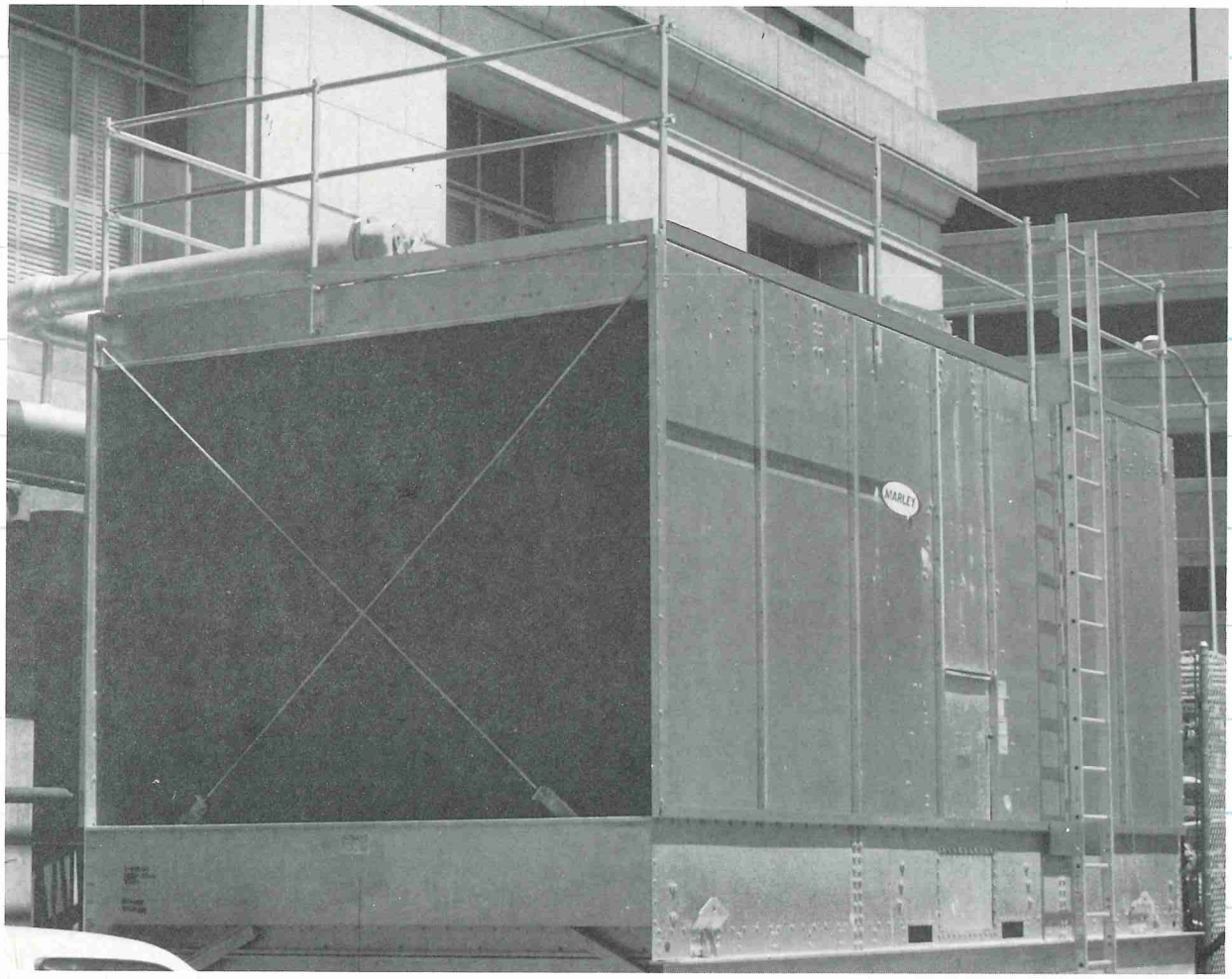
Series NC®



MARLEY®

Factory Mutual System

Approval Available

CTI

Founding Member

Heavy Duty Cooling Towers for HVAC and Industrial Service

The Marley Difference

You'll enjoy single source responsibility and reliability because we design and manufacture virtually all major cooling tower components.

All Marley components are designed and selected to be part of an ***integrated system***. For example, the spray pattern from nozzles and the pressure drop through drift eliminators both affect a fill's heat transfer capacity. So, we include that impact in our thermal analysis.

Drift eliminators must be effective at the air velocities where fill is most efficient. So, we've carefully designed both components to work together efficiently.

How many other cooling tower companies can offer you this assurance? They may use Brand "A" nozzles with Brand "B" fill and Brand "C" drift eliminators. When they all come together, the whole may be less than the sum of the parts.

Our ***total system*** approach assures that ***all the parts work together*** to provide you the greatest total performance.

And because we design specifically for cooling towers, all our components will provide many years of service with minimal maintenance.

The Marley Cooling Tower Company Five-Year Limited Warranty

The Marley Cooling Tower Company warrants that the Mechanical Equipment, which includes the fan(s), gearbox(es), driveshaft(s), coupling(s), and torque tube(s) or mechanical equipment support(s), [but excluding the motor(s) which is warranted by its manufacturer, and all motor components] sold will be free from all defects in materials and workmanship for a period of five years from the date of shipment by Marley to the original installation. The obligation under this warranty is limited to the repair or the replacement of defective materials, at Marley's option, F.O.B. original shipping point. Warranty on repaired or replaced Equipment will be for the time remaining under the terms of the original warranty. This warranty is not transferable.

This warranty does not obligate Marley to bear the cost of labor, transportation charges, or other costs incurred in connection with the repair or replacement of defective parts; nor does this warranty apply to normal wear and tear nor to damage resulting from operation not conforming with Marley's operation and maintenance instructions, accident, alteration, misuse, or an abnormally corrosive or abrasive use environment.

This warranty applies only to the Marley Series NC, Series NC Modular, Compac II®, QuadraFlow®, Series 10, Series 15, Series 100/120 Sigma, and the Masonry Shell (MS) cooling tower product lines.

MARLEY SHALL NOT BE LIABLE FOR DAMAGES TO OR LOSS OF OTHER PROPERTY OR EQUIPMENT, OR ANY SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RESULTING FROM THE FAILURE OF THE MECHANICAL EQUIPMENT TO COMPLY WITH CONTRACT OF SALE, BREACH OF THE ABOVE WARRANTY, OR THE BREACH OF ANY EXPRESS OR IMPLIED WARRANTIES ARISING UNDER APPLICABLE LAW, NEGLIGENCE, OR OTHERWISE.

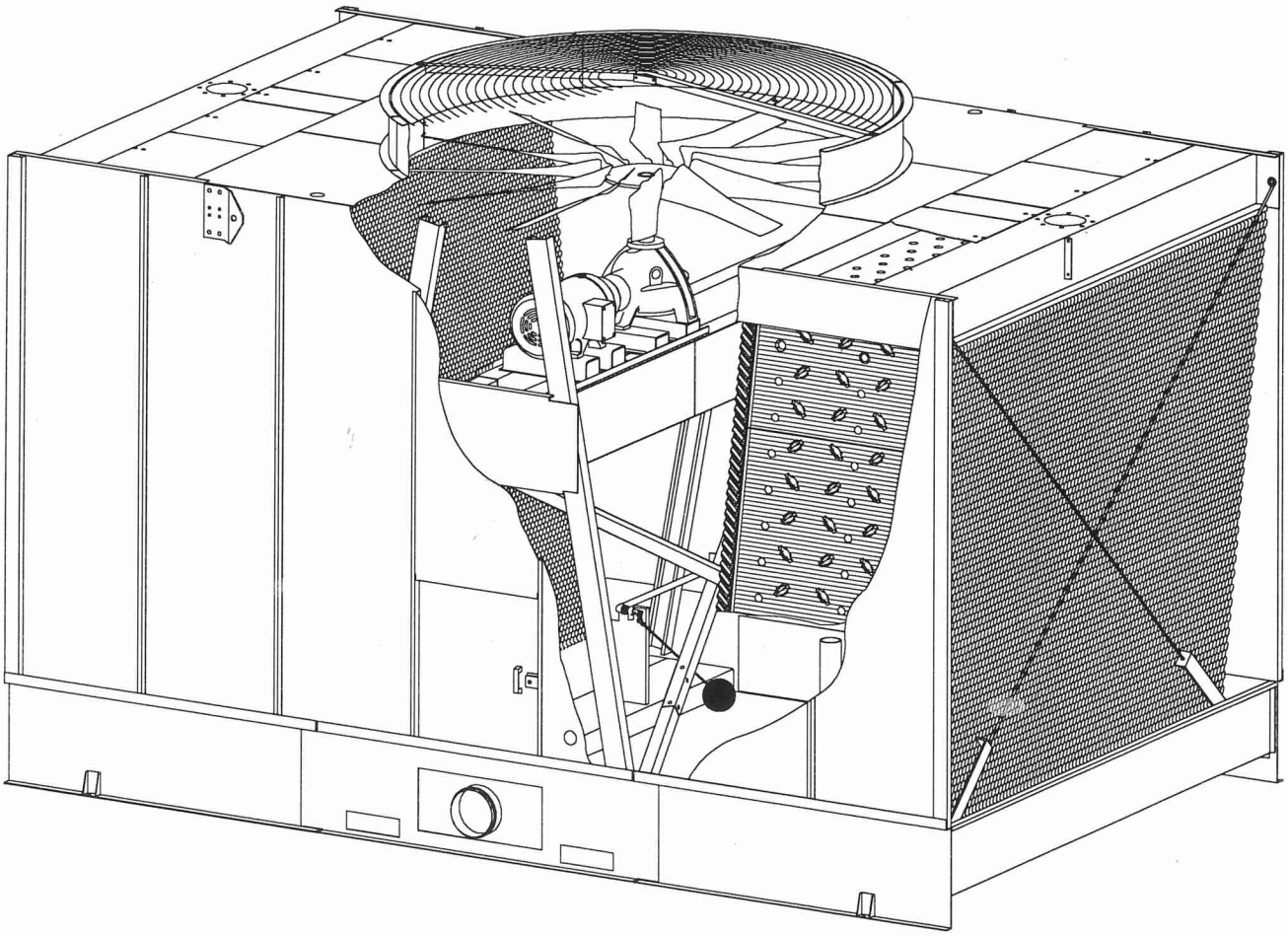
THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED ON THE MECHANICAL EQUIPMENT, AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED AND EXCLUDED FROM THIS AGREEMENT.

MARLEY®

The Marley Cooling Tower Company
5800 Foxridge Drive • Mission, Kansas 66202
913/362-1818

APWARR-3

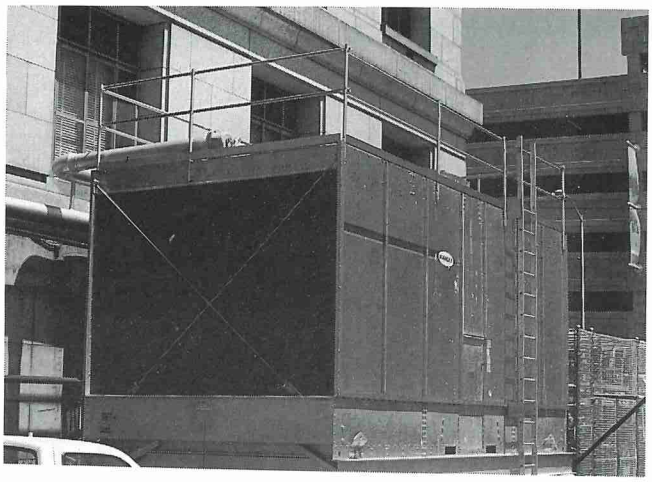
Series NC Advantages

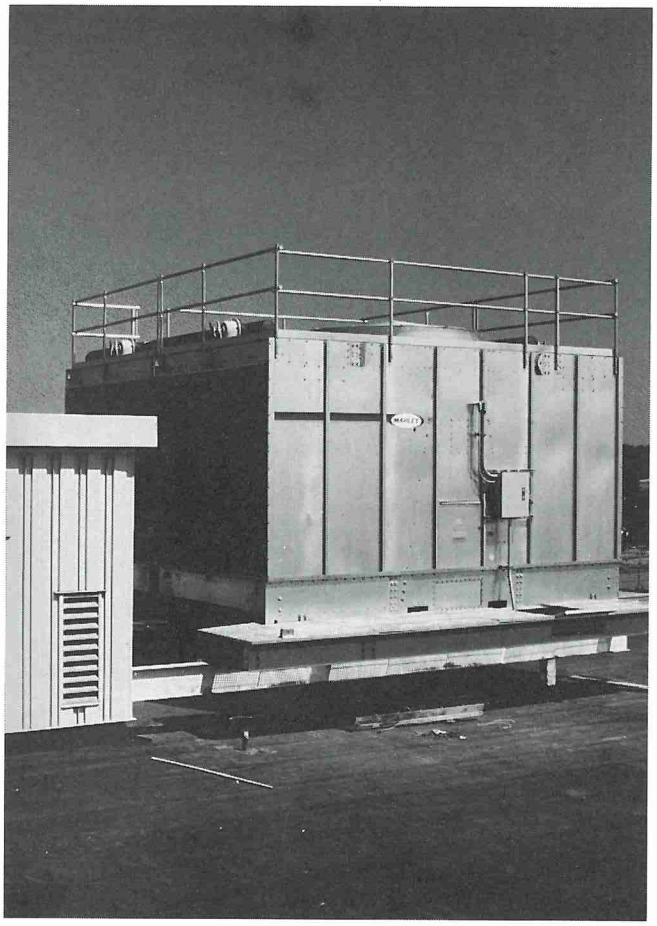


1. **Guaranteed Performance.** Don't rely on outside agencies with limited enforcement powers. We'll stand by our responsibility for reliable thermal performance. We designed it. We rate it. *We guarantee it!*
2. **Exclusive 5-Year Mechanical Equipment Warranty.** Your no-cost assurance of trouble-free mechanical operation for 5 years. Isn't that where a lot of your tower maintenance dollars have gone in the past? (See the certificate on page 4.)
3. **Low Operating Costs.** Marley's high-efficiency fill and fans, gravity-flow water distribution, and efficient Geareducer® drive work together to offer maximum cooling with minimum power use.
4. **Low Maintenance Costs.** Induced-draft propeller fans on Marley right-angle Geareducers; TEFC, 1.15 service factor motors; and heavy-duty mechanical equipment supports assure long service life with minimum maintenance.
5. **All-Season Reliability.** Series NC towers perform as specified in the heat of summer. They respond well to energy management techniques in the spring and fall. They operate virtually ice-free in the dead of winter. And they offer simple maintenance all year long. *We guarantee it!*
6. **Proven Corrosion Protection.** Thousands of users over more than 30 years confirm the value of heavy galvanizing. And Marley's G-210 is the most effective galvanizing used in the industry. For especially tough applications, you can choose either all stainless steel construction or galvanized tower on a stainless cold water basin.
7. **Single Source Parts Availability.** Marley designs, manufactures, guarantees, and stocks all major components of the tower except motors. (In fact, we stock a number of motors, too.) We'll have the parts if you ever need them.
8. **Select Your Tower From This Bulletin.** You can use the charts on pages 12 through 15 for almost all your needs. If available space is a problem, or if you run into some unusual operating requirements, we'll be glad to help.
9. **No Hidden Rigging or On-site Labor Costs.** Just mount the fan cylinder extension and fan guard, and adjust the float valve. Your Series NC tower is ready for operation.

Typical Installations

The Series NC is an excellent all-round performer. Its induced draft crossflow design simplifies siting and maintenance access. As the successor to the proven (and often-imitated) NC tower line, the Series NC represents a logical step forward in cooling tower technology. Each Series NC tower benefits from all the knowledge and experience Marley has compiled from manufacturing cooling products for industry since 1922. These installations show you a few of the ways the Series NC can fit neatly into your plans.

