



MANUAL

SERIES 8, SERIES 9, SERIES 10, SERIES 14, SERIES 15,
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WOOD AND STEEL

DOUBLE-FLOW

Operation and Maintenance Instructions

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DOUBLE-FLOW

Operation and Maintenance Instructions

GENERAL

These instructions have been prepared to assist the tower owner and operator in obtaining the best results and long life from his Marley tower. Service manuals on mechanical equipment and a Parts Manual are sent with these instructions and should be read before the tower is put in service.

Any questions concerning the operation and/or maintenance not covered by these instructions should be referred to the nearest Marley representative. *When writing for information or ordering parts, always mention tower serial number shown on the nameplate.*

PRE-STARTING

When a cooling tower is started for the first time or after a long shut down period, it should be cleaned, inspected and lubricated.

1. **Clean** any dirt, leaves or foreign matter from the hot water basins, redistribution basins, cold water basin and air inlet louvers. See that metering orifices in wood or steel hot water and redistribution basins are in place and open. Remove any debris from suction screen and sump in the cold water basin.
2. **Wash Out** the wood-fill assembly and tower basins, and drain to remove accumulated debris.
3. **Grease Motor** if there are grease fittings or plugs. The motors should be greased in accordance with the motor manufacturer's instructions.
4. **Test Motor Insulation** resistance with a "Megger".
5. **Lubricate Bearing Housing** by greasing top and bottom bearings. Use rust and oxidation inhibiting lithium base grease.

6. **Check V-belt Drive** for proper sheave alignment and correct belt tension (see Service Manual).
7. **Check Oil in Geareducer** by draining off a sample and examining for sludge and water. Drain, flush and refill with oil if water or sludge is present. Add oil if level is low. (See Geareducer "Operation and Service" Manual.)
8. **Inspect Drive Shaft** couplings and check alignment of shafts. All cap screws must be tight. (See Drive Shaft "Installation, Balancing and Maintenance" Manual.)
9. **Check the Fan** for free rotation and ample tip clearance. Clearance between the ends of the blades and the cylinder should be a minimum of 1/4".
Check blade pitch to be sure all blades have been properly set.
10. Be sure float valve for make-up water is in place and operating freely.

STARTING

FILLING THE WATER SYSTEM

Fill the cold water basin and connected pipe system with water until the operating water level is reached. (See "Cold Water Collecting Basin".) The float valve should be adjusted to maintain water at the required level, then basin should be filled to overflow level.

Open the hot water valve; then prime and start the circulating water pump. The water depth in the hot water basins should be between 1 and 5 inches.

STARTING THE FAN

Fan must run clockwise, when viewed from above and discharge the air up. Directional arrows on the fan blades show the proper rotation. If the fan operates with considerable vibration, check blades for proper socket and pitch. Vibration generally decreases when wood tower has operated for a day (after soaking wood thoroughly).

If the fan motor is not loaded in accordance with the contract horsepower, adjust fan blade pitch. (See Fan "Installation, Operation and Maintenance Instructions".)

OPERATION

FAN DRIVE

If a two-speed motor is used on this tower, 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 strains are placed on driven machinery and motor unless the motor is allowed to slow to low speed rpm or less before the low-speed winding is energized. When changing direction of fan rotation allow a minimum of two minutes time delay before energizing the motor.

HOT WATER DISTRIBUTION BASINS

To obtain maximum performance, maintain equal water flow and distribution over the basins of all the tower cells. If all the metering orifices are clean and in place, equal water depth (1 to 5 inches) in all basins will indicate even distribution. If a major change in the quantity of water circulated over the tower is made, it may be desirable to change the orifice size to provide adequate water break-up and maintain the proper water level. Contact the Marley Customer Service Department on this problem.

WATER REDISTRIBUTION BASINS (Series 14 Tower Only)

These towers utilize a redistribution basin in the middle of the wood-fill assembly. The purpose of this intermediate basin is to collect and redistribute the water evenly over the remaining fill (lower half). The metering orifices of these basins must be kept clean and in place.

COLD WATER COLLECTING BASIN

Normal operating water level in a wood or steel collecting basin at bottom of tower is a depth of 5 inches. (This may vary from 4 to 8 inches.) Towers which use basins having a depressed center area operate with 1 to 3 inches of water in the basin area under the fill. Maintain sufficient depth to prevent air from entering suction line under normal operation, but not so deep that water is lost out overflow when tower is shut down.

A tower with a concrete basin should have the operating water level 1 to 6 inches below the first fill layer. Special low operating depths of water may be accommodated by the use of air baffles under the fill to prevent air bypassing beneath the fill.

