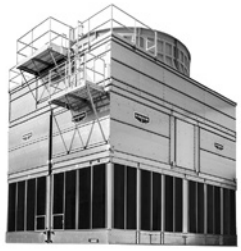
Bulletin 113R-E Metric

evapco for LIFE

REDUCED EUROPEAN
MAINTENANCE INSTRUCTIONS

For EVAPCO Induced Draft and Forced Draft Cooling Towers

AT



AT ATLAS

LSTE

LPT

For EVAPCO Authorized Parts and Service, Contact Your Local Mr. GoodTower® Service Provider or the EVAPCO Plant Nearest You

The full version of the Maintainance Instructions 113-E, is available for download at:

www.evapco.eu

EVAPCO Products are Manufactured Worldwide

EVAPCO, Inc. (World Headquarters) P.O. Box 1300, Westminster, Maryland 21158 USA
Phone (410) 756-2600 - Fax (410) 756-6450

EVAPCO Europe BVBA
Heersterveldweg 19
Industrieterrein Oost
3700 Tongeren, Belgium
Phone: (32) 12 395029
Fax: (32) 12 238527
evapco.europe@evapco.be

EVAPCO Europe S.r.l.
Via Ciro Menotti 10
I-20017 Passirana di Rho
Milan, Italy
Phone: (39) 02 9399041
Fax: (39) 02 93500840
evapcoeurope@evapco.it

EVAPCO Europe A/S
Knøsgårdvej 115
DK-9440 Aabybro,
Denmark
Phone: (45) 9824 49 99
Fax: (45) 9824 49 90
info@evapco.dk

EVAPCO Europe GmbH
Insterburger Straße, 18
D-40670 Meerbusch,
Germany
Phone: (49) 2159-6956-0
Fax: (49) 2159-6956-11
info@evapco.de

EVAPCO M. East DMCC
Reef Tower, 29th level
Cluster O,
Jumeirah Lake Towers
PO Box 5003310
Dubai, U.A.E.
Phone: (971) 56 991 6584
info@evapco.ae

Introduction

Congratulations on the purchase of your EVAPCO evaporative cooling unit. EVAPCO equipment is constructed of the highest quality materials and designed to provide years of reliable service when properly maintained.
It is important to establish a regular maintenance program and be sure that the program is followed.

A clean and properly serviced unit will provide a long service life and operate at peak efficiency.
If you should require any additional information about the operation or maintenance of this equipment, you can consult Bulletin 113-E or contact your local EVAPCO representative. You may also visit www.evapco.eu for more information.

Safety Precautions / Remaining Risks

Qualified personnel should use proper care, procedures and tools when operating, maintaining or repairing this equipment in order to prevent personal injury and/or property damage. The warnings listed below are to be used as guidelines only.

WARNING: Evaporative cooling equipment is considered as "Partly completed machinery". "Partly completed machinery" is a totality which almost forms a machinery but in itself cannot fulfil any particular function. The considered cooling equipment is missing the components to safely connect it to the source of energy and motion in a controlled way. The considered cooling equipment is custom made but is not designed to address the specific needs and safety measures for a specific application. Each application requires a unique designed and integrated operational, control and safety strategy that links all components of the installation and eventually a back-up system in a safe and controlled way.

WARNING: This equipment should never be operated without fan screens and access doors properly secured, locked and in place.

WARNING: For assembling or disassembling the unit or unit sections, please follow the rigging instructions or the instructions on the yellow labels on the individual unit sections.

WARNING: During maintenance operations, the worker must use adequate personal protection equipment (PPE - A minimum, but not limited list of PPE are safety shoes, glasses, gloves, respiration protection, helmet) as prescribed by local authorities.

WARNING: For any exceptional, non routine work to be carried out, protection and adequate safety measures should be considered and a Last Minute Risks Assessment (LMRA) must be made by an authorized person in accordance with safety requirements of the country.

WARNING: A lock-out / tag-out procedure, integrated with the Process Control System, must be foreseen by the customer. Before performing any type of service or inspection of the unit, make certain that all power has been disconnected and locked in the "OFF" position.

WARNING: The top horizontal surface of any unit is not intended to be used as a working platform. No routine service work is required from this area. For any exceptional, non routine work to be carried out on top of the unit, use ladders, PPE and adequate safety measures against the risk of a fall, in accordance with safety requirements of the country in question.

WARNING: The recirculating water system may contain chemicals or biological contaminants including Legionella Pneumophila, which could be harmful if inhaled or ingested. Direct exposure to the discharge airstream and the associated drift generated during operation of the water distribution system and/or fans, or mists generated while cleaning components of the water system, require respiratory protection equipment approved for such use by governmental occupational safety and health authorities.

WARNING: To avoid water and air contamination as a result of biological fouling, the cooling equipment must be maintained in accordance, but not limited to the operating and maintenance instructions. All local legislation related to evaporative cooling equipment must be respected.

WARNING: Accessories like platform and ladders are optional. In case these options are not taken in consideration, the customer must design the installation to comply with local safety and access requirements and legislation.

