ENGLISH EN

STULZ the natural choice

Operating instructions

Release 04.21

Prodigy IROW CW

High density air conditioner
230/1/50-60

STULZ

Table of contents

IMPORTANT

These operating instructions must be read with care and fully complied with prior to installing and using the air conditioning system.

Preserve this manual for the entire working life of the model.

This manual reflects the state of the art at the time the product is marketed. It must not be considered unsuitable merely because it has not been updated following developments in design and manufacturing methods.

STULZ reserves the right to update the product and the relevant manual without having to update products and manuals sold previously except under exceptional circumstances. Contact your local STULZ partner when requesting or receiving any updates of instruction manuals or corrections which are considered to be integral parts of the manual.

Comply with the measures specified in the chapter on Safety Directions.

1. Safety Directions

This manual contains the basic instructions which must be respected during installation, use and maintenance of the unit. Therefore, installer and specialized personnel / user must read and respect these indications before mounting and commissioning the unit.

Read carefully the whole information on this manual, with particular attention to the norms marked with the symbol on the left. Failure of conformity to these norms might cause damages to things, people, ambient and the unit itself.

The manufacturer is not responsible for any misuse of air conditioner, as well as for non-authorized modifications and for the inobservance of instructions on this manual.

This manual must be kept by the customer and made available to the installation, commissioning, use and maintenance personnel.

An informative document on the REACH Regulation is available. Please view it on web site https://www.stulz.it/it/azienda/media/informazioni-generali/

Symbols on this manual:

SYMBOLS ON THIS MANUAL			LABELS ON THE UNIT	
	DANGER	RISK OF INJURY FOR OPERATOR AND POSSIBILITY OF DAMAGING THE UNIT		DANGER: MOVING COMPONENTS
	ATTENTION	INFORMATION OR WARNING OF CAUTION IN CARRYING OUT A PROCEDURE		DANGER: HOT COMPONENTS
	INFORMATION	IMPORTANT INFORMATION		DANGER: HIGH VOLTAGE

1.1 General information

This air conditioning unit has been designed and built for a professional use according to applicable regulations. Please check the complete list of applicable regulations to the attached CE conformity declaration. It has been manufactured with high quality components, tested to certify its reliability and safety (see attached test report), and provided with warranty.
These operating instructions include the basic directions that must be complied with during system installation, operation and maintenance. Consequently both the installer and assigned specialized personnel/operators must read and comply with these directions before proceeding with installation and start-up. The instruction manual must always be available at the site where the system is being used.

- **Works have to be carried out by competent staff only**
- **Observance of regulations for accident prevention**
- **Stay out of danger when lifting and setting off the unit**
- **Secure the unit to avoid the risk of overturning**
- **Do not climb on or enter the air conditioner**
- **Do not remove protection panels. Safety devices may not be bypassed**
- **Respect the corresponding EN and IEC standards for the electric connection of the unit and observe the conditions of power supply companies**
- **Switch off the voltage from the unit when working on it**

- **Observe the national regulations of the country where the unit will be installed**
- **For transport, installation, either ordinary or extraordinary maintenance, operators and maintenance people must wear individual protection devices (i.e. gloves, glasses, helmet, shoes), according to the indications of safety manager and applicable regulations. Cooling water additives have an acidic effect on skin and eyes. Wear safety glasses and safety gloves**
- **The unit may only be used to cool according to the Stulz specification**
- **Before any maintenance operation, read and follow instructions in the corresponding chapter.**

- **Respect material compatibility in the whole hydraulic circuit**
- **The manufacturer is not liable for damages caused by either a misuse or unauthorized modifications of the air conditioner**
- **Any special opening tools have to be placed in a visible location nearby the unit.**

1.2 Safety and environmental requirements

The following requirements relate to the operation of refrigerating plants within the European Community.

- The used components must correspond to the pressure equipment guide-line EC/97/23 and EN 378 part 1-4.
- Independent of the design, the equipment and inspection before the delivery, also the operator of such plants has duties according to EN 378 and national regulations.

This concerns the installation, the operation and the repeated inspection:

Installation: according to EN 378

Operation: Determination of emergency measures (accidents, malfunctions)
Creation of an abbreviated instruction and notification (template page)
a. A unit protocol must be kept
b. To be stored in the proximity of the unit
c. Access for competent staff in case of repairs and repeated inspection must be ensured.

Repeated inspection: according to EN 378. The operator is responsible for the execution.

The operator must ensure that all maintenance, inspection and assembly work is carried out by authorised and qualified specialist staff who have made an in-depth study of the operating instructions.
It is absolutely essential to comply with the procedure for shutting down the system described in the operating instructions. Before maintenance work, the unit must be switched off at the main switch and a warning sign displayed to prevent unintentional switching-on.
Efficiency of safety devices must be kept during the whole life cycle of the unit. In order to perform this task, please follow the prescription given in Chapter 7.

Independent conversion and manufacture of replacement parts

The system may only be converted or modified after consultation with STULZ. Original replacement parts and replacement parts/accessories authorized by STULZ are an aid to safety.

Unacceptable operating methods

The operating safety of the system is only guaranteed when it is used as intended (see this manual, paragraphs 3.1 and 3.2). The limit values stipulated in the technical data must not be exceeded under any circumstances.

1.3 Residual risks

During transport and installation

Area	Danger	Risk	Preventive measures
Under the unit	Defective lifting system of the unit that causes its fall.	Contusions, traumas	Keep away from dangerous area during handling of the unit.
Near the unit	Unstable or unsuitable support of the unit which causes its overturn.	Contusions, traumas	Be sure that the unit has adequate support in relation with its weight, it's stable and levelled. Wear PPE.
Electrical box	Supply cables under voltage.	Electrocution	Check that the power supply of the electrical box has been insulated.Remain electrically insulated from the ground. Wear PPE.

During start-up and operation

Area	Danger	Risk	Preventive measures
Near the unit	Launch of tools and various hardware (screws, nuts, washers, etc.) that can accidentally fall on the fans blades.	Contusions, traumas	In the installation phase, be sure to remove tools and other installation materials. Wear PPE.
Near the unit	Aspiration and following expulsion from the fans of objects, dusts and substances present on the installation site.	Contusions, traumas, inhalation of dusts	Clean installation area. Wear PPE.
In contact with the unit	Electrical connection against regulations and missing ground connection.	Electrocution	Remain electrically insulated from the ground. Wear PPE.
Near the unit (electrical box, supply cables)	Short circuit; wrong dimensioning of the cables or of the general breaker.	Electrocution, fire, forming of acid vapours	Check the fixing of cables in the terminals: select adequately supply cables and main switch. Wear PPE.

During maintenance

Area	Danger	Risk	Preventive measures
Sharp components of the unit (edges of the unit)	Contact with cutting surface.	Cuts, abrasions, bruises	Wear PPE
Electrical box	Powered line even if the switch of the machine is on OFF.	Electrocution	Check the insulation of the power supply from the electrical panel. Be sure that the main switch will not reactivated during maintenance.
Operation of the fans during maintenance	Contact with moving surfaces.	Cuts, abrasions, bruises	Be sure to remove power during maintenance and wait the stop of the moving parts. Wear PPE.

During uninstalling

Area	Danger	Risk	Preventive measures
Electrical box	Powered line even if the switch of the machine is on OFF.	Electrocution	Check the insulation of the power supply from the electrical panel. Be sure that the main switch will not re-activated during maintenance.

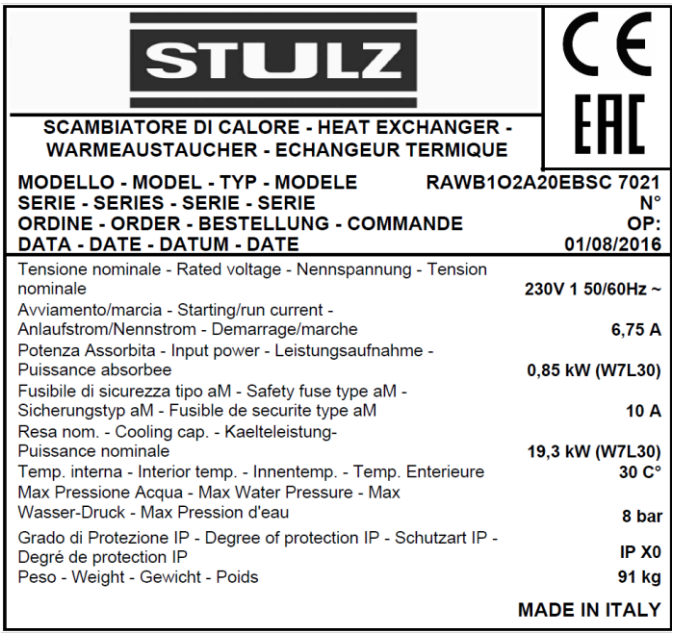
2. Unit identification

Name-plate

This unit can be identified by the name-plate that includes all information regarding its correct use.
The name-plate is located in two copies on the outer casing of the unit (generally on one of the sides) and on the panel that closes the electric box.
The label also includes, in addition to the manufacturer's identification data and to the trademarks of the product, the following information.

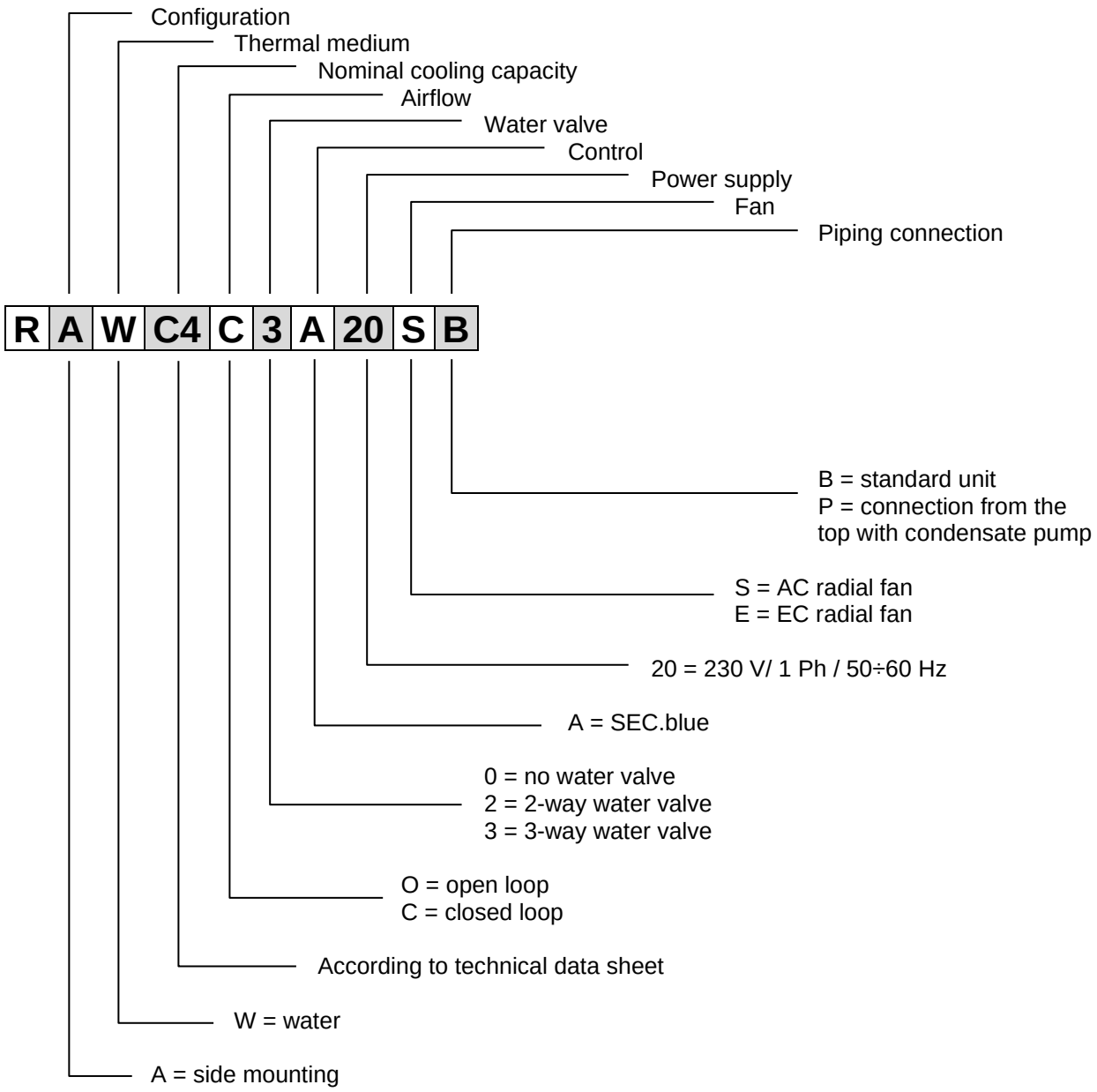
Here an example (data are purely by way of example):

The technical data label is printed on a plastic surface to ensure long durability of the text even in the toughest room conditions.



For any assistance or information concerning the unit described in this manual, knowledge of its serial number is essential.

Coding



Special models are indicated by a Z in the penultimate digit of the code, followed by a progressive number of 3 digits that indicates the special versions. Therefore, the 11th and 12th digits of the code lose their original meaning.

3. Components and operating principle

3.1 Intended and non-intended use

Intended use

STULZ Prodigy IRow conditioners are designed to cool rooms containing technological equipment, sheltered from weather. Use these conditioners to eliminate the problems caused by high temperatures, dirt and humidity in the room subject to climate control and in which the conditioners are to be installed.
As well, STULZ Prodigy IRow conditioners cannot be used outside safety limits specified on the name-plate. Conditioners must not be transported or used in positions that differ from those for which they were designed. These units are designed to be housed in a closed metallic frame for protection. This frame is between two racks (open loop) or beside one rack (closed loop), with front and back panels (not included in this product). Allowed installation positions are shown in this manual.
Main functions of air treatment are: filtration, cooling, dehumidification (with a special function), and condensate pumping (with optional condensate pump).
STULZ is not responsible for any malfunctions caused by failure to comply with these instructions. The operator bears the entire risk.

Non-intended use

Air conditioner cannot be installed on movable, vibrating, oscillating, tilted (non-levelled) parts.

Generally, air conditioner cannot be installed in the following areas:

- with strong heat radiation
- with strong magnetic fields
- with free flames
- with fire risk
- with inflammable products
- with explosive atmosphere
- with saline atmosphere
- with aggressive atmosphere

For any doubt, please consult the manufacturer.

3.2 Application limits

Operation limits		
Return air temperature	Min	25 °C
	Max	45 °C
Return air humidity	Min	6,5 °C dew point
	Max	60% r.h. and 15 °C dew point
Total (static + dynamic) pressure in water circuit	Max	8 bar
Chilled water temperature	Min	5 °C
Percentage of glycol	Max	40%
Nominal power supply		230 V / 1 / 50 ÷ 60 Hz
Voltage tolerance		± 10%
Frequency tolerance		± 2%
Storage limits		
Temperature	Min	-20 °C
	Max	60 °C
Humidity	Max	90%

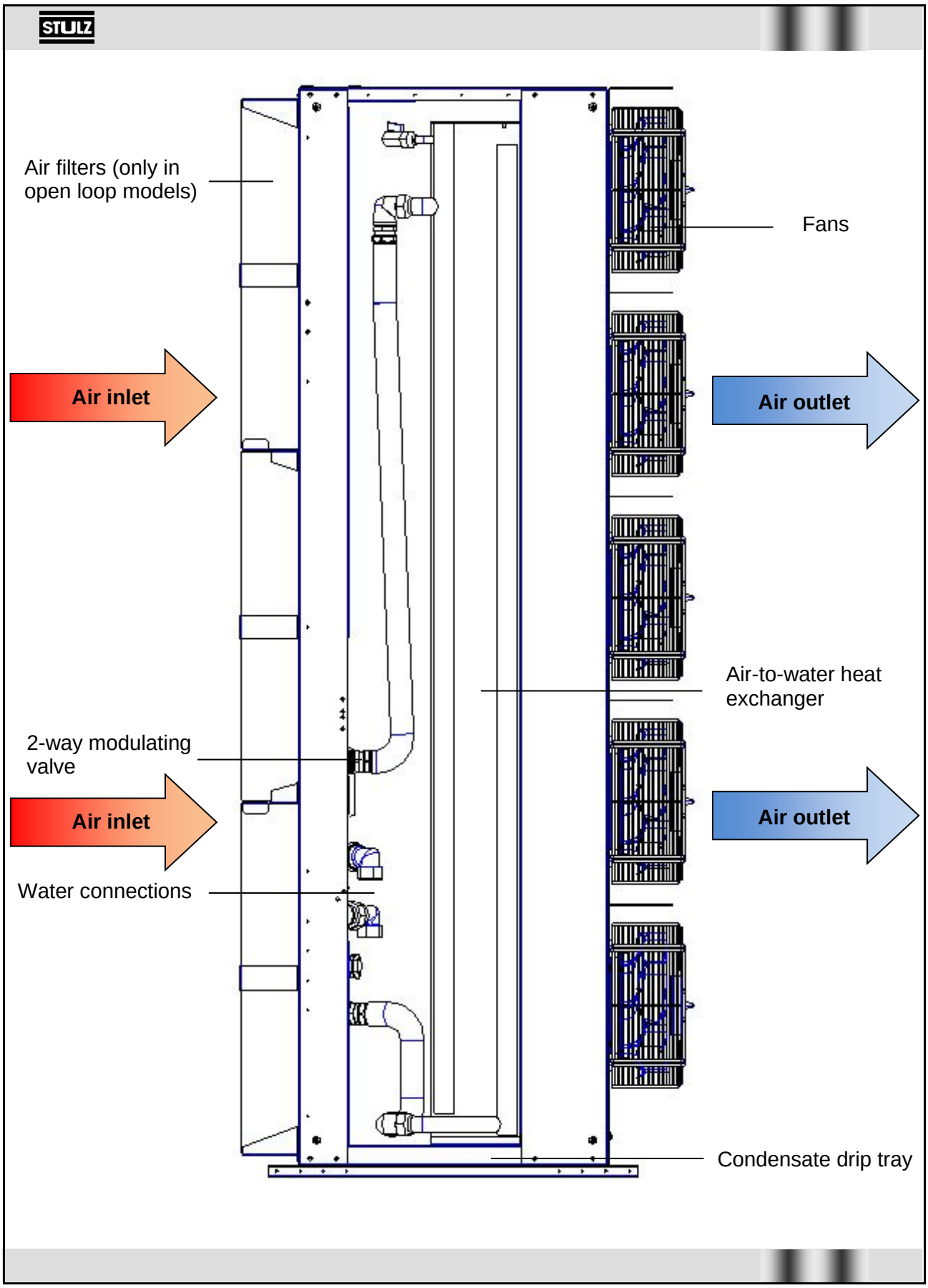
3.3 Component layout

STULZ Prodigy IRow units are installed between two server racks in open loop configuration. They take air from a hot aisle of the room, cool and deliver it to a cold aisle, where it is sucked in by the server rack fans.
In closed loop configuration the air conditioners are beside the rack to which they are dedicated. Therefore, they take air from the discharge of the rack and, after cooling, they deliver it to the rack intake.
In both configurations, air suction and delivery are frontal and can be redirected with a deflector or a plenum (not part of the supplied product).

