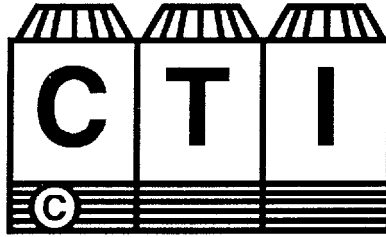


COOLING TOWER MANUAL



Chapter 1

COOLING TOWER OPERATIONS

COOLING TOWER INSTITUTE

PO Box 73383 • Houston, Texas 77273
(281) 583-4087 • FAX (281) 537-1721
<http://www.cti.org> • email: vmanser@cti.org

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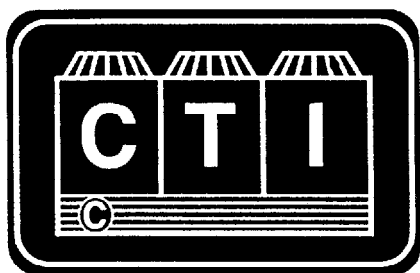
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This guideline document summarizes the best current state of knowledge regarding the specific subject. This document represents a consensus of those individual members who have reviewed this document, its scope and provisions. It is intended to aid all users or potential users of cooling towers.



Approved by the CTI Executive Board

This document has been reviewed and approved as part of CTI's Five Year Review Cycle. This document is again subject to review in 2004.

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Chapter 1

Cooling Tower Operations

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Cooling Tower Operations

1.1 SCOPE

A cooling tower is the most useful device available to industry for dissipating large heat loads at a reasonable cost. Water is usually available, it is inexpensive, and it provides an excellent heat-transfer medium within certain temperature limitations. Unfortunately, many design engineers spend countless hours determining the specifications for heat exchange equipment and then include the cooling tower more or less as an afterthought.

Many things can be done to aid in the maintenance and operation of a tower to increase its efficiency and longevity. An average process cooling tower is operated to some degree on a year-round basis and is, therefore, alternately, exposed to hot, warm, or cold air and water. The air is sometimes dirty, polluted, and carries micro-biological organisms. Also, there is always an abundance of oxygen to support life and to accelerate corrosion. Moisture conditions around the tower range from water saturation to extreme dryness. Temperatures may range from extremely hot to extremely cold. Such a combination of operating conditions cannot avoid creating problems peculiar to cooling towers. Such conditions also point up the fact that the materials of construction (Ref. 1) for a cooling tower are of great importance, and should be given detailed attention. Some material choices are obvious, others have been proven or disproven through experience.

Fortunately, most of the problems encountered in a cooling tower can be overcome either by design (materials of construction) or by operational techniques. However, they can become serious - and costly - if tower maintenance and care are not understood and practiced. It is extremely difficult to separate tower maintenance from tower operation. Neglect by operating personnel in administering the water treating chemicals, in pH control, and in proper housekeeping practices will result in devastating losses. These losses will not be confined to the tower alone, but will be widespread throughout the plant depending upon the circulating water leaving the tower. Remember that good tower operation goes hand-in-hand with preventative maintenance of the tower, so much so that they become almost synonymous.

An operator of equipment must have some familiarity with the equipment if it is to be operated and maintained efficiently. This chapter is directly primarily towards the operator and/or the maintenance man.

Section 1 - Cooling Tower Terminology - is an alpha-

betical listing and definitions of many of the common terms used in cooling tower operation and maintenance.

Section 2 - Type of Cooling Towers - presents a discussion of the various types of cooling towers with schematics depicting air and water flow characteristics.

Section 3 - Maintenance and Inspection - is a discussion of problem areas in cooling towers; what and where to look for these problems; and suggestions on operations and maintenance.

1.2 Definitions

None

1.3 SECTION I - Cooling Tower Terminology

A

ACCESSTUNNEL - opening in Natural Draft Tower used for access to the cold water basin. It can be large enough for a man only, or large enough for mechanical equipment.

AIR FLOW - total amount of dry air and associated water vapor flowing through the tower, measured in cubic feet per minute at the exhaust from the tower and converted to standard air which has a density of 0.075 lb. per cu. ft.

AIR HORSEPOWER - the measure of useful power required to move a given air rate against a given resistance. The ratio of air horsepower to fan input horsepower is the measure of fan efficiency.

AIR INLET - opening in cooling tower through which air enters a tower. On Induced Draft Towers, the air inlet is commonly called the louvered face.

ALGAE - a low form of plant life which generally requires sun- light and air for existence. Causes plugging of heat exchanger tubes and cooling tower distribution systems.

