

# **Matrix** *Multiflow*

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# **Owners Manual**



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*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.*

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**△ Warning**

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

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**△ Caution**

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

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**△ Note**

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

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**△ Note**

*These instructions assist in obtaining efficient, long life from Marley cooling equipment. Direct questions concerning cooling tower operation and maintenance to your Marley sales office or representative. Always include your tower serial number when writing for information or ordering parts. Look for this number on the nameplate on the access door.*

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## Before Start-up

**CLEANING**—Remove any dirt and trash which has accumulated in the cold water basin. Clean any nozzles that are clogged. Remove any sediment from the cold water collection basin, sump, and screens. Use a water hose to flush cold water collection basins.

**OPERATE WATER SYSTEM**—Start the circulating water pumps. Increase the flow of circulating water gradually to match design water flow rate. Circulate water over the cooling tower continuously for several days before starting the mechanical equipment and placing the cooling tower into continuous operation.

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△ **Note**

*When starting in cold weather, follow procedures outlined in Cold Weather Operation on page 5.*

**INSPECTION**—It is imperative that all operating assemblies be inspected before they are placed in operation. The following is a list of components to be checked before starting the tower:

- 1—Check drive shaft alignment. Realign if necessary. See Marley Drive Shaft Service Manual.
- 2— Check tightness of bolts that attach mechanical equipment support to the tower framing. Check tightness of bolts in fan cylinder joints and fan cylinder anchorage. Do not pull washers into the wood.
- 3—Check tightness of bolts at diagonals and columns, and at girts and columns in the area between fan and cold water basin.
- 4—Check tightness of the following bolted joints in the fan and drive assemblies:
  - a—Fan hub clamp bolts. See Marley **Fan Service Manual** for correct torque setting.
  - b—Fan hub cover bolts. Where applicable.
  - c—Geareducer® and motor mounting bolts.
  - d—Drive shaft coupling and guard bolts.
- 5—Check Geareducer oil for sludge or water by draining off and testing a sample as outlined in the Marley **Geareducer Service Manual**. Check Geareducer oil level at “oil level” mark on the side of the case. Add oil as required. The oil level placard must be adjusted so that its “full” mark is at the same elevation as the “full” mark on the side of the Geareducer case. Check oil lines to be sure there are no leaks and all joints are tight. See **Geareducer Service Manual** for oil filling procedure and list of recommended lubricants.

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- 6—Rotate fan by hand to be sure of free rotation and ample tip clearance. See Marley **Fan Service Manual**.
- 7—Check motor insulation with a “Megger”. See Maintenance Section of Marley **Electric Motor Service Manual**.
- 8—Lubricate the motor according to motor manufacturer’s instructions.
- 9—Test run each fan separately for a short time. Check for excessive vibration or unusual noise. If either is present, refer to the Troubleshooting section on pages 14 & 15 of this manual. Fan must rotate clockwise when viewed from above. Recheck Geareducer oil level.
- 10—Check functioning of make-up water supply.
- 11—Make sure the blowdown or bleed-off will carry the proper amount of water.

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## Starting Procedure

**FILL THE WATER SYSTEM**—Fill the cold water collection basin and circulating water system until the operating water level is reached. See Operation Section, below. Prime and start the circulating water pumps. Increase the flow of circulating water gradually to design water flow rate to avoid surges of water hammer which could damage the distribution system piping.

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△ **Note**

*Clean the sump screens several times during the first weeks of operation. After this, check sump screens weekly.*

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△ **Note**

*When starting in cold weather, follow procedures outlined in Cold Weather Operation.*

**STARTING FAN**—Start the fan. After 30 minutes of operating time to permit Geareducer oil to come up to operating temperature, check motor load with watt meter, or take operating volt and ampere readings and calculate motor HP. Refer to Marley Fan Service Manual for instructions. Pitch fans to pull correct contract horsepower when circulating design water rate at design hot water temperature.

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## Operation

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△ **Caution**

*Entering water temperature in excess of 125°F may result in fill deformation.*

**TOWER PERFORMANCE**—Keep the cooling tower clean and water distribution uniform to obtain continued maximum cooling capacity. Do not allow excessive deposits of scale or algae to build up on the fill and eliminators. Keep the nozzles free of debris to assure correct distribution and cooling of water.

