MARLEY®

user manual

CP cooling tower

OPERATION - MAINTENANCE

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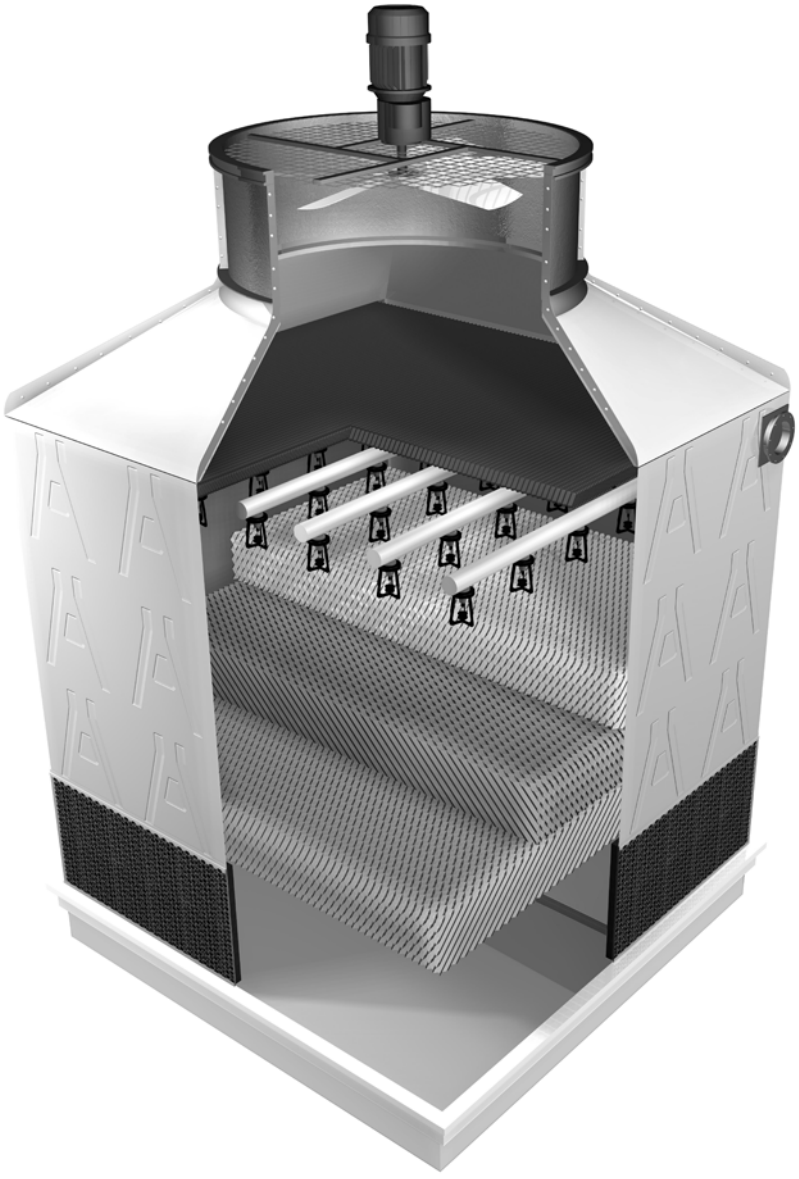
READ AND UNDERSTAND THIS MANUAL PRIOR TO OPERATING OR SERVICING THIS PRODUCT.



contents

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.

Note

These instructions assist in obtaining efficient, long life from Marley counterflow cooling towers. Direct questions concerning cooling tower operation and maintenance to your Marley sales representative. Always include your tower serial number when requesting information or ordering parts. Look for this number on the sidewall casing.

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–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 local public health services and recommendations. Do NOT attempt any service unless the fan motor is locked out.
Remove any dirt and trash which has accumulated in the cold water basin. Remove any sediment from the cold water collection basin, sump, and screens. Use a water hose to flush cold water collection basins.
Fill the cold water collection basin and circulating water system until the operating water level is reached.

OPERATE WATER SYSTEM–Prime and start the circulating water pumps. Increase the flow of circulating water gradually to design water flow rate to avoid water hammer which could damage the distribution piping system. 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.

Note

When starting in freezing weather, follow procedures outlined in Freezing Weather Operation.

