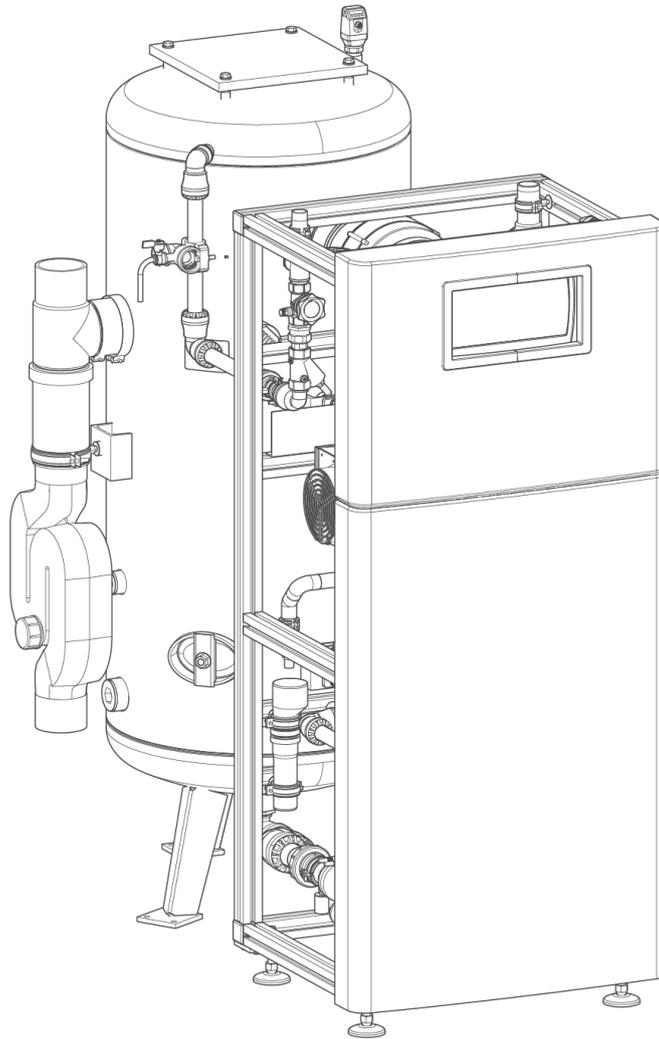


We understand water.



Oxidation filter system | fermalIQ:MA

Operation manual

grünbeck

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1 Introduction

This manual is intended for owners/operating companies, operators/users as well as qualified specialists and ensures the safe and efficient handling of the product. The manual is an integral part of the product.

- ▶ Carefully read this manual and the included manuals on the components before you operate your product.
- ▶ Obey all safety and handling instructions.
- ▶ Keep this manual and all other applicable documents, so that they are available when needed.

Illustrations in this manual are for basic understanding and can differ from the actual design.

1.1 Validity of the manual

This manual applies to the products below:

- fermaliQ:MA2000
- fermaliQ:MA3000
- fermaliQ:MA5000
- fermaliQ:MA10000
- Special designs that essentially correspond to the standard products given above. For information on changes, please refer to the respective information sheet that is enclosed, if applicable.

1.2 Other applicable documents

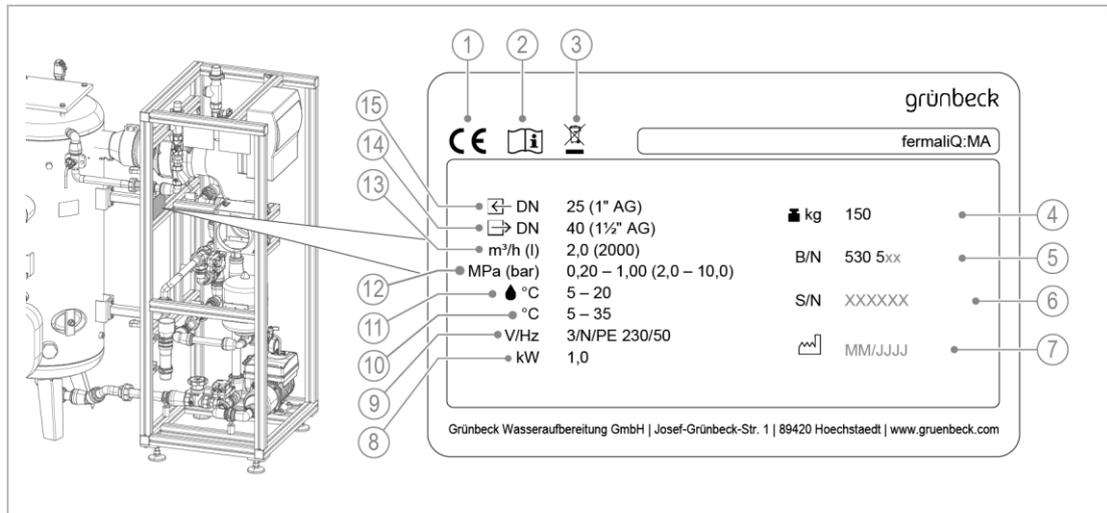
- Electrical circuit diagram, drawing no.: 530547E00R01
- The manuals of all accessories used.

1.3 Product identification

You can identify your product based on the product designation and the order no. indicated on the type plate.

- ▶ Check whether the products indicated in chapter 1.1 correspond to your product.

The type plate is located on the system rack.



Designation	
1	CE mark
2	Obey the operation manual
3	Disposal information
4	Empty weight (rack + filter tank)
5	Order no.
6	Serial no.
7	Date of manufacture
8	Connected load

Designation	
9	Power supply
10	Ambient temperature
11	Water temperature
12	Operating pressure
13	Flow volume
14	Nominal connection diameter of filtrate outlet
15	Nominal connection diameter of raw water inlet

1.4 Symbols used

Symbol	Meaning
	Danger and risk
	Important information or requirement
	Useful information or tip
	Written documentation required

Symbol	Meaning
	Reference to further documents
	Work that must be carried out by qualified specialists only
	Work that must be carried out by qualified electricians only
	Work that must be carried out by technical service personnel only

1.5 Depiction of warnings

This manual contains information and instructions that you must obey for your personal safety. The information and instructions are highlighted by a warning symbol and are structured as shown below:



SIGNAL WORD Type and source of hazard

- Possible consequences
- ▶ Preventive measures

The following signal words are defined subject to the degree of danger and might be used in the present document:

Warning symbol and signal word	Consequences if the information/instructions are ignored	
 DANGER		Death or serious injuries
 WARNING	Personal injury	Possible death or serious injuries
 CAUTION		Possible moderate or minor injuries
NOTE	Damage to property	Possible damage to components, the product and/or its functions, or an object in its vicinity

1.6 Demands on personnel

During the individual phases in the service life of the system, different persons carry out work on the system. This work requires different qualifications.

1.6.1 Qualification of personnel

Personnel	Requirements
Operator/user	<ul style="list-style-type: none"> No special expertise required Knowledge of the tasks assigned Knowledge of possible dangers in case of incorrect behaviour Knowledge of the required protective equipment and protective measures Knowledge of residual risks
Owner/operating company	<ul style="list-style-type: none"> Product-specific expertise Statutory regulations on work safety and accident prevention
Qualified specialist <ul style="list-style-type: none"> Electrical engineering Sanitary engineering (HVAC and plumbing) Transport 	<ul style="list-style-type: none"> Professional training Knowledge of relevant standards and regulations Knowledge of detection and prevention of possible dangers Knowledge of statutory regulations on accident prevention
Technical service (Grünbeck's technical service/ authorised service company)	<ul style="list-style-type: none"> Extended product-specific expertise Trained by Grünbeck

1.6.2 Authorisations of personnel

The table below describes which tasks must be carried out by whom.

	Operator/ user	Owner/ operating company	Qualified specialist	Technical service
Transport and storage			X	X
Installation and mounting			X	X
Start-up/Commissioning			X	X
Operation and handling	X	X	X	X
Cleaning		X	X	X
Inspection	X	X	X	X
Maintenance annually				X
Troubleshooting		X	X	X
Repair			X	X
Decommissioning and restart/recommissioning				X
Dismantling and disposal			X	X

1.6.3 Personal protective equipment

- ▶ As an owner/operating company, make sure that the required personal protective equipment is available.

The components below fall under the heading of personal protective equipment (PPE):



Protective gloves



Protective footwear

2 Safety

2.1 Safety measures

- Only operate your product if all components are installed properly.
- Obey the local regulations on drinking water protection, accident prevention and occupational safety.
- Do not make any changes, alterations, extensions or program changes on your product.
- Keep the premises locked against unauthorised access to protect imperilled or untrained groups of persons from residual risks.
- Lay pipes and cable trays away from traffic routes, escape/rescue routes and accesses to the system.
- Comply with the maintenance intervals (refer to chapter 8.2). Failure to comply can result in the microbiological contamination of your water system.

2.1.1 Mechanical hazards

- You must never remove, bridge, or otherwise tamper with safety equipment.
- For all work on the system that cannot be carried out from the ground, use stable, safe and self-standing access aids (e.g. stepladders).
- Make sure that the system is set up in a way that it cannot tip over and that the stability of the system is guaranteed at all times.

2.1.2 Pressure-related hazards

- Components can be under pressure. There is a risk of personal injury and damage to property due to escaping water and/or compressed air as well as unexpected movement of components. Check the system's pressure lines at regular intervals.
- Before starting repair and maintenance work, make sure that all affected components are depressurised.

2.1.3 Electrical hazards

In case of contact with live components, there is an immediate risk of death due to electric shock. Damage to the insulation or individual components can be life-threatening.

- Only have qualified electricians carry out electrical work on the system.
- If live components are damaged, immediately switch off the power supply. Arrange for repair.
- Switch off the supply voltage before working on electrical system parts. Discharge residual voltage.

- Never bridge electrical fuses. Do not disable fuses. Use the correct current ratings when replacing fuses.
- Keep moisture away from live parts. Moisture can cause short-circuits.

2.1.4 Danger due to chemicals

- Chemicals can be hazardous to health and environment. They can cause skin and eye burns as well as irritation of the respiratory tract or allergic reactions.
- Avoid any skin/eye contact with chemicals.
- Use personal protective equipment.
- Read the safety data sheet before handling chemicals. Always obey the instructions for different activities/situations.
- Current safety data sheets for chemicals are available for download at **www.gruenbeck.de/en/info-centre/safety-data-sheets**.
- Obey in-house instructions when handling chemicals. Make sure that protective and emergency equipment such as emergency showers and eyewash are available where required, and functional.

Mixing and residual amounts of chemicals

- Do not mix different chemicals. Unforeseeable chemical reactions posing a lethal danger can occur.
- Dispose of residual amounts of chemicals in accordance with local regulations and/or internal instructions.
- Residual amounts from used containers should not be transferred into containers with fresh chemicals in order not to impair the effectiveness of the chemicals.

Labelling/Minimum shelf life/Storage of chemicals

- Check the labelling of the chemicals - labels must not be removed or rendered illegible.
- Do not use any unknown chemicals (no labelling or labelling illegible).
- Obey the use-by date (minimum shelf life) stated on the label to ensure the functionality of the system and the quality of the treated water.
- If stored incorrectly, chemicals could change their state of matter, crystallise, out-gas, or lose their effectiveness. Store and use the chemicals at the specified temperatures only.

Cleaning/Disposal

- Immediately absorb spilled chemicals with suitable binding agents.
- Collect and dispose of chemicals in such a way that they cannot pose a risk to people, animals, or the environment.

2.1.5 Persons in need of protection

- Children must not play with the product.
- This product is not designed to be used by persons (including children) with reduced capabilities, lack of experience or lack of knowledge. Unless they are supervised, have been instructed on the safe use of the product and understand the resulting hazards.
- Children must be supervised to make sure that they do not play with the product.
- Cleaning and maintenance must not be carried out by children.

2.2 Product-specific safety instructions

Diaphragm expansion tanks operate with a nitrogen cushion and are subject to the Pressure Equipment Directive 97/23/EC.

- In the event of leaks, there is a risk of nitrogen escaping.
- ▶ Check the diaphragm expansion tank for leaks at regular intervals (refer to chapter 8.4.2).

2.2.1 Signals and warning signs

Warnings/pictograms	
	<p>Danger of electric shock (attached to the switch box)</p> <ul style="list-style-type: none"> ▶ Disconnect the system from the power supply before working on electrical system parts.
	<p>Warning label (attached to the tank)</p> <ul style="list-style-type: none"> ▶ Keep the lid of the filter tank closed during operation.



The affixed information and pictograms must be clearly legible. They must not be removed, soiled or painted over.

- ▶ Obey all warnings and safety instructions.
- ▶ Immediately replace illegible or damaged symbols and pictograms.

2.2.2 Availability of drinking water.

According to DIN 2001-1, the following prerequisites apply to the availability of drinking water:

- When supplied from small units, drinking water must be available at the withdrawal point at all times, in the required quality and sufficient quantity as well as with enough pressure.
- In the event the supply is interrupted, remedial action to eliminate the malfunction must be taken without delay.
- For small units that supply drinking water to third parties or that are used in the scope of commercial or public activities, the owner/operating company must draw up an action plan in accordance with the German Drinking Water Ordinance.
- ▶ As the owner/operating company, draw up an action plan in accordance with the German Drinking Water Ordinance which contains, for example, information on how to change to another supply in the event of an emergency or malfunction.

2.3 Conduct in emergencies

2.3.1 In case of escaping water

1. De-energise the device – pull the mains plug.
2. Locate the leak.
3. Eliminate the cause of the water leak.

2.3.2 System failure

Emergency bypass for emergency supply

- In case of a failure of the treatment system, raw water can be used for fire-fighting purposes and for flushing the toilets (refer to chapter 7.6).
- The emergency bypass must not be used for the supply of drinking water under any circumstances.

3 Product description

By a combination of raw water atomisation, aeration and multi-layer filtration, the substances below are fully automatically reduced in the oxidation filter system fermaliQ:MA:

- Iron
- Manganese
- Ammonium
- Solid particles
- Turbidities
- Unpleasant odours (e.g. hydrogen sulphide)

An additional effect of the treatment is a moderate deacidification of the raw water.

3.1 Intended use

The system is designed for the treatment of well and spring water.



The oxidation filter system fermaliQ:MA only is the first treatment step in the drinking water supply as per DIN 2001-1.

For complete and safe production of drinking water, the filtration stage must always be followed by a disinfection stage (e.g. UV disinfection).

3.1.1 Application limits

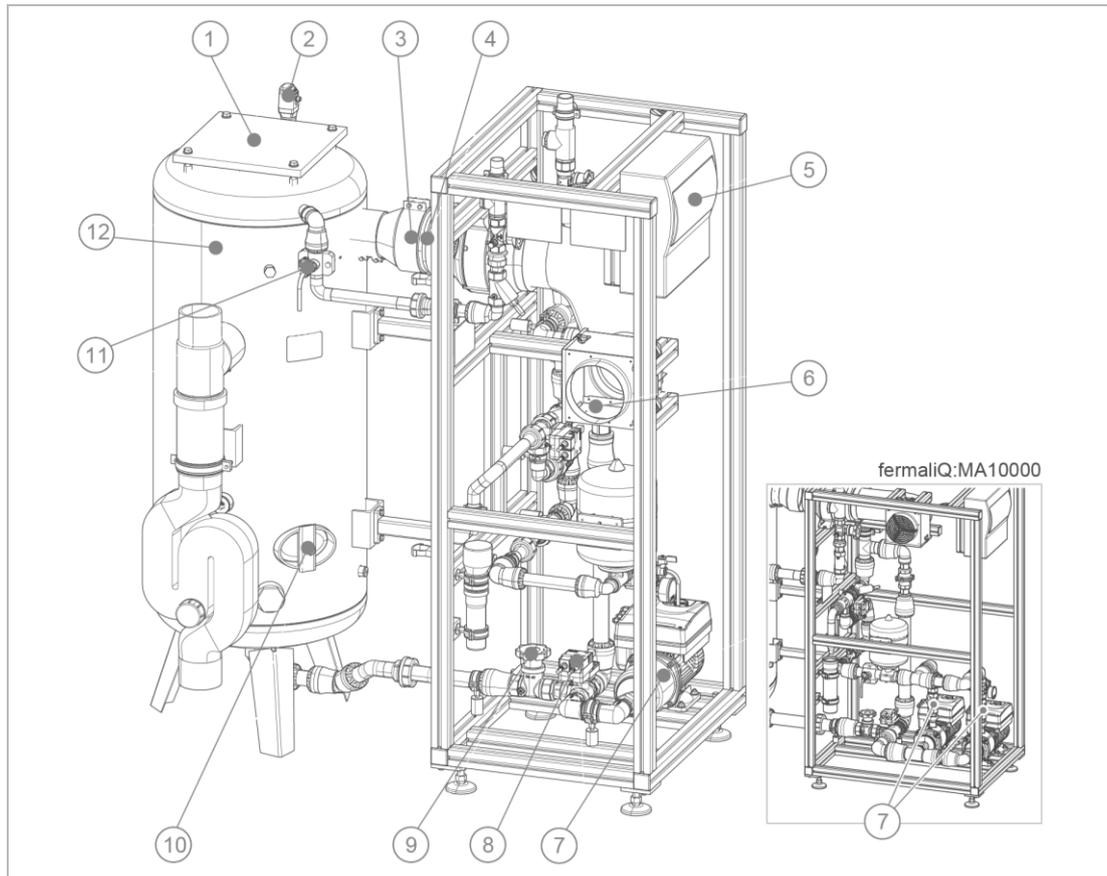
The following application limits must not be exceeded/undershot.

