The Value of Maintaining Evaporative Cooling Equipment

Cooling Tower Maintenance and Upgrades Saves Time, Money, Energy, and Extends the Life of the Unit?

Numerous codes, standards, and rating systems from various organizations govern and surround the building industry, intertwining and sometimes cross referencing themselves. This section defines and differentiates between the primary ones while highlighting the organizations that create, reference, or enforce them.

First, it is important to differentiate between a code, a standard, and a rating system.

A building code establishes the minimum requirements for buildings within a given area/jurisdiction and is enforceable by law. Adoption and implementation can vary. Some states adopt statewide codes, while others leave code adoption up to local agencies, councils, or boards.

A standard provides the enforceable practices and minimum requirements that are supplied by a Standards Development Organization (SDO) such as ASHRAE and ASME. Standards are written in code-ready language and can be adopted by local jurisdiction. Many standards function as the "standard of care" in their area of focus.

A building rating system is a voluntary program that goes beyond the industry minimums set forth in the standards and codes. Qualified buildings attain certification at different levels after they are evaluated by inspectors representing the rating system. Examples include LEED, etc.

For more information on "Codes, Standards, and Rating Systems" see **page J9**.

Cooling Tower

Fluid Cooler / Closed Circuit Cooling Tower

A Cost-Saving Opportunity

Owners and operators who have a working knowledge of cooling tower preventive maintenance and upgrade technology will get the most out of their cooling towers. Their efforts can yield beneficial results, including:

- Smooth and reliable operation
- Longer cooling tower life expectancy
- Consistent performance
- Increased thermal performance
- Lost performance restoration
- Less down time
- Water and energy savings

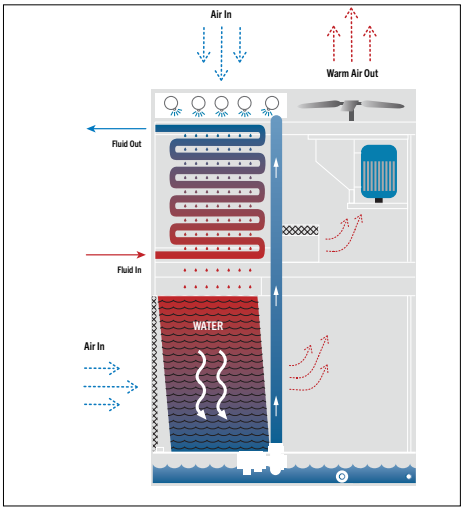
This document will explore routine maintenance and suggest ways to improve cooling tower performance.

Operation Basics

In a cooling tower, warm water from the system is evenly distributed via a gravity or pressurized nozzle system directly over a heat transfer surface called “fill”, while air is simultaneously forced or drawn through the fill, causing a small percentage of the water to evaporate. The evaporation process removes heat and cools the remaining water, which is collected in the tower’s cold water basin and returned to the system (typically a water cooled condenser or other heat exchanger).

Similarly, in a closed circuit cooling tower/evaporative condenser, the heat is rejected indirectly from a fluid/vapor flowing through the coil section by spraying re-circulated water over the coil section, again evaporating a small percentage of the water in the process.

The temperature at which the cooled fluid is returned to the system measures tower performance. This temperature can vary depending upon the actual cooling load, water flow, airflow, and the entering air conditions. For more information see "Configurations" on **page J5.**



Closed Circuit Cooling Tower

Preventive Maintenance

Performing routine preventive maintenance is paramount for consistently achieving the desired temperature and flow rate and plays an important role in maximizing cooling tower operating life.

To perform properly, all tower components must be kept clean and free of obstructions. Maintenance frequency depends mainly on the condition of the circulating water and the environment in which the tower is operating.

Inspecting a Cold Water Basin Strainer

Strainer

Strainers are important to cooling tower performance since they minimize contact between debris and the system components, preventing debris from reaching the condenser loop and pump. Strainers should be routinely inspected and cleaned. Some tower designs allow external access to strainers, permitting inspection during tower operation. All units except remote sump units are factory equipped with strainers. Be sure to contact your local BAC representative should you need a replacement strainer.