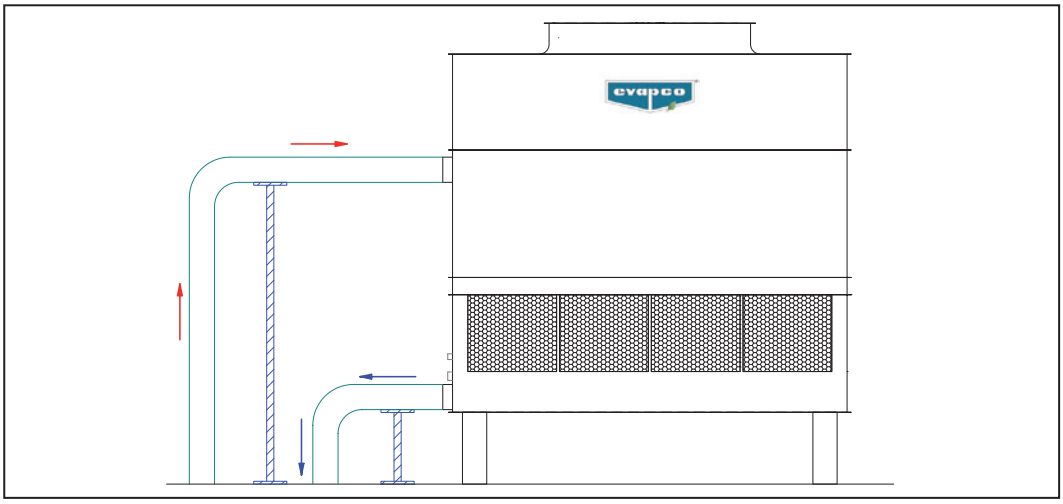
WARNING: Sound reducing options are available. In case these options are not taken in consideration, the customer must design the installation to comply with local sound requirements and legislation.

WARNING: Building water systems receive potable and non-potable water from either a public or private entity for their water supply. This water supply for the building water system can contain various waterborne pathogens, including Legionella bacteria, which can cause or contribute to various illnesses if aspirated, ingested or inhaled. Since evaporative cooling equipment uses the same building water, there is some potential that these pathogens might propagate in the equipment. Therefore, careful consideration should be undertaken with respect to equipment location and the implementation of effective water management, inspection and cleaning protocols. (See Control of Biological Contaminants in these Operation and Maintenance Instructions.)

Installation Precautions

WARNING: To avoid damage of the spray system components, the spray water inlet pressure should never exceed 0,7 bar.

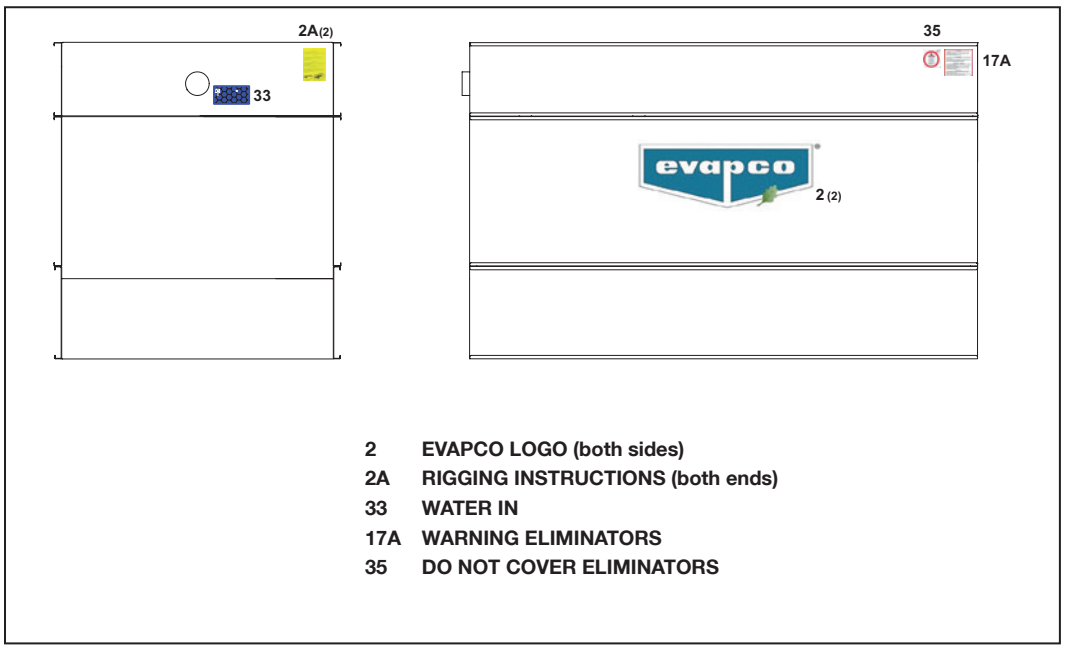
WARNING: The water inlet and outlet connections are not designed to support piping. The piping always need to be supported (by others).



Storage Precautions

WARNING: Never use plastic sheets or tarps to protect a unit during storage. This practice can trap heat inside the unit and could potentially cause damage to plastic components.

Label on the casing section(s)



2	EVAPCO LOGO (both sides)
2A	RIGGING INSTRUCTIONS (both ends)
33	WATER IN
17A	WARNING ELIMINATORS
35	DO NOT COVER ELIMINATORS

Initial Storage and/or Idle Period Recommendations

If the unit will sit idle for long periods of time it is recommended that the following be performed in addition to all component manufacturers recommended maintenance instructions.

- The fan bearings and motor bearings need to be turned by hand at least once a month. This can be accomplished by locking and tagging out the unit's disconnect, grasping the fan assembly, and rotating it several turns.
- If unit sits longer than a few weeks, run gear reducer (if supplied) for 5 minutes weekly or check sheaves and bushings for corrosion. Scrape and coat with a ≥ 95% zinc-rich compound (ZRC).
- If unit sits longer than 3 weeks, completely fill gear reducer with oil. Drain to normal level prior to running.
- If unit sits longer than 3 weeks, lubricate the fan shaft bearings and motor adjustment all-thread bolt.
- If unit sits longer than one month, insulation test motor windings semi-annually.
- If fan motor sits idle for at least 24 hours while the system pumps are energized and distributing water over the heat transfer media, motor space heaters should also be energized. Alternatively, fan motors may be energized for 10 minutes, twice daily, to drive any moisture condensation out of the motor windings.

