



Installation and
Operation
Instructions for

Brute[®] Commercial Electric Boiler

30 kW - 300kW



NOTE: Retain this manual for future reference.

FOR YOUR SAFETY: This product must be installed and serviced by a professional service technician, qualified in hot water boiler and heater installation and maintenance. Improper installation and/or operation could cause serious injury, property damage, or death. Improper installation and/or operation will void the warranty.

⚠ WARNING

Installer must comply with startup and installation instructions to avoid a dangerous situation.

⚠ AVERTISSEMENT

D'installation doit se conformer aux instructions d'installation et de démarrage pour éviter une situation dangereuse.

Electric Hot Water Boiler

BEB Series

Installation & Operating Manual

The BEB Series electric boiler has been specifically designed for closed loop hot water applications with an output temperature range of 40° F to 195° F, including radiant floor heat, water coil, and geothermal back up, commercial process or indirect potable hot water. This electric boiler has options for fixed set point outlet temperature, outdoor reset and 0-10VDC.

This manual contains important installation and safety information for the installer and end user. It should be read carefully before installation begins.

Safety grounding – a single point grounding electrode system must be established for the facility for either the Y or Delta feeds. All points including utility transformer, service entrance, boiler utility transformer, building service entrance ground lug, etc. must be **bonded** to the same facility grounding electrode system.

Vessel – designed and fabricated to comply with ASME Section IV, with “H” Stamp and National Board of Boiler and Pressure Vessel Registration, with a maximum working pressure of either 30 psi or 125 psi (design pressure specified when placing order).

Heating elements – removable, low-watt density, Incoloy sheathed, top vessel plate screw-in element. Access is made easy via top split enclosure top cover.

Piping – 3” NPT top supply, 3” NPT left side return, 3” left side inspection plug, 1” left side bottom drain, 1” top vessel location for pressure relief and/or air relief. All system piping and pumps must be large enough to meet the required GPM flow shown on the Specification Table for the vessel size.



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| Drawings | BH801 BH802 UAW452 |

Specification Table

Design Specifications

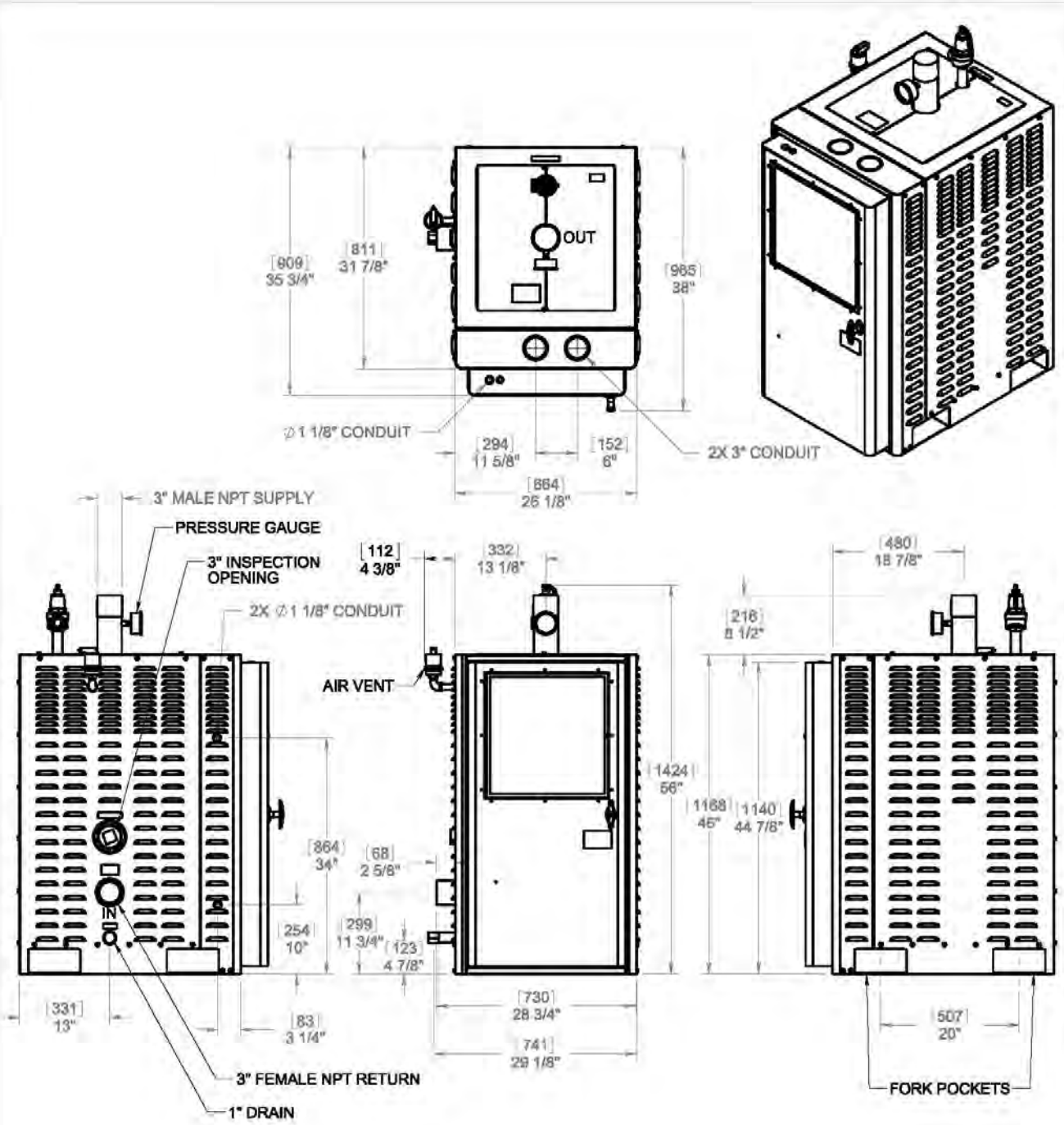
| Model | Volts | kW | Total Amps | Btu/h Output | Amps 3-Phase | | Element Quantity | Steps | Flow Rate @20° ΔT Required GPM | Head Loss | | Boiler Weight |
|--------------|-------|-----|------------|--------------|--------------|----------|------------------|-----------------|--------------------------------|-----------|------|---------------|
| | | | | | Feed #1† | Feed #2† | | | | FT | M | |
| BEB-060-600X | 600 | 60 | 58 | 204,729 | 58 | - | 5 | 5 @ 12 | 21 | 0.1 | 0.03 | 685 |
| BEB-072-600X | 600 | 72 | 70 | 245,675 | 70 | - | 6 | 6 @ 12 | 25 | 0.1 | 0.03 | 690 |
| BEB-084-600X | 600 | 84 | 81 | 286,620 | 81 | - | 7 | 7 @ 12 | 29 | 0.1 | 0.03 | 695 |
| BEB-096-600X | 600 | 96 | 93 | 327,566 | 93 | - | 8 | 8 @ 12 | 33 | 0.1 | 0.03 | 698 |
| BEB-108-600X | 600 | 108 | 104 | 368,512 | 58 | 47 | 9 | 9 @ 12 | 37 | 0.1 | 0.03 | 700 |
| BEB-120-600X | 600 | 120 | 116 | 409,458 | 58 | 58 | 10 | 10 @ 12 | 41 | 0.1 | 0.03 | 705 |
| BEB-132-600X | 600 | 132 | 128 | 450,403 | 70 | 58 | 11 | 11 @ 12 | 46 | 0.1 | 0.03 | 708 |
| BEB-144-600X | 600 | 144 | 139 | 491,349 | 70 | 70 | 12 | 12 @ 12 | 50 | 0.1 | 0.03 | 710 |
| BEB-160-600X | 600 | 160 | 155 | 545,943 | 155 | - | 8 | 8 @ 20 | 55 | 0.1 | 0.03 | 695 |
| BEB-180-600X | 600 | 180 | 174 | 614,186 | 97 | 78 | 9 | 9 @ 20 | 62 | 0.1 | 0.03 | 698 |
| BEB-200-600X | 600 | 200 | 193 | 682,429 | 97 | 97 | 10 | 10 @ 20 | 69 | 0.1 | 0.03 | 700 |
| BEB-220-600X | 600 | 220 | 212 | 750,672 | 116 | 97 | 11 | 11 @ 20 | 76 | 0.1 | 0.03 | 703 |
| BEB-240-600X | 600 | 240 | 231 | 818,915 | 116 | 116 | 12 | 12 @ 20 | 82 | 0.1 | 0.03 | 705 |
| BEB-260-600X | 600 | 260 | 251 | 887,157 | 135 | 116 | 13 | 13 @ 20 | 89 | 0.1 | 0.03 | 708 |
| BEB-280-600X | 600 | 280 | 270 | 955,400 | 135 | 135 | 14 | 14 @ 20 | 96 | 0.1 | 0.03 | 709 |
| BEB-280-600H | 600 | 278 | 268 | 948,576 | 135 | 133 | 13 | 7 @ 20/6 @ 23.3 | 95 | 0.1 | 0.03 | 709 |
| BEB-300-600X | 600 | 300 | 289 | 1,023,643 | 155 | 135 | 15 | 15 @ 20 | 103 | 0.1 | 0.03 | 710 |
| BEB-300-600H | 600 | 299 | 288 | 1,020,231 | 155 | 133 | 13 | 13 @ 23 | 103 | 0.1 | 0.03 | 750 |
| BEB-060-480X | 480 | 60 | 73 | 204,729 | 73 | - | 5 | 5 @ 12 | 21 | 0.1 | 0.03 | 690 |
| BEB-072-480X | 480 | 72 | 87 | 245,675 | 87 | - | 6 | 6 @ 12 | 25 | 0.1 | 0.03 | 693 |
| BEB-084-480X | 480 | 84 | 102 | 286,620 | 102 | - | 7 | 7 @ 12 | 29 | 0.1 | 0.03 | 695 |
| BEB-096-480X | 480 | 96 | 116 | 327,566 | 116 | - | 8 | 8 @ 12 | 33 | 0.1 | 0.03 | 693 |
| BEB-108-480X | 480 | 108 | 130 | 368,512 | 73 | 58 | 9 | 9 @ 12 | 37 | 0.1 | 0.03 | 700 |
| BEB-120-480X | 480 | 120 | 145 | 409,458 | 73 | 73 | 10 | 10 @ 12 | 41 | 0.1 | 0.03 | 705 |
| BEB-132-480X | 480 | 132 | 159 | 450,403 | 87 | 73 | 11 | 11 @ 12 | 46 | 0.1 | 0.03 | 708 |
| BEB-144-480X | 480 | 144 | 174 | 491,349 | 87 | 87 | 12 | 12 @ 12 | 50 | 0.1 | 0.03 | 710 |
| BEB-160-480X | 480 | 160 | 193 | 545,943 | 193 | - | 8 | 8 @ 20 | 55 | 0.1 | 0.03 | 695 |
| BEB-180-480X | 480 | 180 | 217 | 614,186 | 121 | 97 | 9 | 9 @ 20 | 62 | 0.1 | 0.03 | 689 |
| BEB-200-480X | 480 | 200 | 241 | 682,429 | 121 | 121 | 10 | 10 @ 20 | 69 | 0.1 | 0.03 | 700 |
| BEB-220-480X | 480 | 220 | 265 | 750,672 | 145 | 121 | 11 | 11 @ 20 | 76 | 0.1 | 0.03 | 703 |
| BEB-240-480X | 480 | 240 | 289 | 818,915 | 145 | 145 | 12 | 12 @ 20 | 82 | 0.1 | 0.03 | 705 |
| BEB-260-480X | 480 | 260 | 313 | 887,157 | 169 | 145 | 13 | 13 @ 20 | 89 | 0.1 | 0.03 | 708 |
| BEB-280-480X | 480 | 280 | 337 | 955,400 | 169 | 169 | 14 | 14 @ 20 | 96 | 0.1 | 0.03 | 709 |
| BEB-280-480H | 480 | 278 | 335 | 948,576 | 169 | 167 | 13 | 7 @ 20/6 @ 23 | 95 | 0.1 | 0.03 | 709 |
| BEB-300-480X | 480 | 300 | 361 | 1,023,643 | 193 | 169 | 15 | 15 @ 20 | 103 | 0.1 | 0.03 | 710 |
| BEB-300-480H | 480 | 299 | 360 | 1,020,231 | 194 | 167 | 13 | 13 @ 23 | 103 | 0.1 | 0.03 | 750 |
| BEB-060-208X | 208 | 60 | 167 | 204,729 | 167 | - | 4 | 4 @ 15 | 21 | 0.1 | 0.03 | 716 |
| BEB-075-208X | 208 | 75 | 209 | 255,911 | 209 | - | 5 | 5 @ 15 | 26 | 0.1 | 0.03 | 718 |
| BEB-090-208X | 208 | 90 | 250 | 307,093 | 250 | - | 6 | 6 @ 15 | 31 | 0.1 | 0.03 | 719 |
| BEB-105-208X | 208 | 105 | 292 | 358,275 | 292 | - | 7 | 7 @ 15 | 36 | 0.1 | 0.03 | 721 |
| BEB-120-208X | 208 | 120 | 334 | 409,458 | 334 | - | 8 | 8 @ 15 | 41 | 0.1 | 0.03 | 725 |
| BEB-135-208X | 208 | 135 | 375 | 460,640 | 209 | 167 | 9 | 9 @ 15 | 47 | 0.1 | 0.03 | 728 |
| BEB-150-208X | 208 | 150 | 417 | 511,822 | 209 | 209 | 10 | 10 @ 15 | 52 | 0.1 | 0.03 | 731 |
| BEB-165-208X | 208 | 165 | 459 | 563,004 | 250 | 209 | 11 | 11 @ 15 | 57 | 0.1 | 0.03 | 735 |
| BEB-180-208X | 208 | 180 | 500 | 614,186 | 250 | 250 | 12 | 12 @ 15 | 62 | 0.1 | 0.03 | 737 |
| BEB-060-240X | 240 | 60 | 145 | 204,729 | 145 | - | 4 | 4 @ 15 | 21 | 0.1 | 0.03 | 716 |
| BEB-075-240X | 240 | 75 | 181 | 255,911 | 181 | - | 5 | 5 @ 15 | 26 | 0.1 | 0.03 | 717 |
| BEB-090-240X | 240 | 90 | 217 | 307,093 | 217 | - | 6 | 6 @ 15 | 31 | 0.1 | 0.03 | 719 |
| BEB-105-240X | 240 | 105 | 253 | 358,275 | 253 | - | 7 | 7 @ 15 | 36 | 0.1 | 0.03 | 721 |
| BEB-120-240X | 240 | 120 | 289 | 409,458 | 289 | - | 8 | 8 @ 15 | 41 | 0.1 | 0.03 | 725 |
| BEB-135-240X | 240 | 135 | 325 | 460,640 | 181 | 145 | 9 | 9 @ 15 | 47 | 0.1 | 0.03 | 728 |
| BEB-150-240X | 240 | 150 | 361 | 511,822 | 181 | 181 | 10 | 10 @ 15 | 52 | 0.1 | 0.03 | 731 |
| BEB-165-240X | 240 | 165 | 397 | 563,004 | 217 | 181 | 11 | 11 @ 15 | 57 | 0.1 | 0.03 | 735 |
| BEB-180-240X | 240 | 180 | 434 | 614,186 | 217 | 217 | 12 | 12 @ 15 | 62 | 0.1 | 0.03 | 737 |

† Actual calculated amps, not service rating.

