



HygroMATIK®

MiniSteam

Electrode Steam Humidifier



Manual

**IMPORTANT: READ AND SAVE
THESE INSTRUCTIONS**



MSE.CSA
E-8881772

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MSE 05/10 CSA

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WARNING

Risk of electrical shock!

Hazardous electrical voltage!

All electrical work to be performed by certified expert staff (electricians or expert personnel with equivalent training) only.

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1. Introduction

Dear Customer,

Thank you for choosing a HygroMatik steam humidifier.

HygroMatik steam humidifiers represent the latest in humidification technology.

In order to operate your HygroMatik steam humidifier safely, properly and efficiently, please read these operating instructions.

Employ your steam humidifier only in sound condition and as directed. Consider potential hazards and safety issues and follow all the recommendations in these instructions.

If you have additional questions, please contact your expert dealer.

For all technical questions or spare parts orders, please be prepared to provide unit type and serial number (see name plate on the unit).

1.1 Typographic Distinctions

- preceded by a bullet: general specifications
- » preceded by an arrow: Procedures for servicing or maintenance which should or must be performed in the indicated order
- ☑ Installation step which must be checked off.
- italics* Terms used with graphics or drawings

1.2 Documentation

Please note

In addition to this manual, the appropriate FlexLine Control documentation is mandatory for the operation of the unit. This is not applicable to StandardLine devices, here the documentation of the controller is included in the operation manual.

Retention

Please retain these operating instructions in a secure, always accessible location. If the product is resold, turn the documentation over to the new operator. If the documentation is lost, please contact HygroMatik.

Versions in Other Languages

These operating instructions are available in several languages. If interested, please contact HygroMatik or your HygroMatik dealer.

1.3 Symbols in Use

1.3.1 Specific Symbols related to Safety Instructions

According to ANSI Z535.6 the following signal words are used within this document:

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

NOTICE is used to address practices not related to physical injury.

1.3.2 General Symbols

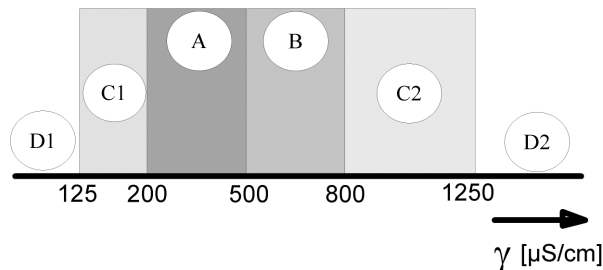
Please note

This symbol is used whenever a situation requires special attention beyond the scope of safety instructions.

1.4 Intended Use

HygroMatik electrode steam humidifiers serve for steam production based on tap water or partially softened water.

Only use supply water featuring a conductivity of 125 to 1250 $\mu\text{S}/\text{cm}$.



D1: Lower threshold

C1: Range of reduced conductivity
(adjustment required)

A: Normal Tap water

B: Range of increased conductivity

C2: Range of high conductivity
(adjustment required)

D2: Upper threshold

In the C1 and C2 ranges, adaptation of the periodic blow-down frequency may be required. Pls. refer to parameter „2-1“ and „2-2“ explanations given in the „Detailed parameter descriptions“ section.

The following applies to the **StandardLine** device series: Please read the explanations of parameters "2-1" and "2-2" in the section "Detailed parameter descriptions" in this manual.

Proper usage also comprises the adherence to the conditions specified by HygroMatik for:

- installation
- dismantling
- reassembly
- commissioning
- operation
- maintenance
- disposal.

Only qualified and authorised personnel may operate the unit. Persons transporting or working on the unit must have read and understood the corresponding parts of the Operation and Maintenance Instructions and especially the chapter 2. „Safety Notes“. Additionally, operating personnel must be informed of any possible dangers. You should place a copy of the Operation and Maintenance Instructions at the unit's operational location (or near the unit).

By construction, HygroMatik steam humidifiers are not qualified for exterior application.

⚠ WARNING

Risk of scalding!

Steam with a temperature of up to 100 °C (212° F) is produced.

Do not inhale steam directly!

2. Safety Instructions

These safety instructions are required by law. They promote workplace safety and accident prevention.

2.1 Guidelines for Safe Operation

2.1.1 Scope

Comply with the accident prevention regulation „DGUV Regulation 3“ to prevent injury to yourself and others. Beyond that, national regulations apply without restrictions. This way you can protect yourself and others from harm.

2.1.2 Unit control

Do not perform any work which compromises the safety of the unit. Obey all safety instructions and warnings present on the unit.

In case of a malfunction or electrical power disruption, switch off the unit immediately and prevent a restart. Repair malfunctions promptly.

⚠ WARNING

Restricted use.

IEC 60335-1 stipulates as follows:

This device may be used by children of eight years of age and above as well as by persons with reduced physical, sensory or mental capabilities or lack of experience and knowledge so long as they are supervised or have been instructed regarding the safe use of the device and understand the hazards that may result from it. Cleaning and user maintenance of the unit must not be undertaken by children without supervision.

2.1.3 Unit Operation

⚠ WARNING

Risk of scalding!

Uncontrolled hot steam escape in case of leaking or defective components possible.

Switch off unit immediately.

⚠ WARNING

For Ministeam devices applies:

Risk of scalding!

No persons may be under the cloud of steam blowing out (at a distance of approx. 1 m/40 inch in the direction of blowing out and 0.5 m/20 inch on both sides of the device).

NOTICE

Risk of material damage!

- The unit may be damaged if switched on repeatedly following a malfunction without prior repair. Rectify defects immediately!
- The unit must not be operated on a DC power supply.
- The unit may only be used connected to a steam pipe that safely transports the steam (not valid for MiniSteam units).
- Regularly check that all safety and monitoring devices are functioning normally. Do not remove or disable safety devices.
- Steam operation is only allowed when the unit cover is closed.

NOTICE

Water leaks caused by defective connections or malfunctions are possible.

Water is constantly and automatically filled and drained in the humidifier. Connections and water-carrying components must be checked regularly for correct operation.

2.1.4 Mounting, dismantling, maintenance and repair of the unit

NOTICE

The HygroMatik steam humidifier is IP20 protected. Make sure that the unit is not object to dripping water in the mounting location.

Installing a humidifier in a room without water discharge requires safety devices to protect against water leakages.

- Use genuine spare parts only
- After any repair work, have qualified personnel check the safe operation of the unit
- Attaching or installing of **additional components** is permitted only with the **written consent** of the manufacturer

NOTICE

Do not install HygroMatik steam generators above electrical equipment such as fuse boxes, electrical appliances, etc. In the case of a leakage, leaking water can damage the underlying electrical equipment

2.1.5 Electrical

⚠ WARNING

Risk of electrical shock!

Hazardous electrical voltage!

Any work on the electrical system to be performed by certified expert staff (electricians or expert personnel with comparable training) only.

Steam operation may only be started when the unit cover is closed.

During maintenance or installation work, the device must be disconnected from the power supply and secured against being switched on again. The absence of voltage must be ensured by a measurement.

Leaks can cause leakage currents. Observe safety regulations on working with voltage parts (applies to electrode steam humidifiers).

After electrical installation or repair work, test all safety mechanisms (such as grounding resistance).

NOTICE

Use only original fuses with the appropriate amperage rating.

Regularly check the unit's electrical equipment. Promptly repair any damage such as loose connections or burned wiring.

Responsibility for intrinsically safe installation of the HygroMatik steam humidifiers is incumbent on the installing specialist company.

2.2 Disposal after dismantling

The humidifier is made up of metal parts and plastic parts. In reference to European Union directive 2012/19/EU issued on 4 July 2012 and the related national legislation, please note that:

The components of the electrical and electronic devices must not be disposed of as municipal waste, and therefore the method of waste separation must be applied. The public or private waste collection systems defined by local legislation must be used.

NOTICE

The operator is responsible for the disposal of unit components as required by law.

3. Transport

Please note

Proceed carefully when transporting the steam humidifier in order to prevent damage due to stress or careless loading and unloading.

Time limits for filing freight claims with shipping companies are*:

Shipping company	After receipt of goods
Carriers	no later than 4 days
Parcel service	immediately

* Time limits for some services subject to change.

3.1 Packing

Please note

Pay attention to the icons affixed to the packing box.

3.2 Interim Storage

Store the unit in a dry place and protect from frost and strong sunlight.

3.3 Check for Complete and Correct Delivery of Goods

Upon receipt of the unit, confirm that:

- model and serial number on the name plate match those specified in the order and delivery documents
- the equipment is complete and all parts are in perfect condition

Please note

In case of damage from shipment and/or missing parts, immediately notify the carrier or supplier in writing.

4. Functional Description and Device Composition

4.1 Mode of Action

Making use of the frictional heat caused by current flow in a water tank

The HygroMatik humidifier utilizes the conductivity normally present in tap water for steam production. Electrodes inside an enclosed steam cylinder are immersed directly into the tap water. They are connected to the alternating current.

