General Maintenance and Care of Evaporative Cooling Equipment

- What is a Cooling Tower?
- Cooling Towers by the Book
- Materials of Construction
- Maintenance
- Thermal performance
- In the Field
- Troubleshooting
- Understand Your Tower

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

What is a Cooling Tower?

Principle Operation of a Cooling Tower

- All cooling towers operate on the principle of removing heat from the water by evaporating a small portion of the water that is recirculated through the tower.

What is a Cooling Tower?

Types of Cooling Towers:

- Open Circuit vs. Closed Circuit
- Counterflow vs. Crossflow
- Induced Draft vs. Forced Draft

What is a Cooling Tower?

Cooling Tower Classifications

- Natural Draft Cooling Tower
  - one in which air movement is dependent upon the difference in density between the entering air and internal air
- Mechanical Draft Cooling Tower
  - a tower by which air movement is affected by one or more fans

What is a Cooling Tower?

Types of Mechanical Draft Towers

- Forced Draft Cooling Tower
  - type of mechanical draft tower in which one or more fans are located at the air inlet to force the air into the tower
- Induced Draft Cooling Tower
  - type of mechanical draft tower in which one or more fans are located in the air outlet to induce air flow through the air inlets

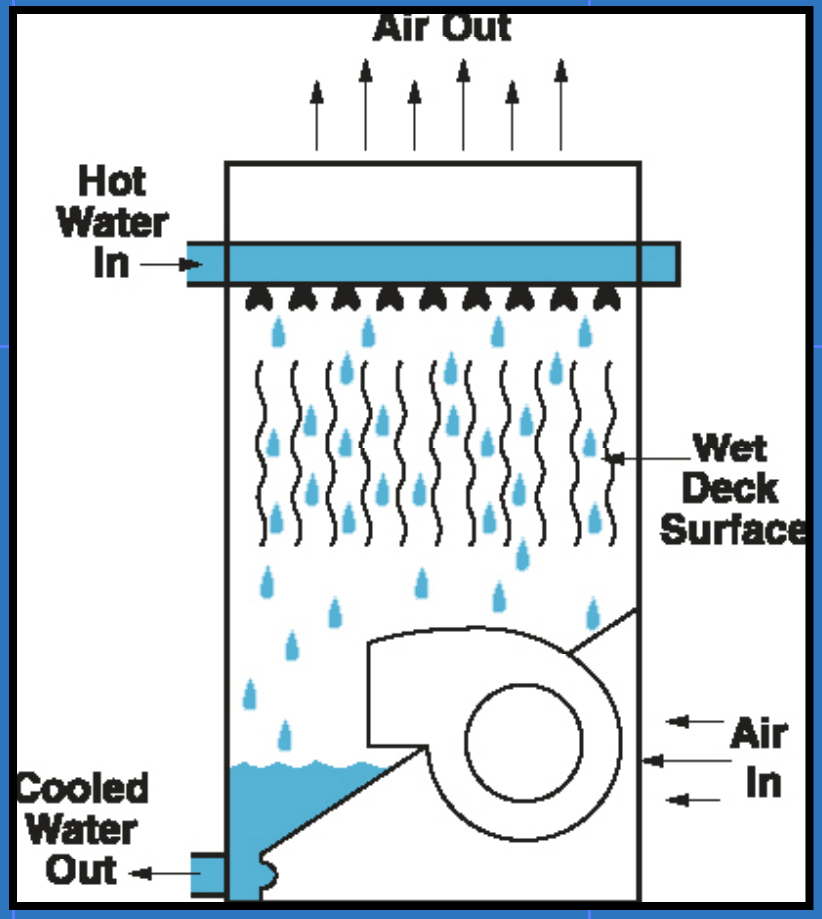
What is a Cooling Tower?

