Installing, Operating & Maintaining
3VO 750–4000 HIGH EFFICIENCY WATER HEATERS AND HEATING BOILERS

3VO 750–4000

750,000 BTU/hr
4,000,000 BTU/hr

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

⚠ WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or death.

WHAT TO DO IF YOU SMELL GAS:
- Do not try to light any appliance
- Do not touch any electrical switch
- Do not use any phone in your building

Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier instructions. If you can not reach your gas supplier, call the fire department.

UL 795-2011/CSA3.4
Classified Commercial Industrial Gas Fired Heating Equipment

ANSI STD Z21-13/Z21.13A
Certified to CSA 4.9-2004
ANSI STD Z21.10.3/Z21.10.3.b
Certified to CSA 4.1-2004, add.A,B

New York
MEA 425-05-E

Massachusetts
Boilers: G1-06-06-24A
Heaters: G1-06-06-24B

SCAQMD
Compliant Rule1146.2

CEC Listed
California Energy Commission

⚠ WARNING

These appliances MUST be installed by a properly licensed individual in the City and State which the unit is being installed. All start up adjustments and subsequent service work must be done by a similarly licensed contractor or a factory trained service individual. Failure to comply could result in loss of warranty and or severe personal injury, death and or substantial property damage. ***These instructions are required to be kept with the appliance on the left side, in the pocket provided.***

USING THIS MANUAL

SPECIAL ATTENTION BOXES

Throughout this manual you will see these special attention boxes similar to this one, which are intended to supplement the instructions and make special notice of potential hazards. These categories are in the judgement of Hamilton Engineering, Inc.

⚠ DANGER

Indicates a condition or hazard which <u>MAY</u> cause severe personal injury, death, or major property damage.

⚠ WARNING

Indicates a condition or hazard which <u>MAY</u> cause severe personal injury, death, or major property damage.

⚠ CAUTION

Indicates a condition or hazard which <u>MAY</u> cause severe personal injury, death, or major property damage.

⚠ WARNING

- THE VENT SYSTEM IS RATED AS AND DESIGNED TO BE 2 PIPE SEALED COMBUSTION **CATEGORY IV** ONLY, PVC/CPVC SCH 40 OR CPVC SCH 40 OR 80, POLYPROPYLENE OR AL 29-4C STAINLESS VENTING FOR ALL MODELS. A FACTORY ENGINEERED VENTING SYSTEM MAY ALLOW FOR EXCEPTIONS; CONSULT FACTORY FOR DETAILS.
- THIS HEATER INSTALLATION MUST CONFORM TO THE LATEST EDITION OF THE "NATIONAL FUEL GAS CODE" ANSI Z223.1 NFPA 54 AND/OR CAN/CGAB149 INSTALLATION CODES. STATE AND LOCAL CODES MIGHT ALSO APPLY TO INSTALLATION.
- WHERE REQUIRED BY THE AUTHORITY HAVING JURISDICTION, THE INSTALLATION MUST CONFORM TO THE STANDARDS FOR CONTROLS AND SAFETY DEVICES FOR AUTOMATICALLY FIRED HEATERS, ANSI/ASME HEATER AND PRESSURE VESSEL CODE, SECTION IV, ALONG WITH CSD-1.
- THE HEATER, GAS PIPING, WATER PIPING, VENTING AND ELECTRICAL MUST BE INSTALLED BY TRAINED & QUALIFIED PERSONNEL FAMILIAR WITH INSTALLATION PRACTICES, LOCAL CODE, AND LICENSING REQUIREMENTS.
- IF THE INFORMATION IN THESE INSTRUCTIONS ARE NOT FOLLOWED EXACTLY, A FIRE OR EXPLOSION MAY RESULT, CAUSING PROPERTY DAMAGE, PERSONAL INJURY, OR DEATH.
- DO NOT STORE OR USE GASOLINE OR OTHER FLAMMABLE VAPORS AND LIQUIDS IN THE VICINITY OR THIS OR ANY OTHER APPLIANCE.

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PART 1. GENERAL INFORMATION

A. HOW IT OPERATES

The 3VO product line is an extremely high efficiency water heating product, requiring special venting and condensate removal precautions. All high efficiency condensing appliances will require more regular maintenance (cleaning) than their non-condensing counterparts. Failure to do so may result in damage to the appliance that is not covered under warranty. Failure to follow all of the instructions contained in this manual may also cause premature product failure that may not be covered under warranty.

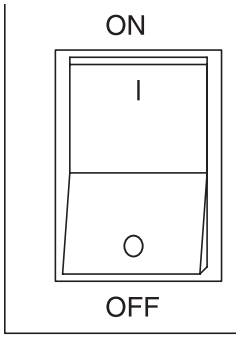
This appliance has built-in freeze protection, automatically activating the circulation pump when the internal water temperature drops below 41°F. If the internal water temperature drops to 37°F, a burn cycle will be initiated and will shut down as soon as the supply water temperature has reached 50°F. *Power must be left on for this function to operate.*

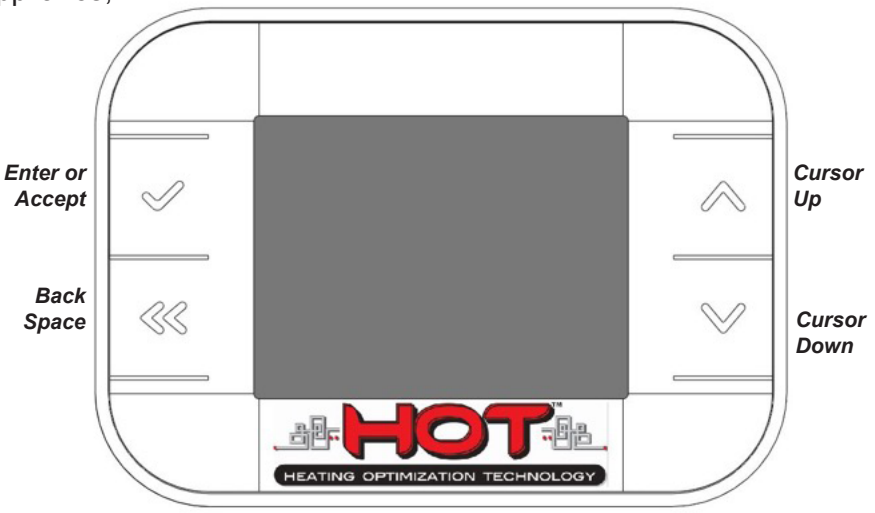
The appliance's primary controller (HOT™) operates all functions of needed control and safety. It contains sophisticated logic that allows it to operate at very precise temperatures while minimizing burner on/off cycling. When multiple units are operated as a Cascade to handle a common load, the control contains the ability to control all of the units as efficiently as one. *Cascade operation is a factory-installed and programmed option, requiring a field wiring connection of factory supplied wiring between appliances for operation.*

Looking at the controls on the front of the appliance,

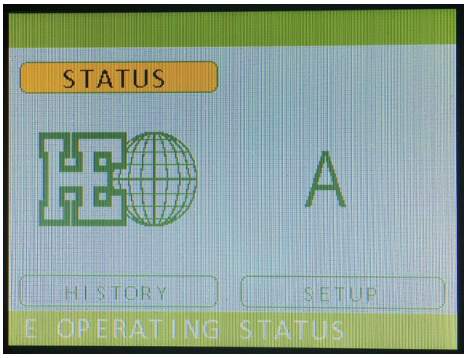
1. POWER on/off switch
2. Display and management buttons

(FIGURE 1-1) HOT™ CONTROL DISPLAY





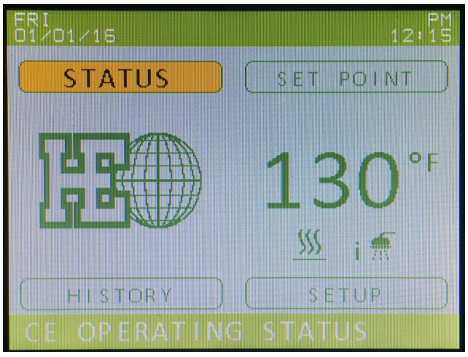
(FIGURE 1-2) TYPICAL BOILER/HEATER DISPLAY AS PART OF A CASCADE



(FIGURE 1-3) TYPICAL CASCADE DISPLAY

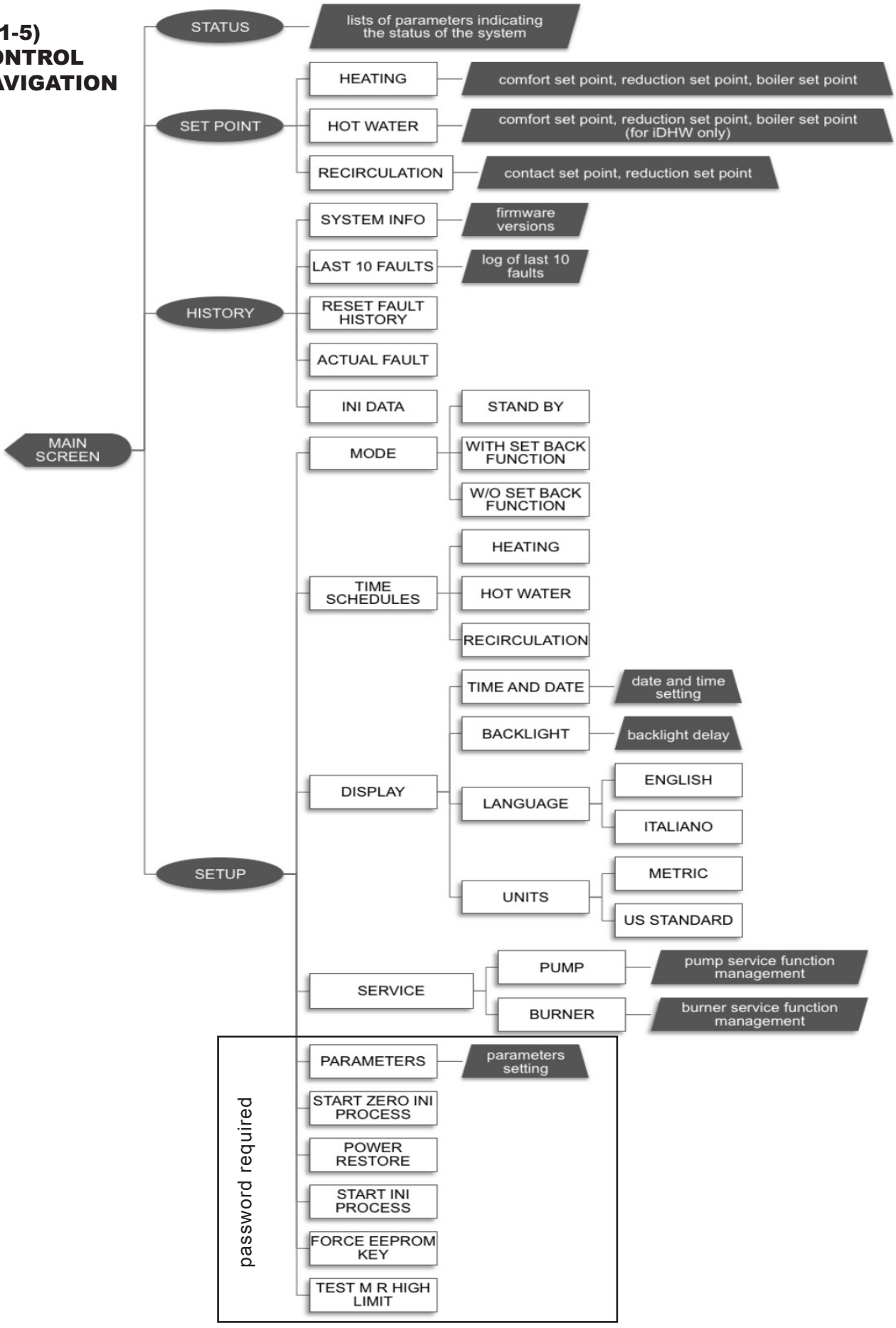
Typical Cascade display - Heating and Indirect Hot Water applications

(FIGURE 1-4) TYPICAL HEATER/BOILER DISPLAY



Typical stand-alone boiler display - Heating and Indirect Hot Water applications

(FIGURE 1-5) HOT™ CONTROL MENU NAVIGATION



B. PASSWORD & PARAMETERS

PLEASE NOTE: Some adjustments may require the use of a password. The Installer password, entered in the SETUP - PARAMETERS section, is EAZ1LVL. Enter Setup Screen; highlight "MODE" and press √ (enter button) and choose "STAND BY" and press √ (enter); press << and v (cursor down) simultaneously for 5 seconds and the password screen appears. Then enter EAZ1LVL, move to the DONE label, and press the √ button. From that point, you can navigate to the required parameter for adjustment; be sure to press the √ button after each change. When all adjustments are done, press the back space button to return to the main screen.

C. SENSOR INFORMATION

(TABLE 1-1) SENSOR TABLES

Number	Sensor Part Name - Part Number	Location - BCB - Boiler Control Board
T1.1	Supply temperature - Adjustable Manual Reset High Limit TST 75001	BCB - appliance outlet pipe
T1.2	Supply temperature p/n see above, duplex sensor	BCB - appliance outlet pipe
T2	Return temperature TST 75000	BCB - appliance header
T3*	Tank for iDHW and DHW temperature TST 76110	BCB to external component
T4*	Outdoor temperature TST 73010	BCB to external location
T5	Flue gas temperature TST 75002	BCB - appliance flue outlet
T6*	External system water temperature TST 76110	BCB - primary piping or Low Loss Header
TR1	Fan Air Pressure transducer PTR 12323	BCB - fan outlet
TR2	Gas Inlet pressure transducer PTR 12304	BCB - gas valve inlet
TR3	Return water pressure transducer PTR 1122E	BCB - appliance inlet pipe
TR4	Supply water pressure transducer PTR 1122E	BCB - appliance outlet pipe
TR5	Blocked drain/flue transducer PTR 12323	BCB - appliance condensate drain pipe

** = not used when Cascade control system is in use*

Number	Temperature Sensor Part Name	Location - CCB - Cascade Control Board
S1	Cascade system sensor - linked to Pump 4	CCB - primary piping or Low Loss Header
S2	Load/Zone, DHW recirc sensor - linked to Pump 8	CCB Supply or return to zone with Pump 8, if the application is iDHW or DHW, it is used as the return line sensor to control Pump 8
S3	Tank iDHW or DHW sensor - linked to Pump 5	CCB - Cascade Control Board
S4	Load/Zone sensor - linked to Pump 6	CCB Supply or return to zone with Pump 6
S5	Load/Zone sensor - linked to Pump 7	CCB Supply or return to zone with Pump 7
S6	Outdoor sensor	CCB to external location
S7	Load/Zone sensor - linked to Pump 9	CCB Supply or return to zone with Pump 9

Note: All temperature sensors (T1.1–T6, S1–S7) are 10k termistors, all pressure transducers (TR1–TR5) are 5vdc. Transducers are specific to their purpose; pressure range, accuracy and media being measured; gas, water or air/gas.

The appliance's primary controller operates all functions of needed control and safety. It contains sophisticated logic that allows it to operate at very precise temperatures while minimizing burner on/off cycling. When multiple units are operated as a Cascade to handle a common load, the control contains the ability to control all of the units as efficiently as one. Cascade operation is a factory-installed and programmed option, requiring a field wiring connection between appliances for operation. A number of parameters must be programmed at the factory to provide proper operation and temperature control, including Controlling sensor; Setpoint, Offset, Hysterese and proportional band, integration time, step percent and step time.

- **Setpoint:** desired operating water temperature (this is set by the end user).
- **Offset:** amount the temperature is allowed to go above Setpoint before finally shutting off.
- **Hysterese:** amount the temperature is allowed to drop under Setpoint plus offset before the appliance turns on.
- **Proportional Band:** the temperature range below Setpoint over which modulation will occur.
- **Integration Time:** the time function used in developing the Proportional Band action.
- **Step:** the percentage of firing rate increase each time, the Time interval elapses.
- **Time:** the amount of time between steps upward in firing rate.

Outlet sensors–two individual sensors in one well
Their purpose is threefold: first stage high limit, second as a sensor for computing ΔT and last as a manual reset, adjustable high limit.

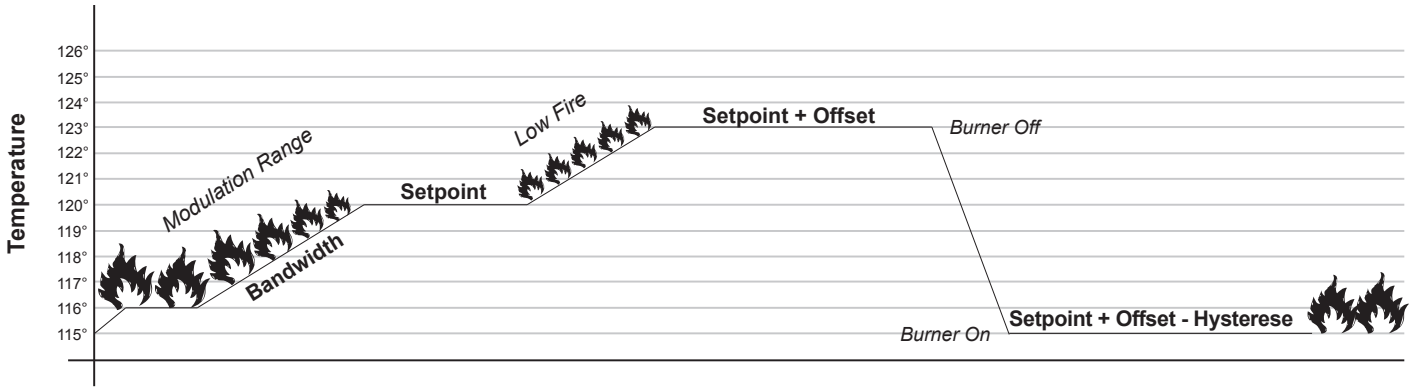
- ***Adjustable Reset High Limit*** — maximum at 200°F on water heaters and 210°F heating boilers.

D. WATER HEATER OPERATING SAMPLE

All of the following parameters are controlled by a storage tank temperature sensor:

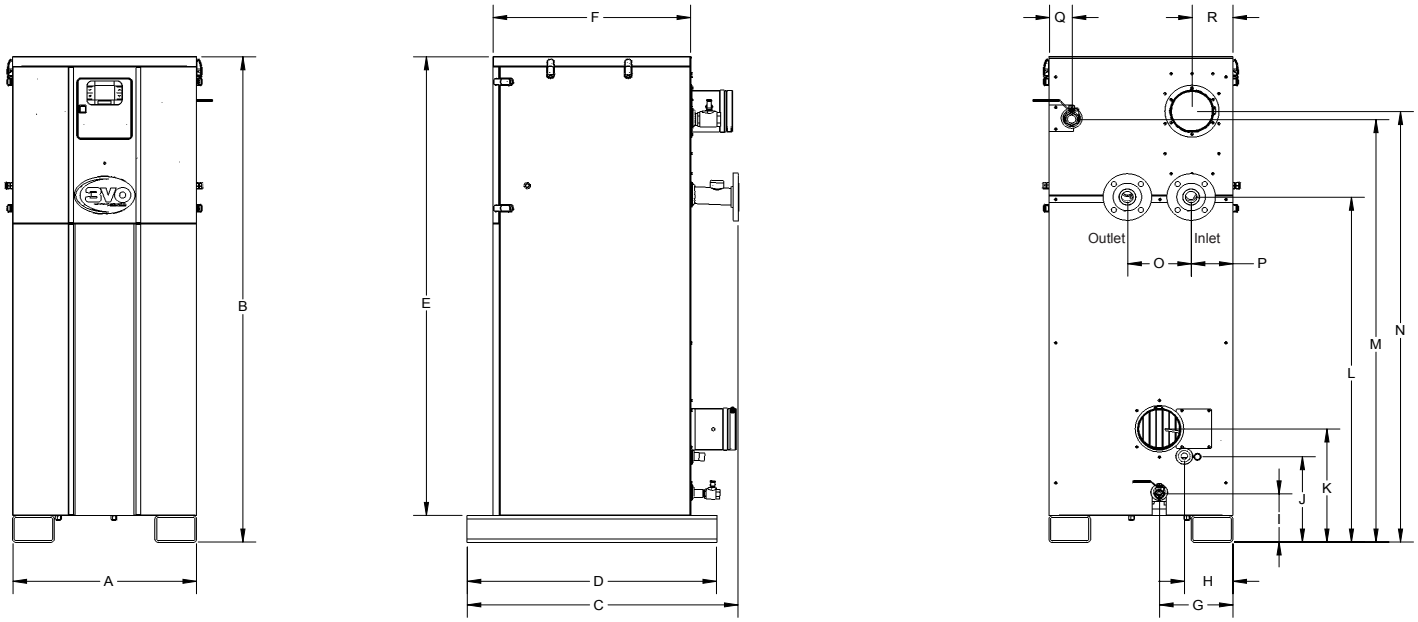
- **Setpoint** = Target Temperature (120°F) Low fire only above this point
- **Offset** = Off Setpoint (3) = 123°F off
- **Hysterese** = On Setpoint (8) (120 + 3 - 8 = 115°F)
- **Proportional Band** = Modulation range (4) (120 - 4 = 116°F, modulation begins)

The heater turns on at 115°F and when the temperature reaches 116°F the flame will begin to modulate down (approximately 25% of the modulation range per degree F of increase in this example). At 120°F, it will be at low fire and will remain there unless the temperature drops below 120°F and it will modulate back up. If it continues to increase, it will shut down at 123°F.



E. 3VO DIMENSIONS

(FIGURE 1-5) 3VO DIMENSIONS



(TABLE 1-2) 3VO DIMENSIONS

Model	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Water Conn.	Gas Conn.	Flue Outlet & Inlet Air	Conden-sate Conn.	Boiler Drain Conn.
750	26.5"	73"	39"	36"	69"	28.5"	10.5"	5"	7"	13"	17"	52"	63.5"	64.5"	9"	6"	3.5"	6"	2.5"	1.25"	5"	0.75"	3 @ 0.75"
850	26.5"	73"	39"	36"	69"	28.5"	10.5"	5"	7"	13"	17"	52"	63.5"	64.5"	9"	6"	3.5"	6"	2.5"	1.25"	6"	0.75"	3 @ 0.75"
1000	26.5"	73"	39"	36"	69"	28.5"	10.5"	5"	7"	13"	17"	52"	63.5"	64.5"	9"	6"	3.5"	6"	2.5"	1.25"	6"	0.75"	3 @ 0.75"
1500	32"	80"	53"	47.5"	76"	41"	13"	7.5"	7.5"	13"	21.5"	52"	61.5"	68.5"	13.5"	7"	3.5"	10"	3"	1.5"	7"	1.0"	3 @ 0.75"
2000	32"	80"	53"	47.5"	76"	41"	13"	7.5"	7.5"	13"	21.5"	52"	61.5"	68.5"	13.5"	7"	3.5"	10"	3"	1.5"	8"	1.0"	3 @ 0.75"
2500	32"	80"	53"	47.5"	76"	41"	13"	7.5"	7.5"	13"	21.5"	52"	61.5"	68.5"	13.5"	7"	3.5"	10"	3"	2.0"	10"	1.0"	3 @ 0.75"
3000	35.5"	88"	63"	59.5"	84"	52.5"	18"	8.5"	8"	13"	21.5"	52"	62.5"	76.5"	20.5"	7.5"	4"	11.5"	4"	2.0"	10"	1.0"	3 @ 0.75"
3500	35.5"	88"	63"	59.5"	84"	52.5"	18"	8.5"	8"	13"	21.5"	52"	62.5"	76.5"	20.5"	7.5"	4"	11.5"	4"	2.0"	10"	1.0"	3 @ 0.75"
4000	35.5"	88"	63"	59.5"	84"	52.5"	18"	8.5"	8"	13"	21.5"	52"	62.5"	76.5"	20.5"	7.5"	4"	11.5"	4"	2.0"	12"	1.0"	3 @ 0.75"

(TABLE 1-3) 3VO INFORMATION

Model	Input BTU/hr	Water Volume Gallons	Heat Exchange Surface Area Total (sq ft)	Output BTU/ hr @ 54ºF incoming water	Output BTU/ hr @ 120ºF incoming water	GPH Recovery @ 100˚FΔT	Water Flow Rate & Pressure Drop @ 50˚FΔT	Water Flow Rate & Pressure Drop @ 20˚FΔT	Shipping Weight
750	750,000	12.70	113.34	736,469	669,177	884	28.5 @ 0.9'	71.3 @ 4.8'	1431 lbs
850	850,000	13.04	125.45	835,833	767,948	1,003	32.3 @ 1.0'	80.8 @ 5.7'	1451 lbs
1000	1,000,000	13.72	149.66	985,743	915,690	1,183	38.0 @ 1.3'	95.0 @ 7.0'	1463 lbs
1500	1,500,000	22.97	234.17	1,513,200	1,397,982	1,817	57.0 @ 1.1'	142.6 @ 6.19'	1639 lbs
2000	2,000,000	25.10	305.5	1,963,416	1,803,951	2,357	76.0 @ 1.5'	190.1 @ 8.2'	1688 lbs
2500	2,500,000	26.98	372.09	2,515,900	2,298,792	3,020	95.0 @ 1.7'	237.6 @ 9.5'	1731 lbs
3000	3,000,000	38.15	425.02	2,979,909	2,753,012	3,577	114.0 @ 1.6'	285.1 @ 8.9'	1860 lbs
3500	3,500,000	40.20	497.66	3,385,732	3.093,562	4,065	133.1 @ 2.1'	332.6 @ 11.2'	1925 lbs
4000	4,000,000	41.73	552.15	3,940,000	3,600,000	4,643	148.0 @ 2.4'	370.1 @ 13.3'	1960 lbs

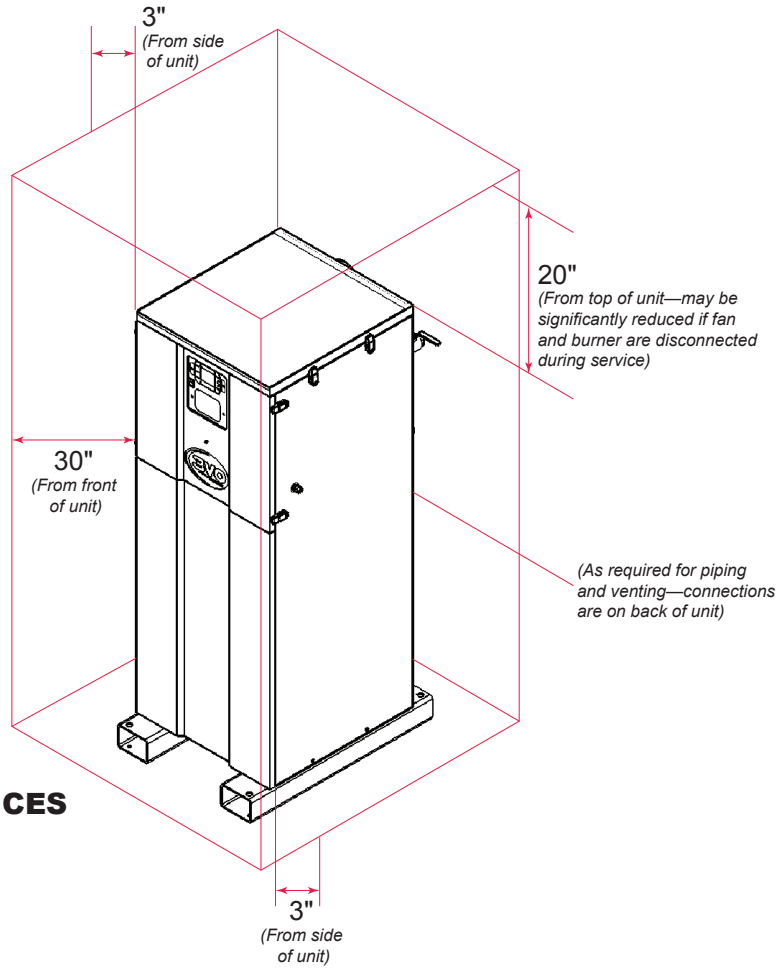
- Rates shown are for natural or propane gas, and elevations up to 9,000 feet. Pressure drop is for heat exchanger only
- Dimensions not to be used for construction purposes. Please consult the factory for construction planning details
- Models 750–1000 maximum amperage draw at 120 volts single phase, is less than 6 amps, plus pump.
- Models 1500–2000 maximum amperage draw at 120 volts single phase, is less than 12 amps, plus pump.
- Models 2500–3000 maximum amperage draw at 120 volts single phase, is less than 15 amps, plus pump.
- Models 3500–4000 maximum amperage draw at 480 volts three phase, is less than 5 amps, plus pump.

RECOMMENDED SERVICE CLEARANCES

NOTE: The 3VO is rated at zero clearance to combustibles.

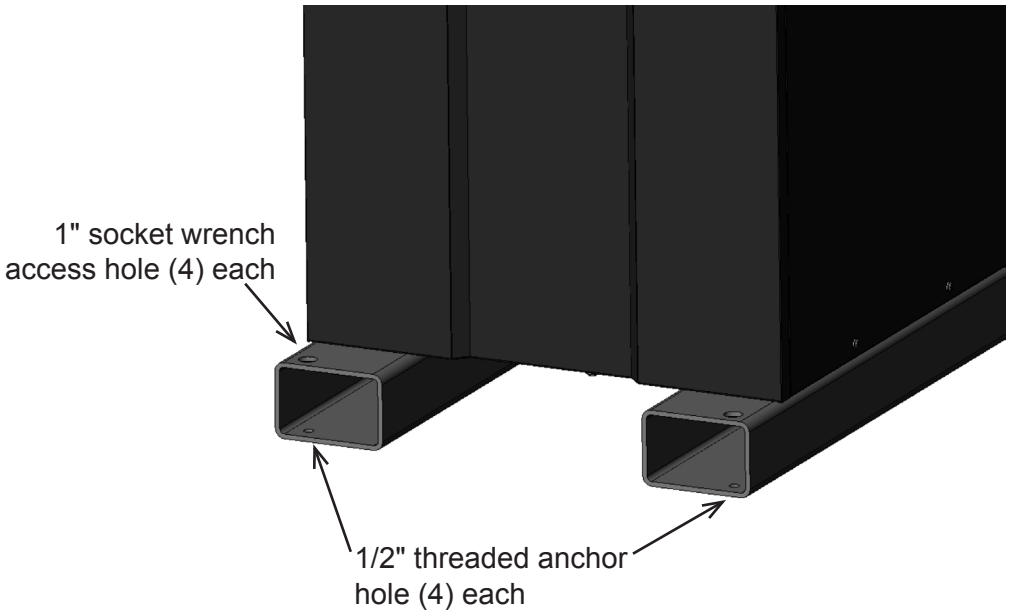
Multiple 3VO appliances may be installed within 3" of each other without compromising service clearance, 12" minimum is recommended for ease of wiring between units.

Holes in the rectangular tube bases can be fitted with supplied leveling bolts or can be used for standard or Seismic anchoring.



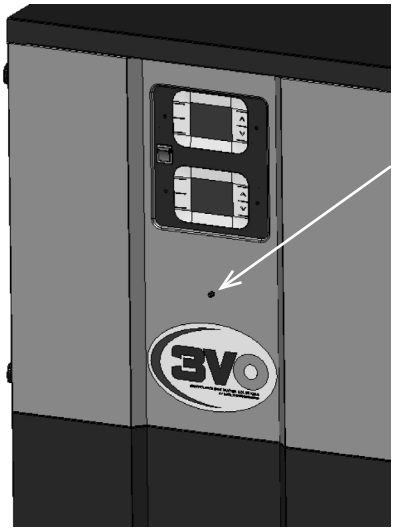
(FIGURE 1-6)
3VO CLEARANCES

(FIGURE 1-7)
3VO LEVELING HOLE DETAIL



(FIGURE 1-8) HOW TO REMOVE THE FRONT COVER

STEP 1:
Be sure to turn off power to unit (not at unit).



STEP 2:
Use screwdriver to undo screw

⚠ WARNING

The 3VO is certified as an indoor appliance. Do not install the 3VO outdoors without optional outdoor kit or locate where it will be exposed to freezing temperatures. This includes all related piping and components. If the 3VO is subjected to flood water or submersed in water, the 3VO must be replaced.

⚠ NOTICE

Condensation Removal: This is a condensing, high efficiency appliance, therefore condensation removal must be addressed to avoid damage to surrounding area or appliance. See Part 4, Section F for Condensate Requirements (pg. 26).

F. PRE INSTALLATION REQUIREMENTS

Choose a location for your 3VO, centralized to the piping system, along with consideration for Electrical (Part 2, Page 11), Gas Connection (Part 3, Page 16), Venting (Part 4, Page 19–21), and Condensate Drain (Part 4, Section F, Page 25).

The 3VO must be level as installed, and the mounting surface must be designed to support the weight (see page 8, Table 1-3 for weights). Be sure the appliance is adequately secured to the mounting surface.

The top front cover is secured by one threaded screw; it can only be installed one way. ***When removing the front cover of the 3VO unit, you must make sure all electric power to the appliance is turned off***. Then remove the screw at the lower center of the top panel, below the control display and remove the cover (see Figure 1-8 above).