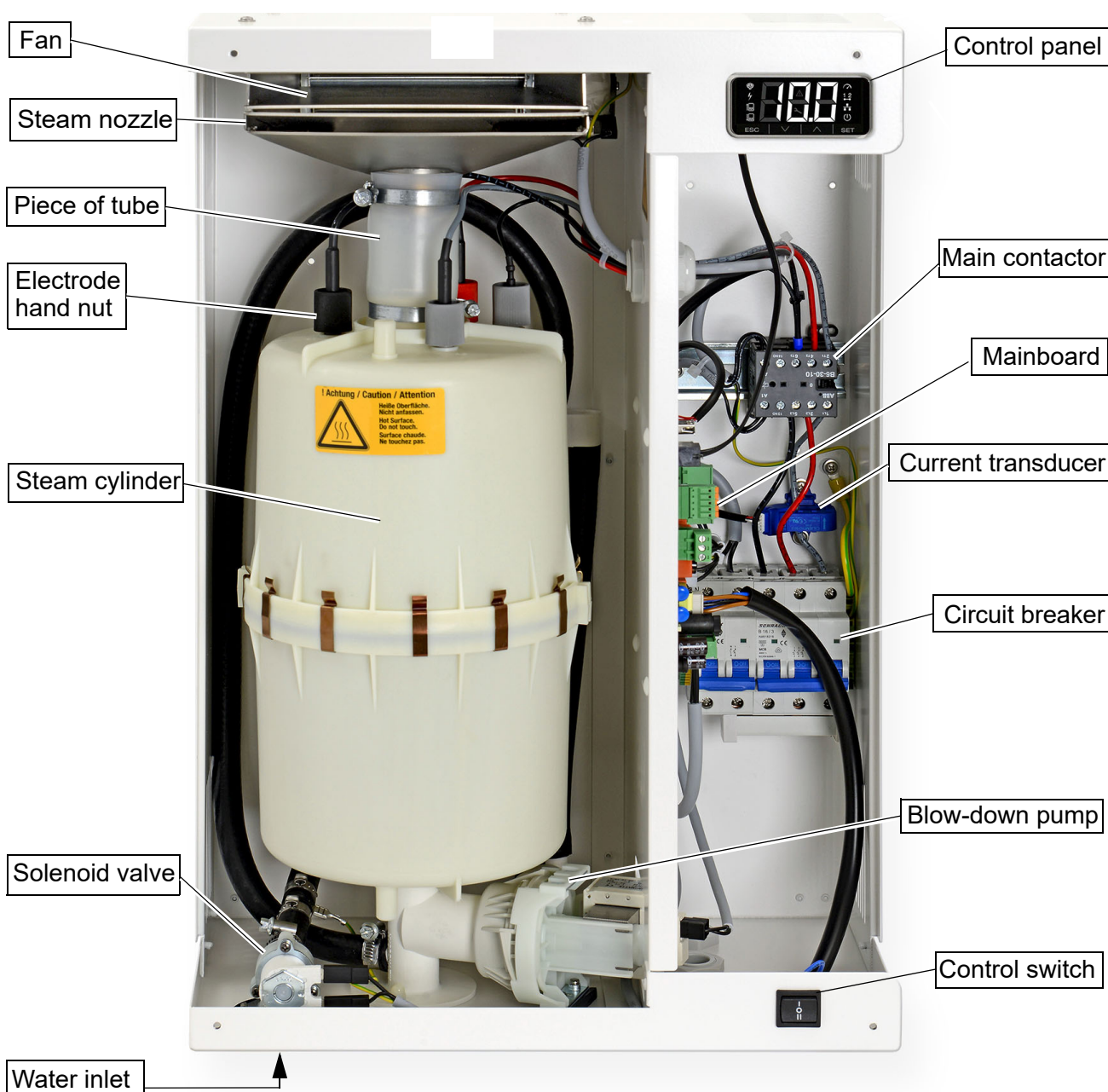
The conductivity of the water generates an electric current between the electrodes.

In this way, the electric power supplied is converted directly into heat without energy loss.

The steam produced has a temperature of about 100°C (212°F) with minimal excess pressure ("pressureless steam"). It is largely free of minerals and germ-free. Mineral deposits typically remain behind in the cylinder.

4.2 Mechanical construction

The MiniSteam humidifiers are designed for wall mounting. For maintenance purposes, the steam cylinders are separable in the middle.



4.3 Operating sequence

By pressing the control switch („Pos. I“) the humidifier is turned on. When the controller specifies an increase in humidity, the main contactor is switched on and the electrodes (48)^{*)} are supplied with power. The water inlet solenoid valve (25)^{*)} feeds water into the steam cylinder (16)^{*)}.

As soon as the electrodes are immersed, the current begins to flow. The water is now heated. When the pre-selected output is reached, the control turns off the solenoid valve and interrupts the water supply.

After a short period of heating up, the water between the electrodes starts boiling and then vaporizes. The vaporization lowers the water level in the steam cylinder, reducing the output provided. To compensate for that, fresh water is fed into the steam cylinder every now and then by opening the intake solenoid valve.

Humidifier power usage is continuously monitored. With a cold start-up, the nominal current increases to 113% in order to achieve quick-start output parameters. This activates the electronic overflow limiter which causes a partial draining of the cylinder. This reduces the immersed surface area of the electrodes, lowering power usage.

The concentration of dissolved salts increases over time, which can lead to a rise in the conductivity of the water. If this continues, conductivity may increase until a short circuit occurs. This could damage the unit, but in any case would significantly reduce the life span of the electrodes.

For this reason, regular, periodic blow-downs of some of the concentrated water are very important. Following this procedure as recommended provides stable cylinder water conductivity as well as minimal water loss for the expected service life of the cylinder.

Water blow-down is performed by a blow-down pump 32)^{*)}. The functioning of the blow-down pump is continuously monitored during operation. If the pump is damaged, the steam humidifier shuts down.

With normal water quality the blow-down loss rate lies between 7 and 15 % of the amount of steam produced. Depending on water quality, a full steam cylinder blow-down is run every 3 to 8 days.

Mineral deposits settle in the open area below the electrodes and are removed through periodic maintenance. The blow-down pump itself has wide openings and can flush out smaller pieces of mineral deposit. This extends the service life of the unit and reduces the required maintenance interval.

On blow-down, water flows from the pump into the drainage system.

For maintenance purposes, the cylinder water may be pumped out by pressing and holding the control switch in the „II“ position.

Monitoring max. level

A sensor electrode (10)^{*)} monitors the maximum water capacity of the cylinder. When the water level reaches the sensor electrode, the water supply is interrupted. This can occur when the water has low conductivity or when the electrodes are worn out. In the case of low water conductivity, however, this state usually lasts only a short time. The built-in control and the large area electrodes combine to produce a rapid rise in conductivity by increasing the concentration of the water.

^{*)} numbers indicated correspond with those in the exploded view in the „Exploded view“ chapter.

5. Mechanical installation

⚠ WARNING

Risk of foot injuries!

Prevent unit from dropping during installation! Helping hand of a second person is advisable.

⚠ WARNING

Risk of electrical shock!

Hazardous electrical voltage.

During installation, the unit must be disconnected from power supply and secured against being switched on again. The absence of voltage must be ensured by a measurement.

5.1 Environment parameters to be met

- By design, HygroMatik steam humidifiers are not qualified for outdoor installation (electronical components and water-bearing parts may be damaged)
- Ambient temperature must lie between +5 and +40 °C (+41 and +104 °F) in order to protect the unit electronics against damage; frost may damage the steam cylinder, the solenoid valve and pump, as well as make hoses burst
- Installation in a closed room requires aeration and, eventually, temperature conditioning in order to meet the a.m. environmental conditions
- Relative humidity must not exceed 80 % r.h., since values beyond may lead to electronic malfunction or damage
- The steam humidifier rear panel heats up during operation to a maximum of 70 °C (158 °F). Take care that the construction on which the unit is to be mounted is not made of temperature-sensitive material
- Protection class IP20

5.2 Mounting recommendations

- Mount the unit on a stable, preferably solid wall offering the bearing capacity required (s. unit technical specifications), using the mounting material supplied with the unit. If such a wall is not at hand, the unit may be attached to a stand bracket firmly bolted to the floor
- The minimum clearances indicated in the below figures must be observed in order to ensure adequate unit ventilation and allow for unobstructed access in case of maintenance
- The steam humidifier should be mounted in a position so that draught effects are avoided. Minimum mounting height above floor is 150 cm (59 inch). In order to keep out of harm's way of scalding in the nozzle area with steam emission with a temperature of 100 °C (212 °F), however, it is recommended that the steam humidifier is positioned in a height of 2.0 m (79 inch).
- Make use of existing water connections for supply and draining
- Hoses must be laid at a consistent 5 to 10 % incline/decline; sagging and kinking prevention is a must

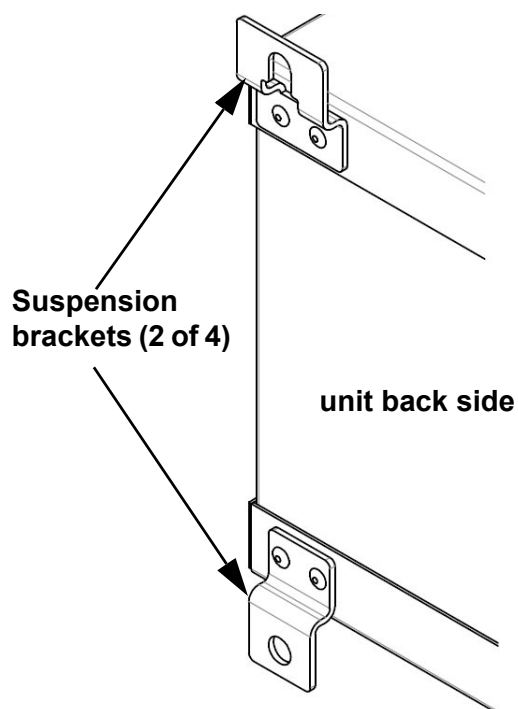
Please note

In order to achieve equal electrode depth of immersion, plumb and level installation of the HygroMatik humidifier is required.

