MARLEY®

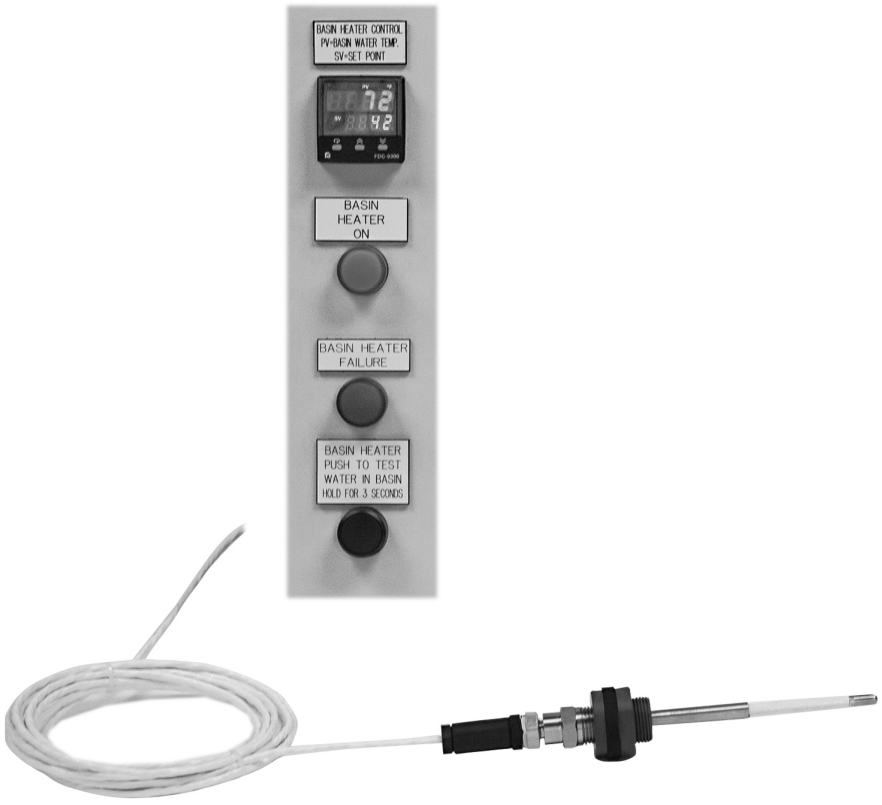
user manual

ABHi basin heater integrated controller

INSTALLATION - OPERATION - MAINTENANCE

Z1079659_A ISSUED 6/2019

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.

introduction

These instructions are intended to assure that field connections are completed properly and the Marley control system operates for the maximum time possible. Since product warranty may depend on your actions, please read these instructions thoroughly prior to operation.

If you have questions about the operation and/or maintenance of this control system and you do not find the answers in this manual, please contact your Marley sales representative.

⚠ Warning

Hazard of electrical shock or burn. Be sure to turn off power to the panel before servicing. If working on equipment out-of-sight of the panel disconnect, lockout using standard lockout procedure.

Safety First

The Marley control system uses UL listed components installed in accordance with the National Electric Code. The location of the cooling tower and field installation of the control system can affect the safety of those responsible for installing, operating or maintaining the cooling tower and controls. However, since SPX Cooling Technologies does not control the cooling tower location or field installation, SPX cannot be responsible for addressing safety issues that are affected by these items.

⚠ Warning

The following safety issues should be addressed by those responsible for installation, maintenance or repair of the tower and controls:

- Access to and from the control panel (including the customer supplied main disconnect/branch circuit protection).
- Proper grounding of electrical control circuits.
- Sizing and protection of branch circuits feeding the control panel.
- Qualification of persons who will install, maintain and service the electrical equipment.

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

Other safety issues are addressed in literature supplied with your cooling tower. Closely review the literature prior to installing, maintaining or repairing the cooling tower.