Application limits		
Manganese	mg/l	≤ 1.0
Iron	mg/l	≤ 15.0
pH range		6.5 – 8.5
Ammonium	mg/l	≤ 3.0

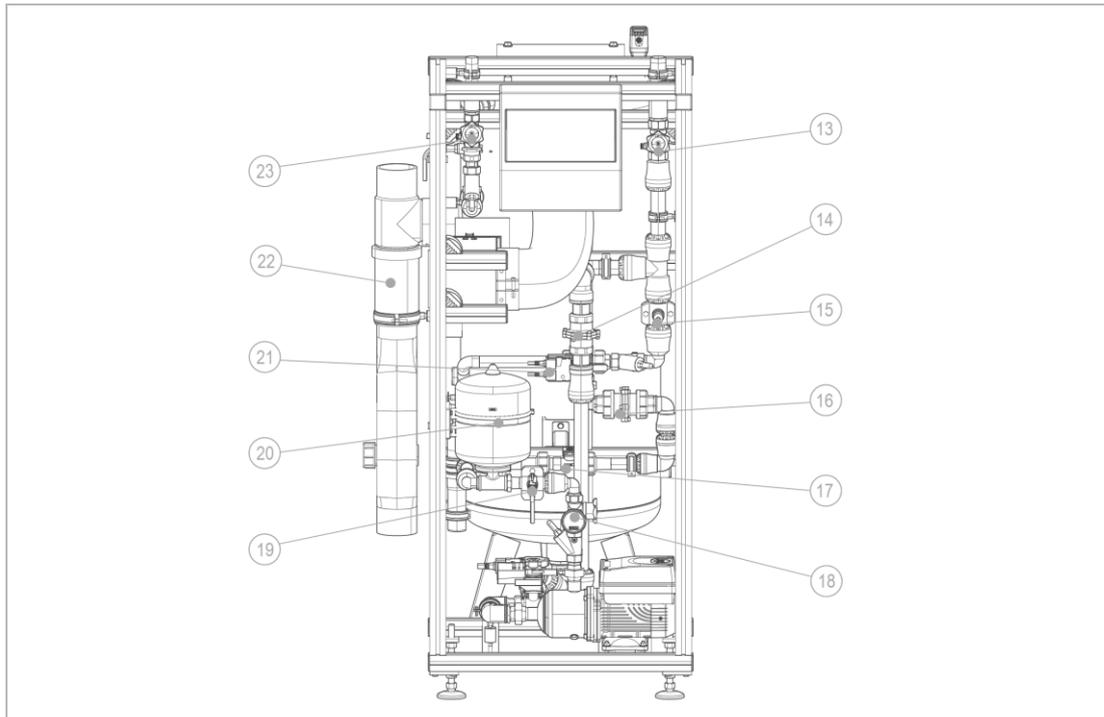
3.1.2 Foreseeable misuse

- Using the system for complete drinking water treatment.

3.2 Product components

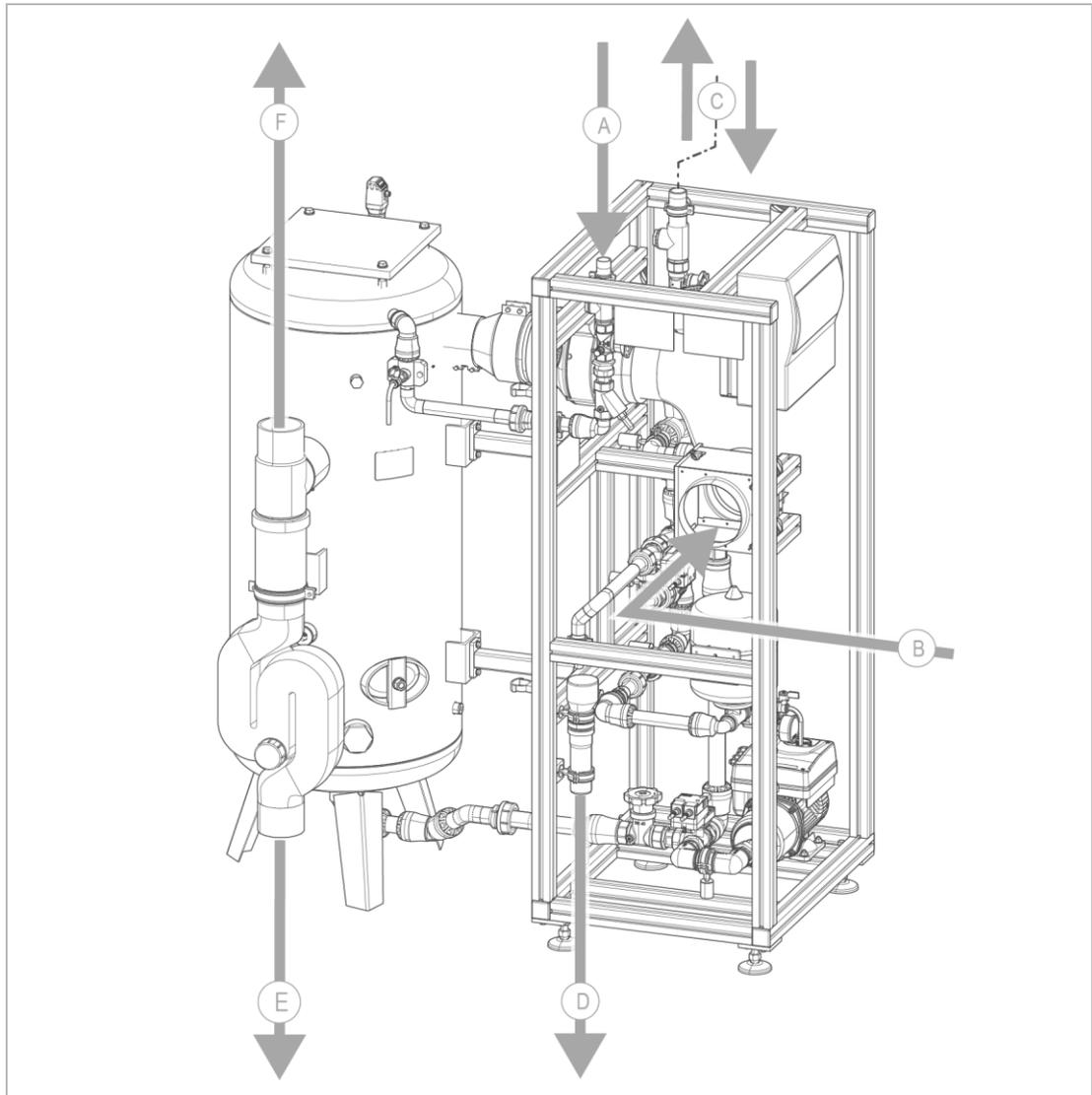


Designation	Function	Coding
1 Lid	Closure of filter tank	-
2 Level probe	Level 1: Filling & aeration OFF Level 2: Filling & aeration ON Level 3: Dry-run protection of filtrate pump	1MSF1CL01
3 Pipe fan	Supply of atmospheric oxygen to oxidate iron and manganese Switch-off delay to outgas moist exhaust air	1MSF1AP03
4 Air backflow flap	Moist air in the filter tank is retained and does not penetrate into the installation room.	-
5 Switch box with operating unit	Control of the filter system	1MSF1AE01
6 Air filter box	Contains a particle filter to filter the intake supply air	1MSF1AF01
7 Filtrate pump	To perform the filtration and the discharge of first filtrate	1MSF1AP02
	<i>For fermaIiQ:MA10000:</i> 2 x Filtrate pump	1MSF1BP02
8 Filtration/backwash shut-off valve	Automatic 3-way ball valve to control filtration and backwash	1MSF1AV01
9 Tank shut-off valve	Piston valve to separate the filter tank from the rack with the technical equipment	1MSF1AH03
10 Handhole	Enables lateral access into the filter tank for maintenance work	-
11 Raw water sampling valve	Flame-sterilisable sampling vale to withdraw water samples	1MSF1AH51
12 Filter tank	Tank including fixtures and filter materials	1MSF1AB01



Designation	Function	Coding
13 Filtrate shut-off valve	Piston valve to separate the filtrate pipe from the interface supplied by the client on site	1MSF1AH05
14 Flow stabiliser Backwash	Setting the backwash volume flow	1MSF1AS05
15 Pressure switch	Backwash monitoring Required minimum pressure (adjustable: 0.1 – 1.0 bar) must be reached during backwash	1MSF1ACP03
16 Flow stabiliser Filtration	Setting of filtrate volume flow	1MSF1AS04
17 Flow sensor	Indication of actual flow rate in the display of the control unit and archiving of total flow	1MSF1ACF01
18 Filtrate pressure gauge	Indication of filtration pressure	1MSF1ACP02
19 Filtrate sampling valve	Flame-sterilisable sampling valve to withdraw water samples	1MSF1AH52
20 Diaphragm expansion tank	To absorb water hammer Autonomous switch-off of filtrate pump (no interference from client on site) Protection of the filtrate pump against frequent switching changes	1MSF1AB02
21 Shut-off valve Filtration/discharge of first filtrate	Automatic 3-way ball valve to switch filtration and discharge of first filtrate	1MSF1AV02
22 Overflow loop	Discharge of backwash water to drain and upward discharge of exhaust air	-
23 Raw water shut-off valve	Piston valve to separate the raw water pipe from the interface supplied by the client on site	1MSF1AH01

3.3 Connections



Inlet

Designation

- A Raw water inlet
- B Supply air
- C Backwash water inlet

Outlet

Designation

- C Filtrate outlet
- D Discharge of first filtrate to drain
- E Backwash water to drain
- F Exhaust air

3.4 Functional description

The filter system is operated in 4 steps.

- Filling and aeration
- Filtration
- Backwash
- Discharge of first filtrate

3.4.1 Filling and aeration

- The raw water is delivered into the filter tank by the raw water pump provided by the client on site.
- Afterwards the raw water is atomised (increase of the water's surface to optimise the oxidation process).
- At the same time, ambient air is introduced into the upper part of the tank by means of a pipe fan (increase of oxygen supply for improved oxidation of iron/manganese and for outgassing odorous substances).
- The raw water pump and the pipe fan are switched on and off by the level control in the filter tank.
- The pipe fan switches off time-delayed to outgas the moist exhaust air generated by the atomisation process from the filter tank.
 - » Oxygenated raw water is located in the filter tank.

3.4.2 Filtration

- The raw water contained in the filter tank is drawn off through the various filter layers and the star-shaped nozzle assembly.
 - » Filtrate was generated.
- A pressure booster system delivers the filtrate to a pressurised water tank provided by the client on site or a diaphragm expansion tank provided by the client on site. This on-site tank on the one hand serves as buffer tank to meet short-term peak consumption and on the other hand, the filtrate volume stored in it is used to backwash the filter tank.
- Via a frequency converter, the filtrate pump is controlled to an adjustable constant pressure. When this pressure is reached permanently (e.g. when all withdrawal points of the consumer are closed), the pump is switched off.
 - » Filtrate is available.

3.4.3 Backwash

- The energy stored in pressure cushion of the tank provided by the client on site is used to deliver the filtrate located there into the filter tank.
 - The uniform distribution of the backwash water in the filter tank is ensured by the star-shaped nozzle assembly and the support layer consisting of quartz gravel.
 - During the backwash process, the filter material is loosened and the substances that have been deposited on the surface of the filter material during filtration are removed. Via the overflow funnel, the substances are then flushed to the drain.
 - A backwash process is triggered when a certain fixed time (weekday and time) has been reached. The duration and time of the work step can be preset.
 - For hygiene reasons, a backwash takes place at least once a day.
 - An automatic backwash monitoring system with backwash counter checks whether the backwash has taken place. Backwash processes that have not been completed properly are detected by the control unit. When a preset counter value (e.g. 3) is reached, an error signal and a visual signal on the display of the control unit indicate an error.
- » The filter tank was backwashed.

3.4.4 Discharge of first filtrate

- The first filtrate is always discharged fully automatically after a backwash process.
 - The discharge of first filtrate corresponds to filtration into the waste water drain with corresponding filtration volume flow.
 - The duration of this work step can be preset.
 - This process is designed to compress the filter material and to prevent particles/turbidities from entering into the filtrate.
- » Backwash and discharge of first filtrate were carried out.
- » Filling & aeration as well as filtration are continued.

3.5 Accessories

Your product can be retrofitted with accessories. Please contact your local Grünbeck representative or Grünbeck's headquarters in Hoechstaedt/Germany for details.

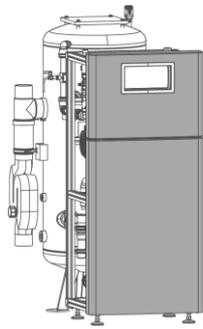
Product	Order no.
 <p>Diaphragm expansion tank DD 33, G^{3/4} To prevent water hammer in the inlet if a compressed-air chamber provided by the client on site is used to store the filtrate.</p>	33 l 890 60 304
 <p>Diaphragm expansion tank In addition to an existing diaphragm expansion tank or for new installations as water supply during the flushing process of the filter system</p>	25 l 535 105
	60 l 535 115
	80 l 535 125
	100 l 535 135
	300 l 535 155
	500 l 535 165
 <p>Pressurised water tank, 6 bar In addition to an existing pressurised water tank or for new installations as water supply during the flushing process of the filter system</p>	150 l 530 505
	300 l 530 515
	500 l 530 525
	750 l 530 535
	1000 l 530 545
<p>Water test kit for iron Measuring range 0 – 0.8 mg/l and 1 – 10 mg/l (30 determinations)</p>	170 150
<p>Water test kit for manganese Measuring range 0.03 – 0.5 mg/l (100 determinations)</p>	170 097
<p>Refill pack of reagents for water test kit for manganese</p>	170 193
<p>Water test kit for pH value Measuring range 4.5 – 10 (100 test strips)</p>	170 148

3.6 Optional accessories



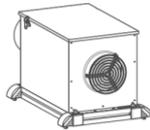
Your product can be retrofitted with additional accessories. Please contact your local Grünbeck representative or Grünbeck's headquarters in Hoechstaedt/Germany for details.

Product		Order no.
---------	--	-----------



Front cover of fermaliQ:MA

530 508



Fine dust filtration for fermaliQ:MA

53080000000

4 Transport, placing and storage

4.1 Shipping/Delivery/Packaging

The system (system rack and filter tank) is fixed on a pallet each at the factory and secured against tipping.

- The system rack is transported standing up and has a low centre of gravity.
- The filter tank is transported in a horizontal position and has a low centre of gravity.
- ▶ Load and unload the system with a forklift or lift truck with suitable pallet forks. Mind the system's centre of gravity.

NOTE

Damage to the system when lifted by crane and lifting strap



- The system does not feature any lifting points for lifting by a crane and lifting strap.
- ▶ The system must not be loaded/unloaded by crane and lifting strap.
- ▶ Dispose of the packaging material in an environmentally sound and appropriate manner only after installation of the system.

4.2 Transport/Placing



WARNING

Risk of tipping over in case of improper transport

- The system can tip and crush persons/limbs.
- ▶ Transport the system by means of a forklift or lift truck with appropriate forks only – mind the marked pick-up direction.
- ▶ Do not transport the system over inclines or stairs.

Transporting the system rack

The system rack is fixed on a pallet at the factory and secured against tipping.

- The system rack is transported standing up.
- The system rack does not feature any lifting points for lifting with lifting gear. The system must not be loaded/unloaded by crane.
- ▶ Only transport the system rack to the installation site (longer distances) when secured on the pallet.
- ▶ Transport the unpacked system (without pallet) in close vicinity of the final installation site only – do not lift it at the system rack.
- ▶ Remove the transport lock, if present.

Transporting the filter tank

The filter tank is fixed on a pallet at the factory and secured against tipping/rolling off.

- The filter tank is transported in a horizontal position.
- ▶ Only transport the filter tank to the installation site (longer distances) when secured on the pallet.
- ▶ Install the level probe (refer to chapter 5.4).
- ▶ Erect the filter tank at the installation site using a suitable lifting device.
- ▶ Use the lugs on the filter tank to lift it.

4.3 Storage

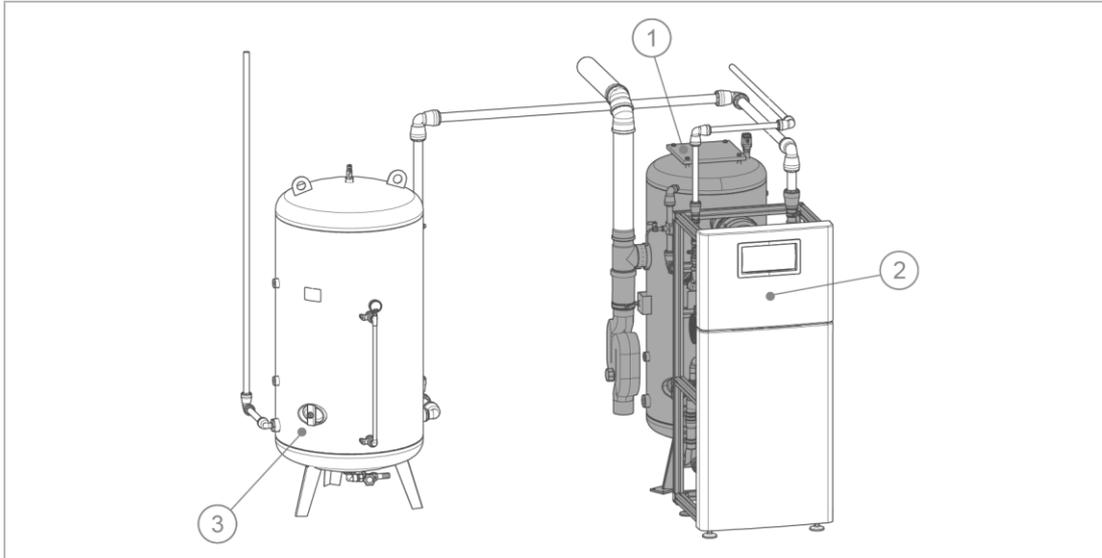
- ▶ Protect the product from the impacts below when storing it:
 - Moisture, wetness
 - Environmental impacts such as wind, rain, snow, etc.
 - Frost, direct sunlight, severe heat exposure
 - Chemicals, dyes, solvents and their vapours
- ▶ Do not stack the individual devices on top of each other and do not place any loads on the product packaging of the system.

