USE AND MAINTENANCE MANUAL

RAP

AXIAL FORCED EVAPORATIVE COOLER

IMM - RAP - ENG - Rev. 000 Ed.01

INDEX

1. GENERAL SAFETY USE AND MACHINERY DESCRCIPTION

1.1 Safety use

These instructions must be followed to ensure the safety, proper installation, operation and maintenance of the machine. All personnel involved in the installation, operation and maintenance of the machine or associated equipment must be made aware of these instructions.
The machine must be installed and used by qualified personnel who are familiar with the safety requirements of the national regulations in force in the country of installation, including EN 60204-1 and Directive 2006/42/EC.
The safety equipment required to prevent accidents during installation and maintenance during operation, must comply with the national regulations in force in the country of installation. In case of conflict with any of the rules described below, please contact our technical department for alternative procedures in order to avoid conflicts. Always remember that any operation with mechanical machinery could be dangerous so be sure to follow all possible precautions before and during installation and maintenance.

SAFETY FIRST!

WARNING: Ignoring these instructions may invalidate all applicable warranties. W-tech is not responsible for any damage to things and people due to the lack of the precautions here described.

1.2 General description

The evaporative cooler of the RAP series uses a heat dissipation principle that allows, with a minimum water consumption, to cool the primary fluid in industrial refrigeration systems. Evaporative coolers are the ideal solution to dissipate large thermal powers. It is estimated, that the consumption of water with this machine, is reduced by about 95% compared to a normal process with disposable water, increasing considerably the economic savings and environmental impact.
These are machines that work in counter-current with an induced air flow, in which the fluid to be cooled (primary fluid) circulates in a closed circuit (coil)). The coil, which constitutes the primary circuit, is continuously externally sprayed with water pumped into an open circuit (secondary circuit) from the collection tank in the basin. The evaporation of part of the water removes a large amount of heat from the fluid in the primary circuit, the rest of the heat is removed by the high flow rate of air sucked into the unit, thanks to the use of axial fans installed in the upper section of the machine, through the grids located just above the level of the water collected in the basin.
The axial forced evaporative cooler is composed by the following elements:

- Casing and water collection basin;
- Ventilation system;
- Coil (primary circuit);
- Water recirculation and distribution pump (secondary circuit);
- Drift eliminator.

1.3 Basement and water collection basin

The axial forced evaporative cooler W-TECH are entirely made of Magnelis ZM310 (steel, zinc, aluminium, magnesium) sheet metal panels to guarantee maximum surface protection comparable to a galvanised sheet metal with over 1000 g/m2 of zinc. AISI 304 or 316 stainless steel (total or partial) are available on request.
The single panels, after the cutting and bending phase, are assembled with AISI 304 stainless steel small parts (316 on request) and highly adhesive butyl mastic gasket reinforced with polyester mesh inside to guarantee a great stability of shape and resistance to temperature variations. Further protection with suitable silicone guarantees the absence of possible water leaks.
The lower section of the unit is the cold water collection basin A minimum slope, on the bottom panels, is guaranteed in order to let water flow naturally out of it. On the water outlet connection, placed on one side of the basin, an anti-cavitation suction filter with stainless steel grid is installed to protect the recirculation pump which is installed outside the basin and to limit the intake of foreign bodies harmful to the impeller of the pump itself.
In the water basin, the following standard connections are provided:

- Water make up with mechanical or electronic (optional) float valve;
- Overflow;
- Drainage.

Other connections could be provided in accordance to the additional option element are possible to fit. For example:

- Increased Outflow On the Bottom, which replaces the normal water outlet pipe for installation on a remote concrete basin.
- Extra connections in the tank, for use the cold water for other purposes.

The complete list of optional can be consulted in the website www.w-tech.it.

1.4 Ventilation system

The air flow, which runs through the machine in counterflow to the water, is ensured by the axial fan installed in the lower part of the evaporative cooler (forced pre-draft).
The fan blades can be made of different materials (PPG, AL, PAG, etc.), the hub is made of die-cast aluminum and all is housed inside the diffuser, which can be produced in different materials such as Magnelis, hot-dip galvanized sheet metal or stainless steel 304 or 316. To protect the fan from any external object and to prevent accidental damage to the service personnel, a hot-dip galvanized steel protective mesh, or stainless steel on request, is attached to the outside of the diffuser.
On the outside of the diffuser, there is an arrow that indicates the correct direction of rotation and the safety indications in order to prevent risks associated with moving parts.
The motors, with mechanical protection IP 56 thermal insulation class F (able to withstand a maximum temperature of 155 ° C on the winding with external temperature is 40 ° C), continuous service S1 and form B3, are installed on solid supports made of galvanized steel sheet. In order to eliminate friction, wear or unnecessary maintenance (typical of indirect coupling) the coupling between the electric motor and the fan is direct.

1.5 Coil

In the middle section there is the thermal exchange between the refrigerant fluid, which circulates inside the coil, and the water coming from the basin below ,by a recirculation pump that externally floods the exchange coil through a system of spray nozzles of large diameter, made of special PVC that are interchangeable in case of maintenance. . Heat is dissipated through the walls of the coil and then delivered to the atmosphere via the airflow generated by the fan. The exchange coil is designed according to the 2014/68/UE Regulation and manufactured with carbon steel tubes of appropriate thickness following our design and then hot-dip galvanized (HDG) to ensure the necessary protection against external corrosion. During the processing of the coil, a pressure test is performed on every single coil to check for possible leaks. At the end of the production cycle, a further test is carried out with nitrogen under pressure according to the directive in force. It's possible to supply the exchange coil made of stainless steel (AISI 304L or 316L) on request ,moreover for special uses (like dry running) it is possible to request the coil equipped with fins (for half or the whole exchange surface). Before the installation on the machine, the coil(s) is (are) charged with nitrogen and left under pressure at a few bars even during shipment.

1.6 Water distribution system

The water is distributed on the coil through a self-priming pump that takes it from the collection basin and makes it flow through a system of secondary pipes, on which the spray nozzles are installed, up to the top of the evaporative cooler.
From there, it will wet the entire surface of the coil and then by gravity will return to the basin to circulate again. The cooling of this water is guaranteed by the air that circulates inside the cooler.
The nozzles are totally static, made of ABS, with wide span and minimal chance of breakage or clogging; their function is to realize a perfect distribution of the secondary fluid on the exchange coil in order to increase the thermal exchange. If, for any reason, they become clogged or damaged, they can be easily disassembled and then cleaned or replaced.In the heat exchange process a part of the water will be lost through evaporation and a small part through air flow dragging. This flow rate of water to be replenished is automatically regulated through a mechanical float valve installed inside the basin.

1.7 Drift eliminatiors

The drift eliminators allow to separate the evaporated process water droplets, dragged by the saturated air flow through the cooler. The panel drift eliminators are very performing both for the efficiency of separation both for the high mechanical resistance.
These components have different goals, despite having low pressure drops and minimal weights:

- reduce the effects of environmental impact (plume effect);
- facilitate the return of condensed water droplets to the basin, reducing water consumption;
- avoid bacterial proliferation and the dispersion of the process water in the surrounding area.

