Safety is an indispensable factor when you are considering climate control for your rooms. Whether you are looking for air-conditioning in offices or banks, climate control in sensitive hospital wards, a process climate for IT and production areas or to meet cleanroom requirements. TOUFAN TAHVIEH Air conditioners provide the Perfect solution for all tasks. TOUFAN TAHVIEH is a 10-year old well established company in IRAN with production facility in KARAJ-IRAN, employing over 100 people. The staff of IRAN factory applies innovative approaches and tried-and tested expertise to provide customer needs solutions in line with the constantly increasing demands of the market place. We bring to fruition special projects and meet bespoke requirements, proof of our flexibility. Well thought out, all embracing solutions, from the original idea to advice, planning, development and production, right through to assembly and maintenance. Modern, state of-the-art production plants and consistently applied quality management under DIN EN ISO 9001:2000 guarantee a recognized quality standard for our products. "Just-in-time" delivery included.

Contents

Overview

Process cooling can be an expensive. In general, we use the following guidelines when trying to reduce cooling costs.

1.Eliminate “once-through” cooling.
2.Use cooling towers rather than chillers when feasible.
3.Apply for sewer exemption on cooling tower make-up water.
4.Use gas-powered chillers rather than electric chillers when cost-effective.

Cooling Towers

Cooling towers are a very important part of many chemical plants. The primary task of a cooling tower is to reject heat into the atmosphere. They represent a relatively inexpensive and dependable means of removing low-grade heat from cooling water. The make-up water source is used to replenish water lost to evaporation. Hot water from heat exchangers is sent to the cooling tower. The water exits the cooling tower and is sent back to the exchangers or to other units for further cooling. Typical closed loop cooling tower system is shown in Figure 1

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Cooling Tower Types :

Cooling towers fall into two main categories: Natural draft and Mechanical draft.
Natural draft towers use very large concrete chimneys to introduce air through the media. Due to the large size of these towers, they are generally used for water flow rates above 45,000 m3/hr. These types of towers are used only by utility power stations. Mechanical draft towers utilize large fans to force or suck air through circulated water. The water falls downward over fill surfaces, which help increase the contact time between the water and the air - this helps maximize heat transfer between the two. Cooling rates of Mechanical draft towers depend upon their fan diameter and speed of operation.

Mechanical draft towers :

Mechanical draft towers are available in the following airflow arrangements:
1. Counter flows induced draft.
2. Counter flow forced draft.
3. Cross flow induced draft.
In the counter flow induced draft design, hot water enters at the top, while the air is introduced at the bottom and exits at the top. Both forced and induced draft fans are used. In cross flow induced draft towers, the water enters at the top and passes over the fill. The air, however, is introduced at the side either on one side (single-flow tower) or opposite sides (double-flow tower). An induced draft fan draws the air across the wetted fill and expels it through the top of the structure. The below Figure illustrates various cooling tower types. Mechanical draft towers are available in a large range of capacities. Towers can be either factory built or field erected - for example concrete towers are only field erected. Many towers are constructed so that they can be grouped together to achieve the desired capacity. Thus, many cooling towers are assemblies of two or more individual cooling towers or “cells.” The number of cells they have, e.g., an eight-cell tower, often refers to such towers. Multiple--cell towers can be lineal, square, or round depending upon the shape of the individual cells and whether the air inlets are located on the sides or bottoms of the cells.

Components of Cooling Tower :

The basic components of an evaporative tower are: Frame and casing, fill, cold water basin, drift eliminators, air inlet, louvers, nozzles and fans.

Frame and casing :

Most towers have structural frames that support the exterior enclosures (casings), motors, fans, and other components. With some smaller designs, such as some glass fiber units, the casing may essentially be the frame.

Fill :

Most towers employ fills (made of plastic or wood) to facilitate heat transfer by maximizing water and air contact. Fill can either be splash or film type. With splash fill, water falls over successive layers of horizontal splash bars, continuously breaking into smaller droplets, while also wetting the fill surface. Plastic splash fill promotes better heat transfer than the wood splash fill. Film fill consists of thin, closely spaced plastic surfaces over which the water spreads, forming a thin film in contact with the air. These surfaces may be flat, corrugated, honeycombed, or other patterns. The film type of fill is the more efficient and provides same heat transfer in a smaller volume than the splash fill.

Cold water basin :

The cold water basin located at or near the bottom of the tower, receives the cooled water that flows down through the tower and fills. The basin usually has a sump or low point for the cold water discharge connection. In many tower designs, the cold water basin is beneath the entire fill.

In some forced draft counter flow design, however, the water at the bottom of the fill is channeled to a perimeter trough that functions as the cold water basin. Propeller fans are mounted beneath the fill to blow the air up through the tower. With this design, the tower is mounted on legs, providing easy access to the fans and their motors.

Drift eliminators:

These capture water droplets entrapped in the air stream that otherwise would be lost to the atmosphere.

Air inlet:

This is the point of entry for the air entering a tower. The inlet may take up an entire side of a tower–cross flow design– or be located low on the side or the bottom of counter flow designs.

Louvers:

Generally, cross-flow towers have inlet louvers. The purpose of louvers is to equalize air flow into the fill and retain the water within the tower. Many counter flow tower designs do not require louvers.

Nozzles:

These provide the water sprays to wet the fill. Uniform water distribution at the top of the fill is essential to achieve proper wetting of the entire fill surface. Nozzles can either be fixed in place and have either round or square spray patterns or can be part of a rotating assembly as found in some circular cross-section towers.

Fans:

Both axial (propeller type) and centrifugal fans are used in towers. Generally, propeller fans are used in induced draft towers and both propeller and centrifugal fans are found in forced draft towers. Depending upon their size, propeller fans can either be fixed or variable pitch. A fan having non-automatic adjustable pitch blades permits the same fan to be used over a wide range of kW with the fan adjusted to deliver the desired air flow at the lowest power consumption. Automatic variable pitch blades can vary air flow in response to changing load conditions.

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Tower Materials:

In the early days of cooling tower manufacture, towers were constructed primarily of wood. Wooden components included the frame, casing, louvers, fill, and often the cold water basin. If the basin was not of wood, it likely was of concrete.

Today, tower manufacturers fabricate towers and tower components from a variety of materials. Often several materials are used to enhance corrosion resistance, reduce maintenance, and promote reliability and long service life. Galvanized steel, various grades of stainless steel, glass fiber, and concrete are widely used in tower construction as well as aluminum and various types of plastics for some components.

