EN
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ThermoKey®
Heat Exchange Solutions

Technical Manual TC

AFS
Adiabatic Air Fresh System

Technisches Handbuch TC

AFS
Adiabatik-Air-Fresh-System

Podręcznik Techniczny TC

AFS
Adiabatik-Air-Fresh-System

Manuel technique TC

AFS
Adiabatik-Air-Fresh-System

MT TC R AFS GEN 03 2018

THE ORIGINAL VERSION OF THESE INSTRUCTIONS IS IN ITALIAN

LANGUAGES SUMMARY

EN

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CAREFULLY READ AND ENSURE YOU HAVE FULLY UNDERSTOOD ALL OF THE INFORMATION CONTAINED IN THIS MANUAL PRIOR TO THE DESIGN, AND IN ANY CASE PRIOR TO CARRYING OUT ANY OPERATIONS OF HANDLING, UNPACKING, MOUNTING, POSITIONING, AND COMMISSIONING OF THE MODULE. THE MANUFACTURER ACCEPTS NO RESPONSIBILITY FOR DAMAGE TO PERSONS OR PROPERTY RESULTING FROM THE FAILURE TO FOLLOW THE INSTRUCTIONS CONTAINED HEREIN.

*The original version of this manual is in **Italian**, and it is available on the website:*
***www.thermokey.com**.*
*The **English** translation is a true copy of the original document and it is available on the website:*
***www.thermokey.com**.*

Translations in other languages may contain errors; if in any doubt, always refer to the original version in Italian or to its translation in English.

ThermoKey S.p.A. Quality Management System is certified in conformity with ISO 9001, ThermoKey S.p.A. Environmental Management System is certified in conformity with ISO 14001 and Safe Management System is certified in conformity with OHSAS 18001.

INDEX

TC 1. Regulatory references

The product described in this manual is compliant with:

MACHINERY DIRECTIVE 2006/42/EC

LOW VOLTAGE DIRECTIVE 2014/35/EU

ELECTROMAGNETIC COMPATIBILITY DIRECTIVE 2014/30/EU

PED DIRECTIVE 2014/68/EU

ERP DIRECTIVE 2009/125/EC

TC 2. Instruction

TC 2.1
Contents of the Technical Manual of the Product:

GENERAL INSTRUCTIONS FOR SAFE USE (I.G.)
INSTRUCTIONS FOR HANDLING AND UNPACKING (I.M.)
INSTRUCTIONS AND TECHNICAL DATA (T.C.)
SPECIFIC INSTRUCTIONS FOR USE AND MAINTENANCE (I.S.)

TC 2.2
This manual constitutes the TC section, denominated as INSTRUCTIONS AND TECHNICAL DATA, of the Technical Manual of the product.
For any information not covered in this manual refer to the other sections (IG-IM-IS), and if in doubt contact the Manufacturer.

TC 2.3
This manual is an integral part of models equipped with the AFS Air Fresh System, and as such must be retained throughout the operational life of the product.

TC 2.4
Any additional technical documentation relating to non-standard products is attached to this manual, becoming an integral part of it, and is identified with a specific code indicated on the shipping documents.

TC 2.5
The product described in this manual is considered a partly completed machine. It is therefore not usable as supplied but as a component for air conditioning and refrigeration systems, and must be installed and commissioned only by qualified operators (see chapter on installation and commissioning).

TC 2.6
Every component is CE marked, where required by the relative legislation.

TC 2.7
Further documentation relating to the product, consisting of catalogues, guide, and technical bulletins, is provided directly by ThermoKey, available on the website *www.thermokey.com*.

CATALOGUES – *http://www.thermokey.com/Cataloghi.aspx*
MANUALS – *http://www.thermokey.com/Manuali.aspx*

TC 3. Preliminary Remarks

ThermoKey equipment needs to be properly installed, operated and maintained.
Documentation of the equipment used, including drawing, technical data sheet and the present manual should be kept on record: ThermoKey strongly recommends to study this manual carefully and, importantly, to make it available for the personnel who installs, operates and maintains the equipment.
In order to achieve a long, trouble-free and safe operation, it is necessary to establish an operating plan including a schedule of regular inspection, monitoring and maintenance. All inspections, maintenance and monitoring actions should be recorded in a cooling system logbook. Operating and maintenance instructions published here can be used as a guide to achieve these goals.
In the unlikely case that you may have some problem not contemplated in this manual or that some information is not completely clear, don't hesitate to contact ThermoKey. Please make sure in advance, that you have checked the Installation and Maintenance Manual of the remote air-cooled unit.