If the 3VO is set up for liquefied petroleum (LP) gas, some geographic areas follow the Uniform Mechanical Code, section 304.6, “Liquefied petroleum gas burning appliances shall not be installed in a pit, basement or similar location where heavier-than-air gas might collect. Appliances so fueled shall not be installed in a below grade under-floor space or basement ***unless such location is provided with an approved means for removal of unburned gas***.”

G. PRESSURE RELIEF VALVE

This unit is supplied with a relief valve sized in accordance with ANSI/ASME Heater and Pressure Vessel Code, Section IV. The relief valve is installed near the hot water outlet. If the valve supplied is replaced, the pressure rating of the valve must not exceed the listed working pressure of this appliance, and must be rated to the proper BTU/hr capacity of the water heater. ***Do not, under any circumstances, thread a cap or plug into the relief valve! Explosion, serious injury or death may result!*** To prevent water damage, the relief valve piping must be directed to the floor or an open drain, but not connected directly. There must be a 6" space between the outlet of relief valve piping and drain or floor. Do not hook up to drain system directly without an air gap. Protect from freezing. Place no other valve between the relief valve and the unit. Do not install any reducing couplings or other restrictions in the discharge line. The discharge line must allow complete drainage of the valve and line. Manually operate the relief valve at least once a year.

Also, care must be exercised when choosing the location of this appliance, where leakage from the relief valve, leakage from related piping, or leakage from the tank or connections, will not result in damage to the surrounding areas, or to the lower floors of the building. A water heating appliance should always be located in an area with a floor drain or installed in a drain pan suitable for water heating appliances. Under no circumstances, shall Hamilton Engineering Company, Inc. be held liable for any such water damage whatsoever.

PART 2. ELECTRICAL

⚠ CAUTION

The incoming power shall be connected directly to the labeled, intended connection points only. Failure to do so may result in an electrical short and the control board will have to be replaced!

⚠ DANGER

IT IS EXTREMELY IMPORTANT THAT THIS UNIT BE PROPERLY GROUNDED! IT IS VERY IMPORTANT THAT THE BUILDING GROUND IS INSPECTED BY A QUALIFIED ELECTRICIAN PRIOR TO MAKING THIS CONNECTION!

A. ELECTRICAL CONNECTION

The electrical connection for the 3VO is on the left side of the unit. There are multiple knockout locations for the electrical connection for the appliance's incoming power connection and power and control switching outputs. All electrical wiring must be performed by a qualified licensed electrician in accordance with National Electrical Code ANSI/NFPA to and/or the Canadian Electrical Code, Part 1 CSA C22.1, or to the applicable codes and standards. For your convenience, all the points for electrical connections needed to operate the 3VO are labeled.

The electrical requirements are 240v, split phase (Models 750–3000); 480v, 3ph and 240v split phase (Models 3500–4000), 50/60 Hz. See table on page 12 for power requirements for each model. When the unit is first powered on, there is a self-setting of the electronics for 50 Hz or 60 Hz. At every power up, the electronics will take a couple of seconds to compare the pulses of the power to the pulses of the crystal, which is built into the electronics. Then all time-related functions are correct no matter the power source.

The standard supplied pumps (required voltage may vary) are wired to terminals on the appliance, specific to the application. In 50 cycle applications, other pumps may need to be supplied, depending on water conditions. With the HOT controller, there is the ability to program a custom pump delay time, or to use a continuous (no time out) setting. The factory default is a 1 minute delay to turn off after completing a burn cycle.

ELECTRICAL CHARACTERISTICS FOR 3VO PRODUCTS

Model	Voltage Required	Boiler	Boiler Pump	Voltage and Total Amps
750	120V Single Phase	120V@12A	120V@6A	120V@18A
750	240V Split Phase	240V@9A	240V@3A	240V@12A
850	120V Single Phase	120V@12A	120V@6A	120V@18A
850	240V Split Phase	240V@9A	240V@3A	240V@12A
1000	240V Split Phase	240V@9A	240V@3A	240V@12A
1500	240V Split Phase	240V@11A	240V@3A	240V@14A
2000	240V Split Phase	240V@11A	240V@5A	240V@14A
2500	240V Split Phase	240V@14A	240V@5A	240V@19A
3000	240V Split Phase	240V@14A	240V@8A	240V@22A
3500	480V Three Phase and 240V Split Phase	480V@6A and 240V@6A	240V@8A	480V@6A and 240V@14A
3500	480V Three Phase and 240V Split Phase	480V@6A and 240V@6A	480V@5A	480V@11A and 240V@6A
4000	480V Three Phase and 240V Split Phase	480V@6A and 240V@6A	240V@8A	480V@6A and 240V@14A
4000	480V Three Phase and 240V Split Phase	480V@6A and 240V@6A	480V@5A	480V@11A and 240V@6A

Notes:
1. *If customer chooses larger pump other than our default pump, Total Amps must be adjusted.*
2. *240V Split Phase requires 120V-L1, 120V-L2, N, GND*
3. *480V Current Draw will increase if Hamilton Engineering is providing a transformer in an electrical package to convert 480V to 240V.*

B. INTERNAL WIRING CONNECTION

Terminal Block 1 in the electrical compartment must be connected to the building ground system; confirm a proper ground to ensure as designed.

It is recommended that a test for Stray Current (ohm reading between a known Earth Ground and the appliance piping, cabinent, and Terminal 1) be conducted by a qualified electrician. The maximum allowable ohm level is 0.5.

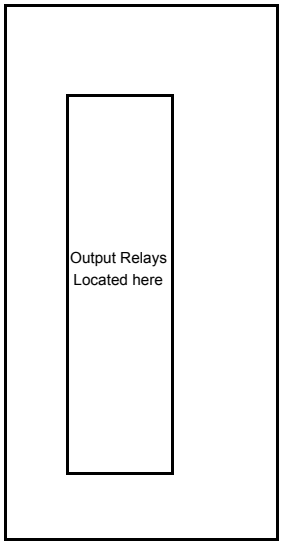
It is important that the electrical power is not turned on at this time. Double check all connections and then turn the power on. The display that is provided with the 3VO should show the Hamilton Logo and other data. *Note: See Start-Up Procedures (Part 6, Page 41) to change the temperature setting or run the appliance.*

Please see Appendix—Electrical Drawings, found on page 66 for reference.

(FIGURE 2-1) FIELD ELECTRICAL CONNECTIONS - SINGLE PHASE

3VO Terminal Wiring Models 750–3000

Back side of appliance display panel



Terminal Block #1	
Heat Demand	1
Heat Demand	2
Fault/Service	3
Fault/Service	4
E-Stop	5
E-Stop	6
PWM Pump Output	7
PWM Pump Ground	8
External Sensor	9
External Sensor	10
Tank Sensor	11
Tank Sensor	12

Terminal Block #2	
1	Additional Safety
2	Additional Safety
3	Cascade In (A)
4	Cascade In (B)
5	Cascade Out (A)
6	Cascade Out (B)
7	Outdoor Sensor
8	Outdoor Sensor
9	0–10 Vdc (+)
10	0–10 Vdc (-)
11	Room Thermostat
12	Room Thermostat

Terminal Block #3	
Empty	1
Empty	2
Pump P1 L	3
Pump P1 N	4
Pump P1 G	5
Pump P3 L	6
Pump P3 N	7
Pump P3 G	8
3-Way NO/P2 L	9
3-Way N/P2 N	10
3-Way NC	11
3-Way G/P2 G	12

Terminal Block #4	
1	Power In 115VAC L
2	Auxillary 115VAC L
3	Auxillary 115VAC L
4	Auxillary 115VAC L
5	Auxillary 115VAC L
6	Power In 115VAC N
7	Auxillary 115VAC N
8	Auxillary 115VAC N
9	Auxillary 115VAC N
10	Auxillary 115VAC N
11	Auxillary 115VAC N
12	Power In 115VAC G

1	2	3	4	5	6	7	8	9	10
P3 Relay Load	P3 Relay Line	P3 Relay Control N	P3 Relay Control L	3-Way NO/P2 Relay Load	3-Way NC Relay Load	3-Way/P2 Relay Line	3-Way NC Relay Control L	3-Way NO/P2 Relay Control L	3-Way /P2 Relay Control N

Terminal Block #5

Terminal Block 1

Terminals 1 & 2	Heat Enable/Disable (Dry Contact)
Terminals 3 & 4	Fault alarm (Dry Contact)
Terminals 5 & 6	E-Stop (remote switch) *current carrying - 0-5VDC*
Terminals 7 & 8	For use with PWM boiler pump only
Terminals 9 & 10	Load (piping, Low Loss Header) sensor (T6) 10k Ohm
Terminals 11 & 12	Tank sensor (T3) here - 10K Ohm

Terminal Block 2

Terminals 1 & 2	Additional safety circuit
Terminals 3 & 4	Cascade in
Terminals 5 & 6	Cascade Out
Terminals 7 & 8	T4 Outdoor Sensor - 10k Ohm
Terminal 9	0 - 10 VDC (+)
Terminal 10	0 - 10 VDC (-)
Terminals 11 & 12	Room Thermostat

Terminal Block 3

Terminals 1–3	Power to P1 Pump - 3 phase
Terminal 4	*Not used for 3 phase* - Neutral to P1 Pump
Terminal 5	Ground to P1 Pump
Terminal 6–8	Power to P3 115v pump or relay for 3 phase
Terminal 9	Line P2 Pump or NO terminal on 3 way valve - 115v
Terminal 10	Neutral on P2 Pump or 3 way valve 115v
Terminal 11	NC terminal on 3 way valve - 115v
Terminal 12	Ground on P2 pump or 3 way valve - 115v

Terminal Block 4

Terminal 1–5	115v Line - *factory wired on 3 phase models*
Terminal 6–11	115v Neutral - *factory wired on 3 phase models*
Terminal 12	115v Ground - *factory wired on 3 phase models*

Terminal Block 5

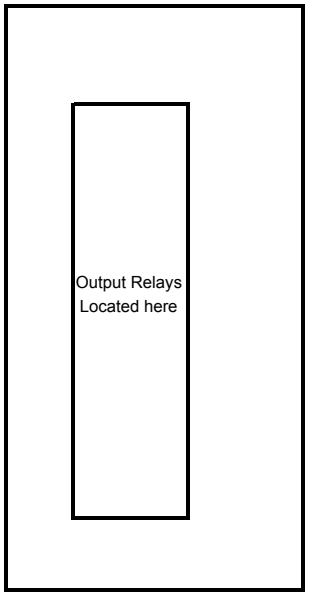
Terminals 1–10	Factory Wired as standard - Relay Switching

Effective 8.12.2016

(FIGURE 2-2) FIELD ELECTRICAL CONNECTIONS - 3-PHASE

3VO Terminal Wiring Models 3500–4000

Back side of appliance display panel



Terminal Block #1

Heat Demand	1
Heat Demand	2
Fault/Service	3
Fault/Service	4
E-Stop	5
E-Stop	6
PWM Pump Output	7
PWM Pump Ground	8
External Sensor	9
External Sensor	10
Tank Sensor	11
Tank Sensor	12

Terminal Block #2

1	Additional Safety
2	Additional Safety
3	Cascade In (A)
4	Cascade In (B)
5	Cascade Out (A)
6	Cascade Out (B)
7	Outdoor Sensor
8	Outdoor Sensor
9	0–10 Vdc (+)
10	0–10 Vdc (-)
11	Room Thermostat
12	Room Thermostat

Terminal Block #3

Pump P1 L1	1
Pump P1 L2	2
Pump P1 L3	3
Pump P1 N	4
Pump P1 G	5
Pump P3 L	6
Pump P3 N	7
Pump P3 G	8
3-Way NO/P2 L	9
3-Way N/P2 N	10
3-Way NC	11
3-Way G/P2 G	12

Terminal Block #4

1	Power In 115VAC L
2	Auxillary 115VAC L
3	Auxillary 115VAC L
4	Auxillary 115VAC L
5	Auxillary 115VAC L
6	Power In 115VAC N
7	Auxillary 115VAC N
8	Auxillary 115VAC N
9	Auxillary 115VAC N
10	Auxillary 115VAC N
11	Auxillary 115VAC N
12	Power In 115VAC G

Terminal Block #5

1	2	3	4	5	6	7	8	9	10
P3 Relay Load	P3 Relay Line	P3 Relay Control N	P3 Relay Control L	3-Way NO/P2 Relay Load	3-Way NC Relay Load	3-Way/P2 Relay Line	3-Way NC Relay Control L	3-Way NO/P2 Relay Control L	3-Way /P2 Relay Control N

Terminal Block 1

Terminals 1 & 2	Heat Enable/Disable (Dry Contact)
Terminals 3 & 4	Fault alarm (Dry Contact)
Terminals 5 & 6	E-Stop (remote switch) *current carrying - 0-5VDC*
Terminals 7 & 8	For use with PWM boiler pump only
Terminals 9 & 10	Load (piping, Low Loss Header) sensor (T6) 10k Ohm
Terminals 11 & 12	Tank sensor (T3) here - 10K Ohm

Terminal Block 2

Terminals 1 & 2	Additional safety circuit
Terminals 3 & 4	Cascade in
Terminals 5 & 6	Cascade Out
Terminals 7 & 8	T4 Outdoor Sensor - 10k Ohm
Terminal 9	0 - 10 VDC (+)
Terminal 10	0 - 10 VDC (-)
Terminals 11 & 12	Room Thermostat

Terminal Block 3

Terminals 1–3	Power to P1 Pump - 3 phase
Terminal 4	*Not used for 3 phase* - Neutral to P1 Pump
Terminal 5	Ground to P1 Pump
Terminal 6–8	Power to P3 115v pump or relay for 3 phase
Terminal 9	Line P2 Pump or NO terminal on 3 way valve - 115v
Terminal 10	Neutral on P2 Pump or 3 way valve 115v
Terminal 11	NC terminal on 3 way valve - 115v
Terminal 12	Ground on P2 pump or 3 way valve - 115v

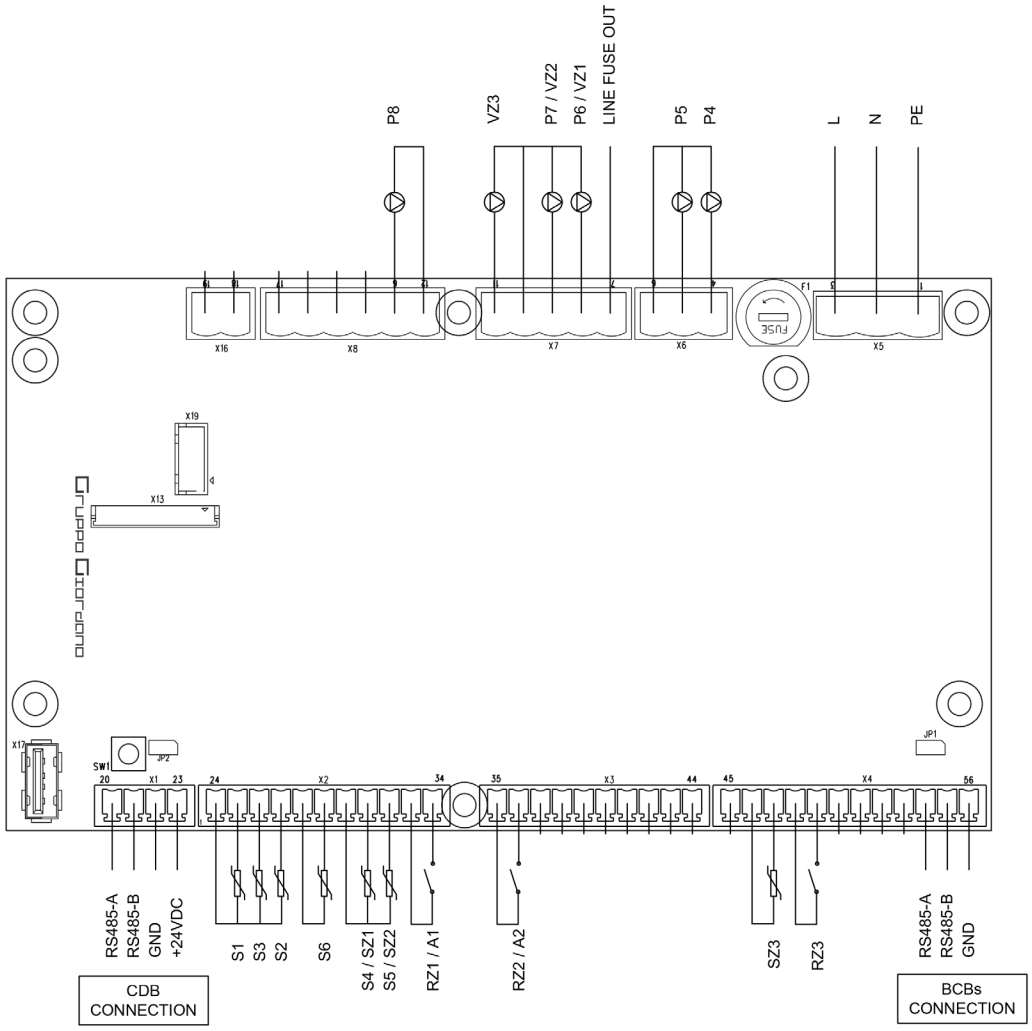
Terminal Block 4

Terminal 1–5	115v Line - *factory wired on 3 phase models*
Terminal 6–11	115v Neutral - *factory wired on 3 phase models*
Terminal 12	115v Ground - *factory wired on 3 phase models*

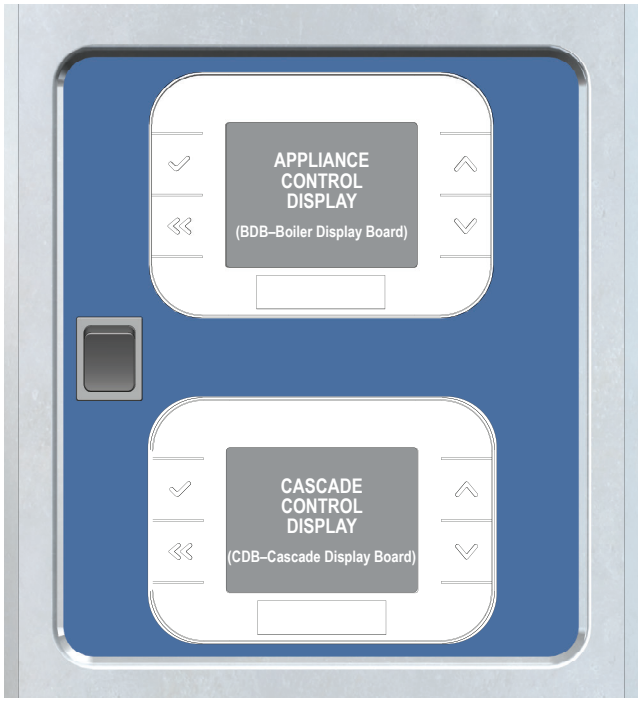
Terminal Block 5

Terminals 1–10	Factory Wired as standard - Relay Switching

(FIGURE 2-3) CASCADE BOARD WIRING



(FIGURE 2-4) CONTROL DISPLAY



PART 3. GAS CONNECTION

A. GAS CONNECTION

⚠ WARNING

Failure to follow all precautions could result in fire, explosion or death!

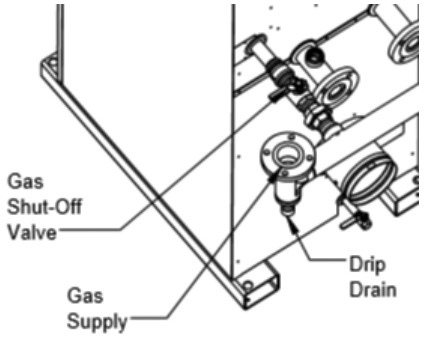
The gas supply shall have a maximum inlet pressure of less than 14" water column (1/2 PSI) (3.44 kPa), and a minimum of 4" water column. The entire piping system, gas meter and regulator must be sized properly to prevent pressure drop greater than 1" as stated in the National Fuel Gas Code. This information is listed on the rating plate. **It is very important that you are connected to the type of gas as noted on the rating plate**, "LP" for liquefied petroleum, propane gas or "Nat" for natural or city gas. All gas connections must be approved by the local gas supplier, or utility in addition to the governing authority, prior to turning the gas supply on. It is mandatory that a drip leg be fabricated, as per the National Fuel Gas code. Once all the inspections have been performed, the piping must be leak tested. It is recommended that a soapy solution be used to detect leaks. Bubbles will appear on the pipe to indicate a leak is present. If the leak test requirement is a higher test pressure than the maximum inlet pressure, you must isolate the 3VO from the gas line. In order to do this, you must shut the gas off using factory and field-installed gas cocks (following the lighting instructions in Part 6, Section B, Pages 43–44.) This will prevent high pressure from reaching the valve. Failure to do so may damage the gas valve. In the event the gas valve is exposed to a pressure greater than 14" water column, the gas valve must be replaced.

Never use an open flame (match, lighter, etc.) to check gas connections.

B. GAS PIPING

The gas piping must be sized for the proper flow and length of pipe, to avoid pressure drop. Both the gas meter and the gas regulator must be properly sized for the total gas load. If you experience a pressure drop greater than 1" WC from the minimum system load to the maximum system load, including all appliances on the same line, the meter, regulator or gas line is undersized or in need of service. You can attach a manometer to the incoming gas drip leg by removing the cap and installing the manometer (see Figures 3-1 and 3-2 on the following page). The 3VO also has a gas pressure transducer on the inlet to the gas valve, viewable on the HOT™ control. The gas pressure must remain between 4" and 14" during stand-by (static) mode and while in operating (dynamic) mode, dropping no more than 1" WC total as indicated above. **If an in-line regulator is used, it must be a minimum of 10 equivalent feet from the 3VO. It is very important that the gas line is properly purged by the gas supplier or utility. Failure to properly purge the lines or improper line sizing, will result in ignition failure.** This problem is especially noticeable in NEW LP installations and also in empty tank situations. This can also occur when a utility company shuts off service to an area to provide maintenance to their lines. This gas valve must not be replaced with a conventional gas valve under any circumstances. As an additional safety feature, this gas valve is easily de-coupled from the fan inlet.

Refer to the following tables to size the supply piping to minimize pressure drop between meter or regulator and unit.



(FIGURE 3-1) 3VO GAS CONNECTION

C. GAS TABLES

1. Run the gas supply line in accordance with all applicable codes.
2. Locate and install manual shut off valves in accordance with state and local requirements.

(TABLE 3-1) NATURAL GAS SUPPLY PIPING

Nominal Iron Pipe Size	Internal Diameter (inches)	Length of Pipe (Feet) 10	20	30	40	50	60	70	80	90	100	125	150	175	200	BTUs per HR x 1,000
1-1/2	0.824	2,150	1,500	1,210	1,020	923	830	769	707	666	636	564	513	472	441	
2	1.049	4,100	2,260	2,260	1,950	1,720	1,560	1,440	1,330	1,250	1,180	1,100	974	871	820	
2-1/2	2.47	6,460	4,460	3,610	3,100	2,720	2,460	2,310	2,100	2,000	1,900	1,700	1,540	1,400	1,300	
3	3.07	11,200	7,900	6,400	5,400	4,870	4,410	1,000	3,800	3,540	3,300	3,000	2,720	2,500	2,340	
4	4.03	23,500	16,100	13,100	11,100	10,000	9,000	8,300	7,690	7,380	6,870	6,150	5,640	5,130	4,720	

(Maximum capacity of pipe in thousands of BTU/hr for gas pressures of 14 inches of water column (0.5 PSIG) or less and a pressure drop of 0.5 inch water column. Based on Natural Gas; 1025 BTU/hr per cubic foot of gas and 0.60 specific gravity.)

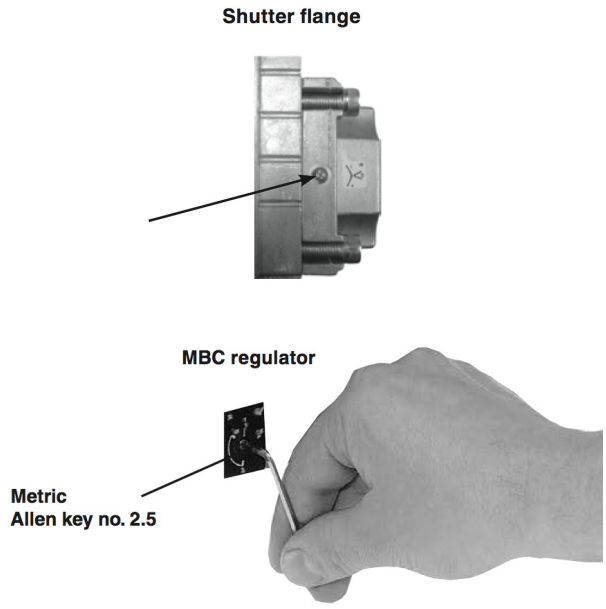
(TABLE 3-2) PROPANE SUPPLY PIPING (Based on 11" WC supply pressure)

Nominal Iron Pipe Size	Internal Diameter (inches)	Length of Pipe (Feet) 10	20	30	40	50	60	80	100	125	150	200	250	300	350	400	BTUs per HR x 1,000
1-1/2	0.824	3,307	2,299	1,858	1,559	1,417	1,275	1,086	976	866	787	665	590	534	491	458	
2	1.049	6,221	4,331	3,465	2,992	2,646	2,394	2,047	1,811	1,606	1,496	1,282	1,138	1,030	9,47	883	
2-1/2	2.47	10,140	7,046	5,695	4,778	4,343	3,908	3,329	2,991	2,654	2,412	2,038	1,808	1,637	1,505	1,404	
3	3.07	17,990	12,510	10,110	8,481	7,708	6,936	5,908	5,309	4,711	4,281	3,618	3,210	2,905	2,671	2,492	
4	4.03	36,710	25,520	20,620	17,300	15,730	14,150	12,050	10,830	9,613	8,736	7,382	6,549	5,927	5,450	5,084	

(Sizing between single or second stage regulator and appliance. Maximum propane capacities listed based on 1/2" WC setting.)

D. GAS VALVE SETUP

(FIGURE 3-2) GAS TRAIN ASSEMBLY



(FIGURE 3-3) GAS VALVE ADJUSTMENT

(TABLE 3-3) COMBUSTION & FUEL RELATED ADJUSTMENT TABLE

	Natural Gas CO_2	Natural Gas CO ppm *(do no use for setup)*	LP Gas CO_2	LP Gas CO ppm *(do no use for setup)*
LOW FIRE	8.9%	Less than 10	9.6%	Less than 15
HIGH FIRE	8.9%	Less than 100	9.6%	Less than 120

(All numbers are approximations)

Please see Part 6 - Start-Up Procedures on page 41 before continuing!

- Read the gas supply pressure on the HOT™ control screen under Status, or alternatively at the gas shut-off at the rear of the unit. The required supply pressure needed for these appliances to work properly is greater than 4" and less than 14" WC. This pressure must remain steady, fluctuating less than 1" from low to high fire; full load, including all gas fired appliances connected to the gas supply where the appliance is installed. There is a plug mounted in the vent connection at the rear of the unit for sampling leaving combustion products. Remove for testing and replace when testing is complete. the plug MUST be in place during normal operation.
- Enter service mode through the SETUP section, placing first in STAND BY mode, then tabbing down to SERVICE. Press the √ button and set to the maxium fan speed (100%) to set high fire; set to minimum fan speed to set low fire (0%) combustion conditions. For detailed instructions on entering Service Mode, see page 43–44.

E. SETTING COMBUSTION

- A means of sampling the leaving flue gas is built into each model, on all models there is a rubber plug mounted in the vent connector on the back of the appliance. Remove for testing and replace when testing is completed. This plug MUST be in place during normal operation.
- While in Service Mode, as indicated above and on Fan Speed screen, set for the maximum fan speed (100%). When steady state firing has been achieved, set appropriate CO_2 level using the shutter adjustment screw or the gas valve outlet (to fan inlet) side. Small adjustments at a time (less than 1/8 turn) are suggested.
- Once the maximum load has been set, set the minimum load. Adjust fan speed to reach the minimum RPM setting (0%, which equals low fire). In order to set or adjust the minimum fire CO_2, turn the MBC regulator screw clockwise to increase or counterclockwise to decrease the CO_2.
- If the measuring process takes more than 40 minutes, the appliance will return to the automatic mode. If so required, enter the Service Mode another time.
- When you are done setting the valve, exit Service Mode to return to normal run mode

If the appliance is to be converted in the field for using Propane (LPG), the following steps must be taken:

- Run the appliance as if on Natural Gas. It will operate, but run rich, high CO.
- After conversion, follow the steps in Section E for setting the maximum and minimum loads, using the LP gas values shown in Table 3-3, on the preceeding page.

When checking or replacing a gas valve, the CO_2 percentage in the flue gas is the preferred measuring method to insure proper combustion and firing rate. CO is used as the alternate.

⚠ WARNING

Failure to follow all precautions could result in fire, explosion or death!

PART 4. VENTING

A. APPROVED VENTING MATERIALS

(TABLE 4-1) APPROVED VENTING MATERIALS

All vent pipe materials and fittings must comply with the following:			
Item	**Material**	**Standards for installation in:**	
		United States	**Canada**
Vent pipe and fittings	AL 29-4C Stainless	ANSI/ASTM UL1738	ULC-S636
	Polypropylene (PP)	ANSI/ASTM UL1738	ULC-S636
	PVC* schedule 40	ANSI/ASTM D1785	CPVC and PVC venting must be ULC-S636 Certified. IPEX is an approved vent manufacturer in Canada supplying vent material listed to ULC-S636.
	PVC* - DVW	ANSI/ASTM D 2665	
	CPVC** schedule 40	ANSI/ASTM F441	
Pipe cement & primer	PVC*	ANSI/ASTM D2564	IPEX System 636 Cements & Primers
	CPVC**	ANSI/ASTM F493	
NOTICE: DO NOT USE CELLULAR (FOAM) CORE PIPE			

**Only setpoints of 120° or less. **Must use CPVC for system setpoints over 120° F.*

Please note: Venting system may contain one or more of the above materials.

The 3VO is a direct vent appliance. The 3VO is listed as a Category IV. Condensing Appliance. (The 3VO Venting is rated at Zero Clearance to combustibles.)

⚠ SPECIAL VENTING SYSTEM DESIGN NOTES

The 3VO efficiency testing and ratings are based on a sealed, two pipe vent system; however, many other vent configurations are available as factory engineered solutions. Please contact the factory if exceptions are required for your installation.

⚠ DANGER

It is extremely important to follow these venting instructions carefully. Failure to do so can cause severe personal injury, death or substantial property damage.

⚠ WARNING

This vent system will operate with a positive pressure in the vent pipe. Do not connect vent connectors serving appliances by natural draft into any portion of mechanical draft systems operating under pressure.

(TABLE 4-2) VENTING SPECIFICATIONS

Model	Vent Diameter	Standard Vent Type	Optional Vent Type *(Adapter Required)*	Minimum Combined Vent Length	Maximum Combined Vent Length*
750	5"	AL 29-4C	PVC,* CPVC, PP	6' plus (2) 90° Elbows	100'
850	6"	AL 29-4C	PVC,* CPVC, PP	6' plus (2) 90° Elbows	100'
1000	6"	AL 29-4C	PVC,* CPVC, PP	6' plus (2) 90° Elbows	100'
1500	8"	AL 29-4C	PVC,* CPVC, PP	6' plus (2) 90° Elbows	100'
2000	8"	AL 29-4C	PVC,* CPVC, PP	6' plus (2) 90° Elbows	100'
2500	10"	AL 29-4C	PVC,* CPVC, PP	6' plus (2) 90° Elbows	100'
3000	10"	AL 29-4C	PVC,* CPVC, PP	6' plus (2) 90° Elbows	100'
3500	10"	AL 29-4C	PVC,* CPVC, PP	6' plus (2) 90° Elbows	100'
4000	12"	AL 29-4C	PVC,* CPVC, PP	6' plus (2) 90° Elbows	100'

Note: For concrete construction or to meet certain fire codes, exhaust and inlet piping at the wall penetration to the 3VO must be CPVC Schedule 40 or 80 or stainless. The balance from the penetrated wall to the outside may be PVC Schedule 40 or 80.
**Without consulting factory for sizing*
**Only for setpoints of 140° or less*

B. VENTING THE 3VO

The inlet and exhaust pipes on the back of the cabinet should be the diameter and material indicated in the Venting Specifications Table above. It is very important that you plan the location properly to eliminate long pipe runs and excessive fittings. Inlet pipe size must not be reduced. *Do not combine the inlet air or exhaust with any other inlet or exhaust pipe including either to an additional similar appliance, unless you have purchased an engineered Common Venting System from Hamilton Engineering Company, Inc.* The joints must be properly cleaned, primed and cemented if plastic, and sealed per the manufacturer's instructions if stainless. The piping must also be properly supported as per Local and National Standard Plumbing Codes. It is important that the piping must be clean and free from burrs, debris, ragged ends and particles of PVC (if applicable).