quick start guide

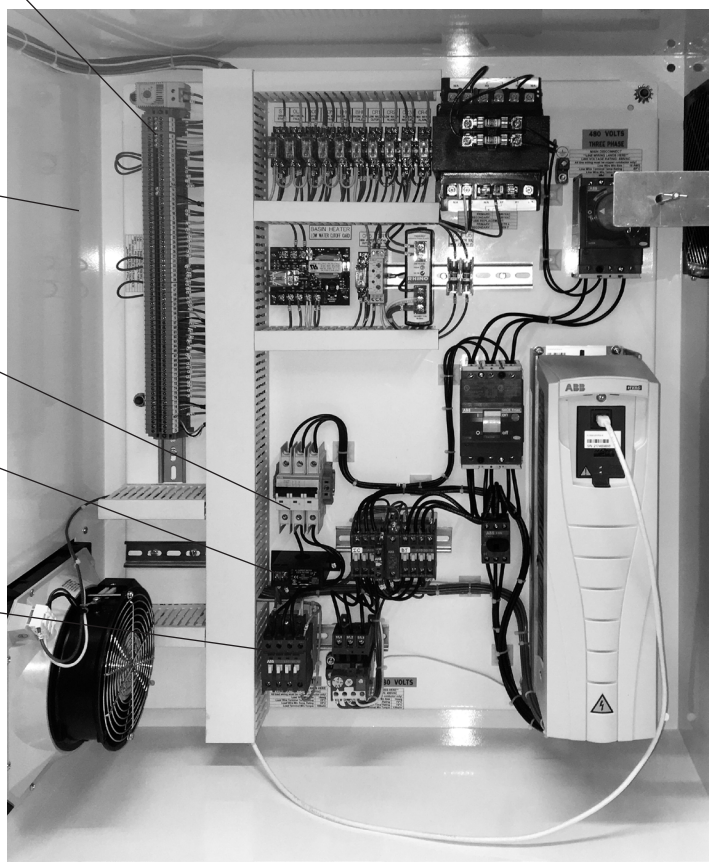
Terminal strip used to connect field devices including the Marley RTD temperature sensor and heater thermal cutout wiring. Additional points are included to connect remote alarm and control circuits as needed. Refer to the wiring diagram located on the inside of the control panel door

Wire the TCO (thermal cut out) safety circuit wiring from basin heater to user terminal strip. Wiring may be run in same conduit as power wiring. Follow NEC rules for wire insulation rating at same voltage as power conductors.

Thermal magnetic branch circuit breaker

Current sensor

Power contactor (route power conductors out bottom of enclosure to basin heater element)



Controller Operation

Display: line 1 = Actual temperature of water in basin
line 2 = Setpoint temperature key pad is locked

Test the Basin Heater

Heater and temperature sensor probe must be in water
Thermal cut out in heater element wired to user terminal strip

Push the "push to test" button and hold 3 seconds
Heater ON light = Heater is good and drawing current
Heater FAILURE light = Heater is not drawing current

The control panel is functional once wiring for utility source, heater element and RTD temperature sensor are installed. As an additional safety measure the thermal cutout wires located in the conduit head of the heater elements should be connected to terminal points C1 and C2 in the control panel after removing its jumper. If multiple heater elements are used per tower cell, wire all thermal cut out wiring in series and route back two wires to the control panel. Other control and alarm circuits included with this panel may be utilized as needed based on job site requirements. Always refer to the wiring diagram on the inside of the control panel door. Some projects require special-built control panels with circuits not reflected in a standard wiring diagram.

installation

Description

The Marley ABHi basin heater package controls the ON and OFF operation of the basin heater device providing freeze protection in the cold water collection basin of a cooling tower. The stand-alone control package includes a main circuit breaker disconnect that feeds a contactor providing power for the heater element.

The solid-state temperature controller is programmed to monitor water temperature in the cold water basin and control the heater element. The controller has a two line display for PV (process variable) and SV (setpoint variable)values. The value shown on the PV line is water temperature in the basin being monitored by the temperature sensor and the value shown on the SV line is the set point.

An RTD (resistant temperature device) monitors water temperature in the basin for the temperature controller and includes a low water cutout circuit preventing the control from energizing if the sensor is not submerged in water. Standard sensor lead length is 30'-0 (9m), longer leads are available. The factory lead may be lengthened in the field, maximum distance is 200'-0 (60m) as tested. Existing sensor wiring may be spliced with 18 gauge stranded copper wire to increase the length. It is recommended the splice be a set of terminal points within a junction box. An alarm contact will close when the temperature approaches a freezing condition for indication back to a BMS (building management system).

Sequence of Operation

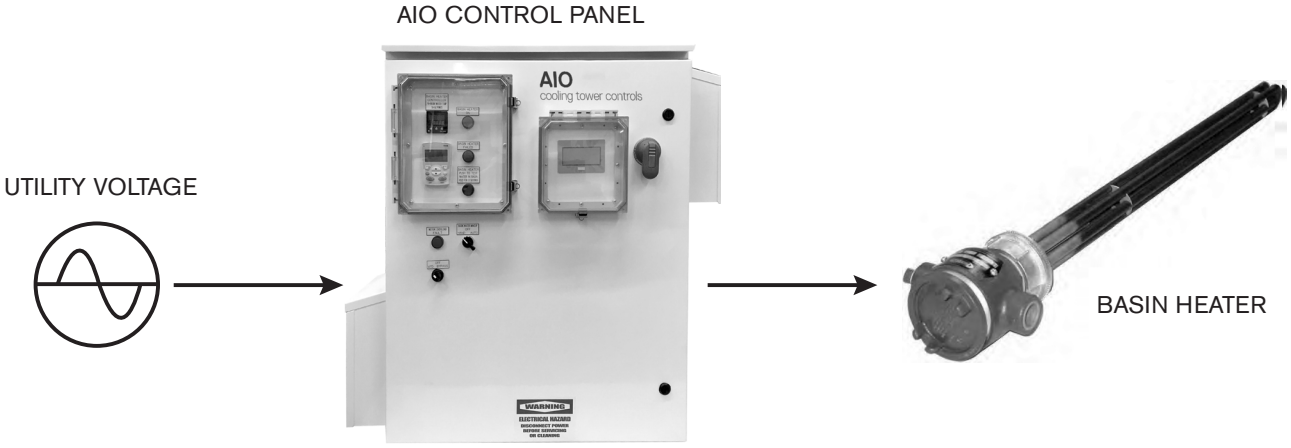
Utility power applied to the main disconnect provides all required power to the internal and external circuits including the basin heater element. The main disconnect provides a means to isolate the incoming utility voltage.