5 Installation



The installation of the system represents a major intervention into the water system and must be carried out by a qualified specialist only.

Installation example



Designation

- | | |
|---|---|
| 1 | Oxidation filter system fermaliQ:MA3000 |
| 2 | Front cover of fermaliQ:MA (option) |

Designation

- | | |
|---|--------------------------------------|
| 3 | Pressurised water tank (supply tank) |
|---|--------------------------------------|



CAUTION Laying cable trays/pipes on traffic routes.

- Persons can stumble/fall.
- ▶ Do not lay pipes and cable trays in traffic routes or accesses to the system components.
- ▶ Make sure that necessary traffic routes and escape routes are kept clear.

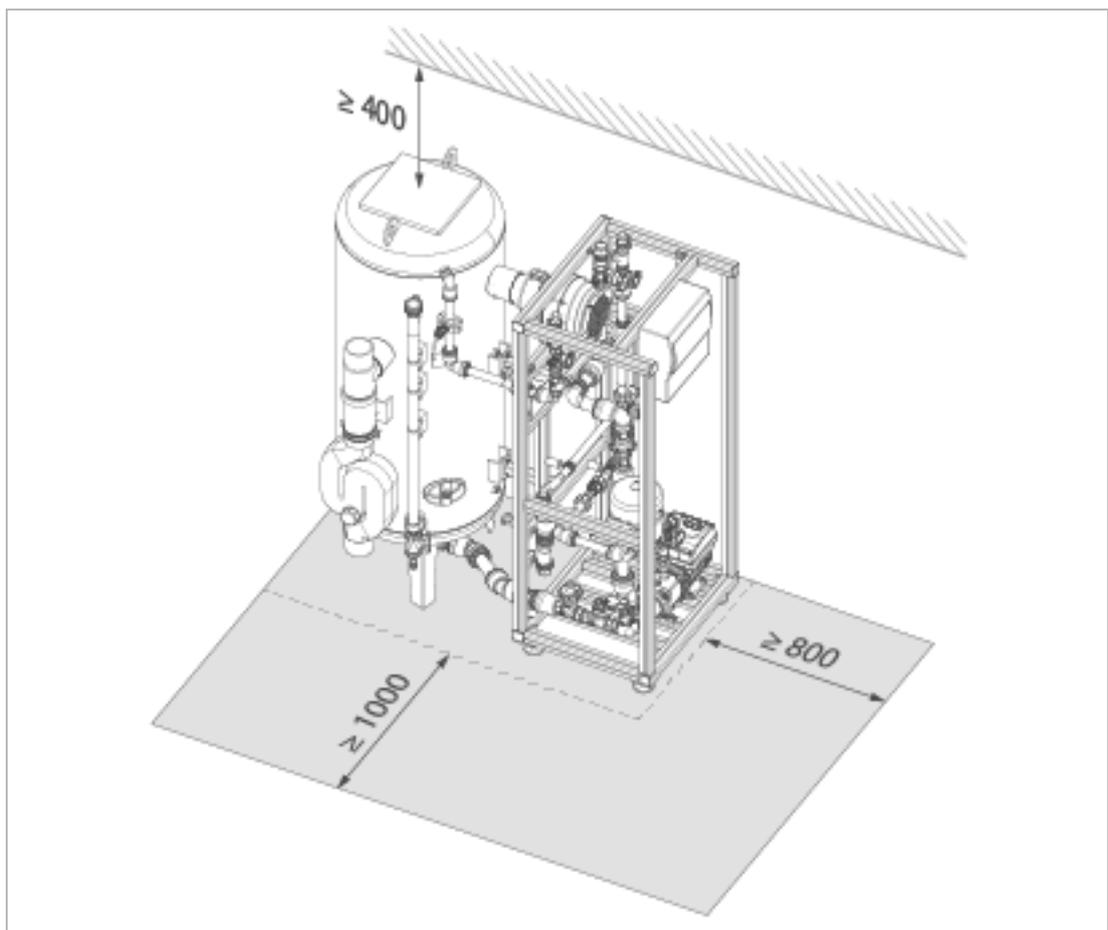
5.1 Requirements for the installation site

- ▶ Obey local installation directives, general guidelines and technical specifications.
- The installation site must be frost-proof and ensure the system's protection from chemicals, dyes, solvents and their vapours as well as from unauthorised access, etc.
- Avoid strong heat radiation and direct sunlight.
- A Schuko socket is required within a distance of approx. 2 m of the system. The socket outlet requires a permanent power supply and must not be coupled with light switches, emergency heating switches or the like.
- The installation site must be adequately illuminated and ventilated.

- Unimpeded and prompt placing of the system must be possible.
- Disturbing influences and restrictions on site must be indicated in advance and taken into account in the design of the system.
- A drain connection of adequate dimensions (DN 100) must be present.
- A floor drain suitable for the respective system size must be available at the installation site. If no floor drain is available, the client must install a backwash water tank including waste water lifting system on site.
- Lifting systems must be secured against power failure.

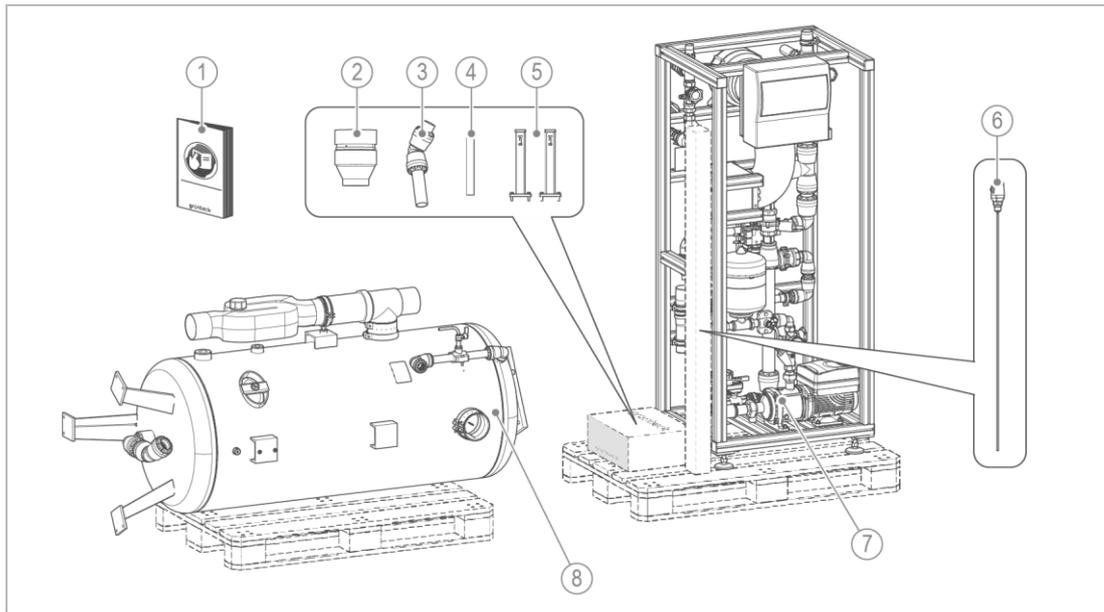
5.1.1 Placing of the system/Required space

- The sufficiently dimensioned installation surface of the system (foundation) must be level and have sufficient strength and load-bearing capacity to support the operating weight of the system.
- The system must be accessible for maintenance and repair work.
- ▶ Before setting up the individual systems, check that there is sufficient working space.



- ▶ Set up the system in a way that there is a working space of at least 800 mm on the front side (switch cabinet) and at least 1000 mm on the left side (to the left of the switch cabinet) of the system.
- In addition, a distance of at least 400 mm must be kept to the ceiling.

5.2 Checking the scope of supply



Designation

- 1 Operation manual
- 2 Non-return flap of pipe fan
- 3 Outlet pipe of filter tank
- 4 Inlet pipe of filter tank

Designation

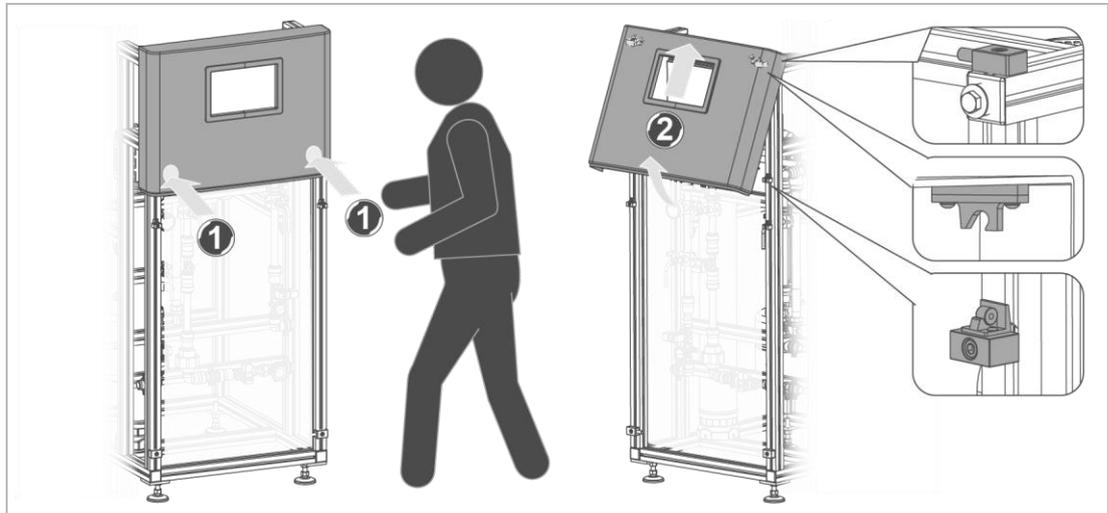
- 5 Profile rail to connect the system rack and the filter tank (incl. screws)
- 6 Level probe
- 7 System rack fixed on a pallet
- 8 Filter tank fixed on a pallet

► Check the scope of supply for completeness and damage.

5.3 Removing the front cover (optional equipment)

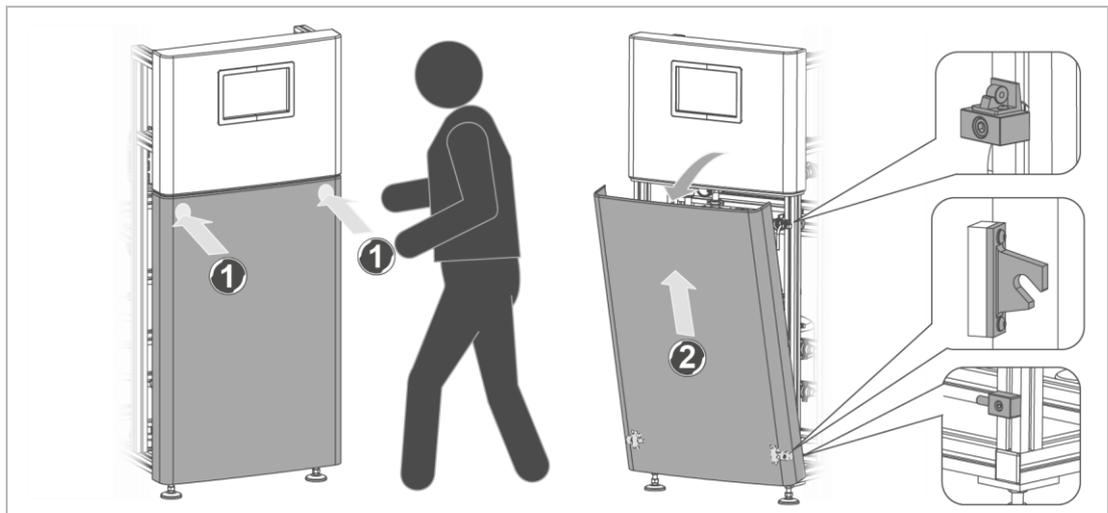
The optional front cover must be removed in order to carry out preliminary work (installation, inspection and maintenance) on the technical equipment.

Removing the upper cover



1. Push the cover against the system rack at the bottom corners.
 - » The snap-fit connections release the cover.
2. Lift off the cover from the upper attachment.
3. Put the cover down and secure it against toppling.

Removing the lower cover



1. Push the cover against the system rack at the upper corners.
 - » The snap-fit connections release the cover.
2. Lift off the cover from the lower attachment.
3. Put the cover down and secure it against toppling.
 - » The front cover is removed.

5.4 Installation

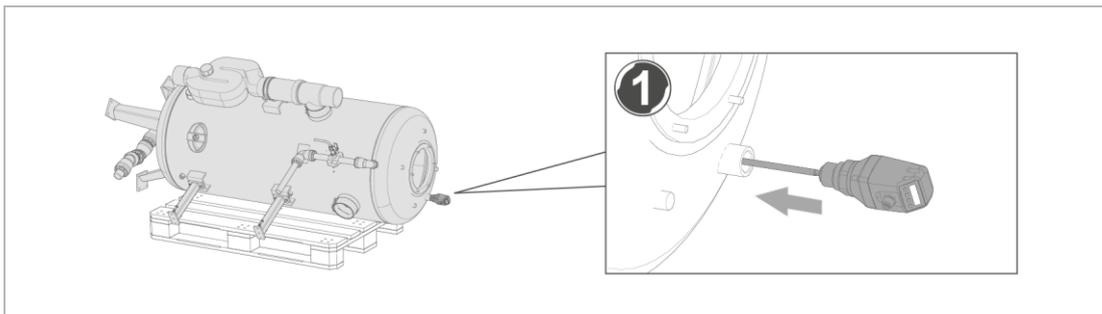
5.4.1 Preliminary work

1. Release the system rack from the transport lock.
2. Remove the pallet.
3. Securely place the system at the designated location – take note of the minimum space required.
4. Level out possible unevenness with the levelling feet.
5. Remove the protective caps from the connections.

5.4.2 Installing the level probe

To protect against damage, the level probe is dismantled for transport.

- ▶ Proceed as follows to install the level probe on the tank while the tank is still in horizontal position:



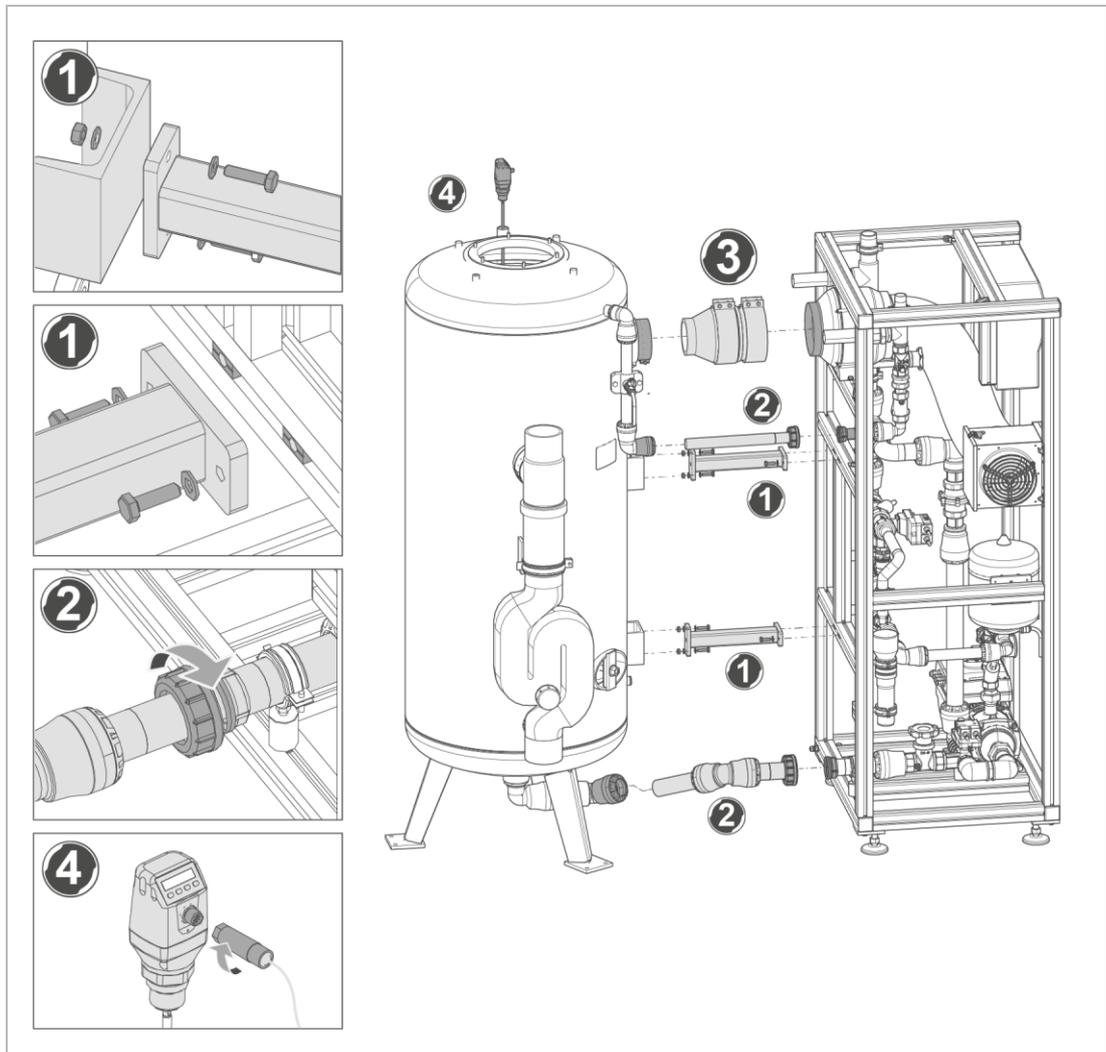
4. Insert the measuring rod of the level probe into the opening provided for this purpose.
5. Screw the level probe to the filter tank. Make sure that the sealing washer is located between the level probe and the filter tank. Tighten the level probe.