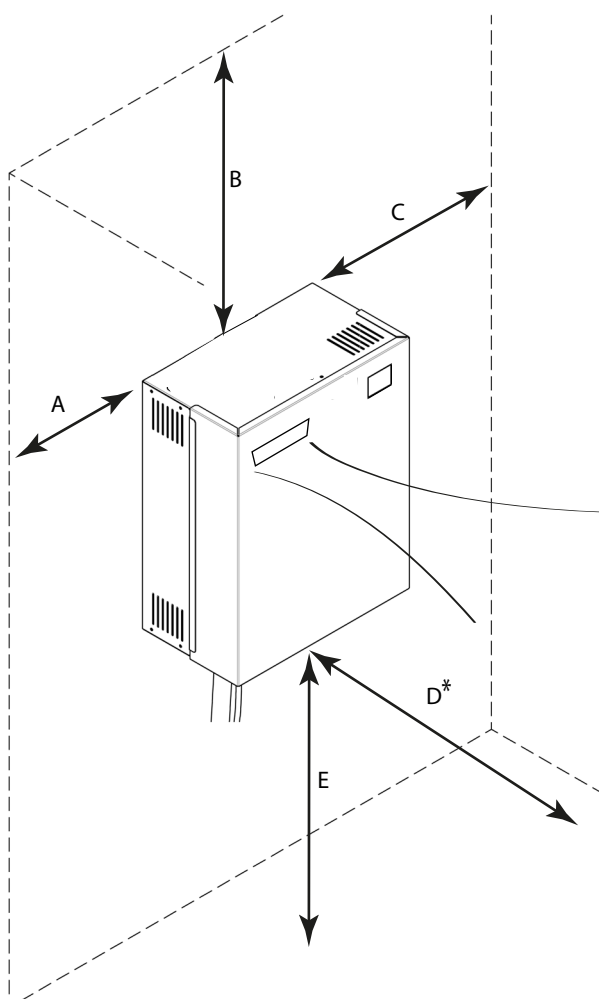
5.3 Mounting steps

- » Mark the holes for the upper suspension brackets screws.
- » Drill holes and dowel.
- » Screw in the supplied mounting screws; let the screws protrude approx. 12 mm/.5 inch from wall.
- » Ensure firm fixation and load-carrying capacity of the mounted screws!
- » Hook in the unit and ensure safe suspension.
- » Mark the holes for the lower suspension brackets screws.
- » Remove the unit.
- » drill holes and dowel.
- » Hook in the unit in final position and mount screws in lower suspension brackets.

Suspension brackets for wall mounting



Minimum distances to surrounding walls and designated paths



Wall distances

During installation, observe the minimum distances to walls and designated paths (D) shown in the sketch.

:

steam output kg/h	A cm	B cm	C cm	D cm	E cm
3	30	30	30	70	30
4	30	30	30	110	30
5	40	30	40	120	30
6	50	30	50	160	30
7	60	50	60	210	50
8	70	80	70	230	80
9 / 10	75	90	75	240	90

The minimum distance to the opposite wall is at least 3 metres!

The behaviour of the steam cloud depends on the surrounding temperature and the room height. At higher room heights, the steam climbs faster and the length of the steam cloud is shortened. A higher room temperature causes the steam cloud to dissipate more quickly (vertically and horizontally).

Please note

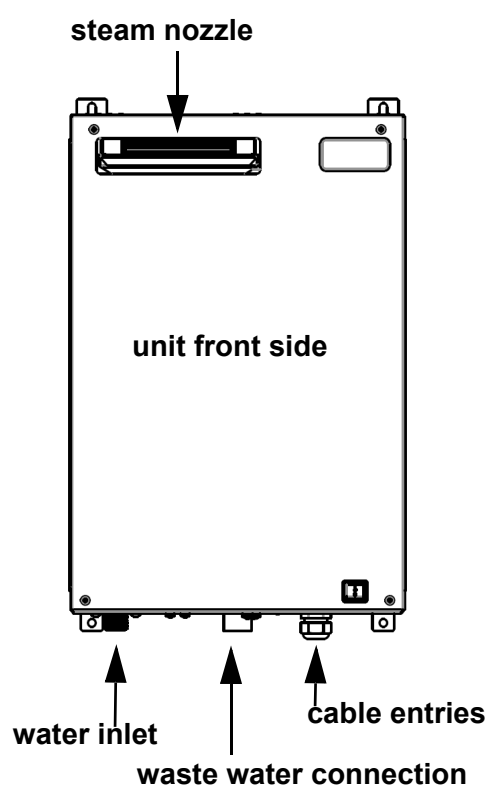
- To function properly, the steam humidifier must hang level and plumb.
- When choosing the installation location, consider the necessary distance between the unit and existing designated paths.
- The mounting wall must be made of a temperature-resistant material, as the enclosure can heat up to 70°C

5.3.1 Unit installation check

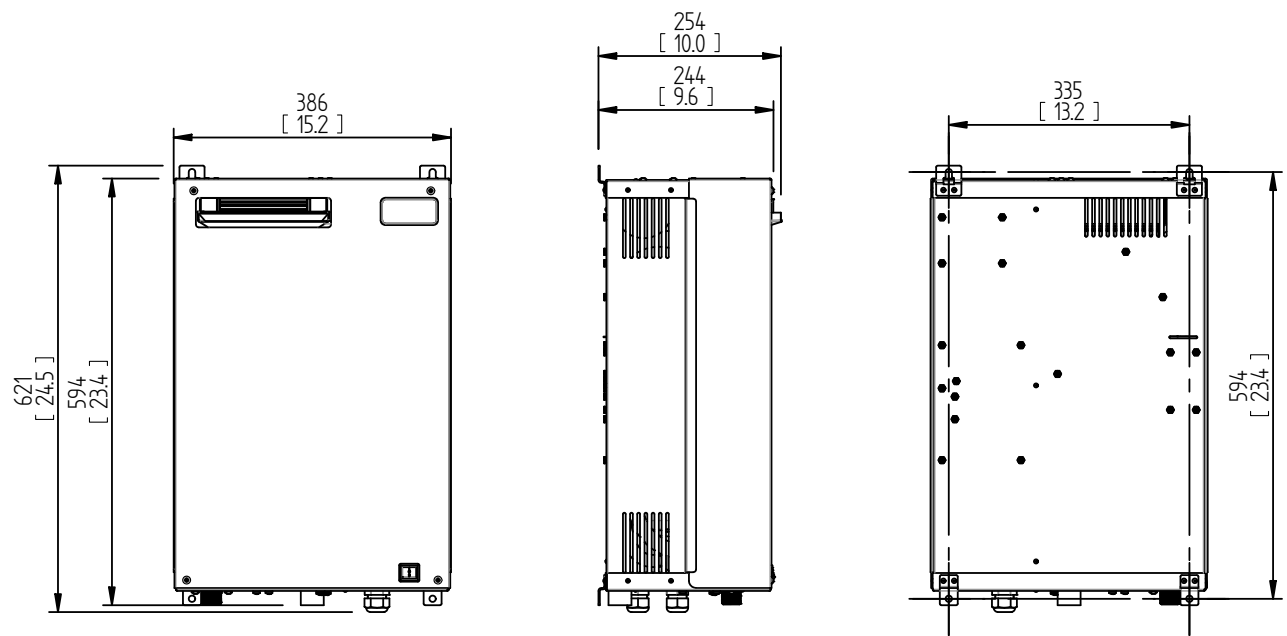
Prior to commissioning, please check the proper device installation using the following list:

- ☒ Was the unit mounted plumb and level?
- ☒ Are wall distances to the unit within the range
- ☒ Is the unit installed in such a way that draught effects are avoided?
- ☒ Are all bolts and clamps tightened?

Device connections



6. Dimensions



all measures in mm [inch]

Detailed measurements under

<https://www.hygromatik.com/files/pdf/hygromatik-ministeam-e-dimensions.pdf>

3D models under <https://www.hygromatik.com/en/downloads>

7. Water connection

⚠ WARNING

Risk of scalding!

Very hot water to be found in and around the steam humidifier during and after operation. Have all installation work done by expert staff in order to avoid scalding hazards due to improper water guidance.

⚠ WARNING

Risk of electrical shock!

Hazardous electrical voltage!

Before starting installation work ensure that the unit is not yet connected to the power supply.

General Rules

- Obey local water utility regulations
- Verify that necessary safety measures have been taken – in compliance with either German Technical and Scientific Association for Gas and Water (DVGW) guidelines (DIN EN1717) or local regulations – that eliminate back-flow of polluted water into drinking water treatment facilities. This may require the installation of a system separator of the CA type (minimum measure, allowable only when free discharge into the drainage system is given). Within the humidifier, a double check valve (58) is located in the water supply line. It prevents - in accordance with DIN EN 61770 - the backflow of water.
- Supply water must not exceed 40°C (104°F)
- Allowable range of water pressure: 1 to 10 bar /14.5 to 145 psi (100×10^3 to 100×10^4 Pa)
- For connection to the water supply pipe, make use of a water hose
- Blow-down water must drain freely

The following applies to electrode steam humidifiers:

- Use feed water without chemical additives and with a conductivity between 200 and 800 $\mu\text{S}/\text{cm}$ only. Beyond conductivity levels of 800 $\mu\text{S}/\text{cm}$ up to a maximum of 1250 $\mu\text{S}/\text{cm}$ and below conductivity levels of 200 $\mu\text{S}/\text{cm}$ to a minimum of 125 $\mu\text{S}/\text{cm}$, special adjustments are required. In this case please contact your specialist dealer.
- As an option for installation by the customer, the DVGW-conform **HyFlow** system separator or a after market system separator of the BA/CA type are available from HygroMatik.

The following applies to heater steam humidifiers:

- min. conductivity of feedwater: 3 $\mu\text{S}/\text{cm}$
- from a water hardness of 15° German hardness, a preceding water softening is recommended
- operation with fully softened water (0° German hardness) is possible

7.1 Operation of electrode steam humidifier with softened water

NOTICE

Do not use softened water unless special measures are taken!

When feeding softened water into the Hygro-matik steam humidifier, the aspects outlined below must be taken into account.

Softened water may cause

- unacceptably high conductivity
- the formation of salt bridges between the electrodes and the electrode leads on the inner surface of the steam cylinder upper part
- foaming in the steam cylinder

Salt bridges may cause electrical arcs. These are indicated by the presence of black grooves in the top part of the cylinder. The cylinder must then be replaced to prevent further damage to the cylinder material, as well as short circuits which may trip main circuit breaker.

Foam may come into contact with the maximum level sensor electrode and trigger the max. level status message despite the cylinder not being full yet and the nominal current not yet established.

With softened water, at operating temperature conductivity level usually is higher than is the case with tap water.

If using a water softening system, we recommend diluting the softened water with normal tap water to produce an overall **hardness between 4-8°gH**. This value can be set lower if the water does not foam.