According to the air flow through the air conditioner, the following components can be seen:

- Air filter (only in open loop configuration)
- Piping with modulating valve (3-way or 2-way) and air valve on the top
- Cooling coil with condensate tray underneath
- Radial fans

Openings for water pipes are placed both on the base and on the top panel of the unit. When condensate pump is present, passage of pipes and cables is only from the top.
The electric box is separated from the air conditioner and designed to be fixed to the rack metallic frame above the air conditioning unit. It is closed by a protective cover.
A columnar metal bar with button switches for each fan is supplied loose, to be integrated in the frame containing the air conditioner.


Air filters (only in open loop models)
Fans
Air inlet
Air outlet
Air-to-water heat exchanger
2-way modulating valve
Air inlet
Air outlet
Water connections
Condensate drip tray

3.4 Working modes

Cooling

Air is sucked in by the radial fans, is filtered (only in open loop units) and then it is cooled passing through the chilled water heat exchanger. After treatment, air is delivered through the frontal opening. Cooling capacity is modulated by SEC.blue in different ways, acting on the 3-way valve and / or on the fan speed, according to the temperature measured by the return probes.

Dehumidification

According to the signal of humidity inside the room, supplied by the humidity sensor, the air conditioner electronic controller SEC.blue reduces fan speed. Consequent air flow reduction causes a higher temperature difference between inlet and outlet air, helping condensation of humidity in the heat exchanger.

Hot spot mode

Enabled by an external thermostat connected to a digital input of SEC.blue, fans rotate at maximum speed, unless dehumidification is required.

Emergency

When a fan is blocked, temperature control is in emergency mode. The remaining fans work at maximum speed, unless dehumidification is required.

3.5 Mechanical components

Structure

These units are made of self-supporting galvanized sheet metal parts that offer good corrosion resistance (suitable only for non-corrosive and non-saline environments). Electric box and fan switch bar are powder coated with protective paint. Internal metal parts are used to strengthen the unit and direct air flow. This system is designed for an easy inspection of the unit.
Inner components are accessible by removing the outer panels and doors of the rack where the air conditioner is mounted.

Air filter (only in open loop version)

Air filter is installed on open loop units to filter air from the hot aisle before it enters the air-water heat exchanger, preventing dirty particles from obstructing the coil. It belongs to efficiency class ePM10 50% (EU3/ EN779). Its zigzag shape with 100 mm height implies a wide filtering surface, reducing pressure losses and frequency of maintenance.

Condensate water tray

Made of aluminium sheet, it is placed below the heat exchanger to collect water condensing on its surface during cooling mode. It is provided with a connector with 15 mm outer diameter for water drain.

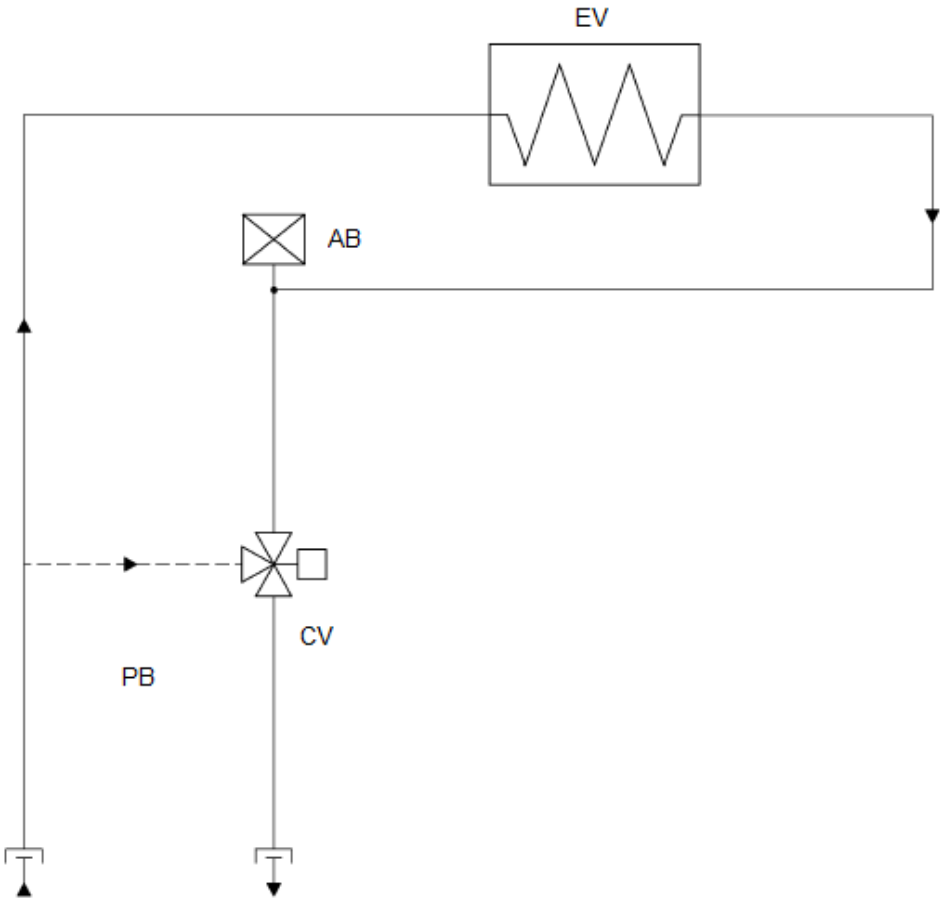
3.6 Hydraulic circuit components

Air-to-water heat exchanger

It is made of copper pipes and aluminium fins. In this coil, heat is exchanged between inner air and chilled water. It is not suitable to either corrosive or saline environments. Surface has hydrophilic treatment.

2-way modulation valve

2-way valve is used when CW unit is connected to a chilled water distribution system with variable flow; this requires circulation pumps with variable speed. See working logic diagram.



Legend:

EV = Chilled water exchanger	CV = 2/3 way chilled water control valve
AB = Automatic breather valve	PB = By-pass only for 3 way chilled water

3.7 Motors

Fans

AC fans are radial, with backward curved blades made of galvanised sheet steel. Rotor is painted with epoxy black RAL9011, mounted on ball bearings and dynamically balanced according to VDI2060. Protection degree IP44. Insulation class B.
Optional EC (electronic commutation) fans are radial, with backward curved blades made of galvanised sheet steel. Rotor is also made of galvanised sheet steel, mounted on ball bearings and dynamically balanced according to DIN ISO1940, quality level G6.3. Protection degree IP44. Insulation class B.

Modulating valve servomotor

Power supply 24 V AC 50/60 Hz. Absorbed power 1 W at nominal torque. Control signal 0÷10 V. Running time = 90 s for an angle of 90°. Protection class III, IP54 protection degree.

3.8 Control, monitoring and safety components

All unit components are factory adjusted and generally do not require further adjustment. If, for special reasons, it becomes necessary to change the adjustment settings of the automatic devices these changes must only be performed by specialists who are experts on the product and only after informing the STULZ engineering division department.
STULZ conditioners come with a set of devices designed to ensure proper operation. Tripping by any one of these automatic safety devices is a sign of a malfunction and it is absolutely necessary to eliminate the cause.

It is forbidden to electrically by-pass the safety devices. Doing so, in addition to being dangerous, also immediately invalidates guarantee coverage for the product.

Isolate the system from electric mains before performing any repair or maintenance work.

Work on the units must only be done by qualified and authorized experts.

Contactors

These control motors that operate with auxiliary voltage. They comply with IEC947-4-1 standards.

Fan switches - circuit breakers

Double-pole main switches are placed on the multi-switch bar which is separated from unit frame. They disconnect main power supply of all electric circuits downstream. According to the directions on Chapter 5, one additional disconnecting switch must be always installed on main power supply lines upstream the unit, in order to cut power supply before any maintenance on the unit.

Fan speed controller (with AC fans)

This electronic module receives a PWM signal from SEC.blue controller and transforms it in a change of effective voltage through a phase-cut system. Protection degree is IP20.

Expansion tachometric board (with more than 3 EC fans)

This expansion board receives the three V1 – V2 – V3 signals 0÷12 V from SEC.blue and duplicate them to control speed of 3 couples of fans. This board receives a tachometric signal as a feedback from each single fan to check whether it runs.

Temperature probes

4 PTC temperature probes are connected to analogue inputs of SEC.blue controller, in order to measure following parameters:

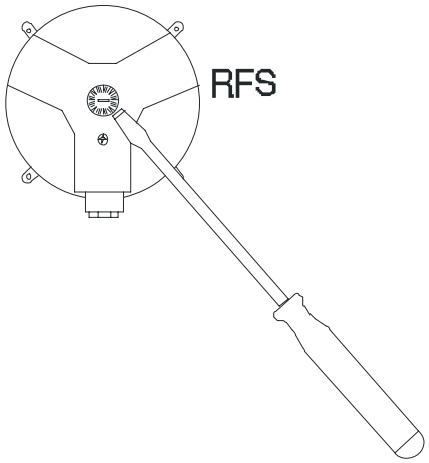
- 2 return air probes, placed behind air intake opening, higher and lower parts
- 2 supply air probes, placed on multi-switch bar, higher and lower parts

Humidity sensor

Placed behind air intake opening, it sends a humidity analogue signal (4 ÷ 20 mA) to SEC.blue controller, in order to enable dehumidification mode. Measured range of humidity 0 ÷ 100%. Protection degree IP54.

RFS dirty filter pressure switch (only in open loop models)

RFS gives a dirty filter signal (only with open loop units), shown both on the display and on a voltage-free contact. It indicates when it is necessary to clean or replace the air filter.

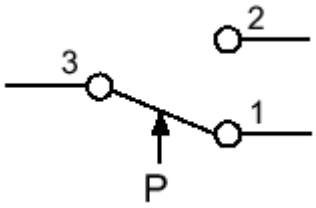


Range : 20 – 200 Pa
Differential pressure: 10 Pa ± 15%
P1 : High pressure connection
P2 : Low pressure connection
Adjustment:
Use a screwdriver on the central screw to adjust the differential pressure to the desired value at which the dirty filter signal trips.

Technical characteristics:

Power supply:	1,0 (0,4) A; 250 Vac - 0,1 A; 24 Vdc
Operating temperature:	-20/+85°C
Maximum pressure:	10 kPa
Casing:	PA 6.6
Protection:	IP00
Diaphragm:	Silicone
Pressure connection:	Ø 6 pipe

Connection :

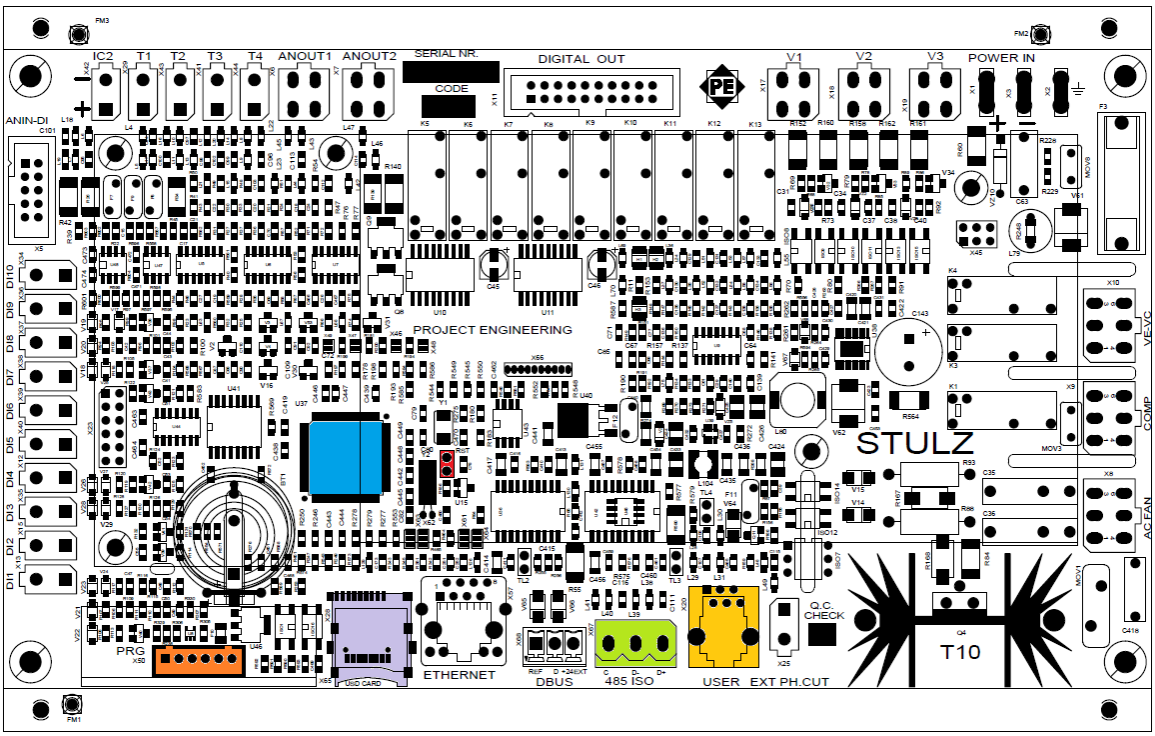


Contact 3-1 opens when the differential pressure exceeds the preset value. At the same time contact 3-2 closes. The signal is transmitted through this contact.

SEC.Blue I/O CONTROLLER

This microprocessor-based electronic board is equipped with a set of terminals which are necessary to connect the board to the controlled devices (e.g. valves, compressors, fans). Software with working logic and parameter settings are written in the EEPROM so that they remain permanently stored even in case of power failure. SEC.Blue controller is housed inside the electrical panel and can control only one unit.

A keypad can be connected to the SEC.Blue card to display information regarding operating conditions, the state of the unit and any alarm. As standard, the keypad for Prodigy IRow is supplied loose, to be mounted on the rack frame (see paragraph 5.4). The keypad is provided with 4 m cable for connection to the USER socket in the e-box.



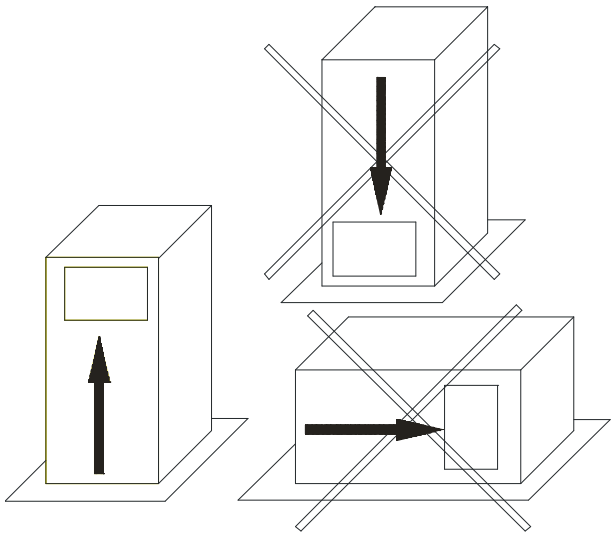
Refer to the wiring diagram given in part 2 of the manual, which is specific for each unit, when assigning the card inputs / outputs.

4. Unpacking and inspection

INSPECTION

STULZ products are delivered ex-works. All units have been individually inspected in all their components and been carefully packaged before the delivery.
Immediately inspect the unit upon receipt of the goods:

- Make sure that it has been transported in the correct position. Note any unsuitable shipping conditions on the shipping document.
- Check that no components are missing, that are presents on shipping document and the integrity of the conditioner at the moment of the receiving.
- Check that there aren't any external damages and eventually note them on the shipping document in the presence of deliverer.
- Hidden damage, that are verified after removal the packing, must always be notified to the shipper by registered letter within 8 days of receipt of the goods.



With ex works delivery conditions, carrier is the sole responsible for any damage caused during transport. STULZ is not responsible for damages to the goods caused by the carrier, but it will do everything in its power to assist clients on those situations.

If delivery conditions are not ex works, in case of damage, please follow instructions either on transport document or on www.stulz.it web site.

This product cannot be returned without prior approval of STULZ. For any assistance, please consult your local STULZ partner.

Risk of personal injuries during materials handling

Material handling and unpacking must be done only by trained personnel with suitable individual protection devices (i.e. gloves, glasses, helmet, shoes)

LIFTING AND TRANSPORT

Risk of downfall of heavy units

Capacity of lifting device must be appropriate for the weight of air conditioner.

Load must be balanced to avoid tilting.

Avoid offhanded or rough manoeuvres.

Don't lay other objects upon the air conditioner.

Risk of top collision with building structure

Check unit dimensions (height in particular) and building clearances. Make sure that there is space enough for a correct movement of the unit, especially regarding doorway height.

Risk of unit deformation

Don't move the unit on rolls, or with forklift after removing the pallet, to avoid any structural deformation.

Air conditioner must be lift without tilting or laying it on its sides (see drawing above), in safety, using appropriate equipment.
Lifting devices with ropes can be used, securing ropes to the pallet and protecting upper edges of the units with wooden or metallic angles.
As an alternative, when the unit is still packed with pallet, a forklift can be used, taking care that the centre of gravity is inside fork area.

STORAGE

Except differently agreed, standard packing of air conditioners is composed of:
- Pallet under the unit, fixed to its lower frame
- Lateral protection panels
- Protective film around the surface (except bottom side in contact with the pallet)
- Air bag on the upper part.

Standard packing doesn't protect air conditioner from rain and bad weather.

Standard packing is not suitable for seafreight.

Standard packing is not suitable for airfreight.

Following information can be found on packing:
- STULZ logo
- unit code
- accessories put in the packaging
- warning symbols

If unit is stored before installation, comply with following instructions:
- don't expose to direct solar radiation
- store the unit with its original packing

Ambient conditions for storage are in paragraph 3.2

REMOVAL OF PACKING

- Remove packing without damaging air conditioner: remove top air bag, external film, lateral and corner protections.
- Recover any document or component inside the packing.
- Keep original packing (pallet and protections) for future shipments.

Components inside the packing:
- RAW air conditioning unit.
- Multi-switch bar.
- Keypad of SEC.blue with connection cable, packed in a carton box (code ACTKPDC1010H).

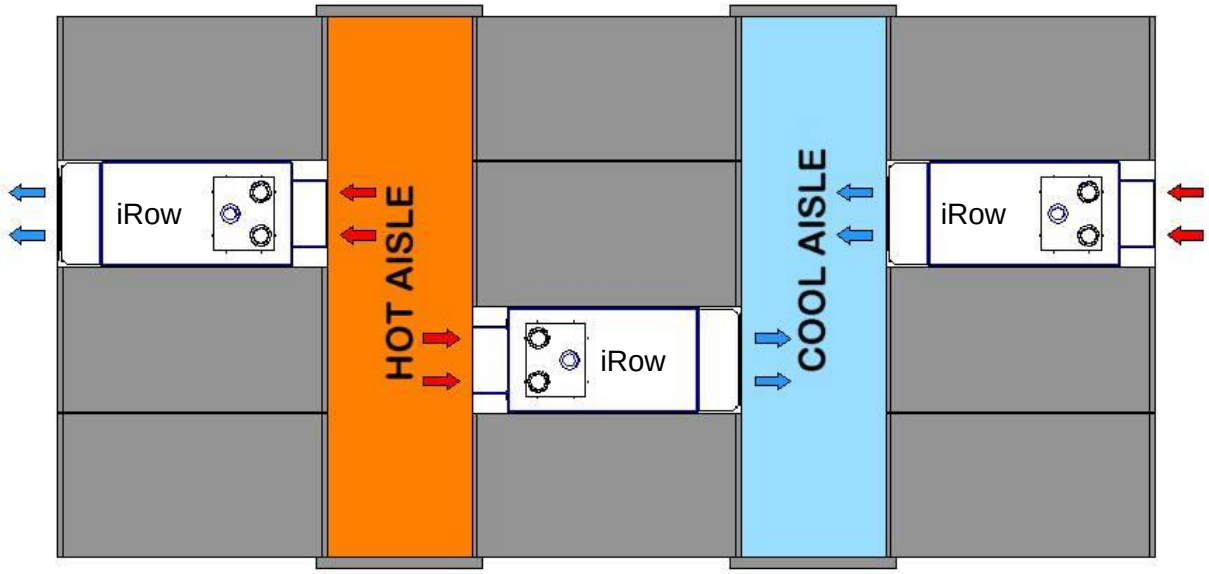
Use original packing to ship the air conditioner to any other destination.