Wood towers are still available, but they have glass fiber rather than wood panels (casing) over the wood framework. The inlet air louvers may be glass fiber, the fill may be plastic, and the cold water basin may be steel.

Larger towers sometimes are made of concrete. Many towers–casings and basins– are constructed of galvanized steel or, where a corrosive atmosphere is a problem, stainless steel. Sometimes a galvanized tower has a stainless steel basin. Glass fiber is also widely used for cooling tower casings and basins, giving long life and protection from the harmful effects of many chemicals.

Plastics are widely used for fill, including PVC, polypropylene, and other polymers. Treated wood splash fill is still specified for wood towers, but plastic splash fill is also widely used when water conditions mandate the use of splash fill. Film fill, because it offers greater heat transfer efficiency, is the fill of choice for applications where the circulating water is generally free of debris that could plug the fill passageways.

Plastics also find wide use as nozzle materials. Many nozzles are being made of PVC, ABS, polypropylene, and glass-filled nylon. Aluminum, glass fiber, and hot-dipped galvanized steel are commonly used fan materials. Centrifugal fans are often fabricated from galvanized steel. Propeller fans are fabricated from galvanized, aluminum, or molded glass fiber reinforced plastic.

Tower Performance :

A cooling tower is a counter-flow or cross--flow heat exchanger that removes heat from water and transfers it to air. Cooling towers come in many configurations. Induced-draft cooling towers, such as the one shown below, generally use less fan power and have short circuit less air than forced-draft cooling towers.

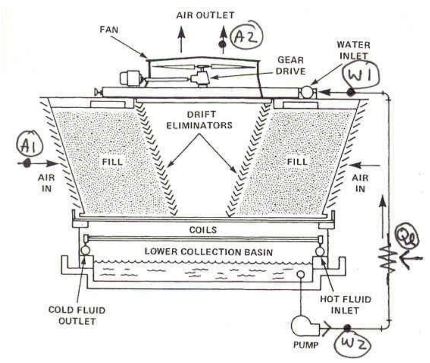
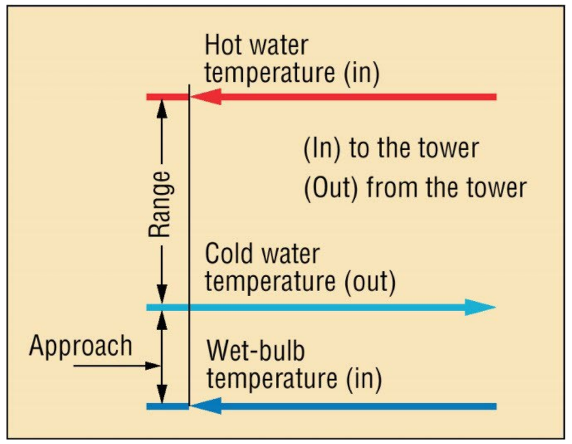


Figure 1. Induced-draft cross-flow cooling tower (Source: ASHRAE Handbook: HVAC Systems and Equipment, 2000)

The temperature difference of water through a tower, dT = Tw1-Tw2, is determined by the load, Ql, and the mass flow rate of water, mw. Neither the size of the tower nor the state of the outside air influences the temperature difference; however, larger towers or lower outdoor air wet-bulb temperatures will decrease the exit water temperature, Tw2.

Typically, most towers are sized for a 10 F temperature difference and about 2.4 gpm/ton of cooling. Fan motor hp is about 0.1 hp/ton and air flow rates are about 2,000 cfm/hp. The temperature of water from a cooling tower, Tw2, can be calculated based on tower performance data such as that shown below, water flow rate, cooling load, and the ambient wet-bulb temperature. This process can be automated in software to predict cooling tower performance with varying ambient conditions. For example, CoolSim (Kissock, 1997) calculates exit water temperatures, and the fraction of time that a cooling tower can deliver water at a target temperature, based on entering water temperature, Tw1, and TMY2 weather data. This information is useful in determining how often a cooling tower can replace a chiller in cooling applications.



Typical cooling tower performance curve (Source: ASHRAE Handbook: HVAC Systems and Equipment, 2000).

The important parameters, from the point of determining the performance of cooling towers, are:

i) “Range” is the difference between the cooling tower water inlet and outlet temperature.

ii) “Approach” is the difference between the cooling tower outlet cold water temperature and ambient wet bulb temperature. Although, both range and approach should be monitored, the ‘Approach’ is a better indicator of cooling tower performance.

iii) Cooling tower effectiveness (in percentage) is the ratio of range, to the ideal range, i.e., difference between cooling water inlet temperature and ambient wet bulb temperature, or in other words it is = Range / (Range + Approach).

iv)Cooling capacity is the heat rejected in kCal/hr or TR, given as product of mass flow rate of water, specific heat and temperature difference.

v) Evaporation loss is the water quantity evaporated for cooling duty and, theoretically, for every 10,00,000 kCal heat rejected, evaporation quantity works out to 1.8 m3 . An empirical relation used often is:

*Evaporation Loss (m3 /hr) = 0.00085 x 1.8 x circulation rate (m3 /hr) x (T1-T2)

T1-T2 = Temp. Difference between inlet and outlet water.

*Source: Perry’s Chemical Engineers Handbook (Page: 12-17)

vi) Cycles of concentration (C.O.C) is the ratio of dissolved solids in circulating water to the dissolved solids in make-up water.

vii) Blow down losses depend upon cycles of concentration and the evaporation losses and is given by relation:

Blow Down = Evaporation Loss / (C.O.C. – 1)

viii) Liquid/Gas (L/G) ratio, of a cooling tower is the ratio between the water and the air mass flow rates. Against design values, seasonal variations require adjustment and tuning of water and air flow rates to get the best cooling tower effectiveness through measures like water box loading changes, blade angle adjustments.

Thermodynamics also dictate that the heat removed from the water must be equal to the heat absorbed by the surrounding air:

L(T1 –T2) = G(h2 – h1)

L/G = (h2 – h1) / (T1– T2)

Where: L/G = liquid to gas mass flow ratio (kg/kg)

T1 = hot water temperature (°C)

T2 = cold water temperature (°C)

h2 = enthalpy of air-water vapor mixture at exhaust wet-bulb temperature (same units as above)

h1 = enthalpy of air-water vapor mixture at inlet wet-bulb temperature (same units as above)

The psychometrics of evaporation

Evaporation as a means of cooling water is utilized to its fullest extent in cooling towers, which designed to expose the maximum transient water surface to the maximum flow of air for the longest period of time.

