Installation and maintenance manual

Open type cooling tower

Centrifugal Type

Series TC
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1. MACHINERY DESCRIPTION

1.1 General Safety use:

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.

SAFETY FIRST!

1.2 General description

The open type cooling tower of series TC is a water cooling system. 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 by gravity through the tower in the form of minute drops, thanks to the use of nozzles placed at the base of the fluid inlet pipe to be cooled, yielding part of its calorie content for direct contact with the atmospheric air.

The air is forced in counter-flow to the water, through centrifugal impellers located in the lower body of the unit, which turn is just above the water collected in the basin.

The tower is composed by the following elements:

- Filler
- Water distribution system
- Ventilation system
- Drift eliminators
- Water collection basin

1.3 Exchange material

The filler consists of suitable PVC/PP sheets shaped by thermoforming. The height of the thermoformed profile may vary due to the chosen profile (12/19/27 mm). The design of the sheets is crossed type with raceways inclined at 60° horizontal and present an inlet section of variable height from 24 to 54 mm. The alveolar structure of the filler and its high specific surface makes this section a vital elements to the operation of the unit.

1.4 Water distribution system

The water is distributed on the filler through primary piping and anti-clogging nozzles.

The spay nozzles are completely static, made of polypropylene reinforced with fiberglass, with large light and minimal chances of breakage or clogging; these allow perfect distribution of the fluid on the filler, in order to increase the heat exchange. If, for whatever reason, the nozzles clog or get damaged, they can be easily disassembled, cleaned or replaced. The amount of make-up water is adjusted automatically by a float valve installed in the basin.

1.5 Ventilation system

Air is supplied in counter-flow to the water and is provided by centrifugal fan(s) statically and dynamically balanced, installed at the steel-painted shaft supported at the ends by self-aligned ball bearings with cast iron supports (forced draft). The impeller made of galvanized steel is located within the diffuser that is in painted galvanized sheet metal or stainless steel.

An arrow indicates the direction of rotation is placed on the diffuser. In order to prevent objects of any kind to fall in the diffuser causing damages to the fan or any other element, a galvanized steel wire guard s mounted. The motors, with mechanical protection IP 55 insulation class F, able to withstand a maximum temperature of 155ºC if the average temperature of cooling is 40ºC (as required by VDE standards for motor installations) continuous service S1 and B3 form, are mounted on adjustable sturdy sledges in galvanized steel placed in protected position from the weather. The transmission is delivered by a drive belt, calculated at 150% of the rated output and always service factor greater than 1,6.

1.6 Drift eliminators

Drift eliminators allow to separate the water droplets present in the air steam that passes through the tower. The panel drift separators are very performing both from an efficiency point of view both the high mechanical strength.

These components reduce the environmental impact phenomena, favouring the return of condensed water drops in the basin reducing the water consumption avoiding the bacterial proliferation, all with low load loss and minimum weight.

1.7 Water basin system and structure

The body of the unit is manufactured in "Sendzimir" galvanised steel covered with 300 g/m² zinc layer. As a standard, a minimum 70µ complete paint of epoxy-polyester layer is applied on each side of the panels. The application is done by electrostatic process, following the paint is polymerized in an oven at 180 ° to guarantee a perfect application in every point. This gives a considerable resistance against water corrosion, ultraviolet rays and other atmospheric elements. This painting procedure is internally named W-COAT® and is given as standard protection on all products manufactured W-Tech.

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 one side of the basin, a stainless steel anti cavitation suction filter is provided to protect the re-circulating pump that is installed outside the basin.
In the water basin, the following standard connections are provided:
• Make up water with float valve
• Overflow
• Drainage
• Water outlet

Other connections could be provided in accordance to the additional option element are possible to fit. For a quick review and not limited to, we can mention:
• Electric heater (to avoid water freezing in the basin in winter time)
• Minimum water level switch for heaters (to protect the electric heater from working under the water level)
• Minimum water level switch for pump (to protect re-circulation pump to work without the necessary water level)

Full list of options are listed in the technical sheet.
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 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

Is composed of the following elements:

• Water basin with all its elements
• Ventilation system (impellers, motor/s and transmission components)
• Protection grids

2.1.2 Upper body

Composed of:

• Filling pack
• Water distribution system
• Drift eliminators

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 eyebolts, 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](image1.png)

![Fig. 2](image2.png)
3. INSTALLATION

3.1 Tower foundation and anchoring

This unit doesn't need any special foundation. It can be placed directly onto a concrete slab or onto concrete coated ground, making sure that the anchoring is able to resist the operating load distributed by the tower bed-frame. It is possible to anchor the tower on two steel beams, as a double T throughout the length of the basin. This anchoring can be observed in fig. 3 and will need some bolts and nuts (bolt + 2 rings + nut) 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 air may circulate through the aspiration grids and allow the access to all the components that require maintenance. For correct positioning see figure 4 and 5. Any obstacle above the tower at a height lower than that of the higher side of the tower must be avoided.
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, remove the bolts that fix the porthole. See fig. 6.

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.

