



Industrial Series

Electric Hot Water Boiler

EB-NB Series

Installation & Operating Manual

See page 1 Specification Chart for specific model by voltage and kW size.

Evaluate utility service/utility transformer feed. EB-NB 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 EB-NB 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 – Theoretically, the element life is increased with a 3-wire Delta service. However, a special ground fault protection kit must be added to this basic model. Electro Industries' EB-N-GFM-KIT is available for this boiler and includes Bender insulation resistance ground fault detector with wiring kit and instructions. The addition of this kit to the EB-NB 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.

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, Electro-Boiler utility transformer, building service entrance ground lug, etc. must be **bonded** to the same facility grounding electrode system.

Application – retrofit, dual boiler – see drawing BX803 for suggested minimum valving, controls included for switchover from remote utility device or outdoor temp.

- New installation or replacement – sized for full load capacity, internal controls have backup troubleshooting features for emergency heating.

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 page 1 for the vessel size.

Limited Warranty Statement – see document XX024 included in this installation manual.

Drawings: BX802, BX803, BH801, BH802, UAW452, XX024



Table of Contents

Specification Table	1
Dimensional Drawings	2
Handling & Storage	3
Placement & Mechanical Information	3
Installation Requirements	5
Electrical Installation	
Preparation	6
Power Feed	7
Control Box	7
Additional Safety Control Options	8
Multiple Boilers, Same System	8
Dual Boilers/Dual System	8
Temperature Sensing & Alarm Control Board (TS & A)	9
Control Option	12
Pre-Start or Setup	13
Observations	14
Startup Inspection	16
Troubleshooting	17
Emergency Override	23
Accessories	24
Replacement Parts	24

Support Documentation:	BX802
	BX803
	BH801
	BH802
	UAW452
	XX024

Specification Table

Electric Supply

Model	Volts	kW	Btu/h Output	Amps 3-Phase		Element Quantity	Steps	Flow Rate @20° ΔT Required GPM	Boiler Weight
				Feed #1†	Feed #2†				
EB-NB-72-600	600	72	245,736	70	-	6	6 @ 12	25	690
EB-NB-84-600	600	84	286,692	81	-	7	7 @ 12	29	695
EB-NB-108-600	600	108	368,604	105	-	9	9 @ 12	37	700
EB-NB-120-600	600	120	409,560	93	24	10	10 @ 12	41	705
EB-NB-144-600	600	144	491,472	93	46	12	12 @ 12	49	710
EB-NB-160-600	600	160	546,080	154	-	8	8 @ 20	55	695
EB-NB-200-600	600	200	682,600	154	39	10	10 @ 20	68	700
EB-NB-240-600	600	240	819,120	154	77	12	12 @ 20	82	705
EB-NB-300-600	600	300	1,023,900	154	135	15	15 @ 20	102	710
EB-NB-300-600H	600	300	1,023,900	154	135	13	13 @ 23	102	750
EB-NB-84-480	480	84	286,692	101	-	7	7 @ 12	29	695
EB-NB-108-480	480	108	368,604	116	15	9	9 @ 12	37	700
EB-NB-120-480	480	120	409,560	116	29	10	10 @ 12	41	705
EB-NB-144-480	480	144	491,472	116	58	12	12 @ 12	49	710
EB-NB-160-480	480	160	546,080	193	-	8	8 @ 20	55	695
EB-NB-200-480	480	200	682,600	193	48	10	10 @ 20	68	700
EB-NB-240-480	480	240	819,120	193	96	12	12 @ 20	82	705
EB-NB-300-480	480	300	1,023,900	193	169	15	15 @ 20	102	710
EB-NB-300-480H	480	300	1,023,900	193	169	13	13 @ 23	102	750
EB-NB-60-208	208	60	204,780	167	-	4	4 @ 15	21	716
EB-NB-75-208	208	75	255,975	209	-	5	5 @ 15	26	721
EB-NB-105-208	208	105	358,365	292	-	7	7 @ 15	36	721
EB-NB-150-208	208	150	511,950	292	125	10	10 @ 15	50	731
EB-NB-180-208	208	180	614,340	292	210	12	12 @ 15	61	737
EB-NB-60-240	240	60	204,780	145	-	4	4 @ 15	20	716
EB-NB-75-240	240	75	255,975	181	-	5	5 @ 15	26	721
EB-NB-105-240	240	105	358,365	253	-	7	7 @ 15	36	721
EB-NB-150-240	240	150	511,950	289	73	10	10 @ 15	51	731
EB-NB-180-240	240	180	614,340	289	145	12	12 @ 15	61	737

† Actual calculated amps, not service rating.

Options

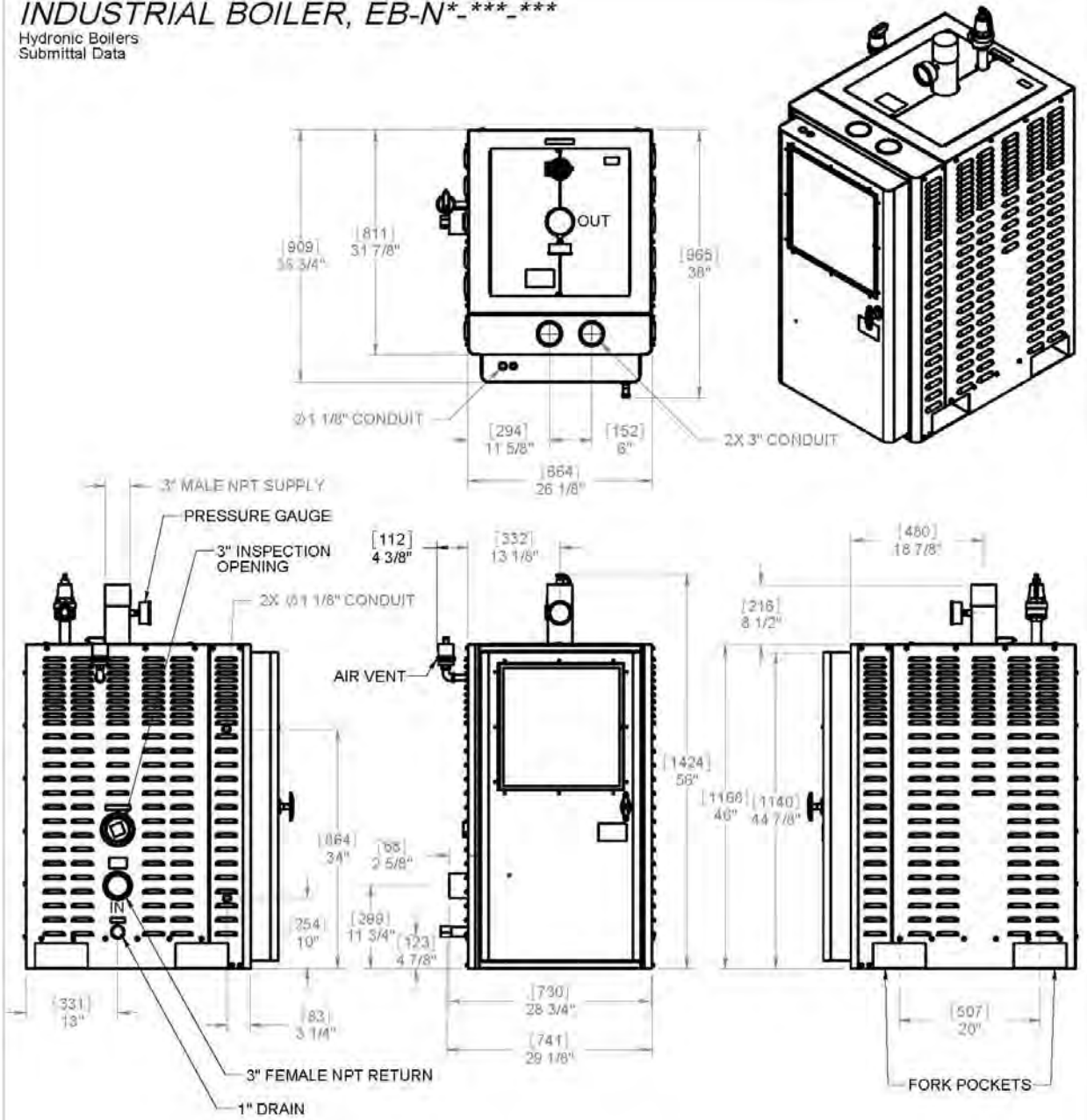
EB-N-GFM-KIT – Ground fault monitor kit. ONLY suitable for use with dedicated 3-wire Delta service with unbonded neutral. Not suitable for WYE service or non-dedicated 3-wire Delta.

EB-NB-***-***H – 125 psi vessel and relief valve.

Dimensional Drawings

INDUSTRIAL BOILER, EB-N* - *** - ***

Hydronic Boilers
 Submittal Data



CLEARANCES

	MINIMUM CLEARANCE FROM COMBUSTIBLE SURFACES		SUGGESTED MINIMUM SERVICE CLEARANCE	
	INCHES	MM	INCHES	MM
BACK	0	0	0	0
LEFT	12	305	24	610
RIGHT	0	0	12	305
FRONT	24	457	38	914
TOP	28	660	28	660

DIMENSIONS ARE:
 [mm]
 IN

 ELECTRO INDUSTRIES, INC.
 MONTICELLO, MN 55362

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 page 2 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 PC WF cable, software CD, 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. Drawing BX803 represents the minimum valving suggestion by the factory.

- The control design includes provisions for utility load control, also see pages 8 and 9.

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 1/2" 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. Electro Industries, Inc., sponsors installation and service schools to assist the installer. **Visit our web site at electromn.com for upcoming service schools.** Note – if the trained and qualified contractor is not involved with this sale and installation, Electro Industries can require their representative to be onsite during startup. Typically this is a time and material extra charge, often on the original quotation sheet.

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. Electro Industries, Inc. 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 Electro-Boiler products relate only to the addition of the Electro-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 Electro Industries 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, EB-N-GFM-KIT module has been installed to maintain warranty.
- See nameplate and/or Specification page 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 page 1 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 page 1 Specification 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.

PC setup – this is further defined in its own section, but there are five operating **modes** and other setup possibilities relating to various applications, control options, and troubleshooting. These factory defaults are set up from the factory, so PC connection is not necessarily required but may be necessary if the order was not necessarily written up correctly. Packed loose is a PC software disk and special cable.