WATER MAKE-UP AND BLEED-OFF

The amount of "make-up" water that is required to maintain adequate water depth in the cold water collecting basin depends upon the

"evaporation loss", "drift loss" and "bleed-off". Water for make-up averages 1-1/2 percent of the tower water circulated for a cooling range of 10°F. For additional information see section on "Water Treatment".

WINTER OPERATION

Towers that operate in freezing weather should be equipped with two-speed motors and reversing switches. This equipment will not only reduce power consumption but will also provide positive control of ice formation.

During periods of low temperature operation (32° and below) ice will form on the relatively dry parts of the tower that are in contact with the incoming air. Primarily this includes the louvers and adjacent structural framing. Regulation of the air flow through the tower will control this condition.

Ice formation can be minimized and controlled as follows:

1. Operate the fans at half speed forward. This reduces the cooling rate (heat transfer) and increases the quantity of warm water on the louvers.
2. Shut the fans down. This reduces the cooling rate to a minimum and increases the quantity of warm water on the louvers to a maximum.
3. Operate the fans in reverse. This forces warm air out through the louvers, melting any accumulated ice. Reversal may be at either full or half speed, however, full speed is recommended. Reverse operation of fans should only be used to eliminate ice, not to prevent it.

During reverse fan operation, ice build-up can occur on the blade tips or fan cylinder with resultant damage. For this reason, prolonged reverse operation of the fan should be avoided. Ice build-up should be controlled so that the removal time by reverse fan operation does not exceed 20 to 30 minutes.

See "Fan Drive" for fan speed change and reversing precautions.

INTERMITTENT WINTER OPERATION

When the cooling tower is operated intermittently during winter weather, it is necessary that the water be drained from the exposed piping and tower basin to insure protection against freezing and possible pipe rupture. Basin drains should be left open during winter shutdown periods to allow rain and melted snow to escape.

If the tower is equipped with oil gage and drain lines, condensate must be drained from these.

TOWER MAINTENANCE

Maximum performance and service life depends on inspection and maintenance of all parts of the tower and its supply system. In most cases, a general tower inspection once a day should be sufficient. The schedule in Table I can be used by the operator to obtain continuously good performance with least tower maintenance. Marley recommends setting up a regular inspection schedule to insure effective safe operation of the cooling tower. Keep continuous lubrication and maintenance records for each cooling tower. Regular inspection and repair of personnel safety items, indicated by asterisk in Table I, and a record of same is especially important. "SAFETY FIRST".

HOT WATER DISTRIBUTION BASINS

Metering orifices in the bottom of the hot water basin may be cleaned without shutting down any part of the tower. Remove dirt, algae, leaves, etc., which might get in these basins or orifices. The metering orifices must be kept in place to assure proper water distribution.

WATER REDISTRIBUTION BASINS (Series 14 Towers Only)

The redistribution basins are cleaned and serviced from the outside of the tower by standing on a short step ladder. Removing several of the tower louvers will make the basins accessible. All metering orifices are within reach from the outside of the tower. The basin area under the fill can be cleaned by scraping with a long handled hoe.

COLD WATER COLLECTING BASIN

Pre-wetting wood basins for a few days prior to operating the tower will allow the boards to swell. This will reduce the leakage when the basin is filled. If leaks exist after several days' operation, they can be sealed with mastic and candle wicking.

Leaks in steel basins will probably be in bolted joints. They can be stopped by tightening or loosening bolts as required and sealing with caulking compound.

The water level in the cold water basin should be checked daily. Inspect the suction screen each week, cleaning away any accumulated debris. Float valves or make-up water controls should operate freely and maintain the proper water level.

TOWER FRAMEWORK

Keep wood framework bolts tight. Wood towers operated seasonally should have the bolts tightened at each start-up after the wood has become thoroughly soaked. Bolts in the mechanical equipment and its supports should receive particular attention. Check wood annually for indications of deterioration.

WOOD FILL

The wood fill must be kept level and clean. It is easier to prevent the deposition of foreign materials than to remove it later. This is covered more completely in the "Water Treatment" section of this manual. Fill layers must be level and all members must be in place to obtain maximum tower performance.

MOTOR LUBRICATION

The lubrication and maintenance of each electric motor should be in accordance with the manufacturer's instructions. (See Electric Motor "Installation, Operation and Maintenance" Manual.)

BEARING HOUSING

Grease the bearings before placing in operation and thereafter every 170 hours of operation or at least once a month. Use a rust and oxidation inhibiting lithium base No. 2 consistency grease.

V-BELTS AND SHEAVES

Check belt tension after the first 8 hours of operation. Inspect belts weekly for frayed edges and proper tension.

GEAREDUCER

Check oil level weekly and test the oil for sludge and water monthly. (See Geareducer "Operation and Service" Manual.)

DRIVE SHAFT

Check shaft alignment, tightness of cap screws and condition of coupling every six months.