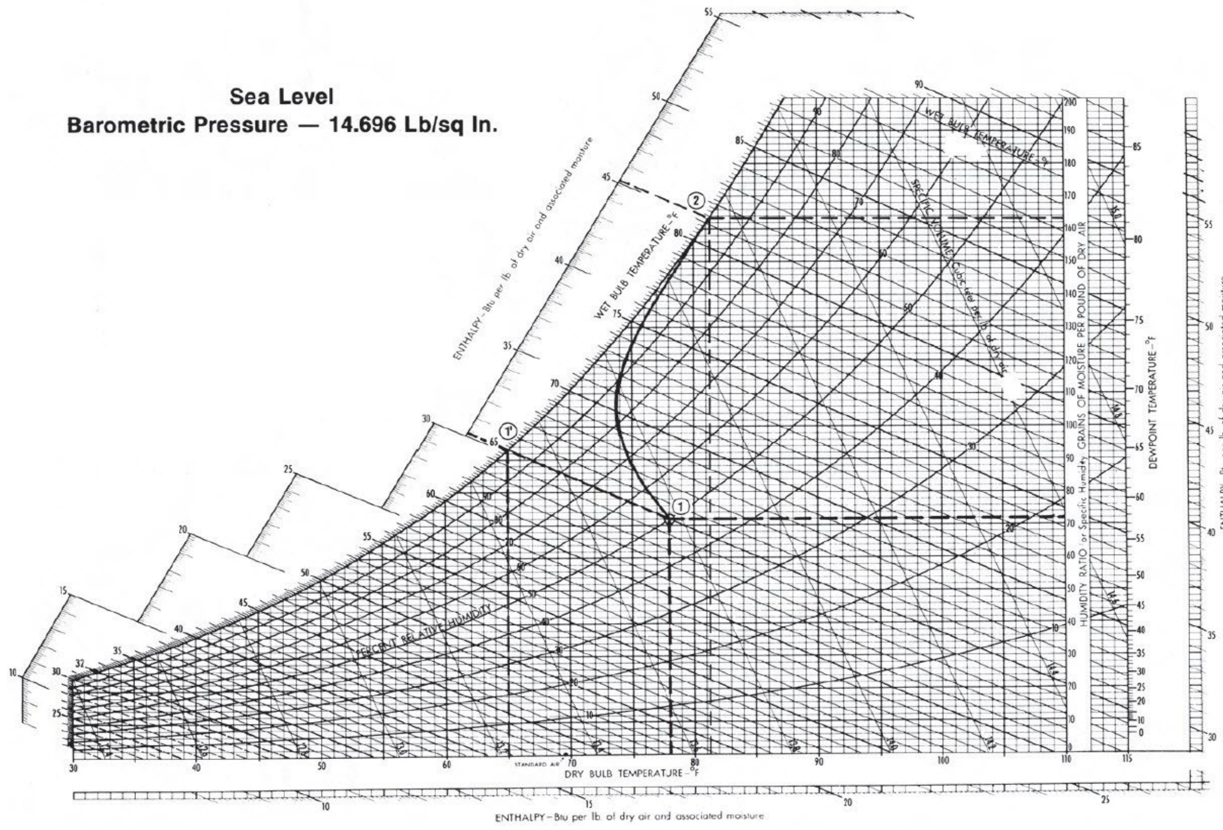
The spray-fill, counter flow tower attempts to accomplish this basic function by spraying the water into fine droplets, and in containing those droplets to fall through a mechanically--induced, upward-moving stream of air.

It is rather obvious that the overall cooling effect would be improved by increasing the height of the tower, thereby increasing the distance of water fall and maximizing the total time of contact between air and water. In utilizing that method, however structural and economic limitations would soon be reached.

A significantly better way to increase contact time is by the installation of “fill” within the tower to impede the progress of falling water. Placed in the horizontal area of the tower below the spray and above the air inlet level, in staggered rows, these splash bars retard the falling water and increase the surface area exposed to the air, thereby promoting the process of evaporation. Primary knowledge of how to achieve effective air and water contact notwithstanding, given the problem of cooling water from 85°F to 70°F, how can one hope to do so when the sensible air temperature is 78°F at a 50 percent relative humidity?

Utilizing only sensible heat transfer (as in an air-cooled heat exchanger) the problem would be impossible because the entering air dry-bulb temperature (78°F) is higher than the desired cold water temperature (70°F). However, the process of evaporation that occurs in a cooling tower makes the solution an easy one.

Understanding the evaporative cooling process can be enhanced by tracing on a psychometric chart the change in condition of a pound of air (dry wt.) as it moves through the tower and contacts a pound of water (L/G = 1), as denoted by the solid line. Air enters the tower at Condition 1 (78°F dry bulb & 50% R.H), whereupon it begins to gain moisture content and enthalpy (total heat) in an effort to reach equilibrium until it exits the tower at Condition.



AIR MOVEMENT PACKAGE

- Forward-curved centrifugal fans are dynamically balanced and mounted on tubular steel shafts
- Fans are supported by roller-bearings mounted at both ends with heavy-guage steel supports.
- Spherical roller bearings are rated at life of 50,000 hours.
- Fan guard / Air-inlet screens are 16 gauge galvanized steel.
- TEFC Fan Motor 1.0 service factor, variable torque, and specially insulated for cooling tower duty.
- The TFDC Series air movement package including the structural support guaranteed against failure for a period of five full years. The motor is warranted separately by the motor manufacturer.

WATER DISTRIBUTION SYSTEM

- Pressurized spray system distributes water evenly over the fill.
- Low-clog polypropylene nozzles deliver precise distribution of water over the fill area.
- Thermoformed PVC film fill assembled into packs for ease of removal and cleaning.
- Drifts Eliminators limit drift losses to no more than 0.005% of the design m3/hr flow rate.

STRUCTURE

- Forced-draft, counter-flow design requires considerably less plan area than crossflow towers typically use.
- Series 300 stainless steel, 316 stainless steel or Z725 galvanized steel construction.
- Factory assembled ensures final field installation will be hassle-free.
- Centrifugal fans and a fully-enclosed falling water area create one of the quietest cooling tower configurations on the market.

