IOM-542-V11

EvaPack™ Series
Evaporative Pad Adiabatic Humidifier/Cooler
Installation and Operation Manual
For RW and DW configuration

Armstrong®

Table of Contents

General Safety Information

This bulletin should be used by experienced personnel as a guide to the installation of the Armstrong EvaPack™. Selection or installation of equipment should always be accompanied by competent technical assistance. Please contact Armstrong International or its local sales representative for additional information.

IMPORTANT

Please read, heed and follow the enclosed safety information and the warning labels inside the humidifier before installation or maintenance.

EvaPack™ Evaporative Pad Material

The EvaPack™ evaporative pad material should not be cut or crushed as doing so may generate dust.

Emergency Overview:

This product is non-hazardous under ordinary conditions of use.

There is almost no possibility of creating dust. However dust will be created in process of cutting, polishing or destroying of this product.

Hazard information of generated dust is described as below.

Primary Routes of Entry:

Via respirable dust to the lungs and respiratory system and via coarse dust and particulate to the eyes.
Primary Target Organs: Lungs, respiratory system and eyes.
Potential Health Effects:
Eye Contact: May cause mechanical irritation.
Skin Contact: May cause transitory mechanical dermatitis.
Inhalation: Long term overexposure to airborne dust may cause respiratory disease.
Ingestion: None-hazardous when ingested.
Carcinogenicity: Glass filament is classified as IARC Group 3 (Not classifiable as its carcinogenicity to humans).

FIRST AID MEASURES

Inhalation: Remove from exposure to fresh air.
Ingestion: Ingestion is unlikely. If ingested, drink sufficient water and vomit and get medical attention.
Skin Contact: Flush with water or slightly warm water and wash with soap. Get medical attention if pain and inflammation.
Eye Contact: Flush eyes with water for a least 15 minutes. Abrasive action may cause damage to the outer surface of the eye. Get medical attention if irritating.
Note to Physician: Treat symptomatically.

TOXICOLOGICAL INFORMATION

Acute Effects: Exposure to glass filament sometimes causes skin irritation and occasionally upper respiratory tract irritation.
Chronic Effects: A number of epidemiology studies, done over many years of workers employed for up to 40 years in manufacturing of glass filament have shown no effects.
Carcinogenicity: Glass filament is classified as IARC Group 3 (Not classifiable as its carcinogenicity to humans.).
Mutagenicity: No available data.

FIRE FIGHTING MEASURES

Flammable Properties: This product is not flammable.
Extinguishing Media: Not applicable.
Fire Fighting Procedure: Not applicable.
Unusual Fire and Explosion Hazards: None.

Delivery, Lifting, Inspection and Storage
Any loss or damage during delivery should be reported to carrier by registered letter within 3 working days

and be advised to Armstrong International or to an authorized dealer.
Lifting or handling must only be carried out by trained and qualified personnel.
It is the customer's responsibility to ensure that operators are trained in handling heavy goods and to enforce the relevant lifting regulations.
It is recommended that the EvaPack™ humidifier be kept in its transit packaging for as long as possible prior to maintenance. If the humidifier is to be put into storage prior to installation, it must be stored under cover and protected from physical damage, dust, frost, rain and humidity. More than 6 months storage is not recommended.

GENERAL

This manual contains all details necessary for the planning and installation of the EvaPack™ humidifier. In addition commissioning and maintenance details are included. The manual is intended for use by engineers and properly trained technical personnel. Maintenance, servicing or repair work must only be carried out by suitable skilled and qualified personnel; the customer must be responsible for ensuring their suitability. Any risks or hazards, especially when working from ladders or towers should be identified by a skilled and Health and Safety representative and effective control measure put in place. No liability will attach to the Distributor if any damage, injury or accident is attributable to inattentive, inappropriate, negligent or incorrect operation of the machinery whether or not caused deliberately. Always isolate all electrical and water supplies before commencing any maintenance. Every effort has been made to ensure details contained in this manual are correct, however, in view of the wide range of conditions experienced in air handling systems, the information provided should only be used as a guide. Please contact your Agent if any doubt.

CORRECT USE

EvaPack™ humidifiers are ONLY intended for use with air handling systems or direct air humidification. ANY OTHER APPLICATION IS NOT CONSIDERED USE FOR THE INTENDED PURPOSE. THE MANUFACTURER CANNOT BE MADE LIABLE FOR ANY DAMAGE RESULTING FROM INCORRECT USE.

ELECTRICITY

All work concerned with electrical installation MUST only be performed by skilled and qualified technical personnel (electricians or technicians with appropriate training). The customer must be responsible for ensuring their suitability. It is the duty of the installer to ensure that suitable sized cables and MCB protection is provided. Please observe the local regulations concerning the provision of electrical installations.

DISPOSAL

You must observe local laws and regulations when disposing of your EvaPack™ HUMIDIFIER at the end of its working life. Use personal protective equipment as recommended in the handling section above when handling the evaporative material. In addition, respiratory protection should be worn to avoid inhalation of dust or debris from the air flow which may have accumulated on the material.

NOTE

The manufacturer's policy is one of continuous researches and development. He therefore reserves the right to amend without notice the specifications given in this document. The photographs are for illustrating purposes only.

Manufacturer's Name and Address - Authorized Representative
Armstrong International - Devatec SAS
185 Boulevard des Frères Rousseau
76550 Offranville - FRANCE

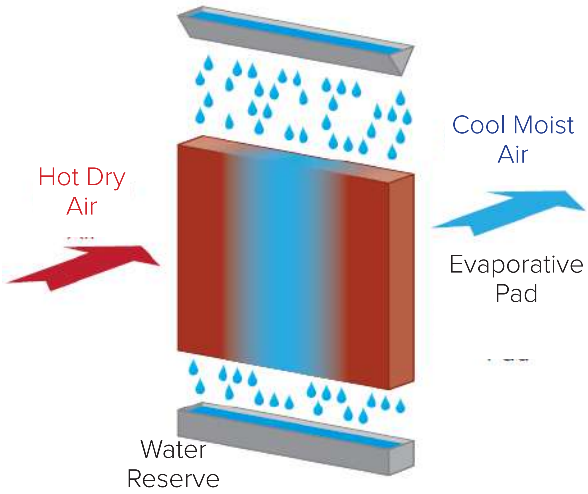
CE conformity declaration
EvaPack™ is CE. EAC, VDI 6022 compliant.
Devatec-Armstrong is ISO 9001, ISO 14001 compliant.

Type of equipment: Humidifier
Model Name (s) & Series: EvaPack™
We the undersigned, hereby declare that the equipment specified above conforms to the above **Directive(s) and Standard(s).**

Product Information

EvaPack™ humidifier, operation principle

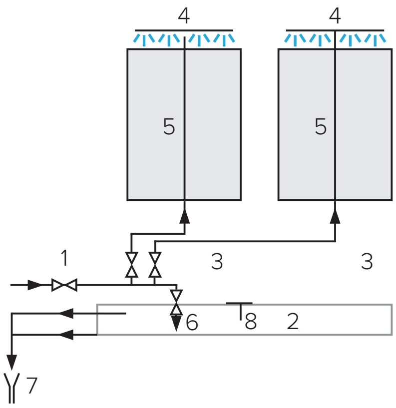
Armstrong EvaPack™ Series converts ordinary tap water into water vapor by using an adiabatic process. Dry air passes through a corrugated bank of wetted cells media made from non-organic fibers. EvaPack™ series uses the sensible air heat to evaporate the water. The air is cooled and humidified.
All types of water can be used (see page 8 for more details on water quality).

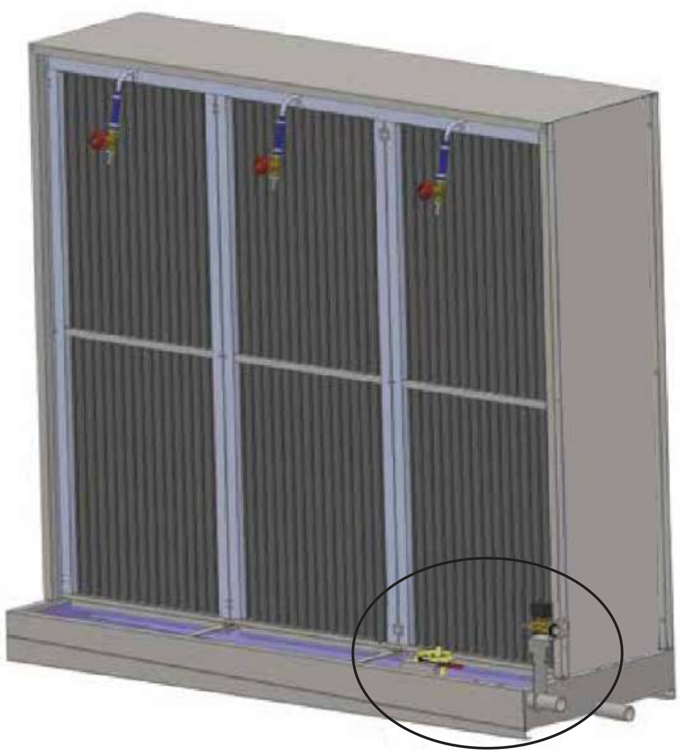


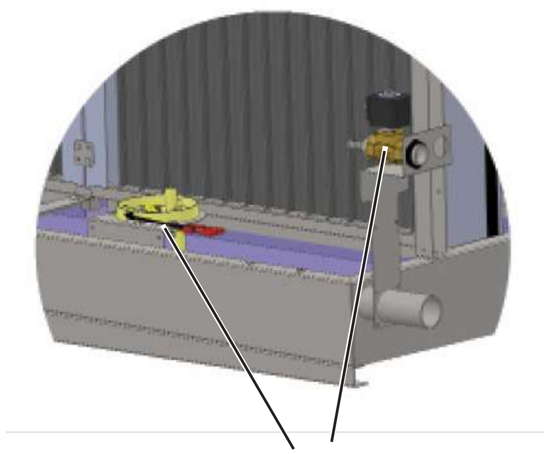
Direct Water configuration

__Operation sequences__

A. Water enters from the water supply (1) and arrives to the dispersion manifold (4). The water flow is adjusted with a manual gate valve (3).
B. The calibrated orifices deliver uniformly the water over each media pad (5).
C. Dry air passes through a corrugated bank of wetted cells media (5). Air is cooled and humidified.
D. The irrigation piping draining (6) should be installed in order to avoid any microbiological issues.
E. The excess water washes the EvaPack™ evaporative pad and is eliminated (with minerals) from the water basin (2) through the draining connection (7).
This configuration is recommended with high hardness supplied water (to increase the pad life time) or with reverse osmosis water (to reduce the RO water consumption).
F. Water level switch option (8) could be installed as an alarm system.





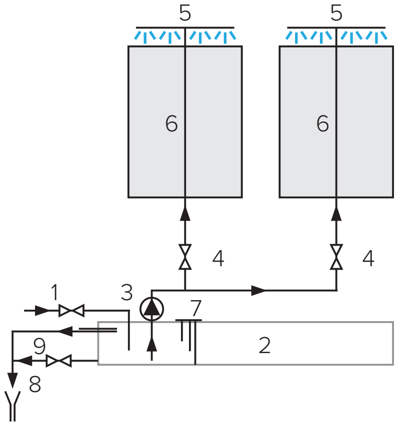


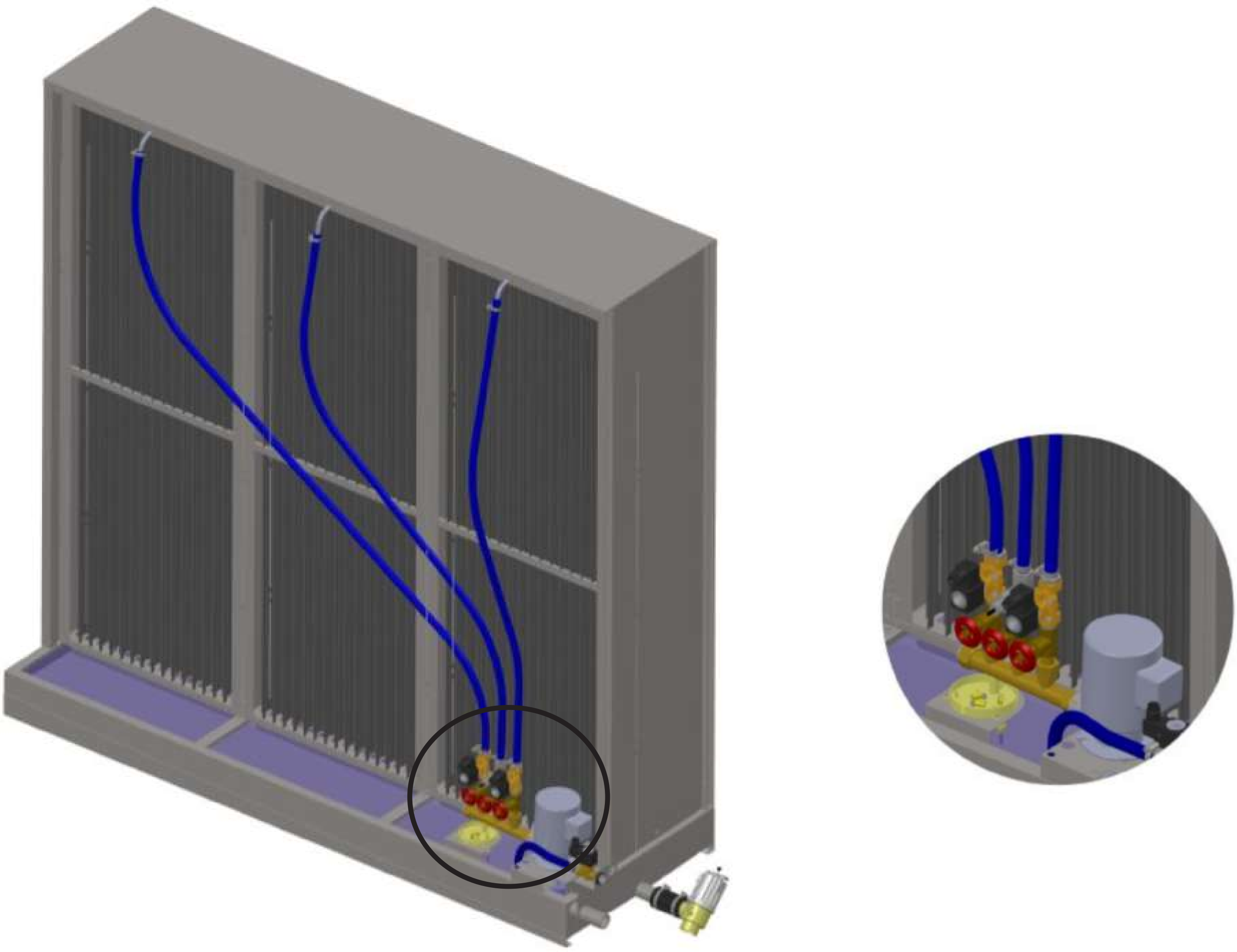
Inlet water valve and water level sensor are optional

Recirculated Water configuration

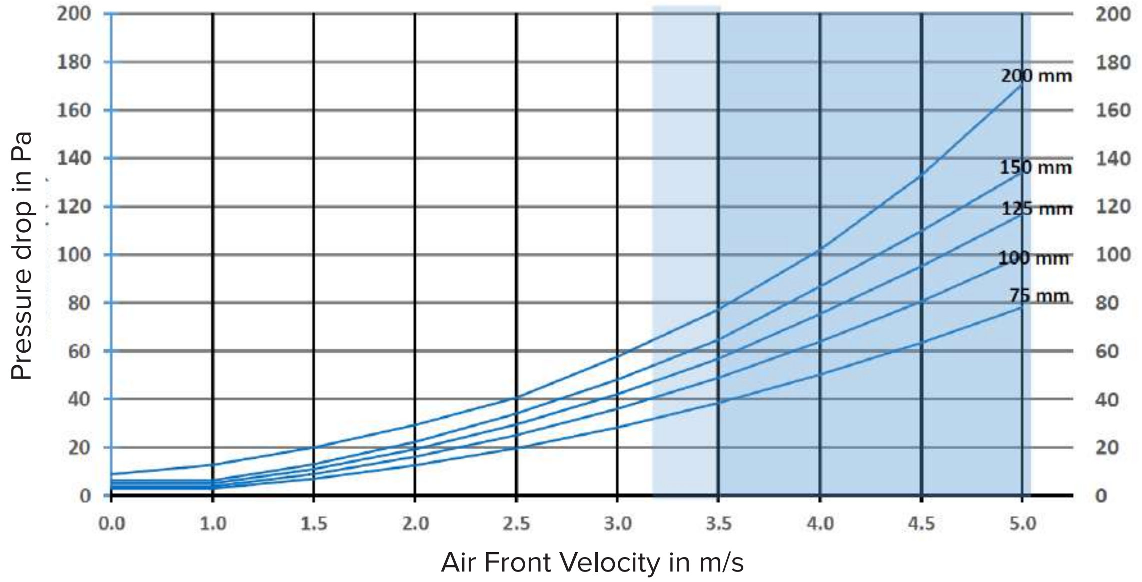
Operation sequences

A. Water enters into the basin passing through the filling valve (1). The water level sensor (7) controls the basin (2) filling, the pump (3) starting-up and the fill valve opening.
B. The recirculation water pump (3) supplies water to the different dispersion manifolds (5). The water flow of each cassette (6) is adjusted with a manual gate valve (4). Calibrated orifices deliver the water evenly over each media pad (6).
C. Dry air passes through a corrugated bank of wetted cells media (6), is cooled and humidified.
D. The excess water washes the evaporative pad and falls.
(with minerals) into the water tank.
E. The excess of minerals is drained by the draining valve minimizing the water consumption and the media scaling. This configuration is recommended when the available supplied water has a low or medium hardness.



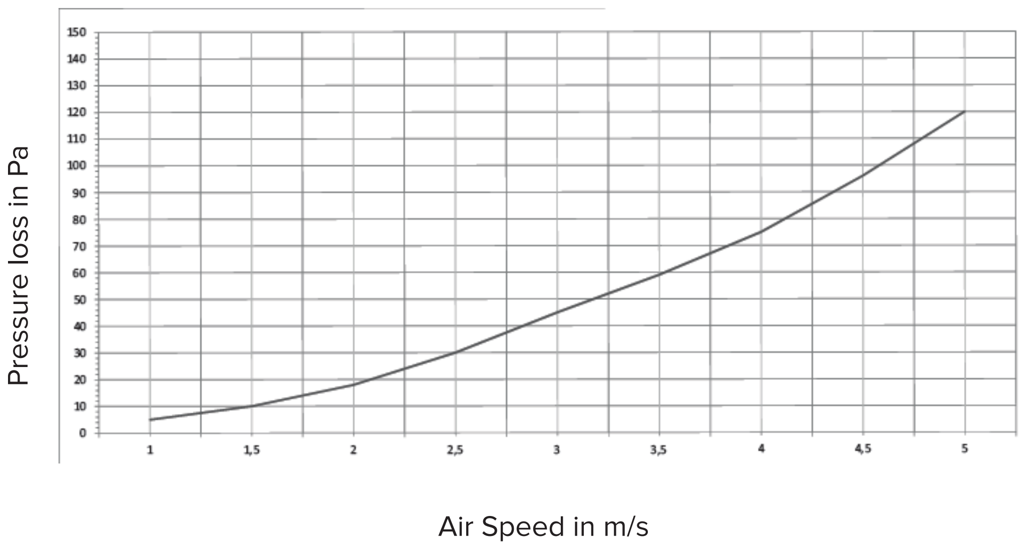


EvaPack™ Pad pressure drop



Droplet separator is:
Recommended when net air velocity ≥ 3.2 m/s
Necessary when net air velocity ≥ 3.5 m/s

Droplet separator pressure drop



Product Installation

General installation requirements

1. EvaPack™ humidifier must be installed into the Air Handling Unit (AHU) or Duct.
2. AHU / Duct – work floor must be designed with a loading capacity capable of supporting the humidifier weight when wet.
3. EvaPack™ humidifier must be installed horizontally. Armstrong International recommends using a spirit level to make sure that the unit is level front to back and across the width when installed. Failure to observe this point could result in footing of the AHU/Duct, or an incomplete unit emptying.
4. Once EvaPack™ humidifier has been positioned in a section of air handling unit, non-corrosive blanking plates must be installed to prevent air bypass around the unit in the AHU.
5. EvaPack™ must be cleaned before the initial fan starting-up, the pad must be flushed with water several times to eliminate remaining dust.
6. Check that there is no water leakage coming from water connection or others.
7. The standards EN 13053 and EN 1886 should be respected and mainly:

   7-a. Humidifiers must not be placed directly upstream of filters or attenuator (according to EN Standards)

   7-b. Supply air units to have at least two filter stages (first stage min. ePM1 ≥ 50% or F7 filter). The humidifier must be placed in-between the filter stages.