Gravity Water Distribution

Water Distribution

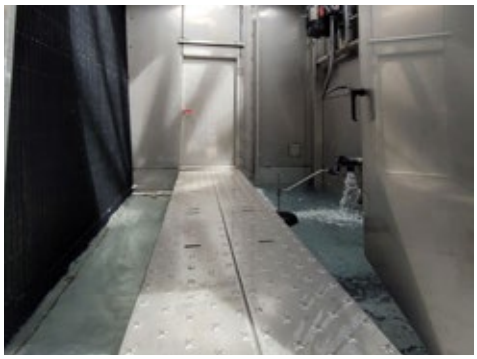
The water distribution system’s role is to evenly distribute water over the fill or coil section via either a gravity distribution system or a pressurized spray system. If the heat transfer surface is not fully wetted, the nozzles need to be checked, cleaned, and if need be replaced.

In a gravity distribution system, the nozzles can be externally accessed, visually inspected, and cleaned by removing the hot water basin covers on the fan deck. Most pressurized spray distribution systems use nozzles and branches held in place by rubber grommets, which allow easy removal to clean and flush debris.

Pressurized Spray Water Distribution

Cold Water Basin

Smart cooling tower design should facilitate debris removal from the cold water basin, since some debris will eventually make its way into the cooling tower. A well designed cold water basin is sloped toward the strainer to keep dirt from accumulating. The basin should be kept clean by occasionally flushing the dirt out of the system through the tower drain. Alternatively, you can install basin sweeper piping in conjunction with a filtration system, which automatically performs this maintenance. Water filtration saves maintenance costs by removing debris and unwanted particulates in the cooling water system, which in turn reduces the time required to clean the cold water basin. It also reduces water treatment cost, as water treatment chemicals tend to work more effectively in clean water. Foreign particles can absorb treatment chemicals, thus requiring the distribution of even more chemicals to properly treat the tower water.

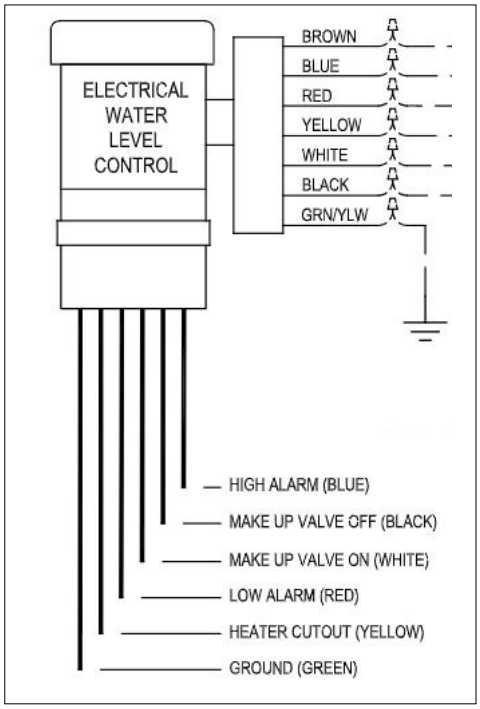


Mechanical Water Level Control

Make-up Water Supply

Cooling tower water level is critical to reducing air entrainment, as well as conserving water. Though most of the water in the system is recirculated, some water must be added to replace the percentage lost by evaporation and bleed. Bleed is defined as the water that is discharged to prevent the accumulation of solids in the recirculated water. The make-up water system replaces the lost water via a mechanical float ball and valve assembly or an electric water level probe assembly (with solenoid valve). The make-up water supply pressure should typically be maintained between 15 psig and 50 psig to ensure proper valve shut-off and avoid “chatter.” If the supply pressure is higher than 50 psig, install a pressure reducing valve.

The operating water level of the cooling tower will vary with system thermal load (evaporation rate), the bleed rate employed, and the make-up water supply pressure.



Electric Water Level Control

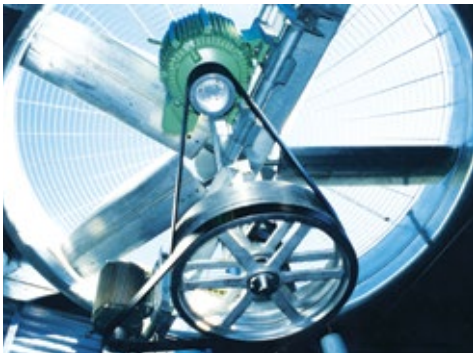
Bleed

To prevent the accumulation of solids in the recirculating water, the tower should be equipped with a bleed line, including a metering connection and globe valve, that is connected to a nearby drain. In a closed circuit cooling tower or evaporative condenser with a spray water pump, a metering valve to control the bleed rate should be provided at the pump discharge. While a manually adjusted bleed valve is the simplest system, getting the proper bleed rate can be a problem, as cooling tower loads vary throughout the day. A conductivity meter connected to a solenoid valve solves this problem by maintaining the proper cycles of concentration at all times. Also, it is recommended that a separate meter is installed to measure bleed volume, since less water is discharged to drain than supplied to the cooling tower. This may reduce sewer water charges.