If packing disposal is necessary, we remind to dispose different materials suitably.

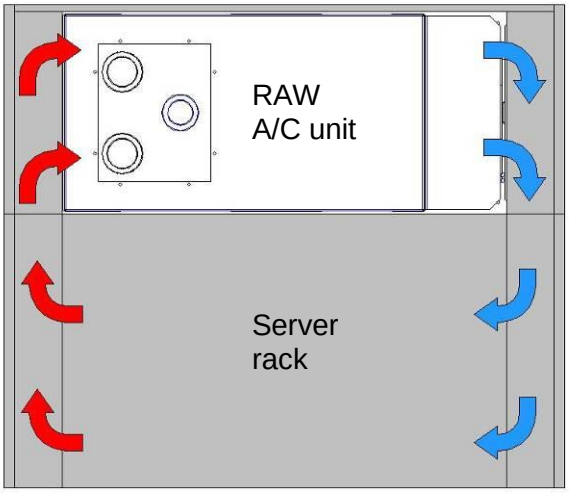
5. Installation

5.1 Positioning the unit

iRow air conditioners are not provided with either lateral or top or door panels. Therefore, they must be installed inside a frame with suitable protection.
In open loop version they must be installed between two server racks. Installation at an end of a row is not recommended because there is a mix of hot and cold air. Furthermore it is recommended to install them near the racks with highest heat load.



In closed loop version they must be installed beside a rack. A closed air circuit must be created between the rack and the unit, installing suitable plenums.



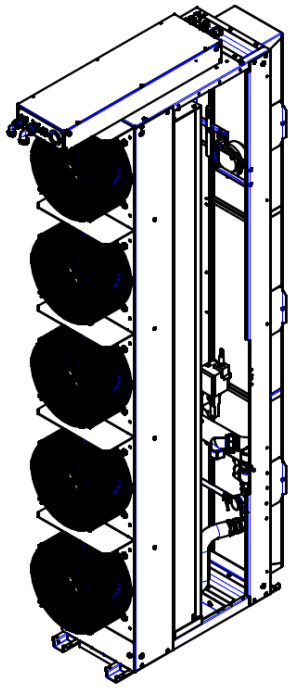
Furthermore, check that:

- there's room enough for an easy installation and maintenance of the unit: please check dimensional drawings, with particular attention to the accessibility of water connections and wiring. There must be a free space of 1 m from both front and back sides of the unit for installation and maintenance;
- air circulates correctly, both inside and outside the frame, avoiding any short circuit, re-circulation or by-pass;
- more in detail, check that air suction and discharge are correctly separated inside the frame. Separate air suction from discharge placing sealing material (gaskets) suitably;
- in open loop version, avoid to place two units such as their air supplies are one in front of the other;
- avoid any obstacle to the air flow;
- any measure (i.e. deflectors) to separate hot and cold aisles increases the efficiency of the system, so it is highly recommended;
- units are installed on flat and perfectly horizontal bases so that they will operate correctly and that condensate will drain properly.

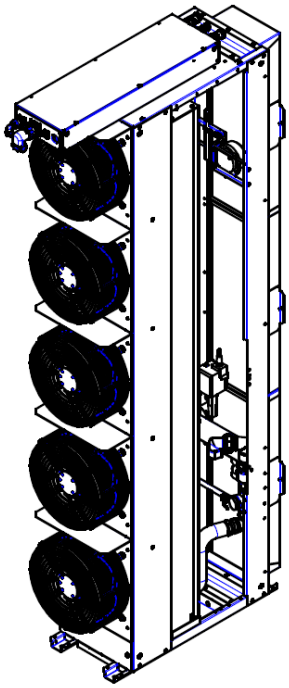
Put the unit into the rack frame and fix it to it with suitable devices (screws, brackets, metal tongues). The position of fixing points is in the following drawings.
Then, unscrew the cover of multi-switch bar and fix it to the rack frame from inside.

The electric box leaning on the unit is provided with external fast connections, so that it can be unplugged and removed to ease unit insertion.

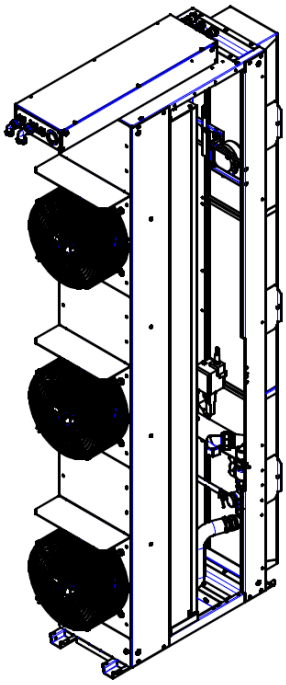
Before inserting the unit into the rack, please observe position of condensate water discharge and water connection passages in the following drawings.



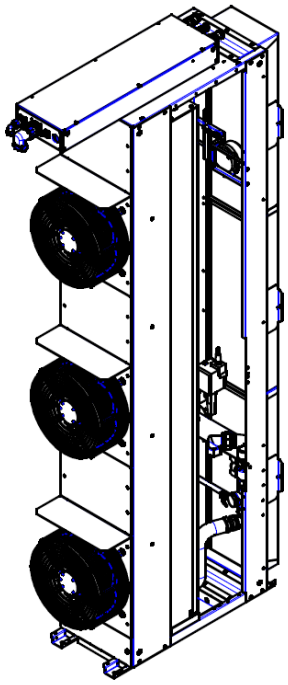
5 AC-FAN



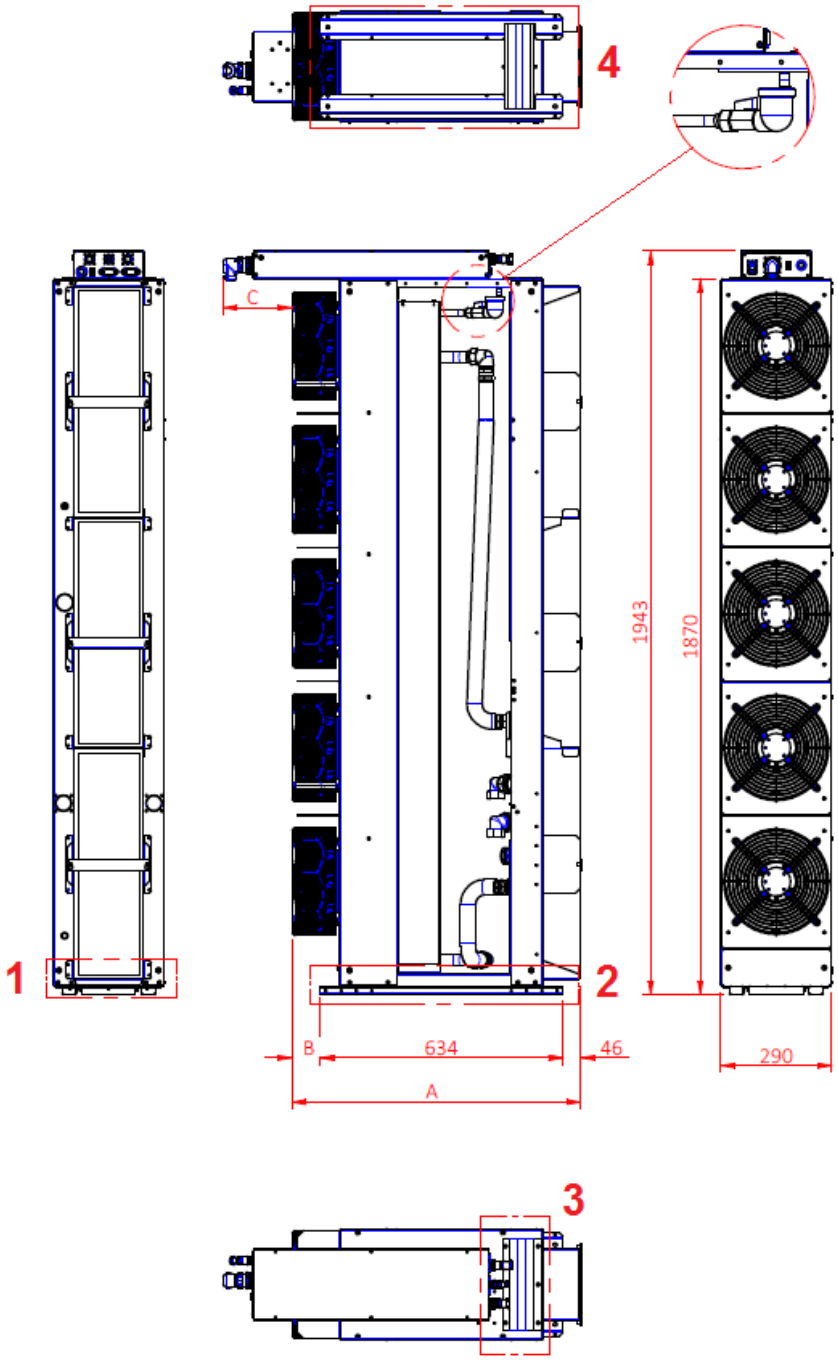
5 EC-FAN



3 AC-FAN

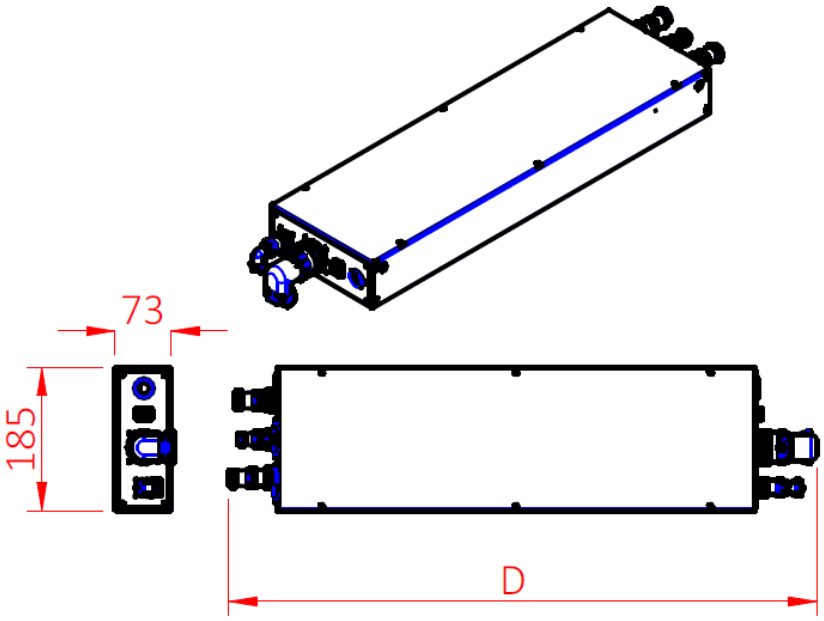


3 EC-FAN

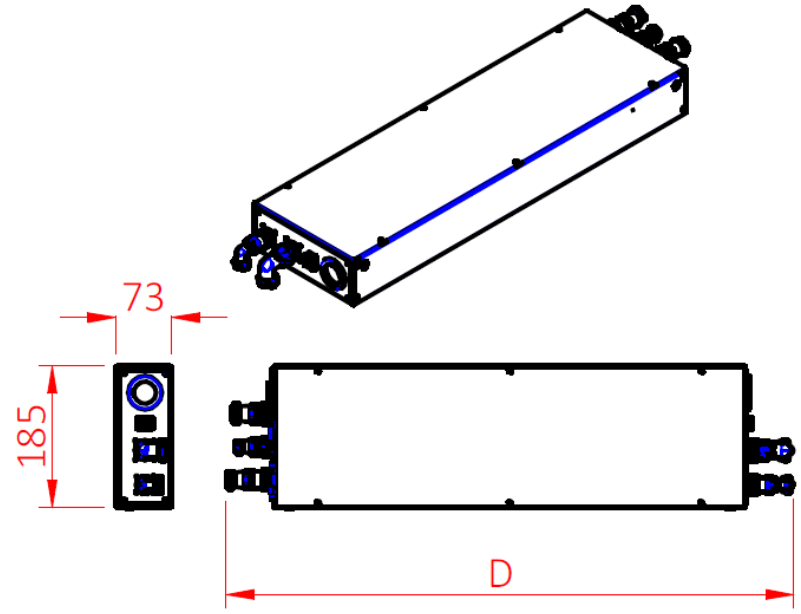


RAW		A	B	C	D
Open loop	AC fans	776	96	155	740
	EC fans	753	73	180	757
Closed loop	AC fans	730	96	155	740
	EC fans	707	73	180	757

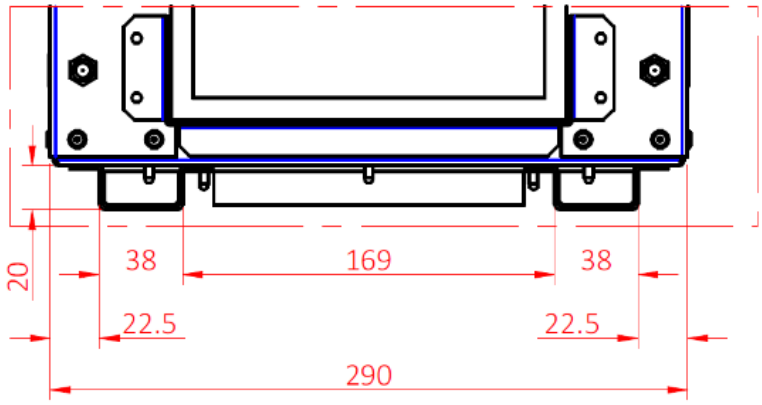
ELECTRICAL BOX EC-FAN



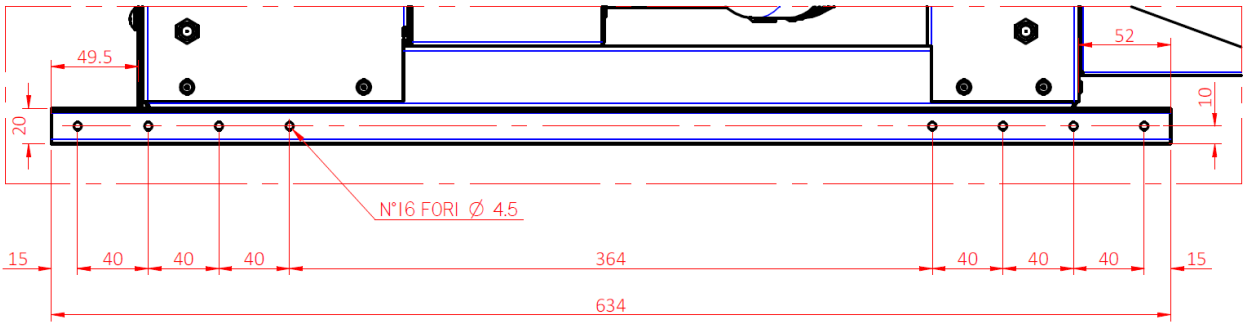
ELECTRICAL BOX AC-FAN



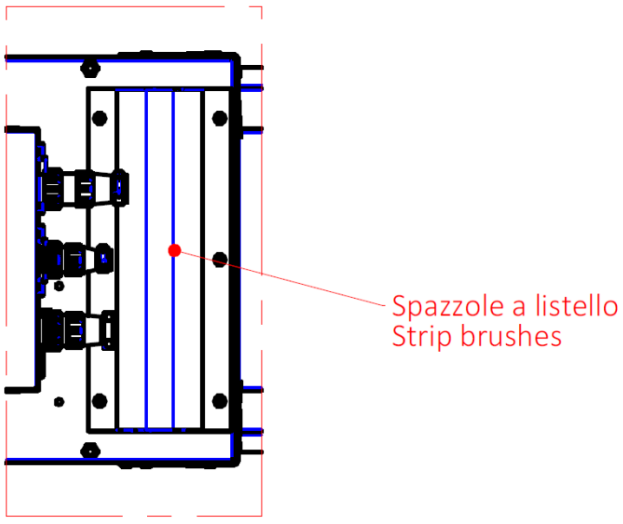
Detail 1



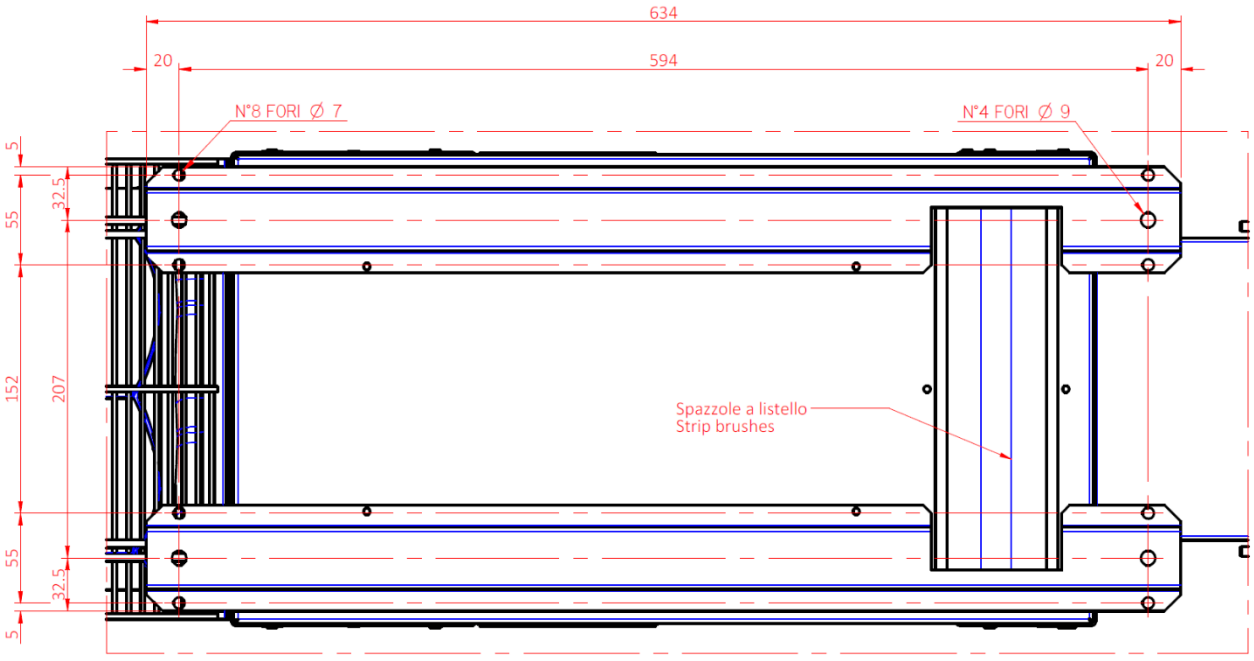
Detail 2 (position of fixing points on lateral-bottom frame)

