SPX®

ENGINEERING DATA
AND SPECIFICATIONS

Marley AV

COOLING TOWER

Marley®

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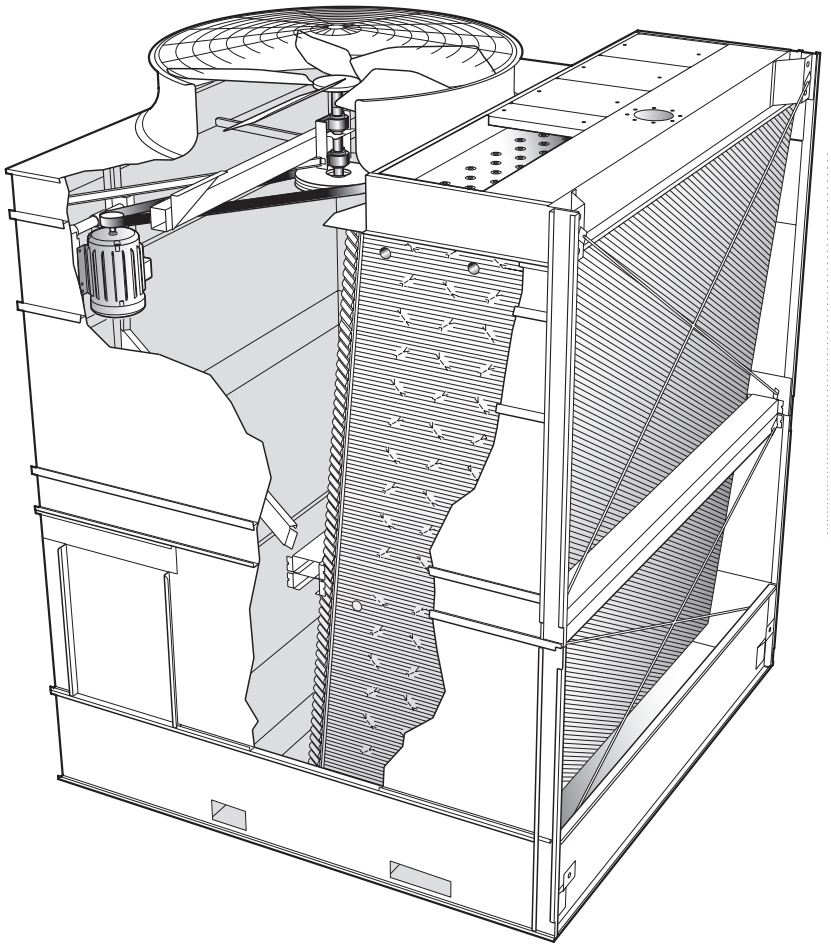


AV towers are galvanized steel, factory-assembled, general purpose crossflow cooling towers, designed to serve normal air conditioning and refrigeration systems as well as light industrial loads. They evolve from a singleflow concept of towers pioneered by Marley in the 1950s, and incorporate all of the design advancements that our customers have found valuable. They represent the current state of the art in this cooling tower category.

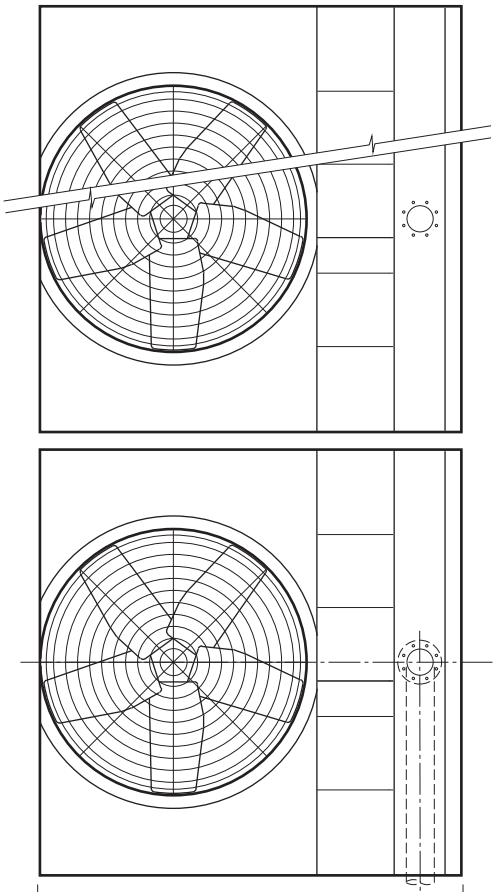
This booklet not only relates the language to use in describing an appropriate AV cooling tower—but also defines why certain items and features are important enough to specify with the intention of insisting upon compliance by all bidders. The left hand column of pages 18 thru 35 provides appropriate text for the various specification paragraphs, whereas the right hand column comments on the meaning of the subject matter and explains its value.

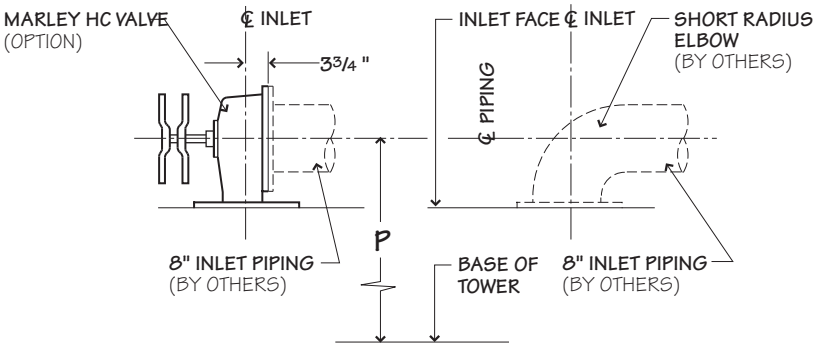
Pages 18 thru 25 indicate those paragraphs which will result in the purchase of a basic cooling tower—one that accomplishes the specified thermal performance, but which will lack many operation—and maintenance-enhancing accessories and features that are usually desired by those people who are responsible for the continued and continuing operation of the system of which the 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 26 thru 35 provide paragraphs intended to add those features, components, and materials that will customize the tower to meet the user's requirements.

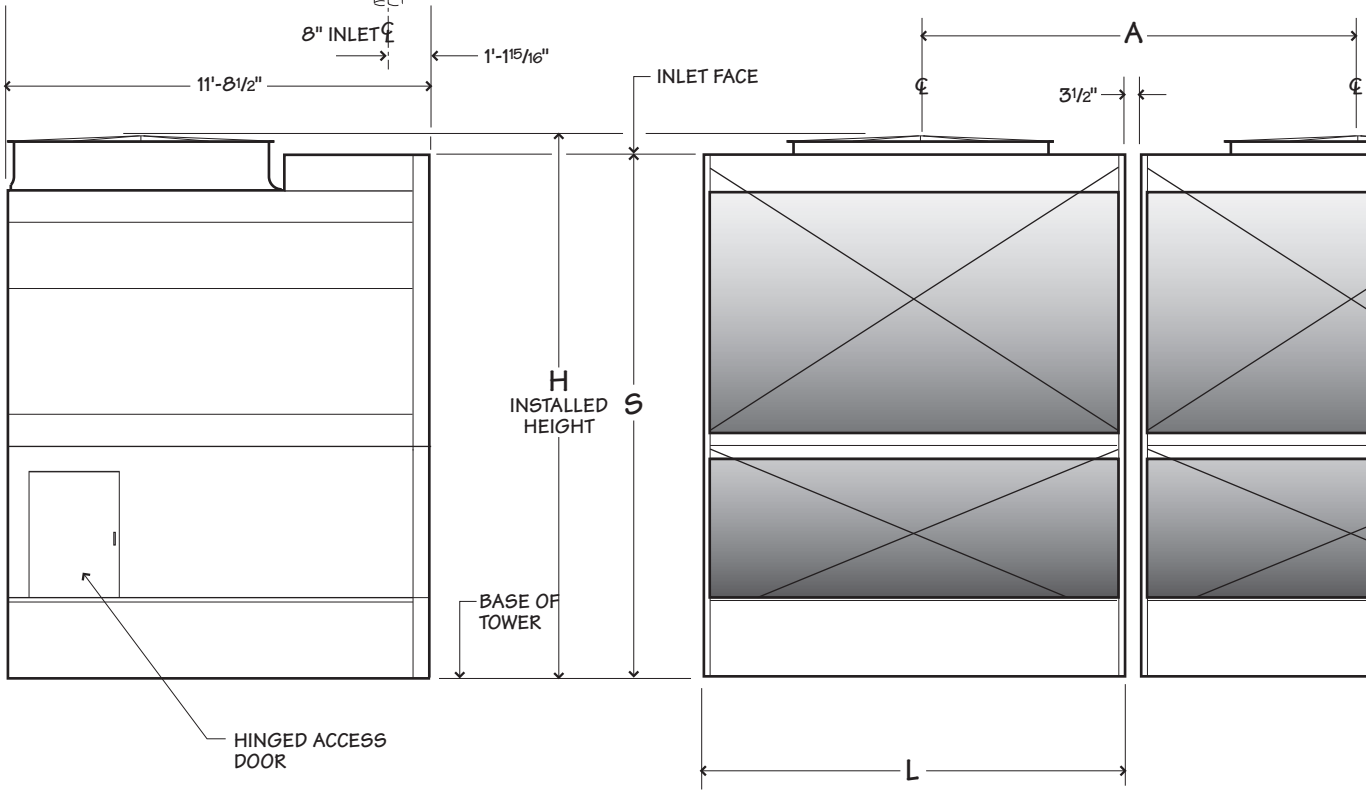
Use this data for preliminary layouts only. Obtain current drawing from your Marley sales representative.

UPDATE™ web-based selection software, available at spxcooling.com/update provides AV cooling tower model recommendations based on customer's specific design requirements.





INLET PIPING DETAILS



Tower Model note 2	Nominal Tons note 3	Dimensions					Motor hp	Design Operating Wt/Cell lb	Shipping Weight lb	
		L	H	A	S	P			Weight/Cell	Heaviest Section
AV6100A	117	8'-4"	12'-3 3/16"	8'-7 1/2"	11'-6 11/16"	12'-3 15/16"	3	8098	4248	—
AV6101A	138						5	8135	4285	—
AV6102A	157						7 1/2	8165	4315	—
AV6103A	167						10	8356	4506	—
AV6104A	195						15	8454	4604	—
AV6200A	172	11'-10"	12'-3 3/16"	12'-1 1/2"	11'-6 11/16"	12'-3 15/16"	5	10779	5316	—
AV6201A	193						7 1/2	10809	5346	—
AV6202A	213						10	10837	5374	—
AV6203A	229						15	11192	5729	—
AV6204A	259						20	11235	5772	—
AV6205A	275						25	11335	5872	—
AV6300A	190	8'-4"	15'-2 11/16"	8'-7 1/2"	14'-6 3/16"	15'-3 7/16"	7 1/2	9939	5467	3112
AV6301A	204						10	9969	5497	3142
AV6302A	232						15	10248	5776	3335
AV6303A	248						20	10344	5872	3431
AV6304A	264						25	10442	5970	3529
AV6400A	201	8'-4"	16'-7 15/16"	8'-7 1/2"	15'-11 7/16"	16'-8 11/16"	7 1/2	10573	5735	3112
AV6401A	217						10	10583	5765	3142
AV6402A	246						15	10836	6057	3335
AV6403A	263						20	10932	6153	3431
AV6404A	285						25	11029	6250	3528
AV6405A	302						30	11069	6290	3568
AV6500A	242	9'-10"	16'-7 15/16"	10'-1 1/2"	15'-11 7/16"	16'-8 11/16"	10	12019	6428	3513
AV6501A	270						15	12120	6529	3614
AV6502A	288						20	12468	6877	3836
AV6503A	311						25	12572	6981	3940
AV6504A	329						30	12615	7019	3978
AV6505A	345						40	12780	7189	4148
AV6600A	279	11'-10"	15'-2 11/16"	12'-1 1/2"	14'-6 5/16"	15'-3 7/16"	15	13247	6943	3990
AV6601A	305						20	13400	7036	4083
AV6602A	322						25	13774	7410	4326
AV6603A	343						30	13812	7448	4364
AV6604A	355						40	13982	7618	4534
AV6700A	293	11'-10"	16'7 15/16"	12'-1 1/2"	15'-11 7/16"	16'-8 11/16"	15	14052	7267	3990
AV6701A	320						20	14145	7360	4083
AV6702A	344						25	14249	7464	4187
AV6703A	365						30	14578	7641	4364
AV6704A	390						40	14748	7811	4534

NOTE

1 **Use this bulletin for preliminary layouts only.** Obtain current drawings from your Marley sales representative. All table data is per cell.

