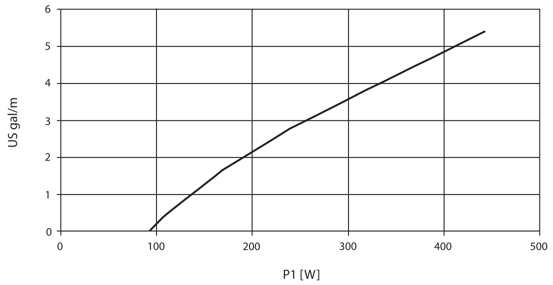
5.9.1 Test value curves

The curve shown in the curve charts below is the minimum performance curve for the pump.

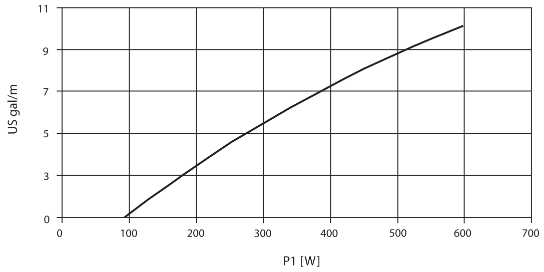
Service test, 3 SQF-2
H = 200 ft.



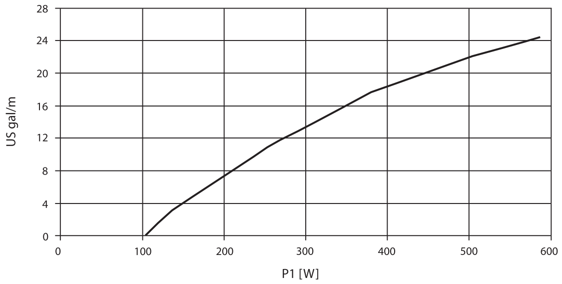
Service test, 6 SQF-2
H = 200 ft.



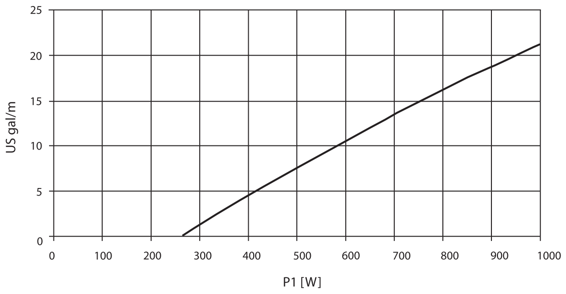
Service test, 11 SQF-2
H = 130 ft.



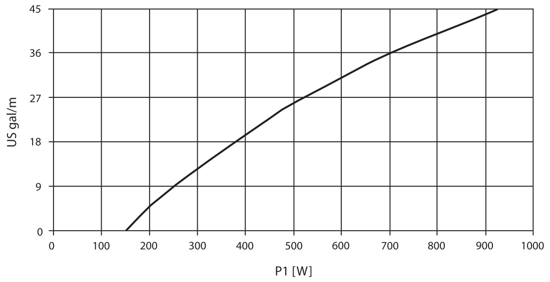
Service test, 25 SQF-3
H = 30 ft.



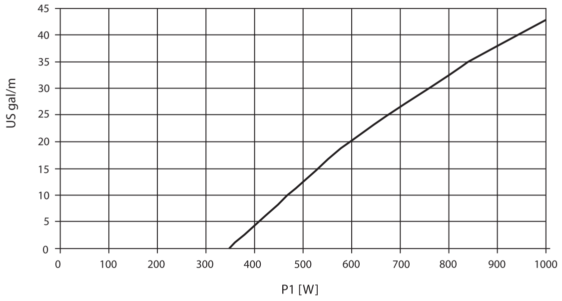
Service test, 25 SQF-6
H = 100 ft.



Service test, 40 SQF-3
H = 30 ft.

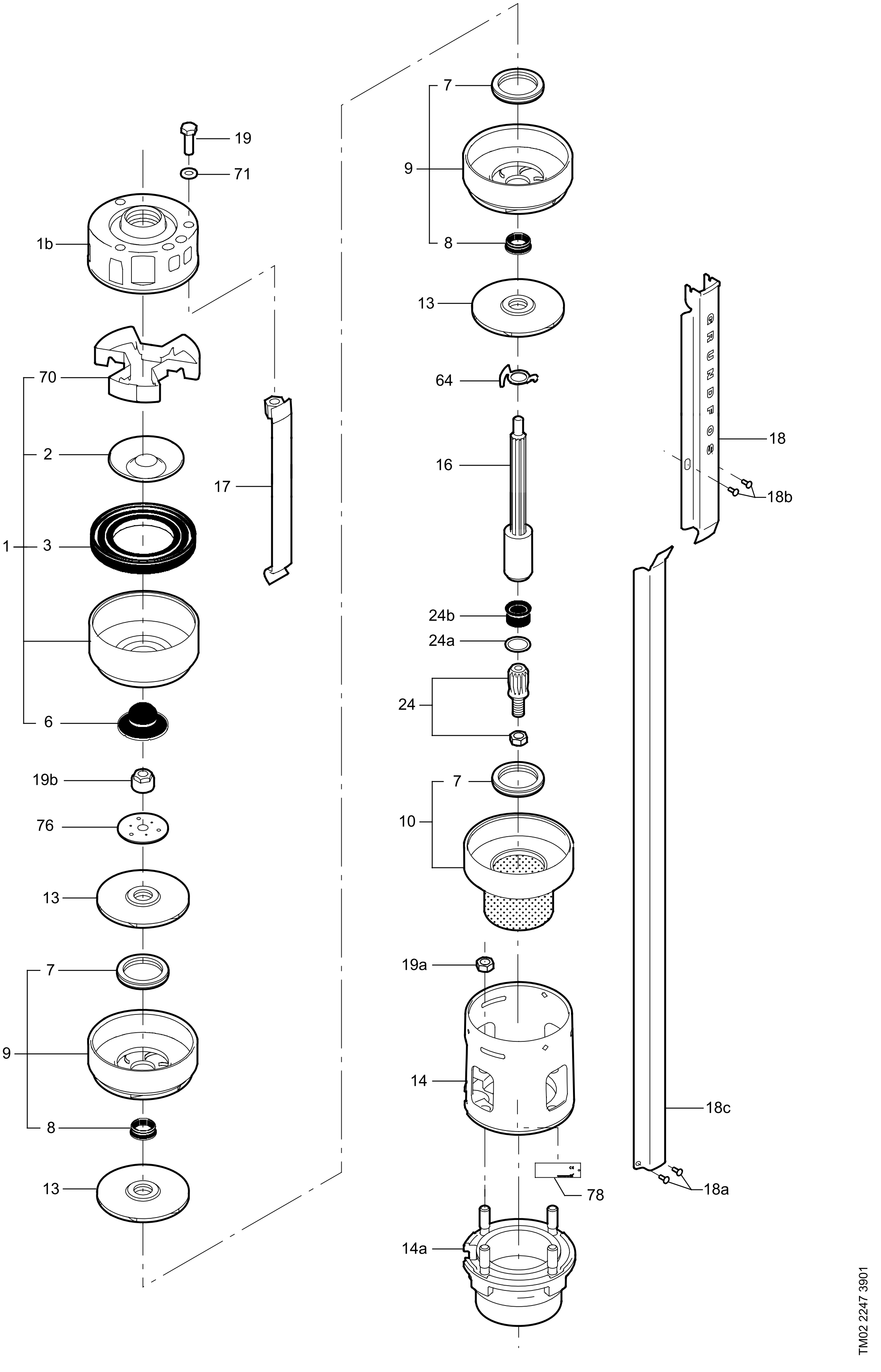


Service test, 75 SQF-3
H = 50 ft.



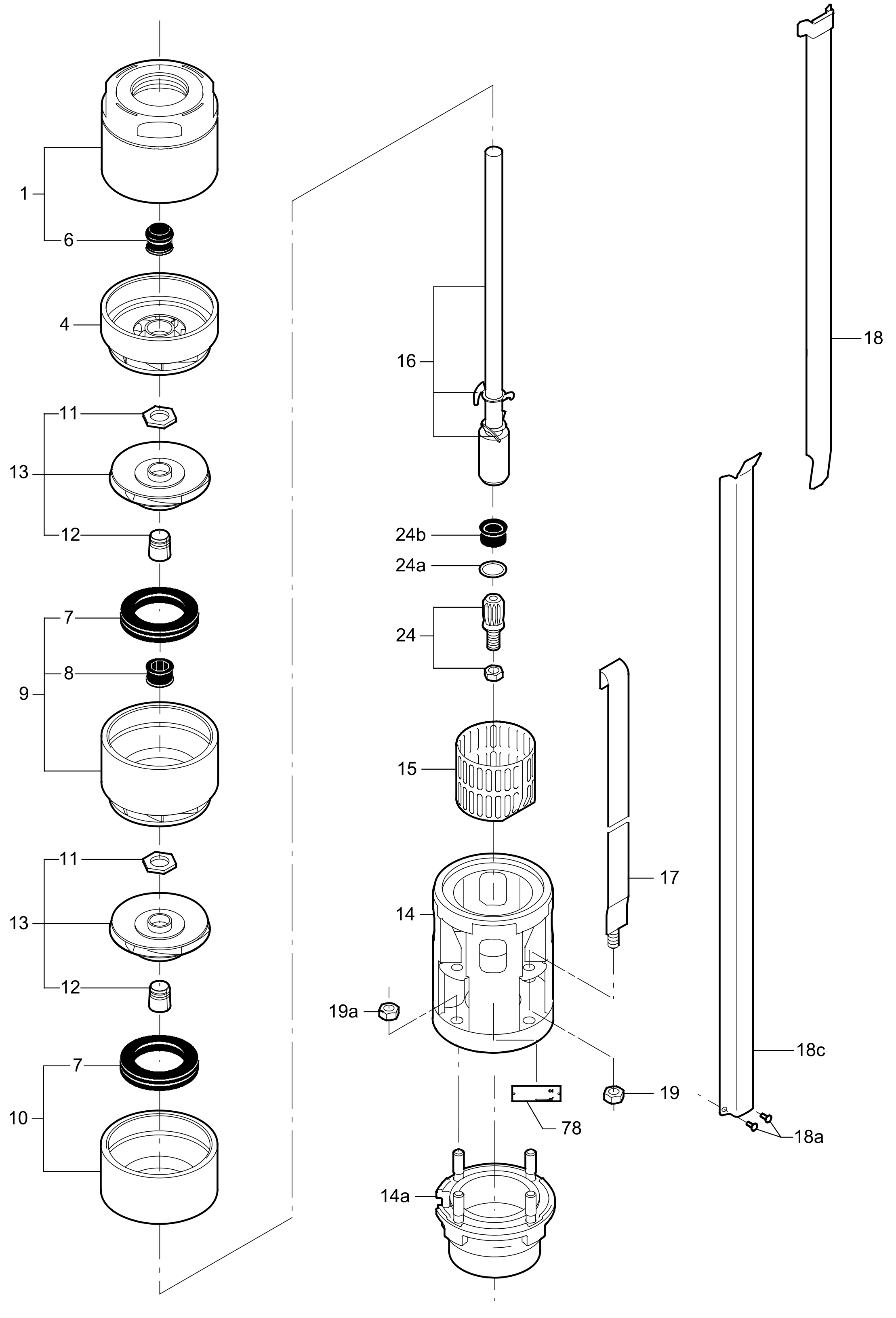
5.9.2 Drawings

25 SQF-3



7
9
8
13
64
16
24b
24a
24
7
10
19a
14
78
14a
19
71
1b
70
2
17
1
3
6
19b
76
13
7
9
8
13
18
18b
18c
18a
TM02 2247 3901

40 SQF-3


1
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19a
78
14a
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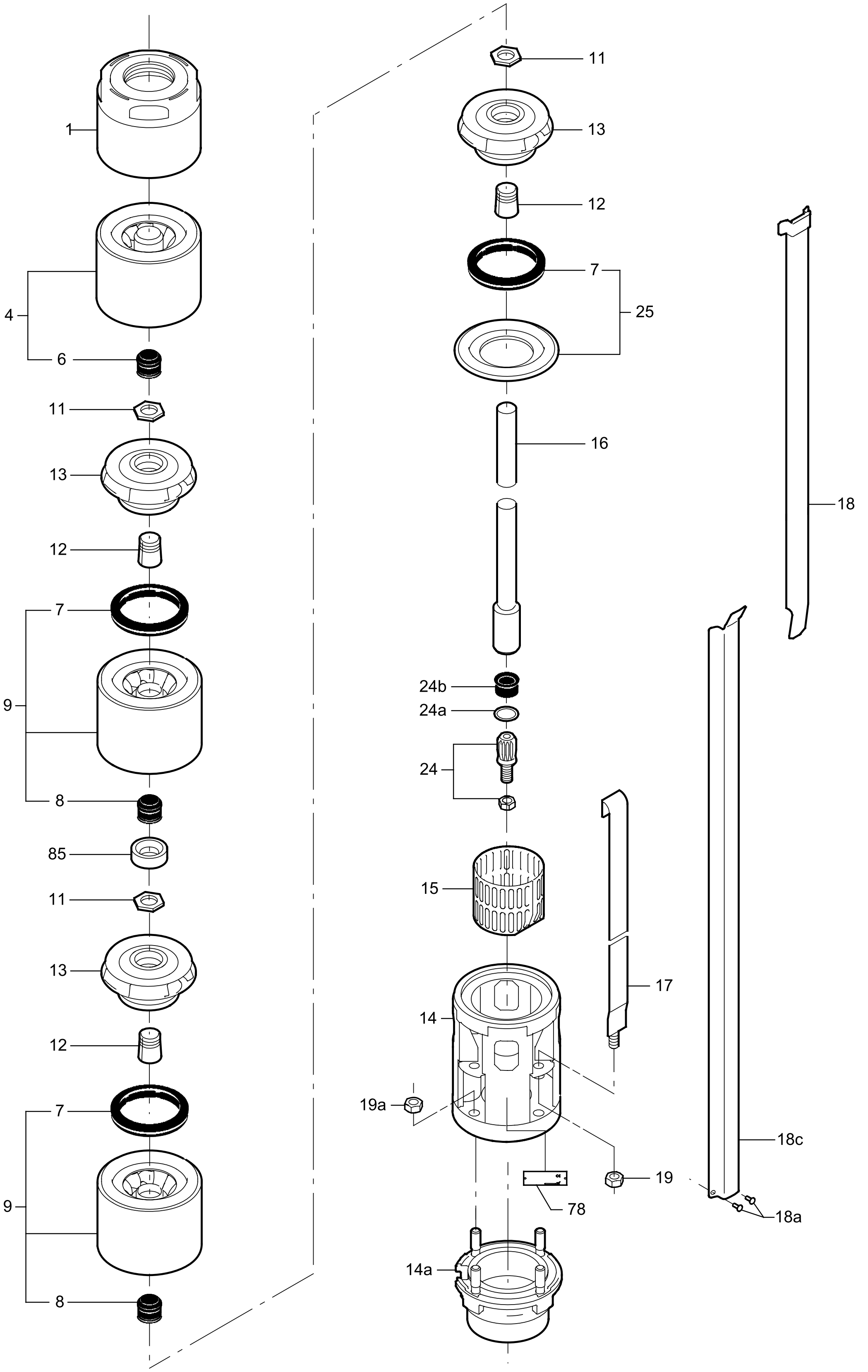
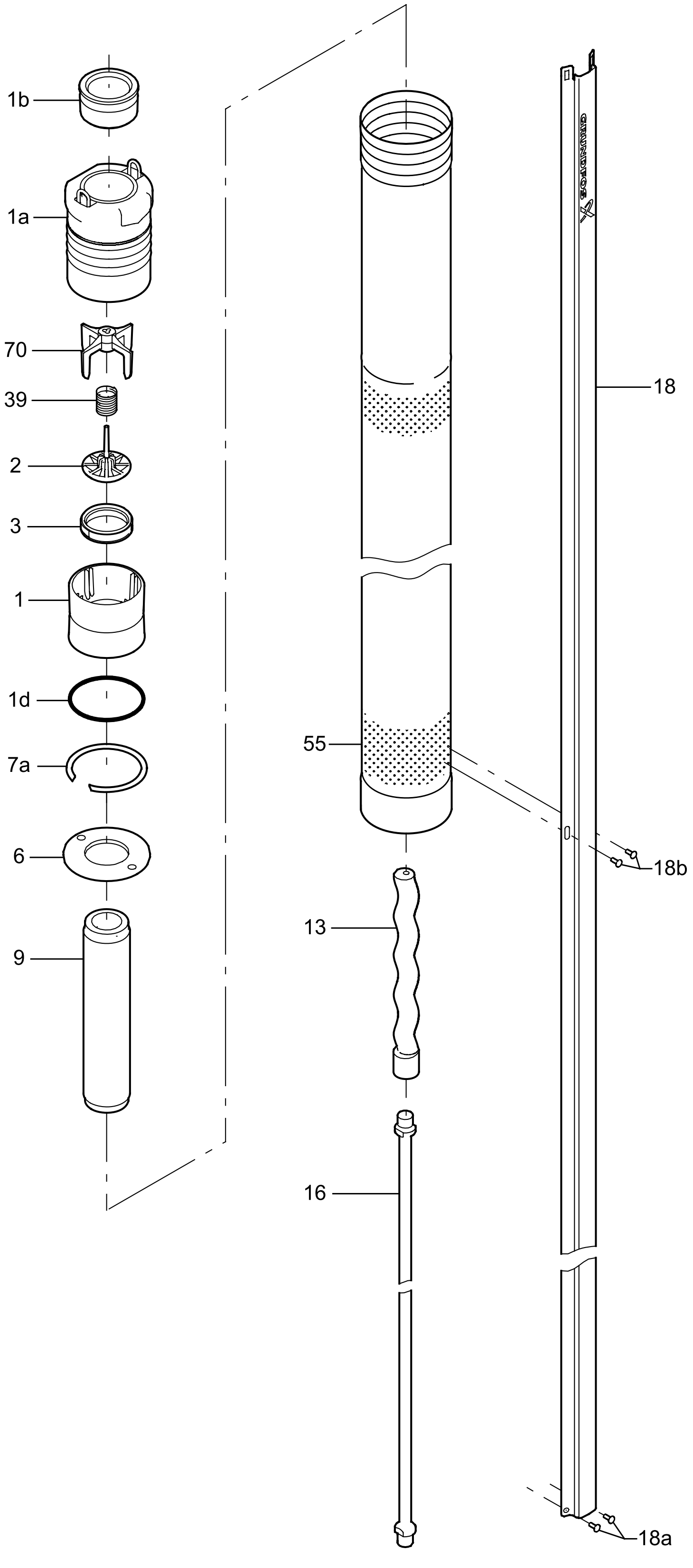
19
18
18c
18a
TM02 2247 3901

75 SQF-3



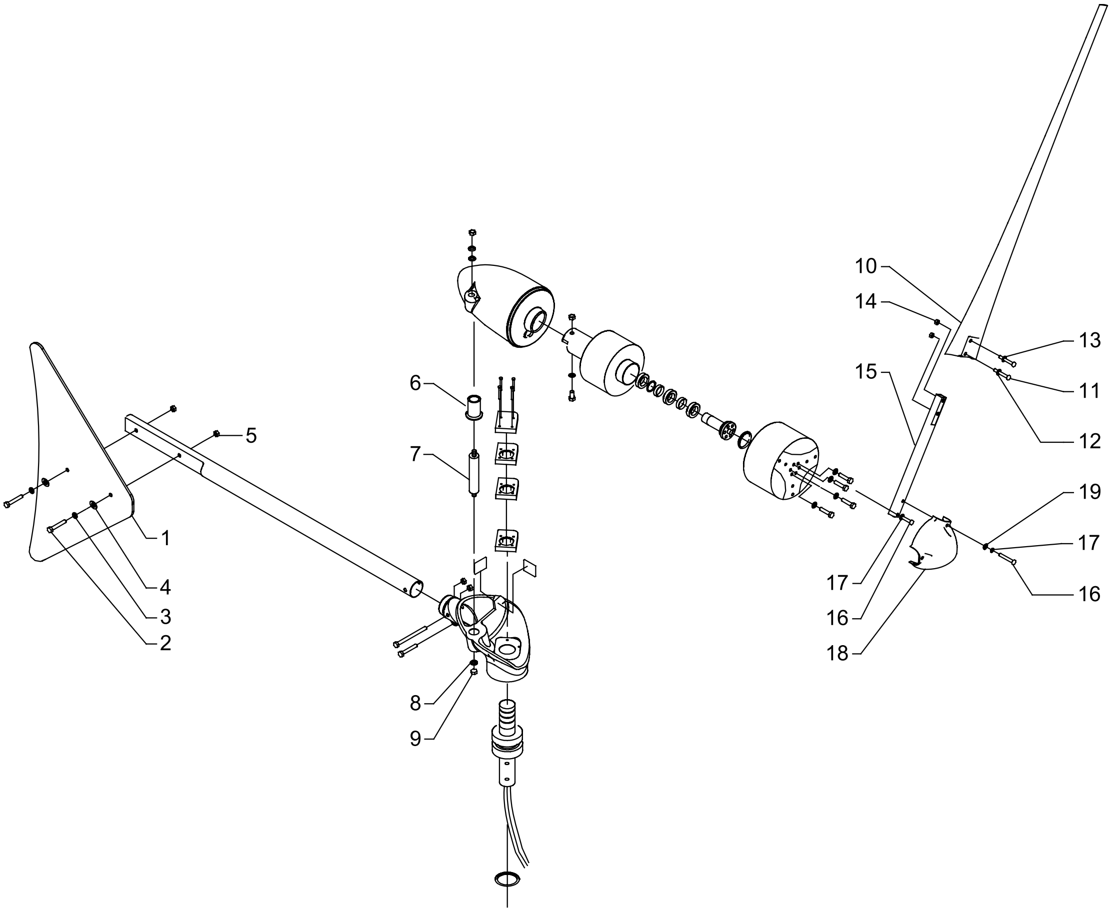
TM02 2438 4301

Helical 3 SQF-2, 6 SQF-2, 11 SQF-2



TM02 2216 3901

Windturbine



TW-60 Water Treatment System

section 9

GRUNDFOS **PRODUCT GUIDE**

SQFlex

Renewable-energy based
water supply systems
50/60 Hz

BE > THINK > INNOVATE >

GRUNDFOS®

1. **Product data** **3**
   - Introduction 3
   - Applications 5
   - Features and benefits 5
   - Performance range 7
   - System overview 8
   - Identification 9

2. **Construction** **10**
   - Material specification, helical rotor pump 10
   - Material specification, centrifugal pump 11
   - Material specification, motor 12

3. **Selection** **13**
   - Sizing of SQFlex system 13
   - Application examples 14

4. **Solar panel wiring** **23**
   - Methods of solar panel wiring 23

5. **Performance curves** **25**
   - Curve conditions 25
   - Curve charts 26

6. **Technical data** **32**
   - Dimensions and weights 32
   - SQF pump 33
   - Motor 33
   - CU 200 SQFlex control unit 34
   - IO 50 SQFlex switch box 34
   - IO 101 SQFlex switch box 34
   - IO 102 SQFlex breaker box 34
   - Charge controller 34

7. **Accessories** **35**
   - CU 200 SQFlex control unit 35
   - IO 50 SQFlex switch box 37
   - IO 101 SQFlex switch box 37
   - IO 102 SQFlex breaker box 37
   - Charge controller 38
   - Submersible drop cables 38
   - Whisper 200 wind turbine 39
   - GF100 solar panel 41

8. **Further product documentation** **42**
   - WebCAPS 42
   - WinCAPS 43

1. Product data

Introduction

The SQFlex system is a reliable water supply system based on renewable energy sources, such as solar and wind energy. The SQFlex system incorporates an SQF submersible pump.

Very flexible as to its energy supply and performance, the SQFlex system can be combined and adapted to any need according to the conditions on the installation site.

The system components are

- SQF submersible pump
- CU 200 SQFlex control unit
- IO 50 SQFlex switch box
- IO 101 SQFlex switch box
- IO 102 SQFlex breaker box
- charge controller
- energy supply:
  - – solar panels
  - – wind turbine
  - – generator
  - – batteries.

SQF submersible pump

The SQF pump range comprises two pump technologies:

- the helical rotor pump (3") for high heads and small flows.
- the centrifugal pump (4") for low heads and large flows.

The performance curves in fig. 1 illustrates the pump performance for the two pump models.

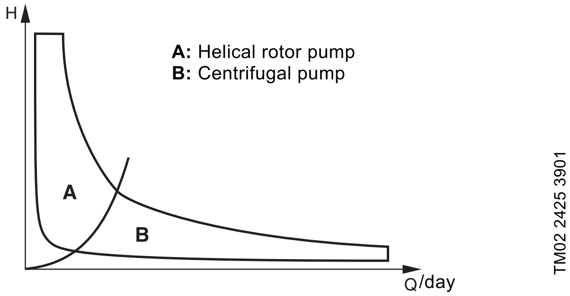


Fig. 1 Performance ranges for helical rotor and centrifugal pumps

The SQF pump is available as a complete unit only.

The SQF pump complete comprises:

- motor
- 6 ft (1.8 m) cable with water level electrode and socket
- cable guard.

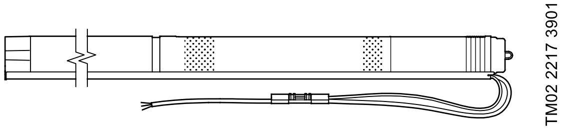


Fig. 2 SQF pump

Pump type	Pump size	Product number
3 SQF 2	3"	95027332
3 SQF 3	3"	95027333
6 SQF 2	3"	95027334
6 SFQ 3	3”	96834840
11 SQF 2	3"	95027335
16 SQF 10	4"	95027350
25 SQF 3	4"	95027351
25 SQF 7	4"	95027353
40 SQF 3	4"	95027354
40 SQF 5	4"	95027355
60 SQF 3	4"	95027443

Currently the complete range consists of six centrifugal pumps and five helical rotor pumps. The centrifugal pumps are adapted from Grundfos’ present 4” SP range (16S, 25S, 40S, and 60S). These pumps are used when lower heads and higher flow rates are required.

The positive displacement helical pump ends are 3” in diameter and available in five models ranging from 3 to 11 gpm (0.68 to 2.50 m^3/h). These are designed for higher head and lower flow requirements. The pump rotor is a single-twisted helix (spiral) made of hard-chromium plated stainless steel. During operation, the rotor rotates eccentrically in a double helical elastic stator.

Motor

The motor has been developed specifically for the SQFlex system and is designed according to the permanent-magnet principle with built-in electronic unit and is available in only two sizes.

The motor speed range is 500-3600 rpm, depending on power input and load.

The motor is constructed in 304 stainless steel.

Max. ratings are as follows:

- Maximum power input (P_1) of 1400 W
- maximum current of 8.4 A
- maximum speed of 3600 rpm

The pump delivers its maximum performance when one of the above parameters is reached.

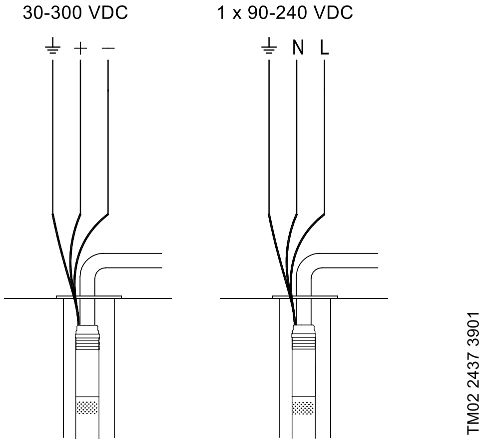


Fig. 3 Wiring diagram

The motor is to be connected to the power supply as shown in fig. 3.

As the integrated electronic unit enables the motor to handle both DC and AC supply voltages, it makes no difference how the wires "+" and "–" or "N" and "L" are connected.

Supply voltage

Flexible as regards power supply and power range, the motor can be supplied with either DC or AC voltage:

- 30-300 VDC, PE
- 1 x 90-240 V –10 % / +6 %, 50/60 Hz, PE.

CU 200 SQFlex control unit

The CU 200 is a combined status and control unit for the SQFlex pump system. Moreover, the CU 200 enables connection of a level switch placed in a water reservoir or tank.

IO 50 SQFlex switch box

The IO 50 is an on/off switch box designed for opening and closing the system power supply.

IO 101 SQFlex switch box

The IO 101 is an on/off switch box designed for opening and closing the system power supply and is used in solar-powered SQFlex systems with a back-up generator.

IO 102 SQFlex breaker box

The IO 102 is an on/off breaker box designed for opening and closing the system power supply and is used in wind-powered SQFlex systems or wind- and solar-powered SQFlex systems.

The IO 102 makes it possible to slow down or stop the wind turbine.

Charge controller

The charge controller is used when a battery backup system is installed with an SQFlex pumping system.

Solar modules

Grundfos' solar modules have been developed specifically for the SQFlex system. The solar modules are equipped with plugs and sockets enabling easy connection in series or parallel.

For further information on solar modules, please contact your local Grundfos company.

Generator

In case the power supply from its primary source of energy is temporarily insufficient or unavailable, the SQFlex system can be powered by a generator.

Batteries

The SQFlex system can be powered by batteries with a voltage supply of 30-300 VDC, maximum current 8.4 A.

Applications

Being designed for continuous as well as intermittent operation, the SQFlex system is especially suitable for water supply applications in remote locations, such as

- villages, schools, hospitals, single-family houses, etc.
- farms
  - – watering of cattle
  - – irrigation of fields and greenhouses
- game parks and game farms
  - – watering applications
- conservation areas
  - – surface water pumping
  - – floating pump installations for pumping of water from ponds and lakes.

Pumped liquids

SQF pumps are applicable in thin, clean, non-aggressive, non-explosive liquids, not containing solid or long-fibered particles larger than sand grains.

pH value: 5 to 9.

Liquid temperature: +32 °F to +104 °F (0 °C to +40 °C)

The pump can run at free convection (~ 0 ft/s) at maximum 104 °F (+40 °C).

Sand content

Maximum sand content: 50 ppm.

A higher sand content will reduce the pump life considerably due to wear.

Salt content (chloride ions Cl^-)

The table below shows the resistance of stainless steel to Cl^-. The figures in the table are based on a pumped liquid with a pH value of 5 to 9.

Stainless steel AISI	Cl^- content [ppm]	Liquid temperature [°F (°C)]
304	0-300	< 104 (40)
	300-500	< 86 (30)

Features and benefits

Dry-running protection

The SQF pump is protected against dry running in order to prevent damage to the pump. The dry-running protection is activated by a water level electrode placed on the motor cable 12-24 in. (.3 to .6 m) above the pump, depending on pump type.

The water level electrode measures the contact resistance to the motor sleeve through the water. When the water level falls below the water level electrode, the pump will be cut out. The pump will automatically cut in again 5 minutes after the water level is above the water level electrode.

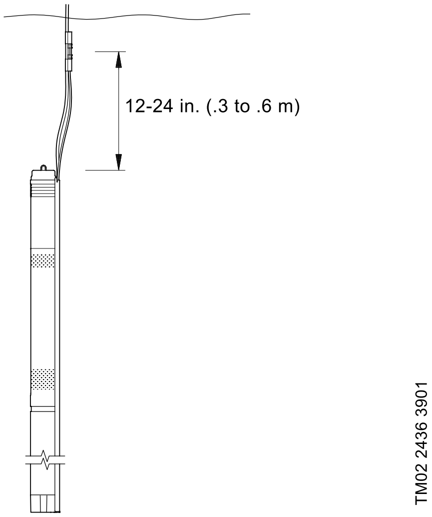


Fig. 4 Vertical installation

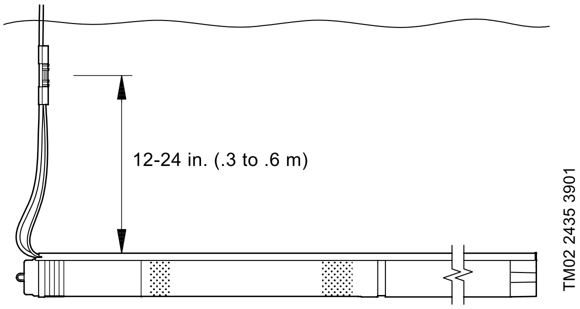


Fig. 5 Horizontal installation

High efficiency

The MSF 3 motor is a permanent-magnet motor (PM motor) featuring a higher efficiency within the power range compared to a conventional asynchronous motor.

In addition to this, the segmented motor stator contributes considerably to the high efficiency.

The MSF 3 motor is furthermore characterized by a high locked-rotor torque even at low power supply.

Overvoltage and undervoltage protection

Overvoltage and undervoltage may occur in case of unstable power supply or a faulty installation.

The pump will be cut out if the voltage falls outside the permissible voltage range. The motor is automatically cut in when the voltage is again within the permissible voltage range. Therefore no extra protection relay is needed.

Note: The MSF 3 motor is protected against transients from the power supply according to IEC 60664-1 "overvoltage category III" (4 kV). In areas with high lightning intensity, external lightning protection is recommended.

Overload protection

In case the upper load limit is exceeded, the motor will automatically compensate for this by reducing the speed. If the speed falls below 500 rpm, the motor will be cut out automatically.

The motor will remain cut out for 10 seconds after which period the pump will automatically attempt to restart.

The overload protection prevents burnout of the motor. Consequently, no extra motor protection is required.

Overtemperature protection

A permanent-magnet motor gives off very little heat to its surroundings. In combination with an efficient internal circulation system leading the heat away from the rotor, stator and bearings, this fact ensures optimum operating conditions for the motor.

As an extra protection, the electronic unit has a built-in temperature sensor. When the temperature rises above 185 °F (85°C), the motor is automatically cut out. When the temperature has dropped to 165 °F (73 °C), the motor is automatically cut in again.

Maximum Power Point Tracking (MPPT)

The built-in electronic unit gives the SQFlex system a number of advantages compared to conventional products. One of these advantages is the built-in microprocessor with MPPT (MPPT = **M**aximum **P**ower **P**oint **T**racking).

Thanks to the MPPT-function, the pump duty point is continuously optimized according to the input power available. MPPT is only available for pumps connected to DC supply.

Wide voltage range

The wide voltage range enables the motor to operate at any voltage from 30-300 VDC or 90-240 VAC. This makes installation and sizing especially easy.

Built-in sand shield

The built-in sand shield prevents sand damage to the pump and motor by slinging it out through the oval slots located at the base of the pump end.

Reliability

The MSF 3 motor has been developed with a view to high reliability achieved through the following features:

- carbon/ceramic bearings
- excellent starting capabilities
- various protection facilities.

Simple installation

The following features ensure simple installation of the SQF pump:

- low weight ensuring user-friendly handling
- installation in 3", 4" or larger boreholes
- only an on/off switch is needed, which means that no extra motor starter / starter box is necessary.

Note: Horizontal installation requires the water level electrode to be placed above the pump to ensure the dry-running protection.

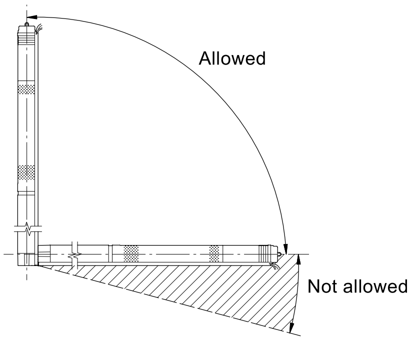


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Fig. 6 Installation of SQF pumps

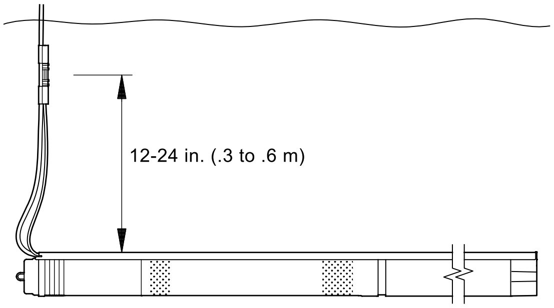

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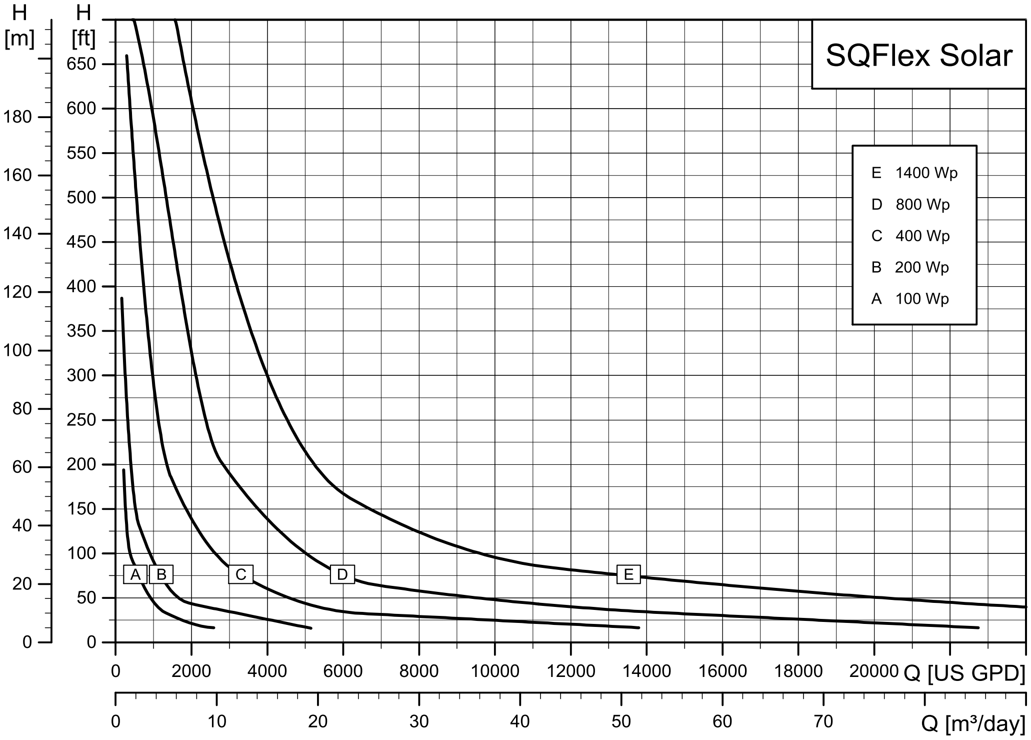
Fig. 7 Horizontal installation

Ease of service

The modular pump and motor design facilitates installation and service. The cable and the end cover with socket are fitted to the pump with screws which enable replacement.

Performance range



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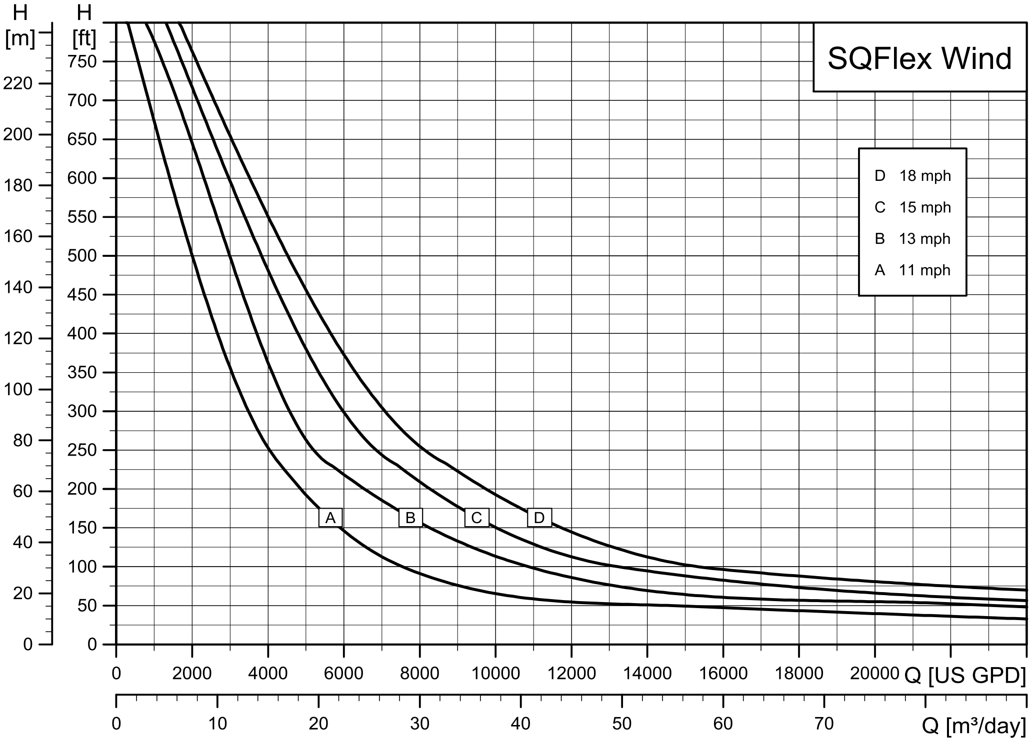
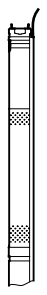
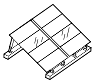
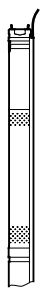
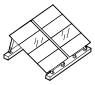
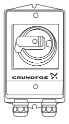
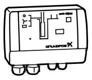
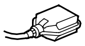
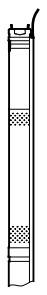
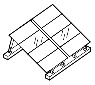
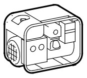
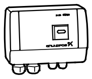
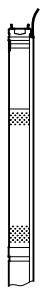
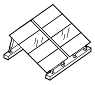
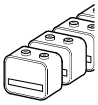
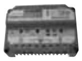
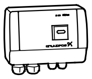
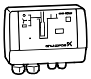
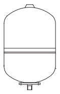
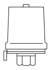
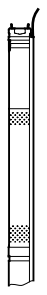
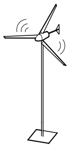
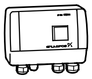
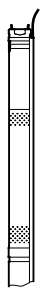
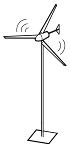
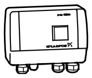
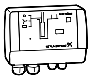
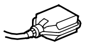
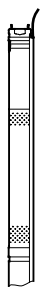
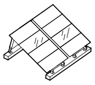
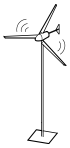
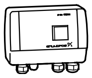
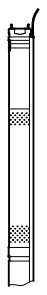
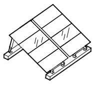
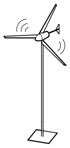
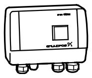
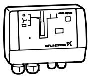
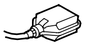
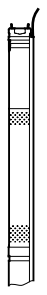
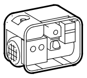
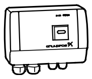


TM02 2434 4311

Note: The curves must not be used as guarantee curves.

System overview

The SQFlex system can be used in a number of combinations as shown in the table below.

System	consists of the following components							
	Pump	Solar panels ★	Wind turbine	Generator/ battery/ power supply	Charge controller	Switch box or breaker box	Control unit	Additional extras
SQFlex Solar See page 14.						 IO 50		
SQFlex Solar - with CU 200 and level switch See page 15.						 IO 50	 CU 200	 (★★)
SQFlex Solar - with back-up generator See page 16.						 IO 101		
SQFlex Solar - with back-up batteries See page 17.						 IO 50 or IO 101 (★★)	 CU 200	Pressure tank  Pressure switch 
SQFlex Wind See page 18.						 IO 102		
SQFlex Wind - with CU 200 and level switch See page 19.						 IO 102	 CU 200	 (★★)
SQFlex Combo - combination of solar and wind energy See page 20.						 IO 102		
SQFlex Combo - with CU 200 and level switch See page 21.						 IO 102	 CU 200	 (★★)
SQFlex system - with generator as power supply See page 22.						 IO 101		

★ For number of solar modules required, please consult the sizing tool in Grundfos WinCAPS/WebCAPS.
★★ Optional.

Identification

Type key for helical rotor pumps

Example **6 SQF -2**

Rated flow at 3000 rpm [gpm]

Type range

Number of stages

Type key for centrifugal pumps

Example **25 SQF -3**

Rated flow of corresponding SP pump [gpm]

Type range

Number of stages

2. Construction

Material specification, helical rotor pump

Pos.	Component	Material	SQF
			AISI
1	Valve casing	Polyamide	
1a	Discharge chamber	Stainless steel	304
1d	O-ring	NBR	
2	Valve cup	Polyamide	
3	Valve seat	NBR	
6	Flange, upper	Stainless steel	304
7a	Circlip	Stainless spring steel	310
9	Pump stator	Stainless steel/EPDM	304
13	Pump rotor	Stainless steel	304
16	Torsion shaft	Stainless steel	316
39	Valve spring	Stainless spring steel	316 LN
55	Outer sleeve	Stainless steel	304
70	Valve guide	Polyamide	
159c	Sand shield	Polyamide	
	Cable guard	Stainless steel	304
	Screws for cable guard	Stainless steel	316

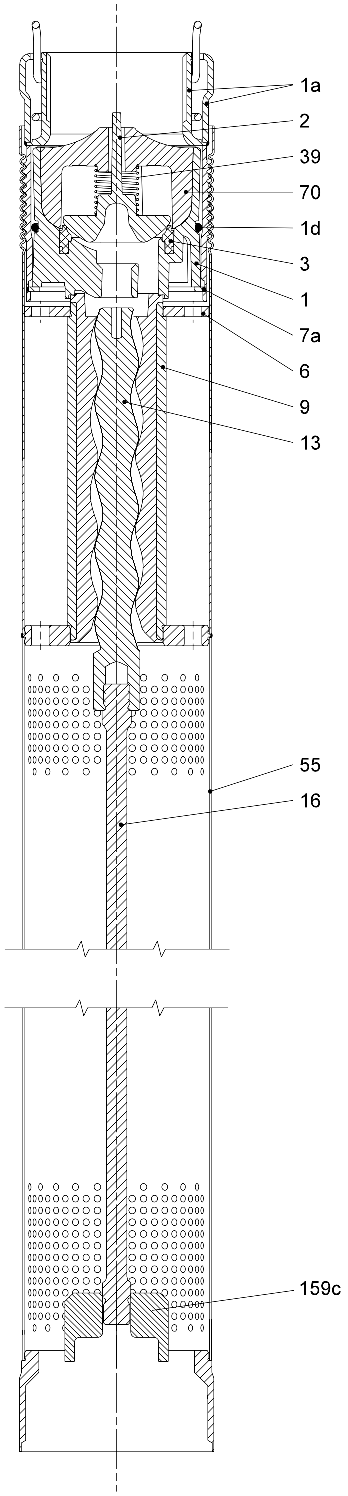


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Fig. 8 Example: 6 SQF-2

Material specification, centrifugal pump

Pos.	Component	Material	SQF
			AISI
1	Valve casing	Stainless steel	304
4	Chamber, top	Stainless steel	304
6	Top bearing	NBR	
7	Neck ring	NBR/PPS	
8	Bearing	NBR	
9	Chamber, complete	Stainless steel	304
11	Nut for split cone	Stainless steel	304
12	Split cone	Stainless steel	304
13	Impeller	Stainless steel	304
14	Inlet part	Stainless steel	304
14a	Connecting piece, complete (MSF 3 adapter)	Stainless steel	304
15	Strainer	Stainless steel	304
16	Shaft, cylindrical	Stainless steel	431
17	Strap	Stainless steel	304
18	Cable guard, pump	Stainless steel	304
18c	Cable guard, motor	Stainless steel	304
19	Nut for strap	Stainless steel	304
19a	Nut	Stainless steel	316
24	Coupling with nut	Stainless steel	329
24a	Supporting ring	Stainless steel	316
24b	Spline protector	NBR	
25	Retainer for neck ring, complete	Stainless steel	304
85	Stop ring (only 25 SQF and 60 SQF)	Carbon/graphite PTFE	
	Screws for cable guard	Stainless steel	316

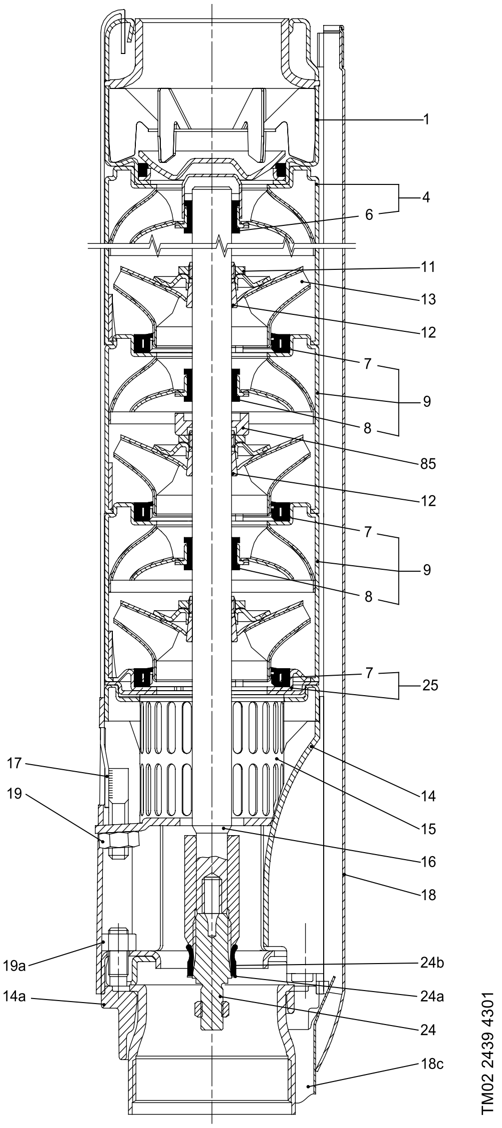

Fig. 9 Example: 60 SQF-3

Material specification, motor

Pos.	Component	Material	MSF 3
			AISI
201	Stator with sleeve, complete	Stainless steel	304
202	Rotor	Stainless steel	304
202a	Stop ring	PP	
202c	Shaft end	Stainless steel	316
203	Thrust bearing, stationary	Stainless steel/carbon	316
205	Bearing plate with radial bearing	Silicon carbide	304
206	Thrust bearing, rotating	Stainless steel/aluminium oxide Al_2O_3	316
220	Motor cable with plug		
222a	Filling plug	NBR	
223	Electronic unit		
224	O-ring	NBR	
225	Top cover	NBR	
232	Shaft seal	NBR	
243	Thrust-bearing housing	Stainless steel	316
	Four screws (M4)	Stainless steel	316

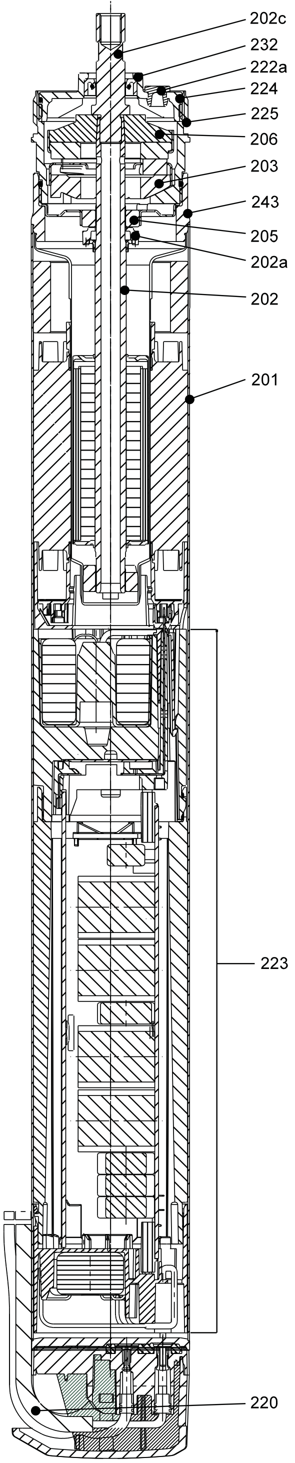

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Fig. 10 MSF 3

3. Selection

Sizing of SQFlex system

Grundfos has developed a PC-based sizing tool enabling the sizing of SQFlex systems.

The sizing tool is integrated in Grundfos WinCAPS and covers both solar- and wind-powered systems. Visit Grundfos.com to use WebCAPS, our online version of WinCAPS.

The following three parameters must be known for the sizing of the optimum SQFlex system:

- installation location
- maximum head required
- quantity of water required.

With a view to the sizing of a correct solar-powered SQFlex system, the world has been divided into six regions:

- North America
- South America
- Australia/New Zealand
- Asia/Pacific
- Southern Africa
- Europe/Middle East/Northern Africa.

Each region is divided into a number of zones according to the solar radiation in kWh/m^2 per day.

Voltage effect on pump efficiency

The pump efficiency can vary quite a bit depending on input voltage. This chart shows the dropoff in efficiency as the voltage gets lower. For example, if you have two systems with the exact same wattage rating, but System A is running at 120V and System B is running at 35V, System A will produce 20 % more water than System B.

SQ Flex optimal efficiency	
Panel output voltage	**(% loss in gallons/day)**
120V - 300V	- 0 %
90V	- 5 %
60V	- 10 %
35V	- 20 %

Application examples

SQFlex Solar

The SQFlex Solar system is the simplest of the range of SQFlex systems.

Benefits

- Easy to install
- Maintenance confined to periodic cleaning of the solar panels
- Few and simple components.

The protective circuit incorporated in the motor electronic unit cuts out the pump in case of dry running or similar situations.

By using the IO 50, the power supply to the pump can be closed manually, for example when

- there is no need for water supply
- the system requires service.

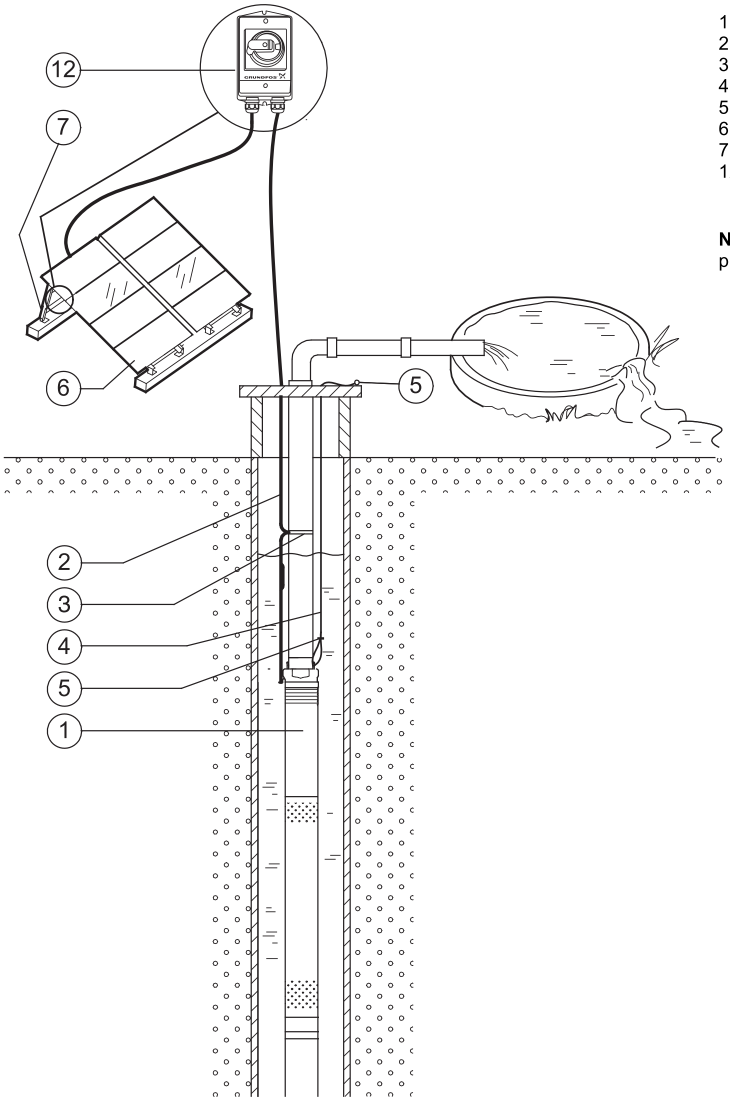


Fig. 11 SQFlex Solar

1	SQF pump
2	Submersible drop cable
3	Cable clips
4	Straining wire
5	Wire clamp
6	Solar panels
7	Support structure
12	IO 50 SQFlex switch box

Note: For the number of solar modules required, please consult the sizing tool in Grundfos WinCAPS.