The TFDC Series towers is a galvanized steel, factory assembled, forced draft, counter flow cooling tower, designed to serve air conditioning and refrigeration systems as well as light to medium industrial process loads on clean water. The TFDC is particularly suited to the urban environment, reducing noise while increasing energy efficiency and performance.

The specifications portion of this publication not only relates the language to use in describing an appropriate TFDC cooling tower but also defines why certain items and features are important enough to specify with the intention of insisting upon compliance by all bidders. The left hand column of pages 17 thru 24 provides appropriate text for the various specification paragraphs, whereas the right hand column comments on the meaning of the subject matter and explains its value.

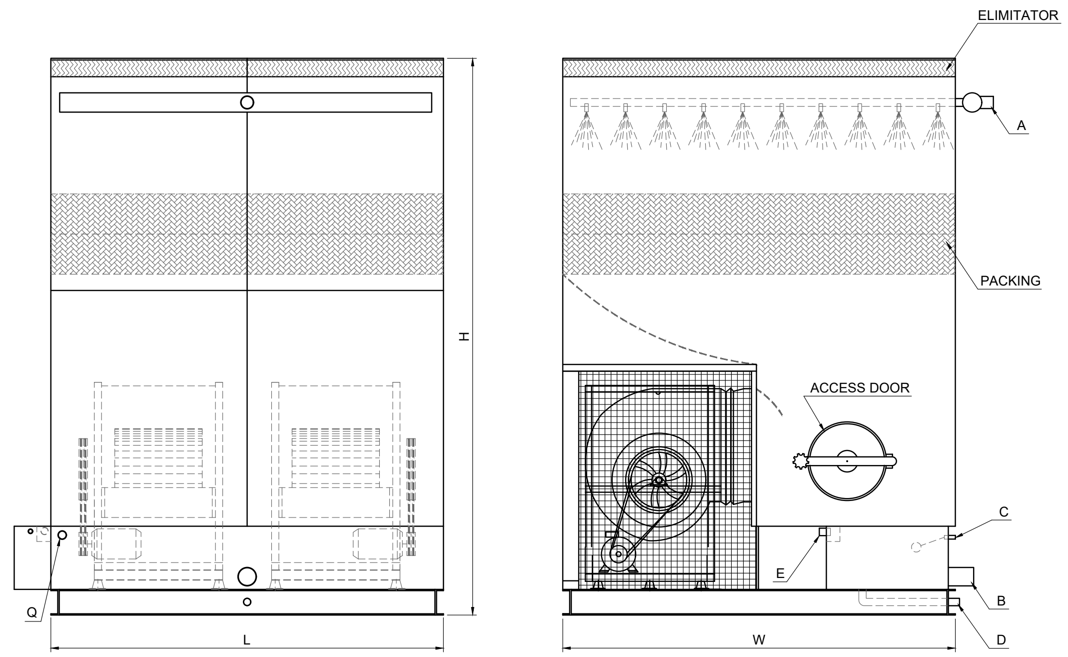
Pages 13 thru 15 indicate those paragraphs which will result in the purchase of a basic cooling tower one that accomplishes the specified thermal performance, but which will lack many operation and maintenance enhancing accessories and features that are usually desired by those persons who are responsible for the continuing operation of the system of which the cooling tower is part. It will also incorporate those standard materials which testing and experience has proven to provide acceptable longevity in normal operating conditions.

Pages 5 thru 10 provide paragraphs intended to add those features, components, and materials that will customize the cooling tower to meet the user's requirements.

Engineering Data: Schematic

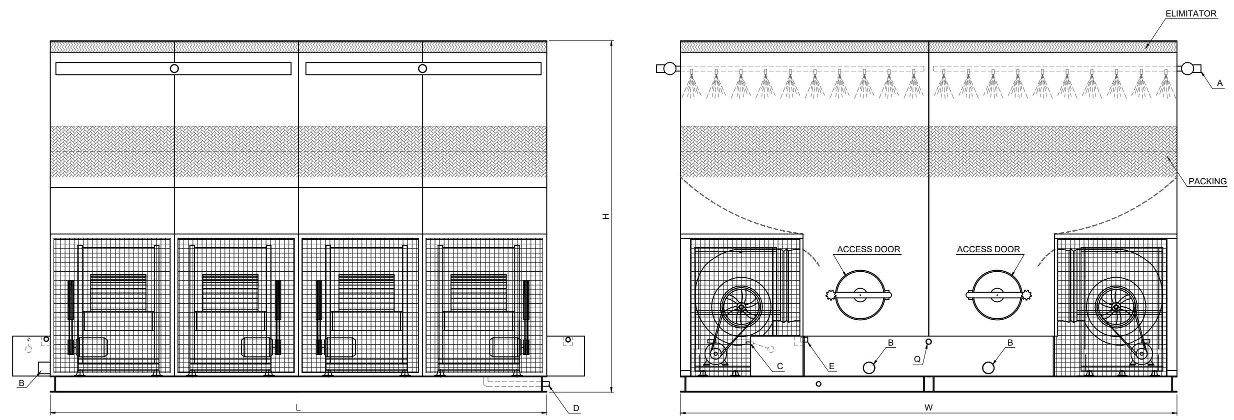
Series 1 (fan on one side)

Model 1 TCT-10 to 1 TCT-450



Series 2 (fan on both side)