2 Last numeral of model number indicates number of cells. Change as appropriate for your selection.

3 Nominal tons are based upon 95°F HW, 85°F CW, 78°F WB and 3 GPM/ton.

4 Standard overflow is a 4" dia. connection in the collection basin wall on the air inlet side of the tower. A 3" dia. drain connection is located below the overflow. See page 7 for details

5 Outlet sizes vary according to GPM and arrangement. See pages 6 and 7 for outlet sizes and details.

6 Makeup water connection may be 1" or 2" dia., depending upon tower heat load, water pressure, and desired connections. See page 6 for additional information.

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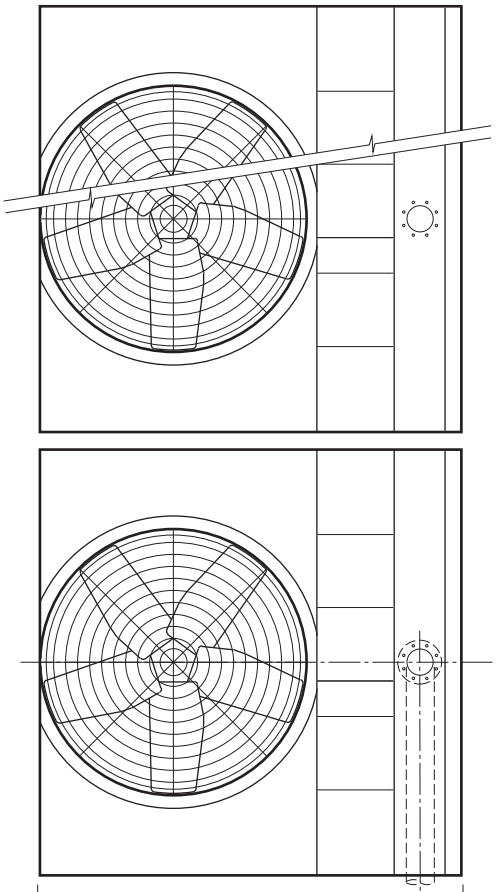
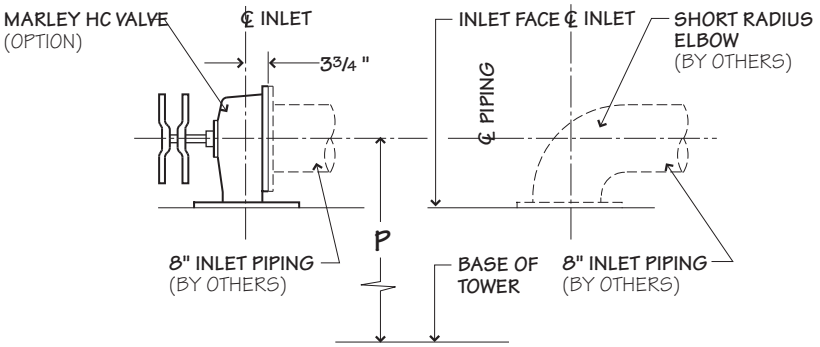
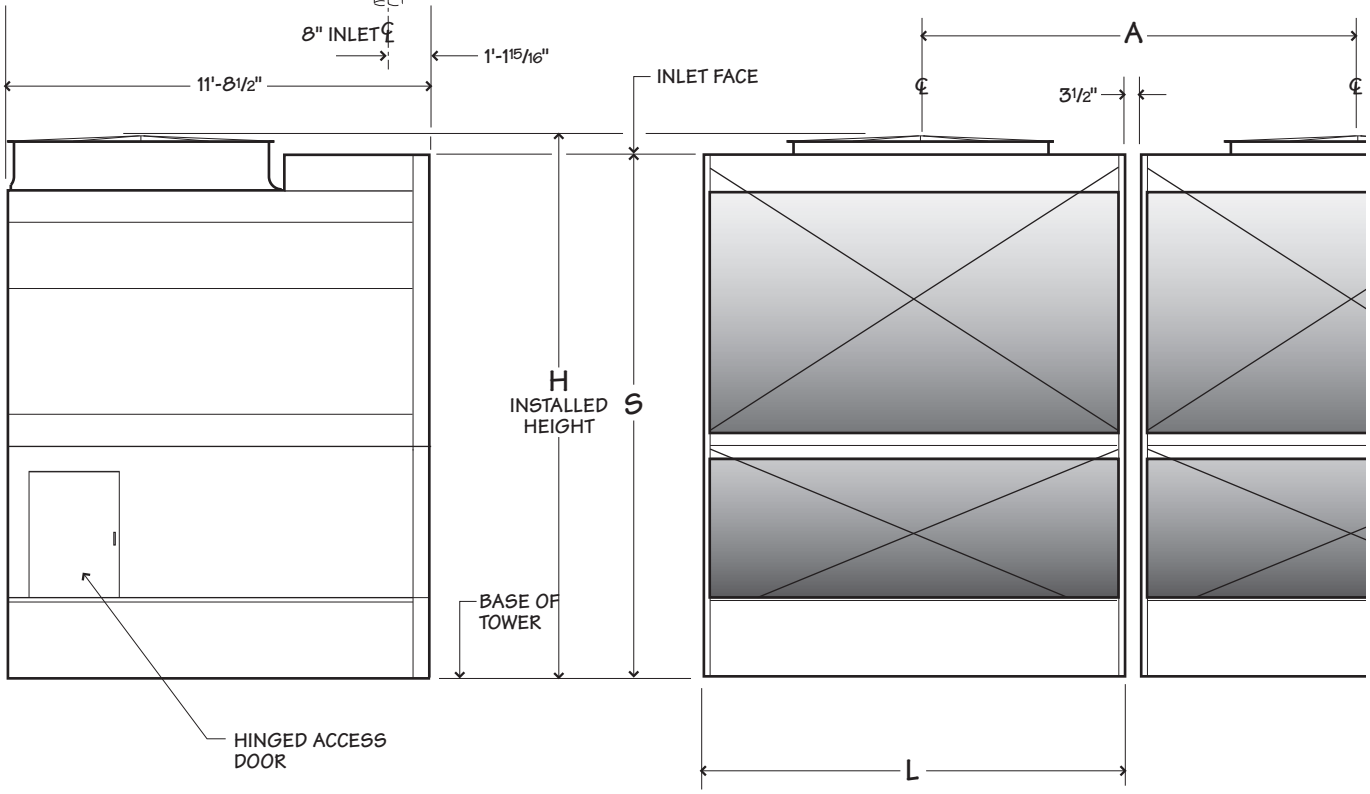




INLET PIPING DETAILS



Tower Model note 2	Nominal Tons note 3	Dimensions					Motor hp	Design Operating Wt/Cell lb	Shipping Weight lb	
		L	H	A	S	P			Weight/Cell	Heaviest Section
AV6100L	115	8'-4"	12'-3 3/16"	8'-7 1/2"	11'-6 11/16"	12'-3 15/16"	3	8232	4382	—
AV6101L	135						5	8283	4433	—
AV6102L	154						7 1/2	8383	4533	—
AV6103L	164						10	8532	4682	—
AV6104L	191						15	8653	4803	—
AV6200L	169	11'-10"	12'-3 3/16"	12'-1 1/2"	11'-6 11/16"	12'-3 15/16"	5	10926	5463	—
AV6201L	189						7 1/2	11027	5564	—
AV6202L	209						10	11068	5605	—
AV6203L	224						15	11344	5881	—
AV6204L	254						20	11412	5949	—
AV6205L	270						25	11584	6121	—
AV6300L	186	8'-4"	15'-2 11/16"	8'-7 1/2"	14'-6 3/16"	15'-3 7/16"	7 1/2	10157	5685	3330
AV6301L	200						10	10201	5729	3374
AV6302L	227						15	10449	5977	3536
AV6303L	243						20	10517	6045	3604
AV6304L	259						25	10692	6220	3779
AV6400L	197	8'-4"	16'-7 15/16"	8'-7 1/2"	15'-11 7/16"	16'-8 11/16"	7 1/2	10791	5953	3330
AV6401L	213						10	10815	5997	3374
AV6402L	241						15	11059	6280	3558
AV6403L	258						20	11105	6326	3604
AV6404L	279						25	11280	6501	3779
AV6405L	296						30	11360	6581	3859
AV6500L	237	9'-10"	16'-7 15/16"	10'-1 1/2"	15'-11 7/16"	16'-8 11/16"	10	12251	6660	3745
AV6501L	265						15	12345	6754	3839
AV6502L	282						20	12651	7060	4019
AV6503L	305						25	12821	7230	4189
AV6504L	322						30	12906	7310	4269
AV6505L	338						40	13202	7611	4570
AV6600L	273	11'-10"	15'-2 11/16"	12'-1 1/2"	14'-6 5/16"	15'-3 7/16"	15	13473	7169	4216
AV6601L	299						20	13578	7214	4261
AV6602L	316						25	14023	7659	4575
AV6603L	336						30	14103	7739	4655
AV6604L	348						40	14404	8040	4956
AV6700L	287	11'-10"	16'7 15/16"	12'-1 1/2"	15'-11 7/16"	16'-8 11/16"	15	14278	7493	4216
AV6701L	314						20	14323	7538	4261
AV6702L	337						25	14493	7708	4431
AV6703L	358						30	14869	7932	4655
AV6704L	382						40	15171	8234	4957

NOTE

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3 Nominal tons are based upon 95°F HW, 85°F CW, 78°F WB and 3 GPM/ton.

4 Standard overflow is a 4" dia. connection in the collection basin wall on the air inlet side of the tower. A 3" dia. drain connection is located below the overflow. See page 7 for details

5 Outlet sizes vary according to GPM and arrangement. See pages 6 and 7 for outlet sizes and details.

6 Makeup water connection may be 1" or 2" dia., depending upon tower heat load, water pressure, and desired connections. See page 6 for additional information.