- TS & A reset
- 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 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 (like all Electro Industries products). 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/standby remote switch – most traditional Electro Industries’ products have a NORMAL/STANDBY front panel switch. This product does not have the switch itself, but has provisions for field installed switch. Locate the SB/SW tab approximately center left side of TS & A board and add a switch between this tab and a COM tab. When the SB SW point is pulled to common, the system is in standby or fossil fuel mode.

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 page 1 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 page 6 grounding details, the main unit ground lug is bonded to the building grounding electrode system.

Remote operating thermostat or operating device – there must be a closed contact between R and W (Temp Sensing and Alarm board) to initially active the electric elements and the pump relay on the Temp Sensing and Alarm board. This also activates the Sequencer for the staging contactor.

- 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.

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 Temp Sensing and Alarm 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.

Utility load control – if this is a required part of this installation, remove the left blue jumper (Temp Sensing and Alarm board) and route two wires to the utility load receiver.

Outdoor sensor (OT) – this series is factory shipped with a 25' (7.6 meter) cable and OT sensor. It has three push-on tabs at the TS & A board, bottom left.

If the mode = TS & A reset (factory default) the OT sensor must be installed and connected to measure the outdoor temperature. If the mode is **set point**, sensor does not have to be installed or connected.

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, but when there is a somewhat parallel route the sensor tip must be installed up, cable end must remain dry. Install at any shaded sun outside temperature location.

Fault detector – if 3-phase Delta service, verify Bender installation resistance fault detector model EB-N-GFM-KIT has been installed, module directly above control transformer.

Additional Safety Control Options

Remote or boiler room stop switch – a field provided stop switch with a normally closed contact can be easily wired into TB1-1 and 2. Simply remove the factory provided black/yellow jumper between 1 and 2 and connect the normally closed stop switch. If it is a push/pull (internal to stop switch), the alarm monitor LED will identify this function.

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 “EM stop” 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 alarm 4).

- 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).

Field added ground fault type detector, interlock safety – if there is a desire to incorporate the ground fault detector (in addition to or outside of Delta feed Bender kit EB-N-GFM-KIT) into the Temperature Sensing & Alarm module control as a hi-limit type device and monitor with the audible and alarm LED, the following steps can add this feature.

1. The external fault detector will required two normally closed independent isolated contacts. If only one is available an interposing 2-pole relay could be used.
2. Contact A is inserted in the black/yel wire in the 120 black wire before LWCO TB3.
3. The TS & A module top connector (J1) cable has the red and yellow/grn wires wire-nutted. Remove this wire-nut closure and route to contact B.
4. When the external fault detector double contacts open the element contactors immediately drop out and the TS & A module receives an open DC voltage which activates the audible and provides the LED #2 function.

Option remote, phone dialer, Web controller, zone controller, etc. – these are connected to the RS485 bus terminals. The installation information is within each of these devices.

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 page 1 chart for required flow **through each vessel**.

Boiler identification – each boiler is the same model and the standard equipped unit. Water flow design and operation will be considerably easier if each boiler is the same kW size and in fact the exact same model number, see page 1 chart.

System or boiler room temperature control – each boiler has its own safety LWCO, HL1, and HL2 temperature limits. The system temperature controller must be external and have a 0-10VDC analog output (example – Honeywell T775R) or a building energy management system. The temperature sensing for this central temperature controller would be in the header pipe away from any individual boiler. The output of this system temperature controller (0-10VDC) is connected to (in parallel to each boiler) the TS & A control board, lower right tab and common.

Dual Boilers/Dual System

Plumbing/valving – suggestion is represented on drawing BX803.

Utility load control – when the utility receiver is tied into the TS & A module LMC loop, as shown on BH801, the electric stages are terminated and there is a 24-volt output on tab “SB OUT”. This can be connected directly to the fossil fuel boiler W terminal. In this case the R and W at the TS & A module controls “SB OUT”. The fossil fuel boiler should not have R and W jumpered or go to a room type thermostat.

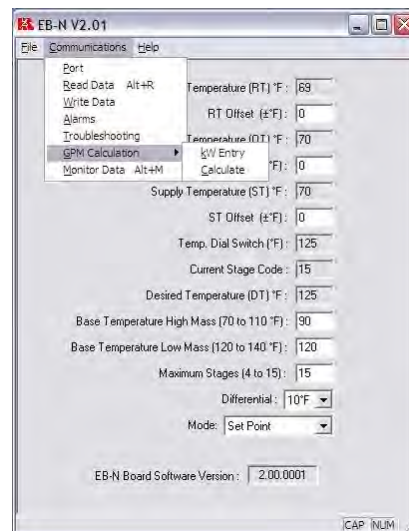
- The 24-volt common from the fossil fuel boiler needs to be tied to a COM tab on the TS & A board.
- In the case of an oil gun with T and T terminals, an isolation relay is required with the isolation relay contacts going to T and T.
- See previous section for electric/standby remote switch option.

TS & A Setup/Programming

This boiler is supplied with a PC CD. There are a multitude of setup functions on this CD. A PC with a USB connection is required. Based on the information the factory received for this specific model number and its application, this unit is pre-programmed with this information. However, the installer should verify the correct parameters, see the CD HELP file.

Comment: This is the basic information section for the PC CD program. Do not necessarily perform all steps at this time, when the appropriate sections appear in Prestart-up, Start-up, or Troubleshooting revert back to the following.

1. The flat cable connector is plugged into the TS & A J3 header connector. By looking at the end of the cable female you will notice one pin has a dummy plug. Observing the TS & A board pins you will notice there is one pin missing. This is the keying pin when inserting the cable flat connector.
2. Power must be on the TS & A board, green LED on.
3. Plug the cable into the PC USB connector.
4. Load in the CD software. The screen should look like the image below.
5. Keyboard – Alt → R, monitor field should be filled.
 - a. 3 temperature values
 - b. Base temperature values, should coincide with Fig. 1 and Fig. 2 (next section).
 - c. Maximum stages, should agree with the specific model number of this unit and as coordinated with page 1 model number chart.
 - d. Differential, this applies to **set point** mode only.
 - e. Mode, as currently setup.
 - f. Temp dial, the position of the temperature dial switch on the upper right corner of the board.
 - g. Current stage code, the sequencer output value.
6. Pull down the communication tab and observe the various functions.
 - a. **Write** is required to download any changes. Write downloads the complete screen and all values, whether you change them or not.
 - b. Troubleshooting and GPM calculation are convenience functions, see Troubleshooting section.
7. See the appropriate section in the manual where this procedure is used.
8. Read HELP file.



Setup

Your EB-NB series boiler is easily set up using a PC computer, the furnished software disks, and the furnished USB cable. Simply attach the USB cable to your PC and the J3 header on the control board and install the EBN software using the enclosed instructions. Your EB-NB boiler is now ready to configure.

Temperature Sensing & Alarm Control Board (TS & A) – The TS & A control board in EB-NB boiler monitors various alarm components and utilizes three different temperature sensors in order to determine the boiler’s proper heat level and number of stages to activate. It communicates this information to the sequencer board, which activates and deactivates heating stages as needed.

In order to handle the various input or monitor devices and relate them to the boiler staging operation, this TS & A board must be setup to select the correct **MODE** for the specific application or installation. This MODE setup selection is via the PC CD download arrangement (see the previous section). These setup modes are as follows:

Set point – this requires supply sensor only, and works as an electronic aquastat in the supply water outlet pipe. The temp dial switch has 8 positions (0-7) and the decal lists the operating temperature relating to each of the 8 positions.

The differential (or the lower temperature re-engage point) is entered from the PC CD download. Factory default is 10° F (-12° C).

Temperature Dial Settings			
Switch Position	Mass	Mode	
		Set Point	Reset @ 0°F
0	High	125°	120°
1	High	135°	130°
2	High	145°	140°
3	High	155°	150°
4	High	165°	160°
5	Low	175°	170°
6	Low	185°	180°
7	Low	195°	190°

UAI344 B

TS & A reset – this mode requires an outdoor sensor (OT, bottom left corner), supply sensor, and a temp switch dial setting relating to a 0° F (-18° C) OT operating point. For this unit and Electro’s definition of RESET, the supply water or the boiler vessel temperature is raised as it gets colder outside, see Fig. 1 and Fig. 2. The same temp dial switch (0-7) is used to select the OT versus ST temperature relationship shown on Fig. 1 and Fig. 2. In this case the dial selection or value has a 0° F (-18° C) reference as represented by the curve numbers.

Example – if the temp dial switch is set on 3, and is the OT sensor is reading 10° F (-12° C), the boiler staging will be controlled at 140° F (60° C) ST (this point is referred to as DT).

The baseline (90° or 120° horizontal) determines the slope of each required line (Fig. 1 and Fig. 2). This baseline can also be field selected, but it is part of the PC CD download.

Fig. 1 - High Mass

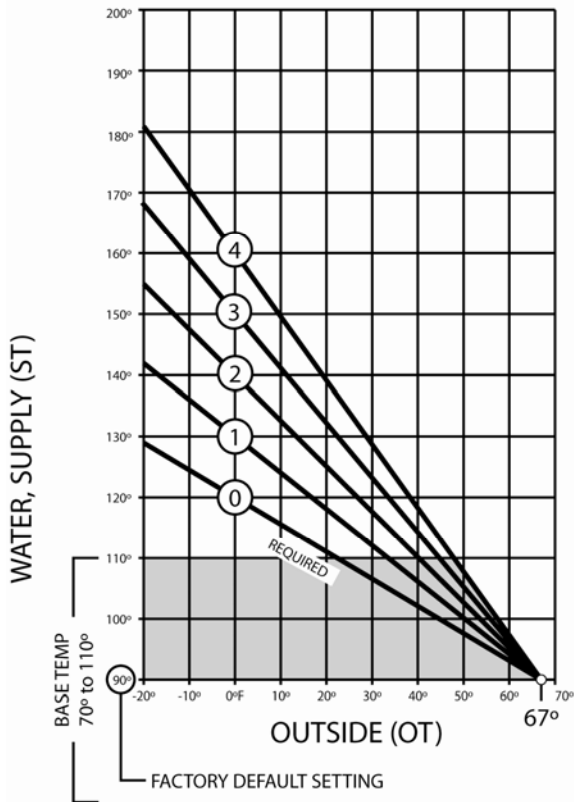
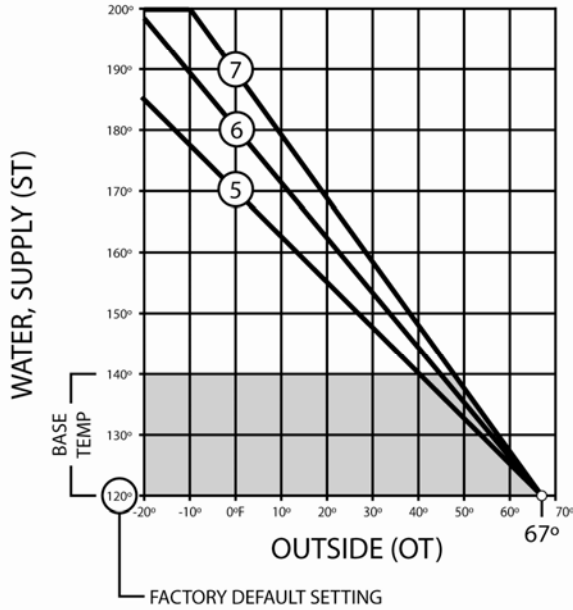


Fig. 2 - Low Mass



ART-258-00 1.0

T775R – if the optional Honeywell T775R controller is installed or used, select this mode. The T775R controller has a full range of programming features, its own supply sensor, and its own outdoor sensor. The T775R outputs an analog 0-10VDC voltage level to the TS & A control board. The temperature control management is then a function of this 0-10VDC level (see option section).

