MARLEY®

user manual

# **NX** cooling tower

INSTALLATION - OPERATION - MAINTENANCE

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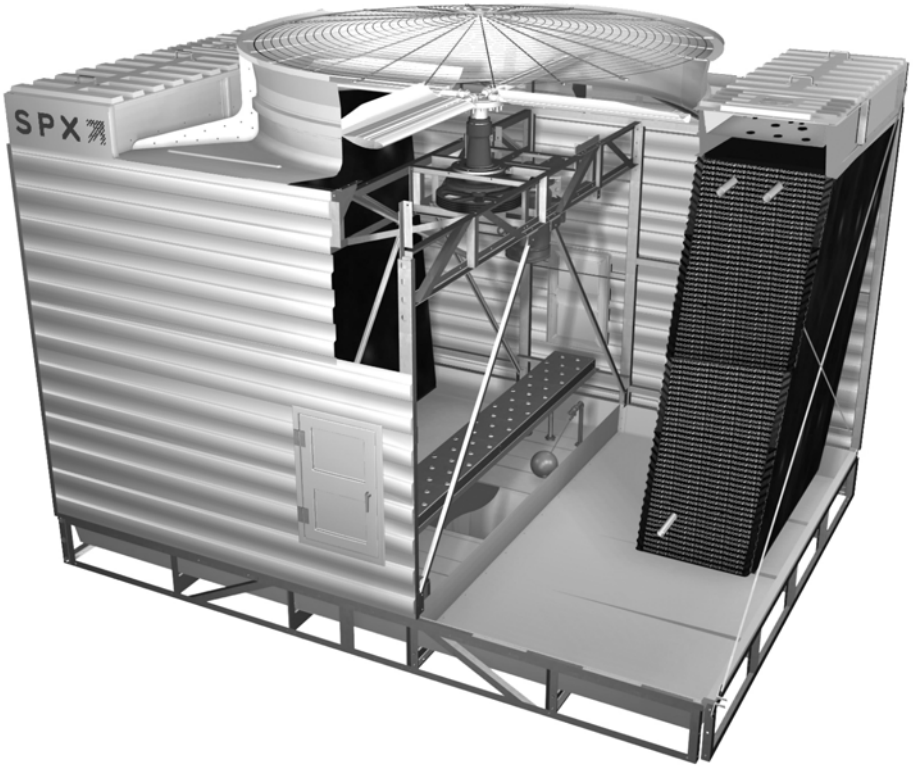
READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.



# contents

**Note**

***This manual contains vital information for the proper installation and operation of your cooling tower. Carefully read the manual before installation or operation of the tower and follow all instructions. Save this manual for future reference.***



The following defined terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning the life of the product.

**⚠ Warning**

***Indicates presence of a hazard which can cause severe personal injury, death or substantial property damage if ignored.***

**⚠ Caution**

***Indicates presence of a hazard which will or can cause personal injury or property damage if ignored.***

**Note**

***Indicates special instructions on installation, operation or maintenance which are important but not related to personal injury hazards.***

# overview - safety

This User Manual as well as those offered separately on motors, fans, Geareducer, couplings, drive shafts, float valves, pumps, etc., are intended to assure that this cooling tower serves you properly for the maximum possible time. Since product warrantability may well depend upon your actions, please read this User Manual thoroughly prior to operation.

This User Manual provides information regarding general cooling tower installation and operation. Any deviation from, change or modification to, the User Manual, the original design conditions or the original intended use of the equipment may result in improper installation and/or operation of the tower.

Any such deviation, change or modification shall be the responsibility of the party or parties making such deviation, change or modification. SPX Cooling Technologies, Inc. expressly disclaims all liability for any such deviation, change or modification. The equipment shall be warranted in accordance with the applicable SPX Cooling Technologies Certification of Limited Warranty.

If you have questions about the operation and/or maintenance of this cooling tower, and you don't find the answers in this manual, please contact your Marley sales representative. When writing for information, or when ordering parts, please include the serial number shown on the cooling tower nameplate.

**⚠ Warning**

***The following safety issues should be considered by those responsible for designing the tower installation.***

- ***Access to and from the fan deck***
- ***Access to and from maintenance access doors***
- ***The possible need for ladders (either portable or permanent) to gain access to the fan deck or maintenance access doors***
- ***The possible need for handrails around the fan deck***
- ***The possible need for external access platforms***
- ***Access issues due to obstructions surrounding the tower***
- ***Lockout of mechanical equipment***
- ***The possible need for safety cages around ladders***
- ***The need to avoid exposing maintenance personnel to the potentially unsafe environment inside the tower.***

***Those are only some of the safety issues that may arise in the design process. SPX strongly recommends that you consult a safety engineer to be sure that all safety considerations have been addressed.***

Several options are available that may assist you in addressing some of these personnel safety concerns, including:

– a handrail system around the perimeter of the fan deck with either one or two ladders for access to the deck

- ladder extensions (used where the base of the tower is elevated)
- safety cages for fan deck ladders
- fan cylinder extensions

## Tower Shipment

Unless otherwise specified, NX towers ship by truck (on flat bed trailers), which lets you receive, hoist, and install the tower in one continuous operation. Single-cell towers ship on one truck. Multicell towers, depending on their size, may require more than one truck.
Responsibility for the condition of the tower upon its arrival belongs to the trucker—as does the coordination of multiple shipments, if required.