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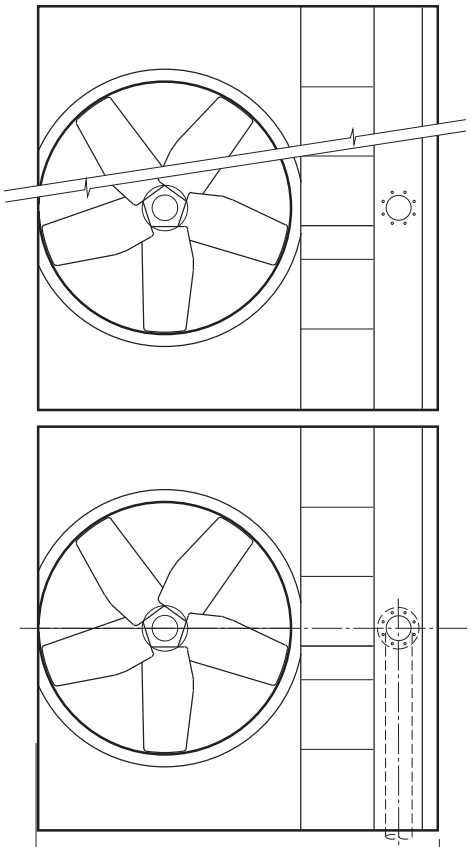
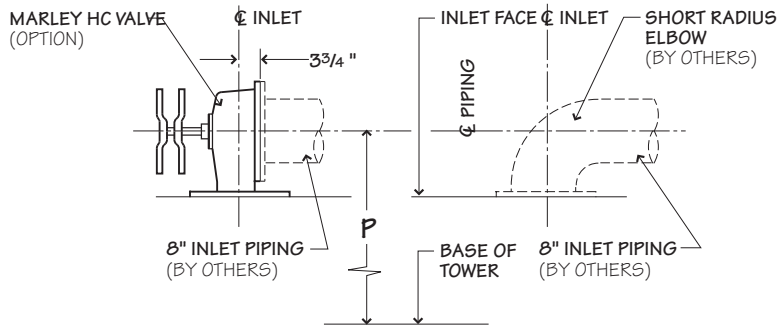
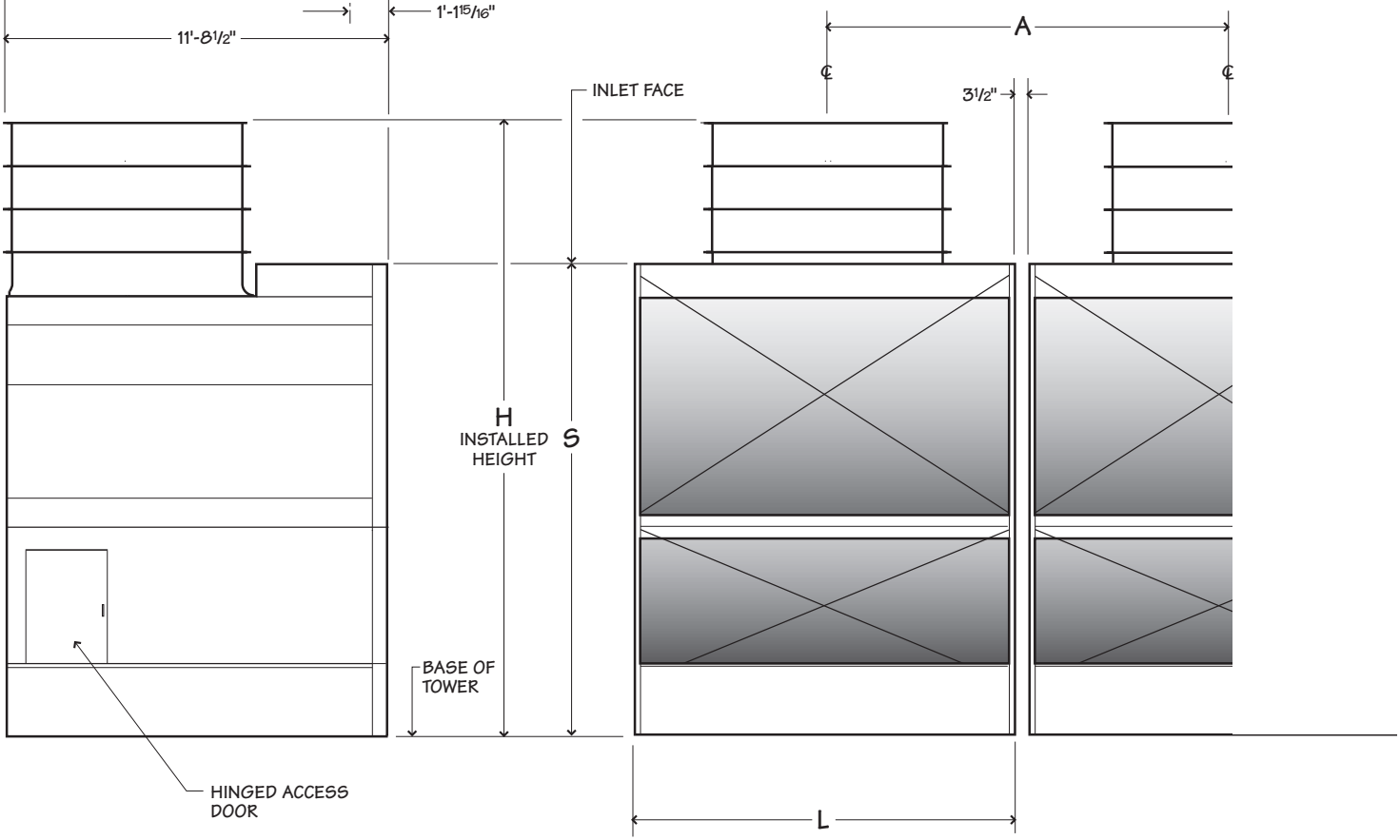




INLET PIPING DETAILS



Tower Model note 2	Nominal Tons note 3	Dimensions					Motor hp	Design Operating Wt/Cell lb	Shipping Weight lb	
		L	H	A	S	P			Weight/Cell	Heaviest Section
AV6100C	117	8'-4"	14'-8⅞"	8'-7½"	11'-6¹¹⁄₁₆"	12'-3¹⁵⁄₁₆"	3	8358	4508	—
AV6101C	138						5	8390	4540	—
AV6102C	157						7½	8489	4639	—
AV6103C	167						10	8662	4812	—
AV6104C	195						15	8760	4910	—
AV6200C	172	11'-10"	14'-8⅞"	12'-1½"	11'-6¹¹⁄₁₆"	12'-3¹⁵⁄₁₆"	5	10953	5490	—
AV6201C	193						7½	11051	5588	—
AV6202C	213						10	11090	5627	—
AV6203C	229						15	11399	5936	—
AV6204C	259						20	11435	5972	—
AV6205C	275						25	11609	6146	—
AV6300C	190	8'-4"	17'-8½"	8'-7½"	14'-6⁵⁄₁₆"	15'-3⁷⁄₁₆"	7½	10563	6091	3736
AV6301C	204						10	10609	6137	3782
AV6302C	232						15	10882	6410	3969
AV6303C	248						20	10926	6454	4013
AV6304C	264						25	11099	6627	4186
AV6400C	201	8'-4"	18'-1¹¹⁄₁₆"	8'-7½"	15'-11⁷⁄₁₆"	16'-8¹¹⁄₁₆"	7½	11196	6358	3735
AV6401C	217						10	11219	6401	3778
AV6402C	246						15	11470	6691	3969
AV6403C	263						20	11510	6731	4009
AV6404C	285						25	11687	6908	4186
AV6405C	302						30	11767	6988	4266
AV6500C	242	9'-10"	18'-1¹¹⁄₁₆"	10'-1½"	15'-11⁷⁄₁₆"	16'-8¹¹⁄₁₆"	10	12619	7028	4113
AV6501C	270						15	12723	7132	4217
AV6502C	288						20	13019	7428	4387
AV6503C	311						25	13192	7601	4560
AV6504C	329						30	13277	7681	4640
AV6505C	345						40	13579	7988	4947
AV6600C	279	11'-10"	17'-8½"	12'-1½"	14'-6⁵⁄₁₆"	15'-3⁷⁄₁₆"	15	13805	7501	4548
AV6601C	305						20	13902	7538	4585
AV6602C	322						25	14349	7985	4901
AV6603C	343						30	14429	8065	4981
AV6604C	355						40	14736	8372	5288
AV6700C	293	11'-10"	18'-1¹¹⁄₁₆"	12'-1½"	15'-11⁷⁄₁₆"	16'-8¹¹⁄₁₆"	15	14610	7825	4548
AV6701C	320						20	14647	7862	4585
AV6702C	344						25	14824	8039	4762
AV6703C	365						30	15195	8258	4981
AV6704C	390						40	15502	8565	5288

NOTE

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2 Last numeral of model number indicates number of cells. Change as appropriate for your selection.

3 Nominal tons are based upon 95°F HW, 85°F CW, 78°F WB and 3 GPM/ton.

4 Standard overflow is a 4" dia. connection in the collection basin wall on the air inlet side of the tower. A 3" dia. drain connection is located below the overflow. See page 7 for details

5 Outlet sizes vary according to GPM and arrangement. See pages 6 and 7 for outlet sizes and details.

6 Makeup water connection may be 1" or 2" dia., depending upon tower heat load, water pressure, and desired connections. See page 6 for additional information.

OUTLET AND MAKEUP PIPING DETAILS

Unless otherwise specified, single-cell towers normally have a side-outlet suction appropriate for the design water flow rate—see page 7. This usually assures the lowest possible installed tower elevation. Side-suction connection pipes extend roughly 3" outside the basin, and are beveled for weld connection and also grooved for a mechanical coupling.

Outlet piping can be kept below the cold water basin level by choosing a bottom outlet connection in lieu of the side suction. Bottom outlet design conform to standard class 125 ANSI pipe flange specifications. All outlet arrangements include easily removable debris screens.

Multicell towers, intended to operate together as a common unit, are joined by steel flumes between the collection basins. These flumes equalize the operating water level between basins and also provide a flow passage from cells not equipped with outlets or makeup valves, often eliminating the need to specify an outlet and makeup valve for each cell on a multicell installation. Refer to sales drawings to obtain flow values of suctions and bottom outlets for multicell installations.

The best choice for a tower used with a remote or indoor storage tank—see page 11—or on a concrete cold water basin is usually a bottom outlet, with or without screen.

MAKEUP

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

The AV tower is equipped with a float-operated, mechanical makeup valves to automatically replenish this lost water. The following tables, 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 makeup water, we offer a price reduction for deleting the makeup valve.

Makeup Water Flow Required–gpm to maintain three (3) concentrations

Tower gpm	Cooling "Range" (hot water° minus 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

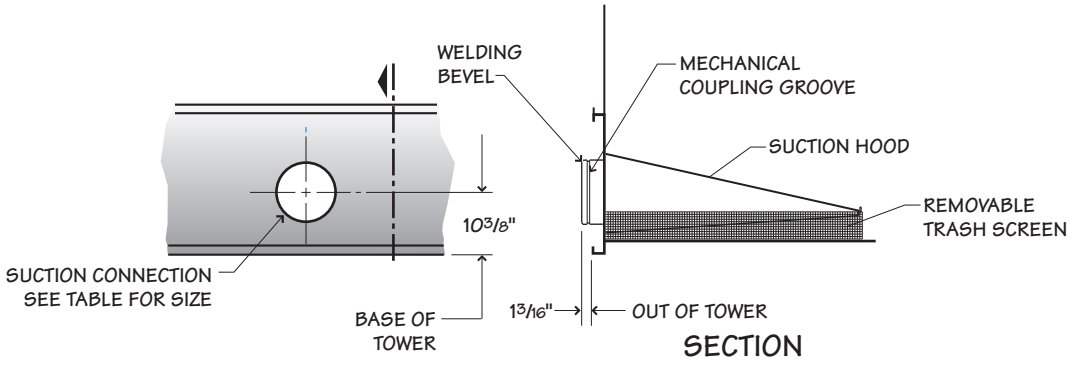
- If circulating water is to be maintained at 2 concentrations instead of 3, multiply table gpm values by 1.36 before sizing makeup valve.

Makeup Valve Flow Capacities–GPM

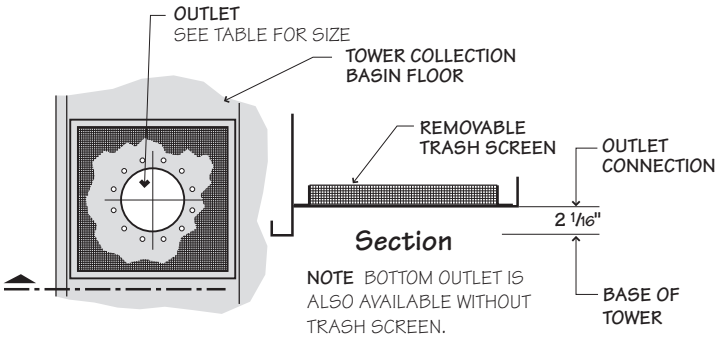
Pressure at Valve Inlet while flowing–psig	1" Diameter Valve	2" Diameter Valve
10	56	90
20	78	120
30	92	143
40	106	160
50	117	167

NOTE

- If makeup water pressure exceeds 50 psig, use pressure reducer ahead of valve.
- For flow requirements exceeding the above limitations, use multiples of the same size valve.