7.2 Water supply

NOTICE

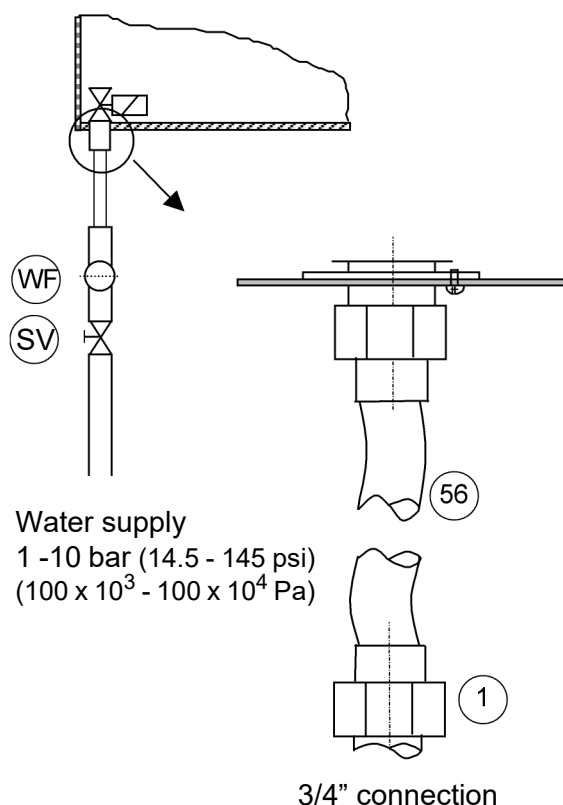
Foreign material in water supply pipe may cause premature wear of the solenoid valve.

Flush the water supply pipe before making connection to the solenoid valve. This is of particular importance in case of a newly installed pipe.

- » Install a shut-off valve (SV) in the supply line.
- » Install a water filter (WF) if required due to bad water quality.

Please note

- Shut-off valve (SV) and water filter (WF) are not included in the delivery
- For connection to the water supply line, the water hose (56) with cap nuts (1) on both ends supplied with the unit may be used.
- In case of no safety device for drinking water protection according to DIN EN 1717 present in the house installation system, a system separator at least of the CA type or use of the Hyflow retrofit option (only for electrode steam humidifiers) is mandatory.



*) the numbers refer to the exploded view in the chapter with the same name.

Make connection as follows:

- » Attach cap nut with inner seal ring to inlet screw joint on the humidifier housing and tighten.

NOTICE

Do not overtighten the cap nut!
Excessive tightening will destroy the fitting.

Please note

- » Screw the other hose end cap nut with its inner seal on a customer-provided water tap (cap nut internal thread is 3/4").
- » Strainer must be placed inside the solenoid valve

7.3 Water discharge

⚠ WARNING

Risk of scalding!

During blow down, up to 0.3 l/sec (08 gal./sec) are being drained with a temperature of about 95 °C (203°F).

Ensure that the drain hose is reliably fastened and wastewater can drain freely and pressureless.

Please note

Humidifier installation location and wastewater discharge must be on the same pressure level. In case of a drain connection on positive pressure, pls. consult your expert dealer.

Guidelines for water discharge composition

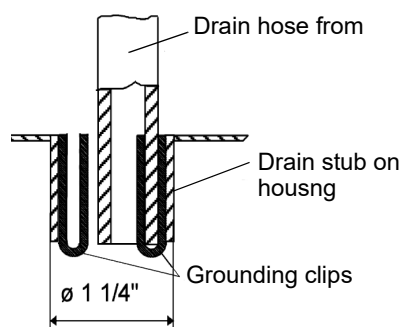
- Use flexible water hose
- Do not buckle drain hose
- Discharge line and drain pipe material must be temperature resistant up to 95°C(203°F)

How to proceed

- » Run a 1 1/4 " drain hose of 250 to 1000 mm (10 to 40 inch) length into a pressure-free outlet according to DIN EN 1717. The hose must be guided sideways of the humidifier to prevent ascending vapor from condensing on the humidifier's housing.

Valid for all steam humidifiers (KITS are not included):

- » Fit drain hose to connection stub on humidifier housing bottom side.
- » Slide pump drain hose onto one of the grounding clips (s. fig. below).
- » Slide overflow hose of the HyFlow system separator (if present) onto the other grounding clip.



Grounding clip functioning

The two grounding clips attached to the inner surface of the housing drain stub are in direct contact with water and shunt potential residual electric currents away from the housing during blow-down and in case of a cylinder water overflow.

Between the pump drain hose jacket and the inner surface of the cabinet drain connection, a gap exists due to the diverging diameters. If water collects on the base plate, it will flow through this gap into the drain hose and then into the drainage system.

Please note

With the optional wastewater cooling system **HyCool** (not available for FLP-XX-TPRO units), HygroMatik offers an option for limiting the steam humidifier wastewater temperature in order to protect thermosensitive wastewater pipe lines. By blending with tap water during blow-down, wastewater temperature is below 60°C (140°F) as long as inlet water temperature does not exceed 30°C (86° F).

7.4 Water connections final check

Go down the following water installation checklist:

- ☒ All screws and clamps properly tightened?
- ☒ Water supply line flushed before making connections?
- ☒ Water connection properly installed?
- ☒ Water discharge properly installed?
- ☒ Does blow-down water drain freely?
- ☒ Water supply line and water discharge leakage-free?

8. Electrical connection

⚠ WARNING

Danger of electrical shock!

Dangerous electrical voltage!

All work relating to the electrical installation may only be carried out by designated specialist personnel (electrician or qualified person with equivalent training).

Please note

The customer is responsible for monitoring the qualifications of the specialist personnel.

Do not connect the steam humidifier to the live power supply before all installation work has been completed.

General installation rules

- All local rules concerning the implementation of electrical installations must be obeyed
- Electric connector cables to be laid professionally
- Install the electrical connections according to the wiring diagram

NOTICE

Possible electronical components destruction through electrostatical discharge!

Prior to commencing electrical installation work, steps must be taken to guard the sensitive electronical components of the unit control against damage from electrostatical discharge.

8.1 Electrical installation approach

- » Provide fuses with a contact gap of at least .12 inch (3 mm) per pole.
- » Install a separate main connection for each steam cylinder including main circuit breaker, main switch etc. .
- » Make main connection according to the table below.

Main connection

For the MiniSteam humidifiers, main connection is to be implemented as follows:

Model	Main connection
MSE05	208 - 240 VAC/1/N 50-60 Hz
MSE05 MSE10	208 - 240 VAC/3/ 50-60Hz
MSE05 MSE10	440-480 VAC/3/ 50-60Hz

Other operating voltages on request.

Fusing

HygroMatik recommends the use of slow blowing up to middle time-lag main fuses (only applies to the a.m. mains supply voltages).

Please note

Steam humidifier installations should incorporate an individual resilient current circuit breaker (Type A-RCD).

Maximum current draw of the MiniSteam models and the required fusing resulting from that can be taken from the table below.

Model	Main connection	Current draw [A]	Fusing [A]
MSE05	208 - 240 VAC/1/N/ 50 - 60 Hz	15	1 x 20
MSE05	208 - 240 VAC/3/ 50 - 60 Hz	9.4	3 x 15
MSE05	440 - 480 VAC/3/ 50 - 60 Hz	4.7	3 x 10
MSE10	208 - 240 VAC/3/ 50 - 60 Hz	15	3 x 15
MSE10	440 - 480 VAC/3/ 50 - 60 Hz	9.4	3 x 10

8.2 Cable connections

The table below shows the number and dimensioning of the cable connections provided by the various StandardLine housing types.

Housing type	M25 (PG16)	M25 with MSI*)
MSE05	1	1
MSE10	1	1

*) Multiple seal insert

Characteristics of metric cable connections

Thread	Wrench size [mm/in.]	Cable diameter supported [mm/in.]
M25x1.5	30/~ 1.2	9 - 17/~ .35 - .67
M25 MSI*)	30/~ 1.2	6 (3x)/~ .24 (3x)

*) Multiple seal insert

8.3 Safety interlock

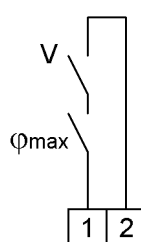
⚠ WARNING

Risk of electrical shock!

Hazardous electrical voltage!

When standard wiring was made, terminal 1 shows 230 VAC after commissioning.

Across terminal 1 and 2 the so-called safety interlock is wired. This wiring allows for integration of safety devices. In case of an open safety interlock the steam humidifier does not operate.



**Safety
interlock terminals 1/2 on**

Please note

Factory setting leaves the safety interlock open!

Install contact interlocks, e.g. a max. hygrostat etc. in series across terminal 1 and 2.

NOTICE

Contacts across terminals 1 and 2 must be potential free and properly rated!

Rating must comply with the control voltage in use.

Best practice implies the integration of a max. hygrostat in the safety interlock wiring to protect against over-humidification due to a r.h. sensor malfunction.

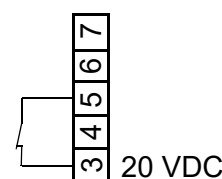
8.4 Control signal

The behaviour of the unit control is defined by parameter settings. You will find the parameter descriptions in the co-applicable manual „Controls Standard“, particularly in the „Unit control“ chapter, section „Provider level submenus and relating parameters“.

The unit control type is determined by parameter „1-2“, „control signal“. In accordance with the control type selected, terminal wiring of the connection terminal (s. „Unit control“ chapter, section „Main PCB connections“ in the co-applicable „Control Standard“ manual) is to be made.

8.4.1 1-step operation

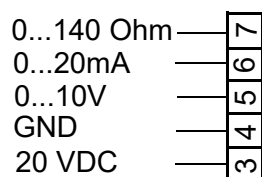
Steam humidifier operation is controlled by the contact across terminals 3 and 5 provided by the customer. This contact needs only to be low voltage proof.