During the assembly of the sections check that both connections of the external piping of the secondary circuit are on the same side, in order to proceed with proper and easy installation.

Clean the surface...
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 fan section on the middle section following the instructions above.
3.4 Electrical connection

To connect the electric motor it is necessary to act on the lower body through the manholes. Introduce the connection cable up to the motor electrical box through the holes of the panel.

Secure the cable to one of the tubes that make up the engine support using cable ties. See fig. 13.

Fig. 13

To make the connection of the motor 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.

3.5 Other installation information:

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 undamaged, correctly positioned and free of any kind of obstacle.
• 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 motor/s and make sure they are correctly and securely tightened.
• Check visually the fans assembly, making sure they were installed correctly.
• Verify the contacts of the electrical boxes of the motors terminals.
• Ensure that there are no rubbing or interference between the impeller and diffuser, ensuring that the same rotates with ease and in the direction indicated rotation, without any noise or unusual rubbing.
• Make sure there are no foreign objects inside the diffuser.
• Make sure there are no objects that do not belong to the tower inside the collection tank.
5. START UP

1. Fill the cold water basin through the make-up float valve 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 cavitation. This level can be checked from the manhole door, with the electric pump and the fans completely stopped.

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

VERY IMPORTANT!! THE TOWER MUST NEVER OPERATE WITHOUT THE FAN GUARD AND THE ACCESS DOOR CORRECTLY FITTED. STOP THE FAN OPERATION BEFORE STARTING TO REMOVE OR REPLACE THE INSTALLED ELEMENTS.

6. OPERATING INSTRUCTIONS

6.1. Tower Performance

In order to get the appropriate performance from the cooling tower, the flow of both fluids must correspond to those in phase of designing, the water distribution is correct and that the different pipes of the distribution system are clean and not clogged. If a variation on the water flow is required it may be necessary to replace the nozzles, according to the difference of the designed flow and the new required. Please consult W-TECH.

It is vital to keep the filler clean, otherwise the cooling tower performance will be reduced. It is recommended to occasionally control visually the filler.

6.2. Control of water quality in the circuit

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

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, where pHs is the pH of saturation and pHc is the true level measured in the circuit.
- 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:
- Total blow down needed in the circuit as a percentage of circulating water flow:

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 IT SELF.

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 on the drift eliminators and the fillers.

Ice formation can be reduced, even prevented, by taking the following measures:

- By installing heating resistances and a level protection sensor
- By using materials (filler, drift eliminators, 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 primary and secondary circuits 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. Ventilation system

7.1 In the water recirculation system

The functioning of these systems is based in the water evaporation of the sprayed water, therefore, 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 filler. The drainage connection will be used to do this.

The water conditions will be controlled continuously, by purging of dirty water and replacing it with clean one, by adding bio dispersant agents and biocides, inhibitors to prevent lime scale formation or the corrosion of the metallic parts of the circuit. Several products 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 using any acid product, pH below 6.5 is not recommended. It is suggested to follow the values indicated in chapter 10.

Another aspect to take into consideration, the used products need to be compatible with the kind of materials composing the units.

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

• Before starting up the unit;
• If the unit had been still for a long period of time;
• If repairing operation had been done;
• When routine inspection so indicates;
• When the Sanitary Authorities so determines.

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

If only chlorine is being used, between 5 and 15 p.p.m will be injected, verifying the chlorine level once an hour.

After this will be necessary to clean out the basin and complete the washing by adding clean water until it comes out clean. The water will be drained out of the basin when the unit is not in use.

The maintenance operations to be performed on the different elements are listed below.

7.1.1 Grid

It 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

The float valve has to be controlled once a month, verifying that the water level in the basin is always above the aspiration level.

7.1.4 Spraying system

This has to be checked monthly. In order to check the internal part, some packs drift eliminators need to be removed from the manholes. Fan has to be stopped.

The nozzles, that have wide light with minimum breaking possibility or blockage, allow perfect water distribution, and are positioned above the filler. If by any reason they are obstructed, they can be easily disassembled. The cause is to be attributed to a blocked aspiration filter or at dirty distribution piping. Therefore, once they have been cleaned, place them on their position taking care to install them in the correct position according the indications shown on fig. 14.

![Fig. 14](image-url)

NOZZLES  PYPING OF SPRAYING SYSTEM  WATER INLET  OF THE SECUNDARY CIRCUIT
7.1.5 Filler

The filler has to be checked regularly. Keep in mind that it is a key element to the tower performance. Therefore, because stale formation and obstruction at the cavities may occur, it is recommended to verify the fillers monthly and the drainage of the spraying water daily.

7.2 In the ventilation 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 Bearings

The maintenance of the rolling bearings is linked to the environmental conditions in which the tower will be placed. In clean environmental conditions proceed with a six-month greasing intervals, in dirty or very humid conditions re-lubricate the bearings monthly. Proceed using a grease type of ball to be applied on the outside of the same. Grease frequently but with very small amount of grease (do not use oil in any case). Verify when needed the tightness of the same and the state of wear of the rolling elements.