ThermoKey will not be in any way responsible and the product warranty will no longer be valid if these instructions are not observed or the units are not used correctly.

TC 3.1 AUTHORIZED PERSONNEL

Operation, maintenance and repair of this equipment should be undertaken only by authorized and qualified personnel. All such personnel should be thoroughly familiar with the equipment, associated systems and controls and the procedures set herein and in other relevant manuals. Proper care, procedures and tools must be used in handling, lifting, installing, operating and repairing of this equipment to prevent personal injury and/or property damage.

TC 3.2 MECHANICAL SAFETY

- Mechanical safety of the equipment is in accordance with the requirements of the EU machinery directive.
- Do not walk or place heavy objects on the ramps, racks, pipelines.
- Also, please read the Installation and Maintenance Manual of the remote air-cooled unit on which the adiabatic system is installed.

TC 3.3 ELECTRICAL SAFETY

- No service work should be performed on or near the fans, unless motors are electrically isolated.
- Before proceeding with electrical maintenance on a fan, make sure that repair switch is open and padlocked.
- Before proceeding with electrical wiring, make sure that power line circuit is open and Box main switch is open and padlocked.

TC 3.4 LOCAL REGULATIONS

- Installation and operation of cooling equipment may be subject to local regulations, such as establishment of risk analysis. Ensure that regulatory requirements are consistently met.

TC 3.5 NOTES

- The manufacturer reserves the right to make any modifications it deems necessary to the manual at any time.
- The total or partial reproduction of this manual is strictly prohibited without the manufacturer's written authorization.
- For the Conditions of Guarantee, refer to the conditions specified in the order confirmation. Any kind of intervention must be agreed in advance with ThermoKey Spa. Failure to do so will render the Conditions of Guarantee null and void.

- For any other information please examine the Installation and Maintenance Manual of the remote air-cooled unit on which the adiabatic system is installed.
- ThermoKey is not responsible for any actions caused by incorrect adopting of manual's instructions, that could induce to physical harm or damage to a person.

TC 3.6 ANTI LEGIONELLA CERTIFICATE

- TÜV Sud Laboratory certifies that AFS carries no danger in correlation with the risk of leggionnaires disease.

TÜV SÜD Industrie Service GmbH · Ridlerstrasse 65 · 80339 Munich · Germany

TÜV SÜD Industrie Service

Choose certainty. Add value.

Statement for the "AFS" Air Fresh System, Thermokey adiabatic system, in correlation with legionella bacterium growth

Basis and requirement
The company Thermokey has developed a system on "V-Dry coolers" and/or "V-Condensers" to work with an adiabatic system.

"AFS" description from Thermokey: "The method employed makes use of adiabatic cooling with low water consumption by means of special nozzles developed to work with very high water pressures. The physical phenomena of the adiabatic cooling consist in creating an even diffusion of micro drops of water (Misting effect) through which is passing a current of air that will be cooled by the evaporation of the water."

For description and use of Thermokey´s Air Fresh System, refer to "AFS Instruction Manual".

Based on this information a statement for the hazard of legionnaires disease should be provided.

Evaluation
Water side:
The quality of the water supplied to the adiabatic system is tap water (according drinking water regulation). The special nozzles in the "AFS" combined with the high pressure of the water produce micro drops that are completely evaporated by the flow of air without leaving residues of water on the heat exchanger coils; no water is present in equipment and above all on the discharge of the fans or on the ground.
Water is present in the water distribution nozzles only during the operation of the "AFS", the water distribution nozzles are emptied each time the "AFS" is not in use.
Taking this into account, there could be no legionella bacterium growth.

Air side:
The air inlet from the unit is going back to the ambient and is not used anyway for supplying air. Therefore no risk can be seen during operation.

Date: 14.05.2009

Our reference:
IS-TAK2-MUC/ps

Document:
AFS Thermokey 090514.doc

This document consists of
1 Page
Page 1 of 1

Conclusion
With this "AFS" there is no standing water during continuous operation. Working according to the instruction manual we can state that Thermokey "Air Fresh System" carries no danger in correlation with the risk of legionnaires` disease.