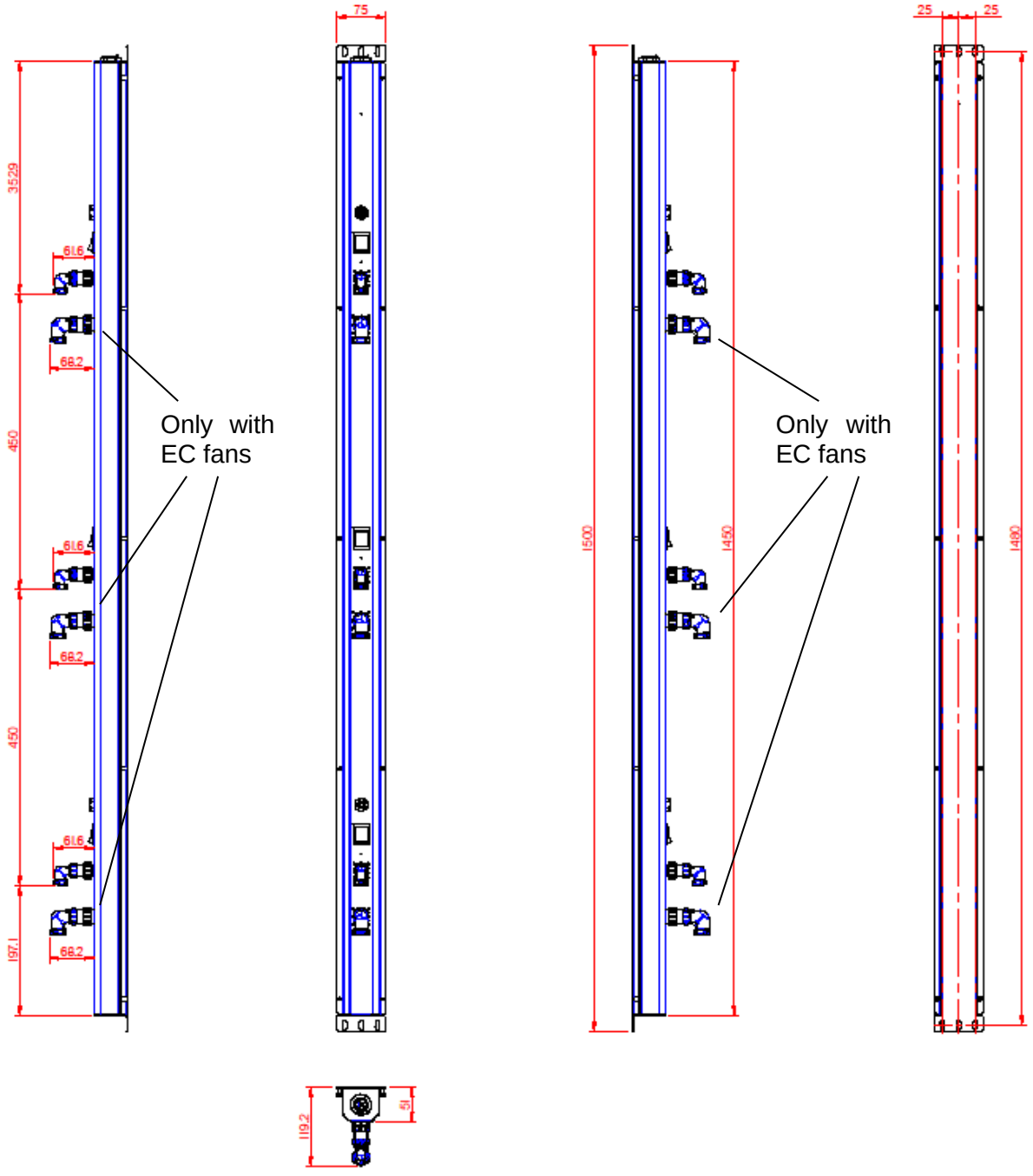


Detail 3

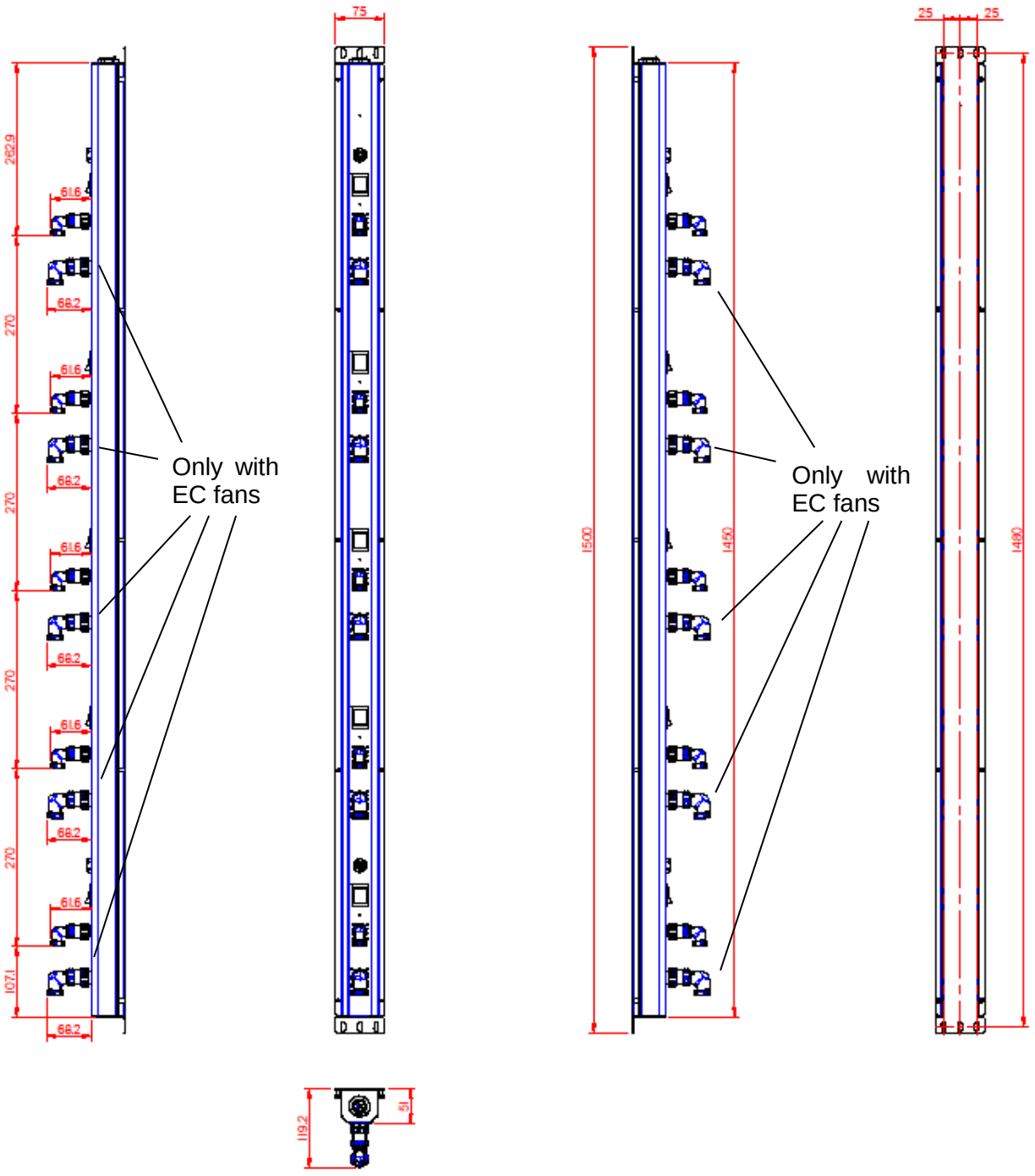


Detail 4 (position of fixing points on bottom side)





Dimensions of multi-switch bar (3 fans)



Dimensions of multi-switch bar (5 fans)

5.2 Hydraulic connection

Prodigy RAW air conditioners must be connected to a circuit with chilled water, including either a chiller or a dry cooler or a cooling tower. For chilled water circulation, pumps have to be provided. These pumps must be selected according to total pressure losses through the hydraulic circuit.

Pressure losses through RAW air conditioners are shown in the technical data sheet at the end of this manual. Pressure losses are referred to pure water. Correction factor for pressure losses in case of monoethylene glycol addition is shown in the following diagram.

An important requirement for hydraulic circuit is quality of water. In case its cleanliness is inadequate, a fine mesh filter in the circuit is recommended.

Cooling fluid temperature must be > +5°C.

In the following table, substances which must be added in particular working conditions to ensure correct functioning:

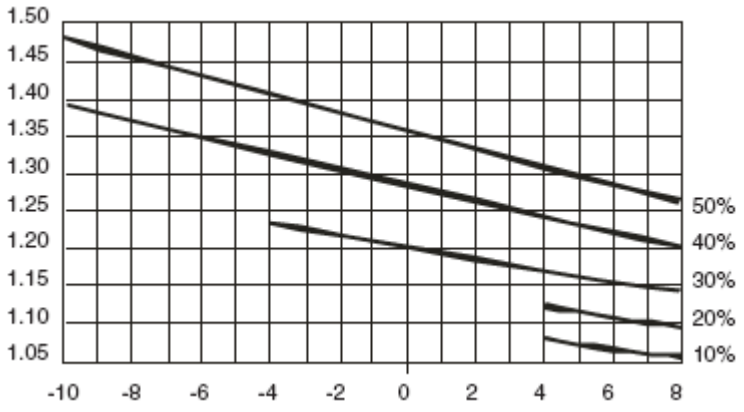
WORKING CONDITIONS	ADDITIVE
OUTDOOR TEMPERATURE < 0°C	**Antifreeze containing inhibited monoethylene glycol (*)**
HYDRAULIC CIRCUIT MADE OF MULTI-METALLIC SYSTEMS: CAST IRON, STEEL, COPPER, BRASS, ALUMINIUM	**Passivating inhibitor of corrosion with neutral PH (*)**
(*) Dose following the prescriptions of antifreeze supplier, according to minimum ambient and working temperatures.	

An excess of additive worsens performance of cooling equipment. For any doubt please consult the manufacturer.

Maximum admitted quantity of glycol 40%

Maximum total (static + dynamic) pressure in water circuit = 8 bar for every standard RAW model.

Coefficient of correction for pressure losses through the hydraulic circuit, using monoethylene glycol.

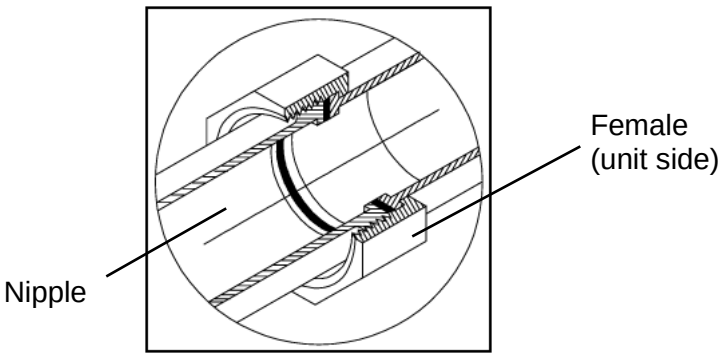


Hydraulic connections in RAW units are screw type, with 1” diameter for all models.

Holes for water pipes are placed both on the base and on the top panel of the unit. When pipes pass from the top, loosen the ring nut of water connectors on the unit and rotate them by 180° upwards. When condensate pump is present, passage of pipes and cables is only from the top. Connect corresponding nipple (not supplied with the unit) as a terminal of external chilled water circuit. Then screw it to the female connector on the unit, respecting water inlet and outlet positions.

Select hydraulic pipes with diameter suitable to their equivalent length (considering pressure losses through curves, unions, etc.), to the water flow, to the circulation pump head. The following minimum diameters are suggested:

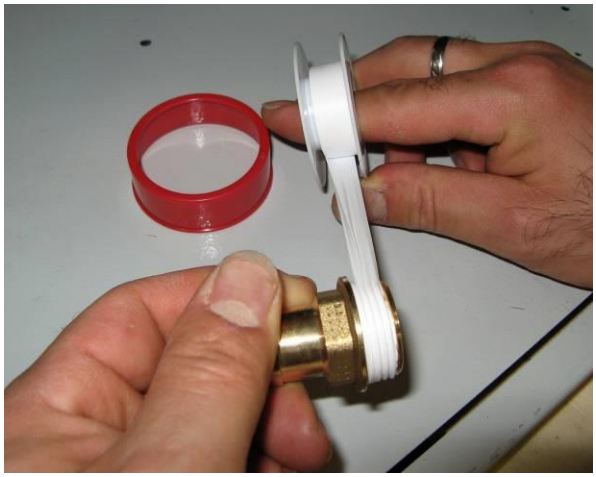
WATER FLOW	< 2500 l/h	From 2500 to 3000 l/h	From 3000 to 4000 l/h	From 4000 to 5500 l/h
PIPE DIAMETER	1 “	1 1/2 “	2 “	2 1/2 “



Union screwed connections

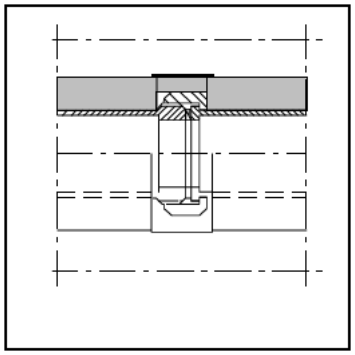
In case some gaskets are missing, use always glycole-proof rubber gaskets.

Apply teflon gasket on the nipple and tighten it to the female connector on the unit.



Application of Teflon gasket (not supplied) to the nipple

Insulate water pipes with anti-diffusion material, to avoid heat exchange with ambient air and consequent condensation of humidity in it on the pipes.



Insulation of water pipes

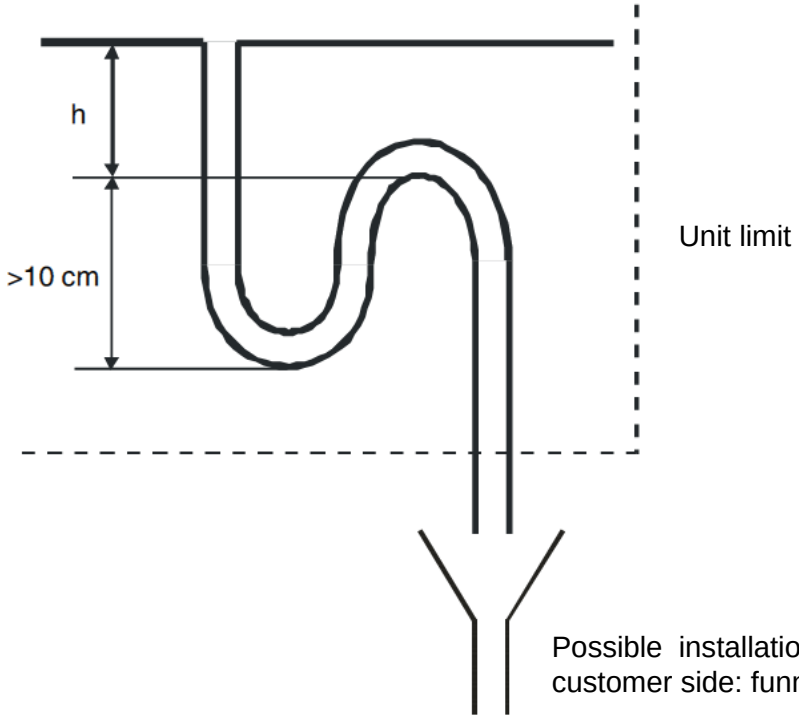
Once water circuit is closed, open the red water cocks and the 2-way valve manually (if it's closed). Then, de-ventilate the circuit through the valve on the top part of internal piping.

5.3 Condensate drain connection

Condensate drain connector is placed on the rear side of the drain pan, under the CW coil. Connection diameter is 16 mm for all models. If condensate pump is not present, a PVC pipe with 0,3 m length is provided. This pipe has to be routed outside the unit through the opening on its base used also for pipes and electric cables.
Make a siphon according to the following instruction:

Siphon installation

Ensure that there is a sufficient height difference between the fan pan and the upper bow of the siphon or the highest part of the drain tube, in order to avoid a water column in the drain siphon caused by the pressure in the suction area of the A/C unit, which prevents the draining of the condensate water



Connect the condensate water drains to the local waste water system. Ensure a 2% gradient towards water drain

Comply with the regulations of the local water supply authority.

5.4 Electric connections

It's absolutely necessary, before making any connections, to check the supply voltage with a tester. The voltage that is measured must correspond with the voltage indicated on the unit label.

The installer must install, upstream from the unit, an isolating switch with fuse and capacity as specified on the label in order to permit maintenance on the machine with total absence of electricity.

The ON-OFF key on the SEC.blue keypad (if present) is only used to put the unit on stand-by. It must not be considered to be a safety component permitting maintenance on the unit. Maintenance must only be carried out after having isolated the power supply to the unit (see previous note).

All electric connections and wiring must be done exclusively by authorized technical personnel.

The system must be equipped with an efficient ground connection.

RAW units are provided with an additional terminal to connect emergency power supply. Emergency line supplies the whole unit and it must have the same features as the main supply line.

The electric connection to the climate-control system must comply with the following regulations:
Machine safety directive (2006/42/CE)
Low voltage directive (2006/95/CE)
Electromagnetic compatibility directive (2004/108/CE)
National mechanical and electric systems regulations

- Check power supply voltage and frequency.
- Check that these values are compatible with those of the unit (shown in its name-plate).
- Cut off both the main power supply before working on the unit.
- Section of power supply cables must be selected in accordance to their length, kind of power supply and the current absorbed by the unit, as prescribed by current regulations. These cables must comply with currently applicable standards. In any case we recommend using shielded cables unless the installer carries out, at his expense, tests that demonstrate that shielding is not necessary.
- Check that the power cables are installed at an adequate distance from alarm, communication and monitoring cables.
- Install an omnipolar circuit breaker on the main power supply lines, if necessary equipped with another ground fault switch; please refer to the electrical diagram in manual part 2. Do the same on emergency power supply line.

Failure to comply with these points can cause damage or malfunctions to components and immediately invalidates guarantee coverage.

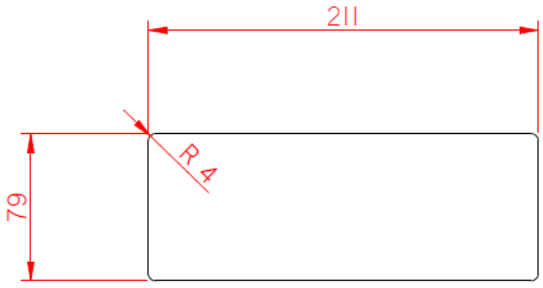
- The electric box is supplied loose on the top of the unit. It is provided with 4 lateral inserts for fixation to the rack frame. The electric box is plugged to internal components of the unit. When inserting the unit into the rack, it is possible to unplug the electric box and put it into the rack in a second moment. Then electric connections must be restored following the wiring diagram.
- Connect electric cables from each single fan to the multi-switch bar following the wiring diagram.
- Connect power supply and signal cables from electric box to multi-switch bar following the wiring diagram.
- Connect main power supply cables from the distribution panel of the site to the unit power terminal board located inside its electric box.
- Repeat the same operation to connect also emergency power supply, if available.

For use of leakage-current (FI) circuit breakers, EN 50178 5.2.11.2 must be taken into account. Only type B pulse-current FI circuit breakers are permitted. FI circuit breakers do not provide protection against bodily harm during operation of the unit or frequency converters.

In case of units at 60 Hz, it's necessary to set the parameter C.4.4.1.1.1=1 (60Hz), using 'Service' password 111.