0-10VDC input – if this application includes a building system Energy Management Controller and it is determined this controller should control the boiler staging/temperature output, the 0-10VDC analog from the Energy Management is plugged into (with common) to the “0-10VDC” tab connector, left mid/bottom of this control board.

Troubleshooting – this is totally a manual mode for entering the number of element stages. It disconnects all temperature sensing and temperature set operations. It must “only be used” by properly trained installer or boiler room technician. Also, it should only be used when the qualified technician is onsite, operating and monitoring, the Electro-Boiler.

- This mode is required for the communication pull-down – troubleshooting and GPM calculation.
- After performing the manual stage entry function (troubleshooting) or GPM calculator, the mode must be set back to the requirement for this installation. Communication – WRITE must always follow any changes on the main screen.

⚠ WARNING

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

Control Option

Provisions and limited instructions are included in this manual for using a Honeywell T775R temperature controller. There is space in the control cabinet, upper right, for installing this T775R.

Basic hookup or connections – 24VAC power can be paralleled from the transformer secondary or the terminals on the left side of the TS & A board. Proper grounding is required.

The setup for this Electro-Boiler application is 0-10VDC output. Connect a wire between T775R MOD 1 terminal screw +W and at the bottom of the TS & A board the 0-10VDC tab.

The Honeywell sensors, etc. are connected and installed per manufacturer's instructions.

Setup mode – using PC setup software, the mode must be “T775R”.

Initial or basic programming – a minimal setup for sensor A with a set point differential could be as follows:

- Press menu (hold 5 seconds) – select output → MOD1 → type → 0-10VDC → min out % → set to 0% → integral → set to 0 sec → derivative → set to 0 sec → exit and home.
- Menu → program → MOD1 → set point → set to 170° → THROT RNG → set to 12° → sensor A → heat/cool heat → exit and home.

See Honeywell manual for sensor B and outdoor reset, other usage programming.

Pre-Start or Setup

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 (see Specification, page 1) 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 pages 4 and 5 – System Flush 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 TS & A 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 TS & A board green LED should be on, see the Operations section for definition of other LED’s. There should not be an alarm. If there is, check out the number of pulses on the alarm LED and troubleshoot as required.

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 TS & A, right center pushbutton

Delta feed, Option Fault Detector, EB-N-GFM-KIT – front panel setup:

- Both bit switches **up** – NO and 1 k ohm.
- Setting, suggest 5 to 6 k ohm for 480 system and 10 or more elements. If small boiler can probably set at 10 k ohm.
- Press TEST, 5 seconds – then RESET.

Control device or mode – with power now on the TS & A board, the procedure from the previous TS & A programming section can easily be run. Keyboard – Alt → R fills in the monitor data points and shows the current setup MODE. If the mode shown is correct for this application (refer back to previous section defining the five different modes) simply observe the other entries and proceed.

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 **Temp Sensing and Alarm** module (TS & A) LED's.

- Green – control power, control 120 CB on, proper fuse, 24-volt transformer
- Yellow – electric mode, not in utility interrupt or standby (SB)
- 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)
- Bright – alarm, count pulses*
 - 1 – auto reset limit
 - 2 – Bender ground fault monitor
 - 3 – LWCO, reset at TS & A, right
 - 4 – open TB1-1, 2 jumper (remote stop switch or flow switch, etc.)
 - 5 – manual reset hi-limit, reset at this control board
 - 6 – bad RT sensor
 - 7 – bad OT sensor
 - 8 – bad ST sensor
 - 9 – freeze
 - 10 – internal

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

Audible alarm – continuous alarm indicates a manual reset required.

Delta feed, Option Fault Detector, EB-N-GFM-KIT – study the enclosed Bender supplied sheets, important LED's.

- Top LED row – indicates impedance to ground measurement.
- Green – on – A1 and A2 power source connected.
- Amber – alarm – typically both can come on at the same time when there is a phase to ground low impedance or short. Alarm active, interrupts system and should also produce audible.
- Do not bypass this safety device.

WARNING

THIS FAULT DETECTOR HAS AN EXTREMELY IMPORTANT FUNCTION WITHIN THIS 3-PHASE, DELTA SERVICED UNIT. IT IS EXTREMELY IMPORTANT TO DETECT THE GROUNDING OF 1 PHASE AND IMMEDIATELY SHUT DOWN TO DETERMINE THE GROUNDING SOURCE AND REPAIR AS REQUIRED.

Temp dial switch – this dial switch must be set for either “set point” or “reset” **mode**. See pages 10 and 11.

Staging CB's, main unit – one per element stage, interrupts power from 480V 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.

***See Component Information, Familiarization section for further details regarding alarm.**

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

- The TS & A board, with its supply sensor, controls the stages to maintain a supply temperature represented by the dial switch selection. This sensing monitor and control applies to mode = **set point** and mode = **TS & A 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 at TS & A module (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 Electro 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 Electro 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.

Progressive sequencing examples:

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. Delta feed, Option Fault Detector, EB-N-GFM-KIT – reset and observe Bender unit, the LED's will be as follows:
 - ON – green – A1 and A2 power
 - Alarm – off
 - Top row – system impedance to ground – higher is good, expect > 10.
11. Using a volt meter, verify service power phase to phase voltage.
12. 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.
13. Close the external thermostat type R to W device. One minute delay, pump relay closes first.
14. Verify pump is on and water flow circulation.
15. If the mode is still TS & A **reset** or **set point** and assuming the vessel water is typically room temperature, the supply sensor should be looking for water temperature considerably higher than it probably is. Thus the controller should activate all stages attempting to bring up the water temperature.
 - Staging is verified by the behind the door staging monitor lights next to each staging CB
 - Main unit CB's are still off
16. 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.
17. Open the external R to W contact.
18. 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 model number chart on page 1 for specific installation requirement. This Electro-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 **is required**.

Delta feed, Option Fault Detector, EB-N-GFM-KIT – the alarm condition is also witnessed by Bender illuminating two amber lights. This unit monitors each phase and determines resistance to ground. If a phase is shorted or near shorted to ground the Bender activates its alarm internal function. At this point there has not necessarily been a severe power short condition within the boiler electrical system because as a “floating phase” delta system one phase can indeed be pulled to ground without an immediate problem. However, if a second phase is shorted to ground an immediate catastrophic ground fault and failure will exist. This catastrophic second phase shorting usually results in serious permanent damage within the boiler cabinet and/or associated wiring to the utility supply transformer.

CAUTION

IT IS ABSOLUTELY IMPERATIVE THE FIRST FAULT BE FOUND AND THUS THE BENDER ALARM BE TAKEN SERIOUS WITHOUT ATTEMPTING TO JUMPER OUT ANY OF THE ASSOCIATED SAFETY CIRCUITS.

Depending upon the characteristics of a **power outage**, the Bender unit may flash or pulse its amber LED's. This will also be the case if the top row has the left most LED on (infinity resistance) and/or there is an interruption of the power source monitor wires at Bender L1 or L2. It simply cannot sense enough information to calculate its internal resistive impedance on the power source circuits or wires.

1. First verify the power source voltage between Bender top screw terminals L1 and L2.
2. Check L1 and L2 to ground, will not necessarily be 277 (120) but should also not be 0 volts on one leg and very high on the other leg. Perhaps 200VAC to 300VAC would be okay.
3. The above voltage should verify proper fuses at the main unit upper left small fuse block.
4. If the unit still does not reset, call Bender for assistance, see enclosed Bender installation sheet.

Bender alarm, possible fault identification procedure –

1. Verify main unit top power source monitor fuses.
2. With the Bender alarm active, turn off all main unit staging CB's.
3. Reset the Bender and it should come back to a reset or normal condition.
4. If it does not reset, phase low resistance problem could be at the large power distribution block, wiring to staging CB's, power source monitor wire to Bender, main unit, Bender screw terminals L1 and L2. Next possible step is a failed Bender unit itself.
5. With the Bender unit in its normal mode, set the T775R controller for all sequencing relay stages on and monitor the main unit lights next to each CB. If the Bender unit activates an alarm, the problem is in the power source internal wiring associated with the contactors.
6. Energize one staging CB at a time while monitoring the Bender unit. As you proceed through the stages, when the Bender unit activates an alarm, that stage wiring circuit is identified. The Bender unit also has a row of LED's which provide an indication of the fault impedance or ohms, see Bender sheet.

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

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 measure at the Temp Sensing and Alarm module center left terminals and no PWR ON LED, TS & A control board is inoperative.
- If there is no 24VAC at TS & A module, troubleshoot transformer, fuse, 120 source, etc.

Diagnostics, Using PC & CD Software, Provided

Microprocessor controllers – both the TS & A and the Sequencer board have a plug-in software chip, verify code and software revision.

- TS & A V2.0*
- Sequencer 1.00 – (number of stages)

Manual, select stage operation – see PC software HELP file, when in the TROUBLESHOOTING mode, the communication tab – Troubleshooting – can be used to manually enter an operating stage number. When doing ENTER, the sequencer will immediately go to the stage number entered. Repeated manual stage number entry can take place, thus checking current, general observation, stage function checkout, etc.

WARNING

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

GPM calculator – since this unit has both a supply sensor (ST) and a return water sensor (RT), it is quite easy to calculate and monitor GPM.

This function requires PC hookup and the CD loaded and functional.

For this handy, real time, GPM calculator you will need to set the **mode** to TROUBLESHOOTING and the communication pull-down is GPM calculator.

