Engineering Considerations - Cooling Towers

Location

Units must have an adequate supply of fresh air to the air inlet(s). When units are located adjacent to building walls or in enclosures, care must be taken to ensure that the warm, saturated discharge air is not deflected off surrounding walls or enclosures and drawn back into the air inlet(s).

CAUTION:

Each unit should be located and positioned to prevent the introduction of the warm discharge air and the associated drift, which may contain chemical or biological contaminants including *Legionella*, into the ventilation systems of the building on which the unit is located or those of adjacent buildings.

For detailed recommendations on layout, refer to page M34 or consult your local BAC Representative.

For Series V products, bottom screens or solid bottom panels may be desirable or necessary for safety, depending on the location and conditions at the installation site.

Piping and Valves

Piping must be sized and installed in accordance with good piping practice. All piping should be supported by pipe hangers or other supports and not by the unit. On open systems, in order to prevent basin overflow at shutdown and to ensure satisfactory pump operation at start-up, all heat exchangers and as much piping as possible should be installed below the operating level of the cooling tower.

Some units may require flow balancing valves (usually supplied by others) at the hot water inlets to balance the flow to individual inlets and cells. External shut-off valves (supplied by others) may also be required if the system design necessitates the isolation of individual cells.

When multiple cells are used on a common system, equalizing lines should be installed between the cold water basins to ensure balanced water level in all cells. It is good engineering practice to valve the inlet and outlet of each tower separately for servicing. The shut-off valves can be used, if necessary, to adjust any minor unbalanced condition in water flow to or from the units. For more information see page M125.

Capacity Control

Variable frequency drives offer the most precise control of leaving fluid temperature or condensing pressure and the lowest operating cost. VFDs provide compliance with the part load power consumption and speed control requirements in current energy codes, such as ASHRAE 90.1 and California Title 24. In addition, soft-starts, stops and smooth accelerations prolong the life of the mechanical system. Sound is also reduced by minimizing start-up noise and running the tower at the lowest speed necessary to meet the system demand.

VFD reliability has improved and first costs have come down over the years. This, combined with the system benefits noted above, makes VFDs the most preferred method for controlling evaporative cooling equipment. Fan cycling and two speed motors are used less frequently as a result. Note that units with VFDs require the use of inverter duty motors, designed per NEMA Standard MG 1, Section IV, part 31. This standard recognizes the increased stresses placed on motors by these drive systems. The use of a non-inverter duty motor in these applications may void the motor warranty.

WARNING:

When the fan speed is to be changed from the factory-set speed, including through the use of a variable speed control device, steps must be taken to avoid operating at or near fan speeds that cause a resonance with the unit or its supporting structure. At start-up, the variable frequency drive should be cycled slowly between the minimum allowable setting (6 Hz for belt drive or 15 Hz for gear drive) and full speed and any speeds that cause a noticeable resonance in the unit should be "locked out" by the variable speed drive.

Fan cycling is the simplest method of capacity control. However, there are drawbacks to fan cycling that limit its application. These drawbacks include:

- Hard starts and stops for the fan and motor which stresses the mechanical drive system
- Sudden sound level increases or decreases due to the starting and stopping of the motor
- Difficulty maintaining control of the design setpoint (temperature or pressure) as the fan cycles on/off

Therefore, if capacity control is required at off-design conditions, BAC recommends using VFDs, the BALTIGUARD™ or BALTIGUARD™ Plus Fan Systems, or two speed motors.

Vibration Cutout Switches

Vibration cutout switches are recommended on all installations. Vibration cutout switches are designed to interrupt power to the fan motor and can provide an alarm to the operator in the event of excessive vibration. BAC offers both electronic and mechanical vibration cutout switches on all cooling tower models.

Water Treatment

As water evaporates in an open cooling tower, the dissolved solids originally present in the water remain in the system. The concentration of these dissolved solids increases rapidly and can cause scale and corrosion. In addition, airborne impurities and biological contaminants, including *Legionella*, may be introduced into the circulating water. To control all potential contaminants, a water treatment program must be employed. In many cases, a simple bleed-off may be adequate for control of scale and corrosion. *Note: Bleed lines are to be provided and installed by others.* However, biological contamination, including *Legionella*, can be controlled only through the use of biocides. Such treatment should be initiated at system startup, after periods of equipment shutdown, and continued regularly thereafter. For more information, consult the appropriate Operation and Maintenance Manual.