5.4.3 Connecting the system rack with the filter tank



CAUTION Working at heights (approx. 2 m) during installation

- Risk of injury when falling.
- ▶ Use a stable stepladder.



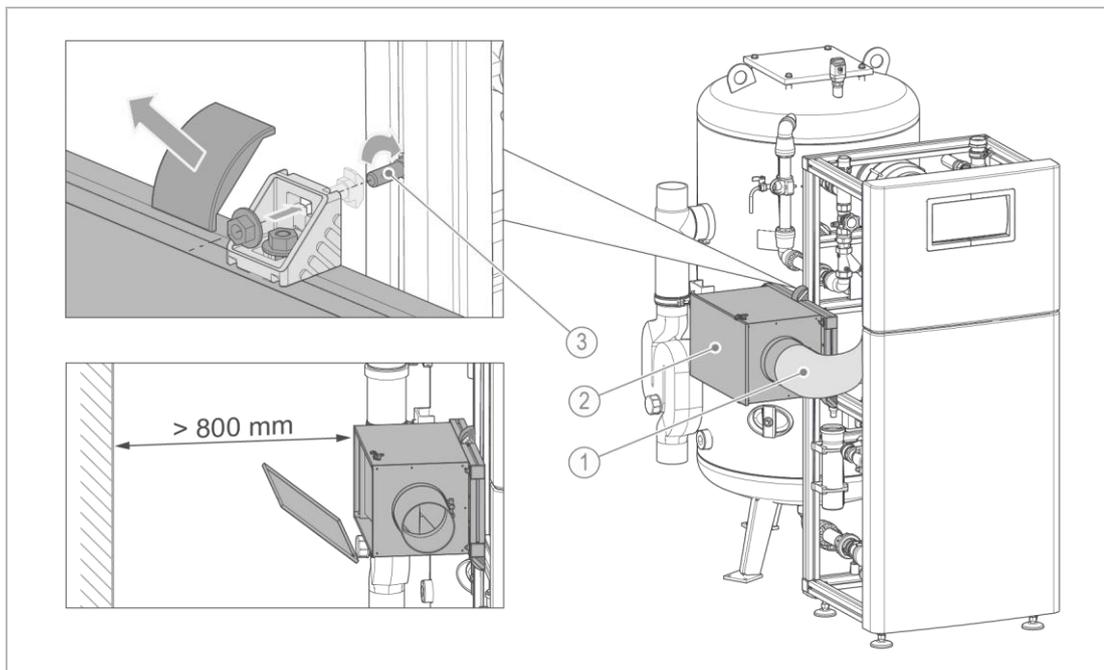
1. Screw the system rack to the filter tank.
2. Connect the inlet and outlet pipes of the filter tank to the system rack.
3. Connect the pipe fan to the filter tank.
4. Connect the level probe. The cable is prepared at the factory.
5. Fix the feet of the filter tank to the floor with suitable fastening materials (depending on the floor conditions).
 - » The system rack and the filter tank are installed.

5.4.4 Installing the fine dust filtration (optional equipment)

You can install the fine dust filter directly on the system rack or on an even surface on site (e.g. a wall) near the system. The supply air pipe is approx. 5 m long.

- ▶ Chose the installation location of the filter box in a way that it is easily accessible for the replacement of the filter.

Installation on system rack



Designation

- 1 Supply air pipe
- 2 Filter box

Designation

- 3 Hammer head screw

1. Remove the cover at the angle brackets of the pre-assembled filter box.
2. Screw the filter box with the bracket angles and a hammer head screw to the system rack.
 - » Connect the supply air pipe. Use a hose clamp to fix the pipe at the filter box.

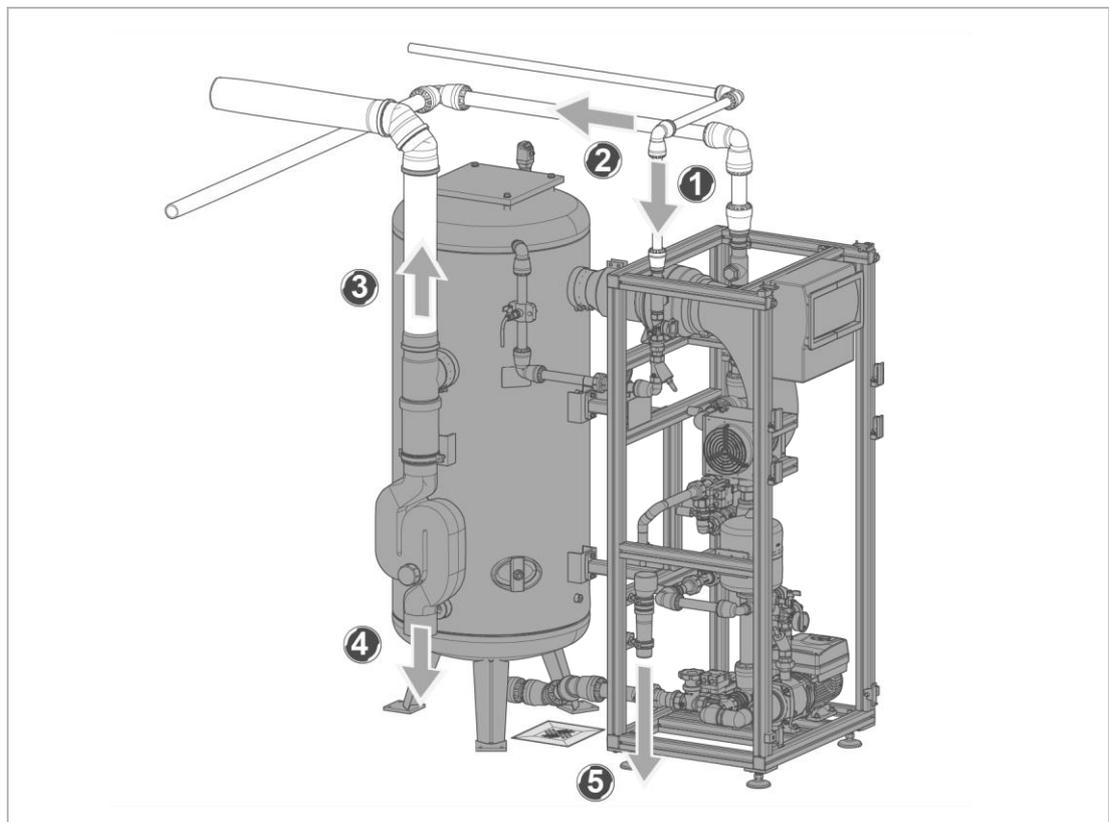
5.5 Water installation

5.5.1 Connecting the system



WARNING Incorrect routing of the exhaust air pipe

- Irritation/chemical burns of the respiratory tract due to harmful gases (H₂S, CH₄) escaping – only applicable if these gases are dissolved in the raw water.
 - ▶ Check the inlet and exhaust air piping provided by the client on site as well as the inlet and exhaust air hoses for leaks at least once a week.
-
- Pipes for raw water, waste water and filtrate provided by the client on site must be separable, for instance, by a screw connection (shut-off valve).
 - ▶ Only use corrosion-resistant materials for the piping of the system/system components.



1. Connect the inlet pipe to the “raw water inlet” connection.
2. Connect the outlet pipe “filtrate outlet” to the supply tank.
3. Connect the exhaust air piping to the upper part of the overflow loop. Route the pipe upwards and then along the ceiling. Make sure to use as few angles as possible to the interface to the outside in order to avoid any unnecessary slowing of the exhaust air volume flow.
4. Route the outlet “backwash water to drain” to the drain.
5. Route the outlet “discharge of first filtrate to drain” to the drain.

5.6 Electrical installation



DANGER

Life-threatening voltage of 230 V

- Risk of severe burns, cardiovascular failure, fatal electric shock
- ▶ The electrical installation must be carried out by a qualified electrician only.
- ▶ Check the system for proper condition before start-up/commissioning.
- ▶ Switch off the supply voltage before working on electrical system parts.
- ▶ Secure the system against restart.
- ▶ Discharge residual voltage.
- ▶ Only use suitable, undamaged tools.
- ▶ Use personal protective equipment – do not work with wet hands.

NOTE:

Malfunctions caused by the frequency converter

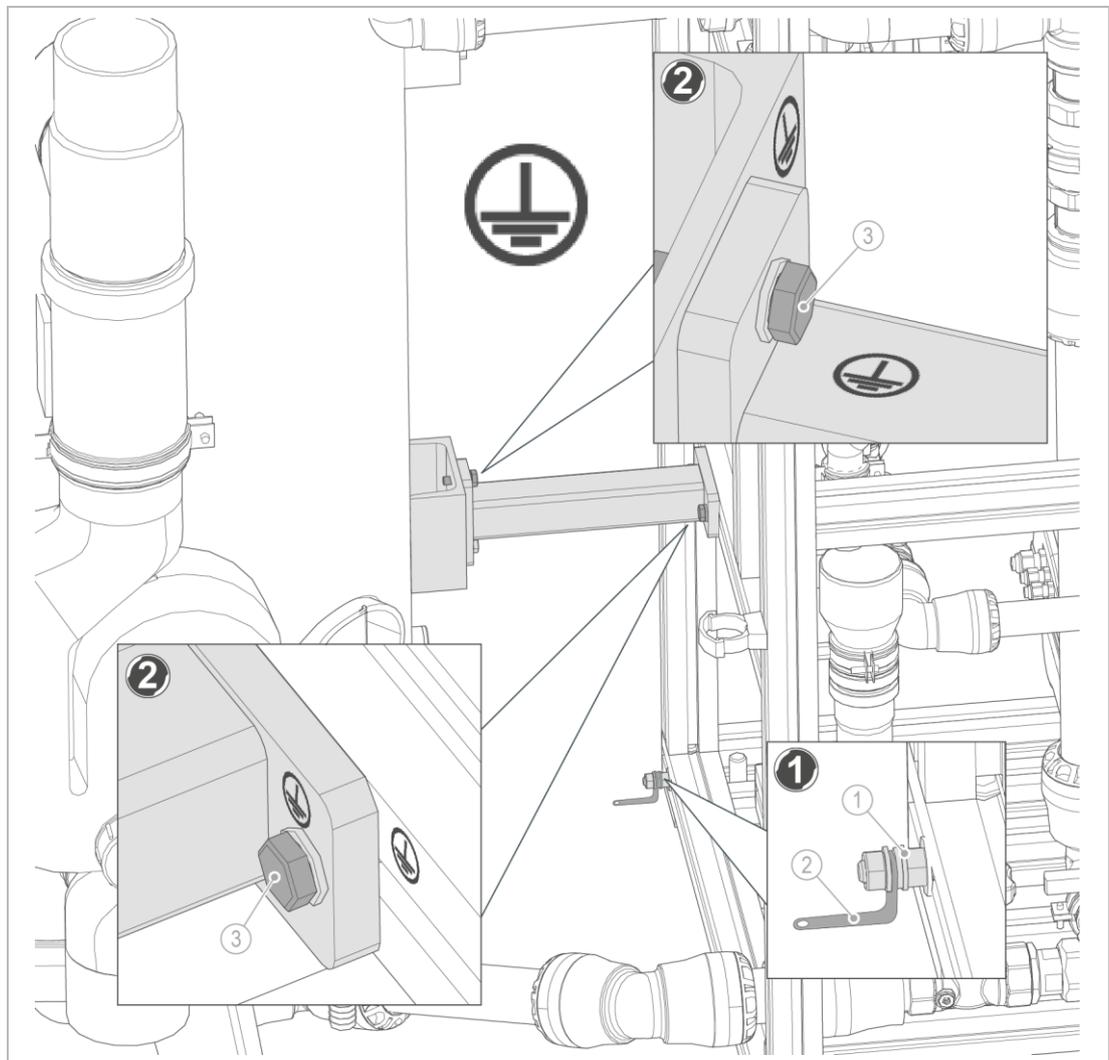
- The frequency converter of the centrifugal pump can cause malfunctions of the residual current circuit breaker installed in the mains supply line.
- ▶ Use an AC/DC sensitive RCCB with a response threshold of 30 mA.
- ▶ Use a of 230 V/50 Hz/L/N/PE power outlet with 16 A fuse protection for the on-site power supply of the system.
- ▶ Make sure that the protective conductor has at least a cross section of 10 mm² (Cu).

1. Carry out the electrical installation according to the electrical circuit diagram no. 530547E00.
2. Connect the raw water pump (refer to electrical circuit diagram no. 530547E00).
- 6.
- 7.

5.6.1 Establishing potential equalisation

In normal operation, the speed-controlled filtrate pump can have a ground leakage current > 10 mA.

► Proceed as follows to establish the connection to the potential equalisation:



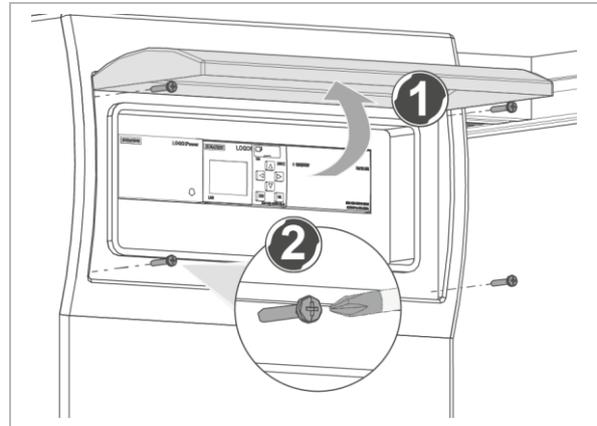
Designation		Designation	
1	Hammer head screw	3	Earth screw
2	Ribbon cable		

1. Connect the system rack to the potential equalisation provided by the client on site.
 - a Connect the ribbon cable to the hammer head screw.
 - b Connect the ribbon cable to the potential equalisation provided by the client on site.
2. Screw the system rack and the filter tank together on both sides with an earth screw each in accordance with the standard.

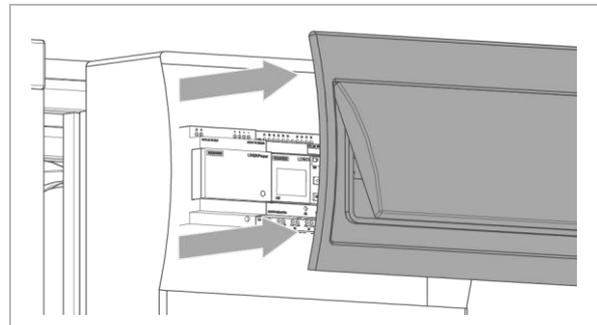
5.6.2 Connecting the raw water pump

The raw water pump provided by the client on site is enabled from switch cabinet 1MSF1AE02.

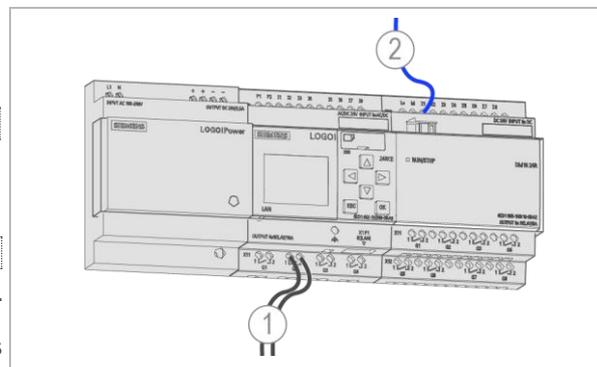
1. Open the cover of the control unit.
2. Using a cross-headed screwdriver, loosen the four screws at the corners under the cover.



3. Remove the cover toward the front.



4. Connect the raw water pump:
 - a Connect “Enable raw water pump” to output terminals Q2 of the middle module 4A1 .
 - b Connect “Raw water pump in operation” to input terminal I1 of the right-hand module 4A2.
 - c Bridge the input L+, if there is no “Raw water pump in operation”.

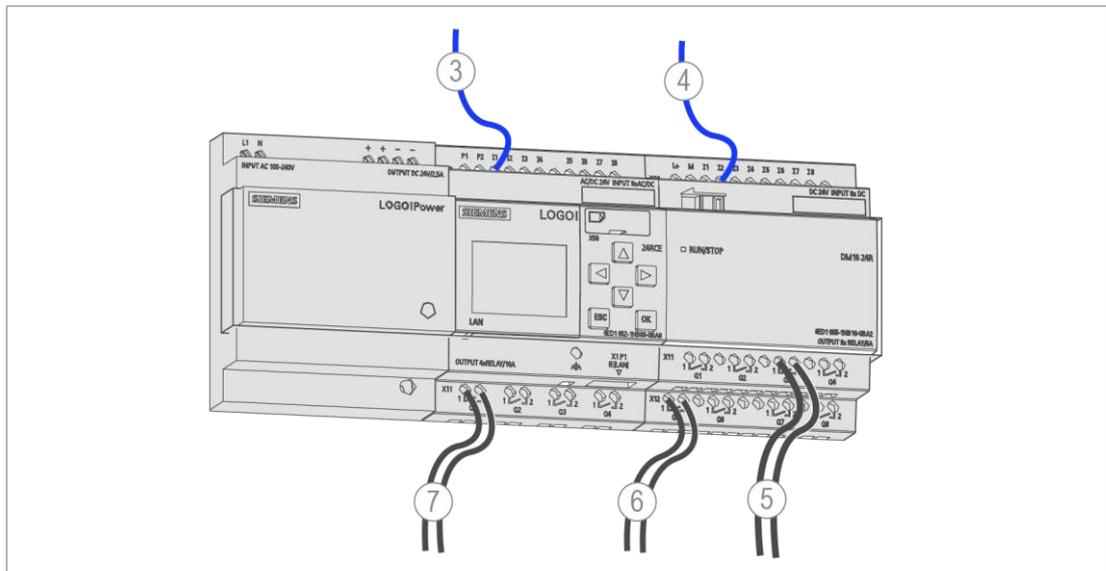


Designation

- | | |
|---|---|
| 1 | Enable raw water pump
<i>voltage-free, max. 250 V, 2 A</i> |
| 2 | Raw water pump in operation |

5.6.3 Connecting the options

- ▶ Open the cover (refer to chapter 5.6.2, steps 1 – 3).



