BALTIMORE
AIRCOIL AUSTRALIA

# Series 1500E/XE Cooling Towers

## OPERATION & MAINTENANCE MANUAL

# Recommended Maintenance Service[1]

| Inspect and clean as necessary: | Start-Up | Monthly | Quarterly | Annually | Shutdown |
|---|---|---|---|---|---|
| Inspect general condition of the unit[2] and check unit for unusual noise or vibration | ✓ | ✓ | | | |
| Inspect cold and hot water basins | ✓ | | ✓ | | |
| Inspect spray nozzles | ✓ | | ✓ | | |
| Drain basin and piping | ✓ | | | | ✓ |
| Inspect air intake louvers/Combined inlet shields | ✓ | ✓ | | | |
| Check and adjust water level in cold water basin | ✓ | ✓ | | | |
| Check operation of make-up valve | ✓ | ✓ | | | |
| Check and adjust bleed rate | ✓ | ✓ | | | |
| Inspect unit finish | | | | ✓ | |
| **Mechanical equipment system:** | **Start-Up** | **Monthly** | **Quarterly** | **Annually** | **Shutdown** |
| Check belt condition | ✓ | ✓ | | | |
| Adjust belt tension[3] | ✓ | | ✓ | | |
| Lubricate fan shaft bearings[4] | ✓ | | ✓[4] | | ✓ |
| Lubricate motor base adjusting screw | ✓ | | ✓ | | ✓ |
| Check drive alignment | | | | ✓ | |
| Check motor voltage and current | ✓ | | ✓ | | |
| Clean fan motor exterior | ✓ | | ✓ | | |
| Check fan motor for proper rotation | ✓ | | | | |
| Check general condition of the fan | ✓ | | ✓ | | |
| Verify fan blade drain holes are not obstructed (hollow blade fans) | | | ✓ | | |
| Check fan for uniform pitch | | | ✓ | | |
| Check fan for rotation without obstruction | ✓ | | ✓ | | |
| Check and recoat steel shafts with RUST VETO® | ✓ | | ✓ | | ✓ |
| Check optional basin heater | | | | ✓ | |
| Check optional vibration cutout switch | ✓ | | | ✓ | |

**DANGER:** Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out, and tagged out.

**NOTES:**

1. Recommended service intervals are the minimum for typical installations. Different environmental conditions may dictate more frequent servicing. Follow all safety and equipment precautions on pages 2 and 3.
2. When operating in ambient temperatures below freezing, the unit should be inspected more frequently. Refer to “Cold Weather Operation” on page 24 for more details.
3. Tension on new belts must be readjusted after the first 24 hours of operation and quarterly, thereafter.
4. Lubricate fan shaft bearings quarterly or every 2,000 hours of operation, whichever occurs first.

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## OPERATION & MAINTENANCE » SERIES 1500E/XE COOLING TOWERS

# Safety and Equipment Precautions

## DANGER

- **DANGER:** Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out, and tagged out.

## WARNING

- **WARNING:** When access to the top of the unit is desired, the purchaser/end-user is cautioned to wear proper equipment and use appropriate means to comply with applicable safety standards related to working on elevated surfaces.
- **WARNING:** When the fan speed of the unit is to be changed from the factory set speed, including changes achieved by the use of a variable fan speed device, steps must be taken to avoid operation at or near the fan's "critical speed" which could result in fan failure and possible personal injury or damage.
- **WARNING:** The recirculating water system may contain chemicals or biological contaminants, including Legionella, which could be harmful if inhaled or ingested. Personnel exposed directly to the discharge airstream and the associated drift mists, generated during operation of the water distribution system and/or fans, or mists produced by high pressure water jets or compressed air (if used to clean components of the recirculating water system), must wear respiratory protection equipment approved for such use by governmental occupational safety and health authorities.
- **WARNING:** All electrical, mechanical, and rotating machinery are potential hazards, particularly for those not familiar with their design, construction, and operation. Accordingly, use appropriate lockout procedures. Adequate safeguards (including the use of protective enclosures where necessary) should be taken with this equipment both to safeguard the public from injury and to prevent damage to the equipment, its associated system, and the premises.
- **WARNING:** A lockable disconnect switch should be located within sight of the unit for each fan motor associated with this equipment. Before performing any type of service or inspection, make certain that all power has been disconnected, and the switch is locked out in the "OFF" position.
- **WARNING:** Dangerous voltages are present in this equipment. Disconnect the electrical service of the source and follow proper lock out and tag out procedures to de-energize the circuit before servicing or replacing components.

## Caution

- **CAUTION:** Openings and/or submerged obstructions may exist in the bottom of the cold water basin. Use caution when walking inside this equipment.
- **CAUTION:** Follow exposure control and personal protective equipment requirements as outlined in the MSDS for all recommended lubricant and maintenance materials.

## Warranties

Please refer to the Limitation of Warranties in the submittal packet applicable to and in effect at the time of the sale/purchase of these products. Described in this manual are the recommended services for start-up, operation, and shutdown, and the approximate frequency of each.

# NOTICE

- The basin heater is not designed to prevent icing during unit operation.
- Check to ensure the controls for the fan motor are set to allow a maximum of six on-off cycles per hour to prevent motor overload.
- For fan motors controlled with VFDs with a switching frequency of 2.5 kHz, the line lead length cannot exceed 100 feet. If the switching frequency is higher than 2.5 kHz and/or the line lead length exceeds 100 feet, a dV/dT output filter is recommended to protect the motor.
- When reversing the direction of fan rotation, allow the fan to come to a complete stop before restarting the motor.
- Only lubricate the bearings with one of the following compatible water resistant greases on page 13.
- Do not use steam or high pressure water to clean PVC eliminators or materials other than steel.
- Never use chloride or chlorine based solvents such as bleach or muriatic (hydrochloric) acid to clean stainless steel. It is important to rinse the surface with warm water and wipe with a dry cloth after cleaning.
- Neglected damaged areas on the Whisper Quiet Fan can result in the attack of the glass-fiber layers (a process commonly known as fiberbloom) because of moisture entering through these spots.
- For installations with 2-speed motors when slowing from high speed, allow a minimum 15-second time delay for the fan to slow down before energizing the low-speed winding.

# General Maintenance Information

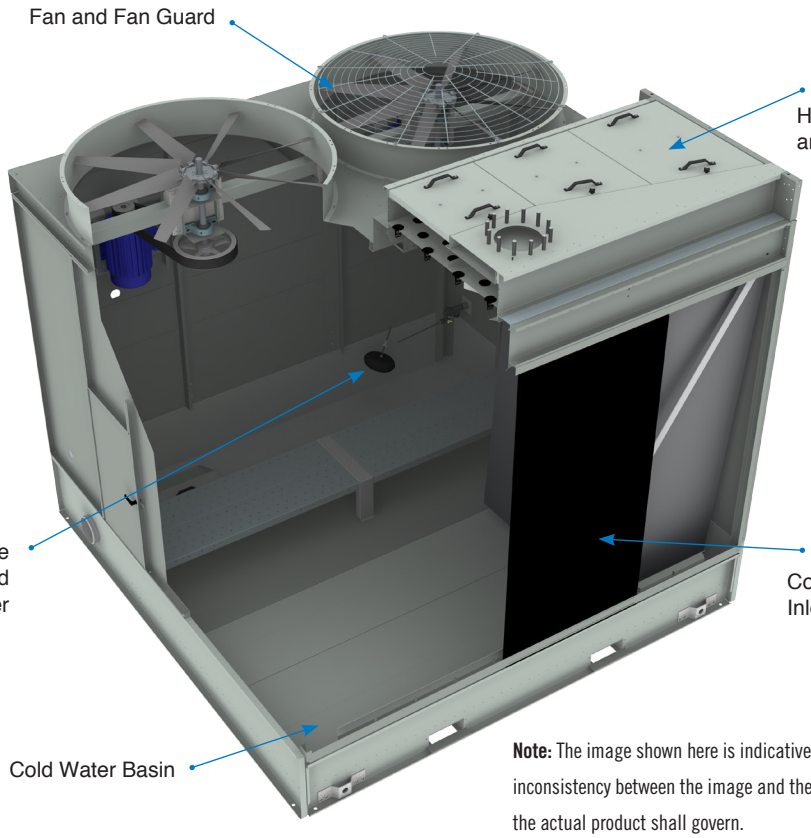
The services required to maintain a piece of evaporative cooling equipment are primarily a function of the quality of the air and water in the locality of the installation:

- **AIR:** The unit should be located such that unusual quantities of industrial smoke, chemical fumes, salt, or heavy dust do not enter the equipment. Such airborne impurities entering into the equipment and absorbed by the recirculating water, which can form a corrosive solution.
- **WATER:** As water evaporates from the equipment, dissolved solids are left behind, which were originally contained in the make-up water. These dissolved solids may be either alkaline or acidic and as they are concentrated in the circulating water, they can cause scaling or accelerated corrosion.