SQFlex Solar

- with CU 200 and level switch

The SQFlex Solar system allows solar energy to be stored as water in a reservoir.

SQFlex Solar water supply systems with a water reservoir are used where

- there is a need for water supply at night
- for short periods, the solar energy is insufficient to run the pump
- there is a need for a back-up water source.

Benefits

Combined with the CU 200, the level switch acts as a pump cut-out function when the water reservoir is full.

The CU 200 offers indication of

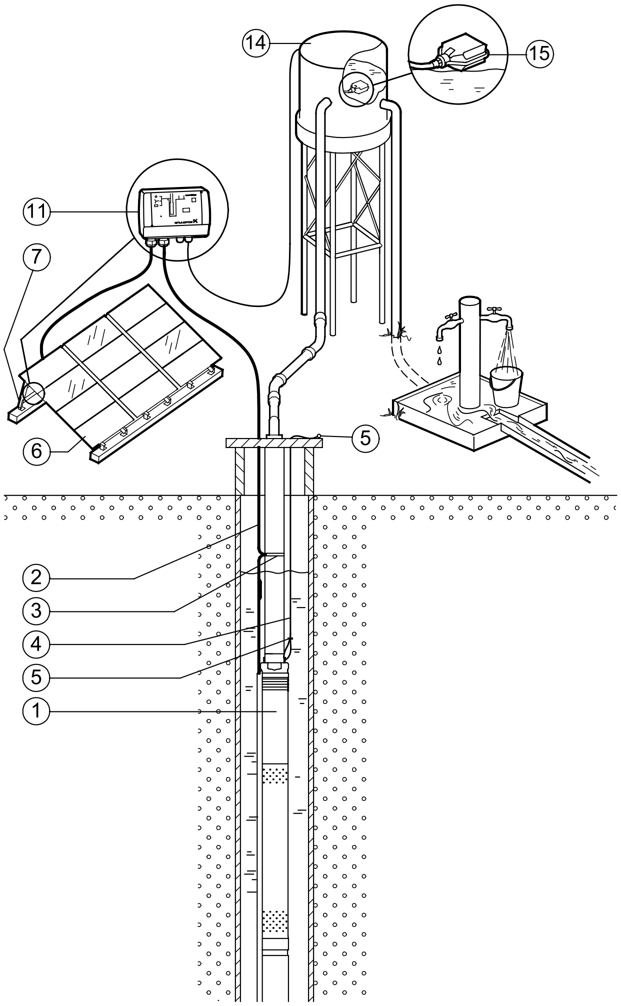
- full water reservoir (level switch activated)
- pump operation
- input power.

The CU 200 indicates operational stoppage in case of

- dry running
- service (see page 35)
- insufficient energy supply.

In addition, the system features

- easy installation
- maintenance confined to periodic cleaning of the solar panels.



1	SQF pump
2	Submersible drop cable
3	Cable clips
4	Straining wire
5	Wire clamp
6	Solar panels
7	Support structure
11	CU 200 SQFlex control unit
14	Water reservoir
15	Level switch

Note: For the number of solar modules required, please consult the sizing tool in Grundfos WinCAPS.

Fig. 12 SQFlex Solar with CU 200 and level switch

SQFlex Solar

- with back-up generator

During periods of limited solar energy, the SQFlex Solar water supply system provides reliable water supply. The system is connected to an external back-up generator via the IO 101.

The system switches automatically to operation

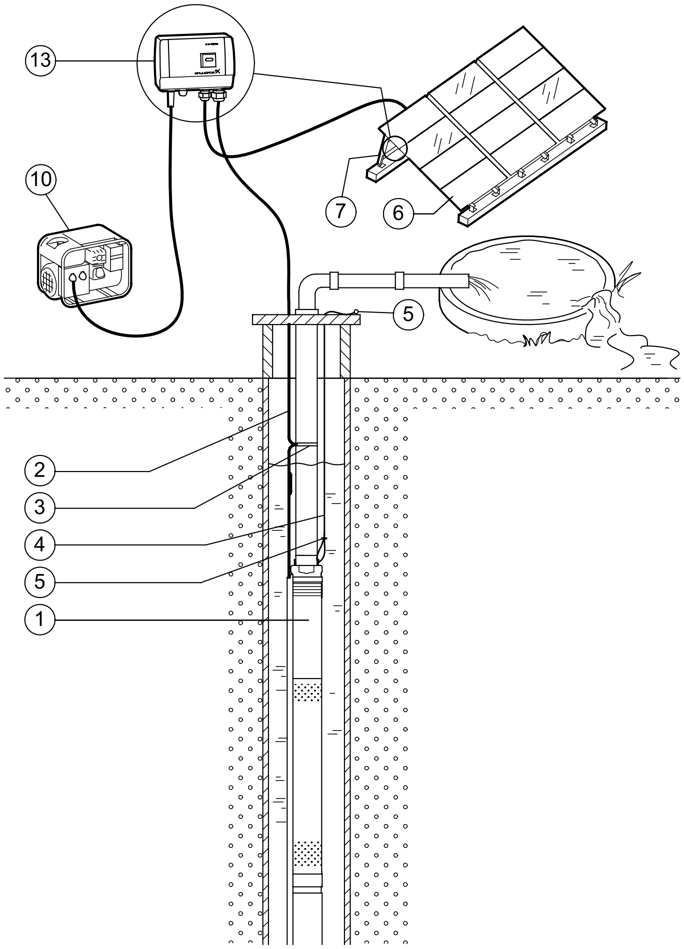
- via generator when
  - – the energy supply from the solar panels is insufficient
- via solar panels when
  - – the generator is stopped manually or
  - – the generator runs out of fuel.

Benefits

The system offers water supply during the night or during periods of insufficient solar energy.

Other benefits of the system include

- easy to install
- maintenance confined to periodic cleaning of the solar panels
- few and simple components
- flexible in terms of energy supply.



1	SQF pump
2	Submersible drop cable
3	Cable clips
4	Straining wire
5	Wire clamp
6	Solar panels
7	Support structure
10	Diesel or gasoline driven generator
13	IO 101 SQFlex switch box

Note: For the number of solar modules required, please consult the sizing tool in Grundfos WinCAPS.

TM02 2309 4101

Fig. 13 SQFlex Solar with back-up generator

SQFlex Solar

- with back-up batteries

During periods of limited solar energy, the SQFlex Solar system provides reliable water supply.

The supply of water is ensured by back-up batteries connected to the system via the charge controller.

The system is connected as shown in fig. 14.

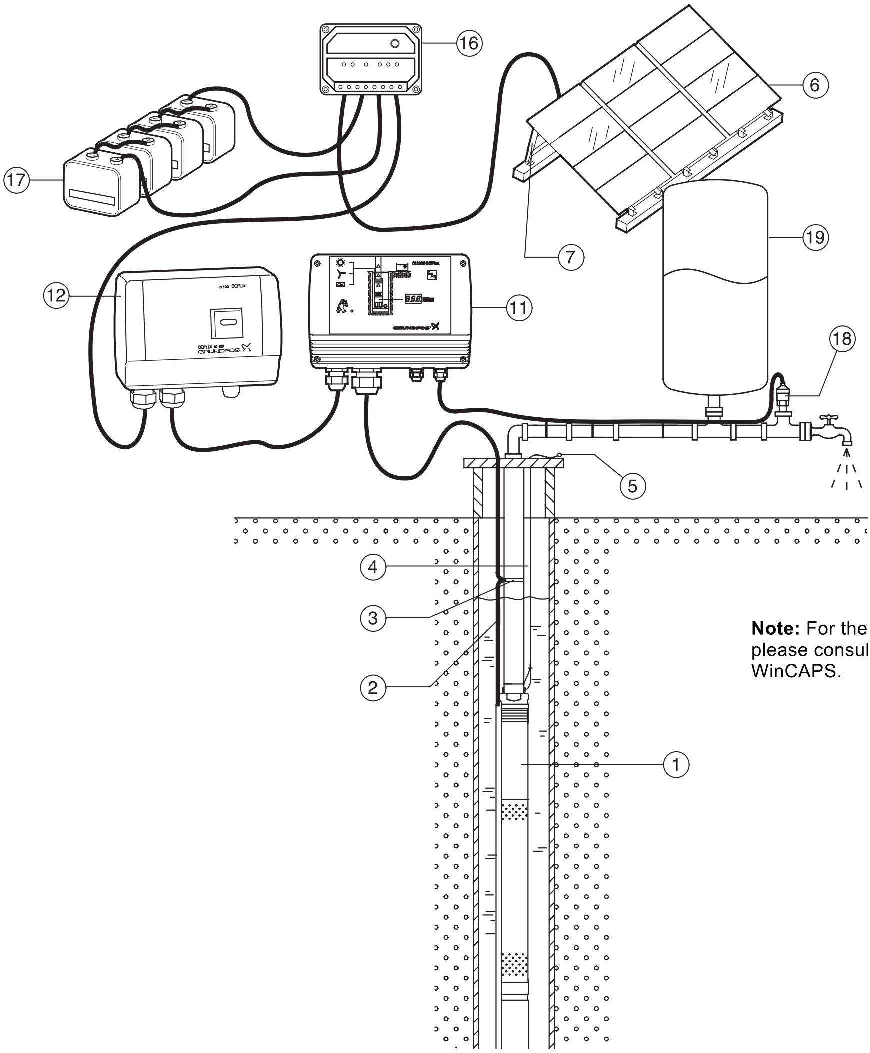
- Power will be provided by the solar panels wired to produce 48-110 VDC (rated).
- Power from the solar panels will feed into a 48 VDC charge controller, which will regulate the current fed to the batteries.
- From the charge controller, power passes into the battery bank, which consists of the number of appropriately sized batteries, wired in series to achieve 48 VDC (rated) output.
- Power is drawn from the battery bank and routed through a CU 200.
  Option: An IO 50 or IO 101 is to be installed to enable disconnection of the DC voltage.
  If an IO 101 is installed, it is possible to add a generator to the system.
- Power is run from the CU 200 to the SQFlex pump.

Benefits

The system offers water supply during the night or during periods of insufficient solar energy.

Other benefits of the system include

- easy installation
- a minimum of maintenance
- few and simple components
- flexibility in terms of energy supply.



1	SQF pump
2	Submersible drop cable
3	Cable clips
4	Straining wire
5	Wire clamp
6	Solar panels
7	Support structure
11	CU 200 SQFlex control unit
12	IO 101 SQFlex switch box (optional)
16	Charge controller
17	Batteries
18	Pressure switch
19	Pressure tank

Note: For the number of solar modules required, please consult the sizing tool in Grundfos WinCAPS.

TM03 4232 1906

Fig. 14 SQFlex Solar with back-up batteries

5. Performance curves

Curve conditions

Performance range, SQFlex Solar

The SQFlex Solar performance range shown on page page 7 is based on

- solar radiation on a tilted surface (tilt angle of 20°)
- H_T = 6 kWh/m^2 per day
- ambient temperature: +85 °F (+29 °C)
- 20° northern latitude.

Performance range, SQFlex Wind

The SQFlex Wind performance range shown on page 7 is based on

- average wind speed, measured over one month
- calculations according to Weibull's factor k = 2
- continuous operation over 24 hours.

Specific performance charts

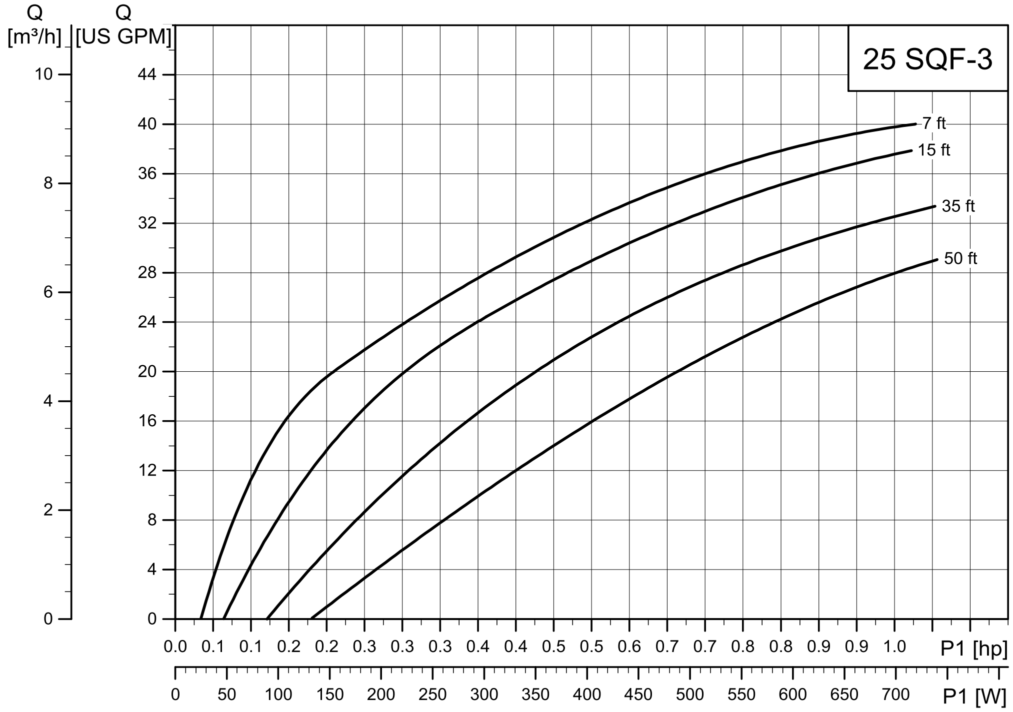
The specific performance charts in the Performance Curves section of this booklet are based on the following guidelines:

- All curves show mean values.
- The curves must not be used as guarantee curves.
- Typical deviation: ±15 %.
- The measurements have been made at a water temperature of +68 °F (+20 °C).
- The curves apply to a kinematic viscosity of 1 mm^2/s (1 cSt). If the pump is used for liquids with a viscosity higher than that of water, this will reduce the head and increase the power consumption.

Pressure loss

The QH curves are inclusive of inlet and valve losses at actual speed.

25 SQF-3



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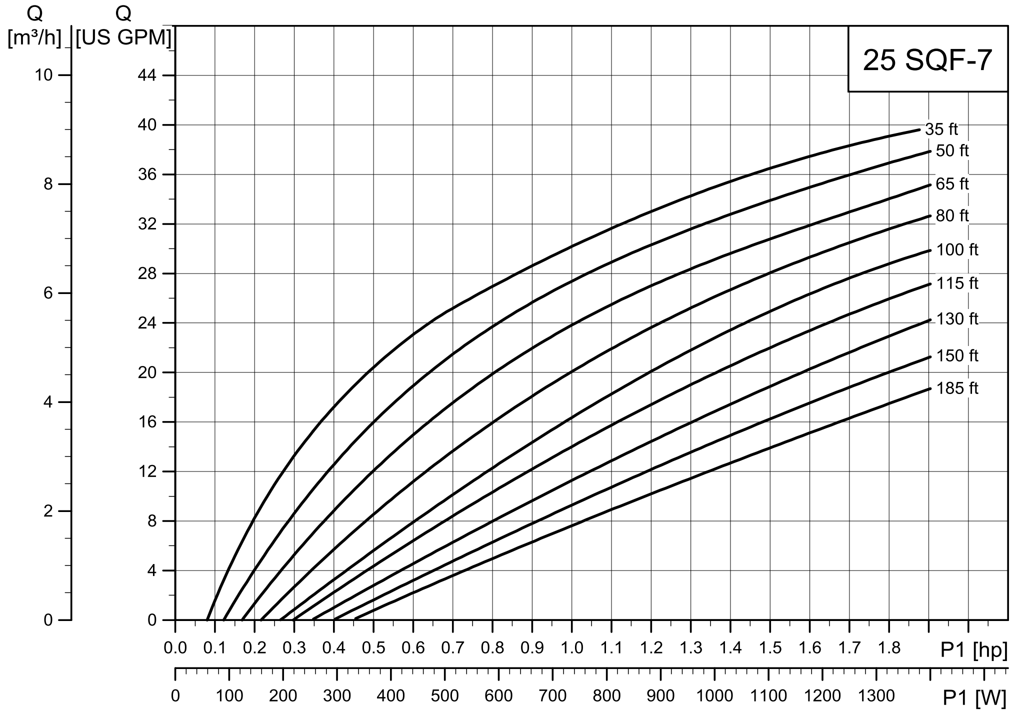
25 SQF-7



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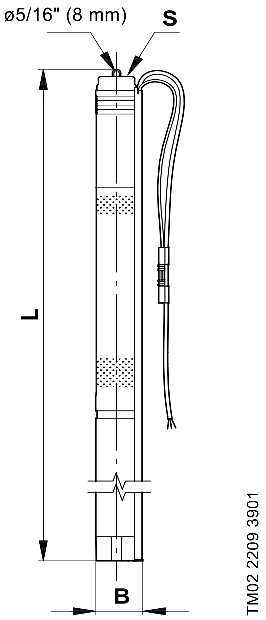
Note: Max. P1 (W) shown on curve represents max. motor RPM.

6. Technical data

Dimensions and weights



Pump type	Dimensions [in (mm)] ★			Net weight [lb]★	Gross weight [lb]★	Shipping volume [ft^3]★
	L	B	S			
3 SQF-2	47 (1194)	2.9 (74)	1" NPT	17	21	0.85
3 SQF-3	49 (1247)	2.9 (74)	1" NPT	17.5	21	0.85
6 SQF-2	48 (1219)	2.9 (74)	1" NPT	17.5	21	0.85
6 SQF-3	51 (1296)	2.9 (74)	1" NPT	1.8	2.2	0.85
11 SQF-2	49 (1247)	2.9 (74)	1 1/4" NPT	18	22	0.85
16 SQF-10	38 (965)	3.9 (100)	1 1/4" NPT	21	24	1.00
25 SQF-3	32 (813)	3.9 (100)	1 1/2" NPT	18	21	1.00
25 SQF-7	35 (889)	3.9 (100)	1 1/2" NPT	19.5	23	1.00
40 SQF-3	36 (915)	3.9 (100)	2" NPT	21	24	1.00
40 SQF-5	40 (1016)	3.9 (100)	2" NPT	23	26.5	1.00
60 SQF-3	39 (991)	3.9 (100)	2" NPT	24	27	1.00

★ Pump complete

SQF pump

Power supply to pump	30-300 VDC, PE. 1 x 90-240 V –10 % / +6 %, 50/60 Hz, PE.
Run-up time	Depends on the energy source.
Start/stop	No limitation to the number of starts/stops per hour.
Enclosure class	IP 68.
Motor protection	Built into the pump. Protection against • dry running by means of a water level electrode • overvoltage and undervoltage • overload • overtemperature.
Conductivity	≥ 70 µs/cm (micro siemens).
Sound pressure level	The sound pressure level of the pump is lower than the limiting values stated in the EC Machinery Directive.
Radio noise	The SQF complies with the EMC Directive 89/336/EEC. Approved according to the standards EN 61000-6-2 and EN 61000-6-3.
Reset function	The SQF can be reset via the CU 200 or by disconnecting the power supply for 1 minute.
Power factor	PF = 1.
Operation via generator	Voltage: 115-230 VAC –10 % / +6 %. The generator output must be • minimum 1000 W (helical rotor pumps) • minimum 1500 W (centrifugal pumps).
Earth-leakage circuit breaker	If the pump is connected to an electric installation where an earth-leakage circuit breaker (ELCB) is used as an additional protection, this circuit breaker must trip out when earth fault currents with DC content (pulsating DC) occur.
Borehole diameter	3 SQF, 6 SQF, 11 SQF: Minimum: 3 in. 16 SQF, 25 SQF, 40 SQF, 60 SQF: Minimum: 4 in.
Installation depth	Minimum: The pump must be completely submerged in the pumped liquid. Maximum: 500 ft below the static water table (220 psi).
Suction strainer	Holes of the suction strainer: 3 SQF, 6 SQF, 11 SQF: ø0.090 in. 16 SQF, 25 SQF: ø0.10 in. 40 SQF, 60 SQF: 0.16 in x 0.80 in.
Pumped liquids	pH 5 to 9. Sand content up to 50 ppm.
Marking	CE.

Motor

Electrical data

30-300 VDC or 1 x 90-240 VAC, 50/60 Hz

Pump type	Motor type	Max. power input P_1 [W]	Max. current [A]
3 SQF-2	MSF 3	1400	8.4
3 SQF-3	MSF 3	1400	8.4
6 SQF-2	MSF 3	1400	8.4
6 SQF-3	MSF 3	1400	8.4
11 SQF-2	MSF 3	1400	8.4
16 SQF-10	MSF 3	1400	8.4
25 SQF-3	MSF 3	1400	8.4
25 SQF-7	MSF 3	1400	8.4
40 SQF-3	MSF 3	1400	8.4
40 SQF-5	MSF 3	1400	8.4
60 SQF-3	MSF 3	1400	8.4

CU 200 SQFlex control unit

Voltage	30-300 VDC, 8.4 A. 90-240 VAC, 8.4 A.
Power consumption	5 W.
Current consumption	Maximum 130 mA.
Pump cable	Maximum length between the CU 200 and the pump: 650 ft. Maximum length between the CU 200 and the level switch: 2000 ft.
Back-up fuse	Maximum 10 A.
Radio noise	The CU 200 complies with the EMC Directive 89/336/EEC. Approved according to the standards EN 55014 and 55014-2.
Relative air humidity	95 %.
Enclosure class	IP 55.
Ambient temperature	During operation: –22 °F to +122 °F (–30 °C to +50 °C). During storage: –22 °F to +140 °F (–30 °C to 60 °C).
Marking	CE.
Weight	4.5 lb.

IO 50 SQFlex switch box

Voltage	Maximum 300 VDC, 8.4 A. Maximum 265 VAC, 8.4 A.
Enclosure class	IP 66.
Ambient temperature	During operation: –22 °F to +122 °F (–30 °C to 50 °C). During storage: –22 °F to +140 °F (–30 °C to 60 °C).
Marking	CE.

IO 101 SQFlex switch box

Voltage	**115 VAC –15 % / +10 %, 50/60 Hz (internal relay). Maximum 225 VDC, 8.4 A. Maximum 115 VAC, 8.4 A. ** 230 VAC –15 % / +10 %, 50/60 Hz (internal relay). Maximum 225 VDC, 7 A. Maximum 265 VAC, 7 A.
Enclosure class	IP 55.
Ambient temperature	During operation: –22 °F to +122 °F (–30 °C to 50 °C). During storage: –22 °F to +140 °F (–30 °C to 60 °C).
Marking	CE.

IO 102 SQFlex breaker box

Voltage	Maximum 225 VDC, 8.4 A. Maximum 265 VAC, 8.4 A.
Enclosure class	IP 55.
Ambient temperature	During operation: –22 °F to +122 °F (–30 °C to 50 °C). During storage: –22 °F to +140 °F (–30 °C to 60 °C).
Marking	CE.

Charge controller

Voltage (solar input)	Maximum 110 VDC.
Current (solar input)	Maximum 15 A.
Output current (load)	Maximum 15 A.
Ambient temperature	–40 °F to +140 °F (–40 °C to +60 °C).
Weight	0.75 lb.

7. Accessories

CU 200 SQFlex control unit

Product	Product number
CU 200 SQFlex	96625360

The CU 200 is a combined status, control and communication unit especially developed for the SQFlex system. The CU 200 also enables connection of a level switch.

The CU 200 incorporates cable entries for

- power supply connection (pos. 6)
- pump connection (pos. 7)
- earth connection (pos. 8)
- level switch connection (pos. 9).

(The position numbers in brackets refer to fig. 24.)

Communication between the CU 200 and the pump takes place via the pump power supply cable. This is called mains borne signalling (or Power Line Communication), and this principle means that no extra cables between the CU 200 and the pump are required.

It is possible to start, stop and reset the pump with the on/off button (pos. 1). The CU 200 offers

- system monitoring
- alarm indication.

The following indications allow the operation of the pump to be monitored:

- water reservoir is full (level switch) (pos. 2)
- pump is running (pos. 3)
- input power (pos. 11).

The CU 200 offers the following alarm indications:

- Dry running (pos. 10)
- Service needed (pos. 5) in case of
  - – no contact to pump
  - – overvoltage
  - – overtemperature
  - – overload.

In addition, the CU 200 shows the symbols of the energy supply options (pos. 4).

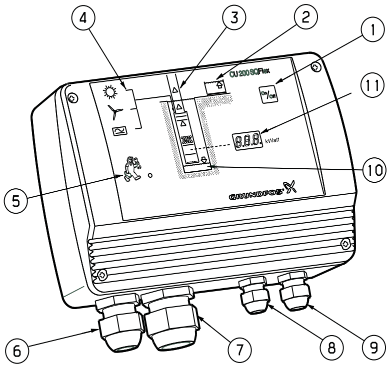


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Fig. 24 CU 200 elements

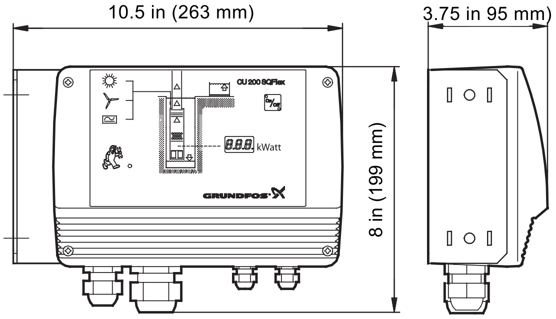

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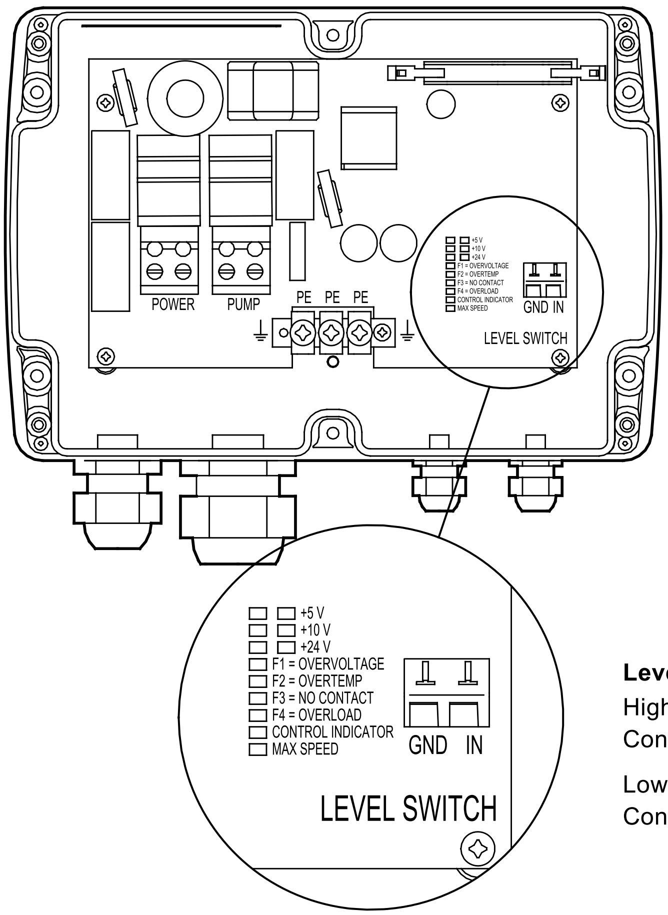
Fig. 25 CU 200, dimensional sketch



Level switch input

High water level:
Contact is closed.

Low water level:
Contact is open.

Fig. 26 Electrical connections, CU 200

IO 50 SQFlex switch box

Product	Product number
IO 50 SQFlex	96959028

The IO 50 is designed specifically for solar-powered SQFlex systems.

The IO 50 enables manual starting and stopping of the pump in an SQFlex Solar system and functions as a connection box joining all necessary cables.

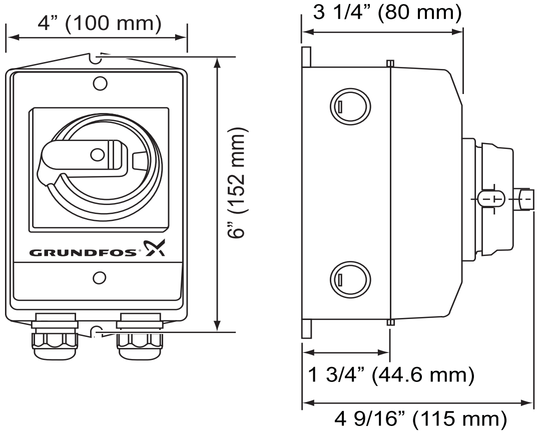
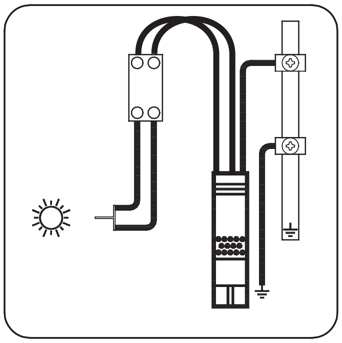


Fig. 27 IO 50, dimensional sketch



TM02 4058 4701

Fig. 28 Wiring diagram

IO 101 SQFlex switch box

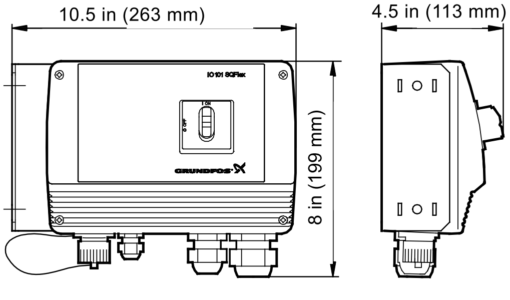
Product	Product number
IO 101 115 VAC SQFlex	96481502
IO 101 230 VAC SQFlex	96475074

The IO 101 is designed specifically for solar-powered SQFlex systems.

The IO 101 enables the connection of a back-up generator in case of insufficient solar energy. The switching between solar power and generator must be made manually.

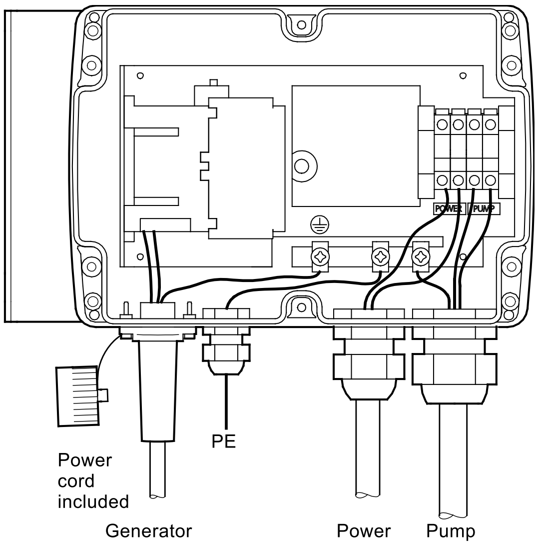
In case the generator is stopped manually or runs out of fuel, the IO 101 will automatically change over to the solar panels.

The IO 101 functions as a connection box joining all necessary cables.



TM02 2546 4003

Fig. 29 IO 101, dimensional sketch



TM02 4162 5001

Fig. 30 Electrical connections

IO 102 SQFlex breaker box

Product	Product number
IO 102 SQFlex for wind turbine	96475065

The IO 102 is designed specifically for wind-powered SQFlex systems.

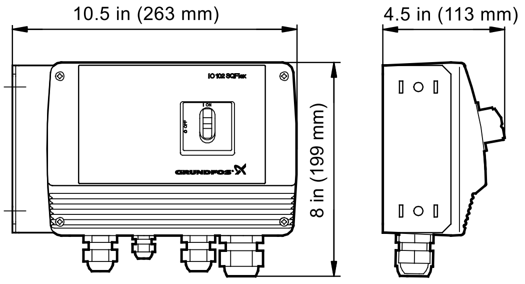
The IO 102 enables manual starting and stopping of the pump in an SQFlex Wind system or an SQFlex Combo system.

The on/off switch has a built-in "electrical brake" for the turbine. When the switch is in "off" position, the turbine stops or slows down.

The IO 102 rectifies the three-phase AC voltage from the wind turbine into DC voltage.

Furthermore, the IO 102 enables the combination of wind energy from the wind turbine and solar energy from the solar panels.

The IO 102 functions as a connection box joining all necessary cables.



TM02 4232 4003

Fig. 31 IO 102, dimensional sketch

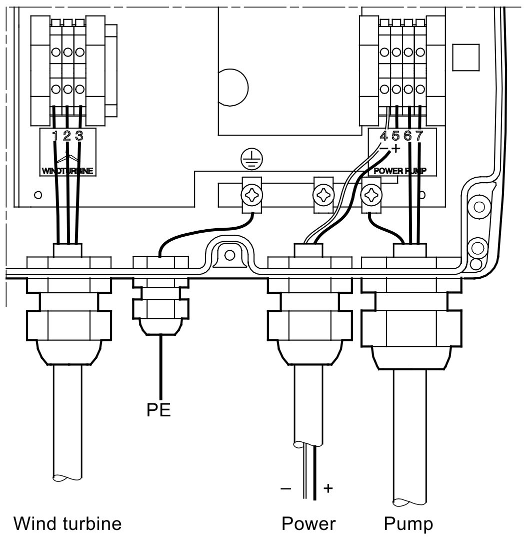


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Fig. 32 Electrical connections

Charge controller

Product	Product number
Charge controller	96023194

The charge controller is used when a battery backup system is installed with an SQFlex pumping system. These systems are typically used in applications where the pump is not running during most of the peak sun hours of the day, or where it is impossible or impractical to store large volumes of water. Examples include remote homes or cabins, automatic livestock waterers and very low-yielding wells.

The charge controller is a fully automatic battery charger and the only setting required is the selection of battery type.

There are three battery types to choose from:

- gel battery
- sealed battery
- flooded battery.

The charge controller enables manual disconnection of the pump, the solar modules or both at the same time.

Submersible drop cables

The submersible drop cables for SQF pumps are approved for use with potable water (KTW-approved). The cables are made of EPR (ethylene-propylene rubber).

Sizing of cable

Use the following formula:

$$L = \frac{\Delta P \times q \times V_{mp}^2}{Wp \times 0.00162} [ft]$$

where

L = Length of cable [ft]

ΔP = Power loss [%]

q = Cross section of submersible drop cable [in^2]

V_{mp} = Maximum power voltage [V]

Wp = Watt peak [Wp]

The sizing tool in Grundfos WinCAPS makes it possible to calculate the exact losses.

BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

L-SP-TL-014 1211

US

Repl. Rev. 0809

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

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

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

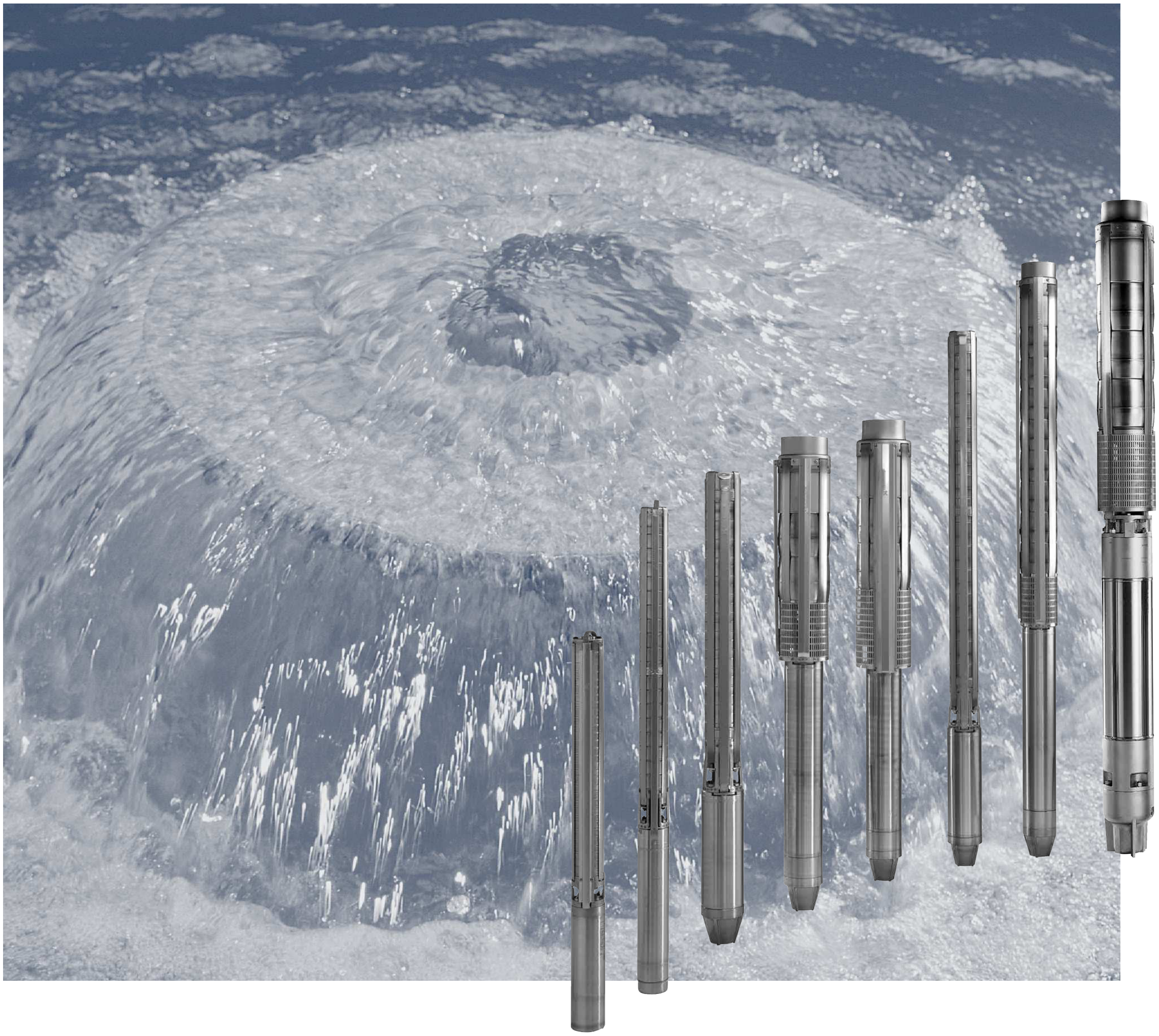
TW-60 Water Treatment System

section 10

GRUNDFOS **PRODUCT GUIDE**

SP

Submersible pumps, motors, and accessories
60 Hz



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GRUNDFOS®

1. Product introduction **3**
Introduction 3
Applications 3
Features and benefits 3
Identification 8

2. Product overview **9**
Performance range 60 Hz 9
Pump range 10
Motor range 10
Motor protection and controllers 10

3. Construction **11**

4. Operating conditions **18**
Operating conditions 18
Curve conditions 18

5. How to read the curve charts **19**

6. Curve charts and technical data **20**
7S (7 gpm) 22
10S (10 gpm) 24
16S (16 gpm) 26
25S (25 gpm) 28
40S (40 gpm) 30
60S (60 gpm) 32
75S (75 gpm) 34
85S (85 gpm) 36
150S (150 gpm) 42
230S (230 gpm) 48
300S (300 gpm) 54
385S (385 gpm) 60
625S (625 gpm) 70
800S (800 gpm) 75
1100S (1100 gpm) 80
Electrical data 85

7. Accessories **86**
MP 204 86
Control functions 89
G100 gateway for communication with Grundfos products 92
Connecting pieces 94
Zinc anodes 95
SA-SPM 5 control boxes 95
Pt100 97

8. Energy consumption **98**
Energy consumption of submersible pumps 98

9. Cables **99**
Cable sizing chart 100

10. Friction loss tables **102**

11. Further product documentation **104**
WebCAPS 104
WinCAPS 105

1. Product introduction

Introduction

The Grundfos SP range of submersible pumps is renowned for high efficiency and reliability. Made entirely of corrosion resistant stainless steel, SP pumps are ideal for a wide variety of applications.

Grundfos SP pumps represent state-of-the-art hydraulic design. Built to deliver optimum efficiency during periods of high demand, SP pumps provide low long-term costs and high operating reliability regardless of the application.

The SP range offers high efficiency, high resistance to sand and other abrasives, motor burnout protection, and easy maintenance. A complete monitoring and control system is available for constant optimization of the pumping system.

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Fig. 1 Grundfos SP pumps

Applications

Grundfos Large SP submersible pumps are suitable for:

- Groundwater supply to waterworks
- Irrigation in horticulture and agriculture
- Groundwater lowering (dewatering)
- Pressure boosting
- Industrial applications
- Domestic water supply.

Pumped liquids

Grundfos SP pumps are suitable for pumping clean, thin, non-aggressive liquids without solid particles or fibers.

SP offers stainless steel construction which ensures good wear resistance and a reduced risk of corrosion where the water has minor chloride content.

Optional, upgraded stainless steel construction is available for pumping more aggressive liquids:

A complete range of zinc anodes for cathodic protection is available; see p. 97 for applications (for example, sea water applications).

For slightly polluted liquids (for example, containing oil), Grundfos offers a complete range of stainless steel SP NE pumps with all rubber parts made of FKM.

Features and benefits

Grundfos SP submersible pumps offer these features and benefits:

- State-of-the-art hydraulics provide high efficiency and low operating costs
- 100 % stainless steel components inside and outside for long service life
- Sand resistant
- Resistant to aggressive water
- Dry-running protection
- Monitoring, protection and communication via protection unit MP204, and remote control, R100.

A wide pump range

Grundfos offers energy-efficient SP submersible pumps with a performance range of up to 1,400 gpm and 2,100 ft of head.

The pump range consists of many pump sizes, and each pump size is available with an optional number of stages to match any duty point.

High pump efficiency

Often pump efficiency is given less consideration than the price of a pump; however, owners who choose efficiency will find substantial savings in energy costs over time. See fig. 2 for an illustration of SP efficiencies in relation to flow.

Example

For example, a pump and motor with a 10 % higher efficiency than a cheaper, less efficient pump, can save its owner more than $80,000.00 over 10 years*.

* If producing 880 gpm at 325 ft of head for 10 years @ 13.8 cents per kWh. U.S. kWh costs range from 6 cents to more than 20 cents, depending on region.

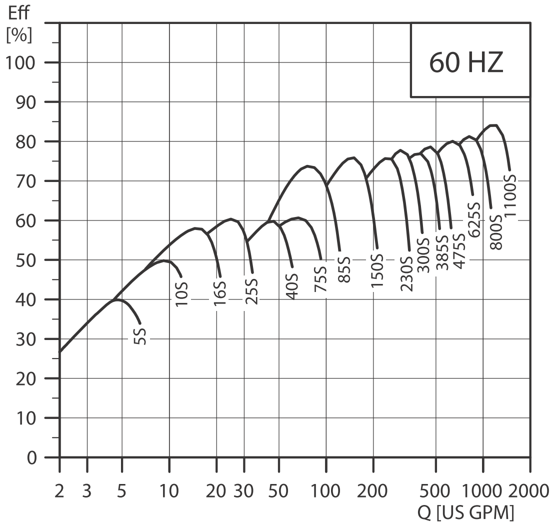

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Fig. 2 SP pump/motor efficiencies in relation to flow

Pump design

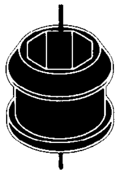
Grundfos SP submersible pumps feature components that contribute to the superior performance and durability of the range.

Lower installation costs

Stainless steel means low weight for ease in the handling of pumps, resulting in lower equipment costs and reduced installation and service time.

Bearings with sand channels

All bearings are water-lubricated and have a squared shape enabling sand particles, if any, to leave the pump together with the pumped liquid.

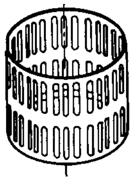


TM00 7301 1096

Fig. 3 Bearing

Inlet strainer

The inlet strainer prevents particles over a certain size from entering the pump.



TM00 7302 1096

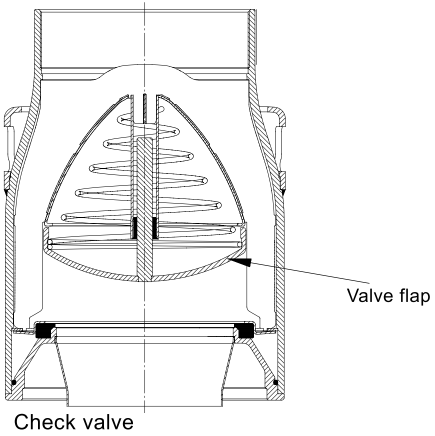
Fig. 4 Fig. Inlet strainer

Non-return valve

All pumps are equipped with a reliable check valve in the valve casing preventing back flow in connection with pump stoppage.

Furthermore, the short closing time of the check valve means that the risk of destructive water hammer is reduced to a minimum.

The valve casing is designed for optimum hydraulic properties to minimize the pressure loss across the valve and thus to contribute to the high efficiency of the pump.



TM01 2499 1798

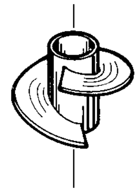
Fig. 5 Check valve

Priming screw

All Grundfos 4" pumps are fitted with a priming screw. Consequently, dry running is prevented, because the priming screw will make sure that pump bearings are always lubricated.

Due to the semi-axial impellers of large SP pumps this priming is provided automatically.

However, it applies to all pump types that if the water table is lowered to a level below the pump inlet neither pump nor motor will be protected against dry running.



TM00 7304 1096

Fig. 6 Priming screw

Stop ring

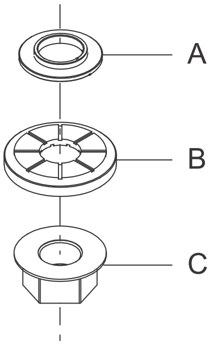
The stop ring prevents damage to the pump during transport and in case of up-thrust in connection with start-up.

The stop ring, which is designed as a thrust bearing, limits axial movements of the pump shaft.

Example: SP 385S

The stationary part of the stop ring (A) is secured in the upper intermediate chamber.

The rotating part (B) is fitted above the split cone (C).



TM01 3327 0412

Fig. 7 Stop ring (rotating and stationary part) and the split cone

Grundfos submersible motors

A complete motor range

Grundfos offers a complete submersible motor range in different voltages. For an overview of motor types, sizes and voltages, see page 85.

MS 402 is designed for the domestic ground water market and covers outputs. The MS 4000 and MS6 series are designed for use in a variety of applications in water supply. When equipped with features like oversized motor, temperature measurement, cooling jacket, and SiC/SiC mechanical shaft seals, these motors are suitable for heavy-duty industrial applications such as dewatering operations.

As a standard, all external surfaces of the Grundfos MS motors in contact with water are made of AISI 304 stainless steel. For aggressive water, such as seawater or brackish water, R-versions made of AISI 904 are available.

Grundfos rewindable MMS motor range

Grundfos MMS motors are suitable for any submersible installation, including heavy-duty industrial applications and dewatering operations (when equipped with temperature control, oversized motor, cooling jacket, and SiC/ SiC mechanical shaft seals).

As a standard the MMS motors are supplied with black cast-iron end-bells. Optionally, the range is available in all-stainless steel AISI 316 or AISI 904 versions.

The 2-pole Grundfos MMS submersible motors are all easy to rewind. The windings of the stator are made of a special water-proof wire of pure electrolytic copper sheathed with special non-hydroscopic thermoplastic material. The fine dielectric properties of this material allow direct contact between the windings and the liquid for efficient cooling of the windings.

TM00 7305 1096 - GrA4011 - GrA4013

Fig. 8 Grundfos MS motors

TM01 7873 4799

Fig. 9 Grundfos MMS motors

Industrial submersible motors and MS6 T60-versions

For heavy-duty applications Grundfos offers a complete motor range of industrial motors with up to 5 % higher efficiency than that of Grundfos' standard motors. The industrial motors are available in sizes as from 3 Hp up to 30 Hp.

The cooling of the motor is very efficient due to the large motor surface. The efficient cooling makes it possible to increase the liquid temperature to 140 °F (60 °C) at a minimum flow of 0.49 ft/s (0.15 m/s) past the motor.

The industrial motors are for customers who value low operating costs and long life higher than price.

Grundfos industrial motors are developed for difficult operating conditions. These motors will stand a higher thermal load than standard motors and thus have a longer life when subjected to high load. This applies whether the high load is caused by bad power supply, hot water, bad cooling conditions, high pump load etc.

Please note that heavy duty motors are longer than motors for standard conditions.

Overtemperature protection

Accessories for protection against overtemperature are available for both Grundfos MS and MMS submersible motors. When the temperature becomes too high, the protection device will cut out and damage to the pump and motor be avoided.

Restart of the motor after cut-out can be achieved in two ways:

- manual restart
- automatic restart.

Automatic restart means that the MP 204 attempts to restart the motor after 15 minutes. If the first attempt is not successful, restarting will be reattempted at 30-minute intervals.

MS

The Grundfos MS submersible motors (with the exception of MS 402) are available with a built-in Tempcon temperature transmitter for protection against overtemperature. By means of the transmitter, it is possible to read out and/or monitor the motor temperature via an MP 204 or a PR 5714 relay.

The Grundfos MS6 submersible motors can be fitted with a Pt100. The Pt100 is fitted in the motor and connected directly to the MP 204 or monitored by the PR 5714 relay.

MMS

For the protection of the Grundfos MMS submersible motors against overtemperature Grundfos offers the Pt100 temperature sensor as an optional extra.

The Pt100 is fitted in the motor and connected directly to the MP 204 or monitored by the PR 5714 relay.

Protection against upthrust

In case of a very low counter pressure in connection with start-up there is a risk that the entire chamber stack may rise. This is called upthrust. Upthrust may damage both pump and motor. Both Grundfos pumps and motors are protected against upthrust as standard, preventing upthrust from occurring during the critical start-up phase. The protection consists of either a built-in stop ring or hydraulic balancing.

Built-in cooling chambers

In all Grundfos MS submersible motors, efficient cooling is ensured by cooling chambers at the top and at the bottom of the motor, and by an internal circulation of motor liquid.

See fig. 10. As long as the required flow velocity past the motor is maintained, cooling of the motor will be efficient.

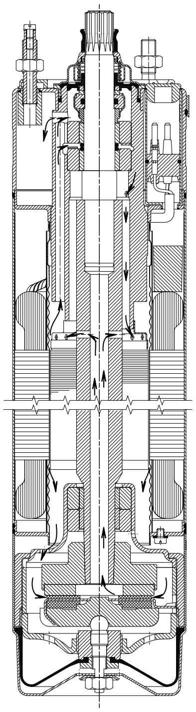


Fig. 10 MS 4000

Lightning protection

The smallest Grundfos submersible motors, such as the MS 402, are all insulated in order to minimize the risk of motor burnout caused by lightning strike.

Reduced risk of short-circuit

The embedded stator winding in the Grundfos MS submersible motor is hermetically enclosed in stainless steel. The result is high mechanical stability and optimum cooling. Also, this eliminates the risk of short-circuit of the windings caused by water condensation.

Shaft seal

MS 402

The shaft seal is of the lip seal type characterized by low friction against the rotor shaft.

The rubber material offers good wear resistance, good elasticity and resistance to particles, and it is approved for use in drinking water.

MS 4000, MS6

The material is ceramic/tungsten carbide providing optimum sealing, optimum wear resistance and long life.

The spring loaded shaft seal is designed with a large surface and a sand shield. The result is a minimum exchange of pumped and motor liquids and no penetration of particles.

Motors, version R, are supplied with a SiC/SiC shaft seal. Other combinations are available request. See fig. 11 and fig. 12 for an illustration of shaft seal components and configuration.

MMS rewindable motors

The standard shaft seal is a ceramic/carbon mechanical shaft seal. The shaft seal is replaceable.

The material features good wear resistance and resistance to particles.

Together with the shaft seal housing, the sand shield forms a labyrinth seal, which during normal operating conditions prevents penetration of sand particles into the shaft seal.

On request, motors can be supplied with a SiC/SiC seal.