2. DELIVERY AND HANDLING

2.1 Delivery mode

All models of this series are supplied in two blocks. To facilitate handling, the single parts are arranged on a wooden beam.

Note: connection elements to be used on site (gaskets, silicone, nuts and bolts) are supplied in a separate box placed inside one of the sections or on separate pallets.

2.1.1 Lower section

This is composed of the following elements:

- Basin and recirculation pump;
- Inlet louvers.

2.1.2 Upper section

- Coil;
- Water distribution system, external and internal piping of the secondary circuit;
- Drift eliminators

The **lower section** is equipped with lifting hooks directly connected to the frame, fig. 1.
The **upper section** will be delivered with some drift eliminators not assembled (supplied with the basin) to allow its lifting by the eyebolts of the coils, placed at the 4 corners of the section, fig.2.

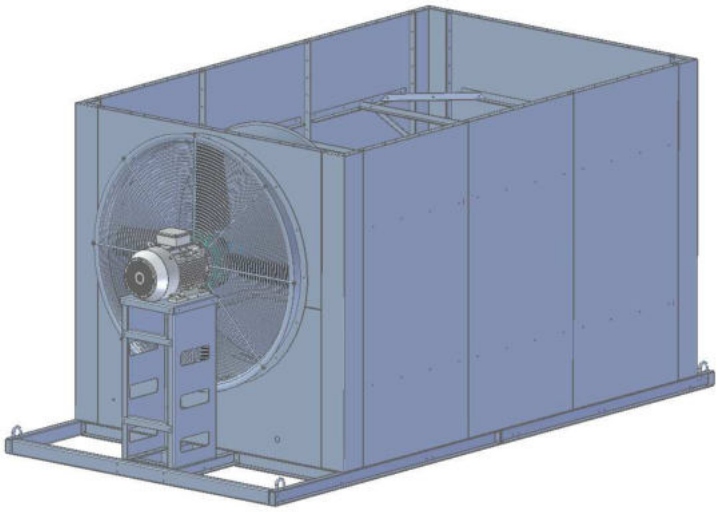


Fig. 1

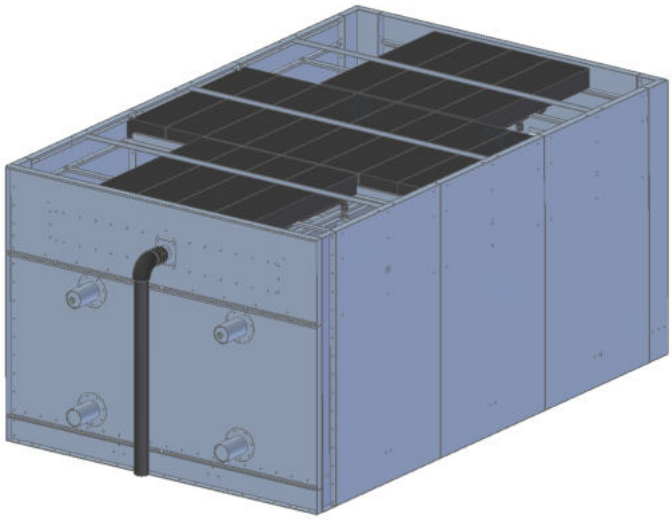


Fig. 2

WOODEN SUPPORTS, SHEETS AND CARDBOARD SHOULD BE REMOVED BEFORE INSTALLING THE MACHINE IN ITS FINAL LOCATION. BE CAREFUL TO CHECK THAT THE BASIN AND WATER DISTRIBUTION ARE FREE OF ANY FOREIGN OBJECTS THAT WOULD CAUSE PROBLEMS OR DAMAGES TO THE NORMAL FUNCTION OF THE EVAPORATIVE COOLER.

2.2 Handling

To facilitate the handling of each part, the sections are equipped with eyebolts so that this operation can be easily performed with the crane through the use of simple or cross barbell. See for example the figures below.

EYEBOLTS SHOULD BE USED ONLY TO TRANSPORT AND HANDLE THE UNIT TO WHICH THEY ARE ATTACHED. ALL EYEBOLTS MUST BE USED DURING THESE OPERATIONS. ALWAYS MAINTAIN A PULL ANGLE >60° BETWEEN THE CHAIN AND THE HORIZONTAL PLANE. THE LOAD MAY BE OFF-CENTER, SO USE ADJUSTABLE CHAINS.

Once the lower section has been installed, clean the supporting surface, the edges of the sheet metal, and then spread the butyl mastic supplied that will be punched where the holes on the edges are. Using all the eyebolts present in the coil section (fig. 4) and with straight or cross bar and adjustable chains, it will be possible to move and place the upper section At this point the coil section will be assembled to the basin and all bolts will be fixed to finally join the two sections.

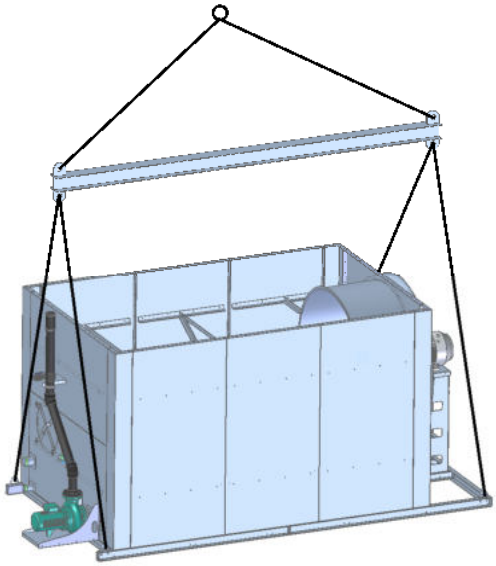


Fig. 3

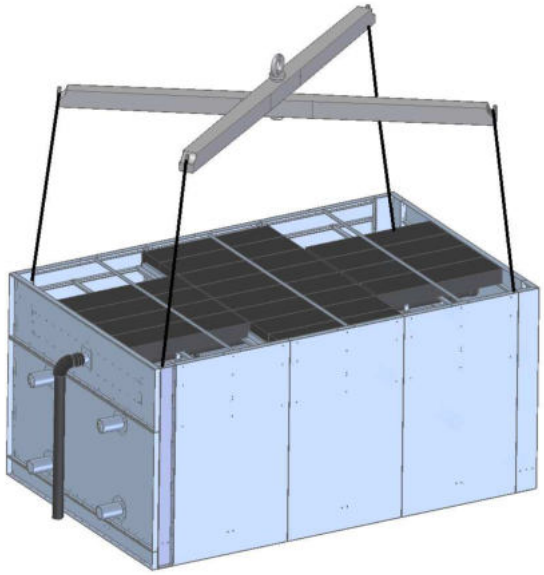


Fig. 4

The upper section can be placed on the coil section after having cleaned the support edges and positioned the butyl mastic, supplied, in the middle of the flap, once this part is coupled to the basin, it will be possible to position the drift eliminators, supplied separately, in their place.