The capacity of a cooling tower to cool water to a given cold water temperature varies with the wet-bulb temperature and the heat load applied to the cooling tower. As the wet-bulb temperature drops, the cold water temperature also drops. However, the cold water temperature does not drop linearly with the wet-bulb temperature.

A cooling tower will not control heat load. The flow rate of water circulated through the cooling tower will determine the temperature range of cooling in conjunction with a given heat load. The hot water and cold water temperatures will increase with higher heat loads and/or high flow rates.

**HOT WATER DISTRIBUTION SYSTEM**—Keep nozzles clean and in place in distribution basins. Adjust water flow to give the same depth in the distribution basins of all cells. Design water depth varies from 3" to 8" (7.6 cm to 20.3 cm) depending upon design circulating water rate. If a major change in the quantity of water to be circulated over the tower is made, replace the removable nozzles with higher capacity nozzles to maintain the proper water level.

**COLD WATER COLLECTION BASIN**—A suitable depth must be maintained to keep the pumps from pulling air into the line. The amount of “make-up” water required to keep the water in the collection basin at the required depth depends upon the “evaporation loss” and “blowdown.” Low operating depths of the water require air baffles under the fill to prevent air bypass. Maintain sufficient water depth to prevent cavitation. Normal operating water depth in a concrete basin is at the base of the bottom fill sheets. (Normally 1'-6" below the top of the basin curb.)

**FAN DRIVE**—When using two-speed motors, allow a time delay of a minimum of 20 seconds after de-energizing the high-speed winding and before energizing the low-speed winding. Tremendous stresses are placed on driven machinery and motors unless the motors are allowed to slow to low-speed RPM or less before the low-speed winding is energized.

**COLD WEATHER OPERATION**—During operation in subfreezing weather, the opportunity exists for ice to form in the colder regions of the tower. Your primary concern is to prevent the formation of destructive ice on the cooling tower fill. Your understanding of cold weather operation will be enhanced if you read “**Operating Cooling Towers in Freezing Weather**” Marley Technical Report #H-003.

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Ice forming characteristics on any given cooling tower will vary, depending on velocity and direction of wind, circulating water rate, and heat load. Excessive ice formation may be controlled by regulating air and water flow through the tower by one or more of the following procedures:

1. Shut the fan down. This reduces the cooling air rate to a minimum and increases the quantity of warm water at the air inlet to a maximum. Except for extreme cold conditions or extended freezing conditions, this procedure will normally control ice formation.
2. When a cooling tower has two-speed motors, operate the fans at half speed forward. This reduces the cooling air rate (heat transfer) and increases the quantity of warm water at the air inlet.
3. With no heat load on the circulating water, icing cannot be controlled. Towers *must not* be operated with reduced water rate and/or no heat load during freezing weather. If a bypass directly into the cold water basin is used, all water must be bypassed.

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△ **Caution**

***Reverse operation of fans is not recommended .***

See “Fan Drive” for fan speed change precautions.

**INTERMITTENT OPERATION**—When the unit is operated intermittently during winter weather, it is necessary that the water be drained from the tower piping to insure protection against freezing and possible rupture.

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## **Tower Maintenance**

Well-maintained equipment gives the best operating results and the least maintenance cost. Marley recommends setting up a regular inspection schedule to insure effective, safe operation of the cooling tower. Use the schedule on page 16 to obtain continuously good performance with the least tower maintenance. See Cooling Tower Inspection Check List in this manual, pages 18 and 19. Keep a continuous lubrication and maintenance record for each cooling tower.

**HOT WATER DISTRIBUTION BASINS**—Water distribution nozzles in the floor of the hot water basins may be cleaned without shutting down any part of the tower. Remove dirt, algae, leaves, etc., from the basins or nozzles.

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△ **Caution**

*If an Amertap condenser tube cleaning system is part of plant equipment, care should be taken during operation to back-wash the strainer section only after the sponge rubber cleaning balls are removed from the system by trapping them in the collector. If the balls are allowed to enter the cooling tower supply piping, they can clog the plastic metering orifices. Clogged orifices will cause unequal water distribution over the fill which will affect thermal performance. Extensive clogging can lead to overflowing of the distribution basins and possible ice damage to towers installed in freezing climates. The basins should be frequently checked for orifice clogging until such time as the operational sequence of the Amertap system assures that no balls enter the cooling tower piping.*

**HOT WATER DISTRIBUTION SYSTEM**—Keep the circulating water and distribution piping and splashboxes clean and free of dirt, algae, and scale. Algae and scale may clog nozzles, eliminators, fill, and piping, and may collect on the equipment served thus reducing its performance. See warning under “Water Treatment” section on page 8.