**Customer-provided contact
for 1-step operation**

8.4.2 Operation with an active humidity sensor or external controller

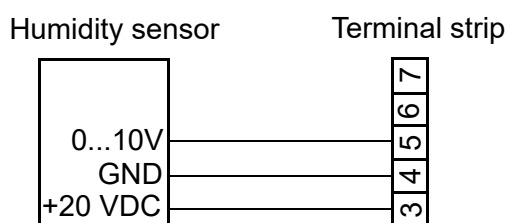
When driving the steam humidifier by an active r.h. sensor or external controller (e.g. a PLC), control signals in the range of 0...10 V, 0...20 mA or 0...140 Ohm may be applied. Each one of the signal types is connected to a dedicated terminal (see „Unit control“ chapter, section „Main PCB connections“ in the „Controls Standard“ manual). Reference is always to terminal 4, GND.



Terminals for control signals

Please note

Active r.h. sensors need an external supply voltage. For that purpose, terminal 3 has a +20 VDC offering.



Exemplary 0...10V humidity sensor connection

8.6 Electrical installation check list

Check electrical installation with respect to customer-site requirements and local power supply regulations.

- ☒ Safety interlock properly wired across terminals 1 and 2?
- ☒ Supply voltage in accordance with name plate voltage rating?
- ☒ All electrical connections made according to the wiring diagram?
- ☒ R.h. sensor properly connected with respect to signal type (0...10 V, 0...20 mA, 0...140 Ω) and supply voltage (only when r.h. sensor is in use)?
- ☒ All screw terminal connections properly tightened?
- ☒ Have all electrical cable and plug connections been properly tightened?
- ☒ Proper unit grounding made?

8.5 Connection diagram

The device-specific wiring diagrams are included in the scope of delivery. Please use them for the installation and keep them in a safe place.

9. Commissioning

▲ WARNING

Risk of operating error!

Start-up of the unit is restricted to expert staff only (electricians or expert personnel with equivalent training).

Step 1: Check of mechanical integrity and wiring

- » Open housing cover.
- » Check cylinder seating.
- » Check steam, condensate and drainhose clamps.
- » Check that all electrical wire connections (including steam cylinder wiring) are tight and secure.

Step 2: Switching on the steam humidifier

- » Switch on main breaker.
- » Open water supply stopcock (operating pressure should be 1bar min., 10bar max.).
- » Switch on unit by setting control switch to "I".

Step 3: The unit performs a self-test and, then, commences normal operation

- During self-test, the display flashes for a couple of seconds
- On completion of the test, the software version is displayed for a short moment. Consequently, normal operation is commenced. However, steam is not produced

Step 4: Trigger steam demand

- » Set control to 1-step operation, i.e. permanent steam demand, and close safety interlock.
- The water inlet solenoid valve opens and feeds water into the steam cylinder

Step 5: Monitor unit function and check for leakage

- » Let unit operate for 15 to 30 minutes.
- » If leaks appear, switch off the unit.

▲ WARNING

Risk of electrical shock!

Hazardous electrical voltage!
Follow safety instructions for work on live components.

Step 6: Repair leaks

- » Find leaks and eliminate.
- » Check again for leaks.
- » When everything is o.k., reattach housing cover.

10. Maintenance

10.1 General

For the achievement of a long unit life span, regular maintenance is a must. Maintenance works to be performed refer to unit assemblies that underlie either mechanical or electrical wear and tear, or may be impeded by residues in their proper functioning.

The steam humidifier's performance and maintenance intervals primarily depend on the water quality encountered and the amount of steam produced. A particular water quality may shorten or lengthen maintenance intervals. The amount of residues found in the steam cylinder allows for a hint on future maintenance intervals.

Another scenario influencing the unrestricted unit availability refers to the main contactor that has a maximum number of switch cycles as indicated by its manufacturer. Unit control monitors the number of switch cycles and produces a maintenance message as soon as the max. number is reached.

Need for maintenance is indicated by illumination of the  service icon in the unit control panel display. The reading value r16 „Service message“ then shows a „1“ (Service Steam Amount) when a certain produced steam amount threshold preset was exceeded, or „2“ (Service Main Contactor K1).

In the latter case, the main contactor should be replaced and the counter be reset (s. parameter „3-2“).

In case of „Service Steam Amount“, maintenance work mainly encompasses checking and cleaning all of the unit parts including the steam cylinder inside, and a unit test run. Steam humidifier electrodes are prone to burn-off during steam production and must, consequently, be replaced in a regular time frame.

As part of the maintenance work, screw terminals and plug connections must be checked every time. If required, retightening the terminal screws is a must as well as ensuring tight fit of all of the plug connections.

Seals are wear parts. As such, seal integrity checks and replacement, if required, is also a part of the regular maintenance work.

10.1.1 Safety instructions for maintenance

⚠ WARNING

Risk of electrical shock!

Hazardous electrical voltage. Unit must be switched off and protected against restart by expert staff (electricians or expert personnel with equivalent training) before any maintenance work is commenced.

⚠ WARNING

Risk of skin burning!

Hot steam cylinder during operation and for some time afterwards.

Drain steam cylinder before any maintenance work is commenced. After that, wait approx. 10 mins before starting maintenance work.

Check steam cylinder temperature by cautious approximation with hand (do not touch!).

⚠ WARNING

Risk of scalding!

Water pumped or drained from the steam cylinder may have a temperature of up to 95 °C (203 °F).

Wear proper PPE (Personal Protection Equipment)!

NOTICE

Take care of ESD protection!

The electronic components of the humidifier control are very sensitive to electrostatic discharges. In order to protect these components during maintenance, steps must be taken to guard against damage from electrostatic discharge..

10.2 Maintenance frame work

Mineral deposits precipitate and crystallize very differently in different types of water, even when two types have the same conductivity and hardness levels (the various constituents in the water interact differently).

Instructions on maintenance and cleaning intervals, or on electrode service life, are based entirely on empirical data.

In most cases, the conductivity levels given in the "Directions for Use" section of this manual may be considered as typical values. Individual parameter settings as part of the control software may be necessary.

Very seldomly, water pretreatment may be necessary (softening by dilution to approx. 4 - 8 °gH; decarbonization/partial desalination to achieve target reductions in carbonate hardness).

For any questions with regard to water treatment systems pls. contact your expert dealer.

Cycle time	Maintenance work
4 weeks after commisioning (also after installation of a new steam cylinder) (with normal water quality)	Visual inspection of electrical and mechanical connections Remove mineral deposits from steam cylinder, water drain hose and blow-down pump Check electrodes for burn-off Re-tighten electrode hand nuts and all screw terminals
semiannually (with normal water quality and "normal" operation, i.e. 8 hours per day)	Visual inspection of electrical and mechanical connections Remove mineral deposits from steam cylinder, water drain hose and blow-down pump. Check electrodes for burn-off and replace, if required. Re-tighten electrode hand nuts and all screw terminals

10.3 Removal and reinstallation of the steam cylinder

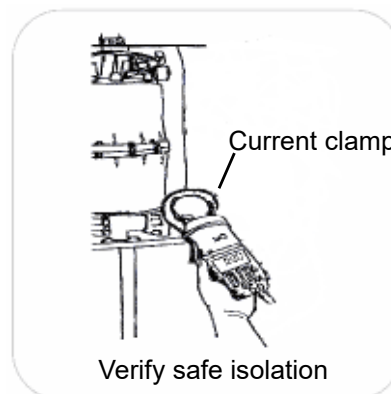
⚠ CAUTION

Risk of eye injuries!

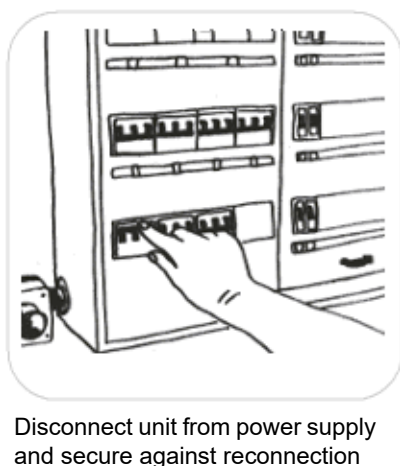
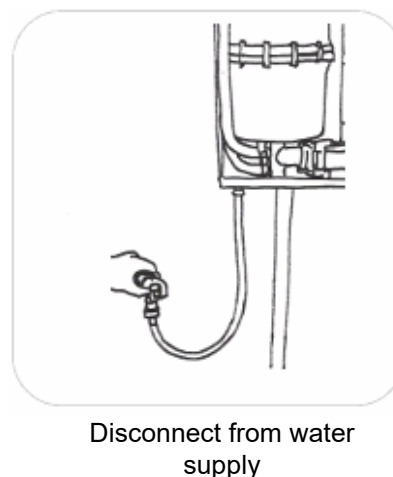
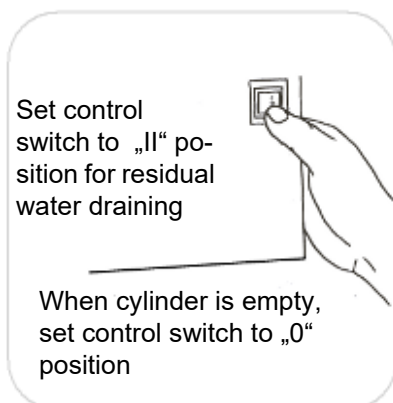
The clips that fix the steam cylinder halves have sharp edges and can jump off during dismantling.

Eye injuries are possible.

Wear proper PPE (Personal Protection Equipment)!



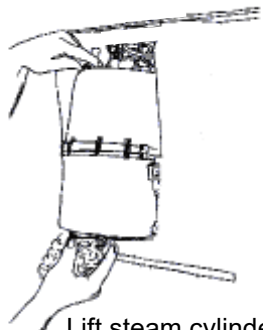
Steam cylinder removal



» Remove unit housing cover

» Remove clamp (23) from piece of tube (3) on steam cylinder side.

» Disconnect electrode plugs (4) and sensor electrode plug (10).