The extent of impurities in the air and water determines the frequency of most maintenance services and also governs the extent of water treatment which can vary from a simple continuous bleed and biological control to a sophisticated treatment system. Refer to “Water Treatment” on **page 18** and “Biological Control” on **page 19** for more details.

SERIES 1500E COOLING TOWER

# 1 Unit Operation and Storage




**Note:** The image shown here is indicative only. If there is inconsistency between the image and the actual product, the actual product shall govern.

**Figure 1.** Series 1500E Cooling Tower

## Start-Up Procedure

**DANGER:** Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out, and tagged out.

### General

- If the unit is mounted on vibration isolators or isolation rails (by others), refer to the vibration isolation manufacturer's guidelines before loading/unloading weight from the unit.
- Verify the fan and system pump motors are disconnected, locked out, and tagged out.

## Cleaning

- Drain the cold water basin with the strainer in place.
- Open the hot water basin covers and remove any dirt or debris from the hot water basins.
- Clean and inspect the fan deck.
- Remove dirt and debris from the fan guard(s).
- Inspect and clean all spray nozzles.
- Clean and inspect the mechanical components, such as the fan and motor.
- Flush the cold water basin to remove any accumulated dirt and debris.
- Remove, clean, and replace the cold water basin strainer.

## Inspection

- Conduct external inspection of the equipment. Check for leaks, corrosion, and any structural damage.
- Conduct internal inspection of the equipment. Check for anything unusual such as structural or mechanical component damage.
- Inspect piping and connections.
- Thoroughly inspect the fan for any damage.
- Verify proper fan tip clearance. Refer to Fan “Inspection & Maintenance” on **pg 10**.
- At seasonal start-up or after prolonged shutdown, check the motor insulation with an insulation tester prior to the motor start-up.
- Check and adjust the belt tension.
- Check that the float operated make-up valve is operating freely.

## Start-Up

Prior to seasonal start-up, lubricate the motor base adjusting screw (see **Figures 5** on **page 13**) and the fan shaft bearings (see **page 13**). At initial start-up, bearings should be lubricated. If the unit has been idle for more than three months, re-lubricate the bearings (see **page 13**).

- Apply RUST VETO® to steel shafts.
- Fill the cold water basin with fresh water to the overflow level via the make-up valve.
- Set the make-up valve float so the water shuts off at the operating level (see **Table 1**, **page 9**).
- Check that the float-operated make-up valve is operating freely. Closely monitor the water level and adjust as necessary during the first 24 hours of operation.
- For multicell arrangements, balance the flow between the cells to obtain even water distribution.



**NOTICE:** Check to ensure the controls for the fan motor are set to allow a maximum of six on-off cycles per hour to prevent motor overload.

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- Adjust the valve (supplied by others) in the tower bleed line to achieve the desired bleed rate by closing or opening the valve.
- Inspect the nozzles and heat transfer section as described in "Water Distribution System" on **page 15 (Figure 7)**.
- Execute one of the following biocide treatment programs while operating the circulating pump and prior to operating the unit fans:
  - Resume treatment with the biocide that was used prior to shutdown. Operate the pump only while maintaining the maximum recommended biocide residual for a sufficient duration (residual and time will vary with the biocide) as recommended by the water treatment supplier. Start the fan only after this treatment period is completed.
  - Check the pH of the circulating water and, if necessary, adjust it to 7.0 - 7.6 pH. Then, running the pump only, treat the system with sodium hypochlorite to maintain a level of 4 to 5 mg/l (ppm) free chlorine (as $Cl_2$) over a six hour period. Test kits for measuring the free residual of chlorine are commercially available. Start the fan only after this treatment period is completed.
- For initial start-up, briefly energize the fan motor(s) and note the direction of rotation. The fan should rotate in the direction indicated by the arrow on the fan cowl.
- Run the fan in manual mode for several minutes to check for any unusual noise or vibrations.
- For 2-speed motors: check that the starter incorporates a 15 second time delay when switching from high to low speed.
- Check the operation of the vibration cutout switch (see **page 26**).
- Once the cooling tower is operating, check the current and voltage of all three phases (legs) of the fan motor with a heat load on the tower under warm ambient conditions. The current must not exceed the motor nameplate rating.
- For units with VFDs, see **page 28**.
- For units with the optional Electric Water Level Control, see **page 16**.

**After 24 hours of operation under thermal load, perform the following services:**

- ✓ Check the tower for any unusual noise or vibrations.
- ✓ Check the operating water level in the hot and cold water basins.
- ✓ Adjust the make-up valve if necessary.
- ✓ Check the belt tension and readjust if necessary.
- ✓ Inspect the spray nozzles and heat transfer section.

## Extended Shutdown

**Perform the following services whenever the unit is shutdown in excess of three days:**

- If the unit is mounted on vibration isolators or isolation rails (by others), refer to the manufacturer's guidelines before loading/unloading weight from the unit.
- Disconnect, lock-out, and tag-out all fans and pumps.
- Close the shut-off valve in the make-up water line (supplied by others) and drain cold water basin and all exposed water piping. Heat trace and insulate all exposed piping.
- To minimize the risk of biological contamination during shutdown, it is recommended the entire system be drained.
- Clean all debris, such as leaves and dirt, from the interior and exterior of the unit, including the combined inlet shields.
- Clean and flush the cold water basin with the basin strainer in place.
- Leave the cold water basin drain open so rain and melting snow will drain from the unit.

**DANGER:** Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out, and tagged out.

- Clean the basin strainer and re-install.
- Cover the fan discharge to keep out dirt and debris.
- Lubricate the fan shaft bearings, motor base, and motor base adjusting screw.
- Apply RUST VETO® to steel shafts.
- Inspect the protective finish on the unit. Clean and refinish as required. Refer to "Corrosion Protection" on **page 18** for more details.
- Lockout the fan motor starting device in the "OFF" position to ensure personal safety in case of future inspection or service.

# Prolonged Outdoor Storage

## Storage Preparation

- Conduct the "Extended Shutdown" procedure on **page 6** if the unit is installed.
- Ensure the cold water basin is fully drained and the drain is open.
- For storage prior to installation, all components and accessories, which sometimes ship inside the tower and are not a permanent fixture in the basin, should be removed and stored indoors.
- Remove and store fan belts (if supplied) at room temperature. Tag belts appropriately for future identification.
- Apply a weather-resistant lubricant or heavy grease such as Anti-Seize to all exposed threaded or flanged connections and adjustable motor base threaded rod.
- Insert desiccant bags into the control panel (if supplied) to absorb moisture. Seal the control panel for storage.
- Spray coat electrical component housings (if supplied) with a suitable protective coating, such as Cosmoline® Weathershed, and individually cover them with plastic taking care to leave openings for free air circulation.
- Hot water basins should be covered to keep out leaves, debris, etc.
- Inspect the protective finish on the unit. Clean and refinish as required. Refer to "Corrosion Protection" on **page 18** for more details.

## Motor Recommendations

BAC standard motors are designed for storage at ambient temperatures of -20ºF to 104ºF (-28.9ºC to 40ºC). Prolonged periods of exposure above or below these specified conditions could degrade components of the motor and cause malfunction or premature failure.