The temperature controller monitors water temperature in the cold water basin of a cooling tower via the RTD providing ON and OFF operation of the basin heater element. A set point temperature resides in the controller factory programmed at 42°F (5.5°C) with an operating band width of 5°F (3°C). When the temperature drops to 40°F (4.5°C) the controller energizes the power contactor to the ON position energizing the basin heater element. The controller de-energizes the power contactor OFF at 45°F (7°F). An alarm contact closes if temperature in the cold water basin is 35°F (2°C) of less.

The RTD provides dual functions, temperature and low water cutout safety circuit. The low water cutout circuit will not allow the heater to energize unless the sensor is submerged in water. The sensor is located about one inch higher than the heater element assuring the heater element is covered with water before energizing.

The basin heater element may be provided with a TCO (thermal cut out) safety device which acts as a one time thermal fuse. If the heater element reaches an overheated condition the TCO opens the safety circuit of the ABHi circuit de-energizing the power contactor. This is a one-time thermal fuse and is field replaceable.

System Diagram



Note

Prevent condensation from forming inside the enclosure. Seal the inside of the conduit at the enclosure forming a vapor barrier. A vapor barrier may be created in the field using expanding foam injected into the conduit after wiring connections have been made.

When using multiple heater elements, wire the heaters in parallel and route three wires and ground to the AIO control panel.

Heater element may have a two-wire thermal cutout. These two wires may be run in same conduit as the power wiring. Follow local

installation

Typical location for the control panel is outdoors at the cooling tower. The location should provide easy access for operating and servicing the control panel–e.g. an access door platform. Run all power and control wiring in and out of the bottom of the enclosure with water tight fittings. When using conduit, seal the inside of the conduit at the enclosure with silicone or expanding foam creating a vapor barrier. If the control panel is located at a lower elevation then the heater element it may provide a path for condensation or vapor to enter the control panel.

RTD Temperature / Water Level Sensor

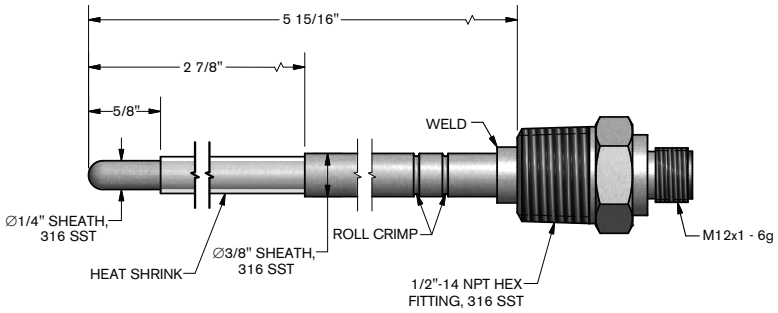
⚠ Warning

This basin heater package is equipped with a combination temperature/liquid level sensor. The level sensor is a safety device that must not be altered or changed in any manner. Disabling this safety feature may result in combustion and/or fire, which could cause damage or destroy the cooling tower and may cause damage to persons or property nearby. Failure of the safety device requires that the control panel be de-energized and tagged out for maintenance. Do not re-energize the unit until all safety devices are fully operational in accordance with manufacturer's specifications.