Exhaust piping should be sloped back to the connection on the 3VO, at least 1/4" per foot to remove additional condensate that forms within the pipe, and contain a drain within the venting routed through the condensate neutralizer and trap supplied with the appliance.The total combined length of pipe (intake piping plus exhaust piping added together) including elbow allowances intake and exhaust should not exceed the length shown in the vent table. The minimum combined vent length should not be less than a combined length of 6' plus two 90° elbows. Choose your vent termination locations carefully. You must also make certain that exhaust gas does not re-circulate back into the intake pipe. You must place them in an open area and follow the following guidelines:

(TABLE 4-3) EQUIVALENT LENGTH IN FEET OF VENT PIPE FOR VENT PIPE FITTING

	Vent Pipe Diameter									
Vent Pipe Fitting	3"	4"	5"	6"	7"	8"	9"	10"	12"	14"
TEE	19	25	31	38	44	50	56	63	75	89
Y-Combination	10	13	16	20	23	26	29	32	39	45
90 Elbow	5	7	9	11	12	14	16	18	21	25
45 Elbow	3	4	4	5	6	7	8	9	10	13

1) Never vent into a walkway, patio area, alley or otherwise public area less than 7' from the ground. (See detail below references Fig. A.12.9 in the National Fuel Gas Code 2009 “Exit Terminals of Mechanical Draft and Direct-Venting Systems.” - see Figure 4-1 on the next page)
2) Never vent over or under a window or a doorway where the exhaust plume or condensation liquid will cause obtrusive or dangerous conditions. (Refer to National Fuel Gas Code, CAN B149).
3) Never install a heat saver or similar product to capture waste heat from exhaust.
4) Always have a vent location at least 12" above maximum snow level.
5) Always have vent a minimum of 24" above ground level, away from shrubs and bushes.
6) Follow local gas codes in your region or refer to National Fuel Gas Code, Can B149.
7) Always have at least 36" distance from an inside corner of the outside walls.
8) Maintain at least 48" clearance to electric, gas meters, windows, exhaust fans, chimneys, inlets or mechanical vents.
9) VERY IMPORTANT! The inlet air connection must be connected to outside air and should be located no closer than 8" and no further than 24" to the exhaust.
10) *Always* place screens in all openings in intake and exhaust to prevent foreign matter from entering the 3VO.
11) The vent intake and exhaust must be properly cleaned and glued if plastic, and sealed per the manufacturer’s directions if stainless for a pressure tight joint.
12) Several methods for venting the 3VO can be found on pages 22–23. Use these layouts as guidelines: certain site conditions such as multiple roof lines/pitches may require venting modifications (consult Hamilton Engineering Company, Inc.).

⚠ NOTICE

The following are code restrictions for the location of the flue gas vent terminal. Compliance to these requirements doesn’t insure a satisfactory installation; good common sense must also be applied.

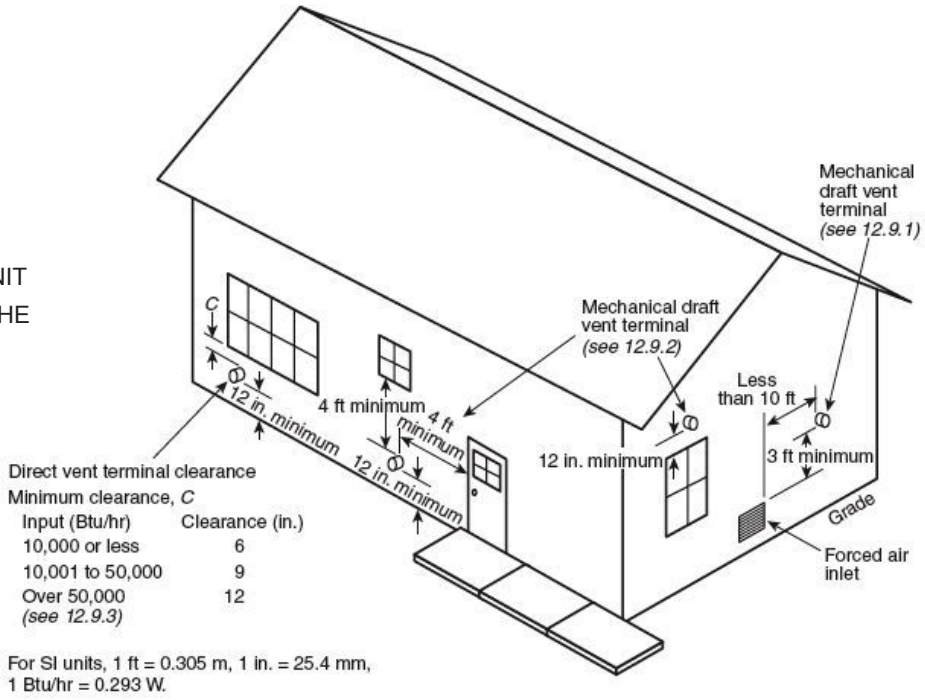
It is important to make sure that exhaust gases are not recirculated into the inlet air of the 3VO. If there is any doubt, contact the factory BEFORE installing.

(FIGURE 4-1) EXIT TERMINALS OF MECHANICAL DRAFT AND DIRECT-VENT VENTING SYSTEM

* REFERENCE: THE NATIONAL FUEL GAS CODE 2009 EDITION

***IMPORTANT NOTE**

HAMILTON ENGINEERING COMPANY, INC. RECOMMENDS A MINIMUM CLEARANCE OF 4 FEET WHERE THE EXHAUST PLUME CAUSED BY THE UNIT MAY OBSTRUCT VIEWS OR AFFECT THE COSMETIC LOOK OF THE BUILDING. IN CANADA, THERE IS A MINIMUM CLEARANCE OF 10 FEET.



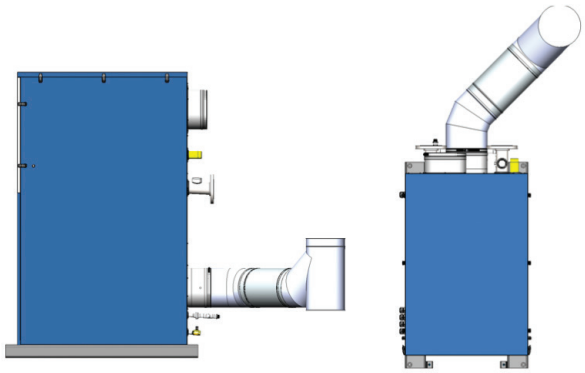
13) A through-the-wall mechanical draft venting system shall terminate at least 3 ft (0.9 m) above any forced air inlet located within 10 ft (3 m).
Exception No. 1: This provision shall not apply to the combustion air intake of a direct vent appliance.
Exception No. 2: This provision shall not apply to the separation of the integral outdoor air inlet and flue gas discharge of listed outdoor appliances.

14) A through-the-wall mechanical draft venting system of other than direct vent type shall terminate at least 4 ft (1.2 m) below, 4 ft (1.2 m) horizontally from, or 1 ft (300 mm) above any door, operable window, or gravity air inlet into any building. The bottom of the vent terminal shall be located at least 12" (300 mm) above finished ground level above max snow fall.

15) The through-the-wall vent terminal of a direct vent appliance with an input of 10,000 BTU/hr (3 kW) or less shall be located at least 6" (150 mm) from any air opening into a building, an appliance with an input over 10,000 BTU/hr (3 kW) but not over 50,000 BTU/hr (14.7 kW) shall be installed with a 9 in. (230 mm) vent termination clearance, and an appliance with an input over 50,000 BTU/hr (14.7 kW) shall have at least a 12" (300 mm) vent termination clearance. The bottom of the vent terminal and the air intake shall be located at least 12" (300 mm) above finished ground level above max snow fall.

(FIGURE 4-2) SIDEWALL VENT WITH DOWN ELBOW (INTAKE) & UP ELBOW (EXHAUST)

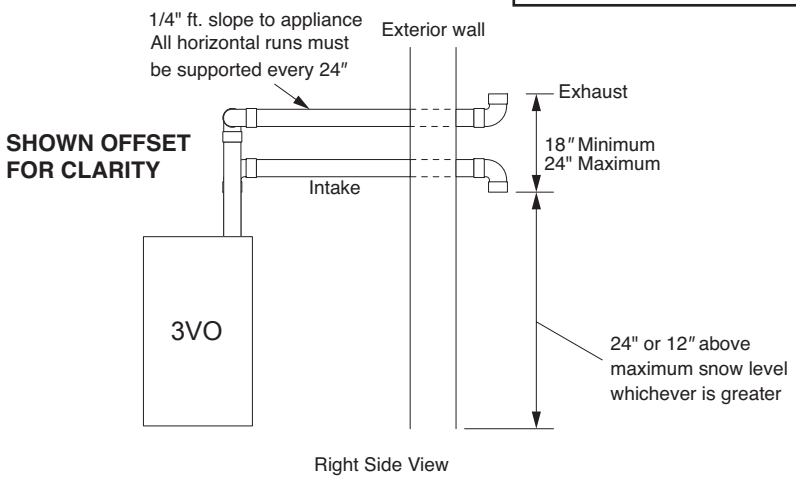
**IMPORTANT NOTE: All vent pipes must be glued, properly supported and the exhaust must be pitched a minimum of a 1/4" per foot back to the heater (to allow drainage of condensate). All stainless venting must be sealed at each joint per manufacturer's instructions. All vent runs must also contain a drain fitting prior to being connected to the appliance vent connector. This drain line must be routed through the condensate neutralizer which also provides a trap.



(FIGURE 4-2)

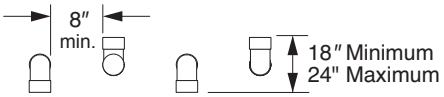
DIAGRAMS FOR SIDEWALL VENTING

PLEASE NOTE:
Exhaust must not terminate beneath an overhang!



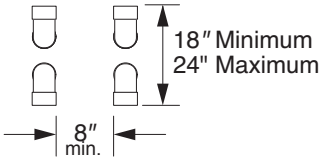
Right Side View

VENTING FOR MULTIPLE UNITS, with vents all on same horizontal plane, spaced at least 8 inches apart, and at level of highest unit.



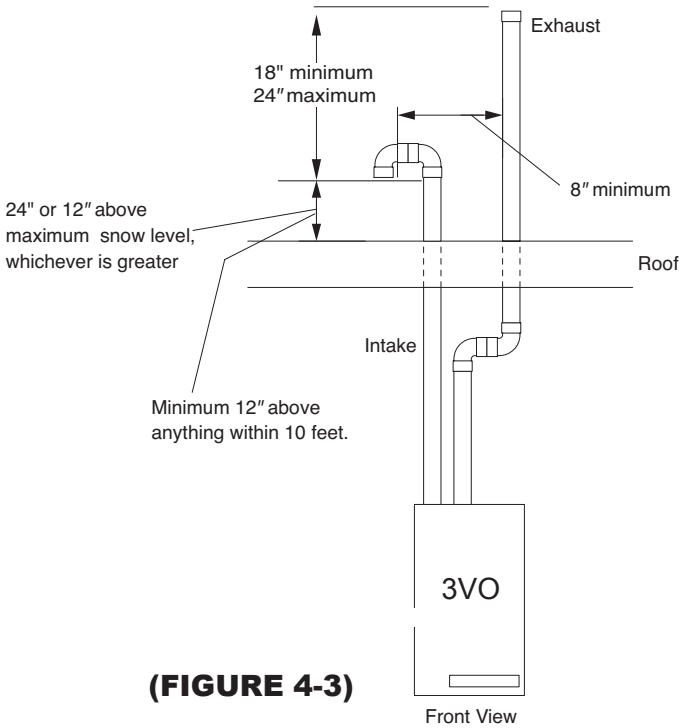
Front Elevation

- OR -



Front Elevation
(Multiple Vents)

DIAGRAMS FOR VERTICAL VENTING



Front View

(FIGURE 4-3)

(FIGURE 4-3) VERTICAL VENT WITH DOUBLE ELBOW (INTAKE) & COUPLING (EXHAUST)

**IMPORTANT NOTE: All vent pipes must be glued, properly supported and the exhaust must be pitched a minimum of a 1/4" per foot back to the heater (to allow drainage of condensate). All stainless venting must be sealed at each joint per manufacturer's instructions. All vent runs must also contain a drain fitting prior to being connected to the appliance vent connector. This drain line must be routed through the condensate neutralizer which also provides a trap.

⚠ CAUTION

Flue Gas will condense as it exits the vent termination. This condensate can freeze on exterior building surfaces which may cause discoloration of these surfaces. Consideration should be given to the plume of condensation that exits the exhaust which may affect the cosmetic appearance of the building.

C. INLET AIR VENT

You may use the same material as used for exhaust or any material that is the same diameter that provides a pressure tight connection. THIS IS ONLY FOR INLET AIR, NOT FOR EXHAUST PIPING!

The air inlet must be a minimum of 12" vertically above the maximum snow level. It is very important that there are no other vents, chimneys or air inlets in any direction for at least 48”.

All venting must be properly supported. The 3VO is not intended to support any venting whatsoever. All piping, glue, solvents, cleaners, fittings and components, must conform to ASTM (American Society for Testing and Materials), and ANSI (American National Standards Institute).

D. VENTING RUNS THAT EXCEED MAXIMUM COMBINED LENGTH

If the combined venting length of a heater’s exhaust/inlet air system exceeds the Maximum Combined Length called out in Table 4-2, Page 20, contact Hamilton Engineering Company, Inc. for an engineered venting calculation. Do not proceed without calling Hamilton Engineering Company, Inc. at 800.968.5530 or 734.419.0200.

VENT CALCULATION EXAMPLE: Installation requires the following material for both inlet and exhaust piping for the 3VO 1000 (maximum combined equivalent length is 100 feet).

Required: 4 Pcs. 90° elbow (4 x 9 = 36 equivalent feet*)	= 36 equivalent feet
Required: 20' of 5" Vent Pipe (20 x 1 = 20 equivalent feet)	= 20 equivalent feet
Required: Inlet air in vertical termination ((2) 90º elbows + bird screen)	= 21 equivalent feet
Required: Exhaust coupling	= 1 equivalent foot
Total Friction Loss in equivalent feet	**= 78 equivalent feet**
**Minimum 6" pipe diameters between elbows*	***THIS VENTING LAYOUT IS OK!***

⚠ DANGER

The 3VO is not intended to be common vented with any other existing appliance! Multiple 3VO products may be common vented only if using an engineered system by Hamilton Engineering Company, Inc.

E. HEATER REMOVAL FROM AN EXISTING COMMON VENT SYSTEM

At the time of removal of an existing heater, the following steps shall be followed with each appliance that remains connected to the common venting system placed in operation, while the other appliances that remain connected to common venting system are not operating.

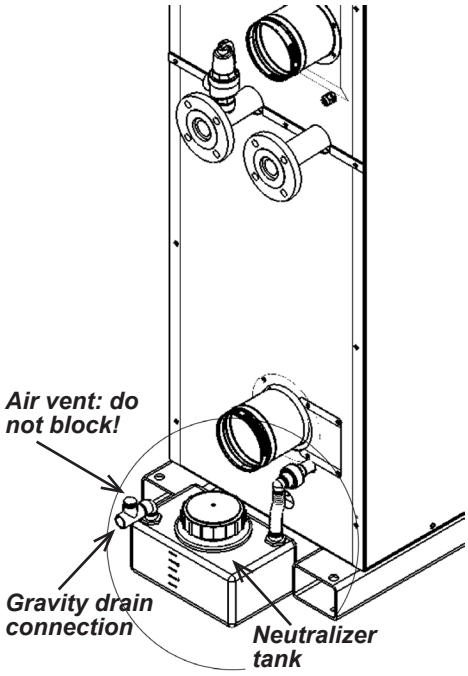
1) Seal any unused openings in the common venting system. ***The 3VO venting is NOT to be combined with this older venting system!***
2) Visually inspect the venting system for proper size and horizontal pitch to determine if there is blockage, leakage, corrosion or other deficiencies that could cause an unsafe condition.

1) If practical, close all building doors, windows and all doors between the space in which the appliance remains connected to the common venting system and other spaces in the building. Turn on clothes dryers and any appliances not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, at maximum speed. Do not operate a summer exhaust fan. Close all fireplace dampers.
2) Place the appliance being inspected in operation. Follow the lighting instructions. Adjust the thermostat so the appliance will operate continuously.
3) Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle or smoke from a cigarette.
4) After it has been determined that each appliance remaining connected to common venting system properly vents when tested as outlined, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous condition of use.
5) Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Appendix G in the National Fuel Gas Code, ANSI Z 223.1

F. CONDENSATE REQUIREMENTS

This is a condensing high efficiency appliance, therefore this unit has a condensate removal system. Condensate is nothing more than water vapor derived from the combustion products, similar to an automobile when it is initially started. This condensate does have a low pH and should be treated with a Condensate Neutralizer Filter. This filter contains either lime or marble rocks, which will neutralize the condensate. The outlet of the filter contains a 1/4" air vent. ***It is very important that the condensate line is sloped away from and down to a suitable inside drain.*** A condensate neutralizer and a condensate pump kit are available from Hamilton Engineering Company, Inc. It is also very important that the condensate line is not exposed to freezing temperatures, or any other type of blockage. Plastic tubing or PVC pipe should be the only materials used for the condensate line. Steel, brass, copper or others will be subject to corrosion and deterioration. A second vent may be necessary to prevent condensate line vacuum lock if a long horizontal run is used. The 3VO appliance has an automatic safety device that will shut it down in the event of a condensate drain blockage. Test PH and drain function annually.

Maximum volume of condensate produced is 11 gallons per hour per 1,000,000 BTU of gas burned.



(FIGURE 4-4)
CONDENSATE DRAIN DETAIL

PART 5. PIPING

A. HYDRONIC HEATING BOILER PIPING

The 3VO is designed to function in a closed loop (minimum) 15 PSI System. Never let the 3VO operate without a minimum of 12 PSI water pressure, this assures that the 3VO heat exchanger can be completely purged of air, failure to do so could cause damage. It is important to note that the 3VO Boiler is flow dependent for proper efficiency and life expectancy; therefore, primary-secondary piping, a low loss header or proper variable primary minimum flow (50°FΔT at full fire) check is a must. Each 3VO Heating Boiler System should have an Air Eliminator, in addition to the heat exchanger mounted air vents, which will remove air from the Hydronic System.

Always follow good piping practices. Observe minimum 1" clearance to combustibles around all uninsulated hot water pipes, or when openings around pipes are not protected by non-combustible materials. On an 3VO installed above the level of the highest heat transfer device, some state and local codes require a low water cut off device at the time of installation by the installer. Water flow sensing is provided as standard and may take the place of a low water cut-off.* If the 3VO supplies hot water to heating coils in air handler units, flow control valves or other devices must be installed to prevent gravity circulation of boiler water in the coils during the cooling cycle.

Basic piping connection steps are listed below. A drawing, specific to your application can be obtained from your distributor or Hamilton Engineering Company, Inc., which will guide you through proper installation of the 3VO.

1) Pipe properly, in accordance with generally accepted piping principals or Hamilton Engineering specific documents.
2) Connect system return to the pipe entering the 3VO closest to the back.
3) Connect system supply to the pipe leaving the 3VO containing the Relief Valve.
4) Install Drain Valve on system supply.

**Reference ASME CSD-1 Code, Section CW-210*

B. FILL & PURGE HEATING SYSTEM

1) Attach hose to balance and purge hose connector and run to drain.
2) Close the other side of the balance and purge valve.
3) Open first zone balance and purge valve, so as to let the water flow out of the hose. If zone valves are used, open zone valves one at a time, manually. (NOTE: please check manufacturer's instructions prior to opening valves manually, so as not to damage the valve.)
4) Manually operate fill valve regulator. When water runs out of hose, connected to the balance and purge valve, in steady stream (with no air bubbles), close balance and purge valve to stop the water from flowing. Disconnect hose and connect to next zone to be purged.
5) Repeat procedure for additional zones (one at a time).

Upon completion, make sure that the fill valve is in automatic position and each zone balance and purge valve is in the open position and zone valves are positioned for automatic operation.

NOTE: Installations that incorporate Standing Iron Radiators and systems with manual high point vents:
Follow the above procedure, then starting with nearest manual air vent, open vent until water flows out; close vent. Repeat procedure, working your way toward furthest air vent. It may be necessary to install basket strainer in an older hydronic system where larger amounts of sediment may be present. Periodic cleaning of the strainer will be necessary.

C. REMOVING AIR FROM THE HEAT EXCHANGER

The 3VO has (4) automatic air vents on the top of the appliance and the air vent cap can be loosened to allow trapped air to escape at a higher rate than normal when the appliance is initially filled and put into operation. In the loosened postion, water will come out the air relief opening when all of the air is gone; close immediately to avoid damage to other components. If an air vent should start to leak, replace it immediately to avoid further damage. When replacing the air vent, the water must be shut off and pressure relieved first.

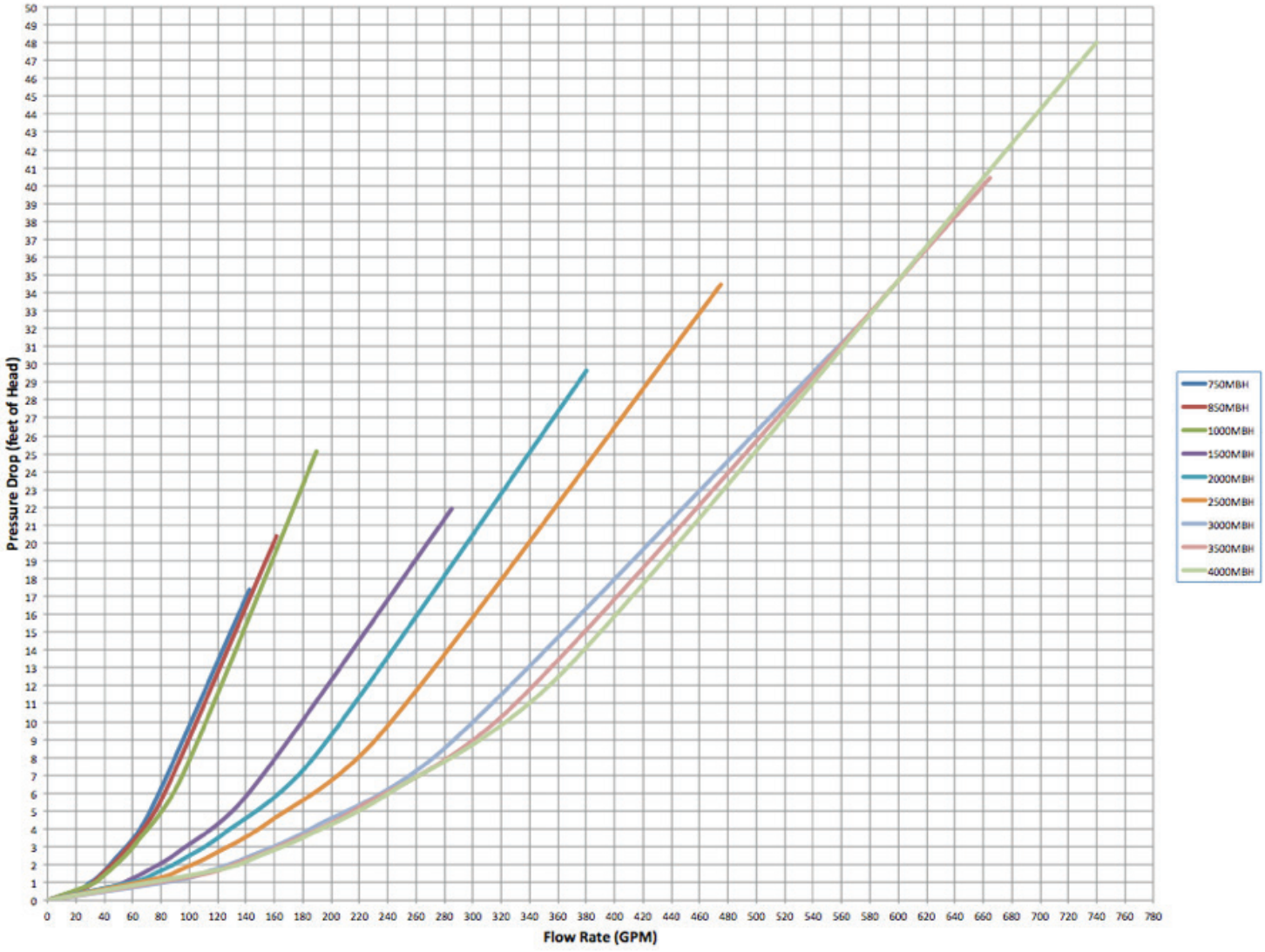
The HOT™ Controls contains software to insure proper air removal from the heat exchanger; an "aeration program" cycles the pump on and off without the appliance firing anytime the power has been cycled to the appliance—this process is indicated on the scrolling message screen.

D. FLOW & PRESSURE DROP DATA

(TABLE 5-1) 3VO FLOW AND PRESSURE DROP DATA

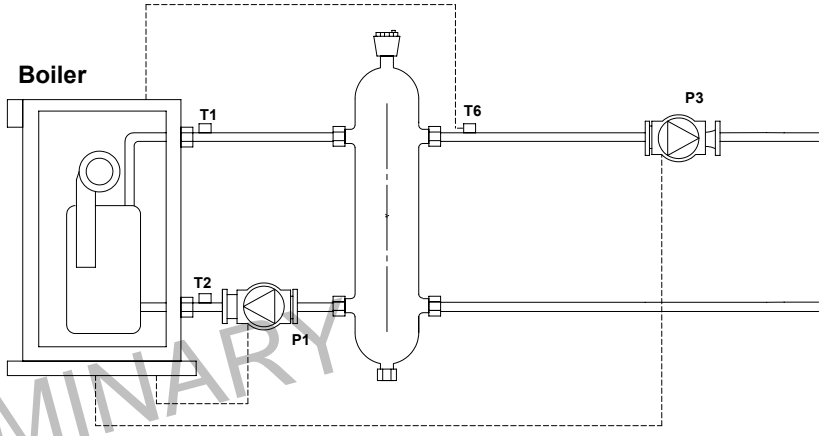
Model	10°F ΔT GPM	10°F ΔT ΔP ft hd	20°F ΔT GPM	20°F ΔT ΔP ft hd	30°F ΔT GPM	30°F ΔT ΔP ft hd	40°F ΔT GPM	40° ΔT ΔP ft hd	50°F ΔT GPM	50°F ΔT ΔP ft hd	*60°F ΔT GPM
750MBH	142.6	17.4	71.3	4.8	47.5	2.3	35.6	1.3	28.5	0.9	23.8
850MBH	161.6	20.4	80.8	5.7	53.8	2.7	40.4	1.6	32.3	1.0	26.9
1000MBH	190.1	25.1	95.0	7.0	63.3	3.3	47.5	1.9	38.0	1.3	31.7
1500MBH	285.1	21.9	142.6	6.1	94.9	2.9	71.3	1.7	57.0	1.1	47.5
2000MBH	380.2	30.3	190.1	8.4	126.6	4.0	95.0	2.3	76.0	1.5	63.4
2500MBH	475.2	35.4	237.6	9.8	158.2	4.6	118.8	2.7	95.0	1.8	79.2
3000MBH	570.2	32.2	285.1	8.9	189.9	4.2	142.6	2.5	114.0	1.6	95.0
3500MBH	665.3	40.9	332.6	11.3	221.5	5.3	166.3	3.1	133.1	2.1	110.9
4000MBH	740.2	48.4	370.1	13.4	246.5	6.3	185.1	3.7	148.0	2.5	123.4

**60° FΔT is not recommended*



E. SAMPLE DRAWINGS—CLOSED LOOP HEATING

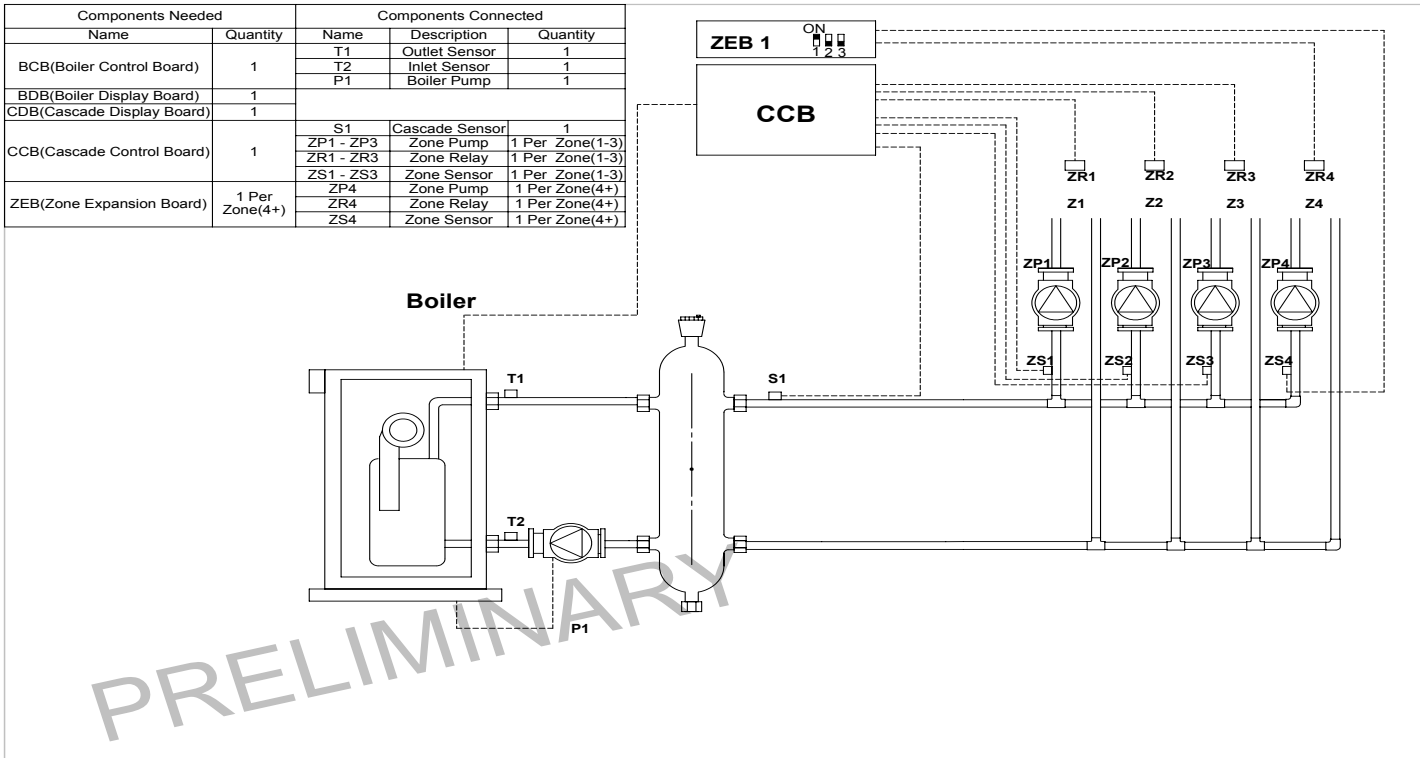
(FIGURE 5-1) HEATING ZONE 1, HSS



PRELIMINARY

(FIGURE 5-2) HEATING 4 ZONES PUMPED, HSS

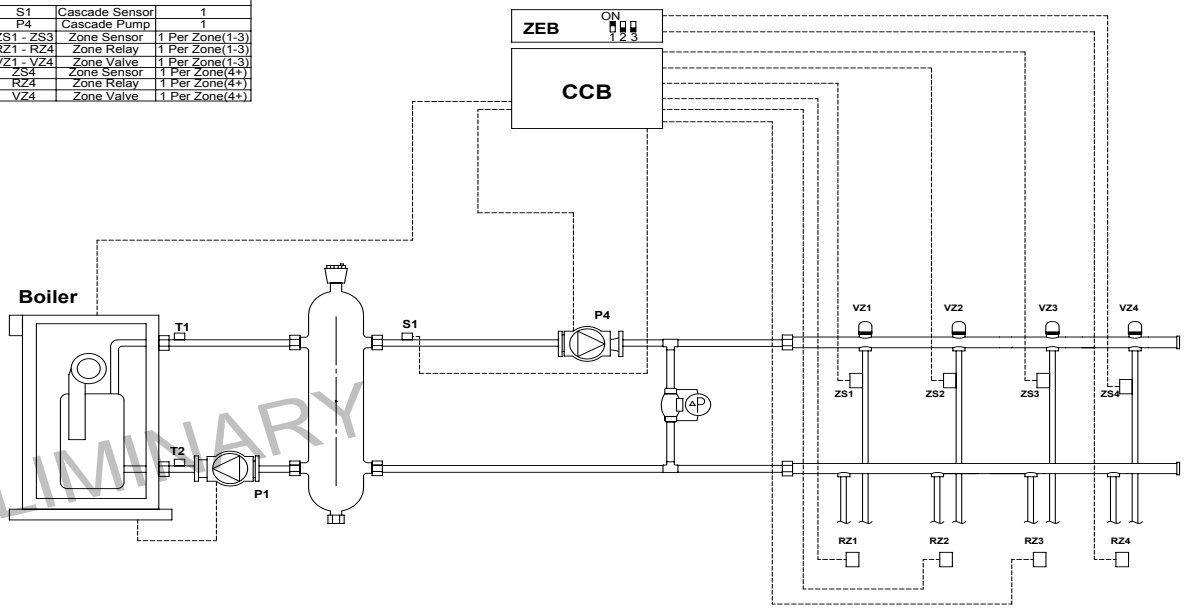
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Outlet Sensor	1
		T2	Inlet Sensor	1
		P1	Boiler Pump	1
BDB(Boiler Display Board)	1			
CDB(Cascade Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		ZP1 - ZP3	Zone Pump	1 Per Zone(1-3)
		ZR1 - ZR3	Zone Relay	1 Per Zone(1-3)
		ZS1 - ZS3	Zone Sensor	1 Per Zone(1-3)
ZEB(Zone Expansion Board)	1 Per Zone(4+)	ZP4	Zone Pump	1 Per Zone(4+)
		ZR4	Zone Relay	1 Per Zone(4+)
		ZS4	Zone Sensor	1 Per Zone(4+)



