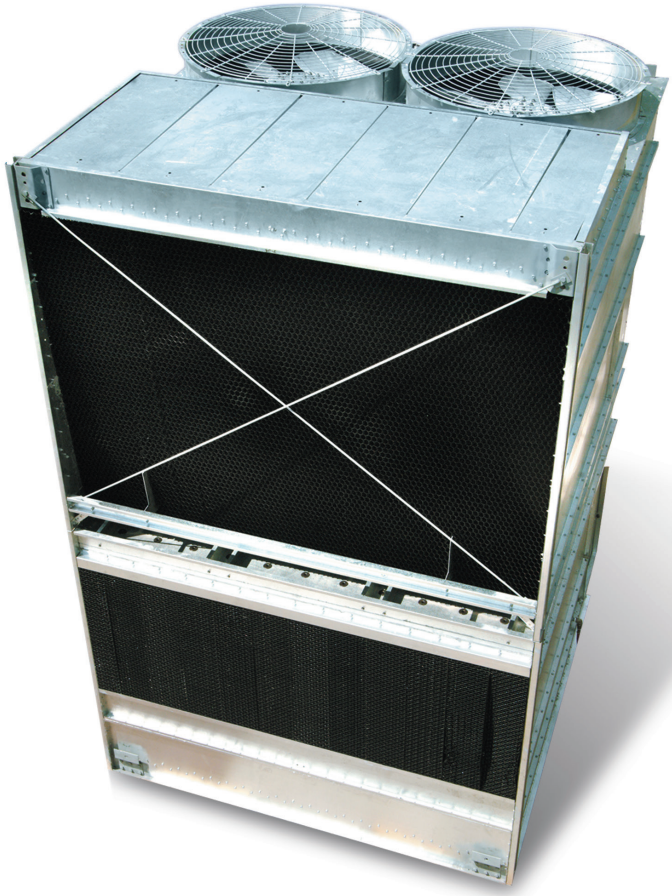
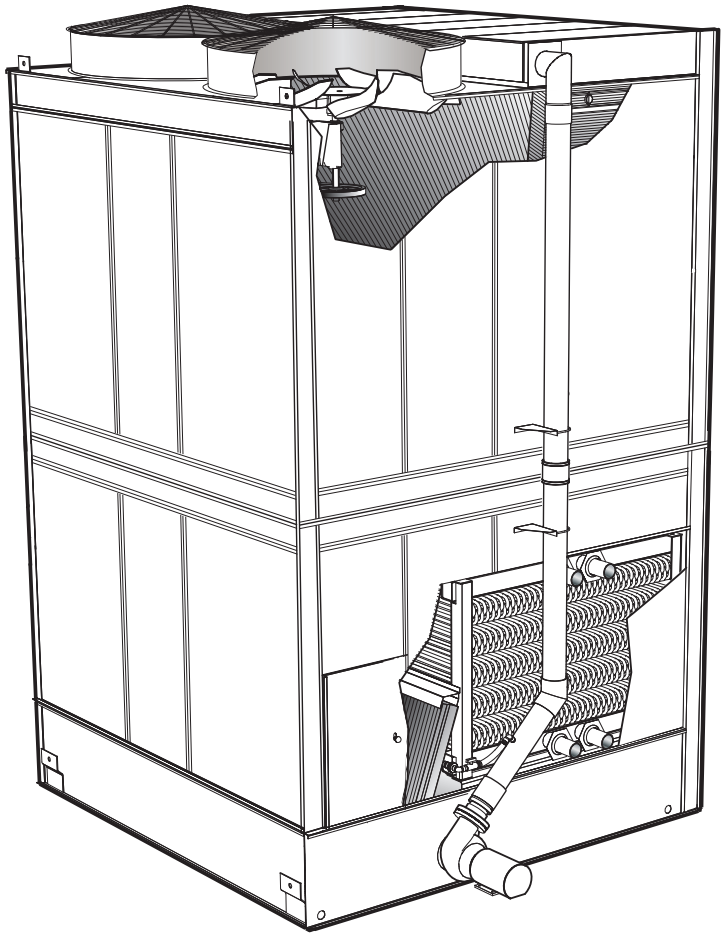
MH fluid cooler

engineering data
and specifications



MARLEY®

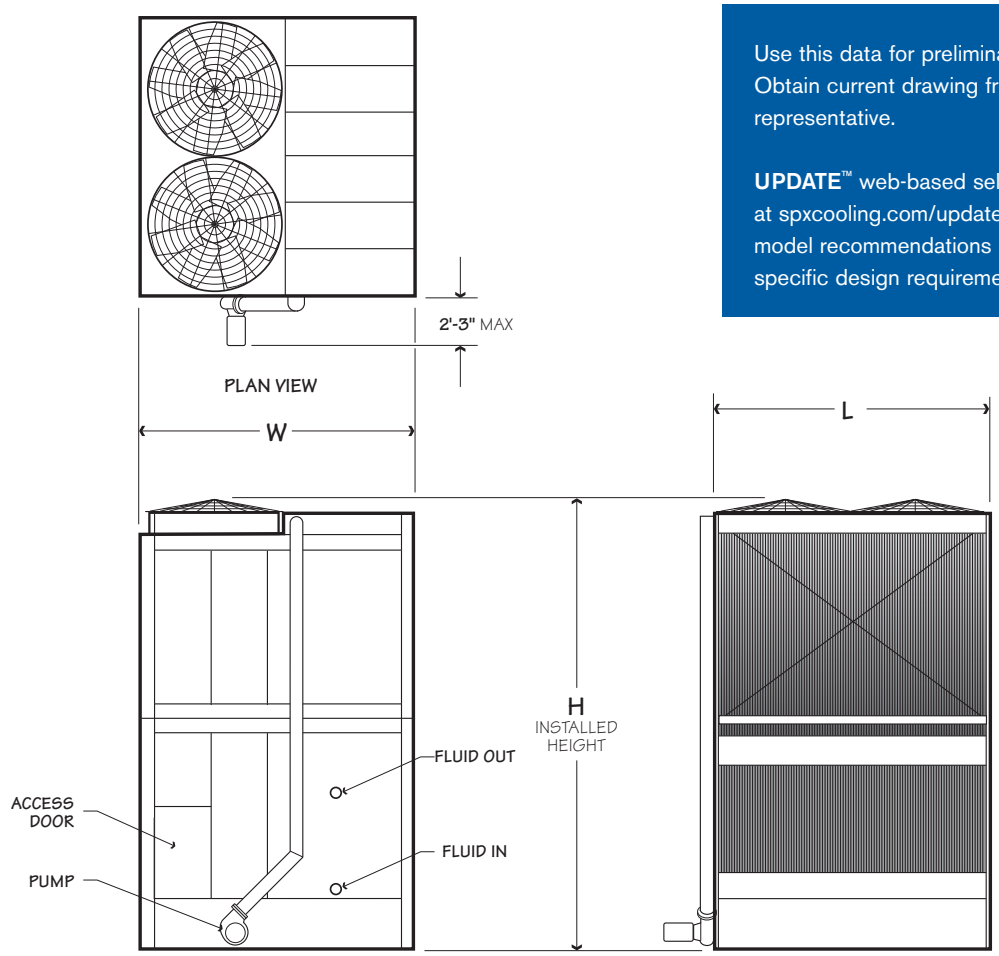


The Marley MH Fluid Cooler is one of the most efficient closed-circuit heat rejection products on the market—and your best choice for industrial and HVAC applications. By keeping the process fluid in a clean, closed loop, and combining the function of a cooling tower and heat exchanger into one system, the MH Fluid Cooler can provide superior operational and maintenance benefits.

The specifications portion of this publication not only relates the language to use in describing an appropriate MH Fluid Cooler—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 9 thru 27 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 9 thru 14 indicate those paragraphs which will result in the purchase of a basic fluid cooler—one that accomplishes the specified thermal performance, but which will lack many operation—and maintenance-enhancing accessories and features that are usually desired by those persons who are responsible for the continuing operation of the system of which the fluid cooler is part. It will also incorporate those standard materials which testing and experience has proven to provide acceptable longevity in normal operating conditions.

Pages 15 thru 27 provide paragraphs intended to add those features, components, and materials that will customize the fluid cooler 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 MH Fluid Cooler model recommendations based on customer's specific design requirements.