Designation	Function
3 "Enable system" <i>voltage-free, max. 250 V, 2 A</i>	If signal at input <i>FALSE</i> (0 V at input), all running processes are aborted and the system returns to basic mode. The system remains locked until signal at input <i>TRUE</i> (+24 VDC at input)
4 "Enable filtrate pump(s)" <i>voltage-free, max. 250 V, 2 A</i>	If signal at input <i>FALSE</i> (0 V at input), the filtrate pump(s) 1MSF1AP02 (1MSF1BP02) does not/do not deliver any filtrate to the consumer. First filtrate and manual discharge of first filtrate are possible nevertheless.
5 "Collective fault" <i>voltage-free, max. 250 V, 2 A</i>	
6 "Enable dosing" <i>voltage-free, max. 250 V, 2 A</i>	Contact is closed during make-up water feed (activation of raw water pump). (Only if "Raw water in operation" is present <i>TRUE</i> (+24 V/DC at the input), the contact is closed).
7 "Backwash signal" <i>voltage-free, max. 250 V, 2 A</i>	Contact is closed during the backwash process until the backwash valve is in the closed position again. (Starting from first filtrate, the contact is open again)

Connecting "Enable system"

- ▶ Connect "Enable system" to output terminals **I1** of the middle module 4A1.

Connecting "Enable filtrate pump(s)"

- ▶ Connect "Enable filtrate pump(s)" to output terminals **I2** of the right-hand module 4A2.

Connecting "Collective fault"

- ▶ Connect "Collective fault" to output terminals **Q1** of the middle module 4A1.

Connecting “Enable dosing”

- ▶ Connect “Enable dosing” to output terminals **Q4** of the right-hand module 4A2.

Connecting “Backwash signal”

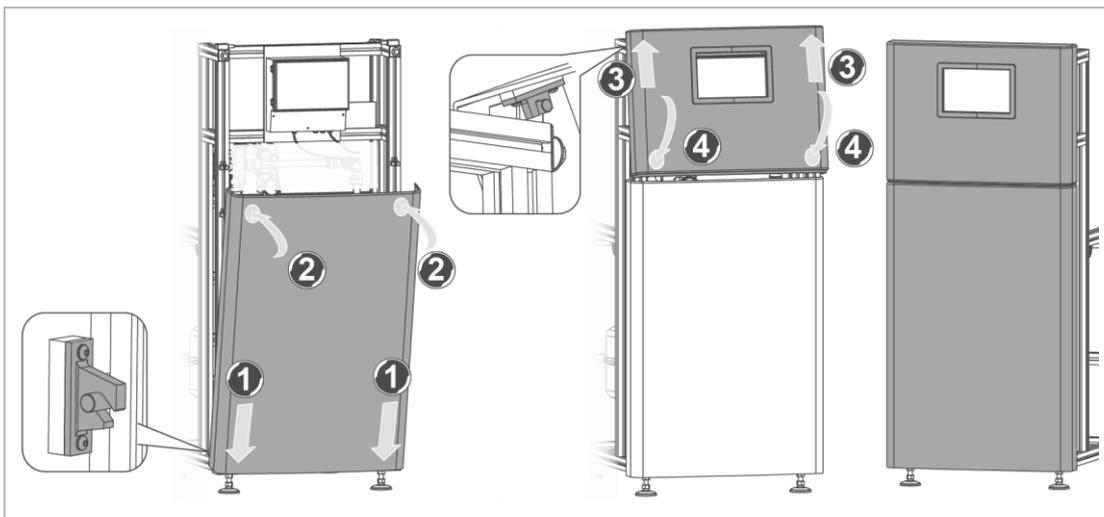
- ▶ Connect “Backwash signal” to output terminals **Q5** of the right-hand module 4A2.

5.6.4 Connection to the power supply

1. Install the cover and close the control unit.
2. Plug in the mains plug.

5.7 Installing the front cover (optional equipment)

After the work has been carried out, the optional front cover can be installed.



1. Insert the upper cover into the attachment.
2. Push the upper cover against the system rack at the bottom corners.
 - » The snap-fit connections click into place.
3. Insert the upper cover into the attachment.
4. Push the cover against the system rack at the upper corners.
 - » The snap-fit connections click into place.
 - » The front cover is installed.

6 Start-up/Commissioning



The start-up/commissioning of the system must be carried out by a qualified specialist only.

6.1 Filling in filter material



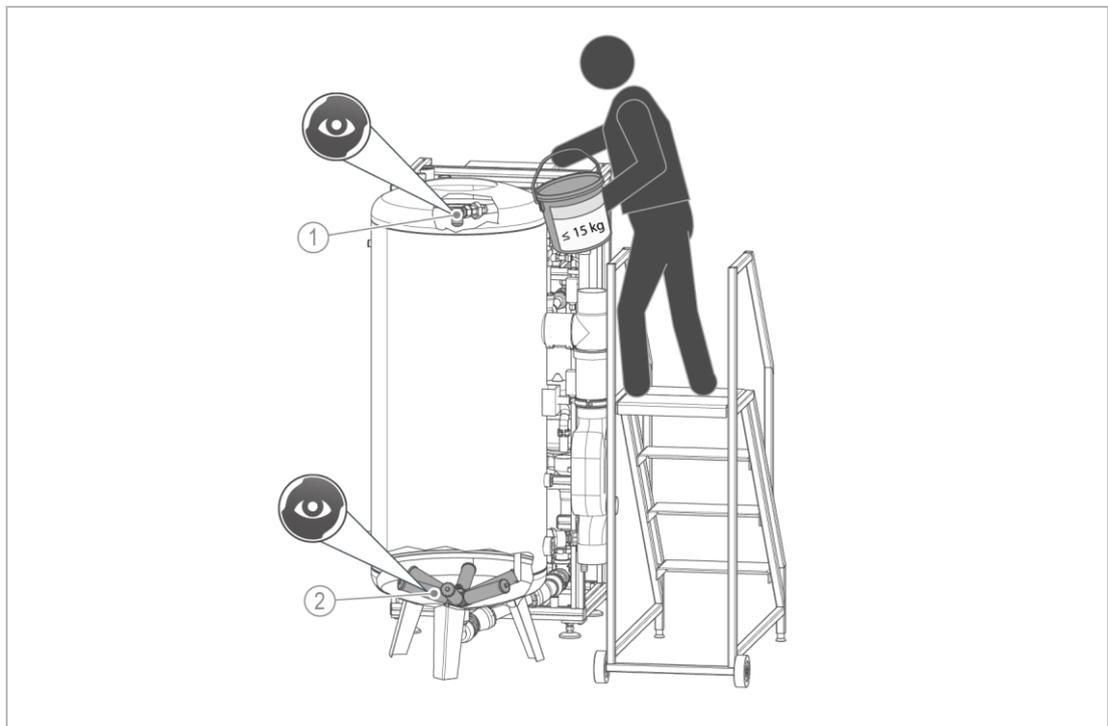
CAUTION The containers/bags containing the filter material are heavy.

- Risk of injury when lifting heavy containers/bags
- When using lifting gear (e.g. cranes), there is a risk caused by suspended loads
- ▶ Use a forklift, lifting cart or wheelbarrow to transport the filter material packed in bags.
- ▶ For transport up or down stairs: Fill the filter material into containers, so that the weight to be transported does not exceed 25 kg.
- ▶ Use an auxiliary container, which does not exceed a weight of 15 kg when full, to fill the filter material into the filter tank.



CAUTION Working at heights (approx. 2 m) during filling

- Danger of falling
- ▶ Use a stable stepladder with platform for the filter material.



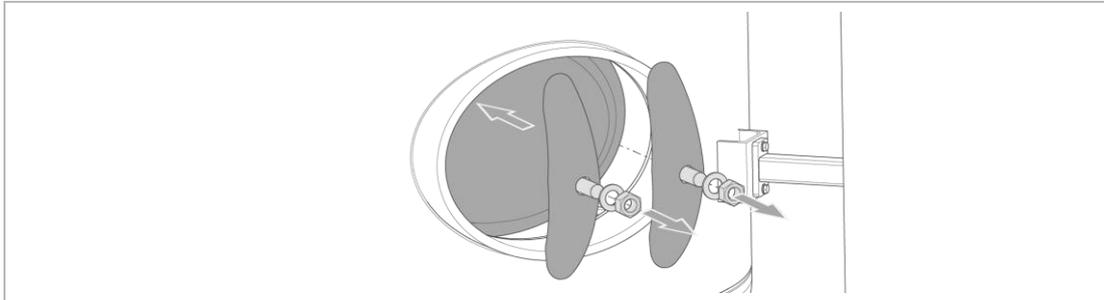
Designation

1 Nozzle

Designation

2 Star-shaped nozzle assembly

1. Loosen the screw connections of the lid.
2. Remove the lid of the filter tank (weight approx. 5 kg) and put it down adjacent to the system.
3. Check the nozzle and the star-shaped nozzle assembly for completeness and integrity – use the handhole to check the star-shaped nozzle assembly.

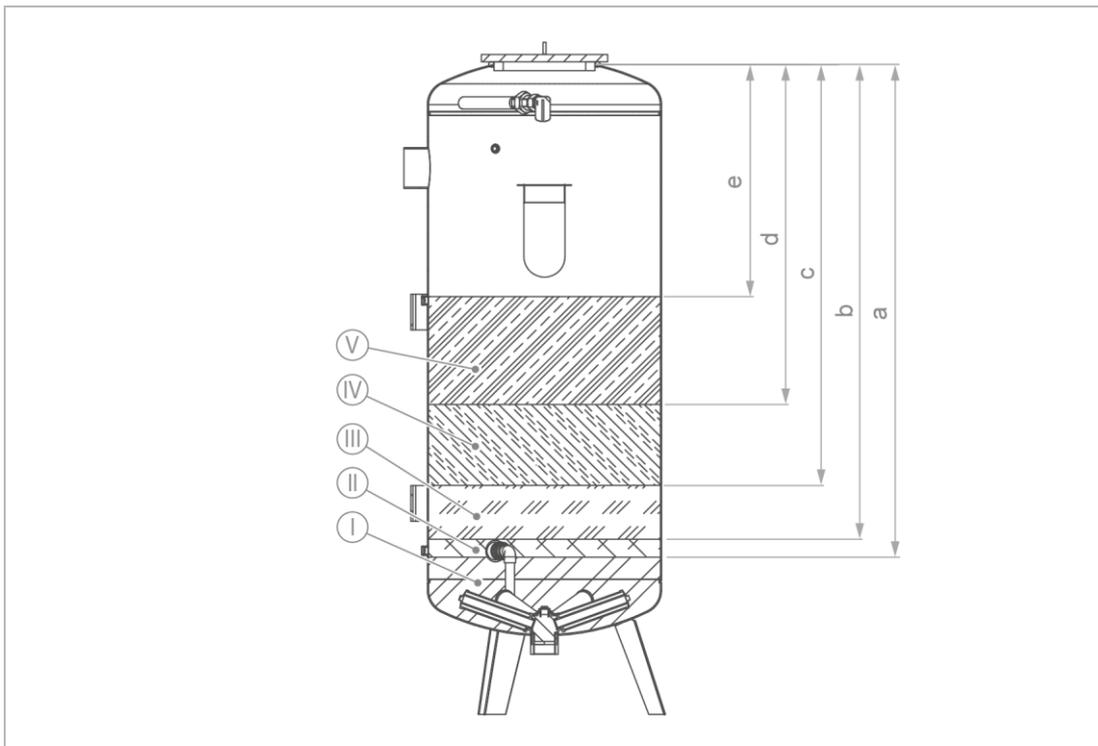


- a Open the handhole by loosening the screw nut.
 - b Carry out a visual inspection.
 - c Close the handhole.
4. Fill the filter tank about halfway with water. This prevents dust when filling in the support and filter layers.

NOTE: Damage to the star-shaped nozzle assembly during filling.

- ▶ Make sure that the filter tank is about half full of water.
- ▶ Pour the filter material in slowly.
- ▶ Make sure that the support layers and filter layers are distributed uniformly.

5. Filling in the support layers:
 - a Fill in the support layers (I, II) in the specified order according to the filling diagram – refer to the chart and tables below.
6. Filling in the filter layers:
 - a Fill in the filter layers (III, IV, V) in the specified order according to the filling diagram – refer to the chart and tables below.
7. Fill the filter tank with water up to the overflow.
8. Leave the system in this state for 24 hours (soaking time).
 - » The filter material wets and partially soaks up the water.
 - » The resulting increase in weight prevents the filter material from being flushed out during future backwash processes.



6.1.2 Filter filling for deferrisation/demanganisation

Filter material		MA	2000	3000	5000	10000
Ⓘ Quartz gravel SB 3.15 – 5.6 T	a Filling height	mm	1150	1425	1410	1660
	Filling volume	kg	50	75	125	250
	Layer height	mm	155	165	180	190
Ⓙ Quartz sand SB 1.0 – 2.0 T	b Filling height	mm	1075	1375	1340	1605
	Filling volume	kg	25	25	50	75
	Layer height	mm	75	50	70	55
Ⓚ Filter sand SB 0.4 – 0.8 T	c Filling height	mm	930	1220	1170	1445
	Filling volume	kg	50	75	125	225
	Layer height	mm	145	155	170	160
Ⓛ GENO-Fermanit 0.5 – 1.0 mm	d Filling height	mm	710	985	940	1215
	Filling volume	kg	100	150	225	425
	Layer height	mm	220	235	230	230
Ⓜ Hydro-anthracite "N" 0.6 – 1.6 mm	e Filling height	mm	490	675	635	895
	Filling volume	l	50	100	150	300
	Layer height	mm	220	310	305	320

6.1.3 Filter filling for solid particle filtration

Filter material		MA	2000	3000	5000	10000	
I	Quartz gravel SB 3.15 – 5.6 T	a Filling height	mm	1150	1425	1410	1660
		Filling volume	kg	50	75	125	250
		Layer height	mm	155	165	180	190
II	Quartz sand SB 1.0 – 2.0 T	b Filling height	mm	1075	1375	1340	1605
		Filling volume	kg	25	25	50	75
		Layer height	mm	75	50	70	55
III	Filter sand SB 0.4 – 0.8 T	c Filling height	mm	710	1010	930	1210
		Filling volume	kg	125	175	300	550
		Layer height	mm	365	365	410	395
IV	–	–	–	–	–	–	
V	Hydro-anthracite “N” 0.6 – 1.6 mm	e Filling height	mm	490	700	625	890
		Filling volume	l	50	100	150	300
		Layer height	mm	220	310	305	320

6.2 Diaphragm expansion tank: Setting the preload pressure

The filtrate pump of the oxidation filter system fermaliQ:MA is speed-controlled via a pressure sensor and keeps the set pressure constant. Smooth start-up and run-down of the centrifugal pump prevent water hammer. In addition, a diaphragm expansion tank operating with forced flow, absorbs pressure fluctuations in case of major changes in the flow rate and reduces the switching frequency in case only small amounts are withdrawn.

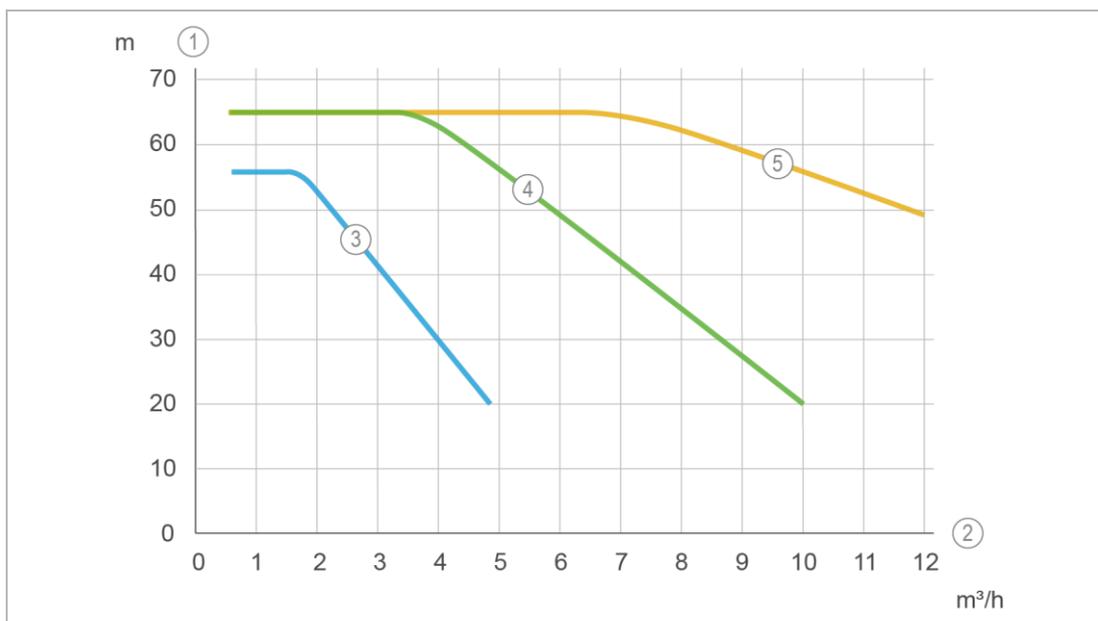


A change in the target pressure (operating pressure) requires an adjustment of the diaphragm expansion tank.

