USE AND MAINTENANCE MANUAL

CC

CENTRIFUGAL EVAPORATIVE CONDENSER

IMM - CC - ENG - Rev. 003 Ed.01

INDEX

1. GENERAL SAFETY RULES AND MACHINERY DESCRIPTION

1.1 General Safety use

These instructions must be followed to ensure the safety, correct installation, operations 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.
Accident prevention equipment, necessary 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 previously rules, 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: Failure to comply with these instructions will void all applicable warranties.
W-tech is not responsible for any damage to things and people due to the lack of the precautions described here.

1.2 General description

The evaporative condenser of the CC series, condenses the refrigerant gas in industrial refrigeration systems with minimum water consumption. Evaporative condensers represent the ideal solution to dissipate large thermal powers. It is estimated, that the water's consumption with this equipment is reduced by about 95% compared to a normal process with disposable water, considerably increasing the economic savings and environmental impact.
The evaporative condenser are counter-flow induced draught coolers, in wich the gas to be condensed (primary fluid) circulating in a closed sealed loop (coil). The coil, that is the primary circuit, is continuously sprayed externally, with water pumped in an open circuit (the secondary) from the basin tank. The evaporation of part of this water removes most of the heat from the fluid in the primary circuit the rest of the heat is subtracted from the high flow rate of air aspirated inside the unit, through axial fan placed in the upper section of the machine, through the inlet louvers placed just above the level of the water collected in the basin.
The centrifugal evaporative condenser is composed by the following elements:

- Basement and water collection basin;
- Air system;
- Coil (primary circuit Air system);
- Water pumping and distribution system (secondary circuit);
- Drift eliminators.

1.3 Basment and water collection basin .

The W-TECH evaporative condensers are interely made of Magnelis panels (steel, zinc, aluminum, magnesium) ZM310 to ensure maximum surface protection comparable to a galvanized sheet metal with over 1000 g/m2 of zinc. Machines in stainless steel AISI 304 or 316 (total or in part) are available on request.
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 and an additional protection with silicone guarantees the absence of small leakage of water.
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 collection basin, the following standard connections are provided:

- Make up water with float mechanical valve, or electronic (optional);
- Overflow connection;
- Drain connection.

Other connections may be provided according to additional options required. For example:

- Increased outlet connection on the bottom, which replaces the normal water outlet pipe for installation on a remote concrete tank.
- Extra connections in the basin, in order to use cold water contained there for other uses.

The complete list of options is available in downloads page of the website www.w-tech.it.

1.4 Ventilation system

The air flow, which crosses the machine in counterflow to the water, is ensured by dynamically and statically balanced double-intake centrifugal fans, with forward curved blades. They are installed on a painted steel shaft, supported at the ends by self-aligning ball bearings with cast iron supports.
The impeller made of galvanized steel is located inside the diffuser, made of Magnelis sheet metal or stainless steel (optional). The correct direction of rotation is indicated by an arrow on the external side of each diffuser. An electro-galvanized steel protection mesh is fitted on the suction compartments to prevent objects of any kind from falling into the diffuser and damaging the fan or any other element, and for the safety of personnel. The motors, with mechanical protection IP 55, thermal insulation class F (able to withstand a maximum temperature of 155 ° C on the winding with external temperature is 40 ° C), continuous duty S1 and form B3, are mounted on sturdy adjustable slides in galvanized steel and placed in a special compartment, protected from the weather but easy to access. Motion transmission is via V-belts, calculated at 150% of rated power and service factor always higher than standard values with a safety factor of no less than 1.5.

1.5 Coil

In the upper section there is the heat exchange between the refrigerant gas, which circulates inside the coil, and the water coming from the basin below by a recirculation pump that floods externally the exchange coil, through a system of large diameter spray nozzles, made of special PVC and interchangeable, in case of maintenance. The heat is released through the coil and then conveyed into the atmosphere through the air flow generated by the fan. The exchange battery is designed in accordance with **Directive 2014/68/EU** is made with carbon steel pipes following our design and then hot dip galvanized (HDG), to ensure the necessary protection against external corrosion. When the coil is being processed, a pressure test is performed on each individual coil to check for possible leaks. An additional test with nitrogen on pressure is carried out at the end of the production cycle, according to the current directive. It is possible to supply the exchange battery made of stainless steel (AISI 304 or 316) on request, for special uses (such as dry running) , it is possible to request the coil with fins (for half or the entire exchange surface).
Before being assembled on the machine, the coil(s) is loaded with nitrogen and left under pressure at a few bar even during shipment.

1.6 Water distribution system

The water is distributed on the coil through a self-priming pump that draws water from the basin and flows it through a network of secondary pipes to the top of the evaporative condenser, on which the spray nozzles are installed. From there it will wet the entire surface of the coil and then, by gravity, it will return to the basin and then to the circle again. The cooling of this water is guaranteed by the air circulating inside the condensers. Spray nozzles are made of suitable diameter to prevent any clogging and are made in ABS and easily replaceable in case of maintenance,their function is to obtain a perfect distribution of the secondary fluid on the exchange coil in order to increase the heat exchange. If they become clogged or damaged, they can be easily disassembled and then cleaned or replaced. In the heat exchange process, part of the water will be lost by evaporation and a small part by the air flow dragging. This flow of water to be replenished, is automatically regulated through a mechanical float valve installed inside the basin.

1.7 Drift eliminators

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

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

w.tech

2. DELIVERY AND HANDLING

2.1 Delivery method

All models of this series are supplied with the maximum number of sections assembled directly in the factory, however, depending on the height and size of the parts, the unit may be delivered in one or more blocks. To facilitate the handling operation, the single parts are laid on a wooden beam. Hooks are arranged on the sides of each block to ensure that it is fastened to the truck floor. These fixing hooks can be removed once the machine is installed.

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:

- Water collection basin and recirculation pump;
- Ventilation system (impellers, motor(s) and transmission parts;
- Protection meshes.

2.1.2 Upper section

Composed by:

- Coil;
- Water distribution system;
- Drift eliminators.