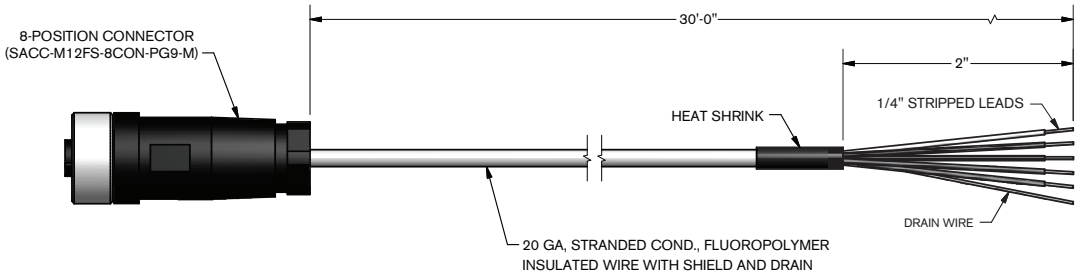
The temperature sensor typically is installed in the cooling tower collection basin side wall. Install the sensor probe in the cold water basin at least 1" above the highest point of the heater element and at least 6" away from the heater. The sensor should be installed in the coldest part of the basin for maximum protection. It should extend into the open basin a minimum of 4". A ½" NPT PVC bulkhead fitting is provided on the sensor for mounting through the basin wall. Provide an 1⅜" clearance hole through the basin wall. Remove the nut from the bulkhead fitting and insert the sensor probe through the hole. Hand tighten the mounting nut onto the fitting, holding the bulkhead fitting to avoid twisting the cord. Lightly tighten the nut.

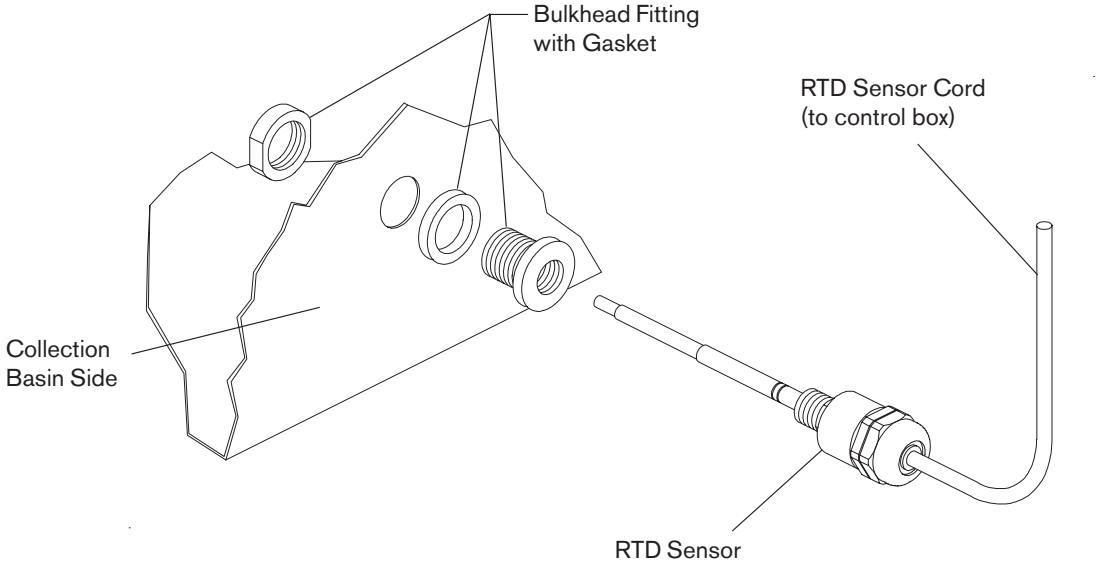
Marley RTD Sensor Type PT-100 with bulkhead fitting.

installation



Platinum PT-100 RTD Sensor





Heater Element

Install the heater element(s) in the depressed area of the cold water basin near the outlet. Provide clearance of ⅞" or more above the floor.

A single centrally located heater can protect up to 300 sq ft of basin surface area from ice damage. To protect larger surface areas, position several heaters so they protect equal areas. For multicell towers, no more than two cells may be protected by a single heater package. For three or more cells additional heater packages are necessary.

Note

For detailed information concerning installation, refer to the heater installation drawing provided with the cooling tower.

⚠ Caution

The heater should never operate out of the water. It would become extremely hot (1500°F) and destroy the heater element and/or ignite nearby combustible materials. As a precaution and to prevent fires when the clearance between any part of a heater element and combustible materials is less than 10", install a sheet metal shield to reflect and dissipate the heat. The shield must not contact the heater element and should extend beyond the heater element in all directions as shown in table.

Heater Clearance inches	1	2	4	6	8	10
Shield Extension inches	10	9	7	4	2	0

Heater Supports

Install metal supports for the heater element where necessary to keep the unsupported length under 30". The number of supports required is as shown in table.

Heater Kilowatts	1 - 9	12-18
Number of Supports	None	1

When using multiple heater elements per cell, wire the heater elements in parallel and run three wires and ground to the ABHi control circuit.

Heater elements may have a two-wire thermal cutout. These two wires may be run in same conduit as the power wiring following the National Electrical Code. Wire multiple cutouts in series back to the AIO panel.

operation

Temperature Controller with Readout

The controller acts as an ON OFF thermostatic type controller with a constant set point of 42°F. If the temperature in the cold water basin drops to 40°F the controller will energize the basin heater element. When the temperature rises to 45°F the controller will de-energize the basin heater element.