PRELIMINARY

(FIGURE 5-3) HEATING 4 ZONES, ZONE VALVES, HSS

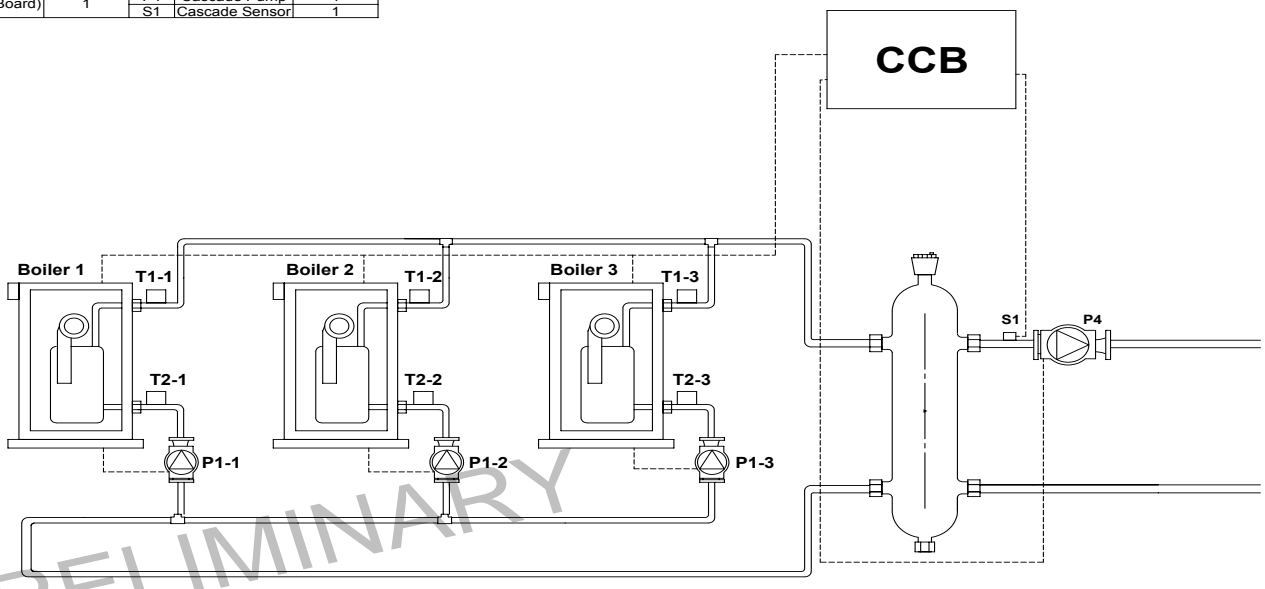
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Outlet Sensor	1
		T2	Inlet Sensor	1
		P1	Boiler Pump	1
BDB(Boiler Display Board)	1			
CDB(Cascade Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		P4	Cascade Pump	1
		ZS1 - ZS3	Zone Sensor	1 Per Zone(1-3)
		RZ1 - RZ4	Zone Relay	1 Per Zone(1-3)
		VZ1 - VZ4	Zone Valve	1 Per Zone(1-3)
ZEB(Zone Expansion Board)	1	ZS4	Zone Sensor	1 Per Zone(4+)
		RZ4	Zone Relay	1 Per Zone(4+)
		VZ4	Zone Valve	1 Per Zone(4+)



PRELIMINARY

(FIGURE 5-4) HEATING CASCADE 1 ZONE, HSS

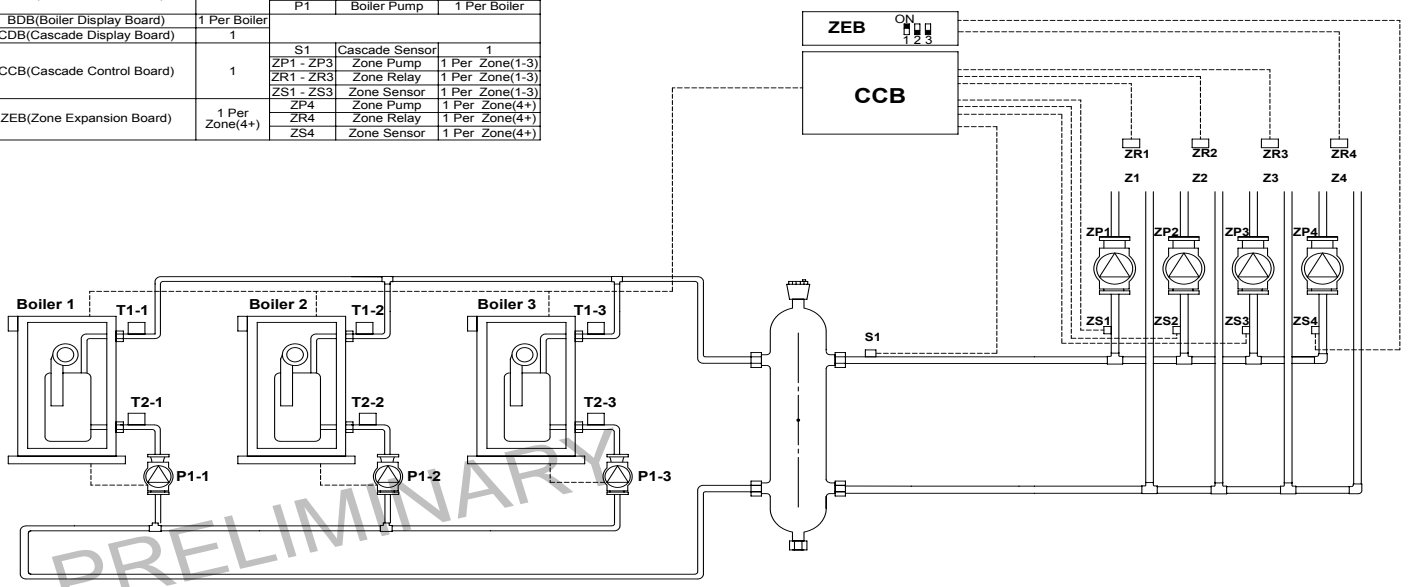
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Outlet Sensor	1 Per Boiler
		T2	Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1 Per Boiler			
CDB(Cascade Display Board)	1			
CCB(Cascade Control Board)	1	P4	Cascade Pump	1
		S1	Cascade Sensor	1



PRELIMINARY

(FIGURE 5-5) CASCADE 4 ZONES PUMPED, HSS

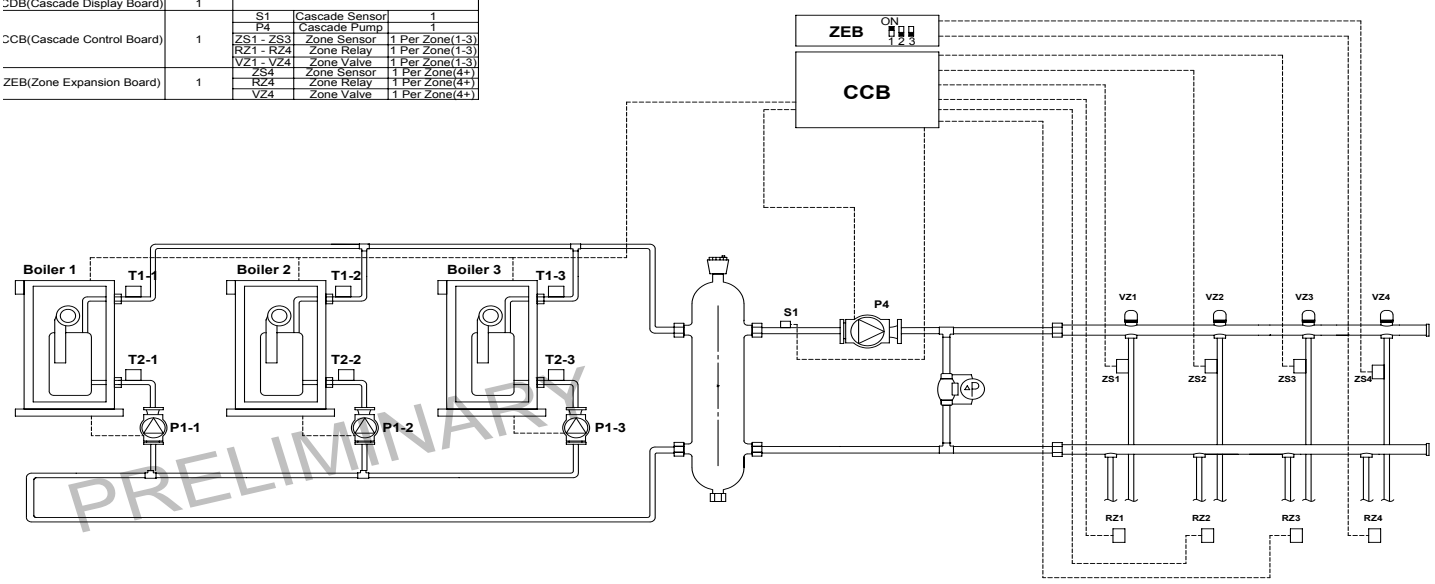
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Outlet Sensor	1 Per Boiler
		T2	Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1 Per Boiler			
CDB(Cascade Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		ZP1 - ZP3	Zone Pump	1 Per Zone(1-3)
		ZR1 - ZR3	Zone Relay	1 Per Zone(1-3)
		ZS1 - ZS3	Zone Sensor	1 Per Zone(1-3)
ZEB(Zone Expansion Board)	1 Per Zone(4+)	ZP4	Zone Pump	1 Per Zone(4+)
		ZR4	Zone Relay	1 Per Zone(4+)
		ZS4	Zone Sensor	1 Per Zone(4+)



PRELIMINARY

(FIGURE 5-6) HEATING CASCADE 4 ZONES, ZONE VALVES, HSS

Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Outlet Sensor	1 Per Boiler
		T2	Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1 Per Boiler			
CDB(Cascade Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		P4	Cascade Pump	1
		ZS1 - ZS3	Zone Sensor	1 Per Zone(1-3)
		RZ1 - RZ4	Zone Relay	1 Per Zone(1-3)
		VZ1 - VZ4	Zone Valve	1 Per Zone(1-3)
ZEB(Zone Expansion Board)	1	ZS4	Zone Sensor	1 Per Zone(4+)
		RZ4	Zone Relay	1 Per Zone(4+)
		VZ4	Zone Valve	1 Per Zone(4+)

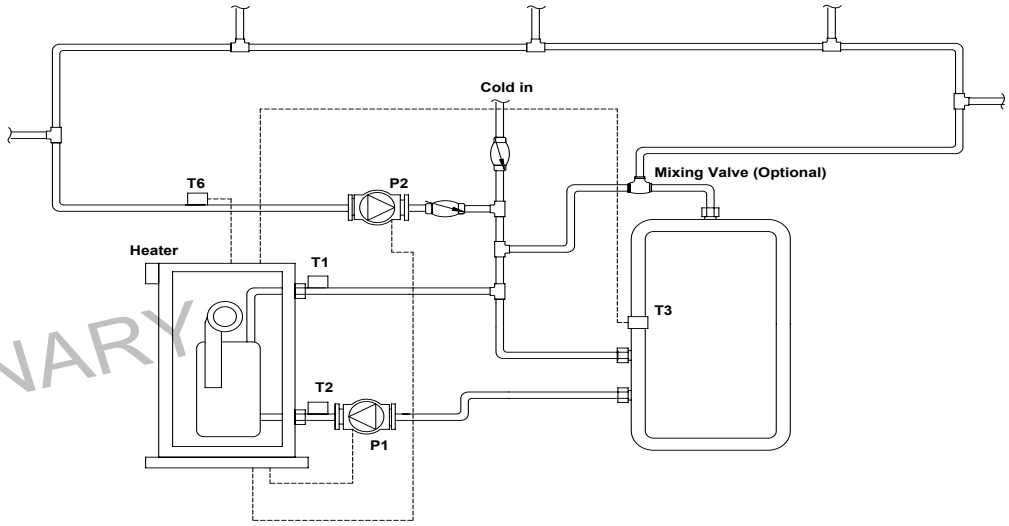


PRELIMINARY

F. SAMPLE DRAWINGS—DIRECT DOMESTIC HOT WATER

(FIGURE 5-7) DIRECT HOT WATER (DHW) WITH RECIRCULATION

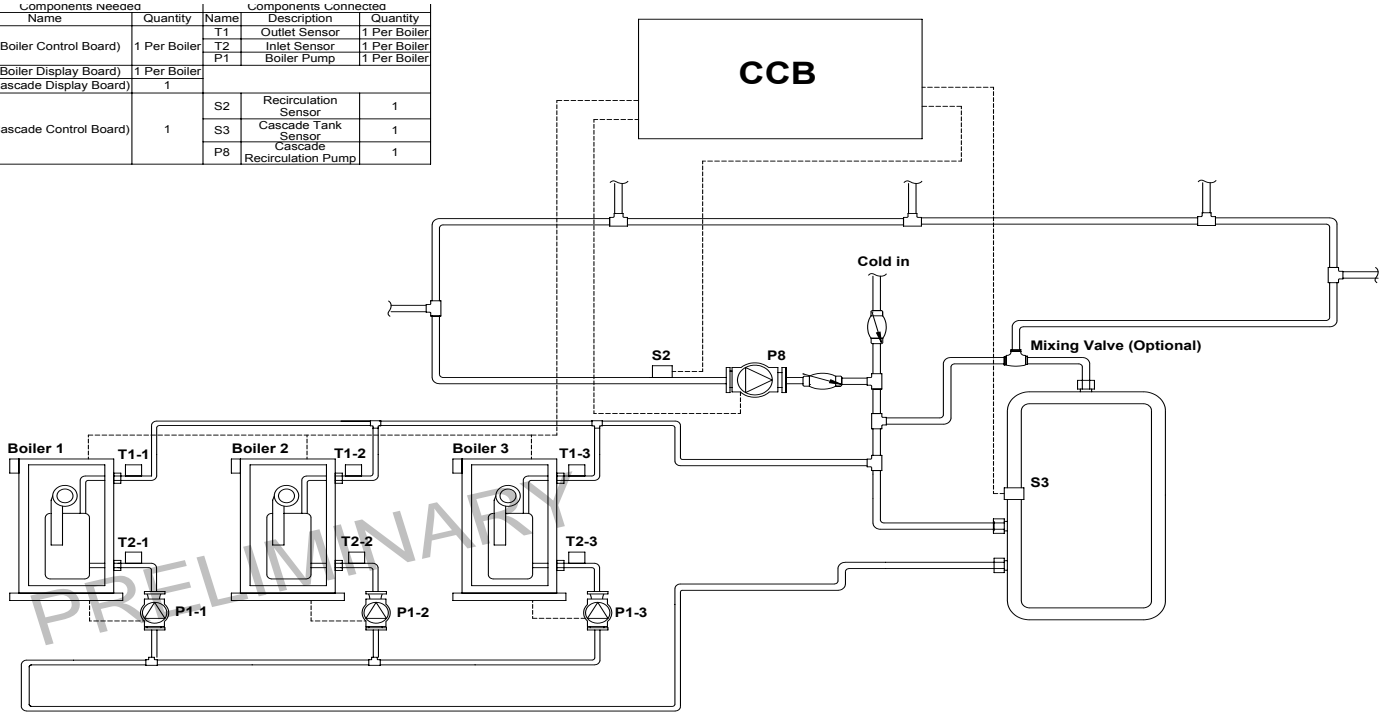
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Outlet Sensor	1
		T2	Inlet Sensor	1
		T3	Tank Sensor	1
		T6	External Sensor	1
		P1	Boiler Pump	1
		P2	Recirculation Pump	1
BDB(Boiler Display Board)	1			



PRELIMINARY

(FIGURE 5-8) DHW CASCADE WITH RECIRCULATION

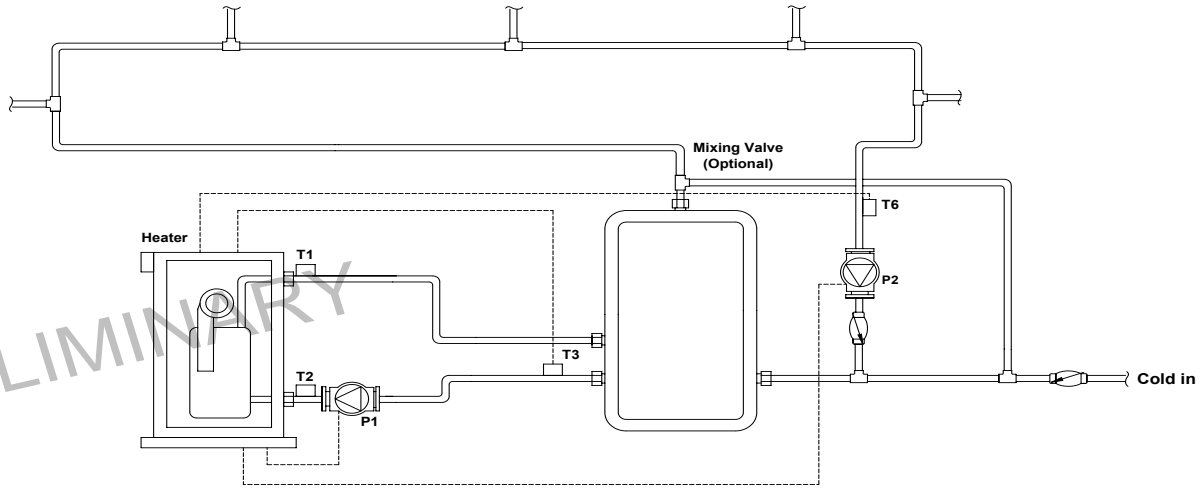
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Outlet Sensor	1 Per Boiler
		T2	Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1 Per Boiler			
CDB(Cascade Display Board)	1			
CCB(Cascade Control Board)	1	S2	Recirculation Sensor	1
		S3	Cascade Tank Sensor	1
		P8	Cascade Recirculation Pump	1



PRELIMINARY

(FIGURE 5-9) DHW, COLD WATER INJECTION SYSTEM (CWIS) WITH RECIRCULATION

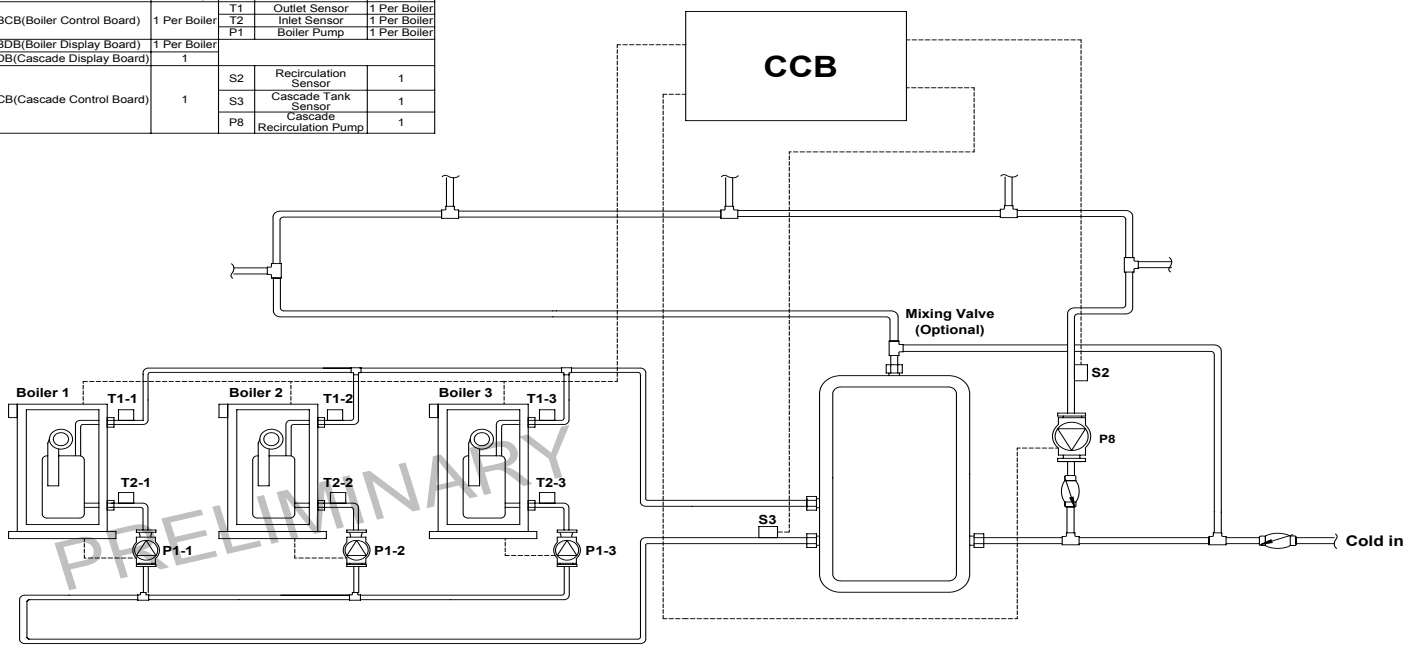
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Outlet Sensor	1
		T2	Inlet Sensor	1
		T3	Tank Sensor	1
		T6	External Sensor	1
		P1	Boiler Pump	1
		P2	Recirculation Pump	1
BDB(Boiler Display Board)	1			



PRELIMINARY

(FIGURE 5-10) DHW CWIS CASCADE WITH RECIRCULATION

Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Outlet Sensor	1 Per Boiler
		T2	Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1 Per Boiler			
CDB(Cascade Display Board)	1			
CCB(Cascade Control Board)	1	S2	Recirculation Sensor	1
		S3	Cascade Tank Sensor	1
		P8	Cascade Recirculation Pump	1

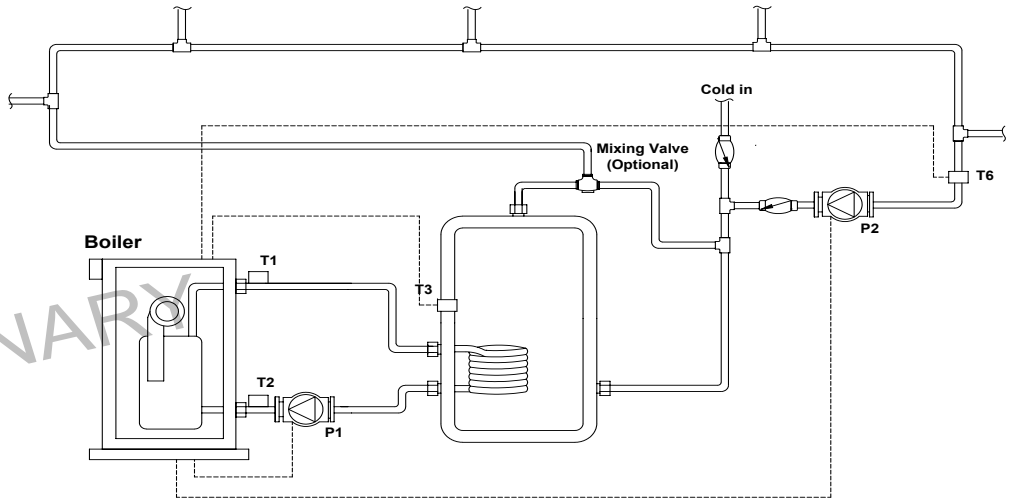


PRELIMINARY

G. SAMPLE DRAWINGS—INDIRECT DOMESTIC HOT WATER

(FIGURE 5-11) INDIRECT HOT WATER (IDHW) WITH RECIRCULATION

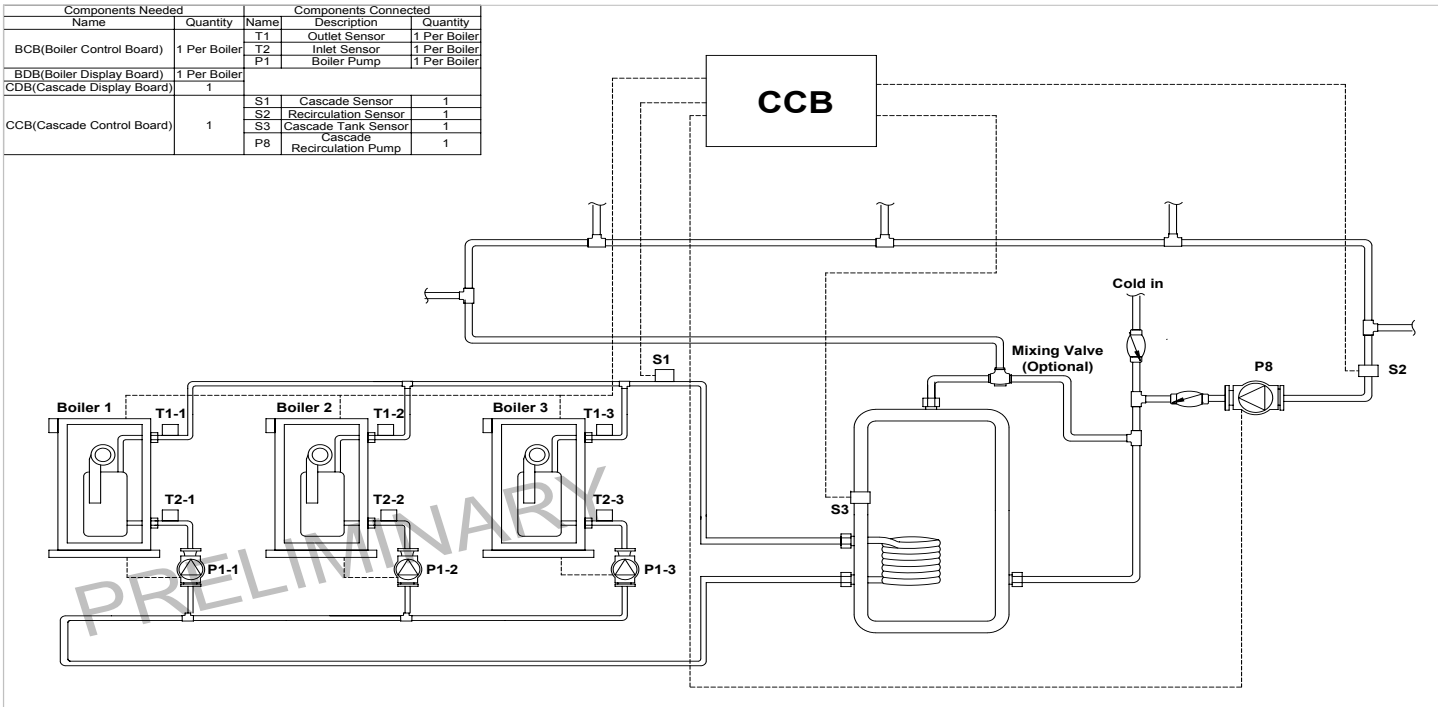
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Outlet Sensor	1
		T2	Inlet Sensor	1
		T3	Tank Sensor	1
		T6	External Sensor	1
		P1	Boiler Pump	1
		P2	Recirculation Pump	1
BDB(Boiler Display Board)	1			



PRELIMINARY

(FIGURE 5-12) IDHW CASCADE WITH RECIRCULATION

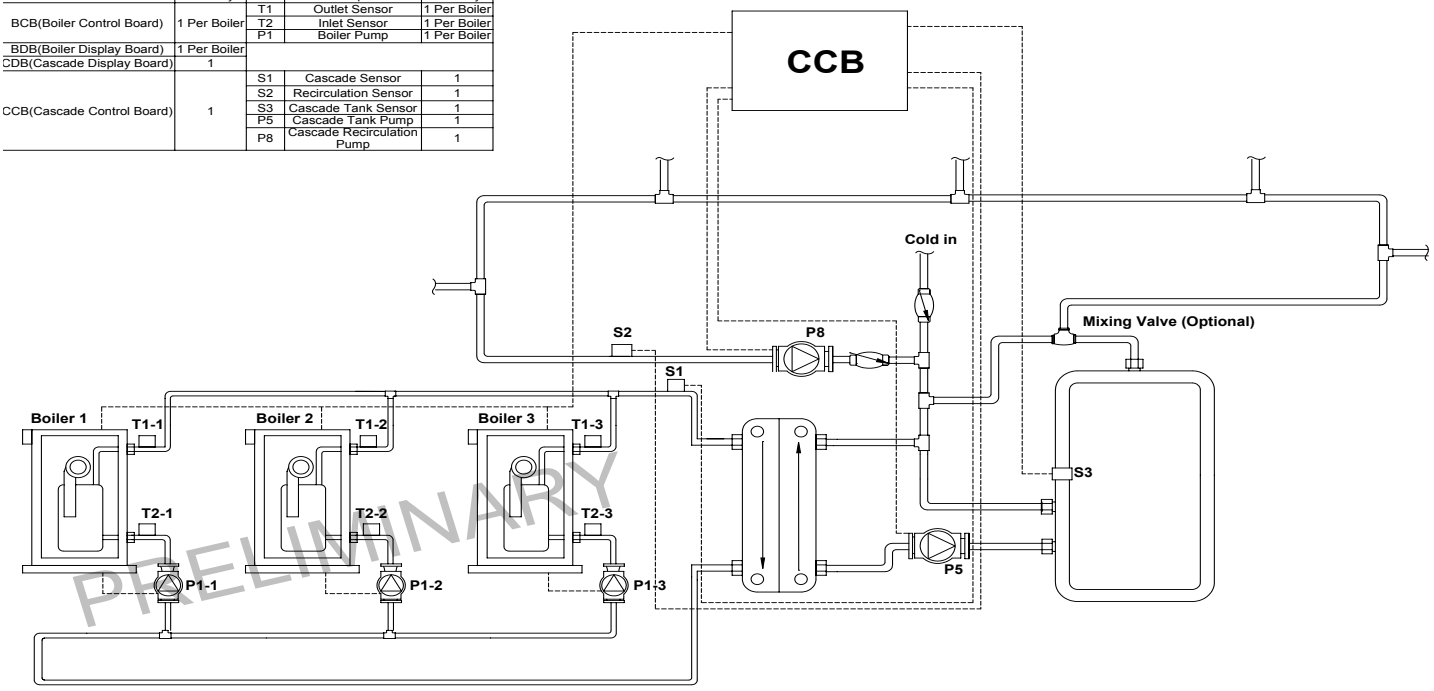
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Outlet Sensor	1 Per Boiler
		T2	Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1 Per Boiler			
CDB(Cascade Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S2	Recirculation Sensor	1
		S3	Cascade Tank Sensor	1
		P8	Cascade Recirculation Pump	1



PRELIMINARY

(FIGURE 5-13) IDHW CASCADE EXTERNAL HX WITH RECIRCULATION

Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Outlet Sensor	1 Per Boiler
		T2	Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1 Per Boiler			
CDB(Cascade Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S2	Recirculation Sensor	1
		S3	Cascade Tank Sensor	1
		P5	Cascade Tank Pump	1
		P8	Cascade Recirculation Pump	1