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 tightness of bolts in fan hood joints.
2–Check bolted joints in the fan and gear motor drive assemblies.
3–Check the piping connection hardware

4–Visually inspect the fill, drift eliminators, air inlet louvers and the distribution piping and spray nozzles.

5–Check gear motor oil for sludge or water by draining off and testing a sample as outlined in the manufacturer's Gear Motor IOM Manual. Check gear motor oil level. Add oil as required. Refer to the Gear Motor IOM Manual for oil filling procedure and list of recommended lubricants.

6–Rotate fan by hand to be sure of free rotation and ample tip clearance.

7–Test run each fan separately for a short time. Check for excessive vibration or unusual noise. If either is present, see **Troubleshooting Guide** on pages 14 and 15 of this manual. Fan must rotate clockwise when viewed from above. Recheck gear motor oil level.

8–Check functioning of make-up water supply. Make sure the blowdown will carry the proper amount of water.

Note

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

STARTING FAN–Operate the fan for 30 minutes to permit the gear motor oil to come up to operating temperature and check the motor load with a watt meter, or take operating volt and ampere readings and calculate motor hp. Pitch fans if required to pull correct contract horsepower when circulating design water rate at design hot water temperature. Refer to the manufacturer's Fan IOM Manual for instructions. Check tightness of fan blade fasteners after a brief period of operation.

⚠ Caution

Entering water temperature in excess of 80°C may result in fill deformation.

TOWER PERFORMANCE–Keep the cooling tower clean and water distribution uniform to obtain continued maximum cooling capacity.

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.

operation

HOT WATER DISTRIBUTION SYSTEM–Maintain uniform water distribution at the nozzles (uniform spray cone). The amount of water circulated should approximate the contract requirements and the nozzle pressure should be kept constant. Lower pressures may indicate excessive losses in the piping system and/or insufficient pump capacity; greater pressures might indicate clogged nozzles and/or overpumping. If a greatly reduced water flow rate is desired, it may be advisable to change nozzle sizes to obtain the desired pressure and maintain proper water distribution. An SPX Cooling Technologies engineer can advise minimum and maximum flow rates for even distribution.

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" .

FREEZING WEATHER OPERATION–During periods of low temperature operation, 2°C to 5°C or below, ice will form on the relatively dry parts of the cooling tower that are in contact with the incoming air. Primarily, this includes the air inlet and adjacent structural framing. Your understanding of cold weather operation will be enhanced if you read **"Cooling Towers and Freezing Weather"** *Technical Report H-003* available at spxcooling.com.

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. However, normal "fan off" operation causes reverse air flow by aspiration and may cause water blowout and therefore must be done with caution and monitoring. For automatic operation, a timer switch can be provided to shut the fan down for a few minutes each hour.

2–If the cooling tower has VFD, 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.

operation

⚠ Caution

Reverse operation of fans is not recommended.

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

⚠ 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.

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

HOT WATER DISTRIBUTION SYSTEM–Keep the circulating water and distribution system (piping and nozzles) 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.

The interior of the cooling tower can be accessed through an inspection door located on the side casing. This will provide access to the water distribution system, eliminators and fill.

maintenance

DRIFT ELIMINATORS–Eliminators should be kept clean.

⚠ Warning

Do not walk or step on the eliminators.

COLD WATER COLLECTION BASIN–Inspect collection basin occasionally for leaks and repair if necessary. Keep cold water outlets clean and free of debris. Makeup and circulating water controls must operate freely and maintain the desired water quantity in the system.

⚠ Warning

Do not walk or step on the fan hood.

The gear motor is located on top of the fan hood. A ladder and platform is provided for access. The fan guard can be removed in sections for fan maintenance.

GEAR MOTOR–Make weekly and monthly oil checks. Inspect internal part during seasonal oil change. Lubricate and maintain each gear motor in accordance with the manufacturer's instructions. If repair work is necessary, contact the nearest representative of the gear motor manufacturer.

FAN–Inspect fan blade surfaces every six months. For detailed maintenance information, refer to the manufacturer's Fan IOM Manual.

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

COLD WATER COLLECTION BASIN–A section of the air inlet louvers can be removed to access the cold water collection basin. Remove both star screws and the top fastening strip. The louver segment can be removed as a block in one piece.