Installation of the display

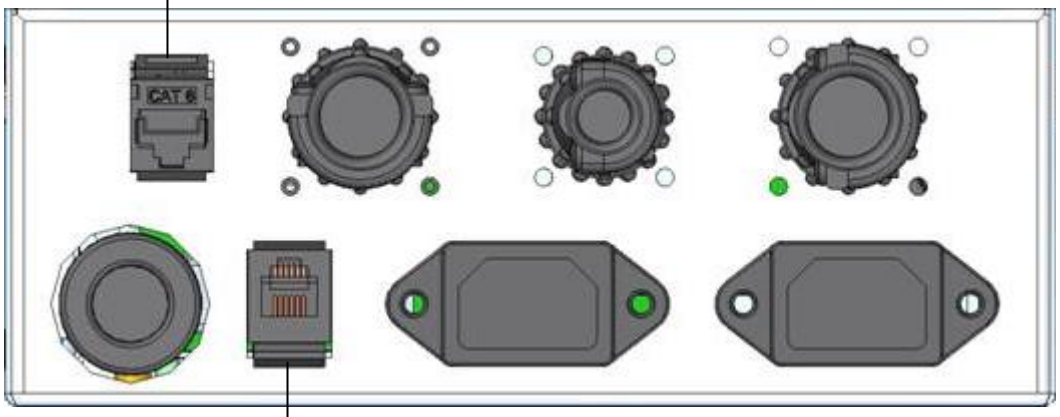
The display of SEC.blue can be installed on the front door of the containing frame. To this purpose the front door must be provided with an opening for positioning the display. Dimensions are shown in the following picture.



Remove the plastic support and install the display on the front door.
Then, using the 4m long cable supplied with it, connect the display to the USER connector located on the front side of the e-box.

Connections and power supply plate:

Connector RJ45 for Ethernet (see paragraph 5.6)



Connector RJ11 for Telemonitoring (see paragraph 5.5)

5.5 Telemonitoring

Telemonitoring net is via RJ11 connector. Units have to be linked each other in a serial RS485 net using pin-to-pin phone cables of the following type: data cable 2CP AWG24 with modular phone plug 6/4. A shielded cable is highly recommended when its length exceeds 10 m.
A line doubler is necessary to connect two cables to the same SEC.blue controller. Both phone cable and line doubler are available as accessories (ACTSEQC10 / ACTSPLITTER).
The same cable is used to connect the last SEC.blue controller in the net to the BMS.

Wires on the ACTSEQC10 cable are configured as follows:

RX+/TX+	pin 3
RX-/TX-	pin 5
Ref	pin 2

Once SEC.blue controllers are connected together:

- Set the communication protocol on SEC.blue controllers with parameter **C.4.3.1.2.1** (Function of serial bus 485 ISO).The same communication protocol must be set on every SEC.blue in the same serial line.
- Give each SEC.blue an address in the monitoring line with parameter **C.4.3.1.2.2** (Address of serial bus 485 ISO). This address must be different from either any SEC.blue or other electronic devices connected in the same serial line.
- Reset the controller to put modifications above into effect. Reset is done interrupting for some seconds power supply to the controller.

PEMS PROTOCOL (PE)

Set parameter **C.4.3.1.1.3** to PEMS

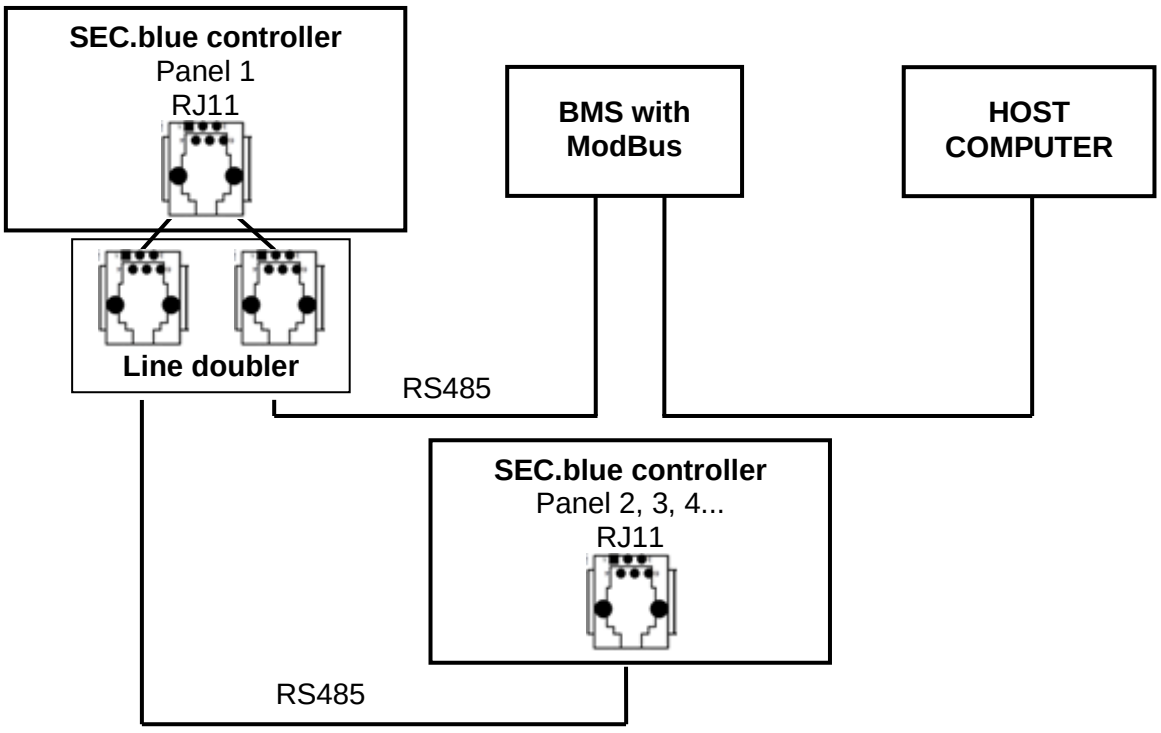
MODBUS PROTOCOL

Set parameter **C.4.3.1.1.3** to MODBUS 2015

The SEC.blue controller can communicate with the software installed on host computer which displays the setup parameters, the controller states and alarms.
The parameter **C.4.3.1.1.3** sets the protocol for the RJ11 connector of the board.
In the system (see figure below) there is no gateway managing the communication.

Thus, there will be 2 kinds of connection in this system:
- the connection between the RS485 serial port (named RJ11) of two SEC.blue controllers;
- the connection between the RJ11 port of a SEC.blue control board and the RS485 serial port of the host computer.

In the system (see figure below), a BMS accepting ModBus manages the communication.



5.6 Ethernet connection

Ethernet connection is via RJ45 connector, with a network cable.
It allows the remote assistance in the following ways:
- Modbus TCP/IP
- Sequencing
- SNMP
- OnBoard
- Web monitoring with Google Chrome

6. Start-up

Before you first start up the system install and connect it up as described in the "Installation" chapter.

- Make sure the main switch is turned off and that the system is isolated from power mains.
- Check that all power switches in the electric system have been turned off.
- Check that the main electric supply cable and the terminals, including the PE terminals, are correctly hooked up.
- Check that contactors are free to move.
- Use the main switch to turn the air climate control system on.
- Activate fan power switches one after another.
- Check the supply voltage on all phases.
- Start either dry-cooler or water chiller. Verify water circulation and temperature.
- At this point the electronic card is powered and the single components of the system can be activated to check for proper operation. The fundamental procedures to follow during installation are described in the following paragraph.
- Set the desired supply air temperature and the desired differential set point (difference between return and supply air temperature) on the conditioner display.
- Start the climate control system by pressing the ON-OFF push-button on the display.
- Check that there aren't any water leakages.
- Check the current absorbed by the fans, comparing these values with those indicated in technical specifications.
- When the system is operating at normal capacity: 1) check that there are no alarms; 2) check that the fans work properly; 3) check, with the unit operating, that power supply voltages remain inside the values indicated on the technical data label for the unit; 4) check that the unit operates according to the logic described in the following chapter.

Shutdown

To shut the unit down, disconnect it from all its power supplies using the related isolating switches.

The ON-OFF key on the SEC.blue display (if present) is only used to put the unit on stand-by. It must not be thought to be a safety component to turn the unit off prior to performing maintenance.

7. Maintenance

7.1 Safety instructions

Installation and intervention on air conditioners must be made in full compliance with specific national regulations for accident prevention, with particular reference on electric and refrigerant equipment. Failure to comply with these regulations might be dangerous to people and environment.
Before any intervention on the unit, refer to instructions on this manual, check data on the name-plate and take any other precaution in order to guarantee optimal safety.

Maintenance operations must be made by authorized and skilled personnel.

Safety procedures

Cut off the power supply to the unit before making any maintenance operation. A "DO NOT SWITCH ON" warning sign must be clearly visible. ON-OFF key on SEC.blue display (if present) is only used to put the unit is stand-by. It must not be considered as a safety device to switch off the unit before maintenance.

Live electric components have to be switched to de-energized and checked to ensure that they are in the de-energized state.

Some verifications must be effected with the unit in operation (measuring current, pressures, temperatures). In such a case, the unit must only be switched on at the master switch after all mechanical connections have been carried out. The unit must be switched off immediately after the measuring procedure.

The electric box might be hot.

Very little routine maintenance is necessary to keep the unit in reliable operating order and protect its moving parts. This maintenance, however, must be performed at the prescribed maintenance intervals. Failure to perform due maintenance both decreases the working life and efficiency of the unit and also invalidates guarantee coverage.

7.2 Preventive maintenance program

Every month
- WATER CIRCUIT: check tightness of the circuit.

Every 3 months
- AIR FILTERS (only in open loop models): check the condition of the filters and replace them if necessary (dirty filter alarm).
- HEAT EXCHANGERS: check that the heat exchangers are efficient and not clogged or dirty.
- CONDENSATE DRAIN: check that the condensate drain system is perfectly clean and efficient.

Every year
- FANS: check that fans do not show signs of overheating or abnormal vibrations and that they are free to rotate.
- ELECTRIC CIRCUIT: check that electric connections are tight, that switches, remote control switches and isolating switches are operating and in good condition. Also check that the control board operates and perform a test of alarm signals.
- MECHANICAL PARTS: clean the inner components of the system.

If air conditioner works in particularly dirty environment or if experience shows that a more frequent maintenance is needed, this must be made as necessary.

7.3 Air circuit

Heat exchanger

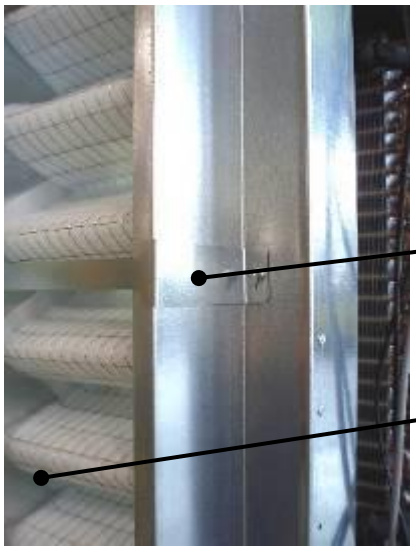
Heat exchanger consists of copper tubes with aluminium fins. Particles of internal and external air passing through the filter might nest between the fins, reducing heat transmission efficiency and increasing air flow resistance. The latter shows when the fan current increases.
For cleaning, proceed as follows: blow compressed air through the heat exchanger in the direction opposite the direction of air flow during normal operation.

Do not distort the fins while cleaning, this also increases the air resistance.

Fan

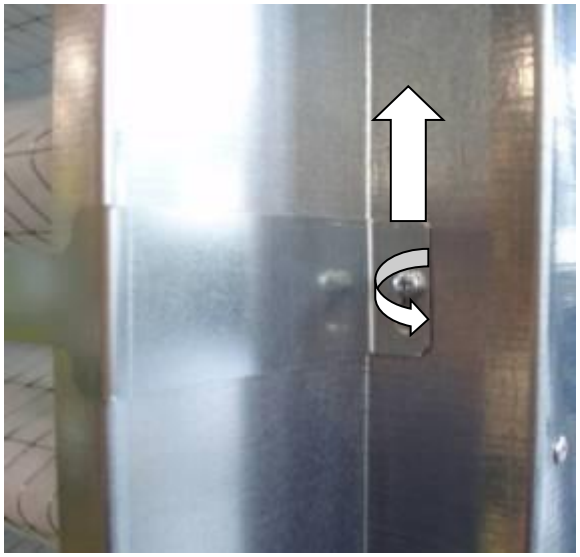
The bearings of the fans are lifetime lubricated and do not need maintenance. Check the operation current. An increased operation current indicates either a higher air resistance by a clogged pre-filter or a winding short circuit in the fan motor.
Fan is automatically controlled with variable speed. To make measurements at nominal speed, use manual control.

Air filters (only in open loop units)



A differential pressure switch monitors air intake filters. As soon as pressure loss exceeds an adjustable value, a dirty filter alarm is enabled by the electronic controller. In this case, filter replacement is necessary. To pull it out, proceed as follows:

RAW open loop units have 3 filters. Each filter is fixed to the unit rear frame with a retaining bracket.



Loosen the fixing screws at the sides of the brackets. Push the bracket up and extract it. Then the filter can be removed.

Spare filters must have filtering medium with the same thickness and density as the original one. A A set of spare filters can be ordered to your local STULZ service partner.

7.4 Water circuit

Check visually tightness of water circuit. In addition, a level indicator in the water tank (if present), can be useful to see changes of water quantity. Water going out of water circuit is replaced by air, which reduces cooling capacity of the unit and might damage circulation pump.

7.5 General appliance cleaning procedures

Never use caustic or acid substances to clean any part of the conditioner.
Use a vacuum cleaner to remove dust.
Inner parts must be cleaned with a liquid detergent and air at a pressure not higher than 4 bar and with the unit suitably connected to ground.
Check also that water pipes are firm: eventual vibrations might cause leakages.
Finally, check pipe insulation.

8. Troubleshooting

PROBLEM	CAUSE	POSSIBLE SOLUTION
The controller and the rest of the unit don't work	Main power supply missing	Restore power supply
	Main switch open	Close main switch
	Power supply to the controller is missing	Check voltage on power supply cables. Repair the broken cable or restore the missing connection
	Faulty controller	Contact Stulz service
Controller is working, but the rest of the unit is not working	Faults blocking the unit	Look for alarms on the display. Contact Stulz service
	Faulty controller	Contact Stulz service
Controller is working but display is not working	Cable between controller and display disconnected	Reconnect cable
	Cable between controller and display broken	Replace cable
	Display faulty	Contact Stulz service
Alarm: High / max temperature	Cooling capacity lower than heat load	Reduce heat load or increase number of units
	Wrong calibration of temperature probes	Check with a reference thermometer and re-calibrate
	Low air flow	Check and replace air filter (see also dirty filter alarm)
	Insufficient cold air circulation in the site	Check unit and racks layout
	Chilled water temperature is too high	Check chilled water cooling system
	Chilled water flow is too low	Check chilled water circulation system
	Water valve is defective	Contact Stulz service
Alarm: Level (if condensate pump is present)	Condensate pump is broken	Contact Stulz service
	Condensate discharge system obstructed	Check and clean condensate water tray and pipes
Alarm: High humidity (if humidity probe is present)	Humidity infiltration from outside	Check passage of air from the outdoor
	Wrong calibration of humidity probe	Check with a reference hygrometer and re-calibrate
Alarm: Fan x blocked	Fan x disconnected	Check and re-connect all wires between fan and controller
	Fan x broken	Contact Stulz service
	Wrong configuration of SEC.blue I/O	Contact Stulz service

PROBLEM	CAUSE	POSSIBLE SOLUTION
Alarm: Dirty filter	Air filter is clogged	Replace the filter
	Air filter pressure switch faulty	Replace the differential pressure switch
	Pipes to the dirty filter pressure switch clogged or bended	Clean and re-position plastic pipes
Alarm: Water detector (if water floor sensor is present)	Room humidity is over the maximum value	Check passage of air from the outdoor
	Condensate discharge system obstructed	Check and clean condensate water tray and pipes
	Leakage from water pipes	Check and repair

9. Uninstalling the unit

This unit must be uninstalled by specialized and authorized persons.
Cut off power supply. Switch off power conducting cables to the unit and secure them against being switched on again. Disconnect the A/C unit from the de-energized network.

Disconnect the unit from external water circuit, closing water valves and emptying hydraulic circuit of the unit.

If either glycole or similar additives have been used, also this mixture must be collected and disposed in a suitable way, avoiding to pour it into the sewer.

Move the unit as described in paragraph “lifting and transport”, with a lifting device of suitable capacity.

Dispose of the unit in accordance with the disposal and safety regulations applicable on site. We recommend a recycling company for this. Basically, the unit contains the following raw materials: aluminium (heat exchanger and condensate tray), copper (heat exchanger, water collector and electric cables), zinc plated iron and steel (panels and metallic frame), rubber (water pipes).

10. Accessories / options

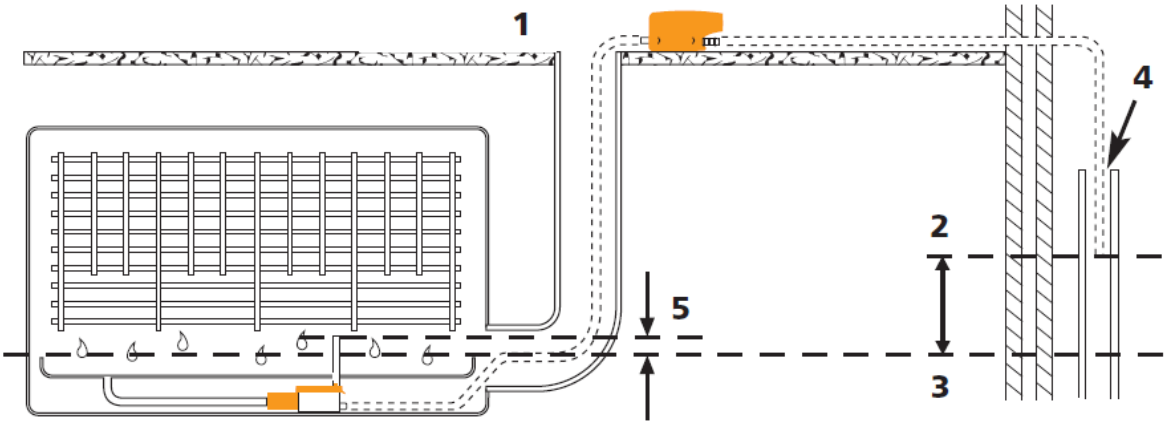
10.1 Condensate pump installed inside the unit – CONDPUMP

A pump is installed inside the unit when condensate evacuation by gravity is not possible.

With condensate pump, the opening for cable and pipes passage through the base cannot be used. In this case, the only available opening is on the top.

The pump receives power supply from the e-box and sends a water level digital signal to SEC.blue controller.

- Use the pump within the following operating limits: maximum head 10 m. With 10 m head, and no suction lift water flow is 4.5 l/h.
- Carry out the discharge pipe in PVC with 6x9 mm diameter provided with the pump from one of the openings used for water and refrigerant pipes. Channel discharge tube to an appropriate drain, avoiding restrictions.
- Always ensure the reservoir is sitting flat and horizontal.
- Test pump operation by pouring water into heat exchanger tray. CHECK FOR LEAKS.
- **Preventing siphoning**: cut discharge tube (2) above water level (3) of heat exchanger tray and direct end into large pipe (4), allowing air break.



