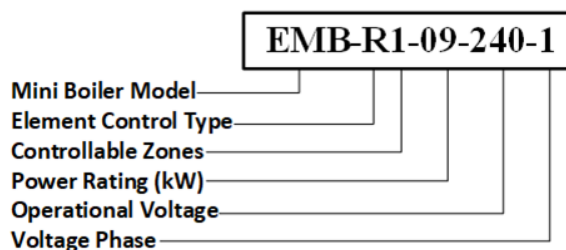


Electric Mini-Boiler™

Installation & Operating Instructions

Application: This Electro Mini-Boiler is factory equipped with outlet temperature sensing control designed to deliver the exact water temperature for your application. This model is equipped with pump/valve outputs, backup gas boiler output, auto and manual high limit safety interlocks, and power company load management. An optional outdoor sensor is available for this model.



Primary application is any hydronic water heating system (high or low temperature systems).

This series is equipped for power company load management interrupt and can apply to standard baseboard radiation, dual heat combinations, under floor radiant, wood boiler supplement, etc.

Note: This product meets the requirements of the ASME Boiler and Pressure Vessel Code.

Conforms to: UL STD.UL834

Certified to: CSA STD.C22.2#165

DO NOT DESTROY THIS MANUAL. PLEASE READ CAREFULLY AND KEEP IN A SAFE PLACE FOR FUTURE REFERENCE BY A SERVICE TECHNICIAN.



ELECTRO
INDUSTRIES

Monticello, MN • 800.922.4138 • www.electromn.com

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INTRODUCTION

The Mini-Boiler has been designed in a compact package with up to 9 kW of heating capabilities for radiant heat applications. When properly sized, the Mini-Boiler will provide the needed hot water to properly heat a space in a single zone application. The EMB-R Series models provide industry leading hydronic control for precise temperature management and ease of use. Proper design of the radiant system is required to assure minimum required water flow (GPM) through the boiler.

GENERAL

The basic **components** for an electric energy heating system typically include:

1. Electric Mini-Boiler itself – covered by this manual.
2. Thermostat hookup control – covered by this manual.
3. Outdoor Thermistor – if outdoor reset option is ordered as a kit, reference catalog number EMB-ODR.
4. Near boiler piping including expansion tank and air eliminator.
5. Circulating pump – typically sized for head pressure and system flow requirement.
6. Radiant heat devices/components.

MINI-BOILER SELECTION GUIDE

Mini-Boiler Selection Guide 1-9 kW								
Element Control	Phase	Zones	Voltage	Power Rating (kW)				
				1	3	5	7	9
Staging	1	1	120VAC	EMB-R1-01-120-1	EMB-R1-03-120-1	-	-	-
			240VAC	-	-	EMB-R1-05-240-1	EMB-R1-07-240-1	EMB-R1-09-240-1

ELECTRICAL SPECIFICATIONS

Model	Power Input, Operation	Circuit Breakers	Power Rating	Amps	Btu/h
EMB-R1-01-120-1	120-volt, 1-Staging	–	1.1 kW	9.2	3,753
EMB- R1-03-120-1	120-volt, 1-Staging	–	2.5 kW	20.8	8,530
EMB- R1-05-240-1	240/208-volt, 1-Staging	30A CB	5/3.7 kW	18.8/16.3	17,065/12,798
EMB- R1-07-240-1	240/208-volt, 1-Staging	45A CB	7/5.3 kW	29.2/25.3	23,884/18,088
EMB- R1-09-240-1	240/208-volt, 1-Staging	60A CB	9/7 kW	37.5/32.5	30,708/23,891

APPROVED TUBING/PIPING

When plumbing this boiler and its peripheral parts to the radiant floor loop system, all plumbing parts and/or tubing must be sealed to prevent entrance of oxygen.

Use only tubing or polyethylene tubing with oxygen Diffusion Barrier (ie. PEX).

WATER FLOW REQUIREMENTS

In order to prevent rapid stage cycling and long term deterioration of components and elements, it is important the water flow be greater than the specified 0.3 GPM per kW.

(MINIMUM 0.3 GPM PER KW WATER FLOW THROUGH BOILER)

Model	Water Temperature Rise							
	Flow – 10° F/6° C		Head Loss		Flow – 20° F/11° C		Head Loss	
	gpm	lpm	ft	m	gpm	lpm	ft	m
EMB-R1-01-120-1	0.96	3.62	0.012	0.004	0.48	1.81	0.003	0.001
EMB-R1-03-120-1	2.05	7.75	0.051	0.016	1.02	3.87	0.014	0.004
EMB-R1-05-240-1	3.41	12.92	0.132	0.040	1.71	6.46	0.037	0.011
EMB-R1-07-240-1	4.78	18.08	0.246	0.075	2.39	9.04	0.068	0.021
EMB-R1-09-240-1	6.14	23.25	0.392	0.119	3.07	11.62	0.109	0.033

Note: Head Loss based on 110° F return temperature, approximately 3 feet of Mini-Boiler ¾" pipe, and a Hazen-Williams Coefficient of 140.

MULTIPLE ZONES AND RADIANT TEMPERATURES

Same water temperature all zones – this model series has a built-in supply control algorithm for staging the elements in single or multi zone applications. If more than one zone is required, a zone controller may be used. If using zone valves, the end switches of all the zone valves are paralleled and directly control the respective R and W zone inputs to turn on the boiler. Since zone valves have a slow reaction time, to ensure proper temperature regulation output from the boiler when using zone valves always connect the end switches of the zone valves to the respective R and W zone inputs.

Two zones with different water temperatures – for applications that require two different temperatures, consider using the EMB-M2 Series Mini-Boiler. For two temperature applications using the EMB-R1 series, it is best to run the boiler at the higher desired water temperature and use a return water mixing valve to lower the water temperature for the lower water temp zone.

CAUTION

ELECTROCUTION IS A RISK INSIDE THE ENCLOSURE OF THE BOILER. ALWAYS TURN POWER OFF TO THE BOILER PRIOR TO MODIFYING THE ZONE 2 TEMPERATURE SETPOINT OR ACTIVATION LOCATED INSIDE THE BOILER. HAZARDS OR UNSAFE PRACTICES COULD RESULT IN PROPERTY DAMAGE, PRODUCT DAMAGE, SEVERE PERSONAL INJURY AND/OR DEATH.

Various water temperature requirements – for applications that require multiple different temperatures, a primary loop with zone pumps and a mixing valve for the various zone temperature requirements is necessary.

SAFETY TEMPERATURE CONTROL

The hi-limits within this unit are for safety purposes only. The system installation must have a proper responding slab or air sensing thermostat or zone controlling device to properly turn the boiler on and off. If the water flow is greater than the nominal GPM specified and the heat load large enough, this boiler should not reach hi-limit and the hydronic loop should continue to flow in the normal heating pattern until the operating slab stat is satisfied. If hi-limiting is experienced prior to satisfying the operating stat, there is likely a water flow issue.

In addition to the built-in supply temperature sensor and temperature control algorithm, there is a 190° F automatic reset hi-limit and a 205° F top vessel manual reset hi-limit.

ROOM THERMOSTAT PLACEMENT – RADIANT FLOOR

Comfort and proper space heating response are a direct relationship to the room thermostat type. For optimal system performance, Electro recommends using a slab sensing thermostat. This type of thermostat uses a remote sensor placed within the concrete slab via a piece of conduit or pex tube installed prior to pouring the slab.

If provisions were not made for a floor sensing thermostat, most any brand of air thermostat will work. We suggest setting the cycles per hour adjustment to a value of 1-2.

INFORMATION/WATER FLOW CALCULATIONS

Water flow, GPM, can easily be calculated if the temperature rise across the electric boiler can be measured. The following formula can only be used when the temperature rise is stable and the boiler is not hi-limiting. In other words, verify constant current draw and stable outlet temperatures for at least 15 minutes.

$$\text{GPM} = \frac{\text{Volts} \times \text{Amps} \times 3.4}{500 \times \text{Temp. rise}} \quad \text{Example: } \frac{240 \text{ volts} \times 36 \text{ amps} \times 3.4}{500 \times 10 \text{ degree rise}} = \frac{29376}{5000} = 5.8 \text{ gpm}$$

INFORMATION/WATER FLOW CALCULATIONS – METRIC

$$\text{L/min} = \frac{\text{Volts} \times \text{Amps} \times 3.587}{251.04 \times \text{Temp. rise } ^\circ \text{C}} \quad \text{Example: } \frac{240 \text{ volts} \times 36 \text{ amps} \times 3.587}{251.04 \times 6^\circ \text{C rise}} = \frac{30991.68}{1506.24} = 20.57 \text{ L/min}$$

INSTALLATION REQUIREMENTS

1. All installation work must be performed by trained, qualified contractors or technicians.

WARNING

ALL ELECTRICAL WIRING MUST BE IN ACCORDANCE WITH NATIONAL ELECTRIC CODE AND LOCAL ELECTRIC CODES, ORDINANCES, AND REGULATIONS.

WARNING

OBSERVE ELECTRIC POLARITY AND WIRING COLORS. FAILURE TO OBSERVE COULD CAUSE ELECTRIC SHOCK AND/OR DAMAGE TO THE EQUIPMENT.