Model 2 TCT-500 to 2 TCT-1200



Technical data

MODEL NO.	TONS NOM.	GPM NOM.	NOZZLE HEAD FT OF W	MOTOR NO+HP	BLOWER NO	BLOWER DIA(IN)	WEIGHT(KG) NET	WEIGHT(KG) OPER
1 TCT-10	10	30	22	1*3/4	1	15	300	360
1 TCT-15	15	45	22	1*1	1	15	330	400
1 TCT-20	20	60	22	1*1 1/2	1	15	400	480
1 TCT-25	25	75	22	1*2	1	18	480	500
1 TCT-30	30	90	22	1*2	1	18	480	520
1 TCT-35	35	105	22	1*3	1	18	600	620
1 TCT-40	40	120	22	1*3	1	18	700	800
1 TCT-50	50	150	23	1*3	1	18	800	1000
1 TCT-60	60	180	23	1*4	1	18	900	1100
1 TCT-75	75	225	23	1*5.5	1	18	1050	1200
1 TCT-90	90	270	23	1*7.5	1	18	1400	1500
1 TCT-105	105	35	23	1*7.5	2	18	1700	1950
1 TCT-120	120	360	23	1*10	2	18	1800	2300
1 TCT-140	140	420	23	1*10	2	18	1900	2400
1 TCT-160	160	480	23	1*10+1*5.5	3	18	2700	2600
1 TCT-180	180	540	23	1*10+1*5.5	3	18	2800	3600
1 TCT-200	200	600	23	1*10+1*5.5	3	18	3000	3850
1 TCT-250	250	750	23	2*10	4	18	3500	4300
1 TCT-300	300	900	23	2*10+1*5.5	5	18	4200	5000
1 TCT-350	350	1050	23	3*10	6	18	5000	6000
1 TCT-400	400	1200	23	3*10	6	18	5400	7000
1 TCT-450	450	1350	23	3*10+1*5.5	7	18	6000	7500
2 TCT-500	500	1500	23	4*10	8	18	7000	8500
2 TCT-600	600	1800	23	4*10+2*5.5	10	18	8500	9500
2 TCT-700	700	2100	23	6*10	12	18	10000	11500
2 TCT-800	800	2400	23	6*10	12	18	11500	13500
2 TCT-900	900	2700	23	6*10+2*5.5	14	18	13000	16000
2 TCT-1000	1000	3000	23	8*10	16	18	13200	18000
2 TCT-1200	1200	3600	23	10*10	20	18	16000	19000

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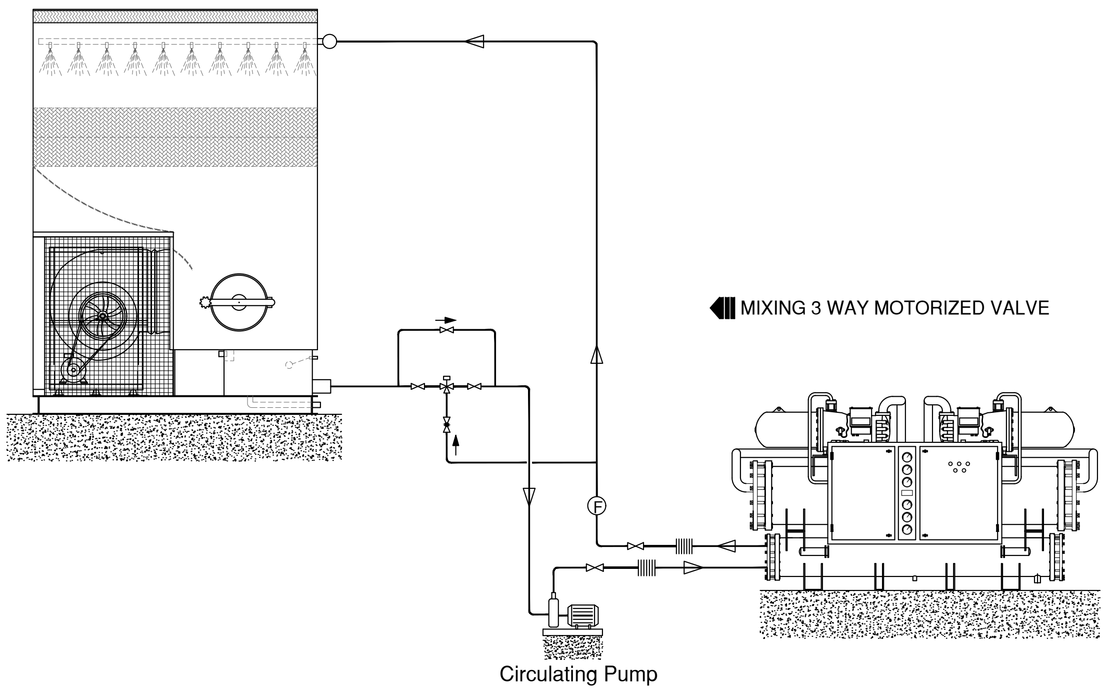
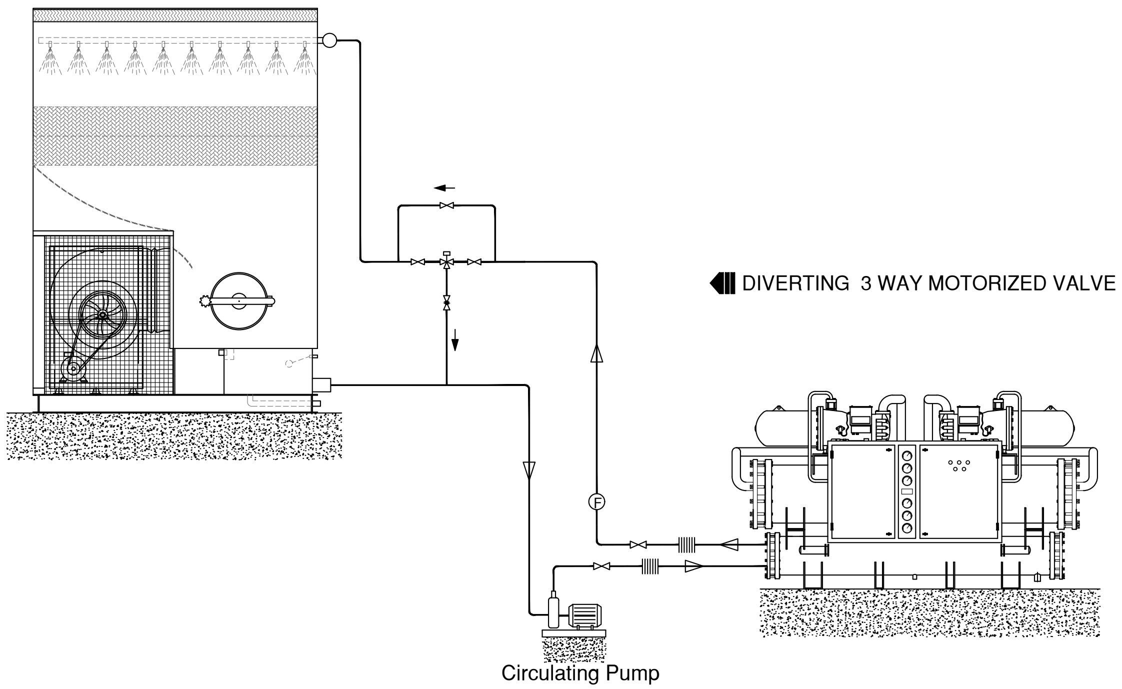
Dimensions and Connections