Model	Dimensions			Shipping Weight Steel Coil lb		Shipping Weight Copper Coil lb		Motor hp	Pump hp
	L	W	H	Weight	Heaviest Section	Weight	Heaviest Section		
MHF7101_ _A	6'-0 3/8"	8'-4 1/16"	12'-10 3/4"	4,880	3,050	4,120	3,150	3 - 15	2
MHF7101_ _B	6'-0 3/8"	8'-4 1/16"	14'-4 3/4"	5,620	3,790	4,430	3,680	3 - 15	2
MHF7101_ _D	6'-0 3/8"	8'-4 1/16"	14'-7"	5,050	3,050	4,290	3,150	3 - 15	2
MHF7101_ _E	6'-0 3/8"	8'-4 1/16"	16'-1"	5,790	3,790	4,600	3,680	3 - 15	2
MHF7103_ _A	9'-0 3/4"	8'-4 1/16"	14'-7"	7,590	4,460	6,280	3,150	5 - 20	3
MHF7103_ _B	9'-0 3/4"	8'-4 1/16"	16'-1 1/8"	8,830	5,700	6,810	3,680	5 - 20	3
MHF7103_ _D	9'-0 3/4"	8'-4 1/16"	15'-11 3/16"	7,810	4,460	6,500	3,350	5 - 20	3
MHF7103_ _E	9'-0 3/4"	8'-4 1/16"	17'-5 1/16"	9,050	5,700	7,030	3,680	5 - 20	3
MHF7105_ _A	12'-0 3/4"	8'-4 1/16"	14'-7"	9,270	5,530	7,800	4,060	7.5 - 25	5
MHF7105_ _B	12'-0 3/4"	8'-4 1/16"	16'-1 1/8"	10,630	6,890	8,590	4,850	7.5 - 25	5
MHF7105_ _D	12'-0 3/4"	8'-4 1/16"	15'-11 3/16"	9,530	5,530	8,060	4,060	7.5 - 25	5
MHF7105_ _E	12'-0 3/4"	8'-4 1/16"	17'-5 1/16"	10,890	6,890	8,850	4,850	7.5 - 25	5
MHF7107_ _A	12'-0 3/4"	11'-11"	17'-5 1/8"	14,680	9,070	11,900	6,290	10 - 40	7.5
MHF7107_ _B	12'-0 3/4"	11'-11"	18'-11 1/8"	17,000	11,390	13,330	7,720	10 - 40	7.5
MHF7107_ _D	12'-0 3/4"	11'-11"	18'-9 1/4"	15,030	9,070	12,250	6,290	10 - 40	7.5
MHF7107_ _E	12'-0 3/4"	11'-11"	20'-3 1/4"	17,350	11,390	13,680	7,720	10 - 40	7.5
MHF7109_ _A	18'-0 3/4"	11'-11"	17'-5 3/16"	21,160	13,320	–	–	15 - 45	10
MHF7109_ _B	18'-0 3/4"	11'-11"	18'-11 3/16"	25,680	17,750	–	–	15 - 45	10

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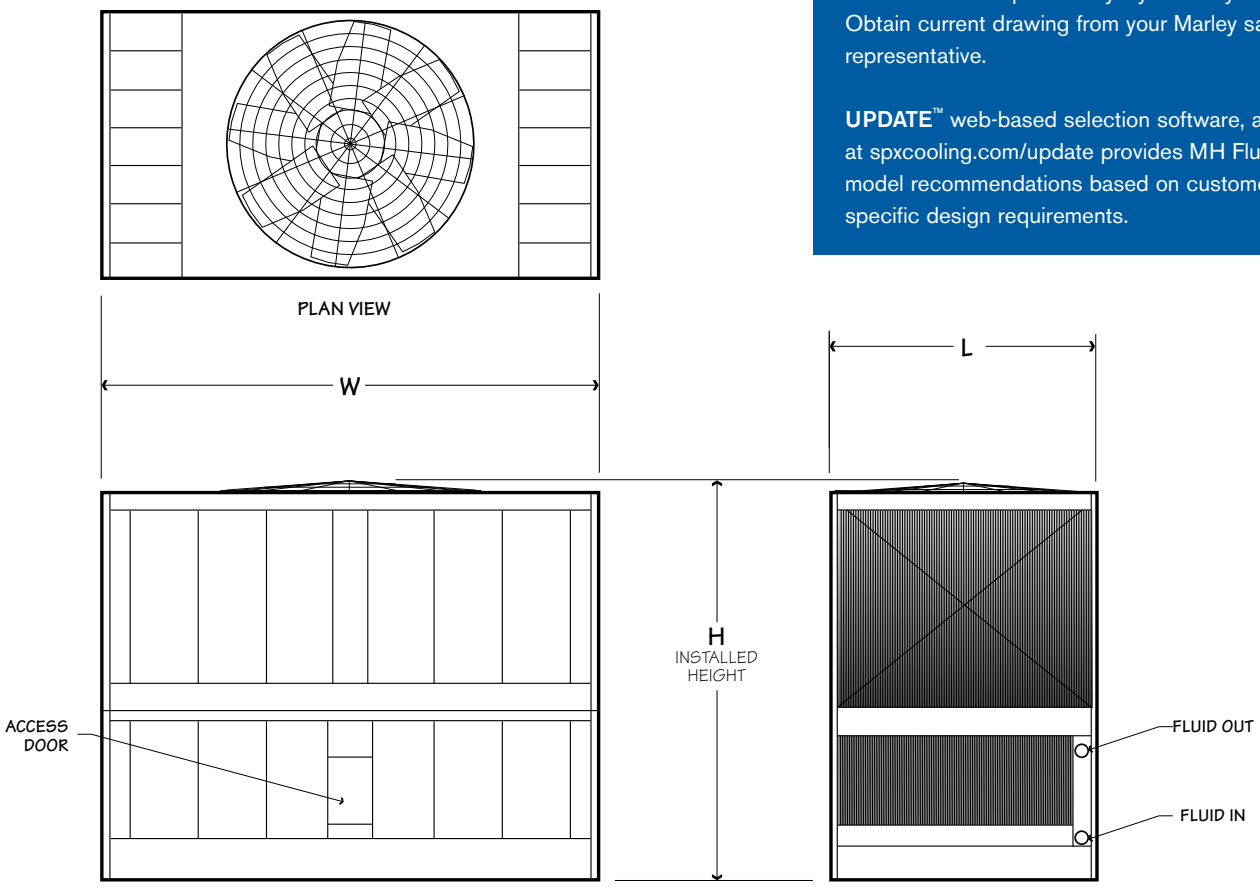
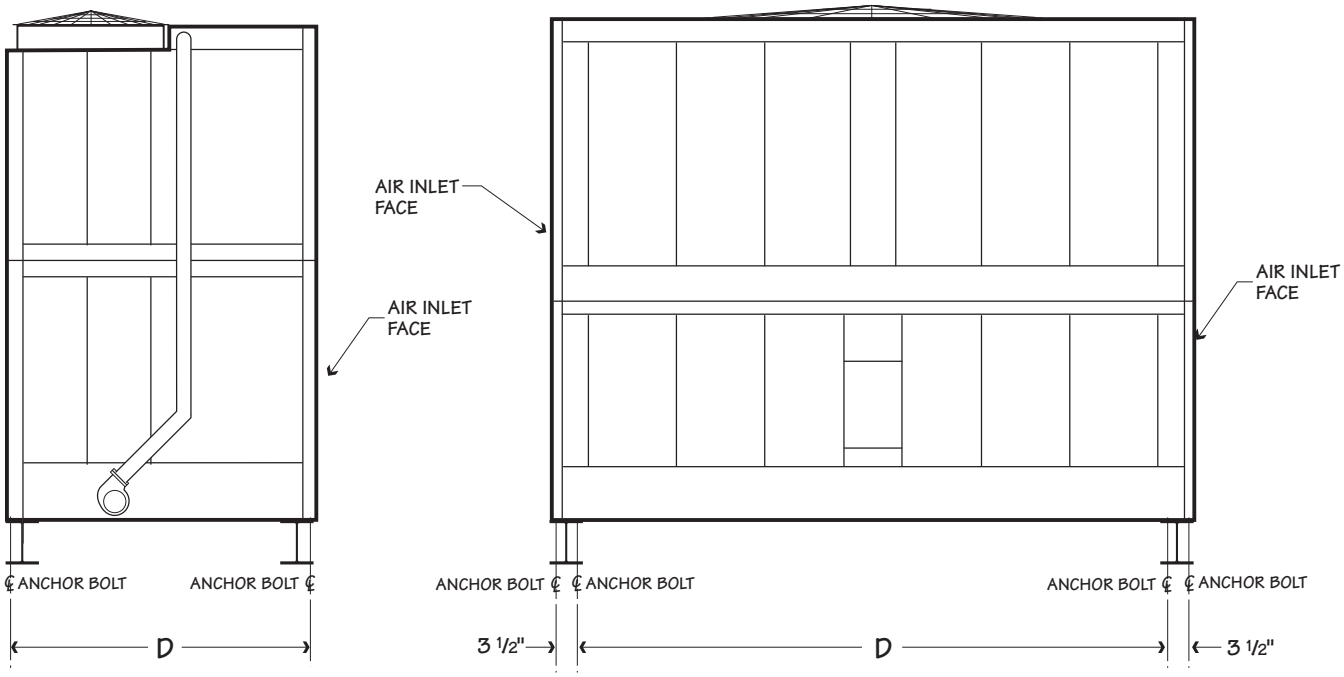


