Installation and maintenance manual

Open type cooling tower

Axial type

Series TAA
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### 1. Machinery Description

#### 1.1 General Safety Use

This painting procedure is internally named W-COAT® and is given as standard protection on all products manufactured by W-Tech.

Other connections could be provided in accordance to the additional option elements, which are possible to fit. For a quick review and not limited to, we can mention:

- Overflow
- Make up water with float valve

In the water basin, the following standard connections are provided:

- Casing, water collection basin, air intake and louver panels
- Air system
- Water distribution system

The open circuit cooling tower is composed by the following elements:

1. Casing and water collection basin
2. Air system
3. Water distribution system
4. Drift eliminator

#### 1.2 General Description

The lower body of the casing forms the cold water basin. A minimum 2% slope is granted, in order to naturally flow water out of it. On resistance against water corrosion, ultraviolet rays and other atmospheric elements.

#### 1.3 Water Distribution System

- 1050 GPH (4002 l/h) provides the best cooling system with 2 towers.
- Each tower has an electric water pump (WEP) supplying the cooling tower with water.
- Make-up water, to replace depletion through evaporation or elimination to avoid scaling, is carried out automatically by means of an intake valve installed in the basin.

#### 1.4 Air System

- Air is supplied in counter-flow to the water and is provided by axial fan(s) statically and dynamically balanced, installed at the top of the cooling tower (induced draught).
- Motor(s) are mounted on a galvanized steel support or plate, and installed inside the cooling tower, just below the fan.
- Running speed can vary in accordance to each single machine project specification. Special motors can be fitted on demand.

#### 1.5 Casing and Water Collection Basin

- The body of the unit is manufactured in "SSPP" depending on the operating cases.

- Full list of options are listed in the technical sheet.

#### 1.6 Electric Heater

Electric heater (to avoid water freezing in the basin in winter time)

- Minimum water level switch for heaters (to protect electric heater to work uncovered by water)
- Minimum water level switch for pump (to protect re-circulating pump to work without the necessary water level)

- Make-up water, to replace depletion through evaporation or elimination to avoid scaling, is carried out automatically by means of an intake valve installed in the basin.

Spray nozzles (made by static fibreglass reinforced polypropylene) are screwed into the PVC pipes and allow water to drop onto the fill pack. Nozzles have a wide water passage, with minimum possibilities of clogging, breaking down or blocking. The design of the nozzles is studied to allow the perfect water distribution (full cone) over the filler.

#### 1.7 Drift Eliminator

Evaporation is achieved thanks to a high quantity of air moved, by the use of axial fan(s) installed on top of the unit, counter-flow to the water flow.

Inside the tower there is a fill pack that has the purpose to increase the contact surface between water and air, creating a series of thin films that promote the evaporation.

- The fluid to be cooled (generally an aqueous solution) by gravity through the tower in the form of minute drops, thanks to the use of films that promote the evaporation.
- The electric motor(s), totally sealed and self-ventilated, are provided standard with class F insulation, capable of withstanding a temperature of 140 °C.
- The content of this manual is to be considered as an integration to the general safety rules applied in your country, in the environment you are working in and also to the rules to be followed by law. In case of conflict with any of the previously mentioned rules in place, please contact our technical office for alternative procedures that will not create conflict.

Always remember that any operation with mechanical machinery could be dangerous and make sure all possible precautions are followed before and during assembly & maintenance.
2. DELIVERY AND HANDLING

2.1 Delivery method

All models of this series are delivered with the maximum possible elements mounted in our factory. Depending on the height of parts, the unit will be divided in order to lower the transport costs. Generally the deliveries are carried out in two or more parts.

To facilitate the handling operation, the single parts are laid on a wooden pallet.

Connection elements to be used on site (gaskets, silicone, nuts and bolts) are supplied in a separate box.