NOTE: Incorrect setting of the preload pressure

- Insufficient function of diaphragm expansion tank
- Increased wear and tear of the diaphragm
- ▶ Check the correct setting of the preload pressure.

- The diaphragm expansion tank is factory-set to a preload pressure of 4 bar.
 - The preload pressure must be checked and adjusted with an empty diaphragm expansion tank without pressure on the water side.
- Set the preload pressure in a way that it corresponds to 90 % of the operating pressure. Proceed as follows to do so:
1. Determine your desired operating pressure which must correspond to the delivery characteristic range of the centrifugal pump.



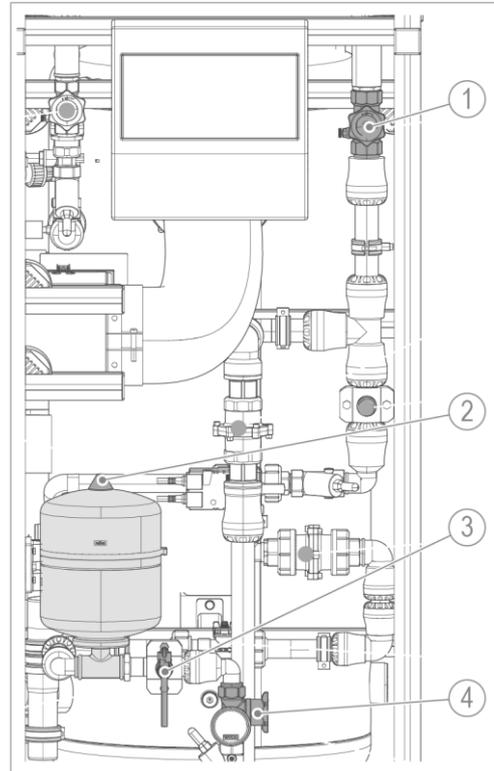
Designation	
1	Delivery head in m
2	Delivery rate in m³/h
3	Characteristic curve of fermalIQ:MA2000

Designation	
4	Characteristic curve of fermalIQ:MA3000/MA500
5	Characteristic curve of fermalIQ:MA10000

2. Set the operating pressure (set pressure) using the buttons \oplus and \ominus on the operating panel of the centrifugal pump.
3. Determine the required preload pressure.

$$\begin{array}{rcccl}
 \text{Example:} & 5.0 \text{ bar} \times 90 \% & = & 5.0 \text{ bar} \times 0.9 & = & 4.5 \text{ bar} \\
 & \uparrow \text{ Operating pressure} & & & & \uparrow \text{ Preload pressure}
 \end{array}$$

4. Adjust the preload pressure of the diaphragm expansion tank.
 - a Close shut-off valves **1** and **4**.
 - b Drain the diaphragm expansion tank via sampling valve **3**.
 - c Measure the set preload pressure on gas filling valve **2** with a hand-held pressure gauge.
 5. Alternative 1: Preload pressure too high – release gas
 - a Open gas valve **2** to release gas.
 6. Alternative 2: Preload pressure too low – refill inert gas
 - a Fill the diaphragm expansion tank with inert gas at the gas filling valve (e.g. by means of a nitrogen bottle) until the desired preload pressure is reached.
 - b Open shut-off valves **1** and **4**.
- » The diaphragm expansion tank is ready for operation.
- Enter the newly set preload pressure on the type plate.



6.3 Checking the system

1. Check the screw connections on the pumps, valves, flange connections and pipes.
 - a Check the screw connections for leaks and retighten them, if necessary.
2. Check the electrical installation:
 - a Check the electrical connections.
 - b Check the cable screw connections and retighten or reseal them, if necessary.
3. Vent the system:

6.4 Flushing the system

1. Completely open all valves except for filtrate shut-off valve (1MSF1AH05).
2. Switch on the system (refer to chapter 7).
3. Initiate the manual discharge of first filtrate (refer to chapter 7.2). Repeat this process until clear water runs off.
 - » After the first filtrate has been discharged, the system returns to normal operation. Completely open the filtrate shut-off valve (1MSF1AH05).
5. Initiate a backwash after an operating time of 30 minutes.

The flushing processes are required to flush out the fines from the uppermost filter layer and thus prevent them from entering the filtrate.



- ▶ Make sure that the soaking time (24 h) indicated above was kept (otherwise the material does not soak up enough water and therefore is too light).
- ▶ Make sure that the pressurised water tank provided by the client on site is functional when filled with filtrate for the first time, i.e. a pressure cushion must form in order to be able to carry out a proper backwash of the filter tank.
- ▶ If fines continue to be discharged after the procedure, check the following:
 - Default setting of the system (refer to the technical service manual)
 - The level must be set in a way that the uppermost filter material is always in the water. Otherwise, the filter material must be backwashed with raw water (refer to the technical service manual).



If fines of the filter material continue to be present in the filtrate after carrying out the flushing steps described above, it is possible to perform an additional “flushing process” – provided the raw water quality is suitable. This flushing process consists of a continuous backwash with raw water until the contained fines have been completely washed out.

6.5 Handing over the product to the owner/operating company

1. Explain to the owner/operating company how the system works.
2. Use the manual to brief the owner/operating company and answer any questions.
3. Inform the owner/operating company about the need for inspections and maintenance.
4. Hand over all documents to the owner/operating company for keeping.



Depending on the quality of the raw water, filter systems for the removal of iron, manganese and ammonium might require a run-in period of several weeks.

6.5.1 Disposal of packaging

- ▶ Dispose of the packaging as soon as it is no longer needed.

NOTE

Danger to the environment due to incorrect disposal

- Packaging materials are valuable raw materials that can be reused in many cases.
- Incorrect disposal can cause hazards to the environment.
 - ▶ Dispose of packaging materials in an environmentally sound manner.
 - ▶ Obey the local disposal regulations.
 - ▶ If necessary, commission a specialist company with the disposal.

7 Operation/handling

Normally, no intervention by owner/operating company/operator/ is required during operation.

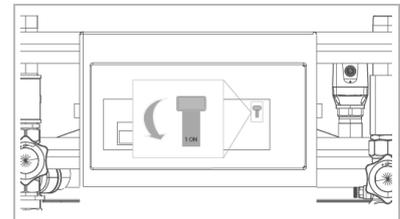


WARNING Leaking exhaust air pipe, failure of pipe fan

- Irritation/chemical burns of the respiratory tract and risk of asphyxiation due to harmful gases (e.g. hydrogen sulphide, methane) escaping – only applicable if these gases are dissolved in the raw water.
- ▶ Check the inlet and exhaust air piping provided by the client on site as well as the inlet and exhaust air hoses for leaks at least once a week.
- ▶ Watch out for the smell of hydrogen sulphide in the installation room and at the exhaust air pipe outside (foul odour) – contact technical service if you suspect this.
- ▶ Make sure the installation site is sufficiently ventilated.

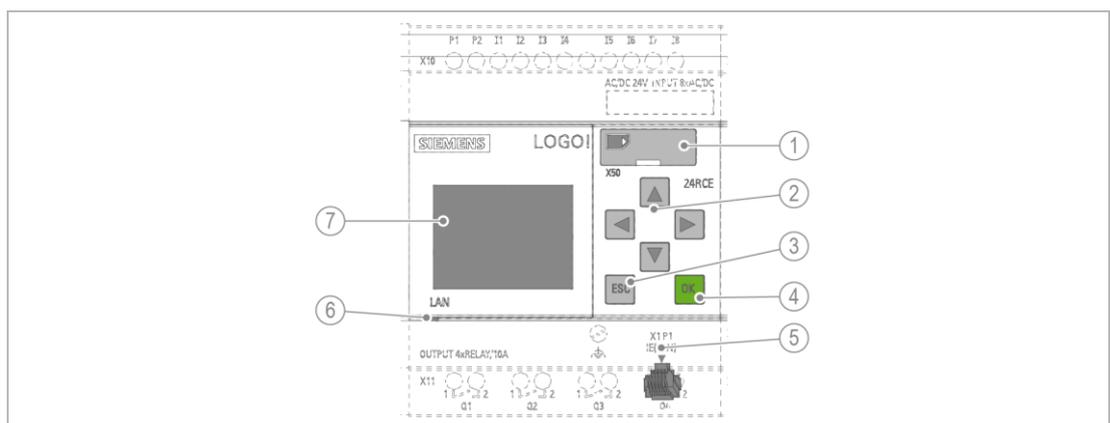
Switching on the system

- ▶ Flip the rocker switch under the plexiglass cover of the switch box to **ON**
- » The display shows **System:On.**



7.1 Operation of the control unit

The system is controlled by means of the PLC controller “Siemens Logo! 12/24RCE”. The operating unit is located at the front of the system rack.



Designation	
1	Slot for memory card (micro-SD)
2	Navigation keys
3	ESC button
4	OK button

Designation	
5	LAN connection
6	LAN indicator lamp
7	Display

7.1.1 Operating concept

The menu consists of one level.

- ▶ Use the navigation buttons  and  to change the displays.

Setting the values

1. Press and hold the  button for 3 seconds.
 - » The input field is highlighted in black.
2. Switch between different input fields within a display by using  and .
3. Press  to change a value.
 - » The input field highlighted in black is flashing.
4. Change the setting value using  and  or trigger an action with .
5. Press  to quit the settings.

7.1.2 Menu structure (as of software V10)

In the eight different views displayed, there are purely informative elements as well as elements where settings can be made, or actions can be triggered.

No.	Display	Explanation
1/11	<div style="border: 1px solid black; padding: 10px; text-align: center;"> System: On 0 l/h Level: 85.7% Make-up feed: Off  </div>	Information: <ul style="list-style-type: none"> • System On/Off • Current flow in l/h • In case of manual discharge of filtrate, “Discharge” is indicated in the empty display line • Filling level in % • Make-up feed: On/Off (enable raw water pump)
2/11	<div style="border: 1px solid black; padding: 10px; text-align: center;">  Filtrate pump(s) Enable: On Auto: On  </div>	Information: <ul style="list-style-type: none"> • Activation of filtrate pump(s) • Enable: On/Off (status of option “Enable of filtrate pump(s)”) • AUTO: On/Off

No.	Display	Explanation
3/11	<p style="text-align: center;">▲</p> <p style="text-align: center;">Input Raw water pump in operation: On</p> <p style="text-align: center;">▼</p>	<p>Information:</p> <ul style="list-style-type: none"> • Status at input "Raw water pump in operation" • On/Off (<i>TRUE/FALSE</i>)
4/11	<p style="text-align: center;">▲</p> <p style="text-align: center;">Initiate manual backwash? Off</p> <p style="text-align: center;">▼</p>	<p>Information:</p> <ul style="list-style-type: none"> • Initiating backwash manually On/Off <p> In case a backwash is initiated manually, the specified backwash requirements are ignored. The backwash process is started irrespective of pressure, level and flow.</p>
5/11	<p style="text-align: center;">▲</p> <p style="text-align: center;">Discharge of filtrate 00:00m/05:00m</p> <p style="text-align: center;">Start/Stop: Off</p> <p style="text-align: center;">▼</p> <hr/> <p style="text-align: center;">System: On 0 l/h</p> <p style="text-align: center;">Discharge Level: 70.5 Make-up feed: On</p> <p style="text-align: center;">▼</p>	<p>Actions:</p> <ul style="list-style-type: none"> • Setting the setpoint for discharge of filtrate • Start or stop the discharge of filtrate <p> Upon start, the first filtrate valve is activated and remains open until either the time has expired, a manual stop takes place again or a backwash is triggered. In the start screen, "Discharge" is shown in the empty display line as long as this function is active.</p>
	<p style="text-align: center;">▲</p> <p style="text-align: center;">Discharge of filtrate 04:49m/05:00m</p> <p style="text-align: center;">Start/Stop: Off</p> <p style="text-align: center;">▼</p>	<p>Information:</p> <ul style="list-style-type: none"> • Remaining time of discharge of filtrate

No.	Display	Explanation
6/11	<p style="text-align: center;">▲</p> <p style="text-align: center;">Backwash: inactive Remaining time: 00:00m</p> <p style="text-align: center;">First filtrate: inactive Remaining time: 00:00m</p> <p style="text-align: center;">▼</p>	<p>Information:</p> <ul style="list-style-type: none"> • Backwash active/inactive • Remaining time of backwash in minutes • Discharge of first filtrate active/inactive • Remaining time of discharge of first filtrate in minutes
7/11	<p style="text-align: center;">▲</p> <p style="text-align: center;">Filtered volume: 0 m³</p> <p style="text-align: center;">Backwash counter: 0</p> <p style="text-align: center;">▼</p>	<p>Information:</p> <ul style="list-style-type: none"> • Total (filtered) volume logged by the water meter in m³ • Number of successful backwash processes
8/11	<p style="text-align: center;">▲</p> <p style="text-align: center;">Repeat ER 2: 0/ 3</p> <p style="text-align: center;">Reset? Off</p> <p style="text-align: center;">▼</p>	<p>Information:</p> <ul style="list-style-type: none"> • Number of failed backwash processes <p>Actions:</p> <ul style="list-style-type: none"> • Determine number of repeats until error ER 2 is triggered • Reset the number of failed attempts
9/11	<p style="text-align: center;">▲</p> <p style="text-align: center;">Collective fault: On</p> <p style="text-align: center;">Raw water pump: Off (NO=Off / NC=On)</p> <p style="text-align: center;">▼</p>	<p>Actions:</p> <ul style="list-style-type: none"> • Logic (opener/closer) of outputs: <ul style="list-style-type: none"> • Collective fault On/Off • Raw water pump On/Off • NO = Normally open = Off NC = Normally closed = On
10/11	<p style="text-align: center;">Software version</p> <p style="text-align: center;">V11</p>	<p>Information:</p> <ul style="list-style-type: none"> • Indication of software version

No.	Display	Explanation
11/11		Information: <ul style="list-style-type: none"> • Time and date

7.2 Initiating manual discharge of filtrate

During start-up/commissioning, it is necessary to thoroughly flush the filter material in the filter tank.

► Proceed as follows to initiate a manual discharge of the filtrate:

1. Navigate to view 5/11.
2. Press and hold **ESC** for 3 seconds.
3. Use **▼** and **▲** to navigate to field **XX:XXm**.
4. Press **OK** to change the value.
5. Use **▲** and **▼** to set the required value for the duration of the discharge of the filtrate.
6. Confirm the value with **OK**.
7. Use **▼** and **▲** to navigate to field **Off**.
8. Press **OK** to change the value.
9. Set the value to **On** using **▼** and **▲**.
10. Press **OK**.
11. Press **ESC** to quit the settings.
 - » The discharge of filtrate starts.

7.3 Initiating manual backwash



Under certain circumstances, it might be necessary to initiate a backwash outside the planned intervals.

In case a backwash is initiated manually, the specified backwash requirements are ignored. The backwash process is started irrespective of pressure, level and flow.

► Proceed as follows to initiate a manual backwash:

1. Navigate to view 4/11.
2. Press and hold **ESC** for 3 seconds.
3. Use **▼** and **▲** to navigate to field **Off**.
4. Press **OK** to change the value.
5. Set the value to **On** using **▼** and **▲**.
6. Press **OK**.
7. Press **ESC** to quit the settings.
 - » The backwash starts.

7.4 Backwash monitoring

If a backwash process has not been carried out or has not been carried out completely, this is logged as a failed attempt.

Possible reasons for an unsuccessful backwash are listed and explained in chapter 9.1, fault ER 2.

7.4.1 Determining the number of failed attempts until an error message is displayed

In the control unit of the system, you can define after how many failed attempts, the error message ER 2 will be output. Proceed as follows to do so:

1. Navigate to view 8/11.
2. Press and hold **ESC** for 3 seconds.
3. Use **▼** and **▲** to navigate to field **O/X**.
4. Press **OK** to change the value.
5. Set the desired value using **▼** and **▲**.
6. Press **ESC** to quit the settings.

7.4.2 Resetting the number of failed attempts

NOTE: Repeated manual reset of the counter

- Malfunctions in the event of repeated manual reset of the counter
 - ▶ Eliminate the cause of failed backwash processes.
 - ▶ If the backwash processes keep failing, contact the technical service.



Resetting the counter is logged and can be followed up by the technical service.

At the next successful backwash, the number of failed attempts is reset automatically.

You can reset the counter manually. Proceed as follows to do so:

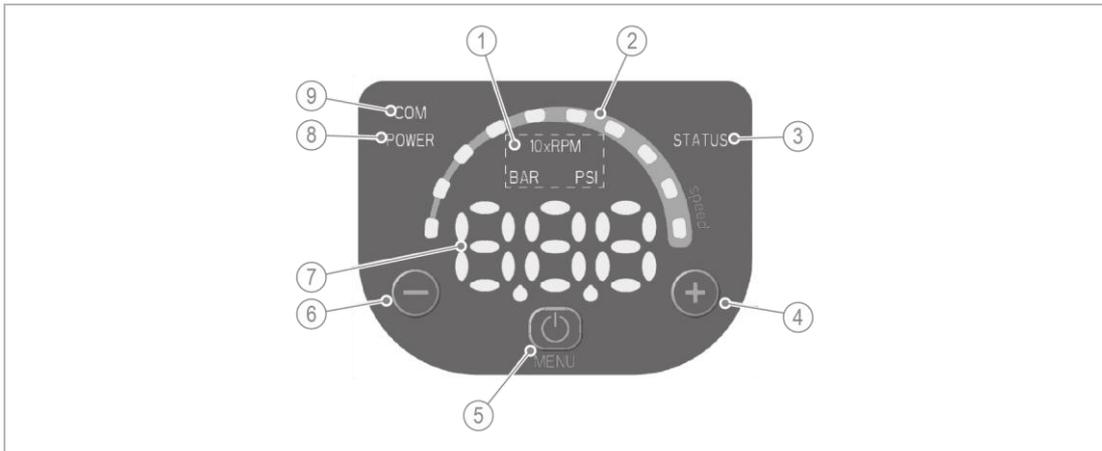
1. Navigate to view 8/10.
 2. Press and hold **ESC** for 3 seconds.
 3. Use **▼** and **▲** to navigate to field **Reset**.
 4. Press **OK** to change the value.
 5. Set the value to **On** using **▼** and **▲**.
 6. Press **OK**.
 - » The counter was reset to 0.
- ▶ Press **ESC** to quit the settings.