Water Quality and Blowdown

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	Number of Concentrations						
	1.5X	2.0X	2.5X	3.0X	4.0X	5.0X	6.0X
3°C	.78	.38	.25	.18	.11	.08	.06
6°C	1.58	.78	.51	.38	.25	.18	.14
8°C	2.38	1.18	.78	.58	.38	.28	.22
11°C	3.18	1.58	1.05	.78	.51	.38	.30
14°C	3.98	1.98	1.32	.98	.64	.48	.38
Multipliers are based on drift of 0.02% of the circulating water rate.							

EXAMPLE: 159 m^3/hr circulating rate, 10°C cooling range. To maintain 4 concentrations, the required blowdown is 0.458% or .00458 times 159 m^3/hr, which is .73 m^3/hr.

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.

Biofilm, 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. If used, chlorine should be added as intermittent (or shock) treatment only as frequently as needed to control the slime and algae. Chlorine and chlorine 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.

Maintenance of Fill Performance

⚠ **Warning**

Water must be kept clean by treatment, screening, or filtering to avoid the possibility of fill clogging and loss of thermal performance.

Potential Causes of Fill Clogging:

- Debris and suspended materials.
- Scale–Can be sulfates, silicates, carbonates, or oxides. Scaling effects can be accentuated by suspended solids.
- Algae and/or Biofilm–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 $CaCO_3$.
- 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_2 stripping.

- Silicates and Oxides–Silica scale is virtually impossible to remove. Silica scale is unlikely if SiO_2 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.

⚠ Caution

Do not walk directly on the fill. Place appropriate walking surface on fill to avoid crushing. Recommended walking surface would be a minimum of 15mm thick plywood measuring at least 30cm x 60cm.

Spare Parts

SPX Cooling Technologies manufactures and inventories cooling tower replacement parts. Typical lead time is 10 working days. Contact your Marley representative for emergency service.

Owners should consider maintaining inventory of critical mechanical components, such as a fan assembly and gear motor to avoid emergency shutdown of cooling tower operations.

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

Seasonal Shutdown Instructions

Tower–Drain all tower piping.

During shutdown, follow recommendations in the **Cooling Tower Inspection and Maintenance** section of this manual before attempting 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.

Mechanical Equipment:

Gear motor – Downtime for 3 months or less.

1. Follow the manufacturer's instruction for shutdown instructions.
2. Check the oil level and if necessary remove any condensation water.
3. Consider the gear motor space heater option

Gear motor – Downtime for 3 months or more.

1. Follow the manufacturer's instruction for shutdown instructions.
2. If the motors do not have space heaters, operate mechanical equipment one hour each week.
3. Do not start the motor without determining that there will be no interference with free rotation of the fan drive.
4. At startup, operate mechanical equipment one hour or until oil is warm, then shut the equipment down. Drain the oil and refill with new oil.
5. Refer to manufacturer's Gear Motor IOM manual for instruction on changing oil.

Refer to the Downtime Instruction User Manual for downtime exceeding six months. If shutdown period is longer than seasonal, contact your Marley sales representative for additional information.

maintenance

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 local public health services and recommendations. • Workersperforming 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.
- 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.

inspection and maintenance schedule

General Recommendations

–more frequent inspection and maintenance may be warranted

	Fan and Fan Guard	Gear Motor	Drift Eliminators	Fill	Cold Water Basin	Hot Water Distribution System	Air Inlet Louvers	Structural Members	FRP Casing	Fan Hood	Ladders, Platform and Doors
Inspect for clogging			M	M		W	W				
Check for unusual noise or vibration	D	D									
Inspect keys, keyways and set screws	S	S									
Make sure vents are open		S									
Lubricate (grease)		R									
Check oil seals		M									
Check operating oil level		D									
Check static oil level		M									
Check oil for water and sludge		M									
Change oil		S									
Check fan blade tip clearance	S										
Check water level					D						
Check for leakage		W		S	S	S			S		
Inspect general condition	S	S	Y	S	Y	S	S	S	Y	S	S
Tighten loose bolts	S	S						S	S	S	
Clean	R	R	R	R	S	R	R				
Repaint	R	R									
Rebalance	R										
Inspect/repair for safe use	Y										Y