WOODEN SUPPORTS, SHEETS AND CARTONS SHOULD BE REMOVED BEFORE INSTALLING THE MACHINE IN ITS FINAL POSITION. TAKE CARE TO CHECK THAT THE BASIN AND WATER DISTRIBUTION ARE FREE OF ANY FOREIGN OBJECTS THAT WOULD CAUSE PROBLEMS TO NORMAL OPERATION OR DAMAGE TO THE CONDENSER.

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 MUST BE USED TO CARRY AND MOVE ONLY THE BLOCK TO WHICH THEY ARE ATTACHED. ALL EYEBOLTS MUST BE USED DURING THESE OPERATIONS
THEY SHOULD NEVER BE USED TO MOVE THE ENTIRE UNIT ONCE THE SECTIONS ARE ASSEMBLED.

On units made up of several blocks, the movement of the lower section, the water collection basin, will be performed using all the eyebolts and adjustable chains, considering that the center of gravity of the unit is decentralized due to the presence of the fan unit on one side of the unit, fig.1 and 2.

Note: If there are central eyebolts as in fig.1, they must be removed before assembling the upper section to the lower section.

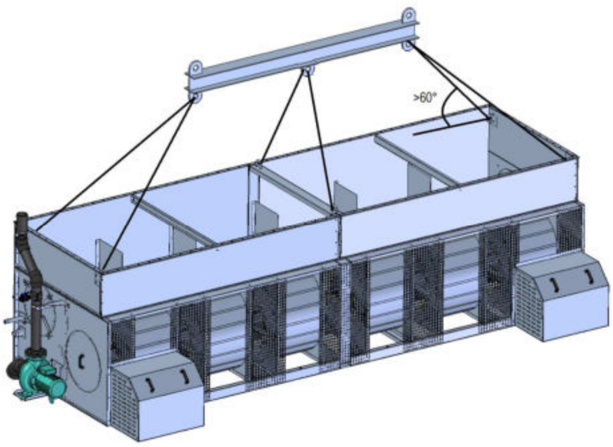

Fig.1

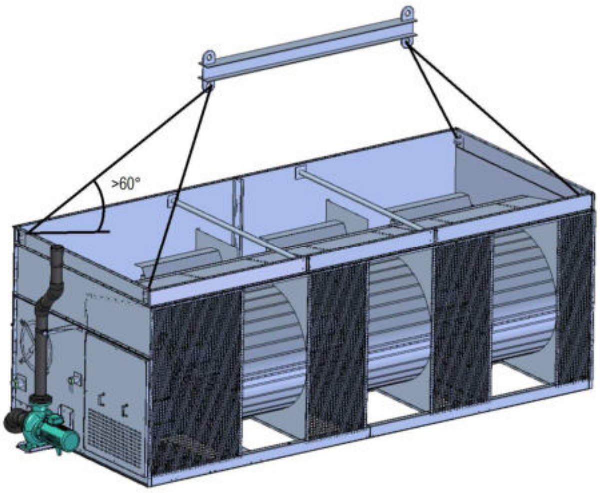

Fig. 2

To move the coil section of these units, made of more than one section, all the eyebolts of the coil itself will be used, as shown in fig.3. For larger units, made with two coils, the movement will be done as in fig.4 using a cross barbell.

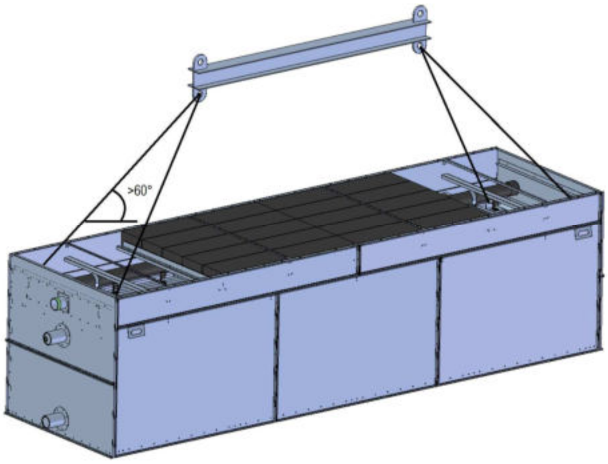

Fig. 3

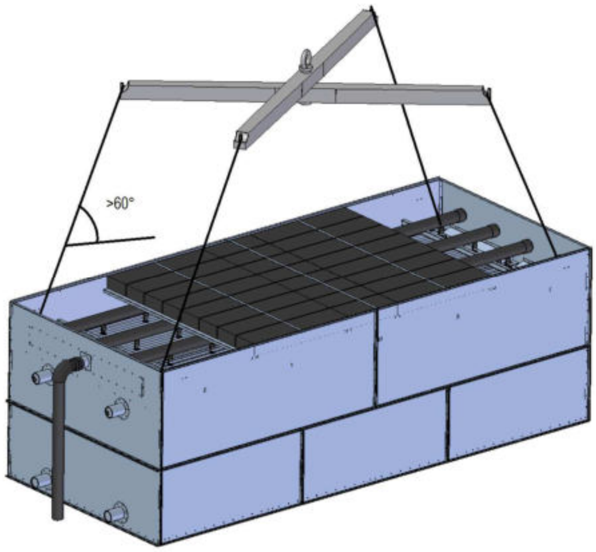

Fig. 4

2.3 Storage

During the storage phase of the units, before the installation, **do not cover the blocks** with tarpaulins or put coatings 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, rotate the fan assembly and if necessary bleed and replace the grease in the bearings on the fan shaft, check for condensate drainage and maintenance of the electric motor, 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 to avoid the formation of musk / mould. In both cases it is recommended to put 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. The number of beams is indicated in the STEEL SUPPORT CONFIGURATION of the purchased model.
This type of anchorage can be seen in fig. 5, some bolts (screw + washers + nut) are needed to complete it.

Note: the surface has to be perfectly level before installing the evaporative condenser. The tower must not be levelled using wedges or any other element between the beams and the basin, because it will not give adequate longitudinal support and the base of the unit would be subject to bending / twisting loads.

