Bulletin 116R-E Metric

evapco for LIFE

REDUCED EUROPEAN
MAINTENANCE INSTRUCTIONS

For EVAPCO Induced Draft and Forced Draft Closed Circuit Coolers and Evaporative Condensers

ATC-E / eco-ATC
ATW / eco-ATW

eco-ATWE

LSWA(-H) / LSCE

LRW(-H) / LRC

ESWA

PMCQ

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 116-E, is available for download at:

www.evapco.eu

EVAPCO Products are Manufactured Worldwide

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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 116-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.

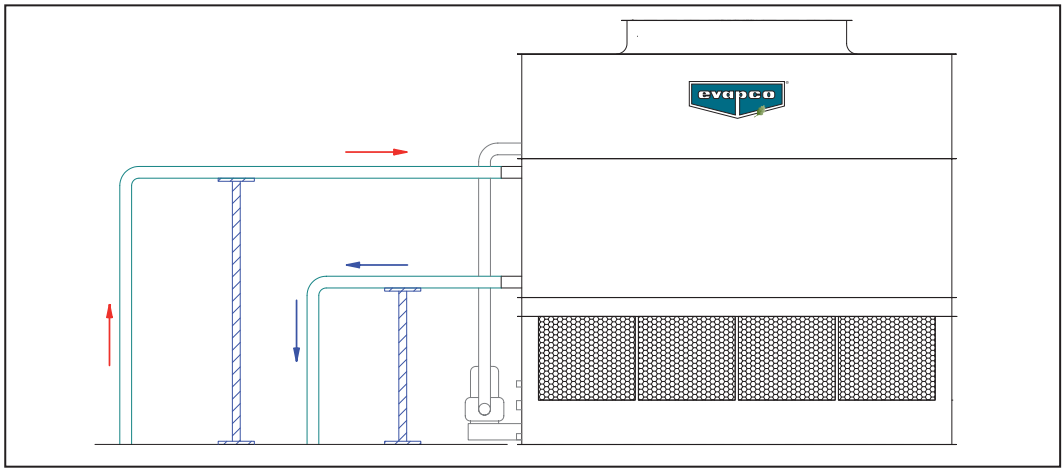
WARNING: In order to avoid excessive pressure, proper safety valves should be foreseen in the cooling installation. These safety measures are not delivered by Evapco and are the responsibility of the customer/contractor. The application of these safety measures has to be evaluated for the cooling system as a whole and not limited to the partly completed machinery.

WARNING: Atmospheric corrosion and corrosion due to the use of corrosive media at the inside/or outside of the coils is forbidden and voids the PED certification.

WARNING: Every handling that effects the integrity of the pressure vessel (example, but not limited to, welding, grinding, drilling, ...) is forbidden and voids the PED certification.

Installation Precautions

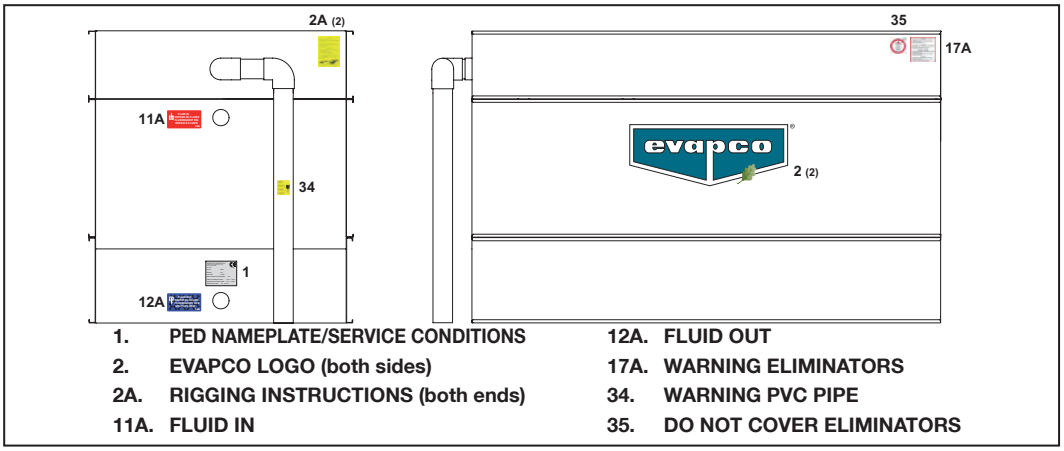
WARNING: The coil connections are not designed to support piping. The water / glycol / refrigerant piping always need to be supported (by others). See also Bulletin 131-E “Piping Evaporative Condensers”.