Maintenance

- This pump, like all mechanical equipment, requires maintenance.
- Every six months the reservoir should be removed, taking care to clean the filter, float and reservoir thoroughly prior to reassembly. We recommend this is done in the Spring and the Autumn, using an anti-bacterial wash.
- Take great care to replace the float with the magnet facing upwards.
- Additional inline filters are available if required.

Troubleshooting

Fault: Pump runs all the time

1. Is float positioned with the magnet uppermost?
2. Is the reservoir lid (sensor) located firmly onto the reservoir, with the float located inside the reservoir, around the sensor column?
3. Is there sludge inside the reservoir, preventing float from resting on the bottom? (This may occur if pump has been in operation for some time without cleaning. Clean using an anti-bacterial wash.)

Please note:

- After installation and during operation, if you notice air in the pipe between the reservoir and the pump, you have a siphoning problem. Follow advice in 'Preventing Siphoning'.
- The pump will only switch off when the float is at the bottom of the reservoir.

Fault: Pump stops and starts and makes a loud noise.

1. The water is siphoning back through the pump. Follow advice in 'Preventing Siphoning'.

Fault: Pump runs but does not pump any water.

1. Are there any air-leaks in the pipe running to the pump?
2. Check that reservoir, filter and inlet tube are free of sludge and debris.

Fault: Pump isn't operating at all.

1. Is power reaching the pump? Is it correctly wired? Is the voltage correct?
2. Is pump very hot? A thermal cut-out may have been activated to protect pump. This will automatically reset once pump has cooled down.

10.2 3-way valve – 3WAYVAL

3-way valve replaces standard 2-way valve when the CW unit is not connected to a chilled water distribution system with variable flow. This valve receives a modulating signal from SEC.blue controller to vary water flow through the heat exchanger, in order to adjust cooling capacity of the unit to the actual heat load. The circuit diagram with 3-way valve is shown in paragraph 3.6. kvs of 3-way valve is the same as 2-way valve, so pressure losses at full opening are the same as the ones indicated in technical data sheet. Operating limits are the same as 2-way valve, please refer to paragraph 3.2.

10.3 External frame

For the open loop units, it's possible to order an external carpentry that contains the unit. In the following table there are the available measures.

Frame 1000 x 300 x 42U
Frame 1000 x 300 x 45U
Frame 1000 x 300 x 47U
Frame 1200 x 300 x 42U
Frame 1200 x 300 x 45U
Frame 1200 x 300 x 47U

11. Technical data

Notes on technical data sheets:

* Nominal conditions
Closed loop: return air temperature 45°C / RH 15%
Open loop: return air temperature 30°C / RH 30%
EWT (all models) = 7°C
Water dT (all models) = 5°C
Gross cooling capacities (including power dissipated by fans)
Refrigerant: water without additives

** Total pressure losses through the water circuit inside the unit.

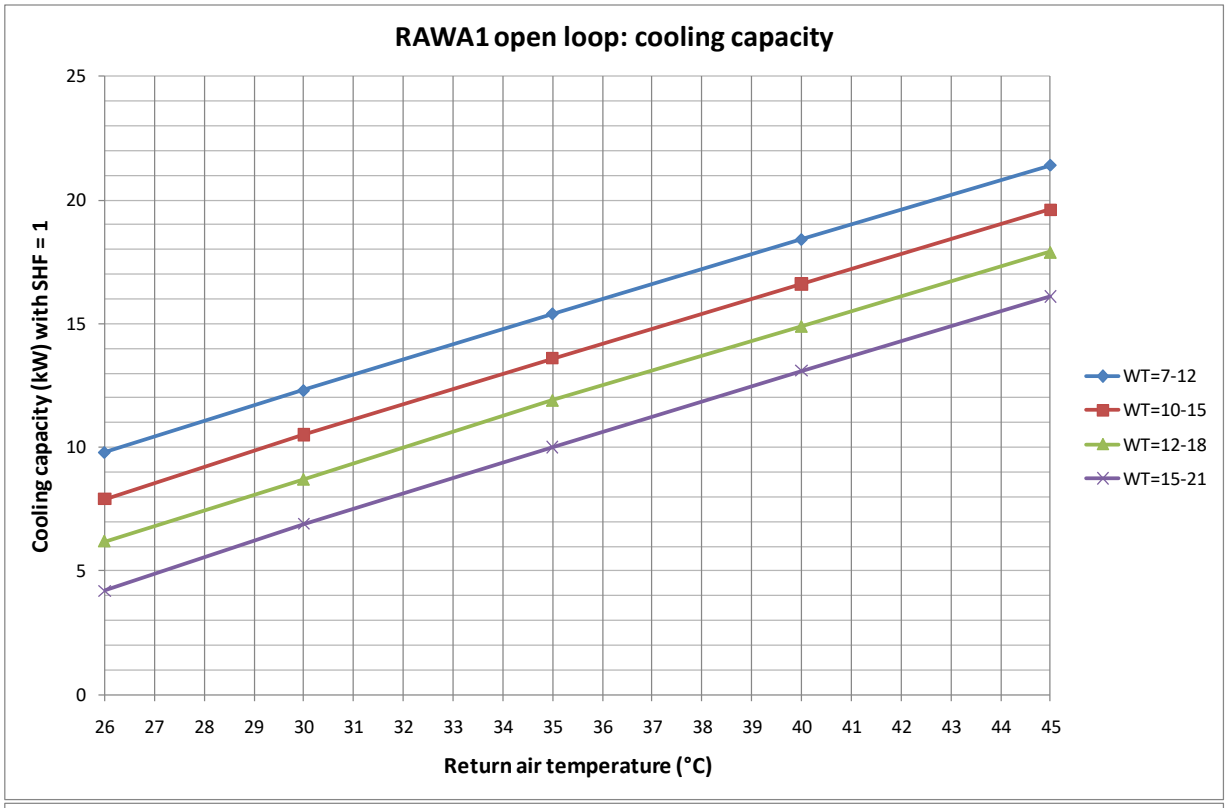
*** Air flow in closed loop models refers to the unit not installed in the rack.

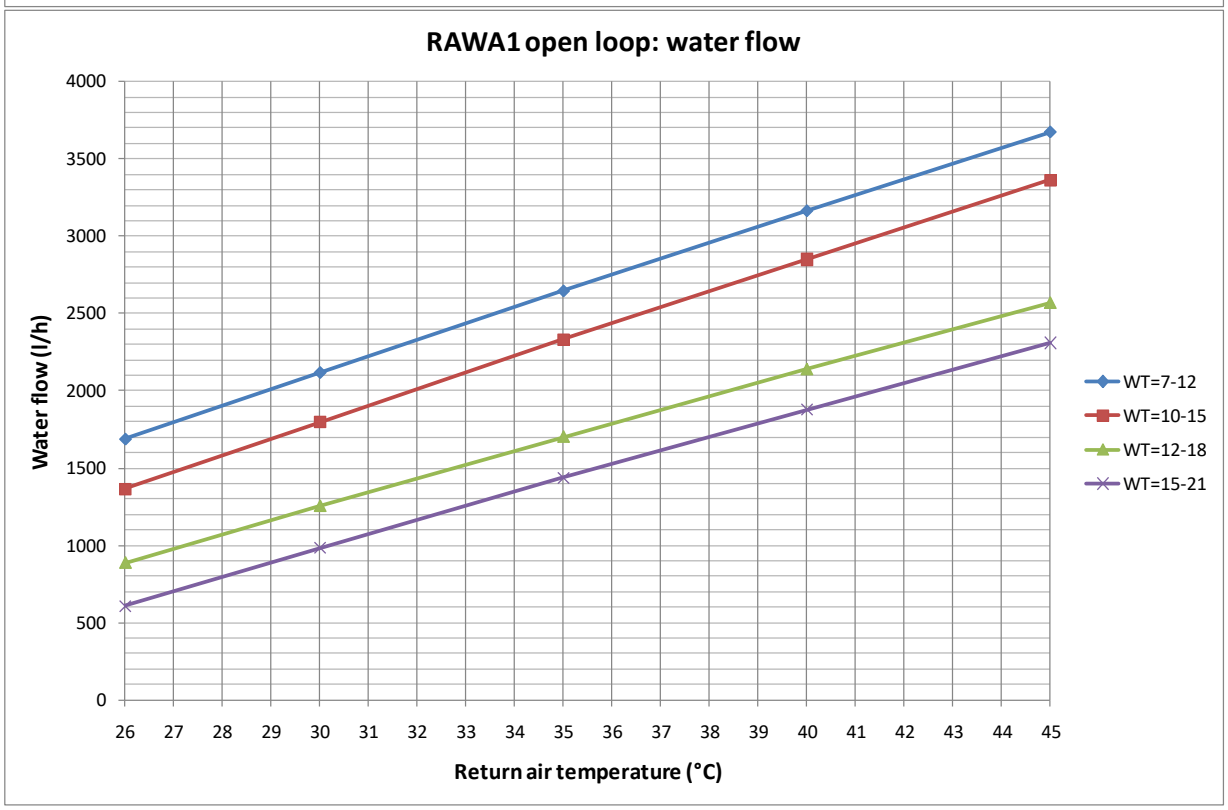
Notes on diagrams:

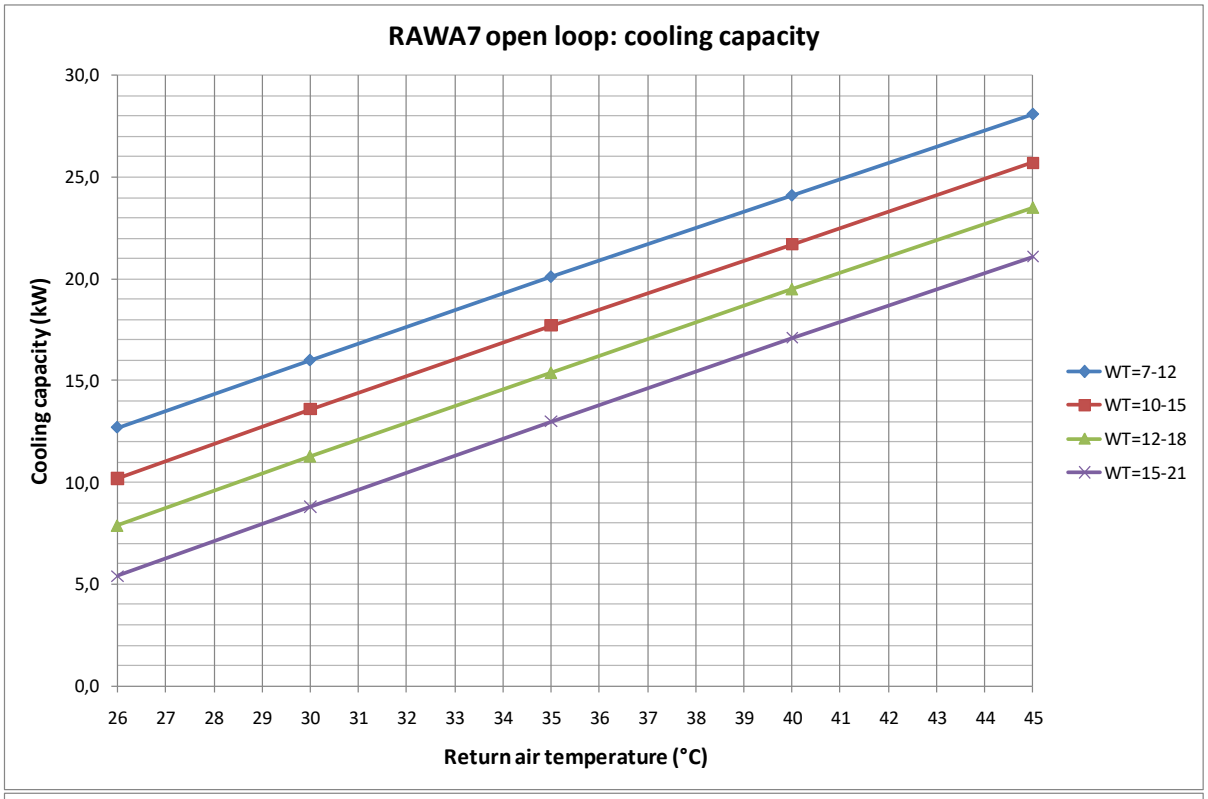
- Return air conditions: T=26°C / RH=40%; T=30°C / RH=30%; T=35°C / RH=25%; T=40°C / RH=20%; T=45°C / RH=15%
- For all models in all working conditions listed above, SHF = 1 (total cooling capacity = sensible cooling capacity)
- Refrigerant: water without additives

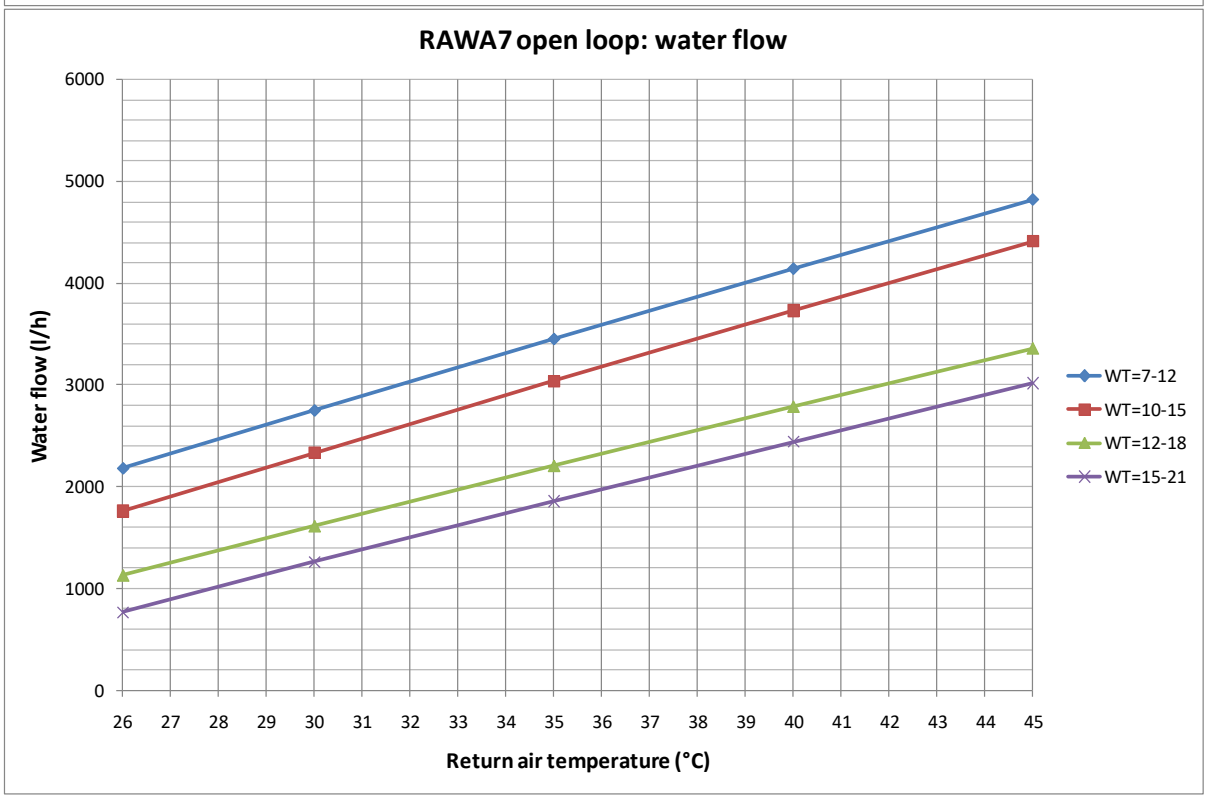
RAW OPEN LOOP		RAW A1	RAW A7	RAW B1
Total cooling capacity*	kW	12,3	16,0	19,5
Sensible cooling capacity*	kW	12,3	16,0	19,5
Power supply	V/ph/Hz	230/1/50		
Air flow	m^3/h	2600	3800	3800
FAN				
AC FAN version				
Number of fans		3	5	5
Fan motor max (each)	W	190		
	A	1,10		
EC FAN version				
Number of fans		3	5	5
Fan motor max (each)	W	175		
	A	1,35		
AIR-TO-WATER HEAT EXCHANGER				
Type		COPPER TUBE / ALUMINIUM FIN		
Face area	m^2	0,35	0,35	0,35
Air face velocity	m/s	2,06	3,02	3,02
WATER CIRCUIT				
Water flow	l/h	2119	2753	3344
Water pressure drop (total)**	kPa	31	49	39
Water valve	type	2-way (optional 3-way) modulating valve		
FILTER - WASHABLE (STANDARD)				
Quantity and shape		3 zig-zag		
Size	mm	600x180		
Depth	mm	100		
Efficiency		ePM10 50%		
PHYSICAL DATA				
Cooling module				
Weight	kg	77	83	83
Height	mm	1870		
Width	mm	290		
Depth with AC fans	mm	776		
Depth with EC fans	mm	753		
Fan connection bar				
Weight	kg	3		
Height	mm	1500		
Width	mm	75		
Depth	mm	119		
Electric box				
Weight	kg	5		
Height	mm	73		
Width	mm	185		
Depth with AC fans	mm	740		
Depth with EC fans	mm	757		
WATER CONNECTION SIZE				
Supply line diameter	in	1" female		

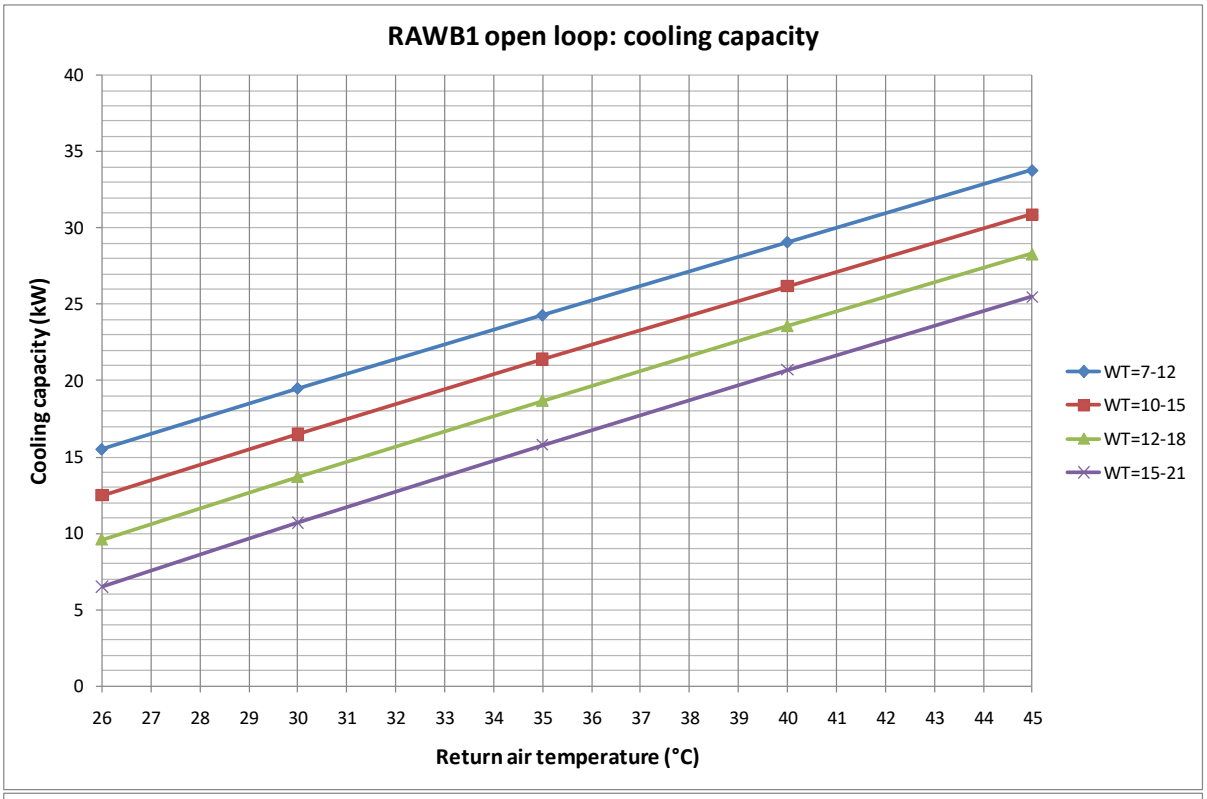
RAW CLOSED LOOP		RAW A6	RAW B2	RAW C4
Total cooling capacity*	kW	22,6	31,0	37,7
Sensible cooling capacity*	kW	22,6	31,0	37,7
Power supply	V/ph/Hz	230/1/50		
Air flow	m^3/h	2800	4400	4400
FAN				
AC FAN version				
Number of fans		3	5	5
Fan motor max (each)	W	190		
	A	1,10		
EC FAN version				
Number of fans		3	5	5
Fan motor max (each)	W	175		
	A	1,35		
AIR-TO-WATER HEAT EXCHANGER				
Type		COPPER TUBE / ALUMINIUM FIN		
Face area	m^2	0,35	0,35	0,35
Air face velocity	m/s	2,22	3,49	3,49
WATER CIRCUIT				
Water flow	l/h	3879	5331	6487
Water pressure drop (total)**	kPa	91	163	133
Water valve	type	2-way (optional 3-way) modulating valve		
PHYSICAL DATA				
Cooling module				
Weight	kg	77	83	83
Height	mm	1870		
Width	mm	290		
Depth with AC fans	mm	730		
Depth with EC fans	mm	707		
Fan connection bar				
Weight	kg	3		
Height	mm	1500		
Width	mm	75		
Depth	mm	119		
Electric box				
Weight	kg	5		
Height	mm	73		
Width	mm	185		
Depth with AC fans	mm	740		
Depth with EC fans	mm	757		
WATER CONNECTION SIZE				
Supply line diameter	in	1" female		
Return line diameter	in	1" female		