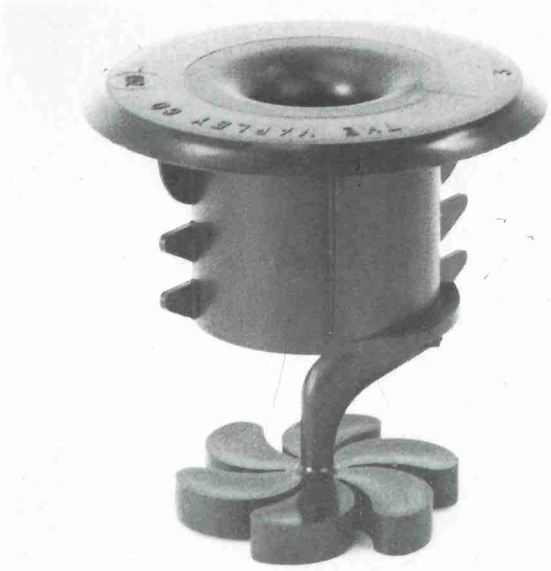




Construction and Components

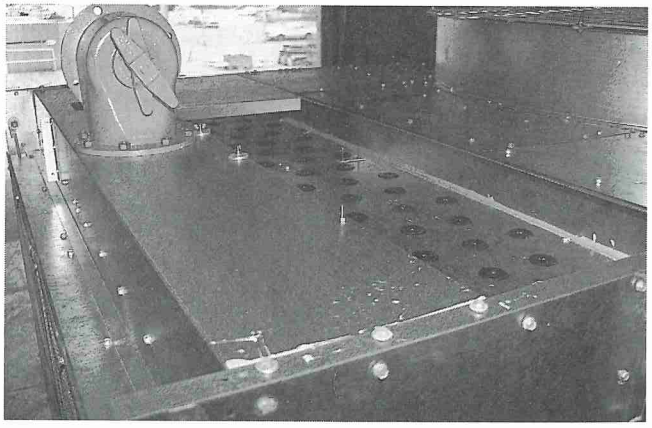
Water Distribution System

Warm water flows through external piping (not included with the tower) into a baffled flume at the top of the tower. This covered chamber provides uniform water distribution and keeps the incoming water in the distribution basin. Water then flows by gravity through patented Marley polypropylene "Target" nozzles to the fill. Nozzles are easily removable and replaceable.



The gravity-flow distribution system designed into the Series NC essentially reduces pump head to its most basic component – static lift – saving you money on pump power.

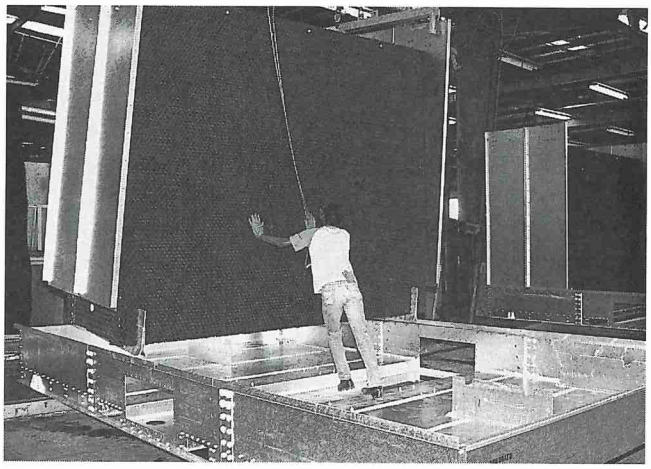
Inlet connections for your piping (two inlets per cell) are standard 125# holes and bolt circles, as shown on pages 16 and 18. Hot water basins are factory-installed. Hot water basin covers are standard to keep basins free from airborne debris and to reduce the likelihood of biological growth.



Fill/Louvers/Drift Eliminators

Fill sheets include both louvers and drift eliminators. The louvers in this patented arrangement prevent water from escaping the fill sheets and assure proper heat transfer throughout wide variations in airflow. Thousands of users over nearly fifteen years have found that this fill operates virtually ice-free even in extremely cold weather.

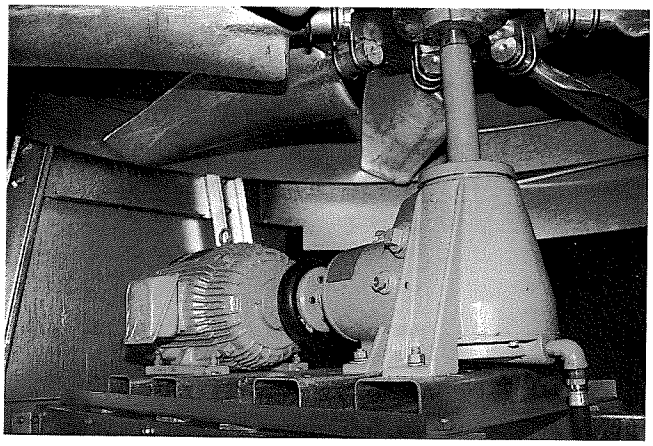
Integral drift eliminators prevent the costly nuisance of drift spotting on objects in the surrounding environment. Their unique shape induces the air flow through three distinct direction changes. The final turn directs air toward the fan to save you fan horsepower. Moisture carried in the air stream can't make these abrupt turns, so drift is less than 0.005% of the circulating water flow rate.



The vacuum formed 15 mil (.015") thick PVC fill sheets withstand hot water temperatures as high as 125°F. Their shape minimizes resistance to airflow to save on fan horsepower. The PVC sheet material used in Series NC fill minimizes your risk of loss from fire damage. Maximum flame spread rating on this fill is 5 per ASTM E-84 and is considered self-extinguishing per ASTM D-88.

Hot dip galvanized steel structural tubes support and stabilize the fill. They also hold the bottom of the fill sheets nominally 2" above the cold water basin floor to simplify basin cleaning.

Chemically and biologically inert, PVC film-type fill provides long service life and exceptional heat transfer efficiency. The self-spacing sheets used in Series NC towers will retain their shape – and their efficiency – throughout the life of your project. For those rare applications where contaminants in the circulating water may pose a threat to plugging film-type fill, Marley offers several alternatives described on page 23.

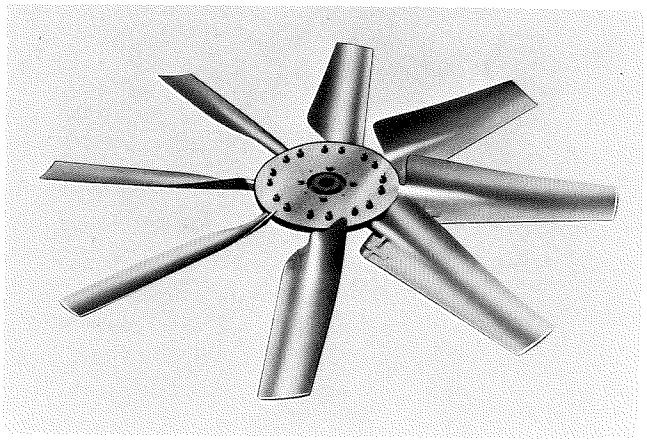


Mechanical Equipment

Marley provides a 5-year warranty against failure of any mechanical equipment component of the fan drive system, except the motor. The Marley Series 10T, 20T and 22.2 Geareducers used in the Series NC have a long record of dependability, long service life, and low maintenance cost. Each Geareducer is equipped with a close-coupled oil level sight glass.

The Geareducer is coupled to a 1.15 service factor, TEFC motor by a Sof-Tork coupling which protects both the motor and the Geareducer against the sudden shock loads that occur in starting and changing speeds. Heavy-gauge galvanized steel members support the Geareducer, fan and motor, maintaining correct alignment throughout the drive train.

At your option, the motor may be mounted outside the airstream. See pages 8 and 9 for description.

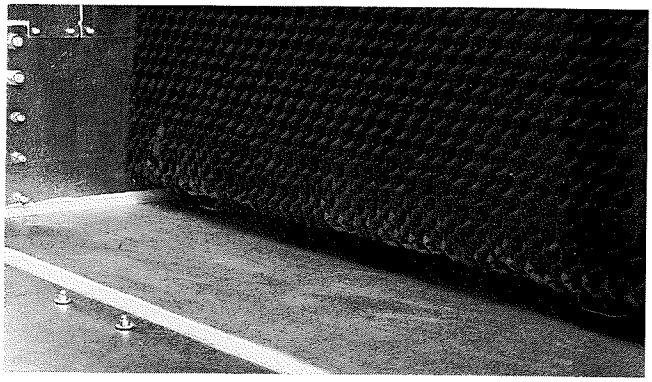


The Marley type H-3 fans used in the Series NC are equipped with cast aluminum blades. Blades are adjustable in pitch, permitting maximum utilization of rated horsepower, or allowing field adjustment to compensate for unusual jobsite restrictions. Marley fans don't require costly accessories for pitch adjustment, as many other manufacturers do.

Marley manufactures all the mechanical equipment components (except the motor) in our own plants. So, service parts are readily available from a single source.

Cold Water Basin

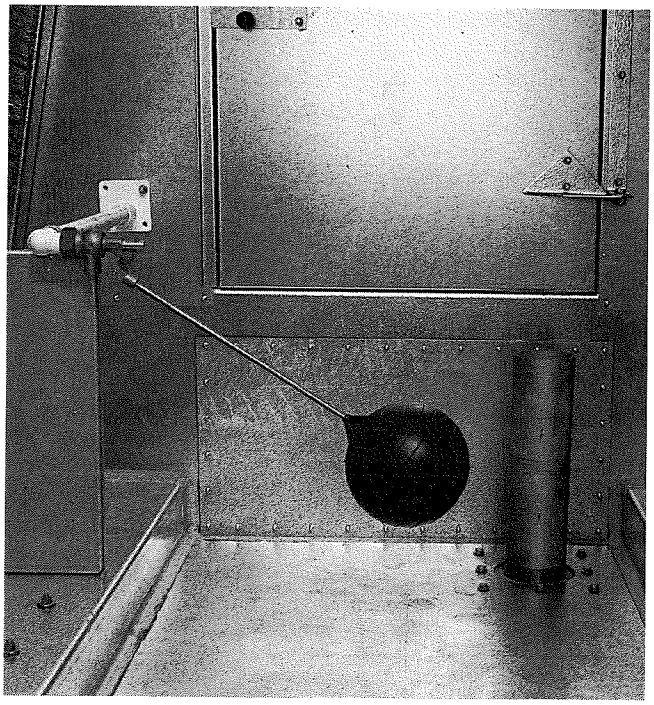
The Series NC cold water basin floor is elevated under the fill areas to minimize operating weight, to facilitate cleanliness and to maintain active water flow into the basin's depressed section. Each basin is fully factory-assembled and sealed.



The standard suction connection on single-cell towers is a pipe located on the side of the basin. The suction is both beveled for welding and grooved for a mechanical coupling. Please refer to page 21 for sizes and capacities of optional alternate outflow locations and configurations.

Standard equipment on each tower basin includes: a removable suction screen; a 4" diameter standpipe overflow which is removable for flush-out basin cleaning; a float-operated make-up valve; and a threaded fitting for wastewater piping. (If your tower will be supported on a flat slab, specify the optional side drain and overflow shown on page 21.)

Optional heaters prevent freezing of any water remaining in the basin at shutdown. See pages 10 and 11 for more complete information.



Construction and Finish

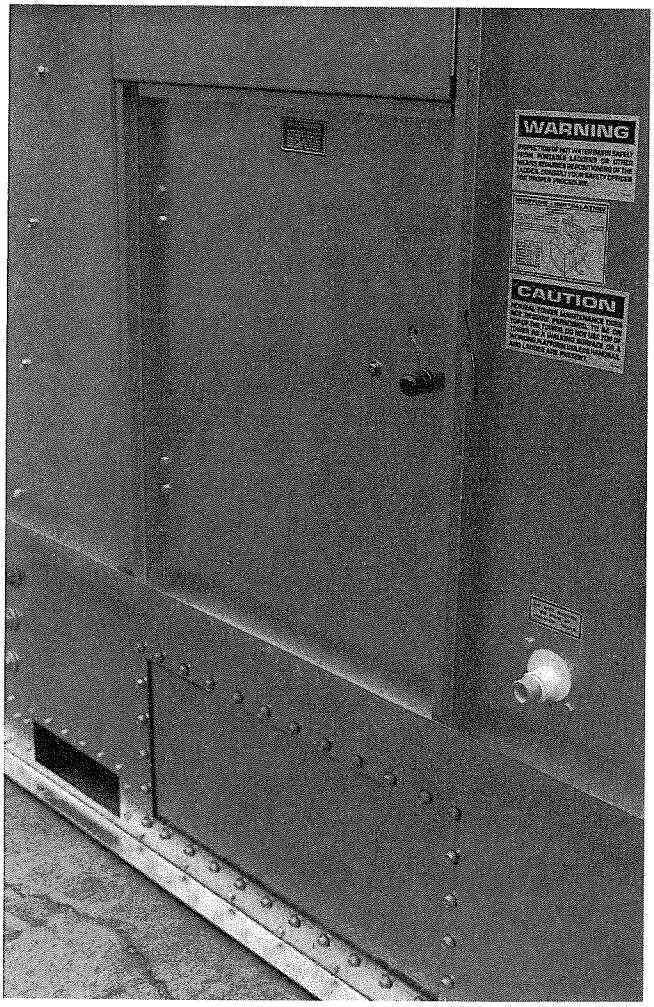
Series NC towers offer the corrosion protection of G-210 galvanized steel. Heavy mill galvanizing applied at the rate of 2.5 ounces per square foot (1.9 mils nominal thickness) provides long term protection for the steel.

Marley's standard galvanizing even meets the U.S. Navy requirement for salt fog testing in accordance with ASTM B-117. This proven corrosion protection is a major reason for Marley's reputation for reliable, long-lasting cooling towers.

You can also choose optional stainless steel construction – either throughout the tower or in the cold water basin only – for those jobs where particularly severe conditions or personal preference demand the ultimate in corrosion resistance. Consult your Marley application engineer for additional guidance. (See page 9.)

Hoisting and Handling

Four (4) heavy-gauge hoisting clips let you hoist the tower either by crane or by helicopter and provide easy accessibility and maximum stability during hoisting operations. You should use a spreader bar, equal in span to the overall width of the tower, to prevent stress damage. Caution decals, similar to the illustration on page 11, are located on both access doors of every tower.

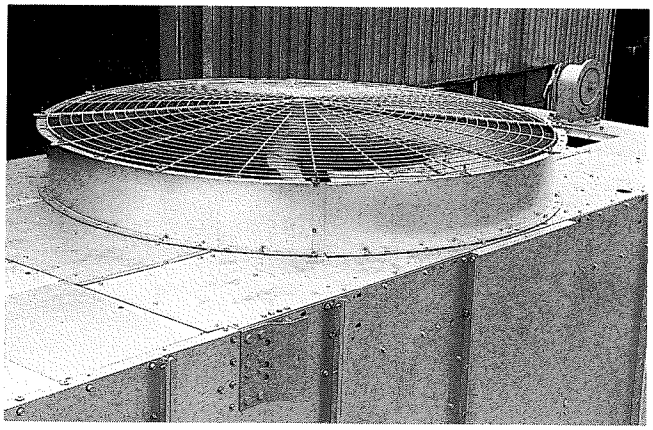


All towers also have forklifting slots in the side of the cold water basin to facilitate unloading and grade-level movement.

Casing, Access and Safety

Heavy gauge steel casing sheets are attached vertically and sealed watertight. All towers are equipped with a hinged access door in each endwall – operable from both the interior and exterior of the tower. This precludes the need for specially-designed doors on multi-cell towers.

Hinged doors in each casing wall permit access to and through the interior of the tower. All mechanical equipment is accessible both from the interior of the tower and through the removable galvanized fan guard.

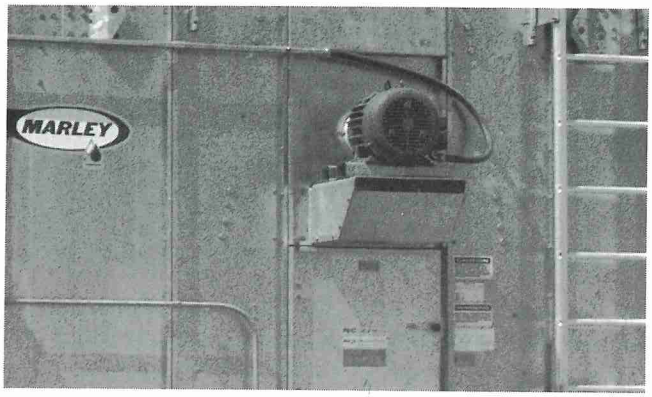


Several optional accessories are available to further enhance your maintenance access. Many of these items are safety related. You can use the information that appears on page 9 to help you decide which ones are appropriate for your particular project, and to help you specify the options you choose. You can also purchase any of the listed accessories later for retro-fitting to the tower.