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 coil section(s)



1.	PED NAMEPLATE/SERVICE CONDITIONS	12A.	FLUID OUT
2.	EVAPCO LOGO (both sides)	17A.	WARNING ELIMINATORS
2A.	RIGGING INSTRUCTIONS (both ends)	34.	WARNING PVC PIPE
11A.	FLUID IN	35.	DO NOT COVER ELIMINATORS

WARNING: Do not operate the pressure vessel at service conditions outside of the PED nameplate located at the coil connection. See position 1 for the location of the PED nameplate.

WARNING: Maximum working temperature of the pressure vessel as mentioned on the PED nameplate exceeds the nominal operating temperature of the unit. Never apply pressure vessel temperatures above 65°C or consult the factory for approval.

WARNING: Legal periodic controls of the pressure vessel need to be performed according to the legal requirements of the country.

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

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 operate 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 for recommendations on locking out resonance frequencies.
5. Verify that a water treatment plan has been implemented including passivation of galvanized steel units. See "Water Treatment" section for more details.
6. 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.
7. 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. 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) and pump(s) by hand to insure it turns freely without obstructions.
10. Visually inspect the fan blades. Blade clearance should be approximately 10 mm (6 mm minimum) 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 12-2000 and CTI Guideline WTP-148 for more information and consult local legislation prior to start-up.
12. Fill the cold water basin manually up to the overflow connection.
13. For closed circuit coolers only, fill the heat exchanger coil with the specified fluid and vent air from the system before pressurizing, using vents on coil inlets.
14. 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.
15. Closed hydronic systems connected to either a closed-circuit cooler or dry cooler should be pre-cleaned and flushed to remove debris, grease, flash rust, oil, and other suspended solids prior to operation. Evapco recommends the use of inhibitor chemistry or inhibited glycol to minimize corrosion and scale during normal operation.

    For eco-WE & eco-W with optional controls, see controls O&M for proper start up procedure.

After the unit has been energized, check the following:

1. Adjust mechanical float valve as required to the proper water level.
2. Unit basin should be filled to the proper operating level. See "Recirculating Water System Operating Levels" section for more details.
3. Verify fan is rotating in proper direction.
4. Start the spray water pump and check for proper rotation as indicated by the arrow on the front cover.
5. Measure voltage and current on all three power leads of pump and fan motor. The current should not exceed the motor nameplate full load amp rating.
6. Adjust bleed valve to proper flow rate. Consult your qualified water treatment person to fine tune the minimum bleed necessary.
7. See fan and pump motor manufacturer maintenance and long term storage instructions for more detailed information. The motors should be lubricated and serviced in accordance with manufacturers 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

The motors are built to “Cooling Tower Duty” specifications. The fan motor bearings for motors up to 30 kW are lubricated for the lifecycle of the bearings, higher motor powers require relubrication (please see motor manual for more detail). After extended shut-downs, the motor should be checked with an insulation tester prior to be restarted.

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 LS 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).

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 0°C continuously.

Table 1 provides a short list of approved lubricants for each temperature range.

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

All bearings used on EVAPCO equipment are factory adjusted and self aligning. Do not disturb bearing alignment by tightening the sleeve bearing caps.

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 10 mm when moderate pressure is applied midway between the sheaves. A properly tensioned belt will not “chirp” or “squeal” when the fan motor is started.

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.

Note: for the eco-ATW with Sage[2] and eco-ATWE with Sage[3] consult the manual.