CAUTION

This unit can only be used for its intended design as described in this manual. Any internal wiring changes, modifications to the circuit board, modifications or bypass of any controls, or installation practices not according to the details of this manual will void the product warranty, the ETL/Intertek certification, and manufacturer product liability. Electro Industries cannot be held responsible for field modifications, incorrect installations, and conditions which may bypass or compromise the built-in safety features and controls.

2. This installation manual and Mini-Boiler products relate only to the addition of the Mini-Boiler to the hydronic system. The owner/ installer assumes all responsibility and/or liability associated with any needed installation of the gas/oil boiler, pump, plumbing, system design, hydronic systems or backup gas/oil boiler, etc. Any instructions or comments made within this manual (or factory phone assistance) relating to the gas/oil furnace are provided as comments of assistance and “helps” only.

CAUTION

Hazards or unsafe practices could result in property damage, product damage, severe personal injury and/or death.

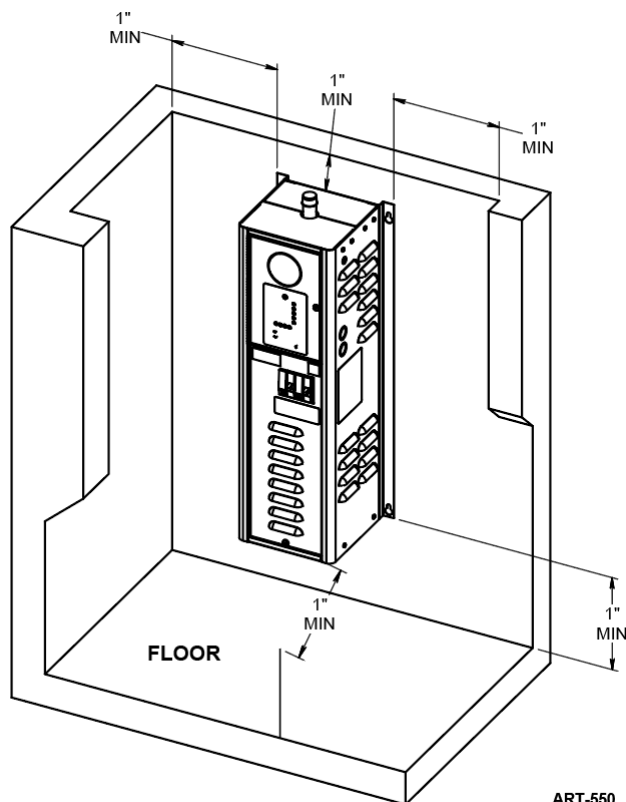
3. Remember, safety is the installer’s responsibility, and the installer must know this product well enough to instruct the end user on its safe use. Safety is a matter of common sense - - a matter of thinking before acting. Professional installers have training and experienced practices for handling electrical, sheet metal, and material handling processes.

ELECTRIC SUPPLY

Model	Volts	Phase	kW	Btu/h	Amps	CB	Element	
							STG 1	STG 2
EMB- R1-01-120-1	120	1-60 Hz	1.4	4,777	11.67	–	1	–
EMB- R1-03-120-1	120	1-60 Hz	3.0	10,236	25	–	1	–
EMB-R1-05-240-1	240/208	1-60 Hz	5.0/3.8	17,060/12,795	20.8/18.0	30A	1	–
EMB-R1-07-240-1	240/208	1-60 Hz	7.0/5.3	23,885/17,913	29.2/25.2	45A	1	(1)
EMB-R1-09-240-1	240/208	1-60 Hz	9.0/6.8	30,709/23,885	37.5/33.7	60A	1	(1)

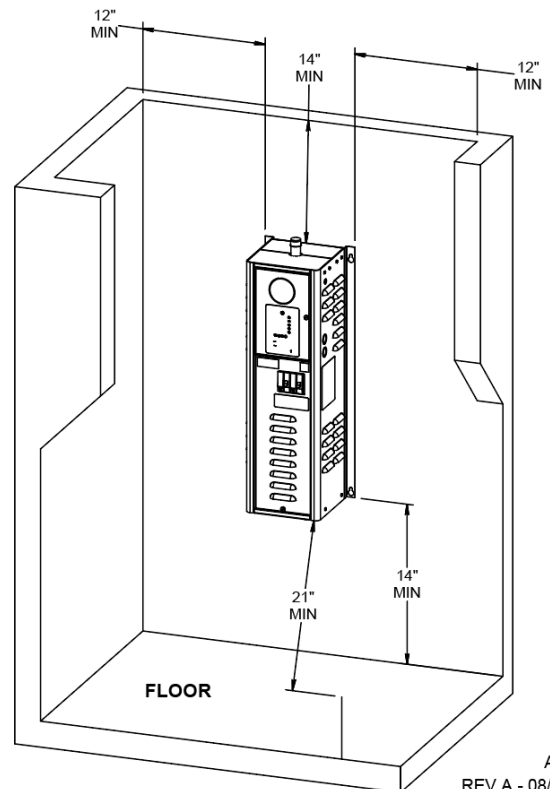
CLEARANCES

	MINIMUM CLEARANCE		SUGGESTED MINIMUM SERVICE CLEARANCE	
LEFT	1 INCH	26 MM	12 INCHES	305 MM
RIGHT	1 INCH	26 MM	12 INCHES	305 MM
BACK	0 INCHES	0 MM	0 INCHES	0 MM
FRONT	1 INCH	26 MM	21 INCHES	534 MM
TOP	1 INCH	26 MM	14 INCHES	356 MM
BOTTOM	1 INCH	26 MM	14 INCHES	356 MM
SURROUNDING AMBIENT TEMPERATURE MUST NOT EXCEED 90°F/32°C				



MINIMUM CLEARANCE

ART-550
REV A- 08/10/2022



SUGGESTED MINIMUM SERVICE CLEARANCE

ART-551
REV A - 08/10/2022

MECHANICAL INSTALLATION



CAUTION

Electro Industries requires the use of dielectric isolation between the boiler vessel supply and return piping when the boiler is plumbed using copper or any other dissimilar metal. Damage to the vessel caused by galvanic corrosion voids Electro Industries' warranty.

Reference drawing BX306

The plumbing components and piping layout shown on drawing BX306 has been very carefully picked and should be plumbed as shown. When following this diagram, the water fill procedure becomes very simple and almost guarantees the removal of all air or prevents air locking problems. Experienced hydronic heating installers may be able to eliminate components such as regulated fill valve, check valve, temperature gauge, etc., but the inclusion of these components guarantees installation and initial operating success.

The key mechanical components required include:

- **Boiler/Near Boiler Piping**– this model series is wall hung and the vessel must be vertical.
 - Near boiler piping is shown on drawing BX306.
 - For future servicing, the unit itself must be installed a minimum of 18” above the floor. The elements are screwed in from the bottom.
 - Allow adequate space for cover removal and maintenance.
- **Expansion Tank** – As a closed loop hydronic heating system, an expansion tank is required.
- **Temperature/Pressure Gauge** – For convenient monitoring a temperature and pressure gauge on the outlet (supply) is factory installed, facing the front of the boiler. For full observation of the system, installing one on the inlet (return) is desirable.
- **Pressure Safety Valve** - This is required at the hot outlet and is furnished as a **loose** component with the boiler unit itself. Failure to install the provided 30 PSI pressure relief valve as shown voids warranty and product listing. A pressure relief valve greater than 30PSI **CANNOT** be used with this boiler.

Add the necessary pipe extension from the relief valve to the floor to prevent water damage on this unit or surrounding area.

- **Gate Valve/Drain Valve** - These are for servicing and easy fill purposes.
- **Circulating Pump** - Depending upon system lift and system loop resistance (feet of head), the proper circulating pump is required to guarantee the minimum GPM flow as specified on the cover sheet.

Comment: Circulator pump should “pump away from” the expansion tank.

- **Air Vent Relief** – The boiler system air vent should be installed at the highest point of the boiler piping. For multi-level applications where the heat emitters are several feet above the boiler, additional air vents may be required at those upper levels to effectively remove all the air from the system.
- **Building Water Supply Connection** – Reference drawing BX306, note 4, some local building codes require sophisticated check valve or anti-syphon check valve when the hydronic heating system is permanently connected to the domestic water system. The intent of this connection is temporary and for fill purposes only. The installer has the responsibility of complying with local building codes.

ELECTRICAL HOOKUP

Reference drawing BH311

WARNING

DISCONNECT ALL ELECTRICAL POWER BEFORE ELECTRICALLY CONNECTING OR SERVICING THE UNIT. FAILURE TO DISCONNECT THE ELECTRICAL POWER BEFORE WORKING ON THIS PRODUCT CAN CREATE A HAZARD LEADING TO PERSONAL INJURY OR DEATH.

1. **Panel breaker sizes** – based upon the installed unit capacity, cover page shows model number/amps/kW, service from appropriate size panel breaker based on NEC code.
2. The larger EMB-R models include a factory provided circuit breaker. This **qualifies** for a local disconnect at the product or appliance.
3. **240/208-Volt Power Source** – route and install the proper current carrying conductors, suggested by local codes, from service panel fuse or circuit breaker. Nameplate shows current & KW rating. Use only copper wire within this unit enclosure or at the circuit breaker connection.