FAN

Check fan operation daily and clean blades when necessary.

PAINTING

All metal parts subject to corrosion should be cleaned and painted periodically with rust-resistant paint. Bitumatic base paints are good for this. The actual time between paintings is dependent upon climatic conditions and the operating cycle.

Redwood does not require protection from the weather; however, in some cases it may be painted for appearance. Any high grade outside paint may be used. If wood appears to be deteriorating, see "Chemical Treatment" part of "Water Treatment" section of this manual.

TABLE I

INSPECTION & MAINTENANCE SCHEDULE
General Recommendations

(More frequent inspection and maintenance may be desirable)

	FAN & FAN GUARD	MOTOR	DRIVESHAFT & GUARDS	GEAREDUCER	DRIFT ELIMINATORS	WOOD FILLING	COLD WATER BASIN	DISTRIBUTION BASINS	STRUCTURAL MEMBERS	CASING	FLOAT VALVE	SUCTION SCREEN	V-BELTS	BEARING HOUSING	STAIRS, LADDERS, WALKWAYS, DOORS, HANDRAILS*	DERRICKS, DAVITS, HOISTS*
1. Inspect for clogging								W				W				
2. Check for unusual noise or vibration	D	D	D	D					Y				D	D		
3. Inspect keys & keyways		S	S	S												
4. Make sure vents are open				M												
5. Lubricate (grease)		Q												M		
6. Test belt tension												W				
7. Check oil seals				S												
8. Check oil level				W												
9. Check oil for water & dirt				M												
10. Change oil, at least				S												
11. Check water level						D	D									
12. Check for leakage				W				S			S					
13. Inspect general condition	S	S	S		Y	Y	Y		S	Y	Y		M		S	S
14. Tighten loose bolts	S	S	S	S					Y	R				S		
15. Clean	R	S	R	R	R	R	S	R			R	W		R		
16. Repaint	R	R	R	R						R				R		
*17. Inspect/repair for safe use	Y		Y												Y	
*18. Inspect and repair before each use																R

D - daily; W - weekly; M - monthly; Q - quarterly; S - semi-annually; Y - yearly; R - as required

WATER TREATMENT

BLEED-OFF

Bleed-off is the continuous removal of a small portion of the water from the circulating system. The purpose of bleed-off is to prevent dissolved solids from concentrating to the point where they will form scale. As a guide,

Cooling Range (Degrees F)	% Of Circulating Rate To Bleed-off To Maintain Three Concentrations	% Of Circulating Rate To Bleed-off To Maintain Two Concentrations
5	.05	.20
10	.30	.60
15	.55	1.00

Example: 1200 GPM circulating rate, cooling range 10°F. to maintain 3 concentrations, the required bleed-off = 1200 × .0030 = 3.6 GPM.

many waters can be allowed to concentrate two or three times without causing scale problems. The amount of bleed-off to hold concentrations to two or three depends upon the cooling range (hot water temperature minus cold water temperature). The accompanying table shows amount of bleed-off required at three different cooling ranges.

CHEMICAL TREATMENT

The quality of many waters is such that chemical treatment for scale prevention or removal will not normally be required if adequate bleed-off is maintained. In areas where bleed-off alone is not sufficient to prevent objectionable scale or corrosion, use a simplified phosphate treatment or contact a rep-

utable water treating company for aid.

Slime (a gelatinous organic growth) and algae (a green moss) may occur in the cooling tower or heat exchanger. There are a number of proprietary compounds which may be procured from water treating companies which will control these organisms. Compounds containing copper or chlorine should be used with care as they may harm the metal or wood parts in the system.

FOAMING

Foaming occasionally becomes a problem with certain water conditions when a new tower is put into operation. The condition is not normally persistent for an extended period, and foaming can be lessened by increasing bleed-

off until condition is improved. If increased bleed-off does not lessen foaming sufficiently, a foam depressant chemical should be used. These are generally available through local chemical supply companies and some water treating companies.

WATER DISCOLORATION

Discoloration, like foaming, is a condition that develops when a new tower is put into operation. It will not harm the normal components in an open recirculating cooling system. However, if discoloration is objectionable, it can be reduced by increasing bleed-off or the system may be emptied and refilled once or twice after the initial start-up of the tower. Commercial bleaching agents may be used but must be used with care as they may damage the system.

SPARE PARTS

The Marley Company maintains a stock of replacement parts for mechanical equipment at Kansas City, Kansas. Shipment of these parts is normally made within ten days after an order is received. If emergency service is necessary, contact the local Marley representative or the Kansas City General Office.

To prevent prolonged shutdown periods in case of damage to mechanical equipment, it is suggested that the following spare parts be

carried in the owner's stock:

1. One fan assembly.
2. One bearing housing assembly (or Geareducer assembly).
3. One set of belts and sheaves (or drive shaft).