1. Fan Motor Cycling

Fan Motor Cycling requires the use of a single stage thermostat which senses the fluid temperature (closed circuit coolers) or condensing temperature (evaporative condensers). 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 start/stop cycles per hour.**

IMPORTANT:
THE RECIRCULATION PUMP MAY NOT BE USED AS A MEANS OF CAPACTY CONTROL AND SHOULD NOT BE CYCLED MORE THEN SIX START/STOP CYCLES PER HOUR.

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.

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.

The VFDs need to have a pre-set shutoff to prevent water temperatures from becoming too cold and to prevent the drive from trying to turn the fan at near zero speed. Operating below 25% of motor speed achieves very little return in fan energy savings and capacity control. Check with your VFD supplier if operating below 25% is possible.

NOTE**:** Pump Motors: VFD’s should not be used on pump motors. The pumps are designed to be operated at full speed and are not intended to be used as capacity control.

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.

Model Number				Operating Level
ATW ATW	9 64	through through	48 866	230 mm 280 mm
ESWA ESWA	72 144	through through	142 216	280 mm 280 mm
LSWA LSWA LSWA LSWA LSWA	20 91 116 135 174	through and and and and	87 182 232 270 348	280 mm 300 mm 300 mm 380 mm 380 mm
LRW	18	through	379	200 mm
C-ATW	67-3H	through	133-6J	280 mm
eco-ATW eco-ATW	0,9 m wide 2,3 m wide	and through	1,2 m wide 7,3 m wide	230 mm 280 mm
eco-ATWE	2,3 m wide	through	7,3 m wide	280 mm
LSCE LSCE LSCE LSCE LSCE LSCE LSCE LSCE LSCE	36 281 591 400 800 410 820 550 1100	through through through through through through through through through	385 386 770 515 1030 560 1120 805 1610	280 mm 300 mm 300 mm 300 mm 300 mm 380 mm 380 mm 380 mm 380 mm
LRC	25	through	379	200 mm
ATC ATC	50E M170E	through through	165E 3714E	230 mm 280 mm
C-ATC	181	through	504	280 mm
PMCQ	316	through	1786	360 mm
eco-ATC	176	through	4086	280 mm

* Measured from lowest point on basin floor.

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

Check the water distribution system 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 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 models, lifting handles are provided along the top layer of eliminators. Eliminators can be easily removed from the access door and the distribution system observed. The diffusers are essentially non-clogging and should seldom need cleaning or maintenance.
If the water diffusers are not functioning properly, it is a sign that the pan or system 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 probed and moving it rapidly 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 end cap in each branch to flush the debris from the header pipe. The branches or header can be removed for cleaning, but do so only if necessary. Check the strainer in the pan to make sure it is in good condition and positioned properly so that cavitation or air entrainment does not occur.

All Evaporative Condensers and Closed Circuit Coolers, except the ESWA Closed Circuit Cooler, are supplied with ZM II® spray nozzles as standard. The ZM II® spray nozzles do not need to be oriented a specific way to achieve proper coil coverage.

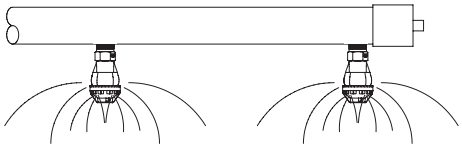


Figure 1 - ZM II® Spray Nozzle Orientation.
All Coil Products except the ESWA

Figure 1 shows the proper spacing of the ZM II® spray nozzles. For the ESWA, wide orifice water diffusers are supplied. When inspecting and cleaning the water distribution system, always check that the orientation of the water diffusers is correct as shown in **Figure 2**.

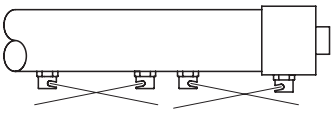


Figure 2 - Proper Water Diffuser Orientation
(2A Nozzles) ESWA Models

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.

Pump (When Supplied)

The pump and pump motor should be lubricated and serviced in accordance with the pump manufacturer's instructions.
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 reduce wet and dry performance.
Note: for the eco-ATW(E), please consult the Sage[2] and Sage[3] manual.

Coils

Contact Evapco in case of damage to the pressure vessel. Do not affect the integrity of the pressure vessel without approval of Evapco.

Evaporative Coil(s)

Check coil surface periodically, but at least twice a year. Inspect the coil surface for scale and/or corrosion.