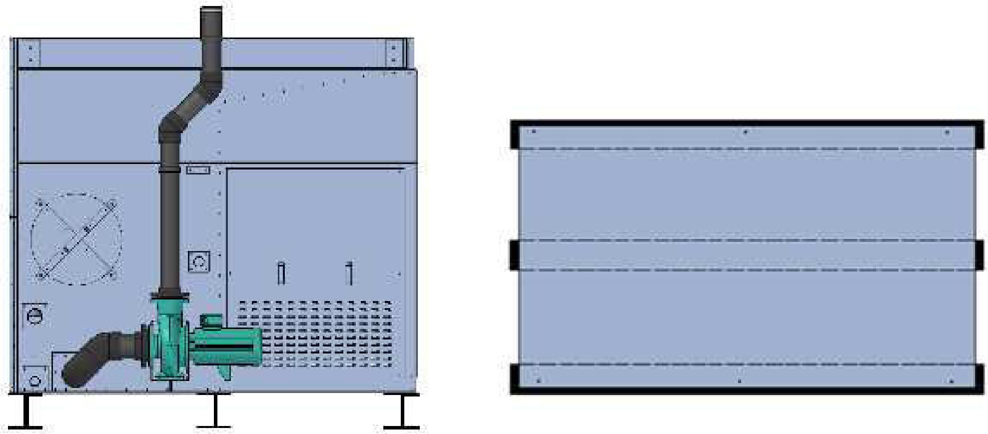

Fig. 5

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 condenser so that fresh air can enter through the intake section, and also allow access to all components requiring maintenance.
Any obstacles, walls/buildings/etc., that go beyond the height of the tower must be avoided in order not to have problems with recirculation of the expelled air, which is pushed by the wind back into the intake. See fig 6a, 6b, 6c and 6d.