1. Using the communication tab – Troubleshooting – stage code entry, setup the boiler capacity for a stable operating condition at a specific stable water flow.
2. Based upon the model installed and its electric element size, determine the kW usage for this particular stage code test run. See page 1 table. Enter kW value.
3. The displayed ST and RT represent the measured temperature.
4. The calculated GPM is a real time value based upon the entered kW converted to Btu.
5. PC is doing the formula:

$$\text{GPM} = \frac{\text{Btu output}}{500 \times \text{temperature differential}}$$

6. If the temperatures are not relatively stable, determine whether there is an optimum number of stages on, you may need to go back to the Troubleshooting/stage code entry and select a different element composite value. When doing this you **again need** to enter the correct kW for the current running condition (number of stages on).
7. When finished observing calculated GPM, simply exit the pull-down window.

Note: The mode will need to be changed back to the correct operating function for this particular installation (if needed see page 9 outlining the 5 modes).

Troubleshooting Chart

Information – the following statements and codes should assist in working through this troubleshooting chart.

1. Basic observation, basic concern.
2. The TS & A main board has five setup modes which are programmed and selected with the PC software disk furnished with the unit. The software/PC HELPS selection can provide selection and entry information. This also requires a special cable for PC or laptop communication with the TS & A control board. See Operations Manual page 9 and following.
3. Heating stat call W – 1 = on or 24VAC from the R screw, 0 = off or no switch closure from R.
4. Load Control – utility blue wire connection – 1 = closed or off-peak, 0 = open or on-peak.
5. TS & A main board LED – there are three LED's which can provide information for the appropriate troubleshooting line (two others – green = general power on and alarm which have their own illumination/pulsing information further detailed within the Operations Manual, page 14). As stated means illuminated.
6. ST vs. DT – these measured temperature values are displayed on the PC software. If this monitor is not on the PC screen, other means of determining vessel temperature could be used. If $ST > DT$, elements will be off.
 - a. DT – the desired or program set point at any one instant or setup condition. If “set point” mode it is from the temperature set dial switch. If reset mode, Operations Manual page 11 provides some graphing or chart information in reference to outside (OT) temperature sensing.
 - b. ST – the vessel supply temperature.
7. 10VDC, T7 – if there is an external device providing an analog 0-10V input to determine temperature operating set point, a DC meter can monitor this tab and determine the correct operation of the external device or input.
 - a. T775R – Honeywell controller properly programmed for 0-10 output.
 - b. 0-10VDC input – building or system energy management device with analog output.
8. Sequence LED – inside the main cabinet, bottom, is a control board which steps in and controls the various element power stages. This LED has three monitoring states (Ver. 1.10 and above) which can be used to isolate this control board. The condition of the vessel top auto reset hi-limit can also be observed from this green LED.
 - a. Solid on – no heat call, no stages on, simply adequate control power.
 - b. Slow pulsing (1 second on/1 second off) – SYS ON indicating there is an operational sequence started, basically a “call for heat” action, and there should be one power stage on.
 - c. Fast pulsing (10 per second) – same as slow, except more than one power stage on.
9. Power stage lights – main unit inside indicator lights representing which staging contactors are closed.
10. Statement of action, but not happening.
11. Specific part to change out or further verify with heating/electrical contractor's best practices.

Symptom	TS & A Mode	Stat Call W	Load Control (LMC)	TS & A LED	ST vs. DT	10VDC T7	Sequence Board LED	Power Stage Light	Expected Action	Remedy
1	2	3	4	5	6	7	8	9	10	11
No elements on	Set point	0	1	Yel	Not concerned	N/A	On	None	Heating	Wrong conclusion, no stat W in
No elements on	Set point	1	0	Red-W	Not concerned	N/A	On	None	Heating	Wrong conclusion, utility load control, on-peak
No elements on	Set point	1	1	Yel Red-W Red-SYS	ST > DT (+15° typical)	N/A	Slow pulse	None	Heating	Vessel warmer than set point
Some elements on	Set point	1	1	Yel Red-W Red-SYS	ST < DT	N/A	Fast pulse	Several	More stages on	Could be ST close to DT
One element missing	Set point	1	1	Yel Red-W Red-SYS	ST < DT	N/A	Fast pulse	All but one	All stages on	Check appropriate staging contactor or hookup wires or electric element
No elements on	Set point	1	1	Yel Red-W Red-SYS	ST < DT	N/A	On	None	Several stages on	Verify auto reset HL closed (J3-8 at seq. must be 24V)
No elements on	Set point	1	1	Yel Red-W Red-SYS	ST < DT	N/A	Slow pulse	None	Several stages on	Main board is not outputting BCD code or cable J2-1 – J2-4 open
Incorrect elements on	Set point	1	1	Yel Red-W Red-SYS	ST < DT	N/A	Fast pulse	Some	Some	Sequence board not outputting correctly, replace
Some elements on	Set point	1	1	Yel Red-W Red-SYS	ST < DT (+10° typical)	N/A	Fast pulse	Some	Some, but not correct	Power contactors or electric element
Some elements on	Reset	1	1	Yel Red-W Red-SYS	ST < DT (+10° typical)	N/A	Fast pulse	Some	Some, but not correct	Power contactors or electric element
All of the above 9 symptoms/lines could relate to Reset mode.										
Some elements on	T775R	1	1	Yel Red-W Red-SYS	N/A	> 2VDC	Fast pulse	Some	Some, but not correct	External controller not outputting correct 0-10V
No elements on	T775R	1	1	Yel Red-W Red-SYS	N/A	< 0.5V	Slow pulse	None	Heating	External controller not outputting
The above first 9 lines can also apply, depending upon 0-10VDC input.										
No elements on	0-10VDC input	1	1	Yel Red-W Red-SYS	N/A	< 0.5V	Slow pulse	None	Heating	External controller not outputting
The above first 9 lines can also apply, depending upon 0-10VDC input.										

Component Information, Familiarization

Temp Sensing and Alarm module (TS & A) – this intermediate control board can have five main functions – alarm monitor and visual, convert 0-10VDC input to digital output for Electro sequencer, electronic aquastat control, Electro WarmFlo outdoor reset function, optional RS-485 bus remote monitor devices, optional energy management controller input.

- LED monitors, also see page 11
- Temp set point, only if setup specifies “TS & A set pt.”
- HL manual reset is on this board
- LWCO reset is on this board
- DC voltmeter can verify 0-10VDC input from other external controller (T775R) or building energy monitor system
- Alarm LED pulses identify specific sensor causing audible and shutdown, see page 11
- RS485 remote terminal block can operate other external devices, see their appropriate information sheets

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 TS & A 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 there is an alarm, four LED pulses. 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 Temp Sensing and Alarm module which activates an alarm and 1 pulse alarm LED.

Bad sensor, alarm pulses – the alarm LED will indicate which sensor for the Temp Sensing & Alarm module 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 alarm LED 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 MODE = TS & A. Set to 0° F (-18° C), boiler should be operating at full output and probably all stages on
- ST sensor – set to 50° F (10° C), all stages are probably on (if MODE = TS & A) because this is significantly well below set point

Alarm, freeze – the ST sensor is sensing a value less than 45° F (7° C). Thus the audible is indicating perhaps this should be checked out.

Alarm, internal – there is some internal logic checks associated with delays, etc; these are not comparing correctly. There is a possibility the system is still working and heating but this is a service notification.

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

TS & A, 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, Electro – this rotating relay output board receives 16-bit binary information from the TS & A 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.

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.

TS & A inoperative, 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.

Electrol 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

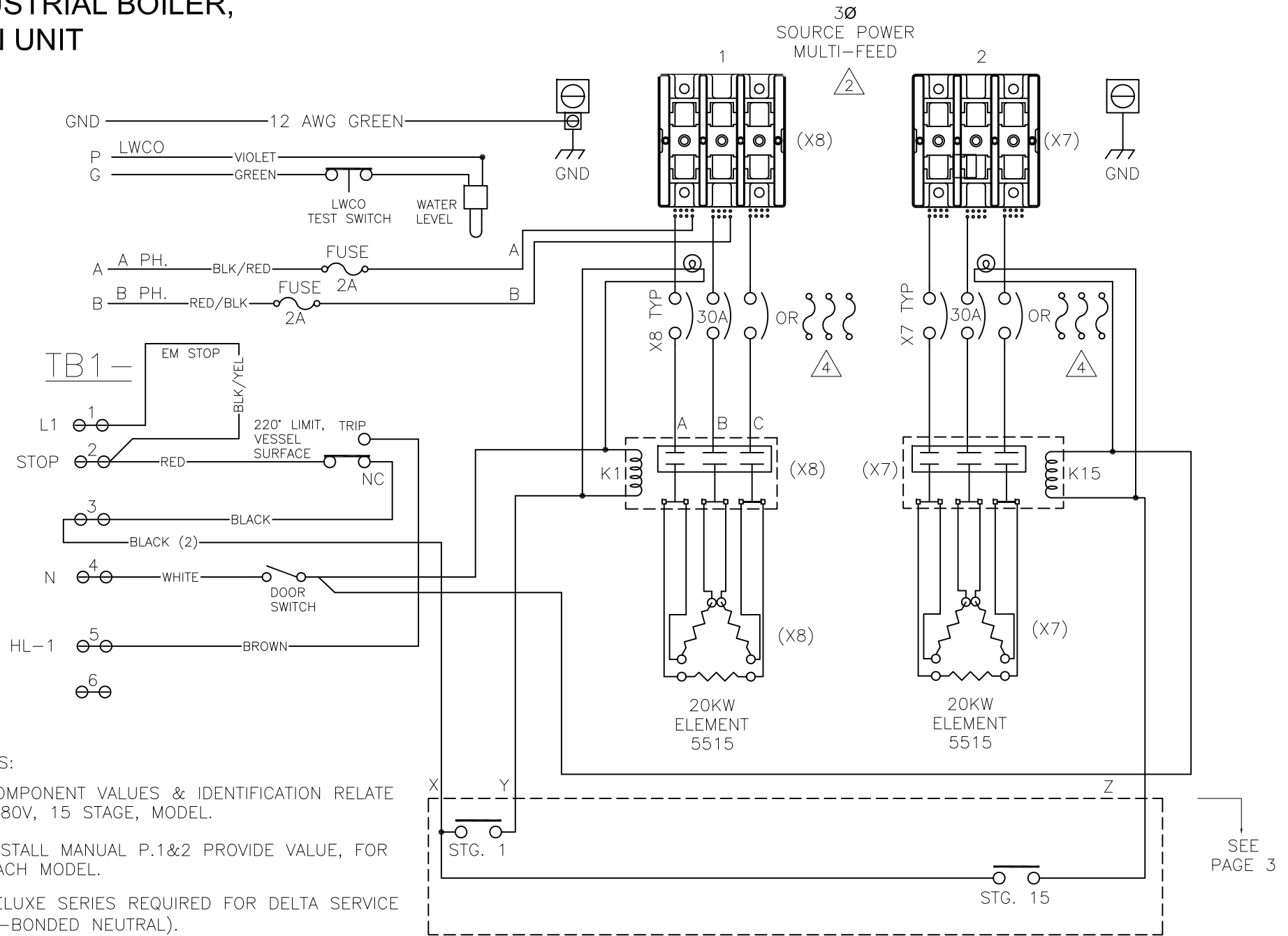
The X's in any horizontal stage column would mean a jumper to ground or control common. The Sequencer will immediately go to that specific stage. Example – stage 10, J3-1 and J3-3 both pulled down.