- Motors should be removed and stored inside whenever possible. When indoor storage is not possible the motors must be covered with a tarpaulin. Do not use plastic or plastic film. This cover should extend below the motor and be secured; however, it should not tightly wrap the motor. This will allow the captive air space to breathe, minimizing formation of condensation.
- Care must also be taken to protect the motor from flooding or from harmful chemical vapors.



**NOTICE:** Covering the unit with a clear plastic tarpaulin during storage can trap heat inside the unit and cause damage to the PVC components. If units must be covered during storage, an opaque, reflective tarp should be used.

**DANGER:** Do not perform any service on or near the fans, motors and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out and tagged out.

- The storage area should be free from ambient vibration. Excessive vibration can cause bearing damage.
- Precautions should be taken to prevent rodents, snakes, birds, or other small animals from nesting inside the motors. In areas where they are prevalent, precautions must also be taken to prevent insects from gaining access to the interior of the motor.
- If not stored indoors in a controlled environment, some form of heating must be utilized to prevent condensation from accumulating in the motor. This heating should maintain the winding temperature at a minimum of 9ºF (-12.8ºC) above the ambient temperature of the surrounding environment, keeping it from dropping below the dew point where condensation could form inside the motor. If space heaters are supplied, they should be energized. Request the required voltage and transformer capacity from your local BAC Representative. A third option is to use an auxiliary heat source and keep the winding warm by either convection or blowing warm air into the motor.
- Rotate the motor shaft monthly to redistribute bearing grease.

## Maintenance Requirements

- Rotate all fans and motor shafts monthly by hand. Hand-turning will ensure that the shafts and bearings are free and will redistribute grease within the bearings. Keep hands away from pinch points such as bolts and sheaves.
- Inspect the cold water basin monthly to ensure that the drain is open and remove any leaves or debris that may have accumulated in the cold water basin.
- Inspect axial fans prior to start-up and at least once annually to ensure that the blades are tight and that there is no obvious corrosion between the hub and the fan blade.
- Inspect the rust preventative coating on all motor external machined surfaces including shaft extensions monthly. If necessary, re-coat the surfaces with RUST VETO®.

## Start-Up Preparation After Prolonged Storage

Keep in mind that start-up procedures after long periods of storage are just as important as pre-shutdown procedures.

- Motors should be thoroughly inspected and cleaned and restored to pre-storage condition.
- Inspect the axial fan(s) prior to start-up to ensure that the blades are tight and that there is no obvious corrosion between the hub and the fan blades. Do not energize the fan(s) if there is obvious corrosion of fan components. Loose fan blades could result in fan failure and possible injury or damage.
- Reinstall all fan belts, motors, door gaskets, and drain plugs (as applicable), and remove all protective coverings.
- For units stored prior to installation, conduct rigging procedures as directed in the unit's *Rigging and Assembly Instructions*, available on www.BaltimoreAircoil.com.au or by contacting your local BAC Representative.
- Perform an insulation test of motor windings to ensure satisfactory insulation resistance.
- Conduct the full start-up procedure as stated in the "Start-Up Procedure" on **page 4**. Be especially thorough for cleaning and inspection prior to start-up.

**DANGER:** Do not perform any service on or near the fans, motors and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out and tagged out.

# Detailed Component Maintenance Procedures

2

## Cold Water Basin

As water circulating though the cooling tower is cooled, it collects in the cold water basin and passes though the suction strainer into the system. The cold water basin is constructed from one of the following materials of construction and the following maintenance applies to all basin materials of construction.

- Galvanized steel
- Welded Type 304/316 stainless steel

### Water Levels

| Model Number | Operating Level | | | Overflow Level | | |
|---|---|---|---|---|---|---|
| | Above Basin Bottom (mm) | Above Unit Base (mm) | Operating Volume (l) | Above Basin Bottom (mm) | Above Unit Base (mm) | Operating Volume (l) |
| S15E/XE15E-0809-06x | 178 | 229 | 583 | 356 | 406 | 1639 |
| S15E/XE15E-0812-06x | 178 | 229 | 787 | 381 | 432 | 2415 |
| S15E/XE15E-1012-06x | 178 | 229 | 995 | 343 | 394 | 2672 |
| S15E/XE15E-1012-09x | 178 | 229 | 995 | 419 | 470 | 3444 |
| S15E/XE15E-1012-10x | 178 | 229 | 995 | 432 | 483 | 3573 |
| S15E/XE15E-1018-09x | 203 | 406 | 1900 | 457 | 660 | 5814 |
| S15E/XE15E-1218-10x | 203 | 406 | 1900 | 476 | 679 | 6105 |
| S15E/XE15E-1212-07x | 178 | 229 | 1067 | 381 | 432 | 3569 |
| S15E/XE15E-1212-09x | 178 | 229 | 1067 | 413 | 464 | 3959 |
| S15E/XE15E-1212-10x | 178 | 229 | 1067 | 425 | 476 | 4114 |
| S15E/XE15E-1212-11x | 178 | 229 | 1067 | 445 | 495 | 4349 |
| S15E/XE15E-1212-12x | 178 | 229 | 1067 | 445 | 495 | 4349 |
| S15E/XE15E-1218-07x | 229 | 432 | 2593 | 425 | 629 | 6264 |
| S15E/XE15E-1218-09x | 229 | 432 | 2593 | 457 | 660 | 6858 |
| S15E/XE15E-1218-10x | 229 | 432 | 2593 | 476 | 629 | 7214 |
| S15E/XE15E-1218-11x | 229 | 432 | 2593 | 483 | 689 | 7332 |
| S15E/XE15E-1218-12x | 229 | 432 | 2593 | 495 | 699 | 7570 |

**Table 1.** Cold Water Basin Water Levels (Measured From Inside the Cold Water Basin)

- The operating water level in the cold water basin will vary with system thermal load (evaporation rate), the bleed rate employed, and the make-up water supply pressure.
- The make-up valve controls the operating level, which should be maintained at the levels shown in **Table 1**.
- Check the operating water level monthly, and readjust the float when necessary to maintain the recommended operating level.
- Consult "Water Level Control" on **page 16** for information on how to set and maintain the basin operating level.

**CAUTION:** Openings and/or submerged obstructions may exist in the bottom of the cold water basin. Use caution when walking inside this equipment.

## Inspection & Maintenance

- Inspect the cold water basin regularly. Remove trash or debris that may have accumulated in the basin or on the strainer.
- Quarterly, or more often if necessary, drain, clean, and flush the entire cold water basin with fresh water. This will remove the sediment, which can collect in the basin during operation. If not removed, sediment can become corrosive and cause deterioration of the protective finish of metallic basins.
  - When flushing the basin, leave the strainer in place to prevent debris from entering the system.
  - Remove the strainer after the basin has been flushed.
  - Clean and replace the strainer before refilling the basin with fresh water.
- Adjust the float to maintain the design operating level. See **Table 1** on **page 9**.

# Fan

The Series 1500E Cooling Tower uses axial fan(s). Thoroughly inspect the fan(s) for damaged or deteriorated fan blades and replace the fan(s) as required.

**DANGER:** Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out, and tagged out.

## Inspection & Maintenance

- If the unit is already in operation, while the fan is running, check for any unusual noise or vibration.
- With the fan(s) off and the motor disconnected, locked out, and tagged out, check the general condition of the fan:
  - Inspect for any loose or missing bolts in the fan shaft bushing, the fan hub, and the fan shaft bearings.
  - Check the fan blades for looseness, first by twisting the blade by hand, and then by moving the blade tip up and down. There should be no play or slippage.
  - Inspect each blade for excessive scale build-up that could cause vibration.
  - Check each blade for any cracks. If cracks are found, the fan motor should be locked out until the fan is replaced. Contact your local BAC Representative for assistance.
- With the fan off and the motor disconnected, locked out, and tagged out, check the general condition of the fan:
  - **Tip Clearance:** Check the clearance between the tip of the blade and the fan cowl. The clearance should be sufficient to prevent the fan blades from contacting the

fan cowl during operation. Contact your local BAC Representative if there are any concerns.– **Drain Holes**: On hollow blades, the drain hole in the blade tip should be unobstructed. Tip: Use a piece of wire to probe the drain hole.