ALGAECIDE - a toxic material which will retard or prevent the growth of algae and slimes. Some of the more commonly used algaecides are chlorine, copper sulfate and phenolic compounds.

AMBIENT - the atmosphere which is adjacent to but not affected by the cooling tower. Generally, this means upwind of the tower, and the other areas where other heat producing equipment is located which supplies extraneous sources of heat to the air coming to the tower.

AMBIENT DEW POINT - the ambient temperature in °F when dew begins to be deposited.

AMBIENT WET-BULB TEMPERATURE - the wet-bulb temperature which is measured in accordance with the

definition of ambient. Readings are obtained by means of a mechanically aspirated psychrometer.

ANCHOR BOLT - a threaded bolt embedded in a concrete basin or fitted to supported members, to which an anchor casting is attached.

ANCHOR CASTING - a device for attaching the tower structure to the foundation; it does not include the anchor bolt. Also known as Column Anchor.

APPROACH - the difference between the cold water temperature in °F and the ambient or inlet wet-bulb temperature in °F.

ATMOSPHERIC TOWER - one in which air movement through the tower is dependent upon atmospheric conditions, not induced by mechanical fans.

B

BASIN - see COLD WATER BASIN and DISTRIBUTION BASIN.

BASIN CURB - the top level of the retaining wall of the cold water basin; usually the datum point from which tower elevation points are measured.

BASIN SUMP - see SUMP.

BAY - the area between two bents or lines of framing members.

BEAM - see JOIST.

BENT - a line of structural framework composed of columns, girts or ties; a bent may incorporate diagonal bracing members.

BEVEL WASHER - a metal fitting used to accommodate through-bolts to angular position of a diagonal member, usually connecting to columns or other framework members.

BHP - (abbr.) see BRAKE HORSEPOWER.

BLOWDOWN - water discharged from the system to control concentration of salts or other impurities in the circulating water.

BLOWER - a squirrel-cage type of air moving device usually applied for operation at higher than normal static pressures or for sound control reasons.

BRACE - see DIAGONAL.

BRAKE HORSEPOWER (BHP) - the actual power output of an engine or a motor.

BRITISH THERMAL UNIT (Btu) - the quantity of heat required to raise the temperature of one lb. of water 1°F.

C

CAISSONS - see FOUNDATION.

CANOPY (Natural Draft Tower) - connects the hyperbolic shell to the cooling section, acting as an air conduit and air seal between the two.

CAPACITY - see THERMAL CAPACITY.

CASING - a vertical enclosing sidewall or endwall of a tower, exclusive of the louvers.

CASING PANEL - a pre-assembled or pre-cut unit of the casing.

CELL - the smallest tower subdivision which can function as an independent unit with regard to air and water flow; it is bounded on exterior walls or partitions. Each cell may have one or more fans or stacks and one or more distribution systems.

CELL DIMENSIONS - (a) Width: dimension perpendicular to tower longitudinal axis and usually at right angles to the louver area; (b) Length: dimension parallel to longitudinal axis and plane where louvers are usually placed; (c) Height: distance from basin curb to top of fan deck but not including fan stack. Nominal width and length are measured from and to the column centerlines.

CIRCULATING WATER RATE - quantity of hot water entering the tower.

COIL SHED - portion of the tower structure housing atmospheric (tubular) heat exchangers.

COLD WATER BASIN - a device underlying the tower to receive the cold water from the tower and direct its flow to the suction line or sump.

COLD WATER TEMPERATURE (CWT) - temperature of the water entering the cold water basin before addition of make-up or removal of blowdown.

COLUMN - framework member; a main vertical supporting member in the tower framework.

COLUMN ANCHOR - see ANCHOR CASTING.

CONCENTRATION - see WATER LOADING.

CONCRETE COOLING TOWER - cooling tower in which the structure is made of concrete.

COOLING RANGE - see RANGE.

COUNTERFLOW TOWER - one in which air, drawn in through the louvers (induced draft) or forced in (forced draft) at the-base by the fan, flows upward through the fill material and interfaces counter currently with the falling hot water.

CROSS STRUTS - framework that holds up the hyperbolic shell of a Natural Draft Tower. The number of cross struts varies according to shell size.

CROSSFLOW TOWER - one in which air, drawn on forced in through the air intakes by the fan, flows horizontally across the fill section and interfaces perpendicularly with the falling hot water.

CWT - (abbr.) - see COLD WATER TEMPERATURE.

CYCLES OF CONCENTRATION - compares dissolved solids in make-up water with solids in the circulating water. Since chlorides are soluble in water, for example, the cycles of concentration are equal to the ratio of chlorides in circulating water to chlorides in the make-up water.