Model	Dimensions			Shipping Weight lb		Motor hp	Pump hp
	L	W	H	Weight	Heaviest Section		
MHF7111	11'-11"	23'-10 3/16"	21'-6 3/8"	32,100	20,010	20 - 75	2@7.5
MHF7113	13'-11"	25'-10 3/16"	21'-6 3/8"	38,070	24,620	30 - 75	2@7.5



SINGLE-FLOW MODELS

DOUBLE-FLOW MODELS

Model	D	Maximum Deflection
MHF7101	8'-2"	3/8"
MHF7103	8'-2"	3/8"
MHF7105	8'-2"	3/8"
MHF7107	11'-9"	1/2"
MHF7109	11'-9"	1/2"

Model	D	Maximum Deflection
MHF7111	22'-9 3/4"	1/2"
MHF7113	24'-9 3/4"	1/2"

Use this data for preliminary layouts only. Obtain detailed support drawings from your Marley sales representative.

Primary support consists of parallel I-beams running the full length of the unit.

FLUID COOLER COIL

When the ambient temperature falls below 32°F, heat loss from the coil be substantial even without recirculating water flowing over the coil. The process fluid, without an applied heat load, may be prone to freezing. There are various methods to protect against coil freezing.

Ethylene and propylene glycol solutions are the best means to protect against coil freezing and are recommended for most installations. The appropriate concentration of ethylene or propylene glycol should be determined based on the required protection from low ambient temperatures.

If the use of an industrial antifreeze solution is not compatible with the system, another accepted method of preventing coil freezing is to maintain a sufficient flow rate and heat load on the process fluid. The fluid exiting the coil must be maintained at or above 45°F at the full process flow rate. If the process load does not yield such a heat load, it may be necessary to apply a supplementary heat load to the process fluid.

Draining galvanized steel coils is not considered to be an acceptable means of protection against freezing. Introducing air to the inside of the heat exchanger coil will promote corrosion. In an emergency, this alternative can be used in the event that the process fluid drops below 45°F, the ambient temperature is below freezing and the coils are not protected with industrial antifreeze. Copper coils and series 300 stainless steel coils may be drained as necessary without significantly increasing corrosion risk.

Cycling of the recirculating water pumps to control process flow temperatures must be approached with caution. Frequent cycling of the recirculating water pump may lead to an excessive scale buildup resulting in a decrease in efficiency.

⚠ CAUTION

Freezing ambient conditions could cause significant damage to the heat exchanger coil of the MH Fluid Cooler. To avoid possible damage, it is imperative to provide for adequate freeze protection.

FLUID COOLING RECIRCULATING WATER

When the ambient air temperature falls below 32°F, the recirculating water within the fluid cooler can freeze. *Marley Technical Report #H-003* "Cooling Towers and Freezing Weather" describes how to prevent freezing during operation. Ask your Marley sales representative for a copy or download a copy at spxcooling.com.

During shutdown, water collects in the basin and may freeze solid. You can prevent freezing by adding heat to the water left in the basin—or, you can drain the tower and all exposed pipework at shutdown.

ELECTRIC BASIN HEATERS

An automatic basin water heater system, 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.

  The enclosure may be mounted on the side of the fluid cooler.
- Control probe in the collection basin to monitor water temperature and level.

The basin heater option is only for freeze protection of the recirculation water in collection basin. The basin heater option does *not* protect the coil during freezing weather.

Heater components are normally shipped separately for installation by others.

INDOOR STORAGE TANK

With this type of system, water flows from an indoor tank and back to the tower where it is cooled and recirculated. The water flows by gravity from the fluid cooler 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 fluid cooler size on 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.

SYSTEM CLEANLINESS

The MH Fluid Cooler can be a very effective air washer. Atmospheric dust able to pass through the relatively small louver openings will enter the recirculating water system. Increased concentrations can intensify systems maintenance by clogging screens and strainers—and smaller particulates can coat system heat transfer surfaces. In areas of low flow velocity—such as the collection basin—sedimentary deposits can provide a breeding ground for bacteria.

In areas prone to dust and sedimentation, you should consider installing some means for keeping the collection basin clean. Typical devices include side stream filters and a variety of filtration media.

BLOWDOWN

Blowdown or Bleedoff is the continuous removal of a small portion of the water from the open recirculating system. Blowdown is used to prevent the dissolved solids from concentrating to the point where they will form scale. The amount of blowdown required depends on the cooling range—the difference between the hot and cold water temperatures of the closed circuit— and the composition of the makeup water. The MH Fluid Cooler is equipped with a blowdown line with metering valve connected directly to the overflow. Specific blowdown adjustment instructions and additional blowdown information can be found in the *MH Fluid Cooler User Manual*.

⚠ CAUTION

The fluid cooler 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 fluid cooler is in compliance with applicable air pollution, fire and clean air codes.

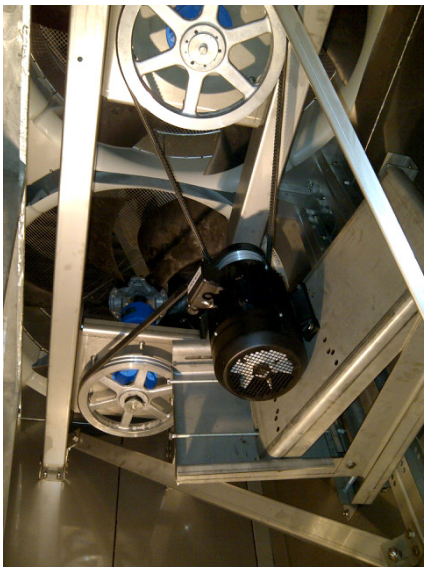
WATER TREATMENT

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 fluid cooler—ideally the pH of the recirculating water should fall between 6.5 and 9.0. Batch feeding of the chemicals directly into the fluid cooler is not a good practice since localized damage to the fluid cooler is possible. Specific startup instructions and additional water quality recommendations can be found in the *MH Fluid Cooler User Manual* which accompanies the fluid cooler and also is available from your local Marley sales representative.