Three Cooling Tower Fluid Paths

- Counterflow
  - one in which air enters at the base of the cooling tower, flows upwards and interfaces counter-currently with the falling hot water
- Crossflow
  - one in which air flows horizontally through the cooling tower and interfaces perpendicularly with the falling hot water
- Parallelflow
  - one in which air flows in a direction parallel to the circulating water

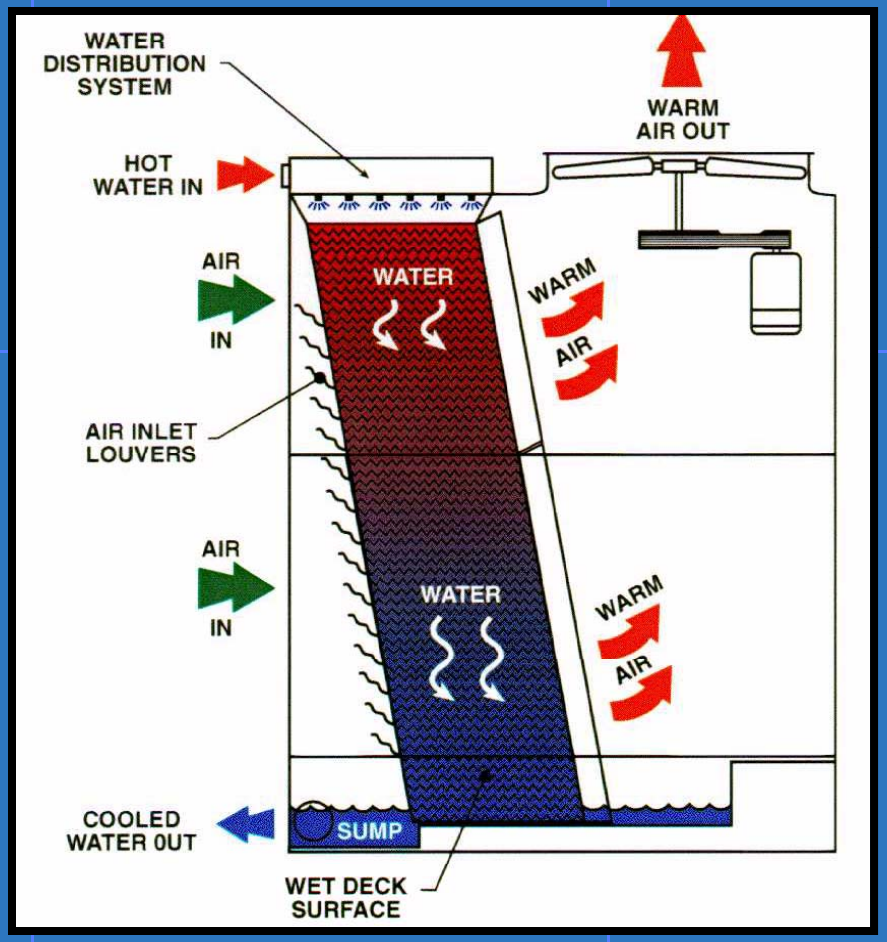
What is a Cooling Tower?

Counter Flow Principle of Operation:



What is a Cooling Tower?

CrossFlow Principle of Operation:



Cooling Towers by the Book

Terms and Definitions

- BTU (British Thermal Unit) – A Btu is the heat energy required to raise the temperature of one pound of water one degree Fahrenheit in the range from 32 – 212 degrees F. An evaporative cooling ton is 15,000 Btu's per hour as opposed to 12,000 Btu's for refrigeration applications

Cooling Towers by the Book

Terms and Definitions

- Approach – The difference between the temperature of the cold water leaving the tower and the wet-bulb temperature of the air.
- Wet-Bulb – The lowest temperature that water theoretically can reach by evaporation. Wet-bulb and Approach are the extreme parameters in selection and design of cooling towers

Cooling Towers by the Book

Terms and Definitions

- Dry-bulb – entering ambient temperature
- Range – the difference between the hot water entering the tower and the cold water leaving the tower, also known as Delta T (ΔT)
- Cell – smallest tower division that operate independently with regard to air/water flow
- Drift – the water entrained in the exit air flow and discharged to the atmosphere – not including evaporation

Cooling Towers by the Book

Terms and Definitions

- Make-up – the amount of water required to replace normal losses caused by bleed, drift and evaporation
- Bleed – water that is discharged to waste to help keep the dissolved solids concentration below a certain limit.

Cooling Towers by the Book

Design Symbols & Formulas

- One Cooling Tower Ton = 15,000 BTU/HR
- T(1) = Entering Water Temperature
- T(2) = Leaving Water Temperature
- ΔT = Delta T or Range

Cooling Towers by the Book

Design Symbols & Formulas

Tonnage = GPM x ΔT x 500/15,000

Range (ΔT) = T(1) – T(2)

Approach = T(2) – T(wb)

Cooling Towers by the Book

Cooling Tower Selection Criteria

- Quantity of water to be cooled (GPM)
- T(1) Entering water temp (°F)
- T(2) Leaving water temp (°F)
- T(wb) Entering air wet bulb temp (°F)

Cooling Towers by the Book

Cooling Tower Selection – Example #1

- Conditions:
  - 1200 USGPM flow
  - 95ºF T(1) entering water temperature
  - 85ºF T(2) leaving water temperature
  - 78ºF T(wb) wet-bulb

What is capacity of this equipment?