We've designed the Series NC so that it's easy to maintain and safe to work on. We also provide drawings and operating / maintenance manuals with every tower; offering routine maintenance instructions to help you get the most from your tower.

However, since your installation will be unique to your job site, we rely on you to provide adequate access and safety devices around the area of the tower. When you select optional safety-related items for your tower, be sure to take into account any unique siting concerns (such as raised supporting steel which will require some means of approach to the tower's access door) or special maintenance procedures. Also, be sure to consult appropriate Marley sales drawings before designing the details of your tower's location and access. Your local Marley application engineer will be glad to help.

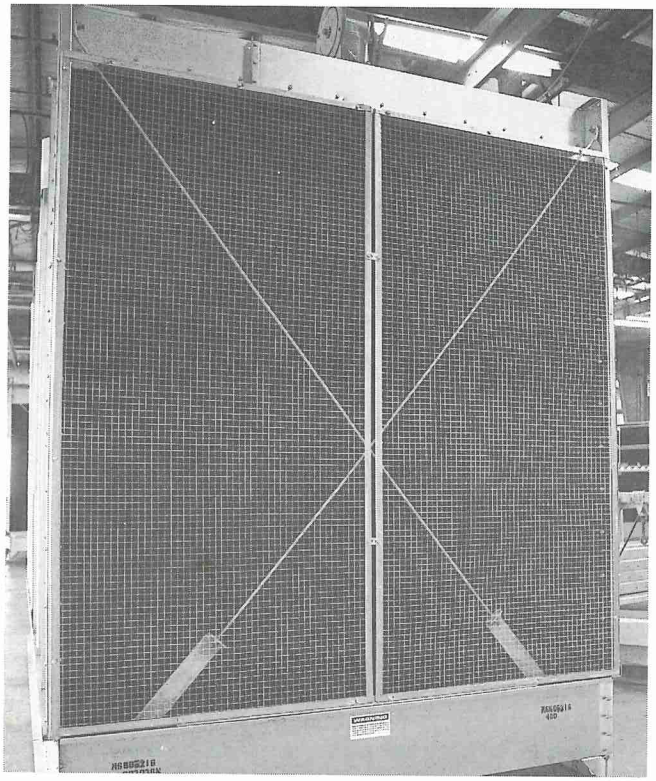
Available Optional Accessories (At Extra Cost)



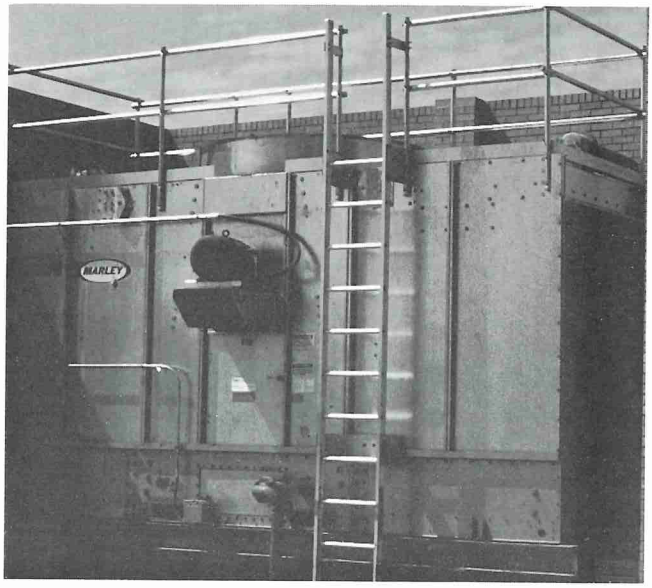
Motor Outside the Airstream

You can choose even easier maintenance and completely free access to the fan motor by choosing this option. You'll get the same dependable performance and reliable Geareducer drive in a configuration that puts the motor out where you can easily reach it from a portable ladder for inspection and service.

The Marley full-floating driveshafts used with this option provide many years of dependable service. Their stainless steel tubes and neoprene flexible elements assure long-term corrosion resistance; and their design provides exceptional tolerance to misalignment.

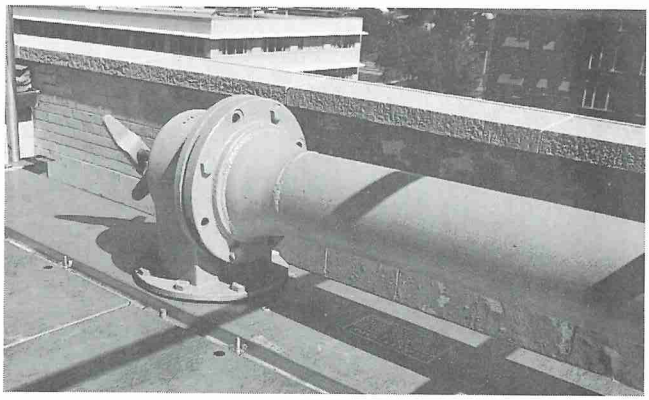


Air Inlet Screens



Handrail and Ladder

If you plan to use the fan deck surface of your Series NC tower as a working surface, the handrail and ladder option addresses the need for worker safety. (Ladder safety cage is also required if fan deck is 20 feet or more above grade - see page 9.) While normal tower maintenance does not usually require access to the fan deck, many users choose this option to assure personnel safety at all times.



HC Flow Control Valve

Available Optional Accessories

Accessory	Description and Remarks
HC Flow Control Valves	Heavy-duty cast iron & stainless steel construction. Used to balance water flow to both sides of tower. More necessary on multi-cell towers than on single cells. Field installed, HC valves simply bolt to the top of the water inlet distribution box. Flange drilling conforms to ANSI B16.1 125# dimensions. Gaskets and attaching hardware are included. (See pages 8 & 18.)
Motor Outside Airstream	This option allows the motor to operate in the dry air outside the tower's humid airstream. The motor couples to the Geareducer through a Marley Twinflex driveshaft. Because of shipping restrictions, motor, motor base plate and driveshaft are field installed. See page 8 for a more complete description.
Air Inlet Screens	Factory-installed, U-edged, galvanized wire mesh screens over the air inlets keep leaves and trash out of the tower. Easily removable.
Handrail and Attached Ladder	Galvanized steel tubing handrail and kneerail surround top of tower. Aluminum ladder attaches to side of tower. (See page 8.) Allow approx. 7 man-hours per cell for field installation. Includes fan deck walkways between cells on multi-cell towers. **Attached ladders are not sold without handrails.**
Additional Attached Ladder	Provides vertical access at both ends of the tower. Requires field cutting of handrail and kneerail tubing. Allow approx. 2 man-hours for installation.
Ladder Extensions	Used when tower is elevated appreciably above working level. Available in increments of 5'-0" & 11'-0" for attachment to base of tower ladder. Base and intermediate lateral support are by others.
Ladder Safety Cage	Galvanized steel circular framework bolts to ladder siderails. Field installed. Specify lengths. Safety cages conform to OSHA standards. OSHA compliance requires use of safety cage if elevation difference from tower fan deck to grade (roof, platform or ground) exceeds 20 feet.
Factory Mutual Approval	Individual tower components **may** require minor modifications.

Accessory	Description and Remarks
Extended Oil Line and Dipstick	Located at the fan deck level near the cased face of the tower. Accessible from portable ladder on one- and two-cell towers. **Dipsticks on towers of three or more cells require that the top level of the tower be used as a routine working platform, so purchase of handrail and attached ladder is usually required.**
Weir Gates	These optional weir gates on the flumes between cold water basins of multi-cell towers permit isolation and draining of appropriate cells. (Discuss your requirements with your Marley application engineer.)
Stainless Steel Collection Basin	All cold water basin parts; columns projecting into the basins; assembly and attaching hardware; and all basin options (including sumps) are stainless steel. All other components remain galvanized. Some designers prefer stainless basins because this is the one area of the tower which is impractical to replace.
Stainless Steel Distribution Basins	All hot water basin parts, including assembly and attaching hardware are stainless steel. Corrosion is usually most aggressive in the distribution basins, so stainless provides assurance of long, trouble-free service life.
All–Stainless Steel Tower	All primary tower components, including assembly and attaching hardware are stainless steel. Only recommended where personal preference or extremely corrosive atmospheric conditions dictate exceptional corrosion resistance.
Basin Heaters (electric)	See page 10.
Basin Heaters (steam)	See page 10.
Alternative Outlet Connections	See page 21.
Fan Cylinder Extensions	Galvanized steel, bolt-on fan cylinder segments available in nominal 1' increments of height. Used to elevate discharge air above parapet level or to penetrate roofed enclosure. **Total extension height should not exceed fan diameter.** Consult your Marley application engineer.

Freeze Prevention

When the ambient air temperature falls below 32˚F, the water in a cooling tower can freeze. Marley Technical Report #H-003 describes how to prevent freezing during operation. Ask your Marley application engineer for a free copy.

Water collects in the cold water basin during shutdowns, and may freeze solid. You can prevent freezing by adding heat to the water left in the tower. Or, you can drain the tower and all exposed pipework at shutdown.

Electric Basin Heaters

We offer an automatic basin heater system, consisting of these components (shipped separately for installation by others):

- Stainless steel electric immersion heater(s). (Threaded couplings are provided in the side of the basin.)
- NEMA 4 enclosure containing these components:
  - Magnetic contactor to energize heater.
  - Transformer to convert power supply to 24 volts for control circuit.
  - Solid state circuit board for temperature and low-water cut-off.

  (Enclosure may be mounted on the side of the tower.)
- Control probe in collection basin to monitor water temperature and water level.

Any exposed piping that is still filled with water at shutdown (including the make-up water line) should be electrically traced and insulated by others.

Steam Injectors (Mufflers)

Penberthy bronze steam mufflers (1/4" to 3/4") are available for control and installation by others. They install in a 3/4" coupling provided in the side of the basin. Live steam, as required, is injected directly into the water. The amount and temperature of steam required is that which will provide the heat equivalent of the "required kW" in the table on page 11. (kW x 3412 = Btu/hr.) Condensed steam adds water to the basin, and the excess will exit the overflow of the tower.

Indoor Tank Method

In 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 table below lists typical drain-down capacities for all Series NC models. Although Marley does not produce tanks, many of our representatives offer tanks supplied by reputable manufacturers.

The amount of water needed to successfully operate the system depends on the tower size and GPM 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 make-up water according to the level where the tank stabilizes during operation.

Series NC Drain-Down Capacity

Tower Model	Range of Tower Design GPM	Maximum Gallons of Drain-Down
NC101 thru NC131	180 – 440	474
	450 – 630	507
	640 – 900	538
	890 – 1200	573
	1210 – 1600	606
NC201 thru NC221	220 – 380	575
	390 – 580	620
	590 – 810	649
	820 – 1530	728
	1540 – 2000	756
NC301 thru NC311	220 – 380	649
	390 – 580	707
	590 – 810	748
	820 – 1530	855
	1540 – 2000	897
NC401 thru NC421	250 – 520	767
	530 – 760	818
	770 – 1040	869
	1050 – 1730	967
	1740 – 2270	1017
NC501 thru NC531	310 – 650	956
	660 – 940	1012
	950 – 1280	1071
	1290 – 2140	1196
	2200 – 2800	1258
NC601 thru NC631	340 – 710	1046
	720 – 1240	1145
	1250 – 1790	1238
	1800 – 2340	1309
	2350 – 3070	1375
NC701 thru NC721	490 – 1010	1558
	1020 – 1760	1695
	1770 – 2550	1831
	2560 – 3330	1930
	3340 – 4140	2000

Note: Volumes shown are maximums for the GPM ranges indicated. Actual volumes will usually be less. Contact your Marley Application Engineer for more specific information.

Temperature Control and Energy Management

Cooling towers are usually selected to produce a specific cold water temperature at the higher summer-time wet-bulb temperatures. During the remainder of the year, the cooling tower is capable of producing much colder water. Unless your system will benefit from the coldest possible water temperature, you should consider controlling cold water temperatures to higher levels. You'll also save energy by using such control. (See Marley Technical Report #H-001A, *Cooling Tower Energy and its Management*.)

Always control leaving water temperature by manipulating the quantity of air that the fan moves through the tower. ***Varying the quantity of water flow is not normally recommended and can be harmful in freezing weather.*** You can alternately start and stop single-speed motors to maintain water temperatures within an acceptable range. However, exceeding a total acceleration time of 30 seconds per hour can overheat the motor, causing the insulation to fail. Limiting the number of motor starts, on the other hand, can produce significant variations in the temperature of the water delivered to the process.

Increased flexibility can simplify your operating procedures and save you money in the long run both on operation and on maintenance. Here are two of the more popular options.

Two-Speed Motors

Two-speed motors improve operating flexibility by increasing the number of potential operating modes. Users in northern climates will find that the tower can carry winter loads at half-speed; reducing fan power requirements by 85+% during that time. Two-speed motors also help to control icing during wintertime operation. (See Marley Technical Report #H-003, *Operating Cooling Towers During Freezing Weather*.)

Normally, two-speed motors are provided in 1800/900 RPM, single winding configuration, which is the least expensive two-speed option. They are also available in other combinations including the more expensive double winding.

Variable Speed Control

Frequency modulation devices work well on induced draft, propeller fan cooling towers such as the Series NC. However, their design must include the capability to lock out any critical fan speeds and the very low fan speed ranges. Consult your Marley application engineer for specific recommendations when considering variable speed control. In many cases, for example, you'll achieve the best results by using a single control to regulate the speed of several fans on a multi-cell tower.

Series NC
Basin Heater Selection Chart

	+10°F Ambient		0°F Ambient		-10°F Ambient	
Tower Model	Req'd kW	Heater kW	Req'd kW	Heater kW	Req'd kW	Heater kW
NC101 - 131	5.84	6	7.53	7.5	9.20	9
NC201 - 221	7.14	7.5	9.21	9	11.24	12
NC301 - 311	7.94	9	10.24	12	12.49	15
NC401 - 421	8.91	9	11.48	12	14.01	15
NC501 - 531	10.85	12	13.98	15	17.05	18
NC601 - 631	11.82	12	15.22	15	18.56	18
NC701 - 721	14.82	15	19.14	2 @ 12	23.34	2 @ 12

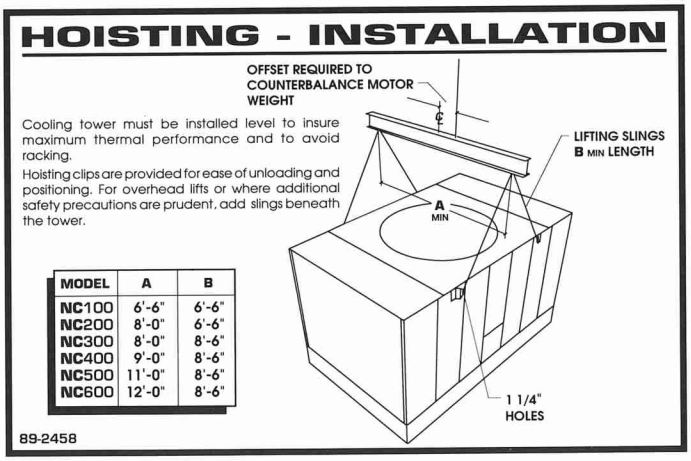
Notes:
1. "Required kW" is the calculated amount of heat needed to maintain +40°F basin water temperature at the indicated ambient air temperature. "Heater kW" is nominal capacity of heater actually supplied.
2. Heaters shown are 480 volts, 3-phase. Options or special heater selections may add several weeks to delivery.
3. Heaters do **not** operate continuously. They cycle on and off automatically as basin water temperature dictates.