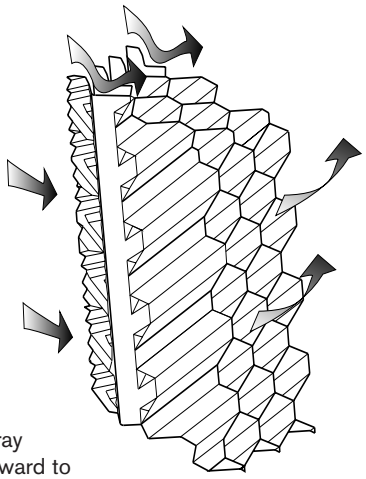
Specifications	Specification Value
1.0 **Base:**	
1.1 Provide an induced-draft, crossflow-type, factory assembled, galvanized steel, closed circuit fluid cooler. Unit shall consist of _____ cell(s), as shown on plans. The limiting overall dimensions of the fluid cooler shall be _____ wide, _____ long, and _____ high to the top of the fan guard. Total operating horsepower of all fans shall not exceed _____ hp. Fluid cooler 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 fluid cooler to be quoted. During the planning and layout stages of your project, you will have focused your attention on a fluid cooler 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 fluid coolers is that they are inherently easy to operate, access, and maintain. Unlike counterflow fluid coolers, crossflow fluid coolers have a spacious plenum between banks of fill for easy access to all of the tower's internal components, and the water distribution system is adjacent to the fan deck.
2.0 **Thermal Performance:**	
2.1 *Water as the heat transfer fluid.* The fluid cooler shall be capable of cooling _____ gpm of water from _____ °F to _____ °F at a design entering air wet-bulb temperature of _____ °F. Coil pressure drop shall not exceed _____ psi. The thermal performance rating shall be Certified by the Cooling Technology Institute.	■ Certification means that the fluid cooler 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. The MH Fluid Cooler has been tested and performance certified with water, ethylene glycol solutions up to 50% concentration and propylene glycol solutions up to 50% concentration. The minimum efficiency per ASHRAE Standard 90.1-2010 for axial-fan closed circuit cooling towers applied to comfort cooling is 14.0 gpm/hp at 102°F / 90°F / 75°F, where hp is the sum of the fan motor nameplate power and the integral spray pump motor nameplate power. If a greater efficiency is desired, a higher ASHRAE Standard 90.1 gpm/hp can be specified. Each model's rating at ASHRAE Standard 90.1 conditions can be viewed in our online selection software at spxcooling.com/update.
2.1 *Aqueous glycol solution as the heat transfer fluid.* The fluid cooler shall be capable of cooling _____ gpm of _____% by volume ethylene/propylene glycol solution from _____ °F to _____ °F at a design entering air wet-bulb temperature of _____ °F. Coil pressure drop shall not exceed _____ psi. The thermal performance rating shall be Certified by the Cooling Technology Institute .	
2.2 The closed circuit cooling fluid cooler shall be capable of a minimum _____ gpm/hp efficiency per ASHRAE Standard 90.1.	
2.3 Heat loss from the fluid cooler shall be limited to ____ Btu/h for the standard fluid cooler/fluid cooler with positive closure dampers/fluid cooler with positive closure dampers and insulation, based on 50°F inlet fluid temperature and -10°F ambient temperature with 45 mph wind and fan(s) and pump(s) off.	

Specifications	Specification Value
3.0 **Performance Warranty:**	
3.1 CTI Certification notwithstanding, the fluid cooler manufacturer shall guarantee that the fluid cooler supplied will meet the specified performance conditions when the fluid cooler 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, Eurovent or ASME standards during the first year of operation; and if the fluid cooler fails to perform within the limits of test tolerance; then the fluid cooler 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, certification alone is not sufficient to assure you that the fluid cooler will perform satisfactorily in your situation. Certification is established under relatively controlled conditions, and fluid coolers seldom operate under such ideal circumstances. They are affected by nearby structures, machinery, enclosures, effluent from other sources, etc. Responsible and knowledgeable bidders will take such site-specific effects into consideration in selecting the fluid cooler–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 **Coil:**	
4.1 Coil(s) shall consist of fully welded box headers with serpentine tube circuits and shall be hot-dip galvanized after fabrication. The coil(s) shall be designed for free drainages of fluid at shutdown. Minimum design operating pressure shall be 150 psi. Coil(s) shall be warranted against any failure caused by defects in materials and workmanship for a period of eighteen (18) months from the date of shipment.	■ The MH Fluid Cooler coil is suitable for cooling water, oils, and other fluids compatible with carbon steel in a closed, pressurized system. Each coil is constructed of all-prime surface, continuous steel tubing, formed into a serpentine shape and welded into an assembly. The complete assembly is then hot-dip galvanized after fabrication. Tubes are sloped to provide free drainage when vented.
5.0 **Design Loading:**	
5.1 The structure and anchorage shall be designed to withstand a wind load of 50 psf while operating, based on International Building Code ASCE7-10, as well as a .3g seismic load. The fluid cooler shall be designed to withstand shipping and hoisting loads of 2g horizontal or 3g vertical. The fan deck and hot water basin covers on doubleflow models shall be designed for 50 psf live load or a 200 lb concentrated load. Guardrails, where specified, shall be capable of withstanding a 200 lb concentrated live load in any direction, and shall be designed in accordance with OSHA guidelines.	■ The indicated design values are the minimum allowables under accepted design standards. They give you assurance that the fluid cooler can be shipped, handled, hoisted–and ultimately operated in a normal fluid cooler environment. Most MH Fluid Cooler models will withstand significantly higher wind and seismic loads. If your geographic location dictates higher wind load or seismic load values, please make the appropriate changes, after discussion with your Marley sales representative.

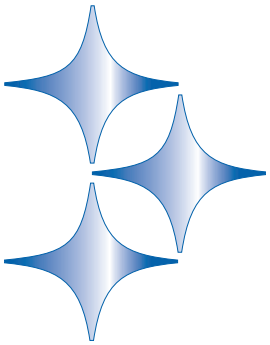
Specifications	Specification Value
6.0 **Construction:**	
6.1 Except where otherwise specified, all components of the fluid cooler shall be fabricated of heavy-gauge steel, protected against corrosion by G-235 galvanizing. After passivation of the galvanized steel (8 weeks at pH 7-8, and calcium hardness and alkalinity at 100-300 ppm each), the fluid cooler shall be capable of withstanding water having a pH of 6.5 to 9.0; a chloride content up to 500 ppm as NaCl (300 ppm as Cl-); a sulfate content (as SO_4) up to 250 ppm; a calcium content (as $CaCO_3$) up to 500 ppm; silica (as SiO_2) up to 150 ppm. The circulating water shall contain no oil, grease, fatty acids, or organic solvents.	■ In the history of fluid coolers, no other coating for carbon steel has exhibited the success and longevity of galvanization in exposure to the normal fluid cooler water quality defined at left. No paints or electrostatically-applied coatings, however exotic they may be, can approach galvanization's history of success. If extended longevity of the fluid cooler is required–or unusually harsh operating conditions are expected–consider specifying stainless steel as either the base construction material, or the material utilized for specific components of your choice. See Stainless Steel Options on page 14.
6.2 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 6.1. They are to be regarded as minimum requirements. Where component materials unique to individual fluid cooler 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.	
7.0 **Mechanical Equipment**:	
7.1 MHF7101, MHF7103, MHF7105, MHF7107 and MHF7109 - Fan(s) shall be driven through a one-piece multi-groove, solid back V-type belt. Bearings and fan shaft shall be contained in a cast steel housing to insure proper fan shaft alignment, pillow block bearings are not allowed. Bearings shall be rated at an L_{10A} service life of 40,000 hours or greater	■ Axial-flow fans require only half the operating hp of blower-type fans. The Marley drive system features all-aluminum sheaves, matched belts, and long-life bearings for dependable service. To reduce cost, some manufacturers may use TEAO motors, whose only source of cooling is the flow of air produced by the fluid cooler fan. They are sometimes applied at horsepowers significantly beyond their nameplate rating. Unless otherwise specified, motor speed will be 1800 RPM, 60 Hertz on standard models.
7.1 MHF7111 and MHF7113 – Fan(s) shall be heavy duty, high efficiency, low sound axial design, incorporating aluminum alloy blades attached to galvanized steel hubs with U-bolts. Blades shall be individually adjustable. Fan(s) shall be driven through a right angle, industrial duty, oil lubricated, geared speed reducer that requires no oil changes for the first five (5) years of operation. All gearbox bearings shall be rated at an L_{10A} service life of 100,000	■ The exclusive Marley System5 Geareducer® requires no oil changes for five years, offering you unmatched reliability and low maintenance.