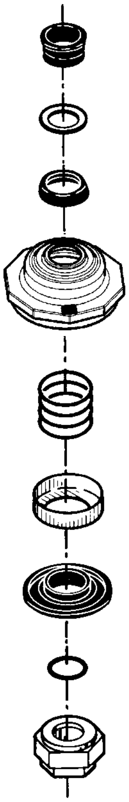


Fig. 11 Shaft seal, MS 4000

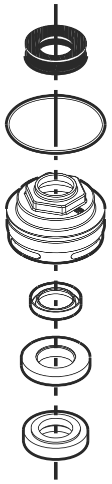


Fig. 12 Shaft seal, MS6

Identification

Type key, SP pumps

Example 475 S 500 - 5 - A B

Rated flow rate in gpm

Type range
Stainless steel parts of material
S= AISI 304
N= AISI 316
R= AISI 904L

Hp of motor

Number of impellers

First reduced-diameter impeller (A, B or C)

Second reduced-diameter impeller (A, B or C)

Type key, MS 4000 motors

Example MS 4 000 R

Motor submersible

Min. borehole
diameter in inches

Generation

- = Stainless steel AISI 304
R = Stainless steel AISI 904L
I = Stainless steel AISI 304 + De-rated
RE = Stainless steel AISI 904 L + FKM
EI = Stainless steel AISI 304 + De-rated + FKM

Type key, MS 402 motors

Example MS 4 02

Motor submersible

Min. borehole
diameter in inches

Generation

- = Stainless steel AISI 304

Type key, MMS motors

Example MMS 6 000 N

Type range

Min. borehole
diameter in inches

Generation

Material:
= Cast iron EN-JL1040
N = DIN/EN 1.4401 (AISI 316)

Type key, MS6 motors

Example MS 6 R E S W D T60

Type range
(**M**otor **S**ubmersible)

Motor diameter in inches

Material
- Blank = stainless steel EN 1.4301 (AISI 304)
- R = stainless steel EN 1.4539 (AISI 904L)

Rubber parts
- Blank = NBR
- E = FKM

Shaft seal
- Blank = ceramics/carbon
- S = SiC/SiC

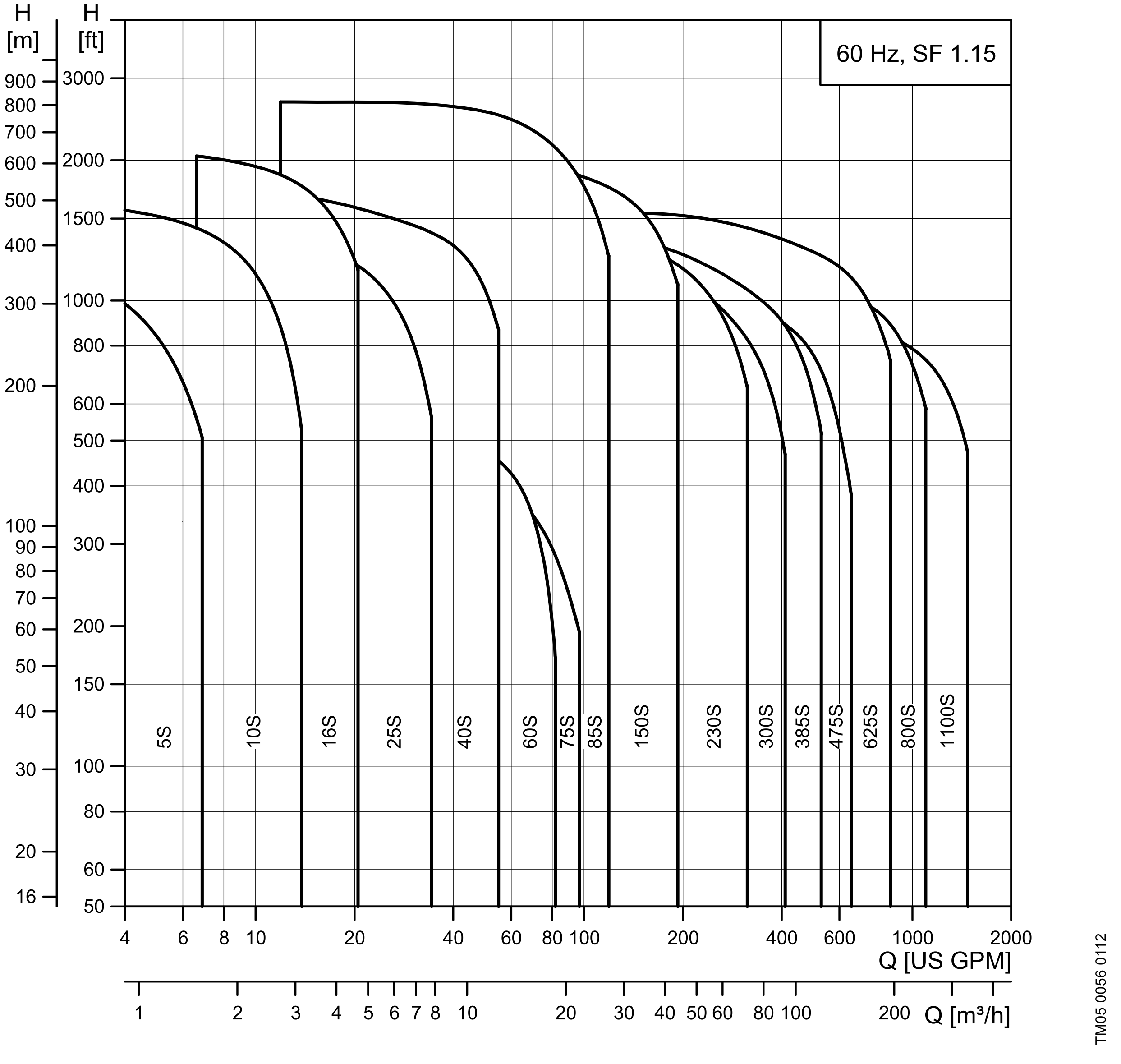
Radial bearings
- Blank = carbon/stainless steel
- W = SiC/tungsten carbide

Motor liquid
- Blank = SML-3
- D = demineralized water

Maximum liquid temperature
- T30 = 86 °F (30 °C)
- T60 = 140 °F (60 °C)

2. Product overview

Performance range 60 Hz



Pump range

Type	5S	10S	16S	25S	40S	60S	75S	85S	150S	230S	300S	385S	475S	625S	800S	1100S
AISI 304 stainless steel	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
AISI 316 stainless steel			●	●	●		●	●	●	●	●	●	●	●	●	●
AISI 904L stainless steel				●	●			●	●	●	●	●	●	●	●	●
Connection ★ NPT	1"	1.25"	1.25"	1.5"	2"	2"	2"	(3")	(3")	3" (4")	3" 4"	5"	5"	6"	6"	6"
Flange connection: Grundfos flange												5"	5"	6"	6"	6"

★ Figures in brackets ( ) indicate connection for pumps with sleeve.

Motor range

Motor output [hp]	0.5	0.75	1.0	1.5	1.5	3.0	5.0	7.5	10.0	15	20	25	30	40	50	60	75	100	125	150	175	200	250
Single-phase	●	●	●	●	●	●																	
Three-phase	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Industrial motor and MS6 T60-versions						●	●	●	●	●	●	●	●										
Rewindable motor							●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Steel: AISI 304	●	●	●	●	●	●	●	●	●	●	●	●	●	●									
Steel: AISI 304 and cast iron							●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Steel: AISI 316							●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Steel: AISI 904L			●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●			
Built-in temperature transmitter in motor			●	●	●	●	●	●	●	●	●	●	●	●									

Direct-on-line starting is recommended up to 100 hp.
Soft starter or autotransformer is recommended above 100 hp.
Motors with star/delta are available from 7.5 hp.

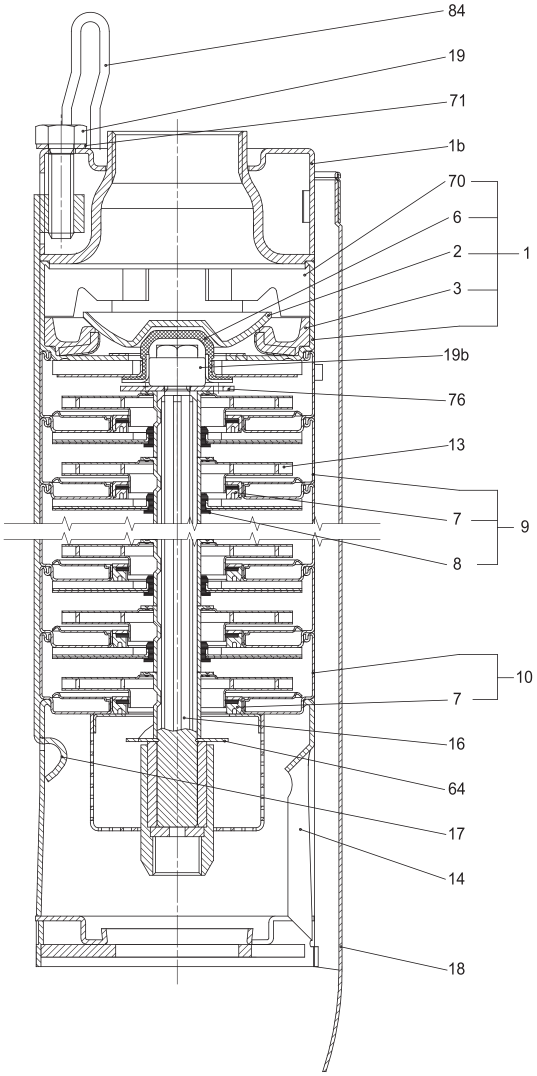
Motor protection and controllers

Motor output [hp]	0.5	0.75	1.0	1.5	1.5	3.0	5.0	7.5	10.0	15	20	25	30	40	50	60	75	100	125	150	175	200	250
MP 204	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Pt100							●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Zinc anode				●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Vertical flow sleeve	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Horizontal flow sleeve	●	●	●	●	●	●		●	●	●	●	●	●	●									
SA-SPM	●	●	●	●	●	●	●																
R100	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
RS-485 communication module	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
G100	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Motor protection of single-phase motors, see page 85.

3. Construction

Sectional drawing, SP pump, 4"



TM00 5606 1907

Fig. 13 SP pump, 4"

Material specification, SP pump, 4"

Pos.	Component	Materials	Standard
			AISI
1	Valve casing	Stainless steel	304
1b	Discharge piece	Stainless steel	304
2	Valve cup	Stainless steel	304
3	Valve seat	Stainless steel/NBR	304
6	Top bearing	NBR	
7	Neck ring	NBR/PBT	
8	Intermediate ring	NBR	
9	Intermediate chamber	Stainless steel	304
10	Bottom intermediate chamber	Stainless steel	304
13	Impeller	Stainless steel	304
14	Suction interconnector	Stainless steel	304
16	Shaft	Stainless steel	304
17	Strap	Stainless steel	304
18	Cable guard	Stainless steel	304
19	Hexagon screw	Stainless steel	304
19a	Nut	Stainless steel	316
19b	Nut	Stainless steel	304
20	Motor cable		
64	Priming disc	Stainless steel	304
70	Valve guide	Stainless steel	304
71	Washer for pos. 19	Stainless steel	316
76	Washer	Stainless steel	304
78	Nameplate	Stainless steel	316
84	Hook	Stainless steel	304

4. Operating conditions

Operating conditions

Flow rate, Q: 0.44 - 1475 gpm (0.1-335 m^3/h).

Head, H: Maximum 2657 ft (810 m).

Maximum liquid temperature

Motor	Installation		
	Flow velocity past motor	**Vertical [°F (°C)]**	**Horizontal [°F (°C)]**
Grundfos MS 4"and MS6 T30-versions	0.49 ft/s (0.15 m/s)	86 (30)	86 (30)
Grundfos 4" MS industry versions	0.49 ft/s (0.15 m/s)	140 (60)	140 (60)
Grundfos MS6 T60-versions	3.28 ft/s (1.0 m/s)	140 (60)	140 (60)
Grundfos MMS 6" to 12" rewindable with PVC in the windings	0.49 ft/s (0.15 m/s)	77 (25)	77 (25)
	1.64 ft/s (0.50 m/s)	86 (30)	86 (30)
Grundfos MMS 6" to 12" rewindable with PE/PA in the windings	0.49 ft/s (0.15 m/s)	104 (40)	104 (40)
	1.64 ft/s (0.50 m/s)	113 (45)	113 (45)

Note: Note: For MMS 6000, 0.5 hp; MMS 8000, 150 hp; the maximum liquid temperature is 9 °F (5 °C) lower than the values stated in the table. For MMS 10000, 250 hp, the temperature is 18 °F (10 °C) lower.

Operating pressure

Motor	Maximum operating pressure
Grundfos MS 4" and 6"	870 psi (6 Mpa) (60 bar)
Grundfos MMS 6" to 10" rewindable	

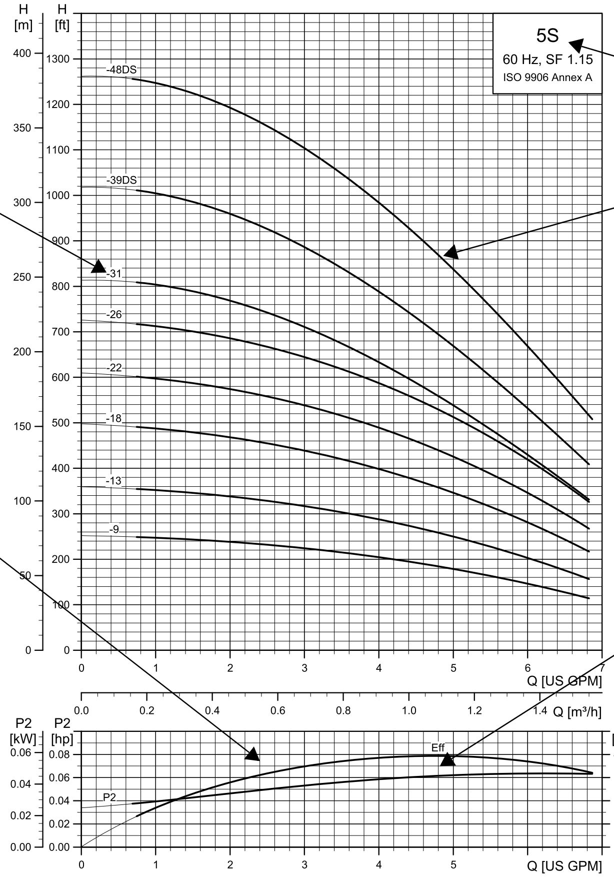
Curve conditions

The conditions below apply to the curves shown on pages 20 - 84:

General

- Curve tolerances according to ISO 9906, Annex A.
- The performance curves show pump performance at actual speed, cf. standard motor range.
  The speeds of the motors are approximately these:
  4" motors: $n = 3470\ \text{min}^{-1}$
  6" motors: $n = 3460\ \text{min}^{-1}$
  8" to 10" motors: $n = 3525\ \text{min}^{-1}$
- The measurements were made with airless water at a temperature of 68 °F (20 °C). The curves apply to a kinematic viscosity of 1 mm^2/s (1 cSt). When pumping liquids with a density higher than that of water, use motors with correspondingly higher outputs.
- The **bold** curves indicate the recommended performance range.
- The performance curves are inclusive of possible losses such as non-return valve loss.
- **Q/H:** The curves are inclusive of valve and inlet losses at the actual speed.
  Operation without non-return valve will increase the actual head at rated performance by 0.5 to 1.0 m.
- **NPSH:** The curve is inclusive of pressure loss in the suction interconnector and shows required inlet pressure.
- **Power curve:** P_2 shows pump power input at the actual speed of each individual pump size.
- **Efficiency curve:** Eta shows pump stage efficiency. If Eta for the actual pump size is needed, please consult WinCAPS or WebCAPS.

5. How to read the curve charts



Pump type, number of poles and frequency.

Number of stages.
First figure: number of stages; second figure: number of reduced-diameter impellers.

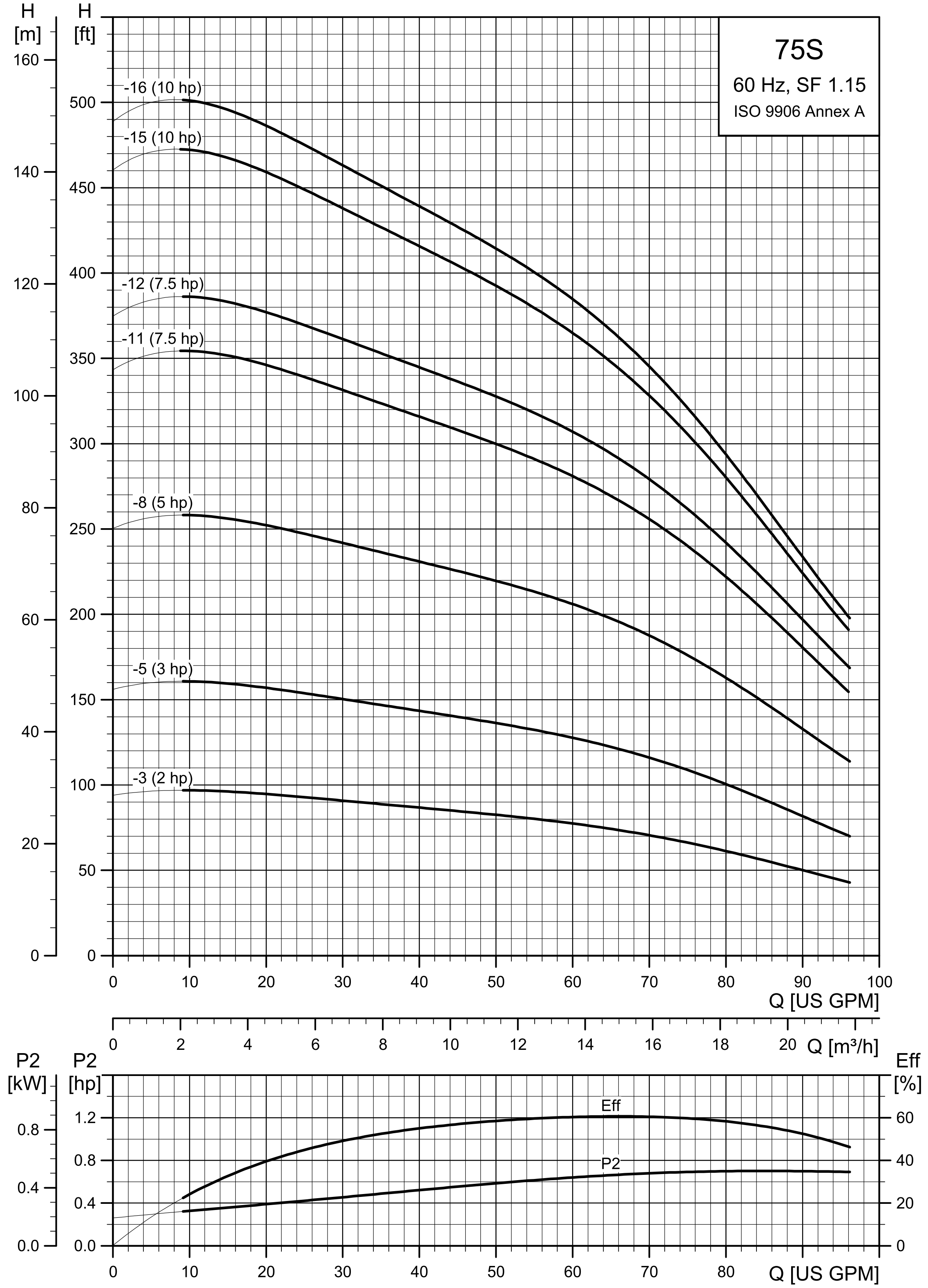
QH curve for the individual pump. The **bold** curves indicate the **recommended** performance range for best efficiency.

The efficiency curve shows the efficiency of the pump. The efficiency curve is an average curve of all the pump types shown in the chart.
The efficiency of pumps with reduced-diameter impellers is approx. 2 % lower than the efficiency curve shown in the chart.

The power curves indicate pump input power **per stage**. Curves are shown for complete (1/1) and for reduced-diameter (2/3) impellers.

TM05 0229 10112

75S (75 gpm)


75S
60 Hz, SF 1.15
ISO 9906 Annex A
H [m]
H [ft]
-16 (10 hp)
-15 (10 hp)
-12 (7.5 hp)
-11 (7.5 hp)
-8 (5 hp)
-5 (3 hp)
-3 (2 hp)
0
20
40
60
80
100
120
140
160
0
50
100
150
200
250
300
350
400
450
500
0
10
20
30
40
50
60
70
80
90
100
Q [US GPM]
0
2
4
6
8
10
12
14
16
18
20
Q [m³/h]
P2 [kW]
P2 [hp]
Eff [%]
Eff
P2
0.0
0.4
0.8
0.0
0.4
0.8
1.2
0
20
40
60
Q [US GPM]

TM05 0234 1812

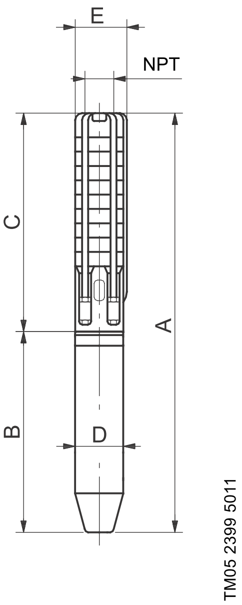
75S (75 gpm)

Pump model	Nom. head [ft]	Ph	Volts [V]	Motor [Hp]		Dimensions					Net weight (complete) [lb]
						A [in (mm)]	B [in (mm)]	C [in (mm)]	D [in (mm)]	E [in (mm)]	
75S - Motor dia. 4 inch, 3 wire motor, 60 Hz, rated flow 75 gpm (2" NPT)											
75S20-3	68	1	230	2	●	34.45 (875)	19.49 (495)	14.97 (380)	3.74 (95)	3.97 (101)	36.9
		3	230	2	■	28.67 (728)	13.71 (348)	14.97 (380)	3.74 (95)	3.97 (101)	34.2
			460	2	■	28.67 (728)	13.71 (348)	14.97 (380)	3.74 (95)	3.97 (101)	34.2
75S30-5	114	1	230	3	●	42.68 (1084)	22.60 (574)	20.08 (510)	3.74 (95)	3.97 (101)	69.3
		3	230	3	●	38.08 (967)	18.00 (457)	20.08 (510)	3.74 (95)	3.97 (101)	57.6
			460	3	●	38.08 (967)	18.00 (457)	20.08 (510)	3.74 (95)	3.97 (101)	57.6
75S50-8	182	1	230	5	●	54.38 (1381)	26.62 (676)	27.76 (705)	3.74 (95)	3.97 (101)	87.3
		3	230	5	●	50.48 (1282)	22.72 (577)	27.76 (705)	3.74 (95)	3.97 (101)	74.7
			460	5	●	50.48 (1282)	22.72 (577)	27.76 (705)	3.74 (95)	3.97 (101)	74.7
75S75-12	273	3	230	7.5	●	64.65 (1642)	26.66 (677)	38.00 (965)	3.74 (95)	3.97 (101)	81.4
			460	7.5	●	64.65 (1642)	26.66 (677)	38.00 (965)	3.74 (95)	3.97 (101)	81.4
75S100-16	364	3	460	10	●	78.82 (2002)	30.60 (777)	48.23 (1225)	3.74 (95)	3.97 (101)	138.0
75S - Motor dia. 6 inch, 3 wire motor, 60 Hz, rated flow 75 gpm (2" NPT)											
75S75-11	250	3	230	7.5	▲	60.12 (1527)	22.25 (565)	37.88 (962)	5.63 (143)	5.43 (138)	130.5
			460	7.5	▲	60.12 (1527)	22.25 (565)	37.88 (962)	5.63 (143)	5.43 (138)	130.5
75S100-15	341	3	230	10	▲	70.16 (1782)	23.23 (590)	46.93 (1192)	5.63 (143)	5.43 (138)	175.5
			460	10	▲	70.16 (1782)	23.23 (590)	46.93 (1192)	5.63 (143)	5.43 (138)	175.5

Notes:
Control box is required for 3-wire, single-phase applications. Data does not include control box.
Performance conforms to ISO 9906. 1999 (E) Annex A. Minimum submergence is 5 feet.

■ MS402 motor.
● MS4000 motor.
▲ MS6 motor.
∧ MMS6000 motor.
★ MMS8000 motor.
♦ Takes MS6 motor; not available as complete.
☼ Takes MMS6000 motor; not available as complete.
* Takes MMS8000 motor; not available as complete.
† Takes MMS10000 motor; not available as complete.

75S



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

7. Accessories

MP 204

The MP 204 is an electronic motor protector, designed for the protection of an asynchronous motor or a pump.

The motor protector consists of:

- a cabinet incorporating transformers and electronics
- a control panel with operating buttons and display for reading of data.

The MP 204 operates with two sets of limits:

- a set of warning limits and
- a set of trip limits.

If one or more of the warning limits are exceeded, the motor continues to run, but the warnings will appear in the MP 204 display.

Some values only have a warning limit.

The warning can also be read out by means of the Grundfos R100 remote control.

If one of the trip limits is exceeded, the trip relay will stop the motor. At the same time, the signal relay is operating to indicate that the limit has been exceeded.

Applications

The MP 204 can be used as a stand-alone motor protector.

The MP 204 can be monitored via a Grundfos GENIbus.

The power supply to the MP 204 is in parallel with the supply to the motor. Motor currents up to 120 A are passed directly through the MP 204. The MP 204 protects the motor primarily by measuring the motor current by means of a true RMS measurement. The MP 204 disconnects the contactor if, for example, the current exceeds the preset value.

Secondarily, the motor is protected via temperature measuring by a Tempcon sensor, a Pt100/Pt1000 sensor and a PTC sensor/thermal switch.

The MP 204 is designed for single- and three-phase motors. In single-phase motors, the starting and run capacitors are also measured. Cos φ is measured in both single- and three-phase systems.

Benefits

The MP 204 offers these benefits:

- Suitable for both single- and three-phase motors
- Dry-running protection
- Overload protection
- Very high accuracy
- Made for submersible pumps.

Many monitoring options

The MP 204 monitors the following parameters:

- Insulation resistance before start-up
- Temperature (Tempcon, Pt sensor and PTC/thermal switch)
- Overload/underload
- Overvoltage/undervoltage
- Phase sequence
- Phase failure
- Power factor
- Power consumption
- Harmonic distortion
- Operating hours and number of starts.

TM03 1471 2205

Fig. 21 MP 204

Five sizes of single-turn transformers, 120-999 A.
Note: Monitoring of motor temperature is not possible when single-turn transformers are used.

TM03 2033 3505

Fig. 22 Single-turn transformers

Product numbers

Product	Product number
MP 204	96079927
R100	625333

Functions

- Phase-sequence monitoring
- Indication of current or temperature (user selection)
- Indication of temperature in °F or °C (user selection)
- 4-digit, 7-segment display
- Setting and status reading with the R100
- Setting and status reading via the GENIbus.

Tripping conditions

- Overload
- Underload (dry running)
- Temperature (Tempcon sensor, PTC/thermal switch and Pt sensor)
- Phase failure
- Phase sequence
- Overvoltage
- Undervoltage
- Power factor (cos φ)
- Current unbalance.

Warnings

- Overload
- Underload
- Temperature (Tempcon and Pt sensor)
- Overvoltage
- Undervoltage
- Power factor (cos φ)
  Note: In connection with single- and three-phase connection.
- Run capacitor (single-phase operation)
- Starting capacitor (single-phase operation)
- Loss of communication in network
- Harmonic distortion.

Learning function

- Phase sequence (three-phase operation)
- Run capacitor (single-phase operation)
- Starting capacitor (single-phase operation)
- Identification and measurement of Pt100/Pt1000 sensor circuit.

External current transformers

When fitted with external current transformers, the MP 204 unit can handle currents from 120 to 999 A. Grundfos can supply approved current transformers from stock (200/5A, 300/5A, 500/5A, 750/5A, 1000/5A).

Remote control R100

The R100 remote control from Grundfos allows for wireless infrared remote control of your MP 204 unit.

With the R100, you get access to a full range of options such as factory setting adjustment, service and fault finding.

Ready for bus communication

The MP 204 allows for monitoring and communication via GENIbus — a Grundfos-designed bus for exchange of pump data, alarms, status information, and setpoints. This enables users to connect the MP 204 to, for instance, SCADA systems.

Technical data - MP 204

Enclosure class	IP 20
Ambient temperature	–4 °F to +140 °F (–20 °C to +60 °C)
Relative air humidity	99%
Voltage range	100-480 VAC
Current range	3-999 A
Frequency	50 to 60 Hz
IEC trip class	1-45
Special Grundfos trip class	0.1 to 30 s
Voltage variation	–25 %/+15 % of nominal voltage
Approvals	EN 60947, EN 60335, UL/CSA 508
Marking	CE, cUL, C-tick
Consumption	Max. 5 W
Plastic type	Black PC / ABS

	Measuring range	Accuracy	Resolution
Current without external current transformers	3-120 A	±1 %	0.1 A
Current with external current transformers	120-999 A	±1 %	1 A
Phase-to-phase voltage	80-610 VAC	±1 %	1 V
Frequency	47-63 Hz	±1 %	0.5 Hz
Power	0-1 MW	±2 %	1 W
Power factor	0-0.99	±2 %	0.01
Energy consumption	0-4x10^9 kWh	±5 %	1 kWh

IO 112	Description	Product number
	The IO 112 is a measuring module and a 1-channel protection unit for use in connection with the MP 204 motor protection unit. The module can be used for protection of pump against other factors than the electrical conditions, for instance dry-running. It can also be used as a stand-alone protection module. The IO 112 interface has three inputs for measured values one potentiometer for setting of limits indicator lights indicating the • measured value of the input • value of the limit set • alarm source • pump status. **Electrical data:** • Supply voltage: 24 VAC ±10% 50/60 Hz or 24 VDC ±10% • Supply current: Min. 2.4 A; max. 8 A • Power consumption:Max. 5 W Ambient temperature: –13 °F to+149 °F (–25 °C to +65 °C) • Enclosure class: IP 20	96651601

Control functions

This table describes the protection provided by MP 204.

Control parameters	Function	Problem	Advantages
Temperature	**MS** The motor temperature is measured by means of the built-in Tempcon temperature transmitter and a signal is sent to MP 204 via the phase leads. In MP 204 the measured temperature is compared with the factory-set value (167 °F (75 °C)). **MMS** The motor temperature is measured by means of the Pt100. The signal is sent to the MP 204 where the measured temperature is compared with the factory-set value. Temperature protection requires a submersible motor with a Pt100. The motor temperature must be monitored during frequency converter operation.	Overload, frequent starts/stops, operation against blocked discharge pipe, insufficient flow velocity past the motor.	Longer motor life, safe operating conditions, service indication.
Overvoltage/ undervoltage	If the set trip value is exceeded, the motor will stop.	The installation is close to a transformer. The mains do not absorb load variations.	Important installation parameter, possibility of improving operating conditions.
Overload	The motor power input is measured on each of the three phases. The registered power input is an average of these three values. If the factory-set value is exceeded, the motor will stop.	Incorrect sizing of pump/motor, voltage supply failure, defective cable, blocking, wear or corrosion.	Longer pump life, safe operating conditions, service indication.
Underload (dry running)	The motor power input is measured on each of the three phases. The registered power input is an average of these three values. If the average value is lower than the factory-set value, the motor will stop.	Pump exposed to dry running or underload, for example caused by wear.	Traditional dry-running protection is no longer necessary, no extra cables.
Current unbalance	The power input of the motor is measured on each of the three phases.	Mains load is uneven, incipient motor defect, phase voltages diverging.	Motor protection against overload, service indication.
Phase sequence	MP 204 and motor are installed so that the phase sequence corresponds to correct direction of rotation. MP 204 monitors changes in the phase sequence.	Two phases are wrongly connected.	Ensures correct pump performance.
Phase failure	MP 204 checks the phases connected, phase failure will cause an alarm.	Phase failure	Indication of phase failure, and alarm.

R100 menus

0. GENERAL

See the operating instructions for the R100.

1. OPERATION

- Operating mode
- Actual trip
- Actual warning 1
- Actual warning 2
- Alarm log 1
- Alarm log 2
- Alarm log 3
- Alarm log 4
- Alarm log 5.

2. STATUS

Display of

- Supply overview
- Average current
- Average voltage
- Tempcon sensor
- Pt100/Pt1000 sensor
- *Power input and energy consumption* (described in the following)
- Energy trip counter
- Phase sequence
- Current unbalance
- Operating hours and number of starts
- Trip counter of hours and starts
- Starting capacitor
- Run capacitor
- Insulation resistance
- Cos φ
- Harmonic distortion.

3. LIMITS

Display and setting of warning and trip limits.

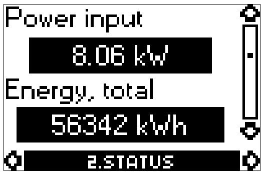
- Tempcon sensor
- Pt sensor
- Tripping current
- Current warning
- Nominal voltage
- Voltage limits
- Current unbalance
- Starting capacitor
- Run capacitor
- Insulation resistance
- Cos φ trip
- Cos φ warning.

4. INSTALLATION

Setting and display of

- Supply mains
- Trip class (described in the following)
- Trip delay
- External current transformers
- Power-on delay
- Restarting (described in the following)
- Automatic restarting (described in the following)
- Tempcon sensor
- Pt sensor
- Insulation resistance measurement
- PTC/thermal switch
- Resetting of trip counters
- Service interval
- Number of automatic restarts
- Units/display
- MP 204 display
- GENIbus ID number
- Learning function.

Power input and energy consumption



Power input

8.06 kW

Energy, total

56342 kWh

Actual input power and motor energy consumption.

The energy consumption is an accumulated value which cannot be reset.

The power is calculated like this:

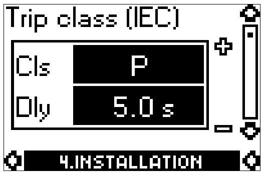
$$U_{average} = \frac{U_{L1-L2} + U_{L2-L3} + U_{L3-L1}}{3} [V]$$

$$I_{average} = \frac{I_{L1} + I_{L2} + I_{L3}}{3} [A]$$

$$\cos\varphi_{average} = \frac{\cos\varphi_{L1} + \cos\varphi_{L2} + \cos\varphi_{L3}}{3} [-]$$

$$P = (U_{average} \times I_{average} \times \sqrt{3} \times \cos\varphi_{average}) [W]$$

Trip class



Trip class (IEC)

Cls P

Dly 5.0 s

Line 1: Select IEC trip class (1 to 45).

If manual indication of trip delay in the case of overload is required, select trip class "P".

Factory setting:

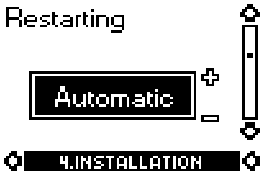
- Cls (trip class): P.

Line 2: Select trip delay.

Factory setting:

- Dly (trip delay): 10 s.

Restarting



Restarting

Automatic

Set whether restarting after tripping is to be

- *Automatic* (factory setting)
- *Manual*.

Setting of time, see section "Automatic restarting".

Automatic restarting

Autom. restarting

300 s

Set the time after which the MP 204 is to attempt automatic restarting of motor after cut-out.

The time runs from the moment when the value which triggered the fault has returned to normal.

Factory setting:

- 300 s.

9. Cables

Grundfos offers submersible drop cables for all applications: 3-core cable, 4-core cable, single leads.

Cables for Grundfos 4" submersible motors are available with or without plugs. The submersible drop cable is chosen according to application and type of installation.

Standard version:	Max. liquid temperature +140 °F +60 °C).
Hot water version:	Max. liquid temperature +158 °F (+70 °C), for short periods up to 194 °F (+90 °C) (for MS only).

Tables indicating cable dimension in borehole

The tables indicate the maximum length of drop cables in meters from motor starter to pump at direct-on-line starting at different cable dimensions.

If star/delta starting is used the current will be reduced by $\sqrt{3}$ (I x 0.58), meaning that the cable length may be $\sqrt{3}$ longer (L x 1.73) than indicated in the tables.

If for example the operating current is 10 % lower than the full-load current, the cable may be 10 % longer than indicated in the tables.

The calculation of the cable length is based on a maximum voltage drop of 1 % to 3 % of the rated voltage and a water temperature of maximum +86 °F (30 °C).

In order to minimize operating losses the cable cross section may be increased compared to what is indicated in the tables. This is economical only if the borehole provides the necessary space, and if the operational time of the pump is long, especially if the operating voltage is below the rated voltage.

The table values are calculated on the basis of the formula:

Max. cable length of a single-phase submersible pump:

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

Max. cable length of a three-phase submersible pump:

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

where

U = Rated voltage [V]

ΔU = Voltage drop [%]

I = Rated current of the motor [A]

q = Cross-section of submersible drop cable [in^2]

X_L = Inductive resistance: 0.024 x 10^{-3} [Ω/ft]

$\cos\varphi$= Power factor

$\sin\varphi = \sqrt{1 - \cos^2\varphi}$

ρ = Specific resistance: 9.5 X 10^{-6} [Ω in^2/ft]

Example

Motor size:	40 hp, MMS 8000
Rated current:	64.0 A
Rated voltage:	3 x 460 V, 60 Hz
Starting method:	Direct-on-line
Power factor:	$\cos\varphi$ = 0.85
Voltage drop:	3 %
Cross-section:	0.025 in^2
$\sin\varphi$:	0.53

$$= \frac{460 \times 3}{64.0 \times 1.73 \times 100 \times \left(0.85 \times \frac{0.0000095}{0.025} + 0.53 \times 0.024 \times 10^{-3}\right)}$$

L = 370 ft

Cable dimensions at 1 x 220 V, 60 Hz

Motor	hp	I_n [A]	0.002 in^2	0.004 in^2	0.006 in^2	0.009 in^2	0.016 in^2
4"	0.33	3.3	315	522	833	1243	2047
	0.50	4.4	239	397	630	938	1548
	0.75	6.6	157	262	417	620	1020
	1.00	7.7	121	203	321	482	797
	1.50	9.0	98	164	259	387	643

Maximum cable length in feet from motor starter to pump.

Cable sizing chart

1 phase, 60 Hz

Motor rating		Copper wire size												
Volts	Hp	14	12	10	8	6	4	2	0	00	000	0000	250	300
		Maximum motor cable length (motor service to entrance) [ft/m]												
115	0.33	130 (40)	210 (64)	340 (104)	540 (165)	840 (256)	1300 (396)	1960 (597)	2910 (887)					
	0.5	100 (30)	160 (49)	250 (76)	390 (119)	620 (189)	960 (293)	1460 (445)	2160 (658)					
	0.33	550 (168)	880 (268)	1390 (424)	2190 (668)	3400 (1036)	5250 (1600)	7960 (2426)						
	0.5	400 (122)	650 (198)	1020 (311)	1610 (491)	2510 (765)	3880 (1183)	5880 (1792)						
	0.75	300 (91)	480 (146)	760 (232)	1200 (366)	1870 (570)	2890 (881)	4370 (1332)	6470 (1972)					
	1	250 (76)	400 (122)	630 (192)	990 (302)	1540 (469)	2380 (725)	3610 (1100)	5360 (1634)	6520 (1987)				
	1.5	190 (58)	310 (94)	480 (146)	770 (235)	1200 (366)	1870 (570)	2850 (869)	4280 (1305)	5240 (1597)				
	2	150 (46)	250 (76)	390 (119)	620 (189)	970 (296)	1530 (466)	2360 (719)	3620 (1103)	4480 (1366)				
	3	120 (37)	190 (58)	300 (91)	470 (143)	750 (229)	1190 (363)	1850 (564)	2890 (881)	3610 (1100)				
	5			180 (55)	280 (85)	450 (137)	710 (216)	1110 (338)	1740 (530)	2170 (661)				
	7.5				200 (61)	310 (94)	490 (149)	750 (229)	1140 (347)	1410 (430)				
	10					250 (76)	390 (119)	600 (183)	930 (283)	1160 (354)				

3 phase, 60 Hz

Motor rating		Copper wire size												
Volts	Hp	14	12	10	8	6	4	2	0	00	000	0000	250	300
		Maximum motor cable length (motor service to entrance) [ft/m]												
208	1.5	310 (94)	500 (152)	790 (241)	1260 (384)									
	2	240 (73)	390 (119)	610 (186)	970 (296)	1520 (463)								
	3	180 (55)	290 (88)	470 (143)	740 (226)	1160 (354)	1810 (552)							
	5		170 (52)	280 (85)	440 (134)	690 (210)	1080 (329)	1660 (506)						
	7.5			200 (61)	310 (94)	490 (149)	770 (235)	1180 (360)	1770 (539)					
	10				230 (70)	370 (113)	570 (174)	880 (268)	1330 (405)	1640 (500)				
	15					250 (76)	390 (119)	600 (183)	910 (277)	1110 (338)	1340 (408)			
	20						300 (91)	460 (140)	700 (213)	860 (262)	1050 (320)	1270 (387)		
	25							370 (113)	570 (174)	700 (213)	840 (256)	1030 (314)	1170 (357)	
	30							310 (94)	470 (143)	580 (177)	700 (213)	850 (259)	970 (296)	1110 (338)
230	1.5	360 (110)	580 (177)	920 (280)	1450 (442)									
	2	280 (85)	450 (137)	700 (213)	1110 (338)	1740 (530)								
	3	210 (64)	340 (104)	540 (165)	860 (262)	1340 (408)	2080 (634)							
	5		200 (61)	320 (98)	510 (155)	800 (244)	1240 (378)	1900 (579)						
	7.5			230 (70)	360 (110)	570 (174)	890 (271)	1350 (411)	2030 (619)					
	10				270 (82)	420 (128)	660 (201)	1010 (308)	1520 (463)	1870 (570)				
	15					290 (88)	450 (137)	690 (210)	1040 (317)	1280 (390)	1540 (469)			
	20						350 (107)	530 (162)	810 (247)	990 (302)	1200 (366)	1450 (442)		
	25						280 (85)	430 (131)	650 (198)	800 (244)	970 (296)	1170 (357)	1340 (408)	
	30							350 (107)	540 (165)	660 (201)	800 (244)	970 (296)	1110 (338)	1270 (387)
460	1.5	1700 (518)												
	2	1300 (396)	2070 (631)											
	3	1000 (305)	1600 (488)	2520 (768)										
	5	590 (180)	950 (290)	1500 (457)	2360 (719)									
	7.5	420 (128)	680 (207)	1070 (326)	1690 (515)	2640 (805)								
	10	310 (94)	500 (152)	790 (241)	1250 (381)	1960 (597)	3050 (930)							
	15			540 (165)	850 (259)	1340 (408)	2090 (637)	3200 (975)						
	20			410 (125)	650 (198)	1030 (314)	1610 (491)	2470 (753)	3730 (1137)					
	25				530 (162)	830 (253)	1300 (396)	1990 (607)	3010 (917)	3700 (1128)				
	30				430 (131)	680 (207)	1070 (326)	1640 (500)	2490 (759)	3060 (933)	3700 (1128)			
	40						790 (241)	1210 (369)	1830 (558)	2250 (686)	2710 (826)	3290 (1003)		
	50						640 (195)	980 (299)	1480 (451)	1810 (552)	2190 (668)	2650 (808)	3010 (917)	
	60							830 (253)	1250 (381)	1540 (469)	1850 (564)	2240 (683)	2540 (774)	2890 (881)
	75								1030 (314)	1260 (384)	1520 (463)	1850 (564)	2100 (640)	2400 (732)
	100									940 (287)	1130 (344)	1380 (421)	1560 (475)	1790 (546)
	125											1080 (329)	1220 (372)	1390 (424)
	150												1050 (320)	1190 (363)
	200												1080 (329)	1300 (396)
	250													1080 (329)

3 phase, 60 Hz														
Motor rating		Copper wire size												
Volts	Hp	14	12	10	8	6	4	2	0	00	000	0000	250	300
		Maximum motor cable length (motor service to entrance) [ft/m]												
575	1.5	2620 (799)												
	2	2030 (619)												
	3	1580 (482)	2530 (771)											
	5	920 (280)	1480 (451)	2330 (710)										
	7.5	660 (201)	1060 (323)	1680 (512)	2650 (808)									
	10	490 (149)	780 (238)	1240 (378)	1950 (594)									
	15		530 (162)	850 (259)	1340 (408)	2090 (637)								
	20			650 (198)	1030 (314)	1610 (491)	2520 (768)							
	25			520 (158)	830 (253)	1300 (396)	2030 (619)	3110 (948)						
	30				680 (207)	1070 (326)	1670 (509)	2560 (780)	3880 (1183)					
	40					790 (241)	1240 (378)	1900 (579)	2860 (872)	3510 (1070)				
	50						1000 (305)	1540 (469)	2310 (704)	2840 (866)	3420 (1042)			
	60						850 (259)	1300 (396)	1960 (597)	2400 (732)	2890 (881)	3500 (1067)		
	75							1060 (323)	1600 (488)	1970 (600)	2380 (725)	2890 (881)	3290 (1003)	

CAUTION: Use of wire size smaller than listed will void warranty.

Notes:

1. If aluminum conductor is used, multiply lengths by 0.5 Maximum allowable length of aluminum is considerably shorter than copper wire of same size.
2. The portion of the total cable which is between the service entrance and a 3ø motor starter should not exceed 25% of the total maximum length to assure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
3. Cables #14 to #0000 are AWG sizes, and 250 to 300 are MCM sizes.

10. Friction loss tables

Friction loss table - SCH 40 steel pipe

		.5"	**.75"**	**1"**	**1.25"**	**1.5"**	**2"**	**2.5"**	**3"**	**4"**
U.S. gpm	**U.S. gph**	**ID 0.622"**	**ID 0.824"**	**ID 1.049"**	**ID 1.380"**	**ID 1.610"**	**ID 2.067"**	**ID 2.469"**	**ID 3.068"**	**ID 4.026"**
		Friction loss in feet of head per 100 feet of pipe								
2	120	4.8								
3	180	10.0	2.5							
4	240	17.1	4.2							
5	300	25.8	6.3	1.9						
6	360	36.5	8.9	2.7						
7	420	48.7	11.8	3.6						
8	480	62.7	15.0	4.5						
9	540	78.3	18.8	5.7						
10	600	95.9	23.0	6.9						
12	720		32.6	9.6	2.5	1.2				
14	840		43.5	12.8	3.3	1.5				
16	960		56.3	16.5	4.2	2.0				
20	1,200		86.1	25.1	6.3	2.9				
25	1,500			38.7	9.6	4.5	1.3			
30	1,800			54.6	13.6	6.3	1.8			
35	2,100			73.3	18.2	8.4	2.4			
40	2,400			95.0	23.5	10.8	3.1	1.3		
45	2,700				29.4	13.5	3.9	1.6		
50	3,000				36.0	16.4	4.7	1.9		
60	3,600				51.0	23.2	6.6	2.7		
70	4,200				68.8	31.3	8.9	3.6	1.2	
80	4,800				89.2	40.5	11.4	4.6	1.6	
90	5,400					51.0	14.2	5.8	2.0	
100	6,000					62.2	17.4	7.1	2.4	
120	7,200						24.7	10.1	3.4	
140	8,400						33.2	13.5	4.5	1.2
160	9,600						43.0	17.5	5.8	1.5
200	12,000						66.3	27.0	8.9	2.3
260	15,600							45.0	14.8	3.7
300	18,000							59.6	19.5	4.9

Friction loss table - SCH 40 PVC pipe

U.S. gpm	U.S. gph	.5"	.75"	1"	1.25"	1.5"	2"	2.5"	3"	4"
		ID 0.622"	ID 0.824"	ID 1.049"	ID 1.380"	ID 1.610"	ID 2.067"	ID 2.469"	ID 3.068"	ID 4.026"
		Friction loss in feet of head per 100 feet of pipe								
2	120	4.1								
3	180	8.7	2.2							
4	240	14.8	3.7							
5	300	22.2	5.7	1.8						
6	360	31.2	8.0	2.5						
7	420	41.5	10.6	3.3						
8	480	53.0	13.5	4.2						
9	540	66.0	16.8	5.2						
10	600	80.5	20.4	6.3	1.7					
12	720		28.6	8.9	2.3	1.1				
14	840		38.0	11.8	3.1	1.4				
16	960		48.6	15.1	4.0	1.9				
20	1,200		60.5	22.8	6.0	2.8				
25	1,500			38.7	9.1	4.3	1.3			
30	1,800				12.7	6.0	1.8			
35	2,100				16.9	8.0	2.4			
40	2,400				21.6	10.2	3.0	1.1		
45	2,700				28.0	12.5	3.8	1.4		
50	3,000					15.4	4.6	1.7		
60	3,600					21.6	6.4	2.3		
70	4,200					28.7	8.5	3.0	1.2	
80	4,800					36.8	10.9	3.8	1.4	
90	5,400					45.7	13.6	4.8	1.8	
100	6,000					56.6	16.5	5.7	2.2	
120	7,200						23.1	8.0	3.0	
140	8,400						30.6	10.5	4.0	1.1
160	9,600						39.3	13.4	5.0	1.4
200	12,000						66.3	20.1	7.6	2.1
260	15,600							32.4	12.2	3.4
300	18,000							42.1	15.8	4.4

Type of fitting and application	Pipe and fitting	Nominal size of fitting and pipe						
		1/2"	3/4"	1"	1.25"	1.5"	2"	2.5"
		Friction loss in equivalent length of straight pipe in feet						
Insert coupling	Plastic	3	3	3	3	3	3	3
Threaded adapter (plastic to thread)	Plastic	3	3	3	3	3	3	3
90° standard elbow	Steel	2	2	3	4	4	5	6
	Plastic	2	2	3	4	4	5	6
Standard tee (flow through run)	Steel	1	2	2	3	3	4	4
	Plastic	1	2	2	3	3	4	4
Standard tee (flow through side)	Steel	4	5	6	7	8	11	13
	Plastic	4	5	6	7	8	11	13
Gate valve[1]	Steel	1	1	1	1	2	2	2
Swing check valve[1]	Steel	5	7	9	12	13	17	21

Notes:
Based on Schedule 40 steel and plastic fittings
[1] Friction loss figures are for screwed valves and are based on equivalent lengths of steel pipe.

BE > THINK > INNOVATE >

Being responsible is our foundation
Thinking ahead makes it possible
Innovation is the essence

L-SP-PG-001 0612

US

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

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

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

GRUNDFOS **INSTRUCTIONS**

SP

Stainless steel submersible pumps
4", 6", 8", and 10"

Installation and operating instructions

be
think
innovate

English (US)
Installation and operating instructions 3

Español (MX)
Instrucciones de instalación y operación 32

Français (CA)
Notice d'installation et de fonctionnement 64

Appendix 1 94

English (US) Installation and operating instructions

Original installation and operating instructions.

CONTENTS

		Page
1.	**Limited warranty**	**3**
2.	**Symbols used in this document**	**4**
3.	**Product description**	**4**
3.1	Introduction	4
3.2	Applications	4
3.3	Features and benefits	4
3.4	Type key	4
4.	**Delivery and handling**	**5**
4.1	Delivery	5
4.2	Handling	5
4.3	Storage	5
5.	**Operating conditions**	**5**
6.	**Installation**	**5**
6.1	Pre-installation checklist	5
6.2	Positional requirements	6
6.3	Preparation	7
6.4	Splicing the motor cable	9
6.5	Riser pipe	10
6.6	Electrical and CUE information	11
7.	**Startup**	**15**
7.1	Startup with three-phase motors	15
8.	**Operation**	**16**
8.1	Minimum flow rate	16
8.2	Soft starter	17
8.3	Maintenance and service	17
9.	**Troubleshooting**	**17**
9.1	Preliminary tests	18
9.2	Checking pump performance	19
9.3	Troubleshooting chart	20
10.	**Technical data**	**24**
10.1	Minimum water flow requirements for submersible motors	24
10.2	Guide for engine-driven generators in submersible pump applications	24
10.3	Transformer capacity required for three-phase submersible motors	25
10.4	Submersible drop cable selection chart (60 Hz)	26
10.5	Three-phase motor maximum cable length	27
10.6	Approvals	28
10.7	Electrical data	29
11.	**Disposal**	**31**

⚠ *Warning*

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

This booklet should be left with the owner of the pump for future reference and information regarding its operation.

⚠ *Warning*

The use of this product requires experience with and knowledge of the product.
Persons with reduced physical, sensory or mental capabilities must not use this product, unless they are under supervision or have been instructed in the use of the product by a person responsible for their safety.
Children must not use or play with this product.

1. Limited warranty

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

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

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

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

2. Symbols used in this document

⚠ ***Warning***

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

⚠ ***Warning***

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.***

3. Product description

3.1 Introduction

Your Grundfos SP submersible pump is of the highest quality. Combined with proper installation, your Grundfos pump will give you many years of reliable service.

To ensure the proper installation of the pump, carefully read the complete manual before attempting to install the pump.

3.2 Applications

Grundfos Large SP submersible pumps are suitable for the following applications:

- groundwater supply to waterworks
- irrigation in horticulture and agriculture
- groundwater lowering (dewatering)
- pressure boosting
- industrial applications
- domestic water supply.

3.3 Features and benefits

- State-of-the-art hydraulics provide high efficiency and low operating costs
- 100 % stainless steel components inside and outside for long service life
- sand resistant
- resistant to aggressive water
- motor burnout protection via CUE or MP 204
- dry-running protection
- monitoring, protection, and communication via protection unit MP 204, and remote control, R100.

3.4 Type key

Example **475 S 500 - 5 - A B**

Rated flow rate in gpm

Type range
Stainless steel parts of material
S = AISI 304
N = AISI 316
R = AISI 904L

Hp of motor

Number of impellers

First reduced-diameter impeller (A, B or C)

Second reduced-diameter impeller (A, B or C)

4. Delivery and handling

4.1 Delivery

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

Handle the pump with care.

The shipping carton may contain the following components:

- pump end
- motor
- cable
- control box
- nameplate.

Examine the components carefully to make sure no damage has occurred to the pump end, motor, cable or control box during shipment.

4.2 Handling

Your Grundfos SP pump should remain in its shipping carton until it is ready to be installed. The carton is specially designed to protect it from damage. During unpacking and prior to installation, make sure that the pump is not dropped or mishandled.

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

The motor is equipped with a power cable.

Caution ***Never use the power cable to support the weight of the pump.***

You will find a loose nameplate with an adhesive backing with the pump. The nameplate should be completed in pen and attached to the control box.

Note ***Fix the extra nameplate supplied with the pump at the installation site.***

4.3 Storage

4.3.1 Storage temperature

Pump: -4 - +140 °F (-20 - +60 °C).

Motor: -4 - +158 °F (-20 - +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.

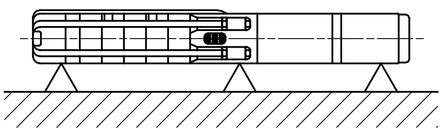


Fig. 1 Pump position during storage

4.3.2 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.

5. Operating conditions

Flow (Q):	Max. 1,400 gpm (318 m^3/h)
Head (H):	Max. 2,100 ft (640 m)
Liquid temp:	32-140 °F (0-60 °C)
Install. depth:	Max. 1,968 ft (599 m)

6. Installation

6.1 Pre-installation checklist

Make the following checks before beginning installation:

- condition of the well
- condition of the water
- installation depth
- power supply
- cable type.

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

6.1.1 Condition of the well

If the pump is to be installed in a new well, the well should be fully developed and bailed or blown free of cuttings and sand. The stainless steel construction of the Grundfos submersible pump makes it resistant to abrasion; however, no pump, made of any material, can forever withstand the destructive wear that occurs when constantly pumping sandy water.

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

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

The inside diameter of the well casing should be checked to ensure that it is not smaller than the size of the pump and motor.

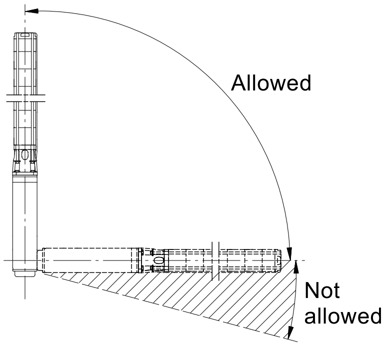
6.2 Positional requirements

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 *6.2.1 Motors suitable for horizontal installation*.

If the pump is installed horizontally, the discharge port should never fall below the horizontal plane. See fig. 2.