Materials of Construction

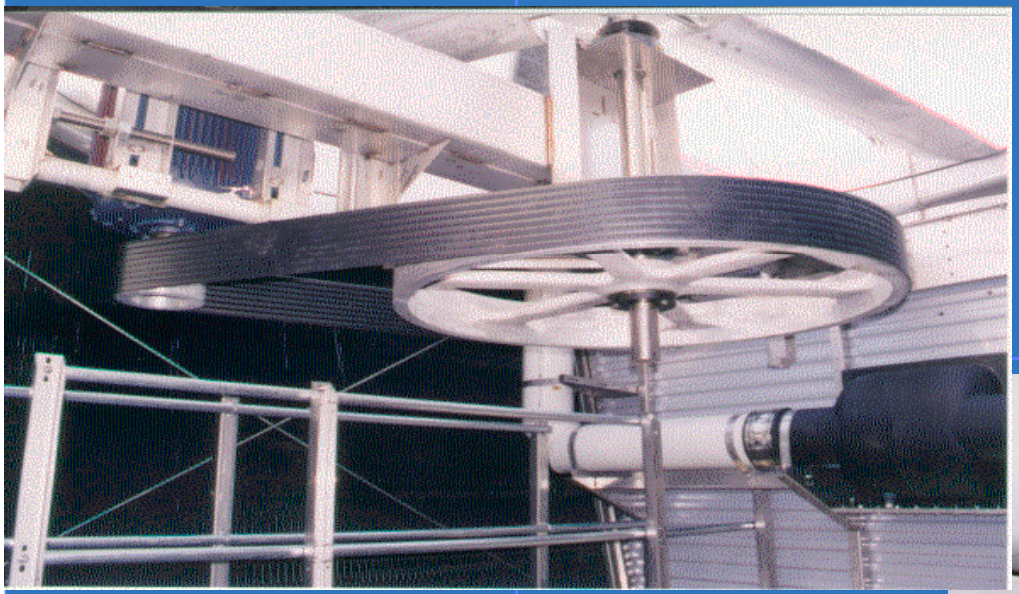
Know your water quality……

- G235 galvanized steel
- Electrostatic sprays or paints
- All Stainless steel construction
  - stainless hot and cold water basins as an option
- Fiberglass/Fiberglass reinforced polyester (FRP)
- Wood
- Concrete

Materials of Construction

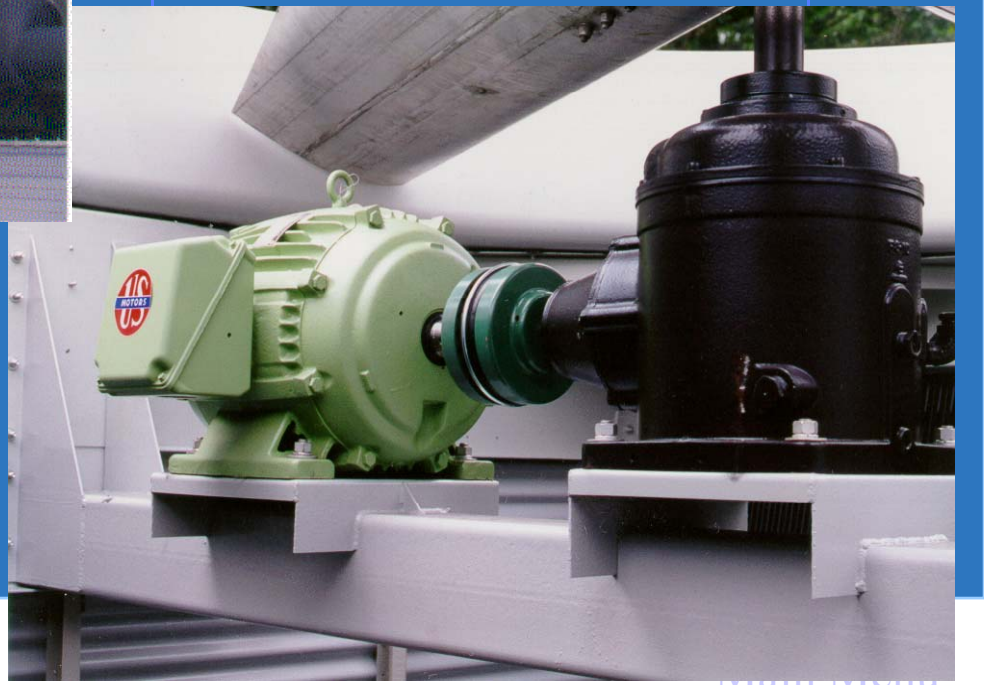
- Heat Transfer Wetdeck Options/History
  - PVC
  - CPVC
  - Steel (galvanized or stainless)
  - Wood
  - Asbestos