Hoisting & Installation

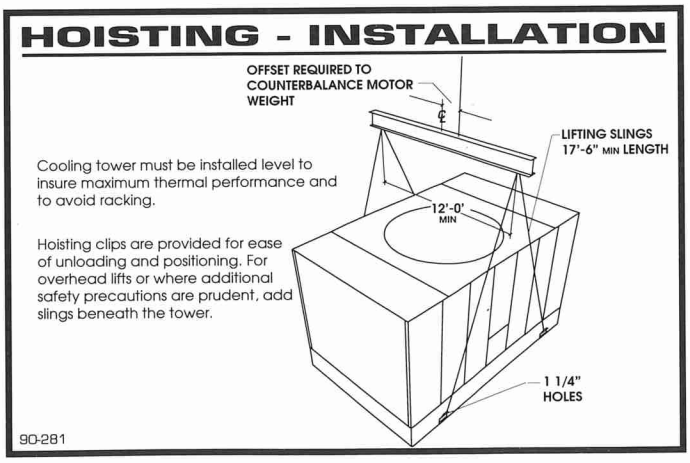
In order to reduce weight for helicopter hoisting, components of the tower may be removed, and reinstalled after hoisting is complete. The adjacent table indicates weight reductions as components are removed – **listed in approved order of removal.**

Series NC Component Weights (Lbs.)							
	Model						
Component	NC101 thru NC131	NC201 thru NC221	NC301 thru NC311	NC401 thru NC421	NC501 thru NC531	NC601 thru NC631	NC701 thru NC721
Fan Guard	30	38	38	86	88	120	142
Upper Fan Cylinder	67	78	78	89	89	100	108
H.W. Basin Covers	73	93	93	104	129	140	237
Flume Assy.	44	54	54	62	76	84	103
Lower Fan Cylinder	41	48	48	55	55	62	67
Suction Assy. & End Plate	76-90	76-90	76-90	76-90	76-104	76-104	133
Overflow	23	23	23	23	23	23	26
Float Valve	16	16	16	16	16	16	16
Fan Deck & C.E.I.	164	187	235	285	345	356	348
Fan	107	231	231	290	290	345	270
Motor & Coupling	108-268	189-329	268-329	268-378	329-596	378-662	451-662
Geareducer	75-218	218	218	218	218-379	379	379
Corner Cols.	37	37	52	52	52	52	50
Fill, Tubes & End Supports	856	1063	1391	1571	1934	2115	3005
Mechanical Eqpt. Suppts.	197	240	240	411	512	557	638
Remainder Do Not Remove	3154	3392	4033	4346	4922	5125	6193

Use the information appearing on these cautionary stickers (reproduced below) to hoist your tower safely. One of these stickers also appears on each access door of every tower.



Models NC100 through NC600 Only



Models NC700 Only

Tower Selection Factors

Select the appropriate Series NC model as follows:

1. Subtract cold water temperature from hot water temperature to determine "Cooling **Range**".
2. Subtract design air wet-bulb temperature from cold water temperature to determine "**Approach** to Wet-Bulb".
3. Choose the table appropriate for your design air wet-bulb temperature.
4. On the line for your calculated **Range**, proceed right to the column for your calculated **Approach** and read **Tower Selection Factor**. Interpolate mathematically, if necessary.
5. Turn to Model Selection Chart on Page 16.

Note: All temperatures shown are degrees Fahrenheit.

Example: Select model to cool 900 GPM of water from 101°F to 85°F at an entering air wet-bulb temperature of 74°F.

1. *Cooling Range is 16°F (101° - 85°).*
2. *Approach to Wet-Bulb is 11°F (85°- 74°).*
3. *74°F Wet-Bulb tabulation is on Page 14.*
4. *At a 16°F range and 11°F approach, Tower Selection Factor is 4.89.*
5. *Proceed to Page 16.*

30°F Wet-Bulb Selection Factors

Approach	10	11	12	13	14	15	16	17	18	19	20
Range											
5	4.38	4.74	5.08	5.40	5.69	5.98	6.25	6.50	6.75	6.98	7.21
6	3.77	4.12	4.45	4.76	5.05	5.33	5.59	5.85	6.09	6.32	6.55
7	3.28	3.62	3.94	4.24	4.53	4.80	5.06	5.31	5.55	5.78	6.00
8	2.87	3.20	3.51	3.81	4.09	4.36	4.61	4.85	5.09	5.31	5.53
9	2.52	2.84	3.15	3.44	3.71	3.97	4.22	4.46	4.69	4.92	5.13
10	2.22	2.53	2.83	3.12	3.38	3.64	3.89	4.12	4.35	4.57	4.78
11	1.95	2.26	2.56	2.83	3.10	3.35	3.59	3.82	4.05	4.27	4.48
12	1.71	2.02	2.31	2.58	2.84	3.09	3.33	3.56	3.78	3.99	4.20
13	1.51	1.81	2.09	2.36	2.61	2.86	3.09	3.32	3.54	3.75	3.95
14	1.32	1.61	1.89	2.15	2.41	2.65	2.88	3.10	3.32	3.53	3.73
15	1.15	1.44	1.71	1.97	2.22	2.46	2.69	2.91	3.12	3.33	3.53
16	0.99	1.28	1.55	1.80	2.05	2.28	2.51	2.73	2.94	3.14	3.34
17	0.85	1.13	1.40	1.65	1.89	2.12	2.35	2.56	2.77	2.97	3.17
18	0.72	0.99	1.26	1.51	1.75	1.98	2.20	2.41	2.62	2.82	3.01

35°F Wet-Bulb Selection Factors

Approach	10	11	12	13	14	15	16	17	18	19	20
Range											
5	4.69	5.06	5.40	5.72	6.02	6.30	6.57	6.83	7.08	7.32	7.55
6	4.09	4.44	4.77	5.08	5.38	5.66	5.92	6.18	6.42	6.66	6.89
7	3.59	3.94	4.26	4.57	4.86	5.13	5.39	5.64	5.88	6.12	6.34
8	3.18	3.52	3.83	4.13	4.42	4.69	4.94	5.19	5.43	5.66	5.88
9	2.83	3.16	3.47	3.76	4.04	4.31	4.56	4.80	5.04	5.26	5.48
10	2.53	2.85	3.16	3.44	3.72	3.98	4.22	4.46	4.70	4.92	5.13
11	2.26	2.58	2.88	3.16	3.43	3.68	3.93	4.17	4.39	4.61	4.83
12	2.03	2.34	2.63	2.91	3.17	3.43	3.67	3.90	4.13	4.34	4.55
13	1.82	2.13	2.41	2.69	2.95	3.20	3.43	3.66	3.89	4.10	4.31
14	1.63	1.93	2.22	2.48	2.74	2.99	3.22	3.45	3.67	3.88	4.09
15	1.46	1.76	2.04	2.30	2.55	2.80	3.03	3.25	3.47	3.68	3.89
16	1.31	1.60	1.87	2.13	2.38	2.62	2.85	3.08	3.29	3.50	3.70
17	1.16	1.45	1.72	1.98	2.23	2.47	2.69	2.91	3.13	3.33	3.53
18	1.03	1.32	1.59	1.84	2.09	2.32	2.55	2.76	2.97	3.18	3.38

40°F Wet-Bulb Selection Factors

Approach	10	11	12	13	14	15	16	17	18	19	20
Range											
5	5.03	5.40	5.74	6.06	6.37	6.65	6.93	7.19	7.44	7.68	7.91
6	4.43	4.78	5.12	5.43	5.73	6.01	6.28	6.54	6.79	7.02	7.25
7	3.94	4.28	4.61	4.92	5.21	5.49	5.75	6.00	6.25	6.48	6.71
8	3.53	3.87	4.18	4.49	4.77	5.04	5.30	5.55	5.79	6.03	6.25
9	3.18	3.51	3.82	4.12	4.40	4.67	4.92	5.17	5.40	5.63	5.85
10	2.87	3.20	3.51	3.80	4.07	4.34	4.59	4.83	5.06	5.29	5.51
11	2.61	2.93	3.23	3.52	3.79	4.05	4.30	4.54	4.77	4.99	5.20
12	2.38	2.69	2.99	3.27	3.53	3.79	4.04	4.27	4.50	4.72	4.93
13	2.17	2.48	2.77	3.04	3.31	3.56	3.80	4.04	4.26	4.48	4.69
14	1.98	2.28	2.57	2.84	3.10	3.35	3.59	3.82	4.04	4.26	4.47
15	1.81	2.11	2.39	2.66	2.92	3.16	3.40	3.63	3.85	4.06	4.27
16	1.66	1.95	2.23	2.50	2.75	2.99	3.23	3.45	3.67	3.88	4.08
17	1.51	1.80	2.08	2.34	2.59	2.83	3.06	3.29	3.50	3.71	3.92
18	1.38	1.67	1.94	2.20	2.45	2.69	2.92	3.14	3.35	3.56	3.76

45°F Wet-Bulb Selection Factors

Approach	10	11	12	13	14	15	16	17	18	19	20
Range											
5	5.40	5.77	6.11	6.44	6.74	7.03	7.31	7.57	7.82	8.06	8.29
6	4.80	5.16	5.49	5.81	6.11	6.39	6.66	6.92	7.17	7.41	7.64
7	4.31	4.66	4.98	5.29	5.59	5.87	6.13	6.39	6.63	6.87	7.10
8	3.90	4.24	4.56	4.86	5.15	5.43	5.69	5.94	6.18	6.42	6.64
9	3.55	3.88	4.20	4.50	4.78	5.05	5.31	5.56	5.79	6.03	6.25
10	3.25	3.58	3.89	4.18	4.46	4.72	4.98	5.22	5.46	5.68	5.90
11	2.98	3.31	3.61	3.90	4.17	4.43	4.69	4.93	5.16	5.38	5.60
12	2.75	3.07	3.37	3.65	3.92	4.18	4.43	4.66	4.89	5.12	5.33
13	2.54	2.85	3.15	3.43	3.69	3.95	4.19	4.43	4.66	4.88	5.09
14	2.35	2.66	2.95	3.23	3.49	3.74	3.98	4.22	4.44	4.66	4.87
15	2.19	2.49	2.77	3.05	3.31	3.55	3.79	4.02	4.25	4.46	4.67
16	2.03	2.33	2.61	2.88	3.14	3.38	3.62	3.85	4.07	4.28	4.49
17	1.89	2.18	2.46	2.73	2.98	3.23	3.46	3.68	3.90	4.11	4.32
18	1.76	2.05	2.33	2.59	2.84	3.08	3.31	3.54	3.75	3.96	4.16

50°F Wet-Bulb Selection Factors

Approach	10	11	12	13	14	15	16	17	18	19	20
Range											
5	5.79	6.16	6.51	6.83	7.14	7.43	7.71	7.97	8.22	8.47	8.70
6	5.19	5.55	5.89	6.20	6.51	6.79	7.06	7.32	7.57	7.82	8.05
7	4.70	5.05	5.38	5.69	5.99	6.27	6.54	6.79	7.04	7.28	7.51
8	4.29	4.64	4.96	5.26	5.55	5.83	6.09	6.35	6.59	6.83	7.05
9	3.94	4.28	4.60	4.90	5.18	5.46	5.72	5.96	6.21	6.44	6.66
10	3.64	3.97	4.29	4.58	4.86	5.13	5.39	5.63	5.87	6.10	6.32
11	3.38	3.71	4.01	4.30	4.58	4.84	5.09	5.34	5.57	5.80	6.02
12	3.15	3.47	3.77	4.05	4.33	4.59	4.84	5.08	5.31	5.53	5.75
13	2.94	3.25	3.55	3.83	4.10	4.36	4.60	4.84	5.07	5.29	5.51
14	2.75	3.06	3.36	3.63	3.90	4.15	4.40	4.63	4.86	5.08	5.29
15	2.58	2.89	3.18	3.45	3.71	3.96	4.21	4.44	4.66	4.88	5.09
16	2.43	2.73	3.02	3.29	3.55	3.79	4.03	4.26	4.48	4.70	4.91
17	2.29	2.59	2.87	3.14	3.39	3.64	3.87	4.10	4.32	4.53	4.74
18	2.16	2.45	2.73	3.00	3.25	3.49	3.73	3.95	4.17	4.38	4.59

55°F Wet-Bulb Selection Factors

Approach Range	10	11	12	13	14	15	16	17	18	19	20
5	6.20	6.57	6.92	7.24	7.55	7.84	8.12	8.39	8.64	8.89	–
6	5.60	5.96	6.30	6.62	6.92	7.21	7.48	7.75	8.00	8.24	8.47
7	5.11	5.47	5.80	6.11	6.41	6.69	6.96	7.22	7.47	7.70	7.93
8	4.70	5.05	5.38	5.68	5.97	6.25	6.52	6.77	7.02	7.25	7.48
9	4.36	4.70	5.02	5.32	5.61	5.88	6.14	6.39	6.63	6.86	7.09
10	4.06	4.39	4.71	5.00	5.28	5.55	5.81	6.06	6.30	6.53	6.75
11	3.80	4.12	4.43	4.72	5.00	5.27	5.52	5.77	6.00	6.23	6.45
12	3.57	3.89	4.19	4.48	4.75	5.01	5.26	5.50	5.74	5.96	6.18
13	3.36	3.67	3.97	4.26	4.53	4.78	5.03	5.27	5.50	5.72	5.94
14	3.17	3.48	3.78	4.06	4.32	4.58	4.82	5.06	5.29	5.51	5.72
15	3.00	3.31	3.60	3.88	4.14	4.39	4.63	4.87	5.09	5.31	5.52
16	2.85	3.15	3.44	3.71	3.97	4.22	4.46	4.69	4.92	5.13	5.34
17	2.71	3.01	3.29	3.56	3.82	4.07	4.30	4.53	4.75	4.97	5.18
18	2.58	2.88	3.16	3.42	3.68	3.92	4.16	4.38	4.60	4.82	5.02

60°F Wet-Bulb Selection Factors

Approach Range	10	11	12	13	14	15	16	17	18	19	20
5	6.63	7.00	7.35	7.67	7.98	8.28	8.56	8.82	–	–	–
6	6.03	6.39	6.73	7.05	7.36	7.64	7.92	8.18	8.43	8.68	8.91
7	5.54	5.90	6.23	6.54	6.84	7.13	7.40	7.66	7.90	8.14	8.37
8	5.14	5.48	5.81	6.12	6.41	6.69	6.96	7.21	7.46	7.69	7.92
9	4.79	5.13	5.45	5.76	6.04	6.32	6.58	6.83	7.07	7.31	7.53
10	4.49	4.83	5.14	5.44	5.72	5.99	6.25	6.50	6.74	6.97	7.19
11	4.23	4.56	4.87	5.16	5.44	5.71	5.96	6.21	6.44	6.67	6.89
12	4.00	4.32	4.63	4.92	5.19	5.45	5.71	5.95	6.18	6.41	6.63
13	3.79	4.11	4.41	4.70	4.97	5.23	5.48	5.72	5.95	6.17	6.39
14	3.61	3.92	4.22	4.50	4.77	5.02	5.27	5.50	5.73	5.95	6.17
15	3.44	3.75	4.04	4.32	4.58	4.84	5.08	5.31	5.54	5.76	5.97
16	3.29	3.59	3.88	4.15	4.41	4.67	4.91	5.14	5.36	5.58	5.79
17	3.15	3.45	3.73	4.00	4.26	4.51	4.75	4.98	5.20	5.42	5.62
18	3.02	3.31	3.60	3.86	4.12	4.37	4.60	4.83	5.05	5.26	5.47

64°F Wet-Bulb Selection Factors

Approach Range	10	11	12	13	14	15	16	17	18	19	20
5	6.98	7.35	7.70	8.03	8.34	8.63	8.91	–	–	–	–
6	6.38	6.75	7.09	7.41	7.71	8.00	8.28	8.54	8.79	9.04	–
7	5.90	6.25	6.59	6.90	7.20	7.49	7.76	8.02	8.26	8.50	8.74
8	5.49	5.84	6.17	6.48	6.77	7.05	7.32	7.57	7.82	8.06	8.29
9	5.15	5.49	5.81	6.11	6.40	6.68	6.94	7.19	7.44	7.67	7.90
10	4.85	5.19	5.50	5.80	6.08	6.35	6.61	6.86	7.10	7.33	7.56
11	4.59	4.92	5.23	5.52	5.80	6.07	6.33	6.57	6.81	7.04	7.26
12	4.36	4.68	4.99	5.28	5.55	5.82	6.07	6.31	6.55	6.77	6.99
13	4.15	4.47	4.77	5.06	5.33	5.59	5.84	6.08	6.31	6.53	6.75
14	3.97	4.28	4.58	4.86	5.13	5.39	5.63	5.87	6.10	6.32	6.53
15	3.80	4.11	4.40	4.68	4.95	5.20	5.44	5.68	5.91	6.12	6.34
16	3.65	3.95	4.24	4.52	4.78	5.03	5.27	5.50	5.73	5.95	6.16
17	3.51	3.81	4.09	4.37	4.63	4.87	5.11	5.34	5.57	5.78	5.99
18	3.38	3.68	3.96	4.23	4.48	4.73	4.97	5.20	5.42	5.63	5.84