   7-c. Inspection access: An inspection opening (Clear width not less than 150 mm) and lighting of EvaPack™ humidifier chamber shall be provided. No external light must enter through the housing of the lighting. It must be possible to recognize the condition of the lighting (on/off) from outside.

ADDITIONAL FOR HYGIENIC VDI 3803 and VDI-6022 REQUIREMENTS

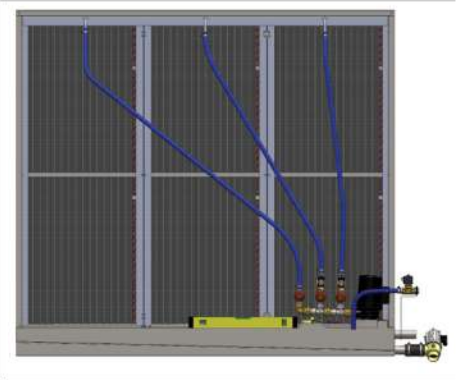
1. All the non-metallic product used for the installation (seal, etc.) must not absorb moisture or provide a nutrient substrate for micro-organisms.
2. The relative humidity downstream from the humidifier section must not exceed 90%. It must be ensured that drops of water could not reach the components installed downstream.
3. Max. number of germs of the circulation water: − relating to the total colony number 1000 cfu/ml. − relating to Legionella spp. 100 cfu/100 ml.
4. Drainage system must be equipped with a siphon with non-return valve or a siphon disconnected from the sewage network.
5. Shutdown: In case of shutdown or failure of the ventilating and air-conditioning system, the humidifier shall be switched off automatically.

OTHER GENERAL INSTALLATION RECOMMENDATIONS

1. ARMSTRONG recommends installation within a waterproof section.
2. EvaPack™ humidifier components should be easily accessible for checking, inspection and cleaning at any time.
3. It is recommended not to exceed 55 °C in the processed air temperature when the pad is not wetted.

The non-metallic parts might be damaged over this temperature.

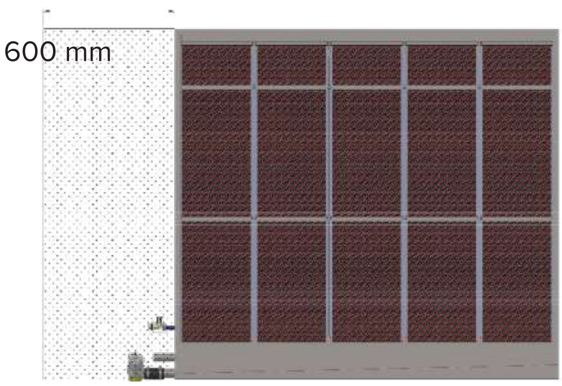
The dry bulb temperature and the wet bulb temperature of the inlet air must be positive to avoid water freezing on the pad.

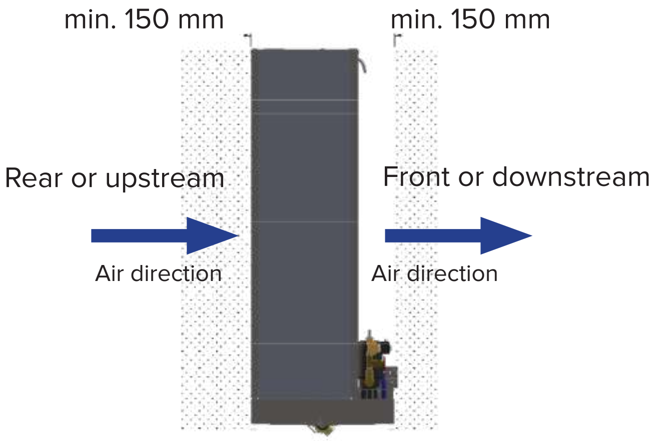


Minimum space needed for the cassette Extraction/Installation

Side Extraction/ Installation

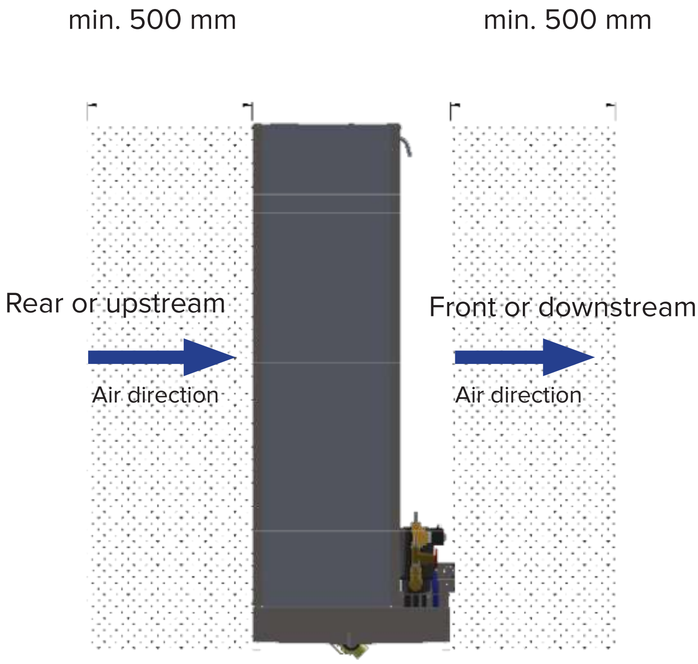
Minimum free space of 600 mm is needed for the cassette Extraction/ Installation. The cassette can be extracted from both sides.





Front Extraction/ Installation

For inspection, commissioning and maintenance, Armstrong International recommends to always providing an area of minimum 500 mm(*) rear and 500 mm front of the EvaPack™ humidifier.

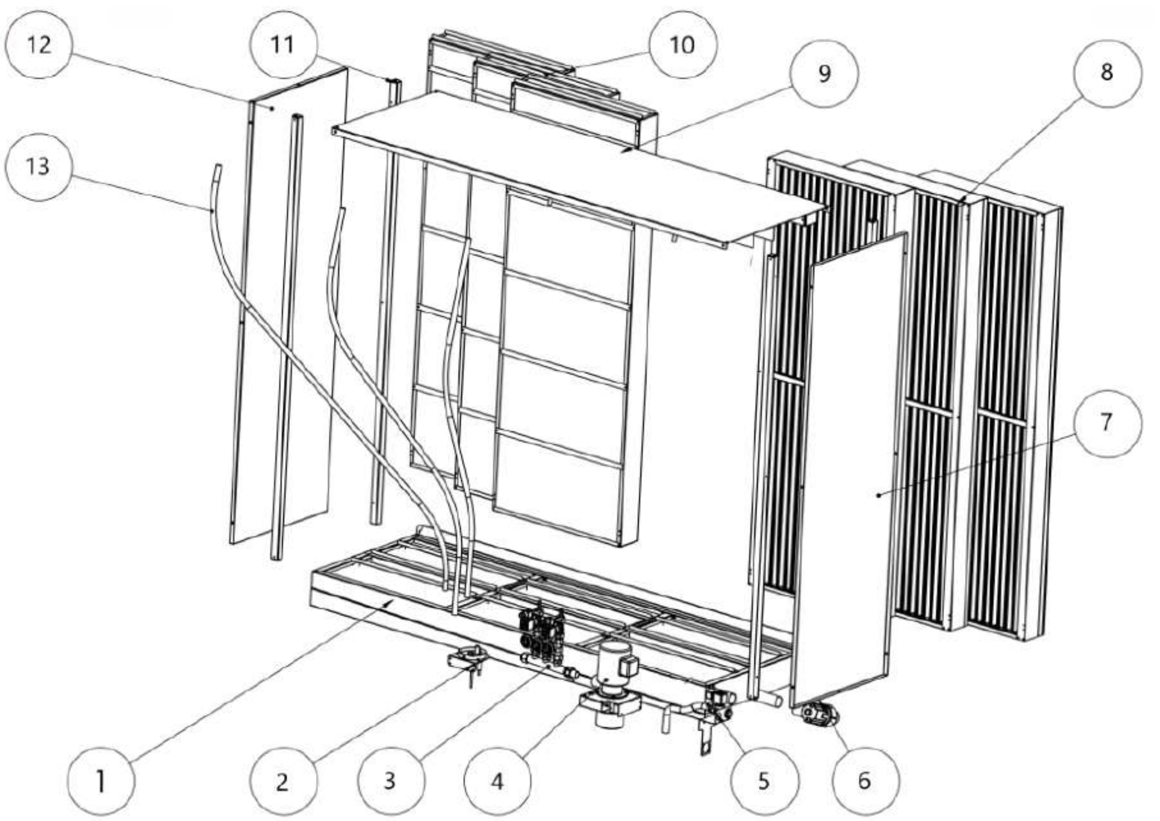


According to the available service rear distance, a specific cassette dismantling procedure should be followed. Please see chapter: Cassette dismantling for replacement.

One EvaPack™ module assembly

When the unit has been supplied dismounted for any transport or installation reason, please follow this procedure to assemble the EvaPack™ module.

INCLUDED WITH STANDARD DELIVERY:

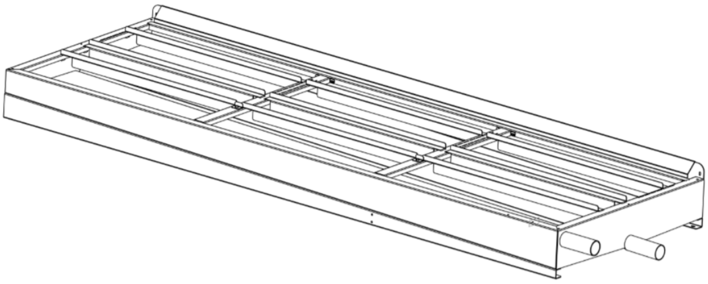


N°	For Standard DW configuration
1	Water basin (x1)
7	Right Lateral door
9	Roof with assembled watering system (x1)
10	Evaporative pad cassettes
11	Pillars (x4)
12	Left lateral door
13	Water hoses

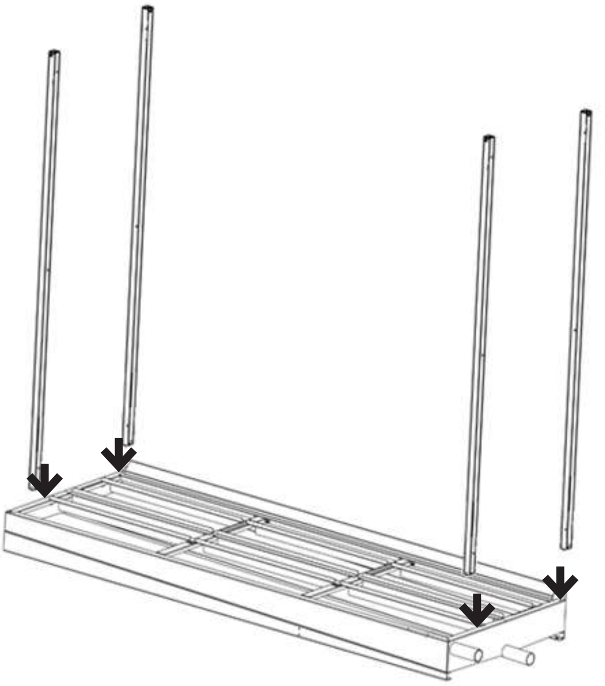
N°	Additional for droplet separator option
8	Droplet separator cassettes

N°	Additional for RW
2	Water level switch
3	Header (x1)
4	Water pump (x1)
5	Inlet water valve (x1)
6	Drain valve (X1)

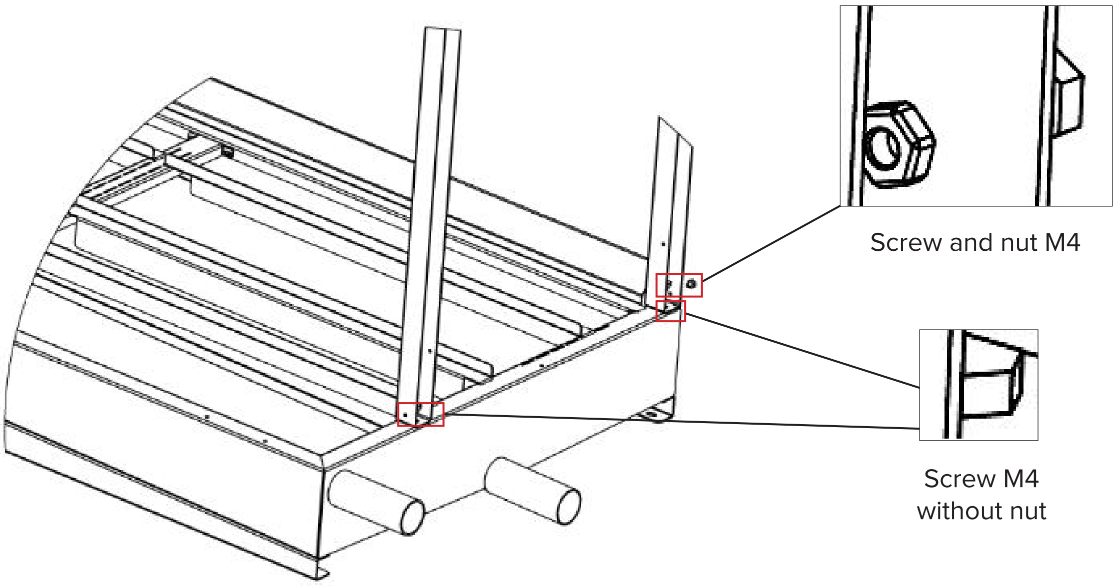
EvaPack™ stucture assembly method

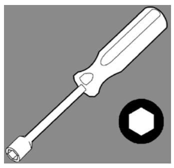


Place the basin on a solid and plane surface.

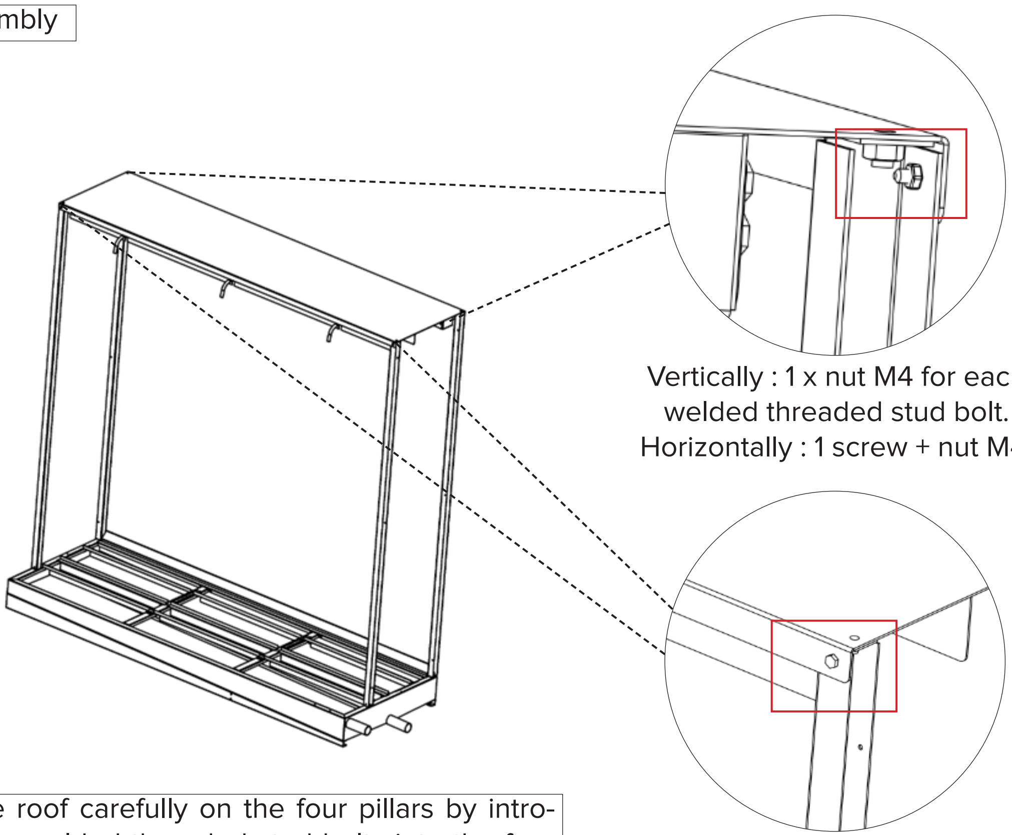


Place the pillars to the intended fixing points on the basin, with the open part towards the outside of the EvaPack™.

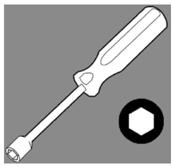




Roof assembly



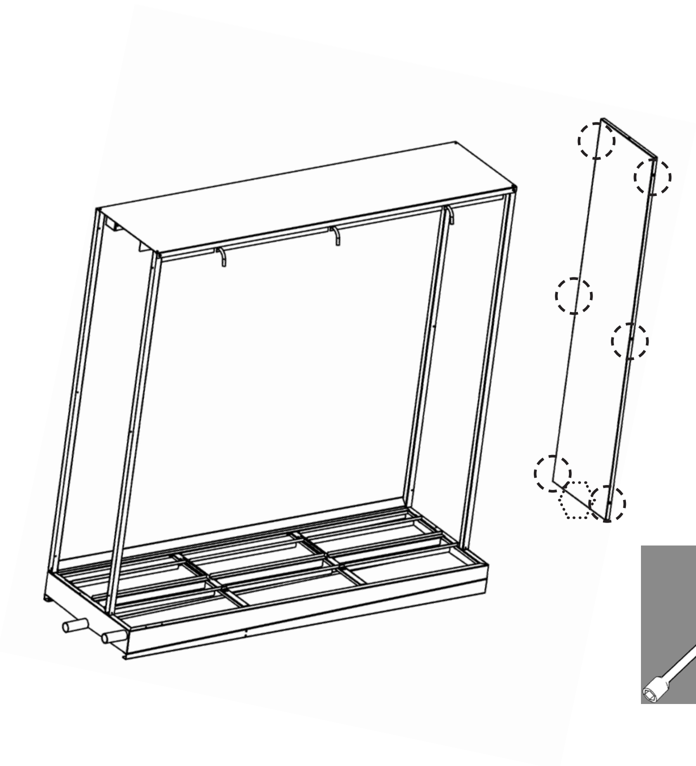
Vertically : 1 x nut M4 for each welded threaded stud bolt.
Horizontally : 1 screw + nut M4.

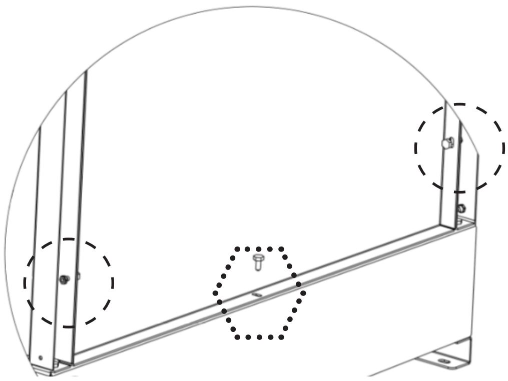


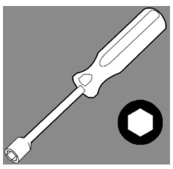
Install the roof carefully on the four pillars by introducing the welded threaded stud bolts into the four intended pillar holes.

Vertically : 1 x nut M4 for each welded threaded stud bolt.
Horizontally : 1 screw + nut M4.

