Installation, Operation and Maintenance Manual

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Preparation

Safety first

The location and anchoring of the cooling tower can affect the safety of those responsible for installing, operating or maintaining it. It is the installer's responsibility to address potential safety issues that may arise from a poorly installed unit, and to install it in compliance with any local laws and codes. MESAN USA assumes no liability for damages or injuries caused by installation defects or omissions

Shipping and unloading on-site

Generally, cooling towers are shipped disassembled. Responsibility for the condition of the products upon the arrival, belongs to the shipper. Please inspect the materials thoroughly, take pictures if necessary and check all components and their quantities against the packing list. Report any missing items within 48 hours of receipt of the cargo.

MESAN USA also offers modular factory pre-assembled towers. These modules are quite large and heavy and require experienced crane and forklift operators for unloading and settling them on-site. Responsibility for this task belongs to the customer or installer. Follow all local codes pertaining handling and hoisting of large and heavy components.

Prior to assembly, read MESAN's assembly instructions and familiarize yourself with all tasks involved. Have all recommended tools and manpower ready, and keep delicate components like the fill and drift eliminators in an indoor place, protected from the sun. Fill and eliminators damage due to improper handling or storage is not covered by our warranty.

Installation

Tower Location

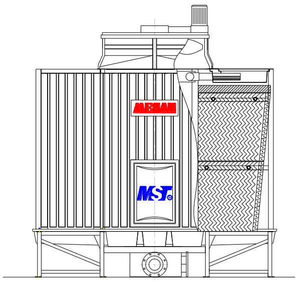
Location of the cooling tower must follow these guidelines:

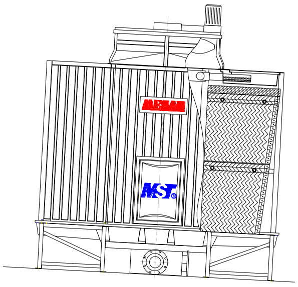
1. Maintenance access: At least 3 feet of space shall be allowed on each access door side for cross-flow towers and the minimum calculated clearance on all sides of counter-flow towers, based on required intake area (refer to MESAN's engineering handbook for air intake calculation procedures)
2. Air intake clearance: Leave at least a horizontal distance from any wall equivalent to at least 50% of the tower height, and for locations with tighter space constraints or multi-cell jobs, please refer to MESAN's engineering handbook for more accurate calculations. Air intake clearance between towers facing each other's air intake, must be equivalent to one tower length as the minimum.
3. Louvered enclosures for cooling towers shall be designed based on the tower's airflow rate and less than 0.01" w.g. external static pressure for the tower fan. Restrictive enclosures negatively affect the tower performance
4. Do not install the tower under a roof or roof eave that may cause hot air recirculation back into the tower intake. Tower must discharge into an unobstructed space
5. Ensure that the installation site is clear from debris, dust and avoid any vegetation in the vicinity of the tower to reduce the amount of dirt, leaves and objects being sucked into the air intakes.
6. Avoid having building's fresh air intakes near the tower's discharge and consider the prevailing wind direction, in order to minimize the health hazards, because the discharged air from a poorly maintained tower may contain harmful bacteria.
7. Ensure that the foundation of the tower complies with local codes, pertaining seismic / wind anchorage and vibration isolation.

Foundation

In addition to what is mentioned above, the foundation shall be designed following MESAN's foundation drawings as a guideline only, and always complying with local building codes. Concrete or steel are valid materials for the foundation. The foundation height shown in our drawings is just a suggestion or a minimum, the customer is responsible for determining this height according to minimum clearances under the tower dictated by local codes and regulations. The surface where the tower will sit must be level within +/- 5 mm or 3/16" over the whole length of such foundation. See picture below.

Structural analysis of the foundation and the building's structure, based on cooling tower's operating weight, is advisable, and it is the customer's responsibility





Correct Wrong

Tower foundation height shall be verified as to avoid pump cavitation due to insufficient NPSHA

Tower assembly and anchoring

For assembling the tower, please follow our detailed instructions and video provided with the tower.
Attach the tower to its foundation only after assembly has been finished, and always complying with local codes.