TM00 1355 5092

Fig. 2 Positional requirements

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

6.2.1 Motors suitable for horizontal installation

Motor	Output power 60 Hz	Output power 50 Hz
	[hp (kW)]	[hp (kW)]
MS	All	All
MMS 6000	5 - 40 (3.7 - 30)	5 - 40 (3.7 - 30)
MMS 8000	30 - 125 (22 - 92)	30 - 125 (22 - 92)
MMS 10000	100 - 225 (75 - 170)	100 - 225 (75 - 170)

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

Warning

If the pump is used for pumping hot liquids 104-140 °F (40-60 °C), make sure that persons cannot come into contact with the pump and the installation, e.g. by installing a guard.

6.2.2 Pumped liquids

Submersible pumps are designed for pumping the following liquids:

- clear and cold water that is free of air and gasses
- clean, thin **non-explosive** liquids without solid particles or fibers.

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

Maximum water temperature should not exceed 102 °F (38 °C). Special consideration must be given to the pump and motor if it is to be used to pump water above 102 °F (38 °C).

The Grundfos stainless steel submersible pump is highly resistant to the normal corrosive environment found in some water wells. If water well tests show that the water has an excessive or unusual corrosive quality, or exceeds 102 °F (38 °C), contact your Grundfos representative for information concerning specially designed pumps for these applications.

6.3 Preparation

Warning

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

6.3.1 Checking of liquid in motor

The MS submersible motors are factory-filled with a special drinking water approved liquid, which is frost-proof down to -4 °F (-20 °C).

Note

The level of the liquid in the motor must be checked, and the motor must be refilled, 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).

Carry out refilling of liquid as described below.

6.3.2 Grundfos submersible motors MS 4000 and MS 402

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. 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 as shown in fig. 3 until the liquid runs back out of the filling hole.
4. Replace the screw in the filling hole and tighten securely before changing the position of the pump.

Torques:

MS 4000: 2.2 ft-lbs (3.0 Nm).

MS 402: 1.5 ft-lbs (2.0 Nm).

The submersible pump is now ready for installation.

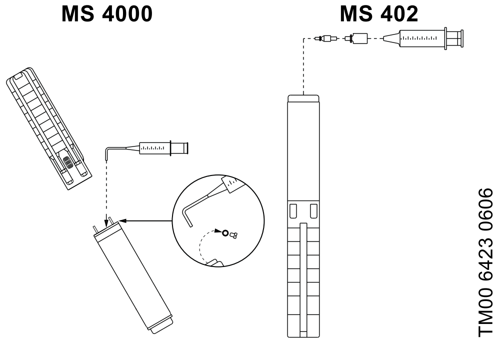


Fig. 3 Pump position during filling - MS 4000 and MS 402

6.3.3 Grundfos submersible motors MS6 and MS 6000

- If the motor is delivered from stock, the liquid level must be checked before the motor is fitted to the pump. See fig. 4.
- On pumps delivered directly from Grundfos, the liquid level has already been checked.
- In the case of service, the liquid level must be checked. See fig. 4.

Filling procedure:

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

1. Position the submersible pump as shown in fig. 4.
   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 (see fig. 4) until the liquid runs back out of the filling hole.
4. Replace the screw in the filling hole and tighten securely before changing the position of the motor.

Torque: 2.2 ft-lbs (3.0 Nm).

The submersible pump is now ready for installation.

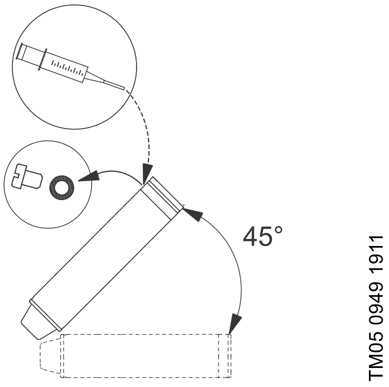


Fig. 4 Motor position during filling - MS6 and MS 6000

6.3.4 Grundfos submersible motors MMS 6000, MMS 8000, MMS 10000 and MMS 12000

Filling procedure:

1. Place the motor at a 45 ° angle with the top of the motor upwards. See fig. 5.
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 at 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.

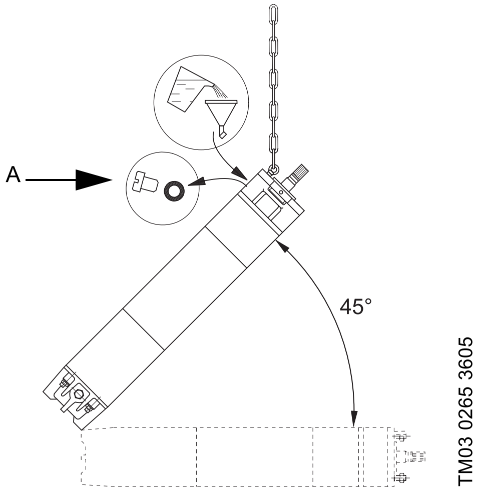


Fig. 5 Motor position during filling - MMS

6.3.5 Installation depth

Make sure that the installation depth of the pump will always be at least (5) five to (10) ten feet (1.5 to 3 m) below the maximum draw-down level of the well. For flow rates exceeding 100 gpm (22.7 m^3/h), refer to performance curves for recommended minimum submergence.

Never install the pump so that the bottom of the motor is lower than the top of the well screen or within five feet of the well bottom.

If the pump is to be installed in a lake, pond, tank or large diameter well, make sure that the water velocity passing over the motor is sufficient to ensure proper motor cooling. The minimum recommended water flow rates ensuring proper cooling are listed in section *10.1 Minimum water flow requirements for submersible motors* on page 24.

6.3.6 Power supply

Check the motor voltage, phase number and frequency indicated on the motor nameplate against the actual power supply.

6.3.7 Power cable type

The power cable used between the pump and control box or control panel should be approved for submersible pump applications. Conductors may be solid or stranded. The cable may consist of individually insulated conductors twisted together, insulated conductors molded side by side in one flat cable or insulated conductors with a round overall jacket.

The conductor insulation should be type RW, RUW, TW, TWU or equivalent and must be suitable for use with submersible pumps. An equivalent Canadian Standards Association certified cable may also be used. See section *10.4 Submersible drop cable selection chart (60 Hz)* on page 26 for recommended cable lengths.

6.4 Splicing the motor cable

Note

A good cable splice is critical to proper operation of the submersible pump and must be done with extreme care.

If the splice is carefully made, it will work as well as any other portion of the cable, and will be completely watertight. Grundfos recommends using a heat shrink splice kit. The splice should be made in accordance with the kit manufacturer’s instructions. Typically a heat shrink splice can be made as follows:

1. Examine the motor cable and the submersible drop cable carefully for damage.
2. Cut the motor leads off in a staggered manner. Cut the ends of the drop cable so that the ends match up with the motor leads. See fig. 6. On single-phase motors, be sure to match the colors.
3. Strip back and trim off 1/2 inch of insulation from each lead, making sure to scrape the wire bare to obtain a good connection. Be careful not to damage the copper conductor when stripping off the insulation.
4. Slide the heat shrink tubing on to each lead. Insert a properly sized "Sta-Kon" type connector on each lead, making sure that lead colors are matched. Using "Sta-Kon" crimping pliers, indent the lugs. See fig. 7. Be sure to squeeze hard on the pliers, particularly in the case of a large cable.
5. Center the heat shrink tubing over the connector. Using a propane torch, lighter, or electric heat gun, uniformly heat the tubing starting first in the center working towards the ends. See fig. 8.
6. Continue to apply the heat to the tubing taking care not to let the flame directly contact the tubing. When the tubing shrinks and the sealant flows from the ends of the tubing, the splice is complete. See fig. 9.

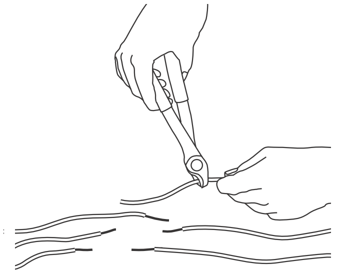


Fig. 6 Cutting and stripping the motor leads

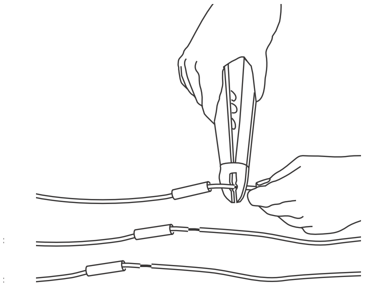


Fig. 7 Crimping the connectors

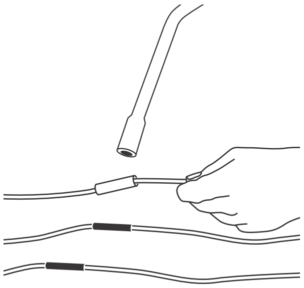


Fig. 8 Applying heat to the connector

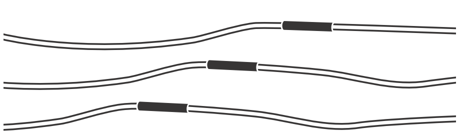


Fig. 9 Completed splices

6.5 Riser pipe

Note *The riser pipe or hose should be properly sized and selected on the basis of estimated flow rates and friction-loss factors.*

6.5.1 If an adapter is required

We recommend you to first install the riser pipe to the pipe adapter. Then install the riser pipe with the adapter to the pump discharge port.

Use a back-up wrench when attaching the riser pipe to the pump. The pump should be gripped only by the flats on the top of the discharge chamber. The body of the pump, cable guard or motor should not be gripped under any circumstance.

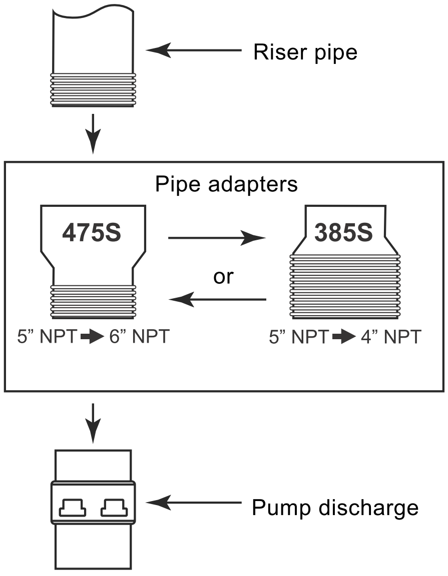


Fig. 10 Pipe adapters

6.5.2 If steel riser pipe is used

We recommend that steel riser pipes always be used with the large submersible pumps. Use an approved pipe thread compound on all joints. Make sure the joints are adequately tightened in order to prevent the joints from coming loose when the motor starts and stops.

When tightened, the first section of the riser pipe must not come in contact with the check valve retainer.

After the first section of the riser pipe has been attached to the pump, clamp the lifting wire to the pipe. **Do not clamp the lifting wire to the pump.**

When raising the pump and riser pipe section to upright position, be careful not to place bending stress on the pump by picking it up by the pump end only.

Make sure that the power cables are not cut or damaged in any way when the pump is being lowered in the well.

Fasten the submersible drop cable to the riser pipe at frequent intervals to prevent sagging, looping or possible cable damage. Nylon cable clips or waterproof tape may be used. The cable splice should be protected by securing it with clips or tape just above and below the splice.

6.5.3 If plastic or flexible riser pipe is used

We recommend that you use plastic type riser pipes only with the smaller domestic submersible pumps.

Caution ***When a plastic riser pipe is used, we recommend that you attach a safety cable to the pump to lower and raise it.***

Note ***Warning***

Important: Plastic and flexible pipes tend to stretch under load. This stretching must be taken into account when securing the cable to the riser pipe. Leave 3 to 4 inches of slack between clips or taped points to allow for this stretching. This tendency for plastic and flexible pipe to stretch will also affect the calculation of the pump installation depth. As a general rule, you can estimate that plastic pipe will stretch to approximately 2 % of its length. For example, if you installed 200 feet (61 m) of plastic riser pipe, the pump may actually be down 204 feet (62 m). If the installation depth is critical, check with the manufacturer of the pipe to determine how to compensate for pipe stretch.

Contact the pipe manufacturer or representative to ensure that the pipe type and physical characteristics are suitable for this use.

Use the correct joint compound recommended by the pipe manufacturer. In addition to making sure that joints are securely fastened, we recommend the use of a torque arrester when using a plastic pipe.

Do not connect the first plastic or flexible riser pipe section directly to the pump. Always attach a metallic nipple or adapter into the valve casing at the top of the pump. When tightened, the threaded end of the nipple or adapter must not come in contact with the check valve retainer.

Fasten the submersible drop cable to the riser pipe at frequent intervals to prevent sagging, looping and possible cable damage. Nylon cable clips or waterproof tape may be used. The cable splice should be protected by securing it with clips or tape just above each joint.

Check valves

Always install a check valve at the top of the well. In addition, for installations deeper than 200 feet (61 m), install check valves at no more than 200 ft (61 m) intervals.

Protect the well from contamination

To protect against surface water entering the well and contaminating the water source, the well should be finished off above grade, and a locally approved well seal or pitless adapter unit utilized.

6.6 Electrical and CUE information

Warning

USA: All electrical work should be performed by a qualified electrician and installed in accordance with the National Electrical Code, local codes and regulations.

Warning

Canada: All electrical work should be performed by a qualified electrician and installed in accordance with the Canadian Electrical Code, local codes and regulations.

Warning

Provide acceptable grounding in order to reduce the risk of electric shock during operation of this pump If the means of connection to the box connected to the power supply is other than a grounded metal conduit, ground the pump by connecting a copper conductor, at least the size of the circuit supplying the pump, to the grounding screw provided within the terminal box.

Make sure that the voltage, phase number and frequency of the power supply match those of the motor. Motor voltage, phase number, frequency and full-load current information can be found on the nameplate attached to the motor.

Motor electrical data can be found in section *10.7.1 Grundfos submersible motors - 60 Hz* on page 29.

Warning

If voltage variations are larger than ± 10 %, do not operate the pump.

Direct on-line starting is used due to the extremely short run-up time of the motor (max. 0.1 second), and the low moment of inertia of the pump and motor. Direct on-line starting current (locked rotor current) is between 4 and 6.5 times the full-load current.

If direct on-line starting is not acceptable and reduced starting current is required, an autotransformer or resistant starters should be used for 5 to 30 hp motors (depending on cable length). For motors over 30 hp, use auto-transformer starters.

6.6.1 Engine-driven generators

If the submersible pump is going to be operated by an engine driven generator, we suggest that you contact the manufacturer of the generator to ensure the proper generator is selected and used. See section *10.2 Guide for engine-driven generators in submersible pump applications* on page 24 for generator sizing guide.

If power is going to be supplied through transformers, section *10.3 Transformer capacity required for three-phase submersible motors* on page 25 outlines the minimum KVA rating and capacity required for satisfactory pump operation.

6.6.2 Control box/panel wiring

Single-phase motors

Single-phase motors must be connected as indicated in the motor control box.

A typical single-phase wiring diagram using a Grundfos control box is shown in fig. 11.

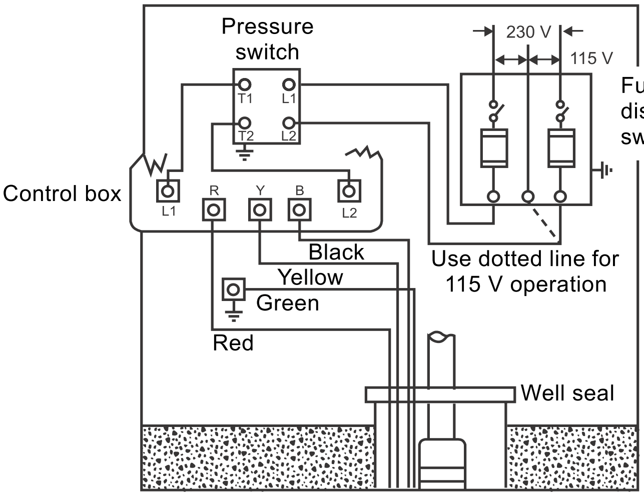


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Fig. 11 Single-phase wiring diagram for Grundfos control boxes

Three-phase motors

Three-phase motors must be used with the proper size and type of motor starter to ensure the motor is protected against damage from low voltage, phase failure, current imbalance and overload current.

A properly sized starter with ambient-compensated, class 10, extra quick-trip overload relays or an MP204 must be used to give the best possible motor winding protection.

Each of the three motor legs must be protected with overloads. The thermal overloads must trip in less than 10 seconds at locked rotor (starting) current. A three-phase motor wiring diagram is shown in fig. 12.

Caution ***Pumps should NEVER be started to check rotation unless the pump is totally submerged. Severe damage may be caused to the pump and motor if they are run dry.***

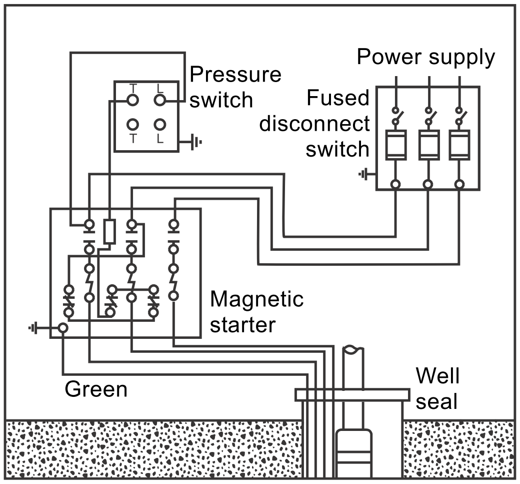

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Fig. 12 Three-phase wiring diagram for Grundfos motors and other motor manufacturers

6.6.3 Variable-frequency drive operation

Grundfos motors:

Three-phase Grundfos motors can be connected to a VFD (variable frequency drive).

Note

If a Grundfos MS motor with temperature transmitter is connected to a VFD, and if the motor becomes overheated, a fuse incorporated in the transmitter will melt and the transmitter will be inactive. The transmitter cannot be reactivated. This means that from that point on, the motor will operate like a motor without a temperature transmitter.

If a new temperature transmitter is required, a Pt100 sensor for fitting to the submersible motor can be ordered from Grundfos.

During frequency converter operation, it is not advisable to run the motor at a frequency higher than the nominal 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 low level that the necessary flow of cooling liquid past the motor is no longer ensured.

To avoid damage to the pump, it must be ensured that the motor stops when the pump flow falls below 0.1 x rated flow.

Depending on the VFD type, it may expose the motor to detrimental voltage peaks.

⚠

Warning

Motors, type MS 402, 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 you to protect other motors against voltage peaks higher than 850 V.

The above disturbance can be abated by installing an RC filter between the VFD 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 VFD.

For further details, please contact your VFD supplier or Grundfos.

Other motor manufacturers than Grundfos

Please contact Grundfos or the motor manufacturer.

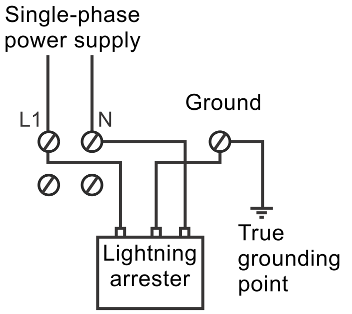
6.6.4 High-voltage surge arresters

Use a high-voltage surge arrester to protect the motor against lightning and switching surges.

Lightning voltage surges in power lines are caused when lightning strikes somewhere in the area.

Switching surges are caused by the opening and closing of switches on the main high-voltage distribution power lines.

Install the correct voltage-rated surge arrester on the supply side of the control box. see fig. 13 and fig. 14. The arrester must be grounded in accordance with the National Electrical Code and local codes and regulations.



TM05 0039 0611

Fig. 13 Single-phase installation

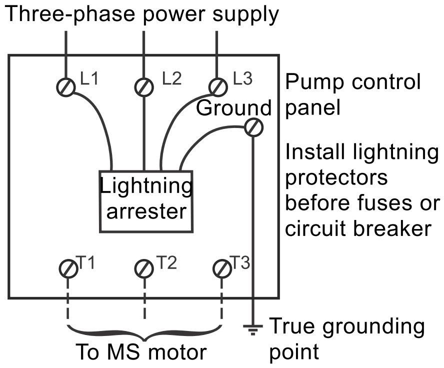


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Fig. 14 Three-phase installation

Note

The warranty on all three-phase submersible motors will become VOID if:

1. The motor is operated with single-phase power through a phase converter.

2. Three-leg ambient compensated, extra quick-trip overload protectors are not used.

3. Three-phase current imbalance is not checked and recorded. See section 7. Startup on page 15.

4. High-voltage surge arresters are not installed.

6.6.5 Control box/panel grounding

Warning

The control box or control panel must be permanently grounded in accordance with the National Electrical Code and local codes or regulations.

The ground wire should be a bare copper conductor at least the same size as the submersible drop cable wire size.

The ground wire should be run as short a distance as possible and be securely fastened to a true grounding point.

True grounding points are considered to be one of the following:

- a grounding rod driven into the water strata
- a steel well casing submerged into the water lower than the pump installation depth
- steel discharge pipes without insulating couplings.

If plastic discharge pipe and well casing are used or if a grounding wire is required by local codes, connect a properly sized, bare copper wire to a stud on the motor and run to the control panel.

Warning

Do not ground to a gas supply line. Connect the grounding wire to the ground point first and then to the terminal in the control box or control panel.

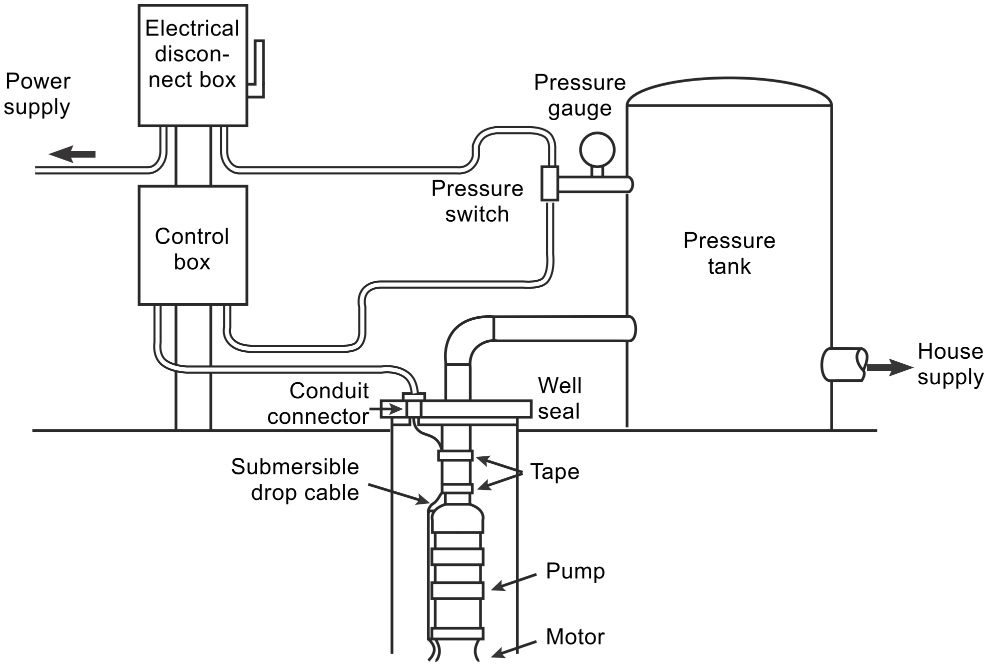

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Fig. 15 Wiring and installation diagram

6.6.6 Wiring checks and installation

Before making the final surface wiring connection of the submersible drop cable to the control box or control panel, it is a good practice to check the insulation resistance to ensure that the cable and splice are good.
Measurements for a new installation must be at least 2,000,000 ohms. **Do not start the pump if the measurement is less than this.**

If it is higher than 2,000,000 ohms, the submersible drop cable should then be run through the well seal by means of a conduit connector in such a way as to eliminate any possibility of foreign matter entering the well casing.

Conduit should always be used from the pump to the control box or control panel to protect the submersible drop cable. See fig. 15.

Finish wiring and verify that all electrical connections are made in accordance with the wiring diagram.

Check to ensure the control box or control panel and high-voltage surge arrester have been grounded.

7. Startup

After the pump has been set into the well and the wiring connections have been made, go through the following procedures:

1. Attach a temporary horizontal length of pipe with installed gate valve to the riser pipe.
2. Adjust the gate valve one-third of the way open.
3. On three-phase units, check direction of rotation and current imbalance according to the instructions below. For single-phase units proceed directly to *7.1.3 Developing the well* on page 16.
4. Under no circumstances should the pump be operated for any prolonged period of time with the discharge valve closed. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed at the well head to prevent the pump from running against a closed valve.

7.1 Startup with three-phase motors

7.1.1 Check the direction of rotation

Three-phase motors can run in either direction depending on how they are connected to the power supply. When the three cable leads are first connected to the power supply, there is a 50 % chance that the motor will run in the proper direction. To make sure the motor is running in the proper direction, carefully follow these procedures:

1. Start the pump and check the water quantity and pressure developed.
2. Stop the pump and interchange any two leads.
3. Start the pump and again check the water quantity and pressure.
4. Compare the results observed. The wire connection which gave the highest pressure and largest water quantity is the correct connection.

7.1.2 Check for current imbalance

Current imbalance causes the motor to have reduced starting torque, overload tripping, excessive vibration and poor performance which can result in early motor failure. It is very important that current imbalance be checked in all three-phase systems. **Current imbalance between the phases should not exceed 5 % under normal operating conditions.**

The supply power service should be verified to see if it is a two- or three-transformer system. If two transformers are present, the system is an "open" delta or wye. If three transformers are present, the system is true three-phase.

Make sure the transformer ratings in kilovolt amps (KVA) is sufficient for the motor load. See section *10.3 Transformer capacity required for three-phase submersible motors* on page 25.

The percentage of current imbalance can be calculated by means of the following formulas and procedures:

$$\text{Average current} = \frac{\text{Total of current values measured on each leg}}{3}$$

$$\%\ \text{Current imbalance} = \frac{\text{Greatest amp difference from the average}}{\text{average current}} \text{ X } 100$$

To determine the percentage of current imbalance:

1. Measure and record current readings in amps for each leg (hookup 1). Disconnect power.
2. Shift or roll the motor leads from left to right so the submersible drop cable lead that was on terminal 1 is now on 2, lead on 2 is now on 3, and lead on 3 is now on 1 (hookup 2). Rolling the motor leads in this manner will not reverse the motor rotation. Start the pump, measure and record current reading on each leg. Disconnect power.
3. Again shift submersible drop cable leads from left to right so the lead on terminal 1 goes to 2, 2 to 3 and 3 to 1 (hookup 3). Start pump, measure and record current reading on each leg. Disconnect power.
4. Add the values for each hookup.
5. Divide the total by 3 to obtain the average.
6. Compare each single leg reading from the average to obtain the greatest amp difference from the average.
7. Divide this difference by the average to obtain the percentage of imbalance.

Use the wiring hookup which provides the lowest percentage of imbalance. See section *10.7.4 Correcting for three-phase power imbalance* on page 30 for a specific example of correcting for three-phase current imbalance.

7.1.3 Developing the well

After proper rotation and current imbalance have been checked, start the pump and let it operate until the water runs clear of sand, silt and other impurities.

Slowly open the valve in small increments as the water clears until the desired flow rate is reached. Do not operate the pump beyond its maximum flow rating. **The pump should not be stopped until the water runs clear.**

If the water is clean and clear when the pump is first started, the valve should still be **slowly opened until the desired flow rate is reached.** As the valve is being opened, the drawdown should be checked to ensure the pump is always submerged. **The dynamic water level should always be more than 3 feet (0.9 m) above the suction interconnector of the pump.**

Disconnect the temporary piping arrangements and complete the final piping connections.

Caution

Warning

Under no circumstances should the pump be operated for any prolonged period of time with the discharge valve closed. This can result in motor and pump damage due to overheating. A properly sized relief valve should be installed at the well head to prevent the pump from running against a closed valve.

Start the pump and test the system. Check and record the voltage and current draw on each motor lead.

8. Operation

The pump and system should be periodically checked for water quantity, pressure, drawdown, periods of cycling and operation of controls.

If the pump fails to operate, or there is a loss of performance, refer to section *9. Troubleshooting* on page 17.

8.1 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 specified in section *6.2.2 Pumped liquids* on page 6 cannot be met.

8.1.1 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.
MS6	Minimum 1 per year is recommended. Maximum 30 per hour. Maximum 300 per day.
MS 6000	Minimum 1 per year is recommended. Maximum 30 per hour. Maximum 300 per day.
MMS 6000	Minimum 1 per year is recommended. Maximum 15 per hour. Maximum 360 per day.
MMS 8000	Minimum 1 per year is recommended. Maximum 10 per hour. Maximum 240 per day.
MMS 10000	Minimum 1 per year is recommended. Maximum 8 per hour. Maximum 190 per day.

8.2 Soft starter

The starting voltage is min. 55 % of the value stamped on the nameplate.

If a high locked-rotor torque is required or if the power supply is not optimal, the starting voltage should be higher.

Run-up time (until voltage stamped on nameplate is reached): Max 3 sec.
Run-out time: Max 3 sec.

If the abovementioned run-up and run-out ramps are followed, unnecessary heating of the motor is avoided.

If the soft starter is fitted with bypass contacts, the soft starter will only be in operation during run-up and run-out.

The soft starter must not be used in connection with operation via a generator.

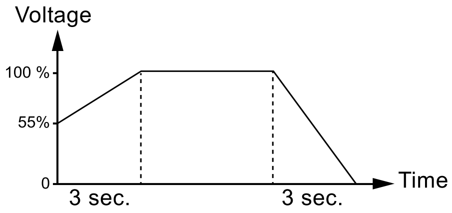

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Fig. 16 Operation with a soft starter

8.3 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 center.

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.

9. Troubleshooting

The majority of problems that develop with submersible pumps are electrical, and most of these problems can be corrected without pulling the pump from the well. The following chart covers most of the submersible service work. As with any troubleshooting procedure, start with the simplest solution first; always make all the above-ground checks before pulling the pump from the well.

Usually only two instruments are needed:

- a combination voltmeter/ammeter
- an ohmmeter.

These are relatively inexpensive and can be obtained from most water systems suppliers.

Warning

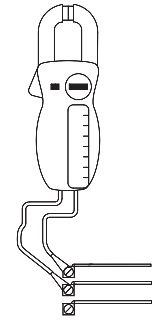
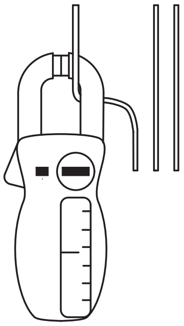
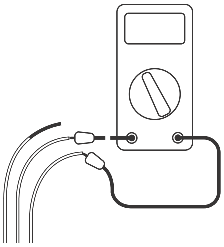
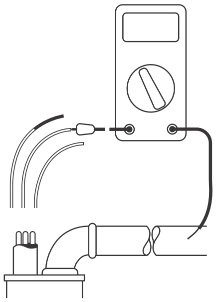
WHEN WORKING WITH ELECTRICAL CIRCUITS, USE CAUTION TO AVOID ELECTRIC SHOCK.

It is recommended that rubber gloves and boots be worn and that care is taken to have metal control boxes and motors grounded to power supply ground or steel drop pipe or casing extending into the well.

Warning

Submersible motors are intended for operation in a well. When not operated in a well, failure to connect motor frame to power supply ground may result in serious electric shock.

9.1 Preliminary tests

Test	How to measure	What it means
Supply voltage  	By means of a voltmeter set to the proper scale, measure the voltage at the control box or starter. • **On single-phase units,** measure between line and neutral. • **On three-phase units,** measure between the legs (phases).	When the motor is under load, the voltage should be within ± 10 % of the nameplate voltage. Larger voltage variation may cause winding damage. Large variations in the voltage indicate a poor power supply and the pump should not be operated until these variations have been corrected. If the voltage constantly remains high or low, the motor should be changed to the correct supply voltage.
Current  	• By means of an ammeter set to the proper scale, measure the current on each power lead at the control box or starter. See section *10.7 Electrical data* on page 29 for motor amp draw information. • Current should be measured when the pump is operating at a constant discharge pressure with the motor fully loaded.	If the amp draw exceeds the listed service factor amps (SFA), or if the current imbalance is greater than 5 % between each leg on three-phase units, check for the following: • burnt contacts on motor starter • loose terminals in starter or control box or possible cable defect. Check winding and insulation resistances. • supply voltage too high or low • motor windings are shortened • pump is damaged, causing a motor overload.
Winding resistance  	• Turn off power and disconnect the submersible drop cable leads in the control box or starter. • By means of an ohmmeter, set the scale selectors to Rx1 for values under 10 ohms and Rx10 for values over 10 ohms. • Zero-adjust the ohmmeter and measure the resistance between leads. Record the values. • Motor resistance values can be found in section *10.7 Electrical data* on page 29. Cable resistance values are in section *10.7.5 Total resistance of submersible drop cable (ohms)* on page 31.	If all the ohm values are normal, and the cable colors correct, the windings are not damaged. If any one ohm value is less than normal, the motors may be shorted. If any one ohm value is greater than normal, there is a poor cable connection or joint. The windings or cable may also be open. If some of the ohm values are greater than normal and some less, the submersible drop cable leads are mixed. To verify lead colors, see resistance values in section *10.7 Electrical data* on page 29.
Insulation resistance  	• Turn off power and disconnect the submersible drop cable leads in the control box or starter. • By means of an ohmmeter or megohmmeter, set the scale selector to Rx 100K and zero adjust the meter. • Measure the resistance between the lead and ground (discharge pipe or well casing, if steel).	For ohm values, refer to section *9.1.1 Ohm value chart* on page 19. Motors of all hp, voltage, phase and cycle duties have the same value of insulation resistance.

9.1.1 Ohm value chart

Ohm value chart			
	Ohm value	**Megaohm value**	**Condition of motor and leads/ recommended procedure**
Motor not yet installed	2,000,000 (or more)	2.0	New motor.
	1,000,000 (or more)	1.0	Used motor which can be reinstalled in the well.
Motor in well (ohm readings are for submersible drop cable plus motor)	500,000 - 1,000,000	0.5 - 1.0	A motor in reasonably good condition.
	20,000 - 500,000	0.02 - 0.5	A motor which may have been damaged by lightning or with damaged leads. Do not pull the pump from the well for this reason.
	10,000 - 20,000	0.01 - 0.02	A motor which definitely has been damaged or with damaged cable. The pump should be pulled from the well and repairs made to the cable or the motor replaced. The motor will still operate, but probably not for long.
	Less than 10,000	0 - 0.01	A motor which has failed or with completely destroyed cable insulation. The pump must be pulled from the well and the cable repaired or the motor replaced. The motor will not run in this condition.

9.2 Checking pump performance

The troubleshooting chart on page 20 may require that you test the pump's performance against its curve. To do so, perform these steps:

1. Install pressure gauge.
2. Start pump.
3. Gradually close the discharge valve.
4. Read pressure at shut-off.
5. After taking reading, open valve to its previous position.
6. To calculate pump performance, first convert psi reading to feet.
   (For water: psi x 2.31 = ____ feet).
7. Add this to the total vertical distance from the pressure gauge to the water level in the well while the pump is running.
8. Refer to the specific pump curve for the shut-off head (pressure) for that pump model.
   If the measured head is close to the curve, pump is probably OK.

9.3 Troubleshooting chart

Problem	Possible cause/how to check	Possible remedy
1. Pump does not run.	a) No power at pump control panel. How to check: Check for voltage at control panel.	If no voltage at control panel, check feeder panel for tripped circuits.
	b) Fuses are blown or circuit breakers are tripped. How to check: Remove fuses and check for continuity with ohmmeter.	Replace blown fuses or reset circuit breaker. If new fuses blow or circuit breaker trips, the electrical installation and motor must be checked.
	c) Motor starter overloads are burnt or have tripped out (three-phase only). How to check: Check for voltage on line or load side of starter.	Replace burnt heaters or reset. Inspect starter for other damage. If heater trips again, check the supply voltage and starter holding coil.
	d) Starter does not energize (three-phase only). How to check: Energize control circuit and check for voltage at the holding coil.	If no voltage, check control circuit. If voltage, check holding coil for short circuits. Replace bad coil.
	e) Defective controls. How to check: Check all safety and pressure switches for operation. Inspect contacts in control devices.	Replace worn or defective parts.
	f) Motor and/or cable are defective. How to check: Turn off power. Disconnect motor leads from control box. Measure the lead-to-lead resistances with the ohmmeter (Rx1). Measure lead-to-ground values with ohmmeter (Rx100K). Record measured values.	If open motor winding or ground is found, pull pump from the well and recheck values at the surface. Repair or replace motor or cable.
	g) Defective capacitor (single-phase only). How to check: Turn off the power, then discharge capacitor. Check with an ohmmeter (Rx100K). When meter is connected, the needle should jump forward and slowly drift back.	If there is no ohmmeter needle movement, replace the capacitor.

Problem	Possible cause/how to check	Possible remedy
2. Pump runs but does not deliver water.	a) Groundwater level in well is too low or well is collapsed. How to check: Check well drawdown. Water level should be at least 3 feet above suction interconnector during operation.	If water level is not at least 3 feet above suction interconnector during operation, then lower the pump if possible, or throttle discharge valve and install water level control.
	b) Integral pump check valve is blocked. How to check: Check the pump's performance against its curve; see section *9.2 Checking pump performance* on page 19.	If the pump is not operating close to the pump curve, pull pump from the well and inspect discharge section. Remove blockage, repair valve and valve seat if necessary. Check for other damage. Rinse out pump and re-install.
	c) Inlet strainer is clogged. How to check: Check the pump's performance against its curve; see section *9.2 Checking pump performance* on page 19.	If pump is not operating close to the pump curve, pull pump from the well and inspect. Clean inlet strainer, inspect integral check valve for blockage, rinse out pump and re-install.
	d) Pump is damaged. How to check: Check the pump's performance against its curve; see section *9.2 Checking pump performance* on page 19.	If pump is damaged, repair as necessary. Rinse out pump and re-install.
3. Pump runs but at reduced capacity.	a) Wrong direction of rotation (three phase only). How to check: Check for proper electrical connection in control panel.	Correct wiring and change leads as required.
	b) Drawdown is larger than anticipated. Check drawdown during pump operation.	Lower the pump if possible. If not, throttle discharge valve and install water level control.
	c) Discharge piping or valve leaking. How to check: Examine system for leaks.	Repair leaks.
	d) Pump inlet strainer or check valve are clogged. How to check: Check the pump's performance against its curve; see section *9.2 Checking pump performance* on page 19.	If not close to the pump curve, pull pump from the well and inspect. Clean strainer, inspect integral check valve for blockage, rinse out pump and re-install.
	e) Pump is worn. How to check: Check the pump's performance against its curve; see section *9.2 Checking pump performance* on page 19.	If not close to pump curve, pull pump from the well and inspect.

Problem	Possible cause/how to check	Possible remedy
4. Pump cycles too much.	a) Pressure switch is not properly adjusted or is defective. How to check: Check pressure setting on switch and operation. Check voltage across closed contacts.	Re-adjust switch or replace, if defective.
	b) Level control is not properly set or is defective. How to check: Check setting and operation.	Re-adjust setting (refer to manufacturer data.) Replace if defective.
	c) Insufficient pressure in diaphragm tank or leaking tank or piping. How to check: Pump air into tank or diaphragm chamber. Check diaphragm for leak. Check tank and piping for leaks with soap and water solution. Check air to water volume.	Repair or replace damaged component.
	d) Plugged snifter valve or bleed orifice. How to check: Examine valve and orifice for dirt or corrosion.	Clean and/or replace snifter valve or bleed orifice if defective.
	e) Tank is too small. How to check: Check tank size. Tank volume should be approximately 10 gallons for each gpm or pump capacity.	If tank is too small, replace with proper size tank.

Problem	Possible cause/how to check	Possible remedy
5. Fuses blow or circuit breakers trip	a) High or low voltage. How to check: Check voltage at pump control panel. If not within ± 10 %, check cable size and length of run to pump control panel.	If cable size is correct, contact power company. If not, correct and/or replace as necessary.
	b) Three-phase current imbalance. How to check: Check current draw on each lead. Imbalance must be within ± 5 %.	If current imbalance is not within ± 5 %, contact power supply company.
	c) Control box wiring and components (single-phase only). How to check: Check that control box parts match the parts list. Check to see that wiring matches wiring diagram. Check for loose or broken wires or terminals.	Correct as required.
	d) Defective capacitor (single-phase only). How to check: Turn off power and discharge capacitor. Check by means of an ohmmeter (Rx100K). When the ohmmeter is connected, the needle should jump forward and slowly drift back.	If there is no ohmmeter needle movement, replace the capacitor.
	e) Starting relay (certain types of single-phase only). How to check: Check resistance of relay coil by means of an ohmmeter (Rx1000K). Check contacts for wear.	Replace defective starting relay.

10. Technical data

10.1 Minimum water flow requirements for submersible motors

Motor diameter	Casing or sleeve I.D. [inches]	Min. flow past the motor [gpm]
4"	4	1.2
	5	7
	6	13
	7	21
	8	30
6"	6	10
	7	28
	8	45
	10	85
	12	140
	14	198
	16	275
8"	8	10
	10	55
	12	110
	14	180
	16	255
10"	10	30
	12	85
	14	145
	16	220
	18	305

Notes:

- A flow inducer or flow sleeve must be used if the water enters the well above the motor or if there is insufficient water flow past the motor.
- The minimum recommended water velocity over 4" motors is 0.25 feet (0.08 m) per second.
- The minimum recommended water velocity over 6", 8", and 10" motors is 0.5 (0.15 m) feet per second.

10.2 Guide for engine-driven generators in submersible pump applications

1- or 3-phase motor [hp]	Generator [kW]	
	Externally regulated	Internally regulated
0.33	1.5	1.2
0.5	2.0	1.5
0.75	3.0	2.0
1	4.0	2.5
1.5	5.0	3.0
2	7.5	4.0
3	10.0	5.0
5.0	15.0	7.5
7.5	20.0	10.0
10.0	30.0	15.0
15.0	40.0	20.0
20.0	60.0	25.0
25.0	75.0	30.0
30.0	100.0	40.0
40.0	100.0	50.0
50.0	150.0	60.0
60.0	175.0	75.0
75.0	250.0	100.0
100.0	300.0	150.0
125.0	375.0	175.0
150.0	450.0	200.0
200.0	600.0	275.0

Notes:

- Table is based on typical +176 °F (+80 °C) rise continuous duty generators with 35 % maximum voltage dip during startup of single-phase and three-phase motors.
- Contact the manufacturer of the generator to make sure the unit has adequate capacity to run the submersible motor.
- If the generator rating is in KVA instead of kilowatts, multiply the above ratings by 1.25 to obtain KVA.

10.3 Transformer capacity required for three-phase submersible motors

3-phase motor [hp]	Minimum total KVA required*	Minimum KVA rating for each transformer	
		2 transformers Open Delta or Wye	3 transformers Delta or Wye
1.5	3	2	1
2	4	2	1.5
3	5	3	2
5	7.5	5	3
7.5	10	7.5	5
10	15	10	5
15	20	15	7.5
20	25	15	10
25	30	20	10
30	40	25	15
40	50	30	20
50	60	35	20
60	75	40	25
75	90	50	30
100	120	65	40
125	150	85	50
150	175	100	60
200	230	130	75

* Pump motor KVA requirements only, and does not include allowances for other loads.

10.4 Submersible drop cable selection chart (60 Hz)

The following tables list the recommended copper conductor sizes and various cable lengths for submersible motors.

These tables comply with the 1978 edition of the National Electric Table 310-16, Column 2 for +167 °F (+75 °C) wire. The ampacity (current carrying properties of a conductor) have been divided by 1.25 per the N.E.C., Article 430-22, for motor branch circuits based on motor amps at rated horsepower.

To assure adequate starting torque, the maximum cable lengths are calculated to maintain 95 % of the service entrance voltage at the motor when the motor is running at maximum nameplate amps. Cable sizes larger than specified may always be used and will reduce power consumption.

Caution ***The use of cables smaller than the recommended sizes will void the warranty. Smaller cable sizes will cause reduced starting torque and poor motor operation.***

Single-phase motor maximum cable length [ft]
(Motor to service entrance) (2)

Volts	Hp		Wire size												
			14	**12**	**10**	**8**	**6**	**4**	**2**	**0**	**00**	**000**	**0000**	**250**	**300**
115	.33	Max. cable length [ft]	130	210	340	540	840	1300	1960	2910					
	.5		100	160	250	390	620	960	1460	2160					
230	.33		550	880	1390	2190	3400	5250	7960						
	.5		400	650	1020	1610	2510	3880	5880						
	.75		300	480	760	1200	1870	2890	4370	6470					
	1		250	400	630	990	1540	2380	3610	5360	6520				
	1.5		190	310	480	770	1200	1870	2850	4280	5240				
	2		150	250	390	620	970	1530	2360	3620	4480				
	3		120	190	300	470	750	1190	1850	2890	3610				
	5				180	280	450	710	1110	1740	2170				
	7.5					200	310	490	750	1140	1410				
	10						250	390	600	930	1160				

Notes:

1. If aluminum conductors are used, multiply lengths by 0.5. Maximum allowable length of aluminum is considerably shorter than copper wire of the same size.
2. The portion of the total cable which is between the service entrance and a ∅3 motor starter should not exceed 25 % of the total maximum length to assure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
3. Cables #14 to #0000 are AWG sizes, and 250 to 300 are MCM sizes.

10.5 Three-phase motor maximum cable length

Caution ***Use of wire size smaller than listed will void warranty.***

Three-phase motor maximum cable length [ft]
(Motor to service entrance) (2)

Volts	Hp		Wire size												
			14	**12**	**10**	**8**	**6**	**4**	**2**	**0**	**00**	**000**	**0000**	**250**	**300**
208	1.5	Max. cable length [ft]	310	500	790	1260									
	2		240	390	610	970	1520								
	3		180	290	470	740	1160	1810							
	5			170	280	440	690	1080	1660						
	7.5				200	310	490	770	1180	1770					
	10					230	370	570	880	1330	1640				
	15						250	390	600	910	1110	1340			
	20							300	460	700	860	1050	1270		
	25								370	570	700	840	1030	1170	
	30								310	470	580	700	850	970	1110
230	1.5		360	580	920	1450									
	2		280	450	700	1110	1740								
	3		210	340	540	860	1340	2080							
	5			200	320	510	800	1240	1900						
	7.5				230	360	570	890	1350	2030					
	10					270	420	660	1010	1520	1870				
	15						290	450	690	1040	1280	1540			
	20							350	530	810	990	1200	1450		
	25							280	430	650	800	970	1170	1340	
	30								350	540	660	800	970	1110	1270
460	1.5		1700												
	2		1300	2070											
	3		1000	1600	2520										
	5		590	950	1500	2360									
	7.5		420	680	1070	1690	2640								
	10		310	500	790	1250	1960	3050							
	15				540	850	1340	2090	3200						
	20				410	650	1030	1610	2470	3730					
	25					530	830	1300	1990	3010	3700				
	30					430	680	1070	1640	2490	3060	3700			
	40						790	1210	1830	2250	2710	3290			
	50						640	980	1480	1810	2190	2650	3010		
	60							830	1250	1540	1850	2240	2540	2890	
	75								1030	1260	1520	1850	2100	2400	
	100									940	1130	1380	1560	1790	
	125											1080	1220	1390	
	150												1050	1190	
	200												1080	1300	
	250													1080	

Three-phase motor maximum cable length [ft]
(Motor to service entrance) (2)

575	1.5	Max. cable length [ft]	2620												
	2		2030												
	3		1580	2530											
	5		920	1480	2330										
	7.5		660	1060	1680	2650									
	10		490	780	1240	1950									
	15			530	850	1340	2090								
	20				650	1030	1610	2520							
	25				520	830	1300	2030	3110						
	30					680	1070	1670	2560	3880					
	40						790	1240	1900	2860	3510				
	50							1000	1540	2310	2840	3420			
	60							850	1300	1960	2400	2890	3500		
	75								1060	1600	1970	2380	2890	3290	
	100									1190	1460	1770	2150	2440	2790

Caution ***Use of wire size smaller than listed will void warranty.***

Notes:

- If aluminum conductors are used, multiply lengths by 0.5. Maximum allowable length of aluminum is considerably shorter than copper wire of the same size.
- The portion of the total cable which is between the service entrance and a ∅3 motor starter should not exceed 25 % of the total maximum length to assure reliable starter operation. Single-phase control boxes may be connected at any point of the total cable length.
- Cables #14 to #0000 are AWG sizes, and 250 to 300 are MCM sizes.

10.6 Approvals

SP 4"	CSA®		UL®
SP 4" pump end	CLASSIFIED UL® WATER QUALITY DRINKING WATER SYSTEM COMPONENTS **ANSI/NSF 61** 65 GM 30 °C / 86 °F PUMP END ONLY		
MS6 motor		CSA®	**IAPMO** File 6591 0.25 % Lead
MS 4000 motor			
MS 402 motor	RU®		

10.7 Electrical data

10.7.1 Grundfos submersible motors - 60 Hz

Grundfos submersible motors - 60 Hz												
Hp	Ph	Volt [V]	S.F.	Circuit breaker or fuses		Amperage		Full load		Max. thrust [lbs]	Name-plate number	Product number
				Std.	Delay	Start [A]	Max. [A]	Eff. [%]	Power factor			
4-inch, single-phase, 2-wire motors (control box not required)												
.5	1	230	1.60	15	7	34.5	6.0	62	76	750	79952102	96465616
.75			1.50	20	9	40.5	8.4	62	75	750	79952103	96465618
1			1.40	25	12	48.4	9.8	63	82	750	79952104	96465620
1.5			1.30	35	15	62.0	13.1	64	85	750	79952105	96465622
4-inch, single-phase, 3-wire motors												
.5	1	230	1.60	15	7	21.5	6.0	62	76	750	79453102	96465606
.75			1.50	20	9	31.4	8.4	62	75	750	79453103	96465608
1			1.40	25	12	37.0	9.8	63	82	750	79453104	9646510
1.5			1.30	35	15	45.9	11.6	69	89	750	79453105	96465612
4-inch, three-phase, 3-wire motors												
1.5	3	230	1.30	15	8	40.3	7.3	75	72	750	79302005	96465629
		460	1.30	10	4	20.1	3.7	75	72	750	79362005	96465651
		575	1.30	10	4	16.1	2.9	75	72	750	79392005	96465630
2	3	230	1.25	20	10	48	8.7	76	75	750	79302006	96465652
		460	1.25	10	5	24	4.4	76	75	750	79362006	791539066
		575	1.25	10	4	19.2	3.5	76	75	750	79392006	791539066
3	3	230	1.15	30	15	56	12.2	77	75	1000	79304507	96405801
		460	1.15	15	7	28	6.1	77	75	1000	79354507	96405810
		575	1.15	15	6	22	4.8	77	75	1000	79394507	96405815
5	3	230	1.15	40	25	108	19.8	80	82	1000	79304509	96405802
		460	1.15	20	12	54	9.9	80	82	1000	79354509	96405811
		575	1.15	15	9	54	7.9	80	82	1000	79394509	96405816
7.5	3	230	1.15	60	30	130	25.0	81	82	1000	79305511	96405805
		460	1.15	35	15	67	13.2	81	82	1000	79355511	96405814
		575	1.15	30	15	67	10.6	81	82	1000	79395511	96405819
6-inch, three-phase, 3-wire motors												
7.5	3	230	1.15	60	35	119	26.4	80.5	76	1000	78305511	96405781
		460	1.15	30	15	59	13.2	80.5	76	1000	78355511	96405794
10	3	230	1.15	80	45	156	34.0	82.5	79	1000	78305512	96405782
		460	1.15	40	20	78	17.0	82.0	79	1000	78355512	96405795
15	3	230	1.15	150	80	343	66.0	84.0	81	4400	78305516	96405784
		460	1.15	60	30	115	24.5	82.5	82	4400	78305514	96405796
20	3	230	1.15	150	80	343	66.0	84	81	4400	78305516	96405784
		460	1.15	80	40	172	33.0	84	82	4400	78355516	96405797
25	3	460	1.15	100	50	217	41.0	84.5	80	4400	78355517	96405798
30	3	460	1.15	110	60	237	46.5	85	83	4400	78355518	96405799
40	3	460	1.15	150	80	320	64.0	85	82	4400	78355520	96405800

10.7.2 Other motor manufacturers

Hitachi motors

Refer to the Hitachi submersible motors application maintenance manual.

10.7.3 Franklin motors

Refer to the Franklin submersible motors application maintenance manual.

10.7.4 Correcting for three-phase power imbalance

Example: Check for current imbalance for a 230 volt, three-phase, 60 Hz submersible motor, 18.6 full load amps.

Solution: Steps 1 to 3 measure and record amps on each submersible drop cable lead for hookups 1, 2 and 3.

Observe that hookup 3 should be used since it shows the least amount of current imbalance. Therefore, the motor will operate at maximum efficiency and reliability.

By comparing the current values recorded on each leg, you will note the highest value was always on the same leg, L_3. This indicates the imbalance is in the power source. If the high current values were on a different leg each time the leads were changed, the imbalance would be caused by the motor or a poor connection.

If the current imbalance is greater than 5 %, contact your power supply company for help.

* For a detailed explanation of three-phase balance procedures, see section *7.1 Startup with three-phase motors* on page 15.