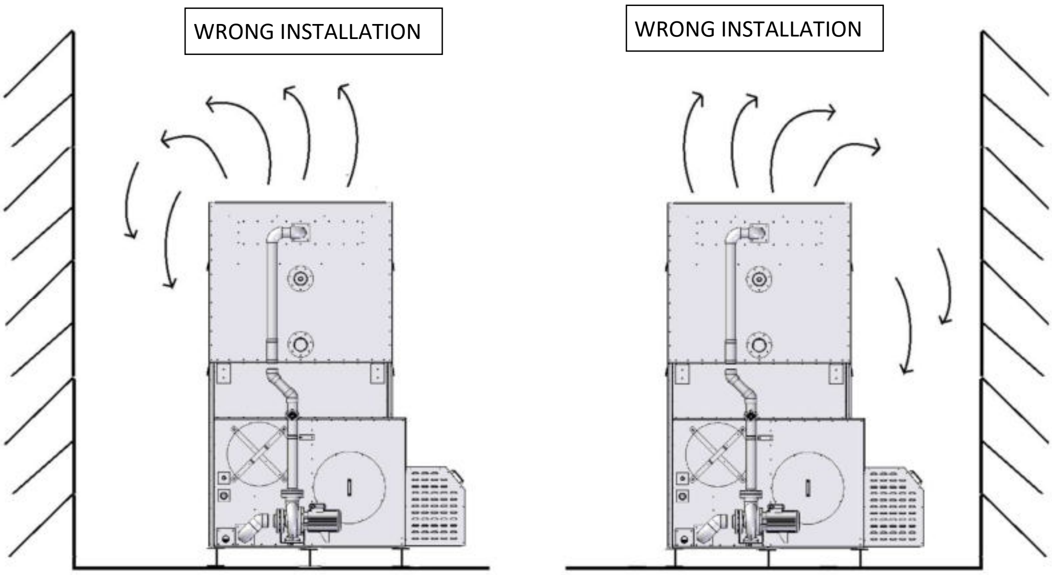

Fig. 6a

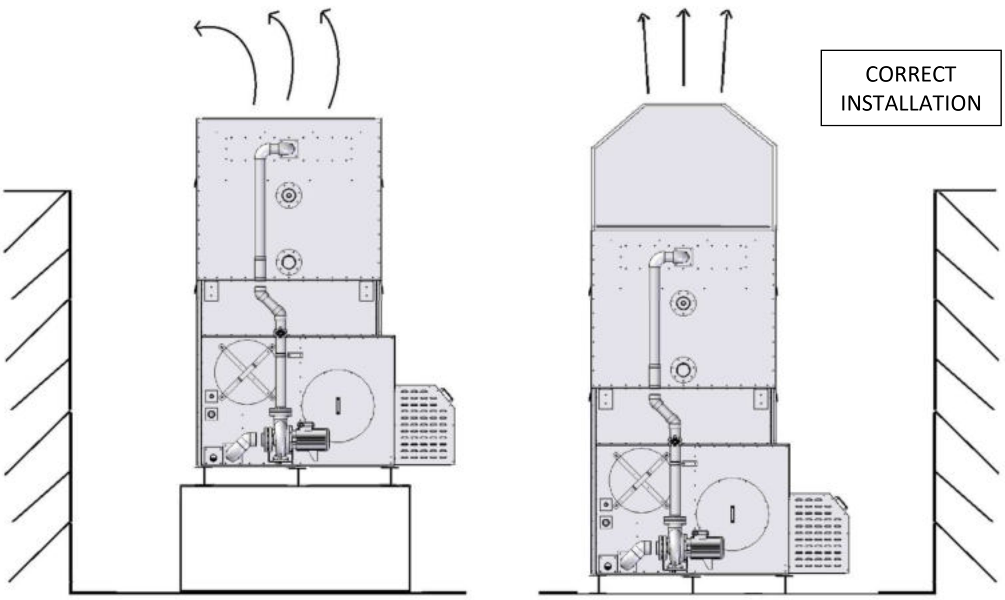

Fig. 6b

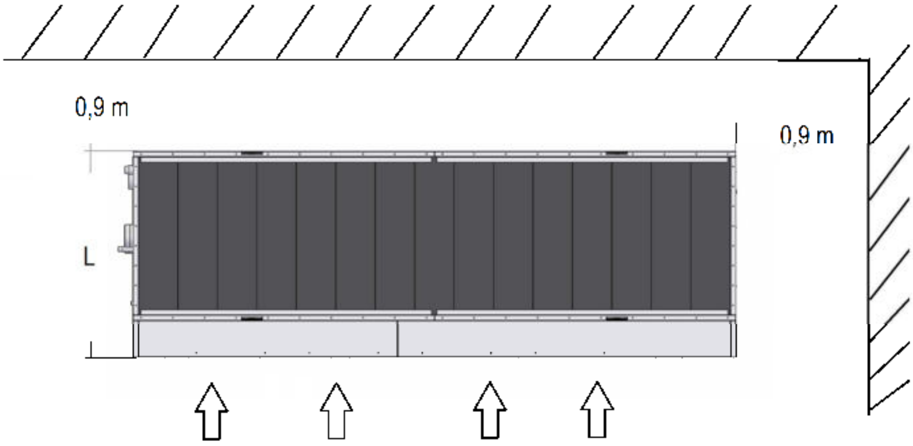

Fig. 6c

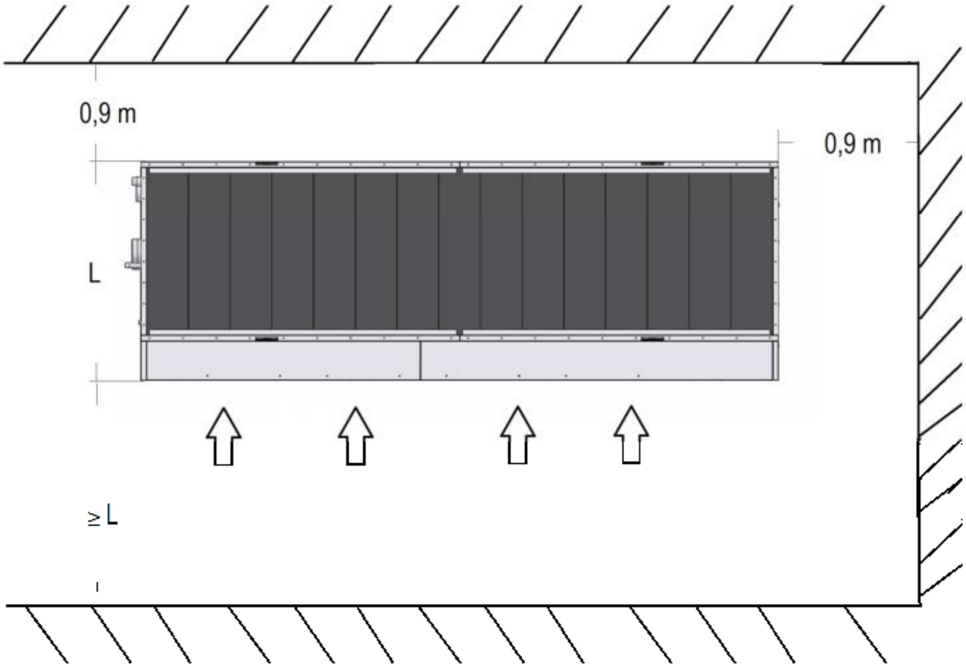

Fig. 6d

3.3 Sections assembly

Before installation, make sure that all items supplied within the basin, have been removed.To access the basin, remove the nuts that secure the portholes, then pull the porthole out of its housing. See fig.7.

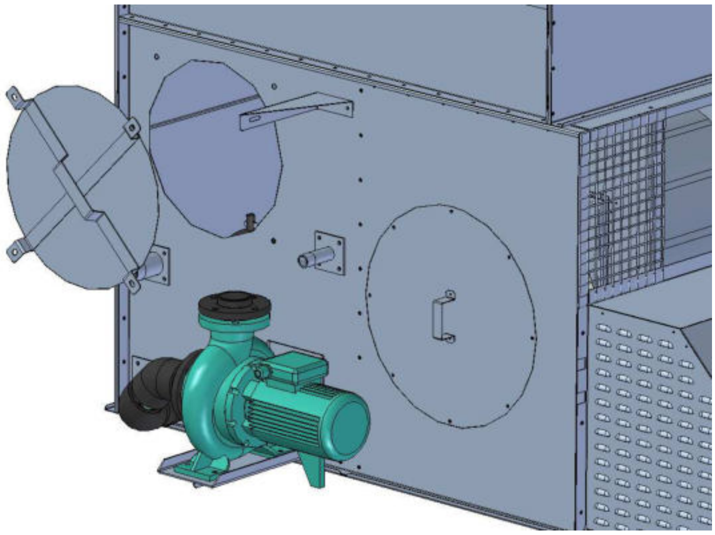

Fig. 7

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.8, 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 upper section.

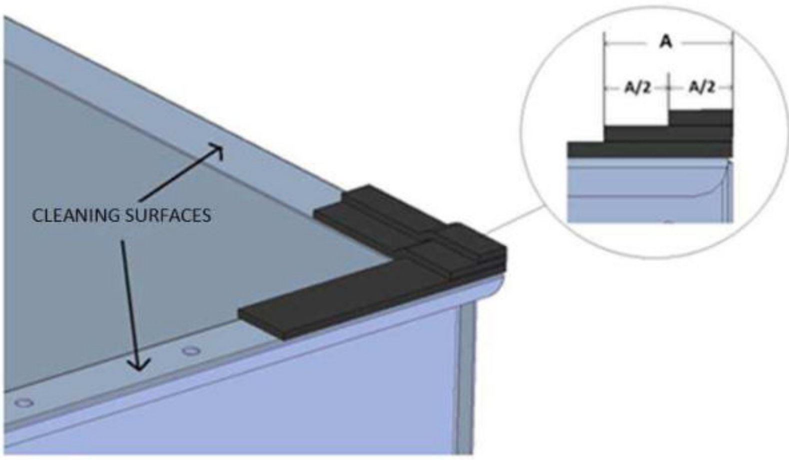

Fig. 8

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. 9.