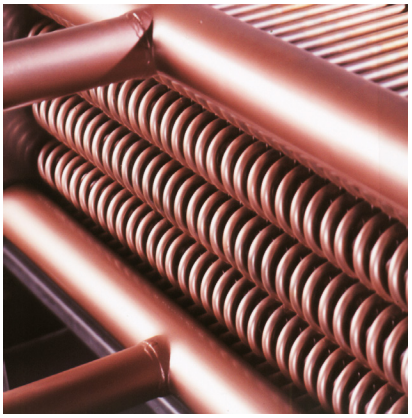
Specifications	Specification Value
hours or greater and the gear sets shall have AGMA Quality Class of 9 or greater. The gearbox shall include any modifications to enable operation down to 10% of full speed.	
7.2 Fan motor(s) shall be ____ hp maximum, NEMA Premium Efficiency TEFC, 1.15 service factor, variable torque, inverter duty and specially insulated for cooling fluid cooler duty (Class F). Speed and electrical characteristics shall be _____ RPM, single-winding, 3 phase, 60 hertz, ____ volts. Motors shall operate in the shaft-vertical position for belt-drive fluid coolers and in the shaft-horizontal position for gear drive fluid coolers. Nameplate power shall not be exceeded at design operation. TEAO motors shall not be acceptable.	
7.3 The fan and fan drive assembly for each cell shall be supported by a rigid, 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 fluid cooler shipment. This warranty shall cover the fan(s), premium efficiency motor(s), geared speed reducer(s), drive shaft(s) and couplings, and the mechanical equipment support. Bearing assemblies and V-belts shall be warranted for 18 months.	■ The value of a 5 year mechanical equipment warranty speaks for itself.
8.0 **Fill, Louvers and Drift Eliminators:**	
8.1 Fill shall be film-type, thermoformed of heavy duty PVC, with louvers and eliminators formed integrally in each fill sheet. Fill shall be suspended from galvanized structural tubing supported from the fluid cooler structure. The air inlet face(s) of the fluid cooler 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.
8.2 Coil air-inlet louvers shall be a minimum of 0'-5" air travel, triple-pass PVC to limit water splash out and prevent direct sunlight from entering the collection basin. PVC louvers shall be easily removable for access to the coil(s). Louvers with less than three changes in air direction are unacceptable.	

Specifications	Specification Value
8.3 Drift eliminators shall be heavy duty PVC with a minimum of three changes in air direction, and shall limit drift losses to 0.005% or less of the design recirculating water 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.
9.0 **Distribution Basins:**	
9.1 An open basin above the fill with removable interchangeable polypropylene nozzles installed in the floor of the basin shall provide full coverage of the fill by gravity flow. Basin shall be installed and sealed at the factory and assembled with bolted connections. Tap screws shall not be allowed. The basins shall be equipped with removable, galvanized steel covers capable of withstanding the loads described in paragraph 5.1. The water distribution system shall be accessible and maintainable during fan and water operation.	■ Gravity-flow distribution basins are a feature of the MH Fluid Cooler resulting in operating pump heads less than that encountered in fluid coolers with pressurized spray systems. Also, these basins are out where they can be easily inspected–even maintained–while the fluid cooler is in operation. Pressurized spray systems used by others are extremely awkward to access and maintain.
9.2 A redistribution basin below the fill with polypropylene nozzles installed in the floor of the basin shall provide full coverage of the coil at a flow rate sufficient to ensure complete wetting of the coil during operation. The basin shall be installed and sealed at the factory and assembled with bolted connections. Tap screws shall not be allowed.	
10.0 **Casing, Fan Deck and Fan Guard:**	
10.1 The casing and fan deck shall be heavy gauge G-235 galvanized steel panels. The top of the fan cylinder(s) 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.	■ Manufacturers who use materials other than heavy-gauge steel for fan decks may be unable to meet your specified loading requirements. Fan decks on the larger models–MHF7111 and MHF7113–are designed to be used as a working platform.
11.0 **Access:**	
11.1 A large galvanized steel, rectangular access door shall be located on both endwalls for entry into the cold water basin and fan plenum area. Access doors shall be a minimum of 24" wide and 42" tall and shall be operable from inside as well as outside of the fluid cooler.	■ Access doors on other manufacturer's 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 MH Fluid Coolers–one in each endwall.



Specifications	Specification Value
12.0 **Collection Basin**:	
12.1 The collection basin shall be G-235 heavy-gauge galvanized steel assembled with bolted connections. Tap screws shall not be allowed. Suction connections shall be equipped with galvanized debris screens. A factory-installed, float-operated, mechanical makeup valve and wastewater blowdown line shall be included. An overflow and drain connection shall be provided in each cell of the fluid cooler. The basin shall include a depressed section into which accumulated particle debris can be flushed to permit cleaning. The basin floor adjacent to the depressed section shall slope toward the depressed section to prevent buildup of debris under the coil area.	 *Location of the coil in the lower portion of the MH Fluid Cooler makes it much easier to access for cleaning and inspection.*
12.2 Recirculation pump(s) shall be mounted to the collection basin in conjunction with a suction assembly. Recirculation piping shall be schedule 40 PVC. A blowdown line with metering valve shall be connected directly to the fluid cooler overflow.	
13.0 **Warranty**:	
13.1 The fluid cooler shall be free from defects in materials and workmanship for a period of eighteen (18) months from the date of shipment.	

Specifications	Specification Value
Alternate Material Options	
All Stainless Steel Fluid Cooler:	
1.1: *Replace paragraph 1.1 with the following:* Provide an induced-draft, crossflow-type, factory assembled, stainless steel, closed circuit fluid cooler. Unit shall consist of _____ cell(s), as shown on plans. The limiting overall dimensions of the fluid cooler shall be _____ wide, _____ long, and _____ high to the top of the fan guard. Total operating horsepower of all fans shall not exceed _____ hp. Fluid cooler shall be similar and equal in all respects to Marley Model _____.	■ For pure resistance to corrosion–coupled with the capability to meet stringent fire and building codes–there is no substitute for stainless steel. No paints or electrostatically-applied coatings, however exotic they may be, can match stainless steel's ability to withstand adverse operating conditions.
6.1 *Replace paragraph 6.1 with the following:* Except where otherwise specified, all components of the fluid cooler shall be fabricated of heavy-gauge, 301L stainless steel. Only low-carbon stainless steel alloys will be accepted in order to minimize the risk of intergranular corrosion in the weld zones. The fluid cooler shall be capable of withstanding water having a chloride content (NaCl) up to 750 ppm; a sulfate content (SO_4) up to 1200 ppm; a calcium content ($CaCO_3$) up to 800 ppm; silica (SiO_2) up to 150 ppm. The circulating water shall contain no oil, grease, fatty acids, or organic solvents.	
Stainless Steel Collection Basin:	
12.1: *Replace paragraph 12.1 with the following:* The collection basin shall be welded 301L stainless steel construction. Only low-carbon stainless steel alloys will be accepted in order to minimize the risk of intergranular corrosion in the weld zones. Suction connections shall be equipped with stainless steel debris screens. All steel items which project into the basin (coil supports, anchor clips, etc) shall also be made of stainless steel. A factory-installed, float-operated, mechanical makeup valve and waste water blowdown line shall be included. An overflow and drain connection shall be provided in each cell of the fluid cooler. The basin shall include a depressed section into which accumulated particle debris can be flushed to permit cleaning. The basin floor adjacent to the depressed section shall slope toward the depressed section to prevent buildup of debris under the coil area.	■ 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.