Piping

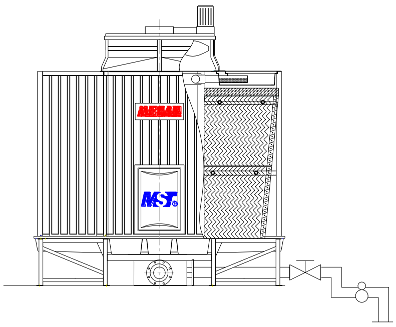
Before assembly that the tower's piping connections are oriented in the correct way to match the building's piping.

All pipes connected to the tower must be supported independently from the tower. The tower is not designed to serve as piping support and structural damage not covered by warranty can occur, if piping is not correctly supported.

If the tower is sitting on vibration isolators, the piping connections to the tower must be fitted with flexible connectors, sized to absorb the maximum deflection of the isolators. Even without vibration isolators it is advisable to use flexible piping connections to dampen any vibration in the piping that could affect the tower integrity

Outlet piping from the tower shall be slopped down with its highest point at the tower, to purge any air

Do not install check valves between the tower outlet and the pump inlet.



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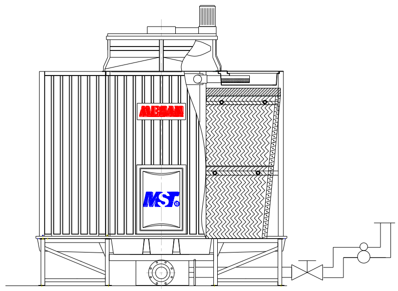
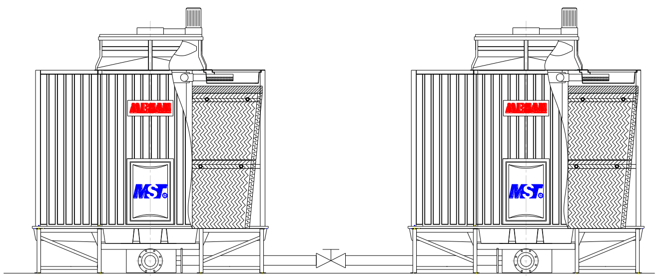


Wrong

Equalizing pipes are recommended for multiple cell towers to maintain equal bain water levels. Such pipes shall be fitted with isolation valves to facilitate maintenance of individual cells



Correct

Electrical

Motor Wiring

Verify available voltage and ensure that it matches the voltage in the motor nameplate.
Wiring hook-up to the motor shall be made as per diagram on the motor's nameplate
Make sure that all wiring connecting nuts are duly tightened to prevent arcing and false contacts.
Always install the cover for the motor's junction box in order to protect the connections from dirt and moisture
Verify motor rotation, current draw and frequency.

Electrical System

Provide overload protection, adequately sized starters and correct wire gauge. Also recommended is an electronic voltage monitor with phase inversion and surge protection.

Motors larger than 10 HP should use some kind of soft start device

Variable frequency drives

Although their advantages are undeniable, VFDs may have some disadvantages that must be known before applying them to cooling towers.
VFDs can increase the noise of cooling tower fans
VFDs shall be sized based on motor HP. When using a single VFD to control multiple motors, ensure that all motors are the same HP rating and be aware that the VFD's overload protection will not trigger if one motor fails, separate overload protection shall be provided individually for each motor
Each VFD manufacturer has limitations in the total wiring distance between the motor and the VFD (usually 99 yards). Consult your VFD's supplier to verify this.
When setting up the VFD, avoid those frequencies that cause or increase vibration in the fan (redundant frequencies).
Minimum motor speed shall not be less than 25% of nominal speed (nameplate speed) to avoid premature motor failure.
Damage caused by improper application of VFDs voids MESAN warranty on the motors