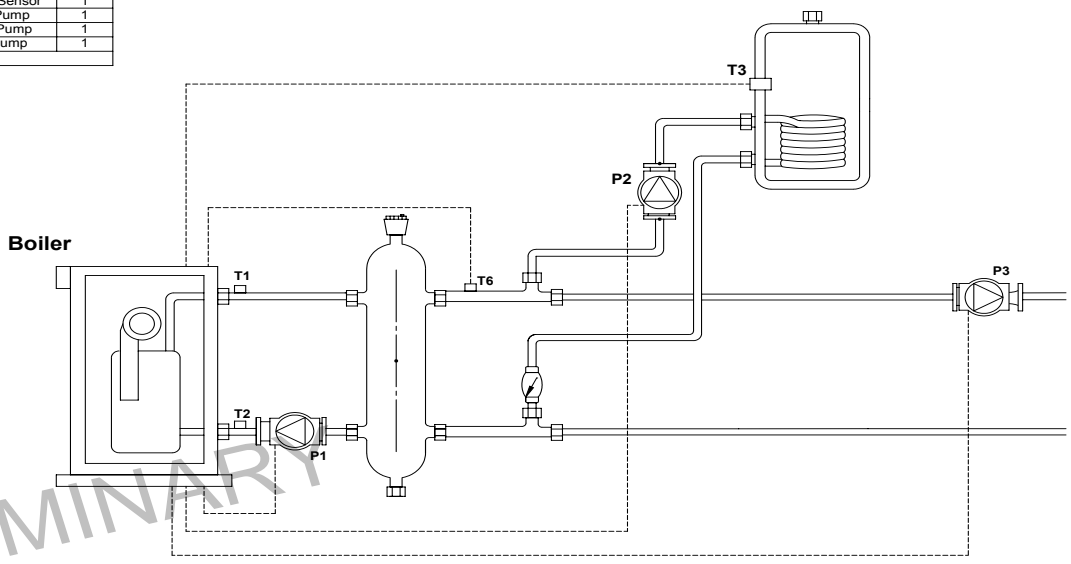


PRELIMINARY

H. SAMPLE DRAWINGS—COMBINATION SYSTEMS

(FIGURE 5-14) HEATING, IDHW 1 ZONE

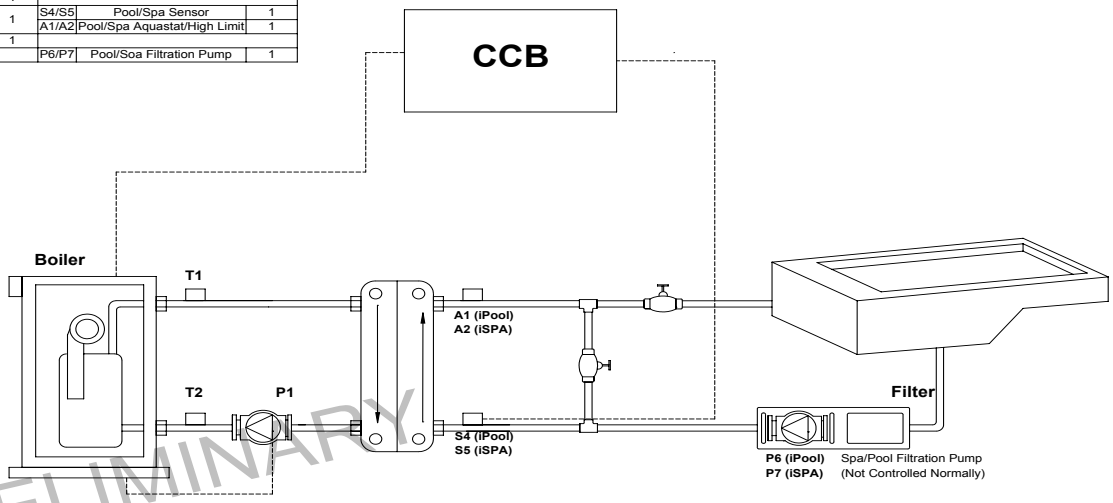
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Outlet Sensor	1
		T2	Inlet Sensor	1
		T3	Tank Sensor	1
		T6	External Sensor	1
		P1	Boiler Pump	1
		P2	iDHW Pump	1
		P3	Load Pump	1
BDB(Boiler Display Board)	1			



PRELIMINARY

(FIGURE 5-15) IPOOL:ISPA

Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Boiler Outlet Sensor	1
		T2	Boiler Inlet Sensor	1
		P1	Boiler Pump	1
BDB(Boiler Display Board)	1			
CCB(Cascade Control Board)	1	S4/S5	Pool/Spa Sensor	1
		A1/A2	Pool/Spa Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
		P6/P7	Pool/Soa Filtration Pump	1

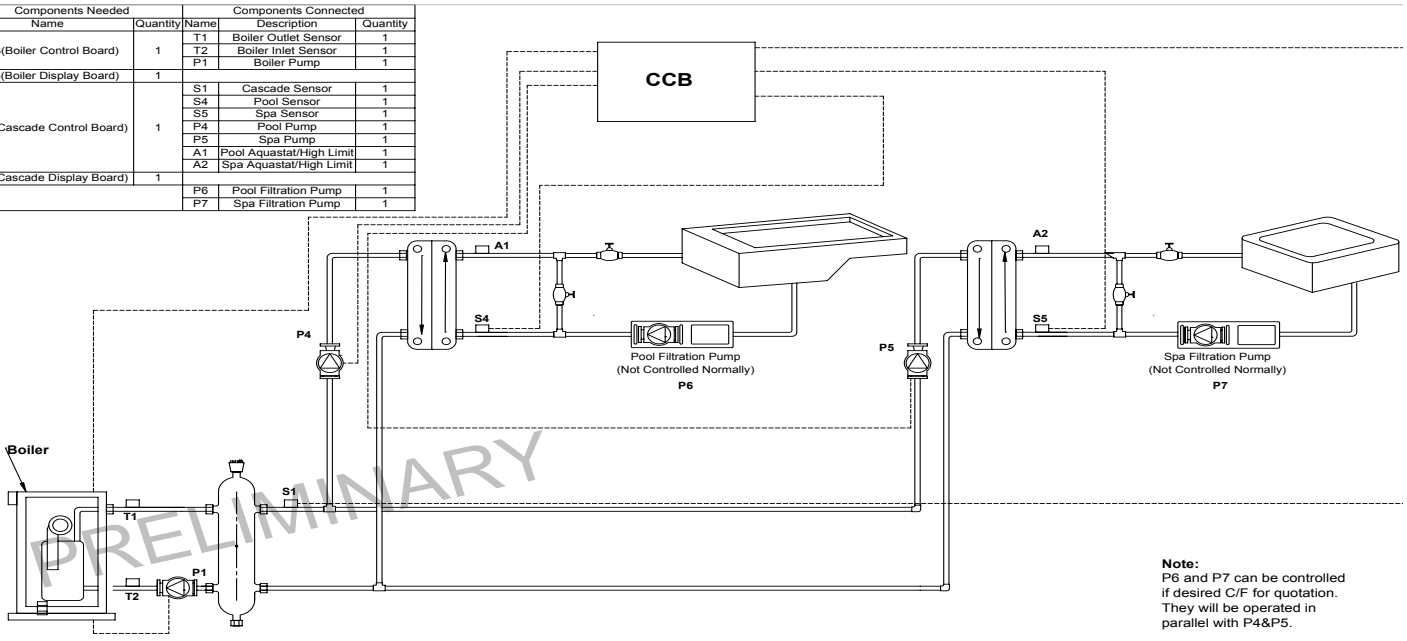


PRELIMINARY

Note:
P6 and P7 can be controlled if desired C/F for quotation.

(FIGURE 5-16) IPOOL & ISPA

Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Boiler Outlet Sensor	1
		T2	Boiler Inlet Sensor	1
		P1	Boiler Pump	1
BDB(Boiler Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S4	Pool Sensor	1
		S5	Spa Sensor	1
		P4	Pool Pump	1
		P5	Spa Pump	1
		A1	Pool Aquastat/High Limit	1
		A2	Spa Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
		P6	Pool Filtration Pump	1
		P7	Spa Filtration Pump	1

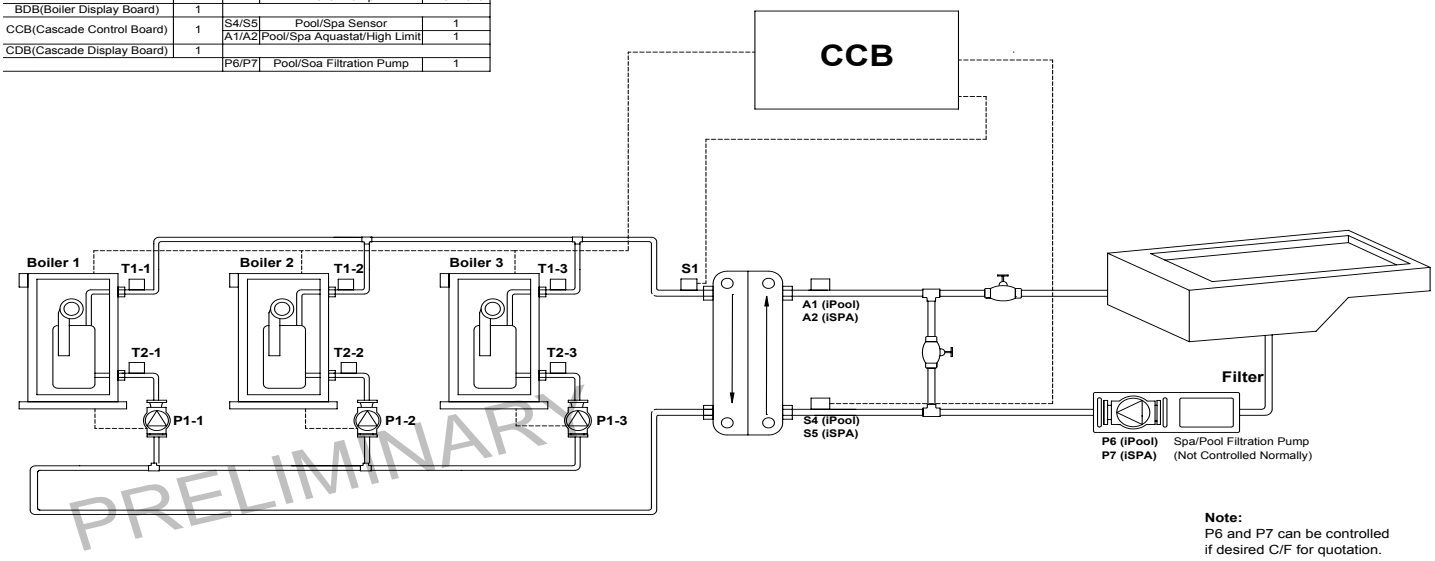


PRELIMINARY

Note:
P6 and P7 can be controlled if desired C/F for quotation. They will be operated in parallel with P4&P5.

(FIGURE 5-17) IPOOL:ISPA CASCADE

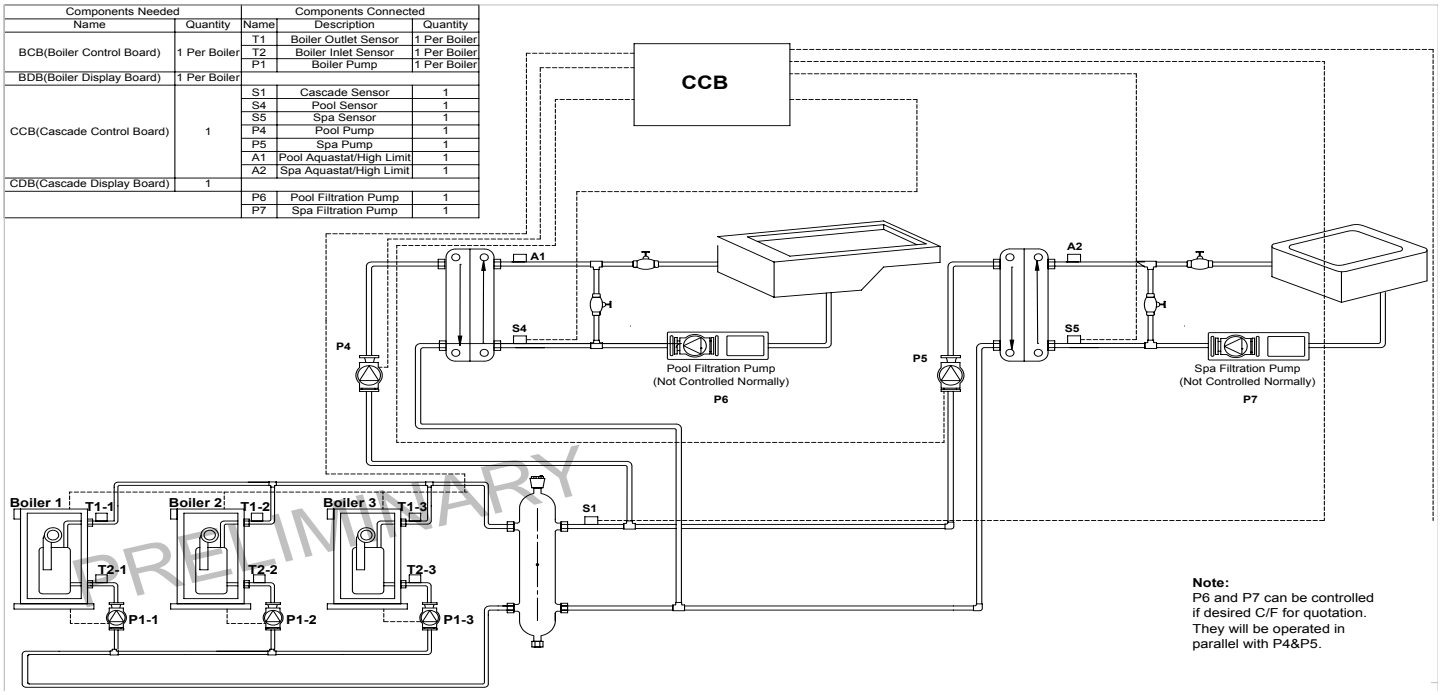
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Boiler Outlet Sensor	1 Per Boiler
		T2	Boiler Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1			
CCB(Cascade Control Board)	1	S4/S5	Pool/Spa Sensor	1
		A1/A2	Pool/Spa Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
		P6/P7	Pool/Soa Filtration Pump	1



Note:
P6 and P7 can be controlled if desired C/F for quotation.

(FIGURE 5-18) IPOOL & ISPA CASCADE

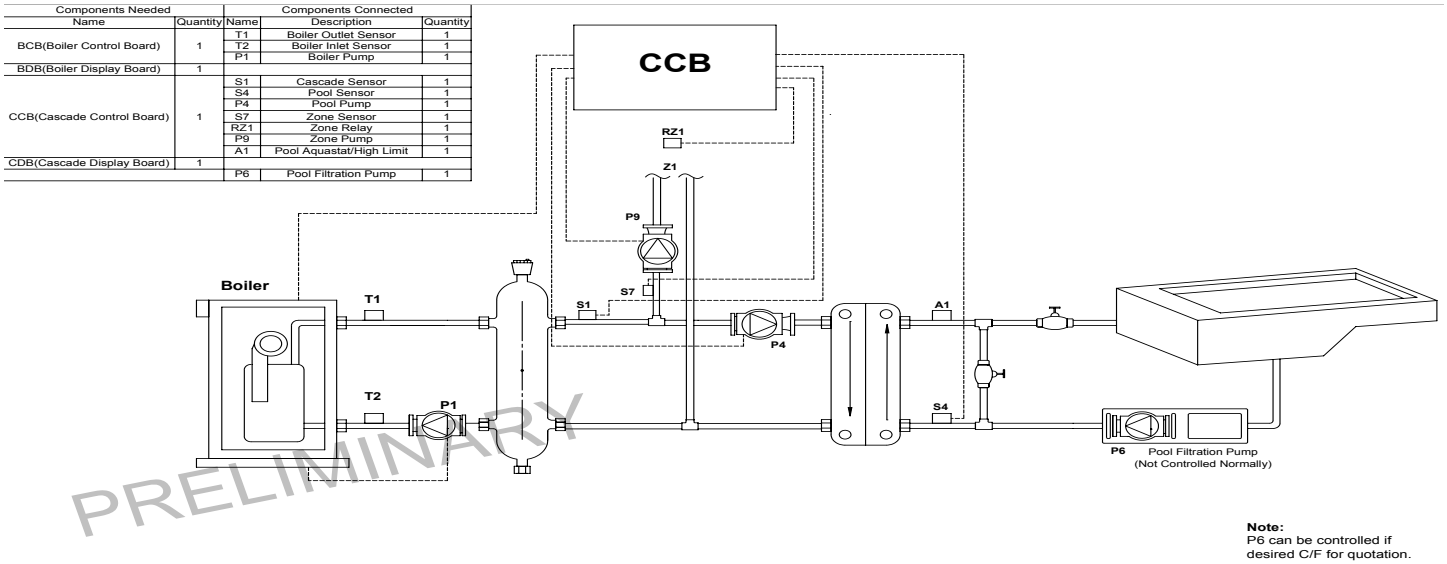
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Boiler Outlet Sensor	1 Per Boiler
		T2	Boiler Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1 Per Boiler			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S4	Pool Sensor	1
		S5	Spa Sensor	1
		P4	Pool Pump	1
		P5	Spa Pump	1
		A1	Pool Aquastat/High Limit	1
		A2	Spa Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
		P6	Pool Filtration Pump	1
		P7	Spa Filtration Pump	1



Note:
P6 and P7 can be controlled if desired C/F for quotation. They will be operated in parallel with P4&P5.

(FIGURE 5-19) HEATING & IPOOL

Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Boiler Outlet Sensor	1
		T2	Boiler Inlet Sensor	1
		P1	Boiler Pump	1
BDB(Boiler Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S4	Pool Sensor	1
		P4	Pool Pump	1
		S7	Zone Sensor	1
		RZ1	Zone Relay	1
		P9	Zone Pump	1
		A1	Pool Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
		P6	Pool Filtration Pump	1

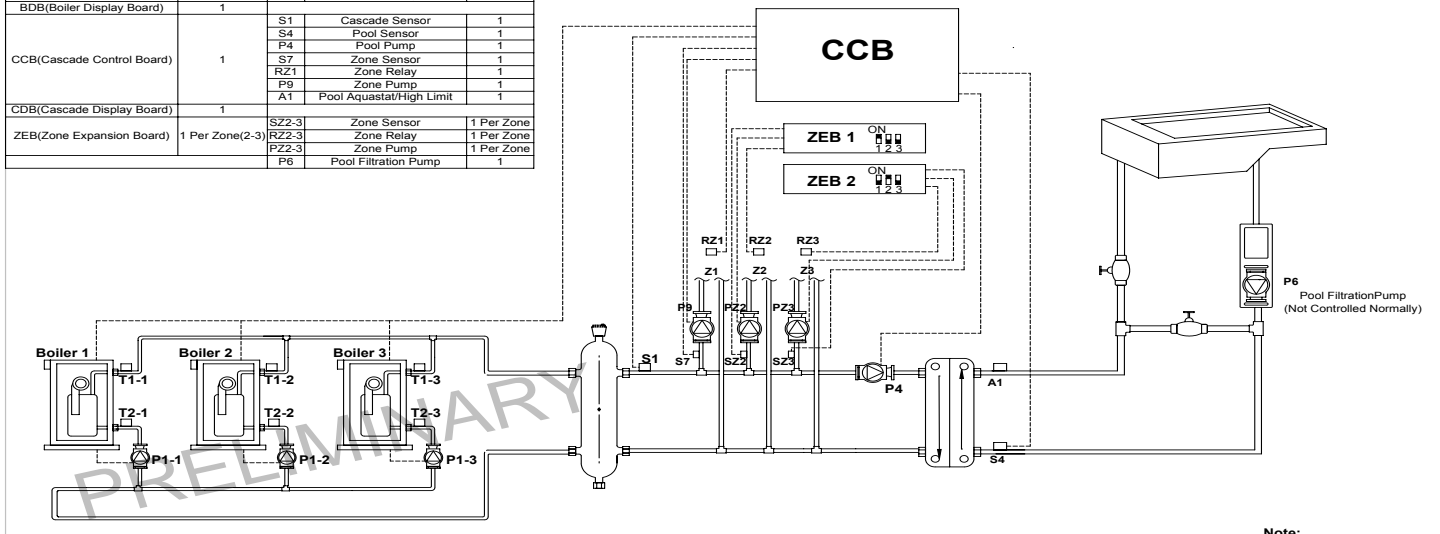


PRELIMINARY

Note:
P6 can be controlled if desired C/F for quotation.

(FIGURE 5-20) HEATING CASCADE & IPOOL WITH 3 PUMPED ZONES

Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Boiler Outlet Sensor	1 Per Boiler
		T2	Boiler Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S4	Pool Sensor	1
		P4	Pool Pump	1
		S7	Zone Sensor	1
		RZ1	Zone Relay	1
		P9	Zone Pump	1
		A1	Pool Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
ZEB(Zone Expansion Board)	1 Per Zone(2-3)	SZ2-3	Zone Sensor	1 Per Zone
		RZ2-3	Zone Relay	1 Per Zone
		PZ2-3	Zone Pump	1 Per Zone
		P6	Pool Filtration Pump	1

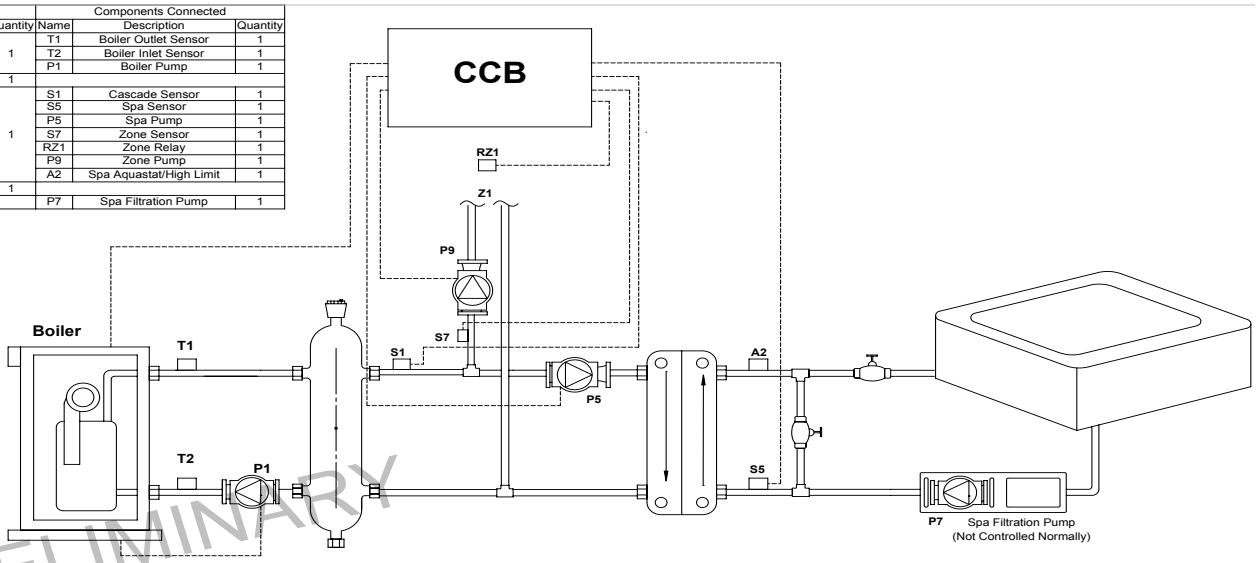


PRELIMINARY

Note:
P6 can be controlled if desired C/F for quotation.

(FIGURE 5-21) HEATING & ISPA

Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Boiler Outlet Sensor	1
		T2	Boiler Inlet Sensor	1
		P1	Boiler Pump	1
BDB(Boiler Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S5	Spa Sensor	1
		P5	Spa Pump	1
		S7	Zone Sensor	1
		RZ1	Zone Relay	1
		P9	Zone Pump	1
		A2	Spa Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
		P7	Spa Filtration Pump	1

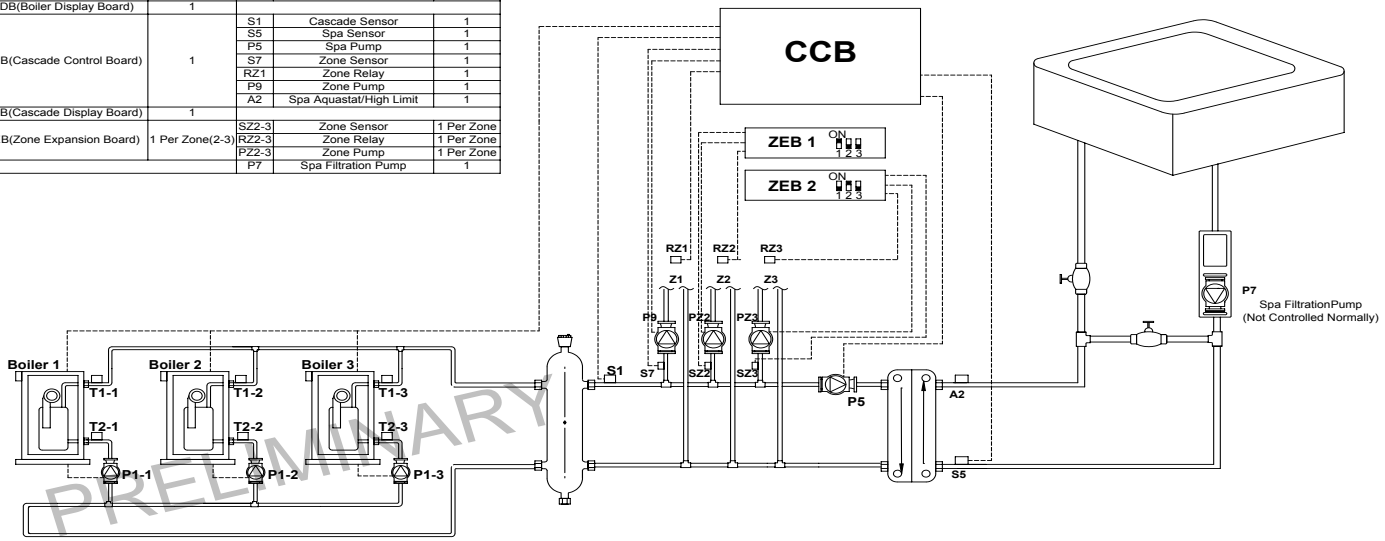


PRELIMINARY

Note:
P7 can be controlled if desired C/F for quotation.

(FIGURE 5-22) HEATING CASCADE & ISPA WITH 3 PUMPED ZONES

Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Boiler Outlet Sensor	1 Per Boiler
		T2	Boiler Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S5	Spa Sensor	1
		P5	Spa Pump	1
		S7	Zone Sensor	1
		RZ1	Zone Relay	1
		P9	Zone Pump	1
		A2	Spa Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
ZEB(Zone Expansion Board)	1 Per Zone(2-3)	SZ2-3	Zone Sensor	1 Per Zone
		RZ2-3	Zone Relay	1 Per Zone
		PZ2-3	Zone Pump	1 Per Zone
		P7	Spa Filtration Pump	1

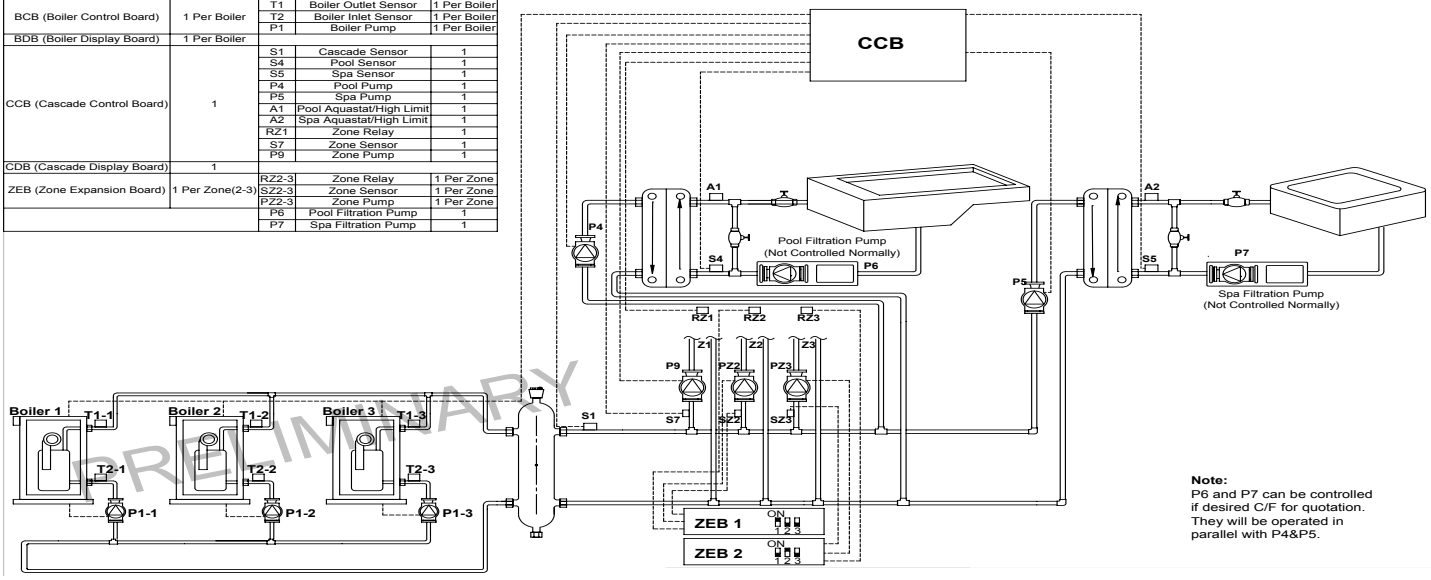


PRELIMINARY

Note:
P7 can be controlled if desired C/F for quotation.

(FIGURE 5-23) HEATING CASCADE & IPOOL & ISPA WITH 3 PUMPED ZONES

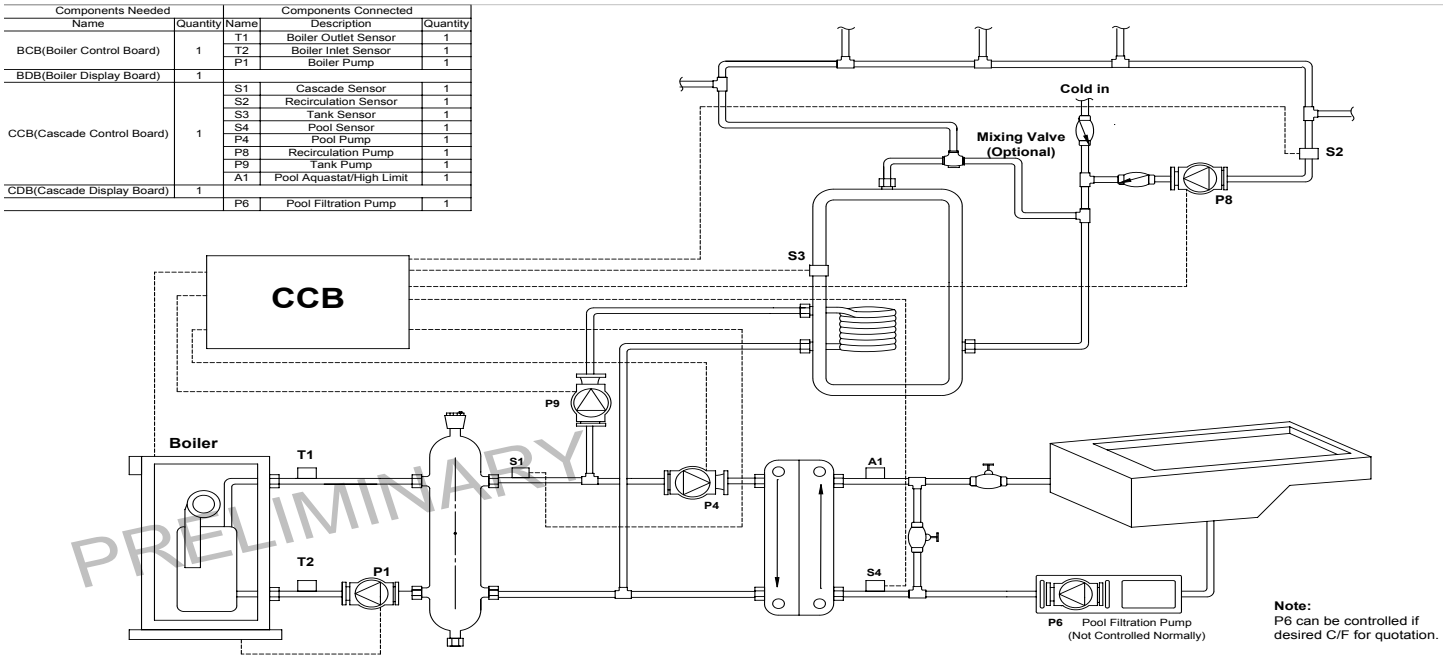
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB (Boiler Control Board)	1 Per Boiler	T1	Boiler Outlet Sensor	1 Per Boiler
		T2	Boiler Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB (Boiler Display Board)	1 Per Boiler			
CCB (Cascade Control Board)	1	S1	Cascade Sensor	1
		S4	Pool Sensor	1
		S5	Spa Sensor	1
		P4	Pool Pump	1
		P5	Spa Pump	1
		A1	Pool Aquastat/High Limit	1
		A2	Spa Aquastat/High Limit	1
		RZ1	Zone Relay	1
		S7	Zone Sensor	1
		P9	Zone Pump	1
CDB (Cascade Display Board)	1			
ZEB (Zone Expansion Board)	1 Per Zone(2-3)	RZ2-3	Zone Relay	1 Per Zone
		SZ2-3	Zone Sensor	1 Per Zone
		PZ2-3	Zone Pump	1 Per Zone
		P6	Pool Filtration Pump	1
		P7	Spa Filtration Pump	1