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

TOWER TROUBLE TIPS

TROUBLE	CAUSE	REMEDY
Excessive Water Drift	Faulty drift elimination	1. Check to be sure all louvers, eliminator sections or slats and splash retainers are in place. 2. Top deck assemblies and wood fill must be intact and level. There must be no tendency to channel water. 3. Metering orifices of hot water basins must be in place and clean of debris. 4. There must be no leaks under hot water basin sides.
	Overpumping	Reduce water flow to tower to design conditions or use larger basin orifices.
Cold Water Too Warm	Overpumping	Reduce water flow to tower to design conditions.
	Wood fill not level	Check wood fill with carpenter's level transversely and longitudinally. Level if required.
	Not enough air	Check motor current and voltage to be sure of correct contract hp. Clean algae or muck from wood fill and eliminators.

TOWER TROUBLE TIPS (CONTINUED)

TROUBLE	CAUSE	REMEDY
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.
	Electrical unbalance	Check voltages and currents of all three lines. Correct if required.
	Ball bearings	Check lubrication. Replace bad bearings.
Motor Runs Hot	Motor overload, wrong voltage or unbalanced voltage	Check voltage and current of all three lines against nameplate values.
	Bearings overgreased	Remove grease reliefs. Run motor up to speed to purge excessive grease.
	Excessive belt tension	Reduce tension and check shaft alignment.
	Poor ventilation	Clean motor and check ventilation openings.
	Wrong grease	Change to proper grease. See motor manufacturer's lubricating instructions.
	Winding fault	Check with ohmmeter.
Geareducer Noise	Sludged lubricant	Drain and flush with light flushing oil. Select flushing oil from lubricant supplier's recommended flushing oil compatible with lubricant used. Drain and refill. See Geareducer service manual.
	Bad Geareducer bearings	If new, see if noise disappears after one week of operation. Drain, flush, and refill Geareducer. See Geareducer service manual. If still noisy, replace.
Fan Noise	Loose bolts in fan cylinder	Check and tighten if necessary.
Thrown Belts	Belts too loose	Adjust belt tightening device.
	Sheaves out of position	See V-belt service manual.
Unusual Fan Drive Vibration	Loose bolts and cap screws	Tighten all bolts and cap screws on all mechanical equipment.
	Unbalanced drive shaft	Make sure motor and Geareducer shafts are in proper alignment and "match marks" properly matched. Re-balance drive shaft by adding or removing weights from balancing cap screws. See drive shaft service manual.
	Unbalanced fan	Be sure blades are properly positioned in correct sockets. (See match numbers.) All blades must be pitched the same. See fan service manual.
	Worn Geareducer bearings	Check fan and pinion shaft endplay.
	Unbalanced motor	Disconnect load and operate motor. If motor still vibrates, rebalance motor.
	Worn bearing housing bearings	Check bearings and mounting bolts.
	Bent shaft	Make sure fan and motor shafts are straight and properly aligned.
	Belts	Belts should be stretched to the proper tension. See service manual on "V-belts and Sheaves".
Scale or Foreign Substances in Water System	Lack of or insufficient blowdown	See "Water Treatment" section of this manual.
	Water treatment	Consult competent water treating specialist. See "Water Treatment" section of this manual.
Wood Deterioration	Improper water treatment or micro-biological attack.	Consult The Marley Company. See "Water Treatment" section of this manual.

SEASONAL SHUTDOWN INSTRUCTIONS

Basin and Frame

Drain the tower basins and all exposed piping. Leave the basin drain open. Water may be left in wood cold water basin if tower is located in a non-freezing area.

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 equip-

ment supports, drive shafts and drive shaft guards. Inspect visually for wood deterioration and test members for soft spots with an ice pick or similar sharp instrument.

Protect wood towers against fire. If tower is wetted for fire protection, wet it down continuously; alternate wetting and drying is destructive to wood.

Mechanical Equipment

FLOW CONTROL VALVE

Grease valve threads at zerk fitting using rust inhibiting lithium base grease of NLGI No. 2 consistency and then open valve.

GEAREDCERS

1. At shutdown, operate Geareducer until oil is warm; drain and refill. See the Lubrication section of Geareducer Service Manual for instructions on changing oil.
2. 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 to re-coat all interior surfaces with oil.

3. At start-up, operate until oil is warm; drain and refill.

ELECTRIC MOTORS

Do not start motor without determining that there will be no interference with free rotation of the fan drive.

Motors are equipped with grease lubricated ball bearings. Refer to motor manufacturer's recommendations for lubrication and maintenance instructions.

If shutdown period is longer than seasonal, contact The Marley Company, Kansas City 14, Missouri, for additional information.