Options

BEB-***-***H – 125 psi vessel and relief valve.

Dimensional Drawings



| CLEARANCES | | | | |
|------------|---|--------|-------------------------------------|--------|
| | MINIMUM CLEARANCE FROM COMBUSTIBLE SURFACES | | SUGGESTED MINIMUM SERVICE CLEARANCE | |
| | 0 INCH | 0 MM | 0 INCH | 0 MM |
| BACK | 12 INCHES | 305 MM | 24 INCHES | 610 MM |
| LEFT | 8 INCHES | 203 MM | 12 INCHES | 305 MM |
| RIGHT | 24 INCHES | 457 MM | 36 INCHES | 914 MM |
| FRONT | 26 INCHES | 680 MM | 26 INCHES | 680 MM |
| TOP | | | | |

DIMENSIONS ARE:
[mm]
IN

ART-241_07

Handling & Storage

Receiving

It is the receiver's (person and/or company signing off on the receiving Bill of Lading) responsibility to inspect for shipping damage. All shipping claims must be made by the receiver. Verify receipt of a pallet.

Storage

This electric boiler, packed or unpacked, shall not be exposed to rain, snow, or other adverse environment. This product is designed for in-building storage and installation only.

As much as possible both the control box and the main unit must be covered with plastic throughout the construction phase to avoid accumulation of dust and moisture on the components and the complete control box. The receiver and installing contractor are responsible for maintaining the cleanliness and quality of this unit until installation is complete and approved by the user/end customer.

Main unit

The heavy construction of the cabinet and internal vessel allows for easy handling and moving of the unit with either a pallet jack or forklift. The bottom openings on the side are arranged for standard pallet jack. Forklift tines can be adjusted accordingly.



CAUTION

ANY FORKLIFT DAMAGE IS THE RESPONSIBILITY OF THE RECEIVER.

The main unit can be laid on its back and strapped to a stair jack.

Holding or lifting straps can be strung through the bottom openings.

Placement & Mechanical Information

Provide a firm and level foundation for this unit, see Specification Chart for weights.

Note: Combustible flooring material shall not be used for electric boilers.

See Dimensional Drawings for dimensions and minimum clearances.

Boiler Room

This must be an inside building installation with adequate ventilation to maintain reasonable maximum temperatures within and around the electrical/electronic components.

Main unit – front electrical panel 122° F (50° C) maximum

Control box – 104° F (40° C) maximum



CAUTION

DO NOT USE THE BOILER HOUSING TOP AS SCAFFOLDING. SEE ABOVE SECTIONS ON STORAGE, ETC.

Shipped Loose Items

Packed within there are loose items such as operational manuals, etc.

Piping Connections

The pipe extensions outside of the boiler cabinet are permanently welded to the vessel. Caution must be used to make sure field piping is properly threaded so damage does not result requiring field repair or a replacement (not under warranty) vessel.

New Installation

Piping connections and valves must comply with state and/or local codes, in addition to compliance with ANSI piping requirements.

Retrofit or Dual Systems

Make sure there is adequate valving between the two boilers for proper individual operation or proper backup boiler room operation plan.

- The control design includes provisions for utility load control, also see Dual Boilers/Dual System.

Safety Pressure Relief Valve

As factory installed, there must be a 1" pipe between vessel and pressure relief valve. The provided relief valve must be mounted with the relief lever up. Field add necessary drain pipe extension to a proper drain location within the boiler room. 30 psi relief valve included with standard models. Special order 125 psi models include 125 psi relief valve.

Vessel Drain Port/Inspection Opening

The left side bottom 1" pipe is provided for maintenance or vessel servicing drain, provide necessary extension/access.

A 3" inspection opening is provided on the lower left side of the boiler.

Purge Eliminator/Air Vent/Expansion Tank, Etc.

All standard, best practices, hydronic components must be field provided and installed external to this unit. This unit has an internal safety low water cutout and the necessary temperature safety cutout and operating controls, see operating section. However, this unit does not have an interlock flow switch or boiler room emergency stop switch. See Electrical Installation for terminal block connection provisions.

Expansion tank must be sized for the maximum Btu/h capacity.

This unit includes a small ½" integrated air vent used to assist in venting potential trapped air at the top of the boiler vessel. It is not intended to be used as a system air vent.

Direction of Flow

The **left side inlet** is the return water and the top outlet is the supply.

System Flush/Boil-Out

Prior to final system fill and start-up, the entire system (including the boiler) **must be thoroughly flushed**. Performing a pre-flush and chemical system flush significantly reduces the chances of any debris or impurities causing premature failure to the boiler and its associated system components.

It is recommended to first flush the system with clean water to remove any major debris in the system. Care should be taken to isolate the circulating pumps to avoid contaminating the pumps during this process. Then proceed with a chemical flush to remove the remaining fine particles in the system. It is recommended that a commercially available boil-out compound be used in this procedure. Follow the manufacturer's instructions for specifics regarding the boil-out procedure.

Water Treatment

Water treatment is strongly suggested to prevent scale deposits, corrosion from acids, oxygen, and other harmful elements within the specific water supply. It is the installer or user's responsibility to verify water quality and maintain acceptable water quality throughout the life of this product. A qualified water treatment specialist should be consulted to establish proper water treatment program.

As a minimum the following water properties must be considered:

- Hardness (ppm): 0-10
- pH: 7.5 – 10
- Iron Content (ppm): 0-20
- Oxygen Content (ppm): 0
- Total Dissolved Solids: 0-5000

Up to a 50/50 propylene glycol mixture is acceptable for use in these boilers.

Installation Requirements

1. All installation work must be performed by trained, qualified contractors or technicians. Bradford White Corporation sponsors installation and service schools to assist the installer. **Visit our web site at www.bradfordwhite.com for upcoming service schools.**

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 CSA/us certification label, and manufacturer product liability. Bradford White Corporation 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 Bradford White boiler products relate only to the addition of the Bradford White boiler to the hydronics system. The owner/ installer assumes all responsibility and/or liability associated with any needed installation of the gas/oil boiler, pump, plumbing, system design, hydronics 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.

At Bradford White, the safety of the installer and the end user is of highest priority. 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. Professional installers should be trained and experienced in the areas of handling electrical components, sheet metal products, and material handling processes.

Electrical Installation – Preparation

Typical external requirements – depending upon the electrical utility servicing the site, this model typically is added to the general service as a 3 Ø “Y” source.

- If the service is delta (unbonded neutral) with dedicated utility transformer, verify ground fault, a ground fault monitor may be required to maintain warranty.
- See nameplate and/or Specification Table for 3-phase operating voltage rating and kW rating to determine service entrance size.

Service feed – depending upon model, but generally this unit is fed by two service entrance 3-phase feeds. These are **not parallel** feeds, the internal distribution blocks are independent loads having a fixed number of electric element stages apply to each feed.

- See Specification Table for service feed sizing and distribution.

External or service wire size – the internal service feed distribution blocks are rated for copper or aluminum wire. It is the installer’s responsibility to have proper electrical connection at this main unit’s distribution block to prevent any overheat within the main unit cabinet.

- Wire insulation rating within the main unit cabinet must be 75° C or greater.
- Wire size, protection, routing, temperature rating, etc. is the responsibility of the installing contractor, local and national codes. See nameplate and/or Specification Table for voltage and main unit kW rating.

Safety grounding – a single point grounding electrode system must be established for the facility. Both the transformer cabinet and the general service transformer grounding conductor with the main building service entrance grounding lug **must be all bonded** to the same facility grounding electrode system.

- The main unit ground lug, next to the service feed distribution block must be connected to the facility grounding electrode system, per NEC or CEC codes. The conductor size from these main unit internal ground lugs depends upon the service feed size and must be per NEC or CEC code.

System setup – this is further defined in its own section, but there are many setup possibilities relating to various applications, control options, and troubleshooting. These factory defaults are set up from the factory, so system setup is not necessarily required but may be necessary if the “out of the box” settings from the boiler do not meet the application.

- Set Point (outdoor sensor not connected)
- Base temp, high mass – 90° F (32° C)
- Base temp, low mass – 120° F (49° C)
- Maximum stages, coordinates with the number of stages for the shipped model number

External R-W device – a contact closure is required between R and W for heat active operation. Do not simply jumper R to W or use for the load control relay. Utility load control is provided at the left blue jumper TB. In the case of hot boiler this is probably the system on external pump switch. As a minimum, suggest a flow switch contact proofing the continuous pump. Product liability and warranty is exempt if R to W has a jumper wire and pumps fail causing no flow.

Electric Installation – Power Feed

Using the information from the previous section, it is the installer's responsibility for proper 3-phase power feed and safety grounding per NEC and CEC electric codes.

- See Specification Table for distribution between the two feeder terminal blocks. Feed #1 always has 8 or less stages.
- Prepare service conductor cables and torque as required within the terminal block as required for the installer selected cable type and size.

Some local codes and CEC electric code require single disconnect and single feed. If this is the case, installer must provide disconnect with multiple feeds per drawing BH802.

Electrical Installation – Control Box

120, single phase, 15A general service or main building service panel source – provide and route to the upper left corner CB and neutral block.

Note: A green wire ground from this general service panel is not required or suggested because the ground lug within the control box is connected to the main safety ground in the main unit. Based upon grounding details in the Electrical Installation – Preparation section, the main unit ground lug is bonded to the building grounding electrode system.

Boiler heat call R-W – there must be a contact closure between R and W to activate this boiler. This can be a thermostat heat call, end switch or building control signal.

- If operating as a hot boiler with continuous pump, typically a system on/off switch controls the R and W. Provisions need to be made to make sure it is continuous pump, suggest with this arrangement a **flow switch** is connected in this R and W contact loop.

Boiler heat call 0-10VDC operation – when the Laars boiler is configured through the boiler control panel to operate on a 0-10VDC signal, the facility boiler control signal must include both the 0-10VDC signal to terminal T7 (0-10VDC in) and a contact closure across the R-W terminal. The 0-10VDC will not function unless R-W is closed. If a jumper is placed across R-W, precautions must be made to ensure the system pump is active whenever a 0-10VDC signal is present at the boiler. This is to prevent elements from activating with no flow and prevent tripping of the manual high limit.

Main circulating pump – determine whether pump is continuous on or is operated by the R to W input signal, use the pump relay (the larger cube relay) on the board. When using the top two terminals this has a 25-amp, 120V or 240V, rating. Route and clearance protect these line voltage wires in and out of the control box as required by NEC/CEC code. This contact can be used to drive an external contactor for 3-phase or higher voltage pumps.

LMC or utility load control – if this is a required part of this installation, remove the blue jumper at the LMC terminal and route two wires to the utility load receiver normally closed contact. The electric boiler elements are disabled when this circuit is open.

External Alarm – a set of dry contacts, “EXT Alarm”, provide a contact closure for remote alarm monitoring. These contacts will close on a low water cut off alarm, manual high limit, or boiler sensor fault. These are all conditions that require physical inspection of the boiler to solve the issue.

Outdoor sensor (OT) – this product is factory shipped with a 25' (7.6 meter) cable and OT sensor. It has three tabs on the board, bottom left. From the factory, this sensor is shipped loose. If the outdoor sensor is required for the application, simply connect the sensor to the board (power cycle required).

Note wire colors and labeling, sensor cable can be disconnected for installation. Do not route OT sensor cable along line voltage Romex or line voltage wiring (crossing is okay when there is a somewhat parallel route). Sensor box must be installed in a location out of direct sunlight. Sensor box should also be mounted high enough off the ground to prevent being covered with snow or ice.

Ground fault detector – BEB Series boilers are manufactured to utilize either of the two common 3-phase electrical feeds:

- 3-Phase Y, with neutral and ground – the internal wiring configuration of the BEB boiler does not require a neutral. This unit is manufactured and shipped without ground fault protection. Certain state and local codes may require the addition of ground fault protection. Be certain to research and follow these codes.
- 3-Phase Delta, no neutral, dedicated service from the transformer with unbonded neutral – a ground fault protection kit must be added in this instance. The addition of this kit to the BEB brings the boiler into “NEC Article 250.21, unbonded neutral” compliance. This kit may be installed at our factory upon your request. In addition to the CSA product certification, this safety control system is approved by Minnesota, North Dakota, and the South Dakota State Boards of Electricity.

Always verify with a qualified electrician if the system is configured as a 3-phase Delta. If a ground fault detector for 3-phase Delta is installed on a 3-phase Y system, the ground fault monitor will not allow the boiler to operate.

Additional Safety Control Options

Remote or boiler room emergency stop switch – a field provided stop switch with a normally closed contact can be easily wired into TB1-1 and 2 located behind the boiler high voltage safety panel. This is a 120V circuit. Simply remove the factory provided black/yellow jumper between 1 and 2 and connect the normally closed stop switch. A “Remote” fault will display on the monitor when this circuit opens during boiler operation.

Additional external low water cutoff – this can also be looped into the TB1-1 and 2 mentioned above. If the external LWCO has a manual reset function, it will need to be reset at that component.

- Alarm monitor “REMOTE” is the monitor for opening TB1-1 and 2.

External water flow switch – this closed to flow contact can also be added to the TB1-1 and 2 black/yel jumper loop. Its function will keep all power contactor coils de-energized whenever 1 and 2 are open (also sets remote fault).