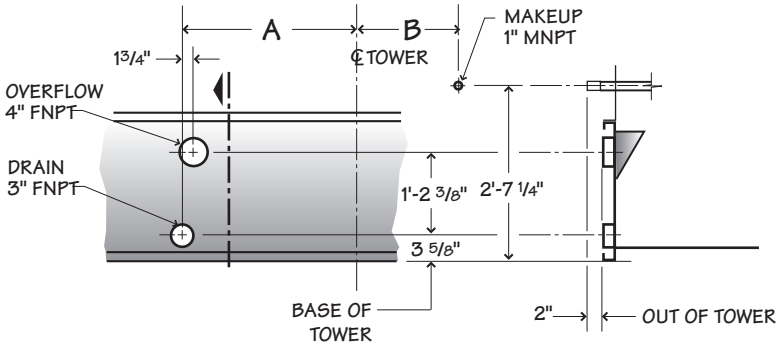


SIDE-OUTLET SUCTION CONNECTION



BOTTOM OUTLET CONNECTION

Outlet Dia.	Maximum gpm Outlet				
	Side Suction pump flow air inlet face		Side Suction pump flow cased face	Bottom Outlet pump flow	Bottom Outlet pump flow w/anti-vortex plate or gravity flow
	AV61 and AV63 thru AV65	AV62 AV66 and AV67	All Models	All Models	All Models
4"	—		—	71	164
6"	—		—	162	372
8"	1595		1568	287	658
10"	2562		—	453	1038
12"	—	3500	—	644	1476
14"	—		—	788	1807



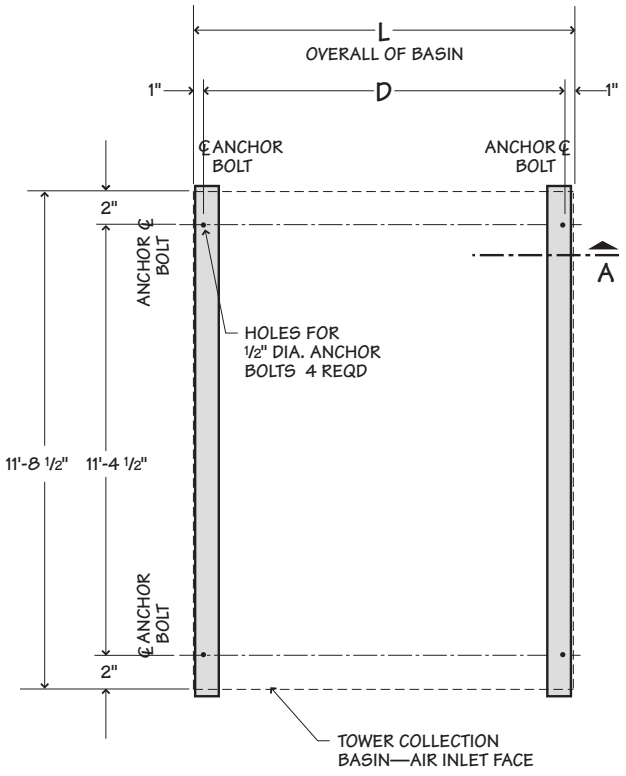
Tower Model	Dimensions	
	A	B
AV61	1'-9"	3'-10"
AV62	3'-6"	5'-7"
AV63	1'-9"	3'-10"
AV64	1'-9"	3'-10"
AV65	2'-6"	4'-7"
AV66	3'-6"	5'-7"
AV67	3'-6"	5'-7"

OVERFLOW, DRAIN, AND MAKEUP CONNECTION

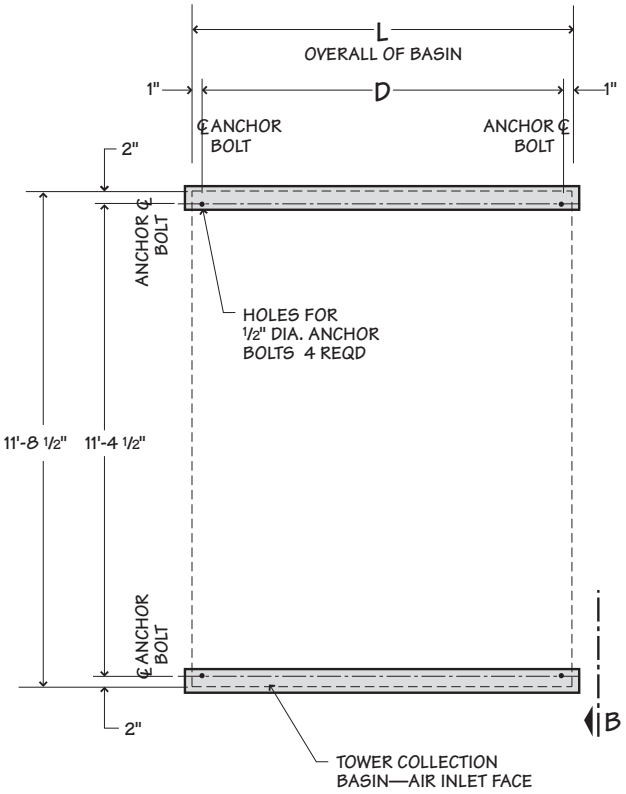
NOTE

1 For gravity-flow situations (as to an indoor tank), use bottom outlet. Side outlet suction is not recommended for gravity flow.

2 GPM limits are based on single-cell or multicell towers with a single outlet per cell. For multicell towers connected with collection basin flumes and less than one outlet per tower cell consult your Marley sales representative for more specific information.

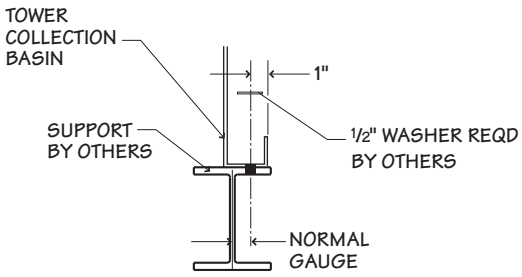


SUPPORTING STEEL
OPTION ONE

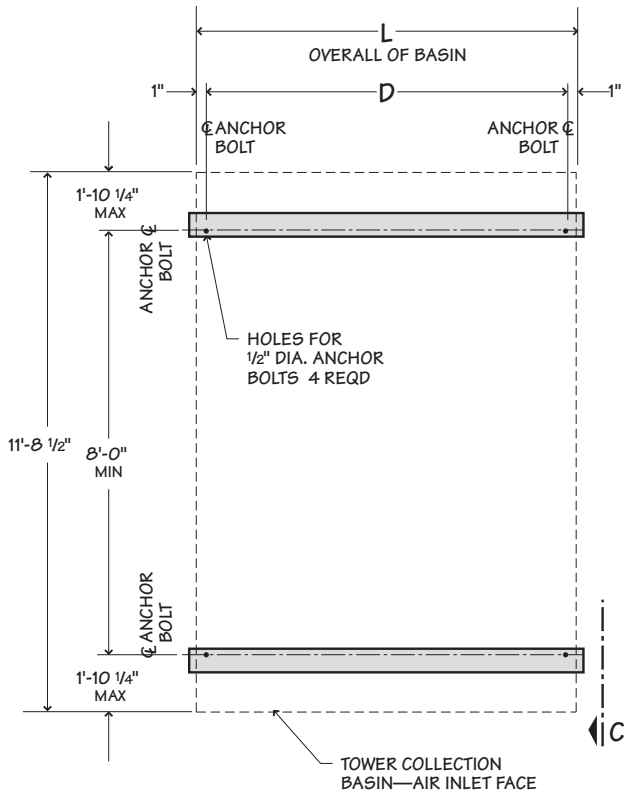


SUPPORTING STEEL
OPTION TWO

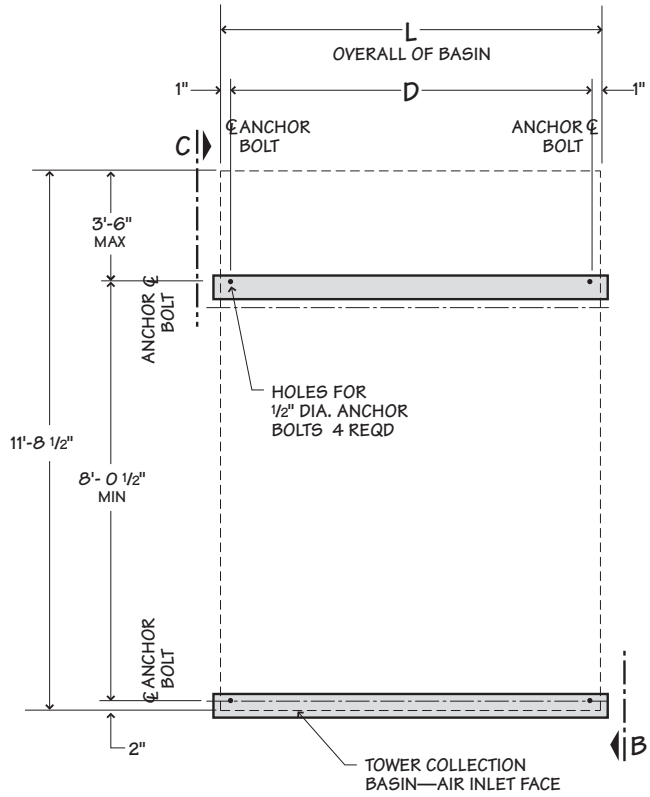
Tower Model	Dimensions		Design Operating Weight/Cell lb	Design Operating Load at Anchor lb
	L	D		
AV6100	8'-4"	8'-2"	8435	2815
AV6200	11'-10"	11'-8"	11314	3824
AV6300	8'-4"	8'-2"	10370	3436
AV6400	8'-4"	8'-2"	11024	3636
AV6500	9'-10"	9'-8"	12709	4203
AV6600	11'-10"	11'-8"	13912	4709
AV6700	11'-10"	11'-8"	14791	4939



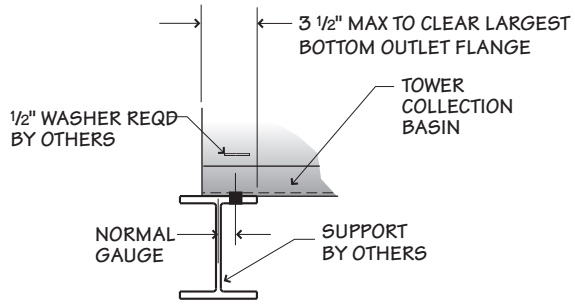
SECTION A



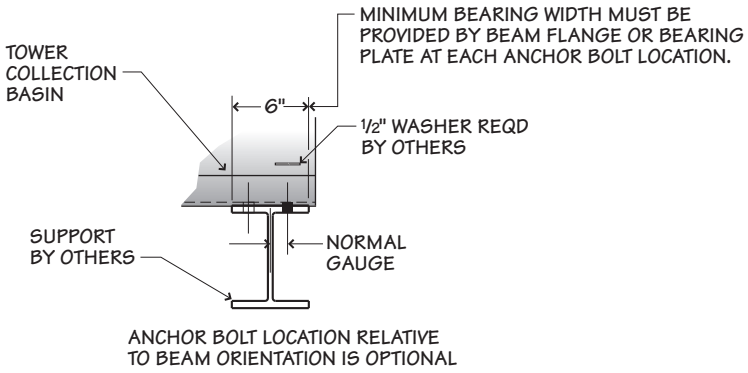
SUPPORTING STEEL
OPTION THREE



SUPPORTING STEEL
OPTION FOUR



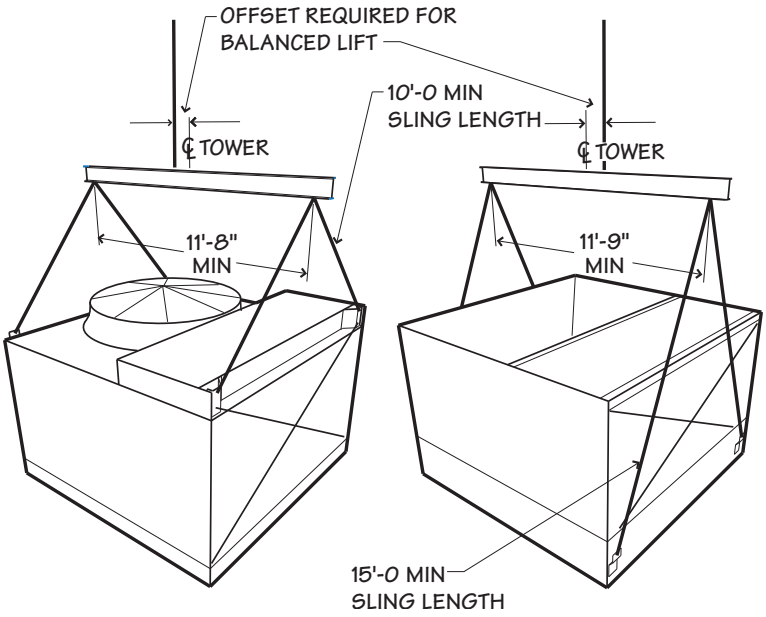
VIEW B



VIEW C

NOTE

1 Use this bulletin for preliminary layouts only. Obtain current drawings from your Marley sales representative for final design.
2 Grillage anchorage Option Three is not intended for use with the Bottom Outlet Option.
3 Multicell installations shall conform to arrangements shown. The standard spacing between the side face anchor bolts is 5½".
4 Purchaser to provide tower support complete with holes and anchor bolts. Do not use studs! Anchor points must be framed flush and level at top.
5 Design operating weight occurs with collection basin full to overflow level. Actual operating weight varies with GPM and piping scheme.
6 Anchorage for Supporting Steel Options One and Two are designed for 30 psf wind and/or .7g seismic loading for AV61 and AV62, 20 psf wind and/or .3g for AV63 thru AV65 and 20 psf wind and/or .46g for AV66 and AV67. Anchorage capacity for Supporting Steel Options Three and Four are less and will vary with the beam spacing.
7 Tower may be placed on a flat concrete slab. Side outlet must be specified. See pages 6 and 7 and consult your Marley application sales representative.
8 Tower may be supported from piers at each anchor bolt location, as a support alternative.