Mechanical

Always shut off electrical power to the tower prior to performing any maintenance on the tower. The use of a safety disconnect switch located at not more than 3 feet and on line sight of the maintenance technician is strongly advised. Follow local electric codes for more details about these safety switches and their location.
Verify belts tension as per assembly manual
Verify that the fan rotates without rubbing against the cylinder
If equipped with, check the oil level in accordance with the Gearbox Reducer's User Manual. Also if equipped with, verify that oil level safety switch is interlocked with the fan's starter
If fan is intended to be reversed for de-icing purposes, make sure that the starter is equipped with an automatic two-minute time delay between changes of direction.

Fan blade pitch adjustment

MESAN's extruded aluminum fan blades along with our exclusive fan hub design and the factory static and dynamical balance of 100% of our fans, prevents harmful vibration to occur during operation, however, blade pitch must be adjusted and verified on-site, which is explained in detail in the "*Fan Assembly Instructions*" provided with the tower

Use the supplied inclinometer to adjust the blade pitch.
When the blade is wider than the length of the inclinometer, use a straight edge or ruler between the instrument and the top surface of the blade, as per the figures below

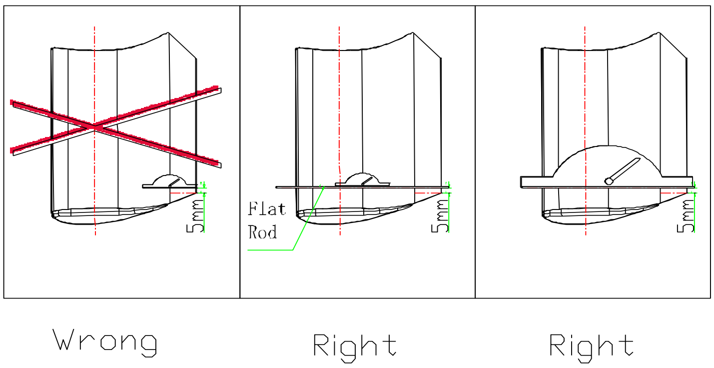
Adjust each blade's angle within +/- 0.5% tolerance. Maximum pitch angle is determined by 95% of motor FLA (full load Amperage)

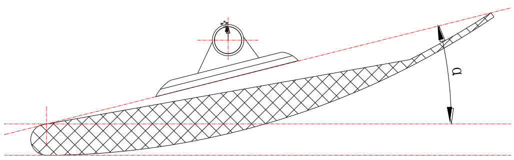
When adjusting the pitch angle do it in maximum increments of 2 degrees

After adjusting all blades, ensure that all U-bolts are tightened to the specified torque in the tower assembly manual, and that the fan is operating without any abnormal vibration

Be aware that current draw or Amps consumption if higher when the tower runs wet than when it's dry. We advise to do final current draw verification under wet operating conditions.

For more details please refer to *Fan Assembly Instructions* supplied with the tower.





Water side

Water treatment is the user's responsibility; a competent water treatment specialist should be in charge.

Open the make-up valve and fill the cold water basin, adjust the float valve as high as possible without reaching the overflow level (approximately 20 mm or ¾" below the overflow pipe). Verify that the float can move freely without any obstruction

Start the condensing water pump (s), observe the water level in the cold water basin and always keep the make-up waster valve fully open. Never use the water in the cold water basin and the condensing pump to fill the condenser and pipes between the chiller and the tower, these components must be filled before starting the tower and pump, otherwise the amount of water in the tower basin may not be enough to fill the pipes and condenser, and the pump will run dry, causing damage to it

Fill or wet deck

MESAN's standard fill is rated for a maximum temperature of 50°C or 122°F. Optional high-temperature infill (white color) is rated for up to 65°F or 149°F. Verify that entering water temperature to the tower does not exceed these values. If it does, stop the chiller(s) immediately and verify the water flow rate (lower than design water flow rates at chillers design load are the most common cause of excessive EWT to the tower). If the water flow rate is within design parameters, check the Wet Bulb temperature and calculate the approach (Approach = LWT – WBT) lower than design approach can also cause an abnormally high LWT. Another possible cause for excessive LWT is obstructions to the air flow on the air intake sides or the tower or above the fan's discharge, verify that the minimum clearances are kept.