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

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.
	Overload	Check fan blade pitch. See “Fan User Manual.” Check for drag in fan drivetrain and from damaged bearings.
	Wrong motor RPM	Check nameplate against power supply. Check RPM of motor and drive ratio.
	Bearing overgreased	Remove bearing reliefs. Run motor up to speed to purge excessive grease.
	Wrong lubricant in bearings	Change to proper lubricant. See motor manufacturer's instructions.
	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.
	Insufficient grease	Remove plugs and regrease bearings.
	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. Consider installing a Marley VFD drive for fine temperature control.
	Deterioration of grease or foreign material in grease	Flush bearings and relubricate.
	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 and cap screws	Tighten all bolts and cap screws on all mechanical equipment and supports.
	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 IOM Manual.” Clean off deposit build-up on blades
Fan noise	Blade rubbing inside of fan hood	Adjust to provide blade tip clearance
	Loose bolts in blade clamps	Check and tighten if necessary.
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
Condensing temperature too warm. See “Cooling Tower Operation.”	Entering wet bulb temperature is above design	Check to see if local heat sources are affecting evaporative condenser. See if surrounding structures are causing recirculation of evaporative condenser discharge air. Discuss remedy with Marley representative.
	Design wet bulb temperature was too low.	May have to increase evaporative condenser size. Discuss remedy with Marley representative
	Actual process load greater than design	May have to increase evaporative condenser size. Discuss remedy with Marley representative
	Overpumping	Reduce water flow rate over evaporative condenser to design conditions.
	Evaporative condenser starved for air	Check motor current and voltage to be sure of correct contract horsepower. Repitch fan blades if necessary. Clean eliminators. Check to see if nearby structures or enclosing walls are obstructing normal airflow to evaporative condenser. Discuss remedy with Marley representative.
Excessive drift exiting evaporative condenser	Spray system malfunction	Inspect spray system for proper operation. Correct as necessary.
	Faulty drift elimination	Check to see that the eliminators are clean, free of debris and installed correctly. Clean if necessary. Replace damaged or worn out components.

SAFETY FIRST–The CP cooling 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 water flow to the tower is shut off or when portions of the tower require maintenance, temporary safety barricades may be required around openings and fall protection equipment should be utilized where appropriate for compliance with OSHA and CE regulations, standards and good safety practices.

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 m^3/hr _____ HW _____ °C CW _____ °C WB _____ °C

Number of Fan Cells _____

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

	1	2	3	Comments
Structure				
Casing Material				
Structural Material				
Fan Deck Material				
Stairway? _____ Material _____				
Ladder? _____ Material _____				
Handrails? _____ Material _____				
Interior Walkway? _____ Material _____				
Cold Water Basin Material _____				
Water System				
Distribution System _____				
Header Material _____				
Manifold Material _____				
Branch Arms _____				
Nozzles – Orifice Diameter _____				
Heat Transfer System				
Fill _____				
Eliminators _____				
Inlet 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**
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 _____				
Backlash _____				
Fan Shaft Endplay _____				
Any Unusual Noises? No Yes Action Required: _____				
Fans				
Manufacturer _____ Fixed Pitch Adjustable Pitch				
Diameter _____ Number of Blades _____				
Blade Material _____				
Hub Material _____				
Hub Cover Material _____				
Blade Assembly Hardware _____				
Tip Clearance _____ min. _____ max.				
Vibration Level _____				
Fan Cylinder Height _____				
Mech.Eqpt. Support Mat'l _____				
Oil Fill and Drain Lines _____				
Oil Level Sight Glass _____				
Vibration Limit Switches _____				
Makeup Valves _____				
Other Components _____				
Motor Manufacturer _____				
Name Plate Data: kW _____ RPM _____ Phase _____ Hz _____ Volts _____				
F.L. Amps _____ Frame _____ SF _____ 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 _____				

CP cooling tower

USER MANUAL

SPX COOLING TECHNOLOGIES UK LTD
3 KNIGHTSBRIDGE PARK
WORCESTER WR4 9FA UK
44 1905 750 270 | ct.fap.emea@spx.com
spxcooling.com

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