	Step 1 (hookup 1)	Step 2 (hookup 2)	Step 3 (hookup 3)
(T_1)	DL_1 = 25.5 amps	DL_3 = 25 amps	DL_2 = 25.0 amps
(T_2)	DL_2 = 23.0 amps	DL_1 = 24 amps	DL_3 = 24.5 amps
(T_3)	DL_3 = 26.5 amps	DL_2 = 26 amps	DL_1 = 25.5 amps
Step 4	Total = 75 amps	Total = 75 amps	Total = 75 amps
Step 5	Average current =	$\frac{\text{total current}}{\text{3 readings}}$ =	$\frac{75}{3}$ = 25 amps
Step 6	Greatest amp difference from the average:	(hookup 1) = 25 - 23 = 2 (hookup 2) = 26 - 25 = 1 (hookup 3) = 25.5 - 25 = 0.5	
Step 7	% Imbalance	(hookup 1) = 2/25 x 100 = 8 (hookup 2) = 1/25 x 100 = 4 (hookup 3) = 0.5/25 x 100 = 2	

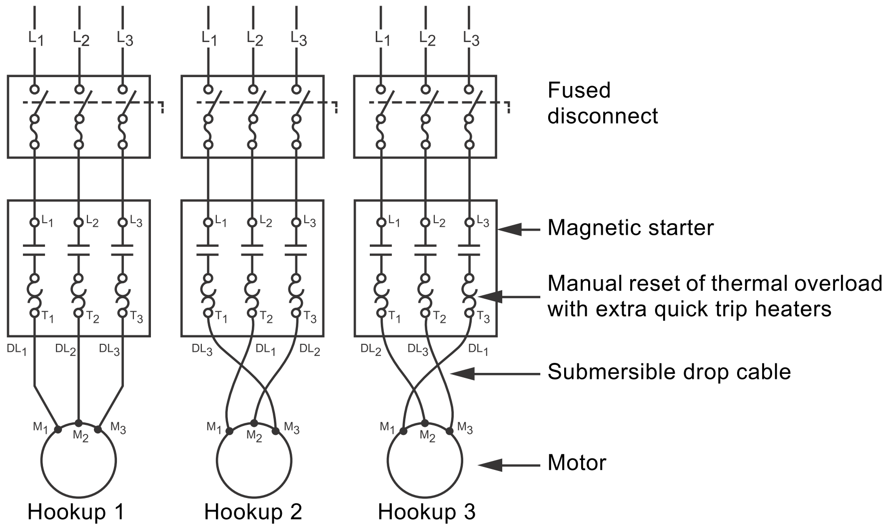


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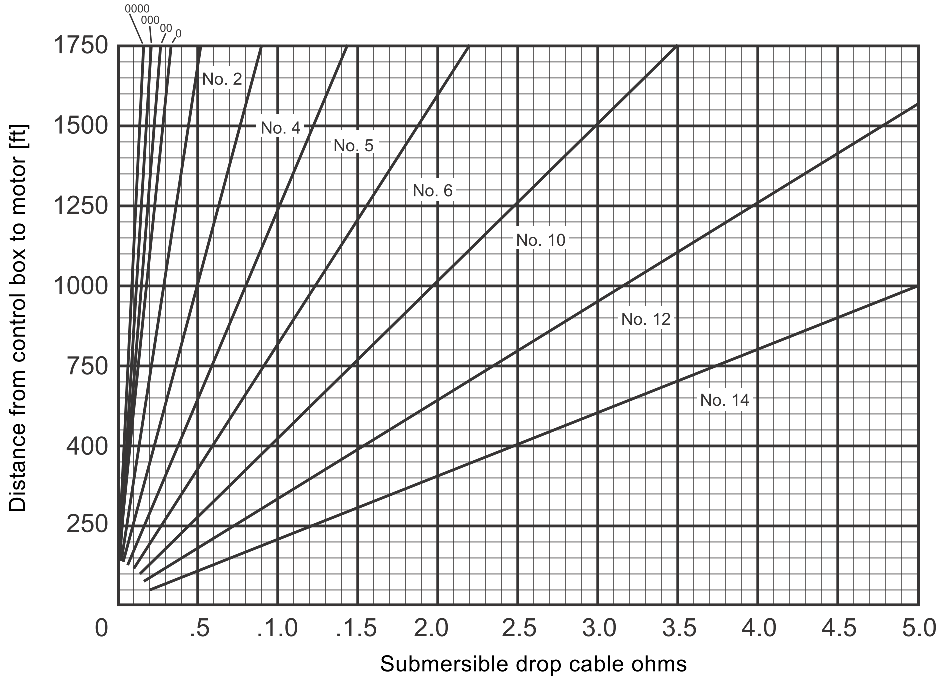
Fig. 17

10.7.5 Total resistance of submersible drop cable (ohms)

The values shown in this table are for copper conductors. Values are for the total resistance of submersible drop cable from the control box to the motor and back.

To determine the resistance:

1. Disconnect the submersible drop cable leads from the control box or control panel.
2. Record the size and length of submersible drop cable.
3. Determine the cable resistance from the table.
4. Add submersible drop cable resistance to motor resistance. Motor resistances can be found in section *10.7 Electrical data* on page 29.
5. Measure the resistance between each submersible drop cable lead by means of an ohmmeter. Meter should be set on Rx1 and zero-balanced for this measurement.
6. The measured values should be approximately equal to the calculated values.



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11. 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.

TW-60 Water Treatment System

section 11

Products > Residential & Light Commercial > Motors > 4-Inch > 4-Inch Motor Specifications

Motors

4-Inch

- Super Stainless
- High Thrust

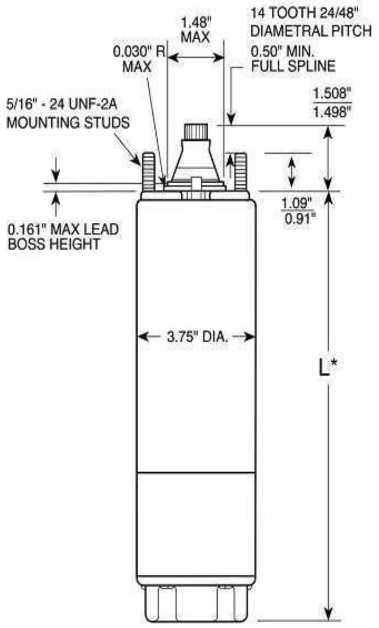
Model: 234 595 8602

4-inch Motors - High Thrust

Motor Specifications:	
Horsepower:	10
Voltage:	460/380-415
Frequency:	60/50
Phase:	Three-Phase
RPM:	3450
Service Factor:	1.15/1.00
Rotation:	CCW Facing Shaft End
Poles:	2
Downward Thrust (lbs):	1500 LBS (6500 N)
Max. Ambient Temp.:	86°F / 30°C
Duty Rating:	Continuous at 0.25 ft/sec flow past motor
Construction Materials:	
Construction:	Water Well
Length (inches):	32.18
Shipping Weight (lbs / kg):	77 / 34.9
Carton Size:	6 x 6 x 34
Stator Shell:	301 SS
Stator Ends:	Low Carbon Steel
Shaft Extension:	17-4 SS
Fasteners:	300 Series SS
Seal:	Nitrile Rubber Lip
Seal Cover:	Acetol
Slinger:	Nitrile Rubber
Lead in Motor:	YES
Lead Wire (or Cable):	XLPE*
Lead Potting:	Epoxy
Diaphragm:	Nitrile Rubber
Diaphragm Cover:	Gray Iron
Diaphragm Cup:	316 SS
Diaphragm Spring:	316 SS
Filter:	Delrin & Polyester

For specifications not included on this page, please contact Franklin's Technical Service Hotline at 800.348.2420

4" High Thrust — Dimensions
(Standard Water Well)



Storage

Franklin Electric submersible motors are a water-lubricated design. The fill solution consists of a mixture of deionized water and Propylene Glycol (a non-toxic antifreeze). The solution will prevent damage from freezing in temperatures to -40 °F (-40 °C); motors should be stored in areas that do not go below this temperature. The solution will partially freeze below 27 °F (-3 °C), but no damage occurs. Repeated freezing and thawing should be avoided to prevent possible loss of fill solution.

There may be an interchange of fill solution with well water during operation. Care must be taken with motors removed from wells during freezing conditions to prevent damage.

When the storage temperature does not exceed 100 °F (37 °C), storage time should be limited to two years. Where temperatures reach 100° to 130 °F, storage time should be limited to one year.

Loss of a few drops of liquid will not damage the motor as an excess amount is provided, and the filter check valve will allow lost liquid to be replaced by filtered well water upon installation. If there is reason to believe there has been a considerable amount of leakage, consult the factory for checking procedures.

Frequency of Starts

The average number of starts per day over a period of months or years influences the life of a submersible pumping system. Excessive cycling affects the life of control components such as pressure switches, starters, relays, and capacitors. Rapid cycling can also cause motor spline damage, bearing damage, and motor overheating. All these conditions can lead to reduced motor life.

The pump size, tank size, and other controls should be selected to keep the starts per day as low as practical for longest life. The maximum number of starts per 24-hour period is shown in Table 3.

Motors should run a minimum of one minute to dissipate heat build up from starting current. Six inch and larger motors should have a minimum of 15 minutes between starts or starting attempts.

Table 3 Number of Starts

MOTOR RATING		MAXIMUM STARTS PER 24 HR PERIOD	
HP	KW	SINGLE-PHASE	THREE-PHASE
Up to 0.75	Up to 0.55	300	300
1 thru 5.5	0.75 thru 4	100	300
7.5 thru 30	5.5 thru 22	50	100*
40 and over	30 and over	-	100

* Keeping starts per day within the recommended numbers provides the best system life. However, when used with a properly configured Reduced Voltage Starter (RVS) or Variable Frequency Drive (VFD), 7.5 thru 30 hp three-phase motors can be started up to 200 times per 24 hour period.

Mounting Position

Franklin submersible motors are designed primarily for operation in the vertical, shaft-up position.

During acceleration, the pump thrust increases as its output head increases. In cases where the pump head stays below its normal operating range during startup and full speed condition, the pump may create upward thrust. This creates upward thrust on the motor upthrust bearing. This is an acceptable operation for short periods at each start, but running continuously with upthrust will cause excessive wear on the upthrust bearing.

With certain additional restrictions as listed in this section and the Inline Booster Pump Systems sections of this manual, motors are also suitable for operation in positions from shaft-up to shaft-horizontal. As the mounting position becomes further from vertical and closer to horizontal, the probability of shortened thrust bearing life increases. For normal motor life expectancy with motor positions other than shaft-up, follow these recommendations:

1. Minimize the frequency of starts, preferably to fewer than per 24-hour period. Six and eight inch motors should have a minimum of 20 minutes between starts or starting attempts
2. Do not use in systems which can run even for short periods at full speed without thrust toward the motor.

Transformer Capacity - Single-Phase or Three-Phase

Distribution transformers must be adequately sized to satisfy the kVA requirements of the submersible motor. When transformers are too small to supply the load, there is a reduction in voltage to the motor.

Table 4 references the motor horsepower rating, single-phase and three-phase, total effective kVA required, and the smallest transformer required for open or closed three-phase systems. Open systems require larger transformers since only two transformers are used.

Other loads would add directly to the kVA sizing requirements of the transformer bank.

Table 4 Transformer Capacity

MOTOR RATING		TOTAL EFFECTIVE KVA REQUIRED	SMALLEST KVA RATING-EACH TRANSFORMER	
HP	KW		OPEN WYE OR DELTA 2- TRANSFORMERS	CLOSED WYE OR DELTA 3- TRANSFORMERS
1.5	1.1	3	2	1
2	1.5	4	2	1.5
3	2.2	5	3	2
5	3.7	7.5	5	3
7.5	5.5	10	7.5	5
10	7.5	15	10	5
15	11	20	15	7.5
20	15	25	15	10
25	18.5	30	20	10
30	22	40	25	15
40	30	50	30	20
50	37	60	35	20
60	45	75	40	25
75	55	90	50	30
100	75	120	65	40
125	93	150	85	50
150	110	175	100	60
175	130	200	115	70
200	150	230	130	75

NOTE: Standard kVA ratings are shown. If power company experience and practice allows transformer loading higher than standard, higher loading values may be used to meet total effective kVA required, provided correct voltage and balance is maintained.

Effects of Torque

During starting of a submersible pump, the torque developed by the motor must be supported through the pump, delivery pipe or other supports. Most pumps rotate in the direction which causes unscrewing torque on right-handed threaded pipe or pump stages. All threaded joints, pumps and other parts of the pump support system must be capable of withstanding the maximum torque repeatedly without loosening or breaking. Unscrewing joints will break electrical cable and may cause loss of the pump-motor unit.

To safely withstand maximum unscrewing torques with a minimum safety factor of 1.5, tightening all threaded joints to at least 10 lb-ft per motor horsepower is recommended (Table 4A). It may be necessary to tack or strap weld pipe joints on high horsepower pumps, especially at shallower settings.

Table 4A Torque Required (Examples)

MOTOR RATING		MINIMUM SAFE TORQUE-LOAD
HP	KW	
1 hp & Less	0.75 kW & Less	10 lb-ft
20 hp	15 kW	200 lb-ft
75 hp	55 kW	750 lb-ft
200 hp	150 kW	2000 lb-ft

Drawdown Seals

Allowable motor temperature is based on atmospheric pressure or higher surrounding the motor. "Drawdown seals," which seal the well to the pump above its intake to maximize delivery are not recommended, since the suction created can be lower than atmospheric pressure.

Grounding Control Boxes and Panels

The National Electrical Code requires that the control box or panel-grounding terminal always be connected to supply ground. If the circuit has no grounding conductor and no metal conduit from the box to supply panel, use a wire at least as large as line conductors and connect as required by the National Electrical Code, from the grounding terminal to the electrical supply ground.

WARNING: Failure to ground the control frame can result in a serious or fatal electrical shock hazard.

Grounding Surge Arrestors

An above ground surge arrestor must be grounded, metal to metal, all the way to the lowest draw down water strata for the surge arrestor to be effective. GROUNDING THE ARRESTOR TO THE SUPPLY GROUND OR TO A DRIVEN GROUND ROD PROVIDES LITTLE OR NO SURGE PROTECTION FOR THE MOTOR.

Control Box, Pumptec Products, and Panel Environment

Franklin Electric control boxes, Pumptec products and three-phase panels meet UL requirements for NEMA Type 3R enclosures. They are suitable for indoor and outdoor applications within temperatures of +14 °F (-10 °C) to 122 °F (50 °C). Operating control boxes below +14 °F can cause reduced starting torque and loss of overload protection when overloads are located in control boxes.

Control boxes, Pumptec products, and three-phase panels should never be mounted in direct sunlight or high temperature locations. This will cause shortened capacitor life (where applicable) and unnecessary tripping of overload protectors. A ventilated enclosure painted white to reflect heat is recommended for an outdoor, high temperature location.

A damp well pit, or other humid location, accelerates component failure from corrosion.

Control boxes with voltage relays are designed for vertical upright mounting only. Mounting in other positions will affect the operation of the relay.

Equipment Grounding

WARNING: Serious or fatal electrical shock may result from failure to connect the motor, control enclosures, metal plumbing, and all other metal near the motor or cable to the power supply ground terminal using wire no smaller than motor cable wires.

The primary purpose of grounding the metal drop pipe and/or metal well casing in an installation is safety. It is done to limit the voltage between nonelectrical (exposed metal) parts of the system and ground, thus minimizing dangerous shock hazards. Using wire at least the size of the motor cable wires provides adequate current-carrying capability for any ground fault that might occur. It also provides a low resistance path to ground, ensuring that the current to ground will be large enough to trip any overcurrent device designed to detect faults (such as a ground fault circuit interrupter, or GFCI).

Normally, the ground wire to the motor would provide the primary path back to the power supply ground for any ground fault. There are conditions, however, where the ground wire connection could become compromised. One such example would be the case where the water in the well is abnormally corrosive or aggressive. In this example, a grounded metal drop pipe or casing would then become the primary path to ground. However, the many installations that now use plastic drop pipes and/or casings require further steps to be taken for safety purposes, so that the water column itself does not become the conductive path to ground.

When an installation has abnormally corrosive water AND the drop pipe or casing is plastic, Franklin Electric recommends the use of a GFCI with a 10 mA set-point. In this case, the motor ground wire should be routed through the current-sensing device along with the motor power leads. Wired this way, the GFCI will trip only when a ground fault has occurred AND the motor ground wire is no longer functional.

Table 22 Three-Phase Motor Specifications (60 Hz) 3450 rpm

TYPE	MOTOR MODEL PREFIX	RATING					FULL LOAD		MAXIMUM LOAD		LINE TO LINE RESISTANCE OHMS	EFFICIENCY %		LOCKED ROTOR AMPS	KVA CODE
		HP	KW	VOLTS	HZ	S.F.	AMPS	WATTS	AMPS	WATTS		S.F.	F.L.		
4"	234501	1/2	0.37	200	60	1.6	2.8	585	3.4	860	6.6-8.4	70	64	17.5	N
	234511			230	60	1.6	2.4	585	2.9	860	9.5-10.9	70	64	15.2	N
	234541			380	60	1.6	1.4	585	2.1	860	23.2-28.6	70	64	9.2	N
	234521			460	60	1.6	1.2	585	1.5	860	38.4-44.1	70	64	7.6	N
	234531			575	60	1.6	1.0	585	1.2	860	58.0-71.0	70	64	6.1	N
	234502	3/4	0.55	200	60	1.5	3.6	810	4.4	1150	4.6-5.9	73	69	24.6	N
	234512			230	60	1.5	3.1	810	3.8	1150	6.8-7.8	73	69	21.4	N
	234542			380	60	1.5	1.9	810	2.5	1150	16.6-20.3	73	69	13	N
	234522			460	60	1.5	1.6	810	1.9	1150	27.2-30.9	73	69	10.7	N
	234532			575	60	1.5	1.3	810	1.6	1150	41.5-50.7	73	69	8.6	N
	234503	1	0.75	200	60	1.4	4.5	1070	5.4	1440	3.8-4.5	72	70	30.9	M
	234513			230	60	1.4	3.9	1070	4.7	1440	4.9-5.6	72	70	26.9	M
	234543			380	60	1.4	2.3	1070	2.8	1440	12.2-14.9	72	70	16.3	M
	234523			460	60	1.4	2	1070	2.4	1440	19.9-23.0	72	70	13.5	M
	234533			575	60	1.4	1.6	1070	1.9	1440	30.1-36.7	72	70	10.8	M
	234504	1.5	1.1	200	60	1.3	5.8	1460	6.8	1890	2.5-3.0	76	76	38.2	K
	234514			230	60	1.3	5	1460	5.9	1890	3.2-4.0	76	76	33.2	K
	234544			380	60	1.3	3	1460	3.6	1890	8.5-10.4	76	76	20.1	K
	234524			460	60	1.3	2.5	1460	3.1	1890	13.0-16.0	76	76	16.6	K
	234534			575	60	1.3	2	1460	2.4	1890	20.3-25.0	76	76	13.3	K
	234305	2	1.5	200	60	1.25	7.7	1960	9.3	2430	1.8-2.4	76	76	50.3	K
	234315			230	60	1.25	6.7	1960	8.1	2430	2.3-3.0	76	76	45.0	K
	234345			380	60	1.25	4.1	1960	4.9	2430	6.6-8.2	76	76	26.6	K
	234325			460	60	1.25	3.4	1960	4.1	2430	9.2-12.0	76	76	22.5	K
	234335			575	60	1.25	2.7	1960	3.2	2430	14.6-18.7	76	76	17.8	K
	234306	3	2.2	200	60	1.15	10.9	2920	12.5	3360	1.3-1.7	77	77	69.5	K
	234316			230	60	1.15	9.5	2920	10.9	3360	1.8-2.2	77	77	60.3	K
	234346			380	60	1.15	5.8	2920	6.6	3360	4.7-6.0	77	77	37.5	K
	234326			460	60	1.15	4.8	2920	5.5	3360	7.2-8.8	77	77	31.0	K
	234336			575	60	1.15	3.8	2920	4.4	3360	11.4-13.9	77	77	25.1	K
	234307	5	3.7	200	60	1.15	18.3	4800	20.5	5500	.68-.83	78	78	116	K
	234317			230	60	1.15	15.9	4800	17.8	5500	.91-1.1	78	78	102	K
	234347			380	60	1.15	9.6	4800	10.8	5500	2.6-3.2	78	78	60.2	K
	234327			460	60	1.15	8.0	4800	8.9	5500	3.6-4.4	78	78	53.7	K
	234337			575	60	1.15	6.4	4800	7.1	5500	5.6-6.9	78	78	41.8	K
	234308	7.5	5.5	200	60	1.15	26.5	7150	30.5	8200	.43-.53	78	78	177	K
	234318			230	60	1.15	23.0	7150	26.4	8200	.60-.73	78	78	152	K
	234348			380	60	1.15	13.9	7150	16.0	8200	1.6-2.0	78	78	92.7	K
	234328			460	60	1.15	11.5	7150	13.2	8200	2.3-2.8	78	78	83.8	K
	234338			575	60	1.15	9.2	7150	10.6	8200	3.6-4.5	78	78	64.6	K
	234549	10	7.5	380	60	1.15	19.3	10000	21.0	11400	1.2-1.6	75	75	140	L
	234595			460	60	1.15	15.9	10000	17.3	11400	1.8-2.3	75	75	116.0	L
	234598			575	60	1.15	12.5	10000	13.6	11400	2.8-3.5	75	75	92.8	L
	234646	15	11	380	60	1.15	27.6	14600	31.2	16800	.86-1.1	77	76	178	J
	234626			460	60	1.15	22.8	14600	25.8	16800	1.2-1.5	77	76	147	J
	234636			575	60	1.15	18.2	14600	20.7	16800	1.9-2.4	77	76	118	J

Table 23 Three-Phase Motor Fuse Sizing

TYPE	MOTOR MODEL PREFIX	RATING			CIRCUIT BREAKERS OR FUSE AMPS (MAXIMUM PER NEC)			CIRCUIT BREAKERS OR FUSE AMPS (TYPICAL SUBMERSIBLE)		
		HP	KW	VOLTS	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER	STANDARD FUSE	DUAL ELEMENT TIME DELAY FUSE	CIRCUIT BREAKER
4"	234501	1/2	0.37	200	10	5	8	10	4	15
	234511			230	8	4.5	6	8	4	15
	234541			380	5	2.5	4	5	2	15
	234521			460	4	2.25	3	4	2	15
	234531			575	3	1.8	3	3	1.4	15
	234502	3/4	0.55	200	15	7	10	12	5	15
	234512			230	10	5.6	8	10	5	15
	234542			380	6	3.5	5	6	3	15
	234522			460	5	2.8	4	5	3	15
	234532			575	4	2.5	4	4	1.8	15
	234503	1	0.75	200	15	8	15	15	6	15
	234513			230	15	7	10	12	6	15
	234543			380	8	4.5	8	8	4	15
	234523			460	6	3.5	5	6	3	15
	234533			575	5	2.8	4	5	2.5	15
	234504	1.5	1.1	200	20	12	15	20	8	15
	234514			230	15	9	15	15	8	15
	234544			380	10	5.6	8	10	4	15
	234524			460	8	4.5	8	8	4	15
	234534			575	6	3.5	5	6	3	15
	234305	2	1.5	200	25	15	20	25	11	20
	234315			230	25	12	20	25	10	20
	234345			380	15	8	15	15	6	15
	234325			460	15	6	10	11	5	15
	234335			575	10	5	8	10	4	15
	234306	3	2.2	200	35	20	30	35	15	30
	234316			230	30	17.5	25	30	12	25
	234346			380	20	12	15	20	8	15
	234326			460	15	9	15	15	6	15
	234336			575	15	7	10	11	5	15
	234307	5	3.7	200	60	35	50	60	25	50
	234317			230	50	30	40	45	20	40
	234347			380	30	17.5	25	30	12	25
	234327			460	25	15	20	25	10	20
	234337			575	20	12	20	20	8	20
	234308	7.5	5.5	200	90	50	70	80	35	70
	234318			230	80	45	60	70	30	60
	234348			380	45	25	40	40	20	40
	234328			460	40	25	30	35	15	30
	234338			575	30	17.5	25	30	12	25
	234349	10	7.5	380	70	40	60	60	25	60
	234329			460	60	30	45	50	25	45
	234339			575	45	25	35	40	20	35
	234549			380	70	35	60	60	25	60
	234595			460	60	30	45	50	25	45
	234598			575	45	25	35	40	20	35
	234646	15	11	380	90	50	70	80	35	70
	234626			460	80	45	60	70	30	60
	234636			575	60	35	50	60	25	50

Overload Protection of Three-Phase Submersible Motors

Class 10 Protection Required

The characteristics of submersible motors are different than standard motors and special overload protection is required.

If the motor is locked, the overload protection must trip within 10 seconds to protect the motor windings. Subtrol/ SubMonitor, a Franklin-approved adjustable overload relay, or a Franklin-approved fixed heater must be used.

Fixed heater overloads must be the ambient-compensated quick-trip type to maintain protection at high and low air temperatures.

All heaters and amp settings shown are based on total line amps. When determining amperage settings or making heater selections for a six-lead motor with a Wye-Delta starter, divide motor amps by 1.732.

Pages 29, 30 and 31 list the correct selection and settings for some manufacturers. Approval for other manufacturers' types not listed may be requested by calling Franklin's Technical Service Hotline at 800-348-2420.

Refer to notes on page 30.

Table 29 - 60 Hz 4" Motors

HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
				FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
1/2	0.37	200	00	K31	L380A	3.2	3.4
		230	00	K28	L343A	2.7	2.9
		380	00	K22	L211A	1.7	1.8
		460	00	-	L174A	1.4	1.5
		575	00	-	-	1.2	1.3
3/4	0.55	200	00	K34	L510A	4.1	4.4
		230	00	K32	L420A	3.5	3.8
		380	00	K27	L282A	2.3	2.5
		460	00	K23	L211A	1.8	1.9
		575	00	K21	L193A	1.5	1.6
1	0.75	200	00	K37	L618A	5.0	5.4
		230	00	K36	L561A	4.4	4.7
		380	00	K28	L310A	2.6	2.8
		460	00	K26	L282A	2.2	2.4
		575	00	K23	L211A	1.8	1.9
1.5	1.1	200	00	K42	L750A	6.3	6.8
		230	00	K39	L680A	5.5	5.9
		380	00	K32	L420A	3.3	3.6
		460	00	K29	L343A	2.8	3.0
		575	00	K26	L282A	2.2	2.4
2	1.5	200	0	K50	L111B	8.6	9.3
		230	0	K49	L910A	7.5	8.1
		380	0	K36	L561A	4.6	4.9
		460	00	K33	L463A	3.8	4.1
		575	00	K29	L380A	3.0	3.2
3	2.2	200	0	K55	L147B	11.6	12.5
		230	0	K52	L122B	10.1	10.9
		380	0	K41	L750A	6.1	6.6
		460	0	K37	L618A	5.1	5.5
		575	0	K34	L510A	4.1	4.4
5	3.7	200	1	K62	L241B	19.1	20.5
		230	1	K61	L199B	16.6	17.8
		380	0	K52	L122B	10.0	10.8
		460	0	K49	L100B	8.3	8.9
		575	0	K42	L825A	6.6	7.1
7.5	5.5	200	1	K68	L322B	28.4	30.5
		230	1	K67	L293B	24.6	26.4
		380	1	K58	L181B	14.9	16.0
		460	1	K55	L147B	12.3	13.2
		575	1	K52	L122B	9.9	10.6
10	7.5	380	1	K62	L241B	19.5	21.0
		460	1	K60	L199B	16.1	17.3
		575	1	K56	L165B	12.9	13.6
15	11	380	2 (1)	K70	L322B	29	31.2
		460	2 (1)	K67	L265B	24.0	25.8
		575	2 (1)	K62	L220B	19.3	20.7

Table 30 - 60 Hz 6" Standard & Hi-Temp Motors

HP	KW	VOLTS	NEMA STARTER SIZE	HEATERS FOR OVERLOAD RELAYS		ADJUSTABLE RELAYS (NOTE 3)	
				FURNAS (NOTE 1)	G.E. (NOTE 2)	SET	MAX.
5	3.7	200	1	K61	L220B	17.6	19.1
		230	1	K61	L199B	15.4	16.6
		380	0	K52	L122B	9.4	10.1
		460	0	K49	L100B	7.7	8.3
		575	0	K42	L825A	6.1	6.6
7.5	5.5	200	1	K67	L322B	26.3	28.3
		230	1	K64	L293B	22.9	24.6
		380	1	K57	L165B	13.9	14.9
		460	1	K54	L147B	11.4	12.3
		575	1	K52	L111B	9.1	9.8
10	7.5	200	2(1)	K72	L426B	34.4	37.0
		230	2(1)	K70	L390B	29.9	32.2
		380	1	K61	L220B	18.1	19.5
		460	1	K58	L181B	15.0	16.1
		575	1	K55	L147B	12.0	12.9
15	11	200	3(1)	K76	L650B	50.7	54.5
		230	2	K75	L520B	44.1	47.4
		380	2(1)	K68	L322B	26.7	28.7
		460	2(1)	K64	L265B	22.0	23.7
		575	2(1)	K61	L220B	17.7	19.0
20	15	200	3	K78	L787B	64.8	69.7
		230	3(1)	K77	L710B	56.4	60.6
		380	2	K72	L426B	34.1	36.7
		460	2	K69	L352B	28.2	30.3
		575	2	K64	L393B	22.7	24.4
25	18.5	200	3	K86	L107C	80.3	86.3
		230	3	K83	L866B	69.8	75.0
		380	2	K74	L520B	42.2	45.4
		460	2	K72	L426B	34.9	37.5
		575	2	K69	L352B	27.9	30.0
30	22	200	4(1)	K88	L126C	96.7	104.0
		230	3	K87	L107C	84.1	90.4
		380	3(1)	K76	L650B	50.9	54.7
		460	3(1)	K74	L520B	42.0	45.2
		575	3(1)	K72	L390B	33.7	36.2
40	30	380	3	K83	L866B	69.8	75.0
		460	3	K77	L710B	57.7	62.0
		575	3	K74	L593B	46.1	49.6
50	37	380	3	K87	L107C	86.7	93.2
		460	3	K83	L950B	71.6	77.0
		575	3	K77	L710B	57.3	61.6
60	45	380	4(1)	K89	L126C	102.5	110.2
		460	4(1)	K87	L107C	84.6	91.0
		575	4(1)	K78	L866B	67.7	72.8

Footnotes for Tables 29, 30, 31, and 31A

NOTE 1: Furnas intermediate sizes between NEMA starter sizes apply where (1) is shown in tables, size 1.75 replacing 2, 2.5 replacing 3, 3.5 replacing 4, and 4.5 replacing 5. Heaters were selected from Catalog 294, table 332 and table 632 (starter size 00, size B). Size 4 starters are heater type 4 (JG). Starters using these heater tables include classes 14, 17, and 18 (inNOVA), classes 36 and 37 (reduced voltage), and classes 87, 88, and 89 (pump and motor control centers). Overload relay adjustments should be set no higher than 100% unless necessary to stop nuisance tripping with measured amps in all lines below nameplate maximum. Heater selections for class 16 starters (Magnetic Definite Purpose) will be furnished upon request.

NOTE 2: General Electric heaters are type CR123 usable only on type CR124 overload relays and were selected from Catalog GEP-1260J, page 184. Adjustment should be set no higher than 100%, unless necessary to stop nuisance tripping with measured amps in all lines below nameplate maximum.

NOTE 3: Adjustable overload relay amp settings apply to approved types listed. Relay adjustment should be set at the specified SET amps. Only if tripping occurs with amps in all lines measured to be within nameplate maximum amps should the setting be increased, not to exceed the MAX value shown.

NOTE 4: Heaters shown for ratings requiring NEMA size 5 or 6 starters are all used with current transformers per manufacturer standards. Adjustable relays may or may not use current transformers depending on design.

Three-Phase Power Unbalance

A full three-phase supply is recommended for all three-phase motors, consisting of three individual transformers or one three-phase transformer. So-called "open" Delta or Wye connections using only two transformers can be used, but are more likely to cause problems, such as poor performance, overload tripping or early motor failure due to current unbalance.

Transformer rating should be no smaller than listed in Table 4 for supply power to the motor alone.

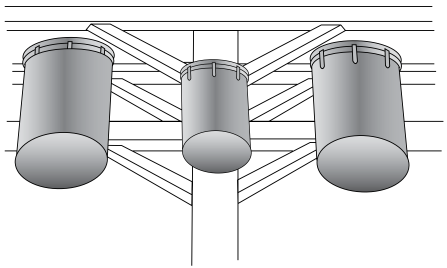


FIG. 7
FULL THREE-PHASE

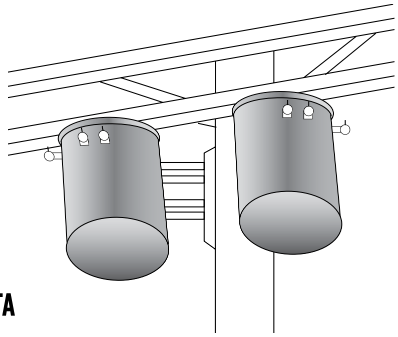


FIG. 8
OPEN DELTA

Checking and Correcting Rotation and Current Unbalance

1. Establish correct motor rotation by running the motor in both directions. Normal rotation is CCW viewing the shaft end. Rotation can be changed by interchanging any two of the three motor leads. The rotation that gives the most water flow is typically the correct rotation.
2. After correct rotation has been established, check the current in each of the three motor leads and calculate the current unbalance as explained in 3 below.

   If the current unbalance is 2% or less, leave the leads as connected.

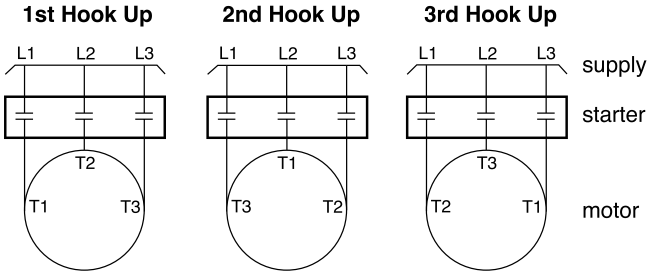
   If the current unbalance is more than 2%, current readings should be checked on each leg using each of three possible hook-ups. Roll the motor leads across the starter in the same direction to prevent motor reversal.
3. To calculate percent of current unbalance:
   - A. Add the three line amps values together
   - B. Divide the sum by three, yielding average current
   - C. Pick the amp value which is furthest from the average current (either high or low)
   - D. Determine the difference between this amp value(furthest from average) and the average
   - E. Divide the difference by the average. Multiply the result by 100 to determine percent of unbalance
4. Current unbalance should not exceed 5% at max amp load or 10% at rated input load. If the unbalance cannot be corrected by rolling leads, the source of the unbalance must be located and corrected. If, on the three possible hookups, the leg farthest from the average stays on the same power lead, most of the unbalance is coming from the "power side" of the system. If the reading farthest from average moves with the same motor lead, the primary source of unbalance is on the "motor side" of the starter. In this instance, consider a damaged cable, leaking splice, poor connection, or faulty motor winding.

Phase designation of leads for CCW rotation viewing shaft end.

To reverse rotation, interchange any two leads.

Phase 1 or "A" - Black, T1, or U1
Phase 2 or "B" - Yellow, T2, or V1
Phase 3 or "C" - Red, T3, or W1

NOTICE: Phase 1, 2, and 3 may not be L1, L2, and L3.



EXAMPLE:

T1 = 51 amps	T3 = 50 amps	T2 = 50 ampsT2 = 46
amps	T1 = 49 amps	T3 = 48 ampsT3 = 53
+ amps	+ T2 = 51 amps	+ T1 = 52 amps
Total = 150 amps	Total = 150 amps	Total = 150 amps
$\frac{150}{3}$ = 50 amps	$\frac{150}{3}$ = 50 amps	$\frac{150}{3}$ = 50 amps
50 - 46 = 4 amps	50 - 49 = 1 amp	50 - 48 = 2 amps
$\frac{4}{50}$ = 0.08 or 8%	$\frac{1}{50}$ = 0.02 or 2%	$\frac{2}{50}$ = 0.04 or 4%

Tightening Motor Lead Connector Jam Nut

4″ Motors with Jam Nut:
15 to 20 ft-lb (20 to 27 Nm)

4″ Motors with 2 Screw Clamp Plate:
35 to 45 in-lb (40 to 51 Nm)

6″ Motors:
40 to 50 ft-lb (54 to 68 Nm)

8″ Motors with 1-3/16″ to 1-5/8″ Jam Nut:
50 to 60 ft-lb (68 to 81 Nm)

8″ Motors with 4 Screw Clamp Plate:
Apply increasing torque to the screws equally in a criss-cross pattern until 80 to 90 in-lb (9.0 to 10.2 Nm) is reached.

Jam nut tightening torques recommended for field assembly are shown. Rubber compression set within the first few hours after assembly may reduce the jam nut torque. This is a normal condition which does not indicate reduced seal effectiveness. Retightening is not required, but is permissible and recommended if original torque was questionable.

A motor lead assembly should not be reused. A new lead assembly should be used whenever one is removed from the motor, because rubber set and possible damage from removal may prevent proper resealing of the old lead.

All motors returned for warranty consideration must have the lead returned with the motor.

Pump to Motor Coupling

Assemble coupling with non-toxic FDA approved waterproof grease such as Mobile FM222, Texaco CYGNUS2661, or approved equivalent. This prevents abrasives from entering the spline area and prolongs spline life.

Pump to Motor Assembly

After assembling the motor to the pump, torque mounting fasteners to the following:

4″ Pump and Motor: 10 lb-ft (14 Nm)

6″ Pump and Motor: 50 lb-ft (68 Nm)

8″ Pump and Motor: 120 lb-ft (163 Nm)

Shaft Height and Free End Play

Table 43

MOTOR	NORMAL SHAFT HEIGHT		DIMENSION SHAFT HEIGHT		FREE END PLAY	
					MIN.	MAX.
4″	1 1/2″	38.1 mm	1.508″ 1.498″	38.30 38.05 mm	0.010″ 0.25 mm	0.045″ 1.14 mm
6″	2 7/8″	73.0 mm	2.875″ 2.869″	73.02 72.88 mm	0.030″ 0.76 mm	0.050″ 1.27 mm
8″ TYPE 1	4″	101.6 mm	4.000″ 3.990″	101.60 101.35 mm	0.008″ 0.20 mm	0.032″ 0.81 mm
8″ TYPE 2.1	4″	101.6 mm	4.000″ 3.990″	101.60 101.35 mm	0.030″ 0.76 mm	0.080″ 2.03 mm

If the height, measured from the pump-mounting surface of the motor, is low and/or end play exceeds the limit, the motor thrust bearing is possibly damaged, and should be replaced.

Submersible Leads and Cables

A common question is why motor leads are smaller than specified in Franklin's cable charts.

The leads are considered a part of the motor and actually are a connection between the large supply wire and the motor winding. The motor leads are short and there is virtually no voltage drop across the lead.

In addition, the lead assemblies **operate under water**, while at least part of the supply cable must **operate in air.** Lead assemblies running under water operate cooler.

CAUTION: Lead assemblies on submersible motors are suitable only for use in water and may overheat and cause failure if operated in air.

System Troubleshooting

Motor Does Not Start

POSSIBLE CAUSE	CHECKING PROCEDURES	CORRECTIVE ACTION
A. No power or incorrect voltage	Check voltage at line terminals. The voltage must be ± 10% of rated voltage.	Contact power company if voltage is incorrect.
B. Fuses blown or circuit breakers tripped	Check fuses for recommended size and check for loose, dirty or corroded connections in fuse receptacle. Check for tripped circuit breakers.	Replace with proper fuse or reset circuit breakers.
C. Defective pressure switch	Check voltage at contact points. Improper contact of switch points can cause voltage less than line voltage.	Replace pressure switch or clean points.
D. Control box malfunction	For detailed procedure, see pages 48-57.	Repair or replace.
E. Defective wiring	Check for loose or corroded connections or defective wiring.	Correct faulty wiring or connections.
F. Bound pump	Check for misalignment between pump and motor or a sand bound pump. Amp readings will be 3 to 6 times higher than normal until the overload trips.	Pull pump and correct problem. Run new installation until the water clears.
G. Defective cable or motor	For detailed procedure, see pages 46 & 47.	Repair or replace.

Motor Starts Too Often

A. Pressure switch	Check setting on pressure switch and examine for defects.	Reset limit or replace switch.
B. Check valve - stuck open	Damaged or defective check valve will not hold pressure.	Replace if defective.
C. Waterlogged tank	Check air charge.	Clean or replace.
D. Leak in system	Check system for leaks.	Replace damaged pipes or repair leaks.

System Troubleshooting

Motor Runs Continuously

POSSIBLE CAUSE	CHECKING PROCEDURES	CORRECTIVE ACTION
A. Pressure switch	Check switch for welded contacts. Check switch adjustments.	Clean contacts, replace switch, or adjust setting.
B. Low water level in well	Pump may exceed well capacity. Shut off pump, wait for well to recover. Check static and drawdown level from well head.	Throttle pump output or reset pump to lower level. Do not lower if sand may clog pump.
C. Leak in system	Check system for leaks.	Replace damaged pipes or repair leaks.
D. Worn pump	Symptoms of worn pump are similar to those of drop pipe leak or low water level in well. Reduce pressure switch setting, if pump shuts off worn parts may be the fault.	Pull pump and replace worn parts.
E. Loose coupling or broken motor shaft	Check for loose coupling or damaged shaft.	Replace worn or damaged parts.
F. Pump screen blocked	Check for clogged intake screen.	Clean screen and reset pump depth.
G. Check valve stuck closed	Check operation of check valve.	Replace if defective.
H. Control box malfunction	See pages 48-57 for single-phase.	Repair or replace.

Motor Runs But Overload Protector Trips

A. Incorrect voltage	Using voltmeter, check the line terminals. Voltage must be within ± 10% of rated voltage.	Contact power company if voltage is incorrect.
B. Overheated protectors	Direct sunlight or other heat source can raise control box temperature causing protectors to trip. The box must not be hot to touch.	Shade box, provide ventilation or move box away from source.
C. Defective control box	For detailed procedures, see pages 48-57.	Repair or replace.
D. Defective motor or cable	For detailed procedures, see pages 45 & 46.	Repair or replace.
E. Worn pump or motor	Check running current, see tables 13, 22, 24, 25, & 27.	Replace pump and/or motor.

Table 46 Preliminary Tests - All Sizes Single- and Three-Phase

TEST	PROCEDURE	WHAT IT MEANS
Insulation Resistance (Fig. 10)	1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter. 2. Use a megohmmeter set to 1000-volt (500-volt minimum). If using an ohmmeter, set to R X 100k. Zero the meter. 3. Connect one meter lead to any one of the motor leads and the other lead to the metal drop pipe. If the drop pipe is plastic, connect the meter lead to ground.	1. If the ohms value is normal (Table 47), the motor is not grounded and the cable insulation is not damaged. 2. If the ohms value is below normal, either the windings are grounded or the cable insulation is damaged. Check the cable at the well seal as the insulation is sometimes damaged by being pinched.
Winding Resistance (Fig 11.)	1. Open master breaker and disconnect all leads from control box or pressure switch (QD type control, remove lid) to avoid electric shock hazard and damage to the meter. 2. Use a multi-meter set to 20 ohms or an ohmmeter set to R X 1 for values under 10 ohms. Use next scale up for values over 10 ohms. Zero the meter. 3. On 3-wire motors measure the resistance of yellow to black (main winding) and yellow to red (start winding). On 2-wire motors: measure the resistance from line-to-line. Three-phase motors: measure the resistance line-to-line for all three combinations.	1. If all ohms values are normal (Tables 13, 22, 24, 25, & 27), the motor windings are neither shorted nor open, and the cable colors are correct 2. If any one value is less than normal, the motor is shorted. 3. If any one ohm value is greater than normal, the winding or the cable is open, or there is a poor cable joint or connection. 4. If some ohms values are greater than normal and some less on single-phase motors, the leads are mixed. See page 48 to verify cable colors.

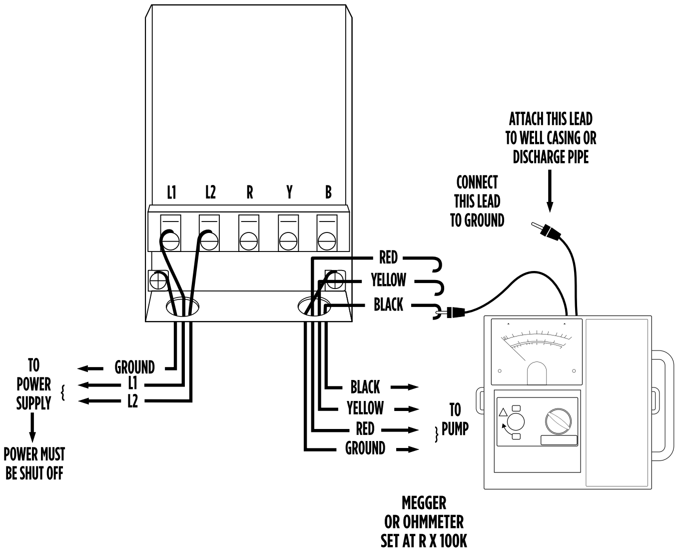


FIG. 10

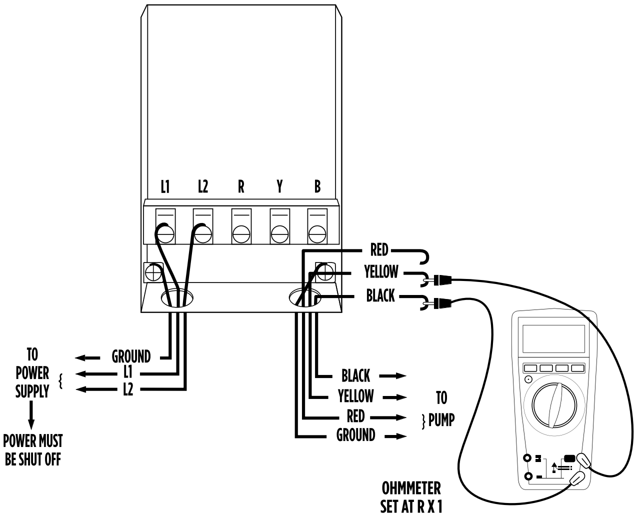


FIG. 11

Insulation Resistance Readings

Table 47 Normal ohm and Megohm Values Between All Leads and Ground

CONDITION OF MOTOR AND LEADS	MEGOHM VALUE	OHMS VALUE
A new motor (without drop cable)	200.0 (or more)	200,000,000 (or more)
A used motor which can be reinstalled in well	10.0 (or more)	10,000,000 (or more)
MOTOR IN WELL. READINGS ARE FOR DROP CABLE PLUS MOTOR.		
New motor	2.0 (or more)	2,000,000 (or more)
Motor in good condition	0.50 - 2.0	500,000 - 2,000,000
Insulation damage, locate and repair	Less than .50	Less than 500,000

Insulation resistance varies very little with rating. Motors of all hp, voltage, and phase rating have similar values of insulation resistance. The table above is based on readings taken with a megohm meter with a 500 VDC output. Readings may vary using a lower voltage ohmmeter; consult Franklin Electric if readings are in question.

Resistance of Drop Cable (ohms)

The values below are for copper conductors. If aluminum conductor drop cable is used, the resistance will be higher. To determine the actual resistance of the aluminum drop cable, divide the ohm readings from this chart by 0.61. This chart shows total resistance of cable from control to motor and back.

Winding Resistance Measuring

The winding resistance measured at the motor should fall within the values in Tables 13, 22, 24, 25, & 27. When measured through the drop cable, the resistance of the drop cable must be subtracted from the ohmmeter readings to get the winding resistance of the motor. See table below.

Table 47A DC Resistance in ohms per 100 ft of Wire (Two conductors) @ 50 °F

AWG OR MCM WIRE SIZE (COPPER)	14	12	10	8	6	4	3	2
OHMS	0.544	0.338	0.214	0.135	0.082	0.052	0.041	0.032

1	1/0	2/0	3/0	4/0	250	300	350	400	500	600	700
0.026	0.021	0.017	0.013	0.010	0.0088	0.0073	0.0063	0.0056	0.0044	0.0037	0.0032

Form 2207 - Action Facts

SUBMERSIBLE MOTOR INSTALLATION RECORD

INFORMATION SUPPLEMENT

1.0 MOTOR

1.1 Verify motor nameplate data meets the application – hp, voltage, phase, and Hertz.

1.2 Check that the motor shaft rotates freely by hand on the second of two complete rotations. (On large motors, this usually requires a motor coupling with a cheater handle welded to it.)

1.3 Check that the motor lead assembly is not damaged.

1.4 Measure insulation resistance to ground at 500 volts – BEFORE SUBMERGED. It should be a minimum of 200 megohms or 200,000,000 ohms.

1.5 Measure insulation resistance to ground at 500 volts – AFTER SUBMERGED. It should be a minimum of 0.5 megohms or 500,000 ohms.

1.6 Verify the system is operating within the ±10% of nameplate voltage requirement.

1.7 Verify the system will not ever operate in excess of the maximum amps indicated on the nameplate.

1.8 Verify the system is operating at 5% or less current unbalance.

Notice:

- If current unbalance exceeds 5%, the maximum operating amps must be derated to the nameplate Full Load Amps.
- Warning - System current unbalance can not exceed 10% without causing heating and mechanical wear issues.
- The submersible motor amperage % unbalance is typically 6x greater than its voltage % unbalance.
- Thus, 0.8% voltage unbalance = greater than 5% current unbalance, and 1.7% voltage unbalance = greater than 10% current unbalance.

2.0 PUMP

2.1 Verify the pump nameplate and curve data meets the application hp, rpm, and flow/TDH requirements.

2.2 Verify the pump NPSH requirement will be met at all times.

2.3 Check that the pump shaft rotates freely by hand before installation.

2.4 Check that the pump shaft moves up about ¼ inch when it is coupled to the motor.

2.5 Check that the pump guard is not pinching the motor leads, especially where it enters and exits the guard.

Notice:

- Pumps and motors 5 hp and above should be assembled in a vertical position to ensure correct alignment.
- A motor-pump assembly 5 hp and above should never be lifted from a non-vertical position by the pump discharge because it can bend the shaft in one or both of the products.

3.0 POWER SUPPLY (3-PHASE)

3.1 Verify the transformer kVA rating is adequate for the motor per the Franklin Application (AIM) manual requirement.

3.2 Verify that all transformers have the same kVA rating.

3.3 Verify the 3-Ph pump panel fuses or its circuit breaker are correctly sized per the Franklin Application (AIM) manual requirement.

3.4 Verify the 3-Ph pump panel motor contactor is correctly sized per the Franklin Application (AIM) manual requirement.

3.5 Verify the 3-Ph pump panel motor overload is ambient compensated.

3.6 Verify the 3-Ph pump panel motor overload has a NEMA Class 10 trip curve.

3.7 Verify the 3-Ph pump panel motor overload heaters or its dial setting are correctly selected based on the system's operating point and not just arbitrarily set at the maximum motor operating amps.

3.8 At no time should the system operating amps or the motor overload system running point setting be higher than the motor nameplate maximum amp rating.

Notice:

- Electronic overloads should be set at the normal system operation point.
- Electronic overloads have a built-in multiplier of 115-125% times the input amps to determine the overload trip point.

4.0 POWER SUPPLY (1-PHASE)

4.1 Verify the transformer kVA rating is adequate for the motor per the Franklin Application (AIM) manual requirement.

4.2 Verify the motor control box and the motor are made by the same manufacturer.

4.3 Verify the motor control box hp rating and its voltage match the motor rating exactly. If not, a premature failure of the control box or motor should be expected.

5.0 HIGH SURGE PROTECTION

5.1 Verify the submersible motor has a dedicated surge arrestor.
All submersible motors require a dedicated surge arrestor.
Motors 5 hp and smaller marked “Equipped with Lightning Arrestors”, have a built-in surge arrestor.

5.2 Verify the surge arrestor is mounted as close to the motor as practical.
The location is usually in the pump panel, but sometimes it is placed at the well head in a separate electrical box.

5.3 Verify the surge arrestor is grounded below the lowest drawdown water level.
This is usually accomplished by attaching the drop cable ground wire to the motor lead or the motor ground lug.

5.4 Verify the ground conductor size meets the minimum requirements of the National Electric Code and all other relevant national, state, regional and local codes.

5.5 Verify the motor is connected to both the electrical system ground and the motor.

6.0 ELECTRICAL DROP CABLE

6.1 Verify the temperature rating of the drop cable – typically 60 °C, 75 °C, 90 °C or 125 °C.

6.2 Verify if the cable is single conductor or jacketed conductor. Web cable is considered jacketed cable by regulating agencies.

6.3 Verify the conductor size – typically AWG, MCM or mm^2.

6.4 Verify if the conductor material is copper; if not, determine the material and contact the factory for acceptability.

6.5 Verify the drop cable meets or exceeds the requirements of the Franklin Application (AIM) manual.

Notice:

- If the service entrance to pump panel or the pump panel to motor cable is not a copper material, contact the factory for the correct length derating factors.

7.0 MOTOR COOLING

7.1 Verify that the well water temperature does not exceed the maximum ambient temperature indicated on the nameplate of the motor.

7.2 Verify there is a minimum of 10 feet of clear water between the bottom of the motor and the bottom of the well.

7.3 Verify that all water entering the well is coming from below the lowest part of the motor.

7.4 Verify the system pumping rate will never deliver less flow than is required by the Franklin Application (AIM) manual to flow by-and-around the full length of the motor for cooling purposes.

7.5 Verify that 3-phase motors above 7.5 hp in a vertical potable water well should not exceed 100 starts in 24 hours and each start should include a minimum of 3 minutes ON and 10 minutes OFF.

Notice:

- If any water is entering the well above the lowest part of the motor, a flow sleeve is required.

8.0 MOTOR-PUMP INSTALLATION

8.1 Verify that the drop cable is supported to the drop pipe every 10 feet.

8.2 Verify at least one spring loaded (non-drilled) check valve is in the drop pipe.
Preferably, the first check valve should be located at the top of the first pipe joint above the pump discharge (~20 feet) if the pump does not have a check built in to its discharge.

8.3 Verify all pipe joints are as tight as practical.
The minimum torque should never be less than 10 foot-pounds times the motor nameplate hp rating.

8.4 Verify the rotation of the pump is correct.
It is preferable to do this by checking the flow and current in both directions on 3-phase motors.
This can be done by having the electrician swap any two leads.
This is considered “best practice” since pumps under some conditions can supply amp readings and a visual flow observation that can be extremely misleading.

Form 2207 – Page 1

SUBMERSIBLE MOTORS INSTALLATION RECORD

RMA Number ____________

KEY DEALER # ____________

DISTRIBUTOR

Name: ______________________
City: ______________________
State: __________ Zip: __________

INSTALLER

Name: ______________________
City: ______________________
State: __________ Zip: __________

END USER

Name: ______________________
City: ______________________
State: __________ Zip: __________

Well ID or GPS: __________ __________ ____________________ Water Temperature: ______________ ☐ °F ☐ °C

Application/Water Use (e.g. potable water, irrigation, municipal, fountain, etc.): ______________________

Date Installed (mm/yy): __________ Date Failed (mm/yy):__________ Motor Position Shaft-Up: ☐ Yes ☐ No

Operating Cycle: ON Time Per Start _____ ☐ Hrs. ☐ Mins. Time OFF Between Stop & Restart _____ ☐ Hrs. ☐ Mins.

MOTOR

Model: ______________ Serial Number: ______________ Date Code (if updated): ________

MOTOR OVERLOAD

System Typical Operating Current: __________ Amps @ __________ Volts

Overload: ☐ FE SubMonitor Input Amps ______ D3 Attached ☐ Yes ☐ No Fault Settings Attached ☐ Yes ☐ No

☐ Other Manufacturer Model: ______________ Dial Set at: ________ or Heater# ________

NEMA Class: ☐ 10 ☐ 20 ☐ 30 Ambient Compensated: ☐ Yes ☐ No

Power to Motor by: ☐ Full Volt Starter ☐ VFD ☐ Soft Starter VFD or Soft Starter Mfr. & Model: ______________

PUMP

Manufacturer:______________________

Model: ______________________

Stages: ______________________

Design Rating: ______ gpm @ ______ ft TDH

Horsepower Required by Pump End: __________

Actual Pump Delivery: ______ gpm @ ______ psi

What Controls When System Runs & Stops:

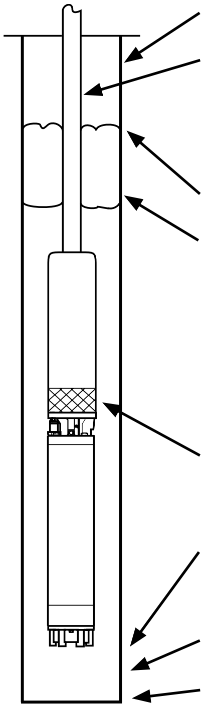
____

(e.g. pressure, level, flow, manual on/off, timer, time clock etc.)