66°F Wet-Bulb Selection Factors

Approach Range	9	10	11	12	13	14	15	16	17	18	19
5	6.76	7.16	7.53	7.88	8.21	8.52	8.81	–	–	–	–
6	6.17	6.56	6.93	7.27	7.59	7.89	8.18	8.46	8.72	8.98	–
7	5.70	6.08	6.44	6.77	7.08	7.38	7.67	7.94	8.20	8.45	8.69
8	5.30	5.67	6.02	6.35	6.66	6.95	7.23	7.50	7.76	8.00	8.24
9	4.97	5.33	5.67	5.99	6.30	6.59	6.86	7.12	7.38	7.62	7.85
10	4.68	5.03	5.37	5.68	5.98	6.27	6.54	6.80	7.05	7.29	7.52
11	4.42	4.77	5.10	5.41	5.71	5.99	6.25	6.51	6.76	6.99	7.22
12	4.20	4.54	4.87	5.17	5.46	5.74	6.00	6.25	6.50	6.73	6.96
13	4.00	4.34	4.66	4.96	5.24	5.51	5.77	6.02	6.26	6.50	6.72
14	3.82	4.15	4.46	4.76	5.04	5.31	5.57	5.82	6.05	6.28	6.51
15	3.65	3.98	4.29	4.59	4.86	5.13	5.38	5.63	5.86	6.09	6.31
16	3.50	3.83	4.14	4.43	4.70	4.96	5.21	5.46	5.69	5.91	6.13
17	3.37	3.69	3.99	4.28	4.55	4.81	5.06	5.30	5.53	5.75	5.97
18	3.24	3.56	3.86	4.14	4.41	4.67	4.92	5.15	5.38	5.60	5.82

68°F Wet-Bulb Selection Factors

Approach Range	7	8	9	10	11	12	13	14	15	16	17
5	6.02	6.50	6.94	7.34	7.71	8.06	8.39	8.70	9.00	–	–
6	5.46	5.93	6.35	6.75	7.11	7.45	7.77	8.08	8.37	8.64	8.91
7	5.01	5.47	5.88	6.26	6.62	6.95	7.27	7.57	7.85	8.12	8.38
8	4.64	5.08	5.48	5.86	6.21	6.54	6.84	7.14	7.42	7.69	7.94
9	4.33	4.75	5.15	5.52	5.86	6.18	6.48	6.77	7.05	7.31	7.56
10	4.05	4.47	4.86	5.22	5.55	5.87	6.17	6.45	6.72	6.98	7.23
11	3.82	4.23	4.61	4.96	5.29	5.60	5.89	6.17	6.44	6.70	6.94
12	3.61	4.01	4.38	4.73	5.05	5.36	5.65	5.92	6.19	6.44	6.68
13	3.42	3.82	4.18	4.52	4.84	5.14	5.43	5.70	5.96	6.21	6.45
14	3.25	3.64	4.00	4.34	4.65	4.95	5.23	5.50	5.76	6.00	6.24
15	3.10	3.48	3.84	4.17	4.48	4.77	5.05	5.32	5.57	5.81	6.05
16	2.96	3.34	3.69	4.02	4.32	4.61	4.89	5.15	5.40	5.64	5.88
17	2.84	3.21	3.55	3.88	4.18	4.46	4.74	5.00	5.25	5.48	5.72
18	2.72	3.09	3.43	3.75	4.05	4.33	4.60	4.86	5.10	5.34	5.57

70°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	5.06	5.66	6.20	6.68	7.12	7.52	7.90	8.25	8.58	8.89	–
6	4.55	5.13	5.64	6.11	6.54	6.93	7.29	7.64	7.96	8.26	8.55
7	4.14	4.70	5.20	5.65	6.06	6.45	6.80	7.14	7.45	7.75	8.04
8	3.80	4.34	4.83	5.27	5.67	6.04	6.39	6.72	7.03	7.32	7.60
9	3.51	4.04	4.51	4.94	5.34	5.70	6.04	6.36	6.67	6.96	7.23
10	3.26	3.78	4.24	4.66	5.05	5.40	5.74	6.06	6.36	6.64	6.91
11	3.05	3.55	4.00	4.41	4.79	5.14	5.47	5.78	6.08	6.36	6.63
12	2.86	3.35	3.79	4.20	4.57	4.91	5.24	5.54	5.83	6.11	6.37
13	2.69	3.17	3.61	4.00	4.37	4.71	5.03	5.33	5.62	5.89	6.15
14	2.54	3.01	3.44	3.83	4.19	4.52	4.84	5.14	5.42	5.69	5.94
15	2.40	2.87	3.29	3.67	4.02	4.36	4.67	4.96	5.24	5.50	5.76
16	2.28	2.74	3.15	3.53	3.88	4.20	4.51	4.80	5.07	5.34	5.59
17	2.17	2.62	3.02	3.40	3.74	4.06	4.37	4.65	4.92	5.18	5.43
18	2.06	2.51	2.91	3.28	3.62	3.93	4.23	4.52	4.79	5.04	5.29

72°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	5.24	5.85	6.38	6.87	7.30	7.71	8.08	8.43	8.76	–	–
6	4.73	5.31	5.83	6.30	6.72	7.12	7.48	7.82	8.15	8.45	8.74
7	4.32	4.88	5.38	5.84	6.25	6.63	6.99	7.33	7.64	7.94	8.23
8	3.98	4.53	5.01	5.45	5.86	6.23	6.58	6.91	7.22	7.51	7.79
9	3.70	4.23	4.70	5.13	5.52	5.89	6.23	6.55	6.86	7.15	7.42
10	3.45	3.97	4.43	4.85	5.23	5.59	5.93	6.24	6.54	6.83	7.10
11	3.24	3.74	4.19	4.60	4.98	5.33	5.66	5.97	6.27	6.55	6.82
12	3.05	3.54	3.98	4.38	4.76	5.10	5.43	5.73	6.02	6.30	6.56
13	2.88	3.36	3.79	4.19	4.56	4.90	5.22	5.52	5.80	6.08	6.34
14	2.73	3.20	3.63	4.02	4.38	4.71	5.03	5.32	5.61	5.88	6.13
15	2.59	3.06	3.48	3.86	4.21	4.54	4.85	5.15	5.43	5.69	5.95
16	2.47	2.93	3.34	3.72	4.07	4.39	4.70	4.99	5.26	5.53	5.78
17	2.35	2.81	3.21	3.58	3.93	4.25	4.55	4.84	5.11	5.37	5.62
18	2.25	2.70	3.10	3.46	3.80	4.12	4.42	4.71	4.98	5.23	5.48

74°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	5.43	6.03	6.57	7.05	7.49	7.90	8.27	8.62	8.95	–	–
6	4.92	5.50	6.02	6.48	6.91	7.30	7.67	8.01	8.33	8.64	8.93
7	4.51	5.07	5.57	6.02	6.44	6.82	7.18	7.51	7.83	8.13	8.41
8	4.17	4.71	5.20	5.64	6.05	6.42	6.77	7.10	7.41	7.70	7.98
9	3.88	4.41	4.89	5.32	5.71	6.08	6.42	6.74	7.05	7.34	7.61
10	3.64	4.15	4.62	5.04	5.42	5.78	6.12	6.43	6.73	7.02	7.29
11	3.42	3.93	4.38	4.79	5.17	5.52	5.85	6.16	6.46	6.74	7.01
12	3.24	3.73	4.17	4.57	4.95	5.29	5.62	5.92	6.21	6.49	6.75
13	3.07	3.55	3.98	4.38	4.75	5.09	5.41	5.71	5.99	6.27	6.53
14	2.92	3.39	3.82	4.21	4.57	4.90	5.22	5.51	5.80	6.07	6.32
15	2.78	3.25	3.67	4.05	4.40	4.73	5.05	5.34	5.62	5.88	6.14
16	2.66	3.12	3.53	3.91	4.26	4.58	4.89	5.18	5.45	5.72	5.97
17	2.54	3.00	3.40	3.77	4.12	4.44	4.75	5.03	5.30	5.57	5.81
18	2.44	2.89	3.29	3.65	4.00	4.31	4.61	4.90	5.17	5.42	5.67

76°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	5.61	6.22	6.76	7.24	7.68	8.08	8.46	8.81	–	–	–
6	5.11	5.69	6.21	6.67	7.10	7.49	7.86	8.20	8.52	8.83	–
7	4.70	5.26	5.76	6.21	6.63	7.01	7.37	7.71	8.02	8.32	8.61
8	4.36	4.90	5.39	5.83	6.24	6.61	6.96	7.29	7.60	7.89	8.17
9	4.07	4.60	5.08	5.51	5.90	6.27	6.61	6.93	7.24	7.53	7.80
10	3.83	4.35	4.81	5.23	5.61	5.97	6.31	6.63	6.93	7.21	7.48
11	3.62	4.12	4.57	4.98	5.36	5.71	6.04	6.36	6.65	6.93	7.20
12	3.43	3.92	4.36	4.77	5.14	5.48	5.81	6.12	6.41	6.68	6.95
13	3.26	3.74	4.18	4.57	4.94	5.28	5.60	5.90	6.19	6.46	6.72
14	3.11	3.58	4.01	4.40	4.76	5.09	5.41	5.71	5.99	6.26	6.52
15	2.97	3.44	3.86	4.24	4.60	4.93	5.24	5.53	5.81	6.08	6.33
16	2.85	3.31	3.72	4.10	4.45	4.77	5.08	5.37	5.65	5.91	6.16
17	2.74	3.19	3.59	3.97	4.31	4.63	4.94	5.22	5.50	5.76	6.01
18	2.63	3.08	3.48	3.85	4.19	4.51	4.81	5.09	5.36	5.62	5.86

77°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	5.71	6.32	6.85	7.33	7.77	8.18	8.55	8.90	–	–	–
6	5.20	5.78	6.30	6.77	7.19	7.59	7.95	8.30	8.62	8.92	–
7	4.79	5.36	5.86	6.31	6.72	7.11	7.47	7.80	8.12	8.42	8.70
8	4.46	5.00	5.49	5.93	6.33	6.71	7.06	7.39	7.70	7.99	8.27
9	4.17	4.70	5.17	5.60	6.00	6.37	6.71	7.03	7.33	7.62	7.90
10	3.93	4.44	4.90	5.32	5.71	6.07	6.41	6.72	7.02	7.31	7.58
11	3.71	4.22	4.67	5.08	5.46	5.81	6.14	6.45	6.75	7.03	7.30
12	3.52	4.02	4.46	4.86	5.23	5.58	5.91	6.21	6.50	6.78	7.04
13	3.36	3.84	4.27	4.67	5.03	5.38	5.70	6.00	6.28	6.56	6.82
14	3.20	3.68	4.11	4.50	4.86	5.19	5.51	5.80	6.09	6.36	6.61
15	3.07	3.53	3.95	4.34	4.69	5.02	5.33	5.63	5.91	6.17	6.43
16	2.95	3.40	3.82	4.19	4.54	4.87	5.18	5.47	5.74	6.01	6.26
17	2.83	3.28	3.69	4.06	4.41	4.73	5.03	5.32	5.59	5.85	6.10
18	2.73	3.17	3.58	3.94	4.28	4.60	4.90	5.19	5.46	5.71	5.96

78°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	5.80	6.41	6.95	7.43	7.87	8.27	8.65	9.00	–	–	–
6	5.30	5.88	6.40	6.86	7.29	7.68	8.05	8.39	8.72	9.02	–
7	4.89	5.45	5.95	6.41	6.82	7.20	7.56	7.90	8.21	8.51	8.80
8	4.55	5.10	5.58	6.02	6.43	6.80	7.15	7.48	7.79	8.09	8.37
9	4.27	4.80	5.27	5.70	6.10	6.46	6.80	7.13	7.43	7.72	8.00
10	4.02	4.54	5.00	5.42	5.81	6.17	6.50	6.82	7.12	7.40	7.67
11	3.81	4.31	4.76	5.18	5.55	5.91	6.24	6.55	6.84	7.12	7.39
12	3.62	4.11	4.56	4.96	5.33	5.68	6.00	6.31	6.60	6.88	7.14
13	3.45	3.94	4.37	4.77	5.13	5.47	5.79	6.09	6.38	6.65	6.91
14	3.30	3.78	4.20	4.59	4.95	5.29	5.60	5.90	6.18	6.45	6.71
15	3.17	3.63	4.05	4.43	4.79	5.12	5.43	5.73	6.00	6.27	6.53
16	3.04	3.50	3.91	4.29	4.64	4.97	5.27	5.56	5.84	6.10	6.36
17	2.93	3.38	3.79	4.16	4.51	4.83	5.13	5.42	5.69	5.95	6.20
18	2.83	3.27	3.67	4.04	4.38	4.70	5.00	5.28	5.55	5.81	6.06

79°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	5.90	6.51	7.04	7.53	7.97	8.37	8.75	–	–	–	–
6	5.39	5.97	6.49	6.96	7.39	7.78	8.15	8.49	8.81	–	–
7	4.98	5.55	6.05	6.50	6.92	7.30	7.66	7.99	8.31	8.61	8.89
8	4.65	5.19	5.68	6.12	6.53	6.90	7.25	7.58	7.89	8.18	8.46
9	4.36	4.89	5.37	5.80	6.19	6.56	6.90	7.22	7.53	7.82	8.09
10	4.12	4.63	5.10	5.52	5.90	6.26	6.60	6.92	7.22	7.50	7.77
11	3.91	4.41	4.86	5.27	5.65	6.00	6.33	6.65	6.94	7.22	7.49
12	3.72	4.21	4.65	5.06	5.43	5.77	6.10	6.41	6.70	6.97	7.24
13	3.55	4.03	4.47	4.86	5.23	5.57	5.89	6.19	6.48	6.75	7.01
14	3.40	3.87	4.30	4.69	5.05	5.39	5.70	6.00	6.28	6.55	6.81
15	3.26	3.73	4.15	4.53	4.89	5.22	5.53	5.82	6.10	6.37	6.62
16	3.14	3.60	4.01	4.39	4.74	5.07	5.37	5.66	5.94	6.20	6.45
17	3.03	3.48	3.89	4.26	4.60	4.93	5.23	5.52	5.79	6.05	6.30
18	2.92	3.37	3.77	4.14	4.48	4.80	5.10	5.38	5.65	5.91	6.16

80°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	5.99	6.60	7.14	7.62	8.06	8.47	8.84	–	–	–	–
6	5.49	6.07	6.59	7.06	7.48	7.88	8.24	8.59	8.91	–	–
7	5.08	5.64	6.15	6.60	7.01	7.40	7.75	8.09	8.41	8.71	8.99
8	4.75	5.29	5.78	6.22	6.62	7.00	7.35	7.68	7.99	8.28	8.56
9	4.46	4.99	5.46	5.89	6.29	6.66	7.00	7.32	7.63	7.91	8.19
10	4.22	4.73	5.19	5.61	6.00	6.36	6.70	7.01	7.31	7.60	7.87
11	4.00	4.51	4.96	5.37	5.75	6.10	6.43	6.74	7.04	7.32	7.59
12	3.81	4.31	4.75	5.15	5.53	5.87	6.20	6.50	6.79	7.07	7.33
13	3.65	4.13	4.56	4.96	5.33	5.67	5.99	6.29	6.58	6.85	7.11
14	3.50	3.97	4.40	4.79	5.15	5.48	5.80	6.10	6.38	6.65	6.91
15	3.36	3.83	4.25	4.63	4.98	5.32	5.63	5.92	6.20	6.47	6.72
16	3.24	3.70	4.11	4.49	4.84	5.16	5.47	5.76	6.04	6.30	6.55
17	3.12	3.58	3.98	4.36	4.70	5.02	5.33	5.61	5.89	6.15	6.40
18	3.02	3.47	3.87	4.24	4.58	4.89	5.19	5.48	5.75	6.01	6.25