The source is either from the standard service panel or may be part of an off-peak separately metered panel/CT metered enclosure. Consult with local utility if questions on off-peak installations.

WARNING

USE ONLY COPPER WIRE FOR CONNECTION TO THE CIRCUIT BREAKER TERMINALS AND INSIDE THIS PRODUCT'S CABINET.

WARNING

TO AVOID THE RISK OF ELECTRIC SHOCK OR DEATH, WIRING TO THE UNIT MUST BE PROPERLY GROUNDED. FAILURE TO PROPERLY GROUND THE UNIT CAN RESULT IN A HAZARD LEADING TO PERSONAL INJURY OR DEATH.

NOTE: This model series is designed and equipped for 240-volt residential single phase. If this unit is used on 208-volt, energy capacity is reduced by approximately 25%. The installed transformer has a primary tap for 208-volt. Rewire internal transformer so the boiler is using this primary tap for 208-volt applications.

4. **Circulating Pump** – the orange pigtail wires, at the cube relay, represent a switch closure (see drawing BH311– 10-amp maximum) to operate the circulating pump motor. **Voltage for the pump must come from a separate 120V source.** Wiring entrance must be through the left knockout, do not combine with thermostat cable or other control wiring.
5. **Operating Thermostat** – this Mini-Boiler is designed to be used for one or multiple zone applications. For single thermostat or external zone operating relay use thermostat connection labeled Zone 1. Temperature set point for Zone 1 is adjusted by using the temp set point dial on the front control panel of the boiler. For multi zone applications simply, connect two independent thermostats or end switches to Zone1, or use a zone control panel. On the EMB-R1 series the thermostat connection labeled Zone 2 does not function. Do not connect to the Zone 2 terminal block.
6. Examples of thermostats that are compatible with this boiler include:
 - **Standard Mechanical** – connect to control board “R” and “W”. **IMPORTANT** – set thermostat internal heat anticipator to 0.2.
 - **Wi-Fi Thermostats** – most brands of Wi-Fi thermostats will work with the EMB-R Mini-Boiler. Wiring connections will typically be R-W-C.
 - **Slab Thermostat** – 3-wire connection required.
R to R, W to W, C to C, green to ground

- **Power robbing thermostats** – power robbing thermostats can be used with the EMB-R Mini-Boiler models depending on thermostat brand and power consumption.
7. **Load Management Interrupt Control (LMC)** – this Mini-Boiler product has been pre-wired and designed for a power company load management receiver connection. This should not be altered in any manner! If load management is not used, simply leave the terminal labeled “load man” jumped. When connecting to load management observe the following:
 - A. Remove jumper from load man terminal.
 - B. Insert two wires at load man and extend to the power company load control device.

As shipped, this unit is only equipped for off-peak = N.C. logic. If reversed logic is required, contact the factory for modification.

Optional 1– if the power company disconnects 240V for load control, please reference BH029 for special wiring requirements.
 8. **Zone Valve** – the installer may elect to totally wire in the zone valves where paralleling the end switches activate the control board R and W. The EMB-R Series has a 40VA, 24-volt transformer which is capable of driving 1 or 2 external zone valves depending on valve power requirements.
 9. **Inspection/final check** – Verify all electrical connections are tight (including factory connections), verify there is proper spacing between all power and electrical wire/terminals, and verify top high limit manual reset is “in”. During shipping freight vibration there are times when the boiler vessel top manual reset high limit is “popped out”.

WATER ADDITIVES

1. Water treatment is strongly suggested to prevent scale deposits, corrosion from acids, oxygen, and other harmful elements within the specific water supply. Unless the source water is unusually poor and/or rust elements, additives are not required for use, but strongly suggested. Failure to manage the proper water voids the element warranty.
2. Impurities within a closed loop hydronic boiler are considerably less damaging than the typical domestic water heater as new impurities are not introduced constantly. In a closed loop electric boiler, the initial filling of the water should be as pure as possible. As a closed system, this “pure water” becomes the operating mode.
3. If there is an auto fill connected from the domestic water source to the boiler system, it is recommended the water source as shown on drawing BX306 comes through the household water softener. If additives are required, use the recommendations and source from your local professional plumber specializing in hydronic heating systems.
 - It is the installer or user’s responsibility to verify water quality and maintain acceptable water quality throughout the life of this product. As a requirement the following water properties must be considered:
 - i. Hardness (ppm): 0-10
 - ii. pH: 7.5-10
 - iii. Iron Content (ppm): 0-20
 - iv. Oxygen Content (ppm): 0
 - v. Total Dissolved Solids: 0-3000

WARNING

FAILURE TO MAINTAIN THE PROPER WATER QUALITY INCREASES THE RISK OF PREMATURE ELEMENT FAILURE OR POOR ELEMENT PERFORMANCE AND WILL VOID THE ELEMENT WARRANTIES.

4. Up to a 50/50 propylene glycol mixture is acceptable for use in these boilers in cold weather applications.
5. For retrofit applications on older systems, a magnetic particle filter is highly recommend.

WATER FILL PROCEDURE

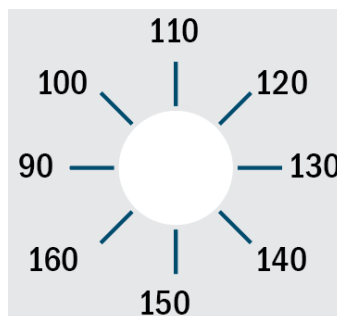
The following procedure only applies to the prepackaged plumbing kit and/or when the system is plumbed exactly as shown on drawing BX306.

1. Do not apply 240/208 volt power during water fill sequence.
2. Connect the temporary household water supply source (probably hose connection) to the "supply water connection" input.
NOTE: If supply water connection is permanent, some local building codes may require special anti-siphon check valve, PRZ check valve, or equivalent between the Mini-Boiler fill regulator and the domestic water source or the city water connection.
3. Connect a drain hose to lower hose bib, "drain valve".
4. **Open** "drain valve" and **close** "inlet gate valve" (between drain valve and boiler bottom inlet).
5. Verify "top gate valve" is **open**.
6. **Open** "water supply valve" and **open** household water supply source.
This may be at normal household pressure (40 to 60 PSI), the auto-fill valve regulator keeps the hydronic loop at its proper low pressure.
7. Allow system to circulate, discharging through drain valve, **for at least 10 minutes**.
8. Put your ear against the metal pipe and listen for air bubbles. If the water flow is consistent and quiet, the system is probably purged and water filled.
9. **Close** the "drain valve". **Open** the "inlet gate valve".
10. The cold system pressure at the gauge should be approximately 10 to 14 PSI.
11. **Close** "water supply valve" and disconnect water supply.
12. Optional – The circulating pump can be energized during this fill operation by having the 240/208-volt power main source breaker off and simply jumpering the 2 screw terminals for the pump wire connection.

WATER TEMPERATURE CONTROL

Determine the design or anticipated outlet temperature. If this is a radiant floor system this typically could be as low as 90°. If it is staple-up or water coil, satisfactory operation may be at 140° to 160°. If this is baseboard or radiators, start with 170° and during very cold weather this may need to be 180°.

The front temperature set point is selected by a small screwdriver dial switch. See next section for higher temperature settings.



Adding a jumper on the header marked “HI TEMP” on the control board automatically shifts each temperature setpoint up 20°F as follows:

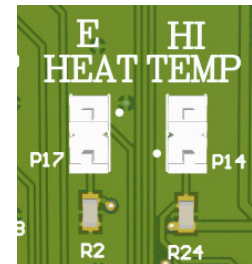
90°F → 110°F	130°F → 150°F
100°F → 120°F	140°F → 160°F
110°F → 130°F	150°F → 170°F
120°F → 140°F	160°F → 180°F

Note: Basic 24V power must be present for this control board function to work.

Outdoor Sensor/Outdoor reset – an outdoor sensor is not included with the EMB-R1 series boilers. If you want to add an outdoor sensor, order P/N 6206KIT. This control can detect whether or not an outdoor sensor is connected.

WARMFLO HI TEMPERATURE MODE & EMERGENCY HEAT

For testing purposes only, adding a jumper on the header marked “Test Only” on the control board automatically sets the temperature setpoint to maximum 180°F. See image to the right. Note: You must have a thermostat Zone Call when using the “Test Only” jumper to keep the system circulator pump running. While in test mode, the “Electric Mode” led will continuously flash.



⚠ CAUTION

FAILURE TO REMOVE THE “TEST ONLY” HEAT JUMPER AFTER TESTING WILL CAUSE THE BOILER TO OVERHEAT AND TRIP THE MANUAL HIGH LIMITS.

Flow Switch Statement

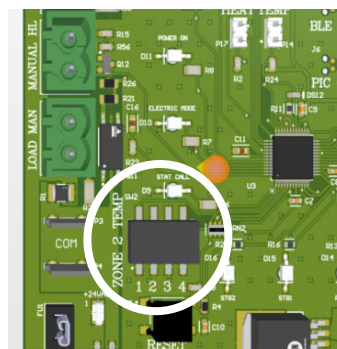
A flow switch is **not** included with the boiler. However, one can be added to the LMC circuit. Simply place the field provided flow switch in series with this circuit.

