

COOLING TECHNOLOGY INSTITUTE

Nomenclature for Industrial Water-Cooling Towers



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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 2027.

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PART I

GLOSSARY OF TERMS

A

Access Tunnel - Opening in a tower used for access to the cold-water basin. It can be large enough for a man only, or large enough for mechanical equipment.

Acid - any substance that donates a proton (H^+) when dissolved in a solution. In water treatment, it usually means circulating water with a pH of less than 7.0. Sulfuric acid is the most common acid used to control cooling water pH.

Actuator – A type of motor used for moving or controlling a mechanism or system. Can be automatic or manual.

Adsorption - assimilation of molecules or other substances onto the physical structure of a liquid or solid without chemical reaction.

Aeration - blowing or mixing of air through water to sweep out other dissolved gases and to equilibrate the water with primarily nitrogen, oxygen and carbon dioxide.

Aerobe - an organism that grows only in the presence of free (molecular) oxygen.

Air Cooled Condenser – ACC, a system of tubes usually with fins, connected to steam ducts and condensate piping usually carrying steam or other fluids where the steam is condensed by air being blown over the tubes. The air is normally provided by an axial flow fan in a forced or induced draft arrangement.

Air flow - Total amount of dry air and associated water vapor flowing through the tower.

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

Air Inlet - Opening in a cooling tower through which air enters a tower.

Air Intake screen - Mesh filter installed at air inlet which stop debris such as pollen, leaves, insects, and litter

Air Mixer – A part in hybrid cooling tower that is responsible for vapor reduction.

Air Inlet Velocity – The velocity of air at the inlet and is a function of the air volume and the inlet size.

Air Mixer – The equipment used to mix the wet air flow and dry air flow before leaving cooling tower.

Algae - A low form of plant life containing chlorophyll that generally requires sunlight and air for existence. Many are microscopic but under favorable conditions can grow sufficiently dense to plug cooling tower distributors on the decks and to interfere with water splashing in the fill. Large masses often slough off the tower and plug heat exchangers or deposit in piping.

Algaecide - A toxic material which will ~~retard or~~ prevent the growth of algae and slimes. An **algaecide** or **algicide** is a biocide (see biocide).

Algaestat – A toxic material that will retard or arrest the growth of algae and associated slimes.

Alkalinity - an expression of the total basic anions (hydroxyl groups) that are present in a solution. It also represents, particularly in water analysis, the bicarbonate, carbonate, hydroxyl and occasionally the borate, silicate, and phosphate salts which will react with water to produce acid neutralizable anions.

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 that supplies extraneous sources of heat to the air coming to the tower.

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Ambient dew point - The ambient temperature in °F (°C) at which water begins condensing out of air (e.g. when dew begins to be deposited) if the air is being cooled at a constant pressure.

Ambient wet-bulb temperature - The wet-bulb temperature that is measured in accordance with the definition of ambient. Readings are obtained by means of a mechanically aspirated psychrometer or wet-bulb instrument – the lowest temperature achievable, by means of evaporation.

Ammonia - a water-soluble, colorless, pungent gas with the formula NH_3 .

Ammonium - positive ion with the formula NH_4^+ that forms when ammonia dissolves in water. It adds non-natural alkalinity to the water.

Anaerobe (facultative) - An organism that can grow under either aerobic or anaerobic conditions.

Anaerobe (strict) - An organism that grows only in the absence of free oxygen (e.g., sulfate reducing bacteria).

Anchor Bolt - A threaded bolt embedded in a concrete basin or fitted to supported members, to which anchors are attached.

Anion - A negatively charged ion.

Anode - A positively charged electrode that, during electrolysis, attracts anions.

Anodic Area - Area on a metal surface where electrons are given up and metal dissolves (corrosion).

Anti-fouling Fill – A fill media which is inherently more resistant to propagation of fouling/deposits (see fouling). Anti-fouling fills are often characterized to have vertical flute design or other geometries which retard or mitigate the formation of fill deposits/clogging.

Antifoam - An agent that prevents foam from forming or reduces its presence.