2.1.1 Lower body

This is composed of the following elements:
- Cold water basin with all its elements
- Air intake section
- Filling body (if not delivered separated)

2.1.2 Middle body (if any)

This is composed of the following elements:
- Filling body

2.1.3 Upper Body

This is composed of the following elements:
- Air system (Fan(s), Motor(s))
- Diffuser and fan-guard
- Water distribution system, secondary circuit
- Drift eliminator

WOOD SUPPORTS AS WELL AS THE PLASTIC OR CARDBOARD SHEETS HAVE TO BE REMOVED BEFORE INSTALLING THE COOLING TOWER IN ITS FINAL LOCATION. PARTICULAR ATTENTION HAVE TO BE GIVEN TO CHECK WATER BASIN, WATER PIPES AND WATER DISTRIBUTION SYSTEM TO BE FREE OF ANY PARTS WHICH CAN CAUSE PROBLEMS OR DAMAGES TO THE NORMAL FUNCTION OF THE COOLING TOWER.

ALL AUXILIARY MATERIAL NEEDED FOR ASSEMBLY ARE DELIVERED IN A BOX, INSIDE THE LOWER BODY.

2.2 Handling

To facilitate the handling of each single part, eyebolts are fitted, located at the top, so that lifting and handling, by crane, can be carried out easily. This can be observed in figures 1 & 2.

THE EYEBOLTS ARE ONLY FOR USE IN TRANSPORTING AND HANDLING THE BODY THAT THEY ARE ATTACHED TO. ALL EYEBOLTS MUST BE USED IN THESE OPERATIONS. THEY MUST NEVER BE USED FOR MOVING THE TOWER ONCE IT HAS BEEN ERECTED AND BOTH BODIES ARE ASSEMBLED.

The lower body handling will be carried out using all its eyebolts due to its weight, as indicated in fig. 1.

To move the upper body, all eyebolts will be used as well, as indicated in fig. 2.

Fig. 1  Fig. 2
3. INSTALLATION

3.1 Tower foundation and anchoring

Our units have no needs of any special foundation. They can be placed directly onto a concrete slab or onto concrete coated ground, making sure in all cases that the anchoring is capable of resisting the operating load distributed by the tower bed-frame. They can be anchored on two or three steel beams, in the larger units, all along the basin. This anchoring can be observed in fig. 3 and will need some bolts and nuts to be fitted.

In any case, the surface has to be perfectly level before installing the tower. 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.

3.2 Location conditions

The unit must never be located in an area that is enclosed on all four sides. Sufficient clearance must be provided all around the tower, so that the cold air may circulate at a speed lower than that of the hot air outlet stream. Therefore, this passage section must be equal in size or bigger than the base plan section of the tower. Any obstacle above the tower at a height lower than that of the tallest side of the tower shall be avoided.

Sufficient space must be provided around the tower to allow access to all parts requiring maintenance. See fig 4.
3.3 Assembly of the bodies

Before beginning the assembly on site, check that all elements delivered inside the basin have been removed. To access the basin, the bolts used to capture the angle that is used to hold the louvers panels have to be eased. Then the angle is to be removed, as well as some panels. The angle to be removed is located in the adjacent side where the floating valve is placed. See fig. 6a and 6b.

Once the lower body has been installed, the entire perimeter of the assembly flanges must be cleaned. Then, a rubber sealing gasket (supplied) will be installed in order to avoid any damp and/or dirt, just in the centre line of the holes of the flange. If the cooling tower has a flange without holes, then a double line of superimposed gaskets will be installed, as shown in fig. 7, in order to protect these bodies more thoroughly.

Once the gasket has been installed, it is recommended to introduce a pointer in the holes, in order to remove any traces of the gaskets that might be left there.

The assembly could be helped by means of pointers, which will be inserted in the holes in the lower body just before the upper one is allowed to rest on it. Please see fig. 8.
3.3.1 Drift eliminators positioning

Before proceeding to the assembly of the sections, it may 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 a 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 the neck apart.

First step is to distinguish the components for width and length so as to prepare them for the provision on the frame pre-assembled in the factory (Fig. 9) which will make simple and intuitive the installation. Once the drift eliminators are distinguished by size, on smaller units you must assemble them shoulder to shoulder on the longer side and insert a pair of them in between. (see Fig. 10). On a larger unit, the drift eliminators should be placed head to head on the shorter side (Fig. 11).

Once all the drift eliminators are positioned it is possible to apply the metal bands that will make sure they stay on their place (fig. 12).