MODEL NO.	DIMENSIONS (mm)			CONNECTIONS (in)			
	L	W	H	NO×A	NO×B	NO×C	NO×D
1 TCT 10	500	1000	1960	1×1 1/2"	1×1 1/2"	1× 1/2"	1×3/4"
1 TCT 15	750	1000	1960	1×1 1/2"	1×1 1/2"	1× 1/2"	1×3/4"
1 TCT 20	950	1000	1960	1×2"	1×2"	1× 1/2"	1×3/4"
1 TCT 25	1250	1000	1960	1×2"	1×2"	1× 1/2"	1×3/4"
1 TCT 30	1500	1000	1960	1×3"	1×3"	1×3/4"	1×1"
1 TCT 35	1500	1000	2850	1×3"	1×3"	1×3/4"	1×1"
1 TCT 40	1500	1000	2850	1×3"	1×3"	1×3/4"	1×1"
1 TCT 50	1750	1000	2850	1×3"	1×3"	1×3/4"	1×1"
1 TCT 60	2000	1000	2850	1×3"	1×4"	1×3/4"	1×1"
1 TCT 75	1200	2000	2850	1×3"	1×4"	1×1"	1×1"
1 TCT 90	1750	2000	2850	2×3"	1×4"	1×1"	1×1"
1 TCT 105	1900	2000	2850	3×3"	1×4"	1×1"	1×1"
1 TCT 120	1950	2000	2850	3×3"	1×5"	1×1"	1×1"
1 TCT 140	2150	2000	2850	4×3"	1×5"	1×1"	1×1"
1 TCT 160	2950	2000	2850	4×3"	2×4"	2×1"	2×1"
1 TCT 180	3000	2000	2850	5×3"	2×4"	2×1"	2×1"
1 TCT 200	3350	2000	2850	5×3"	3×4"	2×1"	3×1"
1 TCT 250	3950	2000	2850	6×3"	3×4"	2×1"	3×1"
1 TCT 300	4950	2000	2850	7×3"	3×5"	2×1"	3×1"
1 TCT 350	5950	2000	2850	8×3"	3×5"	2×1"	3×1"
1 TCT 400	6800	2000	2850	10×3"	4×5"	2×1"	4×1"
1 TCT 450	7400	2000	2850	12×3"	4×5"	2×1"	4×1"
2 TCT-500	4000	3800	2850	12×3"	4×5"	4×1"	4×1"
2 TCT-600	5000	3800	2850	14×3"	4×5"	4×1"	4×1"
2 TCT-700	6000	3800	2850	16×3"	4×5"	4×1"	4×1"
2 TCT-800	6800	3800	2850	18×3"	6×5"	4×1"	6×1,1/2"
2 TCT-900	7500	3800	2850	22×3"	6×5"	4×1"	6×1,1/2"
2 TCT-1000	8000	3800	2850	24×3"	6×5"	4×1"	6×1,1/2"
2 TCT-1200	10000	3800	2850	28×3"	6×5"	4×1"	6×1,1/2"

Piping Diagram





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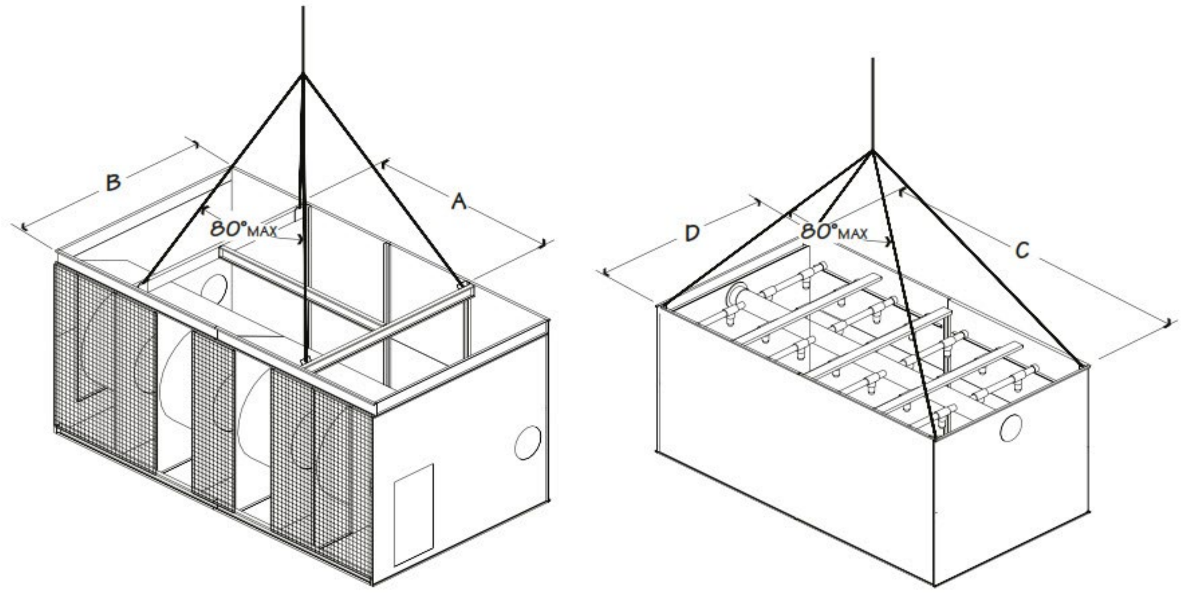
Engineering Data: Hoisting



1 Hoisting operations can be dangerous and suitable safety precautions should be taken to protect personnel and the equipment being hoisted.

2 All hoisting equipment should be certified and comply with local and national safety regulations.

3 Ensure that slings are of sufficient length so not to impose bending loads onto the casing use of spreader bars is essential.

4 For overhead lifts or where additional safety is required, add slings beneath the tower unit

INDOOR STORAGE TANK

With this type of system, water flows from an indoor tank, through the load system, and back to the tower, where it is cooled. The cooled water flows by gravity from the tower to the tank located in a heated space. At shutdown, all exposed water drains into the tank, where it is safe from freezing.

The amount of water needed to successfully operate the system depends on the tower size and m3/hr and on the volume of water contained in the piping system to and from the tower. You must select a tank large enough to contain those combined volumes plus a level sufficient to maintain a flooded suction on your pump. Control makeup water according to the level where the tank stabilizes during operation.