Anti-Reverse Rotation Device – A device that prevents fans from freewheeling backwards.

Approach - The difference between the cold-water temperature and the wet-bulb temperature in °F (°C) in a cooling tower. (*not to be confused with condenser approach*)

Atmospheric Tower - One in which air movement through the tower is dependent upon atmospheric conditions and not by fans. (also known as a natural draft tower)

Atomic Number - A number given to each element representing the number of protons in one atom of that element.

Atomic Weight – The average mass of an element as it occurs in nature that is expressed in atomic mass units.

Autotrophic - An organism that is capable of producing its own food through the use of chlorophyll and light.

B

Bacteria - Unicellular microorganisms which reproduce by fission or spores, identified by their shapes: coccus, round; bacillus, rod shaped; and spirillum, curved.

Back to back arrangement tower - Tower cells are arranged in 2 rows, attached to each other, air inlet at one longitudinal side.

Basin - (see Cold Water Basin and Distribution Basin).

Basin cover - Used to cover the hot water basin in a crossflow tower to decrease algae growth.

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.

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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.

Bicarbonate Alkalinity - In a water solution, the presence of ions resulting from the hydrolysis of carbonates when these salts react with water. A strong base and a weak acid are produced, and the solution is alkaline. Its formula is HCO_3^- , but its concentration is usually denoted in terms of ppm as CaCO_3 .

Biocide - A chemical that is designed to kill troublesome microbes, and possesses an official EPA registration, which describes legally approved end-uses for the product, along with authorized dosage limits.

Biological Deposit - Water-formed deposits of organisms or their waste products (example: slimes, barnacles, etc.).

Biostat - A chemical that is designed to control the population of troublesome microbes by inhibiting their reproduction and subsequent increase in population.

Blow out - Water that is blown or pulled out of the air inlet by wind (Sometimes referred to as “splash out” or “windage”).

Blow through – Air or water blowing from one cell to another if partition walls are not present.

Blowdown – Water deliberately discharged from the system to control concentration of salts or other impurities in the circulating water.

Blower - A centrifugal fan usually applied for operation at higher than normal static pressures or for sound control reasons.

Blue Book (CTI) – A book of demand curves published by the Cooling Tower Institute used to evaluate cooling towers. The curves represent the solution of the Merkel equation of a variety of ranges, approaches, and wet bulb temperatures. The book was replaced by a software version known as the CTI Tool Kit.

Brace - (see Diagonal).

Brake Horsepower (BHP) - The actual power output of an engine or a motor.

Breakthrough velocity - The air velocity at which visible droplets consistently get re-entrained into the exiting air stream. The actual velocity varies based on the class of drift eliminator.

British Thermal Unit (BTU) - The quantity of heat required to raise the temperature of one lb of water 1°F from 39°F to 40°F.

Bypass pipe – A secondary pipe or other channel connected with a main pipe for conducting circulating water around the fill media directly into the cold-water basin.

Balancing (Equalizing) Pipe - piped connection, specifically sized to maintain equal water levels between multiple cells or multiple units for an open cooling tower system

C

Caissons - (see Foundation).

Canopy - Connects the hyperbolic shell of a crossflow natural draft tower to the cooling section, acting as an air conduit and air seal between the two.

Capability – (see Thermal Capability)

Capacity - (see Thermal Capacity).

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Carbonate Hardness - Hardness in water caused by bicarbonates of calcium and magnesium. If alkalinity exceeds total hardness, all hardness is carbonate hardness; if hardness exceeds alkalinity, the carbonate hardness equals the alkalinity.

Casing - Material enclosing a sidewall or end wall of a tower, exclusive of the louvers.

Casing Panel - A pre-assembled or pre-cut unit of the casing.

Cathode - A negatively charged electrode (which attracts cations in electrolysis).

Cation - A positively charged ion resulting from dissociation of molecules in solution.

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

Cell Dimensions - (a) Width: dimensions perpendicular to tower longitudinal axis; (b) Length: dimension parallel to tower longitudinal axis; (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 center lines.