7.5 Operation of filtrate pump

The following chapter provides information on the operating and display elements of the filtrate pump.



Only the technical service personnel must make settings on the filtrate pump.



Designation	Function
1 Measuring unit LEDs	Information on the unit of the rotational speed LED strip and the display
2 Rotational speed LED strip	Indication of the current rotational speed in steps of 10 % (subject to the set min./max. rotational speed)
3 Status LED	Indication of the operating state
4 Plus button 	<ul style="list-style-type: none"> To increase values Navigation in the menu
5 START/STOP button 	<ul style="list-style-type: none"> Start/stop pumps Long press to call up the parameter menu Confirmation of a selection in the parameter menu
6 Minus button 	<ul style="list-style-type: none"> To decrease values Navigation in the menu
7 Display	Indication of parameters/menu
8 POWER LED	Information on power supply
9 Communication LED	Information on communication

7.5.1 Status LED

The status LED indicates the operating state of the pump and signals any malfunctions.

LED	Description
 Off	Pump stopped
 Steady green light	Pump in operation
 Flashing green/orange light	Non-locking alarm during operation of the pump
 Steady orange light	Non-locking alarm when pump is stopped
 Steady red light	Locking error, the pump cannot be started

7.5.2 Rotational speed LED strip

The rotational speed LED strip consists of 10 LEDs.

Each LED represents the rotational speed range between parameter P27 (min. speed) and parameter P26 (max. speed) in stages between 10 and 100 %.

LED	Description
On	Motor in operation – the speed corresponds to the percentage stages that are indicated by the switched-on LEDs on the strip (e.g.: 3 LEDs On = rotational speed 30 %).
First LED flashes	Motor in operation – the speed is below the absolute minimum value (parameter P27)
Off	Motor stopped

7.5.3 Display

The display indicates operating state, operating values, menu and error codes.

Display	Mode	Description
OFF	OFF	Pump Off
StP	STOP	Pump stopped manually
ON	ON	Pump on; the motor starts depending on the selected control mode – appears for a few seconds, then the operating pressure is displayed

Alarm and error indication

Indication (example)	Mode	Description
A01 → 3.56	Alarm	In the event of an alarm, the corresponding code is displayed alternately with the main display.
E15	Error	If an error occurs, the corresponding code number is shown on the display.



Alarm and error codes (refer to chapter 9.2).

7.6 Emergency bypass

All oxidation filter systems fermaliQ:MA feature an emergency bypass as standard which can optionally be connected. The system is bypassed by means of a drinking water hose.

Using raw water (not drinking water quality) as emergency supply (“emergency bypass”) is admissible for the fields of application below:

- Fire-fighting purposes
- Toilet flushing

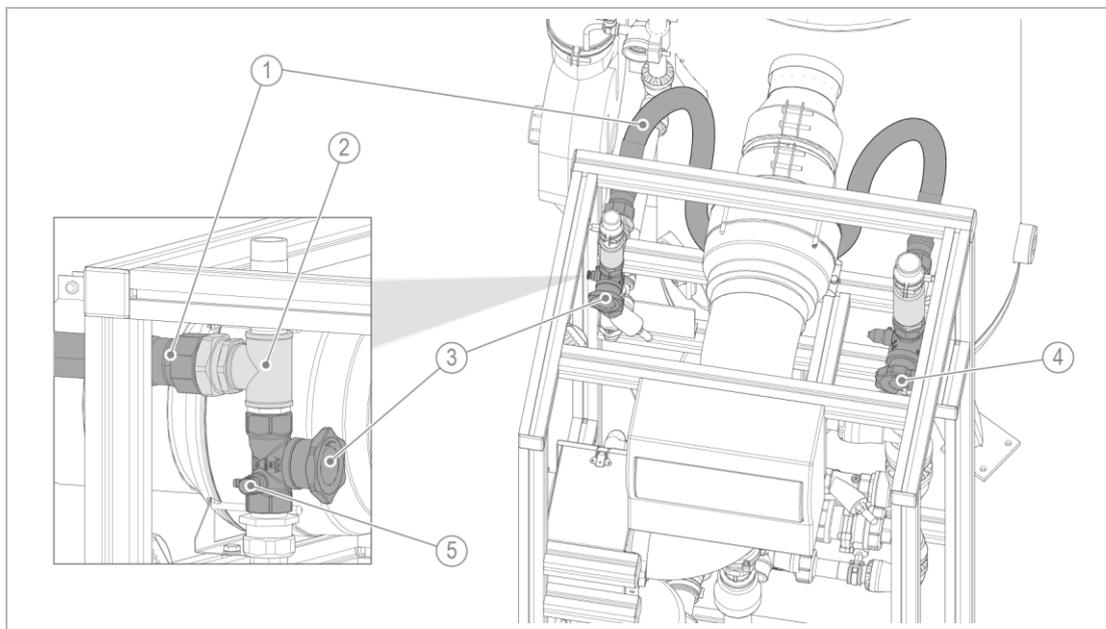


WARNING

Risk of infection due to microbially contaminated water

- Infectious diseases
- ▶ Make sure that no microbially contaminated water gets into the drinking water supply when using the emergency bypass.
- ▶ If it is nevertheless necessary to use microbially contaminated raw water, route the water directly to the above-mentioned consumers, if possible, and do not connect the drinking water hose to the filtrate side.
- ▶ If the water must be routed via the filtrate side, all components that come into contact with the water must be chemically cleaned and disinfected after the emergency bypass has been used or after the emergency has been remedied.

To use the emergency bypass, the following steps are required:



Designation

- 1 Drinking water hose
- 2 Hose connection
- 3 Raw water shut-off valve

Designation

- 4 Filtrate shut-off valve
- 5 Draining at shut-off valve

1. Switch off the system (refer to chapter 7).
2. Close the fittings below:
 - Raw water shut-off valve (1MSF1AH01)
 - Filtrate shut-off valve (1MSF1AH04)
 - Shut-off valves on the raw water side provided by client (downstream of diaphragm expansion tank provided by client)
 - Shut-off valves on the filtrate side provided by client (upstream of pressurised water tank/buffer tank provided by client)
3. Drain the respective pipe section via the draining valves of the raw water (1MSF1AH01) and filtrate (1MSF1AH04) shut-off valves.
4. Remove the blind plugs of the piping.
5. Connect the drinking water hose tightly using tools.
6. Open the shut-off valves on the raw water side provided by the client.
7. Put the system back into operation.



You can also use the drinking water hose to perform “additional flushing” at start-up/commissioning (refer to technical service manual).

8 Maintenance and repair

Maintenance and repair includes cleaning, inspection and maintenance of the product.



The responsibility for inspection and maintenance is subject to local and national requirements. The owner/operating company is responsible for compliance with the prescribed maintenance and repair work.



By concluding a maintenance contract you ensure that all maintenance work will be performed in due time.

- ▶ Only use genuine spare and wearing parts from Grünbeck.

8.1 Cleaning



Have the cleaning work only carried out by persons who have been instructed on the risks and dangers that can arise from the device.



WARNING Damp cleaning of live components

- Risk of electric shock
- Sparking possible due to short circuit
- ▶ Switch off the voltage supply as well as any external voltage before starting the cleaning work.
- ▶ Wait for 15 minutes and make sure that the components do not carry any voltage.
- ▶ Do not open any switch cabinets.
- ▶ Do not use any high-pressure equipment for cleaning and do not blast electrical/electronic devices with water.



CAUTION Climbing onto system components

- Risk of falling when climbing onto system components
- ▶ Do not climb onto system components such as pipes, racks, etc.
- ▶ Use stable, safe and self-standing access aids such as stepladders, platforms, etc. when cleaning components that are located at high levels.

NOTE: Do not clean the system with cleaning agents containing alcohol/solvents

- These substances damage the plastic components
- ▶ Use a mild/pH-neutral soap solution.
- ▶ Use personal protective equipment.
- ▶ Only clean the outside of the system.
- ▶ Do not use any strong or abrasive cleaning agents.
- ▶ Wipe the surfaces with a damp cloth.
- ▶ Dry the surfaces with a cloth.

8.2 Intervals



By way of regular inspections and maintenance, malfunctions can be detected in time and system failures might be avoided.

- ▶ (As owner/operating company) Determine which components have to be inspected and maintained at which intervals (load-dependent).

The interval table below shows the minimum intervals for the tasks to be carried out.

Task	Interval	Execution
Inspection	weekly	<ul style="list-style-type: none"> • Visual check for damage, leaks and tears • Odour test • Check the pipe fan for function • Check the air filter for impurities
Maintenance	annually	<ul style="list-style-type: none"> • Check the entire system for leaks • Check the pump for function • Check the rack • Check the connections • Check the diaphragm expansion tank • Check the control unit • Replace the air filter • Check and clean the pipe fan
	5 years	<ul style="list-style-type: none"> • Replace seals
	as required	<ul style="list-style-type: none"> • Replace the filter material

8.3 Inspection

Regular inspections increase the operational reliability of your product.

- ▶ Carry out an inspection at least once a week. Proceed as follows:
 1. Visually check for damage, leaks and tears.
 2. Check the air filter of the pipe fan for impurities – replace the air filter, if necessary.
 3. Check whether the fan and the ventilation slots of the pump are free of dust – clean the pump, if necessary.
 4. Watch out for the smell of hydrogen sulphide in the installation room and at the exhaust air pipe outside (foul odour) – contact the technical service if you suspect this.

8.4 Maintenance



Doing the annual maintenance work requires specialist knowledge. The maintenance work must be carried out by technical service personnel only.



DANGER

Life-threatening electrical voltage during interventions on the system

- Risk of severe burns, cardiovascular failure, fatal electric shock
- Short-circuits and voltage transfers are possible
- ▶ Only have qualified electricians carry out electrical work on the system.
- ▶ Before starting work on active system parts, make sure they are de-energised. Ensure their de-energised state for the duration of the work. Obey the following 5 safety rules while doing so:
 - a De-energiese
 - b Secure against restart
 - c Verify that no voltage is present
 - d Earth and short-circuit
 - e Cover or block off adjacent live parts

8.4.1 Removing (old) filter material

It might be necessary to change the filter material from time to time. This period of time can vary depending on the quality of the raw water.



CAUTION

Working at heights (approx. 2 m) when removing the filter material

- Risk of falling by slipping or loosing balance
 - ▶ Use a stable stepladder.
1. Remove the lid of the filter tank (weight approx. 5 kg) and place it next to the system.
 2. Extract the filter material through the tank opening.
 - a Use a solid matter vacuum cleaner (the length of the suction hose must reach to the bottom of the tank).

8.4.2 Checking the diaphragm expansion tank

1. Check the diaphragm expansion tank for damage and impurities. Replace the diaphragm expansion tank in case of damage.
 2. Briefly operate the gas filling valve. Replace the diaphragm expansion tank if water escapes.
 3. Check the setting pressure (preload pressure) of the diaphragm expansion tank. Correct it, if necessary.
- Use nitrogen for gas filling. The water side must be non-pressurised.

8.5 Consumables

Filter filling for deferrisation/demanganisation

Product	Order no.
Filter filling fermaliQ:MA2000, FE/MN	530 501
Filter filling fermaliQ:MA3000, FE/MN	530 511
Filter filling fermaliQ:MA5000, FE/MN	530 521
Filter filling fermaliQ:MA10000, FE/MN	530 531

Filter filling for solid particle filtration

Product	Order no.
Filter filling fermaliQ:MA2000, FIL	530 502
Filter filling fermaliQ:MA2000, FIL	530 512
Filter filling fermaliQ:MA5000, FIL	530 522
Filter filling fermaliQ:MA10000, FIL	530 532

Additional consumables

Product	Order no.
Replacement air filter LFV	530 529

8.6 Spare parts, wearing parts

For spare parts and wearing parts, please contact your local Grünbeck representative which you can find on the internet at www.gruenbeck.com.

9 Troubleshooting



WARNING

Contaminated water due to stagnation.

- Infectious diseases
- ▶ Have malfunctions repaired immediately.

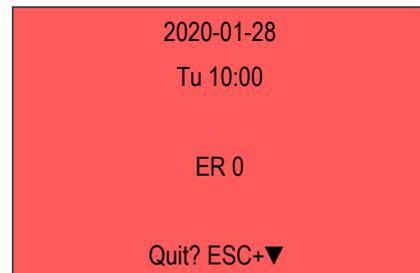
9.1 Display messages

In case of a malfunction, the display of the control unit flashes in red.

The following appears on the display: Time when the fault occurred and error code of the fault.

To acknowledge the malfunctions:

- ▶ Press and hold **ESC** and simultaneously press **▲**.
- » The malfunction was acknowledged.



Code	Meaning	Causes	Remedy
ER 0	Raw water pump defective	<ul style="list-style-type: none"> • The filling level (between level 3 and level 2) is not reached within a certain delay time 	<ul style="list-style-type: none"> ▶ Check function and control signal of raw water pump.
ER 1	Fault Filtrate pump 1MSF1AP02	<ul style="list-style-type: none"> • The pump is in fault mode. 	<ul style="list-style-type: none"> ▶ Check filtrate pump for function. ▶ (For a description of the fault, refer to the error code on the frequency converter and the operation manual of the filtrate pump)



The fermalIQ:MA10000 features two pumps. If one of the pumps fails, a fault is output. However, the system can continue to operate at half power.

ER 2	Backwash unsuccessful	<ul style="list-style-type: none"> • The required backwash volume was not reached. 	<ul style="list-style-type: none"> ▶ Check the compressed air cushion in the pressurised water tank and refill, if necessary.
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Code	Meaning	Causes	Remedy
		<ul style="list-style-type: none"> The existing compressed air cushion was not sufficient for the backwash process (error only appears after repeated occurrence of the cause of the error). 	<ul style="list-style-type: none"> Check pressure switch 1MSF1AP03 for function.
ER 3	Fault End position of backwash valve 1MSF1AV01	<ul style="list-style-type: none"> Backwash does not open or close although it has been activated. 	<ul style="list-style-type: none"> Check function and feedback of valve.
ER 4	Fault End position of discharge valve of first filtrate 1MSF1AV02	<ul style="list-style-type: none"> First filtrate valve does not open or close although it has been activated. 	<ul style="list-style-type: none"> Check function and feedback of valve.
ER 5	Requirements for backwash process not met	<ul style="list-style-type: none"> No backwash process could be started because there was no pressure during the backwash period, water was continuously withdrawn, or the minimum filling level in the tank was not reached. 	<ul style="list-style-type: none"> Check the compressed air cushion in the pressurised water tank and refill, if necessary. Check the backwash times and adjust them, if required. Check function and control signal of raw water pump.

9.2 Pump displays

In the event of an alarm or error, the display of the pump indicates a code and the status LED lights up.

- Alarms and errors are stored with date and time.
- Alarms and errors can be reset by switching the device off for at least one minute.