Install first the side-door not used for cassettes extraction.







Vertically : 1x screw M4.

Horizontally : 1 screw + nut M4 (x6)

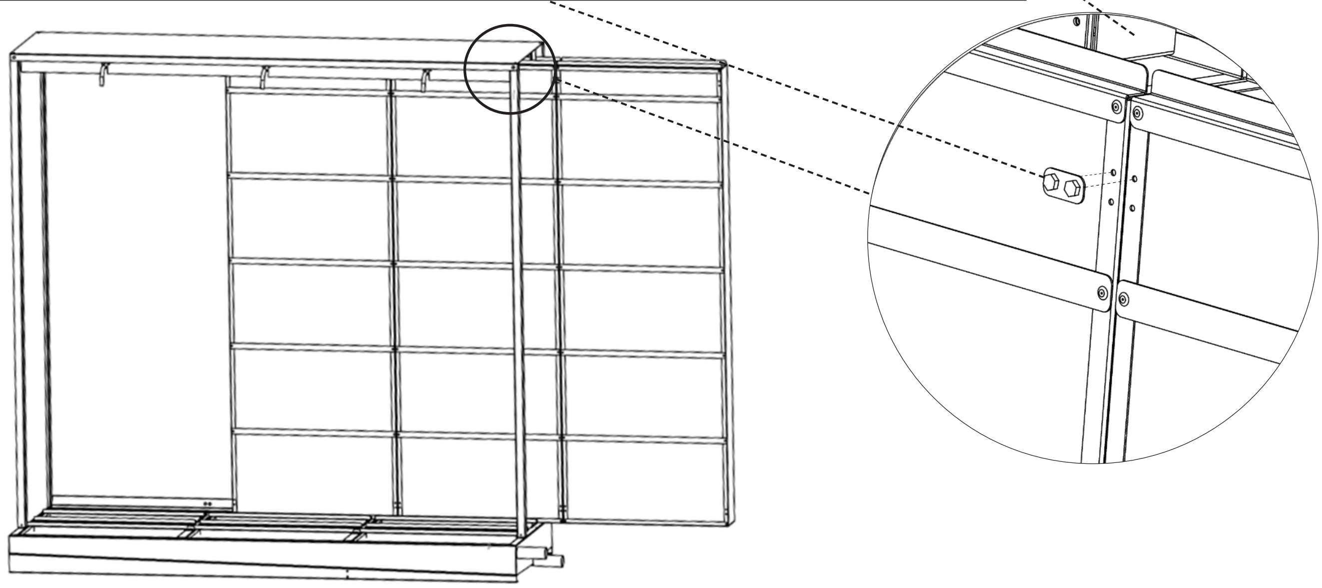
From this stage, please follow the instructions in page 14, if you can install the cassettes from the side, if not (Cassette installation by the front) please follow the instructions in page 15 (Cassette installation by the front).

Cassette installation by the side

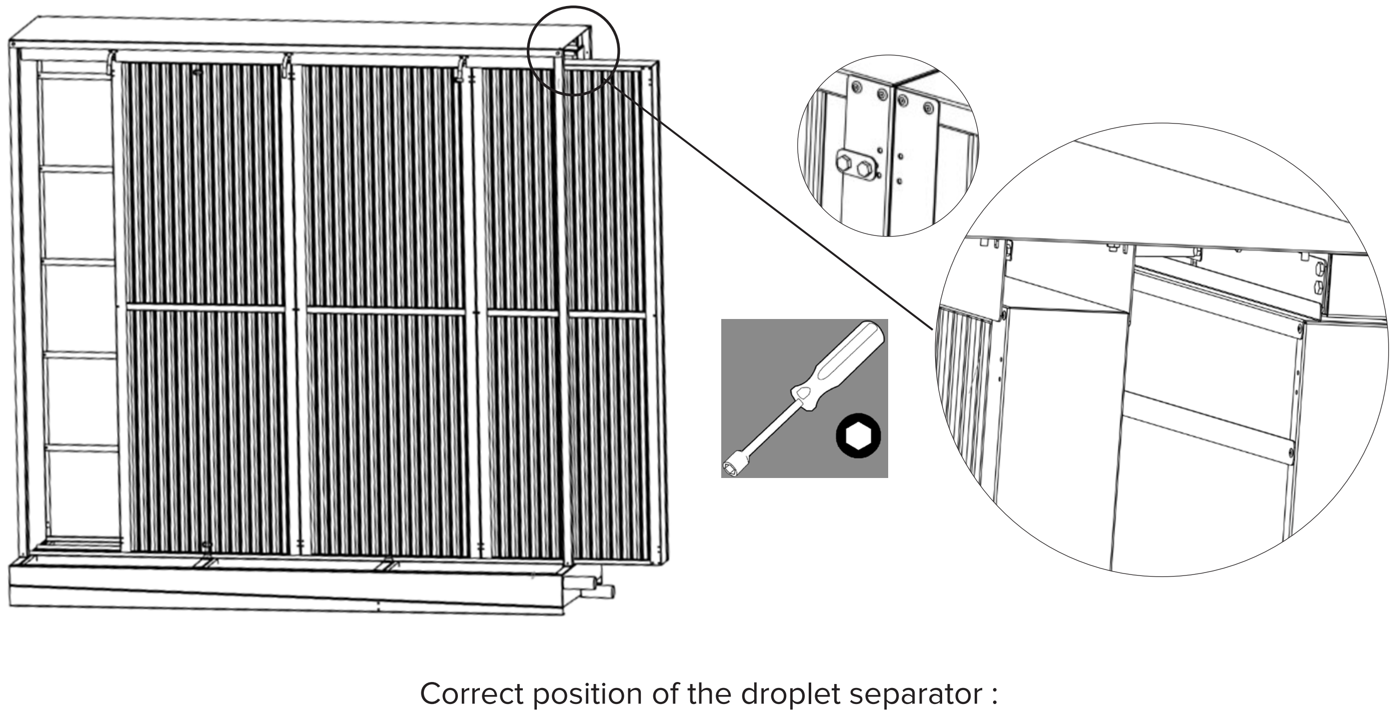
Please respect the minimum space needed for cassette extraction/ installation as described in page 9.

Introduce the cassettes one by one, by sliding them.
Please make sure the watering area is in-between top rails.

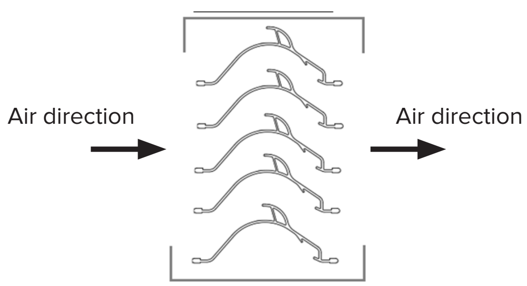
Attach the union frames with M4 screws at the rear and front cassette sides.



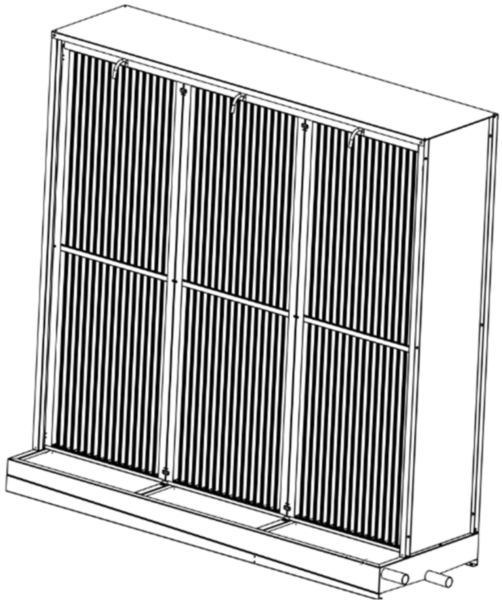
Introduce the droplet separator cassettes (if supplied) one at a time, by sliding them.
Attach the union frames with M4 screws at the rear and front cassette sides.

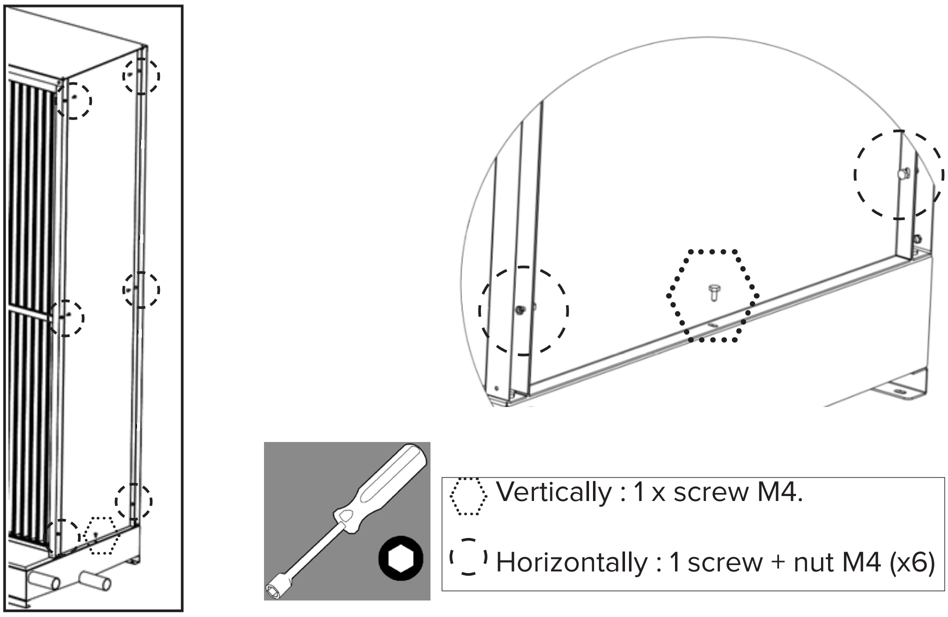


Correct position of the droplet separator :

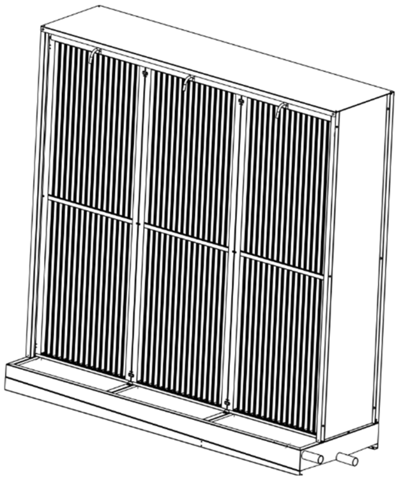


Access side-door assembly.





EvaPack™ final assembly with droplet separator option.

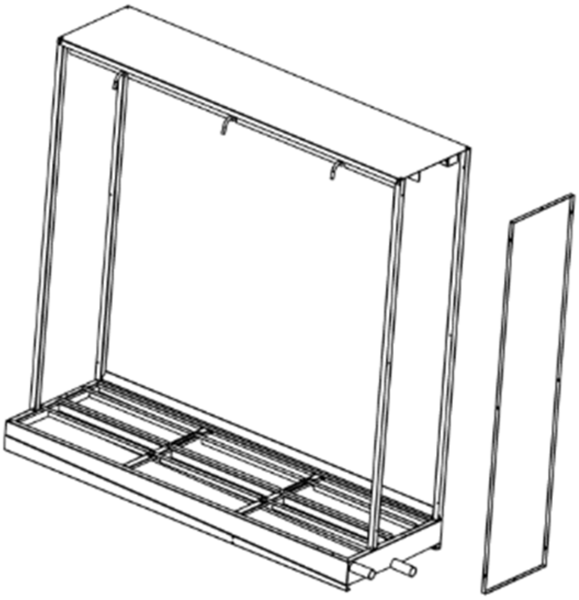


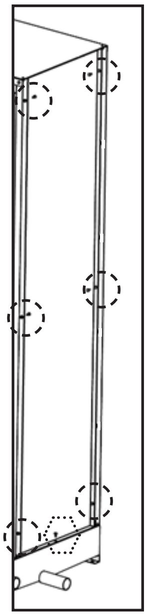
For ancillary installation, please review the corresponding chapter.

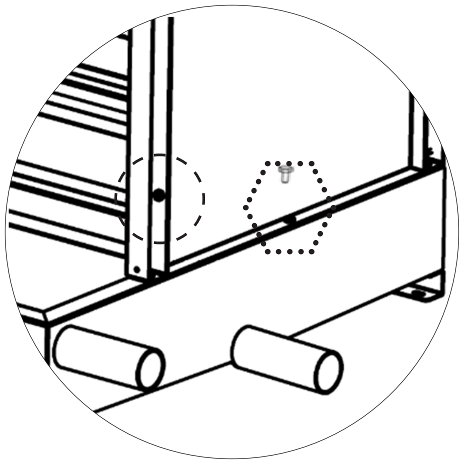
Cassette installation by the front

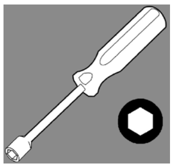
Please respect the minimum space needed for cassette Extraction/Installation as described in page 9.

Second side-door assembly.



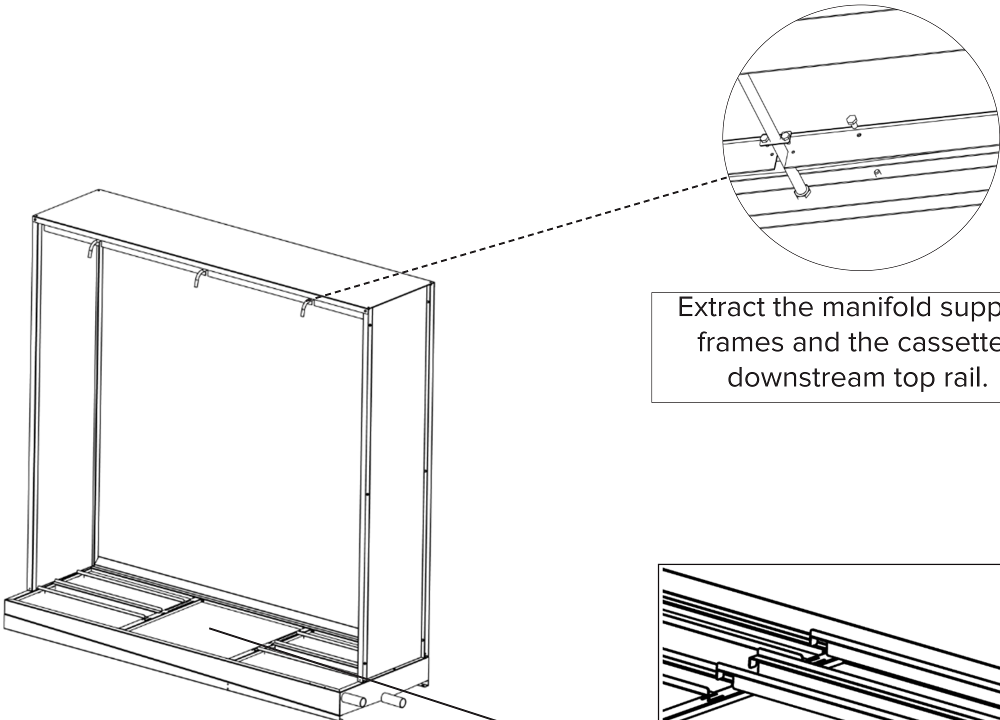




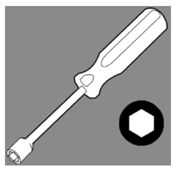


Vertically : 1 x screw M4.

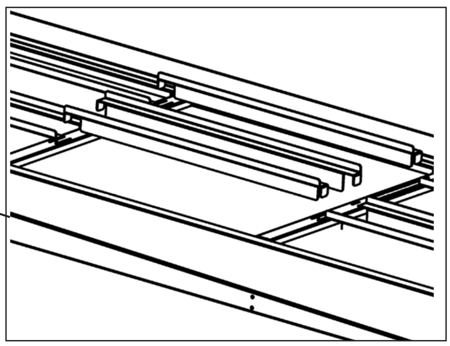
Horizontally : 1 screw + nut M4 (x6)



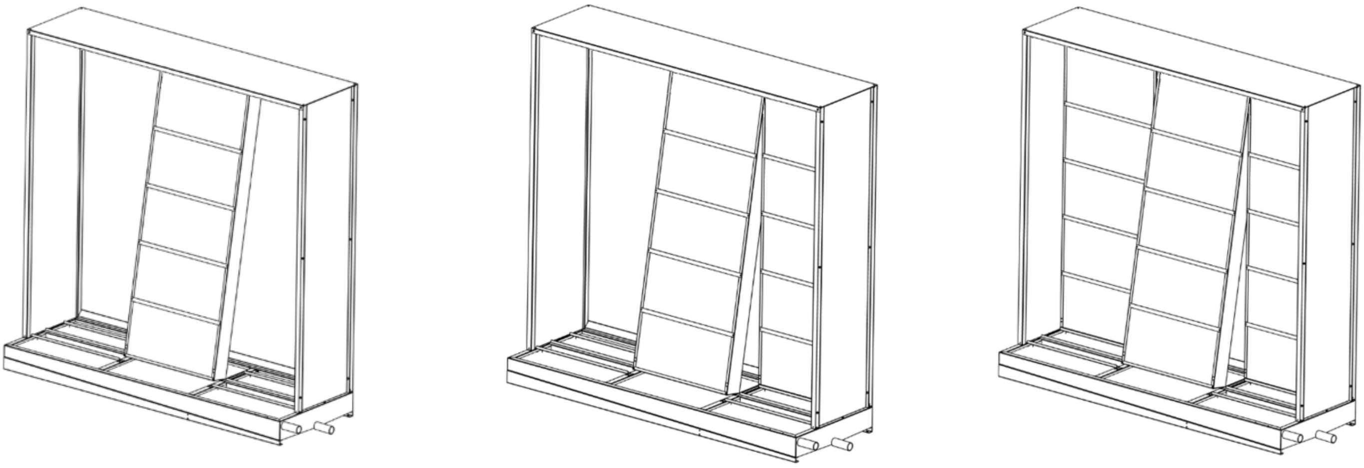
Extract the manifold support frames and the cassettes downstream top rail.



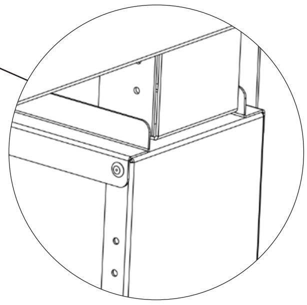
Hexagonal screws M4.



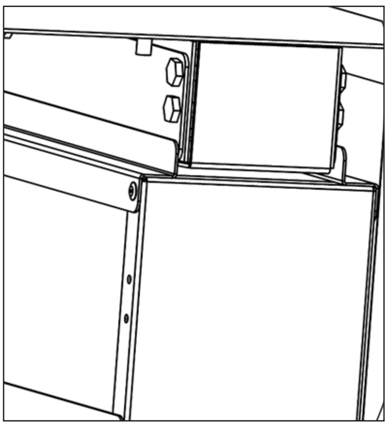
Extract the middle cassette support rails.



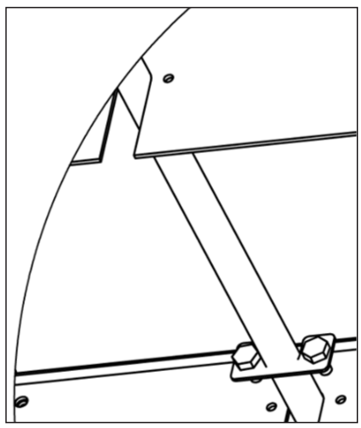
Install the cassettes one by one, from the center, and by sliding them towards the sides.
Be careful: respect the correct insertion of the watering part into the cassette tops.

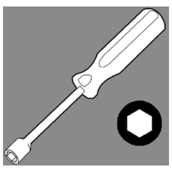


Reinstall the cassettes downstream top rail.