- **Blade Pitch:** Check to ensure that the blades are all at the same pitch. If uncertain, measure the pitch with an inclinometer. All blades should be within 1/2° of each other.
- **Rotation:** Turn the fan by hand to ensure that it moves freely with no rough spots, binding, or other malfunctions that could cause vibration or fan motor overload. While rotating the fan, check the blade tracking. All blades should track within a 25mm band at any single point around the cowl.
- **Direction of Rotation:** On initial start-up, or if the fan motor has been rewired, briefly energize the fan motor and note the direction of fan rotation. It should rotate in the direction indicated by the arrow on the fan cowl.
- **Operation:** On initial start-up, run the fan in the manual position for several minutes, and check for any unusual noises or vibration.

# Fan Drive System

## BALTIDRIVE® Power Train Fan System

The BALTIDRIVE® Power Train consists of a solid-backed, multi-groove, neoprene/polyester belt rated for cooling tower service, and corrosion-resistant sheaves. These components provide high reliability with low maintenance requirements.

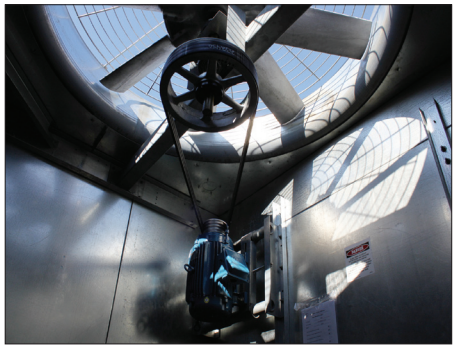

**Figure 2. BALTIDRIVE® Power Train Fan System**

### Inspection & Maintenance

These drives require a periodic check of the belt condition and, when necessary, tension adjustment. The recommended service intervals are as follows:

- **Initial Start-Up:** The drive has been tensioned and aligned at the factory; however, prior to initial startup, check belt tension.
- **Seasonal Start-Up:** Readjust the belt tension (if required).
- **Operation:** After the first 24 hours of operation, readjust the belt tension on a new unit start-up or installation of a new belt. Thereafter, check the belt condition monthly, and adjust tension as necessary. Readjust tension at least once every three months.



**NOTICE:** Check to ensure the controls for the fan motor are set to allow a maximum of six on-off cycles per hour to prevent motor overload.

**DANGER:** Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out, and tagged out.

**NOTE:** If belts are properly tensioned, there should be no “chirp” or “squeal” when the fan motor is started.

**NOTICE:** Check to ensure the controls for the fan motor are set to allow a maximum of six on-off cycles per hour to prevent motor overload.

- **Belt tension check:**
  - Place a straight edge along the belt from sheave to sheave as shown in **Figure 3a**, or use a tape measure as shown in **Figure 3b** to measure belt deflection.
  - Apply a moderate force by hand (approximately 40 lbs/275 kPa) evenly across the width of the belt in the center of the span between the sheaves.
  - There is adequate belt tension if the belt deflects between 6mm and 10mm as shown in **Figures 3a** and **3b**.

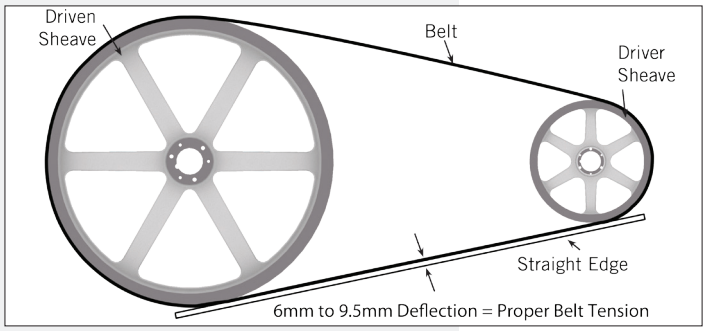


**Figure 3a.** Belt Tension with a Straight Edge

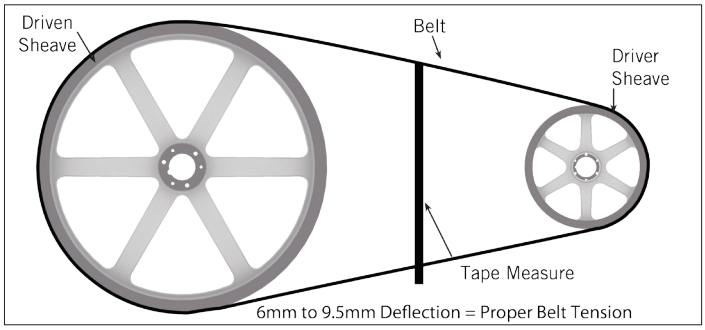


**Figure 3b.** Belt Tension with a Tape Measure

- **Belt tension adjustment (if required):**
  - Loosen the lock nut on the motor base adjusting screw.
  - Turn the motor base adjusting screw clockwise to tension the belt or counterclockwise to relieve belt tension. During adjustment of the belt tension, rotate the drives several times by hand to evenly distribute the tension throughout the belt.
  - When the belt is properly tensioned, retighten the locking nut on the motor base adjusting screw.
- **Drive alignment check and adjustment:**
  - Check the drive alignment annually to ensure maximum belt life.
  - Place a straight edge across the driver and the driven sheaves as shown in **Figure 4.** for standard drives.
  - The straight edge should contact all four points as shown in **Figure 4.** indicating that the drives are properly aligned.
  - There should be no more than 1.5mm deviation from the four points of contact.
  - If realignment is required loosen the motor sheave and align it with the fan sheave. Allow 6mm for draw-up as the bushing screws are tightened.

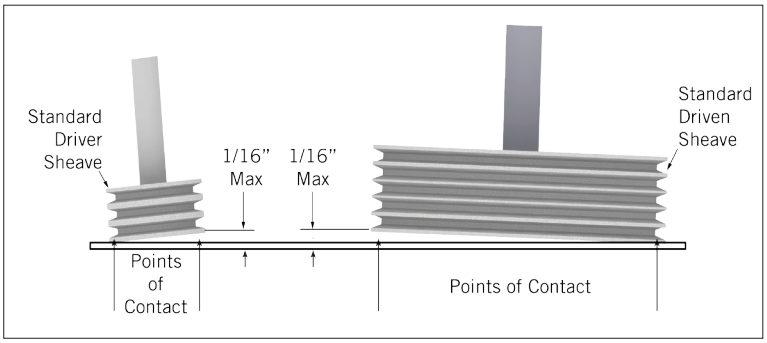


**Figure 4.** Standard Drive Alignment

# Drive System

(Direct driven units, see Figure 8)

The standard fan motor used on direct driven Series 1500 units is a TEAO (Totally Enclosed Air Over) motor. The motor has permanently lubricated ball bearings and special moisture protection on the bearings, shaft, and windings. The only servicing required during operation is to clean the outside surface of the motor at least quarterly to ensure proper motor cooling. After prolonged shutdowns, the motor insulation should be checked with a “megger” insulation tester before restarting the motor.

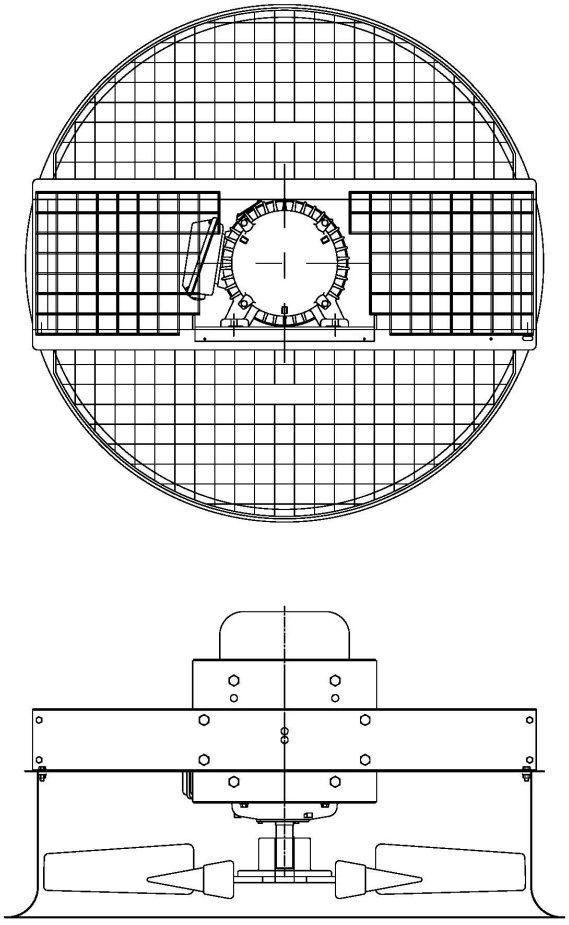

Figure 8 - Direct Drive

# Fan Motors

Series 1500E Cooling Towers use cooling tower duty, premium efficient, totally enclosed, motor(s).