Refrigeration

i.A. Peter Schnepf

i.A. Peter Schnepf

Expert for water chemistry

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TC 4. Transport and Storage

The Kit of the adiabatic system is delivered mounted for all adiabatic models.
If the equipment has to be stored before its installation (for one or more months) it is convenient to take the following precautions:

- Leave the equipment in its packing.
- Store it indoors, in a room at adequate conditions: temperature (15 to 25 º C), humidity (50 to 70 %) and environment without corrosive liquids or vapors.

- *The condition of the unit should be verified at the moment of reception, please check for shock marks or cracks, which could cause damage to the equipment.*
- *In case of damage during transportation, the transportation company should be informed immediately, in written form on the Document of Delivery.*
- *If the receiver accepts the goods (stamps and signs the document) without any note of non-conformity, the forwarder is not responsible for missing packages or damaged goods.*
- *We strongly recommend the customer to evidence damaged or missing goods on the full set of this document at the arrival of the goods.*
- *With a copy of it by e-mail, we can speed up corrective actions towards the forwarder and ask for insurance reimbursement.*
- *ThermoKey should be informed regarding the damage on the equipment.*
- *The Client should complete a written report including photographs concerning each relevant damage.*

TC 5. Layout

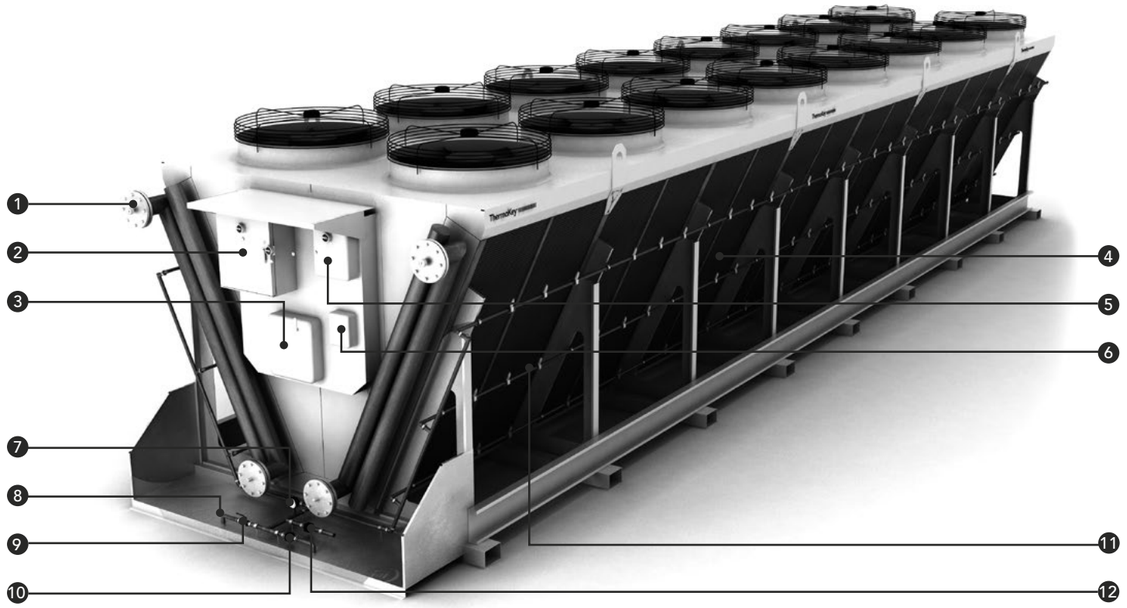
Follow the instructions of unit installation manual and keep in consideration that not all the water sprayed will evaporate; therefore any surplus water must be drained or recovered.
If ThermoKey doesn't provide a drain pan please make sure that the layout could change depending on customer installation.

- Leave the space to connect the kit to the main pipeline.
- Do not install the kit where there is wind.
- Provide sufficient space between unit installed side by side to not compromise spray effect.
- Provide sufficient space around the unit to permit normal operation of maintanance.