## Receiving Tower

Prior to unloading the tower from the delivering carrier, inspect the shipment for evidence of damage in transit. If damage is apparent, note the freight bill accordingly. This will support your future recovery claim.
Find and remove the installation instruction drawings and bills of material located in a plastic tote in the cold water basin. This information should be kept for future reference and maintenance purposes.

## Tower Location

Space available around the tower should be as generous as possible to promote ease of maintenance—and to permit freedom of airflow into and through the tower. If you have questions about the adequacy of the available space and the intended configuration of the tower, please contact your Marley sales representative for guidance.

Prepare a stable, level support foundation for the tower, utilizing weight, wind load, and dimensional information appearing on appropriate Marley submittal drawings. Supports must be level to insure proper operation of the tower.

**⚠ Warning**

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

# installation

## Tower Installation

**Note**

***These installation instructions are intended to help you prepare before your tower arrives. If discrepancies exist between these instructions and those shipped with the tower, the instructions shipped with the tower will govern.***

1. Prior to assembly the tower, confirm that the supporting platform is level, and the embedded bolt, or anchor bolt holes or embedded steel plate are correctly located in accordance with SPX drawings.
2. Make sure that the orientation agrees with your intended piping arrangement.
3. Install all the other component assemblies according to the Field Assembly Manual.

**Note**

***Prior to assembly of equalizer piping or flume between towers, It is important to confirm that the cells be firmly anchored.***
***Each fan blade must be located in the right hub location ensuring the item number is the same. Ensure the fan blade pitch correct. Fan blades and hub of one fan cannot be exchanged each other.***

4. Using gaskets (by others), connect piping to the tower sump (NX1010-NX1015 - 6"; NX1020-NX1025 - 8") in compliance with drawing instructions.
5. Using rubber grommet (NX1010-NX1015 - 5"; NX1020-NX1025 - 6"), Insert inlet piping to the tower inlet cover in compliance with drawing instructions.

**⚠ Caution**

***Except for horizontal components of top-mounted piping and as prescribed on Marley drawings, do not support your pipe from the tower or outlet connection–support it externally.***

**⚠ Warning**

***For maintenance/safety purposes, SPX recommends a lockout type disconnect switch for all mechanical equipment. In addition to a disconnect switch, the motor should be wired to main power supply through short circuit protection, and a magnetic starter with overload protection.***
***The insulation resistance of the motor to ground is less than 0.5MΩ. Motors exceeding 11kw must require low voltage start-up.***

# installation

## Motor Wiring

Wire motor leads as shown on the motor nameplate matching the supply voltage. Do not deviate from the motor nameplate wiring.
Internal space heaters may be present, depending upon the motor manufacturer. For space heater operation and wiring refer to the Marley **"Fan Motor"** User Manual Z0239042.
Either of following symbols may be shown on the motor nameplate – Δ, Δ Δ, Y, or YY. These symbols represent how the motor is constructed on the inside and in no way have anything to do with a Delta or Wye electrical distribution system serving the motor.
Set motor overload protection to 110% of motor nameplate amps. This setting allows the fan motor to operate during cooler weather. During cooler weather it is common for the motor to draw 6 to 10% higher than nameplate amps. High amps are common during tower commissioning when the tower is dry and the ambient air temperature is cool.

**Note**

***Do not start the motor more than six times per hour. Short cycling the tower will cause fuses, breakers or O.L.s to operate and will decrease motor life.***

**⚠ Warning**

***Changing the operational fan speed from the factory settings could cause the fan to operate in an unstable region which may result in damage to the equipment and possible injury.***

## Mechanical Equipment

**⚠ Warning**

***Always shut off electrical power to the tower fan motor prior to performing any maintenance on the tower. Any electrical switches should be locked out and tagged out to prevent others from turning the power back on.***

**⚠ Warning**

***Improper installation of the fan cylinder and fan guard will destroy the structural integrity of the fan guard. Failure of the fan guard could allow personnel to fall into the rotating fan.***

1. Spin the fan manually to assure proper fan tip clearance (8 ±3mm). Observe the action of the sheaves and belts to be sure that the motor is properly parallel with the belt reducer. See **Belt Tensioning and Shave Alignment**.

**⚠ Caution**

***It is essential that the fan cylinder and fan guard be installed in accordance with the Field Assembly Manual shipped with the tower. Do not force the fan cylinder out of round.***

2. Momentarily energize ("bump") the motor and observe rotation of the fan. The fan should rotate in a clockwise direction when viewed from above. If

rotation is backwards, shut off the fan and reverse two of the three primary leads supplying power to the motor.