## Inspection & Maintenance

- Clean the outside of the motor at least quarterly to ensure proper motor cooling.
- After prolonged shutdowns, check the motor insulation with an insulation tester prior to restarting the motor.
- Check the motor voltage and current following start-up and every three months while in operation.

## Adjustable Motor Base

Coat the motor base slides and adjusting screws prior to start-up, every three months while in operation, and following shutdown. Use good quality corrosion inhibiting grease such as one of those recommended for lubricating the fan shaft bearings on **page 14**.

- **Independent Drive Adjustment**: If the motor needs to be adjusted, loosen the lock nut first, then adjust the motor base (see **Figure 5**).

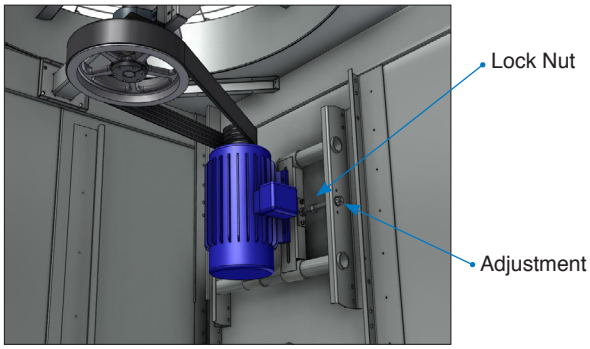


**Figure 5. Independent Drive Adjustment**

**NOTICE:** Check to ensure the controls for the fan motor are set to allow a maximum of six on-off cycles per hour to prevent motor overload.

# Fan Shaft Bearings

Two pillow block ball bearings support the fan shaft. Each bearing is equipped with a lubrication fitting and a slinger/locking collar to keep out moisture.

**DANGER:** Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out, and tagged out.

## Inspection & Maintenance

- Only lubricate the bearings with a manual grease gun or BAC's optional Automatic Bearing Greaser. Do not use high-pressure grease guns since they may rupture the bearing seals.
- Only lubricate the bearings with one of the following compatible water resistant greases which are suitable for ambient temperatures ranging from -65ºF (-53.9ºC) to +250ºF (121.1ºC).
  - Amoco - Rycon Premium #3
  - Chevron - SRI
  - Citgo - Polyurea MP2™
  - Conoco - Polyurea 2™
  - Exxon - Polyrex® EM
  - Exxon - Unirex N™
  - MobilGrease® - AW2
  - Shell - Alvania RL3™
  - Shell - Alvania #3
  - Shell - Dolium "R"
  - SKF - LGHP2™
  - Unocal 76 - Unilife Grease™
- Lubricate the bearings as follows:
  - **Initial Start-up:** Bearings should be lubricated with new grease before initial operation. **When lubricating, purge the old grease from the bearing by gradually adding grease until a bead of new grease appears at the seal on the underside of the bearing.**
  - **Seasonal Start-up**: Purge the bearings with new grease prior to start-up.
  - **Operation**: Purge the bearings with new grease every three months while in operation, or 2,000 hours, whichever comes first.
  - **Extended Shutdown**: Purge the bearings with new grease before and after any prolonged storage or downtime.

**NOTE:** For programming, operation, and troubleshooting of the greaser, consult the user manual shipped with the greaser. This manual is also available through your local BAC Representative.

**DANGER:** Do not perform any service on or near the fans, motors, and drives, or inside the unit without first ensuring that the fans and pumps are disconnected, locked out, and tagged out.

# Heat Transfer Section

## Fill & Drift Eliminator

The Series 1500E has PVC fill with integral drift eliminators.

### Inspection & Maintenance

- Inspect and clean the fill with the integral eliminators at least quarterly.
- The inspection procedure is as follows:
  - Shut-off the fan and the system pump.
  - Inspect the fill for obstructions, damage and fouling.
- Remove any obstructions from the fill.
- Remove any minor fouling chemically. Contact your local water treatment consultant for advice.
- Major fouling requires cleaning and flushing.

**NOTICE:** Do not use steam or high pressure water to clean PVC eliminators or materials other than steel.

**WARNING:** When access to the top of the unit is desired, the purchaser/end-user is cautioned to wear proper equipment and use appropriate means to comply with applicable safety standards related to working on elevated surfaces.

# Water Distribution System

## Hot Water Basin

The hot water basins are located on the fan deck. The system water enters the cooling tower through the hot water basins (refer to **Figure 7**). A series of nozzles, which distribute water over the fill, are located in the hot water basin. There are three materials of construction for the hot water basin: Galvanized steel, Type 304/316 stainless steel.

## Operating Level

At design flow, the hot water basin operating level should not be less than 50mm or greater than 150mm deep.

## Inspection and Maintenance

- Quarterly, or more often as required, remove any dirt or debris which may clog the nozzles. Seasonally, clean and flush the hot water basin with fresh water.
- Access to the nozzles requires removal of the hot water basin covers.
  - If accessing the hot water basin for the first time, remove the hot water basin shipping retainers. Discard the hot water basin shipping retainers **(Figure 6)**.
  - To remove the covers turn the knobs to remove the threaded studs (**Figure 7**). Then, lift the hot water basin covers vertically by using the attached handles. Once the hot water basin covers are removed, the nozzles may be cleaned.
- If access to the nozzles under the pre-distribution chamber is required, remove the hardware that fastens the tabbed baffles, then remove the panels. Retain the hardware to re-install the tabbed baffles.

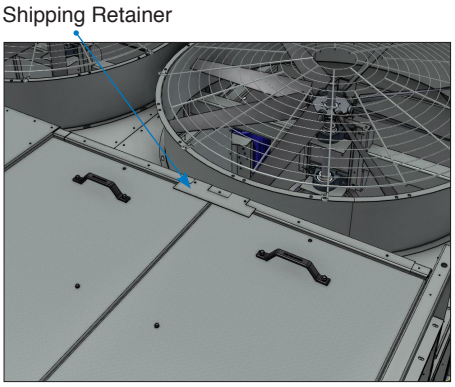


**Figure 6.** Shipping Retainer

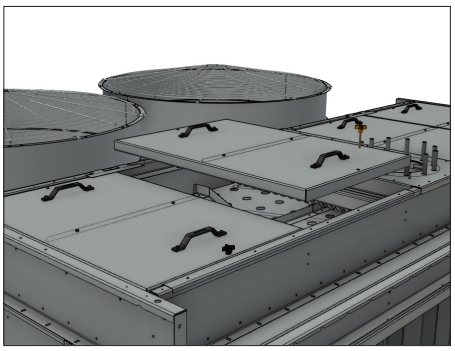

**Figure 7.** Hot Water Basin Cover Removal

# Water Level Control

**There are two types of water level controls used on Series 1500E Cooling Towers:**

- Mechanical make-up valve assembly
- Optional electric water level control package

## Mechanical Make-up Valve Assembly

A float-operated mechanical water make-up assembly is furnished as standard equipment on the cooling tower. The standard make-up assembly consists of a corrosion resistant make-up valve connected to a float arm assembly actuated by a polystyrene-filled plastic float. The float is mounted on an all-thread rod held in place by wing nuts. The cold water basin operating water level can be adjusted by repositioning the float and all-thread rod using the wing nuts provided.