- Another suggestion for hot boiler and continuous pump, use the water flow switch as a contact for opening the R and W system on switch (see Electrical Installation – Preparation section, bottom paragraph).

Multiple Boilers, Same System

Piping/pumps – boilers are plumbed in parallel, each flowing equally into a header or primary loop. Steps need to be taken to make sure there is an evenly divided flow into the header, related to the number of boilers in parallel. Depending upon pump sizing, the primary loop pumping system could be equal size pumps at each boiler supply pipe. See Specification Table for required flow **through each vessel**.

Controlling multiple boilers – the control board has built in multi-boiler control with LEAD/LAG capability. A contact closure is required across R-W at the designated lead boiler. This heat call will activate the lead boiler and establish communication to the lag boiler. Internal control board logic will determine all boiler sequencing functions. Each boiler has its own safety LWCO, HL1, and HL2 temperature limits. This control is limited to two Laars boilers.

If a building energy management system is used, a (0-10VDC) control signal is connected in parallel to each boiler control board. Special setup is required via the boiler control interface panel.

Dual Boilers/Dual System

Electric/gas combination – when the Laars boiler is used in combination with a fossil fuel boiler, control of both boilers can be achieved through the Laars boiler control board. The “SB IN /OUT” terminals serve as a control connection to the fossil fuel boiler “TT” or “RW”.

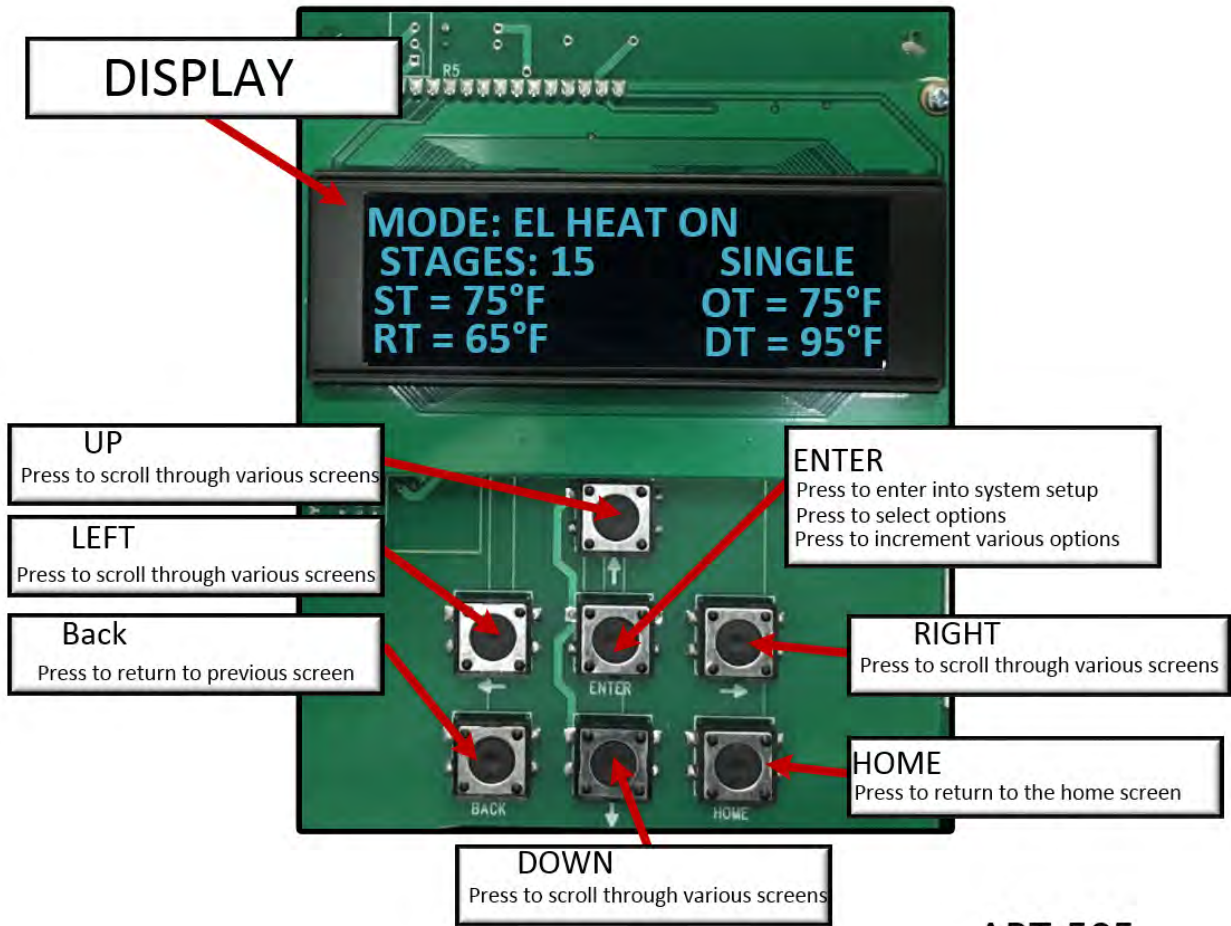
Utility load control – when a utility receiver is connected to the system as shown on BH801, and control is initiated during an active heat call, the electric stages are terminated and a switch closure is made on “SB IN/OUT” connection activating the fossil fuel boiler backup.

Setup/Programming

This boiler is supplied with a display. There are a multitude of setup functions on this display. Exhaustive research has been done to determine a “typical” application for the boiler. From the factory, this boiler is set to meet this typical application. Using the display, the Boiler can be reconfigured to meet your application.

Understanding the Product Display

- The Boiler includes a 4-line OLED display with a set of navigation buttons. Note: This is a display and a system interface with which to customize and reconfigure the operating parameters to better meet the requirements of your particular application.



ART-505
09/15/2017

| LINE | LINES Description |
|------|---|
| 1 | Mode – Displays the current mode. |
| 2 | MISC Data – Displays active system faults as well as various system status |
| 3 | Temperatures – Displays Supply Temperature (ST) and Outdoor Temperature (OT) |
| 4 | Temperatures – Displays Return Temperature (RT) and Desired Temperature (DT) |

Display Line 1, MODES

| | |
|-------------------|--|
| OFF | If there is no active heat call to the Boiler, the OLED will display a mode of “OFF”. This means no heat is being generated from the heating system. |
| EL HEAT ON | Indicates there is a heat call requirement from the system thermostat. The Electric boiler portion of the heating system is receiving this input, and is actively working to heat the space. The stand by boiler is not active (if applicable). |
| SB HEAT ON | Only applicable when a backup fossil fuel boiler is connected to this Boiler. Indicates there heat call requirement from the system thermostat. The standby fossil fuel boiler portion of the heating system is receiving this input, and is actively working to heat the space. The electric boiler is not active. |
| FAULT | This indicates one of the system faults has gone active. Display LINE 2 will signify which system fault has gone active |

Display Lines 2, VARIOUS INFORMATION

| | |
|------------------------------|--|
| STAGES | With the system thermostat active, and the system in electric mode, the “STAGES” indicates how many stages of the electric boiler are active at a given time. The user can expect to see the stages shift up and down depending on the relationship of ST to DT |
| SINGLE / LEAD / LAG | A software setting in the MULTI-BOILER section of the setup menu will be displayed alongside the stages indicator. |
| FAULTS | System faults are communicated via line 2 of the OLED display. The below is a run through of the possible faults. |
| AUTO HL | There is a mechanical auto resetting high limit located on the top of the boiler tank. This high limit is in direct contact with the water inside the tank (not a dry well). Should the water in the tank reach a temperature of 210°F, this limit will open. Should this limit open, all electric boiler elements will be disabled. (O-210 / C-185) |
| BENDER | If this boiler has a ground fault bender connected (DELTA transformer only), this fault will indicate if the bender has detected a ground fault. All electric boiler elements will be disabled and appropriate fault will be displayed should this condition be detected. |
| LOW WATER | Included with this Boiler is a low water cut off. Should this control system detect a low water situation, the electric boiler elements will be disabled and the appropriate fault will be displayed. |
| REMOTE EMERGENCY STOP | Provisions have been made within this Boiler to allow for a field provided remote switch or emergency stop. Simply place your field provided switch in series with the EM STOP circuit located inside this Boiler. All electric boiler elements will be disabled and appropriate fault will be displayed should this condition be detected. |
| MANUAL HL | There is a mechanical manual high limit located on the top of the tank. This is a surface mount component measuring vessel temperature. Should the boiler vessel reach a temperature of 220°F, this limit will open. Should this limit open, all electric boiler elements will be disabled. This limit will have to be manually reset. |
| FREEZE | Should the ST (supply sensor) sensor detect a value less than 45° F (7° C), a freeze condition is declared. All electric boiler elements will remain enabled and appropriate fault will be displayed should this condition be detected. |

Display Lines 3 & 4, TEMPERATURES

| | |
|-----------|---|
| ST | ST is short for “Supply Temperature”. This is the temperature of the water as it leaves the Boiler. If the ST sensor is not working, the LED will display “BAD” after the ST on the OLED display. |
| OT | OT is short for “Outdoor Temperature”. This is the outdoor temperature. If the OT was detected upon power-up, and is no longer working, the OLED will display “BAD” after the OT on the OLED display. |
| RT | RT is short for “Return Temperature”. This is the temperature of the water as it enters the Boiler. If the RT sensor is not working, the OLED will display “BAD” after the RT on the OLED display. |
| DT | DT is short for “Desired Temperature”. This value will either be the fixed set point or the outdoor reset calibrated set point. |

Hardware Setup

The boiler includes an outdoor sensor which is disconnected from the factory.

Based on the condition of this outdoor sensor upon boiler power-up (connected or disconnected), the boiler will work to formulate its desired set point output temperature upon system thermostat demand in one of two ways:

Connected:

If the outdoor sensor is connected upon system power-up, the boiler will enable its outdoor reset function. This function allows the boiler to adjust its set point output water temperature based on the outdoor temperature. This function can be further adjusted by using the display to adjust a software variable known as **“OT @ 0°F SP”** (outdoor temperature at 0°F set point). This allows you to adjust the outdoor reset curve to better meet your application.

NOTE: If sensor is connected upon system power-up, it must be located outside.

Disconnected:

If the outdoor sensor is not connected, the boiler will disable its outdoor reset function and operate based on a fixed set point value. This fixed set point can be adjusted to better meet the application by using the display and adjust a software variable known as **“SET POINT”**. This is the fixed output water temperature the boiler will target when there is a heat demand from the system thermostat.

Software Setup

Understanding System Setup and Configuration

The display and configuration section of the display allows for system setup and calibration.

NOTES:

All changes made to the system will happen immediately. It is best not to make changes while the Boiler is actively operating (active heat call). Satisfy thermostat call before entering the setup up section of the display.

General Layout and Navigation

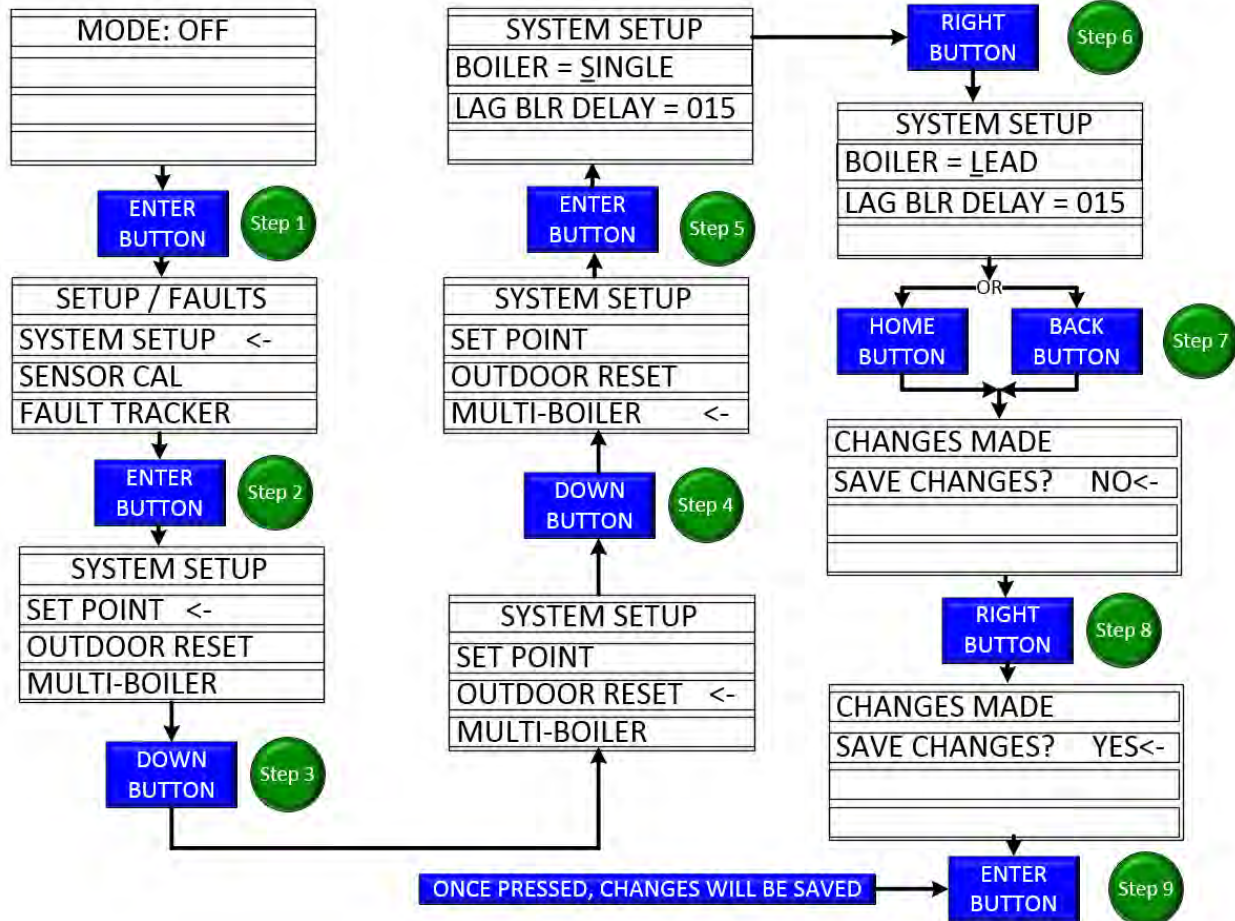
The next section will overview the various sections embedded within the SETUP / FAULT section of the product display. Deeper in the manual, we'll discuss the options imbedded within these setting in more detail. Below is meant to be a brief overview with the goal of introducing you to the various buttons and general navigation of the display.