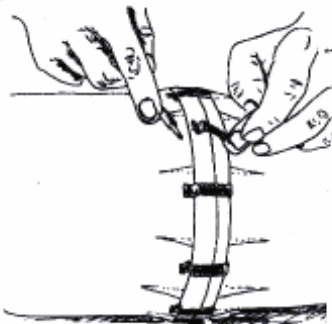


Lift steam cylinder
from cylinder base



Remove o-ring in use

Reinstallation



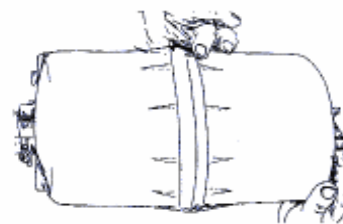
Remove cylinder
flange clamps



Insert new o-ring

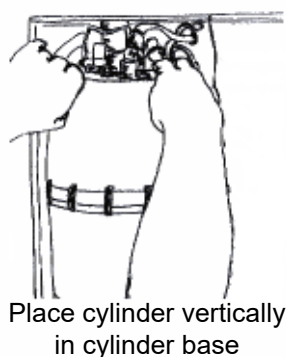
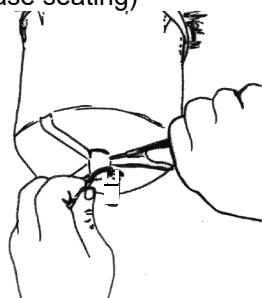


Separate cylinder
halves

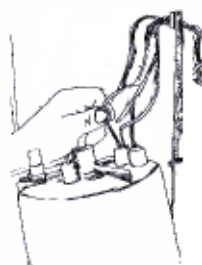


Join cylinder halves and affix
with clamps

Replace o-ring on steam cylinder lower end (cylinder base seating)



Place cylinder vertically in cylinder base

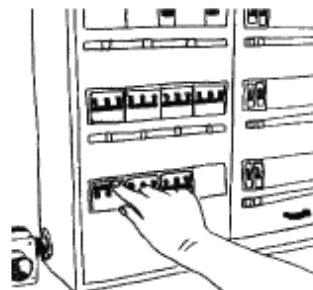


Reconnect cabling (for electrodes and sensor electrode), keep in mind color of hand nuts

Please note

The electrode connections must not show any signs of corrosion. Replace plugs, if required. Plugs must sit firmly on the electrode pins and must be pushed down as far as they will go.

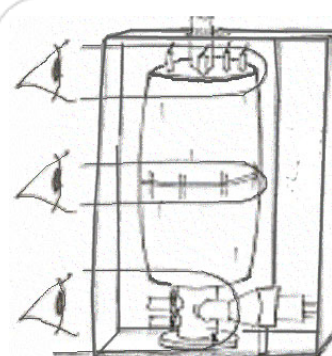
» Attach piece of tube (3) to steam cylinder stub with clamp (23)



Activate main circuit breaker



Open water supply



Check for leakage in relevant areas

» Reattach unit housing cover

10.4 Steam cylinder, electrodes and cylinder base cleaning

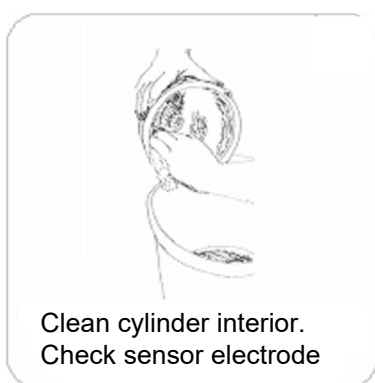
For cleaning, mechanical removal of the deposits is usually sufficient.

NOTICE

Risk of functional disruption!

When using acids or other chemicals for cleaning, thoroughly flushing and rinsing is essential otherwise cylinder water conductivity may be impaired.

Steam cylinder cleaning



- » Check the inside of the top part of steam cylinder for crust build-up and possible salt bridges (black grooves between the electrode leads). If present, wash away/scrape off completely.
- » Check sensor electrode for salt deposits and remove them if necessary.

Please note

If electrical arcs have burned deep grooves into the material, the complete cylinder must be replaced.

Electrode cleaning

- » Clean the sensor electrode until metallically bright.
- » Clean electrodes and check electrode wear (see „Changing electrodes“ section).

Cylinder base cleaning

- » Just as the cylinder, the cylinder base and its connection joints must be checked for deposits and be cleaned, if required.

Reinstallation of the steam cylinder is to be performed as described in the „Cylinder removal and reinstallation“ section.

10.5 Checking cable connections

NOTICE

Risk of functional disruption!

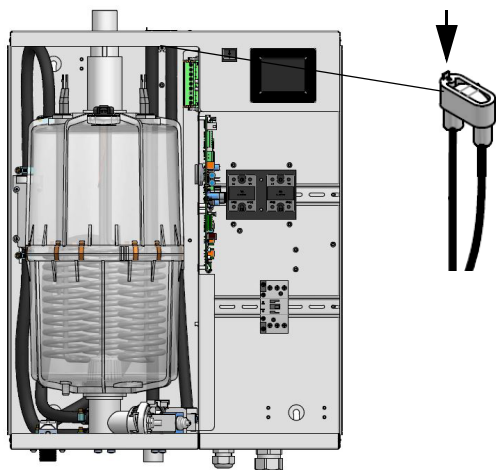
Risk of material damage!

Loose cable connections may result in increased transition resistance and contact area overheating.

- » Check all cabling screw terminals and plugs for tight seating. Plugs must sit on their respective contacts as far as they will go.

10.6 Cleaning the vent hole on the pipe elbow

The pipe elbow is only accessible when the steam cylinder is removed.



- » Remove the pipe elbow from the back wall of the housing by unscrewing the fixing screw of the pipe elbow.
- » Check the small opening on the top of the pipe elbow for dirt.
- » Remove any dirt, e.g. with a small screwdriver.
- » Reattach the pipe elbow to the back wall of the housing with the screw.

Please note

The vent hole should be checked for free circulation during every maintenance. A blocked vent hole has a negative effect on the drainage process (see also chapter "Trouble shooting" in the manual of the control)..

10.7 Solenoid valve removal/ reinstallation and fine filter cleaning

Removal

- » Shut off water supply and disconnect tap water hose cap screw connection.
- » Remove connecting hose (20) from cylinder base.
- » Detach electrical cable connector from solenoid valve (25).
- » Unscrew solenoid valve mounting screws.
- » Remove solenoid valve from housing bore.

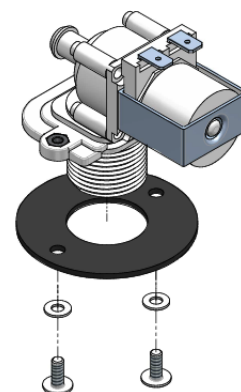
Fine filter cleaning

- » Remove fine filter from solenoid valve tap water connection side and clean under running water.

Reinstallation

- » Reinsert fine filter into solenoid valve.
- » Reinsert solenoid valve with seal in unit housing bore.
- » Bolt-down solenoid valve.
- » Reestablish tap water connection.
- » Reconnect electrical cable to solenoid valve.
- » Reattach connecting hose (20) to cylinder base using clamp.
- » Turn on water tap.
- » Switch on unit and check for leakages after 15 to 30 mins of operation.

Solenoid valve



⚠ WARNING

Risk of electrical shock!

Hazardous electrical voltage!

Follow safety instruction for work on live components.

Leakages may invoke leak currents.

- » In case of leakage turn off power supply and secure against being switched on again.
- » Find leakage and eliminate.
- » Check again

10.8 Cleaning of blow-down pump

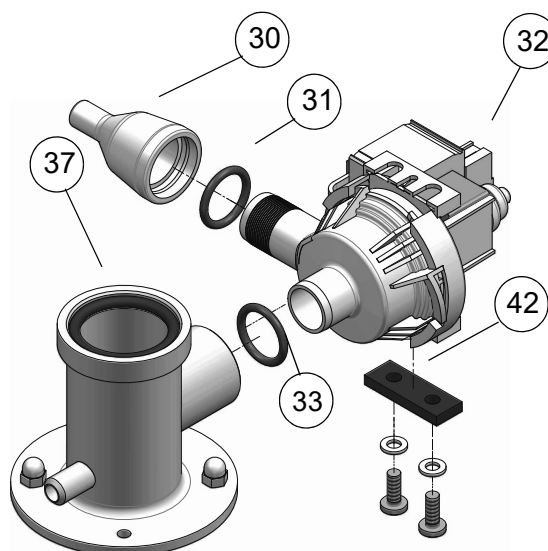
Removal and cleaning

- » Remove steam cylinder as described in „Removal and reinstallation of steam cylinder“ section.
- » Detach adapter (30) from pump (32).
- » Detach electrical cable from pump.
- » Unscrew mounting screws from housing bottom plate (safe vibration buffer, bolts and washers for reinstallation) and pull pump out of cylinder base (37).
- » Open pump bayonet lock.
- » Remove residues from pump and drain hoses (replace O-ring if required).

Reinstallation

- » Moisten O-ring (33) and insert into cylinder base (37) horizontal stub.
- » Push pump back into cylinder base and bolt to bottom plate incorporating the vibration buffer and washers saved during removal.
- » Moisten O-ring (31) and insert into adapter.

- » Slide adapter (30) onto pump stub.
- » Refit electrical cable to pump connector (no polarisation).
- » Let unit run for 15 to 30 mins, then check for leakages.



Blow-down pump

⚠ WARNING

Risk of electrical shock!

Hazardous electrical voltage!

Follow safety instructions for work on live components.

Leakages may invoke leak currents.

- » In case of leakage turn off power supply and secure against being switched on again.
- » Find leakage and eliminate.
- » Check again.

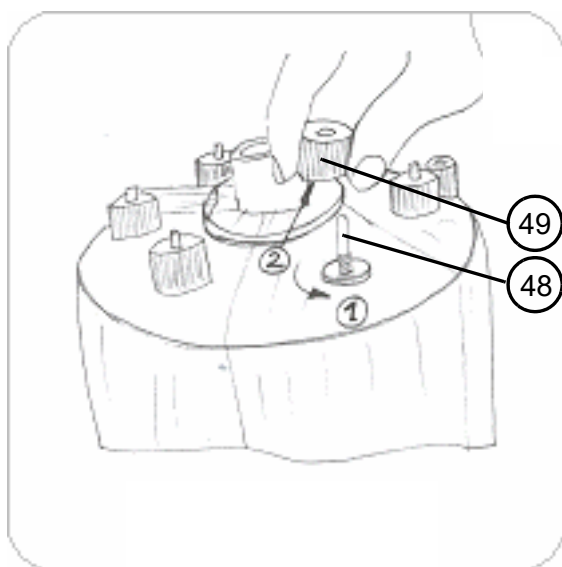
10.9 Electrode replacement

» Remove and open cylinder, as described in section "Removal and reinstallation of the steam cylinder".