International Building Code Provisions

The International Building Code (IBC) is a comprehensive set of regulations addressing the structural design and installation requirements for building systems – including HVAC and industrial refrigeration equipment. The code provisions require that evaporative cooling equipment and all other components permanently installed on a structure must meet the same seismic design criteria as the building.
All items attached to EVAPCO Cooling Towers must be independently reviewed and isolated to meet applicable wind and seismic loads. This includes piping, ductwork, conduit, and electrical connections. These items must be flexibly attached to the EVAPCO unit so as not to transmit additional loads to the equipment as a result of seismic or wind forces.

Initial and Seasonal Start-Up Checklist

General

1. Verify that the overall installation reflects the requirements of the installation guidelines found in EVAPCO Bulletin 311 - Equipment Layout Manual, available at **www.evapco.eu**.
2. For multi-speed fan motors, verify that 30 second or greater time delays are provided for speed changes when switching from high to low speed. Also check to see if interlocks are provided to prevent simultaneously energizing high and low speed and confirm both speeds turn in the same direction.
3. Verify all safety interlocks work properly.
4. For units operating with a variable frequency drive, make certain that minimum speed requirements have been set. Check with VFD manufacturer for recommended minimum speeds and recommendations on locking out resonance frequencies.
5. Verify that the sensor used for fan sequencing and/or by-pass valve control is located downstream of the point where the by-pass water mixes with the condenser supply water, if applicable.
6. Verify that a water treatment plan has been implemented including passivation of galvanized steel units. See "Water Treatment" section for more details.
7. For units subject to freezing climates, high humidity climates, or idle periods lasting 24 hours or more, motor space heaters are suggested and (if equipped) should be energized. Alternatively, fan motors may be energized for 10 minutes, twice daily, to drive any moisture condensation out of the motor windings.
8. If the unit is going to sit idle for an extended period of time, follow all manufacturers' fan motor and pump instructions for long term storage. Plastic sheets or tarps should never be used to protect a unit during storage. This practice can trap heat inside the unit, and could potentially cause damage to plastic components. See your local EVAPCO representative for additional information on unit storage.

BEFORE BEGINNING ANY MAINTENANCE, BE CERTAIN THAT THE POWER IS TURNED OFF AND THE UNIT IS PROPERLY LOCKED AND TAGGED OUT!

Initial and Seasonal Start-Up

1. Clean and remove any debris, such as leaves and dirt from the air inlets.
2. Flush the cold water basin (with the strainer screens in place) to remove any sediment or dirt.
3. Remove the strainer screen, **clean and reinstall**.
4. Check mechanical float valve to see if it operates freely.
5. Inspect water distribution system nozzles and clean as required. Check for proper orientation. *(This is not required at initial start-up. The nozzles are clean and set at the factory).*
6. Check to ensure drift eliminators are securely in place.
7. Adjust fan belt tension as required. See "Fan Belt Adjustment" section.
8. Lubricate fan shaft bearings prior to seasonal start-up.
9. Turn the fan(s) by hand to insure it turns freely without obstructions.
10. Visually inspect the fan blades. Blade clearance should be approximately 10 mm (min. 6 mm) from tip of blade to the fan cowl. The fan blades should be securely tightened to the fan hub.
11. If any stagnant water remains in the system including "dead legs" in the piping, the unit must be disinfected prior to the fans being energized. Please refer to Ashrae Guideline 12-2020 and CTI Guideline GDL-159 for more information and consult local legislatiopn prior to start-up.
12. Fill the cold water basin manually up to the overflow connection.
13. All new evaporative cooling equipment and associated piping should be pre-cleaned and flushed to remove grease, oil, dirt, debris and other suspended solids prior to operation. Any pre-cleaning chemistry should be compatible with the cooling equipment's materials of construction. Alkaline formulations should be avoided for systems which include galvanized materials of construction.

After the unit has been energized, check the following:

1. Adjust mechanical float valve as required to the proper water level. See the *"Recirculating Water System – Routine Maintenance"* section for more details.
2. Verify fan is rotating in proper direction.
3. Measure voltage and current on all three power leads. The current must not exceed the motor nameplate full load amp rating taking the service factor into account.
4. Adjust bleed valve to proper flow rate. Maximum bleed-off is 2,58 l/min per 100 kW.
   Consult your qualified water treatment person to fine tune the minimun bleed necessary.
5. Refer to the fan motor manufacturer's maintenance and long term storage instructions for more detailed information. Motors should be serviced in accordance with manufacturer's instructions.

Fan System

The fan system must be checked regularly and lubricated at the proper intervals. The following maintenance schedule is recommended.

Fan Motor Bearings

EVAPCO evaporative cooling units use either a T.E.A.O. (Totally Enclosed Air Over) or a T.E.F.C. (Totally Enclosed Fan Cooled) fan motor. These motors are built to "Cooling Tower Duty" specifications. They are supplied with permanently lubricated sealed bearings up to 30 kW and special moisture protection on the bearings, shaft and windings. After extended shutdowns, the motor should be checked with an insulation tester prior to restarting the motor.

Fan Shaft Ball Bearings

Lubricate the fan shaft bearings every 1,000 hours of operation or every three months for induced draft units. Lubricate the fan shaft bearings every 2,000 hours of operation or every six months for forced draft units. Use any of the following synthetic waterproof, inhibited greases which are suitable for operation between -40°C and 120°C. (For colder operating temperatures, contact the factory).

- Chevron - Multifak Premiums 3
- Shell Alvanias
- Total - Ceran WR2
- or similar

Fan Shaft Sleeve Bearings (1,2 m wide LSTE units only)

Lubricate the intermediate sleeve bearing(s) before unit start up. The reservoir should be checked several times during the first week to ensure that the oil reserve is brought to full capacity. After the first week of operation, lubricate the bearing(s) every 1.000 hours of operation or every three months (whichever occurs first). High temperatures or poor environmental conditions may necessitate more frequent lubrication. The oil reservoir consists of a large felt packed cavity within the bearing housing. It is not necessary to maintain the oil level within the filler cup.