2.3 Storage

During the storage phase of the units, before the installation, **do not cover the block with tarps or other coverings on top of the units,** as the excessive heat caused by a possible greenhouse effect could cause irreversible damage to the drift eliminators. If the installation time is longer than 3 months, check the condensate drainage and maintenance of the motor fan and pump, refer to the respective downloadable manuals on web site www.w-tech.it .

3. INSTALLATION

3.1 Machine support and anchorage

This machine must be placed on steel beams with "double T" section for the entire length of the basin or alternatively on reinforced concrete beams in order to keep the bottom of the unit ventilated, and avoid the formation of musk / mold. In both cases, it is recommended to prepare a rubber mat, suitable for this application, between the bottom of the unit and the base, in order to dampen the vibrations transmitted from the machine to the ground, ensure uniform support of the structure and reduce the risk of stray currents and galvanic currents.
It is recommended to anchor the base to the underlying structure before assembling the upper sections. The beams should be sized according to the structural calculation limiting bending to a minimum.
Some examples of anchorage can be seen in fig. 6, some bolts (screw + washers + nut) are needed to complete it.

Note:the surface must be perfectly level before installing the evaporative cooler. For no reason, the unit, should be leveled using wedges or other items ,placed between the beams and the basin, as this will not give adequate longitudinal support and the unit will be subject to bending/torsion loads.

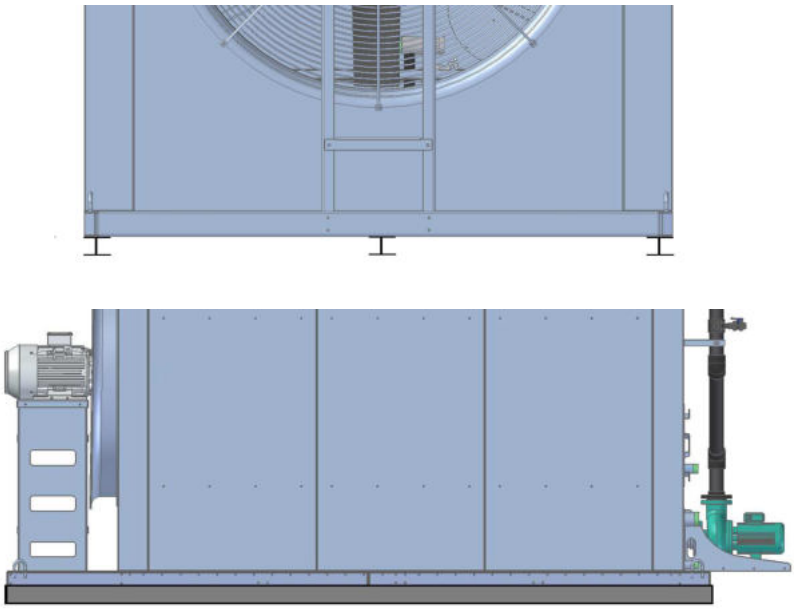


Fig.5

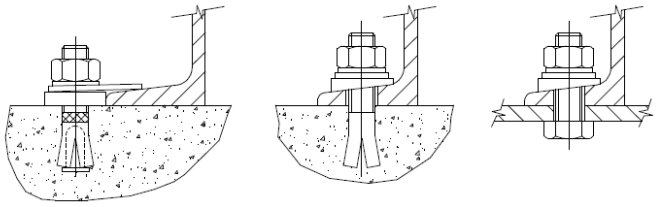


Fig. 6

3.2 Placement conditions

The unit must never be located in an area that is enclosed on all four sides. Sufficient space must be provided all around the cooler so that fresh air can enter through the intake section, and also allow access to all components requiring maintenance.

Any obstacles, walls/buildings/etc., wich goes beyond the height of the unit, must be avoided in order not to run into problems of recirculation of the expelled air, which is pushed by the wind and returns to the suction again.See fig 7a, 7b, 7c.