Saving your Changes

The display uses the "BACK" and "HOME" buttons to compare changes and prompt you to save your changes.

Let's run through an example.

We're going to set the boiler up as a multi-boiler system designating this boiler as the "LEAD"



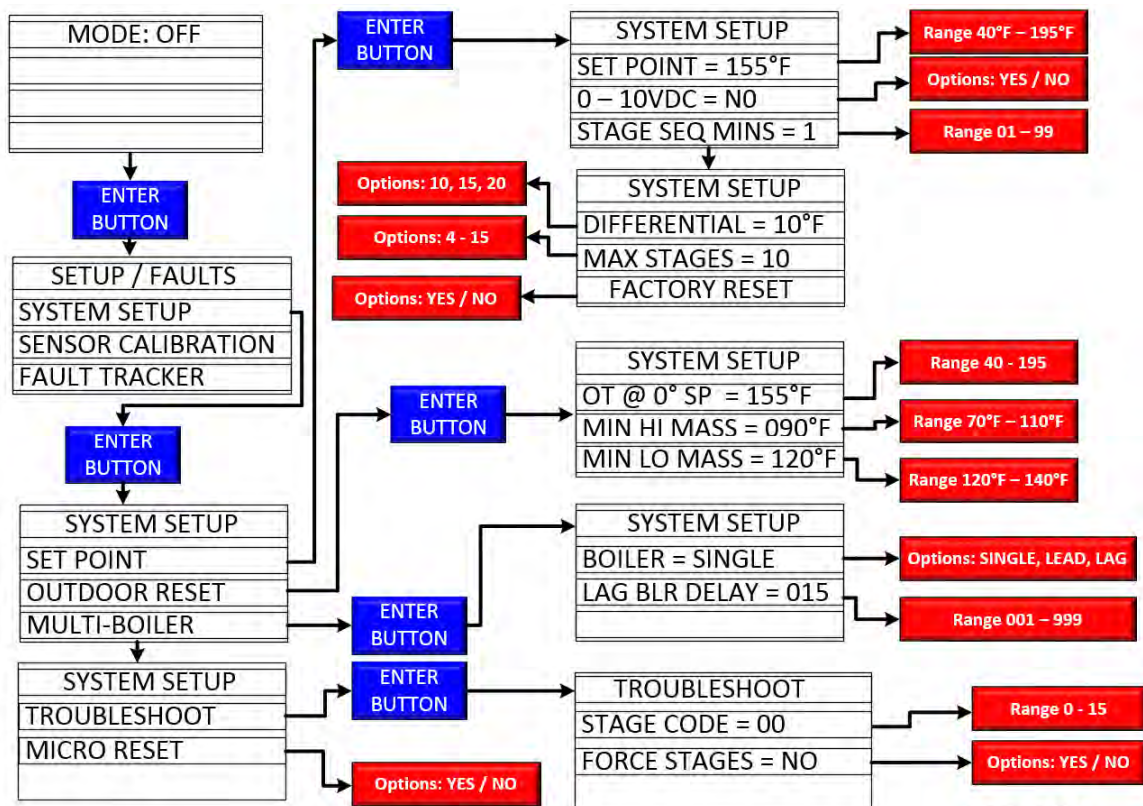
ART-506
09/15/2017

SYSTEM SETUP



ART-503
09/15/2017

SYSTEM SETUP:



ART-504
09/15/2017

SETUP / FAULTS:

SET POINT: When operating this boiler in NON-outdoor reset mode (outdoor sensor not connected upon power-up), this value is the fixed set point output water temperature the boiler will try and achieve and maintain upon an active thermostat heat call.

- RANGE 40°F – 195°F
- Default from factory is 155°F

0 – 10VDC: If an external controller (EX: Automated Building System Management Controller) will be used to operate this boiler with a 0 – 10VDC control signal, this set up parameter must be set to “YES”.

- Options are “YES” / “NO”
- Factory default is “NO”
- If set to “YES”, boiler will still need a switch closure between R & W upon 0 – 10VDC heat demand
- If set to “YES”, all Laars Boiler temperature sensing will be disabled
- After you change the set up to 0-10VDC you must initiate a micro reset from the control panel or cycle control power to the board.
- If the change is successful you will see 0-10VDC in the mode section of the display.

WARNING

There is no temperature sensing, no control, etc. in this mode. It is the technician’s responsibility to manually control the water temperature.

STAGE SEQ MINS: This option allows the user to delay the boiler stage up sequence.

EX: If it is determined that the boiler must not reach full output for 1 hour and boiler has 10 stages. You would set this variable to 6. This would indicate that the boiler can only add another stage of heat every 6 minutes. This timer is only used upon an initial heat demand. Once at full output (timer expired), it will not be reset until the next thermostat heat call.

- Factory is 1 minute

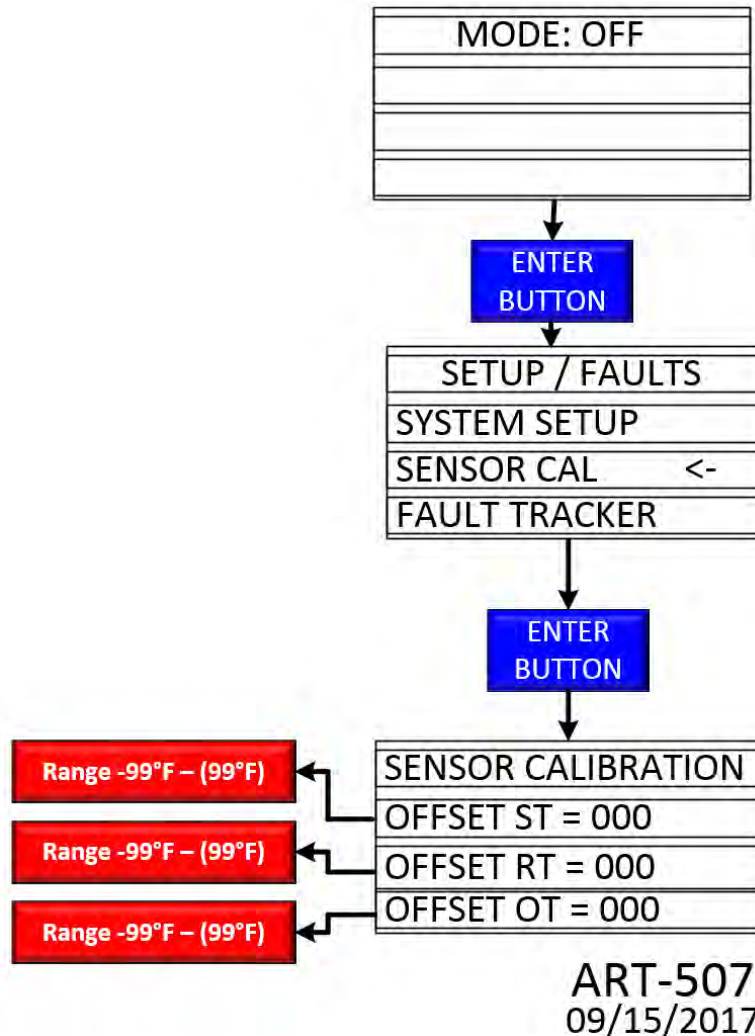
DIFFERENTIAL: This is used to indicate to the logic board (non 0-10VDC mode) how tightly to maintain boiler target temperature. It must be noted that the lower the value used, the more boiler cycling will occur. This has direct relation to life span of the boiler contactors and other components.

MAX STAGES: This is typically a factory setup screen, as the boiler is manufactured, we indicate to the logic board the amount of stages it has to work with (4 – 15 stages depending on boiler kW).

FACTORY RESET: To reset the boiler back to its factory settings, use this setting.

- NOTE the boiler will reset, if boiler is active while you reset it, it will shut down and restart.

SENSOR CALIBRATION



Use “ENTER” Button to increase value of digit selected.
Use UP and DOWN buttons to move cursor up and down
Use LEFT and RIGHT buttons to move cursor left and right

OFFSET ST: If there is a need to calibrate the supply temperature sensor, enter in the desired offset.

- NOTE: The value entered is the offset, not sensor temperature. Pressing 075° will add 75° to the existing sensor reading. It will not cause the sensor to now equal 075°.

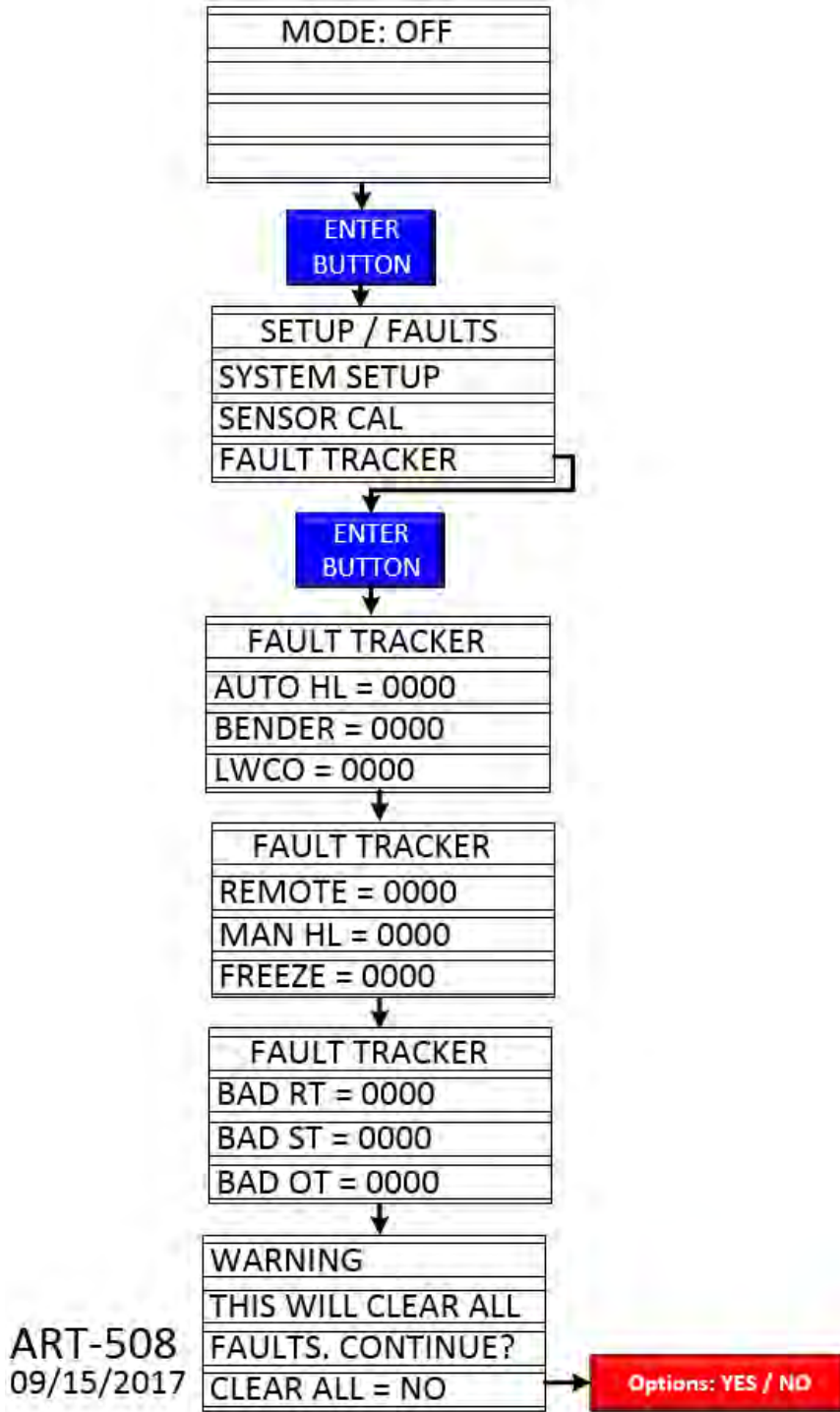
OFFSET RT: If there is a need to calibrate the return temperature sensor, enter in the desired offset.

- NOTE: The value entered is the offset, not sensor temperature. Pressing 075° will add 75° to the existing sensor reading. It will not cause the sensor to now equal 075°.

OFFSET OT: If there is a need to calibrate the outdoor temperature sensor, enter in the desired offset.

NOTE: The value entered is the offset, not sensor temperature. Pressing 075° will add 75° to the existing sensor reading. It will not cause the sensor to now equal 075°.