7.2.2 Fans

Monthly inspection has to be carried out, in order to remove any paper, foil o other elements that could enter the diffusors. Control that there isn’t any contact between impellers and diffusors, clamp the fixing nuts of the impellers if necessary. Verify that the drain holes on the bottom of the diffusor aren’t obstructed.

7.2.3 Transmissions

Monthly inspection to verify the state of wear of the belts. Check the correct alignment and position of the shaft and the pulley and the tightness of the same.

7.3 Casing and water collection basin maintenance

The tower has to be checked and cleaned twice a year at least. The basin needs periodically cleaning, since the drain outlets, overflows, valves and circulation pumps could obstruct. We recommend draining and cleaning every 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 internal and external will be cleaned. If any corrosion is verified, proceed as follows:

1. Clean the affected zone with a steel brush and sand with sandpaper
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 at least twice a year, substituting some parts 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.

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: 2/6,2/8,4/6,6/8
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 100ºC, 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 MOTTOR SPEED MUST NOT BE EXCEEDED. IF MOTOR POWERED BY INVERTER, THE AVARAGE 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 extra ordinary operations that should always be performed by authorized workshop, contact W-tech.
### 9. PREVENTIVE MAINTENANCE SUMMARY CHART

<table>
<thead>
<tr>
<th>OPERATIONS TO BE CARRIED OUT</th>
<th>BLOWDOWN</th>
<th>GRID</th>
<th>BASIN</th>
<th>FLOATING VALVE</th>
<th>ELECTRIC PUMP</th>
<th>WATER DISTRIBUTION</th>
<th>DRIFT ELIMINATOR</th>
<th>MOTOR</th>
<th>BEARINGS</th>
<th>FANSHAFT</th>
<th>FAN</th>
<th>CASING</th>
<th>COLD WEATHER</th>
<th>OPERATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>INSPECTION FOR FOULING</td>
<td></td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>N</td>
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<td></td>
<td>M</td>
</tr>
<tr>
<td>INSPECTION OF THE GENERAL CONDITION</td>
<td></td>
<td></td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>M</td>
<td>S</td>
<td>N</td>
<td></td>
<td></td>
<td>M</td>
</tr>
<tr>
<td>CLEANING AND DISINFECTION</td>
<td>M</td>
<td>M</td>
<td>M/</td>
<td>M/</td>
<td>S/</td>
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<td>BASIN WATER LEVEL</td>
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<td></td>
<td>M</td>
<td>M</td>
<td>M/N</td>
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<tr>
<td>INSPECTION FOR OVERHEATING, NOISE AND VIBRATION</td>
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<td>INSPECTION FOR LEAKS</td>
<td>S/</td>
<td>S/</td>
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<tr>
<td>TIGHTENING OF BOLTS AND ANCHORING</td>
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<tr>
<td>BALANCING AND ALIGNMENT</td>
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<tr>
<td>LUBRICATION (please check also the instruction manual of the suppliers)</td>
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<td></td>
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<td>N</td>
<td>N</td>
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<tr>
<td>BLOWDOWN FLOW AND CONCENTRATION CYCLE CHECKING</td>
<td>D</td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

D = Every Day          M = Every Month          S = Every six Months          N = When Needed
<table>
<thead>
<tr>
<th>TROUBLESHOOTING CHART</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DEFECT</strong></td>
</tr>
<tr>
<td>MOTOR ROTATES IN OPPOSITE DIRECTION</td>
</tr>
<tr>
<td>UNUSUAL VIBRATION IN MOTOR FAN</td>
</tr>
<tr>
<td>BAD HOT WATER DISTRIBUTION</td>
</tr>
<tr>
<td>THE MOTOR DOES NOT START, STARTS WITH DIFFICULTY OR DOES NOT REACH ITS RATED SPEED AND OVERHEATS.</td>
</tr>
<tr>
<td>OVERHEATING OF FIELD WINDING</td>
</tr>
<tr>
<td>LACK OF CURRENT IN ONE OF THE WIRES</td>
</tr>
<tr>
<td>TEMPERATURE RELAY CUTS OFF ELECTRICITY WHEN MOTOR IS CONNECTED OR DURING OPERATION</td>
</tr>
<tr>
<td>MOTOR RUNS IRREGULARLY</td>
</tr>
<tr>
<td>THE FAN SECTION VIBRATES</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>
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<tr>
<td>Hardness CaCO₃ (ppm)</td>
<td>50 – 750</td>
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<td>&lt; 600</td>
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<tr>
<td>Silica SiO₂ (ppm)</td>
<td>&lt; 150</td>
<td>&lt; 150</td>
<td>&lt; 150</td>
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<tr>
<td>Clorides Cl⁻ (ppm)</td>
<td>&lt; 400</td>
<td>&lt; 400</td>
<td>&lt; 2.000</td>
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<tr>
<td>Bacterial (cfu/ml)</td>
<td>&lt; 10.000</td>
<td>&lt; 10.000</td>
<td>&lt; 10.000</td>
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</tbody>
</table>