Materials of Construction



Fan Drive Systems:

- Belt Drive
- Gear Drive



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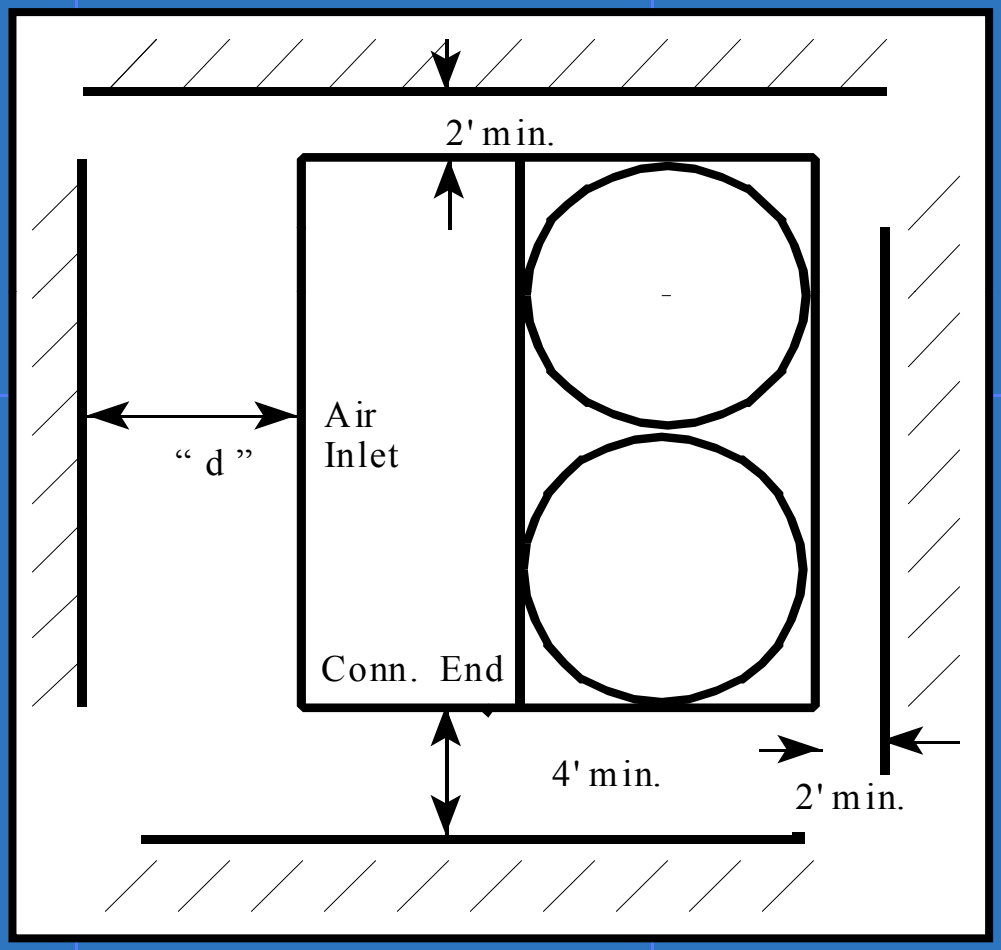
Thermal Performance Layout Considerations

- Location of tower sufficiently from large warm air exhaust discharges and fresh air intakes prevents elevating tower entering air temperature and starving tower of air
- Consider the effects of plume
- Maintenance and piping clearances