Accessories

Replacement Parts

Part Number	Description
5518	Heating elements – 20 kW 480V
5517	Heating elements – 15 kW 240V
5515	Heating elements – 15 kW 208V
5575	Element gasket
XPLG5580	Element plug
UFUSE0440	Fuse, 24V, 2A
VLUG3660	TB, 480, Ferraz-Shawmut
5529	Contactora 50A, Square D
ULAMP2286	Panel lights
5683	CB, 3-pole 30-amp 480V, ETA
5681	CB, 120, 15A, Square D
5685	CB, 3-pole 50-amp 480V, ETA
5541	Transformer, 24VAC, 40VA
5452	Pressure relief valve, 30 psi
5454	Pressure relief valve, 125 psi
5457	Gauge – Temp/Pressure, Miljoco
5561	Low water cutoff, ITT
5569	Low PSI sensor, ITT
5531	HL, M Reset, 14T
5539	HL, A Reset, 210, Nason
5694	Bender, Fault Detector
UFUSE6645	Fuse, Bender monitor wires

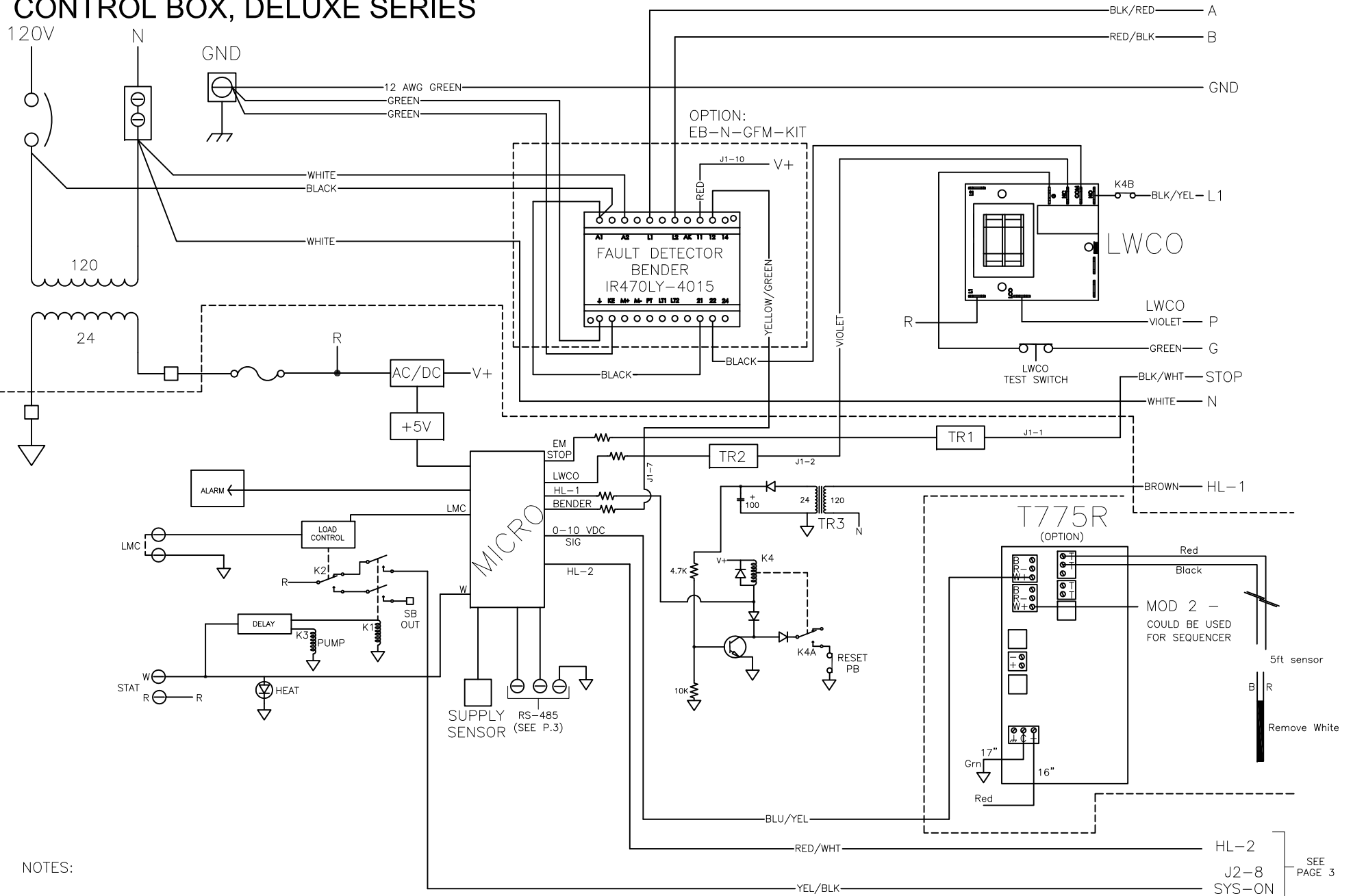
INDUSTRIAL BOILER, MAIN UNIT



NOTES:

1. COMPONENT VALUES & IDENTIFICATION RELATE TO 480V, 15 STAGE, MODEL.
2. INSTALL MANUAL P.1&2 PROVIDE VALUE, FOR EACH MODEL.
3. DELUXE SERIES REQUIRED FOR DELTA SERVICE (NON-BONDED NEUTRAL).
4. IN 600V MODELS FUSES REPLACE CIRCUIT BREAKERS.

INDUSTRIAL BOILER, CONTROL BOX, DELUXE SERIES



NOTES:

1. BASIC SERIES DOES NOT INCLUDE BENDER & T775R CONTROLLER, NOT REQUIRED FOR "Y" 3Ø.

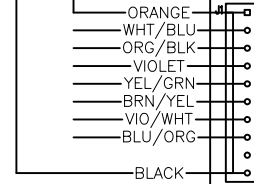
HL-2
J2-8
SYS-ON
J1-8
SEE PAGE 3

INDUSTRIAL BOILER ELECTRO SEQUENCER

SEE P.1

X

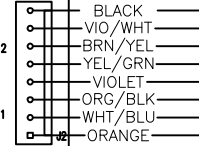
Y



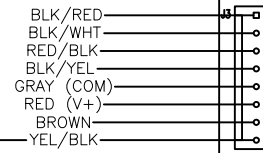
SEE P.1

X

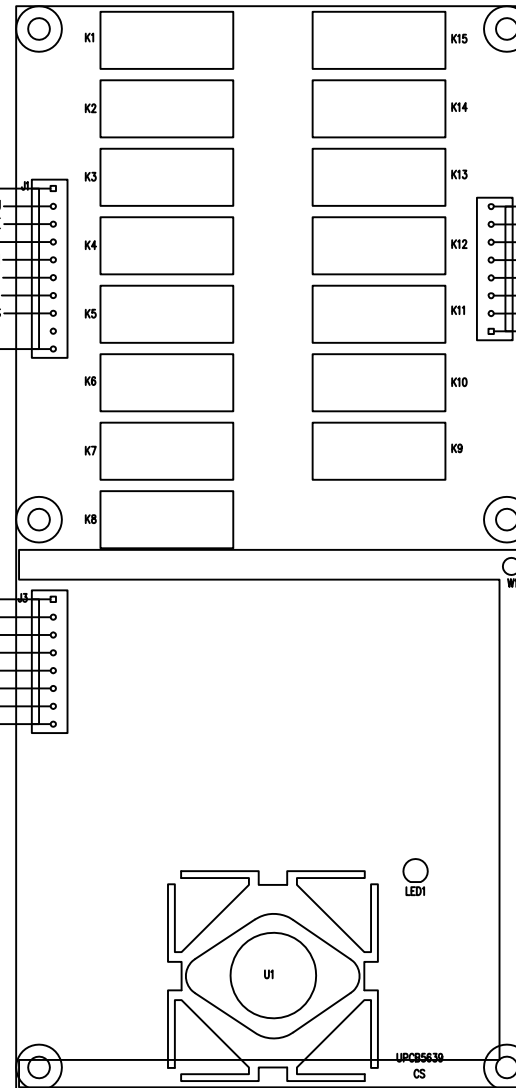
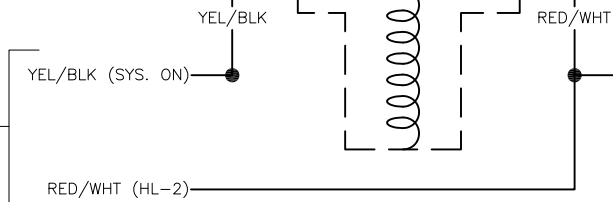
Z



PROBE IN
VESSEL
210°



SEE
PAGE 1



INDUSTRIAL BOILER CONTROL BOX

CB, 15A



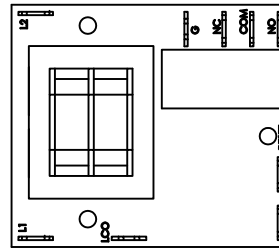
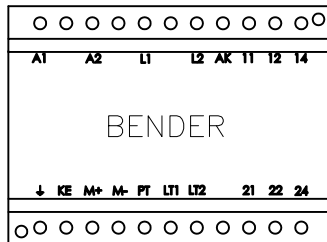
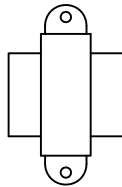
VLUG3630