YOUR NAME / DATE

______________________ / __________

WELL DATA (All measurements from well head down.)



Casing Diameter ______________________ in

Drop Pipe Diameter ______________________ in

Drop Pipe Material _____ PVC _____ Steel _____ Poly _____ Other

Number of Sticks of Drop Pipe __________

Static Water Level ______________________ ft

Drawdown (pumping) Water Level______________________ ft

Spring Assist Check Valves:
(Measured from Well Head Down)

#1______ #2______ #3______ #4______ ft

☐ Solid ☐ Drilled Poppet ☐ Break-Off Plug

Pump Inlet Setting ______________________ ft

Flow Sleeve ☐ No ☐ Yes, Dia. ______________ in

Case Ends ______________________ ft

☐ Well Screen ☐ Perforated Casing

#1 from ____to____ft & #2 from ____to____ft

Well Depth______________________ ft

Form No. 2207 v6 11/14

Franklin Electric

Form 2207 - Page 2

SUBMERSIBLE MOTORS INSTALLATION RECORD

RMA Number ____________

TRANSFORMERS

Number of Transformers: ☐ Two ☐ Three Transformers Supply Motor Only: ☐ Yes ☐ No ☐ Unsure

Transformer #1: ____________ kVA Transformer #2: ____________ kVA Transformer #3: ____________ kVA

POWER CABLES & GROUND WIRE

1 **Service Entrance to Pump Control Panel:**

Length: ____________ ft. & Gauge: ____________ AWG/MCM

Material: ☐ Copper ☐ Aluminum Construction: ☐ Jacketed ☐ Individual Conductors ☐ Web ☐ Twisted

Temperature Rating of Cable: ☐ 60C ☐ 75C ☐ 90C ☐ 125C or Insulation Type: __________________ (e.g. THHN)

2 **Pump Control Panel to Motor:**

Length: ____________ ft. & Gauge: ____________ AWG/MCM

Material: ☐ Copper ☐ Aluminum Construction: ☐ Jacketed ☐ Individual Conductors ☐ Web ☐ Twisted

Temperature Rating of Cable: ☐ 60C ☐ 75C ☐ 90C ☐ 125C or Insulation Type: __________________ (e.g. THHN)

3 **Ground Wire Size:** From Control Panel to Motor: ____________ AWG/MCM

Control Grounded to (mark all that apply):

☐ Well Head ☐ Metal Casing ☐ Motor ☐ Driven Rod ☐ Power Supply

INCOMING VOLTAGE

No Load L1-L2 _______ L2-L3 _______ L1-L3 _______

Full Load L1-L2 _______ L2-L3 _______ L1-L3 _______

RUNNING AMPS & CURRENT BALANCE

Full Load L1 _________ L2 _________ L3 _________

% Unbalance: _______

CONTROL PANEL

1 **Pump Panel Manufacturer/Fabricator:** ____

2 **Short Circuit Protection - Fuses or Circuit Breaker**

Option #1 - Fuse

Manufacturer: ____________________ Model: ____________________ Rating: ______________ Amps

Type: ☐ Time-Delay ☐ Standard

Option #2 - Circuit Breaker

Manufacturer: ____________________ Model: ____________________ Rating: ____________ Amps Setting: ___________

3 **Starter - Full Voltage, Reduced Voltage, Soft-Starter or VFD (Variable Frequency Drive)**

Option #1 - Full Voltage

Manufacturer: ____________________ Model: __________________ Size: _____________ Contacts: ☐ NEMA ☐ IEC

Option #2 - Reduced Voltage

Manufacturer: ____________________ Model: ____________________ Ramp Time to Full Voltage: ______________ sec.

Option #3 - Soft-Starter or VFD

Manufacturer: ____________________ Model: ____________________ Max. Continuous Amp Output Rating: _____________

Min. Setting: _____________ Hz & GPM: _____________ Max. Setting: _____________ Hz & GPM: __________________

Start Ramp Time to 30 Hz: _________ sec. Stop Mode: ☐ Power Off Coast ☐ 30-0 Hz Ramp _________ sec.

Special Output Filter Purchased: ☐ Yes ☐ No

Output Filter Manufacturer: _________________________ Model: _________________________ % Reactance: ____________

4 **Surge Arrestor:** ☐ No ☐ Yes, Manufacturer: _______________________ Model: _______________________

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Option 1 - Franklin Water | **Option 2** - Franklin Control System | **Option 3** - Little Giant Commercial

Call Franklin's toll free TECHNICAL SERVICE HOTLINE for answers to your pump and motor installation questions. When you call, a Franklin expert will offer assistance in troubleshooting and provide immediate answers to your system application questions. Technical support is also available online.

franklinwater.com | franklin-controls.com | solar.franklin-electric.com | constantpressure.com

Franklin Electric

TW-60 Water Treatment System

section 12

MP 204

(GB) Installation and operating instructions

BE > THINK > INNOVATE >

GRUNDFOS®

Declaration of Conformity

We, Grundfos, declare under our sole responsibility that the product MP 204, to which this declaration relates, is in conformity with these Council directives on the approximation of the laws of the EC member states:

- Low Voltage Directive (2006/95/EC).
  Standards used: EN 60335-1: 2002 and EN 60947-5-1: 2004.
- EMC Directive (2004/108/EC).
  Standards used: EN 61000-6-2: 2005 and EN 61000-6-3: 2007.

Bjerringbro, 31st March 2010

Jan Strandgaard

Jan Strandgaard
Technical Director
Grundfos Holding A/S
Poul Due Jensens Vej 7
8850 Bjerringbro, Denmark

Person authorised to compile technical file and
empowered to sign the EC declaration of conformity.

Original installation and operating instructions.

CONTENTS

Page

1. General description 3

1.1 Applications 3

2. Nameplates 4

3. Product range 4

4. Functions 4

4.1 Factory settings 4

5. Mechanical installation 5

5.1 MP 204 in control cabinet 5

5.2 MP 204 on DIN rail 5

6. Connection 6

6.1 Overview 6

6.2 Input for Pt100/Pt1000 7

6.3 Input for PTC/thermal switch 7

6.4 Back-up fuses 7

6.5 Wiring diagrams 8

6.6 External current transformers 11

7. Start-up 12

7.1 Operation 12

7.2 Setting on control panel 12

7.3 Learning function 15

8. R100 remote control 15

8.1 R100 menus 16

8.2 Operating the R100 17

8.3 Menu structure 17

9. Setting with the R100 18

9.1 Menu 1. OPERATION 18

9.2 Menu 2. STATUS 19

9.3 Menu 3. LIMITS 22

9.4 Menu 4. INSTALLATION 25

10. MP 204 with GENIbus 29

11. Approvals and standards 29

12. Pump operation with MP 204 29

12.1 Industrial pumps 29

12.2 Submersible pumps 29

12.3 Wastewater pumps 30

13. Curves 31

13.1 Trip class "P" 31

13.2 IEC trip curves 32

14. Technical data 33

15. Electrical data 33

15.1 Outputs 33

15.2 Inputs 33

15.3 Insulation measurement method 33

15.4 Measuring ranges 34

15.5 Setting ranges 34

16. Fault finding 35

16.1 Warning and trip codes 35

17. Disposal 35

⚠ 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.
Persons with reduced physical, sensory or mental capabilities must not use this product, unless they are under supervision or have been instructed in the use of the product by a person responsible for their safety.
Children must not use or play with this product.

⚠ All cables taken through the MP 204 and the current transformers must be insulated.

1. General description

The **MP 204** is an electronic motor protector, designed for the protection of an asynchronous motor or a pump.

The motor protector consists of:

- a **cabinet** incorporating instrument transformers and electronics.
- a **control panel** with operating buttons and display for reading of data.

The MP 204 operates with two sets of limits:

- a set of warning limits and
- a set of trip limits.

If one or more of the warning limits are exceeded, the motor continues to run, but the warnings will appear in the MP 204 display.

If one of the trip limits is exceeded, the trip relay stops the motor. At the same time, the signal relay is operating to indicate that the limit has been exceeded.

Some values only have a warning limit.

The warning can also be read out by means of the Grundfos R100 remote control.

1.1 Applications

The MP 204 can be used as a stand-alone motor protector.

The MP 204 may also be incorporated in a Grundfos Modular Controls system in which it functions as a motor protector and data collection unit transmitting measured values via the Grundfos GENIbus to the Grundfos CU 401 control unit or other units in the system.

Monitoring of the MP 204 is possible via a Grundfos GENIbus.

The power supply to the MP 204 is in parallel with the supply to the motor. Motor currents up to 120 A are passed directly through the MP 204. The MP 204 protects the motor primarily by measuring the motor current by means of a true RMS measurement. The MP 204 disconnects the contactor if, for example, the current exceeds the preset value.

The pump is protected secondarily by measuring the temperature with a Tempcon sensor, a Pt100/Pt1000 sensor and a PTC sensor/thermal switch.

The MP 204 is designed for single- and three-phase motors. In single-phase motors, the starting and run capacitors are also measured. Cos φ is measured in both single- and three-phase systems.

2. Nameplates

Rating and approvals of the MP 204.

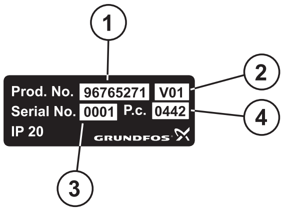


Fig. 1 Nameplate on front cover

These four numbers must be stated when contacting Grundfos:

Pos.	Description
1	Product number
2	Version number
3	Serial number
4	Production code

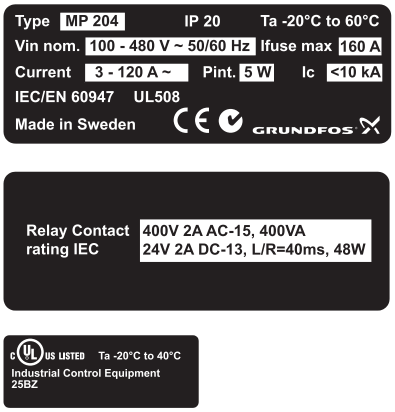


Fig. 2 Nameplates on the side of MP 204

3. Product range

- MP 204
- External current transformers up to 1000 A.

4. Functions

- Phase-sequence monitoring
- Indication of current or temperature (user selection)
- Input for PTC/thermal switch
- Indication of temperature in °C or °F (user selection)
- 4-digit, 7-segment display
- Setting and status reading with the R100
- Setting and status reading via the GENIbus.

Tripping conditions

- Overload
- Underload (dry running)
- Temperature (Tempcon sensor, PTC/thermal switch and Pt sensor)
- Missing phase
- Phase sequence
- Overvoltage
- Undervoltage
- Power factor (cos φ)
- Current unbalance.

Warnings

- Overload
- Underload
- Temperature (Tempcon, see section *12.2*, and Pt sensor)
- Overvoltage
- Undervoltage
- Power factor (cos φ)
  Note: In connection with single- and three-phase connection.
- Run capacitor (single-phase operation)
- Starting capacitor (single-phase operation)
- Loss of communication in network
- Harmonic distortion.

Learning function

- Phase sequence (three-phase operation)
- Run capacitor (single-phase operation)
- Starting capacitor (single-phase operation)
- Identification and measurement of Pt100/Pt1000 sensor circuit.

4.1 Factory settings

Current limit: 0 A

Nominal voltage: 400 V

Class: P (trip delay: 10 seconds)

Trip delay: 5 seconds

Number of phases: 3, non-earthed

Power-on delay: 2 seconds.
Learning function: Active.

Active trip limits

Overload according to class

Underload: –40%

Overvoltage: +20%

Undervoltage: –20%

Phase-sequence monitoring

Current unbalance: 10%

PTC/thermal switch.

Note: The overvoltage and undervoltage trip limits will be deactivated automatically if the temperature monitoring with Tempcon or Pt100/Pt1000 has been set to active, see sections *9.4.8* and *9.4.9*.

Active warnings

Run capacitor, low: –50%

Starting capacitor, low: –50%.

5. Mechanical installation

5.1 MP 204 in control cabinet

The MP 204 is designed for mounting in a control cabinet, either on a mounting plate or on a DIN rail.

5.2 MP 204 on DIN rail

Mounting and removal of an MP 204 mounted on a DIN rail is shown in figs. 3 and 4.

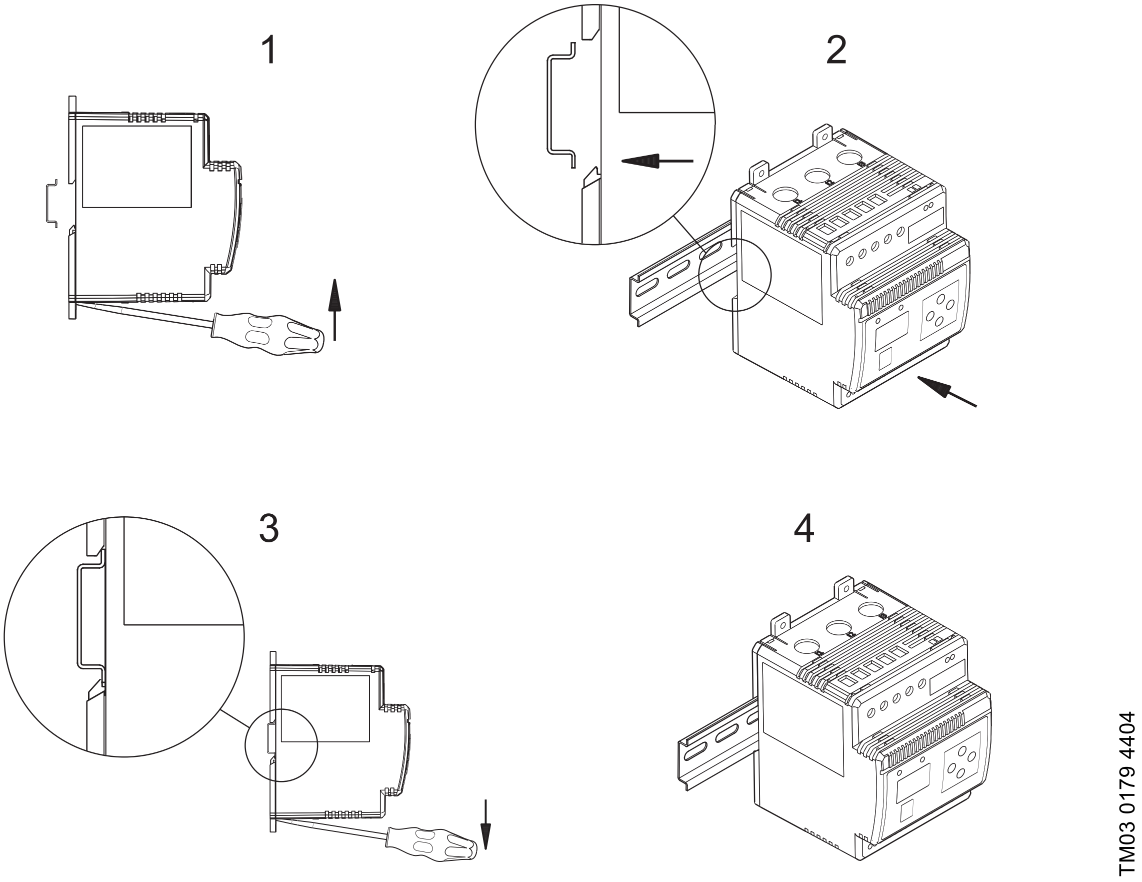


Fig. 3 Mounting

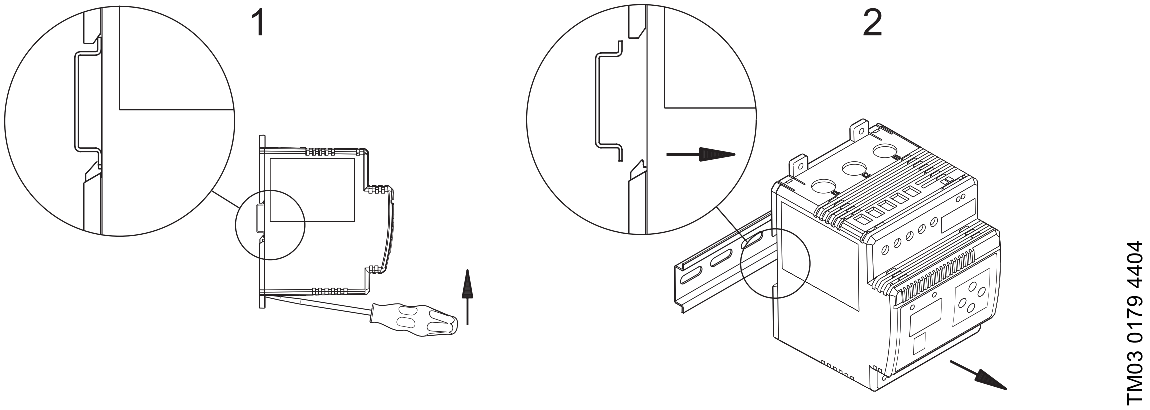
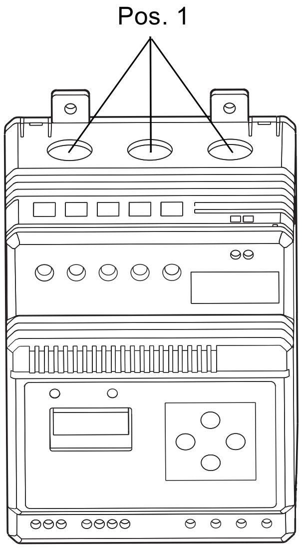


Fig. 4 Removal

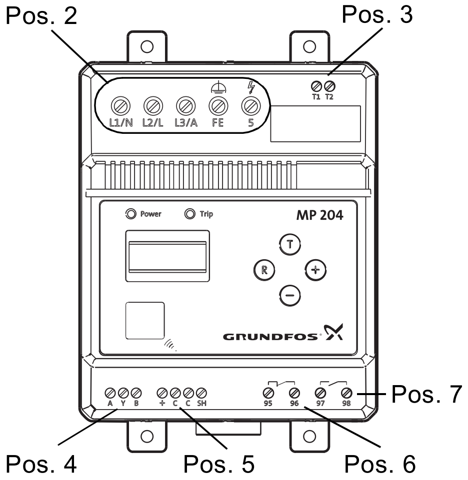
6. Connection

6.1 Overview



TM03 0181 4404

Fig. 5 Cable entries



TM03 0181 4505

Fig. 6 Terminals

Pos.	Designation	Three-phase connection	Single-phase connection	Cable
1	I1	Entry for phase L1 to motor	Entry for neutral	Max. ø16 mm
	I2	Entry for phase L2 to motor	Entry for phase	
	I3	Entry for phase L3 to motor	Entry for auxiliary winding	
2	L1/N	Supply: L1	Supply: Neutral	Max. 6 [1] mm^2
	L2/L	Supply: L2	Supply: Phase	
	L3/A	Supply: L3	Auxiliary winding	
	FE	Functional earth		
	5	Insulation measurement		
3	T1	PTC/thermal switch		Max. 2.5 [2] mm^2
	T2			
4	A	GENIbus data A		
	Y	Reference/screen		
	B	GENIbus data B		
5	+	Pt100/Pt1000 sensor		
	C			
	C			
	SH	Screen		
6	95	Trip relay NC		
	96			
7	97	Signal relay NO		
	98			

[1] 10 mm^2 with cable terminal
[2] 4 mm^2 with cable terminal

UL requirement:
For field wiring terminals, min. 60/75°C stranded copper conductors must be used.

6.2 Input for Pt100/Pt1000

See fig. 6, pos. 5.

Terminal designation	Description
+	Resistance input.
C	Correction for lead resistance. To be connected by means of a three-core Pt100/Pt1000 connection, otherwise the two "C" terminals are to be short-circuited.
C	Correction for lead resistance. To be connected by means of a three-core Pt100/Pt1000 connection, otherwise the two "C" terminals are to be short-circuited.
SH	0 V (screen).

For examples of Pt100/Pt1000 connection, see figs. 7 and 8.

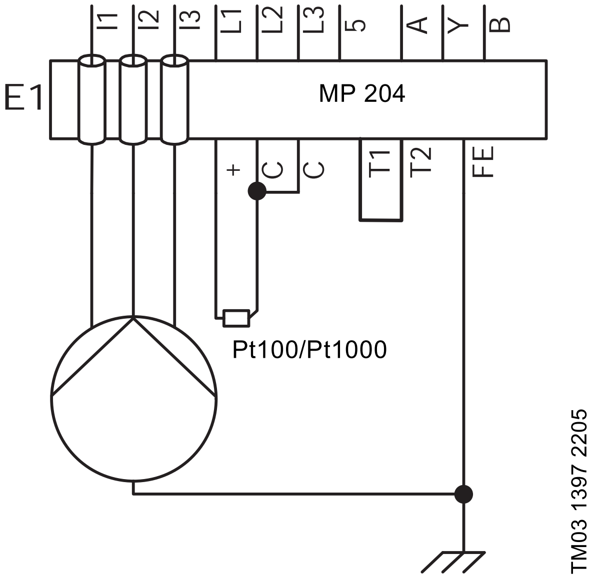


Fig. 7 Two-core Pt100/Pt1000 connection

6.3 Input for PTC/thermal switch

See fig. 6, pos. 3.

Terminal designation	Description
T1	Connection of PTC/thermal switch
T2	

If not used, short-circuit the PTC input using a wire, or deactivate it with the R100. See section *9.4.11*.

6.4 Back-up fuses

Maximum back-up fuse sizes which may be used for the MP 204 appear from the table below:

MP 204	Max. size	Type
Without external current transformer	120 A	RK5
With 200/5 external current transformer	200 A	RK5
With 300/5 external current transformer	300 A	RK5
With 500/5 external current transformer	500 A	RK5
With 750/5 external current transformer	750 A	RK5
With 1000/5 external current transformer	1000 A	RK5

At motor currents up to and including 120 A, the cables to the motor can be taken direct through the I1-I2-I3 of the MP 204.

At motor currents above 120 A, current transformers must be used. See fig. 5, pos. 1.

Note: If back-up fuses above 50 A are used, the L1-L2-L3 and "5" to the MP 204 must be protected separately with max. 10 A fuses. See fig. 8.

If current transformers are used, the L1-L2-L3 and "5" to the MP 204 must be protected with max. 10 A fuses.

For installation examples, see figs. 8 to 12.

6.5 Wiring diagrams

6.5.1 Three-phase system

The wiring diagram, fig. 8, shows an example of a three-phase pump with insulation measurement.

The connections to L1, L2, L3 and "5" can be made with a cable of up to 10 mm^2. A special fuse unit up to approx. 50 A is therefore not required.

If larger back-up fuses are used, the voltage to the L1, L2 and L3 must be protected separately. A maximum of 10 A or less is recommended.

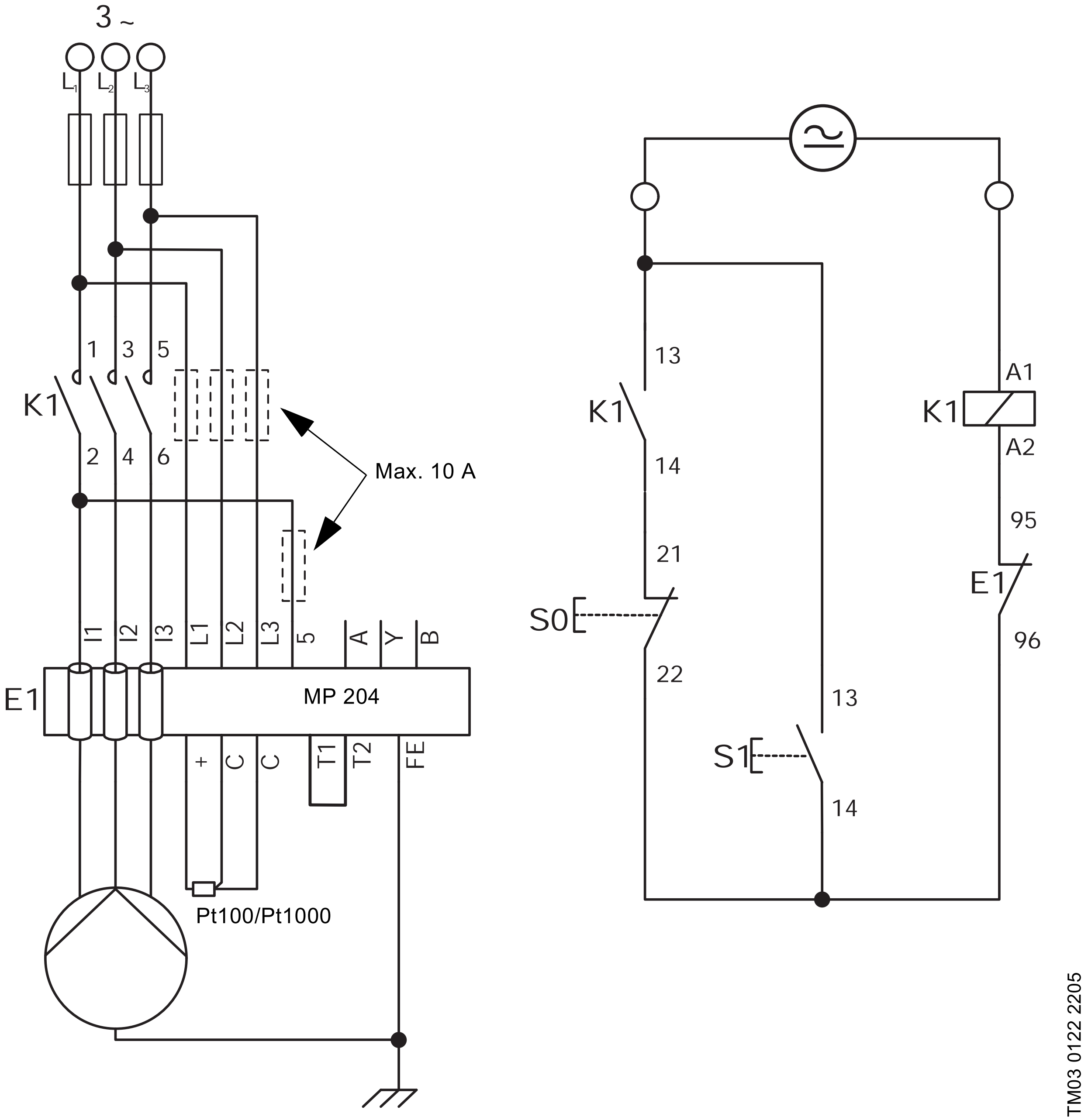
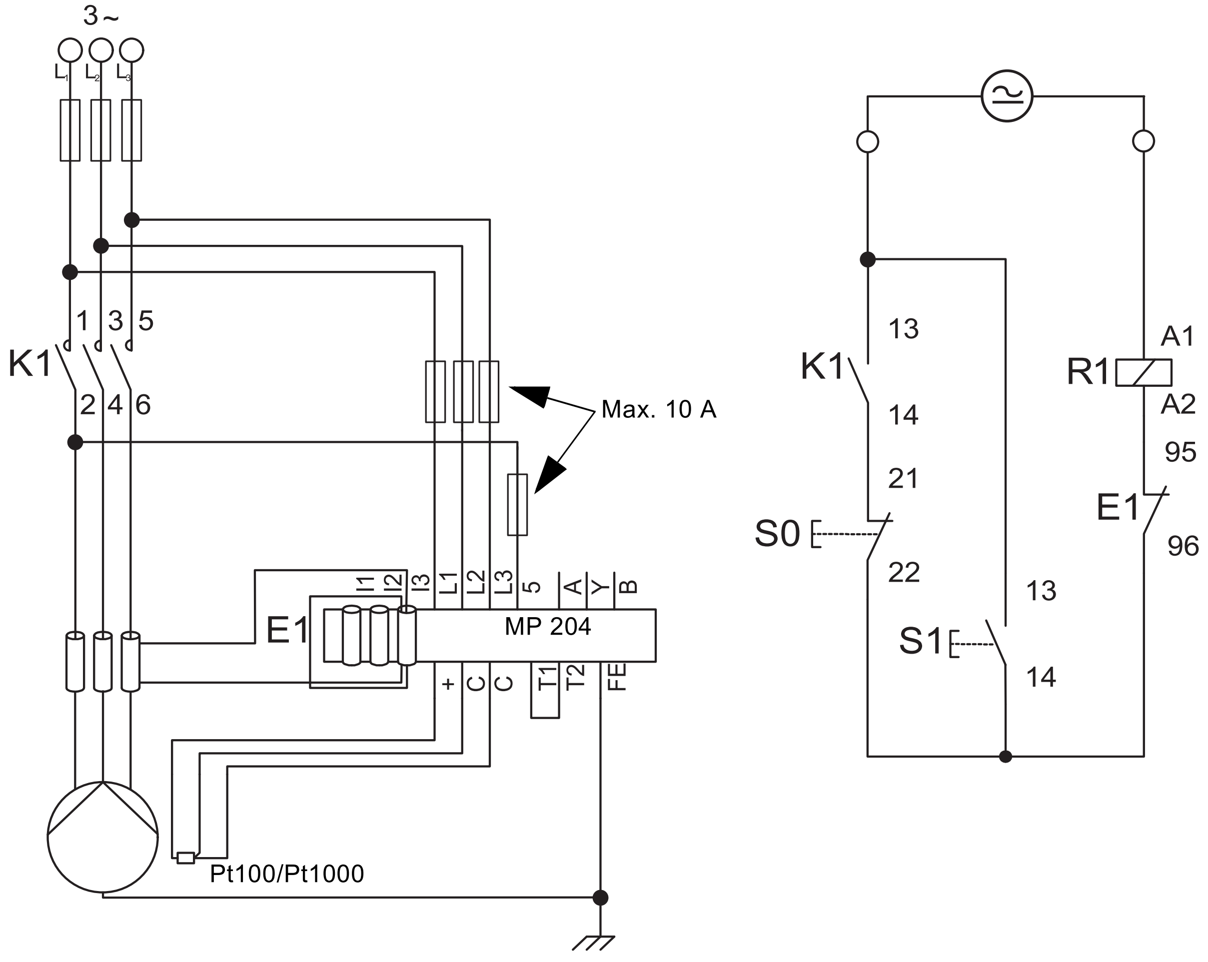


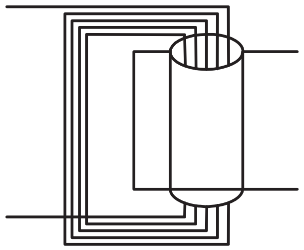
Fig. 8 Three-phase connection

6.5.2 Three-phase system with external current transformers



TM03 0123 2205

Fig. 9 Three-phase connection with current transformers



TM03 1398 1905

Fig. 10 Five windings per phase through the MP 204

6.5.3 Single-phase system with starting and run capacitors

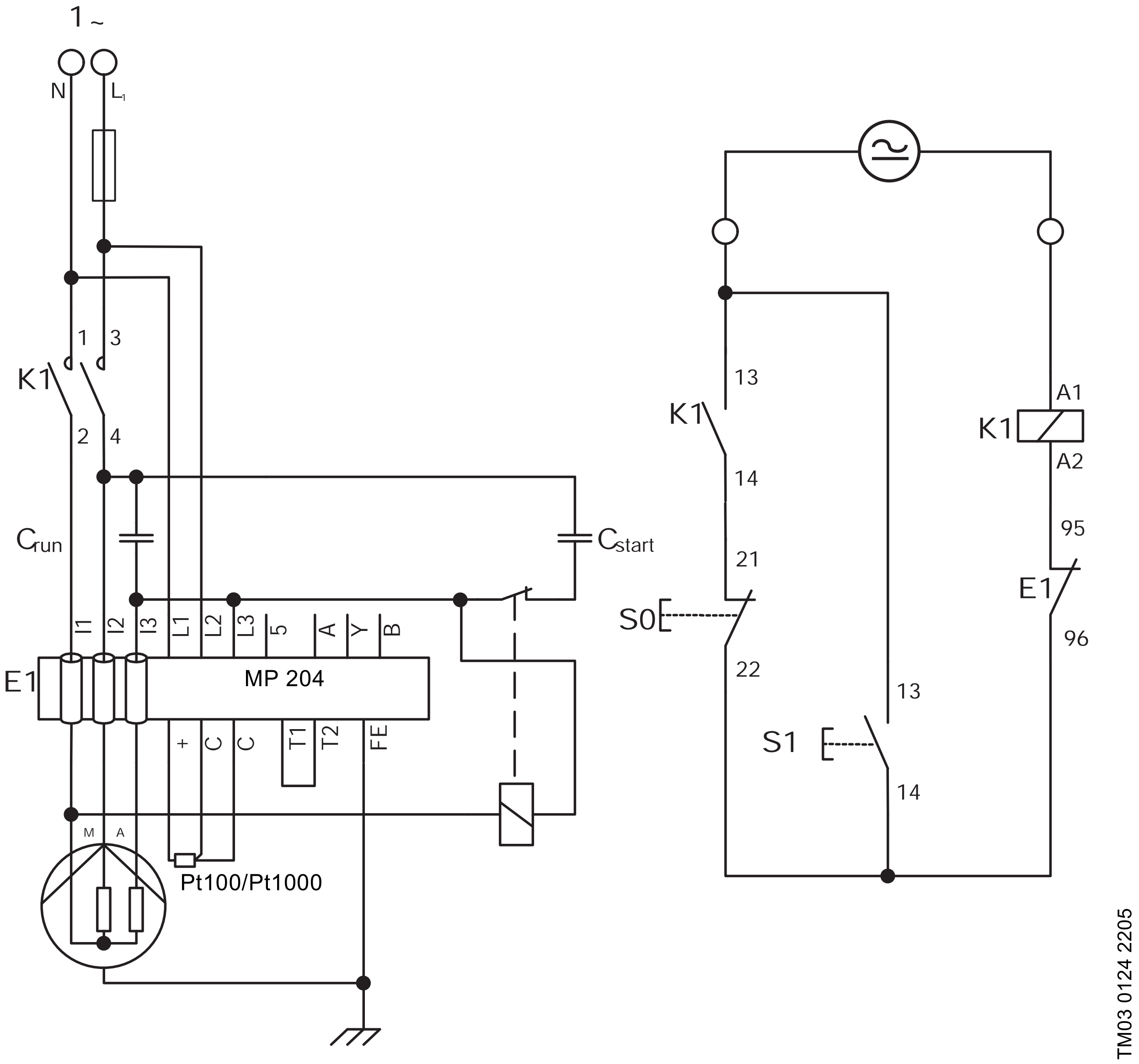


Fig. 11 Single-phase connection

6.6 External current transformers

At motor currents above 120 A, external current transformers must be used. Fit the transformers as shown in fig. 12.

Note: Take the three measuring cables through the three holes in the MP 204 five times per phase. See fig. 13.

Note: The three current transformers must be fitted in the same direction, and the measuring cables must be connected in the same way.

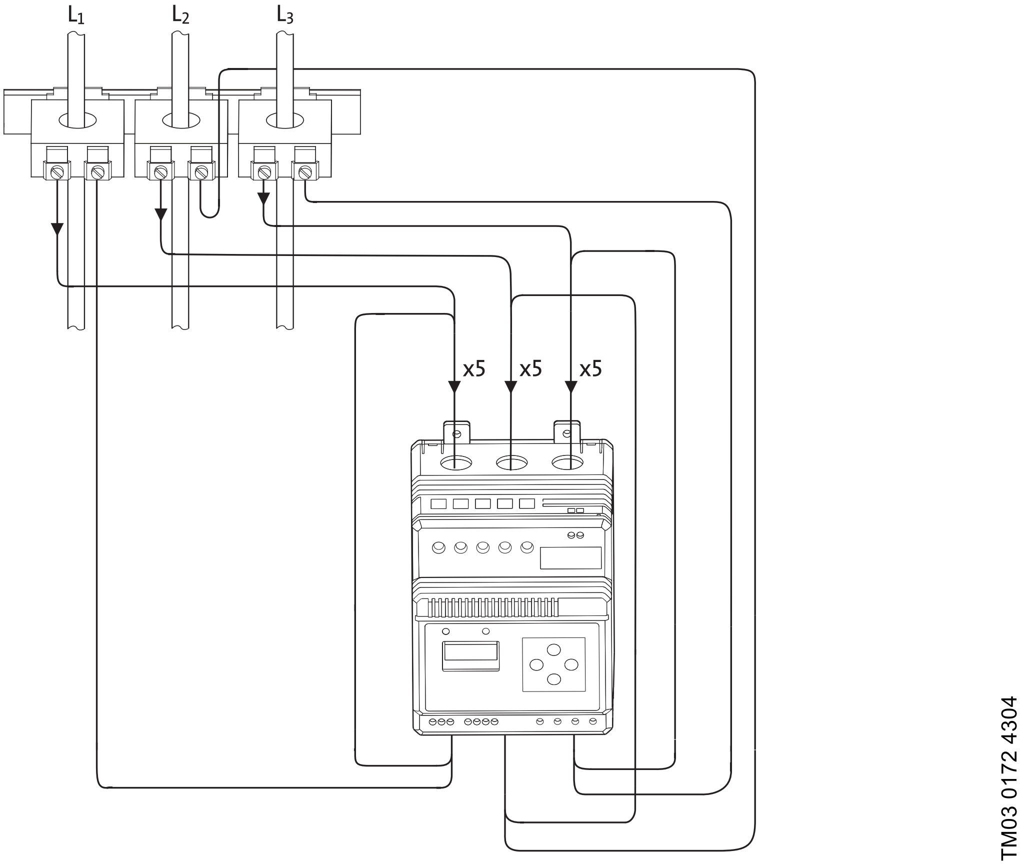


Fig. 12 Current transformers

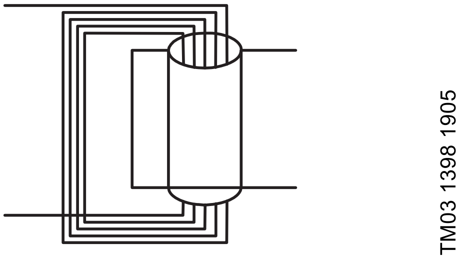


Fig. 13 Five windings per phase through the MP 204

Product number	Current transformer ratio	$I_{max.}$	$P_{max.}$
96095274	200:5	200 A	5 VA
96095275	300:5	300 A	5 VA
96095276	500:5	500 A	5 VA
96095277	750:5	750 A	5 VA
96095278	1000:5	1000 A	5 VA

7. Start-up

A basic setting of the MP 204 can be made on the control panel.

Additional functions must be set with the R100 remote control.

7.1 Operation

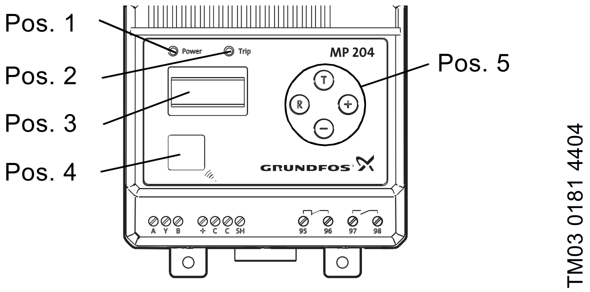


Fig. 14 Control panel

Pos. 1	"Power" indicator light	• Flashes green until the MP 204 is ready for operation (power-on delay, see section *9.4.5*). • Is permanently green when the MP 204 is ready for operation. • Flashes red when communicating with the R100.
Pos. 2	"Trip" indicator light	Is red when the trip relay is activated.
Pos. 3	Display	4 digits, for basic setting and data reading.
Pos. 4	IR field	R100 communication.
Pos. 5	Operating buttons	T R + − Setting and operation.

7.1.1 Button T (Test)

Press the T button to open trip relay connection 95-96 and close signal relay connection 97-98. The red "Trip" indicator light is on. The function is identical to the overload trip.

7.1.2 Button R (Reset)

Press the R button to change the tripped state to normal state with trip relay connection 95-96 closed and signal relay connection 97-98 open. The red "Trip" indicator light is off. This implies that the tripped state has actually ceased. The R button also resets warnings, if any.

7.1.3 Button +

Normally the actual current or temperature appears in the display. Press the + button to show information in the display, according to the following sequence:

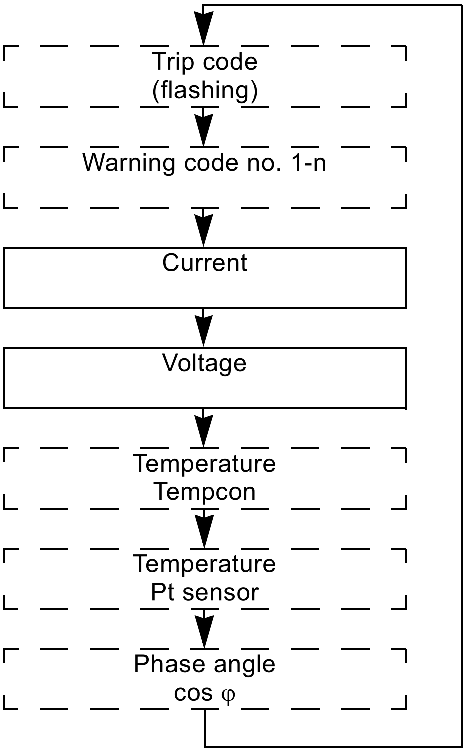


Fig. 15 Sequence in display

- The trip code only appears if the MP 204 is tripped. Switches between "trip" and trip code.
- The warning code only appears if the limit value of one or more warnings has been exceeded, and if warning code indication has been activated. See section *9.4.16*.
- Temperatures only appear if the matching sensors have been connected and activated. If no Tempcon signal is received, "----" appears in the MP 204 display.
- Cos φ only appears if this indication has been activated with the R100. See section *9.4.16*.

When the motor is operating, the display shows the actual value.

When the motor stops, the display shows the last measured value.

7.1.4 Button −

Only used in connection with the basic setting of the MP 204.

7.2 Setting on control panel

Press the ⊕ and ⊖ buttons simultaneously for a minimum of 5 seconds to place the MP 204 in the programming mode. When the display shows "....", the buttons can be released.

The set value, e.g. "4.9 A", appears. The unit symbol "A" is flashing.

Enter the values of

- rated current
- nominal voltage
- trip class
- number of phases.

Note: Insulation measurement is only possible of earthed three-phase systems.

If no buttons are activated, the voltage appears after 10 seconds.

After a further 10 seconds, the set voltage is stored automatically, and the programming mode ends. See fig. 16.

Note: Changes in rated current must be finished by pressing Ⓣ to store the change.

7.2.1 Rated current

Set the rated motor current with the ⊕ and ⊖ buttons. (See motor nameplate.)

- Press Ⓣ to store the setting and continue, or
- press Ⓡ to cancel the change and finish.

The programming mode ends automatically after 10 seconds, and the change is cancelled. See fig. 16.

7.2.2 Nominal voltage

Set the nominal voltage with the ⊕ and ⊖ buttons.

- Press Ⓣ to store the setting and continue, or
- press Ⓡ to store the setting and finish.

The programming mode ends automatically after 10 seconds, and the change is stored. See fig. 16.

7.2.3 Trip class

Set the trip class with the ⊕ and ⊖ buttons.

For submersible pumps, manual setting of the trip delay, class "P", is normally selected. The time is factory-set to 10 seconds. It can be changed with the R100.

For other pumps, the required IEC trip class (1-45) is to be set. Normally class 10 is selected. For trip curves, see page 32.

- Press Ⓣ to store the setting and continue, or
- press Ⓡ to store the setting and finish.

The programming mode ends automatically after 10 seconds, and the change is stored. See fig. 16.

7.2.4 Number of phases

Set the number of phases with the ⊕ and ⊖ buttons (1 phase, 3 phases (non-earthed) or 3 phases w. FE (functional earth)).

- Press Ⓣ to store the setting and continue, or
- press Ⓡ to store the setting and finish.

The programming mode ends automatically after 10 seconds, and the change is stored. See fig. 16.

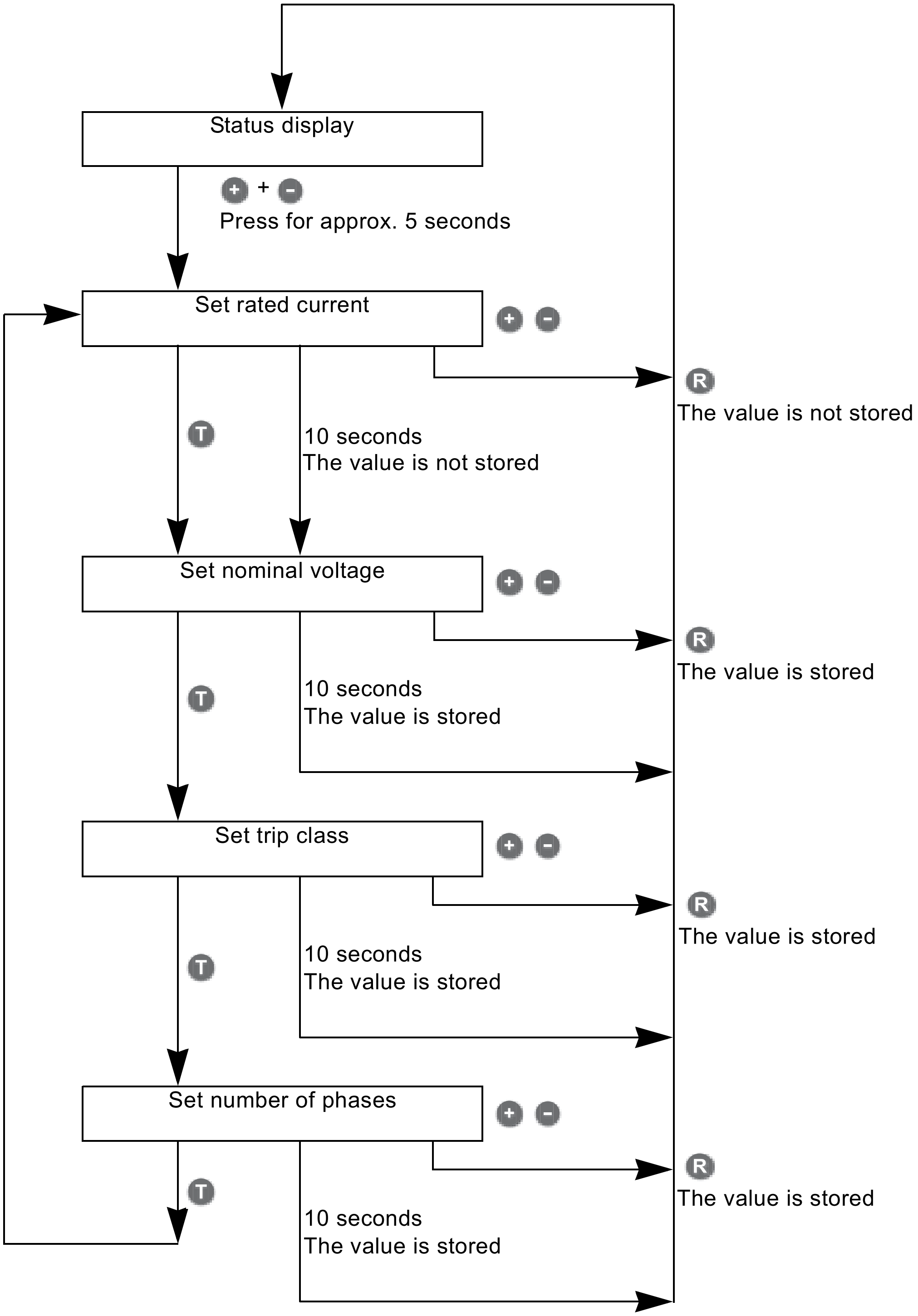


Fig. 16 Example of basic setting

7.3 Learning function

The learning function is factory-set to "Enable".

After two minutes of continuous motor operation, "LRN" appears in the display for approx. 5 seconds, while the values are being stored in the MP 204. See fig. 14, pos. 3.

If, for instance, a Pt sensor or capacitor has been replaced, reactivate the learning function by pressing the R and − buttons for a minimum of 10 seconds.

The dot in the right side of the display is flashing. The MP 204 is waiting for current to pass through the unit for a minimum of 120 seconds. Then the phase sequence is measured and stored.

In single-phase systems, the MP 204 measures the capacity of the starting and run capacitors and stores the values as reference.

If a Pt100/Pt1000 sensor is installed, the cable impedances to the sensor are measured and stored as reference.

8. R100 remote control

The R100 remote control is used for wireless communication with the MP 204. The R100 communicates via infra-red light. During communication, there must be visual contact between the R100 and the MP 204. See fig. 17.

The R100 offers additional settings and status readings for the MP 204.

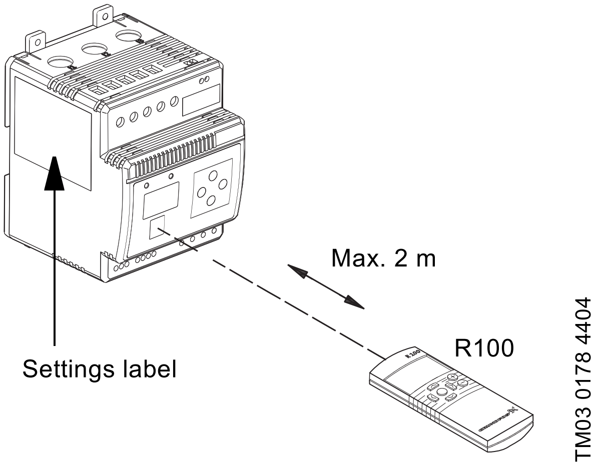


Fig. 17 R100 and label

The settings label, which is enclosed, can be affixed to the MP 204 as required.

If the R100 comes into contact with more than one unit at a time, the number of the desired unit must be entered. See section *9.4.17*.

8.1 R100 menus

0. GENERAL

See operating instructions for the R100.

1. OPERATION

- Operating mode
- Actual trip
- Actual warning 1
- Actual warning 2
- Alarm log 1
- Alarm log 2
- Alarm log 3
- Alarm log 4
- Alarm log 5.

2. STATUS

Display of

- Supply overview
- Average current
- Average voltage
- Tempcon sensor
- Pt100/Pt1000 sensor
- Power input and energy consumption
- Energy trip counter
- Phase sequence
- Current unbalance
- Operating hours and number of starts
- Trip counter of hours and starts
- Starting capacitor
- Run capacitor
- Insulation resistance
- Cos φ
- Harmonic distortion.

3. LIMITS

Display and setting of warning and trip limits.

- Tempcon sensor
- Pt sensor
- Tripping current
- Current warning
- Nominal voltage
- Voltage limits
- Current unbalance
- Starting capacitor
- Run capacitor
- Insulation resistance
- Cos φ trip
- Cos φ warning.

4. INSTALLATION

Setting and display of

- Supply mains
- Trip class
- Trip delay
- External current transformers
- Power-on delay
- Restarting
- Automatic restarting
- Tempcon sensor
- Pt sensor
- Insulation resistance measurement
- PTC/thermal switch
- Resetting of trip counters
- Service interval
- Number of automatic restarts
- Units/display
- MP 204 display
- GENIbus ID number
- Learning function.

8.2 Operating the R100

See operating instructions for the R100.

The function of the buttons and display elements of the R100 is briefly described below.

Change of menu

[<] or [>] steps from one menu to the other. The bottom line of the display shows the actual menu. Arrows indicate in which direction it is possible to step.

The R100 can be switched off by pressing the buttons simultaneously.

Fig. 18 Change of menu

Rolling field

[∨] or [∧] moves one display forwards or backwards in each menu. To the right in the display, the position in the menu is indicated. Arrows indicate in which direction it is possible to move.

[<], [>], [∨] and [∧] In some of the displays, these buttons are also used to select the value field.

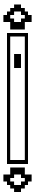


Fig. 19 Rolling field

Value field

[+] or [–] changes values in a display. Only values in framed fields can be changed. The actual/last transferred data will appear as light-coloured text on a dark background.

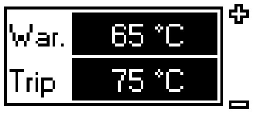


Fig. 20 Value field

Dark-coloured text

When data are changed, the text will be dark-coloured on a light background. When the entered value has been accepted by pressing [OK] and received by the MP 204, the text will again be light-coloured.

Before pressing [OK], the value can be reset by pressing [<] or [>].

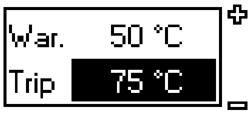


Fig. 21 Dark-coloured text

[OK]

- accepts the entered value or function.
- resets fault indications.

In the menus OPERATION, STATUS, LIMITS and INSTALLATION, data are exchanged between the R100 and the MP 204 each time the button [OK] is pressed.

[No contact]

If the R100 cannot come into contact with the MP 204, make a new attempt by pressing [OK].

Status field

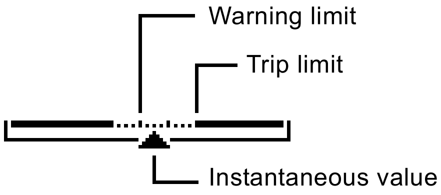


Fig. 22 Status field

In some of the displays in menu STATUS, a graphic display element shows the instantaneous value of the actual function in relation to the warning and trip limits set.

The graphic display element will appear in the following STATUS displays:

- Motor temperature
- Average voltage
- Average current
- Current unbalance
- Starting and run capacitors
- Temperature
- Cos φ
- Insulation resistance.

8.3 Menu structure

The menu structure for the R100 and MP 204 is divided into five parallel menus, each including a number of displays.

0. GENERAL

1. OPERATION

2. STATUS

3. LIMITS

4. INSTALLATION

An overview of the menu is shown at the end of this booklet.

9. Setting with the R100

The individual settings are described by means of matching displays.

An overview of the menu is shown at the end of this booklet.

While the R100 remote control is communicating with the MP 204, "Contact with" appears in the R100 display. The collection of data takes approx. 10 seconds.

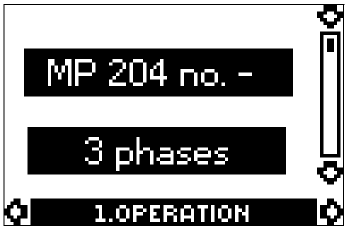
Menu 0. GENERAL

See operating instructions for the R100.

9.1 Menu 1. OPERATION

This menu shows alarms, alarm log and warnings.

9.1.1 Operating mode



MP 204 no. -

3 phases

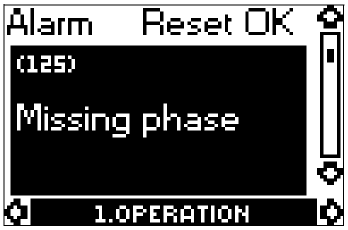
After the first contact, the start-up display shows the main settings.