Certification - A program whereby the Cooling Technology Institute will certify that all models of a line of evaporative heat rejection equipment offered for sale by a specific Manufacturer will perform thermally in accordance with the Manufacturer's published ratings. (see STD-201)

Characteristic curve - A plot of the thermal characteristic value KaV/L on the ordinate axis vs the L/G (liquid to gas) or G/L (gas to liquid) ratio on the abscissa axis. Characteristic curves can be drawn for any of the heat transfer sections of a tower - the fill section, rain zone, and spray zone - and curves may incorporate different combinations or amounts of each of these sections depending on the author of the curves. Characteristic curves may also be drawn for the total heat transfer characteristic of the entire cooling tower system.

Chemical Dosage - The amount of chemical added to a system, usually expressed as ppm, or pounds of chemical per million pounds of water.

Chloramine - A compound formed when chlorine reacts with ammonia or a chemical containing the ammonium ion. The result is mono-, di-, tri-, and organochloramines. The resulting chloramines are weak oxidants. They are a component of total chlorine, known as *combined chlorine*. These are weaker biocides, relative to free chlorine.

Chlorination - Adding chlorine or a chlorine derivative to water to prevent the growth of various organisms that cause biofouling. (see Dechlorination)

Chlorine - A poisonous yellow gas with chemical symbol Cl_2 used for water treatment. It is soluble in water but can be removed by reducing aeration and reaction with sunlight.

Chlorine Demand - The relation of the amount of chlorine to be added to a system to react with chlorine-oxidizable material until a free residual in a given system is achieved.

Chlorine Dioxide - A compound with the symbol ClO_2 , used mainly for bleaching wood pulp for paper. It is also used for the taste and odor control of phenolic compounds in water and can be used as a disinfectant in cooling towers.

Chlorine, Free - The total amount of hypochlorite ion and hypochlorous acid in the system.

Chlorine, Residual - The amount of available chlorine present in water at any given time subsequent to the addition of chlorine.

Chromated Copper Arsenate (CCA) - A wood preservative and treatment chemical consisting of chromium, copper, and arsenic. The EPA has classified CCA as a restricted use product, for use only by certified pesticide applicators.

Closed Circuit Cooling Tower - Pass the working fluid through a tube bundle, upon which clean water is sprayed and a fan-induced draft applied. The resulting heat transfer performance is close to that of a wet cooling tower, with the advantage of protecting the working fluid from environmental exposure and contamination.

Circulating Water Rate - Quantity of water pumped per unit of time from the tower basin to the equipment to be cooled, typically measured in gallons per minute (gpm), or cubic meters per hour (m³/hr.).

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) - Average temperature of the water at the discharge point from the cold-water basin excluding the effect of any make-up entering the basin. Unit °F or °C.

Column - A main vertical supporting member in the tower framework.

Column Anchor - A device for attaching the tower structure to the foundation.

Combined Chlorine - The amount of chloramine or chloro-organic compounds present in water.

Compounds - Substances formed from the chemical bonding of two or more atoms.

Concentration - The process of increasing solids per unit volume of solution, usually by evaporation of the liquid; also, the amount of material dissolved in a unit volume of solution. This occurs in a cooling tower due to evaporation that cools the water. It is normally expressed directly as ppm or indirectly as ~~mhos~~ $\mu\text{mhos/cm}$ ($\mu\text{S/cm}$) conductivity. (See also Water Loading and Cycles of Concentration.)

Concrete Cooling Tower - Cooling tower in which the structure is made of concrete.

Conductivity - The ability of water to conduct electricity. When measured with a standard apparatus, it is called specific conductivity and is a function of the total ionic dissolved solids. As a rule of thumb, TDS = 2/3 specific conductance measured as micromhos/cm ($\mu\text{mhos/cm}$) or microsiemens/cm ($\mu\text{S/cm}$).

Cooling Range - (see Range).

Cooling Tower Dimensions - (see Nominal or Overall Cooling Tower Dimensions).