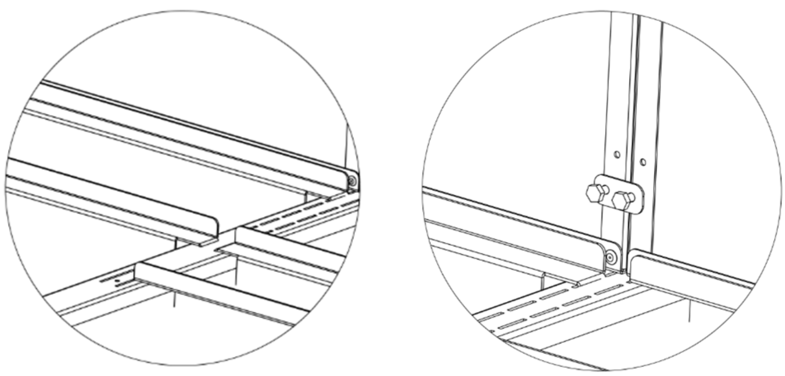
Reinstall the manifolds and their support frames.

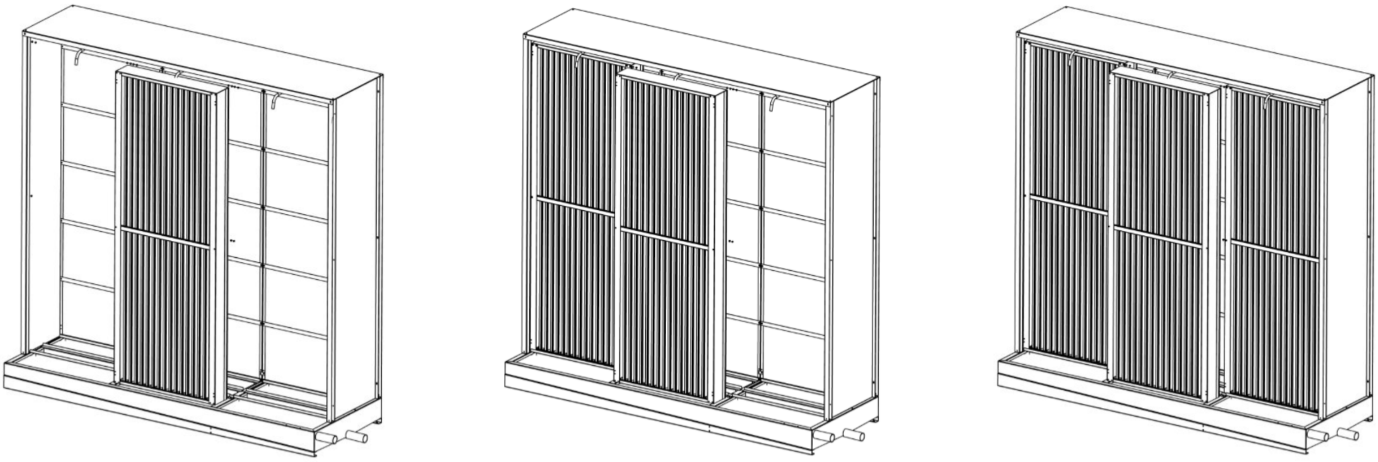




Hexagonal screws M4.

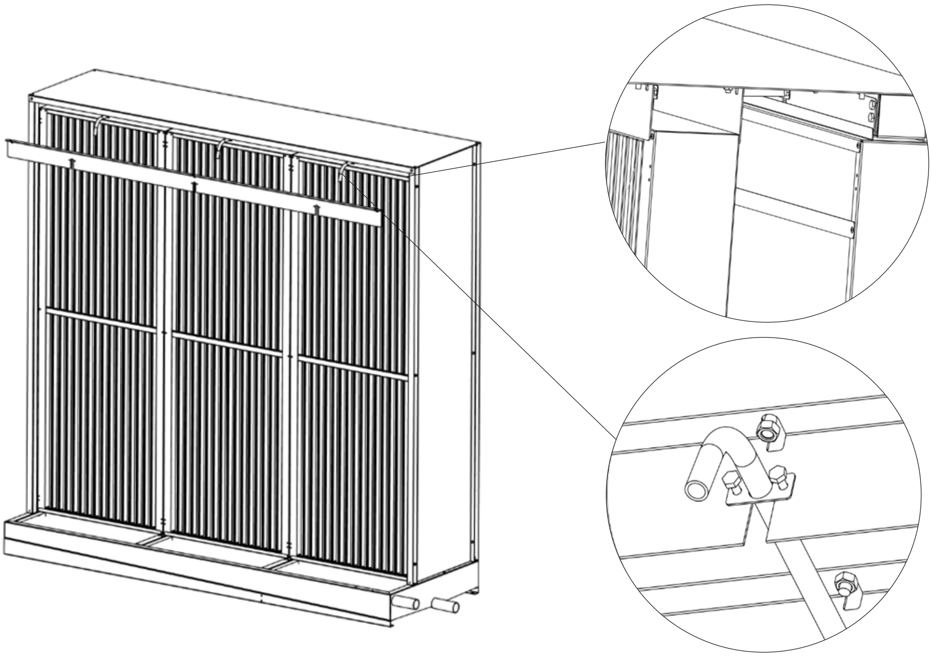
Install the cassettes support rails as shown in the picture.



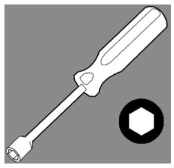


Install the droplet separators one by one, from the center, and by sliding them towards the sides.

The droplet separator can fall down, we recommend at least 2 people for this step.



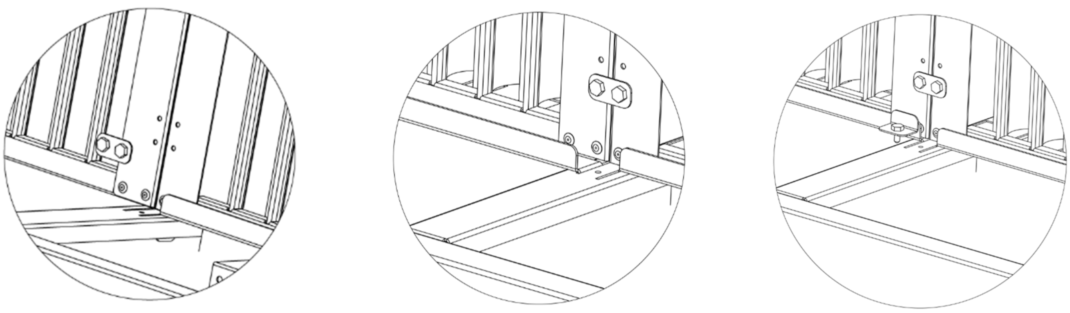
Correct droplet separator cassette top position.

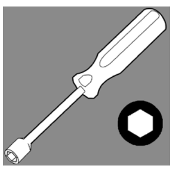


Hexagonal M6 nuts for the droplet separator top rail.

Hexagonal M4 screws for the manifold support frames.

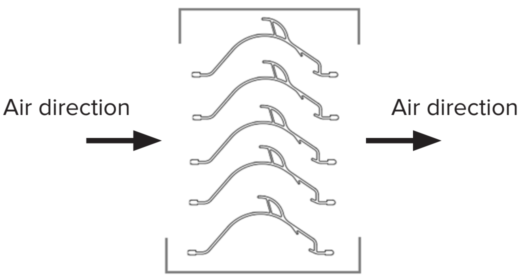
Install the cassette support rail as shown in the pictures below.

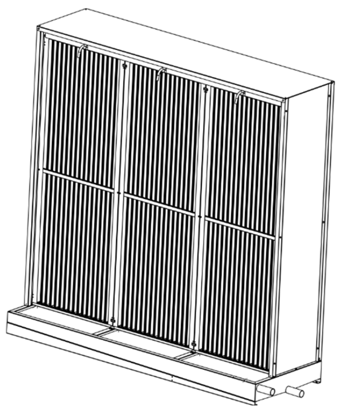




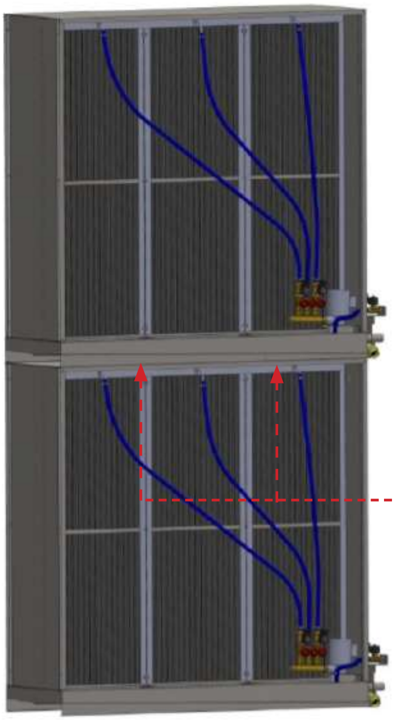
Hexagonal screws M4.

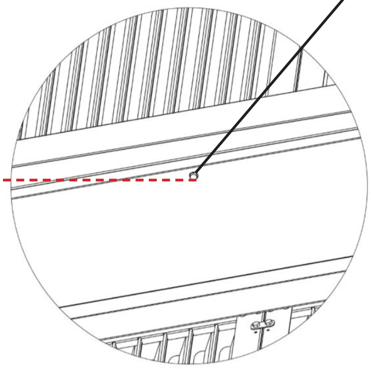
Correct position of the droplet separator :





EvaPack™ configuration "11" assembly (valid also for configuration "21")

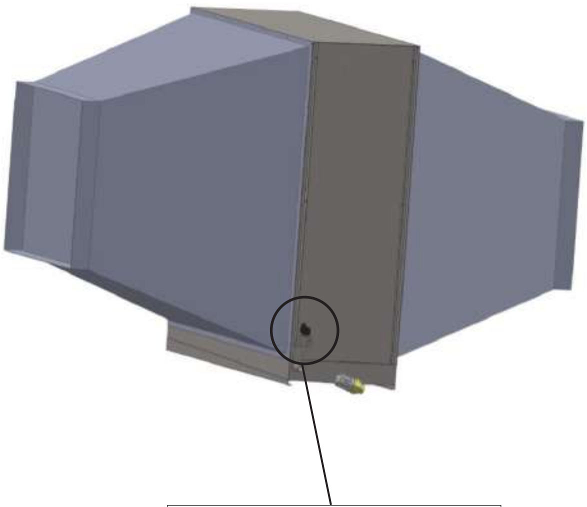




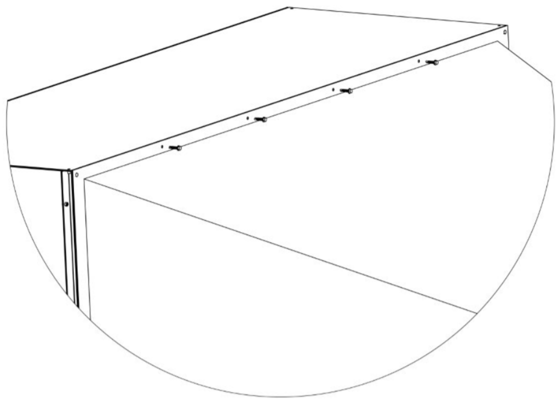
Put several self-drilling screws (upstream and downstream) to secure the two EvaPack™assembly.
Be careful : do not drill the upper water basin.

Flangeable unit for duct installation

Flange the unit to the duct frame and screw it properly.
Do not drill the water basin and use the correct sealant to tight the flange connection.



Inlet water connection



Supplied water installation

EvaPack™ can work with different types of water: potable water, reverse osmosis or softened water. It is the responsibility of the user to ensure that the water supply system is part of a managed, hygiene monitored water system. Water quality must comply with the local regulations and laws.

Reverse osmosis water
Reverse osmosis water is water purified under pressure by a semipermeable membrane. This membrane retains ions, molecules, and larger particles and allows only the water to pass to the other side. EvaPack™ pad accepts RO water with a conductivity > 1µS/cm at 20° C.

Softened Water
Softened water is hard water treated by ion-exchange resins. The resins remove the calcium, magnesium cations of the water. It is essential that the salt maintenance of softeners be programmed for the water volume consumed in order to prevent an excessive salt concentration to humidify once the regeneration cycle is finished (please refer to the softener's user manual).

Potable water
EvaPack™ air evaporative humidifier must be connected to a clean, potable (drinking water quality) water supply.

EvaPack™ air evaporative humidifier must operate within potable tap water specifications (main sources: Directive 98/83/CE and VDI 6022 requirements).

Organoleptic parameters			
Parameter	**Parametric value**	**Parameter**	**Parametric value**
Temperature (*)	< 20°C	Color	Acceptable and no abnormal change
Turbidity	≤ 2,0 NTU	Odor	Acceptable and no abnormal change
		Taste	Acceptable and no abnormal change
Microbiological parameters			
Enterococci (1)	0/100ml	Pseudomonas aeruginosa	0/250ml
Coliform bacteria	0/100 ml	Clostridium perfringens (including spores)	0/100 ml
Escherichia coli (E. coli)	0/250 ml	Legionella spp (2) (3)	< 100 CFU/100 ml
Colony count 22°C (1) Colony count 37°C (1) Total colony number (2)	No variation in a ratio of 10 to the usual value of the inlet water. < 1000 CFU/ml	Sulfate-reducing bacteria (1) (including spores)	0/100 ml (In the event of non-compliance with this value, an investigation must be carried out to ensure that there is no danger to human health resulting from the presence of pathogenic micro-organisms, for example Crystosporidium.)

(1) Value given by Directive 98/83/CE
(2) Value given by VDI 6022-4.3.7 for recirculating water in air humidifiers.
(3) This value must comply with potable water standards applicable in your country.
(4) EvaPack™ air evaporative humidifier must operate within these specifications.

Chemical parameters			
Acrylamide	≤ 0,1µg/l	Epichlorohydrin (1)	≤ 0,1 µg/l
Aluminium	<200 µg/l	Fluoride (1)	≤ 1,5 mg/l
Ammonium (1)	< 0,1 mg/l	Iron total (1)	≤ 200 µg/l
Antimony (1)	≤ 5,0µg/l	Lead (1)	≤ 10 µg/l
Arsenic (1)	≤ 10µg/l	Magnesium (3)	≤ 50 mg
Benzene (1)	≤ 1,0 µg/l	Manganese (1)	≤ 50 µg/l
Benzo(a)pyrene (1)	≤ 0,01µg/l	Mercury (1)	≤ 1,0 µg/l
Boron (1)	≤ 1,0 mg/l	Nickel (1)	≤ 20 µg/l
Bromate (1)	≤ 10 µg/l	Nitrate (1)	≤ 50 mg/l
Cadmium (1)	≤ 5,0 µg/l	Nitrite (1)	≤ 0,50 mg/l
Calcium (3)	≤ 300 mg/l	pH (Hydrogen ion concen-tration) (1)	6.5 to 9
Total organique carbone (TOC) (1)	≤ 2,0 mg/l	Pesticides total (1)	≤ 0,50 µg/l
Chloride (1)	≤ 250 mg/l	Polycyclic aromatic hydro-carbons (1)	≤ 0,10 µg/l
Chromium (1)	≤ 50 µg/l	Selenium (1)	≤10 µg/l
Conductivity (1) (3)	≤ 1000 µS/cm at 20°C	Silicate	< 150 mg/l
Copper (1)	≤ 1,0 mg/l	Sodium	≤ 200 mg/l
Cyanide (1)	≤ 50 µg/l	Sulfate	≤ 250 mg/l
1,2-dichloroethane (1)	≤ 3,0 µg/l	Trihalomethane Total (1)	≤ 100 µg/l
Tetra- and tri-chloroethene (1)	≤ 10 µg/l	Vinyl chloride (1)	≤ 0,50 µg/l
Radioactivity			
Tritium (1)	<100 Bq/l	Total indicative dose (1)	< 0,1 mSv/year

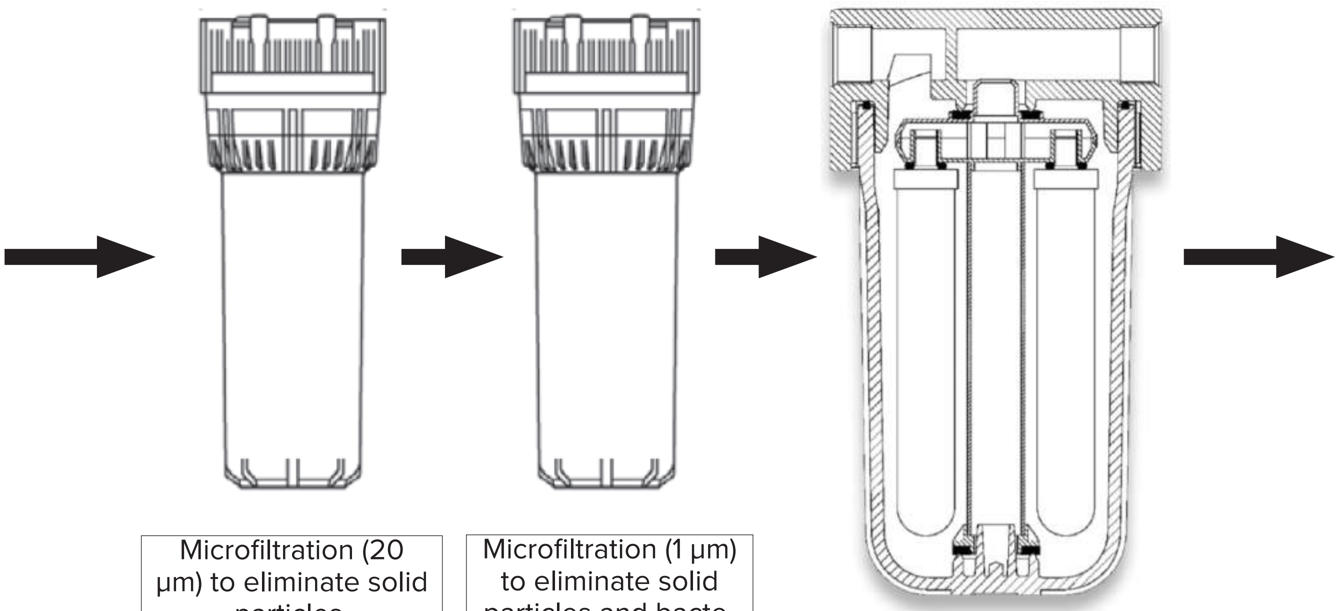
(1) Value given by Directive 98/83/CE
(2) Value given by VDI 6022-4.3.7 for recirculating water in air humidifiers.
(3) Water hardness range will be confirmed by PSI value (please see EvaPack™ bleed-off chapter)
(4) EvaPack™ air evaporative humidifier must operate within these specifications.
These values are to be taken into account when setting the bleed-off limits.

**A too low water temperature can impact humidification efficiency.*

Inlet tap water treatment recommendations (optional)

Water filtration to eliminate solid particles:
To avoid any trouble or leakage due to solid particles obstructing the inlet water valve we recommend the use of water pre-filter.

Water filtration to eliminate microorganisms:
To reduce the inlet tap water microorganism quantity we recommend to use a water filter of 20 µm followed by a water filter of 1 µm mesh size.
To prevent any biofilm contamination, we recommend the installation of a ceramic water filter of 0.5 µm mesh size with silver ions.
To reduce the water microorganisms quantity after the last filtration, we recommend purging regularly the inlet water circuit.



Microfiltration (20 µm) to eliminate solid particles.
Connections: 3/4” FF

Microfiltration (1 µm) to eliminate solid particles and bacteria.
Connections: 3/4” FF

Microfiltration (0.5 µm) to eliminate pathogenic organisms (bacteria, parasites, cysts...)
Silver ions to avoid any internal microbiological growth
45 l/min at 4 bar water pressure.
Operative pressure: between 1 and 9 bar
Connections: 1” FF

NOTES

- Water filters (cartridges and ancillaries) must comply with potable water standards applicable in your country (example : KTW/W270, DVGW, ACS, NSF, etc.).