⚠ CAUTION

ELECTROCUTION IS A RISK INSIDE THE ENCLOSURE OF THE BOILER. ALWAYS TURN POWER OFF TO THE BOILER PRIOR TO MODIFYING ANY TEST JUMPERS OR DIP SWITCHES LOCATED INSIDE THE BOILER. HAZARDS OR UNSAFE PRACTICES COULD RESULT IN PROPERTY DAMAGE, PRODUCT DAMAGE, SEVERE PERSONAL INJURY AND/OR DEATH.

ZONE 2 TEMP DIP SWITCHES

On this EMB-R1 series, the Zone 2 is disabled and the temperature dip switches are not used. However, switch number 4 **must** be in the “off” position. If you find switch 4 in the “on” position, power down the boiler, turn the switch off and restart the boiler. Prolonged operation with the switch in the on position will result in premature failure of the element relays.



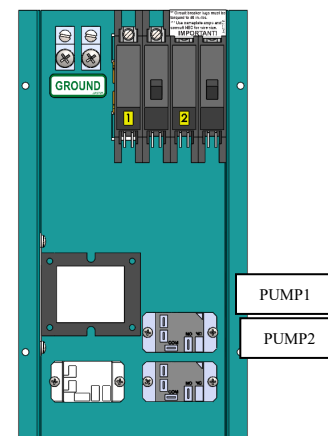
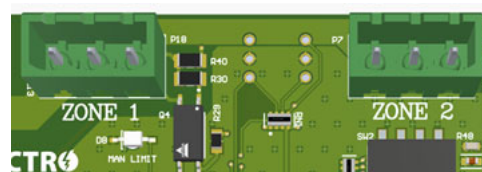
OPERATIONAL TIPS

- Indicator lights – there are eight indicator lights on the front cover. Figure 1 under Aquastat Operation is a reproduction of the front decal giving definition and information for using these indicator lights. Note: There is also a microprocessor status light inside on the control board that will flash green; this light is simply to indicate the processor is working and is not used for diagnostics.

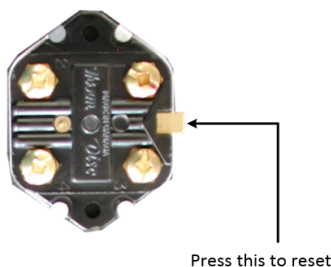
- Boiler Power** – for the R1 series this led indicates the following:
 - Solid green – sensors okay
 - Flashing red – faulty supply sensor
 - Flashing blue – faulty outdoor sensor
- The operating thermostat heat call can be verified by the red LED marked **Thermostat Call** located on front cover. With a thermostat call you will also see PUMP 1 ON, green, which indicates pump for Zone 1 is active.
- STAGE 1-2 ON, green, indicates when boiler stages are active.

POWER LED STATUS	SYSTEM STATUS	REMARKS
 SOLID GREEN	NORMAL STATUS	ALL TEMP SENSORS OPERATING PROPERLY
 FLASHING BLUE	FAULTY SENSOR	FAULTY OUTDOOR SENSOR, OUTDOOR RESET DISABLED
 FLASHING RED	FAULTY SENSOR	FAULTY SUPPLY SENSOR, MODULATION LIMITED
VOYANT D'ALIMENTATION ÉTAT	SYSTÈME ÉTAT	NOTES
 VERT UNI	NORMAL STATUS	TOUS LES CAPTEURS DE TEMPÉRATURE FONCTIONNENT CORRECTEMENT
 CLIGNOTANT BLEU	DÉFECTUEUX CAPTEUR	DÉFECTUEUX CAPTEUR EXTERIEUR, REINITIALISATION EXTERIEURE DÉSACTIVÉE
 CLIGNOTANT ROUGE	DÉFECTUEUX CAPTEUR	CAPTEUR D'ALIMENTATION DÉFECTUEUX, MODULATION LIMITÉE

- Electric Mode** yellow LED is on indicates normal boiler operation when the boiler is being load controlled. This LED will turn off and the boiler will not heat. If a gas boiler is connected to the two brown wires during load control, when the electric mode LED is off, all heat calls will be transferred to the gas boiler.
- The **205°F Manual Reset Limit** red LED is on when the vessel top manual hi-limit switch has opened due to high temperature. The boiler will not operate until this limit is reset,
- The **190°F Auto Reset Limit** red LED is on when the vessel top auto hi-limit switch has opened due to high temperature. This limit will reset when the water temperature reaches approximately 160 degrees.
- The pump relay is activated with a thermostat call. On the EMB-R1 series there is one pump relay, and it is only activated with a zone 1 thermostat call. The zone 2 thermostat input is not used on this model. The pump will not go active if there is a thermostat call on zone 2.
- At outlet temperatures of approximately 160° F, the maximum operating system pressure should be approximately 18 PSI (124 kPa). If the PSI (or kPa) increases from cold water to operating hot water is more than approximately 3 to 4 PSI increase (20.6 to 27.5 kPa), the expansion tank is too small, or there is air in the system.
- At the top of the vessel is a manual reset, 205° F, primary manual hi-limit. This is behind the upper control board cover, at the top of the vessel. In the middle of the manual reset wires there is a tab between the wire terminals. This is the reset button. With power off and the device cooled, press the tab in to reset. *Seek professional maintenance before restarting boiler.



205°F Manual Reset



WARNING – HIGH VOLTAGE

MUST SHUT OFF HIGH VOLTAGE BEFORE ATTEMPTING TO RESET.

WARNING

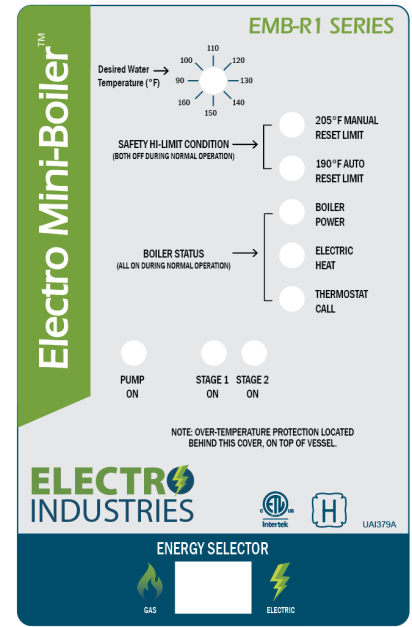
PROFESSIONAL MAINTENANCE IS REQUIRED WHEN THE MANUAL RESET TRIPS. THE SYSTEM IS LIKELY TO TRIP AGAIN IF THE UNDERLYING ISSUE IS NOT FIXED.

- Check for water leaks and repair as required.
- If flow seems to be a concern, determine both inlet and outlet water temperature and apply GPM (L/min) formula detailed in previous section “Information/Water Flow Calculations”.

TROUBLESHOOTING HELPS

Front Cover LED Indications

- The two red LEDs labeled “MANUAL RESET LIMIT” and “AUTO RESET LIMIT” are an indication of whether the manual or auto temperature limits have opened.
- The LED labeled “BOILER POWER” has three functions:
 - Solid green – boiler power on, temperature sensors operating properly
 - Flashing Blue – faulty outdoor sensor
 - Flashing Red – faulty supply sensor
- The yellow LED labeled “ELECTRIC MODE” is a function of the “Load Man” jumper status:
 - Electric Mode On – electric elements can function as normal
 - Electric Mode Off – load man circuit is open or energy selector is switched to gas, electric elements will not heat
 - Electric Mode Flashing – “Test Only” jumper is activated
- The red LED labeled “THERMOSTAT CALL” is an indication of a thermostat call.
 - Thermostat Call On – boiler is receiving a thermostat signal
 - Thermostat Call Off – boiler is not receiving a thermostat signal
- The two red LEDs labeled “STG1” and “STG2” are an indication of whether elements of the boiler are on/off.
- The green LED labeled “PUMP ON” is an indication of whether the zone pump one relay is on or off.



Sequence EMB-R1-*-1

- At thermostat call, pump turns on.
- Elements remain off for 30 seconds.
- In this series, if the supply sensor is detecting supply water temperature below the setpoint, the elements turn on.
- As the outlet temperature approaches the set point, the control algorithm automatically stages the elements to match the BTU load and maintain set point temperature output.
- Above the set point elements 1 and 2 staging is reduced according to the control algorithm.
- The staging of the elements continues to adjust to optimize element usage based on realized heating demand.

Mechanical auto hi-limit, top vessel surface mount, automatic reset – this opens at $190 \pm 5^\circ\text{F}$ at which point the elements are held off. This can be monitored by the “Auto Reset” front indicator light. As the water cools to approximately 160°F it should self-reset and again activate the elements.

Mechanical manual hi-limit, top vessel surface mount, manually reset – surfaced mounted to the top of the vessel, opens at 205°F . This opens all 120V/240V element power thus opening all power conductors to the elements. The observed action is realized through the “Manual Reset” front indicator light. Note: the boiler will not operate until the unit cools down and this limit is manually reset.