Now you can complete the assembly of the unit, positioning the top section on the middle section and follow the instructions above.
3.4 Electrical connection

Our units are normally supplied with the electrical motors already cabled and the wires are available outside of the unit minimizing the labour on site. In case of particular motor versions or if the electrician is willing to re-wire all, please find below the procedure to follow. In order to connect the motor of the fans, it is necessary to go inside the upper body, through its inspection manholes, see fig. 2, or directly from the mouthpiece of the fan for the units without a manhole.

Introduce the connection cable till the terminal box, through the holes available in the casing.

Capture the cable to one of the pipes that composes the motor support, by means of clamps. See fig. 13.

To make the connection of the motors (and also of the fans and the electrical pump) 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 tightened securely and that all stripped wires are carefully insulated in order to carry out the connection.

• Check that the rotation direction of the fan is the same as the direction of the arrows available on the diffuser.

• We recommend that the mains supply line to the motor should be protected with well calibrated thermal relays and fuses. Please remember that in across-the-line starting, a squirrel cage motor needs an intensity 6 to 7 times higher than the nominal one.

• Make sure the local electrical safety regulations in force have been respected.

• Check and remove any material or element which has been part of the packing, and could be still joined to or inside the tower.

IMPORTANT: DO NOT COVER THE UNIT WITH TARPAULINS OR SIMILAR DURING OPERATION NEITHER WHEN THE UNIT IS OFF!

4. OPERATIONS TO BE CARRIED OUT BEFORE THE START UP

4.1 Cleaning

• Make sure that the distribution system is clean and that the distribution nozzles are correctly positioned and free of any kind of blockage.

• Check if the water basin is completely clean, if not, clean it using water under pressure.

4.2 Inspection and checking

• Check the anchoring of the tower, the fans and motors and make sure they are correctly and securely tightened.

• Inspect the motors by sight, checking that they have been correctly installed.

• Check the connections of the terminal boxes of the motors.

• Make the fan turn for an instant, making sure that it turns easily and in the correct direction, without any unusual noise or friction.
5. START UP

1. Fill the cold water basin through the make-up water pipe or, better still, by means of flexible hose inserted provisionally into the basin.

2. Adjust the float arm of the make-up valve to ensure the level is maintained around 25 mm below the overflow level.

3. The level of water inside the basin, with the electric pump working, has to be always above the suction level of the electric pump and grid, in order to avoid cavitations. This level can be checked from the manhole door, with the electric pump working and the fan(s) completely stopped.

4. Once this regulation has been achieved, the fan(s) motor can begin to work and the cooling tower is prepared to start up.

VERY IMPORTANT !! THE TOWER MUST NEVER OPERATE WITHOUT HAVING THE FANGUARD AND THE ACCESS DOOR CORRECTLY FITTED. THE FAN MUST BE STOPPED BEFORE THE OPERATIONS OF REMOVING AND REPLACING THESE ELEMENTS ARE CARRIED OUT.

6. OPERATING INSTRUCTIONS

6.1 Tower Performance

In order to obtain the appropriate performance from the evaporative cooler, care must be taken that the flow of both fluids are the design ones, the secondary circuit water distribution is correct, and the different items in the distribution system must be clean and clear.

If a change in the secondary circuit water flow is required, it might be necessary to replace the nozzles, depending on the difference between the design flow and the new required flow. Please consult W-TECH.

It is essential to keep the filler, inlet louvers and drift eliminators clean, as otherwise the cooling tower performance will be reduced. It is advisable to visually inspect these parts periodically.

6.2 Control of water quality in the circuits

Controlling the quality of the recirculating fluids is essential, not only for the cooling tower itself but also for all the elements that make up the cooling circuits. We recommend that companies specialised in fluid conditioning and treatment should be consulted about the fluids for each circuit. However, some general rules and instructions to be followed for correct circuit control are given below:

This control must be aimed at preventing the elements in the circuits from:

1. Fouling and blocking.
2. Corrosion.

6.2.1 Fouling and blocking

This is caused by:

6.2.1.1 Salt precipitation (scaling), by their solubility product being exceeded.

The most common salts are:

- Calcium Carbonate.
- Calcium Sulphate.
- Silicates.

The following conditions must be maintained in order to eliminate them:

- Ryznar index = 2 pHs - pHc between 6 and 7
- The product of sulphates and calcium concentration in the circuit water, (both expressed in mg/l Co3 Ca), should be less than 500.000.
- Silica content should be lower than 150 mg/l.