Use one of the following industrial grade, non-detergent mineral oils. **Do not use a detergent based oil or oils designated heavy duty or compounded**. Different oils may be required when operating at temperatures below -1°C continuously.

Table 1 provides a short list of approved lubricants for each temperature range. Most automotive oils are detergent based and may not be used. Detergent oils will remove the graphite in the bearing sleeve and cause bearing failure.

Ambient Temp	Texaco	Mobil	Exxon	Total
-32°C to 0°C	-	DTE Heavy	-	-
-17°C to 43°C	-	-	-	-
0 to 38°C	Regal R&O 220	DTE Oil BB	Teresstic 220	-

Table 1 – Sleeve Bearing Lubricants

Oil drippage may result from over-oiling or from using too light an oil. Should this condition persist with correct oiling, it is recommended that the next heavier weight oil be used.
All bearings used on EVAPCO equipment are factory adjusted and self aligning. Do not disturb bearing alignment by tightening the sleeve bearing caps.

Fiberglass Super Low Sound Fan Blades

Quarterly visual inspections are recommended to check the overall condition of the fiberglass fan blades. Clean using a mild detergent to remove any dirt on the surface of the blades. Thoroughly rinse with water after cleaning. Discoloration and surface imperfections are normal. Cracks in the external gel coat layer may occur, however if cracks appear deeper than the surface gel coat layer please consult your local EVAPCO representative for further inspection.

Hub and Bolts (Multi-Piece 132" and 156" [3352 mm and 3962 mm] Diameter Fans Only)

The hub bolts should be checked bi-annually for proper torque. The torque values are noted on the fan hub nameplate. The hub and bolts should be checked annually for corrosion. If present, scrape and coat with ≥ 95% zinc-rich compound (ZRC).

Fan Belt Adjustment

The fan belt tension should be checked at start up and again after the first 24 hours of operation to correct for any initial stretch. To properly adjust the belt tension, position the fan motor so that the fan belt will deflect approximately 13 mm when moderate pressure is applied midway between the sheaves. Belt tension should be checked on a monthly basis. A properly tensioned belt will not "chirp" or "squeal" when the fan motor is started.

Gear Drives

Induced draft units with gear drive systems require special maintenance. Please refer to the gear manufacturer's recommended maintenance instructions. These will be enclosed and shipped with the unit.

Air Inlet

Inspect the air inlet louvers (induced draft units) or fan screens (forced draft units) monthly to remove any paper, leaves or other debris that may be blocking airflow into the unit.

Fan System - Capacity Control

There are several methods for capacity control of the evaporative cooling unit.
Methods include: Fan motor cycling, the use of two speed motors and the use of variable frequency drives (VFDs). In all cases, if motors are idle for extended periods of time with

water still being directed over heat transfer media, motor space heaters are suggested.

1. Fan Motor Cycling

Fan Motor Cycling requires the use of a single stage thermostat which senses the water temperature. The contacts of the thermostat are wired in series with the fan motor's starter holding coil.

In this method, there are only two stable levels of performance: 100% of capacity when the fan is on and approximately 10% of capacity when the fan is off.

Controls should be set to only allow a maximum of six (6) start/stop cycles per hour.

IMPORTANT

THE RECIRCULATION PUMP SHOULD NOT BE USED AS A MEANS OF CAPACITY CONTROL AND SHOULD NOT BE CYCLED FREQUENTLY. EXCESSIVE CYCLING CAN LEAD TO SCALE BUILD-UP AND REDUCES THE PERFORMANCE. FREQUENT CYCLING OF THE SPRAY PUMP, WITHOUT THE FANS IN OPERATION, WILL PROVOKE DRIFT AND SPRAY WATER MIGRATION OVER THE AIR INLET LOUVERS, WHICH IS PROHIBITED IN MOST COUNTRIES. PLEASE CONSULT YOUR LOCAL LEGISLATION.

2. Two Speed Motors

The use of a two-speed motor provides an additional step of capacity control when used with the fan cycling method. The low speed of the motor will provide approximately 60% of full speed capacity.

Two-speed capacity control systems require not only a two-speed motor, but also a two-stage thermostat and the proper two-speed motor starter. The most common two-speed motor is a single winding type. This is also known as a consequent pole design. Two-speed two winding motors are also available. All multi-speed motors used in evaporative cooling units should be variable torque design.

It is important to note that when two-speed motors are to be used, the motor starter controls must be equipped with a decelerating time delay relay. The time delay should be a minimum of a 30 second delay when switching from high speed to low speed.

3. Variable Frequency Drives

The use of a variable frequency drive (VFD) provides the most precise method of capacity control. By adjusting the voltage and frequency, the AC induction motor can operate at many different speeds.

VFD technology has particular benefit on evaporative cooling units operating in cold climates where airflow can be modulated to minimize icing and reversed at low speed for de-icing cycles.

Sequence of Operation for Multi-fan Units with a VFD During Peak Load

1. The VFD should all be synchronized to speed up and slow down uniformly.
2. The VFD needs to have a preset shutoff to prevent water temperatures from becoming too cold and to prevent the drive from trying to turn the fan at near zero speed.
3. Operating below 25% of motor speed achieves very little return in fan energy savings and capacity control. Unless otherwise stated in your factory submittal, 25% is the lowest recommended fan speed. Check with your VFD supplier if operating below 25% is possible.