In the middle of the manual reset wires there is a tab between the wire terminals. This is the reset button. With power off and the device cooled, press the tab in to reset.

Potential causes of 205° manual high limit reset:

- Not enough water in the system
- Little or no system pressure
- Circulator pump is not actively moving water through the boiler
- Element relay stuck “closed” allowing element to heat with no pump running
 - Verify 0 volts across element terminals with no heat call active. If 240VAC is present on the element with no active heat call, element relay is likely stuck closed and should be replaced

Note: In typical abnormal operation the auto hi-limit will always trip prior to the manual limit. In general if the system is properly setup, the manual limit should never trip.

Faulty Temperature Sensor – if the main control board detects a faulty temp sensor the boiler power LED will flash the following codes:

- Solid Green – Sensors Okay
- Flashing Red – Faulty Supply Sensor
- Flashing Blue – Faulty Outdoor Sensor

The sensors used are 10K thermistor type. If the control indicates a failed sensor or if you want to check the accuracy of the sensors, disconnect the sensor from the control board and use an ohm meter to verify approximate resistance, See Table 2.

Table 2

°C	°F	kΩ	°C	°F	kΩ	°C	°F	kΩ	°C	°F	kΩ	°C	°F	kΩ	°C	°F	kΩ
-23	-9.4	127.07	14	57.2	16.61	51	123.8	3.45	-4	24.8	41.68	33	91.4	7.07	70	158	1.76
-22	-7.6	119.32	15	59	15.83	52	125.6	3.32	-3	26.6	39.47	34	93.2	6.78	71	159.8	1.7
-21	-5.8	112.11	16	60.8	15.1	53	127.4	3.2	-2	28.4	37.4	35	95	6.5	72	161.6	1.64
-20	-4	105.38	17	62.6	14.4	54	129.2	3.09	-1	30.2	35.45	36	96.8	6.24	73	163.4	1.59
-19	-2.2	99.1	18	64.4	13.75	55	131	2.97	0	32	33.62	37	98.6	5.98	74	165.2	1.54
-18	-0.4	93.25	19	66.2	13.12	56	132.8	2.87	1	33.8	31.89	38	100.4	5.74	75	167	1.49
-17	1.4	87.78	20	68	12.53	57	134.6	2.76	2	35.6	30.26	39	102.2	5.52	76	168.8	1.44
-16	3.2	82.67	21	69.8	11.97	58	136.4	2.67	3	37.4	28.73	40	104	5.3	77	170.6	1.39
-15	5	77.89	22	71.6	11.44	59	138.2	2.57	4	39.2	27.28	41	105.8	5.09	78	172.4	1.35
-14	6.8	73.43	23	73.4	10.93	60	140	2.48	5	41	25.92	42	107.6	4.89	79	174.2	1.31
-13	8.6	69.25	24	75.2	10.45	61	141.8	2.39	6	42.8	24.63	43	109.4	4.7	80	176	1.27
-12	10.4	65.34	25	77	10	62	143.6	2.31	7	44.6	23.42	44	111.2	4.52	81	177.8	1.23
-11	12.2	61.67	26	78.8	9.56	63	145.4	2.23	8	46.4	22.27	45	113	4.34	82	179.6	1.19
-10	14	58.24	27	80.6	9.15	64	147.2	2.16	9	48.2	21.19	46	114.8	4.18	83	181.4	1.15
-9	15.8	55.02	28	82.4	8.76	65	149	2.08	10	50	20.17	47	116.6	4.02	84	183.2	1.12
-8	17.6	52.01	29	84.2	8.39	66	150.8	2.01	11	51.8	19.2	48	118.4	3.87	85	185	1.08
-7	19.4	49.17	30	86	8.03	67	152.6	1.94	12	53.6	18.29	49	120.2	3.72	86	186.8	1.05
-6	21.2	46.52	31	87.8	7.7	68	154.4	1.88	13	55.4	17.43	50	122	3.58	87	188.6	1.02
-5	23	44.02	32	89.6	7.37	69	156.2	1.82									

Boiler Element Testing

CAUTION

THE WIRES AND SCREWS OF THE ELEMENTS HAVE 240/208-VOLT POTENTIAL AND CAN BE DANGEROUS. USE EXTREME CAUTION WHEN CHECKING VOLTAGE OR RESISTANCE AT THE ELEMENTS.

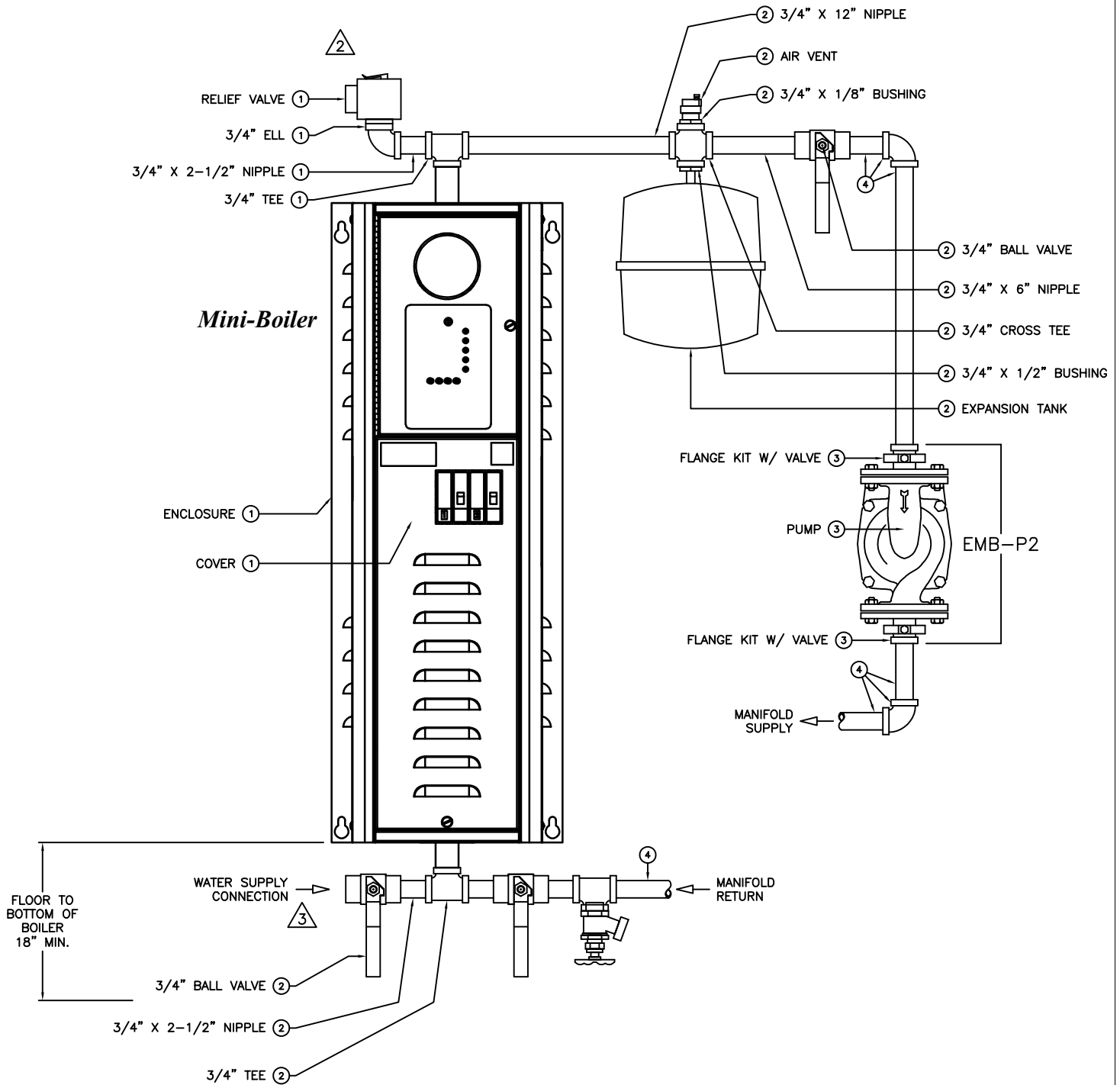
Element resistance test – to access the elements, shut off the 240V power, remove the lower front cover and the boiler bottom panel. Disconnect one wire from each element. Using an ohm meter, measure resistance across the two element screws (not to ground). Resistance value will be between 6 and 13ohms depending on the watt size of the element you are testing. An element that reads O.L is bad. If the element reads normal ohms, reconnect the wires.

You can also test for voltage and amperage at the elements to verify correct operation. While the covers remain off, restore power to the boiler and initiate a heat call so that the indicator LEDs show all elements on. With your voltmeter, very carefully check for 240V across the two screws of each element (not ground). If there is 240V at the element and it has normal resistance the element is good. You can also use a clamp on amp meter to confirm amperage off one wire to each element. Normal reading will be 18-38amps depending on the watt rating of the element. If you do not read 240V across the element, but do find 120V to ground on each element screw further investigation of the control circuitry is required.