82°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	6.19	6.79	7.33	7.81	8.25	8.66	9.03	–	–	–	–
6	5.68	6.26	6.78	7.25	7.68	8.07	8.44	8.78	–	–	–
7	5.28	5.84	6.34	6.79	7.21	7.59	7.95	8.28	8.60	8.90	–
8	4.94	5.48	5.97	6.41	6.82	7.19	7.54	7.87	8.18	8.47	8.76
9	4.66	5.19	5.66	6.09	6.48	6.85	7.19	7.52	7.82	8.11	8.39
10	4.41	4.93	5.39	5.81	6.20	6.56	6.89	7.21	7.51	7.79	8.06
11	4.20	4.70	5.15	5.57	5.95	6.30	6.63	6.94	7.23	7.51	7.78
12	4.01	4.50	4.95	5.35	5.72	6.07	6.39	6.70	6.99	7.27	7.53
13	3.84	4.33	4.76	5.16	5.52	5.86	6.18	6.49	6.77	7.04	7.31
14	3.69	4.17	4.59	4.98	5.34	5.68	5.99	6.29	6.57	6.84	7.10
15	3.56	4.02	4.44	4.83	5.18	5.51	5.82	6.12	6.40	6.66	6.92
16	3.43	3.89	4.30	4.68	5.03	5.36	5.67	5.96	6.23	6.50	6.75
17	3.32	3.77	4.18	4.55	4.90	5.22	5.52	5.81	6.08	6.34	6.59
18	3.22	3.66	4.06	4.43	4.77	5.09	5.39	5.67	5.94	6.20	6.45

84°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	6.38	6.99	7.52	8.01	8.45	8.85	–	–	–	–	–
6	5.88	6.46	6.98	7.44	7.87	8.27	8.63	8.97	–	–	–
7	5.47	6.03	6.54	6.99	7.40	7.79	8.15	8.48	8.80	–	–
8	5.14	5.68	6.17	6.61	7.01	7.39	7.74	8.07	8.38	8.67	8.95
9	4.85	5.38	5.86	6.29	6.68	7.05	7.39	7.71	8.02	8.31	8.58
10	4.61	5.12	5.59	6.01	6.39	6.75	7.09	7.41	7.71	7.99	8.26
11	4.40	4.90	5.35	5.76	6.14	6.49	6.83	7.14	7.43	7.71	7.98
12	4.21	4.70	5.14	5.55	5.92	6.27	6.59	6.90	7.19	7.46	7.73
13	4.04	4.52	4.96	5.35	5.72	6.06	6.38	6.68	6.97	7.24	7.50
14	3.89	4.36	4.79	5.18	5.54	5.88	6.19	6.49	6.77	7.04	7.30
15	3.75	4.22	4.64	5.02	5.38	5.71	6.02	6.31	6.59	6.86	7.11
16	3.63	4.09	4.50	4.88	5.23	5.56	5.86	6.15	6.43	6.69	6.94
17	3.52	3.97	4.38	4.75	5.09	5.42	5.72	6.01	6.28	6.54	6.79
18	3.41	3.86	4.26	4.63	4.97	5.29	5.59	5.87	6.14	6.40	6.65

86°F Wet-Bulb Selection Factors

Approach Range	5	6	7	8	9	10	11	12	13	14	15
5	6.57	7.18	7.72	8.20	8.64	9.05	–	–	–	–	–
6	6.07	6.66	7.17	7.64	8.07	8.46	8.83	–	–	–	–
7	5.67	6.23	6.73	7.19	7.60	7.98	8.34	8.68	8.99	–	–
8	5.33	5.88	6.37	6.81	7.21	7.59	7.94	8.26	8.57	8.87	–
9	5.05	5.58	6.05	6.48	6.88	7.25	7.59	7.91	8.22	8.50	8.78
10	4.81	5.32	5.79	6.21	6.59	6.95	7.29	7.60	7.90	8.19	8.46
11	4.59	5.10	5.55	5.96	6.34	6.69	7.02	7.33	7.63	7.91	8.18
12	4.41	4.90	5.34	5.75	6.12	6.46	6.79	7.10	7.39	7.66	7.93
13	4.24	4.72	5.16	5.55	5.92	6.26	6.58	6.88	7.17	7.44	7.70
14	4.09	4.56	4.99	5.38	5.74	6.08	6.39	6.69	6.97	7.24	7.50
15	3.95	4.42	4.84	5.22	5.58	5.91	6.22	6.51	6.79	7.06	7.31
16	3.83	4.29	4.70	5.08	5.43	5.76	6.06	6.35	6.63	6.89	7.14
17	3.72	4.17	4.58	4.95	5.29	5.62	5.92	6.21	6.48	6.74	6.99
18	3.61	4.06	4.46	4.83	5.17	5.49	5.79	6.07	6.34	6.60	6.84

The following chart defines the maximum cooling capacity in GPM for each Series NC model at the **Tower Selection Factor** defining your design conditions of entering hot water, leaving cold water, and entering air wet-bulb temperatures. **Select the model whose GPM capacity *equals or exceeds* the design requirement at your calculated Tower Selection Factor.**

1. "Safe" selections result from using the **Tower Selection Factor** column equal to *or smaller than* the factor calculated.

2. "Accurate" selections result from mathematical interpolation, if necessary.

Example: **Tower Selection Factor** *is 4.89. Design GPM is 900.*

1. *Using the 4.5 column (**smaller** than 4.89) the selection would be a Model NC411.*

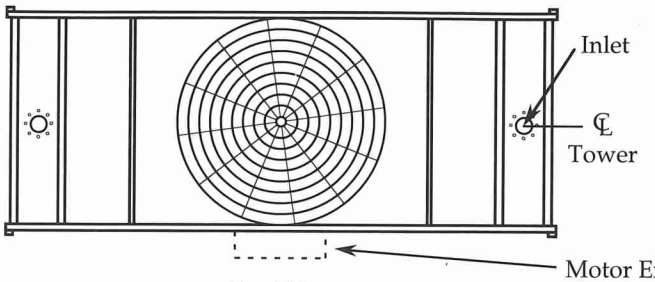
2. *However, interpolating for a 4.89 factor between the 4.5 column (869 GPM) and the 5.0 column (979 GPM) reveals that the Model NC311 is capable of cooling 954.8 GPM at the design temperatures.*

Note: If GPM exceeds maximum model capacity, divide into two or more towers.

Model Capacities In GPM of Clear Water

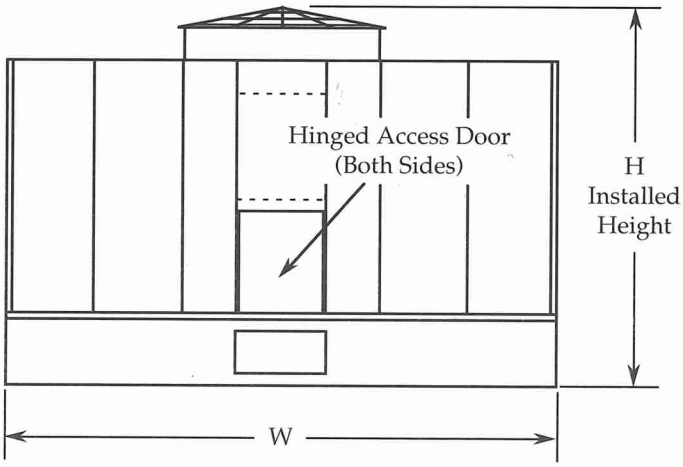
Tower Models	Tower Selection Factor																	
	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0
NC101	*	*	196	222	250	283	319	361	407	459	517	582	654	734	823	923	1034	1159
NC111	*	199	225	254	287	324	366	413	466	524	589	661	740	829	928	1039	1163	1304
NC121	186	209	236	266	301	340	385	434	490	552	621	698	783	878	984	1102	1234	1382
NC131	214	240	271	306	347	393	444	502	566	637	715	801	896	1001	1118	1248	1395	1562
NC201	226	254	287	324	366	413	467	527	594	669	752	845	948	1063	1191	1333	1491	1669
NC211	260	292	330	372	421	476	539	608	685	771	866	970	1086	1214	1356	1514	1690	1888
NC221	284	319	360	407	460	521	590	667	752	846	950	1064	1189	1328	1481	1652	1842	#2000
NC301	302	340	384	433	489	553	624	705	795	896	1009	1134	1273	1426	1595	1781	1985	#2000
NC311	329	371	418	472	533	603	681	770	869	979	1102	1238	1389	1555	1738	1938	#2000	#2000
NC401	332	371	418	472	536	609	691	783	886	999	1123	1259	1408	1572	1753	1953	2177	#2267
NC411	381	429	484	546	618	699	790	893	1008	1136	1278	1435	1607	1796	2002	2227	#2267	#2267
NC421	417	470	530	599	676	764	863	974	1098	1235	1387	1554	1737	1937	2154	#2267	#2267	#2267
NC501	415	466	525	593	671	760	860	973	1100	1241	1398	1571	1763	1974	2207	2464	2747	#2800
NC511	454	511	577	652	736	833	941	1063	1200	1353	1523	1712	1921	2151	2404	2681	#2800	#2800
NC521	470	529	596	674	762	863	977	1105	1249	1409	1587	1784	2000	2239	2501	2788	#2800	#2800
NC531	526	594	670	758	857	969	1094	1235	1393	1568	1762	1977	2212	2471	2754	#2800	#2800	#2800
NC601	494	556	627	708	800	903	1020	1152	1299	1463	1645	1847	2069	2312	2578	2868	#3067	#3067
NC611	518	584	659	744	840	949	1072	1210	1365	1538	1730	1942	2176	2433	2714	3019	#3067	#3067
NC621	566	639	721	815	921	1041	1176	1327	1497	1685	1894	2124	2377	2654	2955	#3067	#3067	#3067
NC631	612	691	781	882	998	1128	1274	1438	1620	1821	2043	2286	2551	2839	#3067	#3067	#3067	#3067
NC701	596	664	744	838	946	1070	1208	1362	1531	1716	1917	2134	2370	2626	2904	3207	3539	3905
NC711	652	727	815	918	1037	1172	1323	1491	1676	1878	2097	2335	2592	2870	3171	3498	3854	#4140
NC721	699	779	874	984	1111	1256	1418	1598	1796	2012	2246	2499	2773	3068	3388	3734	4111	#4140

* Below acceptable flow rate for proper performance
# Maximum design water flow rate

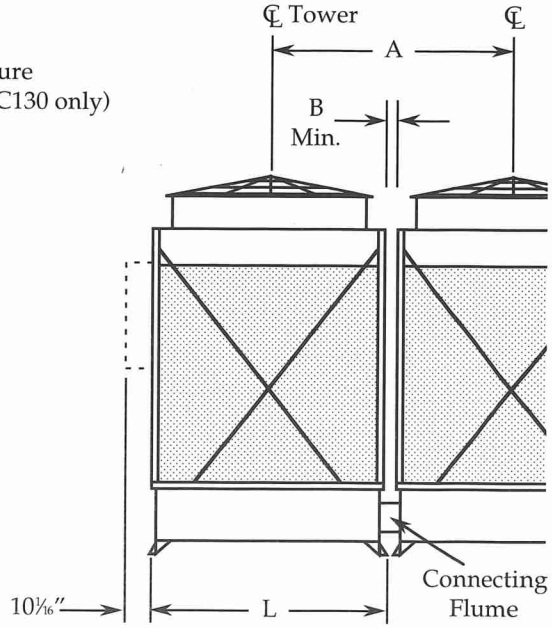


Plan View

Note: Models NC120 & NC 130 require special spacing for 3 or more cells



Casing Side Elevation



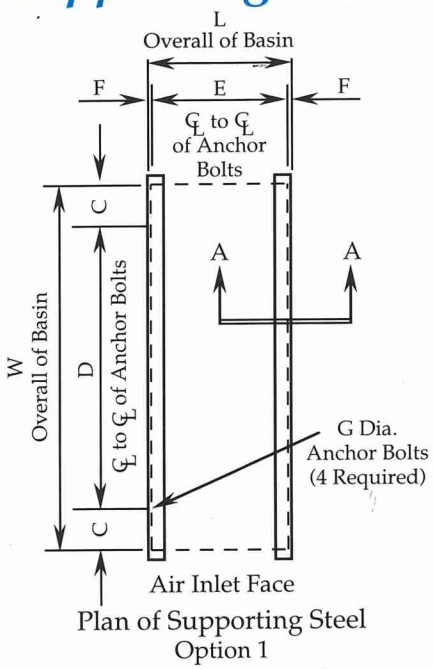
Air Inlet Side Elevation

Tower Model	Nominal Tons (1)	Dimensions					Shipping Weight (lbs.)	Motor HP	Nominal Airflow (CFM)	Inlet Connections
		W	L	H	A	B				
NC101	153	17′-1¾	6′-4½	10′-1½	6′-5½	0′-1″	5045	5	42,050	2 @ 6″
NC111	175	17′-1¾	6′-4½	10′-1½	6′-5½	0′-1″	5100	7.5	48,750	2 @ 6″
NC121	184	17′-1¾	6′-4½	10′-1½	6′-5½	0′-1″	5265	10	51,700	2 @ 6″
NC131	212	17′-1¾	6′-4½	10′-1½	6′-5½	0′-1″	5345	15	60,500	2 @ 6″
NC201	223	17′-1¾	7′-10½	10′-2¼	7′-11½	0′-1″	5960	10	62,400	2 @ 6″
NC211	257	17′-1¾	7′-10½	10′-2¼	7′-11½	0′-1″	6035	15	73,000	2 @ 6″
NC221	282	17′-1¾	7′-10½	10′-2¼	7′-11½	0′-1″	6110	20	80,800	2 @ 6″
NC301	299	19′-1¾	7′-10½	12′-11¼	7′-11½	0′-1″	7080	15	80,350	2 @ 8″
NC311	326	19′-1¾	7′-10½	12′-11¼	7′-11½	0′-1″	7145	20	88,500	2 @ 8″
NC401	333	19′-1¾	8′-10½	12′-11¾	8′-11½	0′-1″	7940	15	89,400	2 @ 8″
NC411	379	19′-1¾	8′-10½	12′-11¾	8′-11½	0′-1″	8000	20	102,950	2 @ 8″
NC421	412	19′-1¾	8′-10½	12′-11¾	8′-11½	0′-1″	8050	25	112,800	2 @ 8″
NC501	414	19′-1¾	10′-10½	12′-11¾	10′-11½	0′-1″	9155	20	111,150	2 @ 8″
NC511	451	19′-1¾	10′-10½	12′-11¾	10′-11½	0′-1″	9205	25	122,200	2 @ 8″
NC521	470	19′-1¾	10′-10½	12′-11¾	10′-11½	0′-1″	9280	30	127,800	2 @ 8″
NC531	523	19′-1¾	10′-10½	12′-11¾	10′-11½	0′-1″	9585	40	143,650	2 @ 8″
NC601	488	19′-1¾	11′-10½	12′-11¾	11′-11½	0′-1″	9930	25	132,000	2 @ 8″
NC611	513	19′-1¾	11′-10½	12′-11¾	11′-11½	0′-1″	10,005	30	139,450	2 @ 8″
NC621	562	19′-1¾	11′-10½	12′-11¾	11′-11½	0′-1″	10,150	40	154,050	2 @ 8″
NC631	607	19′-1¾	11′-10½	12′-11¾	11′-11½	0′-1″	10,215	50	167,550	2 @ 8″
NC701	572	23′-10	11′-11	12′-11¾	11′-11½	0′-½″	12,160	30	142,150	2 @ 8″
NC711	626	23′-10	11′-11	12′-11¾	11′-11½	0′-½″	12,310	40	156,050	2 @ 8″
NC721	671	23′-10	11′-11	12′-11¾	11′-11½	0′-½″	12,375	50	167,550	2 @ 8″

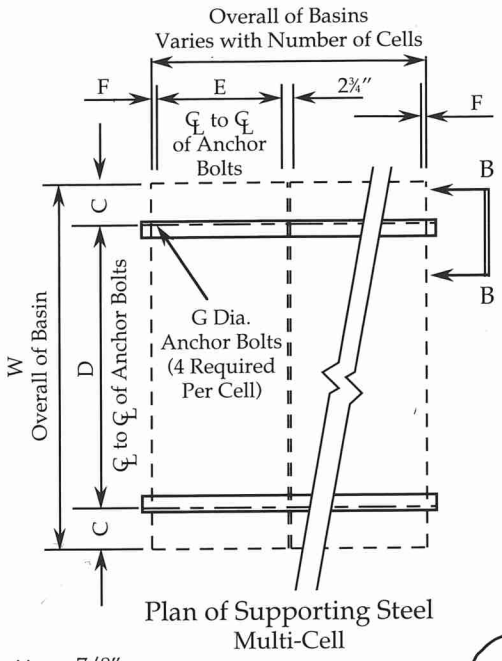
Table Notes

1. Nominal tons are based upon 95°F HW, 85°F CW, 78°F WB and 3 GPM/ton.
2. All table data is per cell.
3. Last digit of model number indicates number of cells. Change as appropriate for your selection.
4. Standard overflow is 4″ dia. standpipe inside basin. Standpipe removes for flush-out and drain. See pages 20 & 21 for details & options.
5. Outlet sizes vary according to GPM and arrangement. See pages 20 & 21 for outlet sizes and details.
6. Make-up connection may be 1″ or 2″ dia., depending upon tower heat load, water pressure, and desired connections. See page 20.