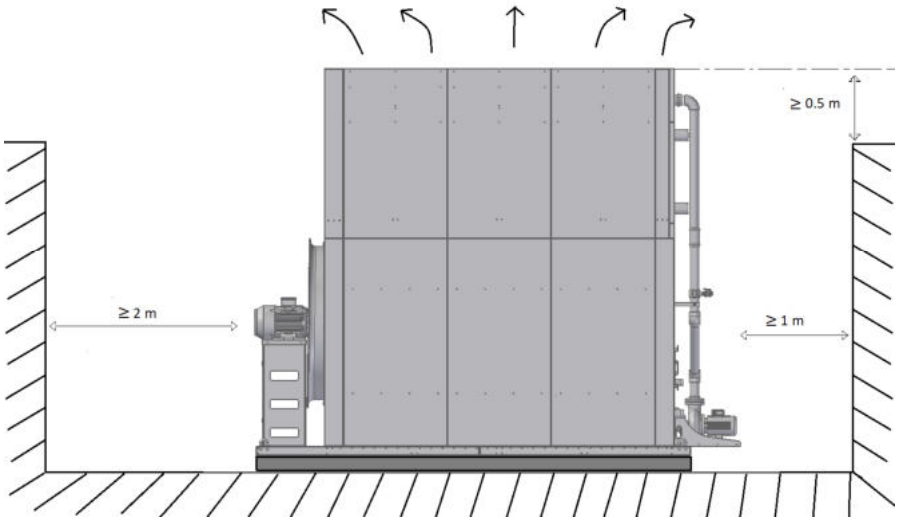


Fig. 7a

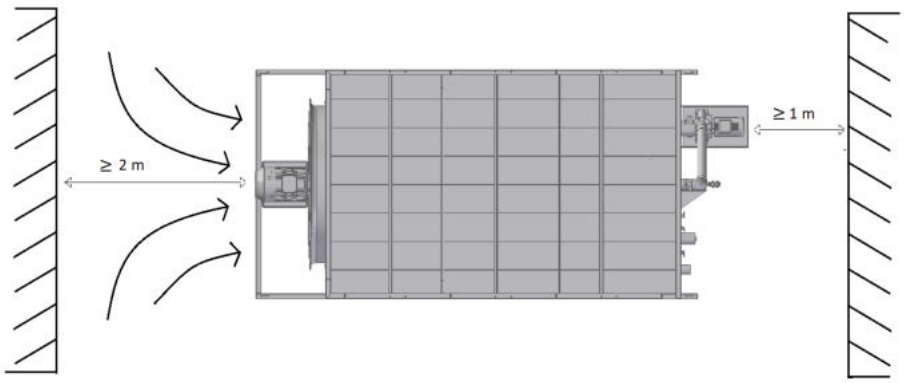


Fig. 7b

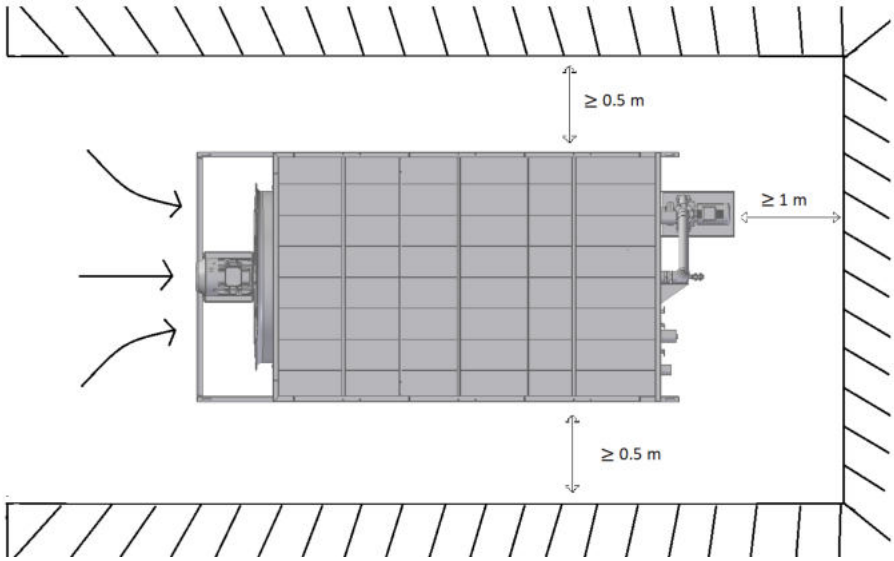


Fig. 7c

3.3 Sections assembly

Before installation, make sure that all items supplid with the basin have been removed. To access to the basin, remove the inspection hole, first making sure that both the pump and the fan motor cannot be electrically powered.

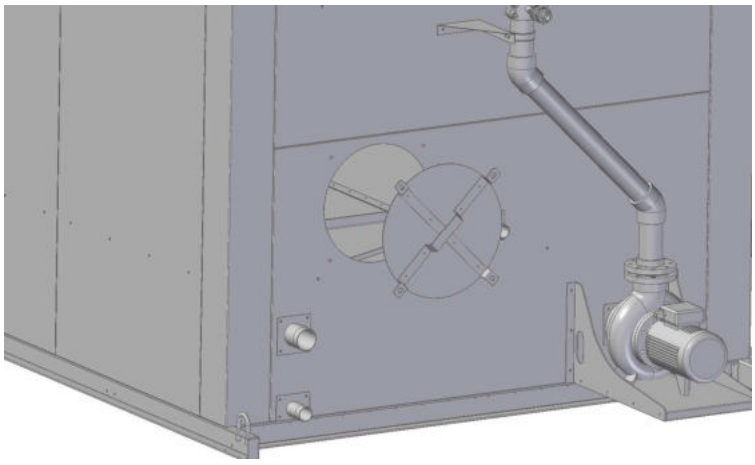


Fig.8

Once the lower section has been installed, the entire perimeter of the assembly flanges must be cleaned, as the mastic seal could be compromised.
Then, a butyl rubber sealing gasket (supplied) will be spread, in order to avoid humidity, dirt and water leaks, just in the middle of the flange where the coupling holes of the sections are located.
If the **panel of the unit has a flange without holes**, then a double line of overlapping gaskets will be installed, as shown in fig. 9, in order to increase the degree of protection from any possible water leaks.

Note: once the gasket has been installed, use a tip to pierce the sealer where the assembly holes are located and remove any traces of gaskets that may have remained there, then remove the protective paper placed on the gasket and proceed with the installation of the top section.

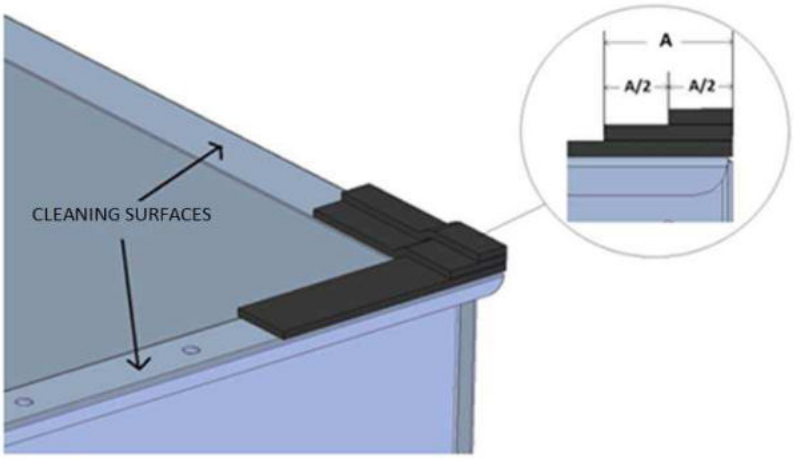


Fig. 9

Assembly can be facilitated by the use of iron tips, which will be inserted into the holes at the bottom of the section, just before placing the upper section on it, as in fig. 10.

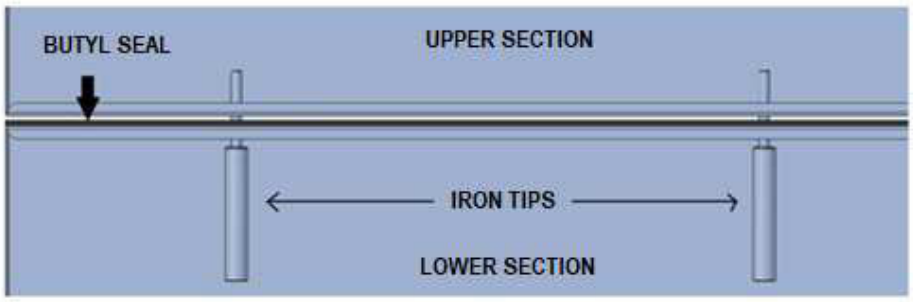


Fig. 10

Once the upper section has been perfectly positioned on the lower one, insert the supplied bolt into each hole, tightening the nut until the butyl seal reaches the outside of the support flange.

3.4 Installation of support and recirculation water distribution pump

In order to reduce the length of the unit and allow the transport of multiple parts and /or more units in reduced spaces, it's necessary to ship the basin section with the recirculation pump not installed, but delivered on pallets inside the basin with the distribution system also disassembled.
It is therefore necessary to reassemble the water distribution system before assembling the various sections. To do this, it is essential to access the basin and extract the pump unit components.
Apply the butyl mastic strips on the pump support and on the internal reinforcement to cover the holes for the fixing pins and use an awl to remove the mastic to free the holes, then place the pump support on the panel. (fig 11). To avoid the possibility of water leaks, fix the nuts inside the basin with silicone.