Identify and Lock-out Harmful Resonant Frequencies

A Variable Frequency Drive (VFD) fan system, unlike traditional fixed-speed systems, is designed to operate between 25% (13Hz) and 100% (50Hz) speeds, which creates an opportunity for operation where resonant frequencies exist. Sustained operation at resonant frequencies may lead to excessive vibration, fatigue of structural components and/or drive system noise and failure. Owners and operators must anticipate the existence of resonant frequencies and lock out frequencies during start-up and commissioning in order to prevent drive system operational problems and structural damage. As a part of the normal start-up and commission processes, resonant frequencies should be identified and locked-out in the VFD's software.

The unit's supporting structure, external piping, and accessories contribute to the overall harmonic make-up and stiffness of the system. The choice of VFD will also have a significant influence on how the system behaves. Consequently, not all resonant frequencies can be determined in advance at the manufacturer's factory during final inspection and testing. Relevant resonant frequencies (if they occur) can only be identified accurately after the installation in the system.

To check for resonant frequencies in the field, a run-up and run-down test must be performed. Additionally, VFD carrier frequencies should be adjusted to best align the VFD with the electrical system. Refer to your drive's start-up procedures for additional information and instruction.

The procedure of checking for resonant frequencies requires stepping through the VFD's operating range at (2) Hz intervals from the lowest operating frequency to full speed. At each step, pause long enough for the fan to reach steady-state. Note changes in unit vibration during this time. Repeat from full speed to minimum speed. Should vibration-inducing frequencies exist, the run-up and run-down test will isolate the resonant frequencies which then must then be locked-out in the VFD programming.

Recirculated Water System - Routine Maintenance

Suction Strainer in Cold Water Basin

The pan strainer should be removed and cleaned monthly or as often as necessary. Make certain that the strainer is properly located over the pump suction, alongside the anti-vortexing hood.

Cold Water Basin

The cold water basin should be flushed out quarterly, and checked monthly or more often if necessary, to remove any accumulation of dirt or sediment which normally collects in the basin. Sediment can become corrosive and cause deterioration of basin materials. When flushing the basin, it is important to keep the suction strainers in place to prevent any sediment from entering the system. After the basin has been cleaned, the strainers should be removed and cleaned before refilling the basin with fresh water.

Operating Level of Water in Cold Water Basin

The operating level should be checked monthly to make sure the water level is correct. Refer to **Table 2** for unit specific levels.

PRODUCT LINE	BOX	OPERATING DEPTH*
AT	4' Wide	7" (180 mm)
AT	14' Wide, Atlas & Four Cell Units	11" (280 mm)
AT/SUN	All Others	9" (230 mm)
AXS	All	9" (230 mm)
LPT	All	8" (200 mm)
LSTE	10' Wide	13" (330 mm)
LSTE	All Others	9" (230 mm)

Table 2 - Recommended Operating Water Level

At initial start up or after the unit has been drained, the unit must be filled to the overflow level. Overflow level is above the normal operating level and accommodates the volume of water normally in suspension in the water distribution system and the riser piping. The water level should always be above the strainer. Check by running the pump with the fan motors off and observing the water level through the access door or remove the air inlet louver.

Water Make Up Valve

A mechanical float valve assembly is provided as standard equipment on the evaporative cooling unit (unless the unit has been ordered with an optional electronic water level control package or the unit is arranged for remote sump operation). The water level in the basin is adjusted by repositioning the float and all-thread using the wing nuts.

The make up valve assembly should be inspected monthly and adjusted as required. The valve should be inspected annually for leakage and if necessary, the valve seat should be replaced. The make up water pressure for the mechanical valve should be maintained between 140 and 340 kPa.

Drift Eliminators

Check the drift eliminators quarterly to make sure the drift eliminators are still in the correct position and not clogged by any debris. If required after inspection, drift eliminators must be removed, cleaned and reinstalled correctly.On forced draft models, the worker must use personal precautions and adequate safety measures against the risk of a fall, in accordance with local regulations. Remove one or two eliminator sections from the top of the unit, protect the fill by use of a hard board before entering the unit and walking on the fill. Never walk on the eliminators! Once standing on the fill, the remaining drift eliminators can be removed. On induced draft models, lifting handles are provided along the top layer of eliminators. Remove one or two eliminator sections, protect the fill by use of a hard board before entering the unit and walking on the fill. Never walk on the eliminators! Once standing on the fill, the remaining drift eliminators can be easily removed through the access door.

Pressurized Water Distribution Systems

All EVAPCO cooling towers are supplied with wide orifice spray nozzles. The water distribution system should be checked monthly to make sure it is operating properly. Always check the spray system with the pump on and the fans off (locked and tagged out). On forced draft units (LSTE and LPT models), remove one or two eliminator sections from the top of the unit and observe the operation of the water distribution system.

On induced draft units (AT models), lifting handles are provided on several sections of eliminators within reach of the access door. Eliminators can be easily removed from outside of the unit to observe the water distribution system. The diffusers are essentially non-clogging and should seldom need cleaning or maintenance.

If the water diffusers are not functioning properly, in most cases it is a sign that the suction strainer has not been working properly and that foreign matter or dirt has accumulated in the water distribution pipes. The nozzles can be cleared by taking a small pointed probe and moving it back and forth in the diffuser opening, with the pump(s) running and the cooling load and fan(s) off.

If an extreme build up of dirt or foreign matter occurs, remove the branch to flush the debris from the header pipe. The spray branches and header can be removed for cleaning, but should only be done if absolutely necessary. Check the suction strainer to make sure it is in good operating condition and positioned properly so that cavitation or air entrapment does not occur.

When inspecting and cleaning the water distribution system, always check that the orientation of the water diffusers is correct as shown for LPT and LSTE models in Figure 1 and as shown in Figure 2 for AT models. The top of the EVAPCO logo on the nozzle is parallel with the top of the water distribution pipe.