- Inspect the make-up valve assembly monthly and adjust if necessary.
- Inspect the valve annually for leakage. Replace the valve seat if necessary.
- Maintain the make-up water supply pressure between 15psig & 50psig (100-350 Kpa) for proper operation. BAC recommends a pressure regulator valve (provided by others) for pressures over 50 psig.
- Set the initial basin water level by adjusting the wing nuts so that the make-up valve is completely closed when the water level in the cold water basin is at the operating level as stated in **Table 1** on **page 9**.
- With the design thermal load and the average water pressure 15psig & 50psig (100-350 Kpa) at the valve, the above setting will produce operating water levels as stated in **Table 1** on **page 9.**
- If the thermal load is less than the design load at the time of unit start-up, the procedure may produce operating levels greater than those shown in **Table 1**. If operating levels are higher than specified, readjust the float in order to attain the recommended operating level.
- Closely monitor the water level in the cold water basin and adjust the level if necessary during the first 24 hours of operation.
- Operating at the recommended water level will ensure that the unit basin contains sufficient water volume to prevent air entrainment in the circulating pump during system start-up and provides sufficient excess basin capacity to accept the total system pull-down volume.

**NOTE:** If the unit has been ordered with the optional electric water level control package or is intended for remote sump application, a mechanical water make-up valve will not be provided.

## Optional Electric Water Level Control Package

As an option, an electric water level control package is available in lieu of the mechanical make-up assembly. The package consists of a probe-type liquid level control assembly and a slow-closing solenoid valve. Stainless steel electrodes, factory-set at predetermined lengths, extend from an electrode holder into the cold water basin.

- Clean the stainless steel electrodes periodically to prevent accumulations of scale, corrosion, sludge, or biological growth, which could interfere with the electrical circuit.
- The water level is maintained at the recommended operating level regardless of the system thermal load. Therefore, it is not recommended that the operating level be adjusted.
- During the start-up of units equipped with the electric water level control package, bypass the control unit in order to fill the unit to the overflow connection.

# 3 Corrosion Protection

BAC products are constructed of corrosion-resistant materials. The fill is made of a polyvinyl chloride (PVC), which is not susceptible to rot, decay, rust or biological attack. Other materials listed below are used in the equipment construction:

- **Galvanized Steel Components**: Inspect the galvanized steel components for blemishes or corrosion. Wire brush and recoat the affected areas with a cold galvanizing compound such as zinc rich compound (ZRC).
- **Stainless Steel Components**: Inspect stainless steel components for signs of blemishes or corrosion. See "Long Term Care of Stainless Steel" on **page 21** for cleaning and care instructions.

## Water Treatment

**NOTE:** Since the quality of the ambient air and make-up water varies significantly from job site to job site, BAC strongly recommends obtaining the services of a competent water treatment specialist prior to the initial start-up of the evaporative cooling equipment. Additionally, to protect against the risk of Legionella contamination, never operate the cooling equipment without adequate biological control.

A proper water treatment program, administered under the supervision of a competent water treatment specialist, is an essential part of routine maintenance to ensure the safe operation and longevity of evaporative cooling equipment, as well as other system components.

In evaporative cooling products, cooling is accomplished by evaporating a small portion of the recirculating water as it flows through the unit. As the water evaporates, the dissolved solids, originally present in the water, remain behind and if not controlled, the concentration of dissolved solids will increase rapidly. This can lead to corrosion, scale, or biological fouling which may negatively affect heat transfer as well as the longevity of system components. A water treatment program must control the following situations:

- **Corrosion** – Red rust on steel components and white rust on galvanized surfaces may affect the longevity of system components.
- **Scale Formation** – Scale not only reduces heat transfer and system efficiency, but also may lead to under deposit corrosion. If scale is not controlled, it may continue building on critical components such as the fill and severely impact thermal performance.
- **Biological Fouling** – Slime and algae formations may reduce heat transfer, promote corrosion, and harbor pathogens such as Legionella.

# Corrosion and Scale Control

- To control corrosion and scale, maintain the water chemistry of the recirculating water within the parameters listed in **Table 2**. The specific measures required vary from system to system and are dependent on the chemistry of the make-up water, the metallurgy of the piping and heat transfer devices exposed to the recirculating water, and the temperatures at which the system will be operating.
- Bleed/blowdown, the continuous flow of a small portion of the recirculating water to a drain, is used to control the concentration of dissolved solids. On rare occasions, this may be adequate to control scale and corrosion. More often, chemical scale and corrosion inhibitors are necessary, which raise the allowable level of dissolved solids without the risk of scale and corrosion.
- In cases where bleed/blowdown alone is being employed for corrosion and scale control without chemical treatment your water treatment specialist may recommend more conservative limits than those shown in **Table 2**.

| Property of Water | Recommended Level |
|---|---|
| pH | 6.5 to 9.0[1] |
| Hardness as $CaCO_3$ | 30 to 750 ppm[2] |
| Alkalinity as $CaCO_3$ | 500 ppm maximum[2] |
| Total Dissolved Solids (TDS) | 1500 ppm maximum |
| Conductivity | 2400 micromhos[3] |
| Chlorides | 250 ppm maximum Cl<br>(410 ppm maximum as NaCl) |
| Sulfates | 250 ppm maximum |
| Silica | 150 ppm maximum |

**Table 2.** Quality Guidelines for Circulating Water

# Biological Control

- The warm, oxygen and nutrient rich environment inside evaporative cooling equipment provides an ideal environment for the growth of algae, slime, and other micro-organisms. Uncontrolled, this can reduce heat transfer, promote corrosion, and promote the growth of potentially harmful organisms such as Legionella.
- To avoid biological contamination and minimize the risk of Legionella, initiate the biocide treatment program at start-up and continue on a regular basis thereafter in accordance with the treatment supplier's instructions.
- Bleed/blowdown or chemical treatment used for corrosion and scale control alone is not adequate for control of biological contamination.
- Introduce solid or granular biocides through a chemical "pot" feeder installed in parallel with the system circulating pump. Diluted liquid biocides may be added directly to the cold water basin.
- If ozone water treatment is used, at no point should concentrations exceed 0.5 ppm to avoid corrosion.



**NOTES:**

1. Galvanized steel units require passivation in order to prevent white rust (refer to "Passivation" on page 20).
2. Hardness and alkalinity limits may be exceeded under certain circumstances. Consult your water treatment specialist for recommendations.
3. The conversion factor used to determine conductivity is 0.625 (TDS = 0.625 x Conductivity).

# Chemical Treatment Requirements

Chemical treatment programs must meet the following requirements:

- The chemicals must be compatible with the unit materials of construction as well as other materials used in the system (pipe, heat exchanger, etc.).
- Chemical scale and corrosion inhibitors, particularly acid (if used), should be introduced into the circulating water through automatic feeders. This should be done at a point in the system where total mixing and dilution occur before reaching the evaporative cooling equipment. The preferred injection point for chemical scale and corrosion inhibitors is on the discharge side of the system circulating pump(s). These chemicals should not be batch-fed directly into the unit's cold water basin or water distribution system, as this can severely damage areas directly contacted.
- When chlorine is added to the system, free residual chlorine should not exceed 1 ppm, except during start-up if biological shock treatment is utilized during treatment. Refer to "Start-Up" on **page 4** for limits. Exceeding this limit may accelerate corrosion.

# Passivation

**NOTE:** Stainless steel cold water basins do not require passivation. However, if the upper structure is galvanized steel, passivation is required on the galvanized area.

- Passivation is the formation of a protective, passive, carbonate layer on galvanized steel surfaces.
- To provide maximum protection from corrosion on newly installed units take special measures to passivate galvanized steel surfaces.
- To ensure proper passivation of the galvanized steel, keep the pH of the circulating water between 7.0 to 8.2 for four to eight weeks after start-up, or until new zinc surfaces turn dull gray in color.
- If white rust forms on galvanized steel surfaces after the pH is returned to normal service levels, it may be necessary to repeat the passivation process.

# Long Term Care of Stainless Steel

When the percentage of chromium in steel exceeds 10.5%, it is called stainless steel. The chromium in the steel reacts with the oxygen in the air to form a chromium-oxide surface layer, also called the passivation layer that provides the corrosion resistance in stainless steel.