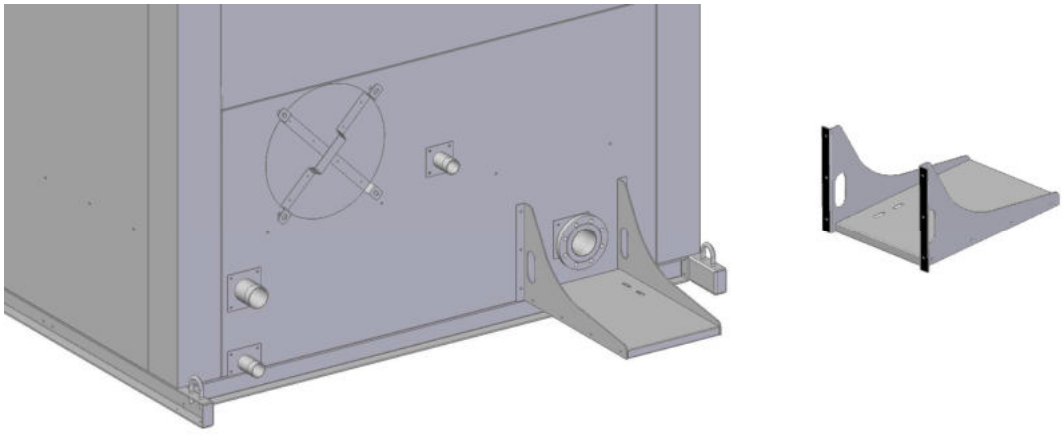


Fig. 11

Once the assembly has been realized, put the pump on the support and adjust the position to align the holes of the pump to those of the support, attach the pump flange to the flange of the socket attached to the wall, fig. 12.
Do not forget to place the gasket seal between the iron flange and the pump body flange, before tightening the bolts.

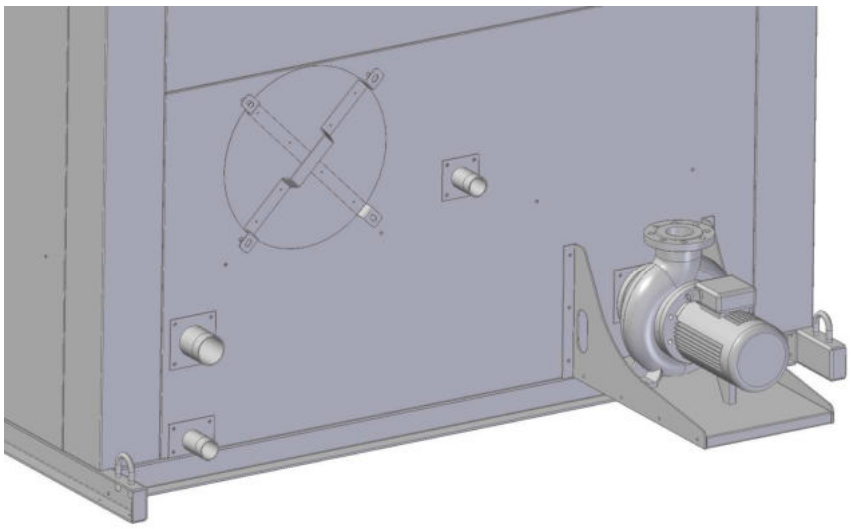


Fig. 12

Finally position the delivery piping to the upper flange of the pump remembering to put the gasket, fix it to the frame of the unit by collar (1), fig.13a, supplied together with the piping and join it to the piping fixed to the upper section by the rubber pipe and the clamps (2), fig. 13b.

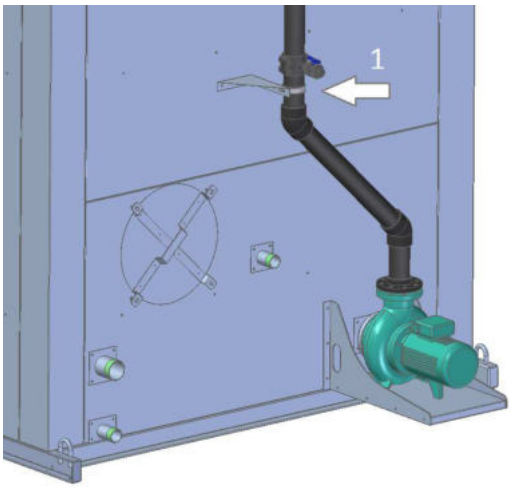


Fig.13a

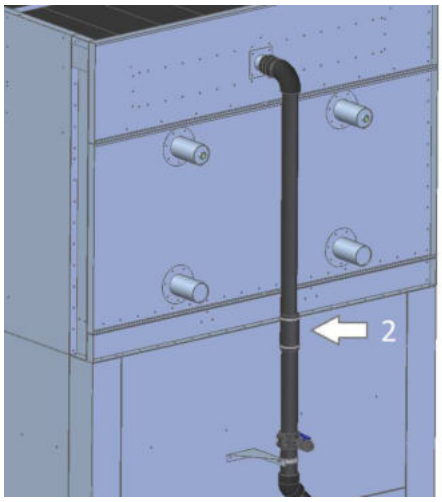


Fig.13b

3.5 Drift eliminators positioning

After the coil section is assembled on the fan section and this part of the unit is placed on the base, it will be necessary to reposition the drift eliminators, sent separately or within the basin, in order to facilitate the lifting of the units during the phases of loading and unloading and avoid breakage of the same. To reposition the drift eliminators, you have to remove the material from the basin, as explained in the previous section, and place it in way as to cover the entire surface above the water distribution system. The drift eliminators are prepared at the factory cut and arranged on the frame to make sure there is the correct number of pieces; only later they are dismantled to be stowed within the basin or on a package apart. First step is to distinguish the components for width and length so as to prepare them for the provision on the frame preassembled in the factory (fig. 14) which will make simple and intuitive the installation.
Once the drift eliminators are distinguished by size, on smaller units you must assemble them side by side in the longer side and insert a pair of them in between, or for longer units, assemble it side by side on short side. Once all the drift eliminators are in place, you can apply the metal bands that will prevent them from moving from their position fig.15.

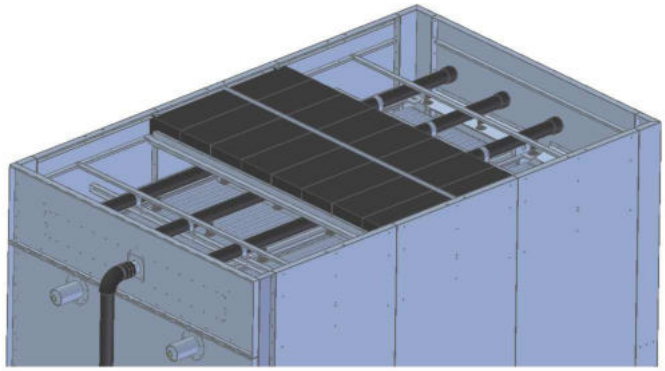
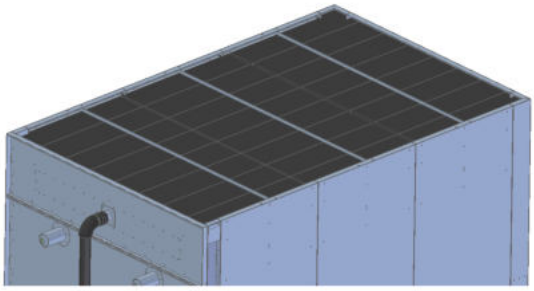


Fig. 14



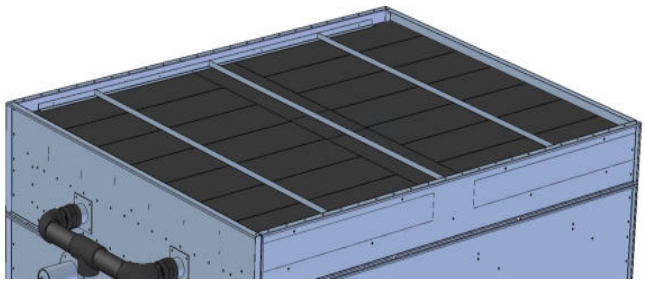


Fig. 15

3.6 Electrical connection

Our units are normally supplied with the electric fan and pump motors without wiring. Inside the terminal box, if purchased, there will be terminals for accessories such as the PTC and the Anticondensation Heater.
Personnel must use a cable of the right section and material, correctly tighten the cable glands on the terminal boxes and correctly install the cover with its gasket in order to keep the degree of protection of the electrical equipment.
Before starting the pump, check that the pipes are correctly connected and that there are no foreign bodies in the suction line.