NOTE

1 All hoisting clip holes are 1¼".
2 Overall length of shackle pins should not exceed 5¼".
3 For overhead lifts or where additional safety is required, add slings beneath the tower unit.

When the ambient air temperature falls below 32°F, the water in a cooling tower can freeze. *Marley Technical Report #H-003* "Operating Cooling Towers in Freezing Weather" describes how to prevent freezing during operation. Available at spxcooling.com or ask your Marley sales representative for a copy.

During shutdown, water collects in the cold water basin 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

An automatic basin water heater system is available consisting of the following components:

- Stainless steel electric immersion heater(s).
  - —Threaded couplings are provided in the side of the collection basin.
- NEMA 4 enclosure containing:
  - —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 cutoff.
  - Enclosure may be mounted on the side of the tower.
- Control probe in the collection basin to monitor water temperature and level.

Heater components are normally shipped separately for installation by others.

Note: any exposed piping that is still filled with water at shutdown—including the makeup water line—should be electrically traced and insulated (by others).

STEAM JET BASIN HEATER

Penberthy Houdaille bronze steam jet heaters (¼" to ¾") are available for freeze protection (installation by others). Injectors install in a coupling provided in the side of the collection basin. Live steam, as required, is injected directly into the water. Condensed steam adds water to the basin, and the excess will exit the overflow of the tower.

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 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 makeup water according to the level where the tank stabilizes during operation.

SOUND CONTROL

Sound produced by an AV 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 6 dBA each time the distance doubles.

All standard AV cooling towers are equipped with low sound fans. This in combination with zero-splash crossflow film-fill results in a line of towers capable of meeting most noise limitations. Where noise at a critical point is likely to exceed an acceptable limit, several other options are available—listed below in ascending order of cost impact:

- The Marley "Quiet Package" includes the affordable Quiet Fan mechanical option, optimized to achieve the lowest possible sound levels while maintaining efficiency.
- A Marley Variable Speed Drive automatically minimizes the tower's noise level during periods of reduced load and/or reduced ambient temperature 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. The natural nighttime reduction in wetbulb temperature makes this a very feasible solution in most areas of the world. It also eliminates fan cycling. In combination with a Marley Quiet Package, the Marley Variable Speed Drive is capable of meeting all but the most restrictive noise limitations.
- For more severe cases requiring the lowest possible fan sound levels the Marley "Ultra Quiet" fan option is now available on most AV models. Tower height will increase—obtain current sales drawings from your Marley sales representative for accurate dimensions.
- 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.

Although not an industry requirement, all published sound data on Marley cooling towers are in accordance with CTI ATC128 so you can be assured of sound data accuracy.

ENCLOSURE

Occasionally, cooling towers are located inside architectural enclosures for aesthetic reasons. Although AV Series towers adapt well to enclosures, the designer must realize the potential impact of a poorly arranged enclosure on the tower's performance and operation. The designer must take care to provide generous air inlet paths, and the tower's fan cylinder discharge height should not be lower than the elevation of the top of the enclosure. Obtain a copy of *Marley Technical Report #H-004* "External Influences on Cooling Tower Performance" from your Marley sales representative.

As suggested in the aforementioned Technical Report, 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 sales representative.

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

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 blowdown 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 circulating water should fall 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 possible. Specific startup instructions and additional water quality recommendations can be found in the AV Series User Manual which accompanies the tower and also is available from your local Marley sales representative. For complete water treatment recommendations, consult a competent, qualified water treatment supplier.

⚠ CAUTION

The cooling tower must be located at such distance and direction to avoid the possibility of contaminated 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 cooling tower is in compliance with applicable air pollution, fire and clean air codes.

TYPICAL APPLICATIONS

The AV cooling tower can be used in normal applications requiring cold water for the dissipation of heat. This includes condenser water cooling for air conditioning, refrigeration, and thermal storage systems, as well as their utilization for free-cooling in all of those systems. They are also used in the cooling of jacket water for engines and air compressors, and are widely applied to dissipate waste heat in a variety of industrial and manufacturing processes.

Choosing the all stainless steel construction option, the AV can be confidently applied in unusually corrosive processes and operating environments. However, no single product line can answer all problems, and selective judgement should be exercised in the following situations

APPLICATIONS REQUIRING ALTERNATIVE COOLING TOWER SELECTIONS

Certain types of applications are incompatible with any cooling tower with PVC film fill—whether an AV or other manufacturer's cooling tower of similar design. PVC is subject to distortion in high water temperatures, and the narrow passages typical of film-type fill are easily clogged by turbid or debris-laden water. Some of the applications, which call for alternative tower designs are:

- Ethylene glycol content—can plug fill passages as slime and algae accumulate to feed on the available organic materials.
- Fatty acid content—found in processes such as soap and detergent manufacturing and some food processing, fatty acids pose a serious threat for plugging fill passages.
- Particulate carry over—often found in steel mills and cement plants, can both cause fill plugging, and can build up to potentially damaging levels on tower structure.
- Pulp carry over—typical of the paper industry and food processing where vacuum pumps or barometric condensers are used. Causes fill plugging which may be intensified by algae.

ALTERNATIVE SELECTIONS

In addition to the AV Series, we offer a full scope of Marley products in various designs and capacities to meet the special demands of specific applications.

spxcooling.com—visit us on the web for a complete list of products, services, publications and to find your nearest sales representative.

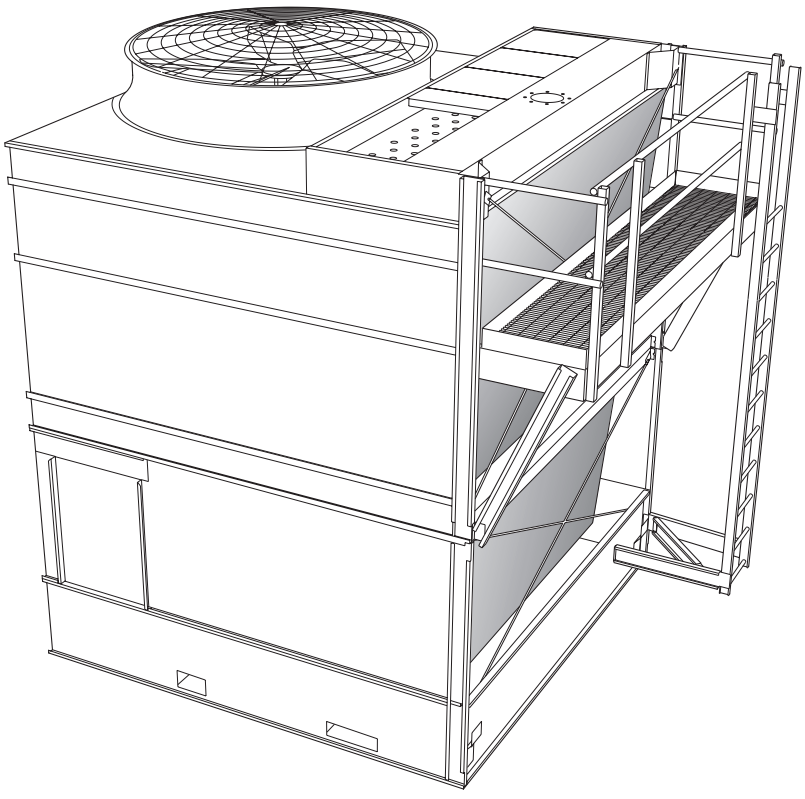
CORROSION RESISTANCE

- QuadraFlow®—fiberglass and stainless steel construction assures long service life in virtually any environment. Five-year full product warranty. Efficient PVC film fill. Uniquely different and architecturally attractive.
- Sigma™—available in wood, fiberglass, HDG steel or stainless steel structure. Field-erected for medium to large projects. Available in a wide range of sizes. Efficient PVC film fill.

SPLASH FILL

- NC® alpha—available in galvanized steel and stainless steel, with splash-type fill. Excellent in “dirty water” applications.

Specifications	Specification Value
1.0 **Base:**	
1.1 Provide an induced draft, crossflow type, factory assembled, film fill, industrial duty, galvanized steel cooling tower situated as shown on the plans. The limiting overall dimensions of the tower shall be _____ ft wide, _____ ft long, and _____ ft high to the top of the fan guard. Total operating power of all fans shall not exceed _____ hp, consisting of ___ @ ___ hp motor(s). Tower shall be similar and equal in all respects to Marley Model _____.	■ 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 horsepower avoid the introduction of unforeseen operational and site-related influences. Specifying the number of cells, and the maximum fan hp/cell will work to your advantage. The benefit of crossflow towers is that they are inherently easy to operate, access, and maintain. Unlike counterflow towers, they have a spacious, full height plenum for easy access to all of the tower's internal components, and the water distribution system is readily open to view and cleaning. If your preference is for a stainless steel tower, or if your water or air quality suggests that the use of stainless steel is prudent, see stainless steel options on page 26.
1.2 The cooling tower shall be designed for quiet operation, and shall produce an overall level of sound not higher than _____ dB(A) measured at _____ ft from the location: _____. Sound levels shall be measured with a Type 1 (precision) system and in full conformance with ATC-128 test code published by the Cooling Technology Institute (CTI). The measurement system shall have a real-time frequency analyzer and separate microphones with an overall tolerance +/- 3 dB. All low sound options shall be CTI Certified for thermal performance.	



Ladder and access platform are optional accessories. See Page 24 for specification wording.

The ladder can be located on either end of the platform by simple field rearrangement of handrails and posts.

Specifications	Specification Value

2.0 **Thermal Performance:**

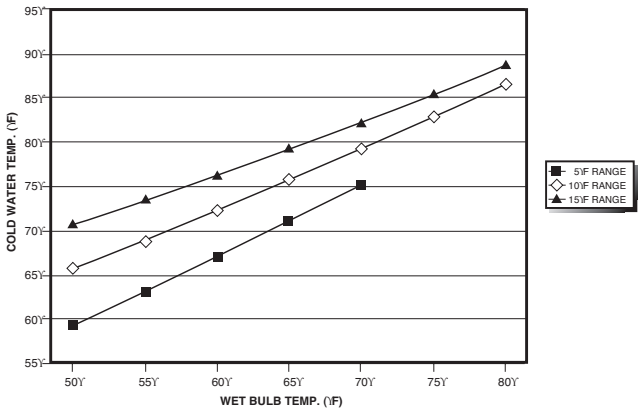
2.1 The tower shall be capable of cooling _____ gpm of water from ____ °F to _____ °F at a design entering air wet-bulb temperature of _____ °F, and its thermal rating shall be Certified by the Cooling Tower Institute.

■ CTI Certification means that the tower has been tested under operating conditions and found to perform as rated by the manufacturer under those circumstances. It assures the buyer that the tower is not intentionally or inadvertently undersized by the manufacturer.

3.0 **Performance Warranty:**

3.1 CTI Certification notwithstanding, the cooling tower manufacturer shall guarantee that the tower supplied will meet 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.

■ However, CTI certification alone is not sufficient to assure you that the tower will perform satisfactorily in your situation. Certification is established under relatively controlled conditions, and towers seldom operate under such ideal circumstances. They are affected by nearby structures, machinery, enclosures, effluent from other towers, etc. Responsible and knowledgeable bidders will take such site-specific effects into consideration in selecting the tower—but the specifier must insist by the written specification that the designer/manufacturer guarantee this “real world” performance. Any reluctance on the part of the bidder should cause you some concern.