Engineering Data: Water Quality

The TFDC cooling tower can be a very effective air washer. Atmospheric dust able to pass through the relatively small louver openings will enter the recirculating water system. Increased concentrations can intensify systems maintenance by clogging screens and strainers and smaller particulates can coat system heat transfer surfaces. In areas of low flow velocity such as the collection basin sedimentary deposits can provide a breeding ground for bacteria. In areas prone to dust and sedimentation, you should consider installing some means for keeping the collection basin clean. Typical devices include side stream filters and a variety of filtration media.

BLOW DOWN

Blow down or Bleed off is the continuous removal of a small portion of the water from the open recirculating system. Blow down is used to prevent the dissolved solids from concentrating to the point where they will form scale. The amount of blow down required depends on the cooling range the difference between the hot and cold water temperatures of the closed circuit and the composition of the makeup water.

WATER TREATMENT

To control the buildup of dissolved solids resulting from water evaporation, as well as airborne impurities and biological contaminants including Legionella, an effective consistent water treatment program is required. Simple blow down may be adequate to control corrosion and scale, but biological contamination can only be controlled with biocides.

An acceptable water treatment program must be compatible with the variety of materials incorporated in a cooling tower ideally the PH of the recirculating water should fall between 6.5 and 9.0. Batch feeding of the chemicals directly into the cooling tower is not a good practice since localized damage to the cooling tower is possible.

Specifications: Base

• Your specification base establishes the type, configuration, base material, and physical limitations of the cooling tower to be quoted. During the planning and layout stages of your project, you will have focused your attention on a cooling tower selection that fits your space allotment, and whose power usage is acceptable. Limitations on physical size and total operating kW avoid the introduction of unforeseen operational and site-related influences. Specifying the number of cells, and the maximum fan kW/cell will work to your advantage.

The benefit of a forced-draft counterflow cooling tower is that they are inherently easy to operate, access, and maintain. Forced--draft counterflow towers have all mechanical equipment located at low level for easy access, and the water distribution system is accessible by simply removing the lightweight drift eliminator panels or fill access doors.

• The indicated design values are the minimum allowables under accepted design standards. They give you assurance that cooling tower can be shipped, handled, hoisted and ultimately operated in a normal cooling tower environment. Most TFDC Series models will withstand significantly higher wind and seismic loads. If your geographic location dictates higher wind load or seismic load values, please make the appropriate changes, after discussion with your Toufan tahvieh sales representative.

• In the history of cooling towers, no other coating for carbon steel has exhibited the success and longevity of galvanization in exposure to the normal cooling tower water quality defined at left. No paints or electrostatically-applied coatings, however exotic they may be, can approach galvanization's history of success. If extended longevity of the cooling tower is required or unusually harsh operating conditions are expected consider specifying stainless steel as either the base construction material, or the material utilized for specific components of your choice. See Stainless Steel Options on page 21

• The Toufan Tahvieh drive system features all-aluminum sheaves (pulleys), power band belts, and long-life bearings for dependable service. To reduce cost, some manufacturers may use Motogen or Siemens motors, whose only source of cooling is the flow of air produced by the cooling tower fan. They are sometimes applied at kWs significantly beyond their nameplate rating.

Unless otherwise specified, motor speed will be 1400 RPM, 50 Hertz on standard models. If you prefer the operating flexibility of two--speed operation, please specify two-speed, single-winding motors which offer full and half speeds for maximum energy savings. Incidentally, two speed motors are a far better choice than separate “pony” motors which simply double the problems indicated above.

The value of a 2 year mechanical equipment warranty speaks for itself.

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• Fill modules can be removed for inspection and cleaning in accordance with local anti--legionella guidelines.

Drift rate varies with design water loading and air rate, as well as drift eliminator depth and number of directional changes. A drift rate of 0.001% is readily available in standard configuration without premium cost. If a lower rate is required, please discuss with your Toufan Tahvieh sales representative.

•The combination of PVC piping and polypropylene nozzles is very resistant to the build-up of scale and slime.

• The TFDC tower design offers side-suction as standard. Bottom outlets may be supplied to accommodate a variety of piping schemes. Unless so specified, the tower you may be asked to approve may only be available with one type of suction connection requiring you to redesign your piping layout. The sloping floor and low-level drain is valuable because it provides a way to achieve flush-out cleanability.

Specifications: Options

• The cold water basin is the only part of the tower that is subject to periods of stagnant water, concentrated with treatment chemicals and customary contaminants. It is also the most expensive and difficult part of any tower to repair or replace. For these reasons, many customers particularly those who are replacing older towers choose to specify stainless steel cold water basins.

• For pure resistance to corrosion coupled with the capability to meet stringent fire and building codes there is no substitute for stainless steel. No paints or electrostatically-applied coatings, however exotic they may be, can match stainless steel's ability to withstand adverse operating conditions.

• Periodic inspection and maintenance of a cooling tower distribution system is fundamental to preserving maximum cooling system efficiency. All cooling towers crossflow or counterflow are subject to clogging to varying degrees by waterborne contaminants such as pipe scale and sediment. Therefore, safe and easy access to these components is of significant value to the operator. Access can be provided in a number of ways; including portable ladders or scaffolding, but for maximum safety and convenience, a field installed Toufan Tahvieh access platform with guardrails is available to make this task as safe and user friendly as possible. Further, its location on the side of the tower does not add to the height of the unit, preserving architectural integrity. It also saves the owner time and money, in that maintenance personnel may devote their time to inspection rather than searching for ladders or erection of portable scaffolding.

• Many cooling towers are installed such that the base of the unit is 600mm or more above the roof or grade level. This makes it difficult to get up to the foot of the attached ladder. The ladder extension alleviates this problem. Marley ladder extensions are available in standard 1524mm and 3353mm lengths.

• Where cooling towers are installed on an elevated grillage or piers, it is often difficult to get to and through the access door conveniently. This platform provides easy, safe, and comfortable access to that door.

• This platform provides easy, safe and comfortable access to the access door facilitating inspection of the fill, distribution nozzles and the underside of the drift eliminators

• Toufan Tahvieh VFD drive systems are designed to combine absolute temperature control with ideal energy management. The cooling tower user selects a cold water temperature and the drive system will vary the fan speed to maintain that temperature. Precise temperature control is accomplished with far less stress to the mechanical equipment components. The improved energy management provides fast payback.