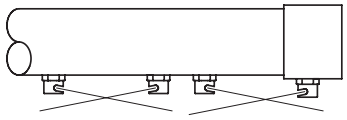


Figure 1 - LSTE / LPT Water Distribution

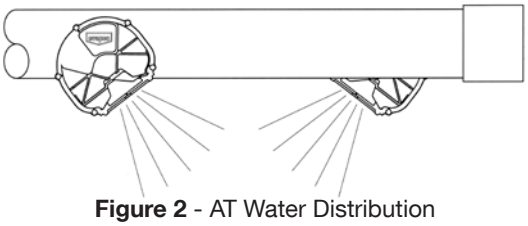


Figure 2 - AT Water Distribution

Bleed-Off Valve

The bleed-off valve, whether factory or field installed, must be checked weekly to make sure it is functioning and set properly. Keep the bleed-off valve wide open unless it has been determined that it can be set partially open without causing scaling or corrosion.

Water Treatment and Water Chemistry

Proper water treatment is an essential part of the maintenance required for evaporative cooling equipment. A well designed and consistently implemented water treatment program will help to ensure efficient system operation while maximizing the equipment's service life. A qualified water treatment company should design a site specific water treatment protocol based on equipment (including all metallurgies in the cooling system), location, makeup water quality, and usage.

Bleed or Blowdown

Evaporative cooling equipment rejects heat by evaporating a portion of the recirculated water into the atmosphere as warm, saturated discharge air. As the pure water evaporates it leaves behind the impurities found in the system's makeup water and any accumulated airborne contaminants. These impurities and contaminants, which continue to recirculate in the system, must be controlled to avoid excessive concentration which can lead to corrosion, scale, or biological fouling.

Evaporative cooling equipment requires a bleed or blowdown line, located on the discharge side of the recirculating pump, to remove concentrated (cycled up) water from the system. EVAPCO recommends an automated conductivity controller to maximize the water efficiency of your system. Based on recommendations from the water treatment company, the conductivity controller should open and close a motorized ball or solenoid valve to maintain the conductivity of the recirculating water. If a manual valve is used to control the bleed rate, it should be set to maintain the conductivity of the recirculating water during periods of peak load at the maximum level recommended by the water treatment company.

Galvanized Steel – Passivation

'White Rust' is a premature failure of the protective zinc layer on hot dip or mill galvanized steel which can occur as a result of improper water treatment control during the start-up of new galvanized equipment. The initial commissioning and passivation period is a critical time for maximizing the service life of galvanized equipment. EVAPCO recommends that the site specific water treatment protocol includes a passivation procedure which details water chemistry, any necessary chemical addition, and visual inspections during the first six (6) to twelve (12) weeks of operation. During this passivation period, recirculating water pH should be maintained above 7.0 and below 8.0 at all times. Since elevated temperatures have a harmful effect on the passivation process, the new galvanized equipment should be run without load for as much of the passivation period as is practical.

The following water chemistry promotes the formation of white rust and should be avoided during the passivation period:

1. pH values in the recirculating water greater than 8.3.
2. Calcium hardness (as $CaCO_3$) less than 50 ppm in the recirculating water.
3. Anions of chlorides or sulfates greater than 250 ppm in the recirculating water.
4. Alkalinity greater than 300 ppm in the recirculating water regardless of pH value.

Changes in water chemistry control may be considered after the passivation process is complete as evidenced by the galvanized surfaces taking on a dull gray color. Any changes to the treatment program or control limits should be made slowly, in stages while documenting the impact of the changes on the passivated zinc surfaces.

- Operating galvanized evaporative cooling equipment with a water pH below 6.0 for any period may cause removal of the protective zinc coating.
- Operating galvanized evaporative cooling equipment with a water pH above 9.0 for any period may destabilize the passivated surface and create white rust.
- Re-passivation may be required at any time in the service life of the equipment if an upset condition occurs which destabilizes the passivated zinc surface.

Water Chemistry Parameters

The water treatment program designed for evaporative cooling equipment must be compatible with the unit's materials of construction, as well as other equipment and piping used in the system. Control of corrosion and scale will be very difficult if the recirculating water chemistry is not consistently maintained within the ranges noted in **Table 3**.

Property	Z-725 Galvanized Steel	Type 304 Stainless Steel	Type 316 Stainless Steel
pH	7.0 – 8.8	6.0 – 9.5	6.0 – 9.5
pH During Passivation	7.0 – 8.0	N/A	N/A
Total Suspended Solids (ppm)*	<25	<25	<25
Conductivity (Micro-Siemens/cm) **	<2,400	<4,000	<5,000
Alkalinity as $CaCO_3$ (ppm)	75 - 400	<600	<600
Calcium Hardness $CaCO_3$ (ppm)	50 - 500	<600	<600
Chlorides as Cl^-(ppm) ***	<300	<500	<2,000
Silica (ppm)	<150	<150	<150
Total Bacteria (cfu/ml)	<10,000	<10,000	<10,000

* Based on standard EVAPAK® fill
** Based on clean metal surfaces. Accumulations of dirt, deposits, or sludge will increase corrosion potential
*** Based on maximum coil fluid temperatures below 49°C

Table 3 - Recommended Water Chemistry Guidelines

Chemicals should be fed through automatic feed equipment to a point which ensures proper control and mixing prior to reaching the evaporative cooling equipment. Chemicals should never be batch fed directly into the basin of the evaporative cooling equipment.

Evapco does not recommend the routine use of acid due to the destructive consequences of improper feeding; however, if acid is used as part of the site specific treatment protocol, it should be pre-diluted prior to introduction into the cooling water and fed by automated equipment to an area of the system which ensures adequate mixing. The location of the pH probe and acid feed line should be designed in conjunction with the automated feedback control to ensure that proper pH levels are consistently maintained throughout the cooling system. The automated system should be capable of storing and reporting operational data including pH reading and chemical feed pump activity. Automated pH control systems require frequent calibration to ensure proper operation and to protect the unit from increased corrosion potential.