**Note**

***If the fan is intended to be reversed for deicing purposes, make sure that the starter is equipped with a 2 minute time delay between changes of direction. These delays will prevent abnormal stress from being applied to the mechanical equipment and the electrical circuit components.***

3. Run the motor and observe the operation of the mechanical equipment. Operation should be stable.
4. Check the torque on the fan and motor sheave and belt reducer after 10 to 60 hours of operation. See Fastener Torque Values on page 16

**⚠ Caution**

***If the water supply system is not being operated–or if there is no heat load on the system–motor amps read at this time may indicate an apparent overload of as much as 10–20%. This is because of the increased density of unheated air flowing through the fan. Determination of an accurate motor load should await the application of the design heat load. Starting the pump before the fan motor is normal operation.***

## Tower Startup

**⚠ Warning**

***Microorganisms including Legionella bacteria can exist in premise plumbing including cooling towers. The development of an effective water management plan (WMP) and implementation of maintenance procedures are essential to prevent the presence, dissemination and amplification of Legionella bacteria and other waterborne contaminants throughout premise plumbing. Before operating the cooling tower, the water management plan and maintenance procedures must be in place and regularly practiced.***

### Water System:

1. Consult a knowledgeable water treatment professional to clean and treat your new cooling tower prior to startup. Cooling towers must be cleaned and disinfected regularly in accordance with ASHRAE Standard 188 and Guideline 12.
2. Do NOT attempt any service unless the fan motor is locked out.
3. Remove any and all accumulated debris from tower. Pay particular attention to inside areas of cold water basin, entire hot water basin, and hot water inlet. Make sure that cold water suction screens are clear and properly installed.
4. For NX1010 fill the water system to an approximate depth of 50mm in the cold water basin. For NX1015 and NX1020 80mm and for NX1025 90mm.

This is the recommended operating water level. Adjust the float valve so that it is essentially closed at that level. Continue filling the system until the water reaches a level approximately 4mm below the lip of the overflow.

5. If the tower equipped with flow-control valves (by others) completely open flow-control and makeup valves. Start your pump(s) and observe system operation. Since the water system external to the tower will have been filled only to the level achieved in the cold water basin, a certain amount of "pump-down" of the basin water level will occur before water completes the circuit and begins to fall from the fill. The amount of initial pump-down may be insufficient to cause the makeup valve to open. However, you can check its operation and make sure reaching operating level. Then shut off the makeup valves.
6. Some trial and error adjustment of the makeup float valve may be required to balance the makeup water with tower operation. Ideally, the makeup float valve setting will be where no water is wasted through the cold water basin at pump shutdown. Overflow through the overflow is acceptable however the water level after pump start-up must be deep enough to assure positive pump suction.
7. If the tower is equipped with flow-control valves (by others) adjust to equalize hot water depth in the distribution basins after reaching design water flow rate. Each basin should have 72mm to 140mm water depth with uniform depth from basin to basin. Fix valves in this position when depth is correct.
8. Continue pump operation for about 15 minutes after which it is recommended the water system be drained, flushed, and refilled.
9. While operating the condensing water pump(s) and prior to operating the cooling tower fan, execute one of the two alternative biocidal treatment programs described in the following:

- Resume treatment with the biocide which had been used prior to shutdown. Utilize the services of the water treatment supplier. Maintain the maximum recommended biocide residual (for the specific biocide) for a sufficient period of time (residual and time will vary with the biocide) to bring the system under good biological control ***or***
- Treat the system with sodium hypochlorite to a level of 4 to 5 mg/L free chlorine residual at a pH of 7.0 to 7.6. The chlorine residual must be held at 4 to 5 mg/L for six hours, measurable with standard commercial water test kits.

If the cooling tower has been in operation and then shut down for a duration of time and not drained, perform one of the two previous biocidal treatment programs directly to the cooling water storage vessel (cooling tower sump, drain down tank, etc.) without circulating stagnant water over the cooling tower fill or operating the cooling tower fan.

After biocidal pretreatment has been successfully completed, cooling water may be circulated over the tower fill with the fan off.

When biocidal treatment has been maintained at a satisfactory level for at least six hours, the fan may be turned on and the system returned to service. Resume the standard water treatment program, including biocidal treatment.

# operation

## Tower Operation

### General:

The cold water temperature obtained from an operating cooling tower will vary with the following influences:

1. **Heat Load**: With the fan in full operation, if the heat load increases, the cold water temperature will rise. If the heat load reduces, the cold water temperature will reduce

$$\text{Range} - °C = \frac{\text{Heat Load (kW)}}{\text{Water Flow } (m^3/hr) \times 1.162}$$

2. **Air Wet-Bulb Temperature:** Cold water temperature will also vary with the wet-bulb temperature of the air entering the louvered faces of the tower. Reduced wet-bulb temperatures will result in colder water temperatures. However, the cold water temperature will not vary to the same extent as the wet-bulb. For example, an 11°C reduction in wet-bulb may result in only an 8°C reduction in cold water temperature.
3. **Water Flow Rate:** Increasing the water flow rate ($m^3$/hr) will cause a slight elevation in cold water temperature, while reducing the water flow rate will cause the cold water temperature to lower slightly. However, at a given heat load (see formula above), $m^3$/hr reductions also cause an increase in the incoming hot water temperature. Use care to prevent the hot water from exceeding 44°C, in order to prevent damage to the tower components.
4. **Airflow Rate:** Reducing airflow through the tower causes the cold water temperature to rise. This is the approved method by which to control leaving water temperature. The motor may be shut off when the water temperature becomes too cold. This will cause the water temperature to rise. When the water temperature then becomes too warm for your process, the motor can be restarted.