Please note

When mounting the electrodes, make sure that the hand nut colours corresponding with the wiring colours remain in the same position as before in order to omit any unwanted shift of electrical potential. Hence, the hand nut positions must be recorded before they are removed. During reassembly, particular care must be taken to ensure that no grey wire is connected to the electrode plug next to the (grey) sensor electrode hand nut.

» Unscrew hand nuts



- » Remove electrodes (48)
- » Install new electrodes (48). Make sure that the electrodes are positioned correctly (see exploded view).
- » Hand tighten the nuts (49).
- » Use solvent-free, HygroMatik-quality o-rings (for flange, electrodes, cylinder base and steam hose adapter).
- » Assemble steam cylinder
- » Plug the electrode plugs (4) directly onto the electrodes (48)
- » Install the steam cylinder

Genuine electrode length

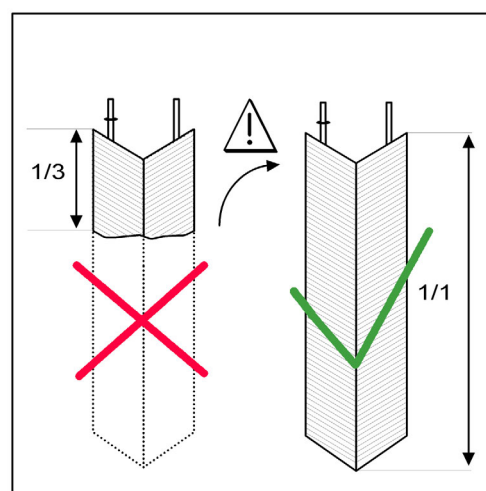
HygroMatik large area electrodes made from stainless steel have the following genuine lengths:

Device model	MS05	MS10
Length [mm]	155	155

Electrode wear

Electrode wear depends on:

- composition and conductivity of the supply water
- the amount of steam produced



In case of the electrodes being burned-off to less than one third to half of their genuine length, electrode replacement should be made.

Please note

When cylinder water maximum level is detected for a period of 60 mins, an error message (s. unit control chapter, error message section in the co-applicable „Controls Standard“ manual) is generated and unit operation is cut. At the latest, electrode replacement should then be made.

10.10 Functional check

- » Run the system with maximum output for a couple of minutes
- » Check all safety devices.
- » Check hose connections and seals for leakage.

10.11 Finishing maintenance

After finishing substantial maintenance work, the service interval „Steam amount“ must be reset (s. sections 3.5.2 und 3.8 in the „Control Standard“ manual).

To do so, follow the procedure below (use the „**▲/▼**“ keys for changing the values displayed):

- » from standard display, select „P00“.
- » confirm with SET key.
- » input code „010“.
- » confirm with SET key.
- » change display from „1--“ to „3 --“ (select parameter group „Service“).
- » confirm with SET key.
- „3-1“ is displayed
- » confirm with SET key.
- » change display from „0“ to „1“ („Reset service interval“).
- » Confirm with SET key.
- » return to standard display by touching the ESC key twice.

The steam amount counter now again holds the value preset (s. „3-3“ parameter, „Service interval [t]“), that determines the next time for maintenance when met.

11. CSA Certificate of Compliance



Certificate of Compliance

Certificate: 1887098

Master Contract: 238708

Project: 80052947

Date Issued: 2020-10-14

Issued To: Hygromatik GmbH
Lise-Meitner Strasse 3
Henstedt-Ulzburg, Schleswig-Holstein, D-24558
Germany

Attention: Michael Lutkemann

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

Issued by: Tony DePompa
Tony DePompa



PRODUCTS

CLASS - C121106 - COMFORT CONDITIONING EQUIPMENT Humidifiers and Evaporative Coolers
CLASS - C121186 - COMFORT CONDITIONING EQUIPMENT-Humidifiers and Evaporative Coolers -
Certified to U.S. Standards

Humidifiers, electrode type, stationary, industrial or commercial, rated 600V or less, 60Hz, 1 ph or 3 ph, as follows:

Models MS05, MS10, 3.5 kW max. (1 ph) and 7.5 kW max (3 ph).
Models MSE05, MSE10, 3.6 kW max. (1 ph) and 7.8 kW max (3 ph).

Models C01, C02, C06, C10, C17, C22, C30, C45, C58; 14.4 kW max. (1 ph) and 43.5 kW max (3 ph).

Models HY05, HY08, HY13, HY17, HY23, HY30, HY45, HY60, HY90, HY116; 28.8 kW max (1ph) and 87 kW max (3 ph).



Certificate: 1887098
Project: 80052947

Master Contract: 238708
Date Issued: 2020-10-14

Models FLE01, FLE02, FLE05, FLE10, FLE15, FLE20, FLE25, FLE30, FLE40, FLE45, FLE50, FLE65, FLE80, FLE100, FLE130; 14.4 kW max. (1 ph) and 50.8 kW max (3 ph) per cylinder.

Models SLE01, SLE02, SLE05, SLE10, SLE15, SLE20, SLE30, SLE45, SLE65; 14.4 kW max (1ph) and 50.8 kW max (3 ph).

Notes:

1. Model designation may be followed by suffix letters and numbers denoting type of control, supply voltage, number of phases.
2. Installation of the equipment in the field is subject to acceptance by the local inspection authority.

APPLICABLE REQUIREMENTS

CSA Std C22.2 No. 104-11 (4 th Ed) (R2016)	-	Humidifiers
UL Std No. 998 (5 th Ed)	-	Humidifiers

MARKINGS

See Descriptive report.



Supplement to Certificate of Compliance

Certificate: 1887098

Master Contract: 238708

*The products listed, including the latest revision described below,
are eligible to be marked in accordance with the referenced Certificate.*

Product Certification History

Project	Date	Description
80052947	2020-10-14	Update to report 1887098 to add new models MSE05, MSE10.
70115693	2016-12-30	Update Report 1887098 to add new model series FLE and SLE, those are similar to existing models.
70027121	2015-03-23	Update report 1887098 to add new model Series MS and add 230 V Control option.
2479304	2011-11-29	Update Report 1887098 to add new models C01 and 02, those are similar to the existing models.
1887098	2007-08-31	Transfer Report LR 86547-3 and add alternate Class 2 ELV controller board & UL Recognized transformers to Certified HY & C line models.

12. Spare Parts

* MSE05 MSE10	Article No.	Description	EUR/pc	USD/pc	Priority
		Steam generation general			
10	1	B-3204027 Sensor electrode compl. with hand nut	22,10	25,90	3
18	1	B-3216021 Flange clamp set, 24 pc	13,40	15,70	3
37	1	E-3220002 Cylinder base	21,00	24,60	3
	1	B-3216023 Mounting kit for cylinder base	5,30	6,20	3
	1	AC-03-00000 O-ring set (consists of: 2 x 31, 35, 17, 34, 3 x 18)	31,00	36,20	3
	1	B-2207101 Hand nuts, set=3pc.	9,20	10,80	
		Steam generation with electrical supply between 380V and 480V			
	1	SP-03-00000 Steam cylinder CY8 DN40 GRP	239,00	279,00	3
49	1	B-3204021 Electrodes EL8/4V	70,00	82,00	
*	Article No.	Description			
		Steam generation with electrical supply between 208V and 240V			3
	1	SP-03-00001 Steam cylinder CY8 DN40 GRP	280,00	327,00	
49	1	B-3204007 Electrodes EL8/2V	132,00	155,00	
		Water feed			
20	1,10	E-2604002 Connecting hose, solenoid valve - cylinder base, per m	17,00	19,90	2
25	1	WF-03-00010 Solenoid valve 90° with mounting set	31,30	36,60	
	1	WF-03-00014 Double solenoid valve 90° with mounting kit for HyCool	75,00	88,00	
	1	WF-03-00012 Double solenoid valve 90° with mounting kit for SuperFlush	73,00	85,00	
22	6	E-8501064 Hose clamp d = 12-22mm	2,45	2,90	
56	1	B-2304031 Hose for water connection, 3/4" cap nuts on both sides	24,30	28,50	2
58	1	E-2604094 Double check valve	20,20	23,60	2
		Water drain			
	1	B-2425005 Drain-hose system (consists of: 31, 30, 14, 15, 6)	41,20	48,20	2
32	1	B-2404027 Drain pump without mounting set	122,00	143,00	
	1	B-2424014 Mounting set for drain pump	8,10	9,50	2
*	Article No.	Description	EUR/pc	USD/pc	Priority
		Control, electrical supply between 380V and 480V			3
	1	E-2510010 Main contactor 16A AC	63,00	73,00	3
		Control, electrical supply between 208V and 240V			Priority
	4	E-2501006 Main contactor 24A AC	59,00	70,00	3
		Control, general			3
	1	CN-07-00000 Mainboard	526,00	615,00	2
	1	CN-07-00001 Display complete	127,00	149,00	2
	2	E-0510012 Clip for display	1,95	2,30	
	1	CN-07-00050 Current transducer	44,30	51,80	
4	1	WR-03-00001 Connecting cable for electrodes	56,00	66,00	
		Accessories			
57	x	E-2420423 Drain hose 1 1/4", per m	32,70	38,30	2
	x	E-2404010 Drain hose clamp 1 1/4"	3,20	3,75	
If you order any spare parts, please specify type and serial number of the unit.					
* see exploded view					

For ordering spare parts, a template can be found on the www.hygromatik.com website under the „Contact“ tab. Your spare parts order may as well be directed per e-mail to the HygroMatik main office using the address hy@hygromatik.de.