PRELIMINARY

(FIGURE 5-24) IDHW & IPOOL WITH RECIRCULATION

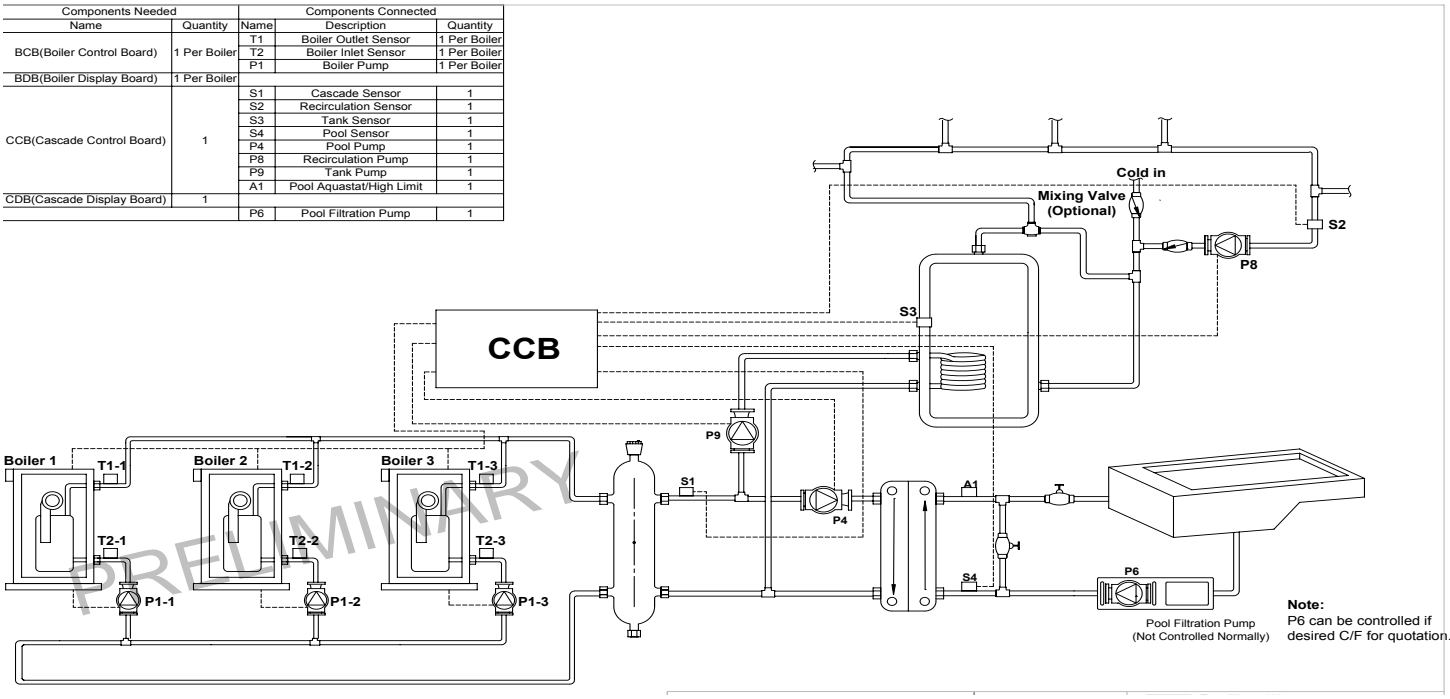
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Boiler Outlet Sensor	1
		T2	Boiler Inlet Sensor	1
		P1	Boiler Pump	1
BDB(Boiler Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S2	Recirculation Sensor	1
		S3	Tank Sensor	1
		S4	Pool Sensor	1
		P4	Pool Pump	1
		P8	Recirculation Pump	1
		P9	Tank Pump	1
		A1	Pool Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
		P6	Pool Filtration Pump	1



PRELIMINARY

(FIGURE 5-25) HEATING CASCADE IDHW & IPOOL WITH RECIRCULATION

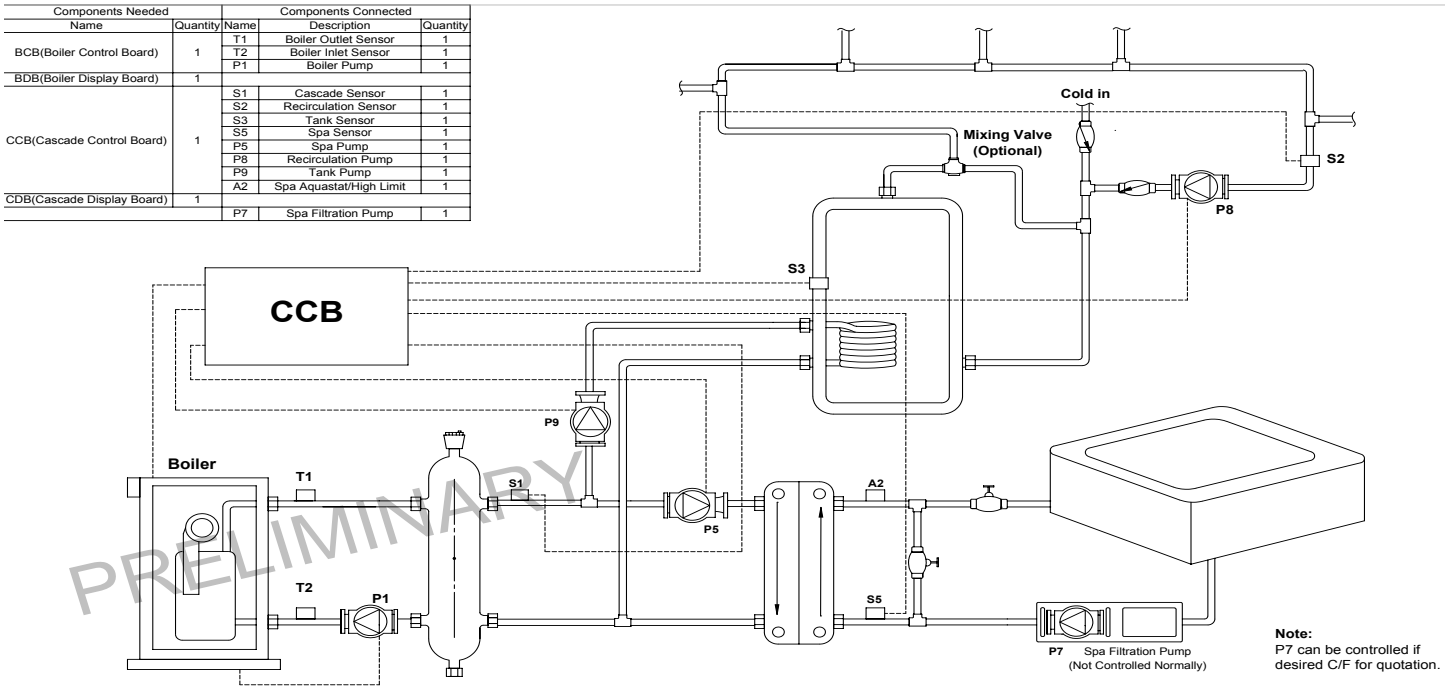
Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1 Per Boiler	T1	Boiler Outlet Sensor	1 Per Boiler
		T2	Boiler Inlet Sensor	1 Per Boiler
		P1	Boiler Pump	1 Per Boiler
BDB(Boiler Display Board)	1 Per Boiler			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S2	Recirculation Sensor	1
		S3	Tank Sensor	1
		S4	Pool Sensor	1
		P4	Pool Pump	1
		P8	Recirculation Pump	1
		P9	Tank Pump	1
		A1	Pool Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
		P6	Pool Filtration Pump	1



PRELIMINARY

(FIGURE 5-26) IDHW & ISPA WITH RECIRCULATION

Components Needed		Components Connected		
Name	Quantity	Name	Description	Quantity
BCB(Boiler Control Board)	1	T1	Boiler Outlet Sensor	1
		T2	Boiler Inlet Sensor	1
		P1	Boiler Pump	1
BDB(Boiler Display Board)	1			
CCB(Cascade Control Board)	1	S1	Cascade Sensor	1
		S2	Recirculation Sensor	1
		S3	Tank Sensor	1
		S5	Spa Sensor	1
		P5	Spa Pump	1
		P8	Recirculation Pump	1
		P9	Tank Pump	1
		A2	Spa Aquastat/High Limit	1
CDB(Cascade Display Board)	1			
		P7	Spa Filtration Pump	1



PRELIMINARY

PART 6. START-UP PROCEDURES

A. INI PROCESS AND PROCEDURES

The HOT™ Controls, contain a unique function, they track the accuracy, degradation and fouling of all connected sensors and pressure transducers and the major components of the system; appliance heat exchanger, fan, pump and igniter.

This tracking is accomplished by taking readings of and creating trend lines for each mentioned item and then running calculations of some versus others to determine how the need for maintenance of specific components is progressing.

Aside from the use of up to 11 different sensors to monitor items like incoming gas and leaving fan pressure and pressure at the exiting side of the heat exchanger and condensate drain connection, we have an initialization (INI) process that takes place automatically in the background to collect this data during steady state conditions and record it, to populate the trend lines.

The creation of a baseline: Zero INI (Z-INI), is an important step in this process and normally occurs during the commissioning of the system. Within 2 minutes of powering the appliances up, a question will be presented on screen: “A ZERO INI IS REQUIRED—RUN NOW?” YES or NO, unless the entire system is fully commissioned and operating normally, answer NO. The question will be presented every 15 minutes until you finally select “YES”. It is best not to answer YES until all appliances are started and combustion set. When they are all ready, turn off power to all at the switch on the front near the display. Go back to the appliance with two displays, power it and all others on, and when the question is presented again (two minutes or less), answer YES ***on each individual appliance.*** The Z-INI should be completed in less than 10 minutes.

If you end up with the Z-INI running when things are not quite 100% as they will be when the system is up and running, not to worry, with the proper password, you can overwrite the Z-INI with a replacement, so you are sure your Z-INI is a true baseline to work from.

To force an INI to run
(this can be done by appliance; individually):

1) Enter SETUP menu

2) Press the back and down arrow simultaneously for 3 sec., to enter the password screen, and enter password level 1 (there is an advanced Level 2 with more options, available if you have attended training at the Hamilton factory).
   - Installer level – EAZ1LVL

3) The setup screen will now have additional selections, scroll down to start INI (be sure only to select Zero if you have had a commissioning issue and need an updated proper baseline to work from), and select it.

4) The INI is now is progress, and will end after a few minutes at which point normal operation will resume. A scrolling message across the bottom of each appliance (if in a Cascade) will indicate it is in process.

Note that the INI process normally occurs in the background, during no call for heat and is rarely noticed. Subsequent INI's happen on a pre-determined basis; they are based on parameter IN1 setting of 1 – 30 days and therefor can be adjusted to fit the environment of the installation. If, you have an operation that requires heat 24 hours a day, when the system setting of days between INI's has been reached, and there is a burn cycle in process, the controls will look to parameter IN2; waiting hours of burn time before a forced INI occurs; default setting of 25 hours. When that quantity of hours has been reached after the days between setting, a forced INI will occur.

A forced INI occurs like this; the burners of all appliances in the Cascade (or the stand alone appliance) are shut down, the pump is run until the gradient (moving temperatures) between the Inlet (T1) sensor and the outlet (T2.1) sensor is less than parameter IN3; with a default setting of 0.36°F/second ΔT. At the moment that setting has been reached, the INI process begins and will take a minimum of 3 minutes for a stand-alone or dual appliance system, and 7 – 8 minutes for up to 8 appliances in the Cascade.

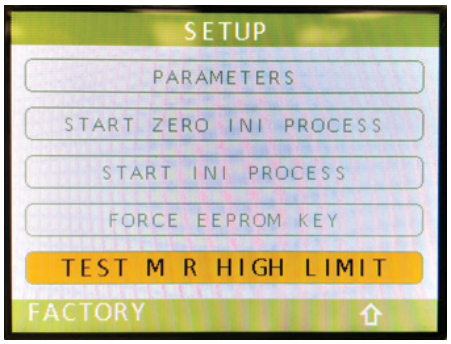
The Cascade operating control remembers the settings of all running appliances prior to the forced shut down and immediately following the INI, it returns to those firing rates to minimize any droop in system water temperature.

From the Home screen, you can navigate to the HISTORY tab, select it and tab down to INI DATA, there you can view the recorded INI data from record 00 (Z-INI) through the last 9 that have been recorded. This is the data that decisions and notifications (if opted for) will be sent based on.

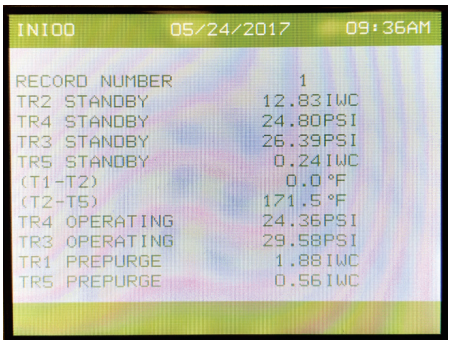
1

2

3



3a



4

B. ITEMS TO BE CHECKED BEFORE LIGHTING THE 3VO

It is recommended that you read the General Information Section (Part 1, Page 4) to get a better understanding of how the 3VO operates before you start the unit. To place the 3VO in Service Mode (manual operation) see below.

1) Make sure that you follow the lighting instructions before running the 3VO.
2) Check and make sure the circulating pump is running, and that the pressure differential of at least 1.5 PSI is indicated when reading inlet versus outlet water pressure sensors.
3) Make sure that the Gas is turned on outside at the back of the cabinet of the 3VO.
4) Double check to be sure the temperature set point is as desired—more than one may need to be set depending on the application or system type.
5) Make sure the unit is properly grounded and the electrical wiring meets the requirements of the Electrical section (Part 2, Pages 11–15). If unsure how to check, consult factory at 800.968.5520.
6) Make sure that no valves are placed between the relief valve and the appliance. The relief valve must be installed in such a manner that the discharge will be conducted to a suitable place for disposal when relief occurs. Ensure that no reducing coupling or other restriction is installed in the discharge line, and that the discharge line is installed to allow complete drainage of both the valve and the line.
7) If a fault code appears in the display, correct the fault before operating. The 3VO will now begin indicating a call for heat by the appropriate icon flashing in the lower right portion of the display. The 3VO must run through its pre-purge and ignition cycles, then begin heating.

⚠ WARNING

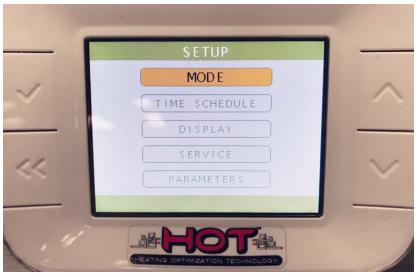
If you do not follow these instructions exactly, a fire or explosion may result, causing property damage, personal injury, or loss of life.

Start Service Mode Procedure:

1) Enter Setup menu

2) Scroll down to service, and select using the √ button

1



2

3) Select burner, and then start

4) The display will return to the setup menu, and service mode has begun. Select service again, and then burner.
   - There will now be a new options in place of start; stop & speed. Set speed to 50% using the up and down arrows.

5) Return to the home screen and select status.

6) When the status screen appears, press the down arrow once to show screen 2, showing fan speed and flame signal.

7) From here, you can watch the fan during pre-purge and ignition, as well as the flame signal strength at ignition.

8) Return to the home screen after ignition, and a flame icon in the lower right corner shows the burner on status.

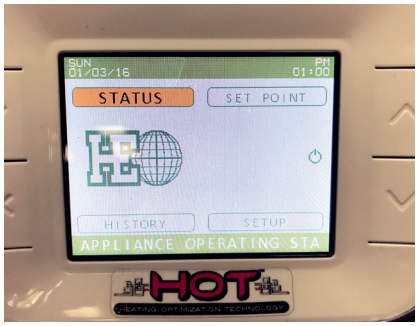
9) Return to the service speed function, and adjust fan speed as needed.

10) Service mode will last for 40 minutes, or until canceled. To cancel the service function, select stop from the service menu.

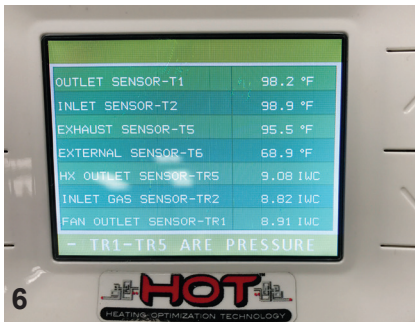
3

4

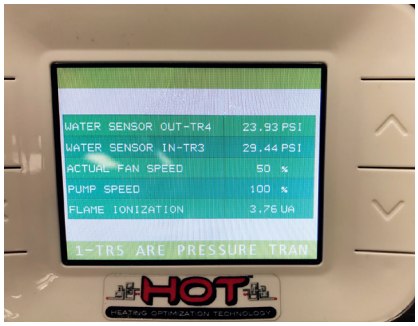
5



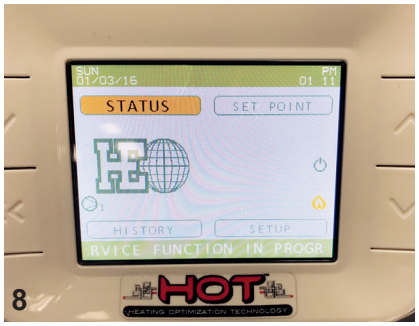
6



7



8



9

C. LIGHTING INSTRUCTIONS

FOR YOUR OWN SAFETY, READ BEFORE OPERATING!

1. This appliance does not have a pilot light. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
2. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.
3. **WHAT TO DO IF YOU SMELL GAS:**
   - Do not try to light any appliance.
   - Do not touch any electric switch; do not use any phone in your building.
   - Immediately call your gas supplier from a neighbor's phone. Follow the gas suppliers' instructions.
   - If you cannot reach your gas supplier, call the fire department.
4. Turn on gas shutoff valve (located outside the cabinet on the back of the appliance) so that the handle is aligned with the gas pipe. If the handle will not turn by hand, don't try to repair it; call a qualified service technician. Force or attempted repair may result in a fire or explosion.
5. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

The 3VO Heater shall be installed so the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation and service (circulator replacement, condensate trap, control replacement, etc.).

D. OPERATING INSTRUCTIONS

1) STOP! Make sure you have read the safety information above.
2) Turn off all electric power to the appliance.
3) This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
4) Turn gas shutoff valve clockwise to "off" The handle will be perpendicular to the gas pipe; do not force it.
5) Wait five (5) minutes to clear out any gas. If you then smell gas, STOP! Follow the instructions from Start Up Procedures (Part 6, Section B: Lighting Instructions on the previous page). If you don't smell gas, go to the next step.
6) Turn the gas shutoff valve counter clockwise to "on" The handle will be parallel to the pipe.
7) Turn on all electric power to appliance.
8) Set the thermostat to the desired setting.
9) If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" (see point 5, above), and call your service technician or gas supplier.

E. ADJUSTING THE OPERATING MODE AND TEMPERATURE SET POINT ON THE 3VO DISPLAY

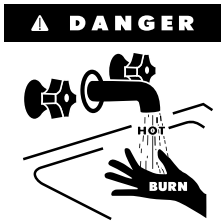
Setpoint is used to set the desired operating water temperature. On the display, navigate to the SETPOINT screen, select the application (Heating, Boiler for iDHW, DHW tank, etc.), hit the button and then adjust the temperature—for more details see pages 4 and 5 near the beginning of this manual.

Operating Mode is set in much the same manner—navigate to the MODE screen where there are three (3) choices: Standby, With Set Back Function (day of week and time of day) and W/O Set Back Function. If you choose Standby, the unit remains powered but will not fire; if you choose With Set Back, you must select/set a schedule.

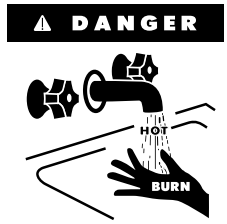
The temperature set point ranges are factory-set at 50–159°F for water heaters and 50–199°F for boilers. Other special ranges are available by contacting the factory. The display can show either °F or °C as selected. Display will have a flashing application icon when in heating mode.

F. SEQUENCE OF OPERATION

⚠ DANGER



Water temperature over 125°F can cause severe burns instantly, or death from scalds. Children, the disabled, and the elderly are at highest risk of being scalded. See instruction manual before setting temperature at water heater. Feel water before bathing or showering! Temperature limiting valves are available.



1) When power is first applied to the control, the control display will read the temperature Setpoint. The control will initially run through a self-diagnostic routine and then go into its operating mode. If there is no call for heat, the system will go into an idle state; all icons will be steady, not flashing.
2) If the thermostat is calling for heat, the control module will determine if the water temperature is below the programmed set point value minus the switching differential. It will then initiate a heating cycle, which will be indicated by the associated icon flashing.
3) The control then performs selected system diagnostic checks. If all checks are successfully passed, a pre-purge cycle is initiated (the blower will be on maximum speed).
4) When the pre-purge period is complete, power is applied to the spark ignitor for 4.5 seconds. Approximately 1/2 second later, flame is verified. If a flame is not verified during the trial-for-ignition, the gas valve is immediately closed and the control will return to Step 3. After four trials, if a flame is not verified, the control will go into a lockout mode. If a flame is confirmed, the control enters the heating mode. The firing rate will be based on the control's proprietary algorithm.

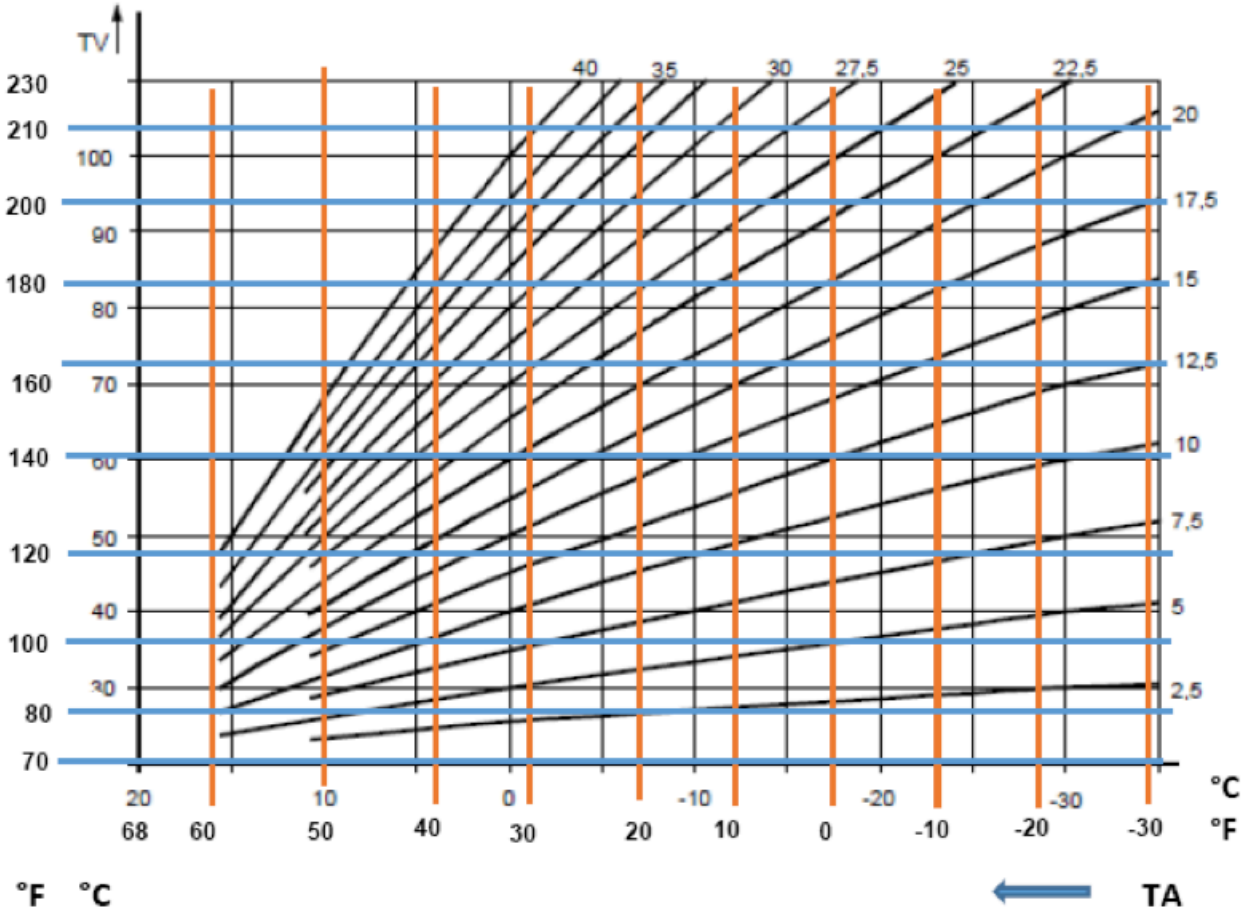
5) When water temperature reaches the temperature set point value, the burner will be at minimum firing rate. If, when firing at minimum rate, it reaches 3°F* over temperature setpoint, the gas valve closes and the control enters a post-purge state (the blower will be on maximum speed). At any time if an external thermostat is being used and becomes satisfied, the gas valve will be closed immediately and the flashing icon in the display will become steady on.
6) When the post-purge is complete, the control enters an idle state while continuing to monitor temperature and the state of other system devices. If a call-for-heat is received, the control will automatically return to Step 2 in sequence and repeat the entire operating cycle.
7) Built in freeze protection: all models will automatically turn the pump on if the heat exchanger reaches 41°F and the burner if it reaches 37°F, it will turn off at 50°F. ***Note: power must be left on for this protection to function.***

**standard factory setting, which may be customized in the field*

G. OUTDOOR RESET FUNCTION

Curve or slope—set using the display option in heating set point.

(FIGURE 6-1) OUTDOOR RESET FUNCTION



1) You must have the Outdoor Sensor (10K) sensor installed, and the power must have been cycled on and off after its installation.
2) Set the outdoor curve parameter using the chart in Figure 6-1 (TA = outdoor temperature, TV = boiler water temperature), default is 180°F water at -10°F outdoor—slope of 18.
3) Set the Warm Weather Shutdown temperature (default is 64.4°F); above this temperature, there is no call for heat.
4) Set the building type correction factor (if desired); default is 1.0:
    a) Old building, not insulated 1.2
    b) Building with thick walls >12 inches 1.3
    c) Normal building, normal insulation 1.0
    d) New building, well insulated 0.9
5) For comfort adjustment after start up, an additional boiler water temperature offset (either higher or lower) is also available in the set up screen, up to 18°F higher or lower than the curve calculation.

PART 7. TROUBLESHOOTING AND TESTING

A. TESTING THE MANUAL RESET HIGH LIMIT

The HOT™ Controls, contain a unique function, they use both pressure transducers and temperature thermistors to monitor appropriate flow through the heat exchanger of the appliance. There are two high limit sensors, both are set through parameters, however, only one requires a manual reset when it is tripped, and often requires an annual test to confirm its proper operation.

So that the manual reset one is not set too low by mistake, the testing process is protected by a password.

To test the manual reset high limit:

1. Enter Setup menu
2. Press the back and down arrow simultaneously for 3 sec., to enter the password screen, and enter password level 1 (there is an advanced Level 2 with more options, available if you have attended training at the Hamilton factory.
    - Installer level – EZ1LVL

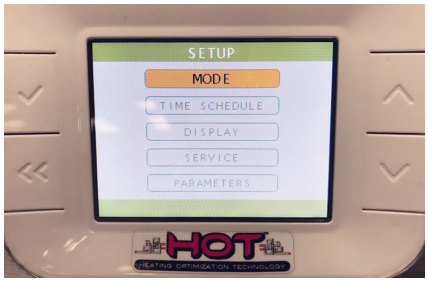
1

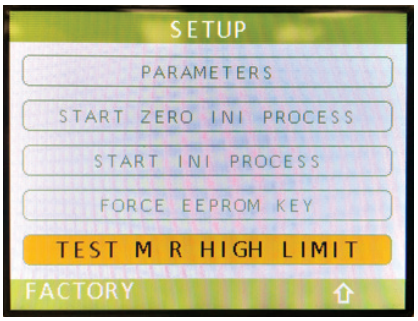
2

3. The setup screen will now have additional selections, scroll down to TEST M R HIGH LIMIT and select it (press the √ when it is highlighted).

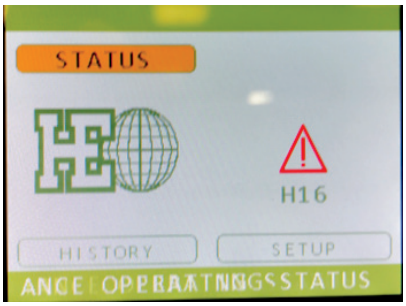
4. Set the temperature you want the MHRL to open at, it will show the current setting as a default, you should select a temperature less than that to complete the test without overheating the stored domestic hot water, just push the down arrow until the appropriate time and then push √.
   - The high limit test is only active for 10 minutes as a default, you can select a time less than that if desired, just push the down arrow until the appropriate time and then push √.
   - The fact that the test is in progress will be indicated on the home screen while it is active.
   - Scroll back up and place the appliance in SERVICE MODE a setting higher than the existing water temperature (and higher than you set the test setpoint) to get the appliance to run and surpass the temporary MRHL setting.
   - When that setting is exceeded, the unit will shut down immediately and indicate a Hard Lock Out and H16 code.
   - Note that if you reset it right away and you have not reached the number of minutes you set for the test period and the temperature is now below your test setting and below your setpoint, it will run and likely trip again.

3





4

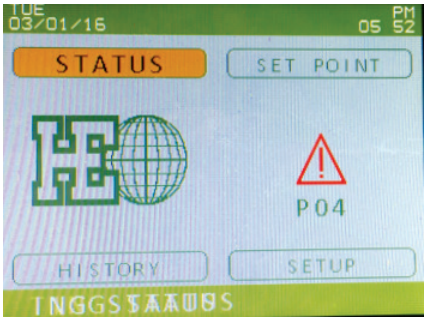


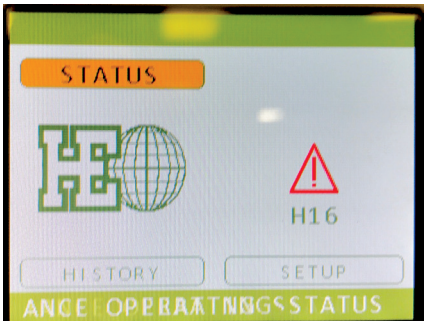
B. RESETTING A HARD LOCK-OUT (HLO)—Displayed on screen:

When there is a red triangle symbol as shown above on the home screen of the appliance, it will require a manual reset before it will operate again.

From the Home Screen, navigate to the HISTORY tab, press the √ (enter) button on the upper left, tab down to the ACTUAL FAULT tab and press the √ button again. There will be a RESET tab, press the √ button again to clear the HLO.

Allow a minute or so after you have completed the reset, the error message will disappear and normal operation will resume.





C. RESETTING AN E-STOP

When the mechanical room E-Stop is wired as shown in the preceding pages, it will require a manual reset on each connected appliance before they will operate again.

After the E-Stop has been reset at the room level, you will need to remove the front stainless steel control panel cover, and access the CB-2 Circuit breaker.

That breaker will need to be turned off and on again to reset this fault, and the display screen will have a scrolling message until such time “E-STOP ACTIVATED—REQUIRES RESET OF EXTERNAL SWITCHES TO RESTORE OPERATION”

Once you have completed the reset, the scrolling message will disappear and normal operation will resume.

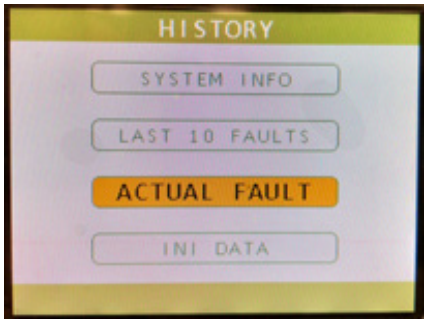
D. TESTING LOSS OF WATER FLOW

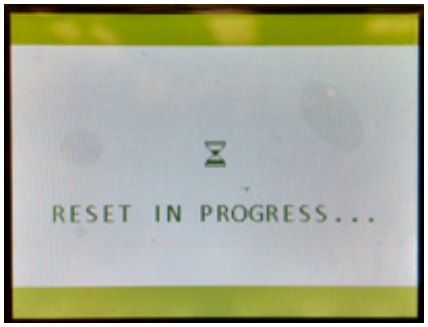
The HOT™ Controls, contain a unique function, they use pressure transducers and temperature thermistors for monitoring water flow through the heat exchanger. The Hard Lockout Fault (HLO) that represents loss of water flow like a traditional water flow switch is P06 and often requires an annual test to confirm its proper operation.

Much like a water flow switch has an adjustable set point, the P06 function is a parameter that can be accessed with the appropriate password (factory trained technician and above) and the percentage of loss of flow through the heat exchanger can be set for the trip point creating the HLO P06.

To properly test for loss of water flow; during a burn cycle, fully close a shut off valve on either the inlet or outlet of the appliance.

- When the parameter setting for P06 is exceed, the unit will shut down immediately and indicate a Hard Lock Out and P06 (P6) code, and the screen will indicate that as below. A manual reset process through the boiler display screen is required to restart the appliance.
- Note that if you reset it right away and you have not reopened the shut off valve again, it will try to run and trip again.