Distribution basins can be reached from the fan deck level through access hatches and permanently installed ladders. The lower level distribution basins may have an optional interior walkway which would be accessed from the tower stairway.

**COLD WATER COLLECTION BASIN** (supplied by others)—Inspect collection basin occasionally for leaks and repair if necessary. Keep cold water outlets clean and free of debris. Make-up and circulating water controls must operate freely and maintain the desired water quantity in the system.

**TOWER FRAMEWORK**—Keep framework bolts tightened. Pay particular attention to bolts in the mechanical equipment supports. Do not pull washers into the wood.

**DRIVE SHAFT**—Check drive shaft alignment and condition of couplings every six months. See the Drive Shaft Service Manual for correcting misalignment, balancing, or replacing parts.

**ELECTRIC MOTOR**—Lubricate and maintain each electric motor in accordance with the manufacturer’s instructions. If repair work is necessary, contact the nearest representative of the motor manufacturer. See Warranty Section of Marley Service Manual on Electric Motors.

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**FAN**—Inspect fan blade surfaces every six months. For detailed maintenance information, refer to Marley Fan Service Manual.

**GEAREDUCER**—Make weekly and monthly oil checks. Inspect internal parts during seasonal oil change. Refer to the Geareducer Service Manual for detailed maintenance instructions.

**PAINTING**—Periodically clean and, if necessary, recoat all metal parts subject to corrosion.

**COOLING TOWER WOOD DETERIORATION**—Treated wood in cooling towers could be damaged by decay anytime after the first year or two of service. If decay is discovered and corrected in its early stages, serious wood damage can be prevented. Routine inspections should be made to assure that decay is discovered before it is heavily advanced.

Decay is commonly of two very general types, soft rot and internal rot. Soft rot is easier to detect because it is almost always on the surface of wood members. It makes the surface soft and weak and in its more advanced stages the decayed wood can be easily removed. This type of rot occurs primarily in the flooded areas of the tower. Internal rot, as the name implies, occurs inside the wood members. For this reason it is more difficult to detect than is soft rot. Internal rot is most commonly found in the heavier members in the plenum areas of the tower. One of the best methods of inspection for internal rot is “sounding” with hammer blows. Members which have internal rot sound “dead” while non-rotted members have a “ring” or “live” sound. Areas which sound “dead” can be probed with a screwdriver or other pointed tool to verify the presence of internal rot.

Marley maintains a laboratory for detailed wood inspections and has personnel on its staff experienced in all aspects of wood deterioration and preservative treatment. In addition, several Marley publications are available which give detailed information on the subject of wood deterioration and treatment. Contact the nearest Marley sales office or representative for more information about wood inspection services and for copies of the publications.

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## Water Treatment

**BLOWDOWN**—Blowdown, or bleed-off is the continuous removal of a portion of the water from the circulating 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 upon the cooling range (the difference



between the hot and cold water temperatures) and the composition of the make-up water (water added to the system to compensate for losses by blowdown, evaporation and drift). The following table shows the amount of blowdown required to maintain different concentrations with various cooling ranges:

**BLOWDOWN—% OF CIRCULATING RATE**

COOLING RANGE—°F	1.5X	2.0X	2.5X	3.0X	4.0X	5.0X	6.0X
5	.78	.38	.25	.18	.11	.08	.06
10	1.58	.78	.51	.38	.25	.18	.14
15	2.38	1.18	.78	.58	.38	.28	.22
20	3.18	1.58	1.05	.78	.51	.38	.30
25	3.98	1.98	1.32	.98	.64	.48	.38

**EXAMPLE:** 7000 GPM circulating rate, 15° cooling range. To maintain 4 concentrations, the required blowdown is .38% or .0038 times 7000 GPM which is 26.6 GPM.

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

**CHEMICAL TREATMENT**—In some cases chemical treatment of the circulating water is not required if adequate blowdown is maintained. In most cases, however, chemical treatment is required to prevent scale formation and corrosion. Sulfuric acid or one of the polyphosphates is most generally used to control calcium carbonate scale. Various proprietary materials containing chromates, phosphates or other compounds are available for corrosion control. When water treatment chemicals are required, the services of reliable water treating companies should be obtained.