**⚠ Caution**

***When operating in this mode care must be taken not to exceed a total acceleration time of 30 seconds per hour.***

### Fan Cycling Limits:

From a dead stop, determine the number of seconds it takes the fan to arrive at full speed. Divide this number into 30 to determine the allowable number of starts per hour. Considering the normal fan and motor sizes used for NX Class towers, anticipate that approximately 4 to 5 starts per hour are allowable. If your tower consists of two or more cells, make sure each tower cell starts or shuts down at the same time.

## Freezing Weather Operation

The fill used in NX cooling towers has air entrance louvers that are molded as an integral part of the fill. This feature makes these towers very forgiving of cold weather operation, even at the low temperature and reduced load conditions encountered in free cooling and other low temperature applications. Nevertheless, during operation in subfreezing weather the opportunity exists for ice to form in the colder regions of the tower.

**Note**

***Slushy, transitory ice forms routinely in the colder regions of the fill of low temperature towers, and is visible through the tower louvers. Such ice normally has no adverse effect on tower operation, but its appearance should be a signal to the operator to undertake ice control procedures.***
***It is the operator's responsibility to prevent the formation of destructive (hard) ice on the cooling tower fill. Certain guidelines should be followed:***

1. Do not allow the tower's leaving water temperature to drop below a minimum allowable level (2° to 5°C) established as follows: During the coldest days of the first season of operation, observe whether any ice is forming on the louver face, particularly near the bottom of the louver face. If hard ice is present on the louvers, an appropriate elevation in the allowable cold water temperature is mandatory. If the coldest possible water is beneficial to your process, ice of a mushy consistency can be tolerated—but routine periodic observation is advisable.

**⚠ Caution**

***If the minimum allowable cold water temperature is established at or near maximum heat load, it should be safe for all operating conditions. However, if established at reduced load, increased heat loads may reintroduce the potential for icing.***

Having established the minimum allowable cold water temperature, maintaining that temperature can be accomplished by fan manipulation. However, in tower installations of more than one cell, where all fans are being manipulated at the same time, Freezing weather operation of multicell towers at low cold water temperature levels requires that the operator be especially watchful.

2. As cold air enters the louvers, it causes the water flowing over the fill to be drawn inward toward the center of the tower. Thus, under fan operation, the louvers and lower periphery of the tower structure remain partly dry, seeing only random splashing from within the tower—plus normal atmospheric moisture from the entering air. Such lightly wetted areas are most subject

to freezing. Therefore, if excessive ice forms on the louvers, stop the fan for a few minutes. With the fan off, the water flow will increase in the vicinity of the louvers and reduce the ice buildup.

3. Under extended extreme cold conditions, it may be necessary to operate the fan in reverse. This forces warm air out through the louvers, melting any accumulated ice—adequate heat load must be available. Reversal may be at either full or half speed; however, we recommend reversal at half speed. Reverse operation of the fan should be used sparingly and should only be used to control ice, not to prevent it. Reverse fan operation should not need to exceed 1 or 2 minutes. Monitoring is required to determine the time required to melt accumulated ice.

**⚠ Warning**

***Reverse operation of fans for prolonged periods during subfreezing weather can cause severe damage to fans and fan cylinders. Ice can accumulate inside fan cylinders at fan blade plane of rotation and fan blade tips will eventually strike this ring of ice, damaging the fan blades or cylinder. Ice can also accumulate on fan blades and be thrown off, damaging fan cylinder or blades. Allow a minimum of 10 minute delay between reverse operation and forward operation during subfreezing weather to permit ice to dissipate from fan blades and fan cylinders.***

4. With no heat load on the circulating water, icing cannot be controlled effectively by air control during freezing weather. Towers must not be operated with reduced water rate and/or no heat load during freezing weather. If the circulating water system cannot be shut down, water returning from the process should be made to bypass the tower. If a bypass is used, all water must be bypassed without modulation. If the water bypass is directly into the tower's cold water basin, its design must be approved by SPX Cooling Technologies.

### Intermittent Freezing Weather Operation:

If periods of shutdown (nights, weekends, etc.) occur during freezing weather, measures must be taken to prevent the water in the cold water basin—and all exposed pipework—from freezing. Several methods are used to combat this. Consult your Marley sales representative for more information.

**⚠ Caution**

***Unless some means of freeze prevention is incorporated into your system, the tower basin and exposed pipework should be drained at the beginning of each wintertime shutdown period.***

# maintenance

## Water Quality and Blowdown

### Maintaining Water Quality:

The materials used in an NX tower are selected to offer long, corrosion-free service in a “normal” cooling tower environment, defined as follows:

- Circulating water with a pH between 6.5 and 8; a chloride content (as NaCl) below 500 mg/L; a sulfate content ($SO_4$) below 250 mg/L; total alkalinity below 500 mg/L; calcium hardness (as $CaCO_3$) above 50 mg/L.
- Startup Conditions: The water conditions during the initial tower operation are crucial in preventing premature corrosion of galvanized steel (white rust). For at least the first eight weeks of operation, pH should be controlled between 6.5 and 8.0 with hardness and alkalinity levels between 100 and 300 mg/L (expressed as $CaCO_3$ ).
- Chlorine (if used) shall be added intermittently, with a free residual not to exceed 1 mg/L – maintained for short periods. Excessive chlorine levels may deteriorate sealants and other materials of construction.
- An atmosphere surrounding the tower no worse than “moderate industrial,” where rainfall and fog are no more than slightly acid, and they do not contain significant chlorides or hydrogen sulfide ($H_2S$).
- Many proprietary chemicals exist for control of scale, corrosion, and biological growth and should be used prudently. Also, combinations of chemicals may cause reactions which reduce treatment effectiveness, and certain chemicals such as surfactants, biodispersants and antifoams may increase drift rate.