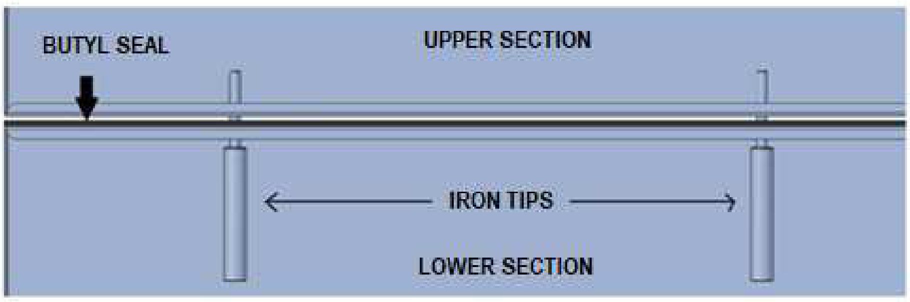

Fig. 9

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.

Note: in units >2m wide, the short side of the exchange section, in yellow, (A) may have the support flange facing inwards.In this case, after having joined the sections on the long sides (B and D) with the bolts and nuts, it is necessary to use the self-tapping screws supplied, tightening them from the bottom panel (C) of the basin section, to the top panel (A) of the exchange section as in fig. 10. On the flange facing the inside of panel (A) of the exchange section, there are holes of small diameter prepared for the self-tapping screw.

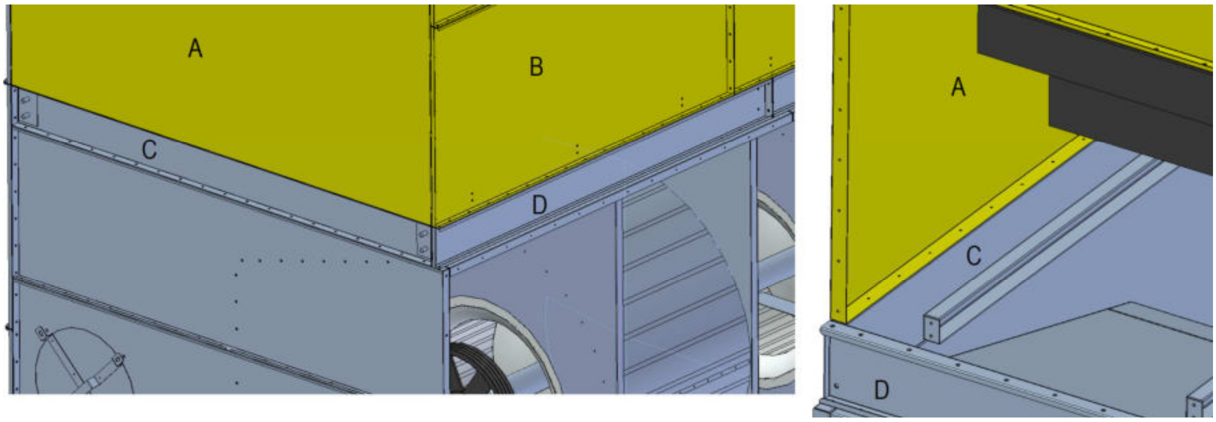

Fig. 10

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 to 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 (fig. 11), then place the pump support on the panel (fig 12), put the reinforcement inside (fig 13) and fix everything with the supplied bolts. To avoid the possibility of water leaks, fix the nuts inside the basin with silicone.

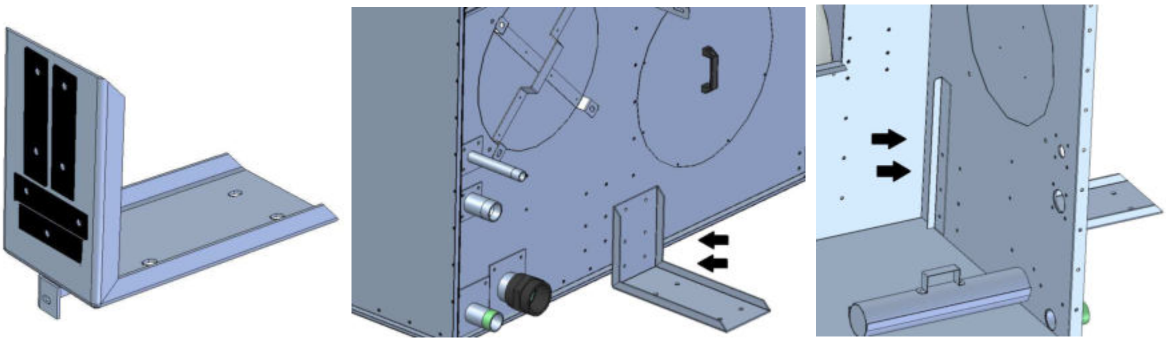

Fig. 11 Fig. 12 Fig. 13

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. When this is done, just take the suction pipe, already assembled in the factory, and join through glue for rigid PVC (tangit for example) the pipe to the sleeve fixed to the threaded tip and the other end to the elbow.
Note: the glueing of the pipe to the fittings must be carried out by experienced personnel, any leakage in the pipe section will not be attributable to W-tech. Then connect the pvc flange to the pump Do not forget to interpose the seal between the pvc flanges and the pump before tightening the flanges. Finally, position the delivery pipe to the upper flange of the pump, remembering to put the gasket, fix it to the frame of the unit through the collar (1), supplied with the pipe, and join it to the pipe fixed to the upper section through the rubber pipe and the clamps (2). See fig. 14.

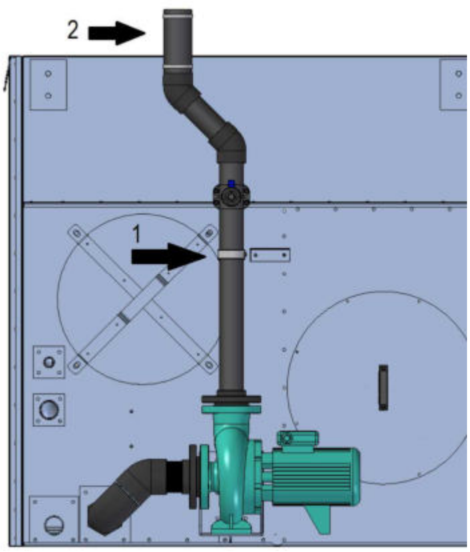

Fig.14

3.5 Drift eliminators positioning

After the coil section is assembled on the fan section, it may be necessary to reposition the drift eliminators,that are 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 such a way as to cover the entire surface above the water distribution system. The drift eliminators are manifactured 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 separate package/block. First step is distinguish the components for width and length so as to prepare them for the disposition on the frame preassembled in the factory (fig. 15) 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, on small units (fig. 16), or for longer units assemble it side by side on short side (fig.17).