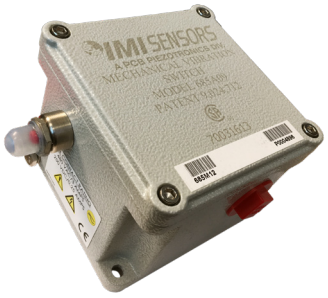
Specifications	Specification Value
Stainless Steel Distribution Basin:	
9.1 *Replace paragraph 9.1 with the following:* An open 301L stainless steel basin above the fill with removable interchangeable polypropylene nozzles installed in the floor of the basin shall provide full coverage of the fill by gravity flow. The basin components shall be installed and sealed at the factory and connected with bolted connections. Tap screws shall not be allowed. The basin shall be equipped with removable, stainless steel covers capable of withstanding the loads described in paragraph 5.1. The water distribution system shall be accessible and maintainable during tower fan and water operation.	■ It would also be advisable to change the fill support tubes in Paragraph 8.1 from galvanized structural tubing to 300 stainless steel structural tubing.
9.2 *Replace paragraph 9.2 with the following:* A redistribution basin below the fill with polypropylene nozzles installed in the floor of the basin shall provide full coverage of the coil at a flow rate sufficient to ensure complete wetting of the coil during operation. The basin components shall be installed and sealed at the factory and connected with bolted connections. Tap screws shall not be allowed.	
Copper Coil: *MHF7101, MHF7103, MHF7105 and MHF7107 models only*	■ Copper coils offer many potential advantages over galvanized steel coils including superior corrosion resistance, improved heat transfer, reduced weight and other benefits. The thermal performance ratings of the MH Fluid Cooler with the copper coil option are certified by the Cooling Technology Institute. 
4.1 *Replace paragraph 4.1 with the following:* Copper coil tubes shall be 5/8" OD with type L headers. Tubes shall be supported by stainless steel tube sheets with floating tube design for long life. Minimum design operating pressure shall be 250 psi. Coil shall be warranted against any failure caused by defects in materials and workmanship for a period of eighteen (18) months from the date of shipment.	
Stainless Steel Coil:	■ For process fluids that are not compatible with the standard hot dip galvanized carbon steel construction, stainless steel offers you the ultimate in corrosion resistance and long life. The thermal performance ratings of the MH Fluid Cooler with the stainless steel coil option are certified by the Cooling Technology Institute.
4.1 *Replace paragraph 4.1 with the following:* Coil(s) shall consist of fully welded box headers with serpentine tube circuits. All coil components shall be assembled from series 300 stainless steel. Minimum design operating pressure shall be 150 psi. The coil(s) shall be designed for free drainage of fluid at shutdown. Coil(s) shall be warranted against any failure caused by defects in materials and workmanship for a period of eighteen (18) months from the date of shipment.	

Specifications	Specification Value
Convenience and Safety Options	
Guardrail and Ladder: *MHF7111 and MHF7113 models only* 11.2 *Add the following paragraph in the Access section:* The top of the fluid cooler shall be equipped with a guardrail, complete with kneerail and toeboard, designed according to OSHA guidelines and factory welded into sub-assemblies for ease of field installation. Posts, toprails and kneerails shall be 1.5" square tubing. The guardrail assembly shall be hot dipped galvanized after welding and capable of withstanding a 200 lb concentrated live load in any direction. Posts shall be spaced on centers of 8'-0" or less. A 1'-6" wide aluminum ladder with 3" I-beam side rails and 1.25" diameter rungs shall be permanently attached to the endwall casing of the tower, rising from the base of the fluid cooler to the top of the guardrail.	■ Good maintenance practice requires periodic access to the top of the fluid cooler to inspect the distribution basins as well as the structural integrity of the fan deck, fan guard, fan cylinder and fan—especially the fan blade securing hardware. These models are large enough to accommodate this convenience. For the comfort and safety of your operating personnel, we recommend that you specify a ladder and guardrail on these models Portable ladders and other "make-do" access means are inappropriate for equipment of this size and complexity. Also, fixed ladders without fan deck guardrails invite unsafe maintenance practices and must not be allowed.
Distribution Basin Access Platform: 11.2 *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 heavy gauge galvanized steel with safety grip perforations, supported by galvanized steel framework attached to the fluid cooler. The platform shall be surrounded by an OSHA compliant guardrail system welded into subassemblies for ease of installation. 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 fluid cooler to the top of the guardrail.	■ Periodic inspection and maintenance of a fluid cooler distribution system is fundamental to preserving maximum cooling system efficiency. All fluid coolers—crossflow or counterflow—are subject to clogging to varying degrees by waterborne contaminants such as pipe scale and sediment. Therefore, safe and easy access to these components is of significant value to the operator. Access can be provided in a number of ways, including portable ladders or scaffolding, but for maximum safety and convenience, a field installed Marley access platform with guardrails is available to make this task as safe and user-friendly as possible. Further, its location on the side of the tower does not add to the height of the unit, preserving architectural integrity. It also saves the owner time and money, in that maintenance personnel may devote their time to inspection rather than searching for ladders or erection of portable scaffolding.
Ladder Extension: 11.2 *Add the following to the end of paragraph 11.2:* Provide a ladder extension for connection to the foot of the ladder. This extension shall be long enough to rise from the roof (grade) level to the base of the fluid cooler. The installing contractor shall be responsible for cutting the ladder to length; attaching it to the foot of the fluid cooler ladder; and anchoring it at its base.	■ Many fluid coolers are installed such that the base of the unit 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.

Specifications	Specification Value
Ladder Safety Cage:	
11.3 *Add the following paragraph in the Access section:* A heavy-gauge aluminum safety cage welded into subassemblies for ease of field installation shall surround the ladder, extending from a point approximately 7'-0" above the foot of the ladder to the top of the guardrail surrounding the fan deck or platform. Maximum weight of welded subassemblies shall not exceed 20 lb for ease of installation.	■ To meet OSHA guidelines, towers whose fan decks are 20'-0" or more above roof or grade, and which are equipped with ladders, should have safety cages surrounding the ladders, but with approximately 7'-0" clear headroom.
Ladder Safety Gate:	
11.3 *Add the following paragraph in the Access section:* A steel, self-closing gate shall be provided at the guardrail level of the ladder.	■ A galvanized steel self-closing gate can be located at the guardrail level of the fan deck, the exterior motor access platform and/or the access door platform for enhanced fall protection. Stainless steel is available with the stainless guardrail option. For the comfort and safety of your operating personnel, we recommend that you specify a self-closing gate. Many user's own safety rules may dictate these options.
Access Door Platform:	
11.4 *Add the following paragraph in the Access section:* There shall be a galvanized access platform at the base of the fluid cooler endwall access door The platform shall be surrounded by an OSHA compliant guardrail system welded into subassemblies for easy installation. The walking surface of the platform shall be perforated to provide a non-slip surface for personnel safety.	■ Where fluid coolers are installed on an elevated grillage or piers, it is often difficult to get to–and through–the access door conveniently. This platform provides easy, safe, and comfortable access to that door. It also extends beyond the door to provide ready access to the optional Control System.
Plenum Walkway:	
11.5 *Add the following paragraph in the Access section:* Provide a factory-installed, heavy gauge steel walkway with safety grip perforations, extending from one cased face access door to the other cased faced access door. This walkway shall be supported by a steel framework, and the top to the walkway shall be at or above the cold water basin overflow level and be equivalent material as the tower basin.	■ A galvanized steel walkway enables easy access to inspect collection basin items such as the coil, coil eliminators, sump screen and make-up valve and provides a dry working area to view and access the drive system.

Specifications	Specification Value
Interior Mechanical Equipment Access Platform: *Plenum walkway required.*	
11.6 *Add the following paragraph in the Access section:* An internal ladder shall extend upward from the plenum walkway to an elevated fiberglass bar grating platform convenient to the care and maintenance of the fluid cooler's mechanical equipment. The platform shall be surrounded by an OSHA compliant guardrail system welded into subassemblies for ease of installation.	■ An elevated fiberglass bar grating service platform with aluminum ladder provides a permanent working surface to inspect and maintain the mechanical equipment components.
Control Options	
Combination Fan and Pump Motor Starter Control Panel:	
6.4 *Add the following paragraph in the Mechanical Equipment section:* Each cell of the fluid cooler shall be equipped with a UL / CUL 508 listed control panel in a NEMA 3R outdoor enclosure designed specifically for fluid cooler applications. The panel shall include a main thermal magnetic circuit breaker disconnect with an external operating handle, lockable in the off position for safety. For fan operation use a full voltage non-reversing magnetic starter controlled with a solid-state temperature controller. For spray pump operation use a full voltage non-reversing magnetic starter with manual ON and OFF control via a door mounted selector switch. The solid-state device for fan control will display two temperatures, one for outgoing water and the other for set point temperature. Water temperature input shall be obtained using a three-wire RTD with dry-well located in the field outlet water piping. Dry status contacts wired to user terminal points indicating typical alarm and status events shall be provided. Two safety circuits for the spray pump, low water cut off preventing a dry run pump and a pump shut down upon approaching freezing temperatures in the cold water basin shall be provided. Available options: Water level control with various combinations of make-up, high alarm, low alarm, high cut off and low cutoff events. Basin heater controller with low water cutout. Spray pump heat trace circuit. Power and control for damper actuator motor.	■ If it is your opinion that the control system for the fluid cooler be part of the fluid cooler manufacturer's responsibility, we are in wholehearted agreement with you. Who better to determine the most efficient mode and manner of a fluid cooler's operation–and to apply a system most compatible with it–than the designer and manufacturer of the fluid cooler? Marley variable speed drives are also available for the ultimate in temperature control, energy management, and mechanical equipment longevity. 