TC 5.1 NOTES

- *Only for adiabatic system with pump pressure: In case of equipment with low sound level (<45 dB(A) at a distance of 10 meters in free field), it will be necessary to install the pump in a technical room to guarantee the sound performance of the equipment. If the pump is supplied separately, it is necessary to observe the diameters of the IN/OUT connections of the drawing. For the supply of the high pressure pump ANNOVI, a flexible hose suitable for pressures of 20 bar must be used*
- *For any other information (e.g. working at heights) please examine the Installation and Maintenance Manual of the remote air-cooled unit on which the adiabatic system is installed.*

TC 6. AFS system



1. **Detection Probe**
2. **Power panel + fan speed control system** (see control brochure)
3. **Fan speed control system** (see control brochure)
4. **Finned pack with idrophobic fins**
5. **Afs main panel** (see Afs control brochure)
6. **Afs card system** (see Afs control brochure)
7. **Manometer**
8. **Low pressure water pump** (OPTIONALLY)
9. **Manual valve for emergency and maintanace** (M)
10. **Solenoid valve to control water spray discharge** (MV5)
11. **Copper tubes 22mm + Nozzles set** (BRASS)
12. **Solenoid valve to control water spray charge** (MV4)

TC 7. Configurations

JUMBO "N" SERIES (MODULE 1250MM) [JW/JG/JKX2XXN EX JGH2810CN]

- Water enters through a 1/2" male brass pipe union (in absence of pump).
- The number of nozzles for standard units is 3 for the coil module for each rack.
- The number of nozzle ramp for each coil is 3 for all configurations.
- The nozzles are made in brass (U01-02-03-04-06-07 type) and oriented in against airflow direction.

JUMBO "Z" SERIES (MODULE 2000MM) [JW/JG/JKX2XXZ EX JGH2510CZ]

- Water enters through a 1/2" male brass pipe union (in absence of pump).
- The number of nozzles for standard units is 5 for the coil module for each rack.
- The Number of nozzle ramp for each coil is 3 for all configurations.
- The nozzles are made in brass (U01-02-03-04-06-07 type) and oriented in against airflow direction.

SUPERJUMBO (MODULE 1200MM) [SJW/JG/JKX2XX EX SJGH2890C]

- Water enters through a 1/2" male brass pipe union (in absence of pump).
- The number of nozzles for standard units is 3 for the coil module for each rack.
- The number of nozzle ramp for each coil is 3 for all configurations.
- The nozzles are made in brass (U01-02-03-04-06-07 type) and oriented in against airflow direction.

MINIJUMBO "N" SERIES (MODULE 1400MM) [JW/JG/JKX1XXN EX JGH1710CN]

- Water enters through a 1/2" male brass pipe union (in absence of pump).
- The number of nozzles for standard units is 3 for the coil module for each rack.
- The number of nozzle ramp for each coil is 2 for all configurations.
- The nozzles are made in brass (U01-02-03-04-06-07 type) and oriented in against airflow direction.

MINIJUMBO "Z" SERIES (MODULE 2100MM) [JW/JG/JKX1XXZ EX JGH1510CZ]

- Water enters through a 1/2" male brass pipe union (in absence of pump).
- The number of nozzles for standard units is 5 for the coil module for each rack.
- The number of nozzle ramp for each coil is 2 for all configurations.
- The nozzles are made in brass (U01-02-03-04-06-07 type) and oriented in against airflow direction.

NOTES

- Configuration of unit with spray system can change from standard: please take into consideration adiabatic configuration of approval drawing of unit.
- The unit is supplied complete with all its parts mounted: should the upper ramps result turned downwards (or demounted) it is for the scope of meeting the maximum acceptable dimensions of the unit for transportation.
- If required, the customer can rotate the entire ramp since they are connected by joints that enable this rotation: ThermoKey can answer on matters of nebulization efficiency of the adiabatic system only when in standard configuration (with nozzle defined by ThermoKey and with installation defined by ThermoKey).

TC 8. Materials

Most sensitive part concerning the promotion of microbiological growth is the coated heat exchanger. Causal for possible proliferation is:

- For some species the polymer coating can be a possible food source.
- The heat exchanger is wet nearly complete with spray water.
- While passing the heat exchanger, the water is warmed up.
- Dirt from the air intake can be caught in the fins of the heat exchanger and is also a possible food source.
- Due to uncorrected make up of the spray water deposition of lime (scaling) can occur.