VLUG5000

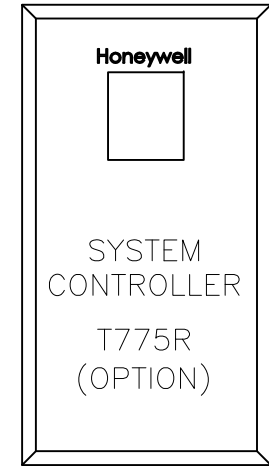
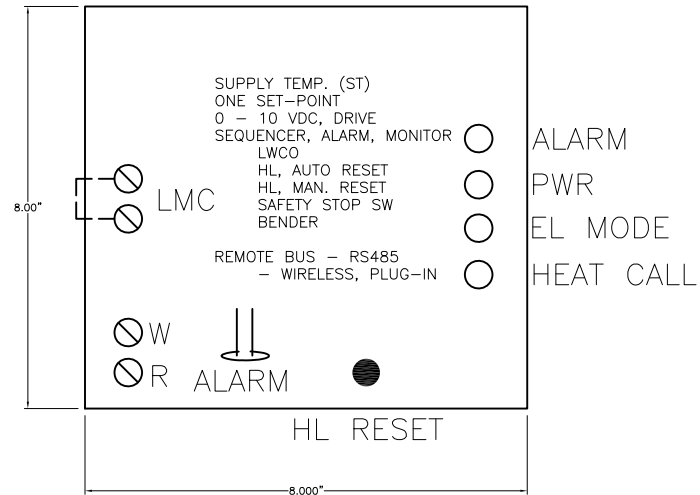