Slime, a gelatinous organic growth, and algae, a green moss, may grow in the cooling tower or heat exchangers. Their presence can interfere with cooling efficiencies. Proprietary compounds are available from water treating companies for the control of slime and/or algae; however, compounds which contain copper are not recommended. Chlorine and chlorine containing compounds are effective algaecides and slimicides but excess chlorine can damage wood and other organic materials of construction. If used, chlorine should be added as intermittent (or shock) treatment only as frequently as needed to control the slime and algae, and free residual levels should not exceed one part per million parts water (1 ppm). Chlorine and chlorine

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containing compounds should be added carefully since very high levels of chlorine may occur at or near the point of entry into the circulating water system.

**FOAMING**—Heavy foaming sometimes occurs when a new tower is put into operation. This type of foaming generally subsides after a relatively short period of operation. Persistent foaming can be caused by the concentrations of certain combinations of dissolved solids or by contamination of the circulating water with foam-causing compounds. This type of foaming can sometimes be minimized by increasing the blowdown, but in some cases foam depressant chemicals must be added to the system. Foam depressants are available from a number of chemical companies.

**WATER DISCOLORATION**—Wood contains some water soluble substances and these commonly discolor the circulating water on a new tower. This discoloration is not harmful to any of the components in the system and can be ignored. However, a combination of foaming and discolored water can result in staining of adjacent structures if foam is picked up by air being pulled through the tower and discharged out the fan cylinders. Avoid operation of fans until the foaming is controlled.

#### **MAINTENANCE OF FILL PERFORMANCE**

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△ **Warning**

*Owner must keep water clean by treatment, screening, or filtering to avoid the possibility of fill clogging and loss of thermal performance.*

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△ **Caution**

*Entering water temperature in excess of 125°F may result in fill deformation.*

#### **Potential Causes of Fill Clogging:**

Suspended materials—Trash, airborne particles, dust, fly-ash, etc.

Scale—Can be sulfates, silicates, carbonates, or oxides. Scaling effects can be accentuated by suspended muds.

Algae and/or Slime—Can control with chlorine or non-oxidizing biocides.

#### **Possible Sources of Scale:**

Calcium Sulfate—From make-up and sulfates produced by sulfuric acid for pH adjustment. Calcium sulfate should be kept below 1000 ppm expressed as CaCO<sub>3</sub>.

Calcium Carbonate—Generally will not form scale in the cooling tower if carbonate scaling does not occur in the condenser.

*Exceptions:* If make-up water contains surplus free carbon dioxide, scaling may be inhibited in the condenser, but may occur in the tower fill because of CO<sub>2</sub> stripping.

Silicates and Oxides—Silica scale is virtually impossible to remove. Silica scale is unlikely if SiO<sub>2</sub> is held below 150 ppm. Oxides, such as iron oxide, can coat all parts of the system if soluble iron is present in concentrations above 0.5 ppm. Iron oxides do not usually develop into thick scales but can accentuate the development of other scales.

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## **Spare Parts**

Marley manufactures and maintains a stock of replacement parts for all cooling tower mechanical equipment. Shipment of these parts are normally made within ten days after an order is received. If emergency service is necessary, contact the local Marley sales office or representative for assistance.

To prevent prolonged shutdown periods in case of damage to the mechanical equipment, it is suggested that the following parts be carried in the owner's stock:

1. One fan assembly.
2. One Geareducer assembly.
3. One drive shaft assembly.

Be sure to furnish the tower serial number when ordering parts.

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## **Seasonal Shutdown Instructions**

**Tower**—Drain all tower piping.

During shutdown, clean the tower and make any necessary repairs. Apply protective coating as required to all metal parts. Particular attention should be given to mechanical equipment supports, drive shaft and drive shaft guards.

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Visually inspect for wood deterioration and test members for soft spots. Protect wood towers against fire. If tower is wetted for fire protection, wet it down continuously—alternate wetting and drying is destructive to wood. *If ambient temperature is 32°F or below, do not put cold water on tower.*

### **Mechanical Equipment**

Geareducer (shutdown for 3 months or less).