Freeze prevention

Tower operation in freezing weather is always a difficult challenge, and in some applications there is a year-round demand for cooling, even at reduced loads, so the tower must remain operational through the winter even under freezing conditions. Here we will discuss ways to deal with freezing on different types of towers

Among all the different types of towers, forced-draft ones have a slight advantage on the fact that their fans do not have to handle the humid discharge air but the dry outside air. Induced draft towers are susceptible to get icing on the fan blades because of the moist air they have to move, however this is a minor issue. Counter flow towers, are better for freezing conditions because the entering air interacts with constant temperature water (after it passed through the infill), while cross flow towers have a temperature gradient in the water (hotter at the top and colder at the bottom of the infill), which tends to cause icing at the bottom sections of the infill pack.

It is not the intention of this document to provide solutions to specific applications but to explain what is available to help dealing with this issue of freezing in cooling towers. It is the designer’s responsibility to specify the correct product with the correct accessories and options for each application

The most popular tower accessory offered for freeze prevention is the electric basin heater, quantity and power depends on the water volume in the cold water basin and the design conditions and although they are a common and practical method, they only perform well when the tower is operating and water is circulating. If the tower is off, under freezing conditions the basin heaters cannot keep up with the heat loss and ice will eventually form. Hot water or steam coils are also offered and installed inside the cold water basin, but great care must be exercised when using steam coils in galvanized basins as steam condensate is very corrosive and will damage the basin in case of any leak from the coil.

The weight of the ice built-up on the fan blades of induced draft tower can be enough to cause unbalance, vibration and consequent failure of the fan. MESAN’s TowerMizer control panels have a “de-icing” function to spin the fan backwards and remove the ice.

What in our opinion is the best way to deal with freezing conditions is to add a remote sump to the system. A remote sump is nothing but an additional water storage tank located inside the building, under warmer conditions, where water from the tower is drained to by gravity, so no water is accumulated in the cold water basin and freezing cannot happen.

The use of inverters or VFDs in the tower fan also helps under low or part load conditions. In general reducing the airflow retards the formation of ice under freezing conditions.

Another alternative is to use closed circuit cooling tower and a glycol solution in the closed circuit loop, plus any of the methods mentioned above for the open side of the tower.

For more specific technical advice on any particular application, please consult your MESAN representative

Maintenance

Water Maintenance

Water Quality

Cooling towers work by evaporating of a small portion of water, approximately 1.8 gallons are evaporated per every ton of tower capacity. As water evaporates the concentration of dissolved solids increases rapidly and can reach unacceptable levels. In addition, airborne impurities and biological contaminants are introduced into the recirculating water; since the cooling tower operates pretty much like an air scrubber

If impurities and contaminants are not effectively controlled, they can cause scaling, corrosion, sludge, which reduce heat transfer efficiency and increase system operating costs. Biological control is also required to reduce the growth of bacteria and algae.
Following are the water quality parameters for any conventional cooling tower:

- pH 6-8.5 for FRP towers and 8-8.5 for metal towers
- Calcium hardness 800-1000 mg/l
- Total Alkalinity 200 mg/l
- Chloride 1000 mg/l
- Silica 150 mg/l
- Fe (iron): 2 ppm maximum
- TDS 8,000 mg/l (TDS = Total dissolved solids)

Tap water as initial tower filling or make-up is the most used and is considered rather reliable, however, if it is recycled water or from a river or lake or even rain water collected on the surface, attention should be paid to the water quality; especially the influence of the water on the other chemicals in the water treatment system and corrective measures should be taken.