Dry Coils (optional)

Depending on outdoor conditions and unit type, the dry coil should be inspected and cleaned at least twice a year. If the unit is located near trees, construction, etc., the required cleaning may be more frequent. The coil should be visually inspected monthly along with inlet louvers and inlet screens. The best cleaning solution for the dry coil is plain water. If the coil has maintained and cleaned at regular intervals, water is sufficient to remove dirt and debris from the fins. Heavy build up on the exterior of the fins can be removed with a brush. If a pressure washer is used, make sure the equipment is set to a low pressure setting and that the nozzle is set to the fan spray, not stream, otherwise damage to the fins could result.

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

Evaporative cooling equipment should be inspected regularly to ensure good microbiological control. Inspections should include both monitoring of microbial populations via culturing techniques and visual inspections for evidence of biofouling.

Poor microbiological control can result in loss of heat transfer efficiency, increase corrosion potential, and increase the risk of pathogens such as those that cause Legionnaires' disease. The site specific water treatment protocol should include procedures for routine operation, startup after a shut-down period, and system lay-up, if applicable. If excessive microbiological contamination is detected, a more aggressive mechanical cleaning and/or water treatment program should be undertaken.

It is important that all internal surfaces, particularly the basin, be kept clean of accumulated dirt and sludge. Additionally, drift eliminators should be inspected and maintained in good operating condition.

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.

Cold Weather Operation & Ice Management

EVAPCO counterflow evaporative cooling equipment is well suited to operate in cold weather conditions. The counterflow design encases the heat transfer media (fill and/or coils) 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 including unit layout, recirculating water, unit recirculating piping, unit heat transfer coils, unit accessories and capacity control of the units.

More information can be found in Bulletin 116-E, pages 21-26.

Freeze Protection of Recirculating Water

The simplest and most effective way of keeping the recirculated water from freezing is to use a remote sump. With a remote sump, the recirculating water pump is mounted remotely at the sump and whenever the pump is shut off, all recirculating water drains back to the sump. Recommendations for sizing the remote sump tank and recirculating water pumps for coil products are presented for Evaporative Condensers and Closed Circuit Coolers in their respective catalog. The pressure drop through the water distribution system measured at the water inlet is as follows in **Table 4** (See next page).

If a remote sump cannot be used, basin heaters are available to keep the recirculating water from freezing when the pump is turned off. Electric heaters may be used to heat the basin water when the unit is shut down. The make-up water supply, overflow and drain lines, as well as the pump and pump piping up to the overflow level must be heat traced and insulated to protect them from damage. Any other connections or accessories at or below the water level, such as electronic water level controllers, must also be heat traced and insulated.

Note: Using basin heaters will not prevent the fluid in the coils, nor the residual water in the pump or pump piping from freezing.

A condenser or cooler cannot be operated dry (fans on, pump off) unless the water is completely drained from the pan. The pan heaters are sized to prevent pan water from freezing only when the unit is completely shut down.