This application is designed to keep the water fluid, at the discharge area of the cooling tower. Some surface ice may form which is normal.

⚠ Caution

The temperature sensor must be underwater before the heater will be energized. Energizing the heater in air will cause the element to reach extreme temperature and burn out.

Controller display:

PV line = Actual water temperature in the cold water basin at the sensor tip

SP line = Set point temperature

Adjustment of the controller is locked to prevent changes by non-qualified personnel.

A dry alarm contact is provided at the user terminal strip which will close when water temperature reaches 35°F. This contact may be wired back to a BMS to complete an alarm circuit.

Options:

4-20mA output representing water temperature:

This integrated module requires special programming of the unit. The module may be supplied from the factory or as a field add on. This signal may be wired to a BMS to provide remote monitoring of the temperature.

Remote set point change:

This feature requires special programming of the unit.

The application may require a change to the set point temperature during free cooling operation. This may be accomplished by applying a remote dry contact closure from the BMS or chiller during free cooling and lowering the set point so the heater does not interfere with cold water output. Once free cooling is no longer required the remote contact may be opened and the controller will revert back to a 42°F set point.

Test Circuit for Basin Heater Element

On the enclosure door are two pilot lights and a push-to-test button. This circuit allows operating personnel to manually test the heater operation any time as long as the heating element is covered with water. Holding the test button in for a few seconds commands the heater element to energize. If the heater element draws current the amber BASIN HEATER ON pilot light is lit. If the heater element is defective the red BASIN HEATER FAILURE pilot light is lit and heater element needs to be replaced.

This same test procedure may be duplicated by interfacing with a remote contact closure from a BMS. Status contacts are available for wiring back to the BMS for remote indication of a normal operating basin heater.

Temperature Sensor

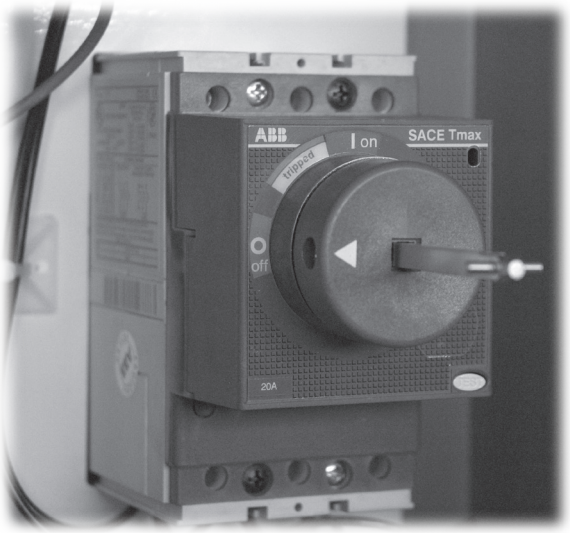
The temperature sensor provides both a temperature measurement and a low water cut out safety circuit. The basin heater element cannot be turned on unless the temperature sensor is submerged in water.

If the temperature sensor is incased in ice the basin heater element will not energize until the ice is melted along the sensor shaft.