The display shows that contact with an MP 204 has been established and the number of the MP 204 in the installation.

On delivery, no number has been assigned to the MP 204. The display shows "–". The display also shows that the MP 204 is set to three-phase, non-earthed operation.

Note: This display appears after the initial contact with the MP 204.

9.1.2 Actual trip



Alarm Reset OK

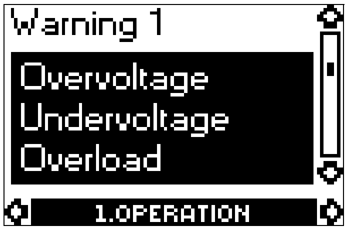
(125)

Missing phase

If the MP 204 is tripped, the cause of the trip is indicated.

For a list of trip and warning codes, see section *16.*

9.1.3 Actual warning 1



Warning 1

Overvoltage

Undervoltage

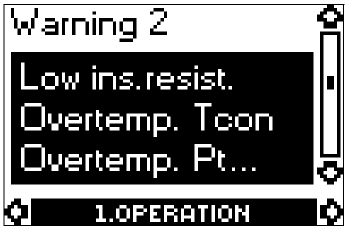
Overload

Six warnings can be shown at the same time.

If there are more than three warnings, the first three warnings are shown in this display, and the last three in the next display. See section *9.1.4*.

Note: There is no time indication of the warnings. The warnings are not indicated in the order of occurrence.

9.1.4 Actual warning 2



Warning 2

Low ins.resist.

Overtemp. Tcon

Overtemp. Pt...

If there are more than three warnings, warnings nos. 4 to 6 are shown in this display.

If there are more than six warnings, three dots "..." are shown after the last warning.

9.1.5 Alarm log 1

Alarm log 1

(64) 1min

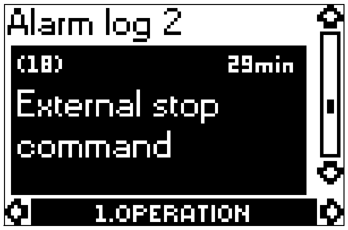
Overtemperature, Tempcon

For a list of trip and warning codes, see section *16.*

The last five tripping causes are stored in the alarm log. The time "1min" indicates the time which has passed since the MP 204 tripped.

Note: The time is measured only as long as the MP 204 is powered. The clock stops when the MP 204 is no longer powered.

9.1.6 Alarm log 2

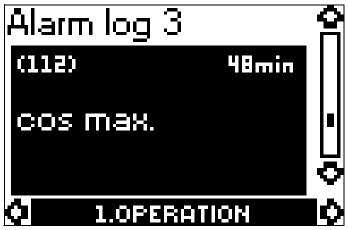

Alarm log 2

(18) 29min

External stop command

For a list of trip and warning codes, see section *16.*

9.1.7 Alarm log 3

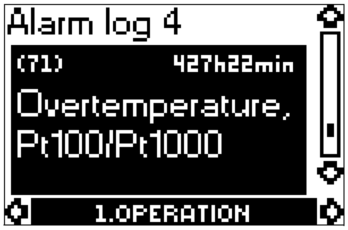

Alarm log 3

(112) 48min

cos max.

For a list of trip and warning codes, see section *16.*

9.1.8 Alarm log 4

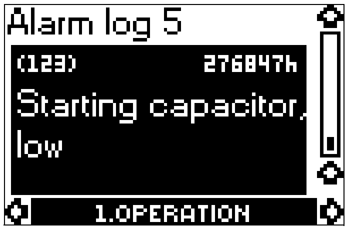

Alarm log 4

(71) 427h22min

Overtemperature, Pt100/Pt1000

For a list of trip and warning codes, see section *16.*

9.1.9 Alarm log 5


Alarm log 5

(123) 276847h

Starting capacitor, low

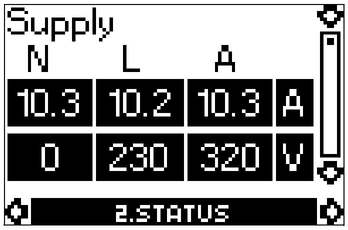
For a list of trip and warning codes, see section *16.*

9.2 Menu 2. STATUS

The displays appearing in this menu are status displays only, i.e. actual operating data. It is not possible to change values. For measuring accuracies, see section *15.4*.

When [OK] is pressed continuously, the displayed value is updated.

9.2.1 Supply overview

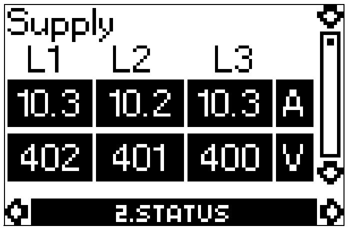

Supply

N	L	A	
10.3	10.2	10.3	A
0	230	320	V

Example of a single-phase current and voltage measurement.

When a single-phase motor is connected correctly, the "N" shows 0 V.

The MP 204 measures the phase voltage as well as the voltage across the auxiliary winding. The current value is the actual phase current and the current through the auxiliary winding.


Supply

L1	L2	L3	
10.3	10.2	10.3	A
402	401	400	V

Example of a three-phase current and voltage measurement.

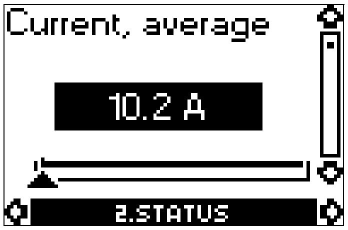
The MP 204 measures all mains voltages and currents.

The voltage is indicated as follows:

L1	L2	L3
U_{L1-L2}	U_{L2-L3}	U_{L3-L1}

The currents are actual values measured through the I1, I2, I3.

9.2.2 Average current


Current, average

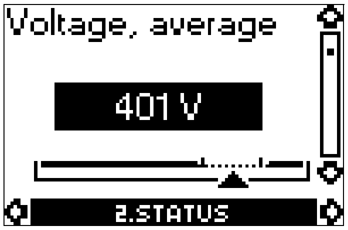
10.2 A

In the case of single-phase connection, the display shows the current in the neutral lead.

In the case of three-phase connection, the display shows the average current of all three phases, calculated as follows:

$$I_{average} = \frac{I_{L1} + I_{L2} + I_{L3}}{3}[A]$$

9.2.3 Average voltage


Voltage, average

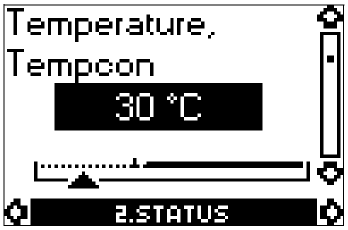
401 V

In the case of single-phase connection, the display shows the mains voltage U_{L-N}.

In the case of three-phase connection, the display shows the average mains voltage of all three phases, calculated as follows:

$$U_{average} = \frac{U_{L1-L2} + U_{L2-L3} + U_{L3-L1}}{3}[V]$$

9.2.4 Tempcon sensor

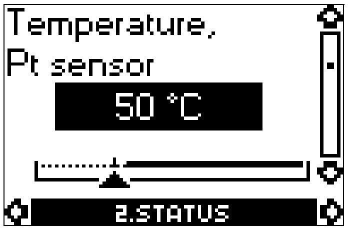

Temperature, Tempcon

30 °C

Actual motor temperature measured with a Tempcon sensor.

It is presumed that the motor incorporates a Tempcon sensor, and that the function is active. See section *9.4.8*.

9.2.5 Pt100/Pt1000 sensor


Temperature, Pt sensor

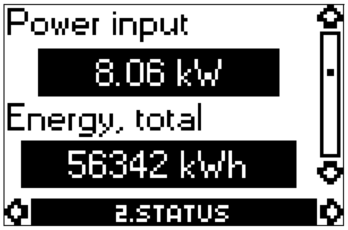
50 °C

Actual temperature measured with a Pt100/Pt1000 sensor.

It is presumed that a Pt sensor has been connected, and that the function is active. See section *9.4.9*.

Note: The learning function registers whether a Pt100/Pt1000 sensor is connected. When using a three-core Pt-sensor connection, the MP 204 automatically compensates for cable impedances.

9.2.6 Power input and energy consumption


Power input

8.06 kW

Energy, total

56342 kWh

Actual input power and motor energy consumption.

The energy consumption is an accumulated value which cannot be reset.

The power is calculated like this:

$$U_{average} = \frac{U_{L1-L2} + U_{L2-L3} + U_{L3-L1}}{3}[V]$$

$$I_{average} = \frac{I_{L1} + I_{L2} + I_{L3}}{3}[A]$$

$$\cos\varphi_{average} = \frac{\cos\varphi_{L1} + \cos\varphi_{L2} + \cos\varphi_{L3}}{3}[-]$$

$$P = U_{average} \bullet I_{average} \bullet \sqrt{3} \bullet \cos\varphi_{average}[W]$$

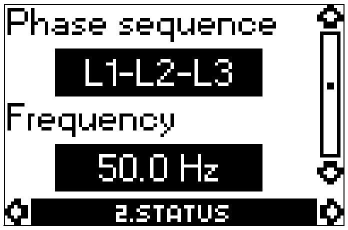
9.2.7 Energy trip counter


Energy, trip counter

185 kWh

Counter for measuring energy consumption. Can be reset. See section *9.4.12*.

9.2.8 Phase sequence

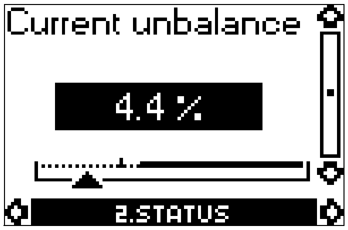

Phase sequence
L1-L2-L3
Frequency
50.0 Hz

Actual phase sequence and frequency:

- L1-L2-L3 (correct direction of rotation)
- L1-L3-L2.

Note: The actual phase sequence is accepted as correct and stored when the learning function is terminated.

9.2.9 Current unbalance


Current unbalance
4.4 %

The display shows the highest value of the following two calculations:

1.

$$I_{unbalance1} = \frac{I_{fmax} - I_{average}}{I_{average}} \cdot 100[\%]$$

2.

$$I_{unbalance2} = \frac{I_{average} - I_{fmin}}{I_{average}} \cdot 100[\%]$$

$I_{fmax.}$:	Highest phase current.
$I_{fmin.}$:	Lowest phase current.
$I_{average}$:	Average current in all three phases.

9.2.10 Operating hours and number of starts


Operating hours
1186 h 32 min.
Number of starts
46982

Number of operating hours and number of motor starts.

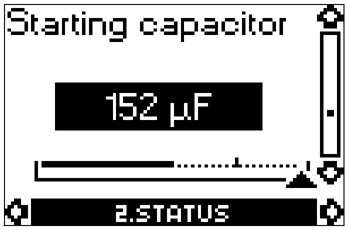
Note: The values cannot be reset.

9.2.11 Trip counter of hours and starts


Hours, trip counter
107 h 54 min.
Starts, trip counter
3879

Trip counter counting the number of operating hours and the number of motor starts. Can be reset.

9.2.12 Starting capacitor

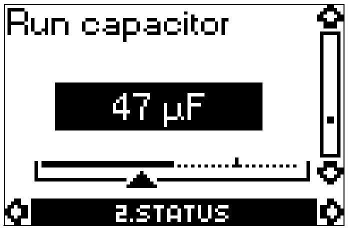

Starting capacitor
152 µF

Actual value of the starting capacitor.

Note:

- The display is shown only in the case of single-phase connection.
- If the learning function is active, this value will be stored for future reference when the learning function is terminated. See section 9.3.8.

9.2.13 Run capacitor


Run capacitor
47 µF

Actual value of the run capacitor.

Note:

- The display is shown only in the case of single-phase connection.
- If the learning function is active, this value will be stored for future reference when the learning function is terminated. See section 9.3.9.

9.2.14 Insulation resistance

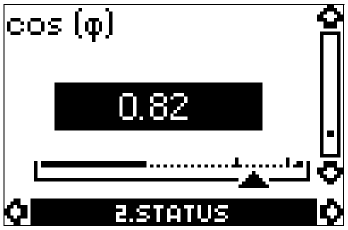
>1000 kΩ

The insulation resistance to earth is measured on supply cables as well as on motor windings.

Note:

- The value is shown only if the MP 204 has been set up for three-phase, earthed operation.
- The insulation resistance is measured when the pump has stopped. If the trip limit has been exceeded, the motor is not capable of restarting.
- Terminal "5" must be connected as shown in figs. 8 and 9.

9.2.15 Cos φ

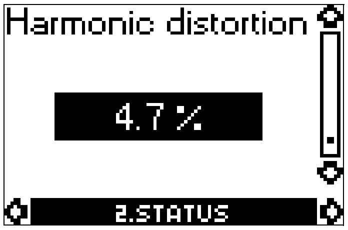


0.82

The actual cos φ of the motor.

Note: Functions in the case of single- as well as three-phase connection.

9.2.16 Harmonic distortion



4.7 %

Measured distortion on connected mains.

The heat dissipation in the motor windings increases with the distortion.

In case of distortion qualities above 15%, the supply mains should be checked for faults and noisy equipment.

9.3 Menu 3. LIMITS

The MP 204 operates with two sets of limits:

- a set of warning limits and
- a set of trip limits.

Some values only have a warning limit. See the table in section *16.*

If one of the trip limits is exceeded, the trip relay stops the motor. Outputs 95-96 open, causing the control current to the contactor to be disconnected. At the same time, the signal relay, terminals 97-98, is closed. See fig. 6, pos. 6 and 7.

The limit values should not be changed unless the pump has stopped.

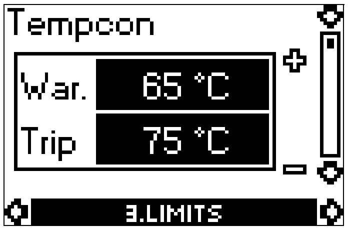
The trip limits must be set in accordance with the motor manufacturer's specifications.

The warning limits should be set to a less critical level than the trip limits.

If one or more of the warning limits are exceeded, the motor continues to run, but the warnings will appear in the MP 204 display, provided that this indication has been activated with the R100.

The warnings can also be read out with the R100.

9.3.1 Tempcon sensor



War. 65 °C
Trip 75 °C

Set the warning and trip limits for the Tempcon sensor.

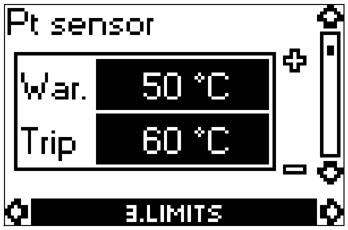
Factory setting:

- Warning: 65 °C.
- Trip: 75 °C.

Note: Above limits are not active until the Tempcon sensor has been activated. See section *9.4.8*.

Note: The overvoltage and undervoltage trip limits will be deactivated automatically if the temperature monitoring with Tempcon has been set to active. See section *9.4.8*.

9.3.2 Pt sensor


Pt sensor

War. 50 °C

Trip 60 °C

Set the warning and trip limits for the Pt sensor.

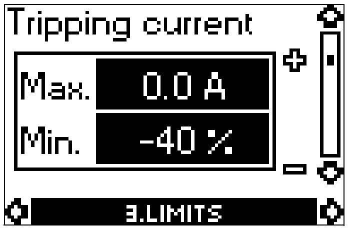
Factory setting:

- Warning: 50 °C.
- Trip: 60 °C.

Note: Above limits are not active until the Pt sensor has been activated. See section *9.4.9*.

Note: The overvoltage and undervoltage trip limits will be deactivated automatically if the temperature monitoring with Pt100/Pt1000 has been set to active. See section *9.4.9*.

9.3.3 Tripping current


Tripping current

Max. 0.0 A

Min. -40 %

Set the rated motor current in the "Max." field. (See motor nameplate.)

Factory setting:

- Max.: 0.0 A.

Set the min. current limit in the "Min." field. The min. current limit is typically a dry-running limit. The value is set in % of max. value.

Factory setting:

- Min.: –40%.

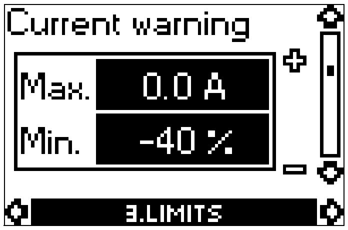
Example:

The rated motor current is 10 A.

The motor is to cut out (trip) at a current below 6 A.

Set "–40%" in the "Min." field.

9.3.4 Current warning


Current warning

Max. 0.0 A

Min. -40 %

Set the warning limits for "Max." and "Min.".

Set the max. warning limit in the "Max." field. The value is set in ampere.

Factory setting:

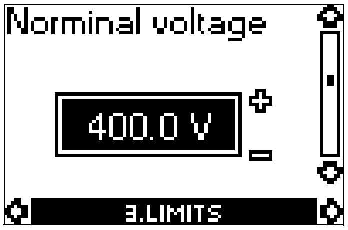
- Max.: 0.0 A.

Set the min. warning limit in the "Min." field. The value is set in % of max. value.

Factory setting:

- Min.: –40%.

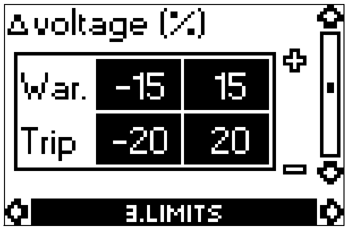
9.3.5 Nominal voltage


Norminal voltage

400.0 V

Set the nominal supply voltage.

9.3.6 Voltage limits


Δvoltage (%)

War.	-15	15
Trip	-20	20

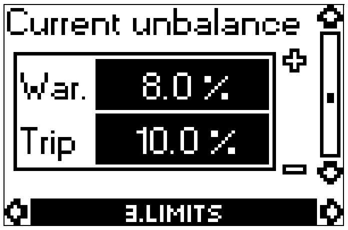
Set the warning and trip limits for under- and overvoltage.

Factory setting:

- Warning: ±15%.
- Trip: ±20%.

The values are set in % of nominal voltage.

9.3.7 Current unbalance


Current unbalance

War. 8.0 %

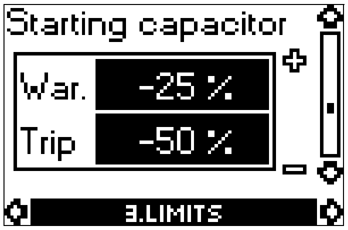
Trip 10.0 %

Set the warning and trip limits for current unbalance. For calculation, see section *9.2.9*.

Factory setting:

- Warning: 8.0%.
- Trip: 10.0%.

9.3.8 Starting capacitor


Starting capacitor

War. -25 %

Trip -50 %

Set the warning and trip limits for the capacity of the starting capacitor.

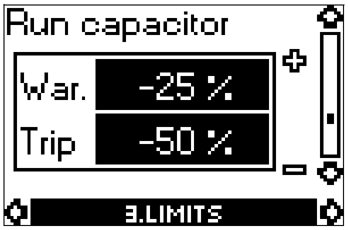
Factory setting:

- Warning: –25%.
- Trip: –50%.

The values are set as % of the value measured by the learning function. See section *9.2.12*.

Note: Setting is only possible when single-phase operation has been selected. See section *9.4.1*.

9.3.9 Run capacitor


Run capacitor

War. -25 %

Trip -50 %

Set the warning and trip limits for the capacity of the run capacitor.

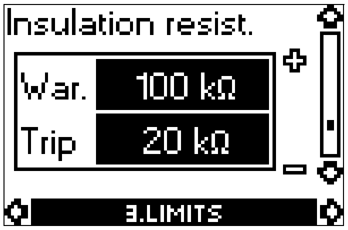
Factory setting:

- Warning: –25%.
- Trip: –50%.

The values are set as % of the value measured by the learning function. See section *9.2.13*.

Note: Setting is only possible when single-phase operation has been selected. See section *9.4.1*.

9.3.10 Insulation resistance


Insulation resist.

War. 100 kΩ

Trip 20 kΩ

Set the warning and trip limits for the insulation resistance in the installation. The value set should be low enough to allow for an early indication of faults in the installation.

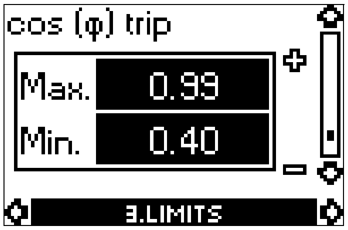
Factory setting:

- Warning: 100 kΩ.
- Trip: 20 kΩ.

Note:

- Insulation faults must be set to active to enable these limits. See section *9.4.10*.
- Setting is only possible when "3 phases w. FE" (functional earth) has been selected. See section *9.4.1*.

9.3.11 Cos φ trip


cos (φ) trip

Max. 0.99

Min. 0.40

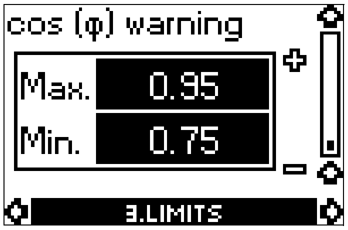
Set the trip limits for cos φ.

Factory setting:

- Max.: 0.99.
- Min.: 0.40.

This function can be used as dry-running protection when dry running cannot be detected by means of a current measurement.

9.3.12 Cos φ warning


cos (φ) warning

Max. 0.95

Min. 0.75

Set the warning limits for cos φ.

Factory setting:

- Max.: 0.95.
- Min.: 0.75.

9.4 Menu 4. INSTALLATION

In this menu, it is possible to set a number of operating data and thus match the MP 204 to the actual installation.

The installation values should not be changed unless the pump has stopped.

9.4.1 Supply mains

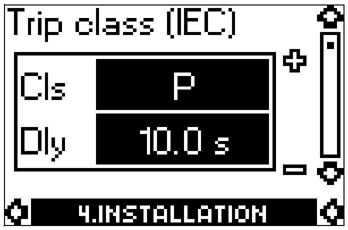
Mains connection

3 phases

Set the supply mains to which the MP 204 is connected:

- ***3 phases*** (non-earthed) (factory setting)
- *3 phases w. FE* (functional earth)
- *1 phase*.

9.4.2 Trip class



Trip class (IEC)

Cls P

Dly 10.0 s

Line 1: Select IEC trip class (1 to 45).

If manual indication of trip delay in the case of overload is required, select trip class "P".

Factory setting:

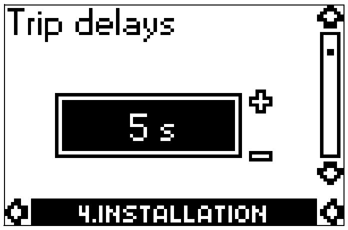
- Cls (trip class): P.

Line 2: Select trip delay.

Factory setting:

- Dly (trip delay): 10.0 s.

9.4.3 Trip delay



Trip delays

5 s

Set the trip delay before the MP 204 trips.

Note: This does not apply to overload. For tripping due to overload, see the curves, pages 31 and 32.

Factory setting:

- 5 s.

9.4.4 External current transformers

External CT factor

1

Set the external current transformer factor.

If no external current transformer is used, the factor is 1.

Factory setting:

- 1.

Note: Set the actual factor.

Example:

A current transformer with a 200:5 ratio is used and five windings through the MP 204 are made, as shown in fig. 9.

$$CT = \frac{200}{5 \bullet 5} = 8$$

Grundfos current transformers	Set CT factor
200:5	8
300:5	12
500:5	20
750:5	30
1000:5	40

Note: The above table only applies to Grundfos current transformers, connected as shown in figs. 9 and 10.

9.4.5 Power-on delay

Power-on delay

5 s

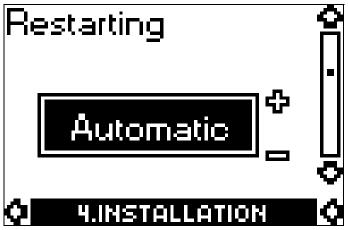
Number of seconds elapsing from the moment voltage is applied to the MP 204 until the activation of the trip relay (terminals 95-96) and signal relay (terminals 97-98).

Factory setting:

- 5 s.

Note: If the MP 204 and the contactor are mounted as shown in figs. 8 and 9, the motor cannot start during this delay.

9.4.6 Restarting


Restarting
Automatic

Set whether restarting after tripping is to be

- ***Automatic*** (factory setting)
- *Manual*.

For setting of time, see section *9.4.7*.

9.4.7 Automatic restarting


Autom. restarting
300 s

Set the time after which the MP 204 is to attempt automatic restarting of motor after cut-out.

The time runs from the moment when the value which triggered the fault has returned to normal.

Factory setting:

- 300 s.

9.4.8 Tempcon sensor


Tempcon
Disable

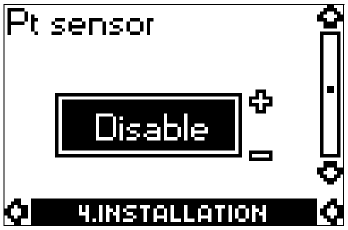
Set whether a Tempcon sensor is incorporated in the motor.

- *Enable*
- ***Disable*** (factory setting).

If the Tempcon sensor is set to active and no Tempcon signal is received from the pump, the MP 204 display shows "----" instead of Tempcon temperature.

Note: The overvoltage and undervoltage trip limits will be deactivated automatically if the temperature monitoring with Tempcon has been set to active.

9.4.9 Pt sensor


Pt sensor
Disable

Set whether a Pt sensor is connected.

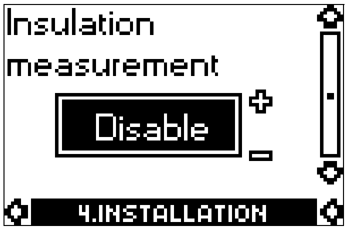
- *Enable*
- ***Disable*** (factory setting).

If the Pt sensor is set to active and no signal is received from the sensor, the MP 204 display shows "----" instead of Pt temperature.

Note: The overvoltage and undervoltage trip limits will be deactivated automatically if the temperature monitoring with Pt100/Pt1000 has been set to active.

Note: The learning function registers automatically whether a Pt100/Pt1000 sensor is connected.

9.4.10 Insulation resistance measurement


Insulation measurement
Disable

Set whether insulation resistance measurement is to be made.

- *Enable*
- ***Disable*** (factory setting).

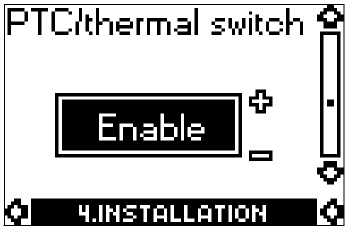
If three-phase, earthed mains is selected (see section *9.4.1*), this setting is automatically changed to "Enable".

If single-phase mains is selected (see section *9.4.1*), this setting is automatically changed to "Disable".

Note:

- The insulation resistance can only be measured if terminal "FE" is earthed and the supply mains is set to "3 phases w. FE".
- The leakage is measured when the MP 204 is powered and the motor stopped.
- The MP 204 must be connected in front of the contactor, and terminal "5" after the contactor. See figs. 8 and 9.

9.4.11 PTC/thermal switch


PTC/thermal switch

Enable

Set whether a PTC/thermal switch is connected.

- ***Enable*** (factory setting)
- *Disable*.

9.4.12 Resetting of trip counters


Reset trip counter

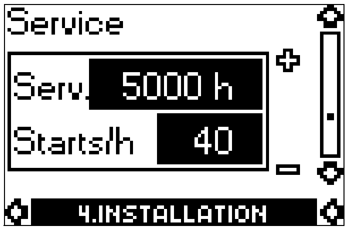
All

Select the trip counters to be reset.

- ***All*** (all trip counters) (factory setting)
- *Hours* (operating hours)
- *Starts* (number of starts)
- *Energy* (energy consumption).

See sections *9.2.7* and *9.2.11*.

9.4.13 Service interval


Service

Serv. 5000 h

Starts/h 40

Line 1: Set the number of hours of motor operation at which the MP 204 is to give a service warning in the display.

Factory setting:

- Service: 5000 h.

Line 2: Set the number of starts allowed per hour at which the MP 204 is to give a warning in the display.

Factory setting:

- Starts/h: 40.

9.4.14 Number of automatic restarts


Restarts/24 h

Alarm Disable

Numb. 3

Set the number of automatic restarts that the motor is allowed to make within 24 hours before cutting out.

Alarm:

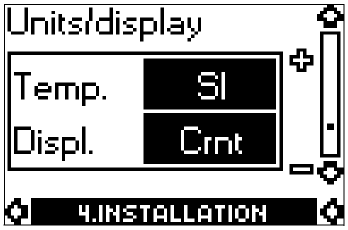
- *Enable*
- ***Disable*** (factory setting).

Number:

- 3 (factory setting).

Note: If this tripped state occurs, the motor can only be restarted manually.

9.4.15 Units/display


Units/display

Temp. SI

Displ. Crnt

Line 1: Set unit.

Temperature:

- ***SI*** (factory setting)
- *US*.

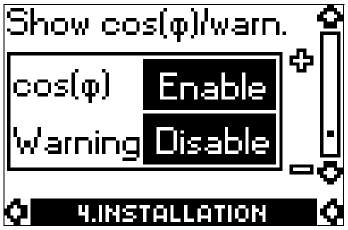
Note: If SI units have been selected, the temperature is indicated in degree Celsius (°C).
If US units have been selected, the temperature is indicated in Fahrenheit (°F).

Line 2: Select the MP 204 display indication during normal operation.

Display:

- ***Crnt*** (current) (factory setting)
- *Tcon* (Tempcon temperature)
- *Pt sen.* (Pt100/Pt1000 temperature).

9.4.16 MP 204 display


Show cos(φ)/warn.

cos(φ) Enable

Warning Disable

Line 1: Set whether the cos φ value is to be shown in the MP 204 display by means of the ⊕ button. See section 7.1.3.

cos φ:

- ***Enable*** (factory setting)
- *Disable*.

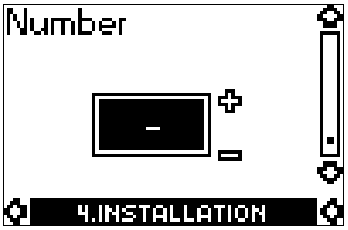
Line 2: Set whether warnings are to be shown in the display.

Warning:

- *Enable*
- ***Disable*** (factory setting).

If display of warnings is active, the MP 204 display will switch from standard display (e.g. current) to warning code display when the limit value is exceeded. The remaining values can still be read out by means of the ⊕ button. See section 7.1.3.

9.4.17 GENIbus ID number


Number

–

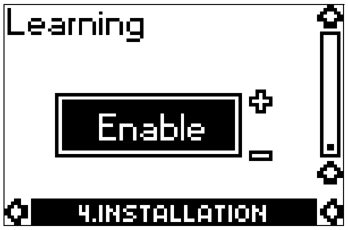
Set ID number.

If several units are connected to the same GENIbus, each unit must be assigned a unique ID number.

Factory setting:

- – (no number assigned).

9.4.18 Learning function


Learning

Enable

The learning function is active until the motor has been operating for a minimum of 120 seconds. The dot in the right side of the MP 204 display is flashing.

During the storing of the measured values, "LRN" appears in the MP 204 display.

Three-phase operation:

- Accepts the actual phase sequence as correct.
- If a Pt100/Pt1000 sensor is connected, the cable impedances to the sensor are measured.

Single-phase operation:

- Starting and run capacitors are measured.
- If a Pt100/Pt1000 sensor is connected, the cable impedances to the sensor are measured.

Note: The learning function changes to "Disable" when the measurements have been made.

- ***Enable*** (factory setting)
- *Disable*.

10. MP 204 with GENIbus

If several MP 204 units are connected to the same GENIbus, the connection is to be made as shown in fig. 23.

Note the connection of screen to conductive support.

If the GENIbus has been in use, and bus communication monitoring has been activated, the MP 204 will continue to monitor the bus activity. If the MP 204 does not receive GENIbus telegrams, the MP 204 presumes that the GENIbus connection has been disconnected and indicates a fault on the individual units.

Each of the units in the chain must be assigned an identification number with the R100, see section *9.4.7*.

For further information about the GENIbus, see WebCAPS at www.grundfos.com.

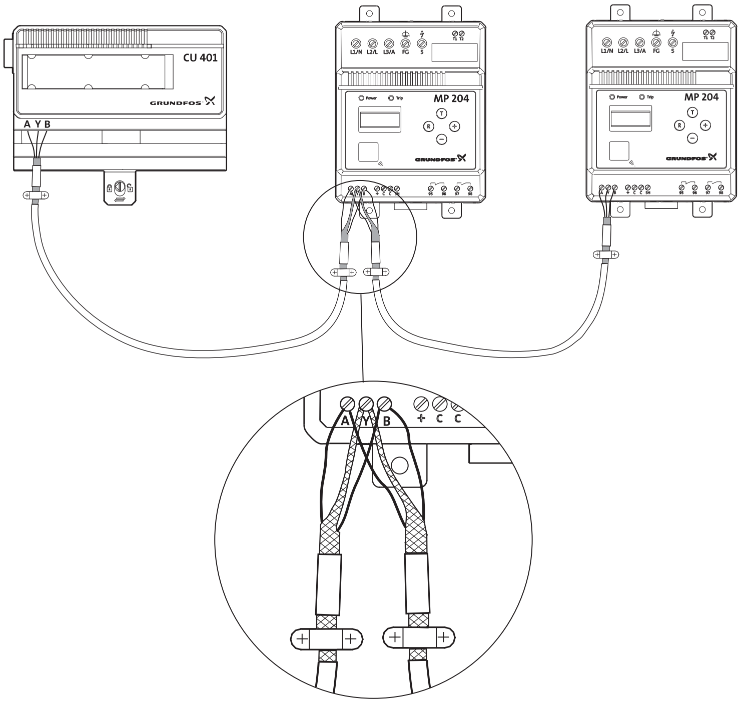


Fig. 23 GENIbus

11. Approvals and standards

The MP 204 conforms to:

- UL 508
- IEC 947
- IEC/EN 60335-1
- IEC/EN 61000-5-1
- IEC 61000-6-3
- IEC 61000-6-2
- EN 61000-6-3
- EN 61000-4-5
- EN 61000-4-4
- EN 61000-4-6.

12. Pump operation with MP 204

12.1 Industrial pumps

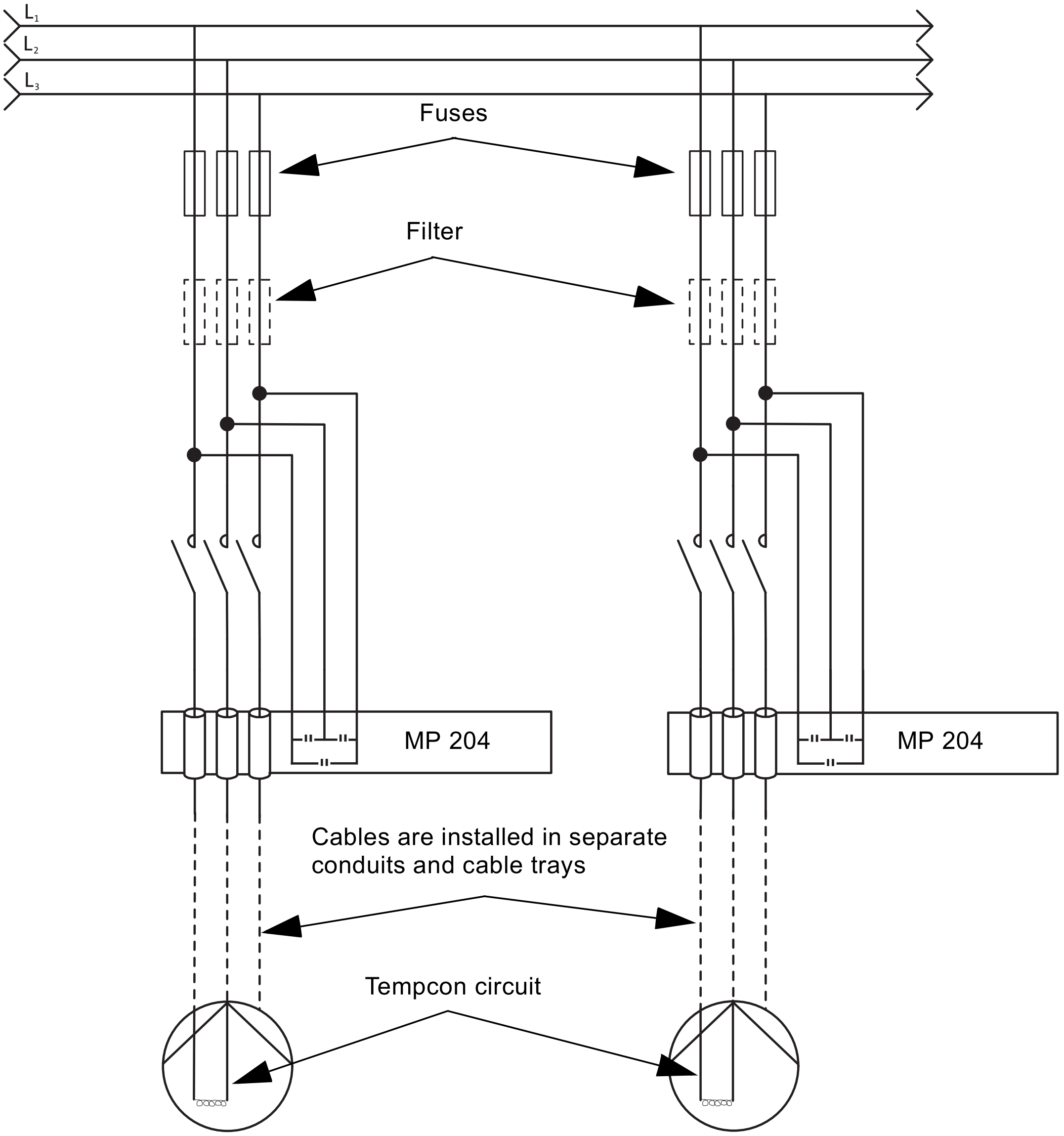
Industrial pumps may incorporate a PTC/thermal switch to be connected direct to the MP 204.

Industrial pumps mainly apply IEC trip classes 20 to 30, depending on the liquid viscosity.

12.2 Submersible pumps

Submersible pumps normally have a short start-up time. Trip class "P" can therefore be applied with advantage for these pumps. It is possible to set very short times down to for example 900 ms, used for certain specific applications.

To prevent the Tempcon signal from one submersible pump from interfering with the signal from another, cabling must be carefully made to allow measurements to be made of both pumps at the same time. The motor cables must be kept apart and not installed in the same cable tray. To avoid interference, it may be necessary to fit a filter on the supply cables. See fig. 24.



TM03 1356 1805

Fig. 24 Submersible pump installation with Tempcon

12.3 Wastewater pumps

Wastewater pumps may incorporate a PTC/thermal switch to be connected direct to the MP 204.

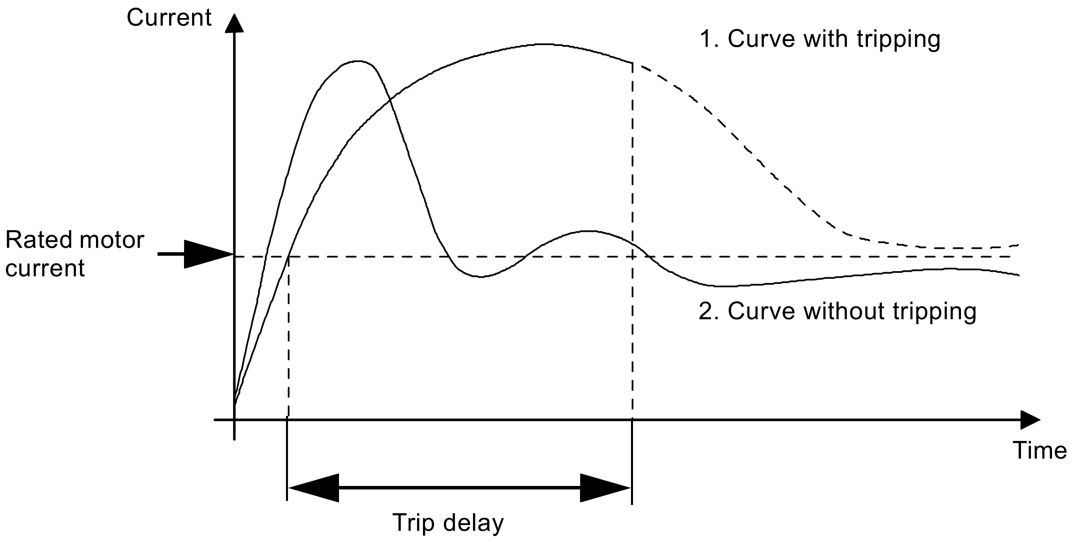
Wastewater pumps may also be connected to a Pt100/Pt1000 sensor. The sensor can also be connected direct to the MP 204.

The Pt100/Pt1000 can be activated with the R100, see section *9.4.9*, or via a CU 401 control unit and an OD 401 control panel.

A high IEC trip class is to be applied for wastewater pumps, especially grinder-type pumps. Classes 25 to 35 are the optimum choice. Apply IEC trip class 45 for the pumping of liquids of extremely high viscosity or liquids containing many solid particles.

13. Curves

13.1 Trip class "P"



TM03 0812 1205

Fig. 25 Curves for trip class "P"

The trip delay indicates the maximum period of time during which the overload condition is allowed to exist, for example 5 seconds.

Example:

A pump is to cut out after 900 ms because the rated current has been exceeded.

- Select trip class "P".
- Set the overload limit to 10 A (the rated motor current is stated on the nameplate).
- Set the trip delay to 900 ms.

Fig. 25, curve 1:
The pump has an abnormal start-up time, and the current exceeds 10 A. The MP 204 trips after 900 ms.

Fig. 25, curve 2:
The pump has a normal start-up time, and the current exceeds 10 A only briefly (< 900 ms). The MP 204 does not trip.

Note: The curves are examples and cannot be used for readings.

13.2 IEC trip curves

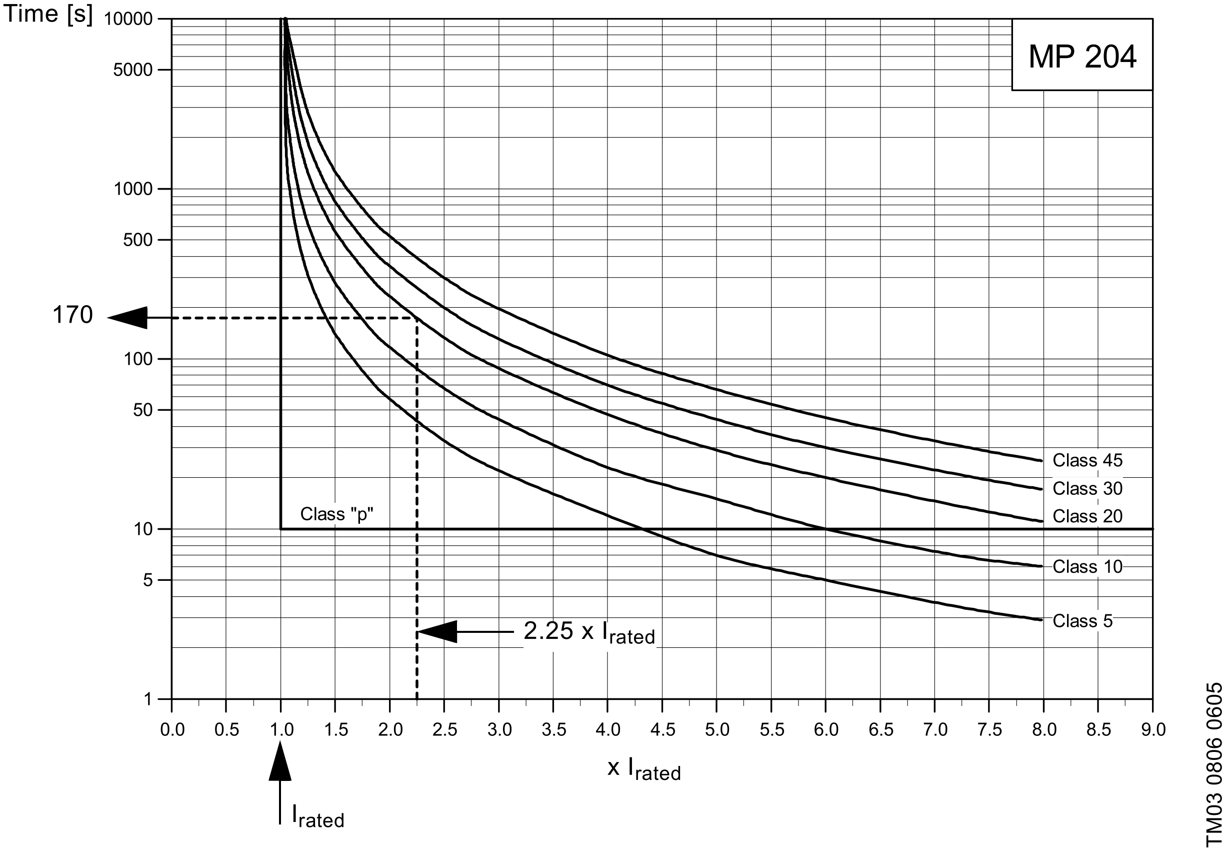


Fig. 26 IEC trip curves

Example:

- Set the MP 204 to IEC trip class 20.
- Set the overload limit to 10 A (the rated motor current is stated on the nameplate).

At a motor current of 22.5 A (10 x 2.25), the MP 204 trips after approx. 170 seconds.

14. Technical data

Ambient temperature

- During operation: –20°C to +60°C
  (must not be exposed to direct sunlight).
- In stock: –25°C to +85°C.
- During transportation: –25°C to +85°C.

Relative air humidity

From 5% to 95%.

Materials

Enclosure class: IP 20.

Plastic type: Black PC / ABS.

15. Electrical data

Supply voltage

100-480 VAC, 50/60 Hz.

Current consumption

Max. 5 W.

Short-circuit rating

Suitable for use on a circuit capable of delivering not more than 15000 RMS symmetrical amperes, 480 V maximum.

15.1 Outputs

Trip relay

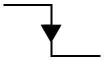
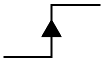
Voltage category	III
Insulation voltage	400 V (to all other terminals)
Insulation test voltage	4 kVAC
Max. load	400 VAC, 2 A, AC-15/ 24 VDC, 2 A, DC-13, L/R = 40 ms
Min. load	5 V/10 mA
Max. load power AC/DC	400 VA/48 W
Contact type	NC (normally closed contact)

Signal relay

Voltage category	III
Insulation voltage	400 V (to all other terminals)
Insulation test voltage	4 kVAC
Max. load	400 VAC, 2 A, AC-15/ 24 VDC, 2 A, DC-13, L/R = 40 ms
Min. load	5 V/10 mA
Max. load power AC/DC	400 VA/48 W
Contact type	NO (normally open contact)

15.2 Inputs

Input for PTC/thermal switch

Voltage category	III
Insulation voltage	400 V (to all other terminals)
Insulation test voltage	4 kVAC
Output voltage (open contact)	5 V
Output current (closed contact)	2 mA
Voltage step from high to low 	2.0 V
Equivalent external load	1.5 kΩ
Voltage step from low to high 	2.5 V
Equivalent external load	2.2 kΩ
Input filter time	41 ±7 ms

Input for Pt100/Pt1000 sensor

Voltage category	II
Insulation voltage	50 V (to system earth)
Insulation test voltage	700 VDC
Temperature range	0-200°C
Sensor type	Screened 2- or 3-core cable
Sensor current (Pt100)	2.5 mA
Sensor current (Pt1000)	0.25 mA
Mains frequency suppression	50-60 Hz
Filter times:	
Integration time	100 ms
Reading interval	400 ms

15.3 Insulation measurement method

The insulation resistance is measured applying a rectified alternating voltage. The test voltage can therefore not be measured using an ordinary voltmeter.

The open-circuit test voltage is calculated as follows:

$$U_{test} \cong \sqrt{\frac{2}{3}} \bullet U_{mains}[V]$$

Example:

The MP 204 is connected to 3 x 400 V.

$$U_{test} \cong \sqrt{\frac{2}{3}} \bullet 400 = 327[V]$$

15.4 Measuring ranges

	Measuring range	Accuracy	Resolution
Current without external current transformer	3 - 120 A	±1%	0.1 A
Current with external current transformer	120 - 999 A	±1%	1 A
Phase-to-phase voltage	80 - 610 VAC	±1%	1 V
Frequency	47 - 63 Hz	±1%	0.5 Hz
Insulation resistance	10 - 1 MΩ	±10%	10 kΩ
Temperature via Pt100/Pt1000	0 - 180°C	±1°C	1°C
Temperature via Tempcon	0 - 125°C	±3°C	1°C
Power consumption	0 - 16 MW	±2%	1 W
Power factor (cos φ)	0 - 0.99	±2%	0.01
Run capacitor (single-phase)	10 - 1000 μF	±10%	1 μF
Starting capacitor (single-phase)	10 - 1000 μF	±10%	1 μF
Number of starts	0 - 65535	–	1
Energy consumption	0 - $4*10^9$ kWh	±5%	1 kWh

15.5 Setting ranges

	Setting range	Resolution
Current without external current transformer	3 - 120 A	0.1 A
Current with external current transformer	120 - 999 A	1 A
Phase-to-phase voltage	80 - 610 VAC	1 V
Temperature via Pt100/Pt1000	0 - 180°C	1°C
Temperature via Tempcon	0 - 125°C	1°C
Power factor (cos φ)	0 - 0.99	0.01
IEC trip class	1 - 45 and "P"	1
Special trip class "P" (pump), trip delay	0.1 - 30 s	0.1 s
External current transformer factor	1 - 100	1
Run capacitor (single-phase)	10 - 1000 μF	1 μF
Starting capacitor (single-phase)	10 - 1000 μF	1 μF
Number of starts per hour	0 - 65535	1
Number of starts per 24 hours	0 - 65535	1
Trip delay (other than current)	1 - 100 s	1 s
Automatic restarting time	10 - 3000 s	10 s
Power-on delay	1 - 19 s	1 s

16. Fault finding

16.1 Warning and trip codes

MP 204 display	A	32
A = Trip E = Warning	← A	
Fault code		← 32

Fault code	Trip	Warning	Cause of trip/warning
2	A	–	Missing phase
3	A	–	PTC/thermal switch
4	A	–	Too many automatic restarts per 24 hours
9	A	–	Wrong phase sequence
12	–	E	Service warning
15	A	–	Communication alarm for main system
18	A	–	Commanded trip (not in alarm log)
20	A	E	Low insulation resistance
21	–	E	Too many starts per hour
26	–	E	The motor is operating even if the MP 204 is tripped
32	A	E	Overvoltage
40	A	E	Undervoltage
48	A	E	Overload
56	A	E	Underload
64	A	E	Overtemperature, Tempcon measurement
71	A	E	Overtemperature, Pt100/Pt1000 measurement
91	–	E	Signal fault, Tempcon sensor
111	A	E	Current unbalance
112	A	E	Cos φ, max.
113	A	E	Cos φ, min.
120	A	–	Auxiliary winding fault
123	A	E	Starting capacitor, low
124	A	E	Run capacitor, low
175	–	E	Signal fault, Pt100/Pt1000 sensor

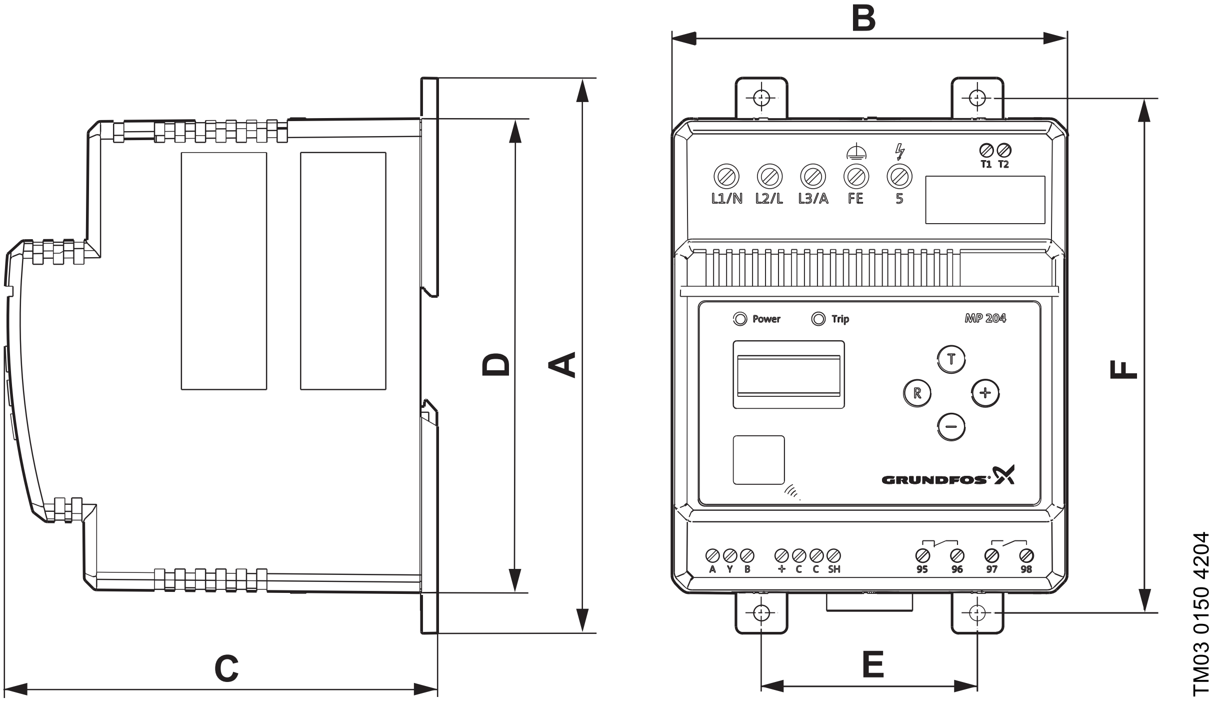
17. Disposal

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.

Dimensions



A	B	C	D	E	F
164	116	127	140	63	151

All dimensions in mm.