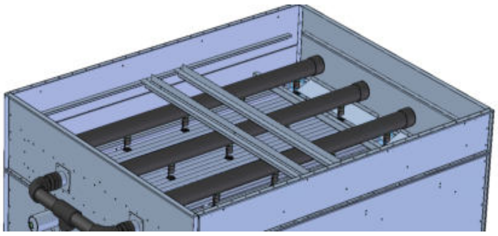

Fig. 15

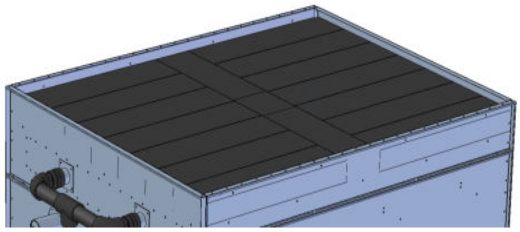

Fig. 16

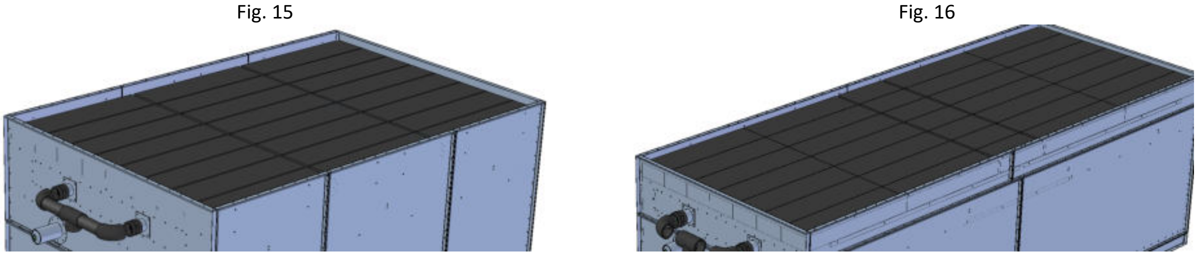

Fig. 17

Once all the drift eliminators are in place, you can apply the metal bands that will prevent them from moving from their position (fig. 18).

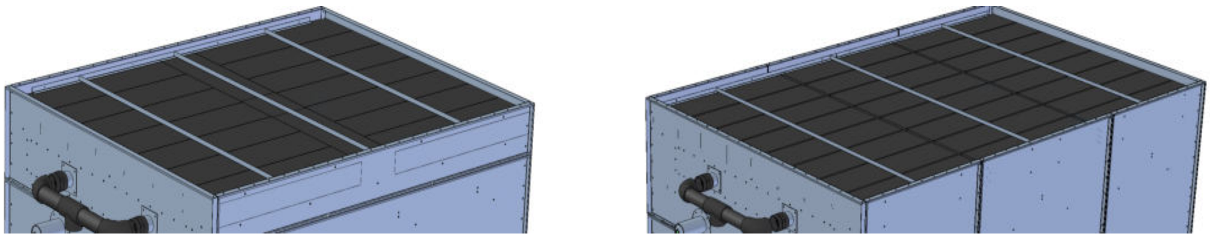

Fig. 18

3.6 Electrical connection

To connect the electric motor it is necessary to work in the lower part of the evaporative condenser through the manholes or the motor door, according to the model purchased. Feed the connecting cable through the holes in the panelling, or the protective mesh, to the motor electrical box fig. 19.
To reduce any hazards, fix the motor power cable to the structure, using cable ties.

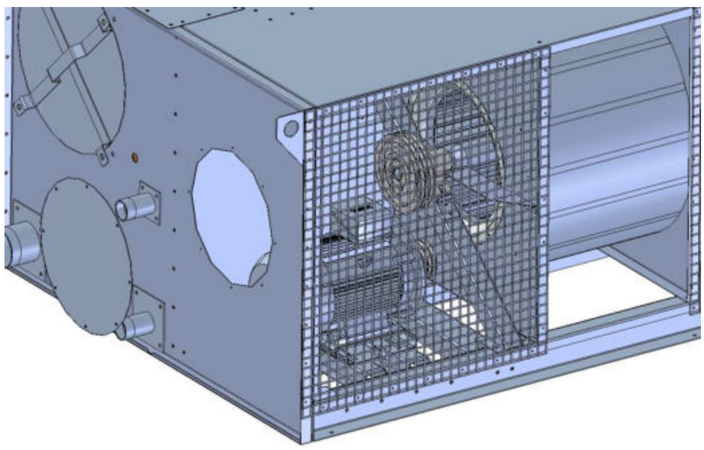

Fig. 19

To connect the electric motor of the pump, simply go to the lower side of the condenser where the pump is located(it's placed outside the evaporative condenser panel). Before starting the pump, check the pipes are correctly connected and there are no foreign bodies in the suction.

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 (pump motor) is perfectly closed to ensure the IP rating of the motor;
- Make sure that the fan blades are not obstructed;
- 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 use 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 gas 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 or gas pipeline 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 with a cloth and keep it wet during welding in order to cool the part of the pipe near the plate.

3.8 Other installation details

Check, and remove if needed, all packaging materials or elements that may still be connected to the evaporative condenser.

IMPORTANT: REMEMBER THAT THE UNIT SHOULD NOT BE COVERED WITH TARPAULINS OR SIMILAR, NEITHER DURING OPERATION NOR WHEN THE MACHINE IS STOPPED!

3.9 Silencers assembly (optional)

Once the unit has been assembled and attached to the structure, clean up the entire perimeter of the support flap, between the air diffuser, placed on the top of the unit and the circular silencer, from traces of dirt, then put on the flange the single adhesive EPDM supplied (not butyl mastic) , which will prevent the passage of air and reduce vibrations. The non-adhesive rubbery part of this gasket, will rest on the silencers edges instead, see Fig 20.