1. Each month, drain water condensate from the lowest point of the Geareducer and its oil system. Check oil level and add oil if necessary. Operate Geareducer to recoat all interior surfaces with oil.
2. At start-up, drain water condensate and check oil level. Add oil if necessary.

Refer to Geareducer Service Manual for maintenance and lubrication instructions.

Geareducer (shutdown for 3 months or longer).

1. If the motors have space heaters, operate mechanical equipment one hour each month.
2. If the motors do not have space heaters, operate mechanical equipment one hour each week.
3. At start-up, operate mechanical equipment one hour or until oil is warm, then shut the equipment down. Drain the oil and refill with new oil.

Refer to Geareducer Manual for instruction on changing oil. Refer to Marley **Downtime Instruction Manual** for downtime of 6 months or longer.

### **Electric Motors**

1. Do not start motor without determining that there will be no interference with free rotation of the fan drive.
2. Refer to Marley **Electric Motor Service Manual**.
3. If shutdown period is longer than seasonal, contact your Marley sales office or representative for additional information.

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## Cooling Tower Cleaning

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### △ Warning

***Any evaporative-type cooling tower must be thoroughly cleaned on a regular basis to minimize the growth of bacteria, including Legionella Pneumophilla, to avoid the risk of sickness or death. Service personnel must wear proper personal protective equipment. Do NOT attempt any service unless the fan motor is locked out.***

Operators of evaporative cooling equipment, such as water cooling towers, should follow maintenance programs which will reduce to an absolute minimum the opportunity for bacteriological contamination. Public Health Service officials have recommended that “good housekeeping” procedures be followed, such as: regular inspections for concentrations of dirt, scale, and algae; periodic flushing and cleaning; and the following of a complete water treatment program including biocidal treatment.

Visual inspection should take place at least once a week during the operating season. Periodic flushing and cleaning should be done at least twice a year. Hot water basins and nozzles, louvers, drift eliminators, and easily accessible fill surfaces should be flushed by use of a moderate-pressure water nozzle, being careful not to cause physical damage. A reliable water treatment program should be installed and maintained.

# Troubleshooting

Trouble	Cause	Remedy	
Motor Will Not Start	Power not available at motor terminals	<ol style="list-style-type: none"> <li>1. Check power at starter. Correct any bad connections between the control apparatus and the motor.</li> <li>2. Check starter contacts and control circuit. Reset overloads, close contacts, reset tripped switches or replace failed control switches.</li> <li>3. If power is not on all leads at starter make sure overload and short circuit devices are in proper condition.</li> </ol>	
	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 Geareducer for cause of problem.	
	Rotor defective	Look for broken bars or rings.	
Unusual Motor Noise	Motor running single-phase	Stop 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.	
	Ball 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 guard	Reinstall or replace fan.	
Motor Runs Hot	Wrong voltage or unbalanced voltage	Check voltage and current of all three lines against nameplate values.	
	Overload	Check fan blade pitch. See Fan Service Manual. Check for drag in fan drive train as from damaged bearings.	
	Wrong motor RPM	Check nameplate against power supply. Check RPM of motor and gear ratio.	
	Bearings overgreased	Remove grease reliefs. Run motor up to speed to purge excessive grease.	
	Rotor rubs stator bore	If not poor machining, replace worn bearing.	
	Wrong lubricant in bearings	Change to proper lubricant. See motor manufacturer's instruction.	
	One phase open	Stop motor and attempt to start it. Motor will not start 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.	
	Insufficient grease	Remove plugs and regrease bearings.	
	Deterioration of or foreign material in grease	Flush bearings and relubricate.	
	Bearings damaged	Replace bearings.	
	Incorrect fan blade pitch	See Fan Service Manual for blade pitching instructions.	
	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 man check motor.