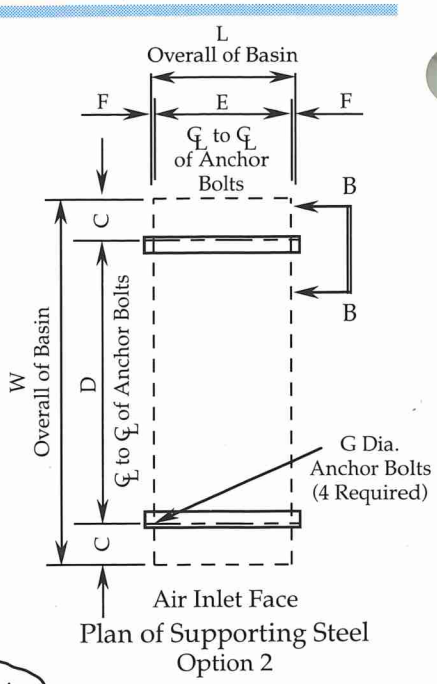
Supporting Steel



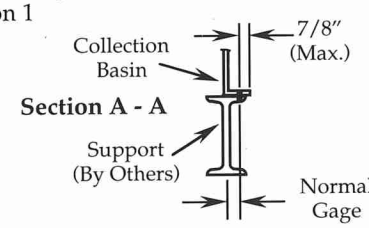
Plan of Supporting Steel
Option 1

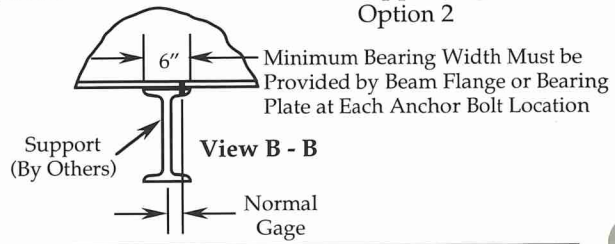


Plan of Supporting Steel
Multi-Cell



Plan of Supporting Steel
Option 2

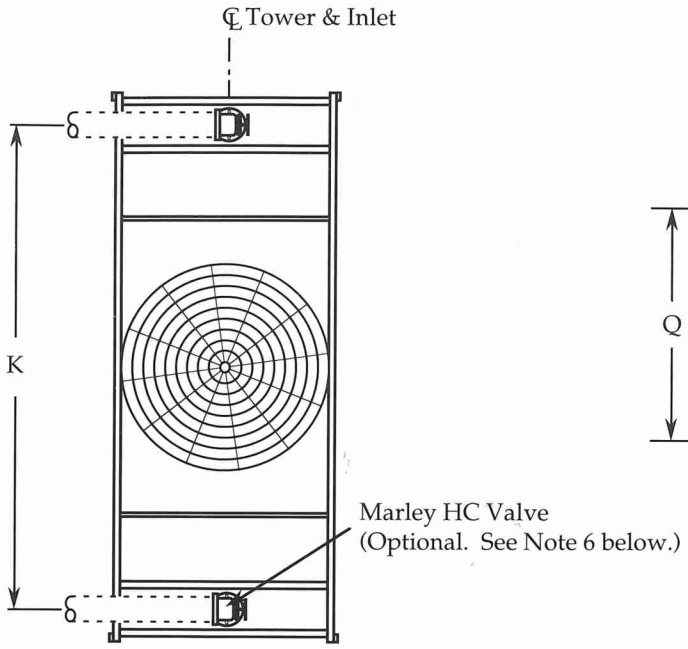




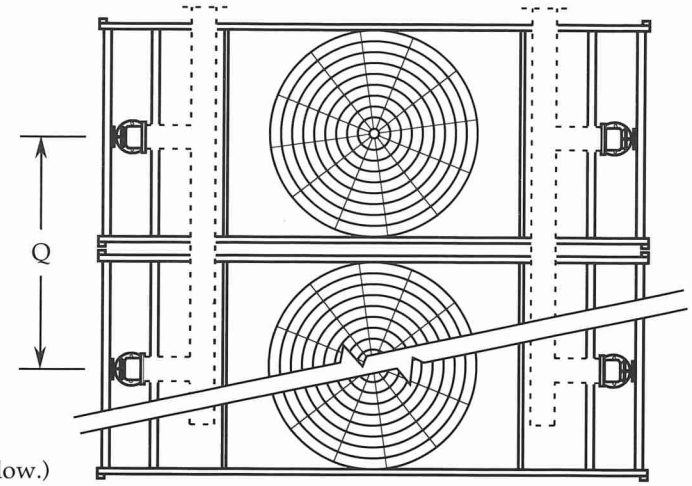
Tower Model	Dimensions							Maximum Operating Wt./Cell (lbs.)	Maximum Operating Load at Anchor (lbs.)	Wind Loads (lbs.)	
	W	L	C	D	E	F	G			Max. Vert. Reaction at Anchor	Max. Horiz. Reaction at Anchor
NC101	17′-1¾	6′-4½	1′-11⅞	13′-2⅞	6′-2¾	7/8″	1/2″	11,720	2930	1680	1150
NC111	17′-1¾	6′-4½	1′-11⅞	13′-2⅞	6′-2¾	7/8″	1/2″	11,780	2945	1680	1150
NC121	17′-1¾	6′-4½	1′-11⅞	13′-2⅞	6′-2¾	7/8″	1/2″	11,940	2985	1680	1150
NC131	17′-1¾	6′-4½	1′-11⅞	13′-2⅞	6′-2¾	7/8″	1/2″	12,020	3005	1680	1150
NC201	17′-1¾	7′-10½	1′-11⅞	13′-2⅞	7′-8¾	7/8″	1/2″	14,320	3580	1680	1150
NC211	17′-1¾	7′-10½	1′-11⅞	13′-2⅞	7′-8¾	7/8″	1/2″	14,380	3595	1680	1150
NC221	17′-1¾	7′-10½	1′-11⅞	13′-2⅞	7′-8¾	7/8″	1/2″	14,460	3615	1680	1150
NC301	19′-1¾	7′-10½	1′-8½	15′-8¾	7′-8¾	7/8″	1/2″	16,340	4085	2580	1685
NC311	19′-1¾	7′-10½	1′-8½	15′-8¾	7′-8¾	7/8″	1/2″	16,400	4100	2580	1685
NC401	19′-1¾	8′-10½	1′-8½	15′-8¾	8′-8¾	7/8″	1/2″	18,420	4605	2580	1685
NC411	19′-1¾	8′-10½	1′-8½	15′-8¾	8′-8¾	7/8″	1/2″	18,480	4620	2580	1685
NC421	19′-1¾	8′-10½	1′-8½	15′-8¾	8′-8¾	7/8″	1/2″	18,540	4635	2580	1685
NC501	19′-1¾	10′-10½	1′-8½	15′-8¾	10′-8¾	7/8″	1/2″	22,100	5525	2580	1685
NC511	19′-1¾	10′-10½	1′-8½	15′-8¾	10′-8¾	7/8″	1/2″	22,160	5540	2580	1685
NC521	19′-1¾	10′-10½	1′-8½	15′-8¾	10′-8¾	7/8″	1/2″	22,240	5560	2580	1685
NC531	19′-1¾	10′-10½	1′-8½	15′-8¾	10′-8¾	7/8″	1/2″	22,540	5635	2580	1685
NC601	19′-1¾	11′-10½	1′-8½	15′-8¾	11′-8¾	7/8″	1/2″	24,600	6150	2580	1685
NC611	19′-1¾	11′-10½	1′-8½	15′-8¾	11′-8¾	7/8″	1/2″	24,680	6170	2580	1685
NC621	19′-1¾	11′-10½	1′-8½	15′-8¾	11′-8¾	7/8″	1/2″	24,820	6205	2580	1685
NC631	19′-1¾	11′-10½	1′-8½	15′-8¾	11′-8¾	7/8″	1/2″	24,880	6220	2580	1685
NC701	23′-10	11′-11	1′-8	20′-6	11′-8¾	1-1/8″	5/8″	34,180	8545	2580	1685
NC711	23′-10	11′-11	1′-8	20′-6	11′-8¾	1-1/8″	5/8″	34,340	8585	2580	1685
NC721	23′-10	11′-11	1′-8	20′-6	11′-8¾	1-1/8″	5/8″	34,400	8600	2580	1685

Table Notes

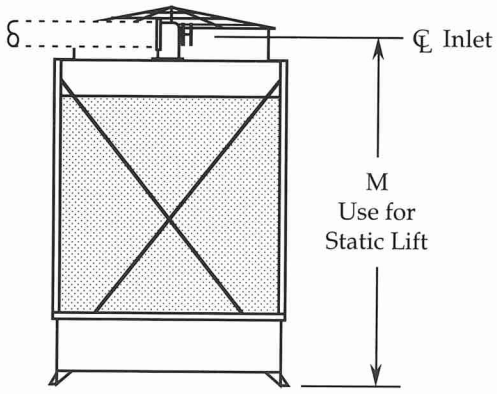
1. ***Use this bulletin for preliminary layouts only.*** Obtain current drawings from your Marley application engineer for final design.
2. Purchaser to provide tower supports complete with holes for anchor bolts furnished by others. Anchor points must be framed flush and level at top.
3. Maximum operating weight occurs with basin full to overflow level. Actual operating weight varies with GPM and piping scheme, but is usually less than shown here.
4. Wind loads are based on 30 psf and are additive to operating loads. Reactions due to wind loads exceed those resulting from seismic loads based on UBC, Zone 4.
5. You may support the tower on a flat concrete slab if you specify side outlet and optional side drain and overflow. See pages 20 & 21 and consult your Marley application engineer.



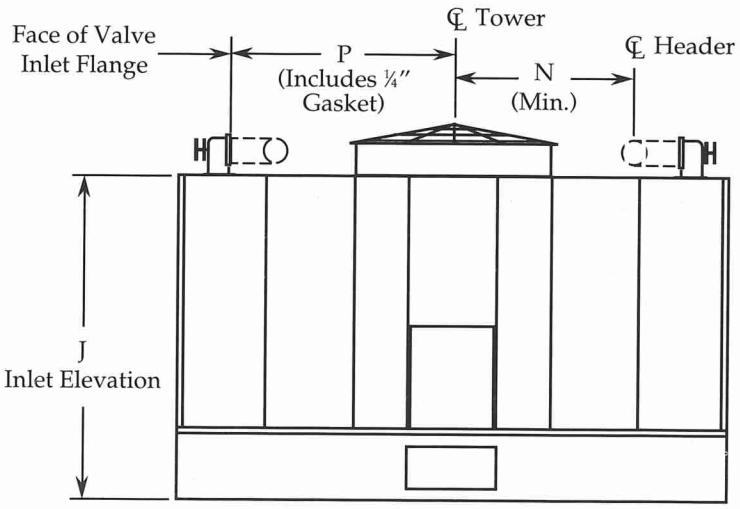
Single Cell Piping Plan View



Multi-Cell Piping Plan View



Single Cell Piping Side Elevation



Multi-Cell Piping End Elevation

Tower Model	Dimensions						Inlet Diameter
	J	K	M	N	P	Q	
NC101 thru NC111	8′-8¾	15′-0⅞	9′-5	5′-5⅛	7′-3	6′-5½	2 @ 6″
NC121 thru NC131	8′-8¾	15′-0⅞	9′-5	5′-5⅛	7′-3	7′-4½	2 @ 6″
NC201 thru NC221	8′-8¾	15′-0⅞	9′-5	5′-5⅛	7′-3	7′-11½	2 @ 6″
NC301 thru NC311	11′-5¾	17′-1	12′-3	6′-5⅛	8′-3	7′-11½	2 @ 8″
NC401 thru NC421	11′-5¾	17′-1	12′-3	6′-5⅛	8′-3	8′-11½	2 @ 8″
NC501 thru NC531	11′-5¾	17′-1	12′-3	6′-5⅛	8′-3	10′-11½	2 @ 8″
NC601 thru NC631	11′-5¾	17′-1	12′-3	6′-5⅛	8′-3	11′-11½	2 @ 8″
NC701 thru NC721	11′-5¾	21′-11	12′-3	6′-6	10′-8	11′-11½	2 @ 8″

Table Notes

1. ***Use this bulletin for preliminary layouts only.*** Obtain current drawings from your Marley application engineer.
2. Pumping head contributed by the tower is static lift "M". Add your system dynamic pipe losses for total.
3. All piping loads, including weight, thrust and lateral loads of riser and horizontal piping must be supported independent of tower. The tower will support the weight of any manifold or horizontal supply piping within the plan area of the tower only.
4. All piping and supports – and their design – are by others.
5. Allow adequate clearance for entry to tower access doors and safe use of attached ladder. Refer to appropriate Marley drawings.
6. You may choose to use 90° short radius flanged elbows in place of balancing valves on single-cell towers where inlet piping is balanced for equal flow. Pipe elevation remains as shown.

Outflow Arrangements

Unless otherwise specified, single-cell towers normally have a side-suction appropriate for the design water flow rate (see page 21). This usually assures the lowest possible installed tower elevation. Side-suction pipes extend roughly 3" outside the basin, and are beveled for weld connections and also grooved for a mechanical coupling.

You can keep all outflow piping below the cold water basin level by choosing either a depressed sump or a bottom outlet connection in lieu of the side suction. Outlets are drilled and gasketed for a standard 125# pipe flange connection. All outflow types include easily removable debris screens.

Depressed sumps are usually made of inert GRP (glass reinforced polyester), but they are also available in heavy-gauge galvanized steel construction.

Multi-cell towers, intended to operate together as a common unit, are joined by stainless steel flumes between the cold water basins. These flumes equalize the operating water level between basins and also provide a flow passage from cells not equipped with outflows.

Therefore, you won't normally have to specify an outflow connection for each cell of a multi-cell tower. Select the number of outflows required to maintain a maximum flow of 1500 GPM through each flumefor Models NC100 through NC600; and 2125 GPM for Models NC700. Remember that ***the flow through flumes of successive cells without outflows is cumulative.***

If you want to equip each cell with an outflow, you can use side-suctions at both ends of multi-cell towers, but not on intermediate cells of installations over two cells. For direct outlet from each cell of towers with three or more cells, use either the sump or bottom outlet arrangements.

Your best choice for a tower used with an indoor tank (see page 10) or on a concrete cold water basin is usually a bottom outlet (with or without screen).

You can mount a side-suction-equipped tower on a flat concrete slab if you also specify a side drain and overflow.

Consult your Marley application engineer for complete information.

Make-Up Water Supply

The amount of water constantly evaporated from a cooling tower varies directly with the heat load applied. In addition to evaporation (and a negligible amount of drift), water is normally lost to the bleed-off necessary to maintain contaminant concentration at an acceptable level in the circulating water system.

Make-Up Water Flow Required (GPM) To Maintain 3 Concentrations

Tower GPM	"Cooling Range" (Hot Water–Cold Water)					
	5°F	10°F	15°F	20°F	30°F	40°F
200	2	3	4	5	8	10
400	3	5	8	10	15	20
600	4	8	12	15	23	30
800	5	10	15	20	30	40
1000	7	13	19	25	38	50
1500	10	19	29	38	57	75
2000	13	25	38	50	75	100
3000	19	38	57	75	113	150
4000	25	50	75	100	150	200
5000	32	63	94	125	188	250
6000	38	75	113	150	225	300
8000	50	100	150	200	300	400

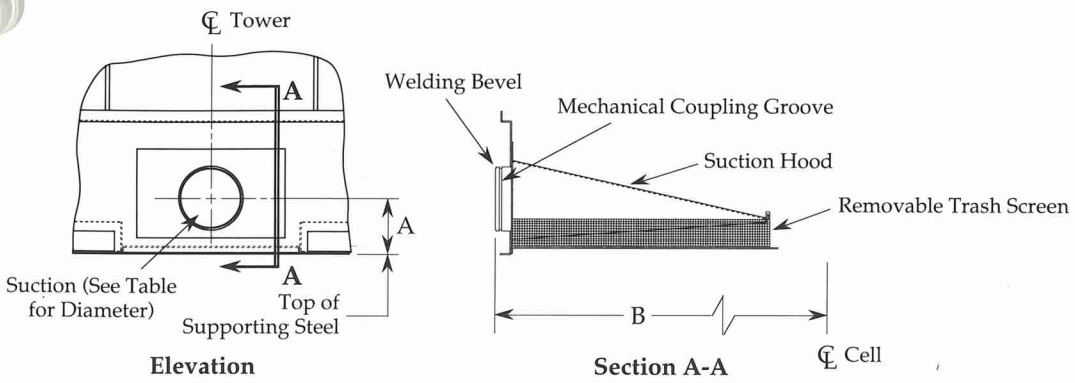
Note: If circulating water is to be maintained at 2 concentrations instead of 3, multiply table GPM values by 1.36 before sizing make-up valve.