C. SOFT LOCKOUT CODES

(TABLE 7-1) 3VO HOT™ CONTROLS SOFT LOCKOUT CODES

Code	Cause	Recommended Action
A1	Excessive pressure differential (ΔP) on water side of heat exchanger	Check for scaling or blockage on water side of heat exchanger, also check pump performance.
		If this SLO is indicated while the unit is firing, it is doing so at a reduced BTU input; low enough to stay below that maximum ΔP set point.
B1	Pressure too high at condensate drain connection during Stand By	Look for condensate backing up into combustion side of heat exchanger.
B2	Pressure too high at condensate drain connection during pre-purge	Insure condensate drain system is flowing freely.
B3	Pressure too low at condensate drain connection	Check for condensate (water) in the condensate neutralizer (if equipped) or the condensate trap at appliance outlet. If it is dry, add water to form trap. The appliance also will initiate an auto-filling process for the condensate trap, indicated on the screen during this operation.
B4	Pressure at flue/condensate sensor is too low	Check flue gas vent connection or sensor connnection located at condensate drain line. Also check for a disconnecetd or open condensate drain line and last, look for a leak in the heat exchanger casing (behind the insulation).
DW7	Temperature rise (ΔP) through heat exchanger is too high	Unit is operating at a reduced BTU input - check for scaling or blockage on water side of heat exchanger, also check pump performance.
FL5	Flue gas temperature too high	Unit is burning at a reduced BTU input rate. The cause of the high flue gas should be investigated and corrected ASAP
FL9	Fouling of the fire side of the heat exchanger	Unit is burning at a reduced BTU input rate. A combustion side inspection and cleaning should be scheduled ASAP.
G1 (also G1A, G1B and G1C)	Gas supply pressure too low	If this occurs at the beginning of an ignition cycle, this SLO will stay until the pressure is high enough for proper ignition.
		If this occurs while the unit is firing, and it continues to fire, it is doing so at a reduced BTU input low enough to stay above that minimum pressure set point.
H3	Inlet sensor (T2) error	Inlet sensor is too far out of calibration or disconnected. The appliance will continue to operate, but at a reduced input until the required correction has been resolved.
H7/9	Calibration between inlet (T2) and outlet (T1)water temperature sensors indicates too great a differential.	Test both sensors against the actual temperature and OHMs as shown in the chart on page 55, replace as required. The appliance will continue to operate, but at a reduced input until the required correction has been resolved.
H24	High Limit set point has been exceeded	Appliance restarts, but at a reduced input; after 3 restarts, the appliance gets a Manual Lock Out (HLO) and needs the cause resolved immediately. Possible causes are high ΔT, temperature setpoint versus high limit setting too close or bad sensor.
ID1	First INI process data missing	Run the Z-INI; starting Inialization numbers must be tested and the saved for all connected sensors in a number of conditions.
ID2	EMB eeprom fault (2)	Reset the fault, cycle power on and off, if the fault reappears, the EMB - eeprom is corrupted.
ID3	EMB eeprom fault (1)	Reset the fault, cycle power on and off, if the fault reappears, the EMB - eeprom is corrupted.
ID4	Internal fault (gv1)	Reset the fault, cycle power on and off, if the fault reappears, the EMB - eeprom is corrupted.
ID5	Internal fault (gv2)	Reset the fault, cycle power on and off, if the fault reappears, the BCB - Boiler Control Board is corrupted.
ID6	Internal fault (gv3)	Reset the fault, cycle power on and off, if the fault reappears, the BCB - Boiler Control Board is corrupted.
ID9	Fan speed error	Cycle power off, check the four wire fan connection; wires and each end at connectors. If all ok, cycle power back on and if fan Speed error reappears, replace fan.
ID11	Flame proof indicated without flame present	Cycle power off, check Igniter, Ignition cable and cable ends, if moisture present, dry thoroughly. Cycle power back on.
ID13	Low voltage to appliance	Check voltage - this fault occurs when the supply voltage is more than 10% less than rated supply.
ID14	High voltage to appliance	Check voltage - this fault occurs when the supply voltage is more than 15% greater than rated supply.
ID16A	External sensor (T6) fault (not connected or open status)	Check the condition of the connectors and wires from the molex plug at the board to the external sensor in the piping or Low Loss Header.
ID16B	External sensor (T6) fault (short circuit status)	Take an OHM reading on the wires from the external sensor in the piping or low lass header - compare it to the chart on page 55 replace if out of range.
ID18A	Inlet sensor (T2) fault (not connected or open status)	Check the condition of the connectors and wires from the molex plug at the board to the inlet water sensor at the rear of the appliance.

(TABLE 7-1) 3VO HOT™ CONTROLS SOFT LOCKOUT CODES (CONTINUED)

Code	Cause	Recommended Action
ID18B	Inlet sensor (T2) fault (short circuit status)	Take an OHM reading on the wires from the inlet water sensor at the rear of the appliance - compare it to the chart on page 55 replace if out of range.
ID19A	Tank sensor (T3) fault (not connected or open status)	Check the condition of the connectors and wires from the molex plug at the board to the storage tank sensor.
ID19B	Tank sensor (T3) fault (short circuit status)	Take an OHM reading on the wires from the storage tank sensor - compare it to the chart on page 55 replace if out of range.
ID20A	Outdoor sensor (T4) fault (not connected or open status)	Check the condition of the connectors and wires from the molex plug at the board to the outdoor air sensor.
ID20B	Outdoor sensor (T4) fault (short circuit status)	Take an OHM reading on the wires from the outdoor air sensor - compare it to the chart on page 55 replace if out of range.
ID87	Actual fan speed is lower than specified fan speed, during ramp up.	The appliance is waiting to allow the fan time to reach the required rpm, if it does not achieve it in 30 seconds, ID88 will become the new fault code.
ID88	Actual fan speed did not reach required rpm in the time alloted.	Fault should clear when fan speed matches required fan speed, if condition lasts more than two minutes, cycle power off and back on again, if the fault does not clear, consult factory.
ID89	Actual fan speed is lower than set fan speed, during speed up.	Either fan is not running (check wiring or replace), or factory programming has been altered (consult factory).
P04 (A, B, C)	No water flow from the pump—looking at pump off versus on ΔP at ignition and each INI, when compared to data taken at last INI	Check for closed valves, pump electrical issues or complete blockage in water line to and from appliance.
P05 (A, B, C)	Reduced water flow through appliance looking at heat exchange ΔP at ignition when compared to data taken at only Z INI	Check for partially closed valves, pump impeller fouling etc. Appliance is operating at a reduced BTU capacity to avoid heat exchanger damage.
W01 (A, B, C)	Maximum pressure (Ph)	Water pressure too high (within 10% of pressure relief valve rating), confirm cause and correct. Unit is operating at a reduced BTU capacity to try and avoid the relief valve opening.
W04 (A, B, C)	Minimum pressure (Pl)	Water pressure too low (within 10% of minimum pressure required), confirm cause and correct. Unit is operating at a reduced BTU capacity to try and avoid any damage to the heat exchanger.

D. HARD LOCKOUT CODES

(TABLE 7-2) 3VO HOT™ CONTROLS HARD LOCKOUT CODES

Code in display	Hard Lock Out	Recommended Action
A1 or A2	Excessive pressure differential (ΔP) on water side of heat exchanger	Check for scaling or blockage on water side of heat exchanger, also check pump performance.
B3	Neutralizer has little or no Condensate (water)	Fill neutralizer (or trap if not a factory neutralizer) with water to avoid flue gases spilling into the room through a dry trap.
B4	Pressure at flue/condensate sensor is too low	Check flue gas vent connection or sensor connnection located at condensate drain line. Also check for a disconnecetd or open condensate drain line and last, look for a leak in the heat exchanger casing (behind the insulation).
DW7	Temperature rise (ΔP) through heat exchanger is too high	Appliance has been through multiple tests and checks including operating at a reduced input to avoid this shut down. The ΔP accross the heat exchanger indicates reduced water flow. Check the pump performance, check for partially closed valves and if all ok, perform a descaling operation on the water side of the heat exchanger.
FL1	Flue gas temperature has exceeded the maximum safe level set in the operating parameters	Flue gas temperature setting has been exceeded by a significant amount even after operation at a reduced firing rate. Check entire burner assembly, if ok, then a complete fire side cleaning must be initiated immediately.
FL5	Flue gas temperature	Unit is burning at a reduced BTU input rate. The cause of the high flue gas should be investigated and corrected ASAP - See FL1
FL9	Fire side of heat exchanger is severly fouled	Remove burner and check condition of fire side of tubes in the burner area.
G1	Gas pressure too low	Find cause of low pressure and correct; piping or regulator sizing is the general culprit
G3	Gas pressure too high during a burn cycle	Correct the cause of the high gas pressure - either adjust regulator or replace and repair as required - maximum allowed by code is 14”w.c.
H15/H16	Manual Reset High Limit set point exceeded	Check set point(s), sensors, pumping etc. Correct cause of high water temperature
ID1	First INI process data missing	Run the Z-INI; starting Inialization numbers must be tested and the saved for all connected sensors in a number of conditions.
ID2	EMB eeprom fault (2)	Reset the fault, cycle power on and off, if the fault reappears, the EMB - eeprom is corrupted.
ID3	No valid data on microcontroller Flash memory	Reset the fault, cycle power on and off, if the fault reappears, the EMB - eeprom is corrupted.

(TABLE 7-2) 3VO HOT™ CONTROLS HARD LOCKOUT CODES (CONTINUED)

Code in display	Hard Lock Out	Recommended Action
ID4	Internal fault (gv1)	Reset the fault, cycle power on and off, if the fault reappears, the EMB - eeprom is corrupted.
ID5	Internal fault (gv2)	Reset the fault, cycle power on and off, if the fault reappears, the BCB - Boiler Control Board is corrupted.
ID6	Internal fault (gv3)	Reset the fault, cycle power on and off, if the fault reappears, the BCB - Boiler Control Board is corrupted.
ID9	Fan speed error	Cycle power off, check the four wire fan connection; wires and each end at connectors. If all ok, cycle power back on and if fan Speed error reappears, replace fan.
ID12	Flue thermostat open.	Take an OHM reading on the wires from the flue gas sensor - compare it to the chart on page 55 replace if out of range.
ID96	Wrong eeprom key connected	Install proper MEB eeprom, if it cannot be found, contact the factory for assistance - be sure to have model and serial number of the appliance in question.
ID99	BDB Reset action finished	There have been too many resets, a concerted effort must be made to find the casue of the fault and correct it. This is a timed action, and the unit cannot be reset until the time has elapsed. Contact the factory with further questions.
IG23	Too many restarts or relights after no-flame.	Appliance has been through multiple tests and checks includingtrying to ignite at different inputs to avoid this shut down. Combustion related items must be checked, including air/gas ration, ignition cable and igniter.
IG45	Too many restarts or relights after no-flame.	Appliance has been through multiple tests and checks includingtrying to ignite at different inputs to avoid this shut down. Combustion related items must be checked, including air/gas ration, ignition cable and igniter.
IG19	Too many attempts for ignition	Appliance has been through multiple tests and checks includingtrying to ignite at different inputs to avoid this shut down. Combustion related items must be checked, including air/gas ration, ignition cable and igniter.
IG27	Too many attempts for ignition	Appliance has been through multiple tests and checks includingtrying to ignite at different inputs to avoid this shut down. Combustion related items must be checked, including air/gas ration, ignition cable and igniter.
P04	Low or no water flow	Check for closed valves, pump issues or complete blockage in water line to and from appliance.
P06	Water flow too low through appliance	Check for partially closed valves, pump impeller fouling etc, to avoid heat exchanger damage.
W04	Minimum waterpressure	Water pressure is too low for safe operation, check for leaks or a failed pressure reducing valve. Minimum pressure is 15 PSI for a “cold” system.

IN MANY CASES, A “HARD LOCKOUT” WILL INDICATE THAT THERE IS SOMETHING WRONG WITH THE APPLIANCE, THAT SHOULD BE SERVICED OR REPAIRED.

EXAMPLE:
If there is a loss of flow due to an air bubble passing through the appliance (sensed via the water flow switch), the appliance will shut down and display a temporary fault (H1). When flow resumes and the reset button pushed, the control board will perform a pre-start diagnostic and then resume a burn cycle.

E. TO TURN OFF GAS TO THE APPLIANCE

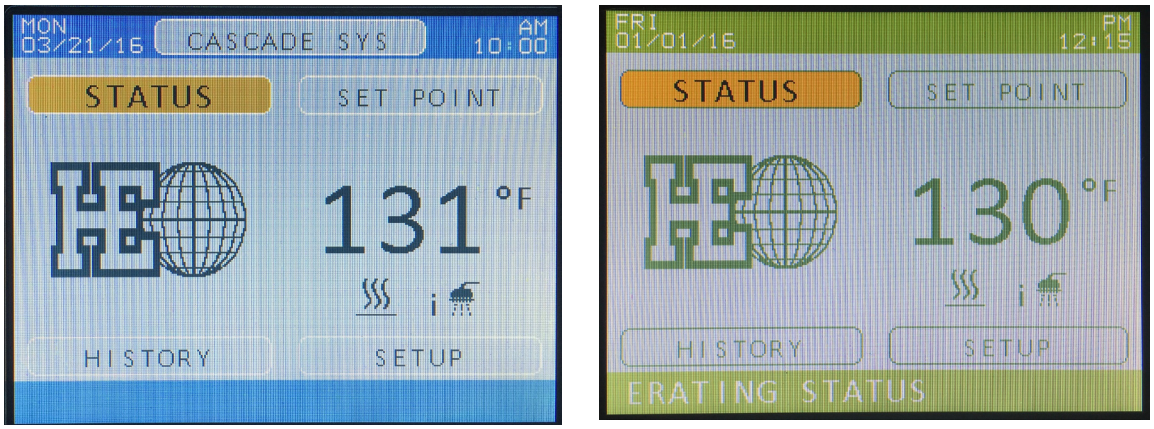
1) Set the thermostat to lowest setting.
2) Turn off power switch on front of unit.
3) Turn off all electric power to the appliance if service is to be performed.
4) Turn gas shutoff valve clockwise to “off.” Handle will be horizontal. Do not force.

F. PUMP & WIRING CONTROL

The 3VO HOT™ control board has an on-board relay for controlling the circulating pump. On a call for heat, the pump will start, allowing the water flow proving circuit to be made and the pre-start diagnostic to continue. After the call for heat has been satisfied, the pump will continue to run for the factory programmed period of time (3 minutes) and then shut off. For water heating applications an external temperature sensor must be mounted in the water storage tank or the pump must be wired to run continuously. For heating applications, the call for heat must come from an external source (room thermostat etc.). In both applications if a continuous pump operation is desired, it may be programmed for that or the pump should be wired directly to an external power supply.

A stand alone 3VO control system has the ability to control up to three (3) pumps or two (2) pumps and a diverting valve. A cascaded system can control up to 8 separate heat demands; heat, domestic hot water, snow melt, pool, hot tub, etc., each with their own sensor and control setpoint and boiler water temperature setpoint. For details, see sample system drawings on pages 31–40 or contact Hamilton Engineering at 800.968.5530.

G. SENSOR READING INSTRUCTIONS



(FIGURE 7-1) SENSOR READING INSTRUCTIONS

Navigate to the STATUS screen then press the √ button, you may then view all connected sensors. A list of available sensors can be found on page 6.

H. 3VO SENSOR RESISTANCE

All temperature sensors utlized by the HOT™ control are 10,000 OHM.

(TABLE 7-3) 3VO SENSOR RESISTANCE TABLE

TEMPERATURE (°F)	RESISTANCE (OHM)	TEMPERATURE (°C)	RESISTANCE (OHM)
32	32550	0	32550
41	25340	5	25340
50	19870	10	19870
59	15700	15	15700
68	12490	20	12490
77	10000	25	10000
86	8059	30	8059
95	6535	35	6535
104	5330	40	5330
113	4372	45	4372
122	3605	50	3605
131	2989	55	2989
140	2490	60	2490
149	2084	65	2084
158	1753	70	1753
167	1481	75	1481
176	1256	80	1256
185	1070	85	1070
194	915	90	915
203	786	95	786

PART 8. MAINTENANCE

A. MAINTENANCE PROCEDURES

All high efficiency condensing appliances will require more regular maintenance (cleaning) than their non-condensing counterparts. Failure to do so may result in damage to the appliance that is not covered under warranty.

Periodic maintenance should be performed at least once a year by a qualified service technician to ensure that all the equipment is in safe, efficient operation. In the first year of operation, it is highly recommended that inspections of all connection points and the combustion chamber be done at three month intervals, any signs of fouling or leaks must be thoroughly investigated immediately as failure to do so may void warranty. Assuming no cause for excessive fouling is found, then the period of months from initial start up that it was found that cleaning was required, shall become the required future minimum cleaning interval, but at no time should it exceed 12 months. The owner MUST make necessary arrangements with a qualified heating contractor for proper maintenance of the heater. Installer must also inform the owner that the lack of proper care and maintenance of the heater may result in a hazardous condition and lack of warranty coverage. The installer should discuss the contents of the User's Information Manual with the owner.

B. ANNUAL INSPECTION

An inspection should cover at least the following areas.

Caution : Before removing the door of the appliance, switch off the electrical power supply to it.

a. Remove the front cover and check all pipes, lines and connections, heat exchanger (top, bottom) for traces of water and water leakage.

b. Inspect the top of the heat exchanger and all connections for water leakage or traces of water from the air supply hose or the air vents.

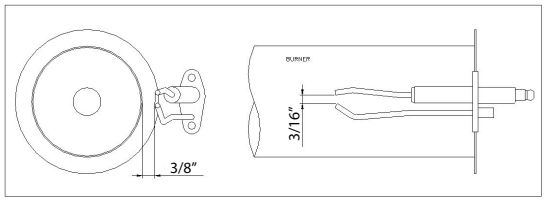
c. Open the condensate drain neutralizer fill cap and look for signs of crusting or buildup. Flush so there is no restriction in water flow, and replace cap (see cleaning instructions below in section C).

d. If the inspection is being carried out by a Hamilton Engineering Certified Technician, enter your appropriate password and perform a service reset to provide a new list of faults from this date forward.

e. Dismantle the burner unit: remove the (4) 9/16" nuts from the burner plate and the ignition cable, and move the burner unit upward. Remove the plugs of the fan cables to the fan before the burner is removed from the appliance. Observe rear and side wall insulation panels (behind tubes) to look for deterioration; replace if any is evident, AFTER the next two cleaning steps. Check the inside of the combusion chamber: only clean residue on the fire side of the heat exchanger tubes. Use a vacuum cleaner, and do not push the residue between the openings of the tubes if at all possible as this may impede the flow of the products of combustion. It is possible to use clear water to rinse any remaining residue away—the water will automatically flow to the condensate drain point. (See cleaning instructions below in section D).

f. Dismantle the air gas mixing plate or chamber on the suction side of the fan; check the blade wheel of the fan, and clean if required.

g. Check the distance from the electrode to the burner; there should be a 3/8" gap in between the two. If the existing electrode pins must be adjusted, caution must be exercised as they will likely be brittle from exposure to the flame; try to bend them as close to the burner door insulation as possible. New electrodes will be less susceptible to breakage during adjustment.



The following steps require the unit to be reassembled and power supply be turned back on; extreme caution must be exercised when performing service with the power supply on and the door off.

h. Fire the appliance on maximum output, and measure and adjust the CO_2 percentage as required.

i. Fire the appliance on minimum output, and measure and adjust the CO_2 percentage as required.

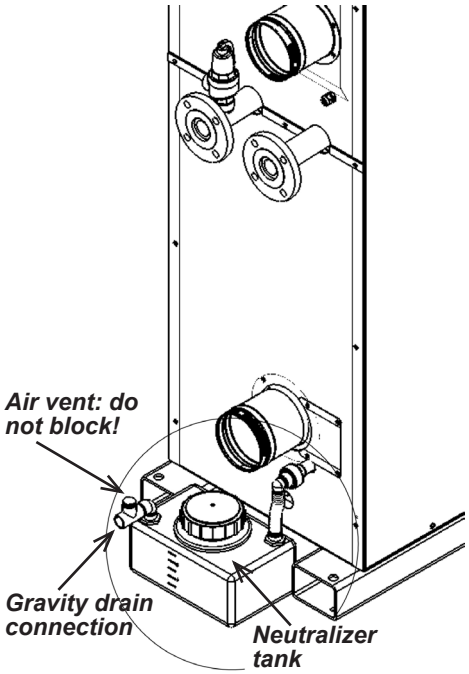
j. Listen for any unusual noise in the circulating pump and the fan.

All findings and concerns should be discussed with the appliance owner after the inspection is complete

C. CONDENSATE TRAP CLEANING INSTRUCTIONS

The condensate (neutralizer) trap should be cleaned at least once every year.

1) Turn off the power to the 3VO.
2) Disconnect the unions in the condensate drain line and remove the condensate neutralizer.
3) Check the drain line leaving the heat exchanger and the neutralizer to be sure they are clear.
4) Flush water through the neutralizer bed.
5) Reinstall the neutralizer.
6) Turn on the power to the 3VO.
7) Monitor the condensate drain until flow has been established.
8) It is highly recommended that the PH of the condensate leaving the heat exchanger be checked during operation, annually and the neutralizing material be replaced if it is less than 6.5.



(FIGURE 8-2) 3VO CONDENSATE TRAP CLEANING

D. COMBUSTION CHAMBER COIL CLEANING INSTRUCTIONS* (see LIT91178 and LIT91179 for detailed instructions)

***Before beginning this procedure, you must have the following items on hand:**

- A Nylon brush—DO NOT use brass, stainless or steel brushes.
- Water
- Shop vacuum

1) Shut down the 3VO by using the following steps:
   a. Turn off the power, close the gas valve, and shut down the unit. Wait for the unit to be cool to the touch.
   b. Remove the neutralizer according to the directions above.
   c. Remove the molex plugs from the fan.
   d. Remove the (4) 9/16" nuts from the burner plate assembly to access the tubes in the combustion chamber.
   e. Pull the entire burner plate assembly upwards and remove fan, igniter and burner.

2) Vacuum all loose material, use the nylon brush to scrub tubes to remove any buildup, then vacuum the debris from the tubes and the bottom tube sheet of the heat exchanger.
3) Disconnect the condensate neutralizer from the rear drain on the heat exchanger. Flush the combustion chamber with water, being careful not to get water on the front or side tubes where the fiberboard sits. This will clear any loose debris in the condensing tubes section, and allow it to drain out the back of the heat exchanger.
4) Before powering up the 3VO follow the steps below:
   a. Re-install the burner and fan assembly.
   b. Replace the (4) 9/16" nuts to the studs through the burner plate.
   c. Reconnect gas valve to fan and burner assembly.
   d. Reconnect ther molex plugs.
   e. Reset thermostats.
   f. Replace the condensate neutralizer.
   g. Turn the 3VO back on** and monitor the condensate drain until flow has been established.

****NOTE: When firing up the boiler for the first few times you may experience some fluttering of the gas burner that may result in a flame lockout. This is normal and will require you to re-cycle the unit until this clears up. This is caused by water still present in the combustion chamber.**

E. COIL ANTI-SCALING PREVENTION FEATURE

The 3VO HOT™ control monitors the pressure and temperature change through the heat exchanger. By doing this, it greatly reduces the possibility of heat exchanger failure due to scaling or fouling. A set of parameters are programmed in at the factory, to provide designed changes (ΔP and ΔT) setting on each size unit that is fixed. The Anti-Scale is based on an increase over the ΔP and ΔT through the heat exchanger.

This Anti-Scale is determined using the inlet and outlet sensors, even if a tank thermistor is being used. If the Anti-Scale setting is reached, the unit will display A1, shut down and not re-fire until it has cooled. After the first three times this condition is reached even with reductions in maximum firing rate in the HOT™ control reset life cycle (reset life cycle is the time between factory service history downloads), the HOT™ control will go into hard Lockout, display A1, and have to be manually reset.

After it has been reset, it will fire again, but at a maximum of 50% of rated input in an attempt to prevent further damage but still provide some hot water. Once the heat exchanger has been cleaned using a non-acidic, netural formulation cleaner (such as Fernox F3), contact the factory for instructions on resetting the unit for full rated BTU/hr capacity operation.

Typical causes for repeated A1 or A2 indications at start up are air trapped in the heat exchanger (be sure air vent caps are loose) or contaminates lodging in the piping or heat exchanger during installation, both of these causes can generally be cleared by isolating the hot water system and flushing water at full city pressure through the drain valve or relief valve on the heater outlet.

Please note, this function is active in all System types (DHW and Heating), and may require an adjustment of parameters for your specific application. Consult factory or local authorized distributor for assistance.

PART 9. SPECIAL INSTALLATION REQUIREMENTS

A. INSTALLATION REQUIREMENTS–MASSACHUSETTS

Requirements for installation – Commonwealth of Massachusetts
For all side wall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes, including those owned or operated by the Commonwealth and where the side wall exhaust vent termination is less than seven (7) feet above finished grade in the area of the venting, including but not limited to decks and porches, the following requirements shall be satisfied:

1) INSTALLATION OF CARBON MONOXIDE DETECTORS. At the time of installation of the side wall horizontal vented gas fueled equipment, the installing plumber or gasfitter shall observe that a hard wired carbon monoxide detector with an alarm and battery back-up is installed on the floor level where the gas equipment is to be installed. In addition, the installing plumber or gasfitter shall observe that a battery operated or hard wired carbon monoxide detector with an alarm is installed on each additional level of the dwelling, building or structure served by the side wall horizontal vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for the installation of hard wired carbon monoxide detectors

    a. In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.

    b. In the event that the requirements of this subdivision can not be met at the time of completion of installation, the owner shall have a period of thirty (30) days to comply with the above requirements; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed.

3) APPROVED CARBON MONOXIDE DETECTORS. Each carbon monoxide detector as required in accordance with the above provisions shall comply with NFPA 720 and be ANSI/UL 2034 listed and IAS certified.

4) SIGNAGE. A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, “GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS”.

5) INSPECTION. The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a)1 through 4.

    a. EXEMPTIONS: The following equipment is exempt from 248 CMR 5.08(2)(a)1 through 4:

        1. The equipment listed in Chapter 10 entitled “Equipment Not Required To Be Vented” in the most current edition of NFPA 54 as adopted by the Board; and

        2. Product Approved side wall horizontally vented gas fueled equipment installed in a room or structure separate from the dwelling, building or structure used in whole or in part for residential purposes.

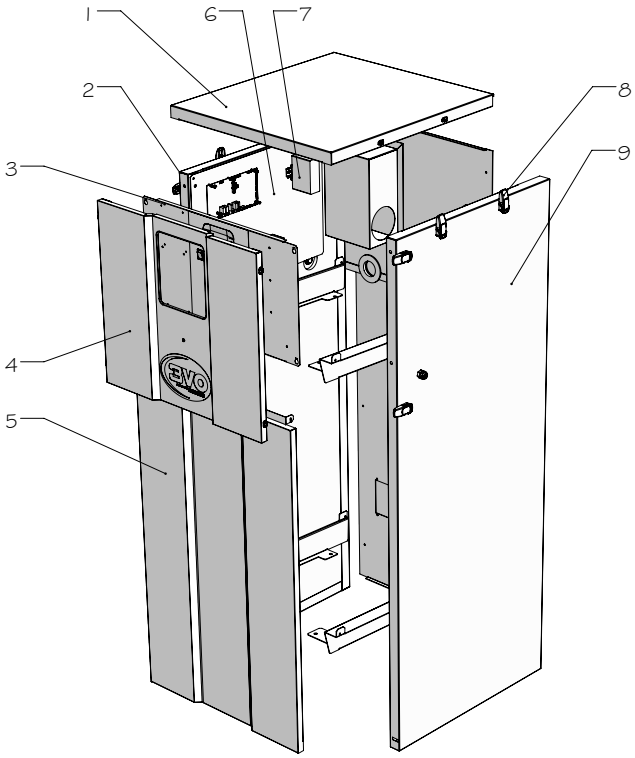
B. INSTALLATION AT HIGH ALTITUDES

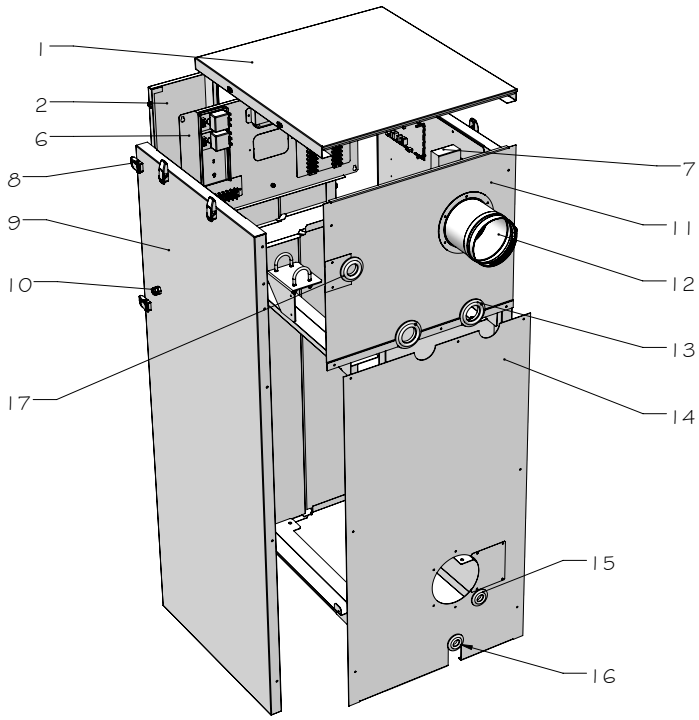
This appliance is equipped with an automatic combustion characteristic adjustment system, provided the installed elevation above sea level is entered into the HOT™ operating control when the height is greater than 2,000 feet and less than or equal to 9,000 feet. To enter the operating elevation:

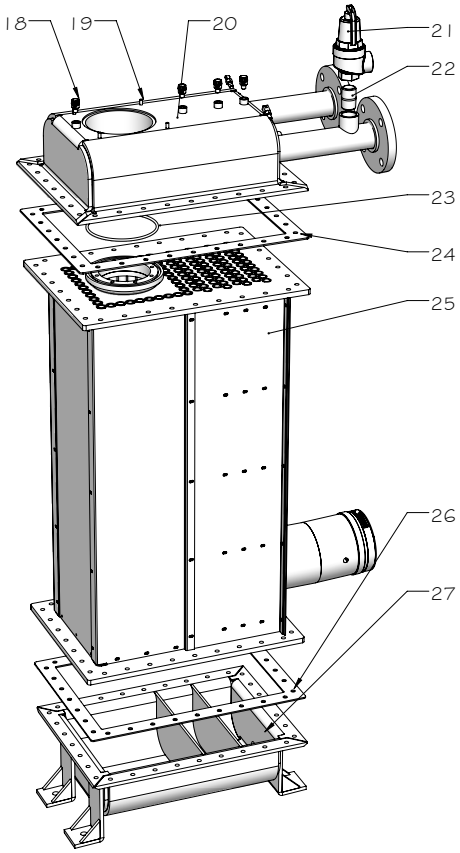
- ***Enter the Parameter adjustment mode—see page 6.*** Enter the appropriate elevation for the installed location—be sure to enter the √ Accept button when complete.
- The adjusted altitude entered is internally converted to an offset on top of the maximum fan speed.
- ***By adjusting the combustion characteristics as described above, there is no de-rate required at altitudes up to 9,000 feet. For elevations in excess of 9,000 feet or gas BTU content levels below 950 BTU/cubic foot, consult the factory at 734.419.0200 or 800.968.5530 for adjustments and de-rating information.***