4.0 **Design Loading:**

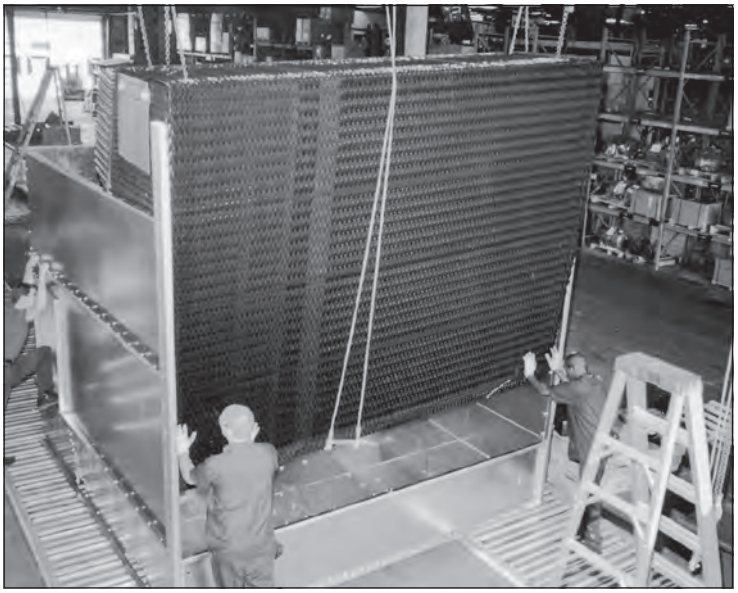
4.1 The tower structure and anchorage shall be designed to withstand a wind load of 20 psf (957 Pa), as well as .3g seismic load while operating. The tower shall be designed to withstand shipping and hoisting loads of 2g horizontal and 3g vertical. Handrails, where specified, shall be capable of withstanding a 200 lb. (890 N) concentrated live load in any direction, and shall be designed in accordance with OSHA guidelines. Fork lift slots shall be provided in the basin side supports to allow handling of the tower at grade level.

■ The design wind and seismic loads at the left are the minimum allowables for any model in the line under accepted design standards. Some models can withstand greater loads as listed below:

Model	*Wind*	*Seismic*
AV61 and AV62	30 psf	.7g
AV63 thru AV65	20 psf	.3g
AV66 and AV67	20 psf	.46g

If your application requires higher loads, consult your Marley sales representative. These standards give you assurance that the tower can be shipped, handled, hoisted and ultimately operated in a normal cooling tower environment.

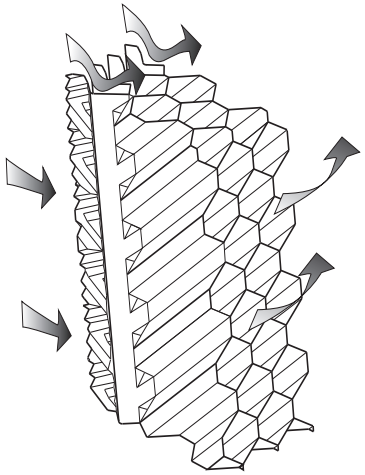
Specifications	Specification Value
5.0 **Construction:**	
5.1 Except where otherwise specified, all components of the cooling tower shall be fabricated of heavy-gauge steel, protected against corrosion by G-235 galvanizing. The tower shall be capable of withstanding water having a pH of 6.5 to 8.0; a chloride content (NaCl) up to 500 ppm; a sulfate content (SO_4) up to 250 ppm; a calcium content ($CaCO_3$) up to 500 ppm; and silica (SiO_2) up to 150 ppm. The circulating water shall contain no oil, grease, fatty acids, or organic solvents. Fiberglass casing, polyurethane barriers, and thermosetting hybrids and the components that are adhered to the sheet metal surface, shall be considered non-recyclable and not allowed.	■ 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. Except for those unusual operating situations where the circulating water may be so laden with suspended solids, algae, fatty acids, product fibers, active organisms reflected in BOD, and the like that plugging of the fill is a probability, reasonable attention to the construction materials and/or their coatings is all that is normally required. If your preference is for a stainless steel tower, or if your water or air quality suggests that the use of stainless steel is prudent, see stainless steel options on page 26.
5.2 The specifications, as written, are intended to indicate those materials that will be capable of withstanding the above water quality in continuing service, as well as the loads described in paragraph 4.1. They are to be regarded as minimum requirements. Where component materials peculiar 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.	
5.3 The tower shall include all design and material modifications necessary to meet the requirements of Factory Mutual. The product proposed shall be listed in the FM Approval Guide, latest edition.	

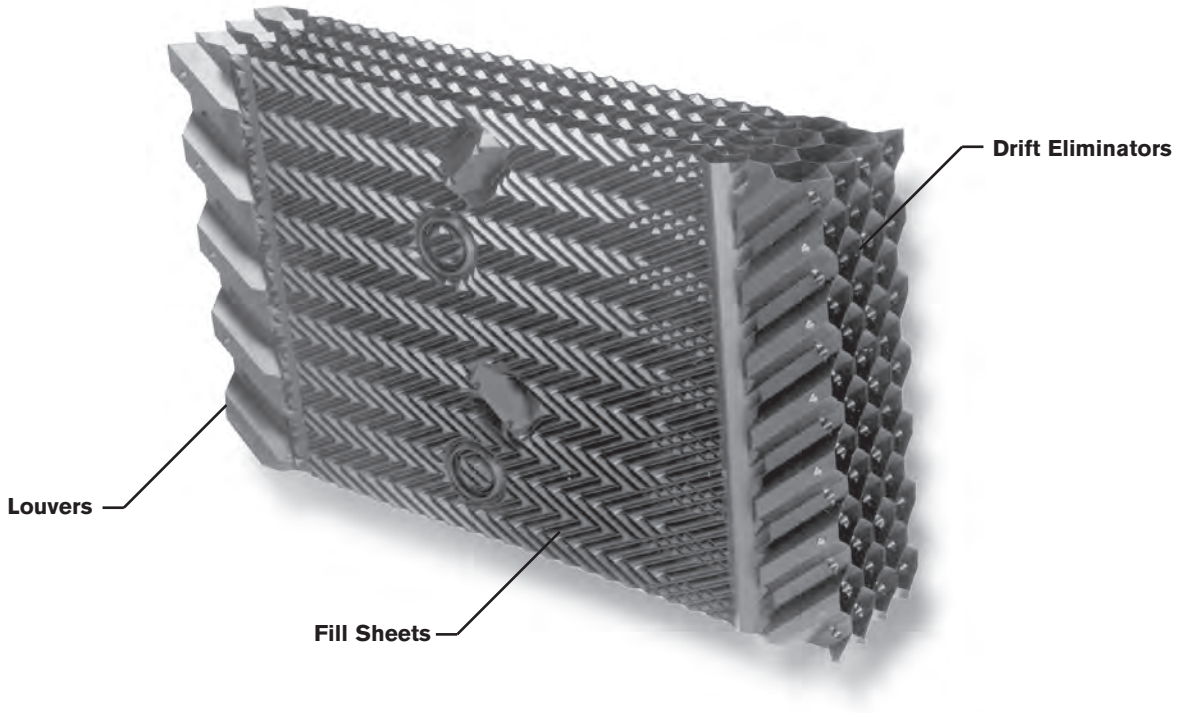


Factory Assembly

Specifications	Specification Value
6.0 **Mechanical Equipment**:	
6.1 Fan(s) shall be propeller type, incorporating heavy duty aluminum alloy blades attached to galvanized hubs with stainless steel U-bolts and hardware. Blades shall be attached to hubs with stainless steel hardware, and shall be individually adjustable. Fan(s) shall be driven through an industrial grade system of V-belts, pulleys, and tapered roller bearings. Bearings shall be rated at 50,000 hours, or greater.	■ Propeller-type fans require only half the operating hp of blower-type fans. However, they should be readily adjustable to permit compensation for job site conditions that may tend to overload the motor. The fans of one manufacturer require the purchase of special positioners for each increment of fan blade pitch. Unless otherwise specified, motor speed will be 1800 RPM in 60 Hertz areas and 1500 RPM in 50 Hertz areas. If you prefer the operating flexibility of two-speed operation, please specify the RPM to be 1800/900 (1500/750 in 50 Hertz regions). Incidentally, two speed motors are a far better choice than separate “pony” motors which simply double the problems indicated above. If your preference is for a stainless steel tower, or if your water or air quality suggests that the use of stainless steel is prudent, see stainless steel options on page 26.
6.2 Motor(s) shall be 40 Hp maximum, Totally Enclosed, 1.15 service factor, variable torque, and specially insulated for cooling tower duty. Speed and electrical characteristics shall be 1800 rpm, single-winding, ___ phase, ____ Hz, ____ volts.	
6.3 The fan and fan drive assembly for each cell shall be supported by a rigid, welded, hot dip galvanized steel structural support that resists misalignment. The mechanical equipment assembly shall be warranted against any failure caused by defects in materials and workmanship for no less than five (5) years following the date of tower shipment. This warranty is limited to the fan, fan shaft, bearings, and mechanical equipment support. The motor, motor components, sheaves and belt(s) are warranted by their manufacturer.	

Specifications	Specification Value
7.0 **Fill, Louvers, and Drift Eliminators:**	
7.1 Fill shall be film-type, thermoformed of PVC, with louvers and eliminators formed as part of each fill sheet. Fill shall be suspended from hot-dip galvanized structural tubing supported from the tower structure, and shall be elevated above the floor of the cold water basin to facilitate cleaning. The air inlet face of the tower shall be free of water splash-out.	■ Louvers integral with the fill keep the flowing water within the confines of the fill. The separate external louvers used by others permit water to escape the fill and form ice or produce an unsightly situation adjacent to the tower. If you plan to use your tower in the wintertime, particularly for free cooling, integral louvers will put your operating concerns to rest.
7.2 Drift eliminators shall be PVC, triple-pass, and shall limit drift losses to no more than 0.005% of the design GPM flow rate.	■ 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 on many standard models. If a lower rate is required, please discuss with your Marley sales representative.





Specifications	Specification Value
8.0 **Hot Water Distribution System:**	
8.1 An open basin above the bank of fill shall receive hot water piped to each cell of the tower. These distribution basins shall be installed and sealed at the factory with bolted connections. Tap screws shall not be allowed. The basin shall , and shall be equipped with removable, galvanized steel covers to keep out leaves and debris, and to retard the growth of algae. The water distribution system shall be accessible and maintainable during tower fan and water operation.	■ Gravity-flow distribution basins are a feature of crossflow type towers, resulting in operating pump heads of from 10 to 20 feet less than that encountered in counterflow towers with pressurized spray systems. Also, these basins are out where they can be easily inspected—even maintained—while the tower is in operation. Spray systems of counterflow towers, sandwiched between the top of the fill and the drift eliminators, are extremely awkward to access and maintain. If your preference is for a stainless steel tower, or if your water or air quality suggests that the use of stainless steel is prudent, see stainless steel options on page 26.
8.2 Each basin shall include an inlet hole and bolt circle to accept a 125# flange connection per ANSI B16.1. Removable, interchangeable polypropylene nozzles installed in the floor of these basins shall provide full coverage of the fill by gravity flow.	
8.3 Heavy-duty flow-regulator valves shall be provided at the hot-water inlet connections. These valves shall be disc-type, with cast iron bodies and stainless steel operating stems. There shall be a locking handle to maintain the valve setting in any position. Valves shall be right-angle configuration, precluding the need for inlet elbows.	
8.4 Variable Water Flow Distribution - The water distribution system shall be equipped with a method to operate under variable flow conditions while maintaining a uniform air-side pressure drop through the fill to maximize cooling efficiency and minimize the risk of ice and scale formation in the fill. System must accommodate flow rates down to _____% of design flow.	
9.0 **Casing, Fan Deck, Fan Cylinder, and Fan Guard:**	
9.1 The casing and fan deck shall be heavy-gauge galvanized steel, and shall be capable of withstanding the loads described in paragraph 4.1. Fan cylinder extensions shall be provided to elevate the fan discharge to a height of ___ ft. (___ m) above the top of the standard fan cylinder. The fan cylinder shall be molded FRP, and shall be through-bolted to the fan deck to provide a consistently stable	

Specifications	Specification Value

operating shroud for the fan. The top of the fan cylinder shall be equipped with a conical, non-sagging, removable fan guard, fabricated of welded 5/16" and 7 gauge rods, and hot-dip galvanized after fabrication.

10.0 **Access:**

10.1 Large galvanized steel access doors 30" (762 mm) wide and a minimum of 42" (1067 mm) high shall be located in both endwalls for entry into the cold water basin and fan plenum area. Access doors shall be operable from inside as well as outside the tower.

10.2 Provide an external platform near the top of the louver face for access to the hot water distribution system. The platform shall be galvanized steel bar grating, supported by galvanized steel framework attached to the tower. The platform shall be surrounded by a handrail, kneerail, and toeboard. A permanently attached 1'-6" (457.2 mm) wide aluminum ladder with 3" (76.2 mm) I-beam side rails and 1.25" (31.8 mm) diameter serrated rungs shall extend from the base of the tower to the top of the handrail.

10.3 Provide a ladder extension for connection to the foot of the external ladder. This extension shall be long enough to rise from the roof (grade) level. The installing contractor shall be responsible for cutting the ladder to length; attaching it to the foot of the tower ladder; and anchoring it at its base.