Specifications	Specification Value
Pump Motor Starter Control Panel: *(used when a VFD controls the fan)*	
6.4 *Add the following paragraph in the Mechanical Equipment section:* Each cell of the fluid cooler shall be equipped with a UL / CUL 508 listed control panel in a NEMA 3R outdoor enclosure designed specifically for fluid cooler applications. The panel shall include a main thermal magnetic circuit breaker disconnect with an external operating handle, lockable in the off position for safety. For spray pump operation use of a full voltage non-reversing magnetic starter with manual ON and OFF control via a door mounted selector switch shall be provided. Dry status contacts wired to user terminal points indicating typical alarm and status events shall be provided. Two safety circuits for the spray pump, low water cut off preventing a dry run pump and a pump shut down upon approaching freezing temperatures in the cold water basin shall be provided.	
Available Options: Water level control with various combinations of make-up, high alarm, low alarm, high cut off and low cutoff events. Basin heater controller with low water cutout. Spray pump heat trace circuit. Power for damper actuator motor. Circuit breaker feeder for a remote mounted VFD.	
Vibration Limit Switch:	
6.5 *Add the following paragraph in the Mechanical Equipment section:* A vibration limit switch in a NEMA 4X housing shall be installed on the mechanical equipment support and wired to the shutdown circuit of the fan motor starter or VFD. The purpose of this switch will be to interrupt control power voltage to a safety circuit in the event of excessive vibration causing the starter or VFD equipment to de-energize the motor. It shall be adjustable for sensitivity and include a means to reset the switch.	■ Unless specified otherwise, an IMI Sensors mechanical 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.
Basin Heater:	
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 fluid cooler to prevent freezing of water in the collection basin during periods of shutdown. The system shall consist of one or more stainless	■ 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.



Specifications	Specification Value
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 cut-off. A control probe shall be located in the basin to monitor water level and temperature. Recirculating pump(s) shall be fitted with heat trace cable and insulated. The system shall be capable of maintaining 40°F water temperature at an ambient air temperature of _____ °F.	Submerged in basin water, in which zinc ions are present, 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.
Water Level Control System: 11.2 *Add the following paragraph in the Cold Water Basin section:* Provide a water level control system including a NEMA 4X control panel, water level probes and probe stilling chamber. The control system shall monitor the water level in the cold-water basin to determine level events used for cold-water make-up, high and low alarms and/or pump shut down. The control panel shall use electromechanical relays providing power for the make-up solenoid and electrical contacts for alarm and pump shutdown control circuits. Probes shall be contained in a vertical stilling chamber to stabilize the water in the cold-water basin. Probes shall have replaceable stainless steel tips and level height shall be field-adjustable.	■ Solid-state liquid level controls provide you with state of the art systems to control and monitor the water level in your fluid cooler collection basin. Relays operating in conjunction with suspended stainless steel electrode probes monitor basin water levels, providing simple solenoid-valve water makeup or discrete on/off signals to more sophisticated automation controls. Optional configurations might include water makeup along with high and low water level alarm and cutoff, or pump cutoff. Packaged systems including any of these variations are available. Consult your Marley sales representative or download a copy of ACC-NC-9 from spxcooling.com for additional information.
Fan Motor Variable Speed Drive: **ACH550 VFD System** 6.4 *Add the following paragraph in the Mechanical Equipment section when VFD is used with customers Building Management System:* For fan control 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	■ Marley VFD drive systems are designed to combine absolute temperature control with ideal energy management. The fluid cooler user selects a cold water temperature and the drive system will vary the fan speed to maintain that temperature. Precise temperature control is accomplished with far less stress to the mechanical equipment components. The improved energy management provides fast payback. *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.*

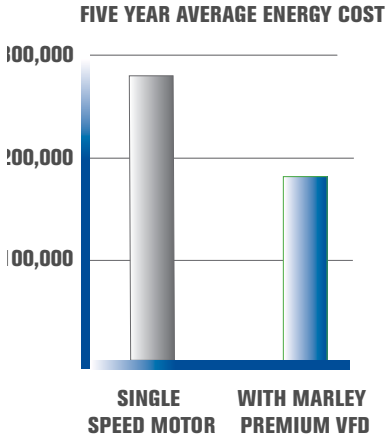
Specifications	Specification Value

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 fluid cooler cold-water temperature. As an option to 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. When using an RTD for temperature monitoring and speed control 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 electromechanical 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 fan motor the VFD system shall de energize the motor once 25% motor speed is reached and cooling is no longer required. The manufacturer shall supply VFD start-up assistance by a certified technician.

Marley Premium VFD System:

6.4 *Add the following paragraph in the Mechanical Equipment section when VFD is used as a stand alone system and not controlled by a BMS:* For fan control a complete UL listed variable speed drive system in a 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 as not to cause mechanical vibration issues with back lash in gearbox teeth or vibration issues associated with long drive shafts.

Specifications	Specification Value
VFD shall be programmed for variable torque application. The VFD 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. In the event of a system fault the VFD program logic shall evaluate type of fault determining if safe to automatically transfer fan motor to the bypass starter. Automatic bypass with an earth ground condition shall not be allowed. Once in bypass mode the internal controls will continue to monitor cold water temperature and cycle the fan motor on and off maintaining cold-water set point temperature. The drive system shall be designed and operated as a stand-alone system without the need for a BMS system. Operator controls shall be mounted on the front of the enclosure and shall consist of Start and Stop control, Bypass/VFD selector switch, Auto/Manual selector switch, Manual speed control, and solid-state temperature controller. An emergency bypass starter selector switch internal to the panel allowing the fan motor to be run at full speed shall be furnished. The system shall include a solid state PI temperature controller to adjust frequency output of the drive in response to the tower cold-water temperature. A four-wire RTD with dry well shall be furnished with the VFD and field installed into the cold-water discharge pipe coming from the fluid cooler cell. The temperature of the cold-water and set point shall be displayed on the door of the control panel. The bypass starter shall be integrated into the same enclosure as the VFD including complete circuitry to isolate the VFD when in the bypass mode. To prevent heating problems in the fan motor the VFD system shall de-energize the motor once 25% motor speed is reached and cooling is no longer required. The VFD shall include deicing logic and manual control with the ability to reverse fan rotation including auto canceling with adjustable time. Speed in deice mode shall not exceed 50% motor speed. The manufacturer shall supply VFD start-up assistance by a certified technician.	



20% reduction in fan speed will typically save 50% of electrical energy

Specifications	Specification Value
Miscellaneous Options	
Positive Closure Dampers:	
4.2 *Add the following paragraph in the Coil section:* Provide positive closure actuating dampers to prevent air from flowing through the coil section when the dampers are closed. All linkage and axles shall be stainless steel and the blade bearings shall be corrosion resistant, molded synthetic bearings. Damper blades shall be single-skin constructed from G60 galvanized steel. Damper frame shall also be manufactured from G60 galvanized steel. Damper actuators shall be either pneumatic or electric depending on customer's preference. Dampers shall be field installed and actuators shall be wired by others.	■ Positive closure dampers give you the added security of safe operation in freezing weather. Heat loss data from the coil can be obtained by accessing the Marley UPDATE web-based selection software at spxcooling.com. Pneumatic damper actuators are UL approved, totally enclosed with spring return actuators. Electric actuators are industrial grade, NEMA 4 rated, 2-position drive both ways. The damper section protrudes from the louver face a minimum of 6".
Motor Out of the Airstream: *MHF7111 and MHF7113 models only with gear drive option.*	■ For many years, a feature of Marley cooling towers was that the electric motors were located outside the fan cylinders, where they were easily accessible, and where they were not subjected to the constant humidity that exists inside the tower plenum. Although improved motor designs (insulation, bearings, seals, and lubricants) have now made it feasible for us to locate the motor inside in close-coupled proximity to the Geareducer, many users still prefer the motor to be located outside the humid airstream. If you are among those users–or are among those who see the wisdom of their thinking–please specify this option.
7.1 *Add the following to the end of paragraph 7.1:* The motor shall be mounted outside the casing of the fluid cooler and shall be connected to the gear reducer by a dynamically-balanced, stainless steel tube and flange drive shaft.	
High Temperature Fill:	■ For process fluid above 135°F.
8.1 *Replace paragraph 8.1 with the following:* Replace paragraph 8.1 with the following: Fill shall be film-type, thermoformed of 20 mil thick high-temperature PVC, with louvers and eliminators formed integrally in each fill sheet. Fill shall be suspended from stainless steel structural tubing supported from the fluid cooler structure. The air inlet face(s) of the fluid cooler shall be free of water splashout.	
Air Inlet Screens:	■ In wooded or windy areas, these screens help to keep leaves or blowing debris out of the fluid cooler and circulating water system.
8.4 *Add the following paragraph:* The air inlet faces of the top module fill area of the fluid cooler shall be covered by 1" mesh hot dip galvanized welded wire screens. Screens shall be mounted in galvanized steel U-edging and shall be removable.	

