What is a Cooling Tower?

- An enclosed, steady flow device for cooling water by evaporation through direct contact with air; used in water cooled refrigeration, air conditioning, and industrial process systems.
Maintenance

- Why?
- Start-Ups
- Routine Maintenance/Tips
- Shut-Downs
Maintenance: Why?

- Maintenance is function of
  - Water quality
  - Air quality
**Warning!** Before performing any maintenance or inspection, make sure that all power has been disconnected, locked, and tagged in the “Off Position”
Start-Up: Cleaning the Cooling Tower

- Drain Cold Water Basin
- Clean all strainers
Start-Up:
Inspection

- Rotating Components
Start-Up: Inspection

• Make-Up
Start-Up:
Cooling Tower Check-Up

• Inspect after 24 hours of operation
# Routine Maintenance: Water Quality

- Quality Recommendations
- Cycles of Concentration

## Circulating Water Quality Guidelines

<table>
<thead>
<tr>
<th>Property of Water</th>
<th>Recommended Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.5 to 9.0¹</td>
</tr>
<tr>
<td>Hardness as CaCO₃</td>
<td>30 to 750 ppm²</td>
</tr>
<tr>
<td>Alkalinity as CaCO₃</td>
<td>500 ppm maximum²</td>
</tr>
<tr>
<td>Total Dissolved Solids</td>
<td>1500 ppm maximum</td>
</tr>
<tr>
<td>Conductivity</td>
<td>2400 micromhos</td>
</tr>
<tr>
<td>Chlorides</td>
<td>250 ppm maximum as Cl</td>
</tr>
<tr>
<td></td>
<td>410 ppm maximum as NaCl</td>
</tr>
<tr>
<td>Sulfates</td>
<td>250 ppm maximum</td>
</tr>
<tr>
<td>Silica</td>
<td>150 ppm maximum</td>
</tr>
</tbody>
</table>

1. If pH levels exceed 8.2, consult a water treatment specialist to properly passivate units with Galvanized steel materials of construction.

2. Consult your water treatment specialist if hardness and alkalinity limits may be exceeded.
Routine Maintenance: Scheduling

- Typical Installation
- Severe Conditions or Winter Operation

<table>
<thead>
<tr>
<th>Type of Service</th>
<th>Monthly</th>
<th>Quarterly</th>
<th>Start-Up</th>
<th>Shutdown</th>
<th>Annually</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect General Condition of Tower</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspect and Clean as Necessary:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) Cold Water and Hot Water Basins</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Flush Cold Water Basin to Remove Silt</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B) Optional BALANCE CLEAN® Chamber Inlet Strainer</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>C) Air Inlet Louvers</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Check and Adjust Water Level in:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold Water Basin/ Hot Water Basin</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check Operation of Make-Up Valve</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Check Bleed Rate and Adjust</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Train:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) Check Condition of Belt</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B) Readjust Tension on Belt</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C) Drive Alignment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Lubricate Fan Shaft Bearings</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Lubricate Motor Base Adjusting Screw</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Clean Outside of Fan Motor</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inspect Protective Finish</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Routine Maintenance: Cold Water Basins & Suction Strainers

- Inspect regularly
- Remove any trash or debris
- Drain, clean, and flush with fresh water to remove silt and sediment quarterly, or more often if necessary
Routine Maintenance: Make-Up

- Mechanical Float & Valve Assembly
Routine Maintenance: Make-Up

• Electric Probe Type Water Level Control
  – Electrodes should be cleaned periodically to prevent accumulations of scale, corrosion, sludge or biological growth
  – Original Equipment
    • Factory preset
  – Aftermarket
    • Look for adjustability
Routine Maintenance:
Spray Nozzles

- Counterflow and Coil Product Design
Routine Maintenance: Bearings

- Ball Bearings (Pillow Block)
Routine Maintenance: Bearings

• Ball Bearings (Pillow Block)

Tip: To ensure maximum bearing life, for induced draft units (vertical shaft), release the axial load in the lower bearing, allowing the upper bearing to support the entire fan (thrust) load by loosening/releasing the lower locking collar and then re-tightening.
Routine Maintenance: Locking Collars (Counter Flow)

![Diagram of Locking Collar Assembly]

- Tap the locking collar in the direction of fan rotation.
- Tighten the set screw after the cam is locked.