To make the connection of the **electric motors of the the pump and fans**, the following measures have to be considered:

- Before connecting the motor terminals to the mains, make sure that the terminal voltage,shown on the motor plate, is the same as the mains voltage;
- Make sure that motor terminals are firmly tightened and that all stripped wires are carefully insulated in order to carry out the connection;
- Make sure that the electrical box (fan motor and pump) is perfectly closed to ensure the IP rating of the motor;
- Make sure the fan blades are free of obstructions and there is no contact with the diffuser walls;
- Make sure there is enough water in the basin;
- Make sure that nobody comes into contact with mechanical moving parts or bare electrical parts.

It's recommend that the main supply line to the motor should be protected with right calibrated thermal relays and fuses. Remember that when starting an engine requires 6 to 7 times more power than the nominal one.

All other information about the electric motor and the pump, such as connection, maintenance, operating conditions, etc., can be found in the user and maintenance manual downloadable on the web site www.w-tech.it.

Note: electrical components must be installed and used by qualified personnel who knows the safety requirements of the national regulations in force in the country of installation, including EN 60204-1, EN61439-1 and Directive 2006/42/EC.

3.7 Water and primary fluid piping connection

All hydraulic connections of the unit are gas threaded up to 6" diameter. Beyond this diameter, therefore from DN 200 onwards, the connections will be made with smooth pipe.
The connections of the coil are normally of DN 100 diameter, smooth pipe with a length between 200 and 250 mm. .

Note: if the water pipeline or the coil are smooth, be very careful when welding the pipeline on site, since the high temperatures reached during the welding of the two pipes, could cause the melting of the mastic and/or silicone applied on the plate of this connection and therefore the loss of water during operation.For this reason, it is necessary to wrap the pipe in a cloth and keep it wet during welding so as to cool the part of the pipe near the plate.

3.8 Other installation details

Check, and if necessary remove, any materials or items in the blocks that may still be connected to the evaporative cooler.

IMPORTANT: REMEMBER THAT THE UNIT MUST NOT BE COVERED WITH TARPAULINS OR SIMILAR, EITHER DURING OPERATION OR WHEN THE MACHINE IS STOPPED!

4. OPERATIONS TO BE CARRIED OUT BEFORE THE START UP

4.1 Cleaning

Make sure that the water distribution system is clean and free of any obstructions, and that the distribution nozzles are intact. Check if the water basin is completely clean, otherwise clean it using low-pressure water jets.

4.2 Inspection and checking

- Check the anchoring of the unit, the fans and motors and make sure they are correctly and securely tightened;
- Check the contacts in the electric box of the pump;
- Check there is no friction or interference between the fan and diffuser, making sure that it rotates easily and according to the direction of rotation indicated without any unusual noise or friction;
- Make sure there are no foreign objects, inside the diffuser;
- Check that there are no foreign objects inside the basin;
- Check that the water recirculation pipes are correctly installed.

5. START UP

Note: Any operation (installation / start-up / maintenance) must be carried out by trained personnel.
1) **Fill the water basin** through the make-up float valve or, even better, through a hose temporarily inserted into the basin through the overflow connection or the inspection window.
2) **Adjust the mechanical float** in to make sure that, with the ball immersed (partially) and float in the closed position, the water evel is about 25 mm below the overflow connection.
3) **Adjust the screw of the head of the float** that acts on the internal piston to facilitate the closure and minimize the vibrations in relation to the delivery pressure of the make-up water. This pressure must not be too high in order to avoid water hammer that would damage the float seal and cause noise and vibrations. The reference values range from 0.5 to 6 bar, causing the flow rate of water introduced through the float to oscillate accordingly.
4) **Check the water level inside the basin** after filling the entire water circuit. This level must always be above the suction o avoid cavitation. This level can be checked by removing an inspection window with the electric pump on, but with the fan motor off.
DO NOT START THE PUMP WITHOUT WATER IN THE BASIN!
5) **Check that** the fan rotation directions are correct as indicated on the diffusers at the top of the unit;
6) **Start the primary circuit** by circulating the fluid within the evaporative cooler coil.
7) **At this point**, if the pressure inside the coil is firm, it is possible to power the electric motor of the fan(s) and the recirculation pump, secondary circuit, thus starting the evaporative cooler.
8) **Check that the** pump rotation direction is correct as indicated on the pump units.
9) In case you find a malfunction, a strange noise, a high absorption of the electric motor , the pump is not draining water, a leak, etc. contact W-tech immediately to solve the problem.
Tamper with the implant or making changes without authorization would avoids the warranty!

THE EVAPORATIVE COOLER MUST NEVER OPERATE WITH THE INSPECTION WINDOW AND PROTECTIVE MESH REMOVED OR IMPROPERLY INSTALLED. DISCONNECT THE POWER SUPPLY OF THE ELECTRICAL MOTOR AND THE PUMP BEFORE THE REMOVAL AND REPLACEMENT OF ANY ELEMENT INSTALLED, MAKING SURE THAT THE PROTECTION DEVICES PREVENT UNINTENTIONAL RE-INSERTION.

6. OPERATING INSTRUCTIONS

6.1 Machine performances

In order to obtain the correct performance of the evaporative cooler, care must be taken to ensure that the flow of both fluids (air and water) match the design ones, that the water distribution is correct, and that the all piping of the distribution are clean and not clogged.
It is essential to use excellent chemical and physical characteristics for the recirculation water in order to keep the surface of the exchange coil clean and free of fouling, otherwise the performance of the unit will be reduced. It is recommended to visually check the coil and the condition of the basin walls periodically, see maintenance table at the bottom.

6.2 Controlling the quality of the fluid solution in the circuits

The quality control of the fluids is essential, not only for the unit itself, but also for all the elements that make up the cooling circuits. It is recommended to consult specialized water treatment companies for the fluids in each circuit.

Note: informations on the **recommended characteristics of recirculating water**, guidelines for the passivation phase and indications to be taken to avoid the presence of legionella in evaporative systems, can be found in the information sheet available for download at www.w-tech.it .
However, some general rules and instructions to be followed for correct circuit control are given below:
this control should protect the circuit elements from:

- Fouling and blocking
- Suspended solid objects
- Biological growth
- Corrosion.

