

Water Quality Guidelines

Water Treatment

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.

- **Corrosion** – Red rust on steel components and white rust on galvanized surfaces may affect the longevity of system components.
- **Scale Formation** – Scale, typically a calcium or magnesium based build-up, 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*.

For more information on water treatment, please see the Filtration Guide section in the previous section.



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.

Corrosion and Scale Control

To control corrosion and scale, maintain the water chemistry of the recirculating water within the parameters listed in **Table 1** on the following page. 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.

Keep the chemically treated water within the guidelines given in **Table 1**. 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 1**.

Table 1. Quality Guidelines for Treated Circulating Water

Property of Water	Recommended Levels for Various Materials of Construction			
	Galvanized Steel	Baltibond® Hybrid Coating	Type 304 Stainless Steel	TriArmor® Corrosion Protection System or Type 316 Stainless Steel
pH	6.5 to 9.0 ^[1]	6.5 to 9.2 ^[1]	6.5 to 9.2 ^[1]	6.5 to 9.5 ^[1]
Total Suspended Solids	25 ppm	25 ppm	25 ppm	25 ppm
Total Dissolved Solids (TDS)	1,500 ppm	2,050 ppm	2,050 ppm	2,500 ppm
Conductivity	2,400 (micromhos/cm)	3,300 (micromhos/cm)	3,300 (micromhos/cm)	4,000 (micromhos/cm)
Alkalinity as CaCO ₃	500 ppm ^[2]	600 ppm ^[2]	600 ppm ^[2]	600 ppm ^[2]
Calcium Hardness as CaCO ₃	50 to 600 ppm ^[2]	50 to 750 ppm ^[2]	50 to 750 ppm ^[2]	50 to 750 ppm ^[2]
Chlorides (CL)	250 ppm	300 ppm	300 ppm	750 ppm
Sulfates	250 ppm	350 ppm	350 ppm	750 ppm
Silica	150 ppm	150 ppm	150 ppm	150 ppm


NOTES:

- Galvanized steel units require passivation in order to prevent white rust (refer to "Passivation").
- Hardness and alkalinity limits may be exceeded under certain circumstances. Consult your water treatment specialist for recommendations.
- The conversion factor used to determine conductivity is 0.625 (TDS = 0.625 x Conductivity).
- EVERTOUGH™ Construction units have a TriArmor® Corrosion Protection System basin.
- The guidelines above refer to the materials used in construction. Different combinations of materials may be used on the same unit.
- Water chemistry will change with operating temperatures. The recommended guidelines listed in Table 1 refers to water temperature at 95°F.

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.).
- BAC discourages acid dosing as means of scale control except for open circuit cooling towers with remote sump applications or towers constructed from stainless steel. 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 as noted in start-up and shutdown section. Exceeding this limit may accelerate corrosion.

Passivation

When new systems are first commissioned, special measures should be taken to ensure that galvanized steel surfaces are properly passivated to provide maximum protection from corrosion. Passivation is the formation of a protective, passive, oxide layer on galvanized steel surfaces. To ensure the galvanized steel surfaces are passivated, the pH of circulating water should be kept between 6.5 and 8.2 and calcium hardness between 50 and 600 ppm (as CaCO₃) for four to eight weeks after start-up, or until new zinc surfaces turn dull gray in color. If white deposits form on galvanized steel surfaces after the pH is returned to normal service levels, it may be necessary to repeat the passivation process. In case the pH can't be kept below 8.2, a secondary approach is to conduct a chemical passivation using inorganic phosphate or film-forming passivation agents. Consult your water treatment specialist for specific recommendation.



NOTE: Stainless steel cold water basins and basins protected by the TriArmor® Corrosion Protection System or Baltibond™ Hybrid Coating do not require passivation. However, if the upper structure is galvanized steel, passivation is required. Closed circuit cooling towers and evaporative condensers with galvanized coil require passivation.

Biological Control

The warm, oxygen and nutrient rich environment inside evaporative cooling equipment provides an ideal environment conducive to 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.

Initial Start-up and Start-up Following a Shutdown Period

To minimize the risk of biological contamination during a shut-down period of three days or more, it is recommended that the entire system (evaporative cooling equipment, system piping, heat exchangers, etc.) be drained. To resume operation of a drained system and at initial start-up, clean all debris from the cold water basin and fill the system with fresh water. Then 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 shut-down. 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 Cl₂) 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.

When it is not practical to drain the system during shut-down periods, install a by-pass line with shut-off valves to permit the recirculating water to circulate throughout the system, including the unit basin, while bypassing the fill section of the evaporative cooling equipment (fans should remain off). Treat the system as per one of the above-described methods prior to restarting the unit.

System Cleaning for Coil Products

This section is applicable to BAC Closed Circuit Cooling Towers and Evaporative Condensers only.

The outside of the heat exchange coil may require occasional cleaning. The chemicals used must be compatible with the materials being treated. For example, the standard coil is galvanized steel on the outside. The inside of the coil is black carbon steel. For finned coils, the coil cleaning must be careful not to damage the fins (outside of the coils) and the coils themselves. For specific recommendations on coil cleaning, contact a qualified consultant.

Closed Circuit Cooling Towers

With proper precautions, prior to start-up circulate an alkaline solution which can be used to clean condenser water systems through a closed circuit cooling tower. The necessary precautions include:

- Limit the duration of the cleaning to one day or at the most two days.
- The temperature of the solution should never exceed 100oF (37.8°C).
- The maximum concentration of chemicals in the circulation solution should not exceed any of the following:
 - 5% Sodium Hydroxide – 5% Sodium Metasilicate – 2% Sodium Carbonate
 - 2% Tetra Sodium Pyrophosphate – 0.5% Trisodium Phosphate – 0.5% Sodium Nitrate – 5-10% Butyl Cellosolve

Evaporative Condensers

The installation and manufacturing processes commonly used for field assembly of steel-piped systems may leave weld byproducts inside coils and connecting piping (especially in refrigeration systems). It is common practice to install filters and/ or strainers that remove contaminants during initial system operation. Shortly after system startup, the filters and/or strainers should be cleaned or replaced.