Cooling Tower Pump Head - The pressure necessary to pump water through a cooling tower. It includes the head of water necessary to overcome piping and/or nozzle losses internal to the cooling tower, the static head required (vertical distance between the inlet centerline and the basin curb), and any velocity head losses.

Cooling Water - Water circulated through a cooling system to remove heat from heat generating equipment.

Copper Alloys - Metals made from a mixture of copper and another metal. (Example brass = copper + zinc).

Corrosion - To be dissolved away, usually by oxidation or acidification. This usually refers to metal loss in cooling systems, often recognized by the local reaction of the dissolved metal with oxygen, carbon dioxide, acids or galvanic action. May result in general (widespread) or pitting (localized) loss of the metal.

Corrosion Coupon - A small piece of representative metal that is inserted into a circulating system that can be analyzed to find the corrosive nature of the system's water.

Corrosion Fatigue - The weakening of a pipe or similar piece of metal due to corrosion acting on it.

Corrosion Inhibitor - Chemical used in a system to prevent corrosion.

Counterflow Cooling Tower - A tower in which air, drawn in (natural draft or induced draft) or forced in (forced draft) at the base, flows upward through the fill and moves counter current to the falling hot water.

Cross Struts Diagonally oriented framework that holds up the hyperbolic shell of a natural draft tower. The number of cross struts varies according to shell size.

Crossflow Cooling Tower – A tower in which air, drawn in (natural draft or induced draft) or forced in (forced draft) through the air intakes, flows horizontally across the fill and moves perpendicular to 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. The ionic species used, depend on treatment products being dosed. If an oxidizing biocide is being fed, chloride *cannot* be used for evaluation, as the cooling tower chloride will be skewed higher as a result of chloride reduction product. Likewise, sulfate cannot be used if sulfuric acid is employed (nor can M-Alkalinity if this is case). Ionic species that can be commonly used, included magnesium, silica, and conductivity/TDS. It is best to analyze several analytes and observe an overall trend, looking for outliers. The cycles of concentration value are equal to the ratio of ionic species/analyte in circulating water to the same analyte in the make-up water. Also, can be defined hydraulically, as the ratio of the volumetric flow rate of incoming makeup water to that of the outgoing blowdown (discharge) water.

Cylinder - (see Fan Stack).

D

Dampers – An operable louver.

DBT - (abbr.) - (see Dry-Bulb Temperature).

Dechlorination - The act of removing chlorine from water, usually via a reducing agent or strong aeration.

Deck Batt – (obs.) - (see Splash Bar).

Deck Stringer – (obs.) – The portion of a wooden splash fill deck that supports the splash bars in a fixed position.

Deck Support – The horizontal structural member supporting splash fill decks. (Not related to Fan Deck Support.)

Deflocculation - The ability of some materials such as polyphosphides to peptize and disperse suspensions of colloidal particles.

Delignification - The dissolving of the lignin (“glue”) portion of wood usually by strong alkaline and/or oxidizing agents.

Demister - Term often used synonymously for drift eliminator. However, by definition mists are much smaller than drift droplets. As a result, typical cooling tower drift eliminators do not scrub out mists.

Denitrification - The removal of nitrogen from a system. This may be done chemically or biologically.

Design conditions - Typically a reference to thermal design conditions which include: the hot water temperature (HWT), cold water temperature (CWT), water circulation rate, fan power, and wet-bulb temperature (WBT) in mechanical draft towers. In natural draft towers; HWT, CWT, GPM, WBT plus either dry bulb temperature (DBT) or relative humidity (RH). Design Conditions can also refer to other site- specific requirements, such as noise level, drift rate, lateral loads or codes to be used for the structural design.

Deicing system – The process of removing ice that occurs during winter season, melting the ice by using the cooling hot water.

De-silting sump - The area in the cold-water basin, usually at a low point, where silt can be flushed to a drain.

Diagonal - (see also Cross Struts for Natural Draft Tower) - A framework or load bearing member transmitting forces at other than a right angle with reference to columns or horizontal ties. Also known as a Brace.

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