Startup Conditions

In new installation, the water should be cleaned and treated with biocides by a water treatment expert before start-up. Remove any and all accumulated debris from tower. Pay particular attention to inside areas of cold water basin, hot water basins, louvers and drift eliminators. Make sure that cold water suction strainers are clean and properly installed.

Blow-down

The blowdown rate will depend on the cycles of concentration required to maintain recirculating water quality and the evaporation rate.
The cycles of concentration (C) is defined as the ratio of the total dissolved solids in the recirculating water to the total dissolved solids in the make-up water (TDSr/TDSm).

To keep solids concentration under control in the cooling water and to prevent precipitation and depositing on system components, a portion of the recirculating water is removed from the system and replaced with the make-up water. The recirculating water removed from the system is referred to as blowdown (B). Cycles of concentration are controlled by the amount of blowdown.

The blowdown will depend on the cycles of concentration and the evaporation rate (E), use the equation as:

$$B=E/(C-1)$$

Evaporation can be estimated for the system using the following expression:

Evaporation Rate (GPM) = Water Flow Rate (GPM) x Range (°F) x 0.001

This expression indicates that the evaporation rate (E) is approximately equal to 0.1% of water circulated over the tower for each 1° F of temperature drop ΔT (T2-T1).

Cycles of concentration is an important consideration in the operation of an open recirculating cooling system. The greater the number of cycles of concentration, the less water (or treatment) the system must lose to blowdown.

Example:
At a flow rate of 100gpm and a cooling range of 10 F, the evaporation is 1 % (.1%×10=1%), the rate of evaporation is 1gpm (100gpm x 1% = 1gpm).
C is confirmed by the silica concentrations, example now C is 4, then Blowdown here is 0.33% (1% / (4-1) = 0.33%), the rate of blowdown is0 .33gpm.

Chemical Treatment

There are two main aspects of water cooling treatment, scaling control and biological control.

Scaling is the accumulation of calcium composites on the wet surfaces of a cooling tower and if not controlled they drastically reduce the tower efficiency and capacity.

Biofilm can directly cause corrosion problems (microbial induced corrosion), pathogen concerns (Legionella), increased pump pressure, heat-transfer problems, dermatological effects, and foul odors.

- Water treatment chemicals or non-chemical systems need to be compatible with the materials of construction used in the cooling system including the evaporative cooling equipment itself.
- In case of chemical water treatment, chemicals should be added to the recirculating water by an automatic feed system. This will prevent localized high concentrations of chemicals, which may cause corrosion. Preferably the water treatment chemicals should be fed into the cooling system at the discharge of the recirculation pump. The chemicals should not be fed in concentrated form, nor batch fed directly into the cold water sump of the evaporative cooling equipment. Special care must be taken to prevent sodium hypochlorite tablets from being thrown into the cold water basin in galvanized steel towers.
- Acid water treatment is not recommended in galvanized steel towers. However for FRP towers consider using acid treatment such as sulfuric, hydrochloric, or ascorbic acid. When added to recirculating water, **acid can improve the efficiency of a cooling system by controlling the scale buildup** potential. Acid treatment lowers the pH of the water and is effective in converting a portion of the alkalinity (bicarbonate and carbonate), a primary constituent of scale formation, into more readily soluble forms. Make sure workers are fully trained in the proper handling of acids. Also note that acid overdoses can severely damage a cooling system. The use of a timer or continuous pH monitoring via instrumentation should be employed. Additionally, it is important to add acid at a point where the flow of water promotes rapid mixing and distribution. For this reason FRP towers are better due to their inherent resistance to low pH water which translates on higher thermal efficiency (less scaling).
- Install a conductivity controller to automatically control blowdown. Working with your water treatment specialist, determine the maximum cycles of concentration you can safely achieve and the resulting conductivity (typically measured as microSiemens per centimeter, uS/cm). A conductivity controller can continuously measure the conductivity of the cooling tower water and discharge water only when the conductivity set point is exceeded. Installing a conductivity meter also earns 2 LEED points towards Green Building Certification.
- Install flow meters on make-up and blowdown lines. Check the ratio of make-up flow to blowdown flow. Then check the ratio of conductivity of blowdown water and the make-up water (you can use a handheld conductivity meter if your tower is not equipped with permanent meters). These ratios should match your target cycles of concentration. If both ratios are not about the same, check the tower for leaks or other unauthorized draw-off. If you are not maintaining target cycles of concentration, check system components including conductivity controller, make-up water fill valve, and blowdown valve.