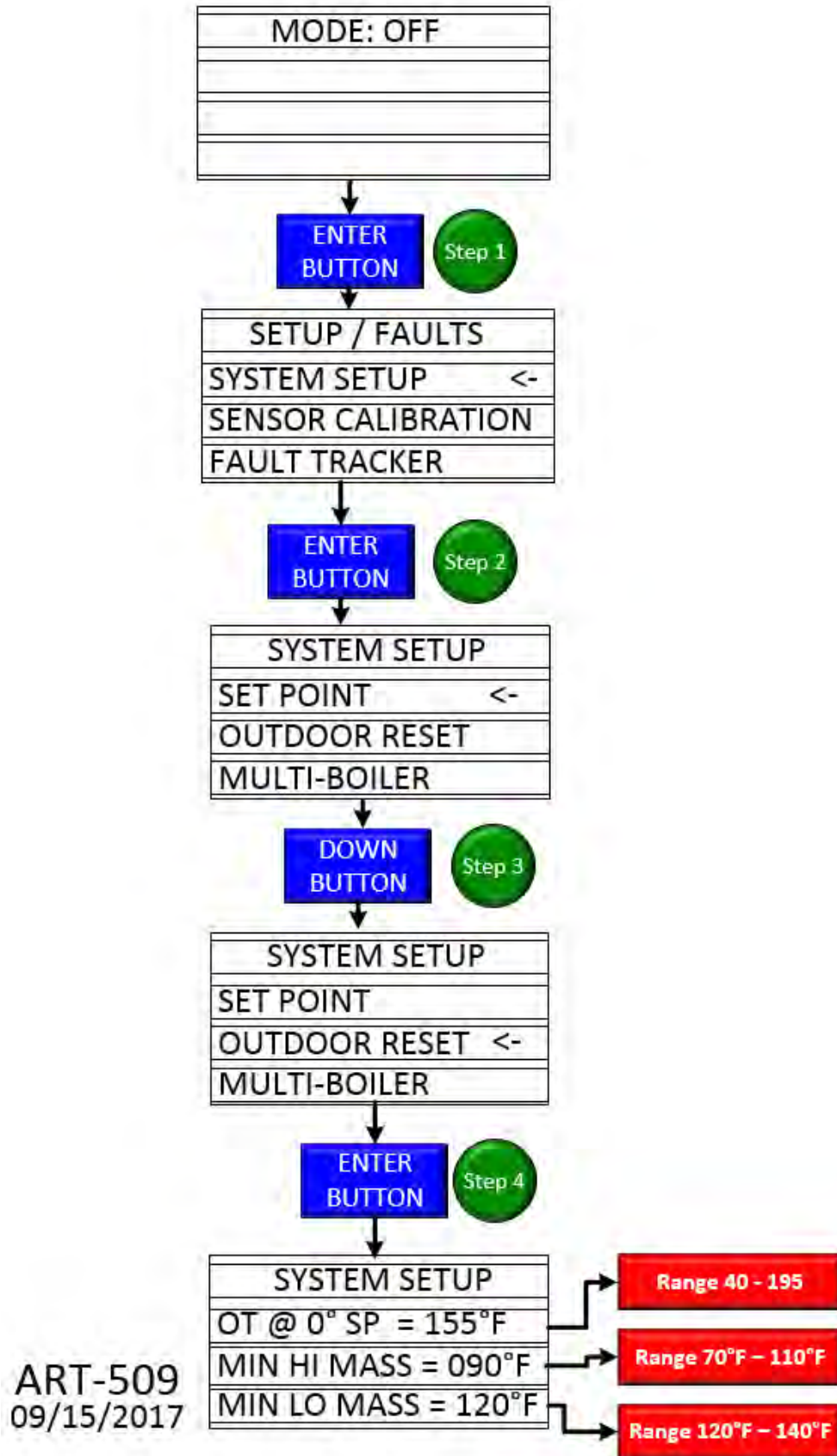
FAULT TRACKER

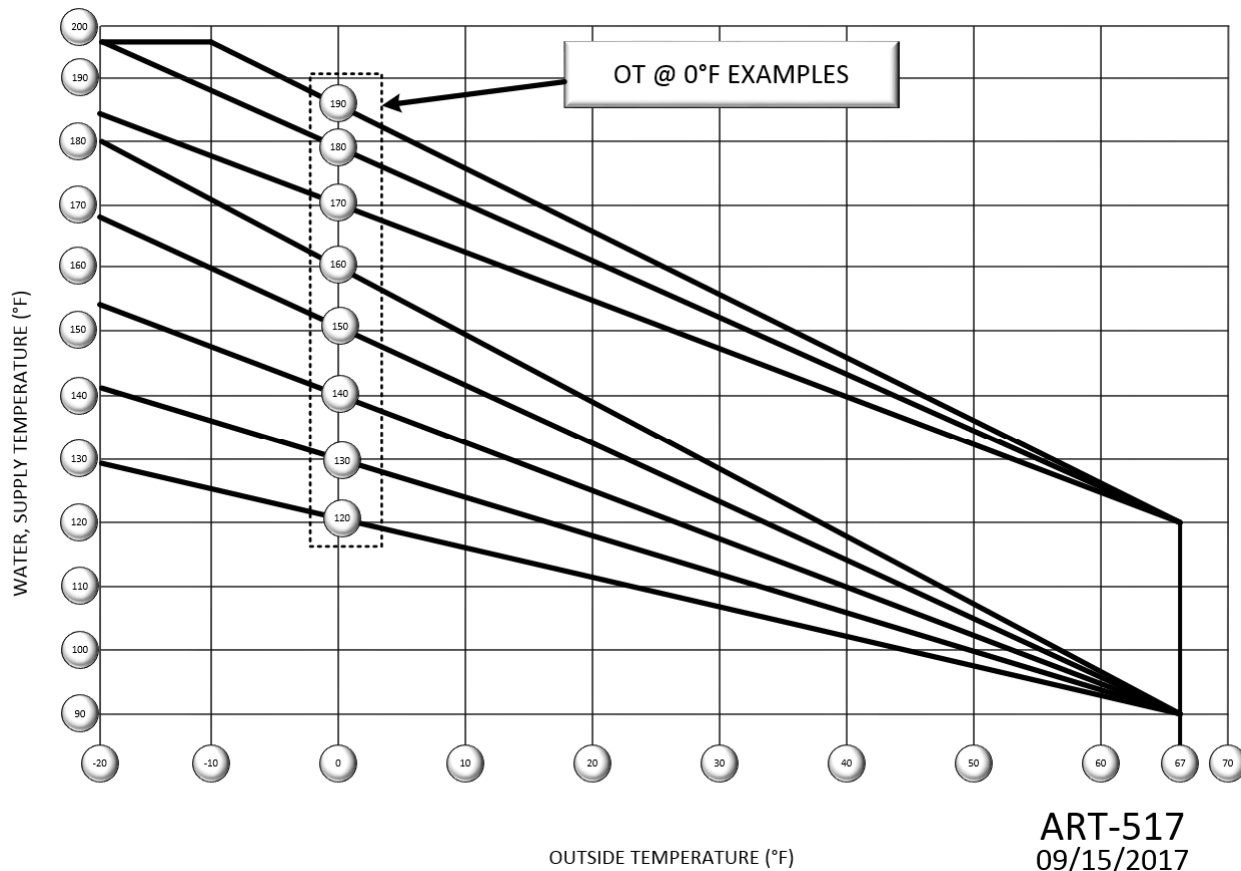


Fault tracker is a read only function of the display. It allows you to view a history of the various faults for this boiler.

You can clear / reset all faults by accessing the last screen in the string of screens. Press “YES” in the “CLEAR ALL” option will reset all to 0.

OUTDOOR RESET PARAMETERS





OT @ 0°F SP: When operating this Boiler in outdoor reset mode (outdoor sensor connected upon power-up), set this value to your desired set point output water temperature when the outdoor temperature is 0°F. As the outdoor temperature fluctuates, the output water temperature desired with shift in an attempt balance the boiler output with the heat load requirement of the space.

- RANGE 40°F to 195°F.
- Factory Default: 155°F

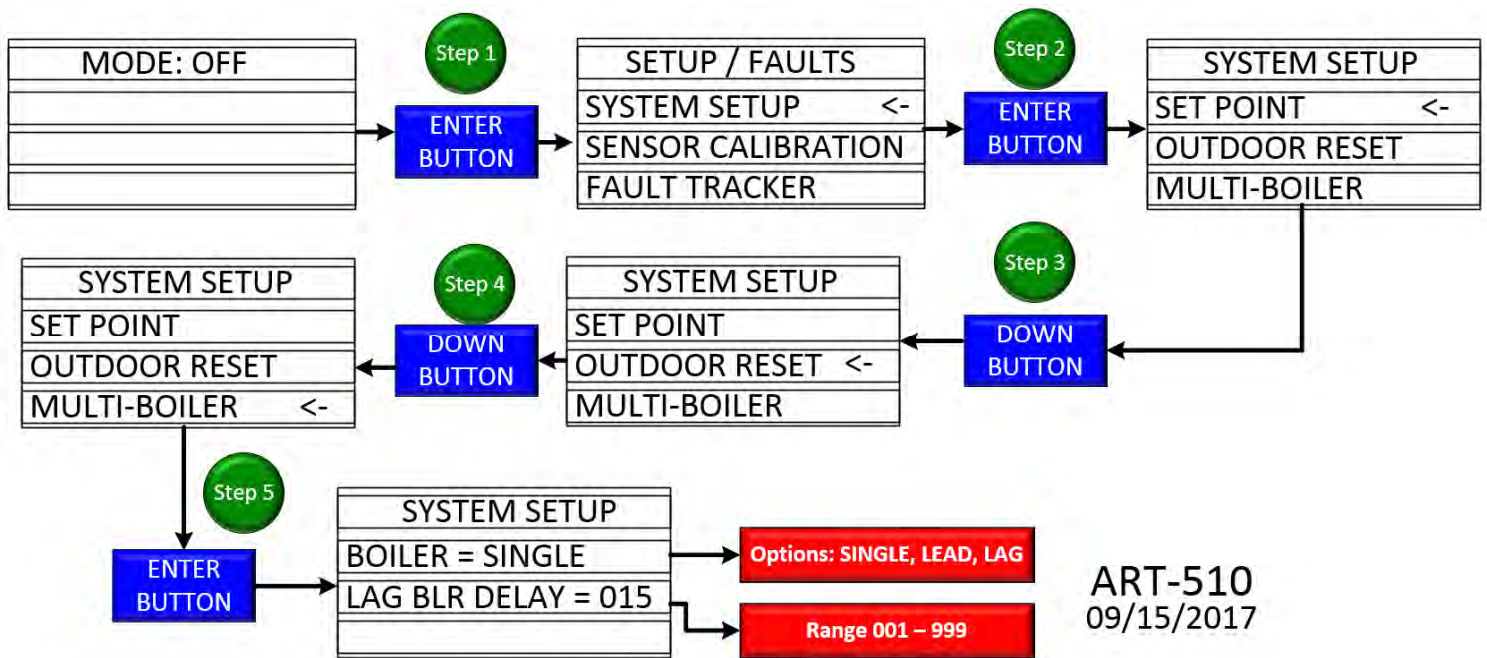
MIN HI MASS: If the application has a requirement for OT @ 0°F SP to be less than 160°F, the application is considered to be high mass (concrete slab, for example). MIN HIGH MASS setting is then used to set the minimum value for the boiler to target based on the outdoor temperature.

- Range: 70 – 110°F
- Factory default is 90°F

MIN LO MASS: If the application has a requirement for OT @ 0°F SP to be greater than 160°F, the application is considered to be low mass (baseboard heat, for example). MIN LOW MASS setting is then used to set the minimum value for the boiler to target based on the outdoor temperature.

- Range: 120 – 140°F
- Default: 120°F

DISPLAY VARIABLES DEFINED



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MULTI-BOILER

BOILER: Enter the role this boiler will play in the heating system.

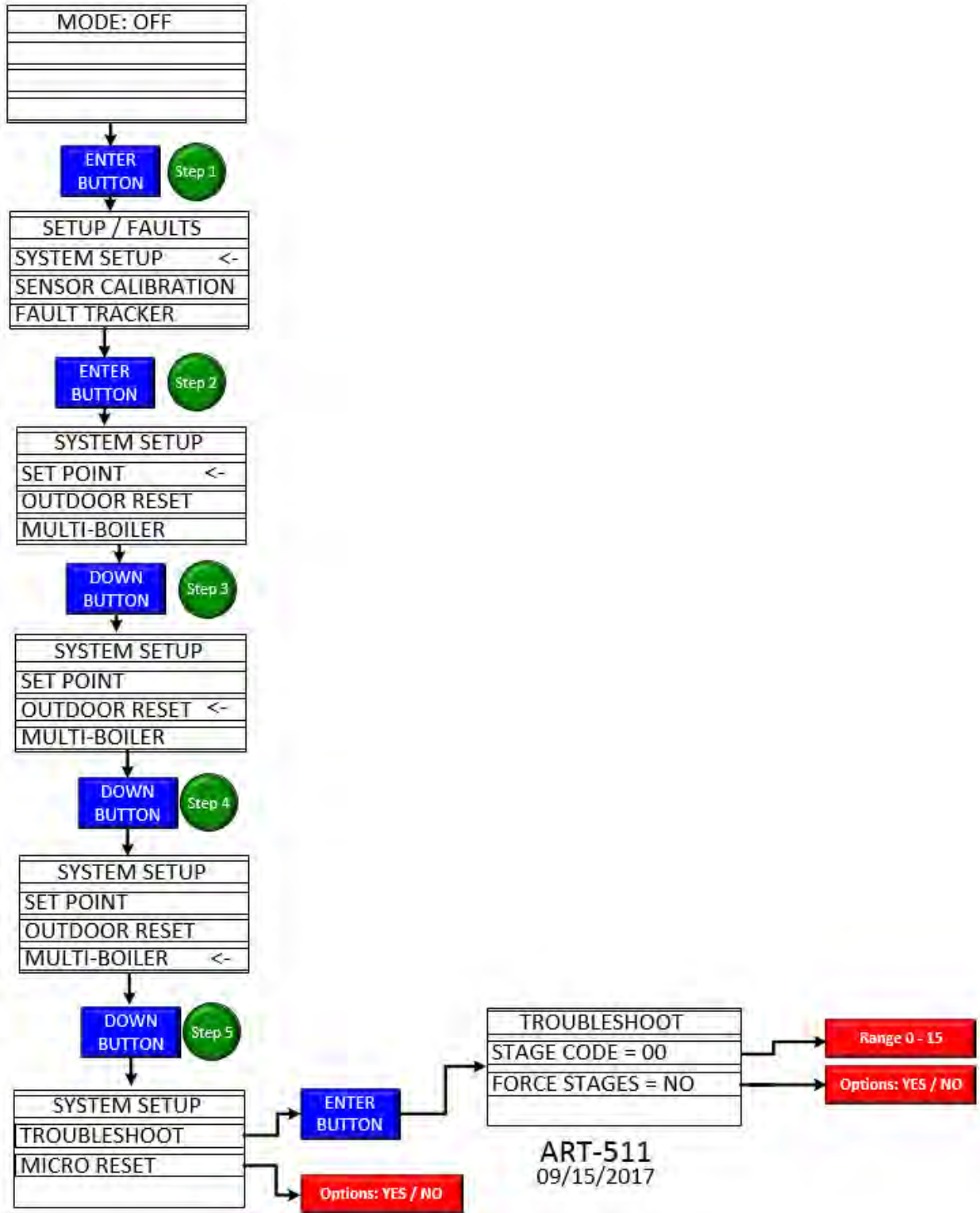
Options:

- **SINGLE:** This indicates there are no other Boilers in this application. It will not attempt to interface with another boiler that does not exist.
- **LEAD:** This indicates that there is another Boiler in this application. LEAD setting tells this boiler that it is the lead boiler and it is in control of an external boiler. The LEAD boiler will control all LEAD / LAG sequencing.
- **LAG:** This indicates that there is another Boiler in this application. LAG setting tells this boiler that it is the lag boiler and that another, external boiler is in control of it. The LAG boiler will only respond to the LEAD boiler LEAD / LAG sequencing.
 - **Default: SINGLE**

LAG BLR DELAY: The function of this setting depends the BOILER setting above.