Therefore the following actions on the heat exchanger must be done and documented regularly:

Position	Inspection for	Frequency	Action to be done by indication
1	Microbiological growth	Monthly	Mechanical cleaning* and disinfection**
2	Dirt from air intake	Monthly	monthly Mechanical cleaning*
3	Scaling	Monthly	Mechanical cleaning* and control of the spray water quality
4	Spray nozzles	Monthly	Mechanical cleaning or exchange
5	Damage	Half a year	Reparation in accordance with ThermoKey
6	Corrosion	Monthly	Reparation in accordance with ThermoKey

* Methods for mechanical cleaning:

- Soft brush.
- Compressed air, maximum pressure: 2 bar.
- Water, maximum pressure: 2 bar.

To prevent a deformation of the fins, the air and water jet must be directed vertical those, at a minimum distance of 200 mm.

** Disinfection agents: Bacillol AF.

TC 9. Water Quality

- The “Air fresh System” is designed for a maximum annual utilization period of 500 hours
- The spray water must comply with the requirements of Council Directive 98/83/EC on the quality of water for human consumption.

Furthermore, the following limits are defined:

Position	Parameter	Unit	Limits
1	El. conductivity	µS/cm	< 500
2	pH -value		6,5 – 8,2
3	Total hardness	°dH	3,5 – 4,0
4	Chloride	mg/l	< 50
5	Sulfate	mg/l	< 90
6	Nitrate	mg/l	< 50
7	Iron dissolved	mg/l	< 0,1
8	Silicon	mg/l	< 20
9	Colony forming units	KBE/ml (22°/37°C)	< 100/ml
10	Legionella	CFU/ 100 ml	< 100
11	SAC 254 (spectral absorption coefficient)*	m^{-1}	< 20
12	Water pressure	bar	10 - 16

* Mandatory when using a UV lamp

TC 9.1 MICROBIOLOGICAL CONTROL OF THE SPRAY WATER

To control the microbiological proliferation of the intake spray water, an UV lamp can be installed into the feed water line. Therefor the spray water must have a SAC 254 (spectral absorption coefficient) of < 20 m-1 and the lamp must have a radiation power of ≥ 400 J/m2.

Monitoring the quality of the spray water:

- ***The quality of the spray water must be controlled online by an electrical conductivity probe.***
- ***The AFS system is delivered without such a system. Please contact your water treatment company to install one.***

TC 9.2 MAINTENANCE

- It should be ensured by installer that the chemicals added in order to respond to these parameters, do not cause any stress corrosion on the materials used in the unit or indeed damage them.
- The water values must be tested during the commissioning procedure by a testing institute and thereafter every six months. The results must be documented and recorded.
- If the water values change, the appropriate countermeasures must be taken without delay and spraying is prohibited in this case.
- If the notification times are not observed, ThermoKey is entitled to refuse to carry out work under the warranty.
- For any other information please examine the Installation and Maintenance Manual of the remote air-cooled unit on which the adiabatic system is installed and Adiabatic Manual.

TC 9.3 NOTES

Hardness conversion

- 1 °dH=10 mg/l calcium oxide (CaO), is dissolved in 1 liter of water.
- German Degrees (°dH) =1,78 X French Degree (°F)=1,24 X English Degree (°E).

Electrical Conductivity

- The treated water must be balanced: to prevent spontaneous corrosion and/or fouling the Langelier Saturation Index (LSI) and Ryznar Stability Index (RI) should be in the following range: -1<=LSI<=+ 1 ; 5.5<=RI<=6.6.

The cooling water must be in any case conditioned by the addition of suitable inhibitors of corrosion/fouling. With appropriate conditioning is possible that they are acceptable even waters with characteristics that do not meet the ideal characteristics indicated above.

TC 10. Maintenance

TC 10.1 NOZZLE MAINTENANCE

Lifetime of materials and efficiency of working can only be guaranteed, if the sprayer is inspected on a regular basis (recommended 5hours after the first use and then every 100 hours).

Common factors of spray nozzles problems:

- **Erosion/wear:** gradual removal of metal causes the nozzle orifice and internal flow passages to enlarge and/or become distorted. As a result, flow is usually increased, pressure may decrease, the spray pattern becomes irregular, and drops become larger.
- **Clogging:** unwanted dirt or other contaminants can block the inside of the orifice. Flow is restricted and spray pattern uniformity disturbed.
- **Caking:** over spraying, misting, or chemical buildup of material on the inside or outer edges of the orifice from evaporation of liquid can leave a layer of dried solids and obstruct the orifice or internal flow passages.
- **Temperature damage:** heat may have an adverse effect on nozzle materials not intended for high-temperature applications.
- **Improper reassembly:** misaligned gaskets or other re-positioning problems can result in leakage as well as poor spray performance.
- **Accidental damage:** scratching through the use of improper tools during installation or cleaning can cause inadvertent harm to an orifice.