10.4 A heavy gauge galvanized steel safety cage shall surround the ladder, extending from a point approximately 7'-0" (2134 mm) above the foot of the ladder to the top of the distribution basin access platform handrail.

- The access doors on competitive towers may be 18" wide or smaller, which is unreasonably small for a human being. Specifying the size of the door will cause those bidders to take exception, alerting you to a potential maintenance headache. Two doors are standard on all towers so that access between cells of multicell towers is assured.

Specifications	Specification Value
10.5 Provide an internal platform approximately 7' (2134 mm) below the level of the fan for access to the mechanical equipment. The platform shall be galvanized steel bar grating, supported by galvanized steel framework attached to the tower. The platform shall be surrounded by a hand-rail and kneerail. A permanently attached 1'-6" (457.2 mm) wide aluminum ladder with 3" (76.2 mm) I-beam side rails and 1.25" (31.8 mm) diameter serrated rungs shall extend from the cold water basin to the top of the handrail.	
10.6 Air Inlet Screens - The air inlet faces of the tower shall be covered by 1" mesh hot-dipped galvanized welded wire screens. Screens shall be secured to removable galvanized U-edge frames.	
11.0 **Cold Water Collection Basin**:	
11.1 The collection basin shall be G-235 galvanized steel and assembled with bolted connections. Tap screws shall not be allowed. The cold water basin shall be heavy-gauge galvanized steel, and The basins shall include the number and type of suction connections required to accommodate the outflow piping system shown on the Plans. Suction connections shall be equipped with galvanized debris screens. A factory-installed, float-operated, mechanical makeup valve shall be included. A 3" (76.2 mm) diameter drain and a 4" (101.7 mm) diameter overflow shall be provided in each cell of the tower. The basin shall include a depressed section into which accumulated silt can be flushed to permit cleaning. The basin floor adjacent to the depressed section shall slope toward the depressed section to prevent buildup of silt under the fill area. Towers of more than one cell shall include flumes for flow and equalization between cells.	■ Choose from side suctions and bottom outlets to accommodate a significant 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. If your preference is for a stainless steel tower, or if your water or air quality suggests that the use of stainless steel is prudent, see stainless steel options on page 26.

Specifications	Specification Value
Stainless Steel Options	
All Stainless Cooling Tower	
1.1 *Replace paragraph 1.1 with the following:* Provide an induced draft, crossflow type, factory assembled, film fill, industrial duty, stainless steel cooling tower situated as shown on the plans. The limiting overall dimensions of the tower shall be _____ ft wide, _____ ft long, and _____ ft high to the top of the fan guard. Total operating power of all fans shall not exceed ____ Hp, consisting of ___ @ ___ Hp motor(s). Tower shall be similar and equal in all respects to Marley Model _____.	■ Where water quality falls outside the limits indicated in Paragraph 5.1, an all-stainless tower is worthy of your consideration.
5.1 *Replace paragraph 5.1 with the following:* Except where otherwise specified, all components of the cooling tower shall be fabricated of 301L stainless steel. The tower shall be capable of withstanding water having a chloride content (NaCl) up to 750 ppm; a sulfate content (SO4) up to 1200 ppm; a calcium content ($CaCO_3$) up to 800 ppm; and silica (SiO_2) up to 150 ppm. The circulating water shall contain no oil, grease, fatty acids, or organic solvents. Fiberglass casing, polyurethane barriers, and thermosetting hybrids and the components that are adhered to the sheet metal surface, shall be considered non-recyclable and not allowed.	
Fill, Louvers, and Drift Eliminators:	
7.1 *Replace paragraph 7.1 with the following:* Fill shall be film-type, thermoformed of PVC, with louvers and eliminators formed as part of each fill sheet. Fill shall be suspended from stainless steel structural tubing supported from the tower structure, and shall be elevated above the floor of the cold water basin to facilitate cleaning. The air inlet face of the tower shall be free of water splash-out.	
Hot Water Distribution System:	
8.1 *Replace paragraph 8.1 with the following:* An open 301L stainless steel basins (one above each bank of fill) shall receive hot water piped to each cell of the tower. These basin components shall be installed and sealed at the factory	

Specifications	Specification Value

and assembled with bolted connections. Tap screws shall not be allowed. The basins shall be equipped with removable, stainless steel covers to keep out leaves and debris, and to retard the growth of algae. The water distribution system shall be accessible and maintainable during tower fan and water operation.

Casing, Fan Deck, Fan Cylinder, and Fan Guard:

9.1 *Replace paragraph 9.1 with the following:* The casing and fan deck shall be heavy-gauge 301L stainless steel, and shall be capable of withstanding the loads described in paragraph 4.1. Fan cylinder extensions shall be provided to elevate the fan discharge to a height of ___ ft. (___ m) above the top of the standard fan cylinder. The fan cylinder shall be molded FRP, and shall be through-bolted to the fan deck to provide a consistently stable operating shroud for the fan. The top of the fan cylinder shall be equipped with a conical, non-sagging, removable fan guard, fabricated of welded 5/16" and 7 gauge rods, and hot-dip galvanized after fabrication.

Access:

10.1 *Replace paragraph 10.1 with the following:* Large 301L stainless steel access doors 30" (762 mm) wide and a minimum of 42" (1067 mm) high shall be located in both endwalls for entry into the cold water basin and fan plenum area. Access doors shall be operable from inside as well as outside the tower.

10.5 *Replace paragraph 10.5 with the following:* Provide an internal platform approximately 7' (2134 mm) below the level of the fan for access to the mechanical equipment. The platform shall be galvanized steel bar grating, supported by stainless steel framework attached to the tower. The platform shall be surrounded by a handrail and kneerail. A permanently attached 1'-6" (457.2 mm) wide aluminum ladder with 3" (76.2 mm) I-beam side rails and 1.25" (31.8 mm) diameter serrated rungs shall extend from the cold water basin to the top of the handrail.

Specifications	Specification Value
Stainless Steel Collection Basin:	
11.1: *Replace paragraph 11.1 with the following:* The collection basin shall be 301L stainless steel construction, assembled with bolted connections. Tap screws shall not be allowed. Only low-carbon stainless steel alloys will be accepted in order to minimize the risk of intergranular corrosion in the weld zones. The basin shall include the number and type of suction connections required to accommodate the outflow piping system shown on the plans. Suction connections shall be equipped with stainless steel 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 cooling tower. The basin floor shall slope toward the drain to allow complete flush out of debris and silt that may accumulate. Towers of more than one cell shall include a method for flow and equalization between cells. The basin shall be accessible and maintainable while water is circulating. All steel items that project into the basin shall also be made of stainless steel.	■ 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. Also, see the notes on page 25 regarding the standard Cold Water Collection Basin. They apply equally well to the stainless steel basin.
Control Options	
Fan Motor Starter Control Panel:	■ If it is your opinion that the control system for the cooling tower be part of the tower manufacturer's responsibility, we are in wholehearted agreement with you. Who better to determine the most efficient mode and manner of a cooling tower's operation—and to apply a system most compatible with it—than the designer and manufacturer of the cooling tower? Marley variable speed drives are also available for enhanced temperature control, energy management and mechanical equipment longevity. See specifications on page 21.
6.4 *Add the following paragraph to the Mechanical Equipment section:* Each cell of the cooling tower shall be equipped with a UL / CUL 508 listed control panel in a NEMA 3R or 4X outdoor enclosure capable of controlling single-speed or two-speed motors as required, and designed specifically for cooling tower applications. The panel shall include a main circuit breaker with an external operating handle, lockable in the off position for safety. Full voltage non-reversing magnetic starter shall be controlled with a thermostatic or solid-state temperature controller. Door mounted selector switches shall be provided to enable automatic or manual control and wired for 120VAC control. Control circuit to be wired out to terminal blocks for field connection to a remote vibration switch, overload trip alarms and remote temperature control devices. The	

Specifications	Specification Value

temperature controller shall be adjustable for the required cold-water temperature. If a thermostatic controller is used it shall be mounted on the side of the tower with the temperature sensing bulb installed in the cold-water basin using a suspension mounting bracket. If a solid-state temperature controller is used the controller will be door mounted on the control panel. The solid state temperature controller will display two temperatures, one for outgoing water and the other for set point. Water temperature input shall be obtained using a three-wire RTD with dry well in the outlet water piping and wired back to the solid-state temperature controller in the control panel.

Terminal Box:

6.4 *Add the following paragraph in the Mechanical Equipment section:* A factory installed terminal box shall be furnished and mounted to the outside of the tower where applicable. The fan motor and optional components—including the vibration switch and water level probes—shall be factory wired to terminal points inside the terminal box. Optional tower components which ship loose, including the oil level switch and immersion heaters shall be field wired to the terminal box. Enclosure shall be NEMA 3R or NEMA 4X with hinged and lockable door meeting UL and CSA standards. Terminal box shall include lockable stainless steel snap-latch door fasteners, terminal blocks marked with wire numbers, sub-pan and a wiring diagram. Complete assembly shall be built to UL 508A standards. Conduit entry and exit points shall be the bottom of the enclosure preventing water collection in the enclosure.

■ The Marley Terminal Box simplifies all electrical connections to the cooling tower motor and optional control accessories.

- Eliminates wiring errors in the field
- Reduces field wiring labor and materials
- Provides an external access location to internal cooling tower wiring
- NEMA 4X fiberglass enclosure suitable for corrosive applications
- Terminal points are well identified
- UL 508 assembly

Vibration Limit Switch:

6.5 *Add the following paragraph in the Mechanical Equipment section:* A single-pole, double-throw vibration limit switch in a NEMA 4 housing shall be installed on the mechanical equipment support for wiring into the owner's control panel. The purpose of this switch will be to interrupt power to the motor in the event of excessive vibration. It shall be adjustable for sensitivity, and shall require manual reset.

■ Unless specified otherwise, a Marley M-5 vibration switch will be provided. The requirement for manual reset assures that the cooling tower will be visited to determine the cause of excessive vibration.

Specifications

Basin Heaters:

11.2 *Add the following paragraph in the Cold Water Basin section:* Provide a system of electric immersion heaters and controls for each cell of the tower to prevent freezing of water in the collection basin during periods of shutdown. The system shall consist of one or more stainless steel electric immersion heaters installed in threaded couplings provided in the side of the basin. A NEMA 4 enclosure shall house a magnetic contactor to energize heaters; a transformer to provide 24 volt control circuit power; and a solid state circuit board for temperature and low water cutoff. A control probe shall be located in the basin to monitor water level and temperature. The system shall be capable of maintaining 40°F water temperature at an ambient air temperature of __ °F.

Fan Motor Variable Speed Drive:

ACH550 VFD System

6.5 *Add the following paragraph in the Mechanical Equipment section:* A complete UL listed Variable Speed Drive system in a NEMA 1 indoor, NEMA 12 indoor or NEMA 3R outdoor enclosure shall be provided. The VFD shall use PWM technology with IGBT switching. VFD output switching signal shall be programmed to not cause mechanical vibration issues with backlash in gearbox teeth or vibration issues associated with long driveshafts. The VFD shall be programmed for variable torque applications and shall catch a fan spinning in the forward or reverse direction without tripping. VFD panel construction shall include a main disconnect with short circuit and thermal overload protection with external operating handle, lockable in the off position for lock-out tag-out safety procedures. A service switch directly ahead of the VFD shall be provided for voltage isolation during VFD maintenance. An integrated full voltage non-reversing bypass starter shall be furnished allowing fan motor operation if VFD has failed. The VFD system shall receive a speed reference signal from the building management system monitoring the tower cold-water temperature. As an option to

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■ The Marley basin heater components described at left represent our recommendation for a reliable automatic system for the prevention of basin freezing. They are normally shipped separately for installation at the jobsite by the installing contractor. When purchased in conjunction with the enhanced Control System option, however, they are customarily factory-mounted and tested.

When zinc ions are present in basin water, copper immersion heaters must not be used. Insist upon stainless steel.

The ambient air temperature that you insert in the specifications should be the lowest 1% level of winter temperature prevalent at site.

■ Marley Variable Speed 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 energy savings to the user.

Motors operated on a VFD shall carry a service factor of 1.0. When operating on a VFD, the drive parameters should be programmed to limit the current to motor nameplate hp. Adjust the Motor specification accordingly.

Applications requiring a cable distance between VFD and motor of over 100 feet requires a separate DV/DT motor filter to be installed and wired at the drive. This filter protects the motor from damaging high voltage spikes on the motor windings, inherent with long lead runs.