9.2.1 Alarm codes

Code	Meaning	Causes	Remedy
A03	Loss of power	<ul style="list-style-type: none"> Temperature too high 	<ul style="list-style-type: none"> Lower the room temperature Lower the water temperature Reduce the load
A05	Data memory alarm	<ul style="list-style-type: none"> Data memory corrupted 	<ul style="list-style-type: none"> Forward error message to technical service
A06	LOW alarm	<ul style="list-style-type: none"> Lack of water detected 	<ul style="list-style-type: none"> Check water level in tank

Code	Meaning	Causes	Remedy
A15	EEPROM	<ul style="list-style-type: none"> Data memory corrupted 	<ul style="list-style-type: none"> Stop the pump for 5 min and then restart it
A20	Internal alarm		<p>If the problem persists:</p> <ul style="list-style-type: none"> Forward error message to technical service
A30	Multi-pump connection alarm	<ul style="list-style-type: none"> Faulty multi-pump connection 	<ul style="list-style-type: none"> Check the condition of the connection cables Check that there are no discrepancies in the addresses
A31	Loss of multi-pump connection	<ul style="list-style-type: none"> Loss of multi-pump connection 	<ul style="list-style-type: none"> Check the condition of the connection cables

9.2.2 Error codes

Code	Meaning	Causes	Remedy
E01	Internal communication error	<ul style="list-style-type: none"> Lack of internal communication 	<ul style="list-style-type: none"> Stop the pump for 5 min and then restart it
E02	Motor overload error	<ul style="list-style-type: none"> High motor voltage Current consumption of motor too high 	<p>If the problem persists:</p> <ul style="list-style-type: none"> Forward error message to technical service
E03	DC-bus overvoltage error	<ul style="list-style-type: none"> DC-bus overvoltage External causes condition pump operation via generator 	<ul style="list-style-type: none"> Check system configuration Check position and integrity of non-return valves
E04	Rotor blocked	<ul style="list-style-type: none"> Motor stands still Rotor synchronicity is lacking, or rotor is blocked by foreign matter 	<ul style="list-style-type: none"> Make sure that there is no foreign matter that prevents the pump from rotating Stop the pump for 5 min and then restart it <p>If the problem persists:</p> <ul style="list-style-type: none"> Forward error message to technical service
E05	EEPROM data memory error	<ul style="list-style-type: none"> EEPROM data memory corrupted 	<ul style="list-style-type: none"> Stop the pump for 5 min and then restart it <p>If the problem persists:</p> <ul style="list-style-type: none"> Forward error message to technical service
E06	Grid voltage error	<ul style="list-style-type: none"> Voltage supply outside the operating range 	<ul style="list-style-type: none"> Check voltage Check electrical connection
E07	Error motor winding temperature	<ul style="list-style-type: none"> Thermal contactor of motor tripped 	<ul style="list-style-type: none"> Check whether there are impurities near the impeller and the rotor – remove them, if necessary

Code	Meaning	Causes	Remedy
			<ul style="list-style-type: none"> ▶ Check condition of installation as well water and air temperature ▶ Wait until the motor has cooled down <p>If the problem persists:</p> <ul style="list-style-type: none"> ▶ Stop the pump for 5 min and then restart it <p>If the problem persists:</p> <ul style="list-style-type: none"> ▶ Contact technical service
E08	Power module temperature error	<ul style="list-style-type: none"> • Thermal contactor of frequency converter has tripped 	<ul style="list-style-type: none"> ▶ Check condition of installation and air temperature
E09	General hardware error	<ul style="list-style-type: none"> • Hardware error 	<ul style="list-style-type: none"> ▶ Stop the pump for 5 min and then restart it <p>If the problem persists:</p> <ul style="list-style-type: none"> ▶ Contact technical service
E11	LOW error	<ul style="list-style-type: none"> • Detection of lack of water (if P48 = ERR) 	<ul style="list-style-type: none"> ▶ Check water level in tank
E12	Pressure sensor error	<ul style="list-style-type: none"> • Missing pressure sensor (not available for ACT mode) 	<ul style="list-style-type: none"> ▶ Check condition of contacts on the sensor
E14	Low-pressure error	<ul style="list-style-type: none"> • Pressure below minimum limit (not available for ACT mode) 	<ul style="list-style-type: none"> ▶ Check settings of parameters P45 and P46
E15	Loss of phase	<ul style="list-style-type: none"> • Loss of one of the three phases (only in case of three-phase version) 	<ul style="list-style-type: none"> ▶ Check connection to mains
E30	Multi-pump protocol error	<ul style="list-style-type: none"> • Incompatible multi-pump protocol 	<ul style="list-style-type: none"> ▶ Update all devices to the same firmware version

9.3 Other observations

Observation	Meaning	Remedy
Pump does not start running	<ul style="list-style-type: none"> • Intervention of amperometric thermal protection 	<ul style="list-style-type: none"> ▶ Wait for reset after cooling ▶ Check voltage and integrity of connection to mains
	<ul style="list-style-type: none"> • Main fuse or residual current circuit breaker has tripped; fuse has blown 	<ul style="list-style-type: none"> ▶ Reset fuse or replace blown fuses
Pump starts running, but after a short time the overload protection trips or the fuses blow	<ul style="list-style-type: none"> • Supply cable damaged, short-circuit of electric motor, overload protection or fuses are not suitable for the supply current of the motor 	<ul style="list-style-type: none"> ▶ Check components and replace, if necessary

Observation	Meaning	Remedy
	<ul style="list-style-type: none"> • Intervention of amperometric thermal protection or protection device because current consumption is too high 	▶ Check motor
	<ul style="list-style-type: none"> • A power supply phase is missing 	▶ Check supply
	<ul style="list-style-type: none"> • Foreign matter inside the pump blocks the impellers 	▶ Clean the pump
Pump starts running but does not deliver water	<ul style="list-style-type: none"> • Pump draws in air 	▶ Check liquid level, seal of suction line and bottom valve
	<ul style="list-style-type: none"> • Pump is not filled correctly 	▶ Repeat filling process
Pump does not deliver enough water		▶ Check the lines for bottlenecks and restrictions
	<ul style="list-style-type: none"> • Pump is not filled correctly 	▶ Repeat filling process
	<ul style="list-style-type: none"> • Direction of rotation is not correct 	▶ Check direction of rotation

10 Dismantling and disposal

10.1 Dismantling



Have this work carried out by qualified specialists only.

1. Flush the system with raw water.
2. Disconnect the system from mains – discharge residual voltage.
3. Close the shut-off valves provided by the client on the raw water and filtrate (upstream and downstream of the system).
4. Vent and drain the system.
5. Drain the filter material.
6. Separate the system from the plumbing installation (raw water inlet, filtrate outlet, exhaust air, drain connections).
7. Disconnect the potential equalisation (grounding) provided by client on site.
8. Remove individual components such as accessories, if necessary.
9. Transport the system secured on a pallet.

10.2 Disposal

- ▶ Obey the applicable national regulations.

Packaging

- ▶ Dispose of the packaging in an environmentally sound manner.

Product



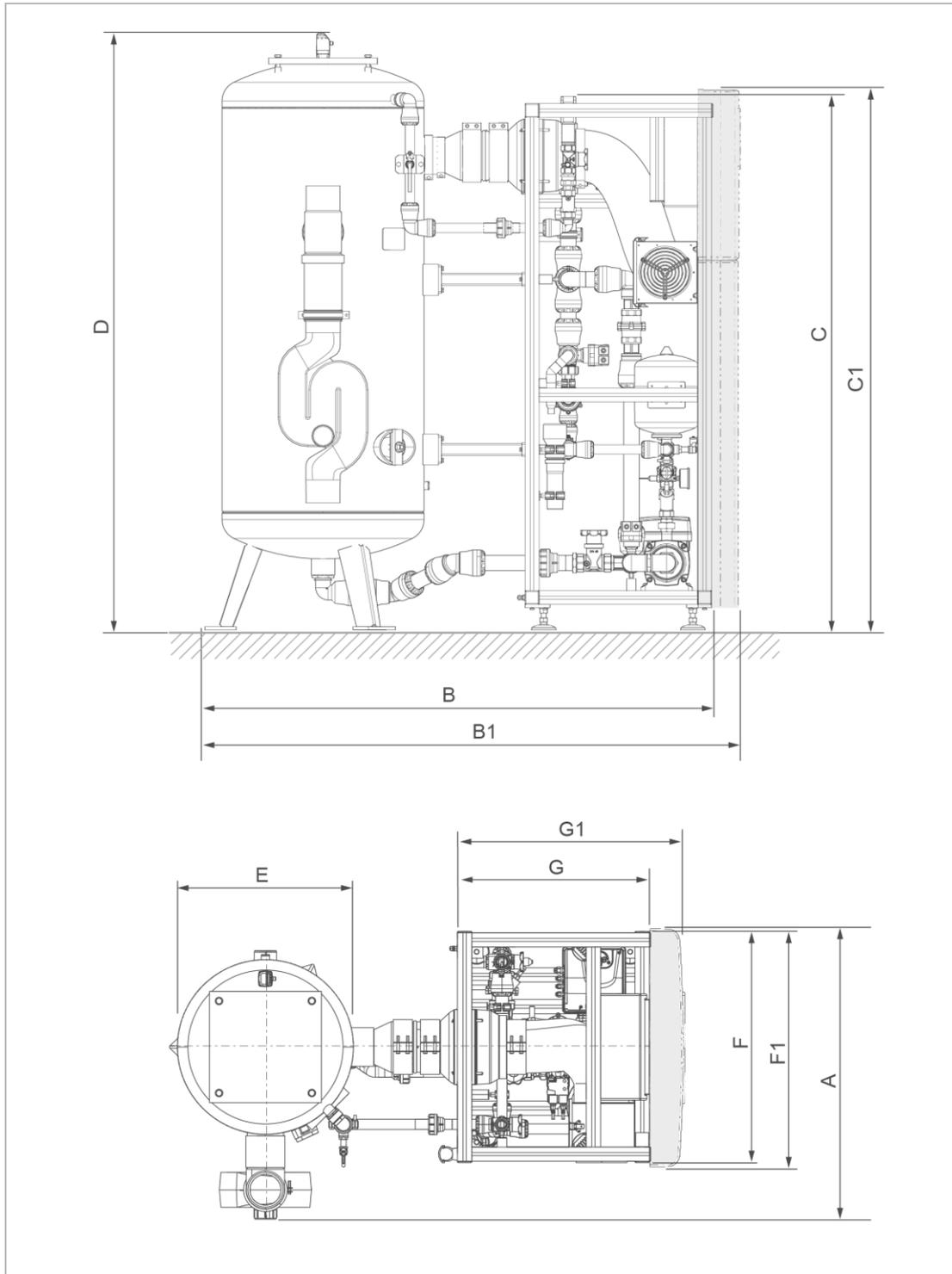
If this symbol (crossed-out wheellie bin) is on the product, this product or its electrical and electronic components must not be disposed of as household waste.

- ▶ Dispose of electrical and electronic products or components in an environmentally sound manner.



For more information on take-back and disposal, go to www.gruenbeck.com.

11 Technical specifications



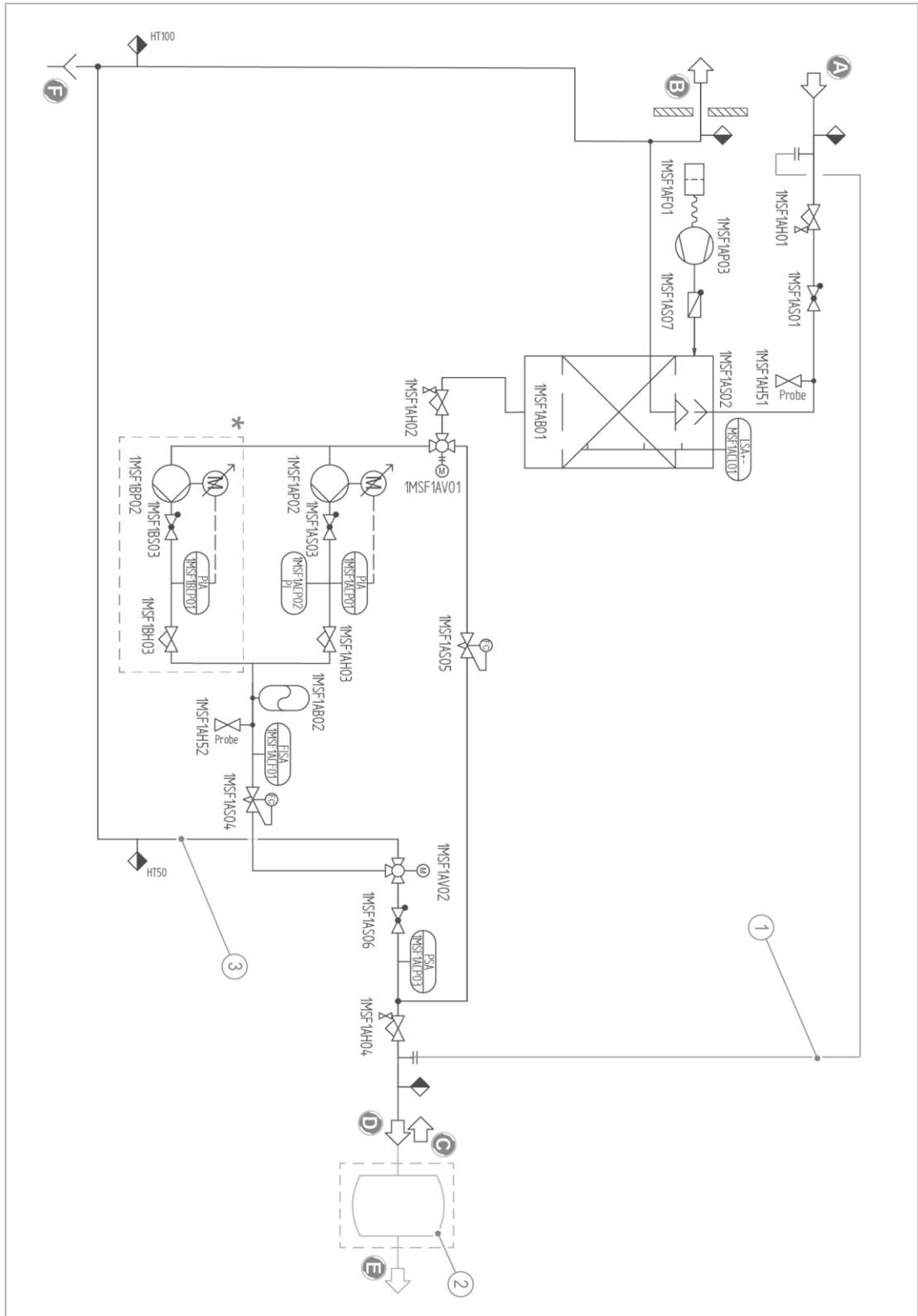
Dimensions and weights			MA2000	MA3000	MA5000	MA10000
A	Width of entire system	mm	880	920	1060	1340
B	Depth of entire system	mm	1540	1630	1800	2430
B1	Depth of entire system with front cover	mm	1600	1690	1860	2490
C	Height of system rack	mm	1730			
C1	Height of system rack with front cover	mm	1750			
D	Height of filter tank	mm	1700	1940	1920	2120
E	Outside diameter of filter tank	mm	550	650	800	1100
F	Width of system rack	mm	720			
F1	Width of system rack with front cover		750			
G	Depth of system rack	mm	600	600	600	990
G1	Depth of system rack with front cover	mm	660	660	660	1050
	Operating weight of filter tank, approx.	kg	500	800	1200	2300
	Empty weight of filter tank, approx.	kg	90	110	130	330
	Weight of rack, approx.	kg	100	100	100	120

Connection data			MA2000	MA3000	MA5000	MA10000
Raw water inlet	DN		25 (1" male thread)	25 (1" male thread)	32 (1¼" male thread)	40 (1½" male thread)
Filtrate outlet/backwash water inlet	DN		40 (1½" male thread)	40 (1½" male thread)	50 (2" male thread)	65 (2½" male thread)
Backwash water to drain (HT pipe)	DN		100 (PE)			
Discharge of first filtrate to drain (HT pipe)	DN		50 (PP)	50 (PP)	50 (PP)	100 (PP)
Supply air D _o	mm		160			
Exhaust air	DN		100 (PE)			
Connected load, approx.	kW		1.0	1.5	1.5	3.0
Power supply	V/Hz		230/50			
Protection/protection class			IP 54 [⊕]			

Performance data			MA2000	MA3000	MA5000	MA10000
Nominal flow (subject to the raw water quality)	m³/h		2.0	3.0	5.0	10.0
Backwash volume flow	m³/h		5.7	7.9	12.5	22.7
Well water volume flow	m³/h		3,0 – 4,0	4,5 – 6,0	7,5 – 10,0	15,0 – 20,0
Operating pressure of well water	bar		2.0 – 5.5			
Operating pressure of filtration	bar		3.5 – 5.5			
Operating pressure of backwash	bar		3.5 – 5.5			
Required dimensioning of pressurised water tank (for backwash)	l		≥ 500	≥ 750	≥ 1000	≥ 2000 or 2 x 1000

General data		MA2000	MA3000	MA5000	MA10000
Water temperature (drinking water)	°C	5 – 20			
Ambient temperature (drinking water)	°C	5 – 25			
Water temperature (technical applications)	°C	5 – 35			
Ambient temperature (technical applications)	°C	5 – 35			
pH value of raw water		6.5 – 8.5			
Humidity (non-condensing)	%	≤ 70			
Order no.		530 500	530 510	530 520	530 520

11.1 PID flow chart



* Only fermaliQ:MA10000, order no. 530 530

No./Coding	Designation
1	Emergency bypass
2	Discharge of first filtrate
3	Pressurised water tank (accessory)
1MSF1AB01	Filter tank
1MSF1AB02	Diaphragm expansion tank
1MSF1ACF01	Flow sensor
1MSF1ACL01	Level control
1MSF1ACP01	Filtrate pressure sensor
1MSF1ACP02	Filtrate pressure gauge
1MSF1ACP03	Pressure switch (backwash monitoring)
1MSF1AE01	Control cabinet
1MSF1AF01	Air filter box
1MSF1AH01	Raw water shut-off valve
1MSF1AH02	Tank shut-off valve
1MSF1AH03	Filtrate pump shut-off valve
1MSF1AH04	Filtrate shut-off valve
1MSF1AH51	Raw water sampling valve

No./Coding	Designation
1MSF1AH52	Filtrate sampling valve
1MSF1AP02	Filtrate pump
1MSF1AP03	Pipe fan
1MSF1AS01	Raw water non-return valve
1MSF1AS02	Hollow cone spray nozzle
1MSF1AS03	Filtrate non-return valve
1MSF1AS04	Flow stabiliser Filtration
1MSF1AS05	Flow stabiliser Backwash
1MSF1AS06	Backwash non-return valve
1MSF1AS07	Air backflow flap
1MSF1AV01	Shut-off valve Filtration/Backwash
1MSF1AV02	Shut-off valve Filtration/Discharge of first filtrate
1MSF1BCP01	Filtrate pressure sensor
1MSF1BH03	Filtrate pump shut-off valve
1MSF1BP02	Filtrate pump
1MSF1BS03	Filtrate non-return valve

Connections

Designation
A Raw water inlet
B Exhaust air to the outside
C Backwash water inlet

Designation
D Filtrate outlet
E To consumer
F To drain

EC Declaration of Conformity

In accordance with the EC Machinery Directive 2006/42/EC



This is to certify that the system designated below meets the safety and health protection requirements of the applicable EC/EU guidelines in terms of its design, construction and execution.

This certificate becomes void if the system is modified in any way not approved by us.

Oxidation filter system fermaliQ:MA

Serial no.: Refer to type plate

Furthermore, we confirm compliance with the essential requirements of the EMC Directive 2014/30/EU

The following harmonised standards have been applied:

- DIN EN ISO 12100: 2011-03
- DIN EN 60204-1:2019-06

Responsible for documentation:

Peter Höß

Manufacturer

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Hoechstädt, 09.04.2020

A handwritten signature in black ink, appearing to read 'P. Höß', is written over a horizontal line.

i. V.

Peter Höß
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