Platinum PT-100 RTD Sensor

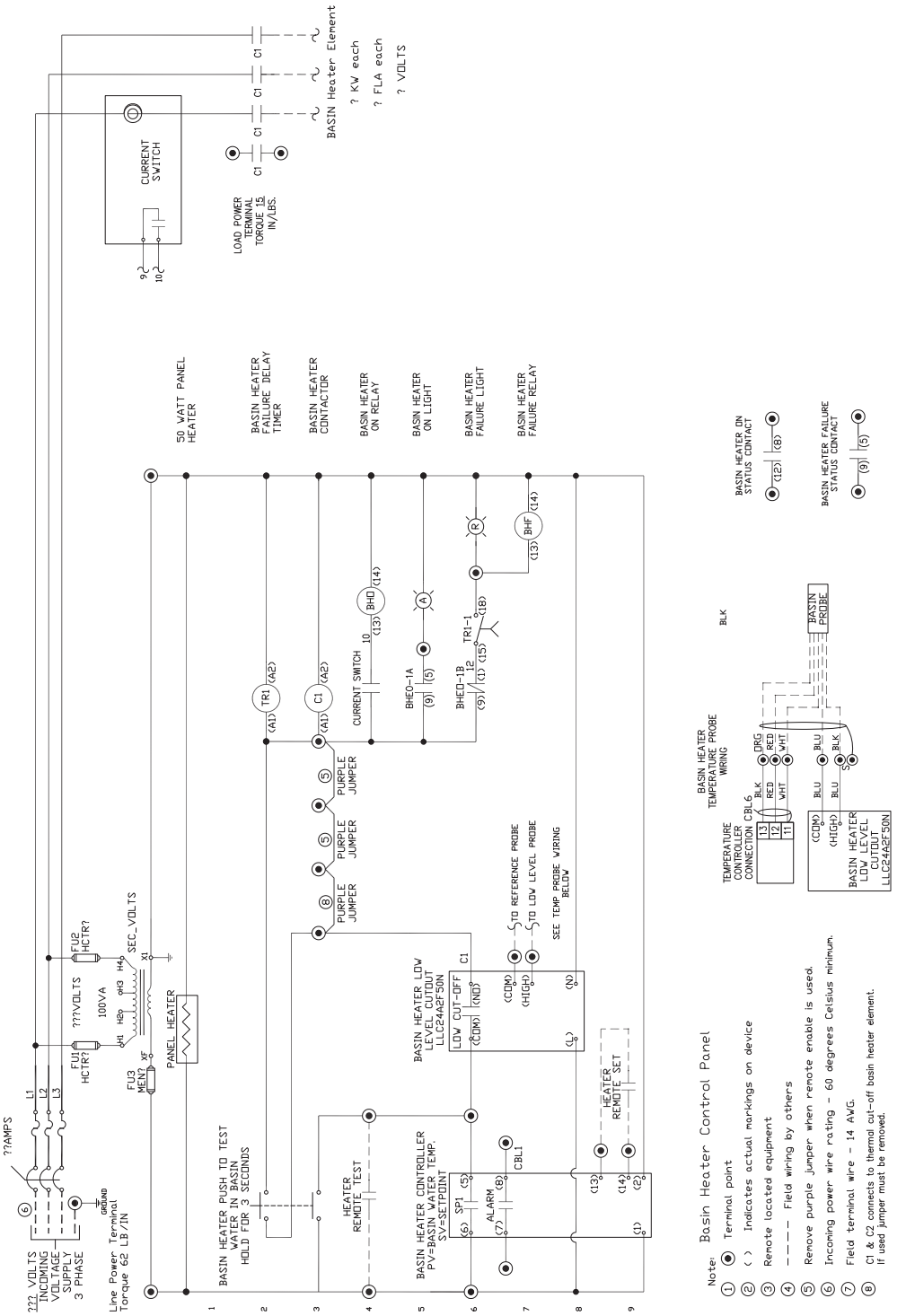
Disconnect Switch

The internal disconnect switch is a thermal magnetic circuit breaker which does not require adjustment.



wiring schematic

This is a typical wiring diagram located on the inside of the control panel door. This product may be ordered with special options so always refer to the as-built wiring diagram on the door of your control panel or ask SPX for an as-built wiring diagram with your order.



Color coding for the probe wiring lead ends reflect a new design probe with a production start date of 6/2019. New probes have a gray sheath lead versus previous white sheath lead. Terminal point wire numbers have not changed. Previous probe design may be replaced with new probe design.

faq

Voltage Ratings

Q What are the available voltage ratings?

A 575V, 480V, 240V, 208V, and 380V 50/60Hz. Contact SPX for other voltage options.

RTD Temperature Sensor

Q Is the temperature sensor furnished with wire?

A Yes – 30 feet is standard.

Q Can sensor leads be extended?

A Yes – use #18 gauge 5-wire stranded copper conductor plus a shield.

Q Are longer sensor leads available from the factory?

A Yes – 30 foot leads are standard and leads are available in 100', 150' and 200' lengths.

Q Can leads be cut to length?

A Yes.

Q Are sensor leads replaceable?

A Yes – the lead attaches to the sensor with a plug and screw connector.

Q Does the sensor require maintenance?

A Yes – the sensor should be cleaned during normal maintenance inspections.

Q Does the sensor lead need to be in conduit?

A The wire is rated for outdoor use (check local codes).

Q Is a low water cutout circuit required?

A Yes – the temperature sensor is a combination sensor with an integral low water cutout circuit already built into it therefore no additional wiring or components required.

Q How is the sensor mounted?

A Typical location is through the side wall of the cold water basin near the heater element and pump suction area. Bulkhead compression fittings are supplied with the sensor.

Main Disconnect

Q Does the AIO panel provide over current protection for the basin heater power feed?

A Yes – a thermal magnetic breaker is provided

faq

Temperature Controller

Q Is the controller solid-state?

A Yes.

Q Is the controller factory programmed?

A Yes - set point 42°F (5.5°C).

Q Is the controller programmable in the field?

A Yes.

Q Can the set point temperature be locked out with a security code?

A Yes.

Q Does the display show water temperature?

A Yes.

Q Does the display show set point temperature?

A Yes.

Q Is a 4-20mA water temperature signal available?

A Yes – as an option.

Pilot Lights

Q Are pilot lights LED type?