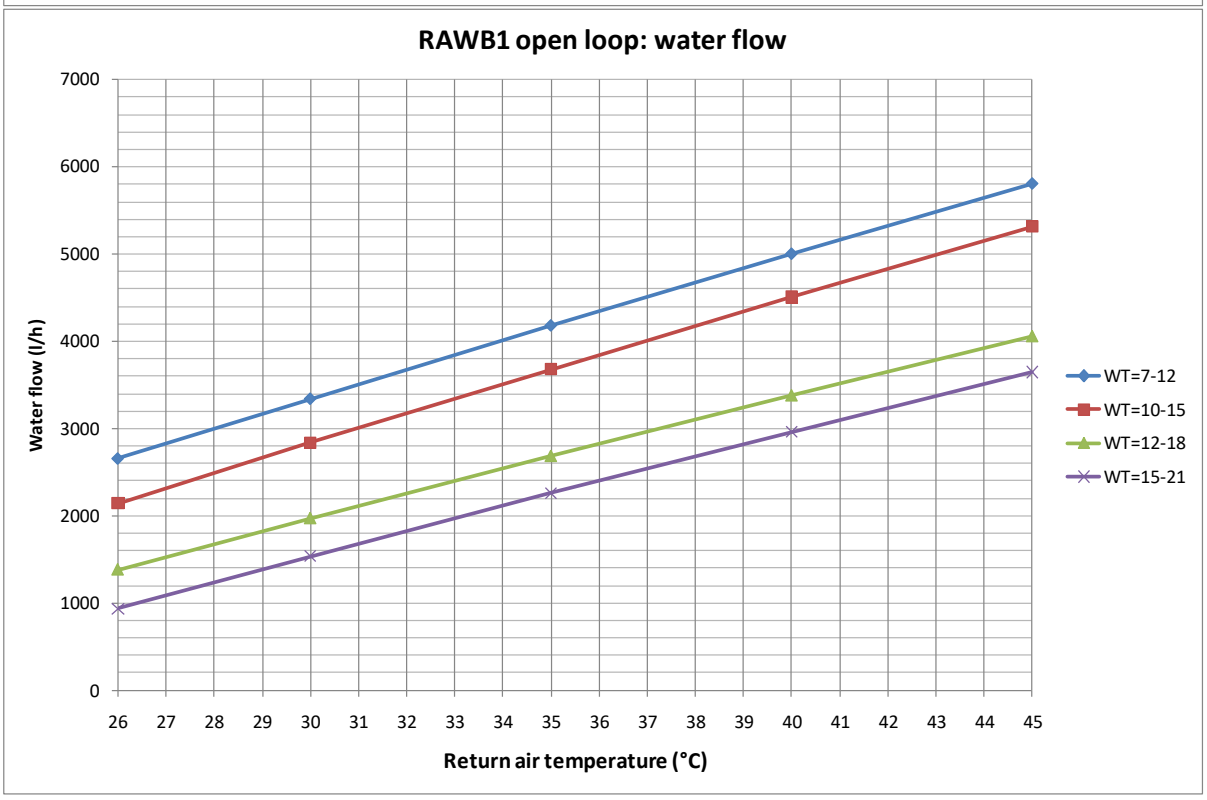

RAWA1 open loop: cooling capacity
Cooling capacity (kW) with SHF = 1
25
20
15
10
5
0
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21

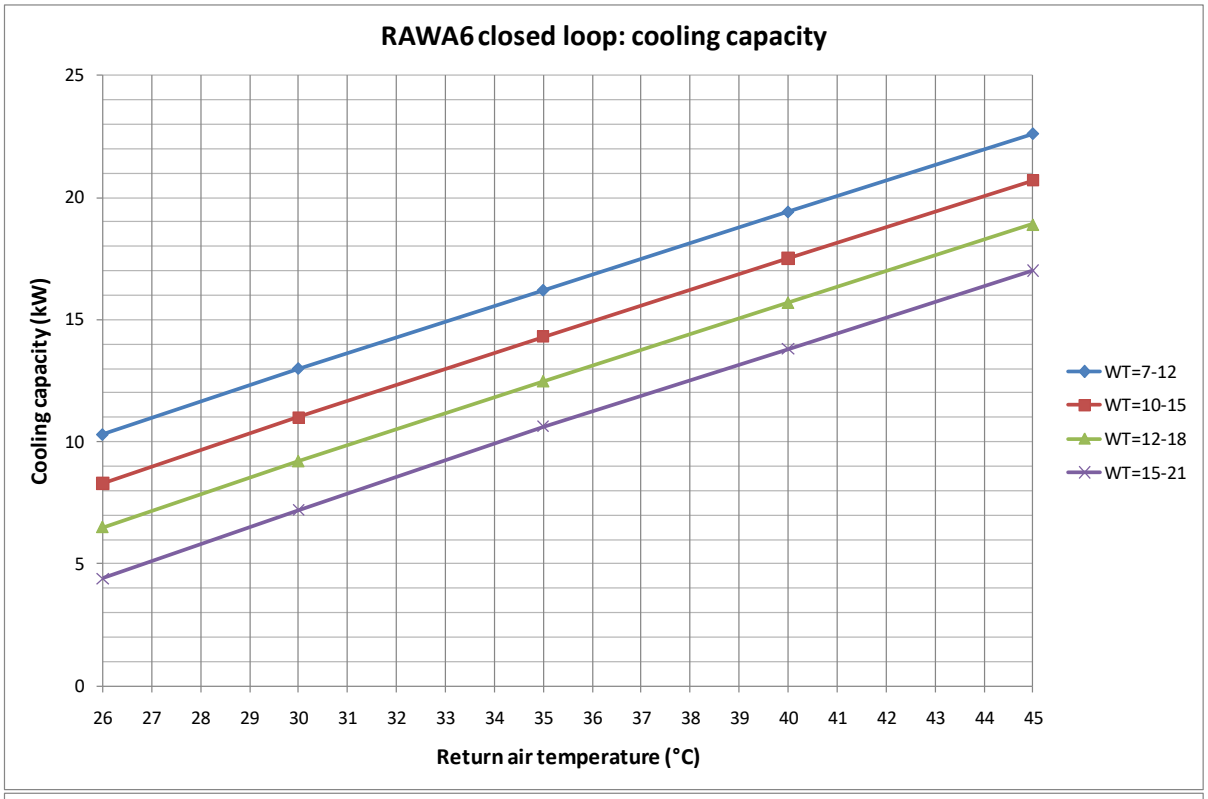

RAWA1 open loop: water flow
Water flow (l/h)
4000
3500
3000
2500
2000
1500
1000
500
0
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21

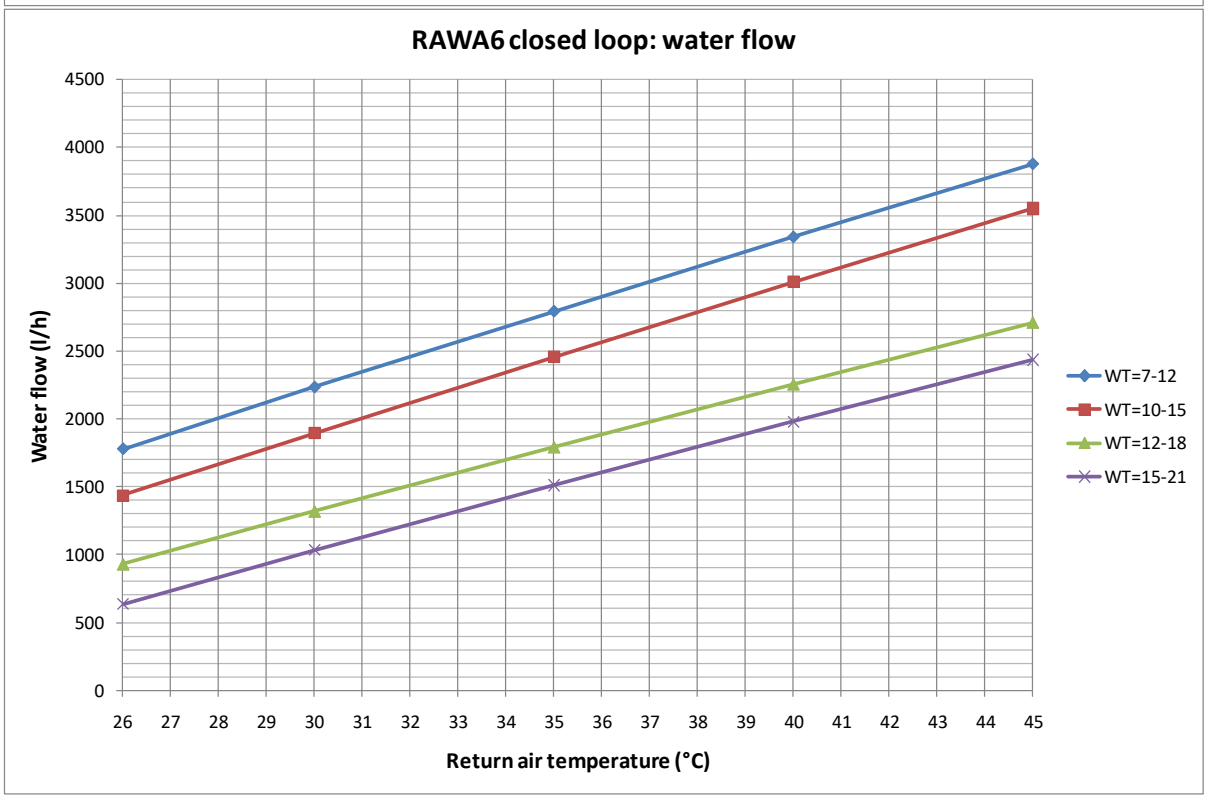

RAWA7 open loop: cooling capacity
Cooling capacity (kW)
30,0
25,0
20,0
15,0
10,0
5,0
0,0
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21

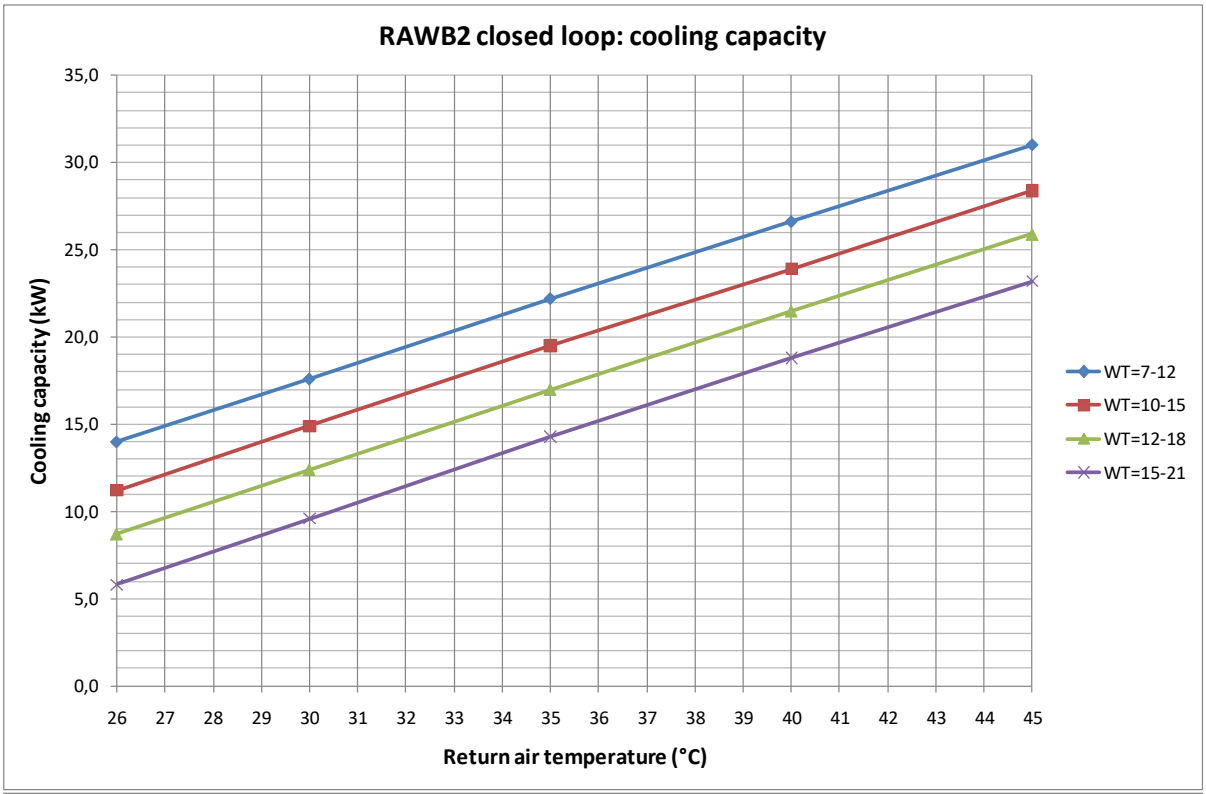

RAWA7 open loop: water flow
Water flow (l/h)
6000
5000
4000
3000
2000
1000
0
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21

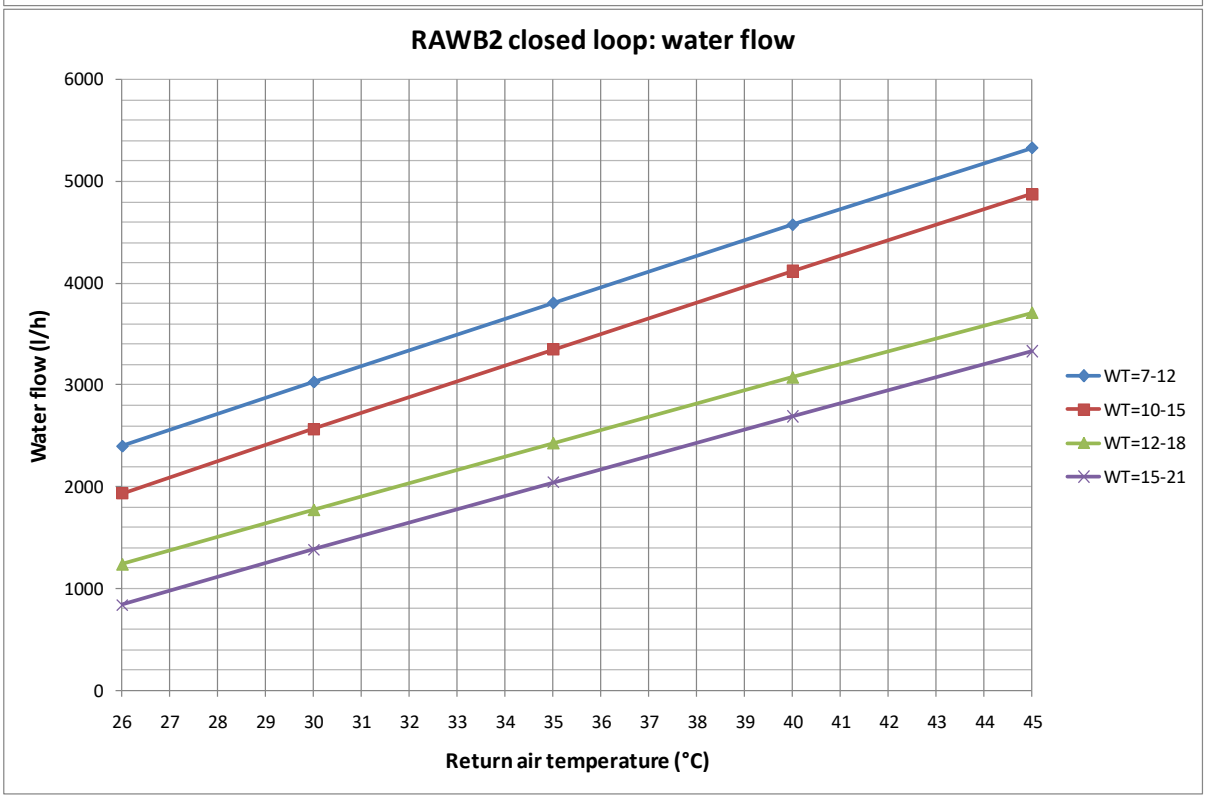

RAWB1 open loop: cooling capacity
Cooling capacity (kW)
0
5
10
15
20
25
30
35
40
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21