• Sound produced by a standard MCW Series tower operating in an unobstructed environment will meet all but the most restrictive noise limitations and will react favorably to natural attenuation. Where the tower has been sized to operate within an enclosure, the enclosure itself will have a damping effect on sound. Sound also declines with distance by about 5 or 6 dB(A) each time the distance doubles. Where noise at a critical point is likely to exceed an acceptable limit, you have several options listed below in ascending order of cost impact:

• Where only a slight reduction in noise will satisfy and the source of concern is in a particular direction merely turning the tower may be the answer. Less sound emanates from the cased face of the tower than does from the air intake face.

• In many cases, noise concerns are limited to night time, when ambient noise levels are lower and neighbors are trying to sleep. You can usually resolve these situations by using two speed motors in either full / half speed or full/ 2/3 speed configuration, and operating the fans at reduced speed without cycling “after hours”. (The natural night time reduction in wet-bulb temperature makes this a very feasible solution in most areas of the world, but the need to avoid cycling may cause the cold water temperature to vary significantly.)

• Variable speed drives automatically minimize the tower’s noise level during periods of reduced load and/or reduced ambient without sacrificing the system’s ability to maintain a constant cold water temperature. This is a relatively inexpensive solution, and can pay for itself quickly in reduced energy costs.

• Where noise is a concern at all times (for example, near a hospital), the best solution is to oversize the tower so it can operate continuously at reduced (2/3 or 1/2) motor speed even at the highest design wet bulb temperature. Typical sound reductions are 7 dB(A) at 2/3 fan speed or 10 dB(A) at 1/2 fan speed, but larger reductions are often possible.

• The most extreme cases may require inlet and discharge sound attenuator sections however, the static pressure loss imposed by discharge attenuators may necessitate an increase in tower size. Two stages of inlet or discharge attenuators supported by the tower and designed and tested for the most stringent requirements are available as an option. See page 20

The advantage is yours. You now have the choices you need to balance your project’s performance, space and cost requirements with your sound level needs for a win-win solution to your cooling system design. Your Marley sales representative will be able to help you meet you sound requirements.

• Where a tower is installed in a building well or there is high surrounding walls it is possible that a proportion of the hot and humid discharge air will be drawn back into the fans thus increasing the inlet wet bulb temperature with detriment to the tower performance.

The tapered discharge duct is intended to increase the exit velocity by up to 70% in order to reduce the effects of recirculation in some installations. Experience and sound judgment should be exercised to determine when and if a duct is required.

If the surrounding walls are much higher than the tower discharge height then extensions to the tapered duct may be installed.

Design Loading:

The tower and its components shall be designed to withstand a wind load of 1.44 kPa as well as .3g seismic load. The cooling tower shall be designed to withstand shipping and hoisting loads of 2g horizontal or 3g vertical.

Handrails, where specified shall be capable of withstanding a 890 N concentrated live load in any direction and shall be designed in accordance with OSHA guidelines.

Construction:

Except where otherwise specified, all components of the cooling tower shall be fabricated of heavy-gauge steel, protected against corrosion by Z725 galvanizing. After passivation of the galvanized steel (8 weeks at pH 7-8, and calcium hardness and alkalinity at mg/L each), the cooling tower shall be capable of withstanding water having a pH of 6.5 to 9.0; a chloride content up to 500 mg/L as NaCl (300 mg/L as Cl-); a sulfate content (as SO_4) up to 200 mg/L; a calcium content (as $CaCO_3$) up to 500 mg/L; silica (as SiO_2) up to 150 mg/L; and design operating ranges up to 10°C The circulating water shall contain no oil, grease, fatty acids, or organic solvents. The specifications, as written, are intended to indicate those materials that will be capable of withstanding the above water quality in continuing service. They are to be regard-ed as minimum requirements. Where component materials unique to individual tower designs are not specified, the manufacturers shall take the above water quality and load carrying capabilities into account in the selection of their materials of manufacture.

Mechanical Equipment:

Fan(s) shall be forward curved centrifugal-type, which are statically and dynamically balanced. The fan impeller is manufactured from galvanized steel, blades are riveted to the center plate and inlet rings and have stay rods to ensure maximum concentricity and rigidity. The stay rods are adjusted by the manufacturer during the balancing operation and require no field adjustment. Fan(s) shall be driven through one-piece, multi-groove, V-belt, pulleys, and spherical roller bearings. Bearings shall be rated at an L10 life of 50,000 hours, or greater. A hinged motor adjustment plate with threaded tensioning bolts shall be installed to allow correct belt tensioning.

The complete mechanical equipment assembly for each cell shall be supported by a rigid, galvanized steel structural support that resists misalignment between the motor and sheaves. The mechanical equipment assembly shall be warranted against any failure caused by defects in materials and

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workmanship for no less than five (5) years following the date of tower shipment. This warranty is limited to the fan, fan shaft, bearings, sheaves and mechanical equipment support. The motor, motor components and belt(s) are warranted by their manufacturer.

Fill and Drift Eliminators:

Fill shall be cross-corrugated, counterflow film type, thermoformed from .38mm thick PVC. Fill shall be assembled into modules for ease of removal and cleaning. Fill shall be supported on galvanized channel sections supported from the tower structure. Drift eliminators shall be PVC, triple pass and shall limit drift losses to 0.005% or less of the design water flow rate.

Hot Water Distribution System:

A pressured spray system shall distribute water evenly over the fill. Header and branch arms shall be PVC with polypropylene spray nozzles attached to the branch arms by an integral screw connection for ease of removal and cleaning. A flanged connection on the header shall be provided for attachment to process piping.

Casing:

The casing shall be heavy- gauge heavy-mill galvanized steel and shall be capable of withstanding

Access:

A large galvanized, rectangular access door shall be located on both end panels for entry into the cold water basin. Rectangular panels are shall be provided for access to the fan plenum area to facilitate inspection and allow maintenance to the fan drive system

Cold Water Collection Basin:

The collection basin shall be heavy gauge galvanized steel and shall include the number and type of suction connections required to accommodate the out-flow piping system shown on the plans. Suction connections shall be equipped with debris screens. A factory installed, float operated, mechanical make-up valve shall be included. An overflow and drain connection shall be provided in each cell of the tower. The basin floor shall slope toward the drain to allow complete flush out of debris and silt which may accumulate.

Warranty:

The TFDC cooling tower shall be free from defects in materials and workmanship for a period of twelve (12) from date of initial use or eighteen (18) months from the date of delivery, whichever comes first.