## BAC's Manufacturing Process

BAC takes precautions to prevent cross-contamination, processing galvanized and stainless steel parts separately. Also, stainless steel brushes are used to clean welds on stainless parts and care is taken to avoid scratching parts during processing. Organic cleaners are used to clean the finished product prior to shipping.

## Jobsite Considerations

While stainless steel itself does not rust so long as the chromium-oxide surface layer is intact, it is not immune to contamination from its surroundings. Some common sources of surface contamination are:

- Dirt and soil
- Shop oil or grease that may carry other contaminants such as metal chips
- Machining or welding galvanized steel at the jobsite may cause debris to embed itself into the stainless steel

These contaminants can deposit on the surface and scratch the passivation layer or prevent it from re-forming. They can also get trapped underneath the passivation layer and reduce corrosion resistance.

# Recommended Cleaning Procedure

Stainless steel needs to be cleaned regularly to maintain the corrosion resistance as well as to maintain the overall aesthetics of the stainless steel.
It is fairly simple to clean most contaminants off the surface of stainless steel. Most dirt and soil can be cleaned with a clean cloth, warm water, and mild detergent. For persistent dirt, a little vinegar can be added in the cleaning water. It is important to always rinse the surface with warm water and wipe with a dry cloth after any cleaning, whether mild or aggressive.

- Fingerprints, mild stains or grease spots can be cleaned using organic solvents such as acetone, methyl or ethyl alcohol, or mineral spirits. Stainless steel wipes or glass cleaners commonly available in stores may also be used.
- Occasionally the surface of stainless steel can get iron chips or shavings embedded in it from having galvanized steel machined or welded in the vicinity. The iron chips can start to rust, reducing the corrosion resistance of the stainless steel, and stain the surface giving the impression that the stainless steel is rusting. These types of contaminants require more aggressive cleaning. Mild abrasives such as Scotch-Brite™ products may be used where aesthetic considerations are not important followed by solvent cleaning with organic solvents as described above. It is important to rinse the surface with warm water and wipe with a dry cloth after cleaning.
- If the iron chips are not removed with the Scotch-Brite™ Products, electro-chemical cleaning may be required. BAC uses commercially available equipment for electro-chemical cleaning in the field. Contact your local BAC Representative for more information or to arrange a service call.



**NOTICE:** Never use chloride or chlorine based solvents such as bleach or muriatic (hydrochloric) acid to clean stainless steel. It is important to rinse the surface with warm water and wipe with a dry cloth after cleaning.

# 4 Bleed Rate

In evaporative cooling, evaporation of a small portion of the recirculating spray water as it flows through the equipment causes the cooling effect. As this water evaporates, the impurities originally present remain in the recirculating water. The concentration of the dissolved solids increases over time and can reach unacceptable levels. In addition, airborne impurities are often introduced into the recirculating water. If these impurities and contaminants are not effectively controlled, they can cause scaling, corrosion, and sludge accumulations that reduce heat transfer efficiency and increase system-operating costs, potentially shortening the useful life of the equipment. The degree to which dissolved solids and other impurities build up in the recirculating water may be defined as the cycles of concentration. Specifically, cycles of concentration equal the ratio of the concentration of dissolved solids (for example - chlorides, sulfates, etc.) in the recirculating water to the concentration of the same material in the make-up water.

- In order to optimize heat transfer efficiency and maximize equipment life, bleed or blowdown a small amount of recirculating water from the system. This controls the cycles of concentration to maintain the quality of the recirculating water within the guidelines given in **Table 2**, on **page 19**.
- Replenish the "bleed" water with fresh make-up water, thereby limiting the build-up of impurities.
- Bleed/blowdown:
  - Accomplish the bleed automatically through a solenoid valve controlled by a conductivity meter. The set point is the water conductivity at the desired cycles of concentration and should be determined by a competent water treatment expert.
  - Alternatively, use a bleed line with a valve to continuously bleed from the system. In this arrangement, adjust the rate of bleed using the valve in the bleed line. Measure the rate of bleed by filling a container of known volume while noting the duration. Check the bleed rate and water quality periodically to ensure that adequate control of the water quality is being maintained.

**NOTE:** A proper water treatment program, administered under the supervision of a competent water treatment specialist, is an essential part of routine maintenance to ensure the safe operation and longevity of evaporative cooling equipment, as well as other system components.

**NOTE:** The solenoid valve and conductivity meter must be supplied by others. Evaporation is proportional to the load and will vary seasonally. BAC recommends the use of a conductivity meter to maximize water conservation.

# Bleed Line Calculations

## Bleed Rate



Bleed rate is determined by the following formula;

**Bleed Rate = B = E/(n-1)** Where:

**B** = Bleed Rate (L/S)

**E*** = Evaporation Rate (L/S)

**Q** = Process Fluid Flow Rate (L/S)

**R** = Range = Entering – Leaving Fluid Temperature (°C)

**n** = Number of Cycles of Concentration = CR/CM

**CR** = Concentration in Re-circulating Water

**CM** = Concentration in Make-Up Water

*The evaporation rate (E) can be determined by any one of the following methods: 1. The evaporation rate is approximately 1.5 L/hr for each kW of operating Total Heat Rejection (THR). 2. The evaporation rate (L/hr) is = 6.3 x R (°C) x water flow.

**NOTE:** Evaporation is proportional to the load and will vary seasonally. BAC recommends the use of a conductivity meter to maximize water conservation.

The following example illustrates a bleed rate calculation:

Closed Circuit Cooling Tower Process Fluid Flow Rate = 50 L/S

Range = 5.5°C

Maximum Allowable Chloride Concentration = 250 ppm

Concentration of Chlorides in Make-Up Water = 45 ppm

**Solution:**

E = 6.3 x R x flow = 6.3 x 5.5 x 50 = 1732.5 L/hr

n = CR/CM = 250/45 ppm = 5.55

**Bleed Rate** = B = E/(n-1) = 1732.5/(5.55-1) = 381 L/hr

Therefore in this case we must bleed 0.159 L/S to limit the concentration of impurities. This example focuses on a single parameter (chloride concentration) of water only. The bleed rate required for a system (when evaluating more than one parameter) is the highest bleed rate required to keep all parameters within recommended limits.

# 5 Cold Weather Operation

## Inspection & Maintenance

BAC products can be operated at subfreezing ambient temperatures provided proper operating methods are established and diligently followed.

- Carry out frequent visual inspections and routine maintenance services during operation in subfreezing weather.
- Ensure all controls for capacity and freeze protection are set properly and functioning normally.
- Prevent excessively high water levels and possible overflow of the cold water basin due to over pumping, clogged strainers, or make-up valve malfunction.
- Some unit icing can be expected in very cold weather. Usually this will not effect the operation of the unit. Resolve any icing conditions that may damage the unit or the supports, impair the system performance, or create a safety hazard.

## Fan Section Icing Protection

There are two basic operational methods which can be used to provide the system's required cooling: temperature setting and fan control. The method of control employed on a given application depends upon the climatic extremes which are expected, the variations in heat load that will be encountered, and the compatibility of the control system with other portions of the installation.

In subfreezing ambient temperatures, effective icing control may require a combination of these two methods. Operate each unit with the highest thermal load it can handle, rather than evenly dividing the total heat load across all cells. During prolonged cold weather periods, bypass the idle units and drain the basins.

### Temperature Setting

Low leaving fluid temperatures promote ice formation. During operation in subfreezing ambient temperatures, maintain the leaving water temperature as high as possible. Ensure the unit operates with the maximum possible heat load. The recommended minimum process fluid temperature is 43°F (6.1°C).

## Fan Control

The following are fan control methods to reducing icing:

- **Variable Frequency Drives**: Cycle fans down to 100% speed for 5 minutes, every 15 to 20 minutes for each cell. See **page 28** for information.
- **Multi-Speed Motors**: If the unit is equipped with 2-speed motors, operation at a lower speed may be sufficient to prevent icing. The motor starter should include a minimum 15 second time delay when switching from high to low speed. If icing is observed, use the fan cycling method.
- **Fan Cycling**: Set the controls to allow a maximum of six on-off cycles per hour. Cycle the fan off for five minutes every 15 to 20 minutes for each cell. If ice continues to build on the air intake, decrease the on-time. Observe the air intake of the unit at least every four to eight hours.
- **Fan Reversal:** This procedure should be used only after the other methods of fan control fail. If utilized, the fans should be run in reverse for no longer than 20 minutes at no more than 20% speed, and the cooling tower should be observed during this time. Before returning to normal operation, visually inspect the fan blades for ice formation.