- Read conductivity and flow meters regularly to quickly identify problems. Keep a log of make-up and blowdown quantities, conductivity, and cycles of concentration. Monitor trends to spot deterioration in performance.
- Due to increased government pressure to reduce the amount of chemicals used for cooling tower treatment, several alternate technologies have emerged in the market such as UV-lights, Ozone and Pulsed-power technology. They all claim to be very effective at biological control and chemical usage reduction.

Select your water treatment vendor with care. Tell vendors that water efficiency is a high priority and ask them to estimate the quantities and costs of treatment chemicals, volumes of blowdown water, and the expected cycles of concentration ratio. Keep in mind that some vendors may be reluctant to improve water efficiency because it means the facility will purchase fewer chemicals. In some cases, saving on chemicals can outweigh the savings on water costs. Vendors should be selected based on "cost to treat 1,000 gallons make-up water" and highest "recommended system water cycle of concentration." Treatment programs should include routine checks of cooling system chemistry.

Cooling Tower Water Filtration

In addition to chemical and/or any other types of water treatment, the most effective way to keep the amount of solids in suspension under control in the system is filtration.

Filtration keeps the entire loop cleaner, thereby minimizing dirt load and any likelihood of a fouled condenser, or exchanger bundle.

The biggest benefit received is the savings realized through efficient electrical consumption with the cleaner chiller condenser running within design specifications.

Filtration can be done inline (larger equipment) or side-stream (smaller equipment), and from a manufacturer's standpoint, "any" filtration is always better than no filtration, so regardless of the type of filters chosen, it is always recommended to use one, to extend the life of the system, keep its efficiency high and reduce maintenance downtime.

Mechanical Maintenance

Always follow the recommended preventative maintenance schedule on page 14. Adverse operating conditions (excessive dust, excessive ambient temperatures, corrosive environment, etc) may require more frequent inspections and maintenance.

Belt Tensioning

New belts always stretch shortly after start-up, so after the first 50 hours of operation please check the tension and re-adjust if necessary. To do this, always tighten the two adjustment bolts at once, to prevent misalignment of the motor base. Re-check the belts every week for the first 3 weeks of operation, and then change to monthly frequency.

Average service life of belts is 4,000 hours, depending to the environment. If one belt breaks, it is recommended to change the whole set.

Gear Reducer Maintenance

Periodically check the oil level, after shutting down the unit for at least 5 minutes, to allow all the oil to drain back to the bottom of the reducer. Follow the gear reducer's manufacturer maintenance and repairs instruction provided with the unit.

Maintenance Schedule

	Motor	Fan	Speed Reducer	Hot Water Basin	Cold Water Basin	Floating Valve	Filli	Structural Parts	Fan Guard	Ladder & Handrail
1. Visually inspect and clean up				W	M		M			
2. Check for abnormal vibration	W	W	W					Y		
3. Check belts tension		S	W							
4. Add lubricant	R		R							
5. Check oil seal			S							
6. Check water level					D					
8. Verify motor current draw	S				M	W				
9. Check general conditions	S	M	S	S	Y	M	S	Y	S	S
10. Re-tighten all bolts	S	S	S					S		
11. General clean up	R	R	R							
13. Safety check	Y	Y						Y	Y	

D – Daily; M – Monthly; R – If Required; S – Every Six Months; W – Weekly; Year – Yearly

Seasonal Shutdown Instructions

When the system has to be shut down for an extended period of time, it is recommended that the entire system (cooling tower, system piping, heat exchangers, etc.) be drained.