- **SINGLE:** If "BOILER" is set to "SINGLE", the LAG BLR DELAY has no function.
- **LEAD:** If "BOILER" is set to "LEAD", LAG BLR DELAY will be the amount of time the LEAD boiler will wait to active either itself, or the LAG boiler, based on which side of the lead / lag cycle it is on.
- **LAG:** If "BOILER" is set to "LAG" the LAG BLR DELAY will act as a redundancy system protection function. Once there is a demand for heat to the boilers, (R & W switch closure), this timer will start. If the LAG boiler does not receive a "GO" signal from the LEAD boiler in this amount of time, an additional 60 minute timer will be started. If this timer expires without getting the "GO" signal from the LEAD boiler, the LAG boiler will override the LEAD boiler and begin heating. Should LEAD boiler ever go down, this will prevent the building from freezing.
 - It is suggested both the LEAD and LAG boilers have identical values placed in LAG BLR DELAY.
 - Default: 015

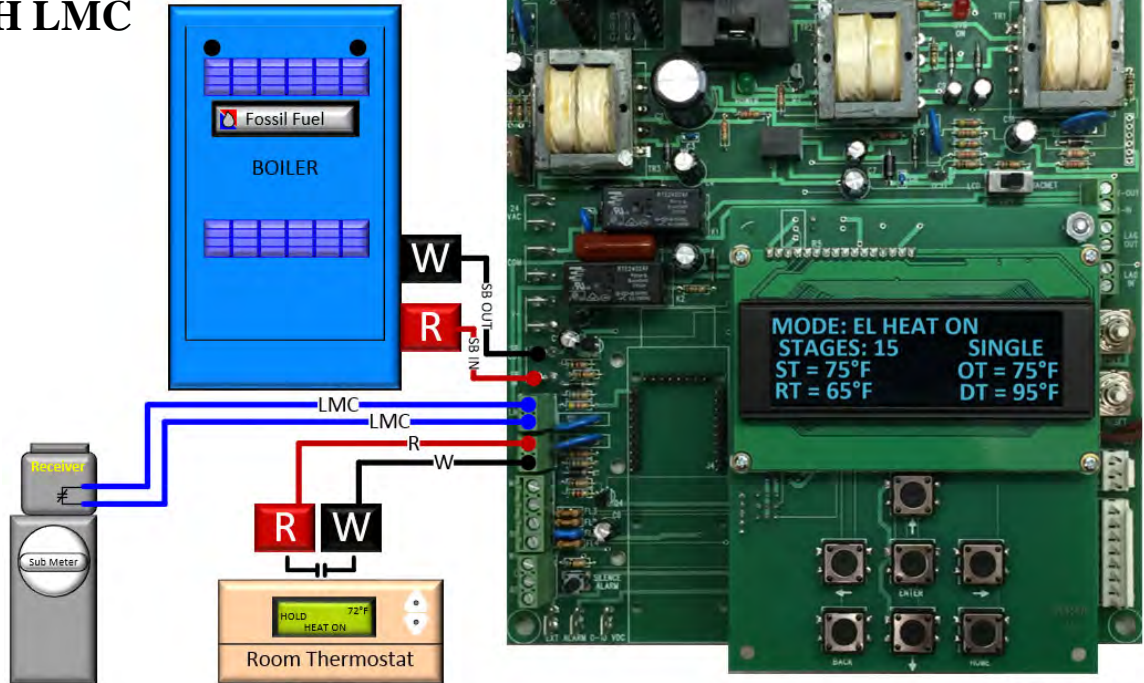
NOTE: Display will show an asterisk (*) to indicate status of the "LAG BLR DELAY" timer.



MICRO RESET

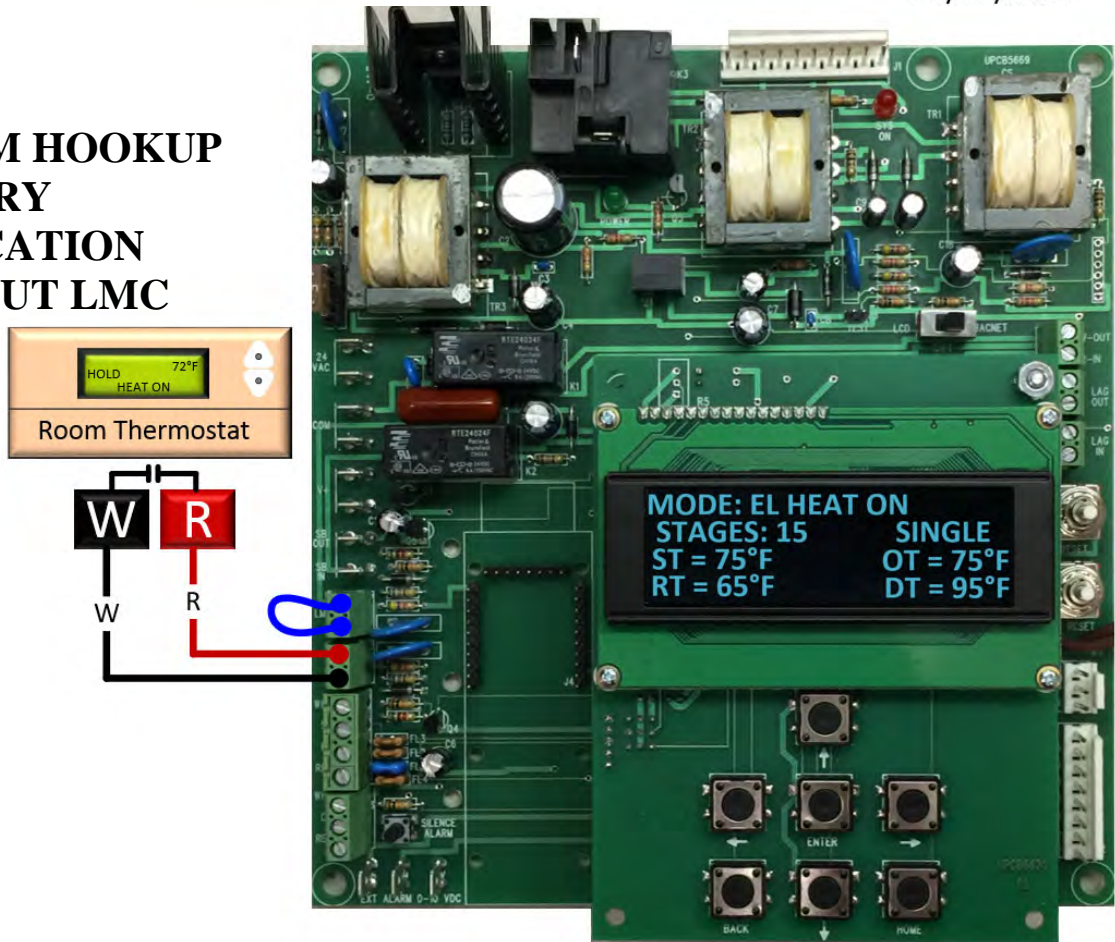
Certain setting changes made by display require a reset of the microcontroller. A power down reset of the boiler is an option, otherwise you can select to reset the microcontroller via this software selection.

**SYSTEM HOOKUP
PRIMARY
APPLICATION
WITH LMC**



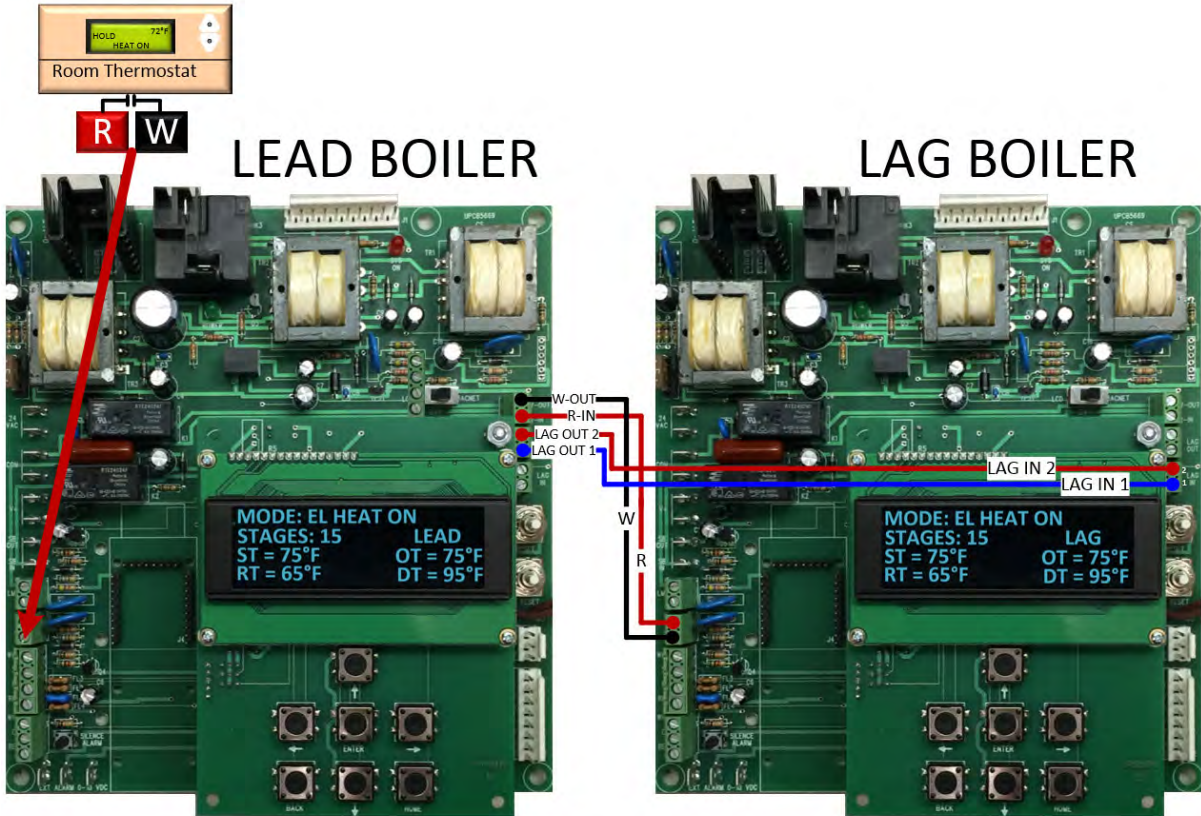
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**SYSTEM HOOKUP
PRIMARY
APPLICATION
WITHOUT LMC**