**Note**

***The NX cooling tower structure consists primarily of galvanized steel, therefore your water treatment program must be compatible with zinc. In working with your water treatment supplier, it is important that you recognize the potential effects on zinc of the specific treatment program you choose.***

### Blowdown:

A cooling tower cools water by continuously causing a portion of it to evaporate. Although the water lost by evaporation is replenished by the makeup system, it exits the tower as pure water–leaving behind its burden of dissolved solids to concentrate in the remaining water. Given no means of control, this increasing concentration of contaminants can reach a very high level.
In order to achieve water quality which is acceptable to the cooling tower (as well as the remainder of your circulating water system), the selected water treatment company must work from a relatively constant level of concentra-

tions. This stabilization of contaminant concentrations is usually accomplished by blowdown, which is the constant discharge of a portion of the circulating water to waste. As a rule, acceptable levels on which to base a treatment schedule will be in the range of 2-4 concentrations. The following table gives approximate rates of blowdown (percent of total water flow rate constantly wasted) to achieve those concentrations at various cooling ranges.*

| Cooling Range | Number of Concentrations | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1.5X | 2.0X | 2.5X | 3.0X | 4.0X | 5.0X | 6.0X |
| 3°C | .7 | .38 | .25 | .18 | .11 | .08 | .06 |
| 6°C | 1.5 | .78 | .51 | .38 | .25 | .18 | .14 |
| 8°C | 2.3 | 1.18 | .78 | .58 | .38 | .28 | .22 |
| 11°C | 3.1 | 1.58 | 1.05 | .78 | .51 | .38 | .30 |
| 14°C | 3.9 | 1.98 | 1.32 | .98 | .64 | .48 | .38 |
| Multipliers are based on drift of 0.02% of the circulating water rate. | | | | | | | |

* Range = Difference between hot water temperature coming to tower and cold water temperature leaving tower.

**EXAMPLE:** 159.1 $m^3$/hr circulating rate, 10°C cooling range. To maintain 4 concentrations, the required blowdown is 0.458% or .00458 times 159.1 $m^3$/hr, which is 0.7 $m^3$/hr.

If tower is operated at 4 concentrations, circulating water will contain four times as much dissolved solid as the makeup water, assuming none of the solids form scale or are otherwise removed from the system.

**Note**

***When water treatment chemicals are added, they should not be introduced into the circulating water system via the cold water basin of the cooling tower. Water velocities are lowest at that point, which results in inadequate mixing.***

## Cooling Tower Inspection and Maintenance

**⚠ Warning**

***Microorganisms including Legionella bacteria can exist in premise plumbing including cooling towers. The development of an effective water management plan (WMP) and implementation of maintenance procedures are essential to prevent the presence, dissemination and amplification of Legionella bacteria and other waterborne contaminants throughout premise plumbing. Before operating the cooling tower, the water management plan and maintenance procedures must be in place and regularly practiced.***

In addition, the following steps are recommended:

Do NOT attempt any service unless the fan motor is locked out.

- Consult a knowledgeable water treatment professional to clean and

treat your cooling tower. See **Tower Startup** section of this manual.

- Cooling towers must be cleaned and disinfected regularly in accordance with ASHRAE Standard 188 and Guideline 12.
- Workers performing decontamination procedures must wear personal protective equipment (PPE) as directed by their facility safety officer.
- Cooling towers must be visually inspected regularly to assess signs of bacterial growth, appearance of debris and scale on drift eliminators and general operating conditions. Refer to ASHRAE Standard 188 and Guideline 12 for specific frequency recommendations.
- Replace worn or damaged components.

To minimize the presence of waterborne microorganisms, including Legionella, follow the water management plan for your facility, perform regularly scheduled cooling tower inspections and maintenance, and enlist the services of water treatment professionals.
For additional technical support, contact your Marley sales representative. For help identifying the sales representative in your area, visit spxcooling.com/replocator.

References:
ashrae.org. Search “ASHRAE Standard 188” and “ASHRAE Guideline 12.”
cdc.gov. Search “Water Management Program.”

### Maintenance:

Some maintenance procedures may require maintenance personnel to enter the tower. Each cased face of the tower has a door for access to the interior of the tower.
The fan deck ladder is designed and intended solely for personnel to gain access to the fan deck. The little access ladder is designed and intended solely for personnel to enter or exit the access door. The standard fan deck ladder is an easy configuration without cage and fan deck guardrail. The optional little access ladder is available. Another optional fan deck guardrail and double cage ladder is also available.

**⚠ Warning**

***The purchaser or owner is responsible for providing a safe method for entering or exiting the access door.***

Included with this instruction packet are separate User Manuals on each major operating component of the tower, and it is recommended that you read them thoroughly. Any discrepancies exist, the separate User Manuals will take precedence.

# maintenance

The following is recommended as a minimum routine of scheduled maintenance.