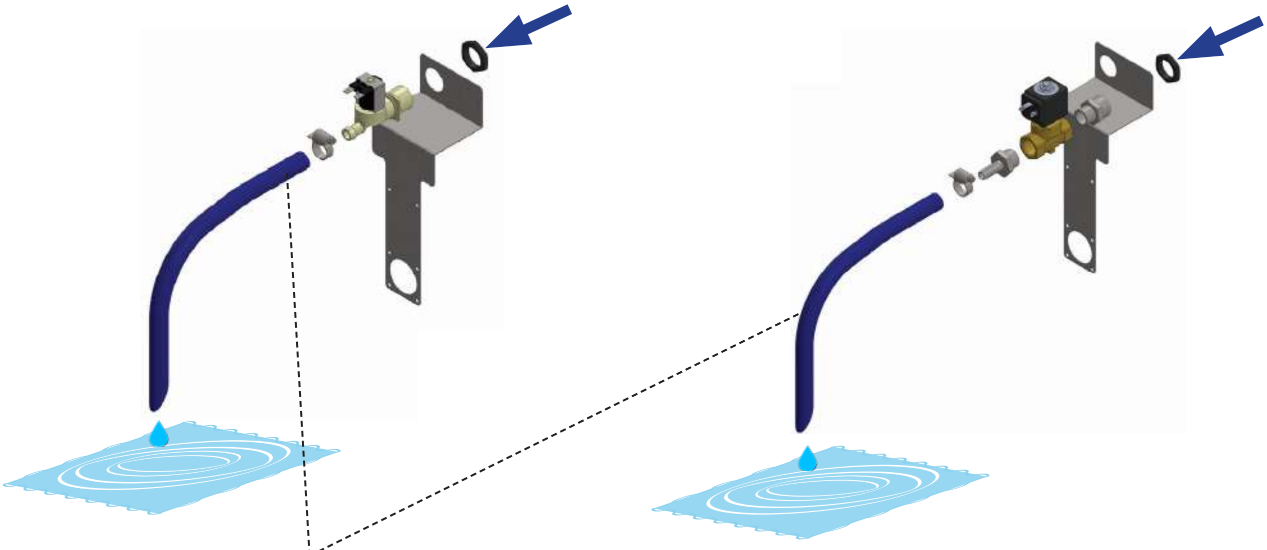
UV lamp water treatment utilisation is subject to the following rules:
- As UV lamp water treatment can increase the water temperature, we recommend to use this system with a loop water system installation or with controlled inlet water purge (in order to maintain water temperature below 20°C).
- UV lamp water treatment must be installed with minimum two water filtration stages (20 µm and 1 µm) to avoid any shadow effect.

Inlet water valve installation

Recirculated Water (RW) configuration

Up to 900 l/h
Operating pressure range: 2 to 10 bar

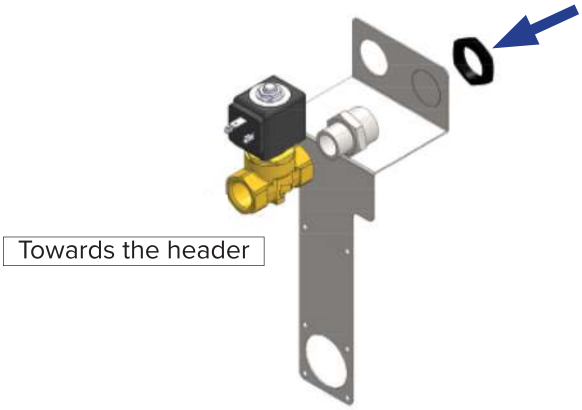
Up to 3 600 l/h
Operating pressure range: 2 to 10 bar



The basin filling hose must be installed without touching the basin water to avoid any inlet water system contamination.

Direct Water (DW) configuration

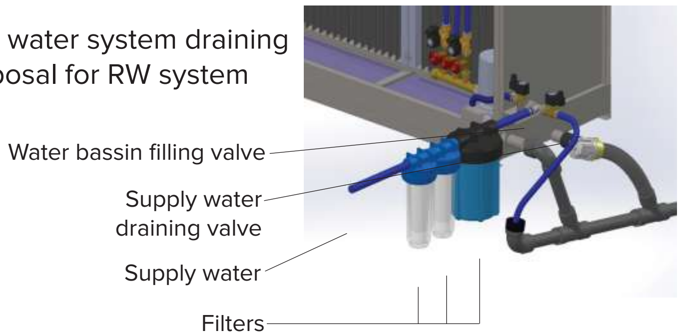
Up to 3 600 l/h
Operating pressure range: 2 to 10 bar



NOTES:
- Inlet water valves have to be protected against impacts, humidity and light.
- The Armstrong ECV2 series water valve in stainless steel can be used for proportional inlet water control when using RO water only.
- For RW system, in order to eliminate possible microorganisms between the last water treatment point and the water inlet valve, we recommend to install an additional solenoid valve for periodic draining of the inlet water system. This inlet water draining valve must be installed to comply with VDI 6022 certification.

ECV2 series

Inlet water system draining proposal for RW system

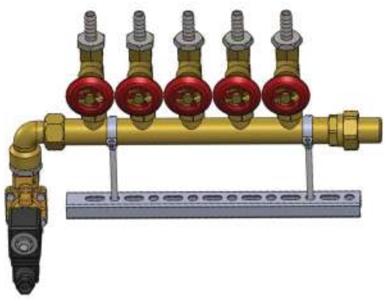


Water distribution headers

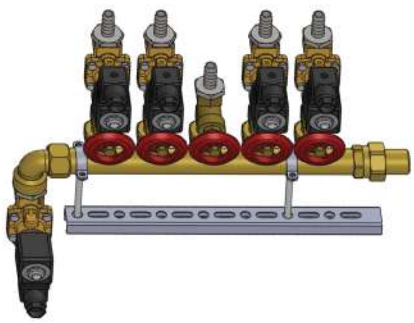
Depending on your needs, we can supply different EvaPack™ headers.

NOTES
For DW units the header should be connected to the inlet water system (solenoid valve or ECV2 valve). In order to comply with VDI 6022 hygienic requirements and guidelines, the header should be installed with a slope towards the draining valve, in order to insure the complete emptying of the irrigation piping.
For RW units the header should be connected to the pump. The draining is done through the pump itself, and passes through the header slope which is created by the pump support.

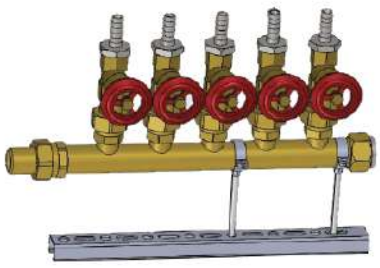
Header examples



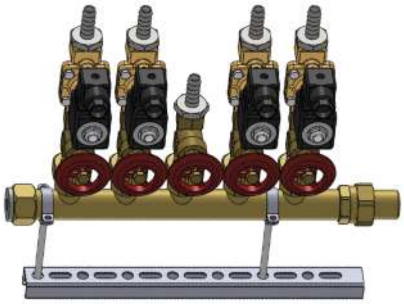
Header for DW system without staging control



Header for DW system with staging control



Header for RW system without staging control



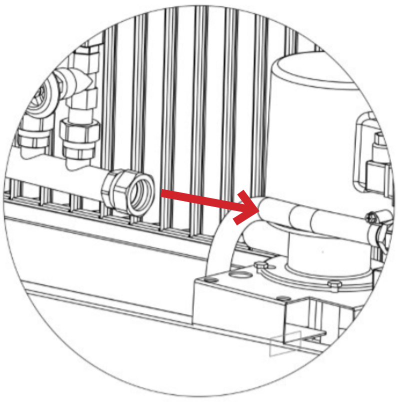
Header for RW system with staging control

Water pump

Water pump is used only for RW configuration

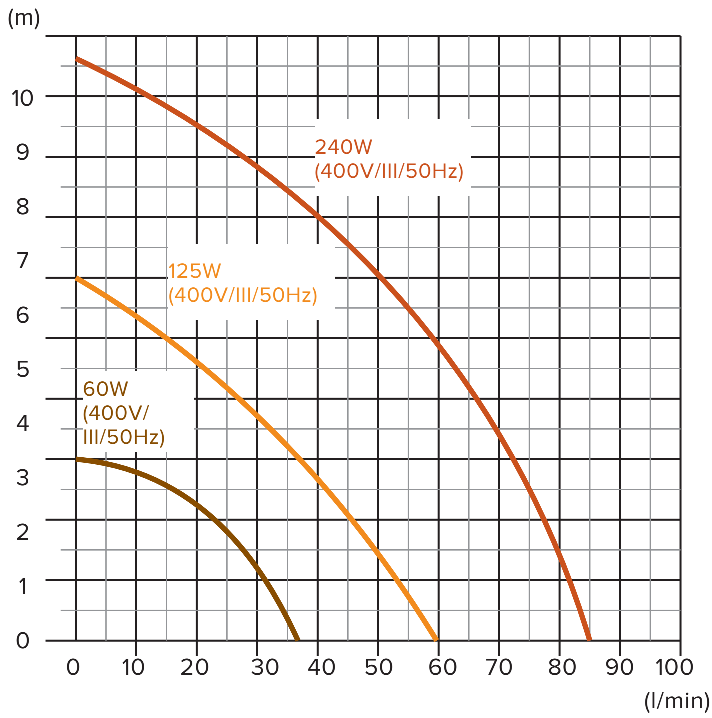
Sizing of watering recirculation pump is oversized for evaporating and continuous cassette washing.

Globe valves adjustment is required in order to avoid any water spillage outside the EvaPack™ frame.



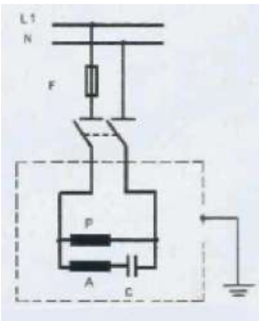
The pump could be connected to the header with a 3/4” F/M threaded connector.
The pump outlet is 3/4” F (female).

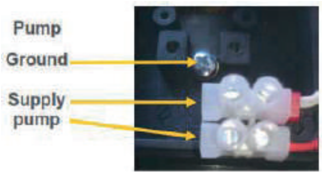
Pump running dry protections:



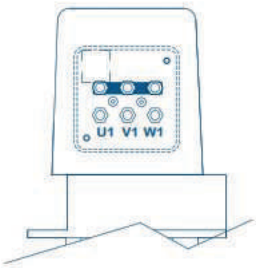
- The pump has a thermic protection which switches off the pump in case of overheating and gives an alarm signal to the control panel.
- The water level switches on the pump only when the minimum water level is reached. The pump is off when the water level is below low level.

Monophasic pump 230V/
I+N/50Hz Wiring diagram

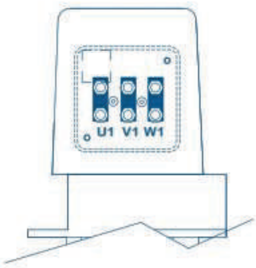




Monophasic pump 230V/
I+N/50Hz Wiring diagram

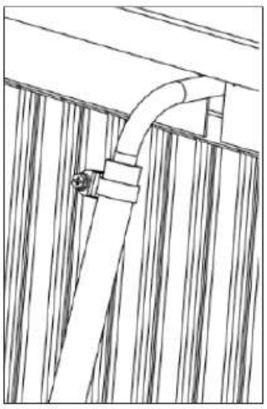


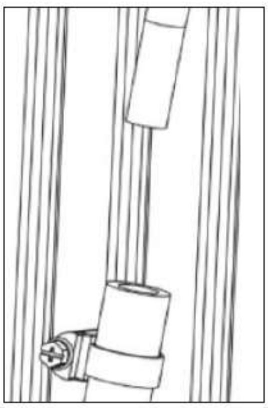
Starconnection
(400V/III/50Hz)

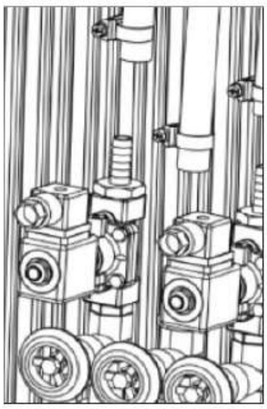


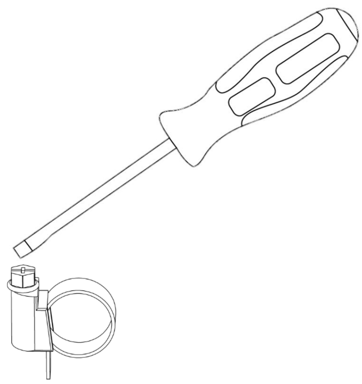
Delta connection
(230V/III/50Hz)

Irrigation water hoses









The water hoses are attached to the watering manifolds and header valves with stainless steel hose clamps.

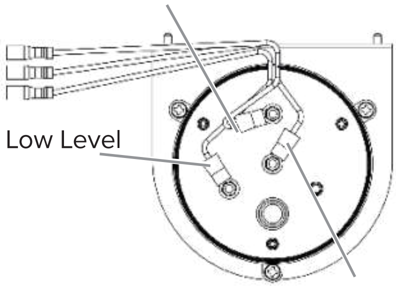
NOTES:
At commissioning and during maintenance, check that there is no water leakage due to unscrewed hose clamps.

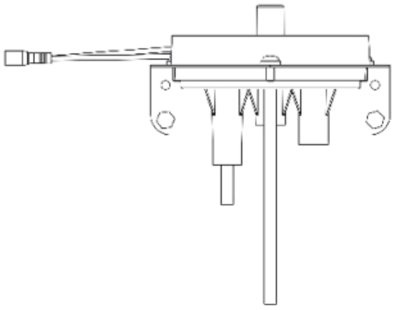
Water level sensor installation

For RW

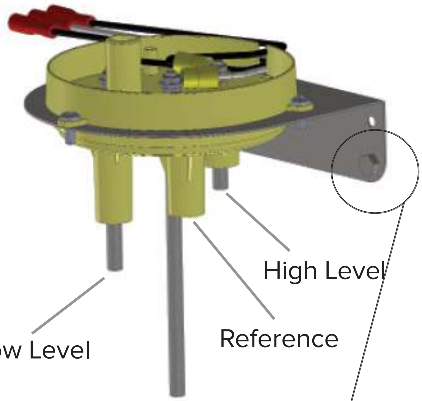
Two water level detections:

- Low level water to protect the pump against running dry,
- High level water to switch off the filling.





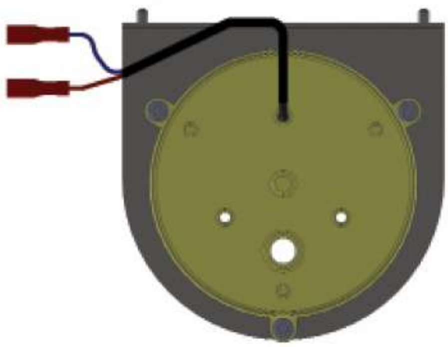
Connection 1-1/2" (DN40)

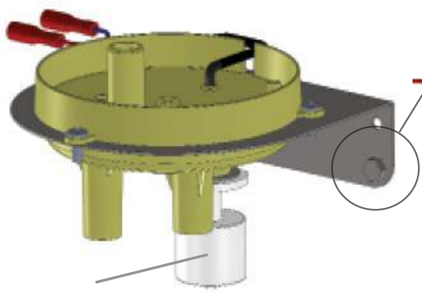


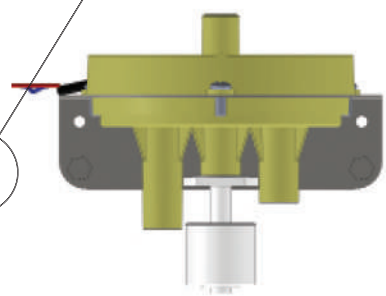
x2 M6 screws

For DW

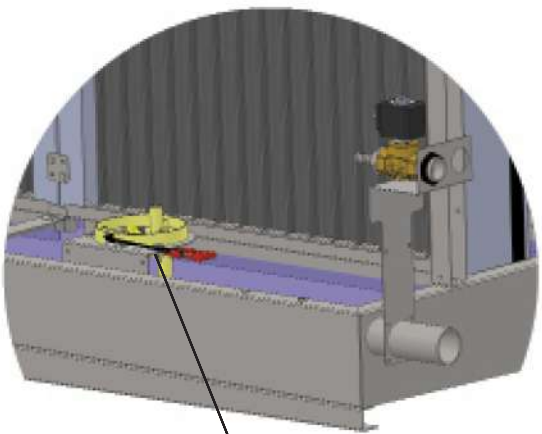
- High water level switch option.



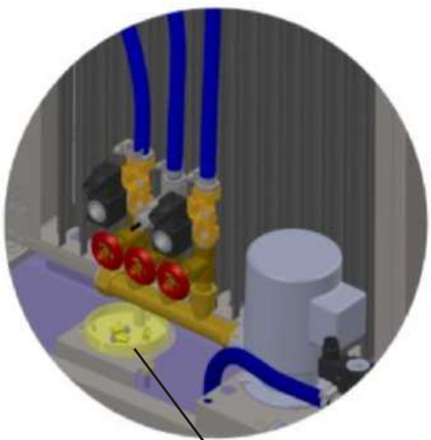




High Water Level
Switch Option



DW: Water level
switch

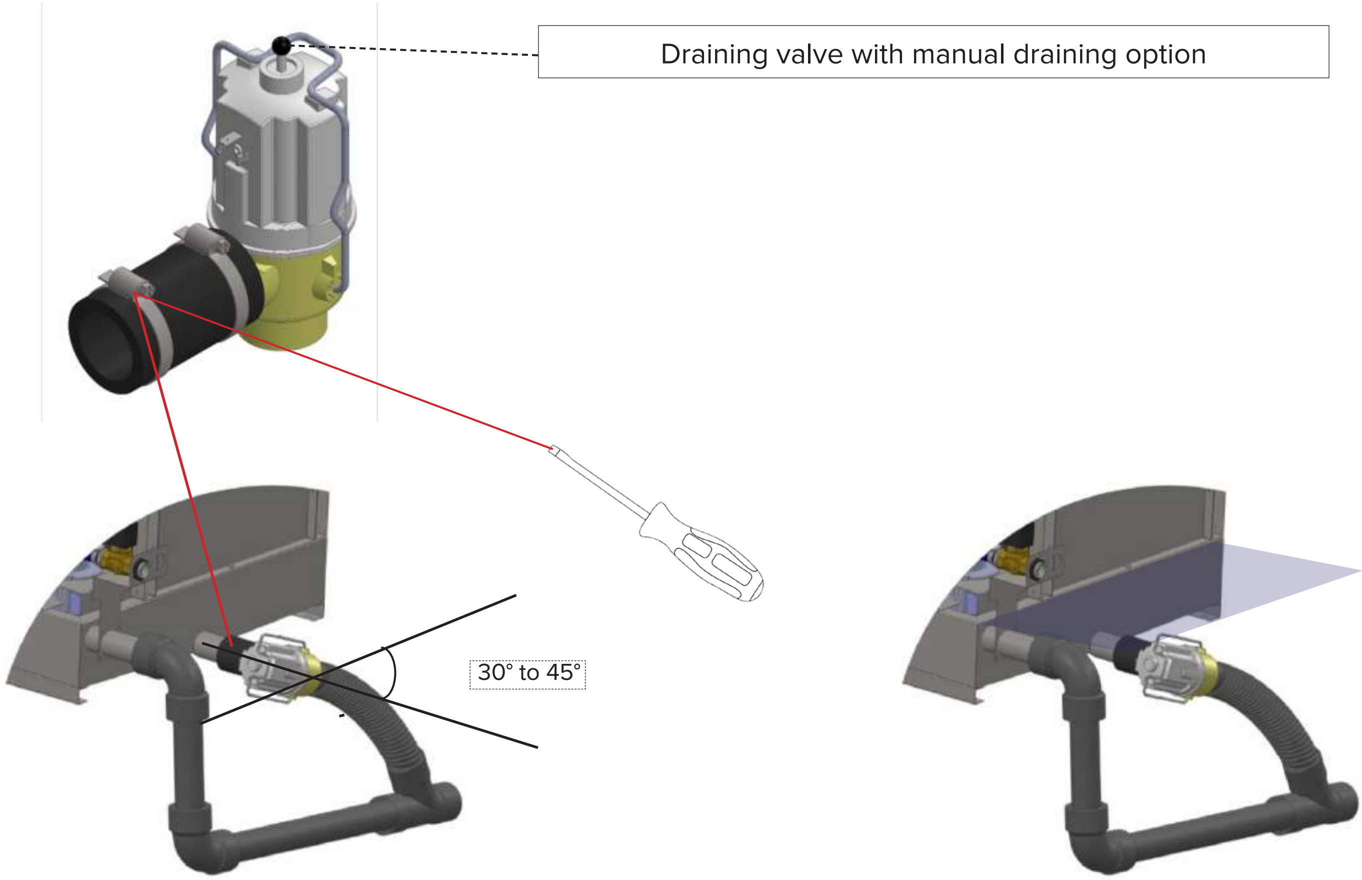


RW: Water level
sensor

Water draining installation

<u>For RW</u>

EvaPack™ humidifier is designed with a water basin sloped on all sides towards the drain.
A draining valve with a water hose connected is supplied loose to avoid any damage during shipment.
The other end of the hose must be connected to the basin draining pipe with a clamp.