6.2.1.2 Suspended solids

These can be brought into the secondary circuit of the cooling tower by the make-up water, by the air or by contamination during the process.

In the secondary circuit of the evaporative cooler, 100 to 150 p.p.m. of suspended solids can be admitted.

6.2.1.3 Biological growth

The ambient conditions existing in a cooling tower favour biological growth.

It is usually necessary to periodically treat circuits with chlorine and/or other biocides in order to prevent these growths. Treatment of this kind is particularly necessary when the circuit might suffer casual (accidental) pollution caused by process fluids, as happens in refineries, sugar refineries, etc..

6.2.2 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.

The above leads to a limitation on the maximum number of concentrations acceptable in the secondary circuit.

The number of concentrations is called "Concentration Cycles" and is represented by the letter N.
Considering that the fluid in question is water we have:

- $E$, evaporated water flow in the tower as a percentage of nominal water flow.
- $P$, total blow down (drift in tower plus losses in circuit plus the concentration blow down) as a percentage of nominal water flow.

The following ratios are obtained:

- Average make-up water flow as a percentage of circulating water flow:

$$ \frac{E}{P} $$

- Total blow down needed in the circuit as a percentage of circulating water flow:

$$ \frac{P}{N} $$

The factors that are used to control the number of concentrations, are normally determined by dividing the concentration of chlorides in the circuit for the concentration of chlorides in the water refilling. Normally they are not practicable values of $N$ (of concentration cycles), more than five, even when the water topping up is high quality.

ALWAYS MAKE SURE THAT ANY PRODUCT USED FOR WATER TREATMENT AND CLEANING IS COMPATIBLE, AND IN THE PROPER CONCENTRATION, WITH THE MATERIALS OF THE UNIT (GALVANISED STEEL, PP, STAINLESS STEEL, ETC) AND WILL NOT DAMAGE THE COMPONENTS OF THE UNIT ITSELF.

6.3 Electrical locking

To ensure this, we recommend that a key-operated stop switch should be fitted, making it impossible to operate when the key is not in the lock.

VERY IMPORTANT! BEFORE REMOVING THE FANGUARD OR THE ACCESS DOOR TO THE MECHANICAL EQUIPMENT, IN ORDER TO CARRY OUT MAINTENANCE OPERATIONS, ALWAYS MAKE ABSOLUTELY SURE THAT THE FAN IS STOPPED AND THAT IT CAN NOT BE RESTARTED UNTIL THESE OPERATIONS HAVE FINISHED.

6.4 Cold weather operation

Cooling tower operation at temperatures below 0°C might give rise to the formation of layers of ice at the air intakes. Ice formation can be reduced, and even prevented, by taking the following measures:

- Install heating resistances and a level sensor.
- Use the materials (air intake grilles, droplet separators, etc.) suitable for temperatures below 0 °C.
7. GENERAL MAINTENANCE INSTRUCTIONS

Due to the quality of these units, maintenance requirements are minimal. Nevertheless, they will be inspected fully on a monthly basis. In the same way, the entire circuit should be cleaned every year.

It is advisable to carry out certain actions regularly in order to ensure that you achieve the service life and performance that these units have been designed for.

There are two basic areas to cover:

1. Water recirculation system
2. Air blowing system

7.1 In the water recirculation system

Due to the fact that the systems in which these products are based are related to evaporation, some salty concentrations, as well as suspended solids are produced. Therefore, some secondary water flow has to be removed, in order to prevent the concentrations in the coils. The drainage connection will be used to do this.

The water conditions will be controlled continuously and automatically, by purging of dirty water and replacement with clean, addition of bio dispersant agents and biocides, inhibitors to prevent lime scale from building up or the corrosion of the metallic parts of the circuit. Several varieties are commercially available and the most suitable should be selected in consultation with specialised firms, who have the knowledge of the water in the installations and the area. Be careful if any acid product is being used, due to the fact that is not recommended the PH to be lower than 6.5. Another aspect to take into consideration is the fact that the products being used have to be compatible with the kind of materials composing the cooling towers.

These units will be disinfected twice a year, at the beginning of spring and of autumn, as well as in the following circumstances:

• Before putting into operation.
• If they have been stopped for a long period of time.
• When repairs have been carried out.
• When routine inspection so indicates.
• When the Sanitary Authorities so determines.