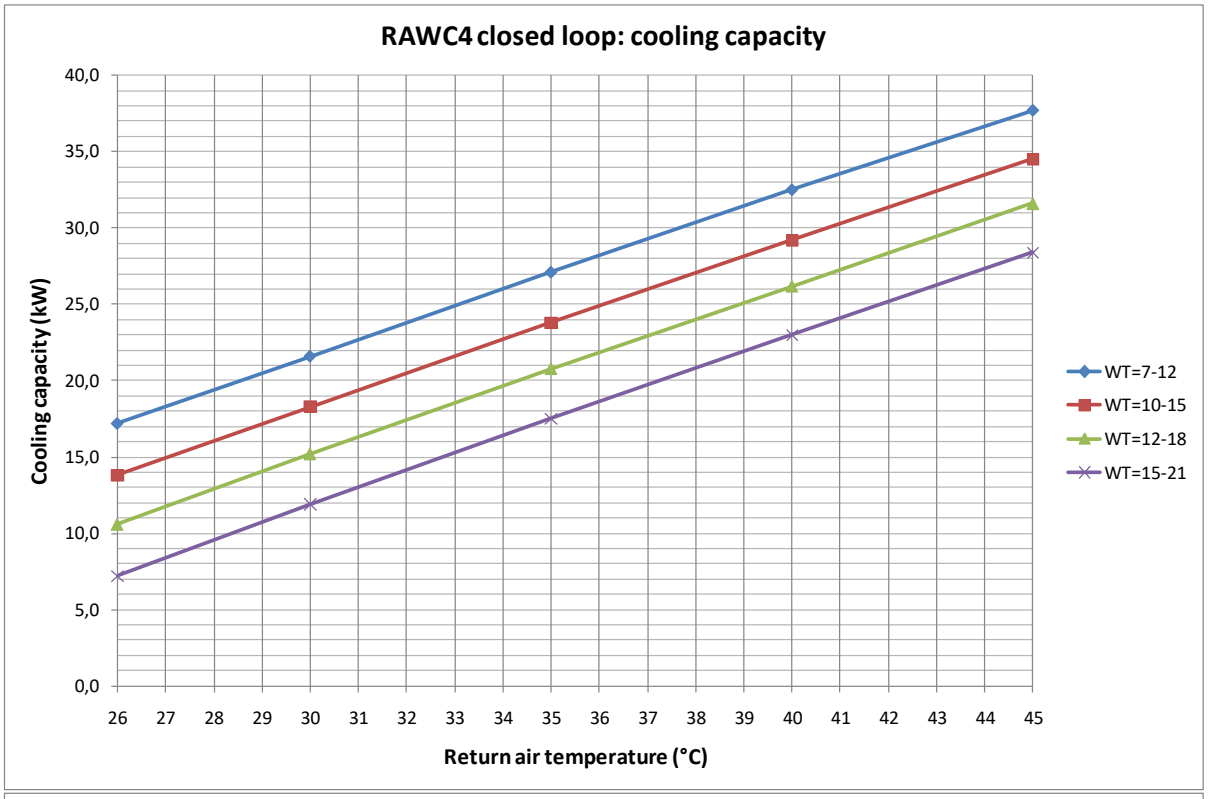

RAWB1 open loop: water flow
Water flow (l/h)
0
1000
2000
3000
4000
5000
6000
7000
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21

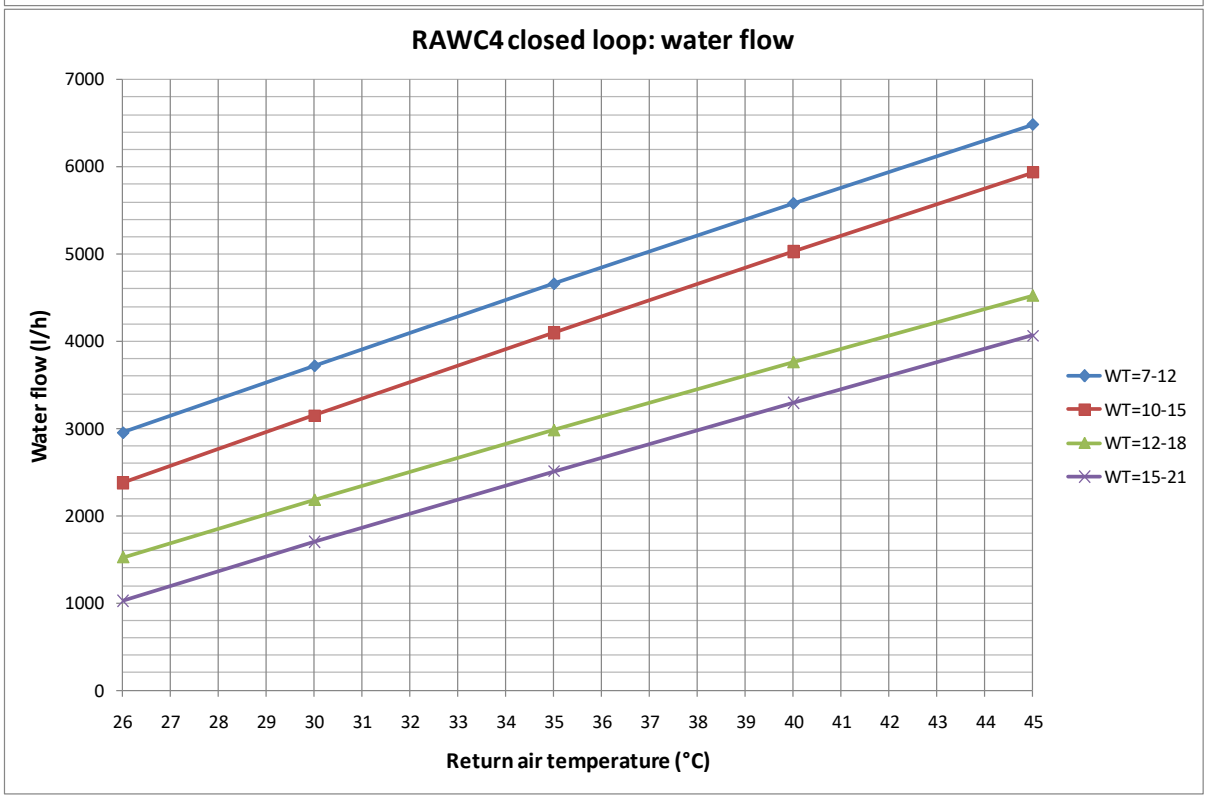

RAWA6 closed loop: cooling capacity
Cooling capacity (kW)
0
5
10
15
20
25
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21

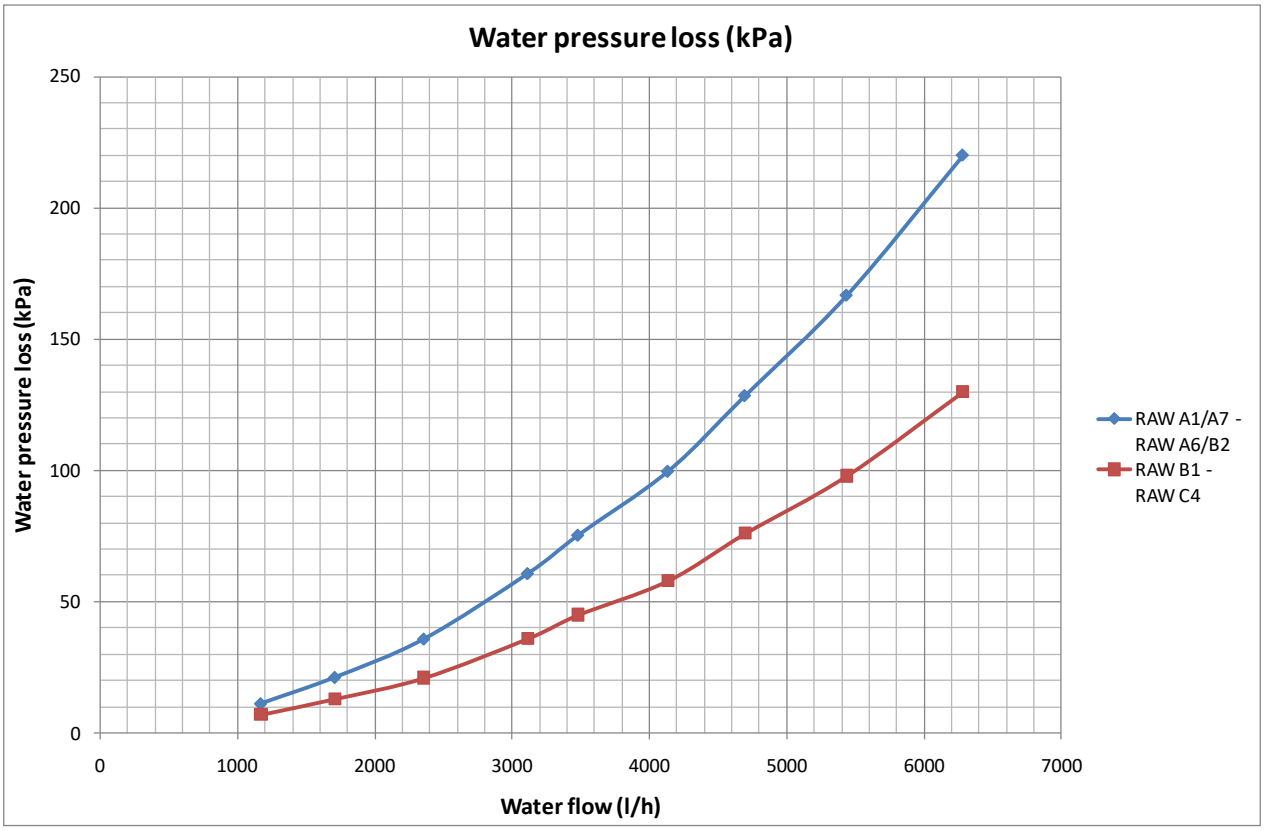

RAWA6 closed loop: water flow
Water flow (l/h)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21

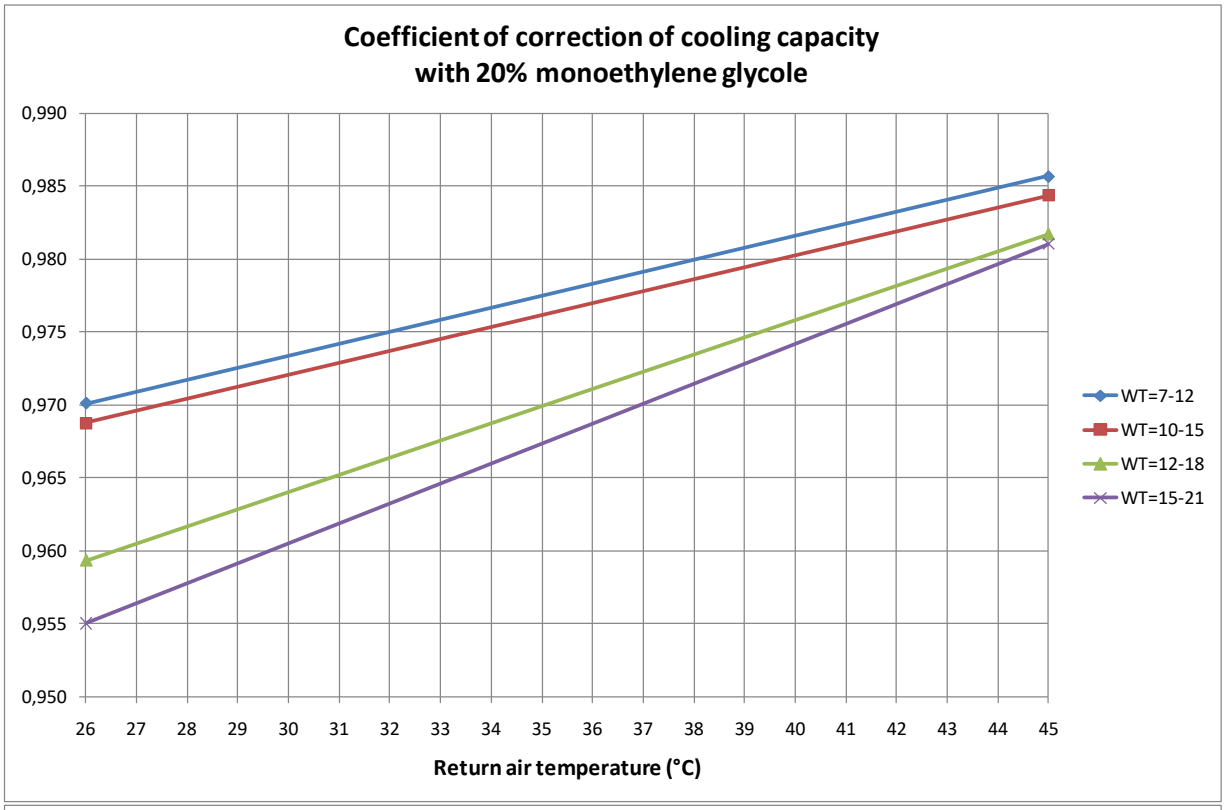

RAWB2 closed loop: cooling capacity
Cooling capacity (kW)
35,0
30,0
25,0
20,0
15,0
10,0
5,0
0,0
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21

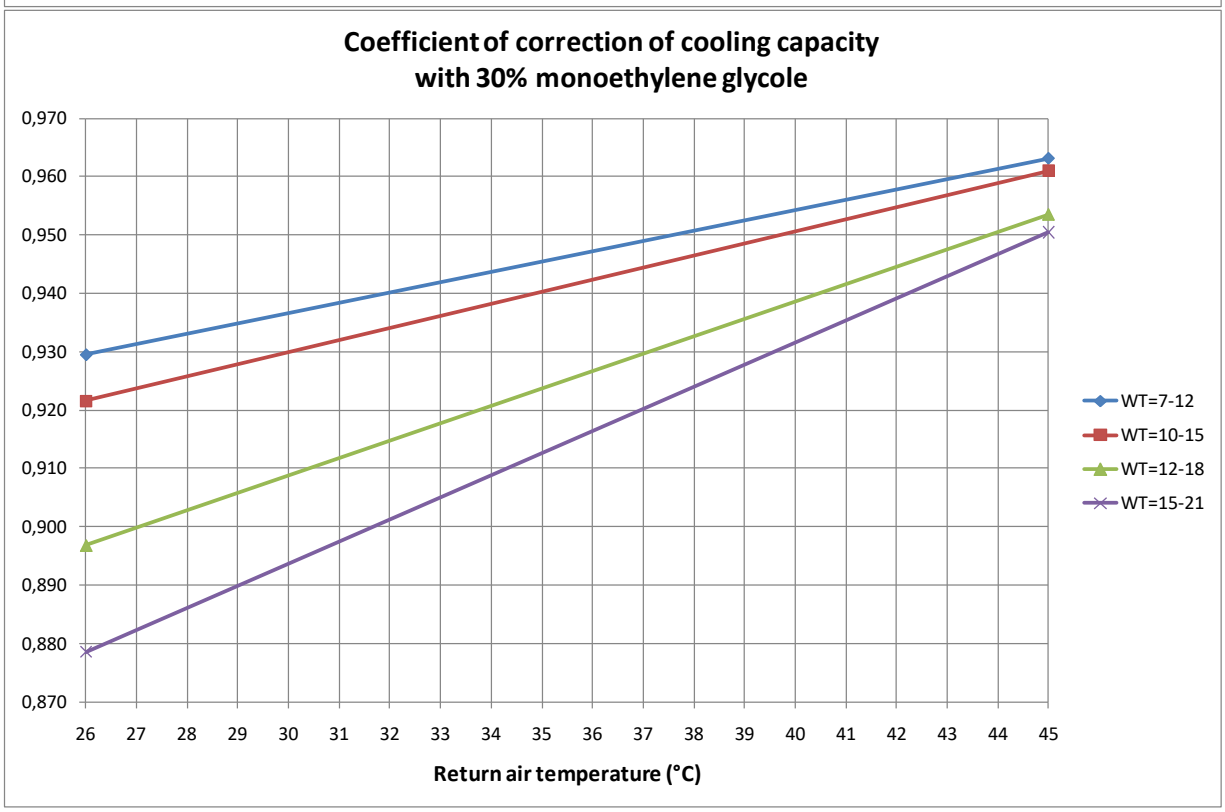

RAWB2 closed loop: water flow
Water flow (l/h)
6000
5000
4000
3000
2000
1000
0
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21

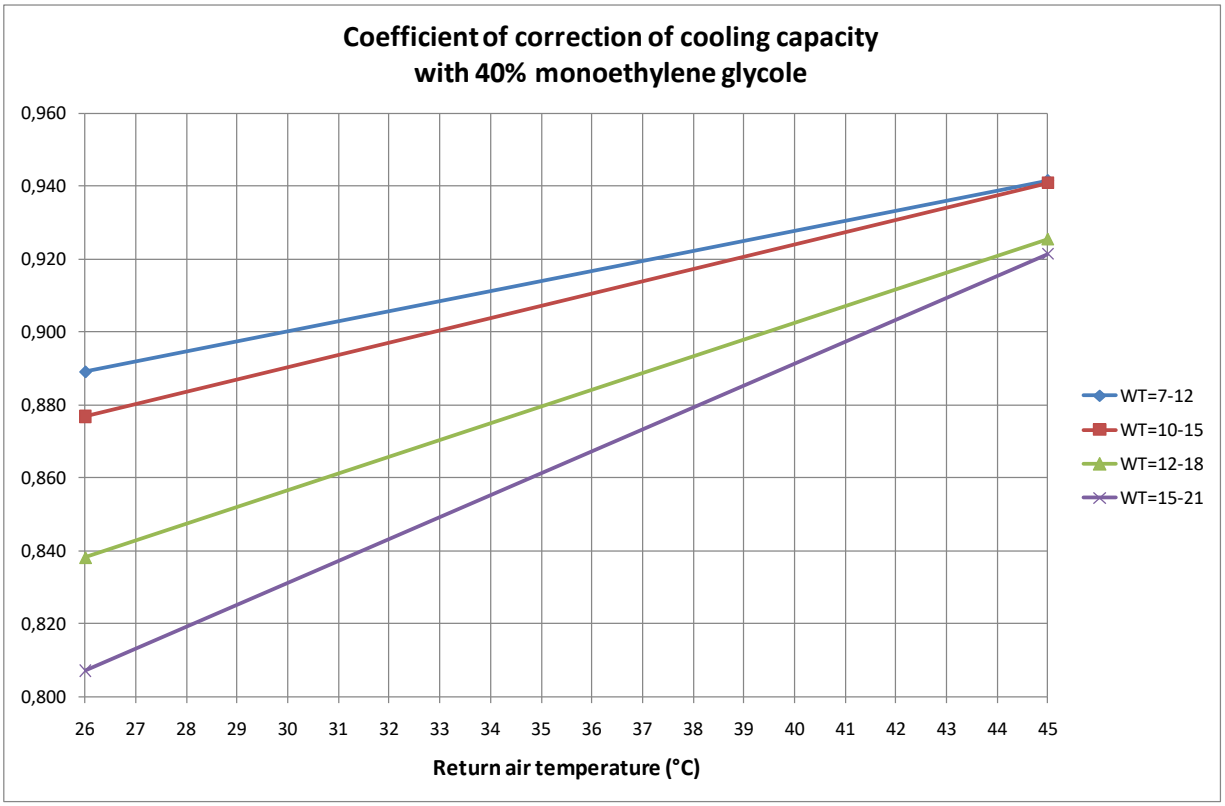

RAWC4 closed loop: cooling capacity
Cooling capacity (kW)
40,0
35,0
30,0
25,0
20,0
15,0
10,0
5,0
0,0
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21


RAWC4 closed loop: water flow
Water flow (l/h)
7000
6000
5000
4000
3000
2000
1000
0
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21


Water pressure loss (kPa)
250
200
150
100
50
0
Water pressure loss (kPa)
0
1000
2000
3000
4000
5000
6000
7000
Water flow (l/h)
RAW A1/A7 - RAW A6/B2
RAW B1 - RAW C4


Coefficient of correction of cooling capacity
with 20% monoethylene glycole
0,990
0,985
0,980
0,975
0,970
0,965
0,960
0,955
0,950
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21


Coefficient of correction of cooling capacity
with 30% monoethylene glycole
0,970
0,960
0,950
0,940
0,930
0,920
0,910
0,900
0,890
0,880
0,870
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21


Coefficient of correction of cooling capacity
with 40% monoethylene glycole
0,960
0,940
0,920
0,900
0,880
0,860
0,840
0,820
0,800
26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45
Return air temperature (°C)
WT=7-12
WT=10-15
WT=12-18
WT=15-21