6.2.1 Fouling and blocking

Excessive fouling on the exchange surfaces of an evaporative cooler significantly reduces its efficiency. This can cause an increase in cooling temperatures from the design ones and possibly plant shutdowns. The formation of fouling also increases power consumption, and this happens throughout the year regardless of the workload of the system.
Caused by:

- Salt precipitation (scaling), by their solubility product being exceeded
- Solid objects suspended
- Presence of microorganisms, a large formation of fouling, constitutes a refuge for the reproduction of microorganisms and this can thus increase the risk of bacteriological contamination.

The most common salts are:

- Calcium Carbonate
- Calcium Sulphate
- Silicates

The following conditions must be maintained in order to eliminate them: according to the **Ryznar Stability Index (RSI):**

RSI = 2 pHs – pHc, between 6 and 7.

index based on the pH saturation for calcium carbonate (pHs), which is then related to the actual pH of the water, measured in the circuit.
The RSI is based on the idea that, when calcium carbonate exceeds, the amount that can remain in solution, precipitates and that the lower is the pH, the more aggressive the water will be. The fact that corrosion occurs at low pH levels is an assumption that works well in hydraulic systems mainly made of ferrous materials.
Generally:

- pHs > pH corrosive water (7<RSI>8.5)
- pHs = pH balanced water
- pHs < pH encrusting water (5<RSI>6)

To calculate these indices it is necessary to know the total amount of dissolved solids, called TDS, the pH, hardness and temperature at the origin as well as the total alkalinity (usually expressed in terms of bicarbonate content). It should be noted that while the fouling depend on the TDS/pH/temperature/alkalinity/hardness factors, these affect the corrosive capacity of the water independently. This index is based on calcium carbonate saturation, it is much more valid to predict fouling than corrosion, however it is helpful.
The product of sulfate and calcium concentrations (both expressed in mg/l CaCO3) in the circuit water, should be less than 500 ppm. The silica content should be less than 150 mg/l.

6.2.2 Suspended solid

They can be introduced into the machine circuit by the water make-up solution, air or by contamination during the process. Between 100 and 150 p.p.m. of suspended solids can be tolerate, in the secondary circuit of the evaporative cooler.

6.2.3 Biological growth

The environment conditions existing in a evaporative cooler favour biological growth. Normally it is necessary to provide mechanical cleaning and treat the unit with chemical biocides to prevent these processes.
The bacteriological growth reduce the efficiency of heat transfer due to the formation of silt or bacterial flora, but, more importantly, the proliferation of bacteria can contaminate the circulating water which thus becomes a potential health hazard Among the harmful bacteria, the most important in this context is the Legionella Pneumophila which can cause "Legionnaire's disease". This kind of treatment is particularly necessary when the circuit may be subject to random pollution caused by process fluids, as may happen in refineries, sugar mills, paper mills, etc…

6.2.4 Corrosion

Besides keeping the Ryznar index in the stable or slightly corrosive zone, corrosion inhibitors must be added to the secondary circuit. Several varieties are commercially available and the most suitable should be selected in consultation with specialized firms.This is why the maximum permissible number of concentrations in the secondary circuit must be limited. The number of concentrations is called **"Concentration Cycles**" and is represented by the letter **N.**
Considering that the working fluid is water, if we indicate with:

- **E**, the percentage of evaporated water in the machine compared to the nominal water flow rate;
- **P**, the total purge (the total of purges to reduce the concentration + the water losses in the circuit) as a percentage of the nominal water flow;

the following reports are obtained:
average flow of make-up water as a percentage of the circulating water flow:

$$\frac{N \text{ x } E}{N-1}$$

total purge needed in the circuit as a percentage of circulating water flow:

$$P = \frac{E}{N-1}$$

The factors used to control the number of concentrations are normally determined by dividing the concentration of chlorides in the circuit by the concentration of chlorides in the make-up water.
Normally **N** values (concentration cycles) are:

- hard water between 1.5 and 2 times;
- softened water between 2.5 and 3 times;
- osmotized waters up to 5 times.

MAKE SURE THAT ANY PRODUCT USED FOR WATER TREATMENT AND MACHINE CLEANING ARE COMPATIBLE AND IN THE RIGHT CONCENTRATION WITH THE MATERIALS OF THE UNIT (GALVANIZED STEEL, MAGNESIUM, PVC, STAINLESS STEEL, ETC.) AND WILL NOT DAMAGE THE COMPONENTS OF THE UNIT ITSELF.

6.2.5 Cold weather operation

The evaporative cooler operation at temperatures below 0°C might give rise to the formation of layers of ice on drift eliminators, diffusers and other components installed inside the unit.
Damages caused by cold / ice can be avoided by purchasing a range of extras optional to replace standard materials suitable for temperatures below 0°C. Moreover, by installing the electrical resistances in the basin and the minimum level to protect them, the risk of freezing of the water contained inside the basin during the periods of shutdown of the circulation pump or the system, is reduced to zero.

7. MAINTENANCE INSTRUCTIONS

Due to the hight quality of these units, maintenance requirements are minimal, however, these should be fully inspected once a month and the entire primary circuit should be cleaned every year.
It is advisable to perform these operations regularly in order to ensure operation and guarantee the durability and the performances for which these units are designed.
The two areas relevant to maintenance are:

- Water collection and circulation system
- Ventilation system

7.1 Water collection and circulation system

The operation of these machines is based on the evaporation of the spray water, therefore some salt concentrations and also solids in suspension are produced. Therefore, part of the water in the circuit, must be purged in order to avoid the accumulation of saline concentrations on the exchange coil.
For this reason it is recommended a purge valve installed on the delivery side of the water recirculation pump. The water conditions will be controlled continuously and automatically, purging dirty water and replenishing with clean water, adding bio-dispersing agents and biocides to prevent limescale formation and corrosion of metal parts of the unit. There are many products available on the market, it is recommended to choose the most suitable for the purpose with the support of specialized firms, who know the quality of water in the plant and in the area.
Act with caution if acid products are used, it is recommended to follow the values indicated in the table of water specifications; in any case, keep the pH at values not lower than 7.
Another aspect to take into consideration is the compatibility of the products used with the type of materials that compose the machines. These should be disinfected twice a year, in early spring and autumn, and also in the following circumstances:

- if they have been stopped for a long period of time;
- when repairs have been carried out;
- when routine inspections indicate the needeed;
- when is required by the Health Authorities.

Disinfection will be carried out by specialized firms, using authorized disinfectants compatible with the materials of the evaporative cooler. The maintenance operations to be carried out on the different elements are listed below.

7.1.1 Basin

The basin requires periodic cleaning, otherwise the drain ,the overflow connection and the filter may become clogged. It is recommended a full purge and monthly cleaning, or as often as needed, according to the current legislation, in order to avoid the accumulation of sediments.

7.1.2 Suction filter

This has to be cleaned monthly, or as frequently as the sediment presence requires.

7.1.3 Water make-up

The float valve will be checked monthly, making sure the water level in the basin is correct, see chapter 5.