Loosen the belts, to avoid unnecessary stress on the bearing.

During shutdown, clean the tower and make any necessary repairs. Pay particular attention to mechanical equipment supports and driveshaft.

Moisture will condensate inside of the motor if the motor stops running for long term. Even during the seasonal shutdown period, it's suggested to run the motor at least 3 hours per month (this is known as "exercising"), this dries up the windings and re-lubricates the bearings.

Troubleshooting

Malfunction	Possible cause	Recommended Solution
Motor does not start	No power supply for motor	Verify that there is power available
	Circuit protection device is open	Check the overload protections and circuit breakers
	Wrong wiring	Verify that motor has been wired according to the wiring diagram
	Over low voltage	To check whether the source voltage are in conformity with the rated voltage on the nameplates of the motor
	Motor winding is open	Measure continuity across the three terminals and if the winding is open, the motor needs to be repaired
	Rotor malfunctions	To check the structure of rotor
Excessive motor current	Excessive fan blades pitch angle	Check and adjust the angle
	Motor malfunction	To repair or replace
	Lower than nominal voltage	Check the voltage
Motor overheats	Incorrect voltage or three-phase voltage imbalance	Check the voltage of power source
	Overload	Check the blades angle, and check the reducer bearings

	Phase loss	Stop the motor immediately, and check the circuit
	Undersized wiring to motor	Replace wiring with correct gauge
	Bad Motor Bearings	Lubricate and if noise persist, replace the damaged bearing
	Improper voltage or three-phase imbalance	Check the voltage at the motor leads
Contrary fan rotation	Wrong phase sequence	To replace the order of phases
Fan vibration	Fan	Check if blades are in their designated positions
		Check if U-bolts are tight
		Check the blades pitch angle
	Bent shaft	Inspect the shaft conditions, looking for any impact
	Motor	Remove the belts and start the motor to isolate the possible cause of vibration
Excessive drift losses	For round towers: wrong angle of sprinkle arm holes	Adjust this angle to about 25° down from the vertical
	Clogged nozzles (counter-flow towers) or clogged distribution holes (cross-flow towers)	Flush the hot water distribution piping or clean the hot water basin
	Cross-flow towers: Wrongly positioned distribution fill	Center the distribution fill underneath the holes in the hot-water basin
	Broken, missing or wrongly installed drift eliminators	Check the drift eliminator panels and re-arrange, or replace
	Excessive air flow rate	Check and adjust fan blades pitch angle (pitch down)
	Cross-flow towers: Check for missing baffle plate behind hot water basin and above the top of the fill pack	Replace or install properly this baffle plate
No airflow with tower energized	Broken belts	Check and replace
	Burned out motor	Check and repair or replace it
	Belts are not broken	Adjust the tension of the belt
	Electrical problems	Verify available voltage at the motor as well as phases and frequency
Abnormally high leaving water temperature	Higher than design, cooling load	Check LWT and EWT at the chiller for any signs of higher load from the building

	Higher than design WB temperature = Low approach	Verify actual WBT
	Insufficient air flow rate	Verify fan operation, belts and blades pitch
	Discharge air recirculation	Improve the site conditions
	Blocked fill by debris or excessive scaling	Clean or replace the fill
Abnormal vibration	Unbalanced fan	Check for any broken fan blades or debris stuck to a blade, or loose blade that lost the pitch angle
	Loose drive-train brackets	To check and tighten all bolts and nuts
	Bad fan bearings	Replace the bearings
	Bad motor bearing	Replace the bearings
	Pipe-induced vibration	Check or install flexible connectors and improve pipe supports.
Excessive scaling	Insufficient bleed or blow-down	Increase blow-down based on cycles of concentration
	Poor water treatment	Improve water treatment quality

Note: For additional support with troubleshooting, please contact MESAN Sales

Important: Damage caused by poor water treatment will not be covered by our warranty.

www.mesanusa.com

sales@mesanusa.com

- Specification & Design are subject to change without notice.
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