Thermal Performance Layout Considerations



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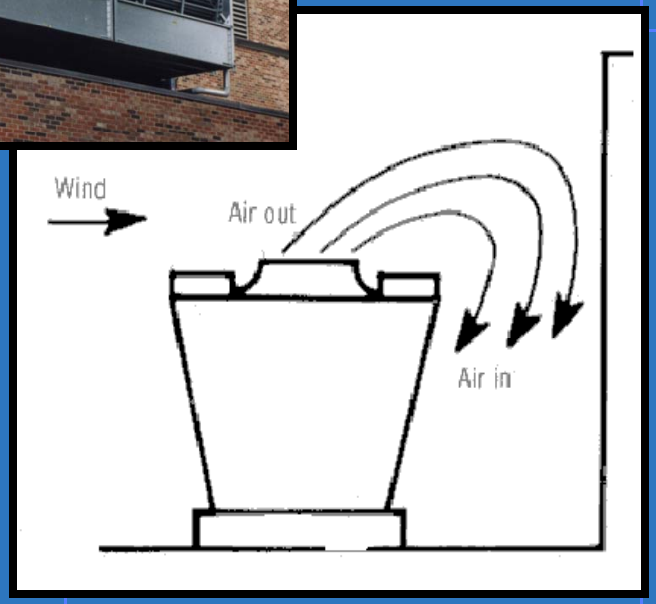
Main Menu

Thermal Performance Layout Considerations



- Nominal
  - 1,500 GPM @ 95/85/78
- 1°F Recirculation
  - 1,384 GPM 95/85/79
  - 8% Derate
- 2°F Recirculation
  - 1,258 GPM 95/85/80
  - 19% Derate

Thermal Performance
Layout Considerations

Locating Towers Near Louvers

- Allow 3’ from Tower to Louvered Wall
  - Allow Airflow to Straighten Out
- Maximum Recommended Velocity Through Louvers: 600 feet per minute
  - Higher Velocities May ‘Starve’ Unit

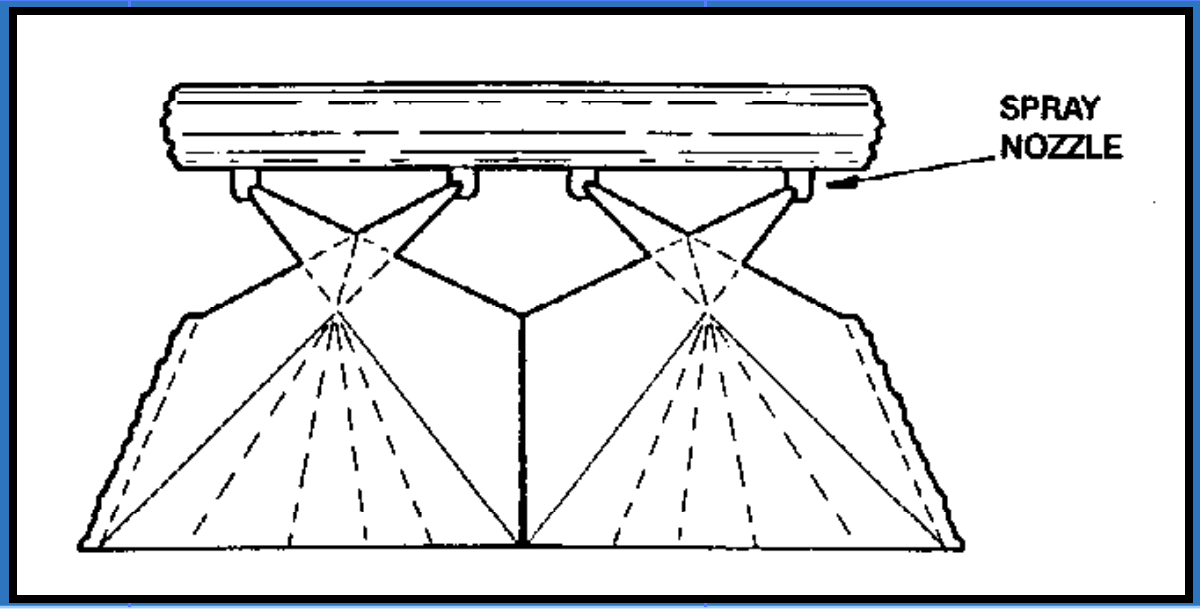
Short Capacity
Cooling Load has Changed

- Computer Loads
- Additional Personnel
- Facility Additions

* Capacity Upgrades are Often Available

Short Capacity
Improper Water Flow

- Flow Rate to tower is too High
- Nozzles
  - Clogged
  - Unfavorable Orientation




Questions?