7.1.4 Spray system

This has to be checked monthly. To do so, some drift eliminators must be removed or it's need to access through the manholes, if are present, to inspect the inside. **The fan must be stopped**. The nozzles, which have a wide passage with minimal possibility of breaking down or clogging and allow perfect water distribution, are above the coil. If for any reason they become clogged, they can be disassembled very easily. The reason for their clogging is the lack of the suction filter or because the distribution pipes are dirty. Once the system is reset to its factory defaults, reinstall nozzle in the correct position.

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7.1.5 Coil

The coil should be regularly checked.The coil is the key element behind the performance of the cooler therefore, due to the possibility of fouling formation on the surface in contact with the recirculating water, a monthly check and daily purging of part of the sprayed water, is recommended.

7.1.6 Drift eliminators

A general cleaning should be carried out twice a year at least, proceeding to its substitution if needed.

7.1.7 Structure

The internal and external cooler panels, must be cleaned at least twice a year. If any corrosion is appreciated, proceed in the following way:

- clean the area with a steel brush and sand with sandpaper;
- apply a coat of rust converter and then a coat of zinc-based primer;
- apply one or more coats of protective paint.

In case of scales, it is better to provide a mechanical cleaning or a treatment with chemical agents by contacting a specialized company.

7.2 In the air flow system

The airflow system does not require any special attention, due to its strength. Nevertheless, like any other moving element ,it has to be regularly checked, following the instructions below.

7.2.1 Fans

A monthly inspection has to be carried out, in order to remove any paper, leaves or any other items that may enter in the diffuser. Make sure the blades are intact and there is no contact between them and the diffusers, tighten the fan fixing bolt on the top of the drive shaft, if it has become loose.

7.2.2 Motor

Schedule a monthly inspection to check the status of the motor. Keep the cooling ducts clean, check for rust and pay attention to bearing wear. If the motor has grease lubricated bearings, perform lubrication as indicated in the manual. Check the tightening of the motor and motor support fixing bolts and that there is no gap between the motor shaft and fan hub. Check the correct direction of rotation of the fans indicated on the diffuser side.
In case of storage of the electric motor, the environment temperature must be kept between -20°C/+40°C.
All the information related to the electric motor are contained in the manual downloadable from the site www.w-tech.it.

ALWAYS DISCONNECT THE MOTOR BEFORE WORKING ON IT OR ON THE EVAPORATIVE COOLER.
DO NOT START THE ELECTRIC MOTOR WITH THE SHAFT KEY STUCK ON THE SHAFT WITHOUT THE FAN INSTALLED AS THIS CAN BE EJECTED WITH SERIOUS DANGER DUE TO CENTRIFUGAL FORCE.

7.2.3 Recirculation pump

Perform a monthly inspection to check the condition of the equipment. Check the general condition, the state of the mechanical parts, check the free rotation of the motor shaft, check that all the electrical terminals in the terminal block are connected.
Clean the suction filter of any foreign object or dirt.
In case of storage of the electric motor, the environment temperature must be kept between -20°C/+40°C.
Check the correct direction of rotation of the impeller as to the one indicated on the pump body.
All the information related to the electric motor are contained in the manual downloadable from the site www.w-tech.it.

8. PREVENTIVE MAINTENANCE SUMMARY CHART

OPERATIONS TO BE CARRIED OUT	DRAIN OF BASIN TANK	SUCTION FILTER	BASIN	FLOATING VALVE	ELECTRIC PUMP	WATER DISTRIBUTION	DRIFTS ELIMINATOR	MOTOR	FAN	BEARINGS	BELTS	FAN SHAFTS	PANELS	COLD WEATHER OPERATION
FOULING CHECK		M				M	S							
CHECK GENERAL CONDITION				M	M/N	M	M	M	M				S	N
CLEANING AND DISINFECTION		M	M		M/N	M/N	S/N	S	S				S	
BASIN WATER LEVEL			M											
INSPECTION FOR OVERHEATING, NOISE AND VIBRATION					M			M						
INSPECTION FOR LEAKS			S/N			S/N							S/N	
TIGHTENING OF BOLTS AND ANCHORING					N			N	N					
BALANCING AND ALIGNMENT														
LUBRICATION (please check also the instruction manual of the suppliers)					N			N						
BLOWDOWN FLOW AND CONCENTRATION CYCLE CHECKING	D													

D = Every Day M = Every Month S = Every six Months N = When Needed

9. TROUBLESHOOTING CHART

PROBLEMS	POSSIBLE CAUSES	ACTION
MOTOR ROTATES IN OPPOSITE DIRECTION	Error in connection	Change two phases in the power supply to the motor.
ABNORMAL VIBRATION IN MECHANICAL EQUIPMENT	Anchorage and bolts not properly tightened	Check the bolts of the fan, assembly and tighten them if necessary.
BAD WATER DISTRIBUTION	Nozzles clogged, broken or disengaged from the seat	Remove the nozzles and clean them, eventually replace them.
BAD THERMAL EFFICIENCY OF THE TOWER	Clogged drifts eliminator Incorrect water distribution Air intake grids obstructed Fouling coil	Remove the drifts eliminators, clean and eventually replace them Remove the nozzles and clean them, eventually replace them. Check recirculation pump (wiring, rotation, flow) Clean the suction filter or replace it if necessary Contact water treatment specialist for an appropriate clean.
THE MOTOR DOES NOT START, STARTS WITH DIFFICULTY OR DOES NOT REACH ITS RATED SPEED AND OVERHEATS	Wrong electrical connection Interruption in connection or in winding Short circuit in the winding, in the casing or to ground The rotor or the fan jam. Excessive number of motor starts The motor may have an open phase	Connect the motor correctly Find and eliminate the interruption Find and eliminate the short circuit (contact W-tech) Find and eliminate the mechanical defects Extend the duration of stops in motor operation or reduce the number of starts Check motor phases and connections
THE MOTOR IS NOT OPERATING REGULARLY	Interruption in connection or in winding Short circuit in the field winding Short circuit to the casing or to ground	Find and eliminate the interruption Find and eliminate the short circuit in the windings (contact W-tech) Find and eliminate the short circuit between the turns or the short circuit to the casing
LACK OF CURRENT IN ONE OF THE WIRES	Interruption in connection or in winding	Find and eliminate the interruption
TEMPERATURE RELAY CUTS OFF CURRENT WHEN MOTOR IS CONNECTED OR DURING OPERATION	Excessive number of motor starts Bad switch connection Interruption in connection or in winding Relay temperature is incorrectly adjusted. Motor prepared for triangle connection but star connected Obstructed ventilation diffuser	Extend the duration of stops in motor operation Connect the motor correctly Find and eliminate the interruption Correct the overload thermal relay Connect the motor correctly Clean the motor
THE FAN UNIT VIBRATES	Worn bearings, mechanical deformation of seals or of contact elements Fan not properly tightened on the motor shaft Motor not aligned	Remove and replace the bearings with an equivalent model Check the condition of the blades and that they are properly secured and clean if needed Tighten the fixing bolt to the shaft Align the motor
PUMP MAKES NOISE	Particles or elements inside pipes The pump and/or pipe are not well assembled/fixed Presence of air bubbles in suction	Inspect basin, filter and pipes, clean and remove foreign objects Fix the pipes and/or electric pump correctly Check the water level

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