A Yes.

Wiring

Q How are heater elements wired back to the ABHi control circuit?

A A cooling tower cell may be furnished with 1, 2, 3 or 4 heater elements depending on amount of heat needed. The heater elements should be wired in parallel and 3 wires plus ground bought back to the ABHi circuit.

Q What is the purpose of the two white wires labeled C1 and C2 located in the conduit head of the heater element?

A This is a secondary safety circuit in case the heater element overheats. These two wires should be wired back to terminal points C1 and C2 in the ABHi circuit and may be run in the same conduit as the power feed. Use wire insulation rated for the feeder voltage. If C1 and C2 are not electrically connected the ABHi circuit will not operate.

Assembly Standards

The assembly is built to the following industrial control panel standards:

UL 508A CUL 508A NFPA 70 (NEC)

specifications

Control Circuit Details

Solid-state temperature controller with dual display and adjustable set points
Low water conductivity cutout safety circuit
Freezing water low temperature alarm contact
Push-to-test button to check if basin heater element is functional
Basin heater ON pilot light
Basin heater FAILED pilot light with dry contact output status
Low water cutout protection for the heater element
User terminal strip for status and RTD terminations
Low temperature alarm contact wired to user terminal strip
RTD PT-100 temperature sensor with long lead voltage drop compensation
30 foot plug on lead for temperature sensor is standard
Built to UL508A industrial control panel standards
Remote heater testing ability via customer's dry contact closure

Communications

1 – N.O. dry alarm contact closes at 35° F
1 – N.O. dry contact closes when the power contactor closes
1 – N.O. dry contact closes for basin heater ON confirmation
1 – N.O. dry contact closes for basin heater failure confirmation

Remote Provisions

– Heater element operation may be remotely checked via dry contact closure
– Second set point may be selected via remote dry contact closure
– Run enabled via remote dry contact closure

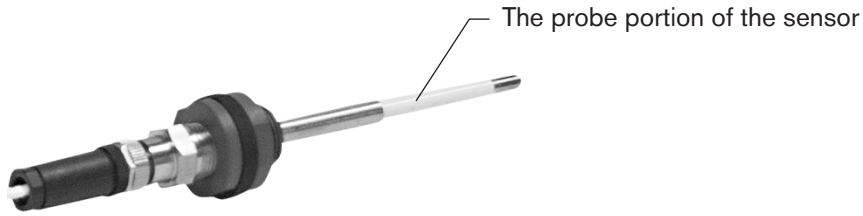
Settings

– Adjustable 42°F (5.5°C) set point ON at 40° (4.5°C), OFF at 45° (7.2°C)
– Adjustable freezing alarm contact at 35°F (1.7°C)

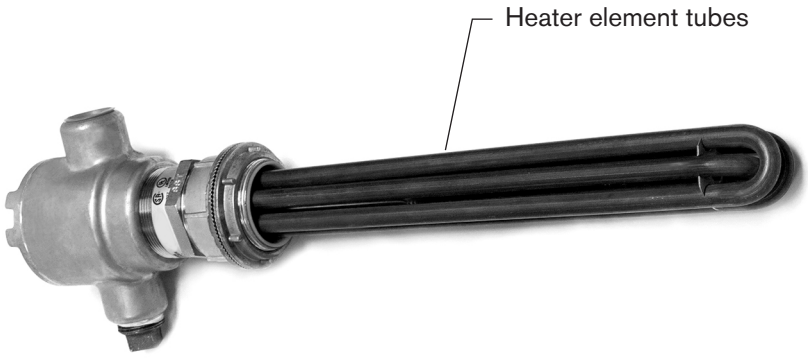
Cleaning the Sensor Probe and Heater Element

The most common reasons for a basin heater system to malfunction is failure to keep the temperature sensor probe and basin heater element clean.

Formation of mud and scale on the temperature probe may prohibit the function of the low-water cutout circuit. The probe portion of the sensor located in the collection basin is made up of two silver surfaces which conduct a small amount of electrical current through the water. This determines if the probe portion is submerged under water which in turn allows the heater element to be energized The probe should be cleaned using an abrasive pad to remove any contaminants.



The basin heater is a high density heater that must be immersed completely in water without heater element tubes touching mud or silt in the basin or exposed to air. Not allowing heat to be dispersed correctly will cause the heater element to overheat and burn out. Scaling of the heater tubes is another deterrent to proper heat dispersion. The element tubes should be cleaned using an abrasive pad to remove any contaminants.