**⚠ Warning**

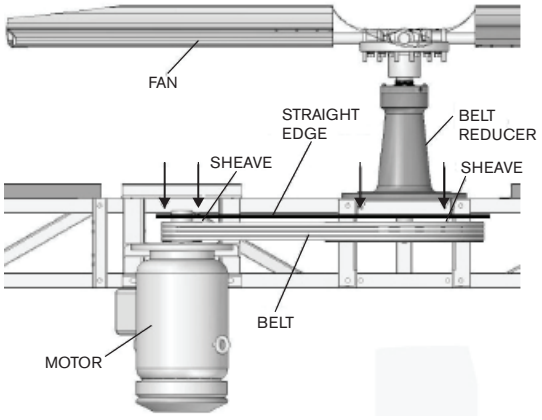
***Always shut off electrical power to the tower fan motor prior to performing any inspections that may involve physical contact with the mechanical or electrical equipment in or on the tower. Lock out and tag out any electrical switches to prevent others from turning the power back on. Service personnel must wear proper personal protective clothing and equipment.***

## Belt Tensioning:

The belts are adjusted by turning the bolts on the mechanical equipment assembly. Before tightening or loosening the belt, the eight nuts holding the motor support in place must be loosened. After achieving proper tension, align the mechanical equipment assembly and then retighten the eight nuts. Ideal tension is the lowest tension at which the belt will not slip under peak load conditions. Check tension frequently during the first 24-48 hours of run-in operation. Over tensioning shortens belt and bearing life. Keep belts free from foreign material which may cause slipping. Never apply belt dressing as this will damage the belt and cause early failure. A Dodge® V-Belt Tension Tester is an alternate method for tensioning V-belts. Check with your local belt supplier.

## Sheave Alignment:

- The motor sheave is to be positioned as close as possible to the motor in order to minimize torque on the motor bushings.
- The bottom surface of the motor and fan sheaves must be aligned within 3mm of each other and level within 3mm in 300mm (½°) in order to not adversely affect belt and sheave life.
- Alignment can be achieved by placing a straight edge across the top of the sheaves making sure that it is level and measuring down to the bottom surface of both sheaves at four points shown below.



# maintenance

## Motor/Belt Reducer Fastener Torque Values:

| Galvanized Fastener Size | Torque | |
|---|---|---|
| mm | ft·lb | N·m |
| 10 | 24-33 | 33-45 |
| 12 | 43-58 | 58-78 |
| 14 | 69-92 | 93-124 |
| 16 | 107-143 | 145-193 |
| 18 | 147-195 | 199-264 |

**Weekly** Visually inspect the cooling tower to assess general operating conditions and for signs of microbial growth and appearance of debris, scale and corrosion. Refer to ASHRAE Standard 188 and Guideline 12 for specific frequency recommendations. Consult a knowledgeable water treatment professional to maintain cooling tower hygiene.

Observe, touch, and listen to the tower. Become accustomed to its normal appearance, sound, and level of vibration. Abnormal aspects relating to the rotating equipment should be considered reason to shut down the tower until the problem can be located and corrected. Observe operation of the motor, fan shaft bearing and fan. Become familiar with the normal operating temperature of the motor, as well as the sight and sound of all components as a whole.

**Monthly** (Weekly at startup) Inspect louvers, drift eliminators and basin trash screens and remove any debris or scale which may have accumulated. Replace any damaged or worn out components. Use of high-pressure water may damage the eliminator and louver material.

Observe operation of the makeup float valve. Depress the operating lever to make sure that the valve is operating freely.

Check for any buildup of silt on the floor of the cold water basin. Mentally note the amount, if any, so future inspections will enable you to determine the rate at which it is forming.

# maintenance

**Every 3 months** Lubricate belt reducer. While rotating equipment by hand, grease the bearings with lithium based grease until a bead forms around the seals. Mobil SHC 460 grease is recommended.

**Semi-Annually** Lubricate motor according to the manufacturer's instructions. Check to see that all bolts are tight in the fan and mechanical equipment region, including the fan cylinder and fan guard. Refer to torque values prescribed in the Assembly Manual. Check the belt tension and condition.

**Annually** Lubricate motor according to the manufacturer's instructions. Fan motors with sealed bearings do not require lubrication maintenance.
Check to see that all bolts are tight in the fan and mechanical equipment region, including the fan cylinder and fan guard. Refer to torque values prescribed in the User Manual
Inspect the tower thoroughly, making maximum use of instructions given in the separate user manuals. Check structural bolted connections and tighten as required. Make preventive maintenance repairs as necessary.