#5541

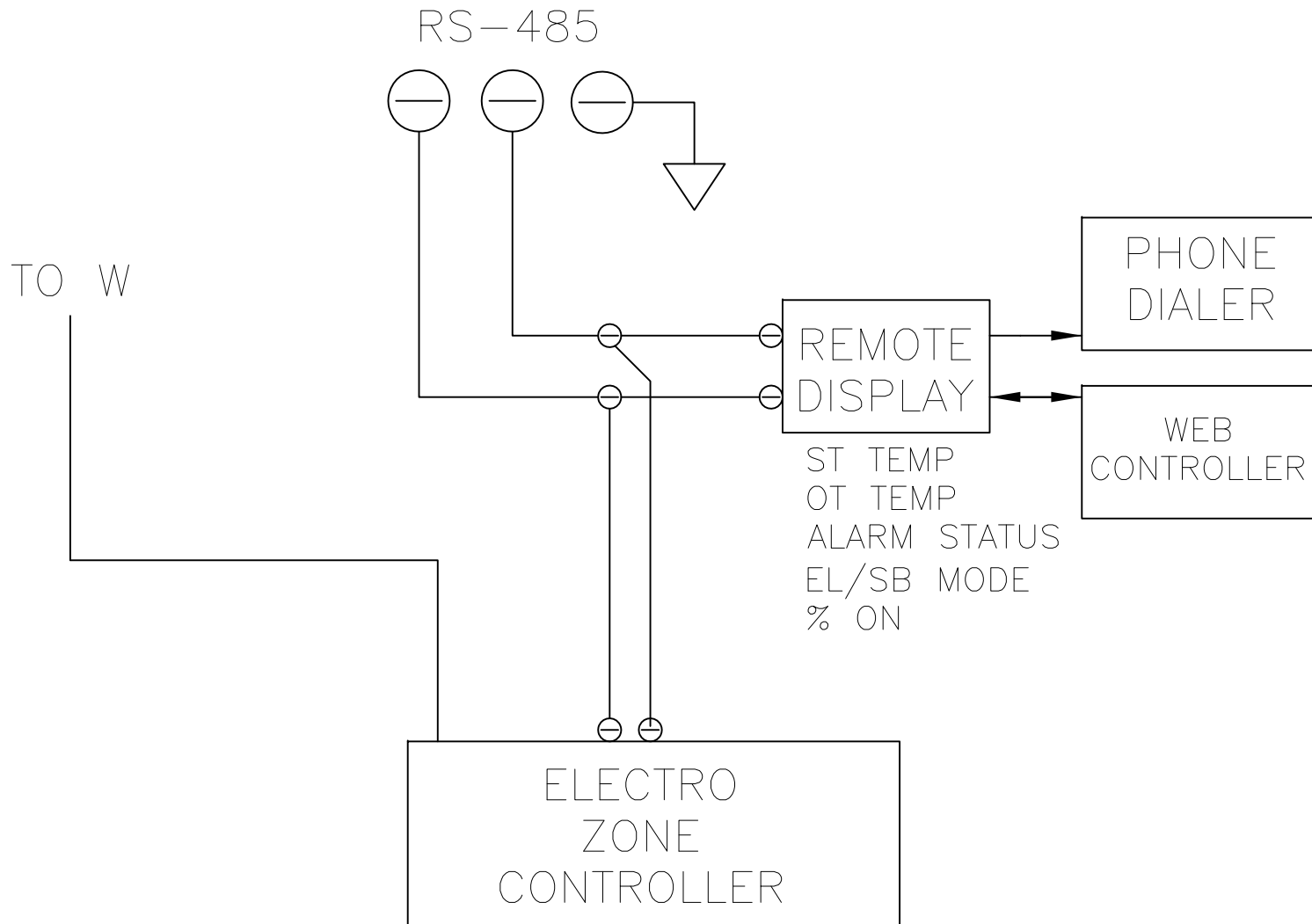


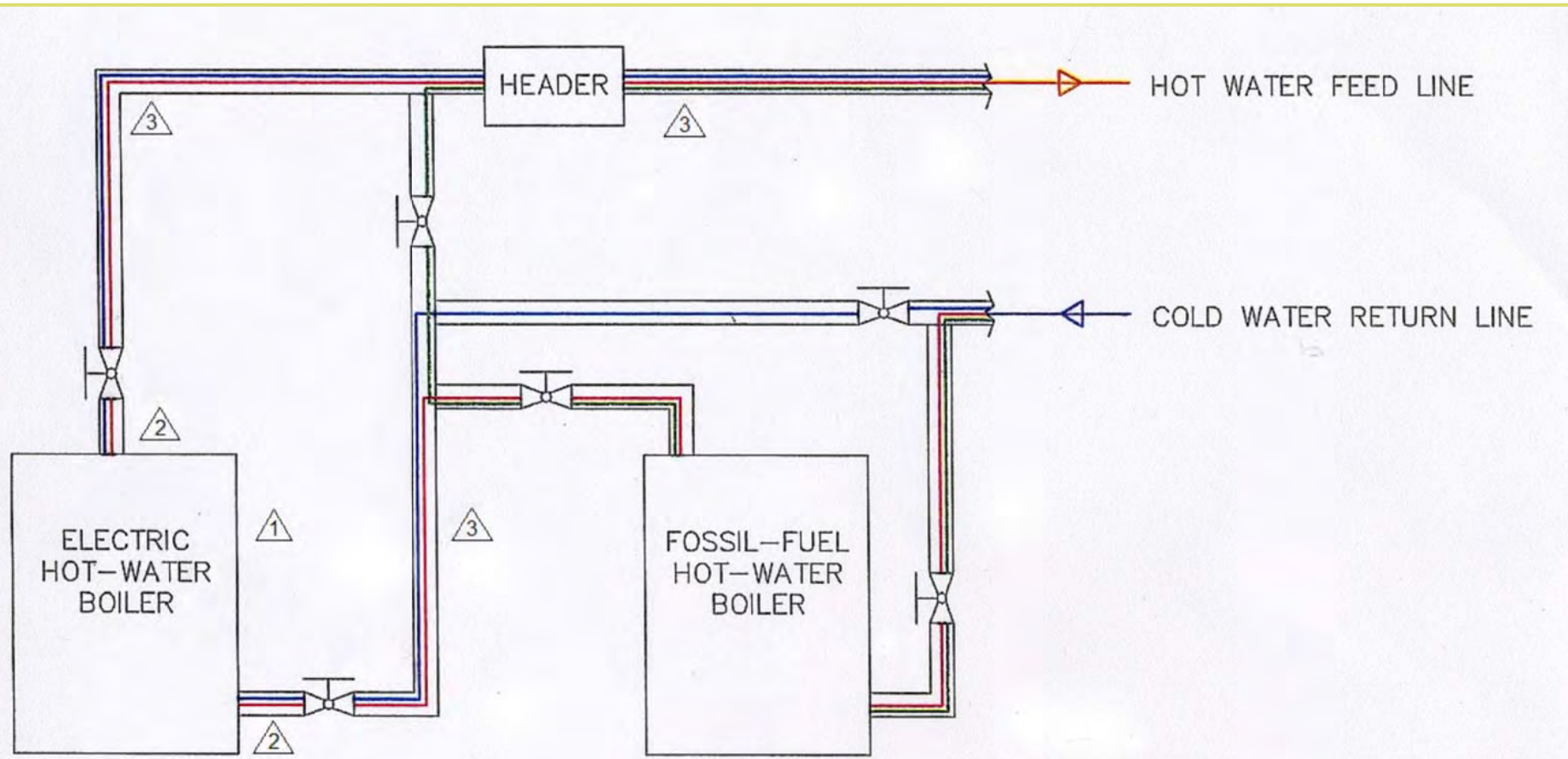
LWCO

TEMP SENSING & ALARM



INDUSTRIAL BOILER CONTROL OPTIONS





NORMAL OPERATION : —
 FOSSIL OPERATION : —
 ELECTRIC OPERATION : —

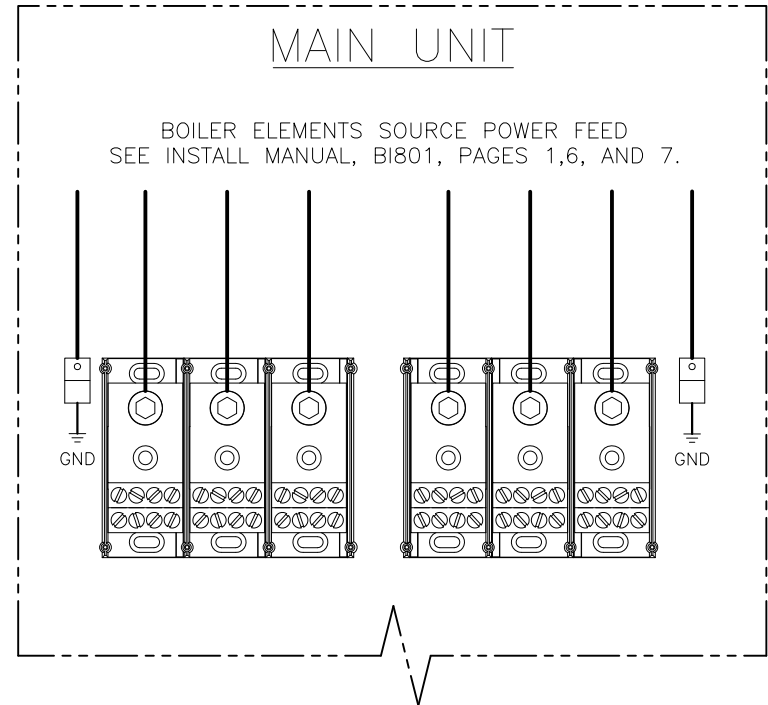
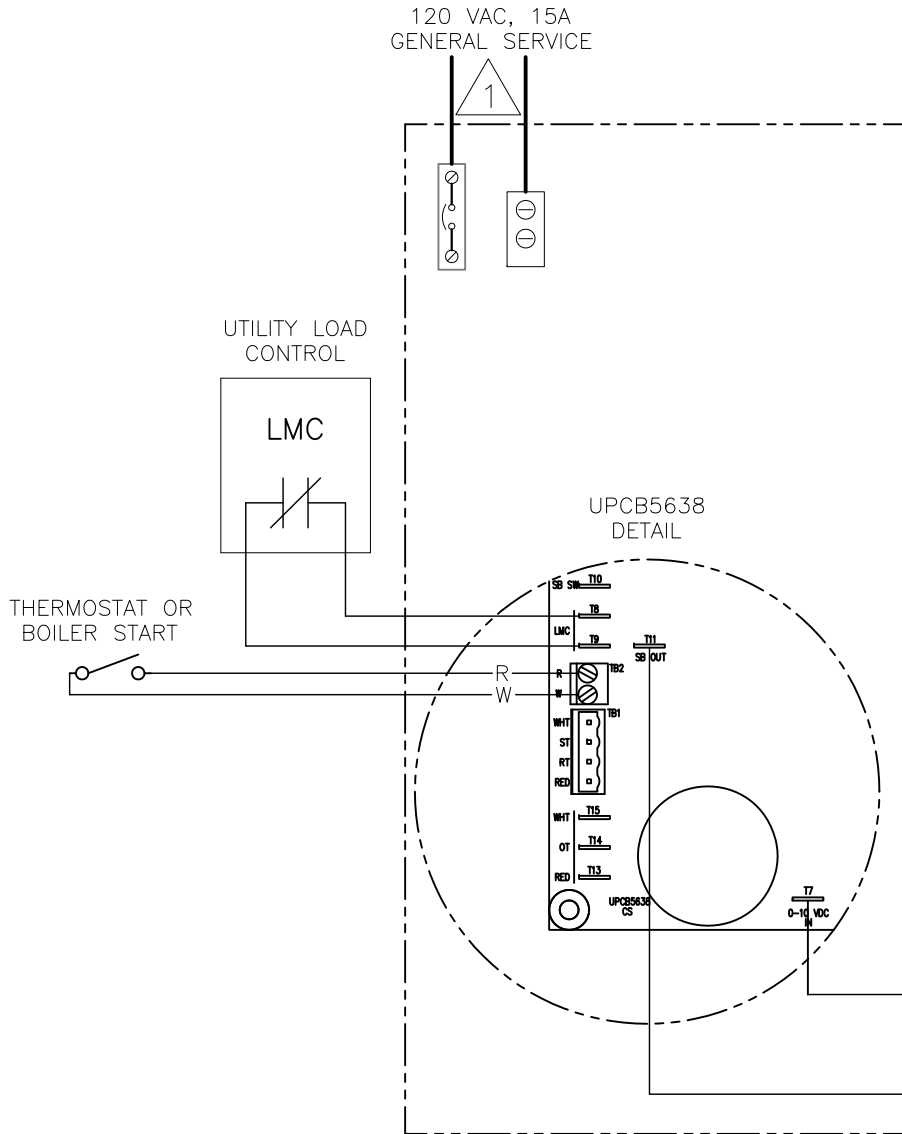
- △1 PUMP NOT SHOWN. SEE BI802 PAGE 1 CHART FOR REQUIRED FLOW THROUGH THE EB-NB VESSEL.
- △2 ELECTRO EB-NB SERIES IS 3" PIPE STUBS.
- △3 ALL PRIMARY LOOP PIPING MUST BE ADEQUATE FOR THE GPM FLOW STATED IN THE BI802 PAGE 1 CHART.

1-24-2013: Added Notes 1-3.
 01_08-11-08: Initial Creation.

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	ELECTRO INDUSTRIES, INC. MONTICELLO, MN 55362	SHEET	SCALE	PART/MODEL NUMBER
	EB-N-***-*** Dual Boilers		1/1	NTS	EB-N*-***-***
			DATE	REV/STATUS	DOCUMENT NUMBER
			1/24/2013	02	BX803

INDUSTRIAL BOILER HOOKUP DRAWING

CONTROL BOX (DOOR)