Disinfection will be carried out using authorised disinfectants. If chlorine is used, inject 5 p.p.m. of chlorine plus bio dispersants into the basin and set the pumps running for five hours. The fans will be stopped.

In case of use of chlorine only, inject a quantity comprised between 5 and 15 p.p.m., with the fans stopped. The pumps will be allowed to run for five hours (check the chlorine level every hour).

Following this, all the water will be drained from the circuit and it will be cleaned thoroughly, adding water until the drain water appears clean.

The water conditions will be controlled continuously and automatically, by purging of dirty water and replacement with clean, addition of bio dispersant agents and biocides, inhibitors to prevent lime scale from building up or the corrosion of the metallic parts of the circuit.

The water will be drained out of the basin when the unit is not in use.

The maintenance functions to be carried out for the different elements are listed below.

7.1.1 Grid

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

7.1.2 Basin

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

7.1.3 Water make-up

Float valve will be check monthly, as well as the water level in the basin, it always has to work above the grid and suction level of the electric pump.

7.1.4 Fill pack

The fill should be inspected regularly. It must keep in mind that is the key element to the base of the tower's performance. Therefore, because of the possibility of formation of scale and fillings of the alveoli, it is recommended that a monthly verification and the daily purge of part of the water spray.

7.1.5 Water distribution system

This has to be checked monthly. To do so, some eliminator blocks have to be removed in order to inspect the inside part. The fans have to be stopped and the electric pump will be switched on.

The nozzles, which are wide passage, with minimum possibilities of breaking down or blocking, allowing perfect water distribution (full cone) over the fill pack. If by any chance they become clogged, they can be dissembled very easily.

Therefore, the grid will be cleaned, the nozzles will be removed if necessary to do so, and the pump will be switched on, in order to clean the pipes. If the nozzles have to be removed, when reinstalling in their place, be careful to put them in the correct position, as shown in fig. 14.
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 Motors

Motor maintenance is essentially limited to keeping winding and cooling ducts clean, as well as attending bearings. If the motor has grease-lubricated bearings, also perform this lubrication. For other details refer to chapter 8.

7.2.2 Fans

A monthly inspection has to be carried out, in order to remove any paper, leaves or any other elements which could enter the impellers. Ensure the integrity of the blades.

7.3 Casing and water collection basin maintenance

The cooler has to be checked and cleaned twice a year at least. The basin needs cleaning periodically, since otherwise the drain outlets, overflows, valves and circulation pumps would become blocked.

We recommend draining and cleaning each month, or as often as necessary, in accordance with the legislation in force, so as to prevent the build-up of sediment.

At least twice a year the casing will be checked, as well as cleaning the tower external and internally.

If any corrosion is appreciated, proceed in the following way:

1. Clean the affected zone by means of a steel brush.
2. A zinc layer has to be applied.
3. Apply an Aluminium layer over the zinc layer.

7.4 Drift eliminator

A general cleaning should be carried out twice a year at least, proceeding to its substitution if necessary.
8. ELECTRIC MOTOR FAN UNIT

Installation and maintenance operations, which involve operations on the electric motor, must be performed by trained EN 60204-1 personnel.

Before commissioning the electric motor, check the general condition of the same, the shaft, the conservation of the mechanical parts; check the free rotation of the shaft, that all electrical terminals in the terminal are connected, that the IEC 60034 motor nameplate values are those of the network that will power it. If these values do not match or there are visible damages do not action the motor. All nominal data shown on the nameplate must be checked carefully in order to ensure that the motor protection and connections are correct. The maintenance is important to prevent faults and ensure reliable and long lasting operation. In case of electrical motor storage, the location must be maintained between -20°C/+40°C.

ALWAYS DISCONNECT THE POWER BEFORE WORKING ON IT OR ON THE EQUIPMENT CONNECTED TO IT.

DO NOT START THE MOTOR WITH THE SHAFT KEY FIXED ON THE SHAFT, BECAUSE DUE TO THE CENTRIFUGAL FORCE IT CAN BE EXPELLED WITH SERIOUS DANGER.