# maintenance schedule

| Maintenance Service | Monthly | Semi-annually | Seasonal Startup or Annually |
|---|---|---|---|
| Inspect General Condition and Operation | x | | x |
| **Observe Operation of:** | | | |
| Mechanical–motor, fan and drive mechanism | x | | x |
| Makeup valve (float valve and quick makeup) | x | | x |
| Inspect for unusual noise or vibration | x | | x |
| **Inspect and Clean:** | | | |
| Air inlet | x | | x |
| Distribution basin, nozzles and collection basin | x | | x |
| Fan motor exterior | x | | x |
| **Check:** | | | |
| Collection water basin level | x | | x |
| Blowdown–adjust as required | x | | x |
| **Belt Drive System:** | | | |
| Fan shaft bearing lubrication (every 3 months) | | every 3 months | every 3 months |
| Check and tighten support fasteners | | | x |
| Check shaft, sheave and belt alignment | | | x |
| Check belt tension and condition | | x | x |
| Check sheave bushing fastener torque | | | x |
| **Fan:** | | | |
| Check and tighten blade and hub fasteners | | | x |
| Check fan blade pitch and tip clearance | | | x |
| **Motor:** | | | |
| Lubricate (as required) | | | **R** |
| Check mounting bolts for tightness | | | x |
| Operate at least | 3 hours a month | 3 hours a month | 3 hours a month |
| **Structure:** | | | |
| Inspect/tighten all fasteners | | x | x |
| Inspect and touch up all metal surfaces | | | x |
| **Inspect and Paint:** | | | |
| Fan, motor, belt reducer and sheaves | x | x | x |

**R** – Refer to Component User Manual

**Note:** It is recommended at least weekly, that the general operation and condition be observed. Pay attention to any changes in sound or vibration that may signify a need for closer inspection.

## Seasonal Shutdown Instructions

When the system is to be shut down for an extended period of time, it is recommended that the entire system (cooling tower, system piping, heat exchangers, etc.) be drained. Leave the basin drain open.

During shutdown, follow recommendations in the **Cooling Tower Inspection and Maintenance** section of this manual before attempting repairs. During shutdown, clean the tower and make any necessary repairs. Pay particular attention to mechanical equipment supports and components.

Following each year's shutdown and cleaning, inspect the tower's metal surfaces for evidence of the need to apply a protective coating. Do not misinterpret grime and transient rust from the piping system as a need to have the tower painted. If relatively bright metal can be exposed by cleaning, consider that the galvanizing has remained effective. Unless there is evidence of a generalized failure of the galvanizing, localized touch-up should be all that is required.

**Note**

***To the extent that the galvanizing (zinc coating) still exists, paint will not adhere to it readily. Contact the manufacturer of the coating you intend to use for instructions.***

**Tower Framework** Check structural bolted connections and tighten as required.

**Fan** Check fan assembly bolting and tighten as required.

**Belt Reducer** Lubricate belt reducer bearings at close of each operating season, see page 16.

**Fan Motor** Clean and lubricate motor (if required) at close of each operating season. (Refer to motor manufacturer's recommendations). Does not apply to motors with sealed bearings. Check motor anchor bolts and tighten as required.

**⚠ Caution**

***Do not start motor before determining that there will be no interference with free rotation of the fan drive.***

The motor should be operated for three hours at least once a month. This serves to dry out windings and lubricate bearing surfaces. Refer to Marley **"Fan Motor"** User Manual Z0239042 for additional information.

At start of new operating season, make sure bearings are adequately lubricated before returning motor to service. Does not apply to motors with sealed bearings.

# maintenance

### Prolonged Shutdown:

If shutdown period is longer than seasonal, contact your Marley sales representative for additional information.

## Additional Services

Our interest in your NX Fiberglass cooling tower does not end with the sale. We want to make sure that you gain the maximum possible benefit from its purchase.

Therefore, the following services are available which are intended to assure the maximum possible service life under your operating conditions, tailor the operating characteristics to your specific needs, and maintain consistent optimum thermal performance capability. They are available by contacting your Marley sales representative.

### Replacement Parts:

A complete stock of parts and components is maintained at Marley plants. In cases of emergency, they can normally be shipped within 48 hours–by air freight if necessary. However, you would obviously benefit from anticipating your need in advance, thus avoiding the cost of special handling.

Be sure to mention your tower model number or series number (from the tower nameplate) when ordering parts.

### Periodic Maintenance:

You may wish to contract with SPX for regularly scheduled visits – for the purpose of inspecting and reporting your tower's condition – to make recommendations intended to prevent emergencies – and to perform maintenance considered outside the norm.
This service is not intended to replace the important function performed by your maintenance staff. Their attention assures the tower's routine operating performance, and is invaluable. However, we recognizes that the unusual manner in which a cooling tower performs its function – as well as the unique forces which act upon it – may be considerations which occasionally require the services of an expert technician.

# maintenance

## Increased Load Requirements:

NX towers are designed so that cells of either equal or unequal capacity can be added in the future. This allows you to compensate for the load increases that normally occur with the replacement or addition of production equipment–and still retain continuity with respect to your cooling tower system.

**Tower Rebuilding** SPX Cooling Technologies routinely rebuilds and upgrades cooling towers of all materials and manufacture. If your tower ever reaches the limit of its service life, we recommend that you investigate the cost of rebuilding before you routinely order a new replacement tower.

Each NX Fiberglass cooling tower includes a document package containing NX Fiberglass Field Installation Manual, and tower component manuals. These documents contain important information relating to safe installation and operation of the cooling tower. If installation details are not covered in the **"NX Field Installation Manual"** a separate installation drawing or manual for each purchased option is included in the document package along with bills of material. If you have purchased an option and can't find the appropriate installation drawing, contact your local Marley sales representative before proceeding.

In addition to these specific documents, SPX publishes numerous technical reports including more detailed information on a variety of cooling tower operation and service topics available at spxcooling.com. Your Marley sales representative will be happy to give you copies of these reports at no charge.