Marley provides one or more float-operated, mechanical float valves to automatically replenish this lost water. The tables below, calculated for a concentration of 3 times normal, indicate the rate of water loss – and the size of valve(s) required. If your installation's cold water basin will drain by gravity to a remote storage tank; or if you plan a separate means of controlling make-up water, we offer a price reduction for deleting the Marley-supplied valve.

Make-Up Valve Flow Capacities (GPM)

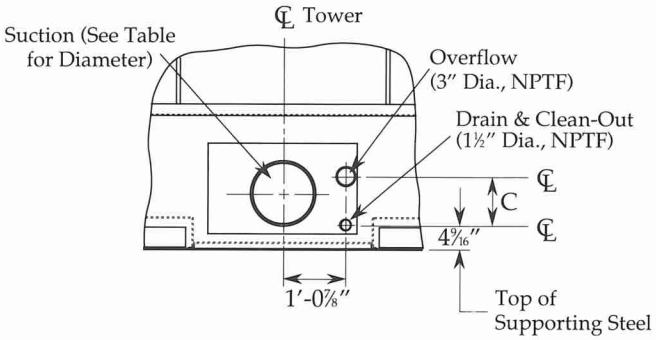
Pressure at Valve Inlet	1" Dia. Valve	2" Dia. Valve
10	45	115
20	64	160
30	78	195
40	90	225
50	100	245

Notes:
1. If make-up water pressure exceeds 50 psig, use pressure-reducer ahead of valve.
2. For flow requirements exceeding the above limitations, use multiples of the **same size valve.**

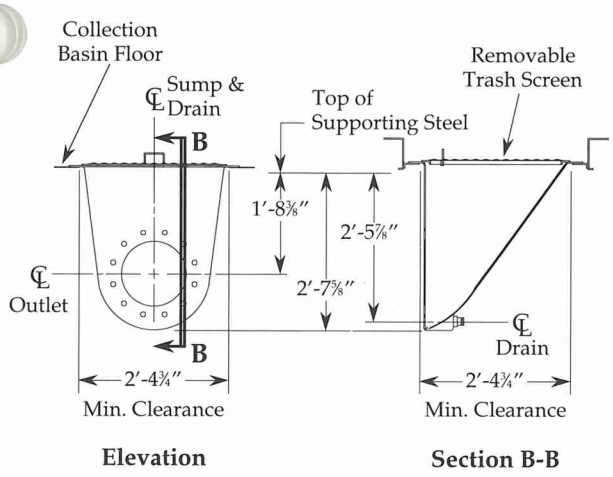


Side Outlet Suction

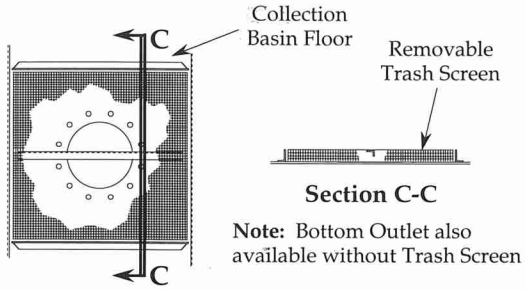
Tower Model	A	B	C
NC100	0′-10″	3′-3 3/16″	0′-6 7/8″
NC200	0′-10″	4′-0 3/16″	0′-6 7/8″
NC300	0′-10″	4′-0 3/16″	0′-6 7/8″
NC400	0′-10″	4′-6 3/16″	0′-6 7/8″
NC500	0′-10″	5′-6 3/16″	0′-6 7/8″
NC600	0′-10″	6′-0 3/16″	0′-6 7/8″
NC700	0′-11 1/4″	6′-0 3/16″	0′-10 3/16″



Optional Side Drain & Overflow



Depressed Side Outlet Sump



Note: Bottom Outlet also available without Trash Screen

Bottom Outlet Plan

Outlet Dia.	Maximum GPM per Outlet					
	Standard		Options			
	Side Outlet Suction		Depressed Side Outlet Sump		Bottom Outlet	
	NC100 thru NC600	NC700	NC100 thru NC600	NC700	NC100 thru NC600	NC700
4″	N/A	N/A	N/A	N/A	150	N/A
6″	900	N/A	900	N/A	350	N/A
8″	1500	1550	1500	1550	600	660
10″	2400	2450	2400	2450	950	1020
12″	2700 for NC100 – NC400 3750 for NC500 – NC600	3500	3500	3500	1400	1500
14″	N/A	4250	3500	4250	1700	1800
16″	N/A	N/A	N/A	N/A	2200	2400
18″	N/A	N/A	N/A	N/A	2800	3050
20″	N/A	N/A	N/A	N/A	3200	3700
24″	N/A	N/A	N/A	N/A	4000	4900

Note: For gravity-flow situations (as to an indoor tank), use bottom outlet or oversize the standard side outlet suction. Request special sizing from your Marley application engineer.

Operating and Environmental Considerations

Sound Control

Sound produced by a Series NC 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 usually have a damping effect on sound. Sound also declines with distance – by about 5 dBA 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:

In many cases, noise concerns are limited to nighttime, 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 1800/900 or 1800/1200 RPM configuration; and operating the fans at reduced speed without cycling "after hours". This is a relatively inexpensive solution, and pays 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 (1200 or 900 RPM) motor speed. Typical sound reductions are 7 dBA at 2/3 fan speed or 10 dBA at 1/2 fan speed.

Extreme cases may require inlet and discharge sound attenuator sections; however, the static pressure loss imposed by attenuators may necessitate an increase in tower size. This is the least desirable approach because of the significant cost impact – and because of the obstruction to normal maintenance procedures.

Your Marley application engineer can help you meet your sound requirements.

Enclosures

Occasionally, cooling towers are located inside architectural enclosures for aesthetic reasons. Although Series NC towers adapt well to enclosures, the designer must realize the potential impact of a poorly arranged enclosure on the tower's performance and operation. (See Marley Technical Report #H-004, *External Influences on Cooling Tower Performance*.) The designer must take care to provide generous air inlet paths, and the tower's fan cylinder discharge height must not fall below the elevation of the top of the enclosure.

It may also be advisable to specify a design wet-bulb temperature 1°F higher than normal to compensate for potential recirculation initiated by the enclosure. You'll benefit from discussing your project with your Marley application engineer.

System Cleanliness

Cooling towers are very effective air washers. Atmospheric dust able to pass through the relatively small louver openings will enter the circulating water system. Increased concentrations can intensify system maintenance by clogging screens and strainers; and smaller particulates can coat system heat transfer surfaces. In areas of low flow velocity (such as the cold water 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 cold water basin clean. Typical devices include side stream filters and a variety of filtration media.

Water Treatment

In order to control the inevitable build-up of dissolved solids as water evaporates from the cooling tower, you should plan to develop a consistent, effective program of water treatment. The program must control corrosion, scale build-up and accumulation of biological contaminants.

An acceptable water treatment program must be compatible with the zinc coating on galvanized steel and must maintain the pH of the circulating water between 6.5 and 8.0. Batch feeding of chemicals directly into the cooling tower is not a good practice, since localized damage to the tower is likely. Additional water quality requirements appear in the Operating and Maintenance manual which accompanies the tower.

For complete water treatment recommendations, consult a competent, qualified water treatment supplier.

Although a reasonable concern for safety is inherent in the design of Marley cooling towers, specifiers, purchasers, and users must understand that there is always some risk involved in operating and maintaining this type of equipment. Accordingly, cautionary warning decals dealing with safety are placed on all Marley towers. Refer to the tower's Operating and Maintenance manual for more complete safety precautions.

Caution

The cooling tower must be located at such distance and direction to avoid the possibility of contaminated tower discharge air being drawn into building fresh air intake ducts. The purchaser should obtain the services of a Licensed Professional Engineer or Registered Architect to certify that the location of the tower is in compliance with applicable air pollution, fire, and clean air codes.

Typical Applications

You can use the Series NC tower in normal applications requiring cold water for the dissipation of heat. Some common applications include:

Condenser water service for air conditioning and refrigeration systems. (They are especially adaptable to free cooling applications.)

Jacket water cooling for engines and air compressors.

Chemical and industrial processes.

Batch cooling.

Welder cooling.

Plastic industry processes.

Dairy, citrus, and other food industry processing where barometric condensers are not in use.

Applications Requiring System Modifications or Alternative Cooling Tower Selections

Certain types of applications are incompatible with ***any*** galvanized steel cooling tower with PVC film-type fill – whether Series NC or a competitive tower of similar manufacture. Some of these applications, which call for either system modifications or an alternative tower design are:

1) **Water temperatures exceeding 125°F** – potential corrosion of galvanized surfaces is accelerated and service life of PVC may be reduced. Use either a cold water by-pass or an intermediate heat exchanger between the load and the tower to limit hot water temperature.
2) **Highly corrosive environment** – typified by proximity to bodies of salt water, presence of corrosive vapors (as in a chemical or steel plant) or the presence of unusually dense air pollution in the form of SO_X, hydrogen sulfide (H_2S) or potentially corrosive particulates. While a galvanized tower will function effectively in these types of environments, an alternative selection constructed of corrosion-resistant materials offers even longer service life.
3) **Ethylene glycol content** – can plug fill passages as slime and algae accumulate to feed on the available organic materials. An intermediate heat exchanger or an alternative splash-filled Marley tower selection will solve the problem. (See **Alternative Selections**.)
4) **Fatty acid content** – found in processes such as soap and detergent manufacture and some food processing, fatty acids pose a serious threat for plugging fill passages. Usually an alternative splash-filled tower offers the best solution.
5) **Particulate carryover** – often found in steel mills and cement plants, can both cause fill plugging and build up to potentially damaging levels on tower structure. Specially-selected spray-filled Marley towers will control the problem.
6) **Pulp carryover** – typical of the paper industry and food processing where barometric condensers or vacuum pumps are used. Causes fill plugging which may be intensified by algae. An alternative Marley splash-filled tower is usually the best solution since intermediate heat exchangers must have flow passages large enough to pass pulp mass.

Alternative Selections

In addition to the Series NC, Marley offers a full range of products in a variety of designs and capacities to meet the special demands of specific applications.

Corrosion Resistance

- **QuadraFlow® 2000** – fiberglass and stainless steel construction assure long service life in virtually any environment. Five-year full product warranty on all components except the motor. Efficient PVC film-type fill.
- **Sigma Series** – wood or HDG steel structure and fiberglass casing for medium to large projects. Available in a wide range of sizes. PVC film-type fill.
- **Stainless steel construction** – you may choose stainless for all or part of your Series NC. See page 9 for more complete information.

Splash-filled Towers

- **Series 10 and Series 15** – wood structure; splash-filled. Similar capacities to Sigma series towers. Proven in hundreds of installations.
- **Class 600** – wood structure and a wide variety of splash fill options make this tower an excellent choice for larger industrial applications.

Special Installations

- **Compac II®** – ideal for those jobs where available space is at a premium. Galvanized steel structure and PVC film-type fill in a counterflow design will fit neatly into your plans.
- **MS Series** – custom-designed to fit your concrete enclosure. PVC film-type fill and Marley industrial-quality internal components provide years of trouble-free service.

For additional information on these products, and for application assistance with whichever Marley product you choose, consult your local Marley Cooling Tower application engineer. We're here to work with you.

Marley Series NC
Cooling Tower Specifications

Base: Furnish and install an induced-draft, crossflow, factory-assembled, steel cooling tower of ____ cell(s), as shown on plans. Tower shall be similar and equal in all respects to Marley Series NC, Model _____.

Performance: Tower shall be guaranteed capable of cooling ____ GPM of water from ____ °F to ____ °F at a design entering air wet-bulb temperature of ____ °F.

Warranty: The cooling tower manufacturer shall certify that the tower supplied meets the specified performance conditions when the tower is installed according to plans. If, because of a suspected thermal performance deficiency, the owner chooses to conduct an on-site thermal performance test under the supervision of a qualified, disinterested third party in accordance with CTI or ASME standards during the first year of operation; and if the tower fails to perform within the limits of test tolerance; then the cooling tower manufacturer will pay for the cost of the test and will make such corrections as are appropriate and agreeable to the owner to compensate for the performance deficiency. In addition, the tower's mechanical equipment must be warranted for at least 5 (five) years as defined below. Towers whose mechanical equipment is not warranted for at least 5 (five) years will ***not*** be accepted.

Construction: Structural components of the tower, including the cold water basin, framework, mechanical equipment supports, casing, hot water basin, fan deck, and fan cylinder shall be fabricated of heavy-gauge steel, protected against corrosion by G-210 galvanizing. All components subjected to factory welding shall be hot dip galvanized ***after*** completion of fabrication to a zinc thickness equivalent of G-210.

Motor: Motor(s) shall be ____ HP, TEFC, 1.15 service factor, and specially insulated for cooling tower duty. Speed and electrical characteristics shall be 1800 (1800/900) RPM, single-winding, ____ phase, ____ hertz, ____ volts.

Mechanical Equipment: Fan(s) shall be propeller type, incorporating heavy-duty, cast aluminum blades. Fan blades shall be individually adjustable and replaceable. Fan(s) shall be driven through a right-angle, industrial-duty, oil-lubricated, geared speed reducer, equipped with an oil level sight glass. The mechanical equipment shall be structurally supported independent of the casing, and shall be installed and adjusted to proper fan tip clearance at the factory. With the exception of the motor itself, the mechanical equipment system shall be warranted against any failure caused by defects in materials and workmanship for a period of 5 (five) years from date of tower shipment. This warranty shall cover the fans, speed reducers, couplings or belts, and the mechanical equipment supports.

Fill, Louvers & Drift Eliminators: Fill shall be film-type, vacu-formed PVC, with louvers and drift eliminators formed as part of each fill sheet. Fill shall be suspended from hot dip galvanized structural tubing supported from the upper tower structure, and shall be elevated above the floor of the cold water basin to facilitate cleaning. Air inlet faces of the tower shall be free of water splash-out. Guaranteed drift losses shall not exceed 0.005% of the design GPM.

Hot Water Distribution System: Two open basins (one above each fill bank) shall receive hot water piped to each cell of the tower. These basins shall be installed and sealed at the factory. G-210 galvanized steel distribution basin covers are required. Each basin shall include a _____" diameter hole and bolt circle to accept a 125# flange connection per ANSI B16.1. If shown on plans, flow-control valves shall be provided at the inlet to each basin. These valves shall permit both flow balancing and positive shut off to selected cells. Water shall enter the basins through removable wave-suppressor flumes. Each basin shall be no less than 6-3/4" deep to provide adequate freeboard against overflow and splash-out. Removable and replaceable polypropylene nozzles installed in the floor of these basins shall provide full coverage of the fill by gravity flow. Nozzles must all have the same orifice size and be spaced symmetrically in both longitudinal and transverse directions.

Cold Water Basin & Accessories: The cold water basin shall be completed and sealed at the factory, requiring only the field installation of cell-interconnecting flumes (if any). The number and type of suction connections shall be as required to accomplish the outflow piping shown on the plans. Towers of more than one cell shall include stainless steel flumes for flow and equalizing between cells. Suction connection shall include a protective screen. A factory-installed, float-operated, mechanical make-up valve shall be included, having a ____" diameter inlet connection. A 4" diameter galvanized standpipe overflow shall be provided in each cell of the tower. Overflows shall be removable to permit flush-out cleaning of the basin. All basin accessories shall be easily accessible through large hinged access doors at each end of each cell of the tower.

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