**Direction of Rotation**

**Locking Collar Assembly**
Routine Maintenance: Fan Drives

- Sheave Alignment

**Tip:** Aluminum sheaves have different bushing torque requirements than cast iron sheaves. Over torquing may cause aluminum sheaves to crack. Check installation instructions or consult unit manufacturer.
Routine Maintenance: Fan Drives

- Fan Belt Tension

![Diagram of fan belt tension with 1/4" to 3/8" deflection indicating proper belt tension]
Routine Maintenance: Motor Base

- Adjustments are made to tension the belts

Tip: Coat the adjusting screw(s) 2 times per year with a corrosion inhibiting grease.
Routine Maintenance: Fan Motor

- Outside surfaces should be cleaned quarterly to ensure proper motor cooling
- New equipment (since ’01) utilize a Cooling Tower Duty Rated motor with permanently lubricated ball bearings and special moisture protection on the bearings, shaft, and windings
## Routine Maintenance:

### Fill Media

- **Check for:**
  - Scale build up
    - OK at top – where cycling wet/dry
  - Torn sheets
  - Melted spots from excessive thermal shock

- **Clean by flushing with high volume water**
  - Not high pressure
# In the Field

## Performance Improvements with Repairs & Refurbishments

- Replace Heat Transfer Wetdeck/Fill
  - New Design = Higher efficiencies
- Replace Spray Distribution/Nozzles
  - More efficient spray pattern
- Increase fan motor horsepower and drives
- Add Heat Transfer Wetdeck
  - New, larger casing
  - Casing sandwich section
- New, larger coil casing
In the Field

Operational Improvements

• Capacity Control & Redundancy
  – Energy Miser Fan System (pony motor)
  – Variable Frequency Drives
    • Do not control capacity via spray water
In the Field
Ease of Maintenance

- Internal Walkway
- Internal Service Platform
- Access Door Platforms
- Extended Lube Lines
In the Field
Ease of Maintenance

- Louver Face Platforms
- Ladders & Safety Cages
- Hand Rail Packages
- Cat Walks around casing

Baltimore Aircoil
# Trouble Shooting

## Common Problems

- Short Capacity (i.e. High Water Temp.)
- Corrosion
- Drift/Carry-Over
- Splash-Out
- Motor Issues
Short Capacity

- Cooling Load has Changed
- Air Flow Issues
- Water Flow Issues
- Clogged/Scaled Fill
Short Capacity
Cooling Load has Changed

• Computer Loads
• Additional Personnel
• Facility Additions

* Capacity Upgrades are Often Available
Short Capacity
Clogged/Scaled Fill

• Air & Water can’t mix properly
• Might be able to clean Fill
  – High water volume, low pressure
• Replace Fill with new High Performance Design
• Re-evaluate water treatment program
  – Filtration
Short Capacity
Improper Air Flow

- Recirculation
- Restrictions
  - External Static Pressure (ESP)?
- Check Amp Draw – Centrifugal Fans
Short Capacity
Improper Water Flow

- Flow Rate to tower is too High
- Nozzles
  - Clogged
  - Unfavorable Orientation
<table>
<thead>
<tr>
<th>Corrosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Cleanliness</td>
</tr>
<tr>
<td>• Low Bleed Rate</td>
</tr>
<tr>
<td>– High Cycles of Concentration</td>
</tr>
<tr>
<td>• Water Treatment</td>
</tr>
<tr>
<td>– White Rust</td>
</tr>
</tbody>
</table>