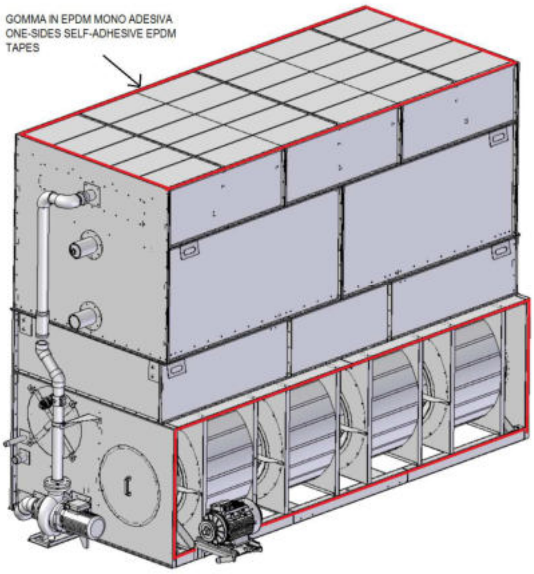

Fig. 20

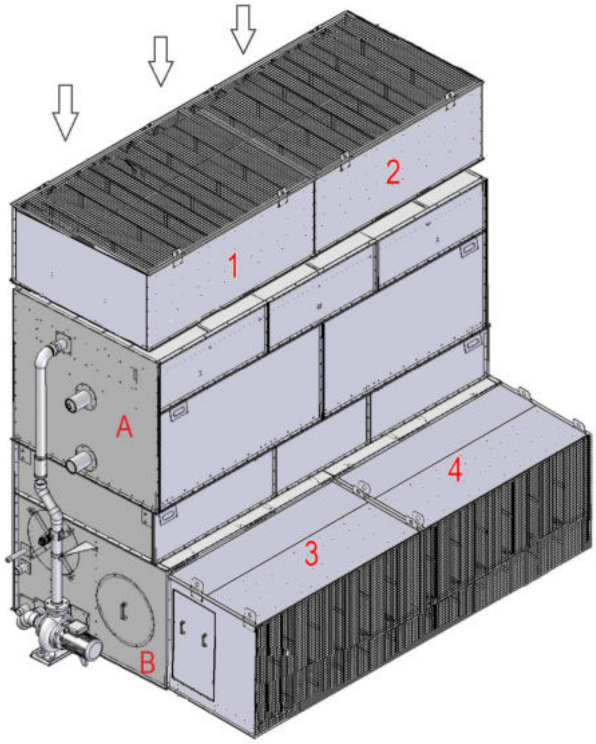

Fig. 21

At this point, move the blocks that form the silencers using the eyebolts provided until they come into contact with the panels of the evaporative condenser. If the length of the condenser is greater than 2.8m then the silencers will be made in multiple pieces. Looking at fig. 21, the inlet silencers, block 3 and 4, will be joined at the basin section (B) but will be independent of each other.

Note: be careful to install the door, present on only one side of each block, from the external side. On the external sides of the silencers (where the door is) the **M8x20 bolts** with nuts supplied, will be used, while,on the upper part of the inlet silencer should be used the **M8 self-tapping bolts** supplied, from the inside of the silencer towards the panel that is put on the fans. The floor of the silencer should only be placed next to the evaporative condenser.

The outlet silencers, blocks 1 and 2, must be placed on the coil section (A) and bolted to it with the **M8x20 bolts** provided. They must be moved using the eyebolts on the block.

Attention: Do not move the entire coil section or the entire unit by the eyebolts of the silencers for any reason.

4. OPERATIONS TO BE CARRIED OUT BEFORE THE START UP

4.1 Cleaning

Make sure 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.

In installations with **inlet silencers** there are bottom panels, under the ventilation compartment, check weekly that the condensate drain hole on the panels is free from foreign objects.

4.2 Inspection and checking

- Check the anchoring of the unit, the fans and motors and make sure they are correctly and securely tightened;
- Visually inspect ventilation components for possible damages;
- Check electrical box contacts on motor terminals;
- Check for friction or interference between the impeller and diffuser, making sure the impeller rotates easily in the direction indicated, without any unusual noise or rubbing;
- Make sure there are no foreign objects, inside the diffuser;
- Check that there are no foreign objects inside the basin;
- Make sure the areas under the fans are clean and free of dirt;
- 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 flexible hose temporarily inserted into the basin through the overflow connection or the inspection window.
2) **Adjust the mechanical float** to make sure that, with the sphere immersed (partially) and float in the closed position, the water level is about 25 mm below the overflow connection.
3) **Adjust the screw at the top of the float** acting on the internal piston to facilitate closing and minimize vibrations in relation to the make-up water delivery pressure. This pressure must not be too high in order to avoid water hammer phenomenon that would damage the float seal and cause noise and vibrations. The reference values range from 0.5 to 6 bar, fluctuating the flow rate of water introduced through the float.
4) **Check the water level inside the basin** after filling the entire water circuit. This level must always be above the suction filter to 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) Start the primary circuit by circulating the refrigerant gas inside the evaporative condenser coil.
6) At this point, if the pressure inside the coil is stable and there are no gas leaks, it is possible to power the electric motor of the fan(s) and the recirculation pump (secondary circuit) thus starting the evaporative condenser.
7) **Check that the fan and pump** rotation direction are correct as indicated on the fan and pump units.
8) In case you find any malfunction, a strange noise, an 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 installation or making unauthorized changes will void the warranty!

THE CONDENSER MUST NEVER OPERATE WITH THE INSPECTION WINDOWS AND SAFETY NETS REMOVED OR INCORRECTLY 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 condenser, care must be taken that the flow of both fluids are the design ones, 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 Quality control 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: information 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 web site 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 condenser 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
- suspended solid objects
- presence of microorganisms, a large formation of fouling, constitutes a refuge for the reproduction of microorganisms and this can 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
- pHs = pH balanced water
- pHs < pH encrusting water

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 $CaCO_3$) 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 condenser.

6.2.3 Biological growth

The ambient conditions existing in a evaporative condensers, 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. Many types are commercially available and the most suitable should be selected in consultation with specialized Companies. 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 results are obtained:
average flow of make-up water as a percentage of the circulating water flow:

$$\frac{N \times E}{N-1}$$

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.