For complete parts and service assistance, contact the Marley sales representative in your area. If you need help locating the office nearest you, please phone 60 3 7947 7800 or check the internet at spxcooling.com.

# troubleshooting

| Trouble | Cause | Remedy |
|---|---|---|
| Motor will not start | Power not available at motor terminals | Check power at starter. Correct any bad connections between the control apparatus and the motor. |
| | | Check starter contacts and control circuit. Reset overloads, close contacts, reset tripped switches or replace failed control switches. |
| | | If power is not on all leads at starter, make sure overload and short circuit devices are in proper condition |
| | Wrong connections | Check motor and control connections against wiring diagrams. |
| | Low voltage | Check nameplate voltage against power supply. Check voltage at motor terminals. |
| | Open circuit in motor winding | Check stator windings for open circuits. |
| | Motor or fan drive stuck | Disconnect motor from load and check motor and fan drive for cause of problem. |
| | Rotor defective | Look for broken bars or rings. |
| Unusual motor noise | Motor running single-phase | Check motor and attempt to start it. Motor will not start if single-phased. Check wiring, controls and motor. |
| | Motor leads connected incorrectly | Check motor connections against wiring diagram on motor. |
| | Bad bearings | Check lubrication. Replace bad bearings. |
| | Electrical unbalance | Check voltages and currents of all three lines. Correct if required. |
| | Air gap not uniform | Check and correct bracket fits or bearing. |
| | Rotor unbalance | Rebalance |
| | Cooling fan hitting end belt guard | Reinstall or replace fan. |
| Motor runs hot | Wrong voltage or unbalanced voltage | Check voltage and current of all three lines against nameplate values. |
| | Wrong motor RPM | Check nameplate against power supply. Check RPM of motor and drive ratio. |
| | Fan pitch too large or incorrect | Check fan blade pitch |
| | One phase open | Stop motor and attempt to start it. Motor will not stat if single-phased. Check wiring, controls and motor. |
| | Poor ventilation | Clean motor and check ventilation openings. Allow ample ventilation around motor. |
| | Winding fault | Check with ohmmeter. |
| | Bent motor shaft | Straighten or replace shaft. |
| | Too frequent starting or speed changes | Limit cumulative accelerations time to a total of 30 seconds/hour. Set on/off or speed change set points farther apart. |
| | Bearings damaged | Replace bearings. |
| Motor does not come up to speed | Voltage too low at motor terminals because of line drop | Check transformer and setting of taps. Use higher voltage on transformer terminals or reduce loads. Increase wire size or reduce inertia. |
| | Broken rotor bars | Look for cracks near the rings. A new rotor may be required. Have motor service person check motor. |
| Wrong motor rotation | Wrong sequence of phases | Switch any two of the three motor leads. |

# troubleshooting

| Trouble | Cause | Remedy |
|---|---|---|
| Unusual fan drive vibration | Loose bolts | Tighten all bolts and cap screws on all mechanical equipment and supports. |
| | Fan blade pitch | All blades must be pitched the same. Clean deposit buildup on blades. |
| | Unbalanced motor | Disconnect load and operate motor. If motor still vibrates, rebalance rotor. |
| | Unbalanced fan | Correct fan balance. |
| | Bent belt reducer shaft | Replace shaft if necessary. |
| Fan noise | Blade rubbing inside of fan cylinder | Adjust cylinder to provide blade tip clearance. |
| | Loose bolts in blade clamps | |
| Belt squeal or chirping | Belt slipping | Adjust belt |
| Scale or foreign substance in circulating water system | Insufficient blowdown | See "Water Treatment" section of this manual. |
| | Water treatment deficiency | Consult competent water treating specialist. See "Water Treatment" section of this manual |
| Cold water temperature too warm. See “Tower Operation.” | Entering wet bulb temperature is above design | Check to see if local heat sources are affecting cooling tower. See if surrounding structures are causing recirculation of tower discharge air. Discuss remedy with Marley representative. |
| | Design wet bulb temperature was too low. | May have to increase cooling tower size. Discuss remedy with Marley representative |
| | Actual process load greater than design | May have to increase cooling tower size. Discuss remedy with Marley representative |
| | Overpumping | Reduce water flow rate over cooling tower to design conditions. |
| | Cooling tower starved for air | Check motor current and voltage to be sure of correct contract horsepower. Clean fill and eliminators. Check to see if nearby structures or enclosing walls are obstructing normal airflow to cooling tower. Discuss remedy with Marley representative. |
| Excessive drift exiting cooling tower | Distribution basins overflowing | Reduce water flow rate over tower to design conditions. Be sure hot water basin nozzles are in place and not plugged. |
| | Fill plugged | Check to see that fill is clean, free of debris and installed correctly. Clean if necessary. Replace damaged or worn out eliminators fill sheets. |
| | Air flow too high | Adjust belt tension and/or reduce fan blade pitch if required. |
| | Unbalanced distribution | Check nozzles and clean if necessary. |
| Cold water basin water level continuously inadequate | Short makeup | Check makeup float valve and quick makeup system. |
| | Filter plugged | Clean. |
| | Short pumping | Repair or replace. |

# **NX** cooling tower

**USER MANUAL**

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