Evaporative Condenser Model Number						Closed Circuit Cooler Box Size			Required Inlet Pressure (kPa)
eco-ATC			ATC			ATW, eco-ATW, eco-ATWE			
-		-	50E	to	165E	0,9 m & 1,2 m wide			14
176	to	272	M170E	to	M247E	2,3 x 2,6 m			14
M208	to	M302	M203E	to	M233E	2,4 x 2,7 m			14
M252	to	M454	M252E	to	M439E	2,4 x 3,2 m / 3,7 m / 4,3 m			14
M411	to	M604	M426E	to	M591E	2,4 x 5,5 m			21
M545	to	M718	M523E	to	M679E	2,4 x 6,4 m			27,5
M600	to	M903	M607E	to	M877E	2,4 m x 7,4 m / 8,6 m			14
M821	to	M1206	M852E	to	M1179E	2,4 m x 11,0 m			21
M995	to	M1384	M1046E	to	M1358E	2,4 m x 12,9 m			27,5
M503	to	M906	M501E	to	M844E	4,9 m x 3,2 m / 3,6 m / 4,3 m			17
280	to	503	XE298E	to	XC462E	3 m x 3,6 m			25,5
559	to	1005	XE596E	to	XC925E	3 m x 7,4 m			25,5
365	to	705	XE406E	to	XC669E	3 m x 5,5 m			39
731	to	1411	XE812E	to	XC1340E	3 m x 11,0 m			39
433	to	942	428E	to	892E	3,6 m x 3,6 m / 4,2 m / 5,5 m			24
866	to	1883	858E	to	1784E	3,6 m x 7,4 m / 8,6 m / 11,0 m			17
867	to	1884	857E	to	1783E	7,3 m x 3,6 m / 4,3 / 5,5 m			21
1908	to	3766	1879E	to	3459E	7,3 m x 7,4 m / 8,6 m / 11,0 m			17
775	to	1023	791E	to	967E	3,6 m x 6,1 m			24
1607	to	2043	1625E	to	1925E	3,6 m x 12,3 m			24
1608	to	2044	1616E	to	1915E	7,3 m x 6,1 m			22
2911	to	4086	2855E	to	3714E	7,3 m x 12,3 m			22
C-ATC						C-ATW			
181	to	373				67-3H	to	133-6J	17
362	to	504				-		-	21
LRC						LRW			
25	to	72				1 m wide			7
76	to	114				1,5 m x 3,7 m			14
108	to	183				1,5 m x 4,6 m			14
190	to	246				1,5 m x 5,6 m			14
188	to	379				2,4 m x 4,6 m / 5,6 m			14
LSCE						LSWA			
36	to	80				1,2 m x 1,8 m			10
90	to	120				1,2 m x 2,7 m			10
135	to	170				1,2 m x 3,6 m			10
185	to	385				1,6 m x 3,6 m / 5,5 m			14
281	to	1120				2,4 m x 3,6 m / 5,6 m / 7,3 m / 11,0 m			21
400	to	1610				3 m x 3,6 m / 5,6 m / 7,3 m / 11,0 m			17
						ESWA			
						72-23H	to	72-46K	21
						96-23H	to	96-46K	17
						142-23H	to	142-46K	24
						144-23I	to	144-46M	21
						216-23J	to	216-46S	17
PMCQ									
316 - 1420 (3 m wide)									21
399 - 1786 (3,6 m wide)									24

Notes: For dual cell units, the inlet pressure shown is per cell.
The spray water flows can be found in the bulletins of the respective models.

Table 4 - Recommended Recirculating Water Pump Sizing for Remote Sump Application - Coil Products Only

Freeze Protection of Closed Circuit Cooler Coils

The simplest and most effective way of protecting the heat exchanger coil from freezing is to use an inhibited ethylene or propylene glycol anti-freeze. If this is not possible, an auxiliary heat load and minimum flow rate must be maintained on the coil at all times so that the water temperature does not drop below 10°C when the cooler is shut down. See **Table 5** for recommended minimum flow rates.

If an anti-freeze solution is not used, the coil must be drained immediately whenever the pumps are shut down or flow stops. This is accomplished by having automatic drain valves and air vents in the piping to and from the cooler. Care must be taken to ensure that the piping is adequately insulated and sized to allow the water to flow quickly from the coil. This method of protection should be used only in emergency situations and is neither a practical nor recommended method of freeze protection. Coils should not be drained for an extended period of time, as internal corrosion may occur.

When the unit is in operation during freezing weather, some type of capacity control is normally required in order to keep water temperatures from dropping below 10°C. Operating dry with a remote sump is an excellent way of reducing unit capacity at low temperatures. Other methods of capacity control include two-speed motors, VFDs and fan cycling. These can be used individually or in combination with dry/ remote sump operation.