Axial-flow hollow cone nozzles

Tangential-flow hollow cone nozzles

A person (or persons) in charge appointed by the user must familiarize with user's installation and the operating personnel with the way in which the nozzle in question functions and should be handled.
The following must be carried out every time before a nozzle is used:

- Check that the connections are secure and not leaking.
- Function test (according to common possible problems)
- Check the effectiveness of general occupational safety measures, bearing in mind the applicable regulations, particularly in the case of applications that create a potentially hazardous or explosive atmosphere.

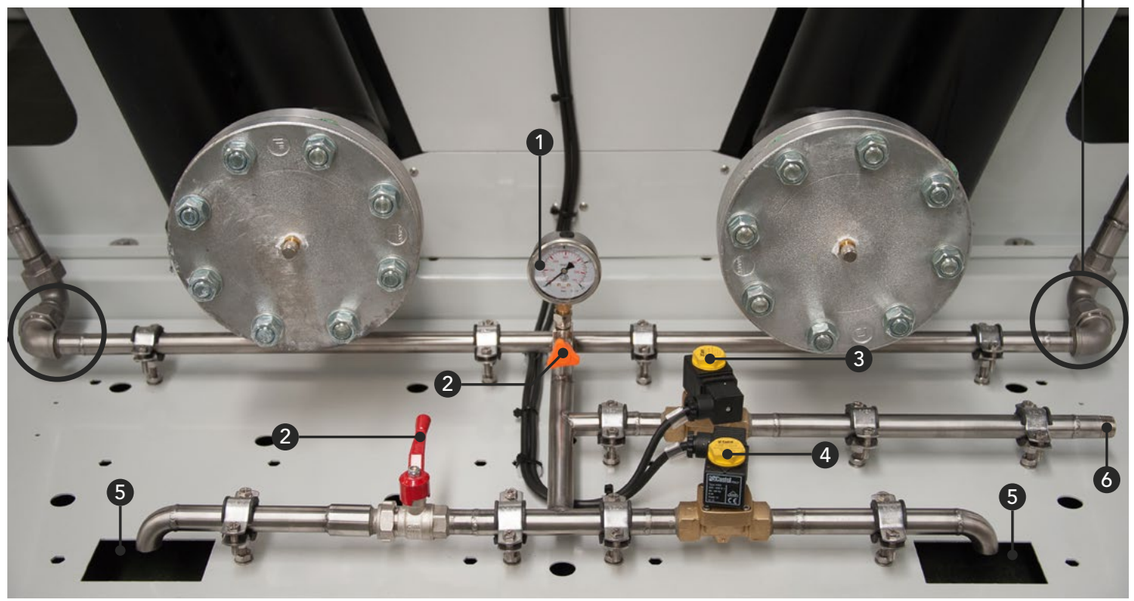
TC 10.2 PIPE MAINTENANCE

Verify that the spray's pipes are not occluded, it can happen if the quality of water is not as requested before (suggested 10 hours after the first use and then every 200 hours)

- During the peaks of air temperatures or when it is necessary, spray nozzles are working when MV4 is opened, MV5 is closed and manual valve is closed (optionally pump active).
- Every time the Adiabatic system is switched off (MV4 closed // MV5 opened) thanks to the automatic opening of the optional NA valves.
- During the autumn and/or winter period when the equipment is not operating, in order to avoid the formation of ice, the connection from the water system to the pump (or plant inlet) must be emptied and the power supply panel must be deactivated. For this period only, we advise you to also keep the manual drain valve open.
- When Adiabatic function is restored, it is important to check the water supply of the pump, the water pressure (>2 bar), the activation of the power supply panel and the switching of the solenoids. It is advisable to have a flow switch installed on the water supply pipe, which will be at the user's expense.

To avoid the risk of ice formation during periods when the ambient temperature is <5 °C, the racks must be emptied.

All screws must be tightened during commissioning (also the unmarked/unvisible).