# Troubleshooting

Trouble	Cause	Remedy
Wrong Rotation (Motor)	Wrong sequence of phases	
Geareducer Noise	Geareducer bearings	Change any two of the three motor leads. If new, see if noise disappears after one week of operation. Drain, flush and refill Geareducer. See Geareducer Service Manual. If still noisy, replace.
	Gears	Correct tooth engagement. Replace badly worn gears.
Unusual Fan Drive Vibration	Loose bolts and cap screws	Replace gears with imperfect tooth spacing or form. Tighten all bolts and cap screws on all mechanical equipment and supports.
	Unbalanced drive shaft or worn couplings	Make sure motor and Geareducer shafts are in proper alignment and "match marks" properly matched. Repair or replace worn couplings. Rebalance drive shaft by adding or removing weights from balancing cap screws. See Drive Shaft Service Manual.
	Fan	Make certain all blades are as far from center of fan as safety devices permit. All blades must be pitched the same. See Fan Service Manual. Clean off deposit build-up on blades.
	Worn Geareducer bearings	Check fan and pinion shaft endplay. Replace bearings as necessary.
	Unbalanced motor	Disconnect load and operate motor. If motor still vibrates, rebalance rotor.
	Bent Geareducer shaft	Check fan and pinion shaft with dial indicator. Replace if necessary.
Fan Noise	Loose fan hub cover	Tighten hub cover fasteners.
	Blade rubbing inside of fan cylinder	Adjust cylinder to provide blade tip clearance. Check and tighten if necessary.
	Loose bolts in blade clamps	

## Safety

The tower has been designed to provide a safe working environment while either operating or shut down. The ultimate responsibility for safety rests with the Operator and Owner. When flow to the tower is shut off or when portions of the tower require maintenance, temporary safety barricades may be required around openings. Other safety precautions such as safety harnesses should be utilized where appropriate for compliance with OSHA regulations and standards and good safety practices.

Routine periodic maintenance must be performed on all personnel access and material handling accessories in accordance with the following schedule:

	Ladders, Stairways, Walkways, Handrails, Covers, Decks and Access Doors	Davits, Derricks, and Hoists
Inspect for General Condition	Semi-annually	Semi-annually
Inspect and Repair for Safe Use	Yearly	
Inspect and Repair Before Each Use		As Required

# Inspection and Maintenance Schedule

## General Recommendations

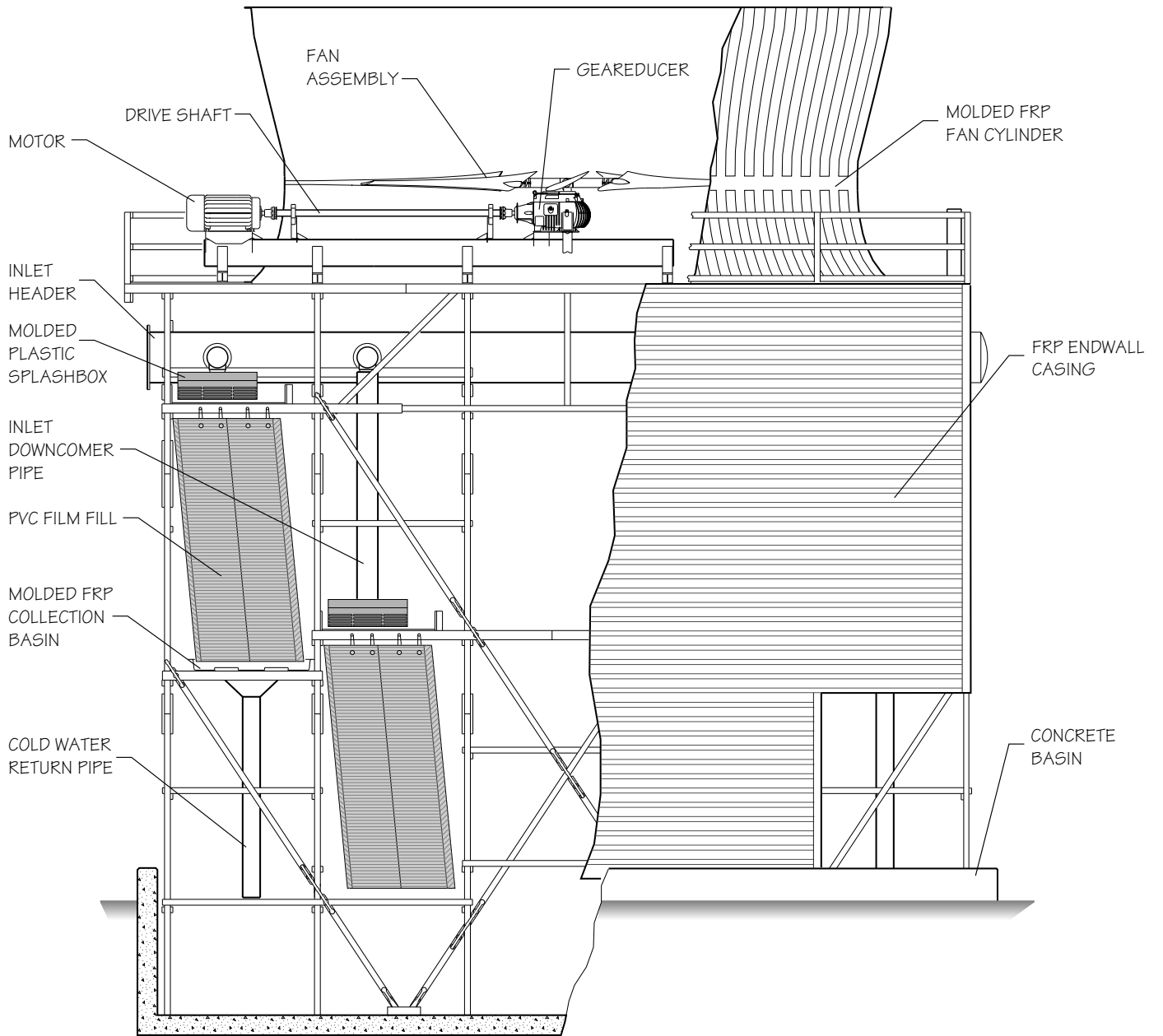
More frequent inspection and maintenance may be desirable