Argentina
Bombas GRUNDFOS de Argentina S.A.
Ruta Panamericana km. 37.500 Lote 34A
1619 - Garin
Pcia. de Buenos Aires
Phone: +54-3327 414 444
Telefax: +54-3327 411 111

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

Belorussia
Представительство ГРУНДФОС в Минске
220123, Минск,
ул. В. Хоружей, 22, оф. 1105
Тел.: +(37517) 233 97 65,
Факс: +(37517) 233 97 69
E-mail: grundfos_minsk@mail.ru

Bosnia/Herzegovina
GRUNDFOS Sarajevo
Trg Heroja 16,
BiH-71000 Sarajevo
Phone: +387 33 713 290
Telefax: +387 33 659 079
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 Pumpen Vertrieb
Representative Office - Bulgaria
Bulgaria, 1421 Sofia
Lozenetz District
105-107 Arsenalski blvd.
Phone: +359 2963 3820, 2963 5653
Telefax: +359 2963 1305

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.
51 Floor, Raffles City
No. 268 Xi Zang Road. (M)
Shanghai 200001
PRC
Phone: +86-021-612 252 22
Telefax: +86-021-612 253 33

Croatia
GRUNDFOS CROATIA d.o.o.
Cebini 37, Buzin
HR-10010 Zagreb
Phone: +385 1 6595 400
Telefax: +385 1 6595 499
www.grundfos.hr

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
Mestarintie 11
FIN-01730 Vantaa
Phone: +358-3066 5650
Telefax: +358-3066 56550

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
Jl. Rawa Sumur III, Blok III / CC-1
Kawasan Industri, Pulogadung
Jakarta 13930
Phone: +62-21-460 6909
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

México
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

România
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 Москва, ул. Школьная 39
Тел. (+7) 495 737 30 00, 564 88 00
Факс (+7) 495 737 75 36, 564 88 11
E-mail grundfos.moscow@grundfos.com

Serbia
GRUNDFOS Predstavništvo Beograd
Dr. Milutina Ivkovića 2a/29
YU-11000 Beograd
Phone: +381 11 26 47 877 / 11 26 47 496
Telefax: +381 11 26 48 340

Singapore
GRUNDFOS (Singapore) Pte. Ltd.
24 Tuas West Road
Jurong Town
Singapore 638381
Phone: +65-6865 1222
Telefax: +65-6861 8402

Slovenia
GRUNDFOS d.o.o.
Šlandrova 8b, SI-1231 Ljubljana-Črnuče
Phone: +386 1 568 0610
Telefax: +386 1 568 0619
E-mail: slovenia@grundfos.si

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(0)771-32 23 00
Telefax: +46(0)31-331 94 60

Switzerland
GRUNDFOS Pumpen AG
Bruggacherstrasse 10
CH-8117 Fällanden/ZH
Tel.: +41-1-806 8111
Telefax: +41-1-806 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
ТОВ ГРУНДФОС УКРАЇНА
01010 Київ, Вул. Московська 8б,
Тел.:(+38 044) 390 40 50
Фах.: (+38 044) 390 40 59
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 8TL
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

Usbekistan
Представительство ГРУНДФОС в Ташкенте
700000 Ташкент ул.Усмана Носира 1-й тупик 5
Телефон: (3712) 55-68-15
Факс: (3712) 53-36-35

Addresses revised 24.03.2010

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Thinking ahead makes it possible
Innovation is the essence

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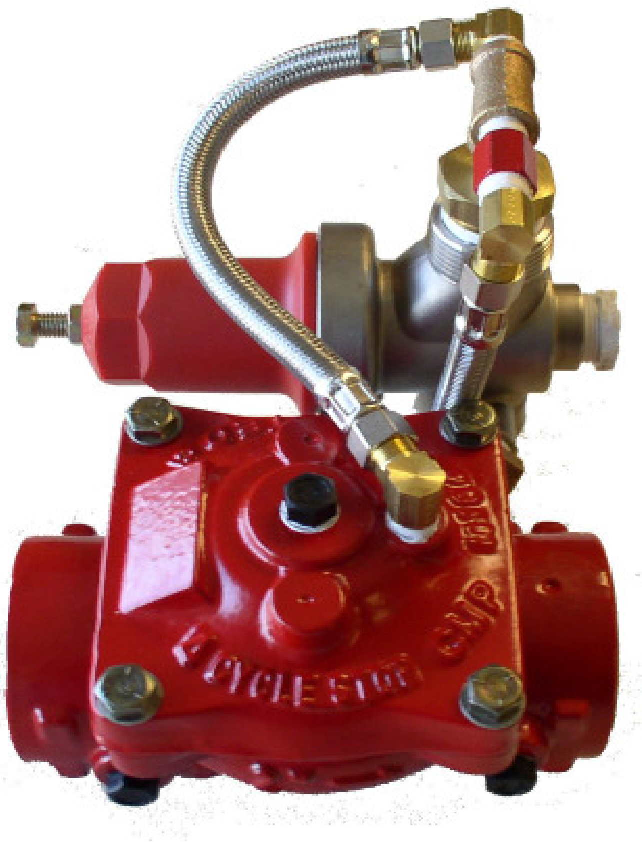
TW-60 Water Treatment System

section 13

Cycle Stop Valves

-Model- CSV3B



Certified
NSF/ANSI 372

What are Cycle Stop Valves?

The Cycle Stop Valve is a pump control valve that makes a variable flow, constant pressure pump out of most standard, constant speed pumps.

Installed between the pump and your water system, the Cycle Stop Valve (CSV) automatically chokes back the output of a pump to match the users demand for water.

86 gallon tank replaces 10,000 gallon tank

As the gallons per minute decrease, the amperage draw decreases as well because it is the weight of the water that determines the horse power or amperage needed, not the pressure.

The CSV maintains a constant pressure for the water user when demand is within the recommended range for the valve model being used.

It is completely mechanical and pressure actuated. No electricity required.

86 gallon tank replaces 30,000 gal standpipe

Constant speed pumps are now capable of providing constant pressure in variable demand situations without expensive controls, huge pressure tanks, or water towers. Pumps equipped with a CSV can operate safely from as low as 1 gpm to as much as the pump can produce.

The CSV stops pump cycling, eliminates water hammer, extends pump life, and reduces energy costs compared to a system allowed to cycle off and on excessively when demand varies.

How Cycle Stop Valves Affect Pumps and Motors

Back Pressure?

As counter intuitive as it may seem, increasing back pressure does not make pumps work harder. One horse power is the measure of power it takes to lift 33,000 pounds of weight (or 3,750 gallons) one foot in one minute. Gallons and weight are the same thing to the pump. If flow from the pump is restricted with a valve, back pressure will increase. As back pressure increases, gallons or weight decreases. As the weight or gallons of water being lifted by the pump decreases, so does power consumption, amps, or horse power. Excess back pressure is a free by-product of horsepower. Back pressure makes pumps pull less amperage, not more. Less amperage means motors run cooler, use less electricity, and last longer.

Minimum Flow?

While Cycle Stop Valves will increase back pressure on pumps when needed, they will never let the back pressure increase to complete shut off head. The Cycle Stop Valve can never completely close. There is always water flowing through the valve even when in its fully closed position. This flow is derived from the minimum cooling requirements of the pump and motor. Large submersible pumps can operate on much smaller flows than .5 feet per second. Flow charts for motors running at FULL LOAD AMPERAGE are not relevant for motors pulling an average 60% of full load. As back pressure increases until the pump is only pumping minimum flow, amperage decreases, derating the motor. When pulling only 50 to 60% of full load, the derated motor can safely pump hot water up to 140 degrees according to the charts. If a derated motor can safely pump any amount of 140 degree water, then a tiny amount of cool water (86 degrees or less) will easily prevent the motor from overheating. Minimum cooling charts for derated motors have not been made available by the motor manufactures. Years of experience has proven many times over that motors such as a 50 HP sub will drop from 77 amps to about 40 amps when the pump is restricted to 5 gpm flow. This 5 gpm flow of 70 degree water going past the motor will increase in temperature to 78 degrees. Seventy eight degrees is not even close to 131 degree water that the charts say can safely cool a 50 HP motor when derated by 40%. Full speed turbines and centrifugal pumps can operate at even lower minimum flows as their motors are cooled by air. Motor and cooling fan are still spinning at full RPM, which will keep a motor that is only pulling 60% of full load amps very cool.

Resting Pumps and Motors?

Pumps and motors are designed for continuous operation and do not need to rest. This means they will last longer if they run continuously than if they “cycle” off and on. Motors that are coasting along at low amperage 24 hours a day will use less electricity than the same motor pulling full load and cycling on and off every 10 minutes or so. Most motor and pump failures occur during start up. Starting current can be six times normal running amperage. Start up tests every component of the pump and motor. Windings, bearings, shafts, impellers, splines, couplings, panels, even the generator at the power company are all tested each time a pump starts. All of these problems go away once the motor is up and running. Common sense would suggest that the fewer times it starts and stops, the longer a motor and pump will last.

Soft Start Equipment?

Some electric companies require soft starts on larger horse power systems. Cycle Stop Valves will completely eliminate water hammer with or without electrical soft start equipment and will also provide the same no load start up comparable to any electrical soft start equipment. This will reduce the electric bill if a demand charge is included.

Cavitation?

Restricting the discharge from a pump with any valve will decrease the NPSH required. The NPSH available will increase as the flow rate decreases. Increasing the NPSHA and/or decreasing the NPSHR reduces the chance of cavitation. Recirculating water from the outlet to the inlet of an impeller can occur at low flow. The 5 GPM bypass exiting the Cycle Stop Valve will keep this recirculating from heating up the pump. Cavitation like wear can occur if the pump chosen has a recirculating problem such as with a loose-fitting wear ring. Pumps that are made of materials with a high tensile strength are more resistant to wear from cavitation. When equipped with an additional pressure sustain pilot the Cycle Stop Valve can also control cavitation at high flow rates by limiting the maximum flow from the pump.

-Model- CSV3B

The Cycle Stop Valve model CSV3B is a pump control valve that automatically adjust pump output to match your variable demands.

As your demands vary, the CSV reacts to changes in pressure and opens and closes accordingly. This enables it to hold a constant pressure as long as your demand is more than the minimum control flow of 5 gpm.

If you demand more than your pump can provide at the pressure the valve is trying to hold, the valve will stop actuating at all and open fully. Your system pressure will become whatever pressure the pump can build at that point.

When there is no longer any demand on the system, water will begin to go into the pressure tank and the system pressure will begin to rise. The pressure tank will then refill slowly at the valve minimum control rate of 5 gpm (not your full pump rate) until it reaches shut off pressure. Keep this in mind when choosing your pressure tank as this function allows for a much smaller pressure tank to protect your pumping system than you would be able to use on a standard system without the CSV valve controlling the pump. Motor manufacturers recommend a minimum 1 minute of run time any time your pump is called to come on. The time it takes to refill your pressure tank will guarantee that run time regardless of how you use water.

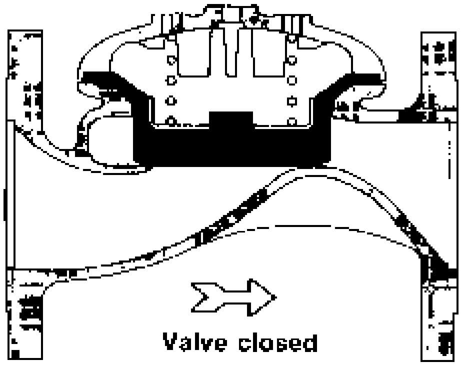
When water is again demanded, the pressure tank will empty causing the system pressure to reach cut in pressure and the pressure switch will start the pump. *NOTE: Pressure switch shut off pressure must always be set higher than the pressure regulated by the CSV.*

The CYCLE STOP VALVE model CSV3B is certified NSF ANSI/372 no lead. It is a single chamber diaphragm operated valve available in 2" and 3" threaded or flanged, and 4" through 12" flanged with flow rates available from 5 gpm to 5000 gpm. Model CSV3B valves are adjustable between 15-150 PSI. Difference in pressure between inlet pressure and outlet pressure cannot be more than 125 PSI. Note: In multiple pump applications, each pump must have its own valve.

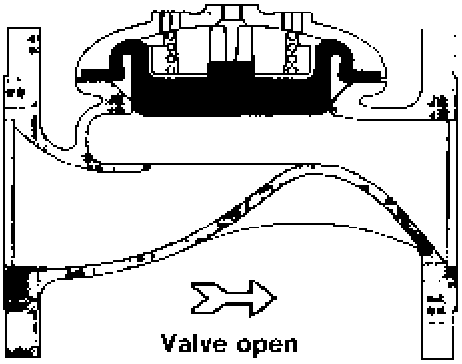
-Model- CSV3B
Principle of Operation

The CSV3 Model B is a single chamber hydraulically operated automatic valve which combines the simplicity and reliability of a diaphragm valve with control capabilities of a pilot operated self acting regulator.

The diaphragm is a single unit comprised of three separate and distinct parts; the flexing element, the guiding element and the sealing element. The flexing element is designed solely as a diaphragm. The sealing element needs only to seal to minimum flow. Additionally, the body design fully supports the guiding element of the diaphragm/seal, which because of its design and hydraulic force, expands against the body support as it closes.



Valve closed

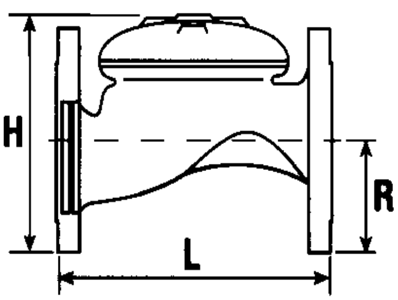


Valve open

-Model- CSV3B Specifications

Cycle Stop Valves®

Certified NSF/ANSI 372



Materials
- * Body and cover; polyester coated cast iron
- * Diaphragm retainer and spring: stainless steel
- * Diaphragm: natural rubber, nylon fabric reinforced (Options -Nitrile, Buna N, EPDM)*
- * Control piping: braided stainless steel
- * Control fittings: brass and 304 stainless steel

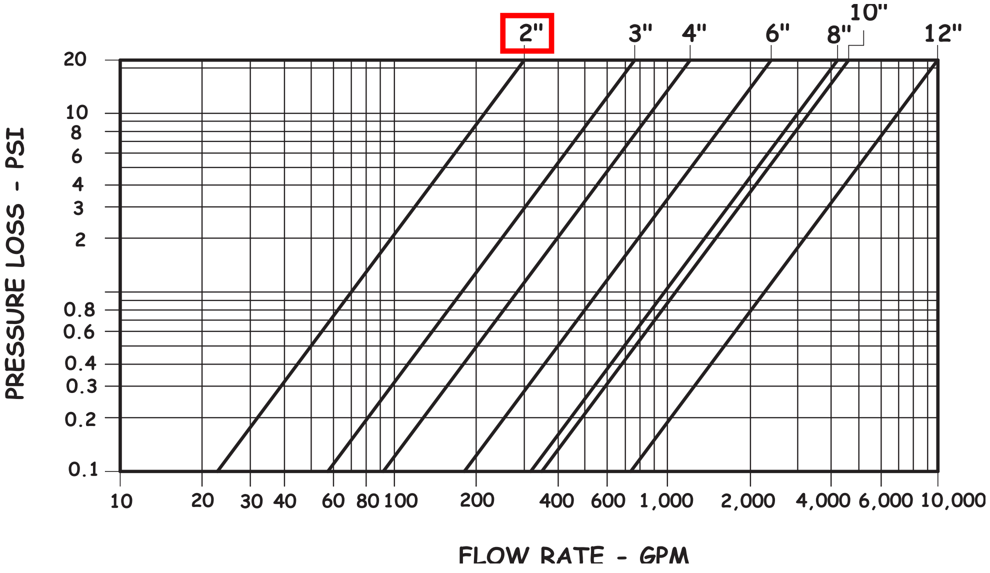
Pressure - Temperature

* Max temperature	100 degrees F
* Max shutoff head	225 PSI
* Pressure ranges	15-150 PSI
150-225 PSI available	
* Max differential pressure	125 PSI
* Min friction loss	14 PSI

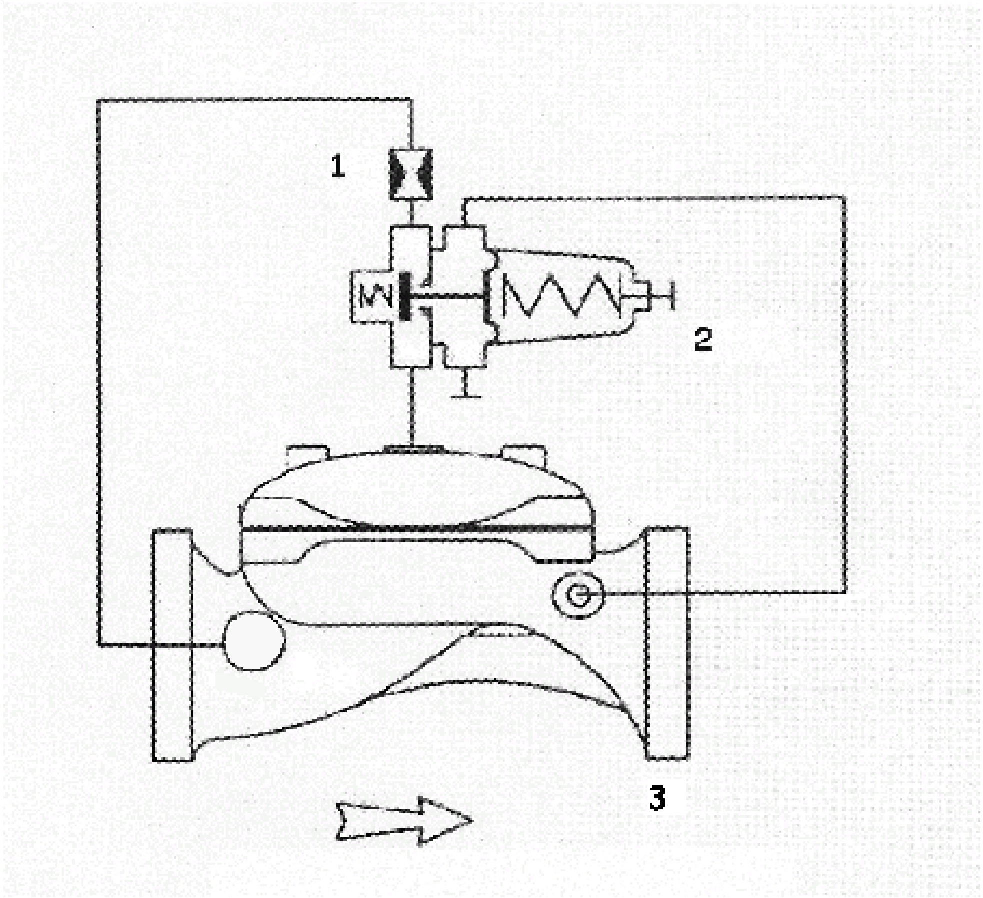
Features
- * Sizes 2”,3” threaded or flanged, 4”,6”,8”, 10” and 12” flanged
- * Flow ranges available between 5-5000 gpm
- * Maintains constant outlet pressure
- * Single chamber diaphragm operated
- * Single one moving part design

Certified NSF ANSI/372 no lead

Size	2"	2"	3"	3"	4"	6"	8"	10"	12"
Type	Threaded	Flanged	Threaded	Flanged	Flanged	Flanged	Flanged	Flanged	Flanged
L	6 7/8	8 1/16	9 13/16	9 13/16	12 5/8	16 5/16	19 11/16	23 13/16	28 1/2
H	4 15/16	6	6 5-16	8 1/16	9 1/2	13 5/16	16 15/16	18 1/8	25
Width	4 3/4	6 1/8	6 7/8	7 7/8	8 3/4	12 3/8	15/ 3/8	15 15/16	22 7/8
R	1 1/2	3 1/16	2 3/16	3 15/16	4 7/16	5 1/2	6 11/16	7 15/16	9 7/16
Weight	18	25	35	45	65	150	309	329	680



-Model- CSV3B
Operating Data

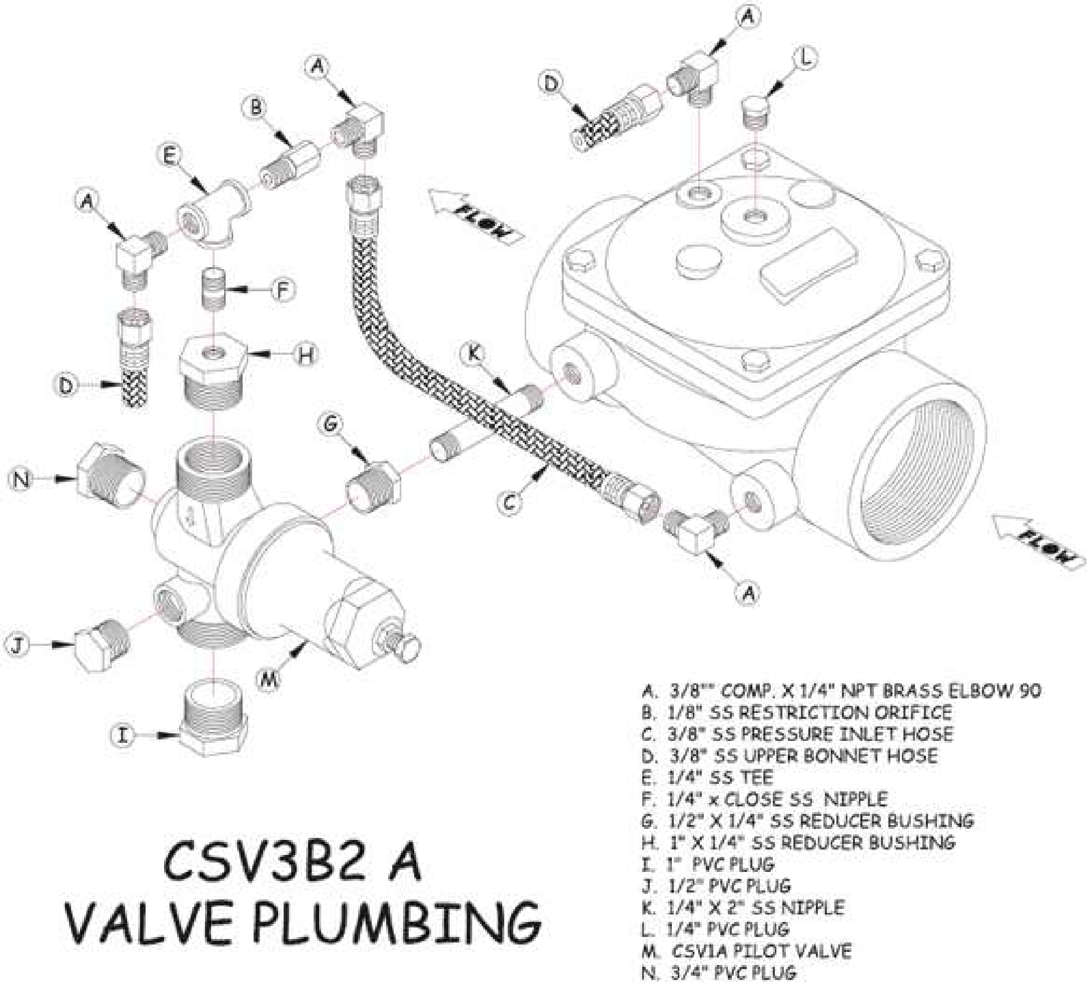


Item#	Basic Components	Qty
1	Orifice	1
2	Pressure Reducing Pilot	1
3	Main Valve Body	1

Description:

The valve maintains a constant downstream pressure regardless of demand or changing upstream pressure. The reducing pilot senses downstream pressure and modulates the main valve to maintain the setpoint. When downstream pressure falls below the setting of the reducing pilot, the pilot opens allowing the main valve to open to increase pressure to the setpoint. When downstream pressure rises above the setting of the reducing pilot, the pilot closes causing the main valve to throttle toward a closed position to maintain the setpoint. When there is no longer any demand on the system, the main body seats to a minimum flow.

CSV3B2TA Parts Breakdown



CSV3B2 A
VALVE PLUMBING

A. 3/8"" COMP. X 1/4" NPT BRASS ELBOW 90
B. 1/8" SS RESTRICTION ORIFICE
C. 3/8" SS PRESSURE INLET HOSE
D. 3/8" SS UPPER BONNET HOSE
E. 1/4" SS TEE
F. 1/4" x CLOSE SS NIPPLE
G. 1/2" X 1/4" SS REDUCER BUSHING
H. 1" X 1/4" SS REDUCER BUSHING
I. 1" PVC PLUG
J. 1/2" PVC PLUG
K. 1/4" X 2" SS NIPPLE
L. 1/4" PVC PLUG
M. CSV1A PILOT VALVE
N. 3/4" PVC PLUG

Cycle Stop Valves®

Constant Pressure Pump Control Valves

Constant Pressure Experts for Over 20 Years!

CSV3B Installation Instructions

NOTE: Submersible motor manufacturers recommend using a flow inducer sleeve to be sure the motor is sufficiently cooled at low flows. Pressure differential across the valve cannot be more than 125 PSI.

Please read all instructions before installation.

1) Be sure that the well has been pumped clean before the valve is installed. It is important that all lines including the pump, be flushed clean of debris. Turn off power to pump and drain system.

2) The valve should be installed horizontally and right side up downstream of the pump before the pressure tank/ pressure switch with all demand downstream of the valve. Four inch and smaller valves can be installed vertically with flow going up, not down. Flow direction is indicated by the arrow on the valve (Note: There cannot be any water outlets between the pump and the valve (ie..gate valve, pressure relief valve, etc. If outlet lines exist between the well and the tank, the valve must be installed at the well head.)

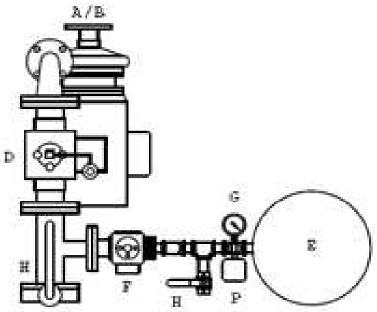
3) We recommend using teflon tape on threaded ends however most thread compounds are acceptable. All connections should be water tight.

4) Pressure tank should be installed downstream of the CSV3B on a tee at a 90 degree angle to the main discharge line . Pressure tank pre-charge should be 5-10 psi lower than the pressure switch start point. A water line at least 8" or longer and no larger than tank inlet size should be used to connect the tank. Pressure switch must be installed on the line going into the tank, as close to base of the tank as possible. (closer to the tank than the main line). Pressure switch should never be installed directly on the main line.

5) For start up, loosen the lock nut on adjusting stem of pilot valve (small valve attached to CSV3B). Make sure adjusting stem is loosened completely by turning counter clockwise until you feel it is no longer making contact with the spring. Set the pressure switch to desired settings. Cut off pressure must be at least 10 PSI higher than the desired valve set pressure (ie..40/60 pressure switch, valve set at 50). Open a small water outlet to turn pump on. It is critical to allow at least 5GPM and not more than 10 GPM out of the system during valve setting procedure (approximately 1 standard 3/4" water hose). Now adjust the CSV3B to desired pressure by turning the adjusting stem on the pilot valve clockwise to increase pressure, and counterclockwise to decrease pressure. When pressure steadies at the desired system pressure, tighten the lock nut on adjusting stem of the pilot valve. Valve setting is complete. (Note: If water hammer occurs on pump start up, you must set valve pressure and cut in pressure the same. For example...40/60 pressure switch, valve set at 40.)

6) Close off the water outlet making sure no water is being demanded. The pressure tank will begin to fill at approximately 5 gpm. As pressure tank slowly fills, pressure in the system will increase until the pressure switch turns the pump off.

Note: In multiple pump applications, never share a CSV with multiple pumps. Each pump must have its own valve.



A) Pump
B) Motor
C) Check valve
D) Cycle Stop Valve
E) Pressure tank
F) Pressure relief valve
G) Pressure gauge
H) Isolation valve
P) Pressure switch
LP) Low Pressure Cut off

Cycle Stop Valves®

Constant Pressure Pump Control Valves

Constant Pressure Experts for Over 20 Years!

CSV3B Troubleshooting

Symptom	**Cause**	**Remedy**
Pump is cycling off and on	Pilot screen is stopped up	Clean screen (2003 or older models)
	Pressure switch is not set correctly	Cut off pressure must be at least 10 psi higher than valve set pressure.
	Valve is not set correctly	Reset valve to at least 10 PSI lower than cut off pressure
	Debri between diaphragm and seat	Clean out valve
	Waterlogged pressure tank	Replace tank
	Bad or torn diaphragm in main valve or pilot valve	Replace damaged diaphragm
Pressure modulates 10-15 PSI from set pressure	Air trapped in mainline-usually occurs on new start ups and spring start ups.	Release air from main line and reset CSV if necessary
Low Pressure	Valve is not set correctly	Reset valve
	Check colored (red on 2", orange on 3" and larger) restriction fitting on pilot for enlarged, missing, or wrong color orifice.	Replace worn orifice or get correct colored orifice.
	Demand is more than pump can provide at desired pressure	Reduce demand so it is within pump capabilities to maintain desired pressure.
Chattering valve	Pressure tank is located too far away from the valve	Relocate valve or tank to bring them closer together or add a second smaller tank to the system close to the valve.
	Too much air pressure in tank	Reduce air pressure in tank to 5-10 PSI below cut in pressure.
	Worn or defective diaphragm	Replace diaphragm

Pump rapid cycles at start up and then begins to function correctly	Pressure switch is located on the main line.	Move pressure switch to a small line at the base of the tank on a line no larger than 1 1/4" in diameter
	CSV setting is too close to cut off pressure	Set pressure switch cut off pressure at least 10 PSI higher than CSV setting
	Air pressure in tank too high	Reduce air pressure in tank to 5-10 PSI below cut in pressure
	Multiple check valves in system working against each other	Remove all but the check valve or foot valve on the pump itself
	Cut in pressure is not the same as CSV set pressure	Set pressure switch to come on at the same pressure the CSV is set to hold
	Air trapped in cover or bonnet	Loosen copper fitting on cover to release trapped air
	More than 125 psi differential between inlet and outlet pressure of valve	Reduce differential pressure or add a second valve

Cycle Stop Valves, Inc.
10221 CR 6900
Lubbock, Texas 79407
Send Email

800-652-0207
Fax: 806-885-1994

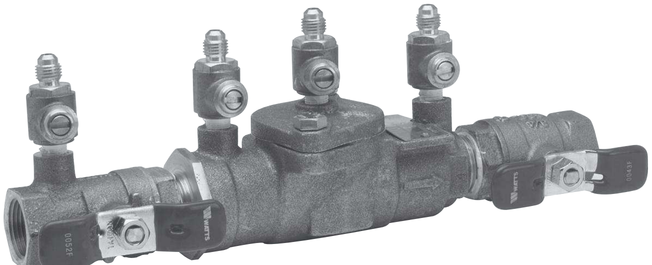
TW-60 Water Treatment System

section 14

Installation, Maintenance, & Repair Series 007 and LF007

Double Check Valve Assemblies

Sizes: ½" – 3" (15 - 80mm)



¾" 007M3QT

⚠ WARNING

Read this Manual BEFORE using this equipment.

Failure to read and follow all safety and use information can result in death, serious personal injury, property damage, or damage to the equipment.

Keep this Manual for future reference.

Local building or plumbing codes may require modifications to the information provided. You are required to consult the local building and plumbing codes prior to installation. If this information is not consistent with local building or plumbing codes, the local codes should be followed.

Need for Periodic Inspection/Maintenance: This product must be tested periodically in compliance with local codes, but at least once per year or more as service conditions warrant. Corrosive water conditions, and/or unauthorized adjustments or repair could render the product ineffective for the service intended. Regular checking and cleaning of the product's internal components helps assure maximum life and proper product function.

NOTICE

For Australia and New Zealand, line strainers should be installed between the upstream shutoff valve and the inlet of the backflow preventer.

Watts product specifications in U.S. customary units and metric are approximate and are provided for reference only. For precise measurements, please contact Watts Technical Service. Watts reserves the right to change or modify product design, construction, specifications, or materials without prior notice and without incurring any obligation to make such changes and modifications on Watts products previously or subsequently sold.

Testing

For field testing procedure, refer to Watts installation sheets IS-TK-DP/DL, IS-TK-9A, IS-TK-99E and IS-TK-99D found on **www.watts.com.**

For other repair kits and service parts, refer to our Backflow Prevention Products Repair Kits & Service Parts price list PL-RP-BPD found on **www.watts.com.**

For technical assistance, contact your local Watts representative.

Installation Instructions

Series 007 and LF007

½" - 2" (15 - 50mm)

Indoors - Figure 1

Check local codes for installation requirements. Pipe lines should be thoroughly flushed to remove foreign material before installing the unit. A strainer should be installed as shown, ahead of backflow preventer to prevent disc from unnecessary fouling. Install valve inline with arrow on valve body pointing in the direction of flow.

For indoor installations, it is important that the valve be easily accessible to facilitate testing and servicing. Do not install in a concealed location.

⚠ CAUTION

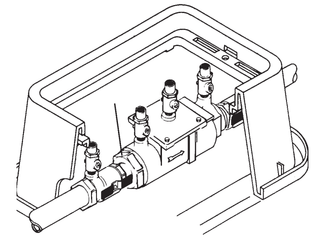
Do not install with strainer when backflow preventer is used on seldom-used water lines which are called upon during emergencies, such as fire sprinkler lines, etc.

It is important that Series 007 and LF007 be tested periodically in compliance with local codes, but at least once a year or more often depending upon system conditions. Regular inspection, testing and cleaning assures maximum life and proper product function.

NOTICE

Fire Protection System Installations

The National Fire Protection Agency (NFPA) Guidelines require a confirming flow test to be conducted whenever a "main line" valve such as the shutoff valves or a backflow assembly have been operated. Certified testers of backflow assemblies must conduct this test. The trim valves of the confirming flow test. When the test is completed, the trim valves must be returned to a fully open position.



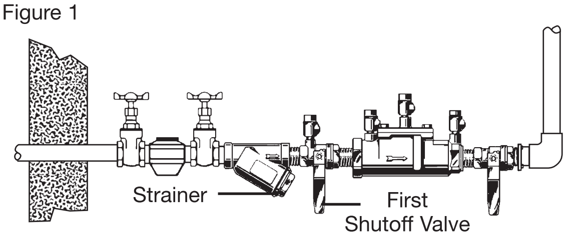
Meter Box Installation

Installation Instructions

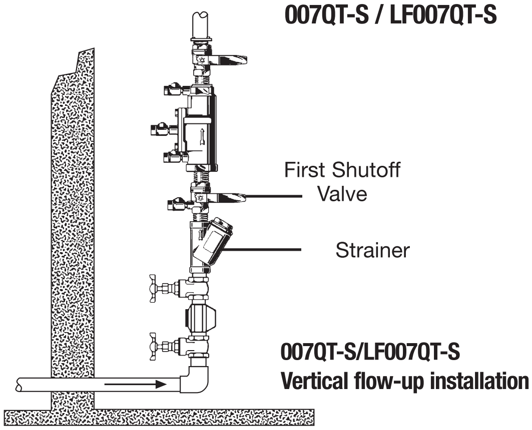
Series 007 and LF007

½" - 2" (15 - 50mm)

Figure 1

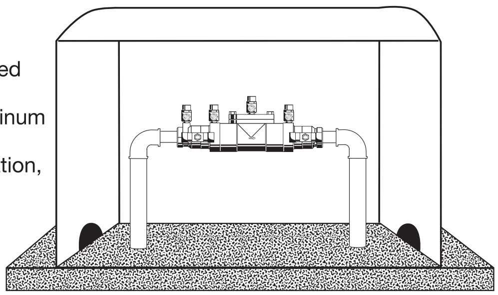


007QT-S / LF007QT-S



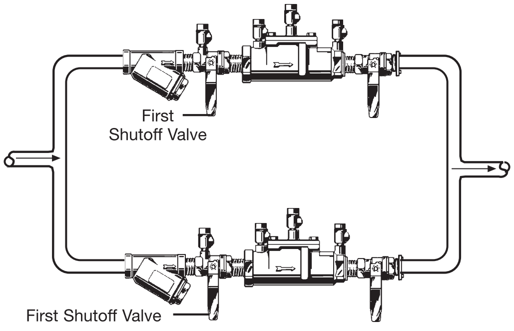
007QT-S/LF007QT-S
Vertical flow-up installation

Figure 2



WattsBox Insulated Enclosure Available in Aluminum or Fiberglass. For more information, send for ES-WB.

Figure 3



007QT-S / LF007QT-S

For repair kits and parts, refer to our Backflow Prevention Products Repair Kits & Service Parts price list PL-RP-BPD found on **www.watts.com.**

Parallel - Figure 3

Two or more Series 007 and LF007 smaller size valves may be piped in parallel (where approved) to serve a larger supply pipe main. This type of installation is employed whenever it is vital to maintain a continuous supply of water/where interruptions for testing and servicing would be unacceptable. It also has the advantage of providing increased capacity where needed beyond that provided by a single valve and permits testing or servicing of an individual valve without shutting down the complete line.

For two valve installations the total capacity of the devices should equal or exceed that required by the system.

The quantity of valves used in parallel should be determined by the engineers judgement based on the operating conditions of a specific installation.

Service and Maintenance

Servicing the First and Second Check Valves

NOTICE

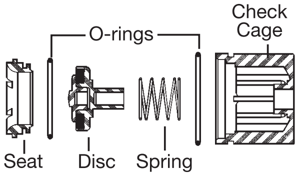
Before servicing, ensure supply water is turned off or shutoff valves are in the closed position.

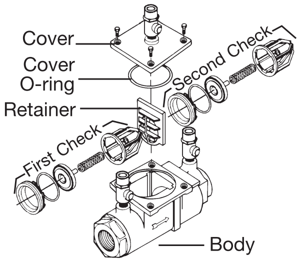
1. Remove the cover, then remove the retainer from the body valve. The check valve modules can now be removed from the valve by hand or with a screwdriver.

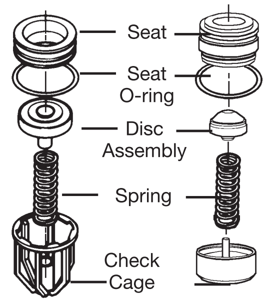
NOTICE

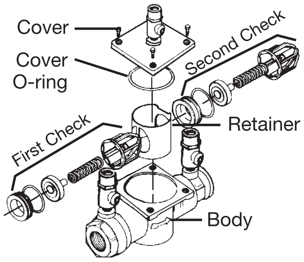
For Series 007 and LF007 sizes ½" - 2" (15-50mm), the seats and springs of the first and second check modules are not interchangeable. The heavier spring and smaller diameter seat belong with the first check module. Series 007M1 sizes ¾" - 1" (20-25mm) and Series 007M2 ¾" (20mm) have interchangeable seats and springs.

2. The check seats are attached to the cage with a bayonet type locking arrangement. Holding the cage in one hand, push the seat inward and rotate clockwise against the cage. For ¾" (20mm) Series 007M2/LF007M2 and LF007 pull apart seat and cage. The seat, cage, spring and disc assembly are now individual components.
3. The disc assembly may now be cleaned and reassembled or, depending on its condition, it may be discarded and replace with a new assembly from the repair kit. O-rings should be cleaned or replaced as necessary.
4. Reassemble the check valve module in the reverse order. Check modules are installed in the valve body with the seats facing the valve inlet. The modules must be securely in place before the retainer can be replaced. On the ¾" - 1" (20-25mm)size, this retainer may have to be tilted slightly into place. Replace cover.









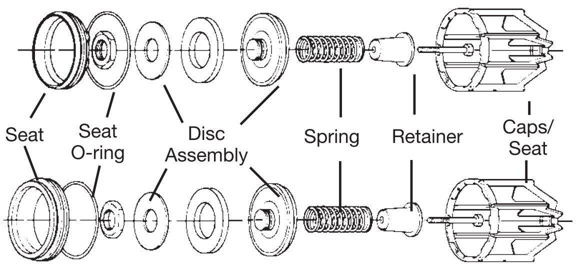
Servicing First and Second Check Valves

Series 007 and LF007

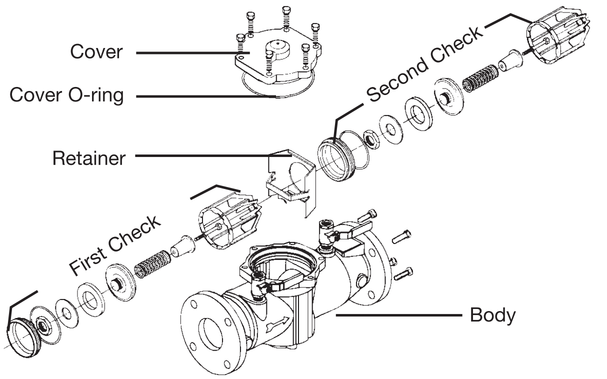
2½" and 3"

1. Remove cover bolts and cover.
2. Remove the retainer from the body bore. The check valve modules can now be removed from the valve by hand or with a screwdriver.
3. The check seats are attached to the cage with a bayonet type locking arrangement. Holding the cage in one hand, push the seat inward and rotate counterclock-wise against the cage. The seat, spring cage, spring and disc assembly are now individual components.
4. The disc assembly may now be cleaned and reassembled or depending on its condition, may be discarded and replaced with a new assembly from the repair kit. O-rings should be cleaned or replaced as necessary. For more information, refer to repair parts price list PL-RP-BPD.
5. Reassemble the Check valve modules. Check modules are installed in the valve body with the seats facing the valve inlet. The modules must be securely in place before the retainer can be replaced.

No special tools required to service Series 007 and LF007.



Check Assemblies



Troubleshooting Guide — Series 007 and LF007

Symptom	Cause	Solution
1. Check valve fails to hold 1.0 PSID minimum	a. Debris on check disc sealing surface	Disassemble and clean
	b. Leaking gate valve	Disassemble and clean or repair
	c. Damaged seat disc or seat o-ring	Disassemble and replace
	d. Damaged guide holding check open	Disassemble and clean or replace
	e. Weak or broken spring	Disassemble and replace spring
2. Chatter during flow conditions	a. Worn, damaged or defective guide	Disassemble and repair or replace guide
3. Low flows passing through mainline valve	a. Mainline check fouled	Disassemble and clean
	b. Meter strainer plugged	Disassemble and clean
	c. Damaged mainline seat disc or seat	Disassemble and replace
	d. Broken mainline spring	Disassemble and replace

For repair kits and parts, refer to our Backflow Prevention Products Repair Kits & Service Parts price list PL-RP-BPD found on **www.watts.com.**

Limited Warranty: Watts Regulator Co. (the "Company") warrants each product to be free from defects in material and workmanship under normal usage for a period of one year from the date of original shipment. In the event of such defects within the warranty period, the Company will, at its option, replace or recondition the product without charge.
THE WARRANTY SET FORTH HEREIN IS GIVEN EXPRESSLY AND IS THE ONLY WARRANTY GIVEN BY THE COMPANY WITH RESPECT TO THE PRODUCT. THE COMPANY MAKES NO OTHER WARRANTIES, EXPRESS OR IMPLIED. THE COMPANY HEREBY SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
The remedy described in the first paragraph of this warranty shall constitute the sole and exclusive remedy for breach of warranty, and the Company shall not be responsible for any incidental, special or consequential damages, including without limitation, lost profits or the cost of repairing or replacing other property which is damaged if this product does not work properly, other costs resulting from labor charges, delays, vandalism, negligence, fouling caused by foreign material, damage from adverse water conditions, chemical, or any other circumstances over which the Company has no control. This warranty shall be invalidated by any abuse, misuse, misapplication, improper installation or improper maintenance or alteration of the product.
Some States do not allow limitations on how long an implied warranty lasts, and some States do not allow the exclusion or limitation of incidental or consequential damages. Therefore the above limitations may not apply to you. This Limited Warranty gives you specific legal rights, and you may have other rights that vary from State to State. You should consult applicable state laws to determine your rights. **SO FAR AS IS CONSISTENT WITH APPLICABLE STATE LAW, ANY IMPLIED WARRANTIES THAT MAY NOT BE DISCLAIMED, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO ONE YEAR FROM THE DATE OF ORIGINAL SHIPMENT.**

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A Watts Water Technologies Company

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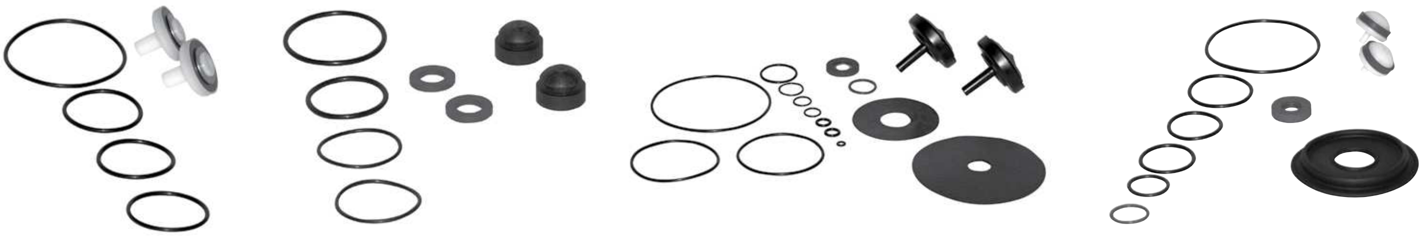
Includes Our **LEAD FREE*** Product Offering.

Watts
2013 Price List

Backflow Prevention Products
Repair Kits & Service Parts



Effective September 4, 2012
(Revised August 31, 2013)

All prices supersede previous issues, are temporary and subject to change without notice.

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*The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.

watts.com

Table of Contents

1 Single & Double Check Valve Assemblies

Series	Size	Page
07F, SS07F	4" – 10"	3
007, LF007	½" – 2"	4
007, LF007, 007DCDA,	2" – 3"	5
709,	¾" – 2"	6
709, LF709	2½" – 10"	7
709DCDA	3" – 10"	8
719, LF719	½" – 2"	9
757, 757DCDA	2½" – 10"	10
757a, 757aDCDA	2½" – 6"	10
770, 770DCDA	4" – 8"	11
772, 772DCDA	4" – 10"	12
773, 773DCDA	4" – 6"	13
774, 774DCDA	2½" – 12"	14
774X, 774XDCDA	6"	14
775	½" – 2"	15
775, 775DCDA	3" – 8"	16
Troubleshooting Guide		17

2 Reduced Pressure Zone Assemblies

Series	Size	Page
009, LF009	¼" – 1"	18
009, LF009	1¼" – 2"	19
009, LF009	¼" – 2"	20
009, LF009	2½" – 3"	21
900	¾" – 2"	22
909, LF909	¾" – 2"	23, 24
909, LF909	2½" – 10"	25, 26
909RPDA	2½" – 10"	27, 28
919, LF919	¼" – 2"	29, 30
957, 957RPDA	2½" – 10"	31, 32
990, 990RPDA	4" – 8"	33, 34
992, 992RPDA	4" – 10"	35, 36
993, 993RPDA	4" – 6"	37, 38
994, 994RPDA	2½" – 10"	39
995	½" – 1½"	40
995, 995RPDA	3" – 6"	41
Troubleshooting Guide		42

3 Vacuum Breakers

Series	Size	Page
008, LF008, 008PC, LF008PC	⅜" – 1"	43
800M, 800CM	½" – ¾"	43
800M4, LF800M4, 800M4FR, LF800M4FR	½" – 2"	44
800M2	½" – 2"	45
800M3	½" – ¾"	45
800	½" – 2"	46

4 Non-Testable Backflow Preventers

Series	Size	Page
9D	½" – ¾"	47
8A, NF8	¾"	47
SD3	¼" – ⅜"	47
9BD	¼" – ⅜"	47
7, LF7	½" – 1¼"	47
N9, LFN9, NLF9, N9-CD, 912HP	¼" – 1"	47
SD2	¼" – ⅜"	47
Governor 80, 80-M1	All	48
188A, 288A, LF288A, 289, LF289, 388ASC, N388, LFN388	¼" – 3"	48

5 Accessories, Auxiliary Equipment

Series	Size	Page
Accessories, Auxiliary Equipment		49
Replacement Shutoff Valves		50
Replacement Gate Valve Packs		50
Replacement Handle Kits		51

Repair Kit Matrix

	Kit Type	Series	Model	Kit Contents	Size
Example:	RK –	909 –	RPDA – M1 –	CK1 –	8"

Kit Type	*Series*	*Model*	*Kit Contents*	*Size*
RK = Repair Kit HK = Handle Kit AK = Accessory Kit UK = Union Kit			B = Bonnet Assembly C = Cover V = Vent or Relief Valve CK = Check or Spring RC = Rubber for Check RV = Rubber for Relief Valve RT = Total Rubber Parts S = Seat M = Metered Bypass L = Less Meter G = GPM C = CFM T = Total (all internal parts) 1 = First Check 2 = Second Check 3 = Both 1st and 2nd Check 4 = Either 1st or 2nd Check SS = Stainless Steel SM = Spring Module HW = Harsh/Hot Water	

Minimum order charge

A $10.00 minimum order charge will apply for an individual parts order.

All prices are temporary and subject to change without notice and supersede all previous prices.

LF007M2QT, 1½"

Series 007, LF007

Double Check Valve Assemblies

Sizes ½" – 2"

Repair Kits

When ordering specify Ordering Code, Kit No., and Valve Size.

Total Repair Kits

	ORDERING CODE	KIT NO.	SIZE	LIST PRICE
LEAD FREE*	0887033	RK 007-T	½"	$66.00
LEAD FREE*	0887724	RK 007M2-T	¾"	46.45
LEAD FREE*	0888554	RK 007M3-T	¾"	44.10
LEAD FREE*	0887027	RK 007-T	¾" - 1"	99.15
LEAD FREE*	0887044	RK 007M1-T	¾" - 1"	95.45
LEAD FREE*	0887723	RK 007M2-T	1¼" - 1½"	183.35
	0887034	RK 007-T	1½" - 2"	194.05
LEAD FREE*	0887192	RK 007M1-T	1½" - 2"	187.05

Kit consists of: first check repair kit, second check repair kit, retainer (if plastic)

Check Kits: 1st or 2nd Check

	ORDERING CODE	KIT NO.	SIZE	LIST PRICE
LEAD FREE*	0887193	RK 007 CK4	½"	$36.70
LEAD FREE*	0887377	RK SS007 CK4	½"	36.70
LEAD FREE*	0887373	RK SS007M1 CK4	1"	53.00
LEAD FREE*	0887026	RK 007M1 CK4	¾" – 1"	53.00

1st Check

	ORDERING CODE	KIT NO.	SIZE	LIST PRICE
LEAD FREE*	0887045	RK 007M2 CK1	¾"	25.80
LEAD FREE*	0888550	RK 007M3 CK1	¾"	24.50
LEAD FREE*	0887393	RK SS007M2 CK1	¾"	25.80
LEAD FREE*	0888070	RK SS007M3 CK1	½" – ¾"	25.80
LEAD FREE*	0887023	RK 007 CK1	¾" – 1"	55.05
	0887025	RK 007 CK1	1½" – 2"	107.80
LEAD FREE*	0887186	RK 007M1 CK1	1½" – 2"	103.95
LEAD FREE*	0887719	RK 007M2 CK1	1¼" – 1½"	101.85

2nd Check

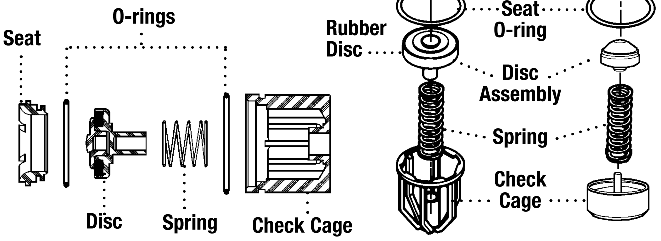
	ORDERING CODE	KIT NO.	SIZE	LIST PRICE
LEAD FREE*	0887046	RK 007M2 CK2	¾"	25.80
LEAD FREE*	0888551	RK 007M3 CK2	¾"	24.50
LEAD FREE*	0888071	RK SS007M3 CK2	½" – ¾"	25.80
LEAD FREE*	0887024	RK 007 CK2	¾" – 1"	55.05
	0887028	RK 007 CK2	1½" – 2"	107.80
LEAD FREE*	0887187	RK 007M1 CK2	1½" – 2"	103.95
LEAD FREE*	0887720	RK 007M2 CK2	1¼" – 1½"	101.85

Stainless Steel 1st or 2nd Check

	ORDERING CODE	KIT NO.	SIZE	LIST PRICE
LEAD FREE*	0887022	RK 007 CK1 SS	¾" – 1"	189.80
LEAD FREE*	0887030	RK 007 CK2 SS	¾" – 1"	189.80
LEAD FREE*	0887032	RK 007M1 CK4 SS	¾" – 1"	182.55
	0887031	RK 007 CK1 SS	1½" – 2"	266.70
	0887035	RK 007 CK2 SS	1½" – 2"	266.70
LEAD FREE*	0887189	RK 007M1 CK1 SS	1½" – 2"	256.55
LEAD FREE*	0887190	RK 007M1 CK2 SS	1½" – 2"	256.55

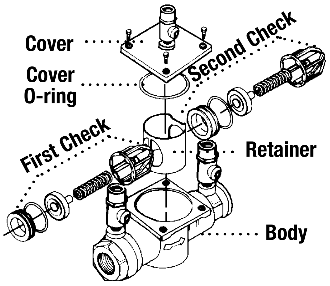
Kit consists of: seat; seat O-ring; disc assembly; spring; check cage; cover O-ring.

¾" 007M3
Check Assembly



Rubber seat disc can be replaced. However, disc holder and disc retainer are permanently bonded to prevent failure.

1¼" – 1½" 007M2



Cover Kit

	ORDERING CODE	KIT NO.	SIZE	LIST PRICE
LEAD FREE*	0887195	RK 007 C	½"	$54.55
LEAD FREE*	0887379	RK SS007 C	½"	155.75
LEAD FREE*	0888073	RK SS007M3 C	½" – ¾"	173.45
LEAD FREE*	0794005	LFRK 007M2/M3-C	¾"	63.74
LEAD FREE*	0887380	RK SS007M2 C	¾"	173.45
LEAD FREE*	0887381	RK SS007M1 C	1"	251.85
LEAD FREE*	0794004	LFRK 007M1 C	¾"– 1"	92.45
LEAD FREE*	0887191	RK 007M1 C	1½" – 2"	136.80
LEAD FREE*	0887722	RK 007M2 C	1¼" – 1½"	120.90

Kit consists of: cover and cover O-ring.

Complete Rubber Parts

	ORDERING CODE	KIT NO.	SIZE	LIST PRICE
LEAD FREE*	0887194	RK 007 RT	½"	$22.30
LEAD FREE*	0887378	RK SS007 RT	½"	22.30
LEAD FREE*	0888072	RK SS007M3 RT	½" – ¾"	22.30
LEAD FREE*	0887394	RK SS007M2 RT	¾"	22.30
LEAD FREE*	0887043	RK 007M2 RT	¾"	22.30
LEAD FREE*	0888552	RK 007M3 RT	¾"	21.25
LEAD FREE*	0887374	RK SS007M1 RT	1"	22.30
LEAD FREE*	0887040	RK 007 RT	¾" – 1"	23.05
LEAD FREE*	0887042	RK 007M1 RT	¾" – 1"	22.30
	0887041	RK 007 RT	1½" – 2"	69.15
LEAD FREE*	0887188	RK 007M1 RT	1½" – 2"	31.10
LEAD FREE*	0887721	RK 007M2 RT	1¼" – 1½"	31.10

Kit consists of: cover O-ring; 2 disc assemblies and 2 seat O-rings.

*The wetted surface of this product contacted by consumable water contains less than 0.25% of lead by weight.

TW-60 Water Treatment System

section 15