8.1 Wiring and electrical connections

The terminal box of single speed standard motors generally contains 6 winding terminals and at least one earth terminal, it is therefore possible to start DOL or Y/D, as in fig. 15. Voltage and type of connection are stamped on the rating plate of the motor. To connect all main cables, suitable cable lugs should be used. For cable entries, use sealed cable glands in accordance with the type of protection and the type of cable diameter used. The cable entry holes not used must be closed with elements according to the IP class of the terminal box. Grounding must be performed in accordance with local regulations, before connecting the motor to the mains.

Fig. 15

For direct network start (DOL) it is possible to use the star connections (Y) or delta (D). Example 690 VY - 400 VD, indicated a star connection (Y) to the voltage of 690 V, and delta (D) to the voltage of 400 V.

WARNING: FOR ENGINES WITH POWER EQUAL OR GREATER THAN 10KW STARTING STAR/DELTA IS RECOMMENDED.

The star/delta starting (Y/D) when using delta connection, involves that the supply voltage must be equal to the rated motor voltage. Remove all connection links from the terminal.

8.1.1 Double speed motor connections

For special 2 speed single or double winding motor, follow carefully the connection instructions inside the terminal box or in the motor handbook. For information purposes, we report the connection diagrams according to IEC 34-08.

Star and delta connection for single-speed motors

Two separate windings for two speed motors:

Number of pole: 2/6,2/8,4/6,8
Synchronous speed at 50 Hz: 3000/1000,3000/750,1500/1000,1000/750.
8.1.2 Auxiliary devices connection

In addition to the main winding terminals and ground terminals, the terminal box can also contain connections for thermistors, the heating elements or other auxiliary devices. These are to be connected following the instructions of the connection diagrams that are located inside the terminal box.

The maximum measured voltage for the PTC thermistor is 2.5 V, the maximum measuring electricity for Pt100 is 5 mA. The use of voltages greater than those indicated can cause errors in reading or damage the components. In fig. 16 the characteristic curve Resistance/Temperature of the PTC installable.

For engines operating under high humidity and extreme thermal excursion we recommend the application of space heaters to eliminate condensation. They are of belt type and are mounted on the head of the stator windings. It is normally expected when the motor supply is interrupted, generating a heating that prevents the condense formation. The normal power voltage supply is 115 V or 220/240 V.

The terminal of the anti-condensation heaters are taken to special terminal board inside the main terminal box. They must be supplied to the voltage indicated on the motor plate.

The heater, if any, should be fed and monitored regularly. Since condensation is particularly deleterious to the electrical components, the temperature of the motor should be maintained above the dew point using internal or external heating sources if heater is not provided.

8.2 Operating conditions

Unless otherwise specified on the rating plate, the motors are designed for the following environmental conditions:

- Temperature between -20°C and +40°C.
- Maximum altitude 1000 m above sea level.
- Tolerance for supply voltage is ±5% and for the frequency ±2% in accordance with EN / IEC 60034-1.

Ensure that the motor has sufficient airflow. Ensure that no nearby objects or direct sunlight wouldn't transmit additional heat to the motor. The temperature of the motor housing can be hot to touch during normal operation and in particular after switching it off. The fact that it can reach around 90 or 100°C might wrongly suggest that the engine is not working properly. It is not necessary, according to methods used in the past, to detect the temperature of the carcass as the sole indicator of the correct motor operating.
8.3 General inspection

Inspect the motor at regular intervals, it is recommended every 3 months, and maintain clean fan and carcass, depending on the humidity level, climate conditions and dust presence.

In case of motor IP 55 and when motor with a condense drain plug closed is supplied, it is suggested to periodically open the drain plugs to ensure that the condensation outlet is not blocked and allows the condensation to escape from the motor. This operating must be carried out when engine is still and in safe conditions.

Every three months presence of rust on the shaft and flange should be verified. If there is any it should be removed with emery cloth working gently. Then prevent a rust treatment. After a long storage, check the bearings. Replace rusted bearings and lubricate.

8.4 Lubrication

During the first start up or after lubrication of a bearing, it is possible that temporary increase of temperature appears, for around 10-20 hours.

To ensure the average duration of the bearings it is important to check the motor periodically, in order to prevent damage caused by increased operating temperature, the accumulation of dirt or dust on the motor housing or in the ventilating system.