# Basin Water and Internal Piping Freeze Protection

## Cold Water Basin Protection

It is important to protect the basin and internal piping. The basin water could freeze when the unit is shut-down and exposed to subfreezing ambient temperatures.

- **Remote Sump**: The ideal method of protection is a remote sump located in a heated indoor space. When the circulating pump stops, the water in the connecting piping will drain by gravity to this indoor sump.
- **Basin Heaters**: On applications without a remote sump, heat must be provided to the cold water basin. Electrical immersion heaters can provide the required function. Contact your local BAC Representative for details.
- **Electric Water Level Control**: An electric water level control will maintain the proper water level regardless of the thermal load or variations in make-up water supply pressure. The two-position, slow closing solenoid valve provided with the BAC electric water level control package also minimizes valve freezing problems (see **page 16**).
- **Heat Tracing**: Heat trace and insulate all exposed water piping including pump piping below the overflow level and make-up water lines with electrical heater tape.

## Cold Weather Operation



**NOTE:** Modulating the water flow rate to the unit is NOT a recommended method of controlling cooling capacity.

**NOTE:** For remote sump applications, the water level in the basin of the equipment is a function of the design flow rate, the quantity, size and location of the remote sump connection and the pipe design between the cooling tower and the remote sump. Units installed on remote sump applications are supplied without a make-up connection.

# 6 Operation Considerations for Accessories

## Basin Heater (Optional)

One or more electric immersion heaters prevent the cold water basin from completely freezing over and damaging the unit during shutdown or standby. The heaters are sized for the specific unit. The heating element has an enclosure that is suitable for outdoor use. Annually, inspect the basin heater prior to the risk of reaching freezing operating conditions.

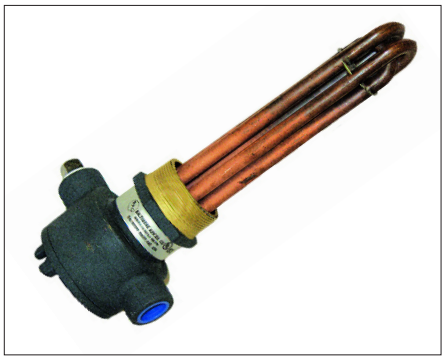

**Figure 8.** Basin Heater

### Operation

Ensure that the heating element is completely submerged before energizing the main disconnect. For installations that have a BAC Controls Enclosure, please consult the submittal package provided with the unit and contact your local BAC Representative for support. For installations that use a stand alone BAC heater control panel, see below.

**NOTICE:** The basin heater is not designed to prevent icing during unit operation.

## Vibration Cutout Switch (VCOS)

The Mechanical Vibration Cutout Switch and the Optional Electronic Vibration Cutout Switch should be tested and field adjusted at start-up and yearly thereafter.

## Mechanical Vibration Cutout Switch (Optional)

**Set Point Adjustment When Installed:**

1. For safety, turn off, then lock and tag-out the electrical supply to the fan motor(s).
2. Turn adjustment screw counterclockwise 1/8 turn at a time until you hear the control trip.
3. Once tripped, rotate adjustment screw ¼ turn clockwise. Push in the manual reset button.
4. Start up the fan(s) to determine if the start-up will cause the cut-out switch to trip.
5. If the VCOS does not trip, start and stop the fan two more times. If the VCOS still does not trip, then calibration is complete.
6. If the VCOS trips, repeat steps 1 through 5 until calibration is complete.

**Electrical Reset and Start-up Lockout (Optional):**

1. If rated voltage is continuously applied to the reset circuit at unit start-up, the reset solenoid energizes for a fixed time interval (approximately 30 sec), after which time the solenoid is automatically de-energized by the thermistor. This provides a trip lockout during machine start-up roughness.
2. The voltage must be removed from the reset circuit when the machine is stopped to allow the thermistor to cool off.
3. The switch mechanism can be reset electrically by a momentary application of the reset voltage or it can be reset manually.

## Electronic Vibration Cutout Switch (Optional)

Two models of electronic vibration cutout switches are available. The single set point model contains one trip limit for shutdown. The dual set point model contains two independent trip limits; one for alarm and one for shutdown. The shutdown set-point is factory set at 0.45 in/sec. Additional details can be found in the submittal packet.

**Testing:**

- The test position sets in the minimum set point so that any vibration will cause a trip condition.
- The light will come on immediately, and the trip will occur after the duration of the time delay, proving the complete system is operational.
- If test position is maintained for less than the duration of the time delay, the trip will not occur, thus permitting the system test without shutdown.

**Calibration:**

- A light adjacent to the set point control comes on the instant the measured vibration level exceeds the set point.
- The unit can be periodically calibrated on line by turning the set point control down until the light comes on. This setting is then compared with the vibration measured with a portable vibration meter, thus providing a calibration check of the unit.
- If the trip setting is maintained, trip will occur after the duration of the time delay.
- **Remote Reset:** Connection between terminals 5 and 6 latches triac output in alarm state after set point is exceeded. Opening the connection will reset the output to non-alarm state.

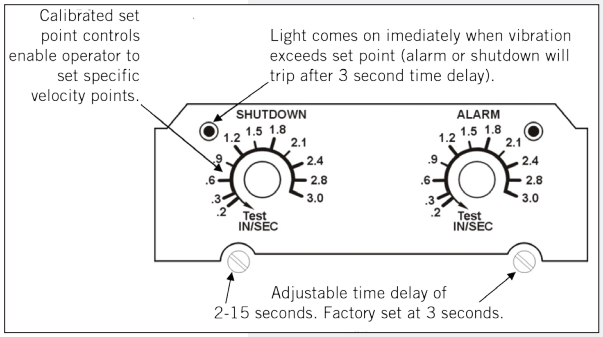


**Figure 9.** Electronic VCOS with Alarm Contact is Shown

## Operation Considerations for Accessories

**Basin Heater**

**Vibration Cutout Switch (VCOS)**

- Mechanical VCOS
- Electronic VCOS

# 7 Fan Control

**NOTES:**

1. With evaporative cooling, a 10 second fan motor start-up delay will not be noticed when staging up.
2. An optional one second time delay between fan on staging can be used to reduce staging current.
3. When staging down, turn off the fan motor needed, no need for any delays.

**NOTICE:** For a unit with a VFD, with a switching frequency of 2.5 kHz, the line lead length cannot exceed 100 feet. If the switching frequency is higher than 2.5 kHz and/or the line lead length exceeds 100 feet, a dV/dT output filter is recommended to protect the motor. Since the switching frequency and maximum line length requirements vary between VFD and motor suppliers, contact your local BAC Representative to determine if a dV/dT filter is required.

**NOTE:** The minimum turndown ratio for units with a belt drive is 10:1

## Control Multiple Fan Motors

BAC has over twenty years of successful experience with motors starting from a backwards condition on Cooling Towers, Closed Circuit Cooling Towers and Evaporative Condensers when there are no partitions. When starting the motors when the fans may be windmilling backwards, there are two control strategy options:

- **VFD:** The best control option is to use a variable frequency drive to control all of the motors. See VFD operation guidelines below.
- **No VFD:** When staging up (for example going from one to two motors, or from two to three motors) turn all motors off for 10 seconds, then bring on the next required stage set of fans.

## Variable Frequency Drive Operation

- Operation of the unit at a speed which resonates with components of the drive system or support structure may result in vibrations which could damage the components or structure, and/or create objectionable noise. Therefore, these resonant speed ranges should be identified at start-up and locked out to prevent operation of the motor at these resonant speeds.
- Please refer to the manufacturer's variable frequency drive recommended start-up procedure for further information or consult with your local BAC Representative for any VFD applications.

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