1. **Manometer**
2. **Manual block valve**
3. **MV4**
4. **MV5**
5. **Drain (½")**
6. **Spray water connection (½" male screw - 3/4" ON SPECIAL PROJECTS)**

TC 10.3 CLEANLINESS OF COIL

Periodically, the batteries must be inspected and cleaned to avoid fouling with scale. According to the water specifications there must not be any deposits of salts or limescale on the coil surface; in the case that they are present, it is necessary to check the water treatment system, which is probably not operating correctly. In any case we recommend an inspection of the coils at least twice during each season of water spray operating.

Please examine the instruction manual of unit in order to follow the correct procedure to clean the coil.

TC 10.4 OPERATING PROBLEMS

PROBLEM *Water is not reaching the nozzles*

SOLUTION Ensure that the inlet valve is fully opened
Ensure that the pressure and flow rate values are correct

PROBLEM *The water reaching the nozzles is not sufficient*

SOLUTION Ensure that the inlet valve is fully opened
Ensure that the pressure and flow rate values are correct

PROBLEM *Some areas of the finned pack are not being sufficiently covered by the spray jet*

SOLUTION Ensure that the pressure and flow rate values are correct
Check for the presence of foreign bodies inside the nozzles and clean them
Check if nozzles are right oriented in air direction

PROBLEM *Excessive accumulation of water inside the remote unit*

SOLUTION Check that the torque of all screws of pipe
Check for the presence of foreign bodies inside the nozzles and clean them
Ensure that the pressure and flow rate values are correct

TC 11. Spare Parts

NOZZLES (U01) - M250502
- Axial flow hollow cone+2 gaskets +Baionet collar+2 inox screws
- Materials:Brass material
- RAFUGC
- 3,78 l\h @15bar

NOZZLES (U02) - M250504
- Axial flow hollow cone+2 gaskets +Baionet collar+2 inox screws
- Materials:Brass material
- RAFUGC2T
- 6,25 l\h @15bar

NOZZLES (U06) - M250514
- Axial flow hollow cone+2 gaskets +Baionet collar+2 inox screws
- Materials:Brass material
- RAFUGC4T
- 13,24 l\h @15bar

NOZZLES (U07) - M250515
- Axial flow hollow cone+2 gaskets +Baionet collar+2 inox screws
- Materials:Brass material
- RAFUGC5T
- 22,30 l\h @15bar

MANOMETER - M990601
- Manometer D.63 0-40 BAR 1/4”

MAGNETIC ELECTRO-VALVES (MV4=MV5) - M1906142
- Type 1132/04A6 + 9 - 150/R02(HM2) : 1/2” Female Gas Inlets
- 220V/230V -50/60HZ-A.C.-IP65
- NC = when the coil is de-energised the plunge stops the refrigerant flow

INLET 1/2” MAGNETIC ELECTRO-VALVES (MV4=MV5) - M1906386
- Type 1132/04S + 9 - 150/R02(HM2): 1/2” Female Gas Inlets
- 24V -50/60HZ-A.C.-IP65
- NC = when the coil is de-energised the plunge stops the refrigerant flow

Magnetic electro-valve

Manometer

Magnetic electro-valve

TC 12. Commissioning and Inspection

TC 12.1 COMMISSIONING

To be done	Component/parameters
Check for residual	▪ Pipes ▪ Valves ▪ Probes ▪ Nozzles
Check spray water quality	Current chemical and microbiological analysis of the spray water in accordance with the specification
Unit for makeup of spray water and online control	Unit installed and ready for operation
Check AFS	▪ The Air fresh system is installed properly ▪ The Air fresh system is operating properly ▪ The Pump in technical room
Documentation	Documentation complete and handed over to the operator
Instruction	The operator is instructed

TC 12.2 INSPECTION

Action to be done and documented regularly, besides those listed in materials for the heat exchanger:

Position	Component/parameters	Frequency	Action to be done by indication
1	Unit for makeup of spray water and online control	Yearly	Inspection of functioning and damages
2	Spray water	Quarterly	Chemical and microbiological analysis
3	Probes	Yearly	Inspection of functioning, residues and damages
4	UV Lamp	Yearly	Inspection of functioning, residues and damages
5	Spray nozzles	Monthly	Check spray
6	Complete unit	Monthly	Check for damage, leakage and residues