AVAILABLE, ELECTRO INDUSTRIES, INSTALL PARTS OR KITS

5456A	GAUGE PRES/TEMP 75 PSI/320DG F .25"
EMBR5625	REPLACEMENT CONTROL BOARD
5402KIT	THERMISTOR, SUPPLY TEMP
5128C	RELAY, 24VDC, 40A
5541	TRANSFORMER, 24V/40VA
6206KIT	OUTDOOR SENSOR 25FT, OPTIONAL (NOT INCLUDED WITH THIS MODEL SERIES)

"BASIC" MECHANICAL PIPING DIAGRAM



LEGEND

- ① COMPONENTS INCLUDED WITH EMB-R*-*-1 and EMB-M*-*-1
- ② COMPONENTS INCLUDED WITH EMB-BK KIT
- ③ COMPONENTS INCLUDED WITH EMB-P2 (PUMP) KIT
- ④ COMPONENTS NOT INCLUDED, SHOWN FOR REFERENCE ONLY

NOTES:

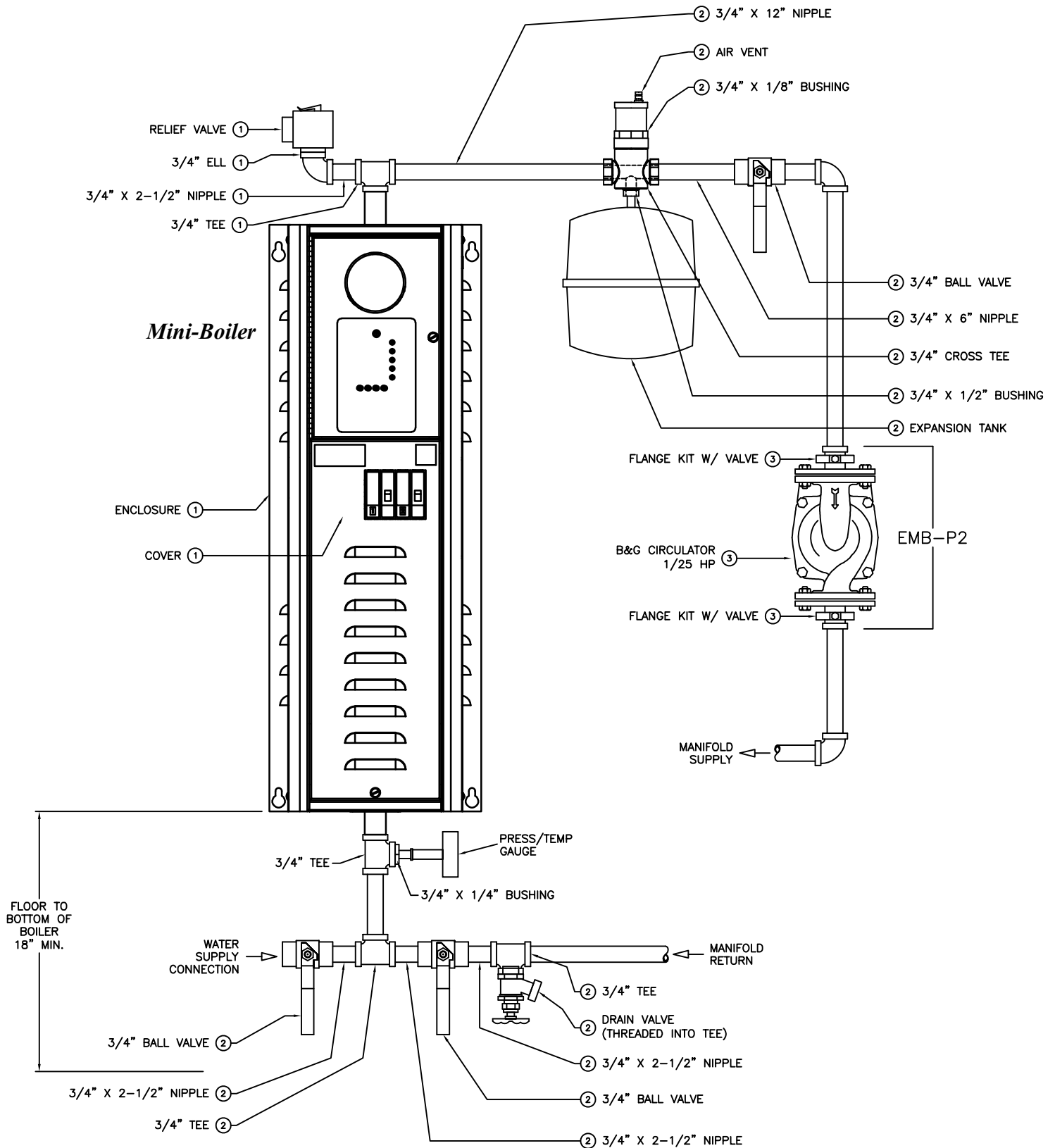
1. INSTALLATION KIT (PART NUMBER EMB-BK) INCLUDES ALL PIPING PARTS (LESS PUMP & FLANGES) EXTERNAL TO THE 9.5" x 30" x 7" ENCLOSURE.
2. ADD NECESSARY DRAIN PIPE.
3. SEE INSTRUCTION MANUAL FOR PRESSURE CONCERNS AND MAY NEED BACKFLOW PREVENTER.



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BX306 P.1
REV A 07/20/22

"PREFERRED" MECHANICAL PIPING DIAGRAM



LEGEND

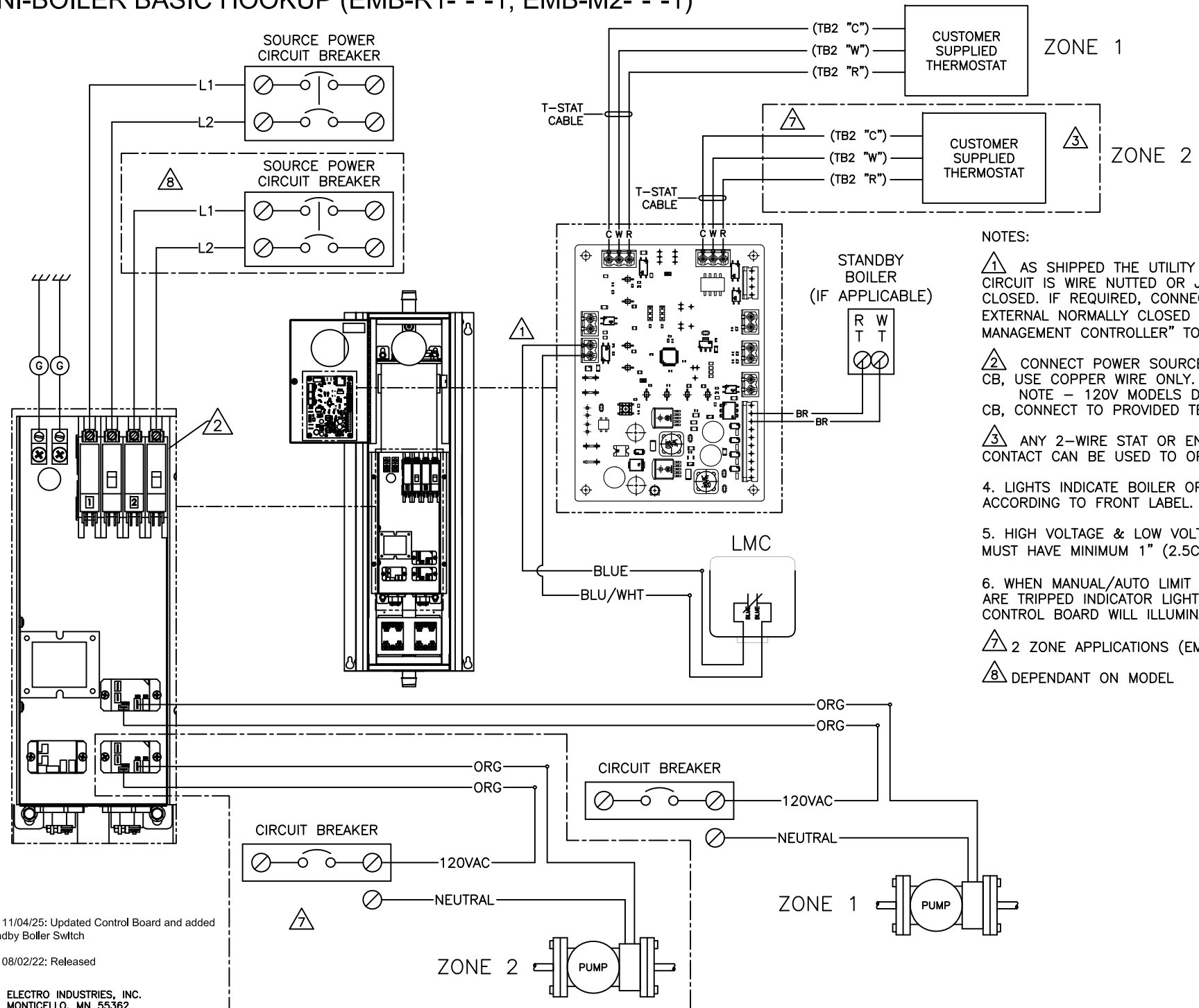
- ① COMPONENTS INCLUDED WITH EMB-R*-*-1 and EMB-M*-*-1
- ② COMPONENTS INCLUDED WITH EMB-PK KIT
- ③ COMPONENTS INCLUDED WITH EMB-P2 (PUMP) KIT
- ④ COMPONENTS NOT INCLUDED, SHOWN FOR REFERENCE ONLY