Please make sure to specify your unit model and serial number.

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13. Technical specifications

	Technical data MiniSteam Electrodes		
Unit type	MSE05		MSE10
Steam output [lb/h]	9,2 - 9,2 - 10,6	9,9 - 9,9 - 11,5	15,9 - 15,9 - 18,3
Electrical connection ⁽¹⁾	208 - 208 - 240V /1Ph /N /50-60Hz	208 - 208 - 240V /3Ph /50-60Hz	
Rated power [kW]	3,1 - 3,1 - 3,6	3,4 - 3,4 - 3,9	5,4 - 5,4 - 6,2
Nominal current [A]	15 - 15 - 15	9,4 - 9,4 - 9,4	15 - 15 - 15
Fuse [A] ⁽²⁾	1 x 15	3 x 15	
Connection terminals max. [in²]	0,2		
Number of steam cylinder	1		
Control	StandardLine mainboard with capacitive touch display		
Control voltage ⁽³⁾	208 - 240V 1,6A		
Water consumption ⁽⁷⁾ [usgal/h]	5,76	6,24	9,96
Water flow rate ⁽⁸⁾ [usgal/min]	0,34 / 2,88		
Max. filling capacity [usgal]	1,3		
Empty weight [lb]	33,1		
Operation weight [lb]	44,8		
Width ⁽⁹⁾ [in]	15,4		
Height ⁽⁹⁾ [in]	23,4		
Depth ⁽⁹⁾ [in]	10,0		
Water connection	tap water of varying qualities 1 to 10 bar, for 3/4" external thread		
Sound level at 1 metre ⁽¹⁰⁾	48		52
Drain water connection	Connection Ø 1 1/4"		

⁽¹⁾ Other voltages on request

⁽²⁾ 1.1 times the current consumption after full blowdown. Observe tripping characteristics of circuit breakers.
If necessary, select next higher circuit breaker level

⁽³⁾ Separate control voltage on request

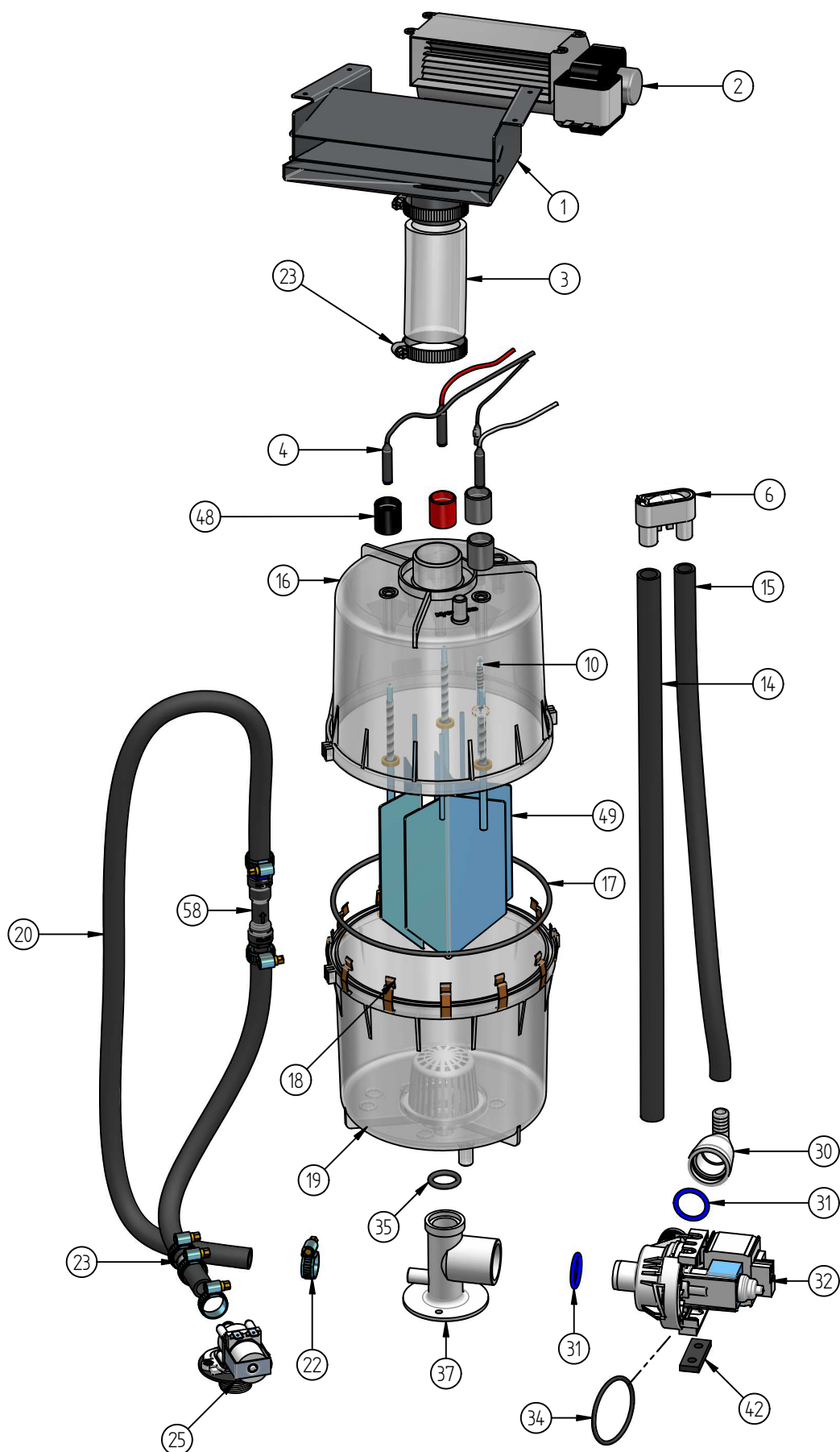
⁽⁷⁾ Maximum water consumption at 100% demand plus blow down losses.
Water consumption depends on the water quality and options installed.

⁽⁸⁾ Flow rate of the feed water during refilling or pumping out. Unit without options / maximum rate with options

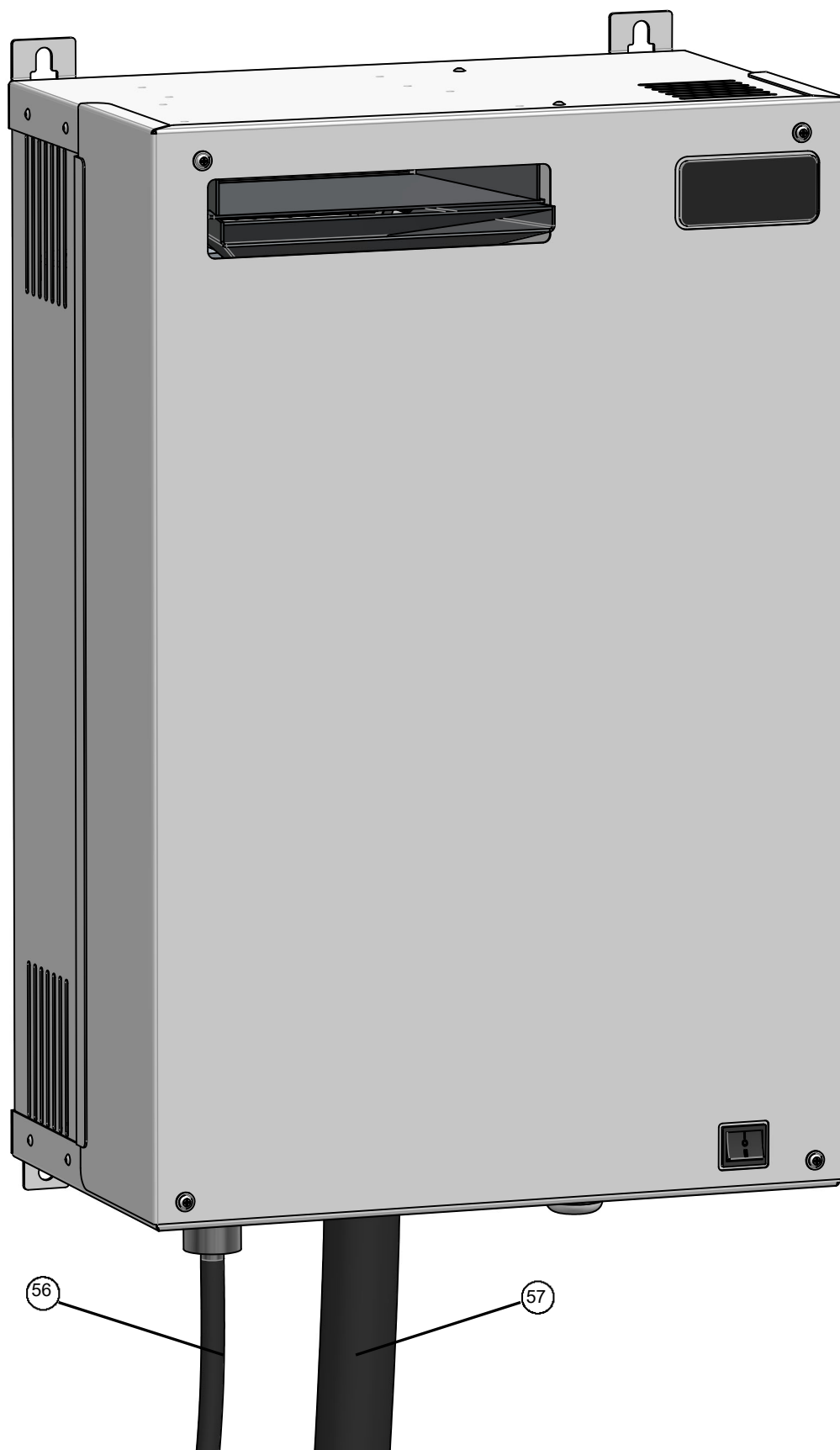
⁽⁹⁾ Outer dimensions of width and depth. Height including drain connection

⁽¹⁰⁾ During sporadic blowdown also higher

14. Exploded view



15. View of housing





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