Closed Circuit Cooler Footprint	Minimum Flows	
	Standard Flow LPS	Series Flow LPS
ATW, eco-ATW & eco-ATWE Products		
0,9 m wide units	—	1,7
1,2 m wide**	4,7	2,4
2,3 m x 2,6 m	9,4	4,7
2,4 m x 2,7 m to 2,4 m x 6,4 m	10,1	5,1
4,9 m wide	20,2	10,1
3 m x 3,6 m & 3 m x 5,6 m	11,9	6,0
3 m x 7,3 m; 3 m x 11,0 m; 6,1 m x 3,6 m; 6,1 m x 5,5 m	23,8	11,9
6,1 m x 7,3 m; 6,1 m x 11,0 m	47,4	23,8
3,6 m x 3,6 m; 3,6 m x 4,2 m; 3,6 m x 5,5 m; 3,6 m x 6,1 m	14,7	7,4
3,6 m x 7,3 m; 3,6 m x 8,6 m; 3,6 m x 11,0 m; 3,6 m x 12,9 m	29,3	14,7
7,3 m x 3,6 m; 7,3 m x 4,2 m; 7,3 m x 5,5 m; 7,3 m x 6,1 m	29,3	14,7
7,3 m x 7,3 m; 7,3 m x 8,6 m; 7,3 m x 11,0 m; 7,3 m x 12,9 m	58,6	29,3
CATW Products	8,9	4,5
LRW Products		
1,2 m wide units	3,8	1,9
1,6 m wide units	6,0	3,0
2,4 m wide units	9,4	4,7
LSWA Products		
1,2 m wide units	4,2	1,9
1,6 m wide units	6,0	3,0
LSWA 91 to LSWA 135	9,4	4,7
LSWA 116 to LSWA 174	11,9	6,0
LSWA 232 to LSWA 348	23,8	11,9
Dual Fan Side Units		
LSWA 182 to LSWA 270	16,7	8,4
ESWA Products		
2,4 m wide units	15,0	7,5
3,6 m wide units	20,9	10,5

** Not available as eco-ATWE

Table 5 - Closed Circuit Cooler Minimum Recommended Flow Rate

Troubleshooting: see Bulletin 116-E, pages 26-29

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. Lubricate pump and pump motor according to manufacturer's instructions												
5. Check operating level in pan and adjust float valve if necessary – **monthly**												
6. Check water distribution system and spray pattern – **monthly**												
7. Check drift eliminators – **quarterly**												
8. Check the fan blades for cracks, missing balancing weights, and vibrations – **quarterly**												
9. Check sheaves and bushings for corrosion. Scrape and coat with ZRC - **annually**												
10. Lubricate fan shaft bearings – **every 1000 hours of operation or every three months**												
11. Lubricate fan motor bearings – see mfg's instructions. Typically for non-sealed bearings, **every 2-3 years**												
12. Check belt tension and adjust – **monthly**												
13. Inspect and grease sliding motor base - **annually or as needed**												
14. Check fan screens, inlet louvers, fans and (dry) cooler coil. Remove any dirt or debris – **monthly**												
15. Inspect and clean protective finish – **annually** - Galvanized: scrape and coat with ZRC - Stainless: clean and polish with a stainless steel cleaner												
16. Check water quality for biological contamination. Clean unit as needed and contact a water treatment program* – **regularly**												
17. Check coil surface for scale and/or corrosion - **every 6 months**												

OPTIONAL ACCESSORIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1. Heater – Inspect junction box for loose wiring and moisture – **one month after start-up and semi-annually**												
2. Heater – Inspect elements for scale build-up – **quarterly**												
3. Electronic Water Level Controller – Inspect junction box for loose wiring and moisture – **semi-annually**												
4. Electronic Water Level Controller – Clean probe ends of scale build-up – **quarterly**												
5. Electronic Water Level Controller – Clean inside the standpipe – **annually**												
6. Solenoid Make-up Valve – Inspect and clean valve of debris – **as needed**												
7. Vibration Switch (mechanical) – Inspect enclosure for loose wiring and moisture – **one month after start-up and monthly**												
8. Vibration Switch – Adjust the sensitivity - **during start-up and annually**												
9. Sump Sweeper Piping – Inspect and clean piping of debris – **semi-annually**												
10. Clean Dry Coil(s) – **semi-annually**												

DURING IDLE PERIODS

1. **Two or more days**: energize motor space heaters or run motor for 10 min twice daily												
2. One Month or longer: Rotate motor shaft/fan 10 turns – **bi-weekly**												
3. One Month or longer: Megger test motor windings – **semi-annually**												

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