ALWAYS MAKE SURE THAT ANY PRODUCT USED FOR WATER TREATMENT AND MACHINE CLEANING IS 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 condense↑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.
Damage caused by cold / ice can be avoided by purchasing a range of suitable optional for temperatures below 0° C. instead of standard materials. Moreover, by installing the electrical [illegible] 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. GENERAL 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 relevant areas 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 companies, 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 it's required by the Health Authorities.

Disinfection will be carried out by specialized companies, using authorized disinfectants compatible with the materials of the evaporative condenser. 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 if present, accessing the manholes to inspect the inside. The fan must be s topped. 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.

7.1.5 Coil

The coil should be regularly checked.The coil is the key element behind the performance of the condenser, 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 with their replacement if necessary.

7.1.7 Structure

The internal and external condenser panels must be cleaned at least twice a year. If any corrosion is present, 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;
- 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.
Make sure the bleed holes in the bottom of the diffuser are not plugged. If bottom panels are present under the fans, check that the holes are clear of any plugs.

7.2.2 Trasmission parts and belts

Make a monthly inspection to check the wear condition of the belts. Check the correct alignment and positioning of the shaft and pulleys and the tightening of the same. Also check the tightness of the bolts that secure the pulleys to the bushing.
Belt tension should be checked at start-up and during the first 24/48 hours of run-in, to verify and correct any initial stretching.

Note: Over-tensioning reduces belt and bearing life. The ideal tension is one at which the belt does not slip under maximum load conditions or whistle when starting the motor.

To adjust the belt tension, place a level on the two pulleys and measure the belt deflection by applying pressure to half of the free section as shown in fig. 22. The correct deflection is 15 mm with a moderate applied force on a 1000 mm free length. The correct tension should be checked monthly.

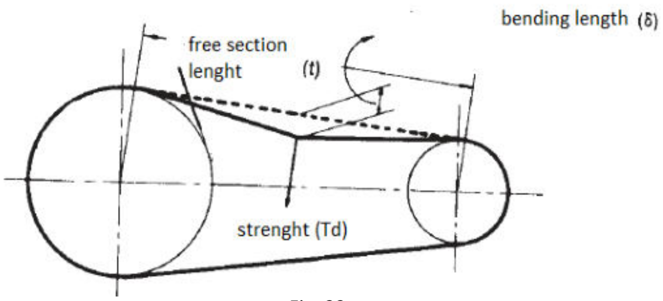

Fig. 22

7.2.3 Bearings

The maintenance of the rolling bearings will be related to the environmental conditions and temperatures in which the evaporative condenser will work. Below is a table showing the various greasing intervals:

Environmental conditions	Operating temperature		Greasing interval
	from °C	to °C	
Clean	0 50	50 70	from 6 to 12 months from 2 to 4 months
Dirty	0	70	4 weeks
Lot of moisture and splashing water	-	-	2 weeks

The bearings can be lubricated by a ball-type grease nipple to be applied to the outside of the bearings. Greasing is made possible by a channel and 2 holes in the inner shell of the bearing, that guide the grease into the bearing.

Grease moderately, frequently but with small amounts of grease (never use oil). Be careful not to put too much grease as this will cause overheating and even mechanical deformation of the seals.
Check, when needed, the tightness of the bolts fixing the cast iron support , the pin that attaches the bearing to the shaft and the wear condition of the rolling elements.

7.2.4 Fan unit electric motor

Installation and maintenance operations on electric motor, must be performed by trained personnel. Before starting the electric motor, check its general condition, the shaft, the integrity of the mechanical parts; check the correct rotation of the motor shaft, that all electrical terminals in the terminal block are connected, that the IEC 60034 motor rating plate values are those of the supply network from which it will be powered. If these values do not match or there is visible damage, do not start the electric motor. All the information on the nameplate of the electric motor must be checked carefully to ensure that the motor protection and connection are correct. If storing the electric motor, the environment should be kept between -20°C/+40°C. Check the correct direction of fan rotation by referring to the direction indicated on the auger.
All the information related to the electric motor are contained in the specific manual downloadable from the site : www.w-tech.it.

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

7.2.5 Recirculation pump

Installation and maintenance operations on electric motor, must be performed by trained personnel. efore putting the pump into use, check the general condition the preservation of the mechanical parts, verify the free rotation of the motor shaft, that all the electrical terminals in the terminal board are connected, that the IEC 60034 motor rating plate values are those of the network from which it will be powered. If these values do not correspond or there is visible damage, do not put the pump into service. All the information on the nameplate of the electric motor must be checked carefully to ensure that the motor protection and connection are correct. If storing the electric motor, the environment should be kept between -20°C/+40°C. Check the correct direction of the impeller by referring to the direction indicated on the pump. All the information related to the electric motor are contained in the specific manual downloadable from the site www.w-tech.it.

8. PREVENTIVE MAINTENANCE SUMMARY CHART

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

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

9. TROUBLESHOOTING CHART

PROBLEM	POSSIBLE CAUSES	ACTION
MOTOR ROTATES IN OPPOSITE DIRECTION	Error in connection	Change two phases in the power supply to the motor
ABNORMAL VIBRATION IN UNIT FAN	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
WATER LEAKAGE OCCURS FROM THE BOTTOM OF THE FANS	The water level is not correctly set	Reset the correct water level by acting on the mechanical float.
THE FAN UNIT VIBRATES	Worn bearings, mechanical deformation of seals or contact elements Impellers not properly tightened to the shaft Motor/Shaft not aligned	Remove and replace bearings with equivalent model Check condition of blades and that they are correctly fixed Clean any dirt from blades Tighten shaft mounting bolts Align motor/shaft
PUMP MAKES NOISE	Foreign objects in the piping Pump and/or piping not correctly installed Presence of air bubbles in the suction line	Check the basin, filter, and piping. Clean and remove foreign objects Correctly fix pipes and/or pump Make sure water level is correct

W-Tech S.r.l.
Head Office
Via Cartiera 90/A – 40037
Sasso Marconi (BO) – ITALY
T: +39 051 6783010

info@w-tech.it - www.w-tech.it