Specifications	Specification Value

receiving the speed reference signal from a building management system, the drive must have the capability to receive a 4-20 mA temperature signal from an RTD transmitter. The VFD shall have an internal PI regulator to modulate fan speed maintaining set point temperature. The drive's panel shall display the set-point temperature and cold-water temperature on two separate lines. The bypass shall include a complete magnetic bypass circuit with the capability to isolate the VFD when in the bypass mode. Transfer to the bypass mode shall be manual in the event of VFD failure. Once the motor is transferred to the bypass circuit the fan motor will run at constant full speed. Operator controls shall be mounted on the front of the enclosure and shall consist of Start and Stop control, Bypass/VFD selection, Auto/Manual selections and manual speed control. To prevent heating problems in the cooling tower fan motor the VFD system shall de-energize the motor once 25% motor speed is reached and cooling is no longer required. The cooling tower manufacturer shall supply VFD start-up assistance.

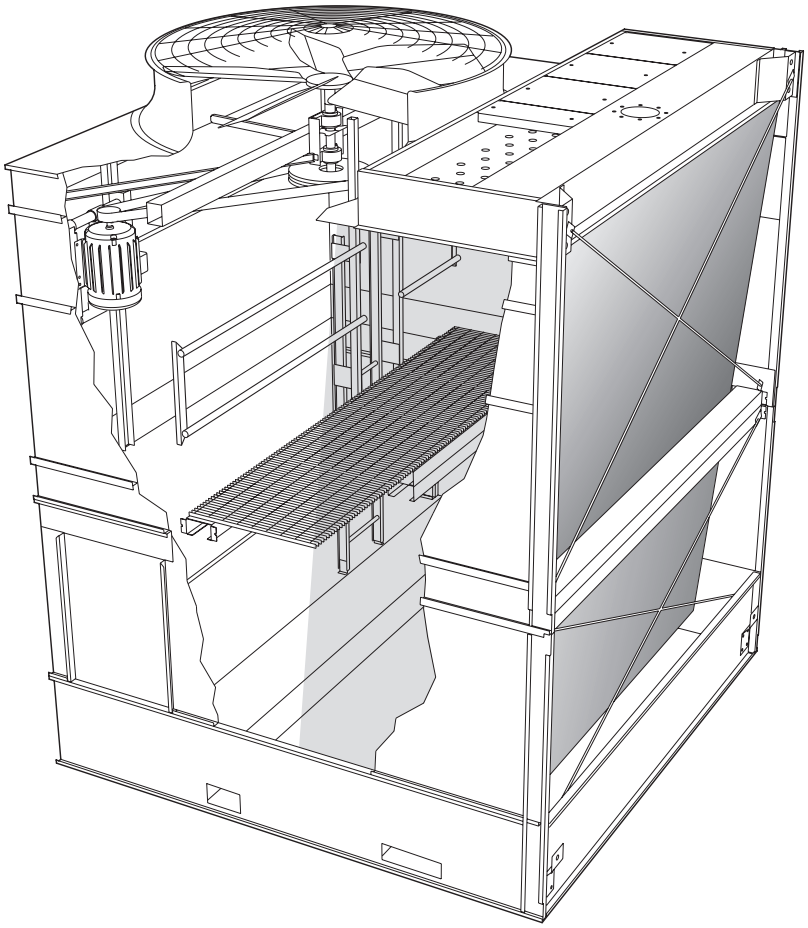
Single-Point Power Connection:

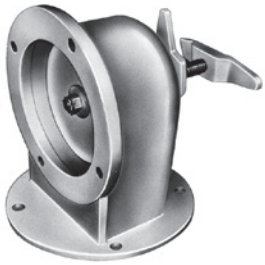
6.6 *Add the following paragraph in the Mechanical Equipment section:* Each cell of the cooling tower shall be equipped with a UL/CUL 508 listed control panel in a NEMA 3R or 4X outdoor enclosure. The panel shall accommodate a single source power supply feeder and include electrical circuits and components to power and control all electrical cooling tower components for a single cell. The panel shall include a main circuit breaker with an external operating handle, lockable in the off position for safety. Controls integrated into the panel shall include a fan motor starter, basin heater controls and water level controls. In the event a VFD is furnished for the fan, a feeder breaker in the panel to a remote mounted VFD shall be provided.

- A main circuit breaker disconnect provides a true single point power connection for cooling tower controls. Contractor connects a single power source and the panel provides power feeds, controls and voltages for tower controls. Typically each cell of a tower requires one SPPC panel.

Specifications	Specification Value
Convenience and Safety Options	
Hot Water Basin Access Platform:	
10.2 *Add the following paragraph in the Access section:* Provide an external platform near the top of the louver face for access to the hot water distribution system. The platform shall be galvanized steel bar grating, supported by galvanized steel framework attached to the tower. The platform shall be surrounded by a handrail, kneerail, and toeboard. A permanently attached 1'-6" wide aluminum ladder with 3" I-beam side rails and 1.25" diameter serrated rungs shall extend from the base of the tower to the top of the handrail.	■ 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 factory installed Marley access platform with guardrails makes 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. See graphic, Page 14. 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.
Ladder Extension:	
10.2 *Add the following to the end of the Hot Water Basin Access Platform paragraph:* Provide a ladder extension for connection to the foot of the external ladder. This extension shall be long enough to rise from the roof (grade) level. The installing contractor shall be responsible for cutting the ladder to length; attaching it to the foot of the tower ladder; and anchoring it at its base.	■ Many towers are installed such that the base of the tower is 2'-0" 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 5'-0" and 11'-0" lengths.
Ladder Safety Cage:	
10.2 *Add the following to the end of the Hot Water Basin Access Platform paragraph:* A heavy gauge galvanized steel safety cage shall surround the ladder, extending from a point 7'-0" to 8'-0" above the foot of the ladder to the top of the distribution basin access platform handrail.	■ To meet OSHA guidelines, towers whose distribution basin access platforms are 20'-0" or more above roof or grade, and which are equipped with external ladders, should have safety cages surrounding the ladders.

Specifications	Specification Value
Mechanical Equipment Access Platform: *Available only on AV63000 models and larger.* 10.3 *Add the following paragraph in the Access section:* Provide an internal platform approximately 7' below the level of the fan for access to the mechanical equipment. The platform shall be galvanized steel bar grating, supported by galvanized steel framework attached to the tower. The platform shall be surrounded by a handrail and kneerail. A permanently attached 1'-6" wide aluminum ladder with 3" I-beam side rails and 1.25" diameter serrated rungs shall extend from the cold water basin to the top of the handrail.	■ Periodic inspection and maintenance of cooling tower fans, motors and other rotating equipment is fundamental to preserving maximum cooling system efficiency. All mechanical draft cooling towers—forced or induced draft—are subject to vibration and wear. Therefore, safe and easy access to these components for inspection and maintenance 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 factory installed Marley access platform with guardrails makes this task as safe and user-friendly as possible. See graphic below. 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.



Specifications	Specification Value
Miscellaneous Options	
Fan Cylinder Extensions:	
9.1 *Insert the following after the first sentence:* Fan cylinder extensions shall be provided to elevate the fan discharge to a height of ___ ft. above the top of the standard fan cylinder.	■ Extensions are available in 11¾" increments to a maximum extension height of 6'-10¼". Such extensions may be considered necessary in order to elevate the discharge beyond the bounds of an enclosure. Discuss applicability with your local Marley sales representative.
Equalizer Flume Weir Gates:	
11.3 *Add the following paragraph under Cold Water Collection Basin:* The interconnecting flume between cells shall be equipped with a removable cover plate to permit the shutdown of one cell for maintenance purposes, or to permit independent cell operation.	■ Where it is your intention to be able to operate other cells of the tower while the flume cover plate is installed, separate outlet connections, float valves, and overflows must be provided for each cell. Likewise, this would require separate sensors and controls for basin heater systems, if installed.
Marley Control Valve:	
8.3 *Add the following paragraph under Hot Water Distribution System:* A heavy-duty, industrial grade flow-control valve shall be provided at the inlet to the hot water basin. The valve shall permit both flow balancing on multicell towers and temporary shut-off for maintenance of selected cells. Valve shall have a machined cast iron body, with stainless steel operating stem, and heavy-duty locking handle.	■ Marley flow-control valves have been a favorite of users since the 1950s. They remain serviceable for the life of the tower and provide a continuing means of flow-regulation between hot water basins—and between cells of multi-cell towers as well. 
Premium Efficiency Motor:	
6.3 *Replace paragraph 6.3 with the following:* The fan and fan drive assembly for each cell shall be supported by a rigid, welded, hot dip galvanized steel structural support that resists misalignment. The mechanical equipment assembly shall be warranted against any failure caused by defects in materials and workmanship for no less than five (5) years following the date of tower shipment. This warranty shall cover the fan, speed reducer, motor, drive shaft and couplings, and the mechanical equipment support. The bearing assemblies and V-belts shall be warranted for 18 months.	■ NEMA premium efficiency motor with a five year warranty enhances the standard five year mechanical equipment warranty of the AV cooling tower.
FM Approval:	
Available only on multi-cell towers.	
5.3 *Add the following paragraph in the Construction section:* For applications of two or more cells, the tower shall be listed in the current FM Approval Guide	■ This could have a very beneficial effect upon your fire insurance premiums. Towers not able to meet FM requirements may require the inclusion of a fire protection sprinkler system to achieve a comparable level of insurance premium cost. Even if you are not insured by FM, this requirement ensures that each cell will contain any fire that may occur without losing the ability of limited operations and capacity.

Specifications	Specification Value

(approvalguide.com) and conform to the FM Approval Standard for Cooling Towers, Class Number 4930 that is approved for use without sprinkler systems. The tower shall have successfully passed full scale fire testing, static and cyclic wind pressure testing, large missile impact testing (for Zone HM), and structural design evaluation as administered by FM Approvals. A copy of the FM Approval Certificate of Compliance dated November 2013 or later shall be available upon request.

Quiet Fan:

6.1 *Replace paragraph 6.1 with the following:* Quiet Fan(s) shall be propeller type, incorporating a minimum of seven heavy duty aluminum alloy blades attached to galvanized hubs with stainless steel U-bolts and hardware and shall be individually adjustable. Fan(s) shall be driven through an industrial grade system of V-belts, pulleys, and tapered roller bearings. Bearings shall be rated at 50,000 hours, or greater.

Ultra Quiet Fan:

6.1 *Replace paragraph 6.1 with the following:* Ultra Quiet Fan(s) shall be propeller-type, incorporating wide-chord acoustic geometry, corrosion and fire resistant marine grade aluminum blades and aluminum hubs. Blades shall be resiliently mounted to fan hub and individually adjustable. Fan blades shall be open cavity with suitable drainage to avoid accumulation of moisture. Foam filled blades are not allowed due to potential moisture contamination of the foam core causing an imbalance of the fan leading to vibration issues. Fan(s) shall be driven through an industrial grade system of V-belts, pulleys, and tapered roller bearings. Bearings shall be rated at 50,000 hours, or greater

Variable Water Flow Distribution:

8.2 *Add the following to the end of this paragraph:* The water distribution system shall be equipped with a method to operate under variable flow conditions while maintaining a uniform air-side pressure drop through the fill to maximize cooling efficiency and minimize the risk of ice and scale formation in the fill. System must accommodate flow rates down to _____% of design flow.

- The Marley "Quiet Package" includes the affordable Quiet Fan mechanical option, optimized to achieve the lowest possible sound levels while maintaining efficiency. In combination with a Marley Variable Speed Drive, this package is capable of meeting all but the most restrictive sound limitations.

  Tip Speed—unlike thermal performance, no certification program exists for sound. While Marley conducts actual sound tests on all its configurations, there are a few ways for the client to ensure they get a quiet tower.

  ▪ One is to conduct a field sound test after installation. On-site testing after installation can, however, be inaccurate depending on the environment.

  ▪ Another is to conduct a sound test at the factory. However both can be cost prohibitive for smaller applications.

  ▪ Specifying fan blade tip speed is one way to physically force the tower selection to be quiet. Tip speed is easily checked by multiplying the fan RPM by the fan circumference at the blade tip (π fan dia). Over 12,000 ft/min is considered high by most people. 10,000-12,000 is considered typical and expected. 8,000-10,000 would be considered low sound. Below 8,000 is difficult to hear above the water noise.

- For more severe cases requiring the lowest possible fan sound levels, the Marley “Ultra Quiet Fan” option is now available on all AV models. Tower height may increase slightly—obtain current sales drawings from your Marley sales representative for accurate dimensions.

Marley AV cooling tower

ENGINEERING DATA AND SPECIFICATIONS

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