When a water treatment program is employed, it must be compatible with construction materials. The pH of the circulating water must be maintained between 6.5 and 9.0. Units having galvanized steel construction and a circulating water pH of 8.3 or higher will require periodic passivation of the galvanized steel to prevent the accumulation of white, waxy, nonprotective zinc corrosion called white rust. Batch feeding of chemicals into the unit is not recommended. If units are constructed with optional corrosion resistant materials, acid treatment may be considered; however, the water quality must be maintained within the guidelines set forth in the Operation and Maintenance Manual.

For complete Water Quality Guidelines, see the appropriate Operation and Maintenance Manual, in section N.

For specific recommendations on water treatment, contact a competent water treatment supplier.

Fill Compatibility

BAC's standard fill is constructed of polyvinyl chloride (PVC) and has a flame spread rating of 5 per ASTM Standard E84. The PVC fill surface is compatible with the water found in most evaporative cooling applications. The maximum allowable water temperature for each product is as shown in the following table:

Maximum Allowable Water Temperature by Fill Material

Product Line	Standard PVC	High Temperature PVC	Steel Fill
Series 3000	130ºF (54.4ºC)	140ºF (60.0ºC)	N/A
Series 1500	120ºF (48.9ºC)	135ºF (57.2ºC)	N/A
FXT	125ºF (51.7ºC)	140ºF (60.0ºC)	N/A
PT2	140ºF (60.0ºC)	150˚F (65.6˚C)	N/A
Series V	130ºF (54.4ºC)	140ºF (54.4ºC) for units with a thermosetting hybrid polymer; 150ºF (65.6ºC) for Galvanized & Stainless Steel Units	170˚F (76.7˚C) for Galvanized & Stainless Steel Units

For applications where the entering water temperature exceeds the limits shown above, contact your local BAC Representative for assistance.

Sound Levels

Sound rating data is available for all BAC Cooling Towers. When calculating the sound levels generated by a unit, the designer must take into account the effects of the geometry of the tower as well as the distance and direction from the unit to noise-sensitive areas. Low sound or Whisper Quiet Fans and intake and discharge sound attenuation can be supplied on certain models to provide reduced sound characteristics (see the "Custom Features and Options" section of the appropriate product line for details). The BALTIGUARD™ Fan System, two-speed motors, or variable frequency drives can also be used to reduce sound during periods of non-peak thermal loads. For more information on sound and how it relates to evaporative cooling equipment, see page M128. For detailed low sound selections, please consult your local BAC Representative.

Protection Against Basin Water Freezing

When a unit is shut down in freezing weather, the basin water must be protected by draining to an indoor auxiliary remote sump tank (see page L5 for remote sump engineering data; page M26 for sizing guidelines) or by providing supplementary heat to the cold water basin. Supplementary heat can be provided by electric immersion heaters or in some cases, hot water or steam coils, or steam injectors. All exposed water piping, make-up lines, and spray pumps (if applicable) that do not drain at shutdown should be traced with electric heater tape and insulated.

Indoor Installations (Applicable to Series V Models Only)

Many indoor installations require the use of inlet and/or discharge ductwork. **Units installed with inlet ductwork must be ordered with solid bottom panels**. Generally, intake ducts are used only on smaller units while the equipment room is used as a plenum for larger units. Discharge ductwork will normally be required to carry the saturated discharge air from the building.

Both intake and discharge ductwork must have access doors to allow servicing of the fan assembly, drift eliminators, and water distribution system. All ductwork should be symmetrical and designed to provide even air distribution across the face of air intakes and discharge openings.

WARNING:

The discharge opening must be positioned to prevent the introduction of discharge air into the fresh air intakes serving the unit or the ventilation systems of adjacent buildings.

Note: Axial fan units are not suitable for indoor installations.

Safety

Adequate precautions, appropriate for the installation and location of these products, should be taken to safeguard the public from possible injury and the equipment and the premises from damage. Operation, maintenance and repair of this equipment should be undertaken only by personnel qualified to do so. Proper care, procedures and tools must be used in handling, lifting, installing, operating, maintaining, and repairing this equipment to prevent personal injury and/or property damage.

Warranties

Please refer to the Limitation of Warranties applicable to and in effect at the time of the sale/purchase of these products.