	Fan and Fan Cylinder	Motor	Drive shaft and Guards	Gearreducer	Eliminator/Louver Face of Fill	Fill	Cold Water Basin	Hot Water Basin	Float Valve	Suction Screen	Distribution System	Structural Members	Casing	Stairs, Ladders, Walkway, Doors, Handrails	Davits, Derricks, Hoists
1. Inspect for clogging					M	M	W			W					
2. Check for unusual noise or vibration	D	D	D	D											
3. Inspect keys, keyways and set screws	S	S	S	S											
4. Make sure vents are open				S											
5. Lubricate (grease)		R									S				
6. Check oil seals				M											
7. Check operating oil level				D											
8. Check static oil level				M											
9. Check oil for water and sludge				M											
10. Change oil				S											
11. Check fan blade tip clearance	S														
12. Check water level							D	D							
13. Check for leakage				W		S	S	S							
14. Inspect general condition	S	S	S	S	Y	S	Y	S	Y	S	S	S	Y	S	S
15. Tighten loose bolts	S	S	S	S											
16. Clean	R	R	R	R	R	R	S	R	R	R	R				
17. Repaint	R	R	R	R											
18. Rebalance	R		R												
19. Inspect/repair for safe use	Y		Y											Y	
20. Inspect and repair before each use															R

D-Daily W-Weekly M-Monthly Q-Quarterly S-Semiannually Y-Yearly R-as Required



# Tower Schematic



# Inspection Checklist

Date Inspected \_\_\_\_\_ Inspected By \_\_\_\_\_  
 Owner \_\_\_\_\_ Location \_\_\_\_\_  
 Owner's Tower Designation \_\_\_\_\_  
 Tower Manufacturer \_\_\_\_\_ Model No. \_\_\_\_\_ Serial No. \_\_\_\_\_  
 Process Served by Tower \_\_\_\_\_ Operation: Continuous  Intermittent  Seasonal   
 Design Conditions GPM \_\_\_\_\_ HW \_\_\_\_\_ °F CW \_\_\_\_\_ °F WB \_\_\_\_\_ °F  
 Number of Fan Cells \_\_\_\_\_

Condition: 1—Good 2—Keep an eye on it 3—Needs immediate attention

1	2	3	Comments
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## Structure

Casing Material \_\_\_\_\_  
 Structural Material \_\_\_\_\_  
 Fan Deck Material \_\_\_\_\_  
 Stairway? \_\_\_\_\_ Material \_\_\_\_\_  
 Ladder? \_\_\_\_\_ Material \_\_\_\_\_  
 Handrails? \_\_\_\_\_ Material \_\_\_\_\_  
 Interior Walkway? \_\_\_\_\_ Material \_\_\_\_\_  
 Cold Water Basin Material \_\_\_\_\_