WARNING: DURING LUBRICATION PAY ATTENTION TO ALL THE ROTATING PARTS. FAT MAY CAUSE IRRITATION TO THE SKIN AND EYE INFLAMMATION. FOLLOW ALL SAFETY PRECAUTIONS INDICATED BY THE MANUFACTURED OF THE GREASE.

8.4.1 Manual lubrication

If intending to lubricate while motor still going proceed as follows:

1. Remove the outlet cap, located under the shield/front flange and rear shield.
2. Check that the lubrication channel on the shield/front flange (DE) and rear shield (NDE) is opened.
3. Inject the recommended amount of grease (motor handbook) in the bearing.
4. Run the motor for 1-2 hours to ensure that the extra grease is forced out of the grease drain plug. Close the outlet plug or the closing valve if provided.

In case of lubrication when motor still, proceed as in steps 1. 2. but in this case use only half the grease requested, then run the engine for a few minutes at full speed. When motor has stopped, apply the rest of the grease in the bearing. After 1-2 hours of operation, close the grease outlet plug or the closing valve if provided.

When regressing, use only special lubricants for ball bearing with the following characteristics:

- Good quality grease with lithium soap and mineral or PAO oil
- Base oil viscosity 100-160 cST at 40°C
- Temperature range -30°C / +110°C, continuing.

Do not mix different types of grease. Incompatible lubricants may cause bearing damage.

WARNING: THE MAXIMUM TEMPERATURE OF GREASE EXERCISE AND BEARINGS (+110°C) MUST NOT BE EXCEEDED.

MAXIMUM NOMINAL MOTOR SPEED MUST NOT BE EXCEEDED.

IF MOTOR POWERED BY INVERTER, THE AVERAGE DURATION OF THE BEARINGS IS REDUCED.

8.5 After sales service

When ordering spare parts of an engine, state the machine serial number, full type designation and product code, as on the nameplate.

Making changes to winding or violating the integrity of the engine itself will invalidate the warranty.

For extraordinary operations that should always be performed by authorized workshop, contact W-tech.
<table>
<thead>
<tr>
<th>Operations to be Carried Out</th>
<th>Every Day</th>
<th>Every Month</th>
<th>Every Six Months</th>
<th>When Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blowdown</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Grid</td>
<td></td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Basin Water Make-up</td>
<td></td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Electric Pump Water</td>
<td></td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Distribution Motor Fan</td>
<td></td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Drift Eliminator Casing</td>
<td></td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Cold Weather Operation</td>
<td></td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Inspect for Fouling</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Inspect General Condition</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Clean &amp; Disinfect</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Basin Water Level</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Overheat, Noise &amp; Vibration</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Inspect Leaks</td>
<td>S/N</td>
<td>S/N</td>
<td>S/N</td>
<td>S/N</td>
</tr>
<tr>
<td>Tighten Bolts and Anchor</td>
<td>N N</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Balancing &amp; Alignment</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
<tr>
<td>Lubrication</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
<td>fi</td>
</tr>
</tbody>
</table>