The use of acids for cleaning should also be avoided. If acid cleaning is required, extreme caution must be exercised and only inhibited acids recommended for use with the unit's materials of construction should be used. Any cleaning protocol, which includes the use of an acid, shall include a written procedure for neutralizing and flushing the evaporative cooling system at the completion of the cleaning.

Control of Biological Contamination

Building water systems receive potable and non-potable water from either a public or private entity for their water supply. This water supply for the building water system can contain various waterborne pathogens, including Legionella bacteria, which can cause or contribute to various illnesses if aspirated, ingested or inhaled. Since evaporative cooling equipment uses the same building water, there is some potential that these pathogens, including Legionella, might propagate in the evaporative cooling equipment. As such, evaporative cooling equipment should be located at such a distance and wind direction to minimize the possibility of tower discharge air and associated drift being drawn into building fresh air intakes or near areas frequented by at-risk individuals. Purchasers should obtain the services of a licensed professional engineer or a registered architect to certify that the location of evaporative cooling equipment is in compliance with applicable building, fire and clean air codes. (See EVAPCO's Equipment Layout Manual for more information.)

In addition, it is recommended that the building employ a site-specific water management program that is designed to minimize the risk of Legionellosis associated with building water systems. (See ANSI/ASHRAE Standard 188-2018 for further details.) An effective water management program also can help promote heat transfer efficiency and limit corrosion potential. Various water treatment professionals are available to provide assistance with such measures.

During operation, off-line cleaning of evaporative cooling equipment should be undertaken on a regular basis. Inspections should be undertaken on a regular basis, and should include both monitoring of microbial populations via culturing techniques and visual inspections for evidence of biofouling. Additionally, drift eliminators should be inspected and maintained in good operating condition. Service personnel must wear proper protective equipment (including approved respiratory protection equipment) while undertaking such cleaning efforts or any other maintenance efforts on evaporative cooling equipment. Requirements for such protection equipment include, but are not limited to, OSHA standards set forth in 29 CFR 1910.132 et seq.

Gray Water and Reclaimed Water

The use of water reclaimed from another process as a source of makeup water for evaporative cooling equipment can be considered as long as the resultant recirculating water chemistry conforms to the parameters noted in Table 3. It should be noted that using water reclaimed from

other processes may increase the potential of corrosion, microbiological fouling, or scale formation. Gray water or reclaimed water should be avoided unless all of the associated risks are understood and documented as part of the site specific treatment plan.

Air Contamination

Evaporative cooling equipment draws in air as part of normal operation and can scrub particulates out of the air. Do not locate the unit next to smokestacks, discharge ducts, vents, flue gas exhausts, etc. because the unit will draw in these fumes which may lead to accelerated corrosion or deposition potential within the unit. Additionally, it is important to locate the unit away from the building's fresh air intakes to prevent any drift, biological activity, or other unit discharge from entering the building's air system.

Stainless Steel

Stainless steel is the most cost effective material of construction available to extend the life of an evaporative cooling unit.

Maintaining the Appearance of Stainless Steel

It is a common misconception that stainless steel is stain and rust proof, making surface maintenance not required at all. This is simply not true. Like mill galvanized steel, stainless steel is most effective when kept clean. This is especially true when located in atmospheres with chloride salts, sulfides or other rusting metals. In these environments, stainless steel can discolor, rust or corrode.

At a minimum, the unit should be washed down annually to reduce residual dirt or surface deposits on the stainless steel. In addition, this wash down will keep the stainless steel components free from corrosive elements in the atmosphere including chlorides and sulfides which are damaging to stainless steel.

Protect stainless steel during unit installation, especially welding of nearby carbon steel pipes as weld slag or other corroding materials may cause staining in stainless steel if not protected or cleaned.

Cleaning of Stainless Steel

Routine Maintenance – Mild Cleaning
Simple pressure washing (of sheet metal components only), using household cleaners, detergents or ammonia annually (more frequently in marine or industrial environments) will help maintain the finish and keep it free of atmospheric contaminants.

Minor Surface Dirt – Mildly Aggressive Cleaning
Use of a sponge or bristle brush with a non-abrasive cleaner is recommended. After cleaning, rinse with warm water from a hose or pressure washer. Towel dry cleaned area and coat area with a high quality wax to provide extra protection.

More Aggressive Cleaning – Removal of Fingerprints or Grease
Repeat processes 1 and 2, then use a hydro-carbon solvent like Acetone or alcohol. As with any hydro-carbon solvent, caution must be taken when using the product. Do not use in confined spaces or while smoking. Keep solvents out of contact with hands and skin. Household glass cleaner, Spic n' Span are other options for cleaners. After cleaning, towel dry and apply a coat of high quality wax for extra protection.

Aggressive Cleaning – Removing Stains or Light Rust
If iron contamination or surface staining is suspected, immediately remove the stain or rust using a chrome, brass or silver cleaner. The use of mild non-scratching creams and polishes are also recommended. When the cleaning procedure is complete; use a high quality wax for extra protection.

Most Aggressive Cleaning – Removing Heavy Rust Deposits, Iron Contamination, Spot Weld Discoloration and Weld Spatter using Acid

First try processes 1 through 4. If the stain or rust is not removed, the following should be used as a last resort. Rinse the surface with hot water. Use a saturated solution of oxalic or phosphoric acid (10 to 15% acid solution). This should be applied with a soft cloth and allowed to stand for a few minutes – do not rub. This acid should etch out the iron particles. Follow this with an ammonia and water rinse. Rinse the surface again with hot water; coat with a high quality wax for added protection. Use extreme caution when working with acids! Synthetic rubber gloves should be used, goggles and aprons are advisable.