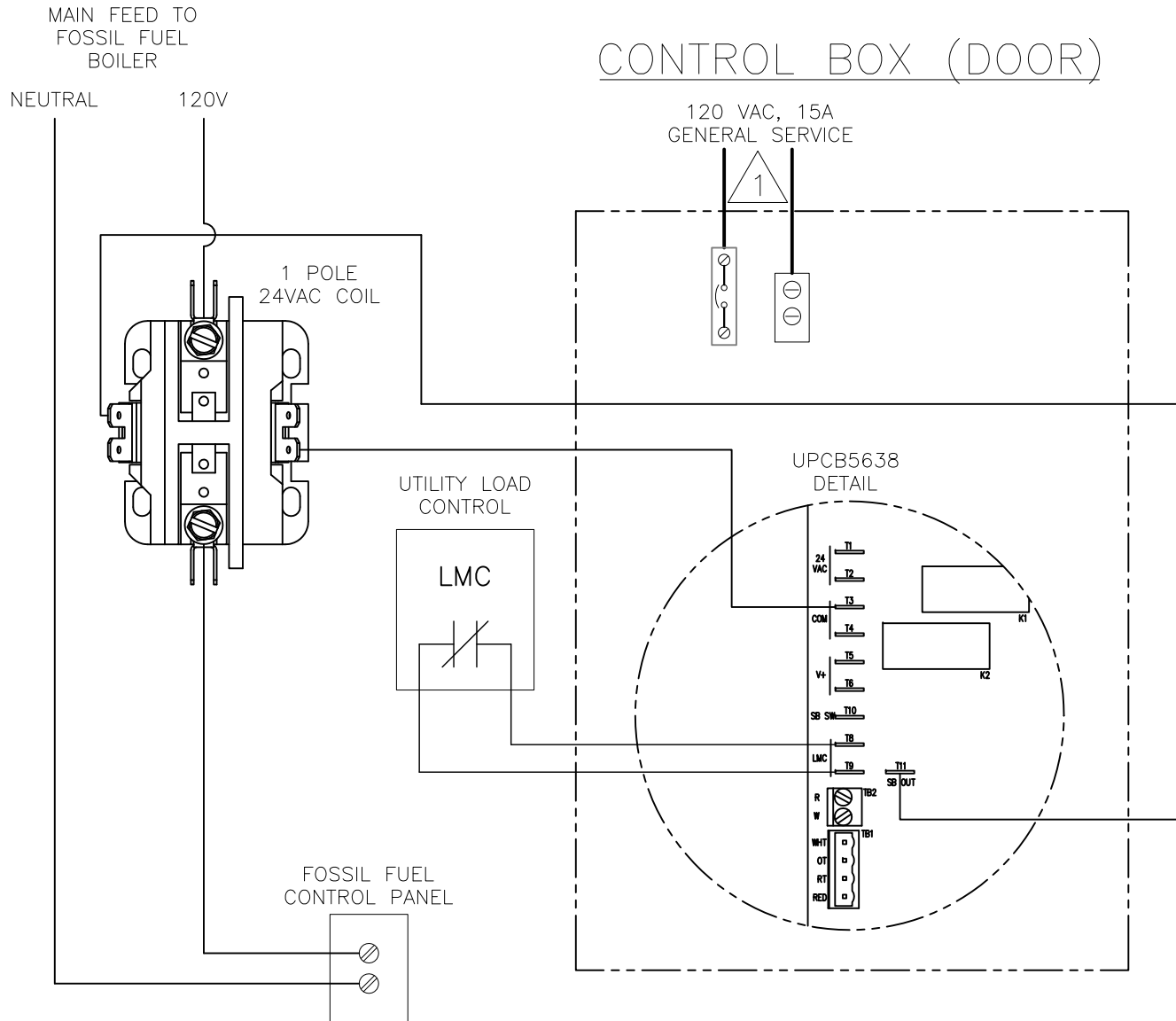


OPTIONAL:
0-10 VDC INPUT FROM BAC-NET OR OTHER FACILITY CONTROL

SB OUT — TO FOSSIL FUEL BOILER

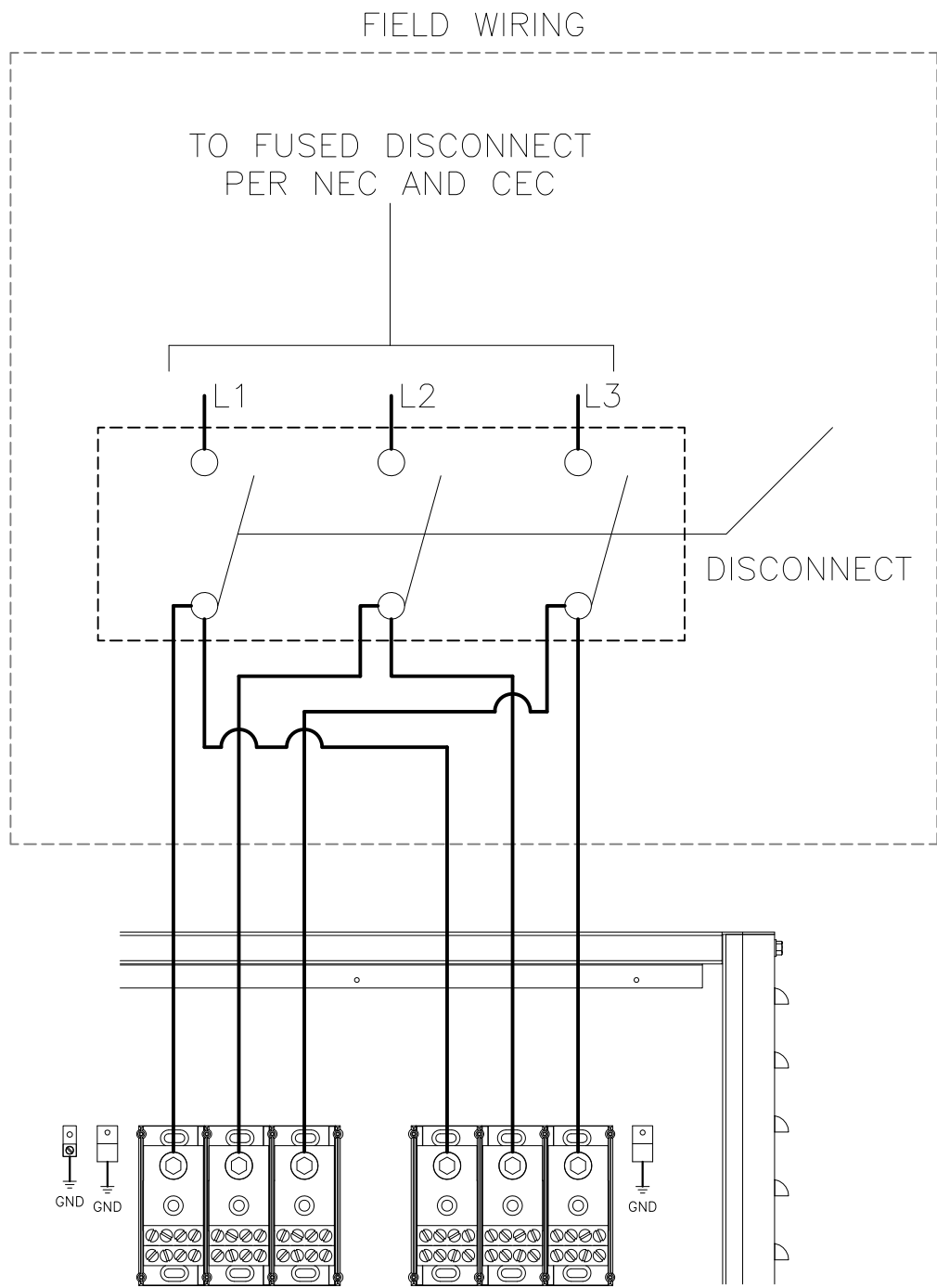
1 WARNING: RISK OF ELECTRIC SHOCK. THIS UNIT IS CONNECTED TO MORE THAN ONE ELECTRICAL CIRCUIT. DISCONNECT ALL ELECTRICAL CIRCUITS BEFORE SERVICING.

INDUSTRIAL BOILER STANDBY OIL BOILER - OPEN LINE VOLTAGE

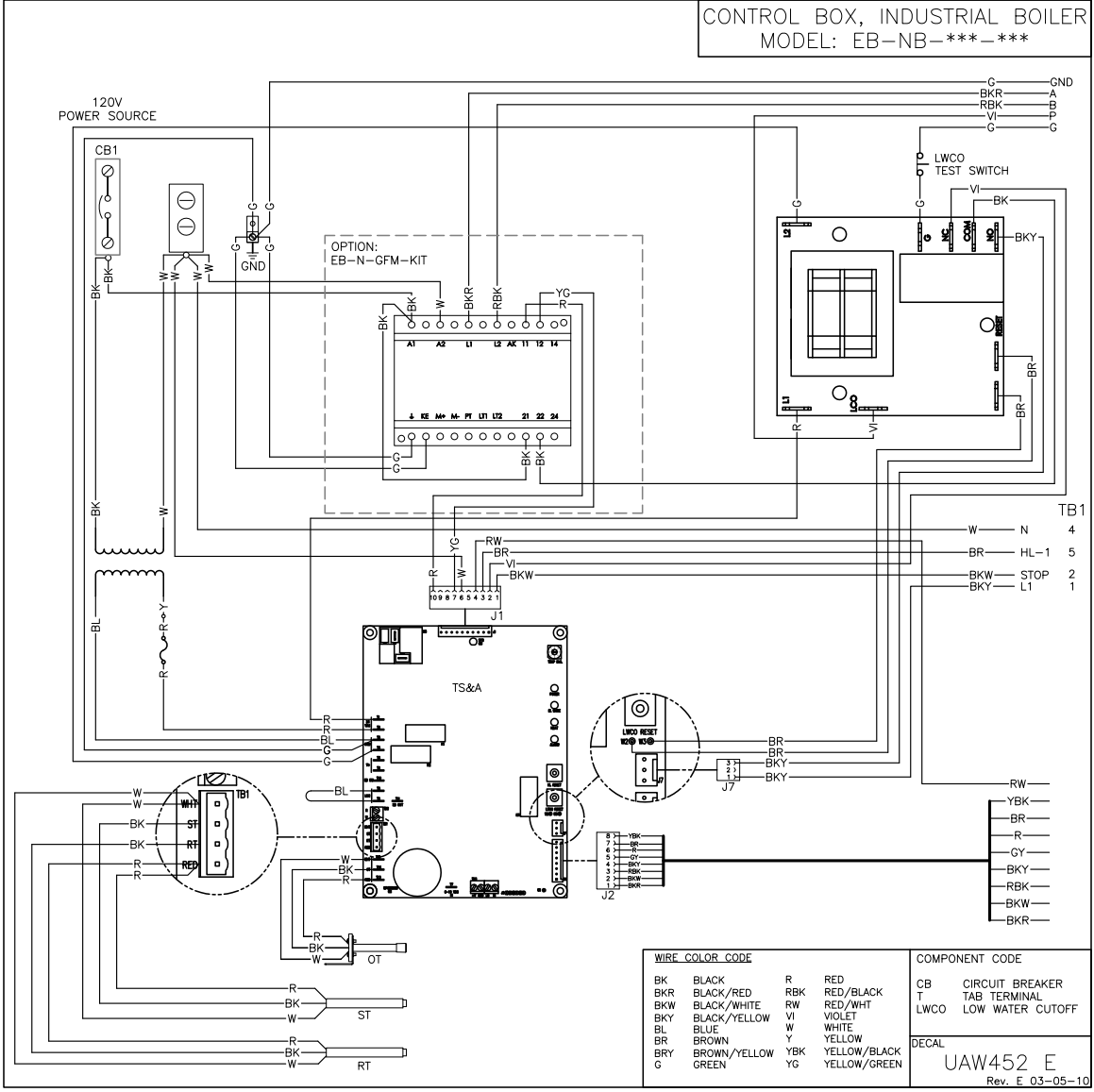


 WARNING: RISK OF ELECTRIC SHOCK. THIS UNIT IS CONNECTED TO MORE THAN ONE ELECTRICAL CIRCUIT. DISCONNECT ALL ELECTRICAL CIRCUITS BEFORE SERVICING.

INDUSTRIAL BOILER FIELD WIRING



CONTROL BOX, INDUSTRIAL BOILER
MODEL: EB-NB-***-***



WIRE COLOR CODE				COMPONENT CODE	
BK	BLACK	R	RED	CB	CIRCUIT BREAKER
BKR	BLACK/RED	RBK	RED/BLACK	T	TAB TERMINAL
BKW	BLACK/WHITE	RW	RED/WHT	LWCO	LOW WATER CUTOFF
BKY	BLACK/YELLOW	VI	VIOLET	DECAL	
BL	BLUE	W	WHITE	UAW452 E	
BR	BROWN	Y	YELLOW	Rev. E 03-05-10	
BRY	BROWN/YELLOW	YBK	YELLOW/BLACK		
G	GREEN	YG	YELLOW/GREEN		

Electro Industries, Inc.

3-Phase Boiler Limited Product Warranty

Effective September 1, 2008

Electro Industries, Inc. warrants to the original owner, at the original installation site, for a period of one (1) year from date of installation, that the product and product parts manufactured by Electro Industries 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. If any product or product parts manufactured by Electro Industries are found to have manufacturing defects in materials or workmanship, such will be repaired or replaced by Electro Industries. Electro Industries, shall have the opportunity to directly, or through its authorized representative, examine and inspect the alleged defective product or product parts. Electro Industries may request that the materials be returned to Electro Industries 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 or its authorized representative.

ONE YEAR (1) LIMITED WARRANTY ON BOILER PARTS

Electro Industries, Inc. warrants that the parts of its 3-Phase Boilers are free from defects in materials and workmanship through the first year following date of installation. If any product parts are found to have a manufacturing defect in materials or workmanship, Electro Industries will repair or replace them at their discretion.

ONE YEAR (1) LIMITED WARRANTY ON BOILER ELEMENTS

Electro Industries, Inc. warrants that the elements of its 3-Phase Boilers are free from defects in materials and workmanship through the first year following date of installation. If any elements are found to have a manufacturing defect in materials or workmanship, Electro Industries will replace them.

FIVE YEAR (5) LIMITED WARRANTY ON BOILER VESSELS

Electro Industries, Inc. warrants that the boiler vessels of its 3-Phase Boilers are free from defects in materials and workmanship through the fifth year following date of installation. If any vessels are found to have a manufacturing defect in materials or workmanship, Electro Industries will repair or replace them at their discretion.



ELECTRO INDUSTRIES, INC.

2150 West River Street, PO Box 538, Monticello, MN 55362

763.295.4138 • 800.922.4138 • fax 763.295.4434

sales@electromn.com • www.electromn.com

THESE WARRANTIES DO NOT COVER:

1. Costs for labor for removal and reinstallation of an alleged defective product or product parts, transportation to Electro Industries, 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 that has been damaged as a result of being improperly serviced or operated, including, but not limited to, the following: operated 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 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 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 that has been defaced, abused or suffered unusual wear and tear as determined by Electro Industries or its authorized representative.
6. Workmanship of any installer of the product. This warranty does not assume any liability of any nature for unsatisfactory performance caused by improper installation.
7. Transportation charges for any replacement part or component, service calls, normal maintenance; replacement of fuses, filters, refrigerant, etc.

CONDITIONS AND LIMITATIONS:

1. If at the time of a request for service the original owner can not provide an original sales receipt or a warranty card registration then the warranty period for the product will have deemed to begin thirty (30) days after the date of manufacture and **NOT** the date of installation.
2. The product must have been sold and installed by a licensed electrician, plumbing, or heating contractor.
3. The application and installation of the product must be in compliance with Electro Industries specifications, as stated in the installation and instruction manual, and all state and federal codes and statutes. If not, the warranty will be null and void.
4. 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.
5. All related heating components must be maintained in good operating condition.
6. All lines must be checked to confirm that all condensation drains properly from the unit.
7. Replacement of a product or product part under this limited warranty does not extend the warranty term or period.
8. 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.
9. Before warranty claims will be honored, Electro Industries 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 or its authorized representative.

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 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 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.