Parts List

Item Description	Marley Item Number
RTD Platinum PT-100 with 30-foot cord and bulkhead fitting—gray cable sheath. 6/2019 production forward—only the wiring has changed, probe remains the same.	2667655
RTD Platinum PT-100 with 100-foot cord and bulkhead fitting—gray cable sheath. 6/2019 production forward—only the wiring has changed, probe remains the same.	2667656
RTD Platinum PT-100 with 30-foot cord and bulkhead fitting—white cable sheath. NLA—replaced by Item Number 2667655.	2584638
RTD Platinum PT-100 with 100-foot cord and bulkhead fitting—white cable sheath. NLA—replaced by Item Number 2667656.	2597798
RTD Platinum PT-100 (no cord) pin out used with a twist-on connector (may be used with white or gray sheathed cord design).	2597799
Low water level cut-out card	A87493
FDC-9300 temperature controller (without 4-20mA temperature module)	2597872
FDC-9300 temperature controller (with 4-20mA temperature module)	2597874
4-20mA temperature transmitter add on module for FDC-9300 controller	2597875
Disconnect handle, shaft, top hat for breaker handle	varies

- Panel design and components may vary. Providing the cooling tower serial number and part numbers of the parts being replaced will help to assure a proper selection.
- Adding a 4-20mA transmitter module to an existing controller originally not furnished with the transmitter may require additional programming. Contact your Marley sales representative.
- To help identify correct parts, provide photos of the part in question and the inside of the control panel.
- It is common for other contractors to add additional parts in the field i.e. interposing relays. SPX does not offer replacements for these parts. All original components are identified on the wiring diagram located on the inside door of the control panel. If this drawing is damaged contact your Marley sales representative.

troubleshooting

Component	Procedure	Check	Note
Main disconnect	To power the control circuit the disconnect handle must be in the ON position.		
Cut-in points	Visually check to make sure circuit points C1, C2, 8 and 9 are complete either with jumpers or remote devices.	If the circuit is broken at either of these points the basin heater panel will not operate. To check operation remove all field device wiring and replace with jumpers for testing.	The TCO fuse in the conduit head of the basin heater element may be open. A controls contractor may have added an interposing relay and the contacts at the relay are open.
Incoming voltage supply	Check voltage phase to phase on all three phases.	Assure utility voltage matches primary of CPT and voltage is well balanced. A-B Volts ____ A-C Volts ____ B-C Volts ____	Utility voltage must match voltage rating of the control panel.
CPT (control power transformer)	Assure voltage on secondary fuse is correct, refer to wiring diagram on door of control panel. Typical voltage is 120 VAC.	Voltage must be present for control circuit to function. Voltage = ____	If no voltage, check primary and secondary fuses on the CPT and replaced if a fuse is open.
TCO (thermal cut off) located inside conduit head of basin heater element—two white wires, wired back to AIO control panel	Is the TCO wired to C1 and C2 inside control panel and the factory jumper at these points removed?	The circuit between C1 and C2 must be complete otherwise the contactor will not engage. YES or NO	For testing purposes C1 and C2 may be jumped. If a controls contractor wired in an interposing relay in series with C1 and C2 the relay contact needs to be closed for control to function.
Testing the TCO located inside conduit head of basin heater element—two white wires, wired back to AIO control panel	Check continuity of TCO device. Continuity check may be taken at the control panel by disconnecting wires at C1 and C2 terminal points and reading for continuity on the two wires though the TCO thermal fuse.	The circuit between C1 and C2 must be complete otherwise the contactor will not engage. YES or NO	If no continuity replace the TCO device which simply pulls out of its tube holder nested inside the heater tube bundle.
Contactor feeding the basin heater element	Assure open/closed functionality of the armature	Manually depress and release the actuator to witness movement. Armature should spring return to open position. YES or NO	If armature does not react then internal contacts may be welded closed and contactor needs to be replaced.
RTD temperature sensor (testing low water cut-out portion of the sensor)	Perform continuity check at leads 17 and 18 on the user terminal strip located inside the ABHi control circuit (leads must be disconnected from the terminal points and two silver metal parts of temperature sensor must be jumped).	Determines if the two wires from ABHi control circuit to sensor makes a complete circuit loop. Is circuit complete? YES or NO	With two silver points on sensor jumped, meter should read continuity at points 17 and 18. If not replace temperature probe. The RTD furnished with the ABHi control circuit was factory tested before shipment.
Basin heater element	Perform an ohm meter check of all phases of the heater element. Measurement may be taken at load side of the power contactor located inside the AIO control panel.	If any or all phases of a heater element are open or out of balance with other phases, the heater is defective. A-B =____Ohms A-C =____Ohms B-C =____Ohms	Ohm values should be balanced. Ohm values will vary based on kW size. If an ohm reading is extremely high or unbalanced between phases most likely the heater is bad and needs to be replaced. Some typical ohm values are: 3kW = 30 Ohm, 2kW = 40 Ohm, 7.5kW = 60 Ohm, 9kW = 50 Ohm. A defective element would read infinity or in the megaohms.

ABHi basin heater

USER MANUAL

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