*Please check also the instruction manuals of the suppliers.*
<table>
<thead>
<tr>
<th>DEFECT</th>
<th>POSSIBLE CAUSE</th>
<th>ACTION TO BE TAKEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTOR ROTATES IN OPPOSITE DIRECTION</td>
<td>Error in connection.</td>
<td>Change two phases in the power supply to the motor.</td>
</tr>
<tr>
<td>ABNORMAL VIBRATION IN MECHANICAL EQUIPMENT</td>
<td>Fan/ fan motor.</td>
<td>Check state of blades and that they are correctly secured. Clean deposits from blades, eventually verify ice formation in winter. Check motor bolts and eventually tighten.</td>
</tr>
<tr>
<td>BAD HOT WATER DISTRIBUTION</td>
<td>Nozzles are blocked, broken or lost.</td>
<td>Remove the nozzles and clean them. Eventually replace it.</td>
</tr>
<tr>
<td>BAD THERMAL EFFICIENCY OF THE TOWER</td>
<td>Drift eliminator is blocked.</td>
<td>Remove the drift eliminator, clean and eventually replace it. Incorrect water distribution. Remove the nozzles and clean them. Eventually replace it.</td>
</tr>
<tr>
<td>Fouling coil.</td>
<td>Contact water treatment specialist for an appropriate clean.</td>
<td></td>
</tr>
<tr>
<td>Air intake grids are obstructed.</td>
<td>Clean. Eventually replace.</td>
<td></td>
</tr>
<tr>
<td>BASIN WATER FILTER</td>
<td>Inspect and clean.</td>
<td></td>
</tr>
<tr>
<td>THE MOTOR DOES NOT START, STARTS WITH DIFFICULTY OR DOES NOT REACH ITS RATED SPEED AND OVERHEATS.</td>
<td>Bad switch connection. Interruption in connection or in winding. Short circuit in the field winding. The rotor or the fan is jamming. Short circuit to the casing or to earth. Excessive number of motor starts.</td>
<td>Connect the motor correctly. Find and eliminate the interruption. Find and eliminate the short circuit in the windings (rewind the motor). Find and eliminate the mechanical defects. Find and eliminate the short circuit between the turns or the short circuit to the casing. Extend the duration of stops in motor operation or reduce the number of starts.</td>
</tr>
<tr>
<td>ASYMMETRY OF THE CURRENT STRENGTH IN THE SUPPLY WIRES</td>
<td>Interruption in connection or in winding. Short circuit in the field winding. Short circuit to the casing or to earth.</td>
<td>Find and eliminate the interruption. Find and eliminate the short circuit in the windings (rewind the motor). Find and eliminate the short circuit between the turns or the short circuit to the casing.</td>
</tr>
<tr>
<td>LACK OF CURRENT IN ONE OF THE WIRES</td>
<td>Interruption in connection or in winding.</td>
<td>Find and eliminate the interruption.</td>
</tr>
<tr>
<td>TEMPERATURE RELAY CUTS OFF CURRENT WHEN MOTOR IS CONNECTED OR DURING OPERATION</td>
<td>Excessive number of motor starts. Bad switch connection. Interruption in connection or in winding. Short circuit to the casing or to earth. Temperature relay is incorrectly adjusted. Motor prepared for triangle connection and star connected.</td>
<td>Connect the motor correctly. Find and eliminate the interruption. Find and eliminate the short circuit between the turns or the short circuit to the casing. Correctly adjust the temperature overload relay. Extend the duration of stops in motor operation or reduce the number of starts.</td>
</tr>
<tr>
<td>THE MOTOR RATTLES</td>
<td>Interruption in connection or in winding. Short circuit in the field winding. Short circuit to the casing or to earth.</td>
<td>Find and eliminate the interruption. Find and eliminate the short circuit in the windings (rewind the motor). Find and eliminate the short circuit between the turns or the short circuit to the casing.</td>
</tr>
</tbody>
</table>
11. RECOMMENDED WATER CHARACTERISTICS

<table>
<thead>
<tr>
<th>Property</th>
<th>300 gr/m² Galvanized steel</th>
<th>AISI 304 Stainless Steel</th>
<th>AISI 316 Stainless steel</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>7.0 – 9</td>
<td>6.0 – 9,5</td>
<td>6.0 – 9,5</td>
</tr>
<tr>
<td>Total suspended solids (ppm)</td>
<td>&lt; 25</td>
<td>&lt; 25</td>
<td>&lt; 25</td>
</tr>
<tr>
<td>Conductivity (micro-Siemens/cm)</td>
<td>&lt; 2.400</td>
<td>&lt; 4.000</td>
<td>&lt; 5.000</td>
</tr>
<tr>
<td>Alcalinity CaCO₃ (ppm)</td>
<td>75 – 600</td>
<td>&lt; 600</td>
<td>&lt; 600</td>
</tr>
<tr>
<td>Hardness CaCO₃ (ppm)</td>
<td>50 – 750</td>
<td>&lt; 600</td>
<td>&lt; 600</td>
</tr>
<tr>
<td>Silica SiO₂ (ppm)</td>
<td>&lt; 150</td>
<td>&lt; 150</td>
<td>&lt; 150</td>
</tr>
<tr>
<td>Clorides Cl⁻ (ppm)</td>
<td>&lt; 400</td>
<td>&lt; 400</td>
<td>&lt; 2.000</td>
</tr>
<tr>
<td>Bacterial (cfu/ml)</td>
<td>&lt; 10.000</td>
<td>&lt; 10.000</td>
<td>&lt; 10.000</td>
</tr>
</tbody>
</table>