## Water Distribution System

Distribution Basin Material \_\_\_\_\_  
 Inlet Pipe Material \_\_\_\_\_  
 Inlet Manifold Material \_\_\_\_\_  
 Branch Arms and Downcomers \_\_\_\_\_  
 Distribution Cones \_\_\_\_\_  
 Splashboxes \_\_\_\_\_  
 Nozzles—Orifice diameter \_\_\_\_\_ inches


## Heat Transfer System

Fill \_\_\_\_\_  
 Louver Face of Fill \_\_\_\_\_  
 Eliminator Face of Fill \_\_\_\_\_


Use this space to list specific items needing attention: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

# Inspection Checklist

Condition: 1—Good 2—Keep an eye on it 3—Needs immediate attention

## Mechanical Equipment

1	2	3	Comments
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### Gear Drive Units

Manufacturer \_\_\_\_\_ Model \_\_\_\_\_ Ratio \_\_\_\_\_

Oil Level: Full  Add Immediately  Low, check again soon

Oil Condition: Good  Contains Water  Contains Metal  Contains Sludge

Oil Used—type \_\_\_\_\_

Seals \_\_\_\_\_

Back Lash \_\_\_\_\_

Fan Shaft End Play \_\_\_\_\_


Any Unusual Noises? No  Yes

Action Required: \_\_\_\_\_

### Drive Shafts

Manufacturer \_\_\_\_\_ Material \_\_\_\_\_

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### Fans

Manufacturer \_\_\_\_\_ Fixed Pitch  Adjustable Pitch

Diameter \_\_\_\_\_ Number of Blades \_\_\_\_\_

Blade Material \_\_\_\_\_

Hub Material \_\_\_\_\_

Hub Cover Material \_\_\_\_\_

Blade Assembly Hardware \_\_\_\_\_

Blade Tip Clearance \_\_\_\_\_ " min. \_\_\_\_\_ " max.

Vibration Level \_\_\_\_\_

Fan Cylinder Height \_\_\_\_\_

Mech. Eqpt. Support Mat'l \_\_\_\_\_

Oil Fill & Drain Lines \_\_\_\_\_

Oil Level Sight Glass \_\_\_\_\_

Vibration Limit Switches \_\_\_\_\_

Other Components \_\_\_\_\_


### Motor

Manufacturer \_\_\_\_\_

Name Plate Data: \_\_\_\_\_ HP \_\_\_\_\_ RPM \_\_\_\_\_ Phase \_\_\_\_\_ Cycle \_\_\_\_\_ Volts \_\_\_\_\_

F.L. Amps \_\_\_\_\_ Frame \_\_\_\_\_ S.F. \_\_\_\_\_ Special Info. \_\_\_\_\_

Last Lubrication—Date \_\_\_\_\_

Grease Used—Type \_\_\_\_\_

Any Unusual Noise? No  Yes  Action Required \_\_\_\_\_

Any Unusual Vibration? No  Yes  Action Required \_\_\_\_\_

Any Unusual Heat Build-up? No  Yes  Action Required \_\_\_\_\_

**The Marley  
Cooling Tower  
Company**  
5800 Foxridge Drive  
Mission, KS 66202  
913 362-1818



# SERVICE **information**

MARLEY COOLING TECHNOLOGIES, INC.

## Health Alert

Among other sources, outbreaks of Legionnaires' Disease have reportedly been traced to cooling towers. Maintenance procedures that prevent amplification and dissemination of Legionella and other airborne bacteria should be formulated and implemented BEFORE systems are operated and continued regularly thereafter to avoid the risk of sickness or death. The following is recommended:

- Do NOT attempt any service unless the fan motor is locked out.
  - New cooling towers should be cleaned and treated with biocides by a water treatment expert before startup. See your Cooling Tower User Manual for more detailed instructions on biocidal treatment.
  - At a minimum, cooling towers should be cleaned and disinfected with biocides twice a year. Systems with biofouling or positive cultures of legionella may require additional cleaning.
  - Units should be inspected weekly for bacterial growth and general operating conditions. Bacterial growth should be reported to your water treatment expert for immediate attention.
  - Drift eliminators should be inspected monthly. Any debris or scale should be cleaned off the eliminators when noted. Replace any damaged or worn out components.
  - Workers cleaning units should use protective clothing and equipment during decontamination.
  - Although using these practices will not guarantee that a system or individual component will not be contaminated by legionella, they should reduce the chance of colonization.
- For additional copies of the tower User Manual or other literature pertaining to this unit, please contact your Marley sales representative.