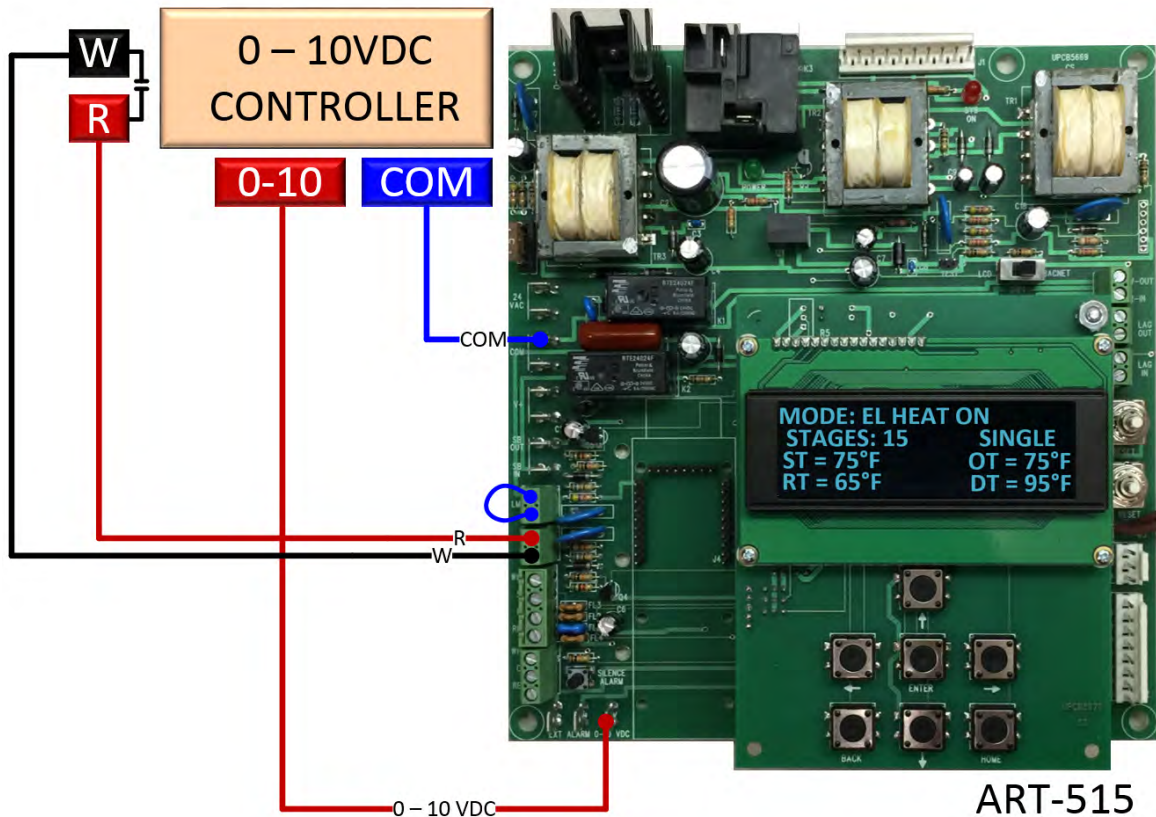
ART-513
09/15/2017

SYSTEM HOOKUP LEAD LAG BOILER



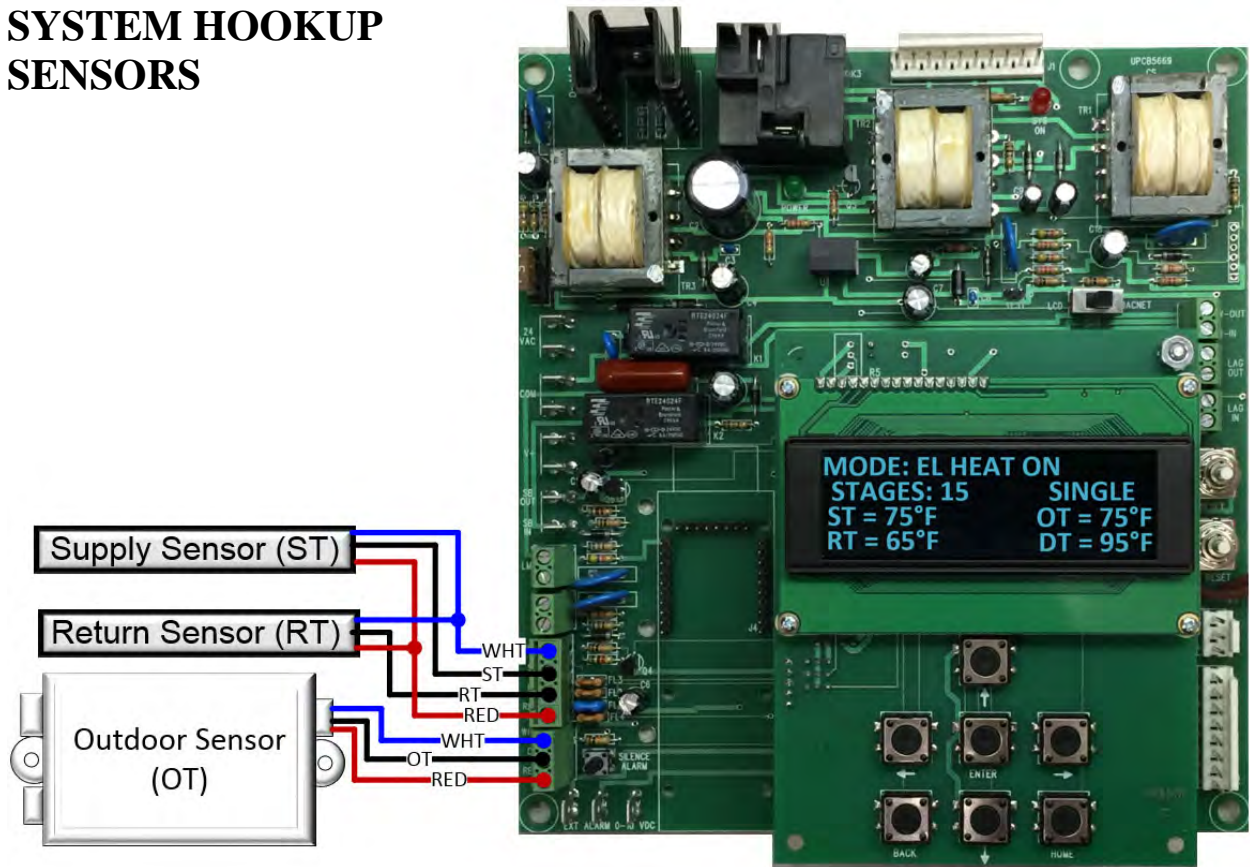
SYSTEM HOOKUP 0 – 10VDC HOOKUP

ART-514
09/15/2017



ART-515
09/15/2017

SYSTEM HOOKUP SENSORS



ART-516
09/15/2017

Pre-Start

General inspection – inspect all components, external and internal to assure there has been no damage during shipment or installation. Verify proper cabinet clearances on both sides and top and the internal is free of construction dirt and debris. Blowing out with an air hose is suggested. Verify all electrical connections are properly tightened and correct.

- It is assumed the system is purged and water filled prior to attempting the following paragraphs (see System Flush/Boil-Out and Water Treatment).

Main unit inside panel “door switch” – the inside dead front panel must be secured before the element power contactors are energized. This door switch is on the upper left inside cabinet flange.

Condition control board to hardware STANDBY – either remove one LMC blue wire or jumper common to SB SW tab (this is a pre-start process).

Control power on – close the control box upper left 120 CB. The control board green LED should be on, see the Operations section for definition of other LED’s. There should not be an alarm.

LWCO – should be in normal or non-reset mode, red LED on.

On initial power the low water cut-off will be in the fault or “open” position. Press the LWCO button located on the control board on initial power-up or after a power failure.

- If not, alarm will count 3 and LWCO board LED is off.
- Verify system is water filled, no air at vessel top, etc.
- Reset at the board, right center pushbutton

Control device or mode – with power now on the control board, the procedure from the previous control programming section can easily be run. .

Reestablish non-standby – turn off the control box 120 CB. Reference 3rd paragraph under this section, return LMC blue wire loop or remove SB SW jumper/switch.

Observations

Become familiar with the main PCB module.

LEDs

- Green – control power, control 120 CB on, proper fuse, 24-volt transformer
- Red-W – operating thermostat on, R to W closed
- Red-SYS – control 24VAC at J3-8 going to seq. J3-8 (via auto-reset HL)

Control box 120 CB – general service panel control circuit source.

Audible alarm – continuous alarm indicates a manual reset required.

Staging CB’s, main unit – one per element stage, interrupts power from the power distribution block.

Main unit, monitor lights – indicates element contactor is active. This is one per stage or power contactor.

LWCO control – red LED on indicates proper vessel water level.

Temperature limits information – there are three temperature sensing monitors which will control the sequencer and electric elements.

- The control main control board, with its supply sensor, controls the stages to maintain a supply temperature represented by system configuration. This sensing monitor and control applies to outdoor reset or no outdoor reset.
- Auto reset limit, HL-2 – probe at the vessel top, fixed at 210° F (99° C), signals sequencer to shut down (auto resets at approximately 195° F (90.5° C)).
- Primary safety limit, HL-1 – mounted on vessel top, fixed 225° F (107° C), manual reset (resets at approximately 160° F (71° C)).

Stage sequencing – in normal operation there is a **progressive** stage up or stage down timing. The delay between stages is not always the same, it depends upon the differential between existing and the next stage command.

- The sequencer plug-in software chip has a version 1.** with a dash number. The dash number must match the number of stages for the specific boiler unit model number (see Specification Table, stage number). This should be verified to make sure your installation and your specific model is setup for the correct maximum number of stages. This provides the correct sequence and operation for the progressive stage-up/stage-down timing.
- During alarm conditions, there is only 1-second between stages.
- For test purposes the sequencer can be setup to only have 1-second between stages. Next to the J3 connector is a W1 test point wire. Simply jumper this test point wire to ground (do not apply a voltage to W1) and all staging will now be 1-second for either up or down.

Startup Inspection

Comment – the words “power service” or “power source” refer to the 480/208/240 3-phase source dedicated to the electric elements.

1. All main unit staging CB’s should be off. The dead front inside panel is still probably off; this is okay because the installer needs to check the source voltage. The panel interlock switch is open thus contactors cannot pull in.
2. Verify the control box 120 CB is off and R to W input is open or off.
3. Verify previous Pre-Start and Setup section and the above Operations section have been completed and have the necessary familiarity to proceed.
4. Verify main unit and control box are free of construction debris, dust and moisture, proper electrical connections, connection terminals are properly tightened, etc.
5. Remove one main unit top cover panel and verify the vessel top is free of debris and all electric element connections are in place with no foreign material which may cause an electrical short. Secure top cover to make sure the top of the vessel remains safe and clean.
6. Verify system is water solution filled, flushed, purged, free of air, and at 10-20 psig.
7. Be prepared to activate the power service source.
8. Turn on the control box upper left 120 control source CB. If installed a Bender alarm should be **active** indicating no power service source.
9. Turn on the power service main disconnect source (208/240/480).

CAUTION

THE INDIVIDUAL STAGING CB’S DO NOT REMOVE ALL 480V POWER FROM INSIDE THE BOILER. THE TOP DISTRIBUTION BLOCK AND WIRING FROM THAT DISTRIBUTION BLOCK BECOMES LIVE AS SOON AS THE MAIN DISCONNECT IS CLOSED.

10. Using a volt meter, verify service power phase to phase voltage.
11. Install the main unit inside dead front panel. This should close the safety interlock switch (upper left) allowing the contactors to activate as required in the next steps.
12. Close the external thermostat type R to W device. One minute delay, pump relay closes first.
13. Verify pump is on and water flow circulation.
14. The unit should begin staging elements in order to satisfy system desired temperature
 - Staging is verified by the behind the door staging monitor lights next to each staging CB
 - Main unit CB’s are still off
15. Turn on one inside staging breaker at a time. The power source current should increase as the stages step in. All stages relating to the specific model number should now be on.
 - If not, review the setup “maximum stages” entry and/or the sequencer chip code dash number.
 - Also, the next section has further information.
16. Open the external R to W contact.
17. The system should be ready for a thermostat call (R to W).

Troubleshooting

Power Source

Electric element supply – the boiler vessel elements are fed from the main unit inside terminal block. Depending upon model number and configuration this may require 480, 208, or 240 3-phase. See Specification Table for specific installation requirement. This boiler is designed and wired for a Delta electric element load arrangement. However, it can be serviced from a Y (no neutral current or hookup) depending upon the utility transformer and the disconnect/wiring within the facility.

- If it is a true Delta service, a specific fault detector may be required.

24-volt control source, no PWR ON LED – verify 120 control power and control box upper left CB. Verify 24-volt transformer, verify fuse, etc.

- If 24VAC is measured at the control module center left terminals and no PWR ON LED, control board is inoperative.
- If there is no 24VAC at control module, troubleshoot transformer, fuse, 120 source, etc.

Component Information, Familiarization

Low water cutout (LWCO) – information on enclosure should be adequate.

On initial power the low water cut-off will be in the fault or “open” position. Press the LWCO button located on the control board on initial power-up or after a power failure.

- Sensor is on vessel, violet wire to LCO terminal.
- 120 control power is at L1 and L2 tabs. The limit loop is from the CB to COM tab, NO tab, to PCB J7 connector (K4 NC from HL-1 reset) to HL1 inside TB.
- Test switch is adjacent to the LWCO control. When pressed, the LWCO must be reset via the reset button located on the lower right side of the control board.

Emergency stop switch field jumper – if the TB1-1 and 2 jumper is removed and a remote contact is put in its place, when this contact is opened a fault display “Remote”. This is **not** a manual reset latching circuit, the reset would need to be built into the remote connected device(s).

Manual reset hi-limit – this is the round, surface mount, limit installed on the vessel top plate. The TB1-2 (L1) 120 passes through this limit (red and black wire) loop back to TB1-3 jumper. Internally at TB1-3 this 120 supplies all of the Sequencer pilot relay “COM” contacts (sequencer J1-10 and J2-8). When the boiler top plate surface mount limit trips, the L1 120 switches from the black to the brown wire and via TB1-5 provides an HL-1 monitor input to the Temp Sensing and Alarm module. This module has a latching circuit (K4, two wire blk/yel loop, LWCO-5 to TB1-1) and the power for the Sequencer remains interrupted until HL pushbutton reset.

Automatic reset hi-limit – screwed into the vessel top plate is a probe thermostat which has normally closed contacts in series with 24VAC Sequencer 24V J3-8 (feeding into J3-5). Thus the automatic reset removes all control power from the Sequencer. Also there is an HL-2 monitor wire fed to the control module which activates an alarm.

Bad sensor– the OLED display indicates which sensor is faulty. In this instance, “faulty” means not connected, shorted cable, or for some reason there is no digital bit pattern on the black wire. It does not mean it’s an incorrect value, there is simply no data transmitted.

- This alarm is for notification, it does not cause a safety total shutdown same as LWCO, high temp, Bender, etc.

Faulty sensor default – the OLED display indicates a sensor issue, but the boiler continues to function based upon a fixed default temperature within the logic.

- RT sensor – no default, this is not critical
- OT sensor – this is only active when outdoor sensor connected during power-up. If faulty, internal logic sets OT to 0° F (-18° C), boiler should be operating at full output and probably all stages on
- ST sensor – Internal logic sets ST to 50° F (10° C), all stages are probably on because this is significantly well below set point

Alarm, freeze – the ST sensor is sensing a value less than 45° F (7° C).

Door switch – this is at the main unit top inside flange and activates when the dead front main unit inside panel is removed.

Alarm voltage interface – this chart can help check sensor output or wire connections.

| Pulses | Name | Non-Alarm | | Active Alarm | |
|--------|--------------------|------------|---------|--------------|---------|
| | | J1- | Port | J1 | Port |
| 1 | Auto Reset HL-2 | 4 – 24VAC | 19 – 5V | 4 – 0V | 19 – 0V |
| 2 | Field added device | 7 – 24VDC | 18 – 5V | 7 – <2VDC | 18 – 0V |
| 3 | LWCO | 2 – 0VAC | 16 – 0V | 2 – 120VAC | 16-5V |
| 4 | Option Switch | 1 – 120VAC | 15 – 5V | 1 – 0VAC | 15 – 0V |
| 5 | Man Reset HL-1 | 3 – 0VAC | 17 – 5V | 3 – 120VAC | 17 – 0V |

Main unit staging CB’s, staging contactors, power source electric element wiring – this should be straightforward from the attached wiring schematic. As stated above, the common or neutral for all contactors is via TB1-4 and the “door switch” neutral wire. The L1 side of each contactor coil is from TB1-2, through the manual reset limit (TB1-3), and through each stage pilot relay at the Sequencer board.

Sequencer – this rotating relay output board receives 16-bit binary information from the control module. This 16-bit binary code is on 4 wires, J3-1 through 4.

- Bit 0 is considered no stages on.
- Bits 1 through 15 represent the 15 stages. This means when the sequencer receives a new bit code it steps in or out to that specific stage. During transition (staging up or staging down going to the next stage number) the change in stage code number is not recognized or examined.
- Time between stage-up is 4 seconds each, time between stage-down is 2 seconds each.
- An SYS-ON signal or wire (J3-8) is the external “turn on/turn off” function.
- The output pilot duty relay contacts associated with each connector are all commoned from J2-10 and J3-8. As the staging relays pull in and out this voltage (typical 120 for contactor coil) is fed to each of the staging contactors.
- At J3-6 24VDC must be there at all times. J3-5 is common or reference.
- Note – the vessel top automatic reset limit (HL-2) is in series with the SYS-ON wire thus it interrupts the Sequencer, but the Sequencer times its stage-down and stage-up function.