DO NOT USE THIS METHOD IF THE UNIT HAS GALVANIZED STEEL COMPONENTS.

As a minimum, these guidelines should be followed to maintain and clean the stainless steel unit. When cleaning stainless steel, NEVER use coarse abrasives or steel wool, NEVER clean with mineral acids and NEVER leave stainless in contact with iron or carbon steel.

Cold Weather Operation

EVAPCO counterflow evaporative cooling equipment is well suited to operate in cold weather conditions. The counterflow cooling tower design encases the heat transfer media (fill) completely and protects it from the outside elements such as wind which can cause freezing in the unit.

When the evaporative cooling unit is going to be used during cold weather conditions, several items need to be considered. These include: unit layout; unit piping; unit accessories and capacity control of the units.

More information can be found in Bulletin 113-E, pages 23-25.

Replacement Parts

EVAPCO has replacement parts available for immediate shipment. Most orders ship within 24 hours from time of order!

To order replacement parts, please visit **www.MrGoodTower.eu** to find your local contact.

MAINTENANCE CHECKLIST

PROCEDURE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1. Clean pan strainer – **monthly or as needed**												
2. Clean and flush pan* – **quarterly or as needed**												
3. Check bleed-off valve to make sure it is operative – **monthly**												
4. Check operating level in pan and adjust float valve if necessary – **monthly**												
5. Check water distribution system and spray pattern – **monthly**												
6. Check drift eliminators – **quarterly**												
7. Check the fan blades for cracks, missing balancing weights, and vibrations – **quarterly**												
8. Check sheaves and bushings for corrosion. Scrape and coat with ZRC – **annually**												
9. Lubricate fan shaft bearings – **every 1000 hours of operation or every three months**												
10. Lubricate fan motor bearings – see mfg's instructions. Typically for non-sealed bearings, **every 2-3 years**												
11. Check belt tension and adjust – **monthly**												
12. Inspect and grease sliding motor base - **annually or as needed**												
13. Check fan screens, inlet louvers and fans. Remove any dirt or debris – **monthly**												
14. Inspect and clean protective finish – **annually** - Galvanized: scrape and coat with ZRC - Stainless: clean and polish with a stainless steel cleaner												
15. Check water quality for biological contamination. Clean unit as needed and contact a water treatment program** – **regularly**												
16. Check AXS (crossflow) hot water basins for debris and corrosion – **regularly**												

* See maintenance manual for start-up instructions and lubrication recommendations

** Cooling Towers must be cleaned on a regular basis to prevent the growth of bacteria including Legionella Pneumophila

OPTIONAL ACCESSORIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1. Coupling/Shaft – Inspect flex elements and hardware for tightness, proper torque & crack/deterioration – **monthly**												
2. Heater Controller – Inspect controller and clean probe ends – **quarterly**												
3. Heater – Inspect junction box for loose wiring and moisture – **one month after start-up and semi-annually**												
4. Heater – Inspect elements for scale build-up – **quarterly**												
5. Inspect junction box for loose wiring and moisture – **semi-annually**												
6. Electronic Water Level Controller – Clean probe ends of scale build-up – **quarterly**												
7. Electronic Water Level Controller – Clean inside the standpipe – **annually**												
8. Solenoid Make-up Valve – Inspect and clean valve of debris – **as needed**												
9. Vibration Switch (mechanical) – Inspect enclosure for loose wiring and moisture – **one month after start-up and monthly**												
10. Vibration Switch – Adjust the sensitivity - **during start-up and annually**												
11. Sump Sweeper Piping – Inspect and clean piping of debris – **semi-annually**												
12. Gear Reducer – Check oil level with unit stopped - **24 hours after startup & monthly**												
13. Gear Reducer/Piping – Do visual inspection for oil leaks, auditory inspection for unusual noises and vibrations – **monthly**												

(continued on next page)

MAINTENANCE CHECKLIST

(continued from the previous page)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
14. Gear Reducer – Replace oil – **semi-annually**												
15. Oil Pump – Do visual inspection for leaks and proper wiring – **monthly**												
16. Gear Reducer/Coupling – Check alignment of the system – **semi-annually**												
17. Electronic Water Level Controller – Inspect controller and clean probe ends – **quarterly**												
18. Water Level Indicator - Inspect and clean – **annually**												

DURING IDLE PERIODS

1. **Two or more days**: energize motor space heaters or run motor for 10 min - **twice daily**												
2. **Few weeks**: run gear reducer for 5 minutes - **weekly**												
3. **Several weeks**: completely fill gear reducer with oil. Drain to normal level prior to running - **once**												
4. **One Month or longer**: rotate motor shaft/fan 10 turns – **bi-weekly**												
5. **One Month or longer**: megger test motor windings – **semi-annually**												

SEASONAL SHUTDOWN CHECKLIST

When the system is to be shut down for an extended period of time, the following services should be performed

1. The evaporative cooling unit cold water basin should be drained												
2. The cold water basin should be flushed and cleaned with the suction strainer screens in place												
3. The suction strainer screens should be cleaned and reinstalled												
4. The cold water basin drain should be left open												
5. The fan shaft bearings and motor base adjusting screws should be lubricated. This should also be performed if the unit is going to sit idle prior to start up												
6. The water makeup valve needs to be closed. All water make-up, overflow and drain piping needs to be drained, if not heat traced and insulated. Electronic Water Level Control (EWLC) should be heat traced and insulated if equipped												
7. The finish of the unit should be inspected. Clean and refinish as required												
8. The fan bearings and motor bearings need to be turned at least once a month by hand. This can be accomplished by making sure the unit's disconnect is locked and tagged out, and grasping the fan assembly, rotating it several turns												
9. Energize motor space heaters												

See fan and pump manufacturer maintenance and long term storage instructions for more detailed instructions.