The bleed rate should be adjusted to prevent an excessive build-up of impurities in the recirculating water. This is largely dependent upon the local water quality and the evaporation rate. Constant bleed and replacement with fresh water will prevent the accumulation of impurities. To obtain specific recommendations, contact a water treatment specialist in your area.

Drive System

The fan drive system has several components operating at high speed that should be checked regularly. Follow proper lock-out/tag-out procedures including locking out all motor disconnect switches before working on the mechanical system.



Mechanical Belt Drive System

Cooling tower fans are typically driven by belt or gear drive systems. Both require routine maintenance to ensure reliable, trouble-free performance. Belt drive systems are popular, reliable, and offer single point adjustment. Proper belt tension is critical to ensure reliable operation. Gear drives also provide reliable operation, when properly maintained. However if a problem occurs, resolution may be more involved if a gear box rebuild or replacement is required. Oil level, oil quality, and shaft alignment should be checked regularly in accordance with the gear box manufacturer's recommendations. BAC offers both systems, along with an EC Fan System and the ENDURADRIVE® Fan System to meet user needs or preferences (see **page H11** for more information).

When starting up a new unit, lubrication for the fan shaft bearings is typically not necessary, since all units leave the factory already greased. However, for seasonal start-up, purge the fan shaft bearings with new grease (per manufacturer's recommendations). Fan shaft bearings should be lubricated every three months at a minimum. BAC's Automatic Bearing Greasers can be easily installed to enhance the life of the bearing and provide labor savings by eliminating monthly bearing maintenance. BAC's Cooling Tower Duty Motors have permanently sealed bearings, never requiring lubrication. Other non-BAC fan motors may require motor bearing lubrication as recommended by the manufacturer's instructions. For maximum life resulting in less motor failures, downtime and replacements, it is best to install motors with a "cooling tower duty" rating like that of BAC Cooling Tower Duty Motors. Motor bearings should be lubricated as recommended by the manufacturer's instructions.

The Importance of Clean Operation

Components must be kept clean and free of obstructions. Neglecting the cooling tower will lead to higher than desired return water temperatures to the system, which will result in higher energy usage from two perspectives. First, the system (chiller) will consume more energy because it must operate at a higher than necessary condensing pressure (head) to satisfy the load. Due to the higher fluid temperatures provided by the cooling tower, as little as 2˚F (1.1˚C) higher temperature can result in 6% more energy consumption by the chiller. Second, the tower must operate longer at higher fan horsepower while trying to attain the design leaving water temperature.

Common Problems: Causes, Effects, and Solutions

Regardless of how often routine maintenance is performed, like any other mechanical component, problems may eventually arise. These include elevated leaving water temperatures, drift, and corrosion. Should any of these problems occur, follow the actions listed and contact your local BAC Representative or water treatment supplier for assistance.

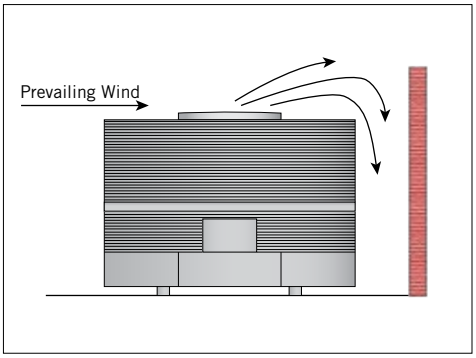
Check Cooling Load: If the actual cooling load exceeds the design load for which the tower was selected, the leaving water temperature will exceed the design specification.

Check Water Flow and Distribution: Visually inspect the water distribution system to ensure the spray nozzles are clean, are correctly installed, and are uniformly distributing the water over the fill. In counterflow towers, measure the pressure at the cooling tower inlet connection and compare it to the design pressure provided by BAC. For towers with a gravity distribution system, the operating level in the hot water basin (typically between 2 and 5 inches) will correlate to a specific flow rate.

Inspecting Spray Nozzles

Check Air Flow: Cooling tower air inlets should be located in an unimpeded supply of fresh air. The cooling tower air discharge should also be at least as high as any surrounding walls to reduce the possibility of hot, moist discharge air being recirculated into the air inlets, creating artificially elevated entering wet-bulb and leaving water temperatures. To insure full design air flow, the cooling tower drive system must be adjusted according to the BAC's Operation and Maintenance Manual.