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BX306 P.2
REV A 07/20/22

MINI-BOILER BASIC HOOKUP (EMB-R1-*-1, EMB-M2-*-1)



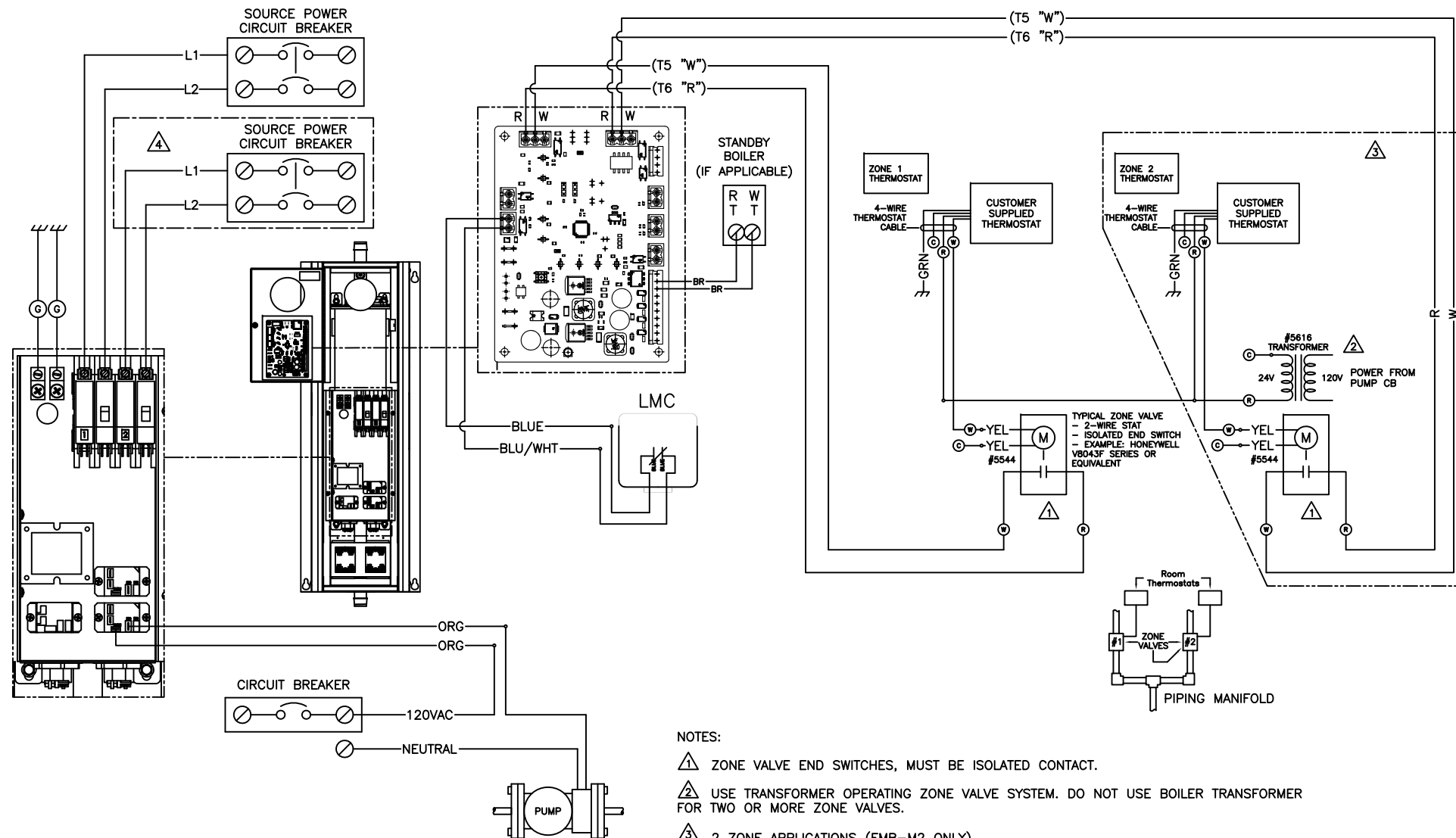
Rev B 11/04/25: Updated Control Board and added Standby Boiler Switch

Rev A 08/02/22: Released



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MINI-BOILER HOOKUP (EMB-R1-*-1, EMB-M2-*-1)



NOTES:

- ⚠ ZONE VALVE END SWITCHES, MUST BE ISOLATED CONTACT.
- ⚠ USE TRANSFORMER OPERATING ZONE VALVE SYSTEM. DO NOT USE BOILER TRANSFORMER FOR TWO OR MORE ZONE VALVES.
- ⚠ 2 ZONE APPLICATIONS (EMB-M2 ONLY)
- ⚠ DEPENDENT ON MODEL



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5.00

EMB-M(ZONE)-KW-VOLT-PHASE

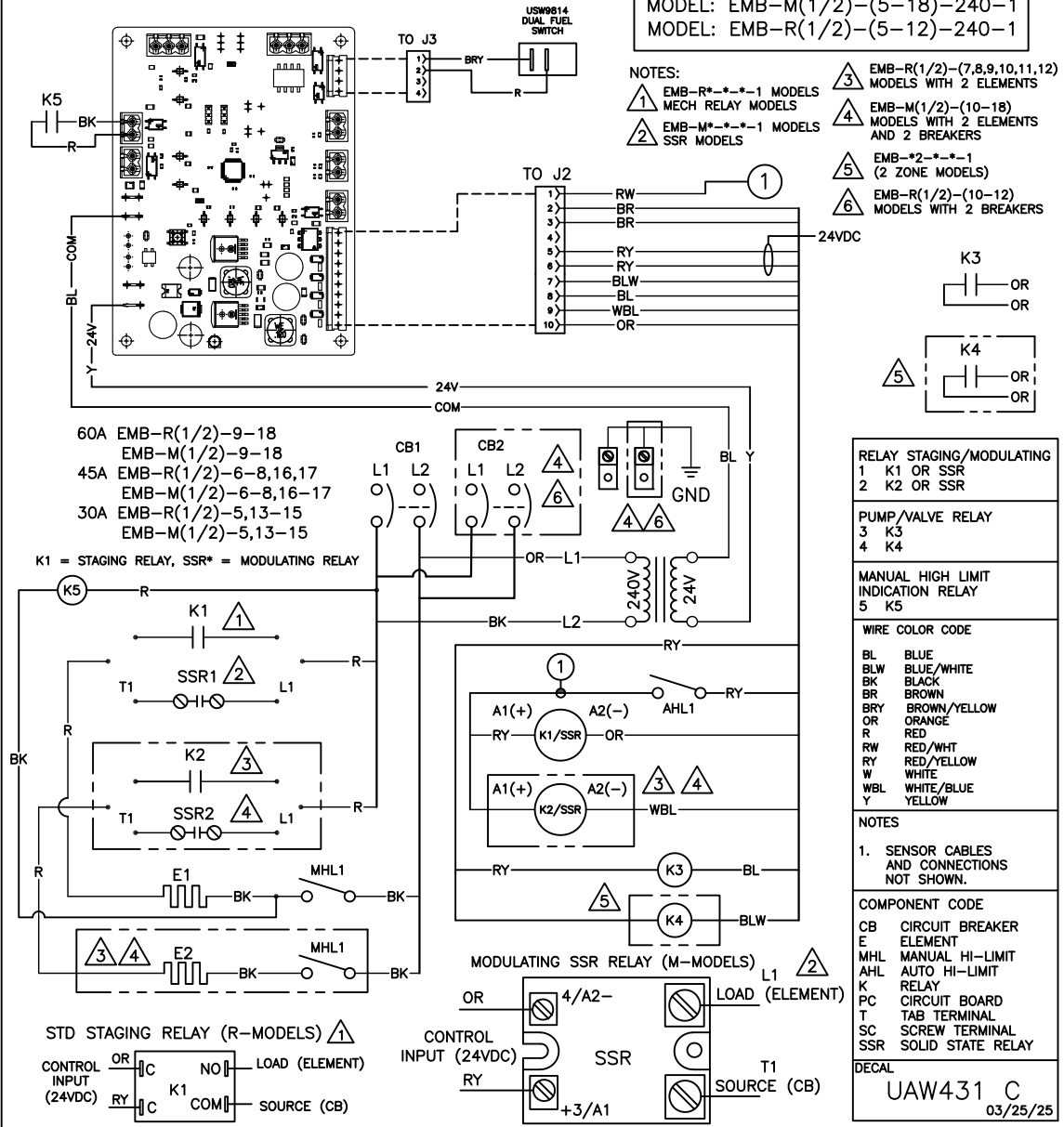
ELECTRO-MINI-BOILER

MODEL: EMB-M(1/2)-(5-18)-240-1
 MODEL: EMB-R(1/2)-(5-12)-240-1

NOTES:

- 1 EMB-R*-*-1 MODELS
MECH RELAY MODELS
2 EMB-M*-*-1 MODELS
SSR MODELS

- 3 EMB-R(1/2)-(7,8,9,10,11,12)
MODELS WITH 2 ELEMENTS
4 EMB-M(1/2)-(10-18)
MODELS WITH 2 ELEMENTS
AND 2 BREAKERS
5 EMB-M(1/2)-(10-18)
MODELS WITH 2 ELEMENTS
AND 2 BREAKERS
6 EMB-R(1/2)-(10-12)
MODELS WITH 2 BREAKERS



NOTES:

1. SIZE = 5.5" X 5"
 2. COLOR = BLACK ON WHITE
 3. MATERIAL = POLY WITH ADHESIVE AND LAMINATE.

Rev. A 07/22/22: Released For Production.
 Rev. B 03/21/23: Removed all 120V info.
 Rev. C 03/25/25: Updated CB and Added Dual Fuel Switch

PROPRIETARY AND CONFIDENTIAL NOTE: THE INFORMATION CONTAINED IN THIS DRAWING IS THE SOLE PROPERTY OF ELECTRO INDUSTRIES INC. ANY REPRODUCTION IN PART OR AS A WHOLE WITHOUT THE WRITTEN PERMISSION OF ELECTRO INDUSTRIES INC. IS PROHIBITED.	DESCRIPTION	EA ELECTRO INDUSTRIES, INC. MONTICELLO, MN 55362			SHEET	SCALE	PART/MODEL NUMBER
	EMB-M(1/2)-(5-18)-240-1				1/1	NTS	EMB-(M,R)
	EMB-R(1/2)-(5-12)-240-1						
	WIRING DECAL						
	DRAWN	CHECKED	APPROVED	DATE	REV/STATUS	DOCUMENT NUMBER	
	NP			07/22/22	C	UAW431	

Electro Industries, Inc. Residential Limited Product Warranty

Effective November 1, 2009

Electro Industries, Inc. warrants to the original owner, at the original installation site, for a period of two (2) years from date of original purchase, that the product and product parts manufactured by Electro Industries, Inc. are free from manufacturing defects in materials and workmanship, when used under normal conditions and when such product has not been modified or changed in any manner after leaving the plant of Electro Industries, Inc. If any product or product parts manufactured by Electro Industries, Inc. are found to have manufacturing defects in materials or workmanship, such will be repaired or replaced by Electro Industries, Inc. Electro Industries, Inc., shall have the opportunity to directly, or through its authorized representative, examine and inspect the alleged defective product or product parts. Electro Industries, Inc. may request that the materials be returned to Electro Industries, Inc. at owner's expense for factory inspection. The determination as to whether product or product parts shall be repaired, or in the alternative, replaced, shall be made by Electro Industries, Inc. or its authorized representative.

Electro Industries, Inc. will cover labor costs according to the Repair / Replacement Labor Allowance Schedule for a period of ninety (90) days from the date of original purchase, to the original owner, at the original installation site. The Repair / Replacement Labor Allowance is designed to reduce the cost of repairs. This Repair / Replacement Labor Allowance may not cover the entire labor fee charged by your dealer / contractor.

TWENTY YEAR (20) LIMITED WARRANTY ON BOILER ELEMENTS AND VESSELS

Electro Industries, Inc. warrants that the boiler elements and vessels of its products are free from defects in materials and workmanship through the twentieth year following date of original purchase. If any boiler elements or vessels are found to have a manufacturing defect in materials or workmanship, Electro Industries, Inc. will replace them.

TWENTY YEAR (20) LIMITED WARRANTY ON SPIN FIN ELEMENTS

Electro Industries, Inc. warrants that the spin fin elements of its products are free from defects in materials and workmanship through the twentieth year following date of original purchase. If any spin fin elements are found to have a manufacturing defect in materials or workmanship, Electro Industries, Inc. will replace them.

FIVE YEAR (5) LIMITED WARRANTY ON OPEN WIRE ELEMENTS

Electro Industries, Inc. warrants that the open wire elements of its products are free from defects in materials and workmanship through the fifth year following date of original purchase. If any open wire elements are found to have a manufacturing defect in materials or workmanship, Electro Industries, Inc. will replace them.



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CONDITIONS AND LIMITATIONS:

1. This warranty is limited to residential, single family dwelling installations only. Any commercial or multi-unit dwelling installations fall under the Electro Industries Commercial Limited Product Warranty.
2. Electro Industries, Inc. shall not be liable for performance related issues resulting from improper installation, improper sizing, improper duct or distribution system, or any other installation deficiencies.
3. If at the time of a request for service the original owner cannot provide an original sales receipt or a warranty card registration then the warranty period for the product will have deemed to begin the date the product is shipped from the factory and **NOT** the date of original purchase.
4. The product must have been sold and installed by a licensed electrician, plumbing, or heating contractor.
5. The application and installation of the product must be in compliance with Electro Industries, Inc. specifications, as stated in the installation and instruction manual, and all state, provincial and federal codes and statutes. If not, the warranty will be null and void.
6. The purchaser shall have maintained the product in accordance with the manual that accompanies the unit. Annually, a qualified and licensed contractor must inspect the product to assure it is in proper working condition.
7. All related heating components must be maintained in good operating condition.
8. All lines must be checked to confirm that all condensation drains properly from the unit.
9. Replacement of a product or product part under this limited warranty does not extend the warranty term or period.
10. Replacement product parts are warranted to be free from defects in material and workmanship for ninety (90) days from the date of installation. All exclusions, conditions, and limitations expressed in this warranty apply.
11. Before warranty claims will be honored, Electro Industries, Inc. shall have the opportunity to directly, or through its authorized representative, examine and inspect the alleged defective product or product parts. Remedies under this warranty are limited to repairing or replacing alleged defective product or product parts. The decision whether to repair or, in the alternative, replace products or product parts shall be made by Electro Industries, Inc. or its authorized representative.

THIS WARRANTY DOES NOT COVER:

1. Costs for labor for diagnosis, removal or reinstallation of an alleged defective product or product part, transportation to Electro Industries, Inc., and any other materials necessary to perform the exchange, except as stated in this warranty. Replacement material will be invoiced to the distributor in the usual manner and will be subject to adjustment upon verification of defect.
2. Any product or product part that has been damaged as a result of being improperly serviced or operated, including, but not limited to, the following: operated during construction phase, with insufficient water or air flow; allowed to freeze; subjected to flood conditions; subjected to improper voltages or power supplies; operated with air flow or water conditions and/or fuels or additives which cause unusual deposits or corrosion in or on the product; chemical or galvanic erosion; improper maintenance or subject to any other abuse or negligence.
3. Any product or product part that has been damaged as a result of natural disasters, including, but not limited to, lightning, fire, earthquake, hurricanes, tornadoes or floods.
4. Any product or product part that has been damaged as a result of shipment or handling by the freight carrier. It is the receiver's responsibility to claim and process freight damage with the carrier.
5. Any product or product part that has been defaced, abused or suffered unusual wear and tear as determined by Electro Industries, Inc. or its authorized representative.
6. Workmanship of any installer of the product or product part. This warranty does not assume any liability of any nature for unsatisfactory performance caused by improper installation.
7. Transportation charges for any replacement product, product part or component, service calls, normal maintenance; replacement of fuses, filters, refrigerant, etc.

THESE WARRANTIES DO NOT EXTEND TO ANYONE EXCEPT THE ORIGINAL PURCHASER AT RETAIL AND ONLY WHEN THE PRODUCT IS IN THE ORIGINAL INSTALLATION SITE. THE REMEDIES SET FORTH HEREIN ARE EXCLUSIVE.

ALL IMPLIED WARRANTIES, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE HEREBY DISCLAIMED WITH RESPECT TO ALL PURCHASERS OR OWNERS. ELECTRO INDUSTRIES, INC. IS NOT BOUND BY PROMISES MADE BY OTHERS BEYOND THE TERMS OF THESE WARRANTIES. FAILURE TO RETURN THE WARRANTY CARD SHALL HAVE NO EFFECT ON THE DISCLAIMER OF THESE IMPLIED WARRANTIES.

ALL EXPRESS WARRANTIES SHALL BE LIMITED TO THE DURATION OF THIS EXPRESS LIMITED WARRANTIES SET FORTH HEREIN AND EXCLUDE ANY LIABILITY FOR CONSEQUENTIAL OR INCIDENTAL DAMAGES RESULTING FROM THE BREACH THEREOF. SOME STATES OR PROVINCES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY. PRODUCTS OR PARTS OF OTHER MANUFACTURERS ATTACHED ARE SPECIFICALLY EXCLUDED FROM THE WARRANTY.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY HAVE OTHER RIGHTS WHICH VARY UNDER THE LAWS OF EACH STATE. IF ANY PROVISION OF THIS WARRANTY IS PROHIBITED OR INVALID UNDER APPLICABLE STATE OR PROVINCIAL LAW, THAT PROVISION SHALL BE INEFFECTIVE TO THE EXTENT OF THE PROHIBITION OR INVALIDITY WITHOUT INVALIDATING THE REMAINDER OF THE AFFECTED PROVISION OR THE OTHER PROVISIONS OF THIS WARRANTY.