STAGE CODE: Should there be a scenario where you’d like to have the boiler force a certain amount of stages on (calculation GPM for example), this is where you would indicate the amount of stages you’d like activated.

FORCE STAGES: Should there be a scenario where you’d like to have the boiler force a certain amount of stages on (calculation GPM for example), this is where you would active this sequence. Once “YES” has been selected, the amount of stages selected in the above description (STAGE CODE) will be activated.

- To exit this operation, “NO” must be selected.

Emergency Override

If this is not a dual boiler installation and in case of an absolute necessity to maintain building heat or freeze-up, the **service technician** or maintenance technician can consider rewire and manually operate the Sequencers.

CAUTION

WHEN OVERRIDING THE BUILT-IN CONTROLLERS IN THE FOLLOWING STEPS, ALL ALARM LIMITS ARE STILL ACTIVE AND WITHIN THE CONTROL CIRCUITRY. IT IS STRONGLY RECOMMENDED NO FURTHER BYPASS BE CONTEMPLATED OR USED IN ORDER TO MAINTAIN PROPER SAFETY.

Green LED off or no 10VDC at test point W2 – depending upon the sequencer, circuitry or wiring can be provided directly into the Sequencer to stage in the contactors.

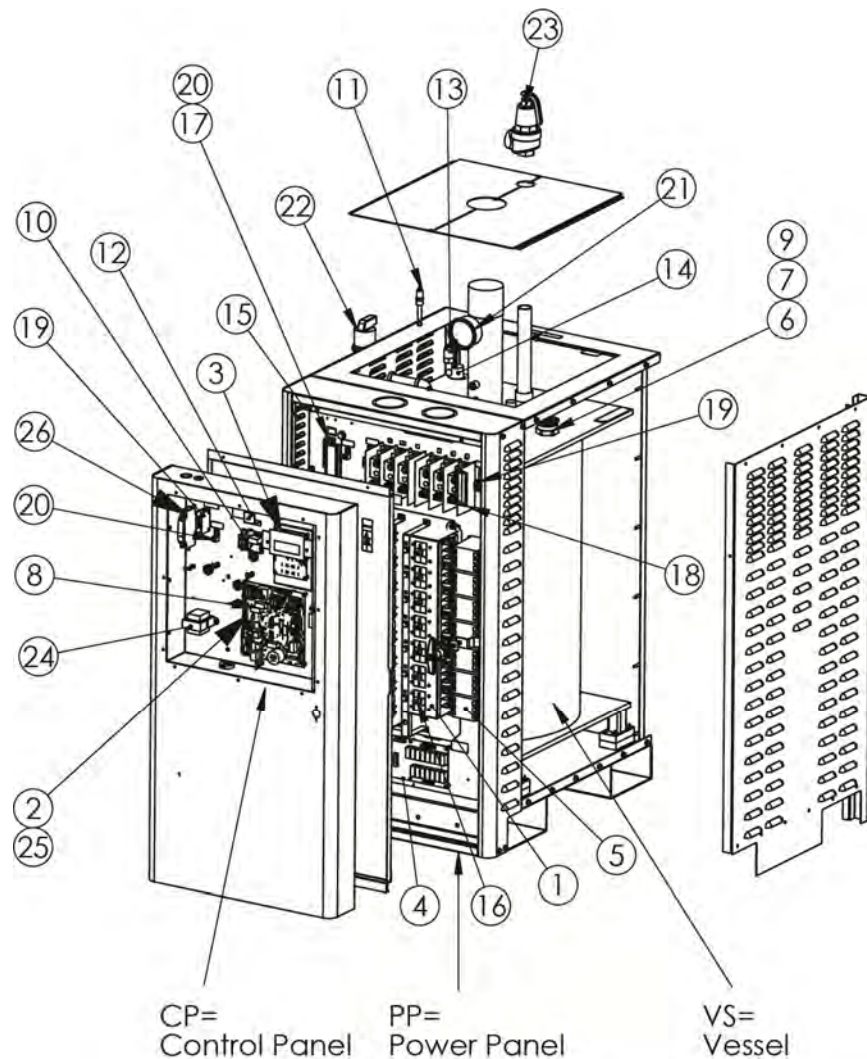
Sequencer – interface is at the J3 connector. 24VAC is required at J3-8 (yel/blk) and 16VDC-24VDC is required at J3-6 (red), J3-5 (gray) is common. Worst case, the 16VDC will work with two 9-volt batteries in series.

Either with 4 switches or jumpers setup the appropriate stage code based upon the following table.

| Heating Stage | J3-1 | J3-2 | J3-3 | J3-4 |
|---------------|------|------|------|------|
| 1 | | | | X |
| 2 | | | X | |
| 3 | | | X | X |
| 4 | | X | | |
| 5 | | X | | X |
| 6 | | X | X | |
| 7 | | X | X | X |
| 8 | X | | | |
| 9 | X | | | X |
| 10 | X | | X | |
| 11 | X | | X | X |
| 12 | X | X | | |
| 13 | X | X | | X |
| 14 | X | X | X | |
| 15 | X | X | X | X |

The X's in any horizontal stage column would mean a jumper to ground or control common. The Sequencer will immediately go to that specific stage. Example – stage 10, J3-1 and J3-3 both pulled down.

Replacement Parts



| | Part Number | Description |
|----|-------------|--|
| 1 | L5683 | Circuit Breaker, 30-amp, 3 Pole, 480V ETA |
| 1 | L5685 | Circuit Breaker, 50-amp, 3 Pole, 480V ETA |
| 2 | LEBNTB5669 | Main Control Board |
| 3 | LEBNSD5670 | Display Interface with Keypad |
| 4 | LEBNSQ5639 | Element Sequencer Control Board (must specify boiler size when ordering) |
| 5 | L5529 | Contactora, 60-amp, 3 Pole Square D |
| 6 | LEBNB5515 | Heating Element 15 kW 208V w/gasket |
| 6 | LEB5517 | Heating Element 15 kW 240V w/gasket |
| 6 | LEB5516 | Heating Element 12 kW 480V w/gasket |
| 6 | LEB5518 | Heating Element 20 kW 480V w/gasket |
| 6 | LEB5518-23 | Heating Element 23 kW 480V w/gasket |
| 7 | L5575 | Element Gasket |
| 8 | LUFUSE0443 | Fuse, 32V, 2-amp Mini Blade Fast Acting (Control Board) |
| 9 | LXPLG5580 | Element Hole Plug |
| 10 | L5734 | Low Water Cutoff Control Module |
| 11 | L5735 | Low Water Cutoff Sensor Probe |
| 12 | LUSW9156 | Low Water Cutoff Pushbutton Switch |
| 13 | L5539 | High Limit, Auto Reset 210° F |

| | Part Number | Description |
|----|-------------|--|
| 14 | L5531 | High Limit, Manual Reset 220° F |
| 15 | LUSW1145 | Door Safety Switch Power Panel |
| 16 | LULAMP2289 | Indicator Light Green, 125VAC |
| 17 | L5086 | Terminal Block 6 Position, 30-amp |
| 18 | LVLUG3660 | Terminal Block, 3 Pole, 380-amp Main Power |
| 19 | LVLUG2340 | Ground Lug 250M-6 GA |
| 20 | LVLUG5000 | Ground Lug 2-14 GA |
| 21 | L5457 | Temperature/Pressure Gauge |
| 22 | L5465 | Air Vent |
| 23 | L5452 | Pressure Relief Valve 30psi |
| 23 | L5454 | Pressure Relief Valve 125psi |
| 24 | L5541 | Transformer 24VAC, 40VA Control |
| 25 | LUFUSE0440 | Fuse, 250V, 2-amp Glass Fast Acting |
| 26 | L5681 | Circuit Breaker, 15-amp, 1 Pole, 120V Square D |
| NS | LWFSB | Temperature Sensor Supply Water |
| NS | LWFSNR | Temperature Sensor Return Water |
| NS | LWFS25F | Temperature Sensor Outdoor |

NS = Not Shown

Boiler Maintenance

The boilers are designed to give years of worry free service. Just like any other piece of mechanical heating equipment they require annual inspection and maintenance for optimal performance. Improper maintenance and missed inspection can lead to such issues as wire connection failure, electrical component failure, excessive noise, and element failure.

CAUTION

ALWAYS DISCONNECT ELECTRIC POWER FROM BOILER BEFORE PERFORMING MAINTENANCE.

1. **Boiler Water** – water treatment is strongly suggested to prevent scale deposits, corrosion, and other chemicals that can be harmful to the boiler elements and internal components. Periodic testing of the boiler water should be performed to maintain water properties as described in this manual, see water treatment section. A qualified water treatment specialist should be consulted to establish a proper water treatment program.
2. **Electrical System** – dust build up, foreign matter, and excessive moisture can cause damage to boiler contactors, relays, and wiring connections. Inspect both the interior and exterior of the boiler and clean as needed. Always clean the interior of the boiler with source power **OFF**.
 - a. Electrical Connections – with power **OFF**, routinely check the tightness of electrical connections. This includes power entrance lugs, fuses or contactors, and circuit breakers.
 - b. Contactor Inspection – check for burned contacts, discolored wire connections, and overheated coils. Contactors that chatter or hum should be thoroughly cleaned and inspected. Replace as needed.
 - c. Heating Element Inspection – make sure wire connections are tight and corrosion free.
 - d. Overall Inspection – check the entire boiler wiring harness for frayed or damaged wires. Replace any damaged wires that may come in contact with metal parts.
3. **Boiler Mechanical System** – routinely inspect the boiler and adjacent piping for any signs of water leaks or corrosion.

CAUTION

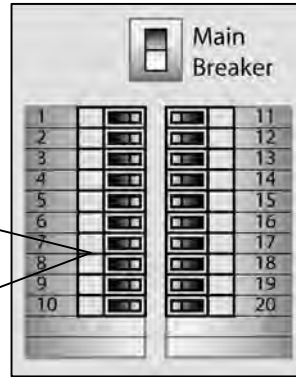
ALWAYS DISCONNECT POWER WHEN SERVICING INTERNAL COMPONENTS OF THE BOILER.

- a. **Boiler Elements** – these are screw-in elements with gasket. If there is indication of a leak near an element, remove the element and inspect the element gasket. Clean the element and boiler threads. Clean or replace the element gasket as needed. **DO NOT OVERTIGHTEN ELEMENTS.**
- b. Check for leaks – repair any leaks on the boiler or piping near the boiler which may cause water to enter the boiler enclosure.
- c. **Boiler Vessel Inspection** – the interior of the boiler vessel must be inspected annually. Remove the 3” inspection plug on the inlet side of the boiler. If there is evidence of scale or excessive sediment inside the boiler vessel, proper steps must be taken to flush and clean the boiler. Consult a local water treatment company for the best course of action. Scale formation will shorten the life of the elements and cause unpredictable control issues as well as excessive noise.
- d. While inspecting the boiler vessel, remove and clean the low water cut off probe.

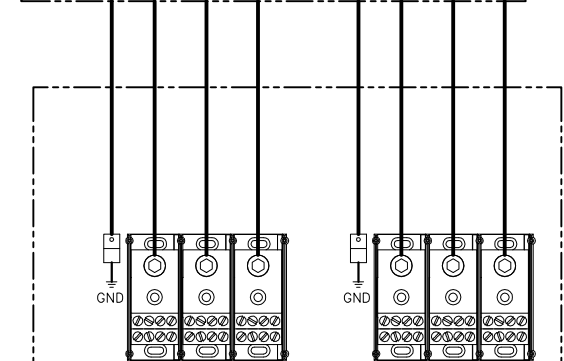
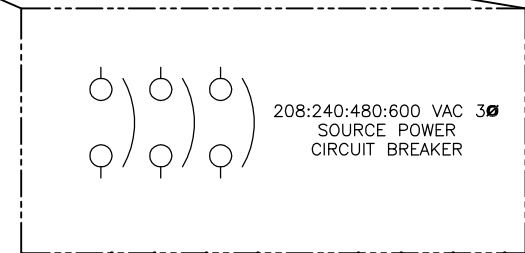
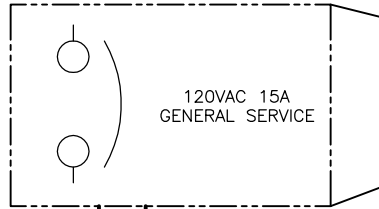
ELECTRIC BOILER HOOKUP DRAWING

CUSTOMER SUPPLIED
SERVICE PANEL

CONTROL BOX (DOOR)

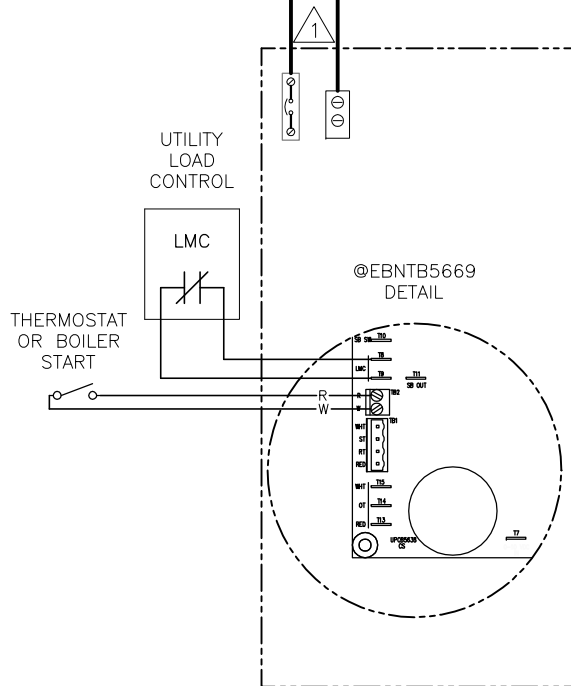


BOILER
MAIN UNIT



POWER DISTRIBUTION BLOCKS

BOILER ELEMENTS
SOURCE POWER FEED



⚠ WARNING: RISK OF ELECTRIC SHOCK. THIS UNIT IS CONNECTED TO MORE THAN ONE ELECTRICAL CIRCUIT. DISCONNECT ALL ELECTRICAL CIRCUITS BEFORE SERVICING.

ELECTRIC BOILER
FIELD SUPPLIED
MAIN POWER
DISCONNECT