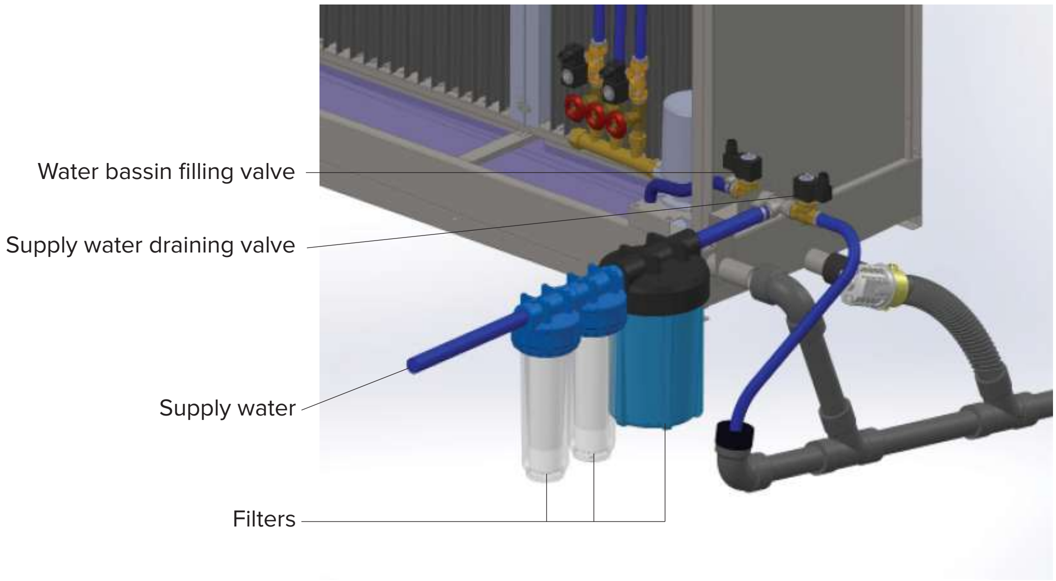
We recommend 30° to 45° angle to ensure complete draining and emptying of the tank.

No drain valve part must be above the lower cassette extraction part.

NOTES:
The drain valve has to be protected from impacts, humidity and light. The overflow piping outlet must be always free.

The drain must be equipped with a siphon with non-return valve or a siphon disconnected from the sewage network.

H min. (mm) = P (Pa)/10
with P = absolute pressure of the AHU/Duct



Water draining installation example with a water inlet purge.

NOTE:
In case of power shutdown, the water basin must be drained manually using the manual draining valve option.

Maintenance Requirements

EvaPack™ drying and bleed-off settings to reduce maintenance

To prevent microorganism development

The EvaPack™ humidifier system must be connected to a clean, potable water supply. It is the responsibility of the user to ensure that the water system complies with local regulations and laws, particularly those for the control of Legionella bacteria.

The EvaPack™ humidifier system must be frequently controlled by microbiological sampling for hygiene as part of the maintenance program.

Bacteria

To prevent the growth of Legionella, and others bacteria:

1. Carry out a risk assessment of the water system using a competent person, and implement an appropriate control.
2. During the installation, maintenance and operation, no material that provides a nutrient for bacteria is allowed.
3. Avoid water temperatures which favor the growth of Legionella (no water temperature higher than 20ºC, this parameter can be monitored by our control panel and a water temperature sensor)
4. Avoid water stagnation.
5. EvaPack™ must be emptied and dried when not used for more than 24 hours.
6. The relative humidity downstream the humidification section must not exceed 90 %.

Algae

To prevent the growth of algae:

1. No external light must enter through the housing.
2. During the installation, maintenance and operation, no material that provides a nutriment for algae is allowed.
3. EvaPack™ must be emptied and dried when not used for more than 24 hours.

Fungi, Mold

To prevent the growth of fungi:

1. During the installation, maintenance and operation, no material that provides a nutriment for fungi or mold is allowed.

2. The relative humidity downstream the humidification section must not exceed 90 %.

3. EvaPack™ must be emptied and dried when not used for more than 24 hours.

Humidifier drying recommendations

It is the responsibility of the user to ensure that the humidifier is emptied and completely dried by fan overrunning for few minutes before switching off the unit.

Drying formula guide

To estimate the cassette drying time, we recommend the following formula:

$$\Delta t = 60 \times 0{,}068 \times H \times L \times E / C$$

With:

(Δt): Drying time in min.

(H): total cassette height in decimeter.

(L): Total cassette length in decimeter.

(E): Pad thickness in decimeter.

(C): Evaporation capacity of the air flow. $C = \Delta x * 1{,}2 * Q$

(with Q = air flow in m^3/h and Δx humidity ratio variation in kg/kg)

EvaPack™ humidifier panel control can be connected to temperature sensors which measure inlet and outlet humidifier temperatures (optional). When both temperatures are equal, the EvaPack™ drying is completed.

To prevent salt deposits on EvaPack™ pad: bleed-off

Water usually has a high percentage of minerals. The evaporative mechanism leaves mineral deposits on the pad, susceptible to clog the porous of the pad and damage it.

For recirculated water units (RW): the bleed-off is made through water draining valve setting.

For direct water units (DW): the bleed-off is made through an excess of water flow.

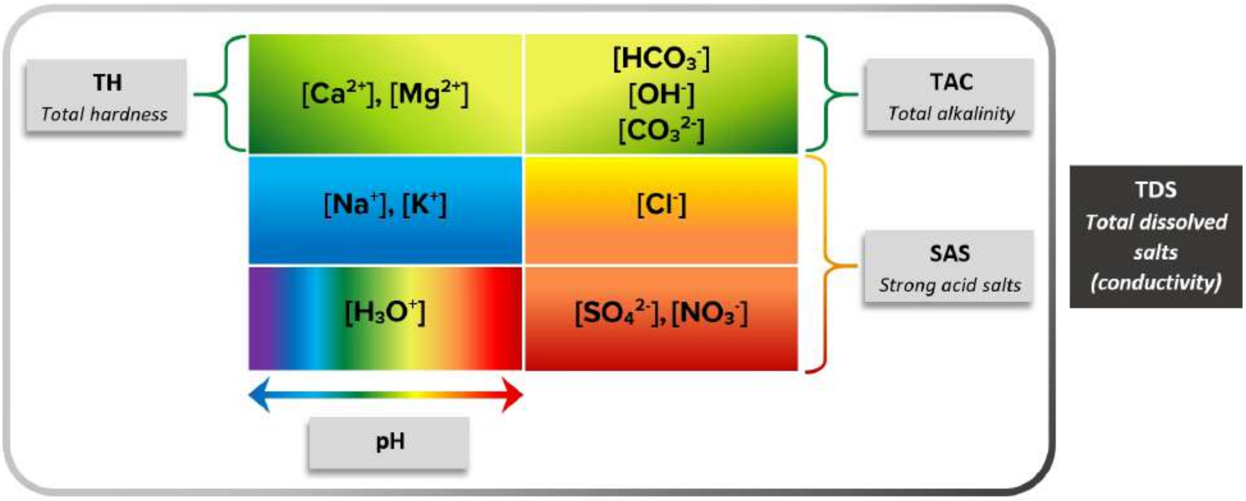
It is the responsibility of the user to adjust regularly the bleed-off time.

Bleed-off time can be reduced if no white minerals deposit is visible on the pad surface or increased if lime scale deposit is visible.

The bleed-off must be set according to the water quality. Water analysis data can be asked to the local water company.

In case of very hard water and in order to minimize scale build up, we recommend to pretreate the water supply.

Understanding of water hardness and other values



Puckorius Saturation Index (PSI)

$$PSI = 2\ pH_s - pH_{eq}$$

For PSI index calculation, we recommend water analysis including the following parameters:

$pH_s = 9.3 + A + B - C - D$ (Edstrom)	
$A = (\log(TDS)-1)/10$	TDS (mg/l or ppm)
$B = (-13.12 \times \log(T+273))+34.55$	Water temperature T (°C)
$C = \log([Ca^{2+}]) - 0.4$	Calcium hardness or Calcium concentration, $[Ca^{2+}]$ (ppm as $CaCO_3$)
$D = \log(TAC)$	TAC (ppm as $CaCO_3$)
$pH_{eq} = 1.465 \times \log(TAC) + 4.54$	TAC (ppm as $CaCO_3$)

Useful conversions

Regional units

	°dH	°eH	°fH	°aH	ppm as $CaCO_3$
1°dH	1	1.253	1.79	1.04	17.8
1°eH	0.798	1	1.43	0.83	14.3
1°fH	0.559	0.702	1	0.58	10
1°aH	0.96	1.2	1.71	1	17.1
1 ppm as $CaCO_3$	0.056	0.072	0.1	0.058	1

Total Alkalinity (TAC)

	ppm as $CaCO_3$	ppm as HCO_3	mmol/l
1 mmol/l	50	61	1
1 pmm as $CaCO_3$	1	1.22	0.02
1 ppm as HCO_3	0.82	1	0.0164

Total Hardness (TH)

	ppm as $CaCO_3$	mmol/l
1 mmol/l	100	1
1 pmm as $CaCO_3$	1	0.02
1 ppm as HCO_3	0.82	0.0164

Calcium hardness of Calcium concentration $[Ca^{2+}]$

Calcium hardness can be expressed in mmol/l or mg/l
1 mmol/l of $[Ca^{2+}]$ = 1/40 mg/l of $[Ca^{2+}]$

Conductivity (TDS)

1000 µS/cm = 1mS/m
1 µS/cm ~ (1.62 ppm CaCO3 = 1.62 mg/l de $CaCO_3$)

Data for quick calculations of PSI for EvaPack™ and tap water

TDS (µS/cm) (µMHO's)	A	T (°C)	T (°F)	B	[Ca^{2+}] (mg/l)	[Ca^{2+}] (PPM as $CaCO_3$)	C	TAC (mmol/l)	TAC PPM (as $CaCO_3$)	D	TAC (mmol/l)	TAC PPM (as $CaCO_3$)	pH_{eq}
50	0.06	10	50	2.38	4	10	0.6	0.2	10	1.0	0.2	10	6.0
100	0.09	11	51.8	2.36	6	15	0.8	0.3	15	1.2	0.3	15	6.3
150	0.10	12	53.6	2.34	8	20	0.9	0.4	20	1.3	0.4	20	6.4
200	0.12	13	55.4	2.32	10	25	1.0	0.5	25	1.4	0.5	25	6.6
250 - 300	0.13	14	57,2	2.30	12-14	30-35	1.1	0.6-0.7	30-35	1.5	0.6	30	6.7
350	0.14	15	59	2.28	16	40	1.2	0.4	40	1.6	0.7	35	6.8
400 - 450	0.15	16	60.8	2.26	18-22	45-55	1.3	0.9-1.1	45-55	1.7	0.8	40	6.9
500 - 600	0.16	17	62.6	2.24	24-28	60-70	1.4	1.2-1.4	60-70	1.8	0.9-1.0	45-50	7.0
650 - 750	0.17	18	64.4	2.22	30-34	75-85	1.5	1.5-1.7	75-85	1.9	1.1-1.2	55-60	7.1
800 - 950	0.18	19	66.2	2.20	36-44	90-110	1.6	1.8-2.2	90-110	2.0	1.3-1.4	65-70	7.2
1000 - 1200	0.19	20	68	2.18	46–56	115-140	1.7	2.3-2.8	115-140	2.1	1.5-1.6	75-80	7.3
1250 - 1550	0,20	21	69.8	2.17	58-70	145-175	1.8	2.9-3.5	145-175	2.2	1.7-1.9	85-95	7.4
1600 - 1950	0.21	22	71.6	2.15	72–88	180-220	1.9	3.6-4.4	180-220	2.3	2.0-2.2	100-110	7.5
2000 - 2450	0.22	23	73.4	2.13	90–112	225-280	2.0	4.5-5.6	225-280	2.4	2.3-2.6	115-130	7.6
2500 - 3100	0.23	24	75.2	2.11	114-140	285-350	2.1	5.7-7.0	285-350	2.5	2.7-3.1	135-155	7.7
3150 - 3900	0.24	25	77	2.09	142–178	355-445	2.2	7.1-8.9	355-445	2.6	3.2-3.6	160-180	7.8
3950 - 4950	0.25				180–224	450-560	2.3	9.0-11.2	450-560	2.7	3.7-4.2	185-210	7.9
5000	0.26				226–280	565-700	2.4	11.3-14.0	565-700	2.8	4.3-4.9	215-245	8.0
											5.0-5.8	250-290	8.1
											5.9-6.8	295-340	8.2
											6.9-7.9	345-395	8.3
											8.0-9.3	400-465	8.4
											9.4-10.9	470-545	8.5
											11.0-12.7	550-635	8.6
											12.8-14.0	640-700	8.7

PSI interpretation

If PSI < 6.0: Scale forming (not usable water)
If 6.0 ≤ PSI < 7.0: water is stable (Usable water for direct water system only)
If PSI> 7.0: Scale dissolving (usable water for RW & DW systems)

Bleed-off flow rate calculation

$$\text{Bleed-off} = \frac{\text{Evaporation}}{\text{COC-1}} \quad \text{(Carrier 1965)}$$

Concentration cycle number (COC) in function of PSI value

Suitable only for DW	
PSIwater	COC
6.1	1.04
6.2	1.09
6.3	1.14
6.4	1.19
6.5	1.24
6.6	1.30
6.7	1.36
6.8	1.42
6.9	1.48
7.0	1.55
7.1	1.62

Suitable for RW or DW									
PSIwater	COC	PSIwater	COC	PSIwater	COC	PSIwater	COC	PSIwater	COC
7.2	1.69	8.2	2.62	9.2	4.05	10.2	6.28	11.2	9.72
7.3	1.77	8.3	2.73	9.3	4.23	10.3	6.56	11.3	10.15
7.4	1.84	8.4	2.86	9.4	4.42	10.4	6.85	11.4	10.61
7.5	1.93	8.5	2.98	9.5	4.62	10.5	7.16	11.5	11.08
7.6	2.01	8.6	3.12	9.6	4.83	10.6	7.48	11.6	11.58
7.7	2.10	8.7	3.26	9.7	5.04	10.7	7.81	11.7	12.10
7.8	2.20	8.8	3.40	9.8	5.27	10.8	8.16	11.8	12.64
7.9	2.30	8.9	3.55	9.9	5.50	10.9	8.52	11.9	13.20
8.0	2.40	9.0	3.71	10.0	5.75	11.0	8.91	12.0	13.79
8.1	2.51	9.1	3.88	10.1	6.01	11.1	9.30		

Note: table valid for set point PSI = 6.0
If set point PSI > 6.0 (6.0+x), please read from $PSI_{water} - x$

COC must be > 1
When bleed-off water flow is more than 1.5 times the evaporated water (COC < 1.66), we recommend DW water configuration only.

IMPORTANT:

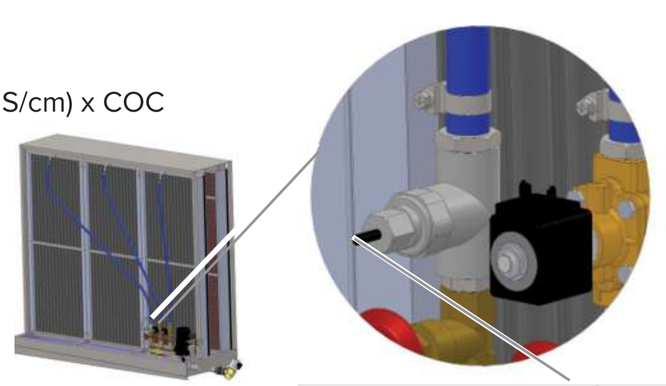
When using softened water, the total hardness cannot be used to determine the bleed-off and COC calculation.

Multiply the calculated COC for limescale deposit with other important inlet water mineral/microorganism value and compare with the recommended limit (see tables of pages 19 and 20). If the value above the limit the COC must be reduced.

Examples:
Conductivity (µS/cm): inlet Conductivity × COC ≤ 1000 µS/cm
Chlorides (mg/l): $[\text{Chloride}]_{inlet}$ × COC ≤ 250 mg/l
Sulphates (mg/l) $[\text{Sulphate}]_{inlet}$ × COC ≤ 250 mg/l
Silicates (mg/l) $[\text{Silicate}]_{inlet}$ × COC ≤ 150 mg/l
Total colony number (CFU/ml); inlet total colony number × COC < 1000 CFU/ml
Same calculations for other maximum concentration values .

Conductivity control for bleed-off

To set-up the bleed-off with conductivity control, the conductivity set point is:
Conductivity set point (µS/cm) = inlet conductivity (µS/cm) x COC (optional but mandatory for the VDI 6022 compliance).



Water consumption
Water consumption = Evaporation + Bleed-off

Conductivity sensor

Draining valve set-up

Draining duration (in s/h) = Bleed-off (in l/h) / 0.7 (in l/s)
Draining duration (in s/h) = Bleed-off (gallon US/h) / 0.1849 (gallon US/s)
Note: For draining duration set-up, it is recommended to consider the complete basin emptying time to avoid fresh water waste. When it is possible, we recommend to set-up the draining duration below the half basin emptying time.

Complete basin emptying timetable													
Basin width (mm)	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700
Basin width (inch)	20	24	28	31	35	39	43	47	51	55	59	63	67
Water vol. (l)	25	30	34	39	43	47	51	55	58	62	65	69	72
Water vol. (gallons)	6.6	7.9	8.9	10.3	11.3	12.4	13.4	14.5	15.3	16.3	17.1	18.2	19.0
Basin emptying time(s)	36	43	49	56	61	67	73	79	83	89	93	99	103

Basin width (mm)	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
Basin width (inch)	71	75	79	83	87	91	94	98	102	106	110	114	118
Water vol. (l)	75	78	80	83	85	88	90	92	94	96	97	99	100
Water vol. (gallons)	19.8	20.6	21.1	21.9	22.4	23.2	23.7	24.3	24.8	25.3	25.6	26.1	26.4
Basin emptying time(s)	107	111	114	119	121	126	129	131	134	137	139	141	143

Draining set-up example:

The data are: Evapack™ basin length: 900 mm
Water evaporation flow: 70 l/h
COC = 2 then bleed-off water flow = 70 l/h
The total draining duration = 70 l/h / 0.7 (l/s) = 100 s/h.
The draining valve must be opened 100s/h for a bleed-off of 70 l/h. The water basin can be emptied in 61s. It is not possible to open the draining valve 100s in once because after 61s only fresh water will be eliminated. These 100s/h must be distributed judiciously in one hour, at least with draining duration < 30s (61s/2).
A drain duration of 17s (6 times/h) each 9 min. (drain frequency) can be used.