Specifications

FM Approval:

6.3 *Add the following paragraph in the Construction section:* The tower shall be listed in the current FM Approval Guide (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.

Basin Sweeper Piping:

11.2 *Add the following paragraph in the Cold Water Collection Basin section:* The cold water basin shall be equipped with factory installed corrosion resistant PVC sweeper piping with plastic nozzles. The sweeper piping system shall be designed to force dirt and debris towards a dedicated drain in the depressed section of the collection basin.

Sound Control:

1.2 *Add the following paragraph in the Base section:* The closed circuit fluid cooler shall be designed for quiet operation, and shall produce an overall level of sound not higher than the overall dB(A) values shown in the following table when measured at a distance of ____ ft. 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

Location	63	125	250	500	1000
Air Inlet SPL					
Cased Face SPL					
Fan Discharge SPL					

Location	2000	4000	8000	Overall dB(A)
Air Inlet SPL				
Cased Face SPL				
Fan Discharge SPL				

Specification Value

- 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.

FM APPROVED

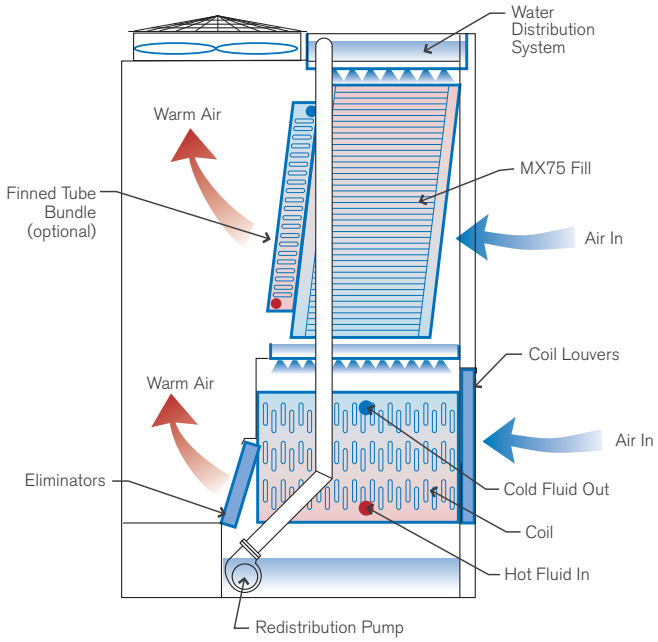
- Sound produced by a standard MH Fluid Cooler operating in an unobstructed environment will meet all but the most restrictive sound limitations, and will react favorably to natural attenuation. Where the fluid cooler has been sized to operate within an enclosure, the enclosure itself will have a damping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

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

  • In many cases, sound concerns are limited to nighttime, when ambient sound levels are lower and neighbors are trying to sleep. You can usually resolve these situations by variable speed drives, and operating the fans at reduced speed “after hours”. The natural nighttime reduction in wet-bulb temperature makes this a very feasible solution in most areas of the world. Variable speed drives automatically minimizes the tower’s sound 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.

  • Where sound is a concern at all times (for example, near a hospital), one possible solution is to oversize the tower so it can operate continuously at reduced motor speed even at the highest design wet-bulb temperature. Typical sound reductions are about 7 dB(A) at ⅔ fan speed or 10 dB(A) at ½ fan speed, but larger reductions may be possible.

Specifications	Specification Value
Inlet Sound Attenuation:	
1.3 *Add the following paragraph in the Base section:* The fluid cooler shall be equipped with inlet sound attenuation baffles positioned and spaced vertically. The baffles will be spaced across the entire length and extend the full height of the air inlet. The baffles shall be constructed of perforated sheet metal filled with sound absorbing material, and contained within a steel box that is self-supporting. The inlet attenuation shall not impact the thermal performance efficiency of the basic fluid cooler configuration.	
Quiet Fan:	
7.1 *Replace paragraph 7.1 with the following:* Fan(s) shall be propeller-type, incorporating a minimum of seven aluminum alloy blades attached to galvanized hubs with U-bolts. Blades shall be individually adjustable. Maximum fan tip speed shall be 11,000 ft/min. Fan(s) shall be driven through a right angle, industrial duty, oil lubricated, geared speed reducer that requires no oil changes for the first five (5) years of operation. The gearbox bearings shall be rated at an L_{10A} service life of 100,000 hours or greater. The gear sets shall have AGMA Quality Class of 9 or greater.	
Ultra Quiet Fan: *MHF7107, MHF7109, MHF7111 and MHF7113 models only.*	■ For more severe cases requiring the lowest possible sound levels, inlet sound attenuator sections and/or the Marley "Ultra Quiet" fan may offer additional sound reduction. The Ultra Quiet fan is available on MHF7107, MHF7109 MHF7111 and MHF7113 models only. Tower dimensions may increase slightly, obtain current sales drawings from your Marley sales representative for accurate dimensions.
7.1 *Replace paragraph 7.1 with the following:* Fan(s) shall be axial design, 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. Maximum fan tip speed shall be 10,000 ft/min. Fan(s) shall be driven through a one-piece multi-groove, solid back V-type belt, sheaves (pulleys), and tapered roller or deep groove ball bearings. Bearings shall be rated at an L_{10A} life of 90,000 hours, or greater. Both motor and fan sheaves (pulleys) shall be all cast aluminum to prevent premature corrosion.	 *Marley Ultra Quiet Fan*

Specifications	Specification Value
Dry Cooling Operation: *Not available on MHF7101 and MHF7109 models.*	
4.2 *Models MHF7103, MHF7105 and MHF7107 – Add the following in the Coil section:* An extended surface tube bundle shall be included in the plenum section of the fluid cooler to enable part-load seasonal dry operation. The finned tube bundle shall be constructed of fully welded box headers and finned tube circuits, and shall be hot-dip galvanized after fabrication. Minimum design operating pressure shall be 150 psi. The coil shall be warranted against any failure caused by defects in materials and workmanship for a period of eighteen (18) months from the date of shipment.	 *Dry cooling option on models MHF7103, MHF7105 and MHF7107*
4.2 *Models MHF7111 and MHF 7113 – Add the following in the Coil section:* An extended surface tube bundle shall be included at both wet section air inlet faces of the tower to enable part-load seasonal dry operation. The finned tube bundle shall be constructed of fully welded box headers and finned tube circuits, and shall be hot-dip galvanized after fabrication. Minimum design operating pressure shall be 150 psi. The coil shall be warranted against any failure caused by defects in materials and workmanship for a period of eighteen (18) months from the date of shipment.	
Extended Geareducer Lube-Line with Dipstick:	■ The dipstick option is accessible from a portable maintenance ladder on one and two cell installations only. Maintenance considerations recommends this option be combined with the ladder and guardrail option on installations of three or more cells since the dipstick cannot be reached without accessing the fan deck.
7.1 *Add the following paragraph to the Mechanical Equipment section:* An external oil level dipstick shall be located adjacent to the motor at the fan deck surface and shall be accessible from a portable maintenance ladder.	
Fan Cylinder Extension:	■ Extensions are available in 1'-0 increments to a maximum height equal to the diameter of the fan. 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.
7.1 *Add the following paragraph to the Mechanical Equipment section:* Fan cylinder extensions shall be provided to elevate the fan discharge to a height of ___ ft above the fan deck level.	

MH fluid cooler

ENGINEERING DATA AND SPECIFICATIONS

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