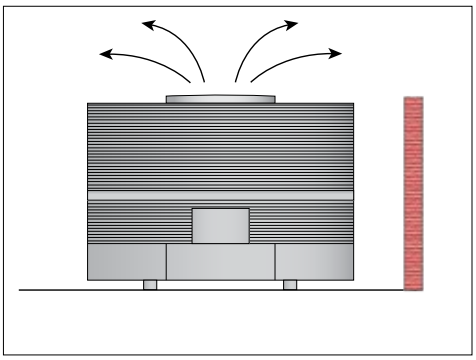
The cooling tower and surrounding area should be examined for air flow restrictions which may cause blockage of the air inlets. Check for clogging or improper distribution of water across the tower fill.



Incorrect Orientation of Tower and Neighboring Walls

Check Ambient Conditions: Cooling towers are selected to produce the required leaving water temperature at the design cooling load and entering wet-bulb temperature. Whenever the actual entering wet-bulb temperature is higher than design conditions, the leaving water temperature will also be higher, which results in decreased efficiency.

Drift occurs as air flows through the cooling tower and carries water droplets out of the tower. Drift eliminators are installed in the discharge stream to remove water droplets from the air. In a properly maintained system, efficient eliminators will reduce drift loss to a negligible percentage of the design flow rate.



Proper Orientation of Tower and Neighboring Walls

If excess drift occurs, check drift eliminators for proper installation, spacing, and overall condition. Examine the fill for even spacing to ensure there is no clogging or blockage, and check water and air flow as described above. Repair or replace eliminators as necessary.

Corrosion: Corrosion is always a concern with cooling towers because of their ability to wash the air of impurities. These impurities cause scale, corrosion, and can damage system components after long-term exposure.

If a constant bleed of the system is ineffective to combat scale or corrosion, water treatment may be necessary. A successful water treatment program should satisfy the specific guidelines set by the manufacturer, provide effective microbiological control, and be compatible with the system's materials of construction.

Inspecting Drift Eliminator

Potential airborne impurities and biological contamination (such as Legionella) should be controlled through the use of biocides, and such treatment should be initiated at system start-up and continued regularly. ASHRAE has taken proactive steps to understand and deal with Legionella through its popular publication, ASHRAE Guideline 12 – 2020, entitled "Minimizing the Risk of Legionellosis Associated with Building Water Systems". To obtain specific recommendations of water treatment programs, contact a competent water treatment supplier.

Performance Improvements

To enhance performance and longevity of the unit, structurally sound cooling towers can be retrofitted with upgrade kits to:

- Conserve energy
- Control capacity and redundancy
- Restore performance
- Facilitate easier and safer maintenance
- Increase capacity
- Reduce sound levels

To conserve energy, variable frequency drives (VFDs) can be added to control the fan motor speed and use only the amount of energy necessary to meet current operating requirements, thus reducing overall energy consumption. Installing an Baltiguard™ Fan System by adding a second single speed motor to the drive system will maximize up time and also provide you with energy savings by operating at approximately 1/3 of the main motor horsepower. The Baltiguard™ Fan System provides you with capacity control similar to a two speed motor. To improve water distribution performance, retrofit nozzle and grommet kits are available to replace older, smaller nozzles or troughs with large-orifice, clog-free nozzles. Access options such as platforms, ladders, and walkways can be added to facilitate easier and safer access for maintenance. BAC's OEM replacement fill kits easily replace the original fill that may be clogged with scale or debris. BAC's fill kits are designed to enhance thermal performance or to restore the lost thermal performance of your cooling tower. For sound sensitive applications, intake and discharge sound attenuation packages can be installed to reduce sound levels.

Conclusion

Paying regular attention to the forgotten system component, the cooling tower, through a regular, comprehensive maintenance program can save time, money, and energy while increasing the tower's life expectancy. A well maintained tower is a candidate for retrofit kits designed to enhance performance and lengthen its life. Owners and operators can save time and money through preventative maintenance technology. If you are not regularly performing routine maintenance on your cooling tower, implement a comprehensive maintenance program today. For more information on how to get started, please contact your local BAC Representative.

In addition to maintaining your cooling equipment, please feel free to contact your local BAC Representative for:

- Free inspections
- Provide training on maintaining your cooling equipment
- Replacement parts
- Capacity upgrades
- Safety and access options
- Performance restoration
- Replacement units