Data for quick bleed-off set-up

		Water hardness levels							
		Very Soft water TH: < 60 PPM as $CaCO_3$ TAC: < 0,6 mmol/l Average COC: 6.0		Soft Water TH: 60-120 PPM as $CaCO_3$ TAC : 0,6 – 1.4 mmol/l Average COC: 3.5		Hard water: TH: 120-180 PPM as $CaCO_3$ TAC: 1.4 – 2.4 mmol/l Average COC: 2.5		Very hard water: TH: 180-220 PPM as $CaCO_3$ TAC : 2.4 – 3.0 mmol/l Average COC: 2.0	
Basin width (mm)	Basin width (inch)	Drain duration (s)	Drain frequency cycle (min.)	Drain duration (s)	Drain frequency cycle (min.)	Drain duration (s)	Drain frequency cycle (min.)	Drain duration (s)	Drain frequency cycle (min.)
500	20	5	19	9	19	14	19	12	11
600	24	5	19	9	19	14	19	12	11
700	28	7	14	12	14	18	14	17	9
800	31	7	14	12	14	18	14	17	9
900	35	7	14	12	14	18	14	17	9
1000	39	15	11	24	11	28	8	29	5
1100	43	15	11	24	11	28	8	29	5
1200	47	15	11	24	11	28	8	29	5
1300	51	17	11	29	9	36	6	39	4
1400	55	17	11	29	9	36	6	39	4
1500	59	17	11	29	9	36	6	39	4
1600	63	21	11	35	9	44	6	48	4
1700	67	21	11	35	9	44	6	48	4
1800	71	21	11	35	9	44	6	48	4
1900	75	25	11	42	9	52	6	52	4
2000	79	25	11	42	9	52	6	52	4
2100	83	25	11	42	9	52	6	52	4
2200	87	29	11	48	9	54	5	56	3
2300	91	29	11	48	9	54	5	56	3
2400	94	29	11	48	9	54	5	56	3
2500	98	31	9	53	7	61	4	61	2
2600	102	31	9	53	7	61	4	61	2
2700	106	31	9	53	7	61	4	61	2
2800	110	34	9	59	7	68	4	68	2
2900	114	34	9	59	7	68	4	68	2
3000	118	34	9	59	7	68	4	68	2

Drain duration and drain frequency may be reduced if no white minerals deposit is visible on the pad surface, or if lime scale deposit is visible on the pad.

Periodic Maintenance

The user is responsible for establishing and respecting its maintenance schedule.

These following recommendations can be completed by the checklists given by the VDI 6022 (p. 35 - 36). We recommend a first checking of the evaporative pad after 300-360 operating hours to confirm that the bleed-off control is correctly done. Adjust it if necessary (see page 29) and check again after 300-360 operating hours more.

We recommend to service the EvaPack™ twice a year minimum. This frequency can be adapted according to the operating conditions (water and air quality, application etc.) and the official maintenance/applicable rules.

Recommended maintenance points

<table>
<tr><th>PARTS</th><th>MAINTENANCE</th></tr>
<tr><td>EVAPORATIVE PAD</td><td>Check the salt deposit, if the pad has a lot of salt deposit:
-Check the water quality
-Increase the bleed-off
Check the dust deposit, if there is a lot of dust deposit:
-Check the upstream filter condition
-Clean the evaporative pad with fresh water
If the dust/ salt deposit cannot be eliminated, the consequences can be: efficiency decreasing, pressure drop increasing or microbiological contamination, etc., we recommend to change the evaporative pad.</td></tr>
<tr><td>DROPLET SEPARATOR</td><td>Check the clean condition of the droplet separators, and if necessary:
-Check the upstream filter condition
-Dismantle the droplet separators cassettes to clean them with detergent and disinfectant</td></tr>
<tr><td>FRAME STRUCTURE</td><td>Check the tightness of the frame, clean the structure and the water basin with detergent and disinfectant. Check corrosion, clean and repair if necessary.</td></tr>
<tr><td>WATERING SYSTEM (HEADER, VALVES, FLEXIBLE HOSES, ETC.)</td><td>Check the tightness of the different elements.
Seal or replace leaking elements and clean them carefully with detergent and disinfectant.</td></tr>
<tr><td>DRAINING ELEMENTS</td><td>Check and clean with detergent and disinfectant if necessary.</td></tr>
<tr><td>ELECTRICAL ELEMENTS</td><td>Check all components (solenoids, motors, connections, cables, etc.), replace the defective components and fix the incorrectly connected elements.
Check sensors , clean or repair them and if necesary calibrate them.</td></tr>
<tr><td>MANIFOLD</td><td>Check the manifold status, if the watering manifold orifices are clogged by mineral salt deposit, it is possible to:
-Clean them by compressed air blowing or with a swab. It is possible to screw off the brass plug.</td></tr>
<tr><td>WATER TREATMENT ELEMENTS (OPTION)</td><td>Check the filters and change them if necessary.</td></tr>
<tr><td>MICROBIOLOGICAL CONTROL</td><td>We recommend a frequent visual inspection and microbiological sampling of the humidifier water.
An increase of CFUs values beyond the parameters given in the table below, must be avoided.
If CFUs values are above these parameters, the unit must be cleaned and disinfected properly.
<table>
<tr><th>Parameter</th><th>Recirculating water in air humidifiers</th></tr>
<tr><td>Total number of CFUs</td><td>< 1000 CFU/ml</td></tr>
<tr><td>Legionella spp.</td><td>< 100 CFU/100 ml</td></tr>
</table></td></tr>
</table>

Checklist for operation and maintenance according to VDI 6022

These checklists must be respected to comply with the VDI 6022.

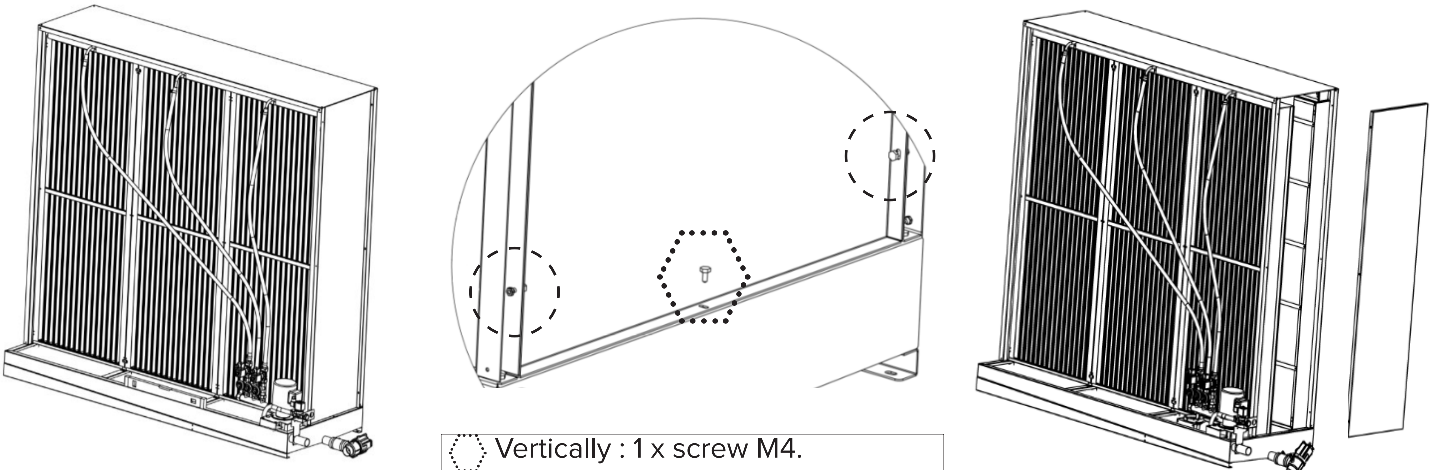
RECIRCULATING WATER (RW) EvaPack™					
Activity	Action required	Frequency			
		1 month	3 months	6 months	12 months
Check for contamination, damage, microbial growth, and corrosion.	Clean and repair.	X			
Function-check, shutdown controls.	Readjust.				X
Determine total number of cfus in re-circulating water.	If number of cfus > 1000 Cfu/m: Clean, rinse and dry the tray; disinfect; test quality of sup-ply water.	semi-monthly			
Check watering manifolds for deposits.	Clean or replace watering manifolds.	X			
Check pump for contamination and scaling in the suction line, check condition and functioning of filters.	Clean pump circuit.		X		
Function-check conductivity sensor.	Repair.	X			
Function-check disinfection system.	Repair.			X	
Completely empty and dry humidi-fier system.		during stand-stills			
Check droplet separator for contamination,damage, scaling, and corrosion.	If deposits have formed, ex-tract and clean unit, check region downstream of drop-let separator.	X			

DIRECT WATER (DW) EvaPack™					
Activity	Action required	Frequency			
		1 month	3 months	6 months	12 months
Check for contamination, damage, microbial growth, and corrosion.	Clean and repair.		X		
Check steam distribution system for deposits.	Clean.			X	
Check watering manifolds.	Clean or replace watering manifold.	X			
Check drain.	Clean and repair.		X		
Determine total number of CFUs in humidifier water.	If number of CFUs > 1000 CFU/m; clean;rinse and dry tray and other water carrying areas/ducts; disinfect;test quality of supply water.			X	
Function-check control valve.	Repair.			X	
Check humidity limiter.	Repair.			X	

Cassettes dismantling for replacement

Cassette Side Extraction

Open the service side-door (the cassette can be extracted by both sides)

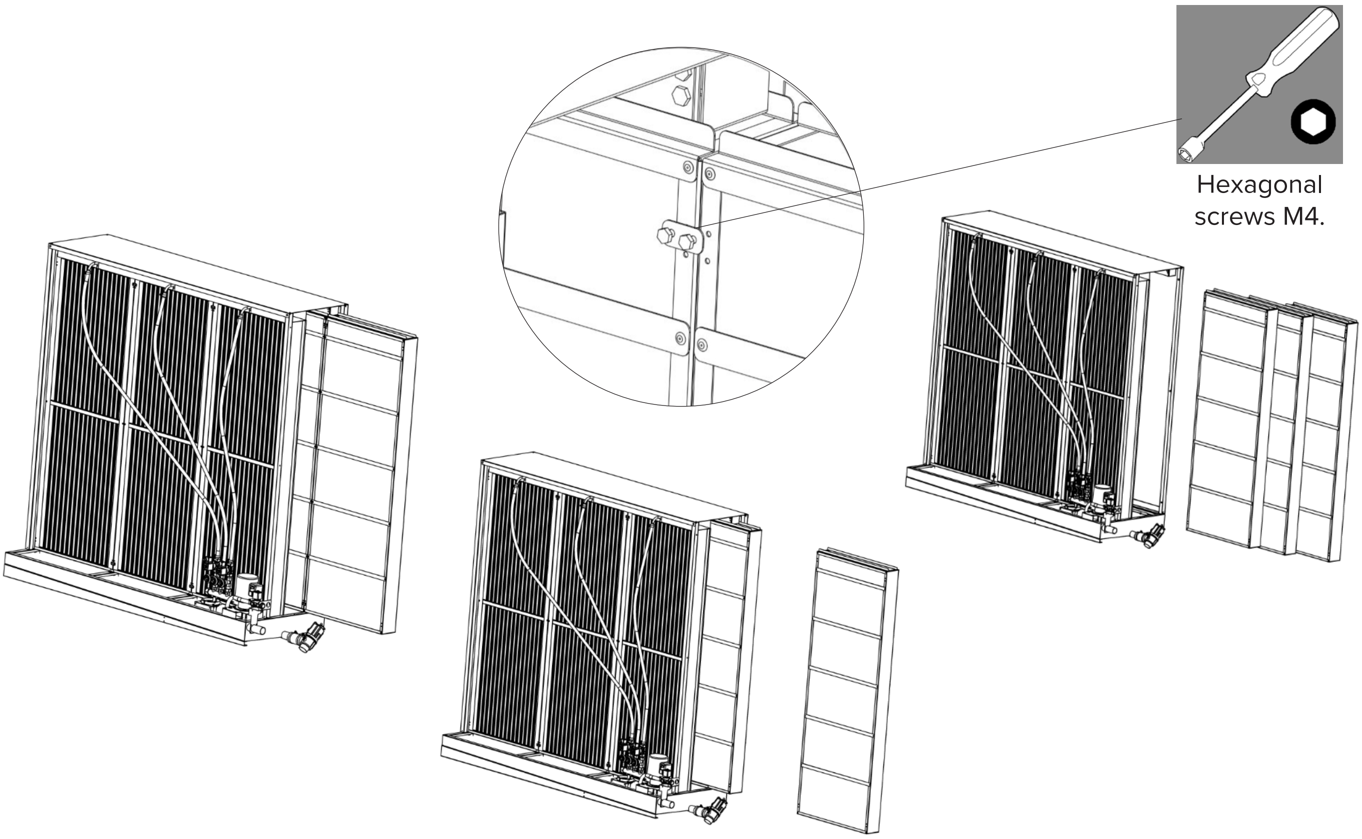


Vertically : 1 x screw M4.

Horizontally : 1 screw + nut M4 (x6)

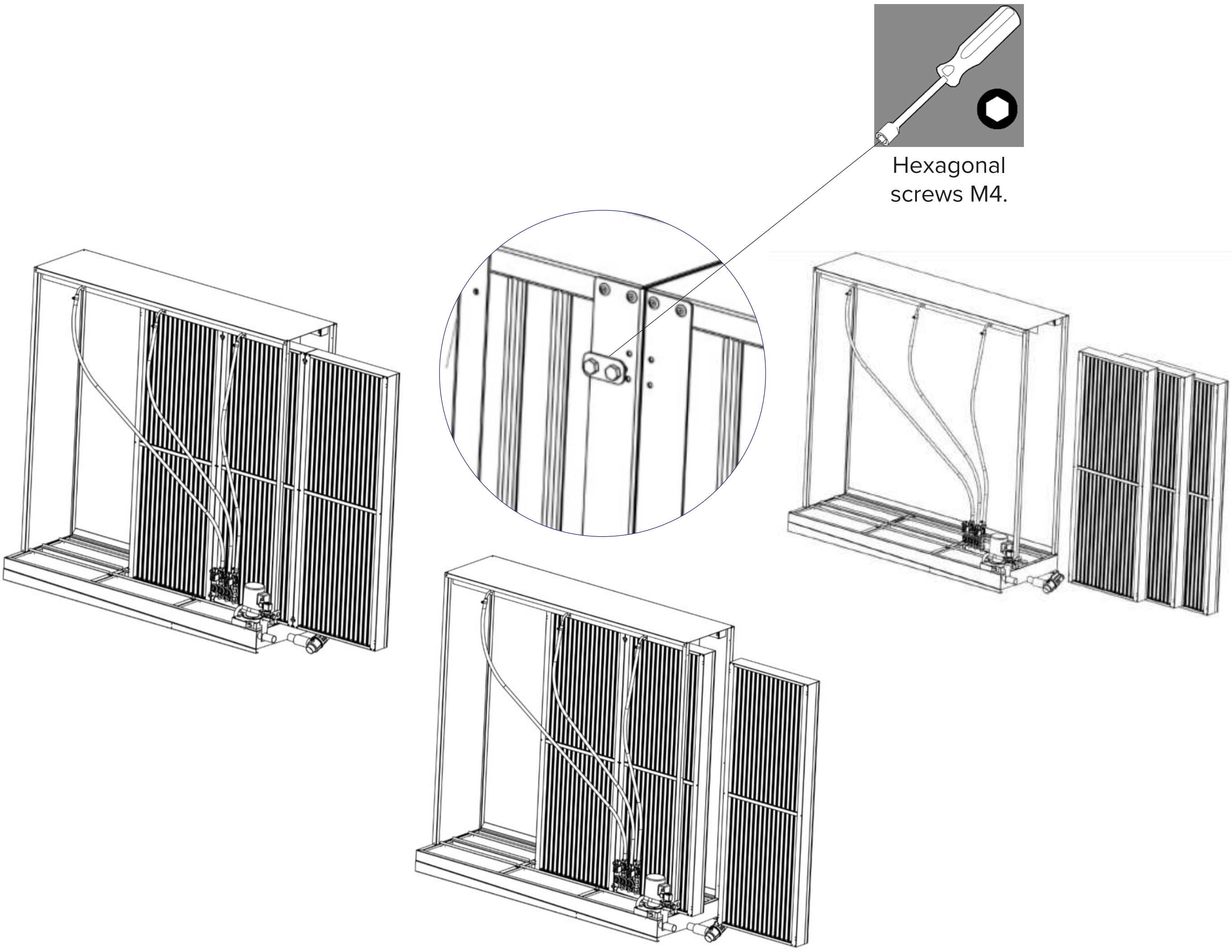
Pull the cassette

Unscrew the cassette union

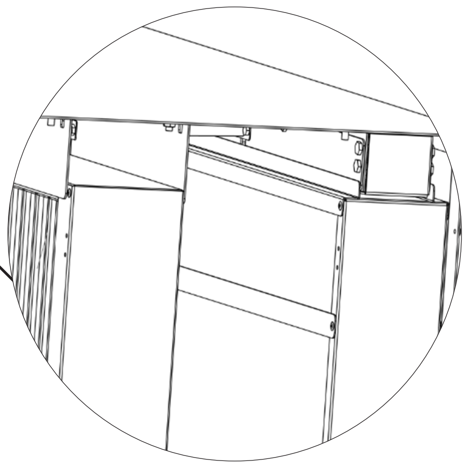


Lateral Extraction for droplet separator cassettes and pad

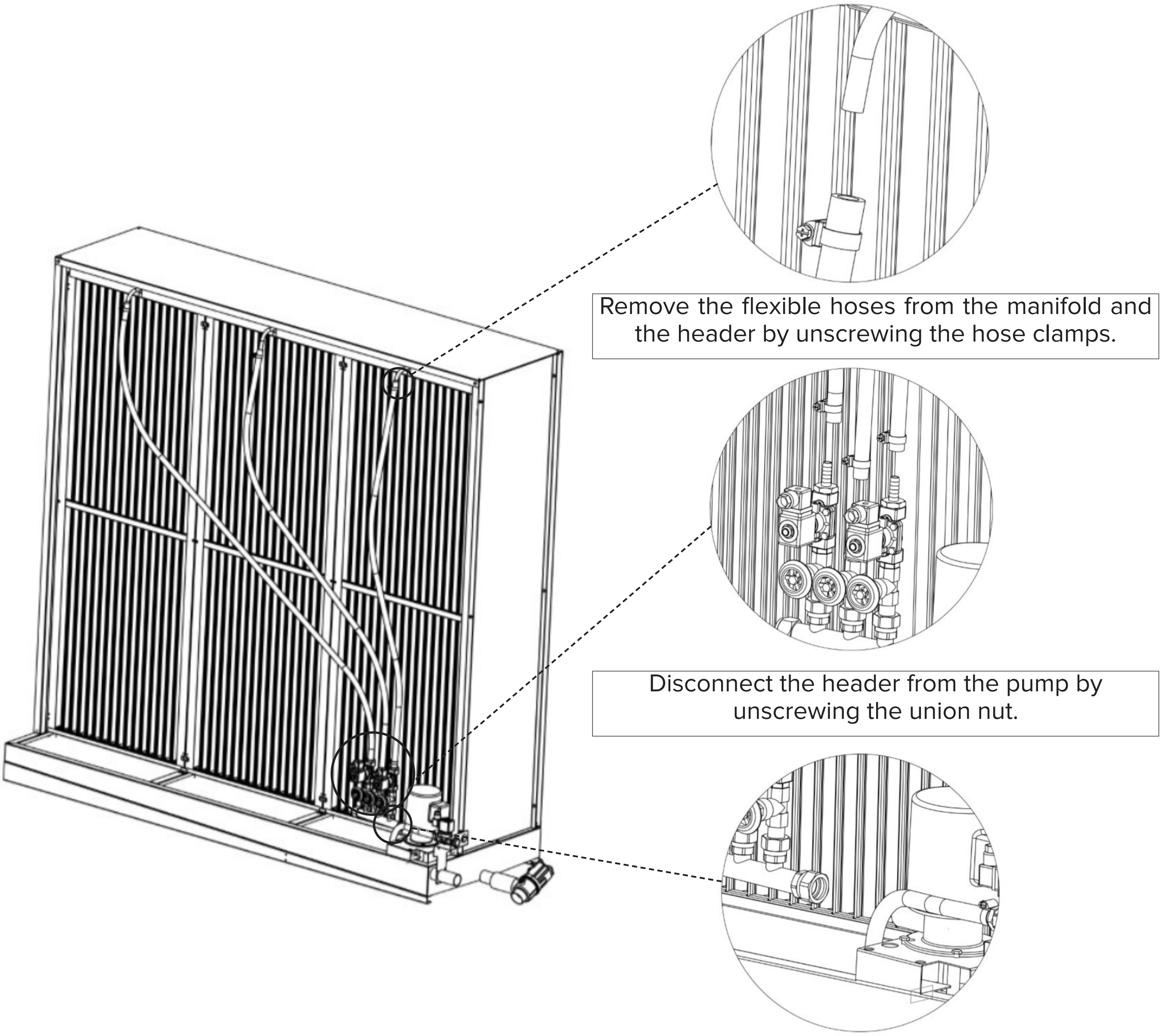
Pull the droplet separator
Unscrew the cassette union



To install the new/cleaned cassettes follow the disassembly instructions inversely.
Be careful and put the cassettes top correctly as shown in this picture :

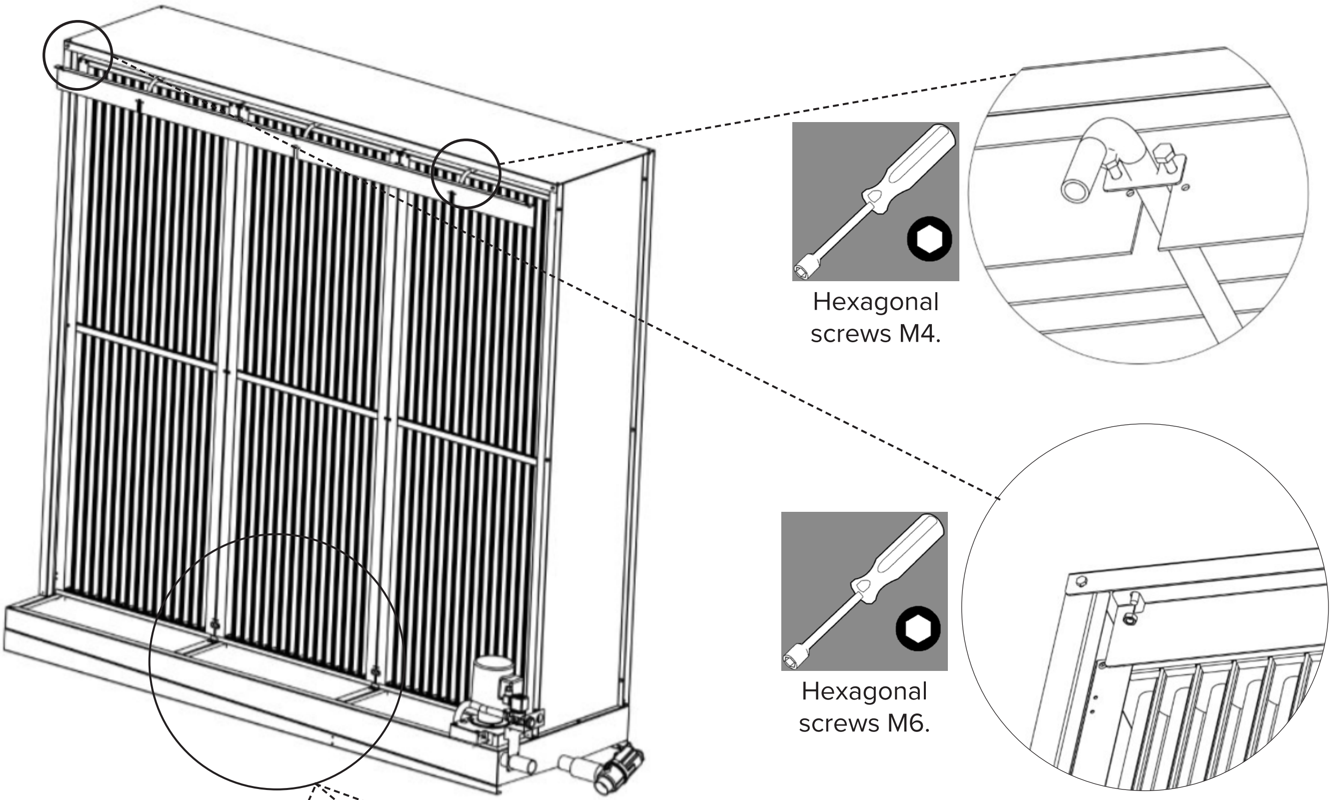


Front Extraction for droplet separator cassettes and pad

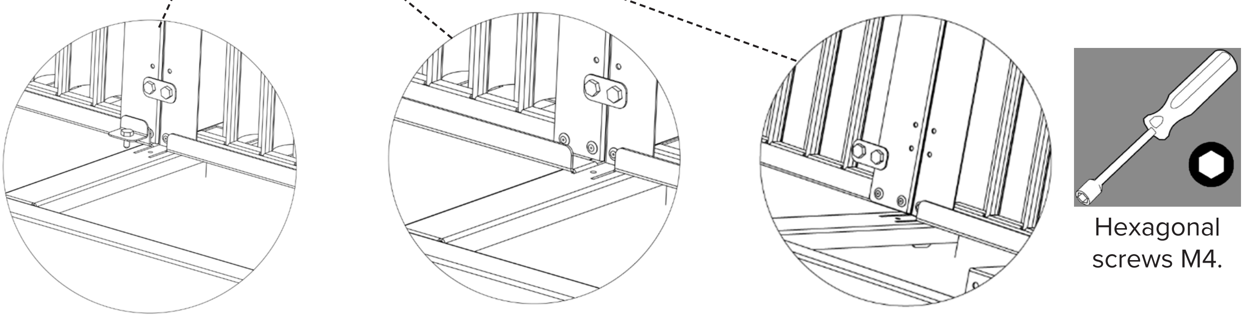


The droplet separator can fall down, we recommend at least 2 people for this step.

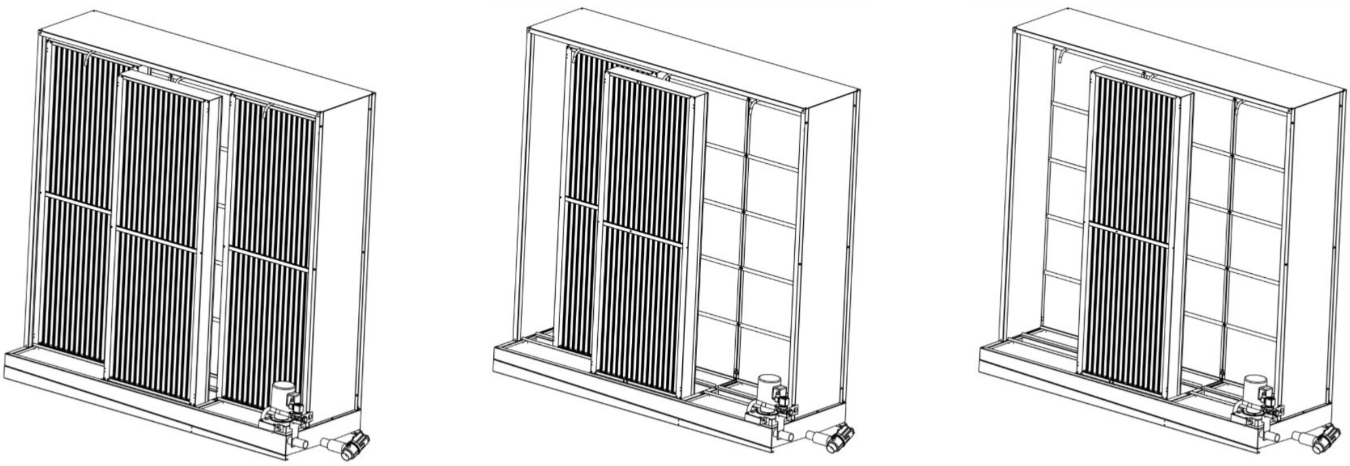
Dismantle the droplet separator guide top.
Unscrew the watering distribution manifold support frame.



Dismantle the droplet separator bottom rails and the droplet separator unions.

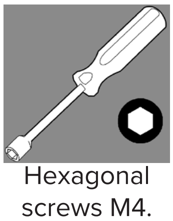


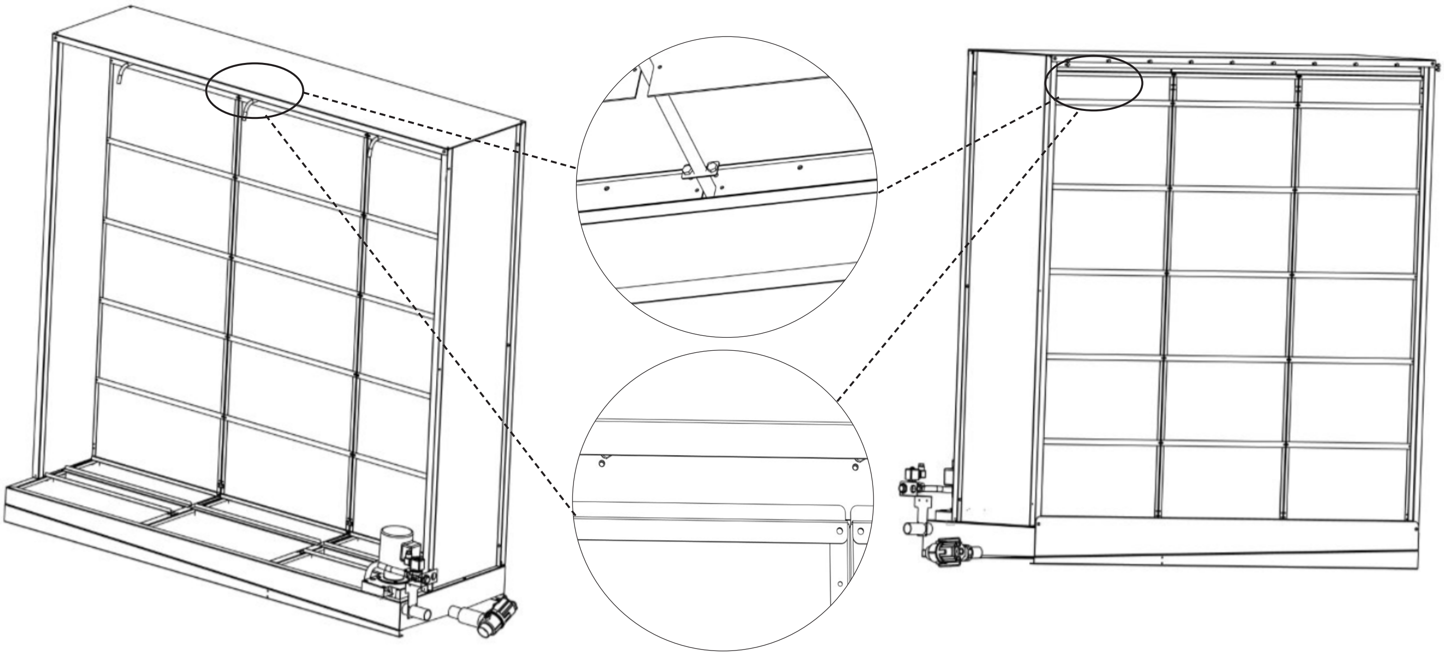
Extract the droplet separator carefully.

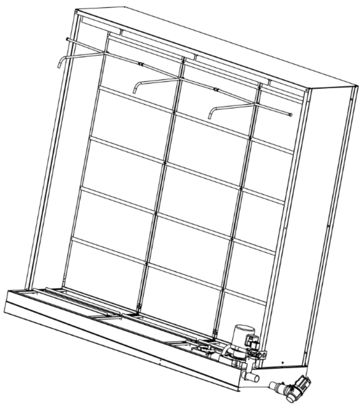


We recommend at least 2 people for this step.

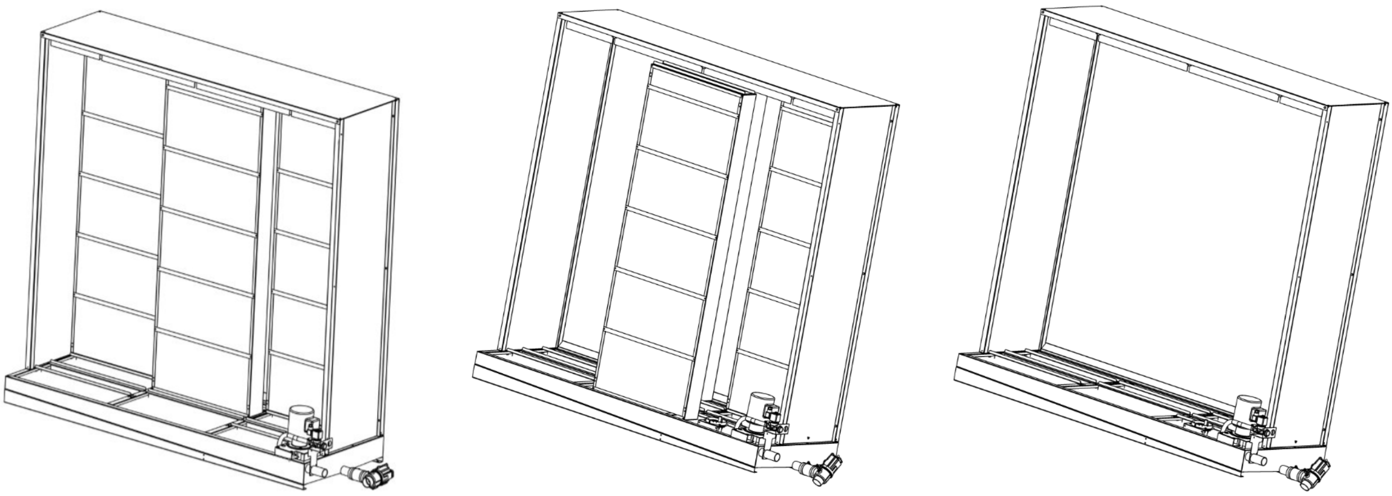
Disassemble the watering distribution manifolds and the evaporative cassette top rails.







Extract the cassette evaporative pad carefully.



Disinfection product recommendations for the EvaPack™ Evaporative Pad

Important : this recommendation is based on our experience. It is of the user's responsibility to use an appropriate disinfection method and/or product. In case of doubt, please contact Armstrong to confirm if the proposed disinfection product/ method is usable on EvaPack™ Evaporative Pad.

For disinfection & anti-mold treatment of the pad, the media must be completely soaked (immerge completely the cassette) in a chlorine based sterilizer such as sodium hypochlorite (bleach) or sodium percarbonate, by ensuring that the disinfection time is respected. If the cassette is too big, dismantle it carefully by removing the rivets, then immerge the EvaPack™ pad sheets in the disinfection solution and disinfect the cassette frame separately.

In case of contamination by biofilms of pseudomonas or legionella we recommend to replace pad cassettes with new ones.

Rinse properly after disinfection.

Please pay attention to toxic chlorine gas if the chlorine based sterilizer is used with an acid solution sterilizer. For bleach, and other forms of hypochlorite, the water pH must be maintained between 7.6 and 7.2, for maximal desinfection efficiency and action against algae.

Recommended free water chlorine dosage:

Continous treatment: 0.1 - 4.0 mg/l (ppm)

(In US EPA, MRDL (Maximum Residual Disinfectant Level) for drinking water is 4.0 PPM or mg/l)

Shock treatment: 2.0 - 5.0 mg/l (ppm)

(WHO (World Health Organization) stated free chlorine concentration in the city water should be below 5 PPM or mg/l).

It is of the user's responsibility to respect limit chlorine air concentration, established to avoid the risk of irritating effects. This limit is given by the Environment / Health State Agencies of user's Country.

To calculate the air concentration of free chlorine (PPM_v):

$$PPM_v = mg/m_{air}^3 * (0.082057338 * (dbt_{air}°C + 273)) / 70.9$$

(with dbt_{air}°C : oulet dry bulb air temperature in °C).

To calculate mg/m_{air}^3 of chlorine from inlet water chlorine concentration ($[Chlorine]_{water}$):

$$mg/m_{air}^3 = [Chlorine]_{water}(mg/l) * \text{evaporated waterflow rate (l/h) / airflow rate } (m^3/h).$$

Example: at 25°C, Chlorine air concentration of 1 PPM_v = 2.9 mg/m_{air}^3

Standard EvaPack™ metal frames are in stainless steel.
However, Please pay attention to metal frame, basin corrosion risk.

Chlorides (mg/l): $[Chloride]_{water} \leq 250$ mg/l
Sulphates (mg/l) $[Sulphate]_{water} \leq 250$ mg/l

Rinse properly after disinfection.

All EvaPack™ parts can be dismantled for easy cleaning.

Troubleshooting

1. There is scale on the pad surface, the pump, and / or water basin.

The potable water is transparent, but it is including salts dissolved. The evaporation reduces the water quantity, increases the salt concentration, and increases the salt precipitation and scale formation. Check the following:

- watering valves are not enough opened.
- watering manifold orifices are clogged.
- filling valve is not operating correctly.
- draining valve is not operating correctly.
- pump operation.
- interval and duration settings, modify them if necessary.
- water quality, it could be different from the last analysis.

2. Performance loss.

- evaporative pad is damaged or clogged. Check it and replace it if necessary.
- watering manifold orifices may be clogged. Clean the manifold if necessary.
- check the pump operation.
- make sure that the air flow is within specification.

3. The pump is not working. Check the following:

- pump: make sure it is not damaged or clogged.
- control panel is switched on and the control signal is calling for humidification.
- the water level switch and the water level sensor.

4. The water basin cannot be filled. Make sure:

- EvaPack™ control panel is switched on and the signal to the filling valve is on.
- filling valve operates correctly.
- water basin is not damaged

5. There are some water leakages. Check the following:

- EvaPack™ humidifier is installed in a waterproof section.
- water connections are correctly fitted.
- water basin is not damaged.

Glossary

CFU (colony-forming unit)
Unit by which the culturable number of microorganisms is expressed. [DIN EN 13098]
Disinfection
Method aiming to reduce the number of viable-microorganisms in a liquid or on a surface to such extent that an infection hazard no longer exists.
Clean swept
Condition of a surface which was cleaned using, e. g., a broom or brush and which, under visual inspection, can be termed clean.
Hygiene
Measures which serve to prevent diseases as well as to maintain and promote health.
Hygiene inspection
Qualified investigation of the hygienic condition of ventilation and air-conditioning systems.
Hygiene check
Periodic observation of the hygienic condition of ventilation and air-conditioning systems at short intervals.
Air hygiene
That branch of hygiene dealing with the interactions between man and the ambient breathing air which are relevant to health and well-being.
Microorganisms
In the context of ventilating and air-conditioning systems, this term is taken to subsume bacteria (such as legionellae), algae and moulds capable of multiplying in water or on humid surfaces (such as in the humidifier water or in condensate).
Ventilating and air-conditioning systems and air handling units
The total of all components required for fan-driven ventilation of one or several rooms.
Evaporative Cooling
A process in which liquid water is evaporated into air. The liquid absorbs the heat necessary for the evaporation process from the air, thus, there is a reduction in air temperature and an increase in the actual water vapor content of the air.
Dry-bulb temperature (DBT)
Temperature of air measured by a thermometer freely exposed to the air but shielded from radiation and moisture. DBT is the temperature that is usually thought of as air temperature.
Wet-bulb temperature (WBT)
The lowest temperature that can be reached under current ambient conditions by the evaporation of water only; it is the temperature felt when the skin is wet and exposed to moving air.
Relative Humidity(RH)
The ratio of the vapor pressure (or mole fraction) of water vapor in the air to the vapor pressure (or mole fraction) of saturated air at the same dry-bulb temperature and pressure.
Adiabatic or Evaporative Cooling (Humidification)
A thermodynamic or psychrometric process that involves the cooling of air without heat loss or gain. Sensible heat lost by the air is converted to latent heat in the added water vapor (cools air temperature).
Saturation efficiency or cooling effectiveness
The Saturation Efficiency (η) or Cooling Efficiency is expressed in % and corresponds to the ratio between the entering dry bulb temperature and exiting dry bulb temperature over the wet bulb depression.
Molar mass
In chemistry, it is defined as the mass of a given substance (chemical element or chemical compound) divided by its amount of substance.[1] The base SI unit for molar mass is kg/mol. However, for historical reasons, molar masses are almost always expressed in g/mol.
Water hardness
The simple definition of water hardness is the amount of dissolved calcium and magnesium in the water.

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