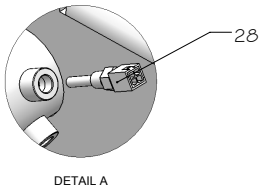
PART 10. PARTS BREAKDOWN

A. PARTS BREAKDOWN

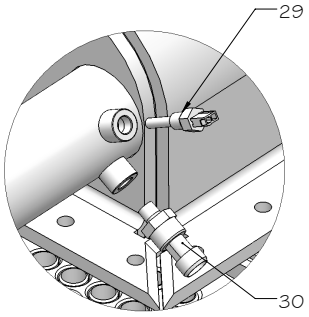




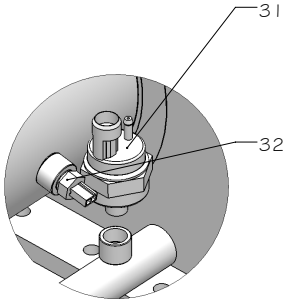




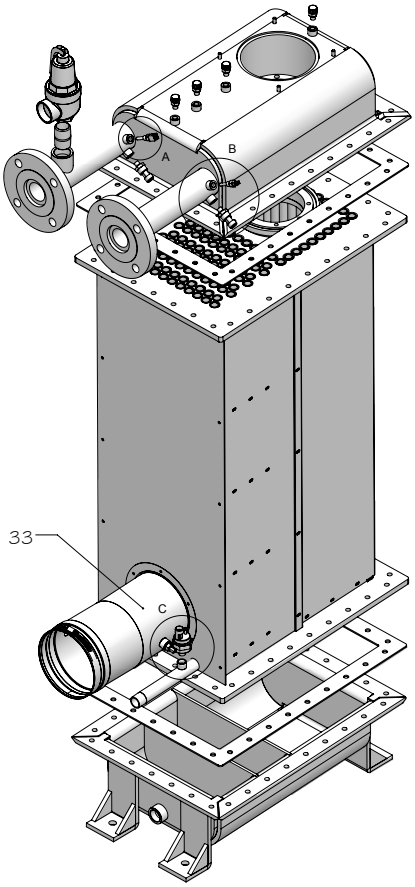
DETAIL A

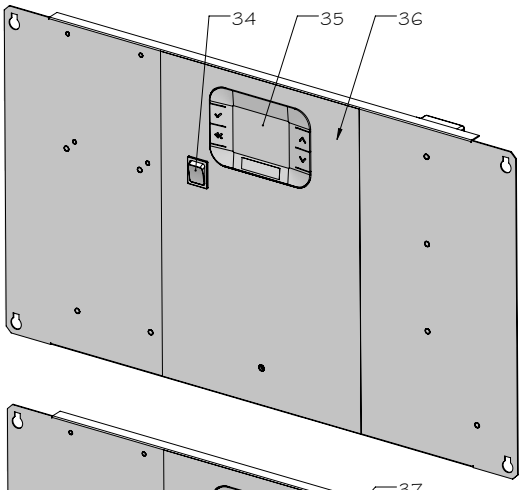


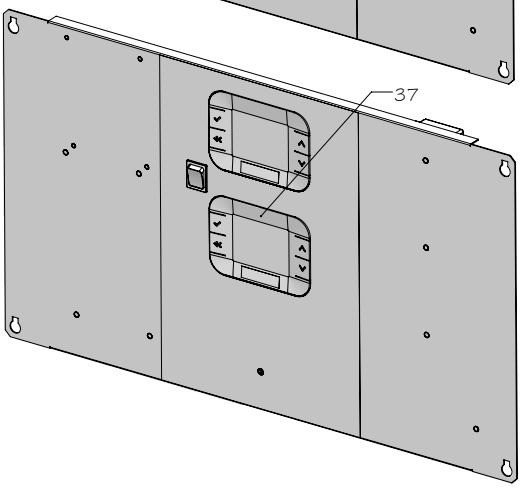
DETAIL B

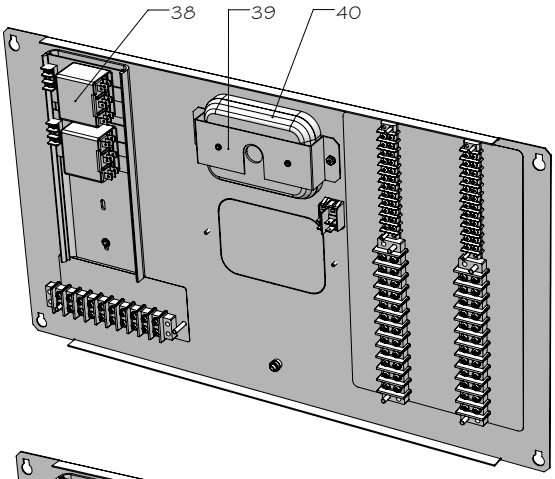


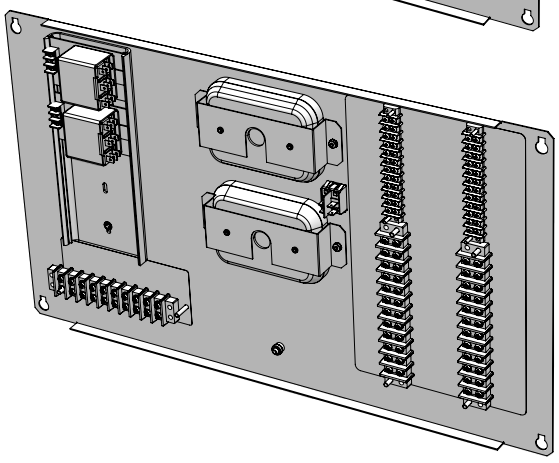
DETAIL C

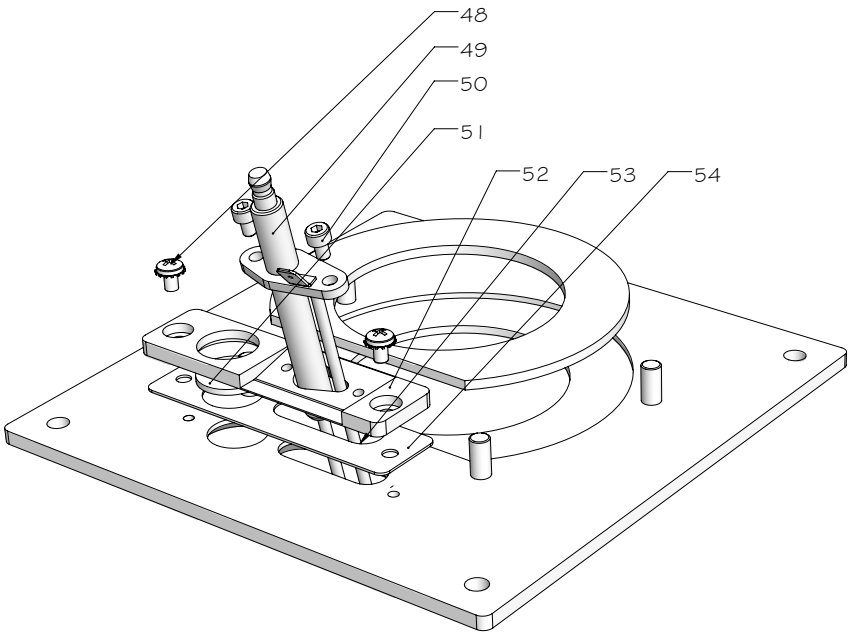








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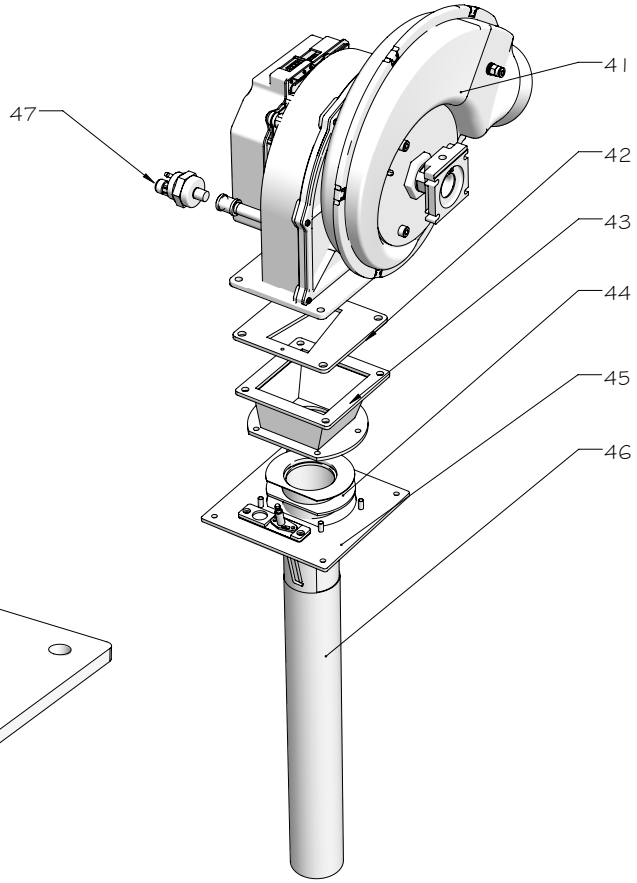
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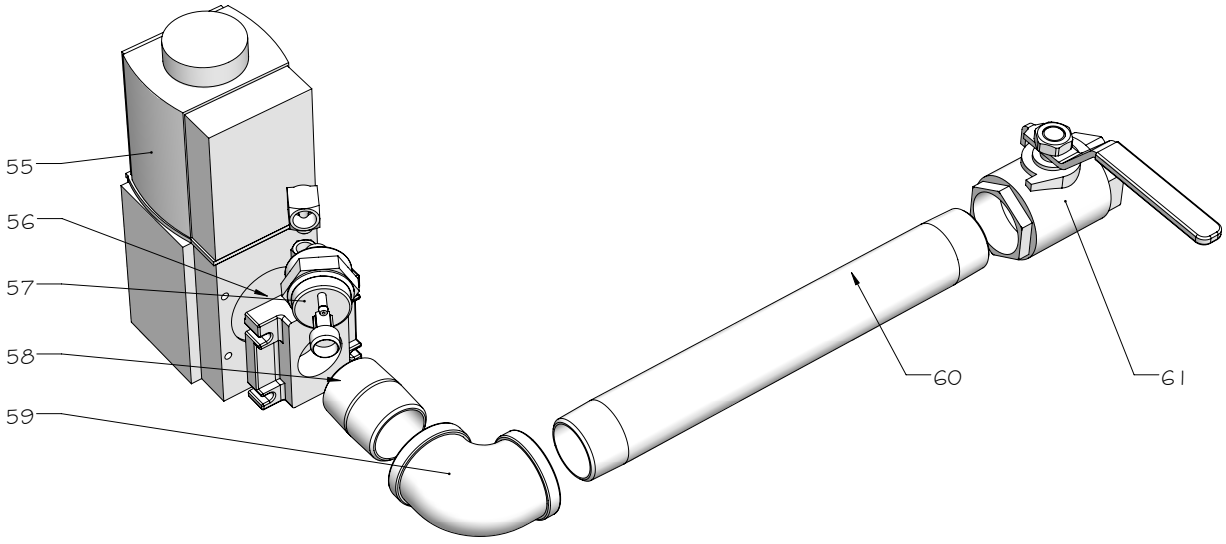
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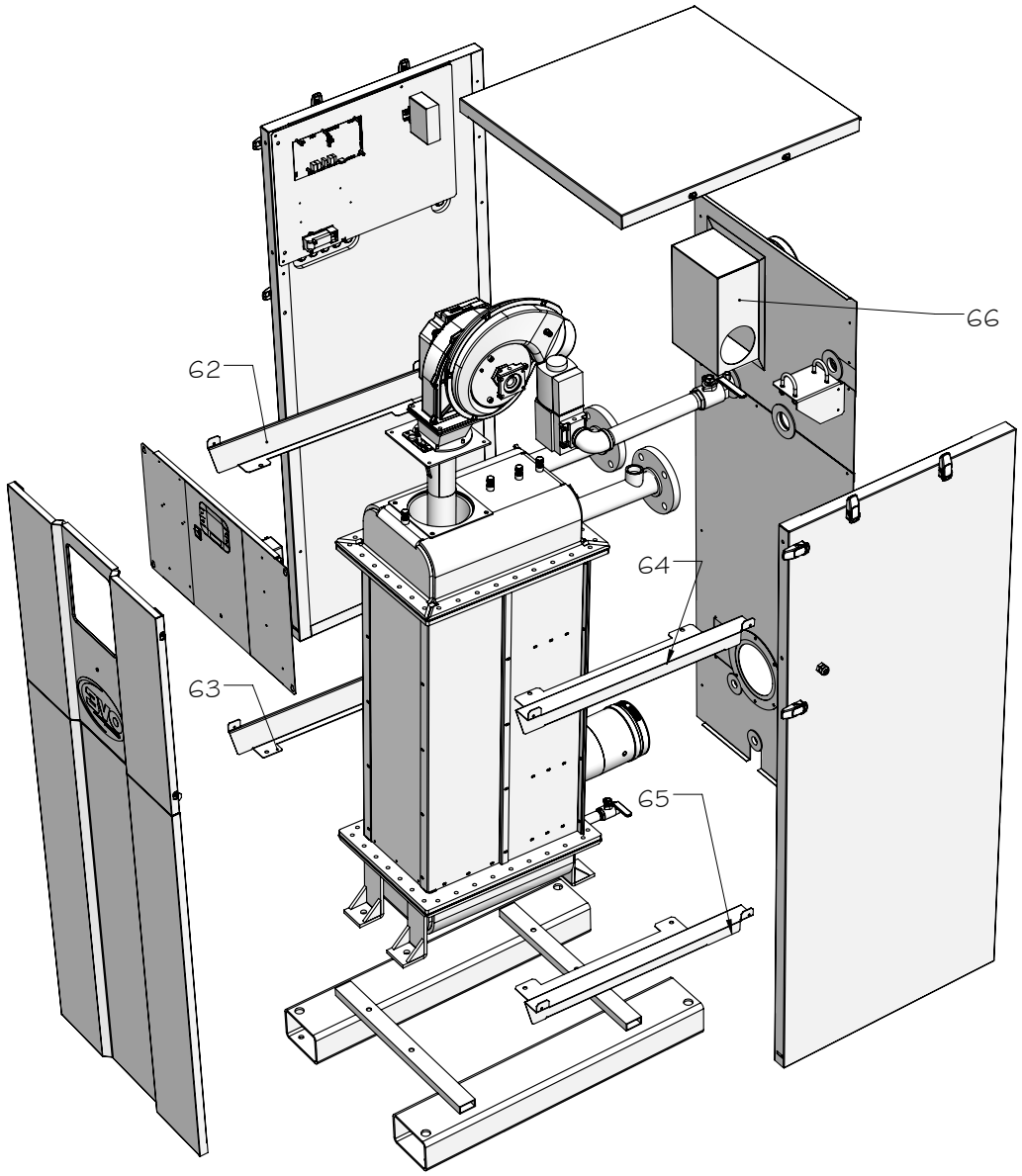
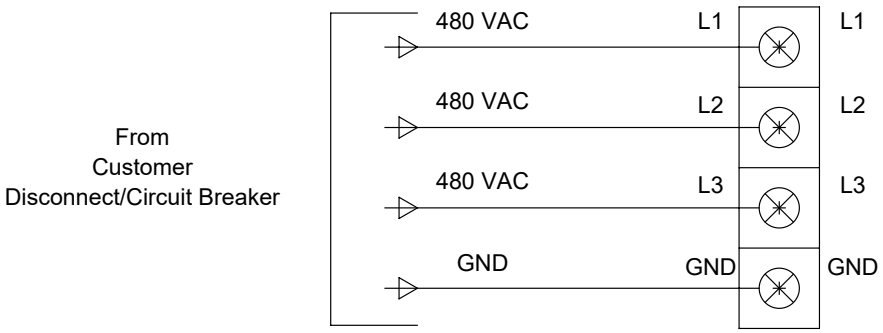


Item	Name	750	850	1000	1500	2000	2500	3000	3500	4000
1	Panel Top Assembly	JKT 95101	JKT 95101	JKT 95101	JKT 95102	JKT 95102	JKT 95102	JKT 95103	JKT 95103	JKT 95103
2	Panel Left Side Assembly	JKS 95103	JKS 95103	JKS 95103	JKS 95105	JKS 95105	JKS 95105	JKS 95107	JKS 95107	JKS 95107
3	Front Display Assembly	PAN 95202	PAN 95202	PAN 95202	PAN 95203	PAN 95203	PAN 95203	PAN 95204	PAN 95204	PAN 95204
4	Door Assembly	JKD 95101	JKD 95101	JKD 95101	JKD 95102	JKD 95102	JKD 95102	JKD 95103	JKD 95103	JKD 95103
5	Front Panel	JKF 95101	JKF 95101	JKF 95101	JKF 95102	JKF 95102	JKF 95102	JKF 95103	JKF 95103	JKF 95103
6	Control Panel Assembly	PAN 95101	PAN 95101	PAN 95101	PAN 95101	PAN 95101	PAN 95101	PAN 95101	PAN 95101	PAN 95101
7	Router Cellular 3G	RTR 10000	RTR 10000	RTR 10000	RTR 10000	RTR 10000	RTR 10000	RTR 10000	RTR 10000	RTR 10000
8	Latch Draw V7 Small w/ Keeper	HWR 15030	HWR 15030	HWR 15030	HWR 15030	HWR 15030	HWR 15030	HWR 15030	HWR 15030	HWR 15030
9	Panel Right Side Assembly	JKS 95102	JKS 95102	JKS 95102	JKS 95104	JKS 95104	JKS 95104	JKS 95106	JKS 95106	JKS 95106
10	Strain Relief .375 Black Nylon w/ Locknut	ELE 47220	ELE 47220	ELE 47220	ELE 47220	ELE 47220	ELE 47220	ELE 47220	ELE 47220	ELE 47220
11	Panel Rear Upper	JKR 95103 U	JKR 95104 U	JKR 95104 U	JKR 95105 U	JKR 95106 U	JKR 95107 U	JKR 95108 U	JKR 95108 U	JKR 95109 U
12	Vent Air Inlet Connector	VNT 75202	VNT 75203	VNT 75203	VNT 75204	VNT 75205	VNT 75206	VNT 75206	VNT 75206	VNT 75207
13	Water Supply/Return Grommet	GKT 22250	GKT 22250	GKT 22250	GKT 22251	GKT 22251	GKT 22251	GKT 23375	GKT 23375	GKT 23375
14	Lower Rear Panel Assembly	JKR 95103 L	JKR 95104 L	JKR 95104 L	JKR 95105 L	JKR 95106 L	JKR 95107 L	JKR 95108 L	JKR 95108 L	JKR 95109 L
15	Condensate Drain Grommet	GKT 21300	GKT 21300	GKT 21300	GKT 21300	GKT 21300	GKT 21300	GKT 21300	GKT 21300	GKT 21300
16	Heat Exchanger Drain Grommet	GKT 21020	GKT 21020	GKT 21020	GKT 21020	GKT 21020	GKT 21020	GKT 21020	GKT 21020	GKT 21020
17	Gas Pipe Grommet	GKT 21625	GKT 21625	GKT 21625	GKT 22250	GKT 22250	GKT 22250	GKT 22250	GKT 22250	GKT 22250
18	Vent Air 1/8 Automatic	HYD 24000	HYD 24000	HYD 24000	HYD 24000	HYD 24000	HYD 24000	HYD 24000	HYD 24000	HYD 24000
19	HEX Top Head Bolt	1/4-20 x 1.25"	1/4-20 x 1.25"	1/4-20 x 1.25"	1/4-20 x 1.25"	1/4-20 x 1.25"	1/4-20 x 1.25"	1/4-20 x 1.25"	1/4-20 x 1.25"	1/4-20 x 1.25"

Item	Name	750	850	1000	1500	2000	2500	3000	3500	4000
20	Assembly Top Head	HDR 75002	HDR 75002	HDR 75002	HDR 75004	HDR 75006	HDR 75006	HDR 75008	HDR 75008	HDR 75008
21.1	Relief Valve - Heater	RLV 10605-125	RLV 10605-125	RLV 10605-125	RLV 10605-125	RLV 10605-125	RLV 10605-125	RLV 10605-125	RLV 10605-125	RLV 10605-125
21.2	Relief Valve - Boiler	RLV 10605-50	RLV 10605-50	RLV 10605-125	RLV 10605-50	RLV 10607-50	RLV 10607-50	RLV 10607-50	RLV 10607-50	RLV 10607-50
22	Nipple Br 1x2	BRS 97102	BRS 97102	BRS 97102	BRS 97102	BRS 97102	BRS 97102	BRS 97102	BRS 97102	BRS 97102
23	O-Ring	ORG 11362	ORG 11362	ORG 11362	ORG 11377	ORG 11377	ORG 11377	ORG 11381	ORG 11381	ORG 11381
24	Header Gasket	GKT 75501	GKT 75501	GKT 75501	GKT 75503	GKT 75503	GKT 75503	GKT 75505	GKT 75505	GKT 75505
25	Tube Bundle	TBD 75003	TBD 75004	TBD 75005	TBD 75006	TBD 75007	TBD 75008	TBD 75009	TBD 75010	TBD 75011
26	Header Gasket	GKT 75501	GKT 75501	GKT 75501	GKT 75503	GKT 75503	GKT 75503	GKT 75505	GKT 75505	GKT 75505
27	Lower Header	HDR 75003	HDR 75003	HDR 75003	HDR 75005	HDR 75007	HDR 75007	HDR 75009	HDR 75009	HDR 75009
28	Thermistor Duplex NTC 10k Ohm 1/8NPT 25mm	TST 75001	TST 75001	TST 75001	TST 75001	TST 75001	TST 75001	TST 75001	TST 75001	TST 75001
29	Thermistor NTC 10k Ohm 1/8NPT 25mm	TST 75000	TST 75000	TST 75000	TST 75000	TST 75000	TST 75000	TST 75000	TST 75000	TST 75000
30	Transducer P 0-150 .125	PTR 1122E	PTR 1122E	PTR 1122E	PTR 1122E	PTR 1122E	PTR 1122E	PTR 1122E	PTR 1122E	PTR 1122E
31	Transducer ΔP 0-.5 .25	PTR 12323	PTR 12323	PTR 12323	PTR 12323	PTR 12323	PTR 12323	PTR 12323	PTR 12323	PTR 12323
32	Thermistor NTC 10k Ohm .25BSPP 55mm	TST 75002	TST 75002	TST 75002	TST 75002	TST 75002	TST 75002	TST 75002	TST 75002	TST 75002
33	Exhaust Vent Connection	VNT 75102	VNT 75103	VNT 75103	VNT 75104	VNT 75105	VNT 75106	VNT 75106	VNT 75106	VNT 75107
34	On/Off Switch	SWT 74144	SWT 74144	SWT 74144	SWT 74144	SWT 74144	SWT 74144	SWT 74144	SWT 74144	SWT 74144
35	Board Boiler Display	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000
36	Assembly Front Display	PAN 95202	PAN 95202	PAN 95202	PAN 95203	PAN 95203	PAN 95203	PAN 95204	PAN 95204	PAN 95204
37	Board Boiler Display (Cascade)	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000
38	Relay 120VAC, 30 Amp 3PDT	RLY 47013	RLY 47013	RLY 47013	RLY 47013	RLY 47013	RLY 47013	RLY 47013	RLY 47013	RLY 47013
39	Bracket 3VO Display Board Mounting	BKT 75103	BKT 75103	BKT 75103	BKT 75103	BKT 75103	BKT 75103	BKT 75103	BKT 75103	BKT 75103
40	Board Boiler Display	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000	BDB 70000
41	Fan Assembly	FAN 20106	FAN 20106	FAN 20106	FAN 20107	FAN 20107	FAN 20108	FAN 20109	FAN 20109	FAN 20109
42	Fan Gasket	GKT 75403	GKT 75402	GKT 75403	GKT 75404	GKT 75405	GKT 75406	GKT 75407	GKT75408	GKT 75409
43	Adaptor Fan-Burner	BNR 75201	BNR 75201	BNR 75201	BNR 75202	BNR 75202	BNR 75203	BNR 75204	BNR 75204	BNR 75204
44	Gasket Burner	GKT 75421	GKT 75421	GKT 75421	GKT 75422	GKT 75422	GKT 75422	GKT 75423	GKT 75423	GKT 75423
45	Burner Plate	BNR 75101	BNR 75101	BNR 75101	BNR 75102	BNR 75102	BNR 75102	BNR 75103	BNR 75103	BNR 75103
46	Burner	BNR 75001	BNR 75002	BNR 75003	BNR 75004	BNR 75005	BNR 75006	BNR 75007	BNR 75008	BNR 75009
47	Transducer ΔP -1-1 .25	PTR 12304	PTR 12304	PTR 12304	PTR 12304	PTR 12304	PTR 12304	PTR 12304	PTR 12304	PTR 12304
48	Pan Head Screw	10-32x1/4"	10-32x1/4"	10-32x1/4"	10-32x1/4"	10-32x1/4"	10-32x1/4"	10-32x1/4"	10-32x1/4"	10-32x1/4"
49	Pilot Spark Electrode Knurled 3VO	PLT 75001	PLT 75001	PLT 75001	PLT 75001	PLT 75001	PLT 75001	PLT 75001	PLT 75001	PLT 75001
50	Socket Head Cap Screw	B18.3.1m - 4x.7	B18.3.1m - 4x.7	B18.3.1m - 4x.7	B18.3.1m - 4x.7	B18.3.1m - 4x.7	B18.3.1m - 4x.7	B18.3.1m - 4x.7	B18.3.1m - 4x.7	B18.3.1m - 4x.7
51	Glass Sight	SGL 75102	SGL 75102	SGL 75102	SGL 75100	SGL 75100	SGL 75100	SGL 75100	SGL 75100	SGL 75100
52	Ignitor Mounting Bar	PLT 75101	PLT 75101	PLT 75101	PLT 75102	PLT 75102	PLT 75102	PLT 75102	PLT 75102	PLT 75102
53	Pilot Spark Electrode Knurled 3VO	PLT 75001	PLT 75001	PLT 75001	PLT 75001	PLT 75001	PLT 75001	PLT 75001	PLT 75001	PLT 75001
54	Gasket Ignitor Mounting Bar	GKT 75441	GKT 75441	GKT 75441	GKT 75442	GKT 75442	GKT 75442	GKT 75442	GKT 75442	GKT 75442
55	Gas Valve	VAL 46101	VAL 46101	VAL 46101	VAL 46102	VAL 46102	VAL 46102	VAL 46103	VAL 46103	VAL 46103
56	Gas Valve Flange	FLG 46100	FLG 46100	FLG 46100	FLG 46110	FLG 46110	FLG 46110	FLG 46110	FLG 46110	FLG 46110
57	Transducer ΔP 0-.5 .25	PTR 12323	PTR 12323	PTR 12323	PTR 12323	PTR 12323	PTR 12323	PTR 12323	PTR 12323	PTR 12323
58	Black Iron Nipple	BLK 97102	BLK 97102	BLK 97127	BLK 97152	BLK 97152	BLK 97152	BLK 97152	BLK 97152	BLK 97152
59	Black Iron 90˚ Elbow	BLK 93206	BLK 93206	BLK 93207	BLK 93208	BLK 93208	BLK 93208	BLK 93208	BLK 93208	BLK 93208
60	Black Iron Nipple	BLK 97139	BLK 97139	BLK 97139	BLK 97154, 97152	BLK 97154, 97152	BLK 97154, 97152	BLK 97154, 97152	BLK 97154, 97152	BLK 97154, 97152
61	Valve Ball T	VAL 98106	VAL 98106	VAL 98106	VAL 98107	VAL 98107	VAL 98108	VAL 98108	VAL 98108	VAL 98108
62	HEX Left Upper Bracket	BKT 75107	BKT 75107	BKT 75107	BKT 75207	BKT 75207	BKT 75207	BKT 75307	BKT 75307	BKT 75307
63	HEX Lower Left Right Bracket	BKT 75106	BKT 75106	BKT 75106	BKT 75206	BKT 75206	BKT 75206	BKT 75306	BKT 75306	BKT 75306
64	HEX Upper Right Bracket	BKT 75105	BKT 75105	BKT 75105	BKT 75205	BKT 75205	BKT 75205	BKT 75305	BKT 75305	BKT 75305
65	HEX Lower Right Bracket	BKT 75104	BKT 75104	BKT 75104	BKT 75204	BKT 75204	BKT 75204	BKT 75304	BKT 75304	BKT 75304
66	Box Air Inlet	VNT 75403-1	VNT 75403-1	VNT 75403-1	VNT 75405-1	VNT 75405-1	VNT 75405-1	VNT 75407-1	VNT 75407-1	VNT 75407-1

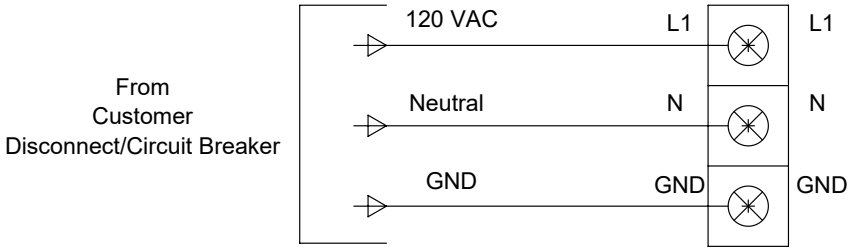
DISCONNECT BOX



480 VAC SYSTEM

6 AMPS PER PHASE 3500 - 4000
20 AMPS PER PHASE 3500 - 4000 W/ TRANSFORMER (120 V / 240 V)

TERMINAL



120 VAC IN

120 VAC SYSTEM

20 AMPS PER PHASE 750-1000

Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

Revision	Revisio
A	Ad
B	Added W
C	Edit
D	Add 3000

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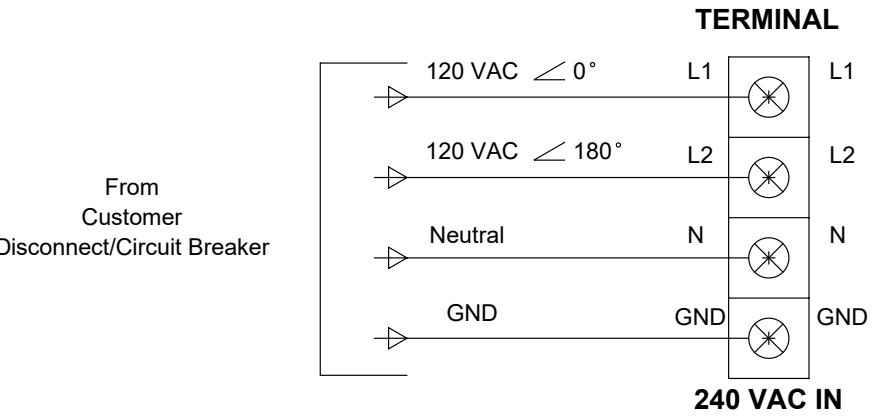


240 VAC SYSTEM

15 AMPS PER PHASE 750 - 1000
20 AMPS PER PHASE 1500 - 2500
25 AMPS PER PHASE 3000

BREAKER	WIRE SIZE
15 Amp	# 14 AWG TNHN
20 Amp	# 12 AWG TNHN
30 Amp	# 10 AWG TNHN
40 Amp	# 8 AWG TNHN
50 Amp	# 6 AWG TNHN

* DO NOT USE WIRE SMALLER THAN #14 ON ANY POWER CIRCUITS *

REVISIONS			
n Description	Revised By	Revision Date	Approved
ded Note	XC	12/20/16	
Vire Size Table	XC	3/10/17	
ted Notes	XC	3/13/17	
) Wire Diagram	JL	6/2/17	

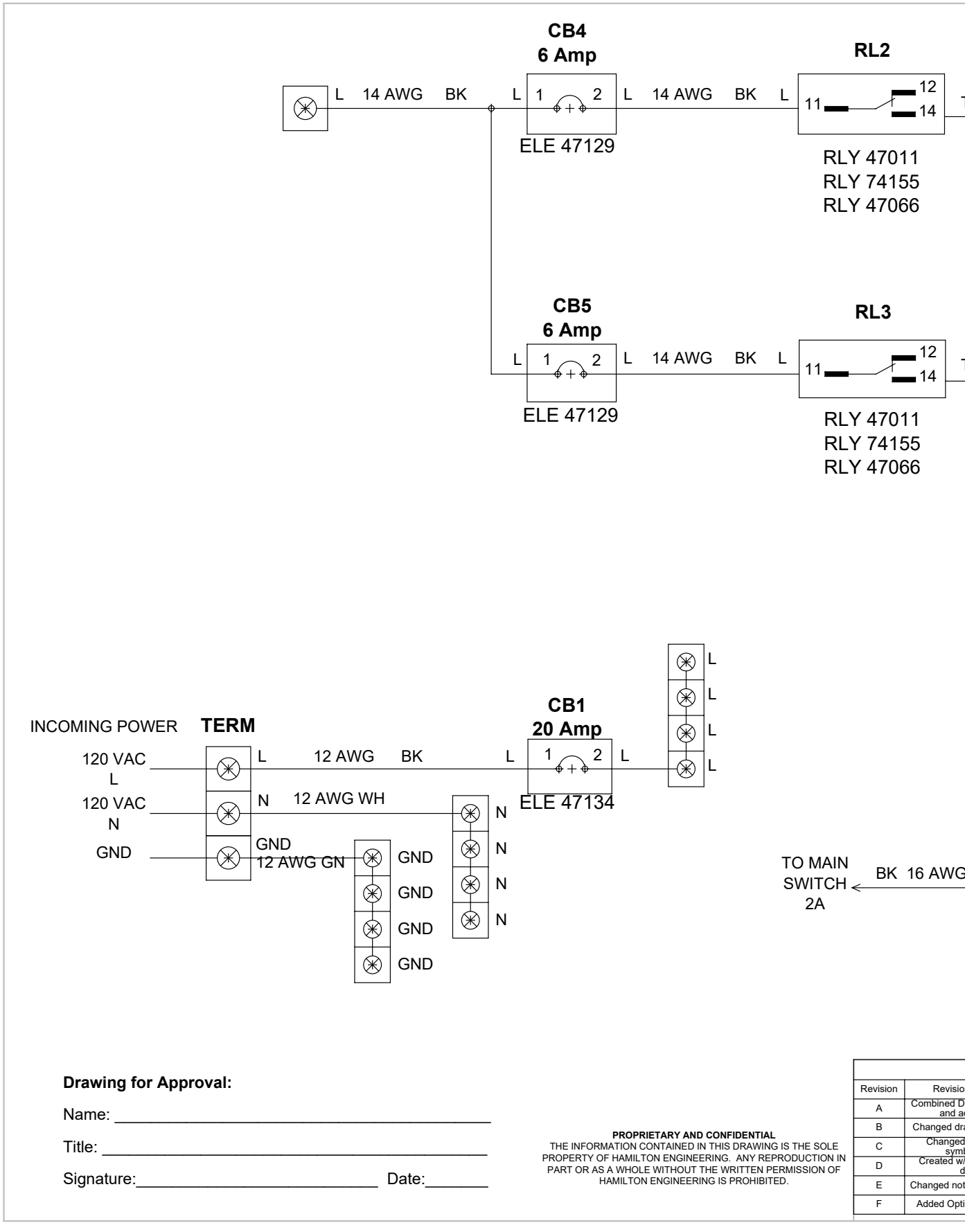
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
3VO Individual Boiler Input Power Diagram

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 1 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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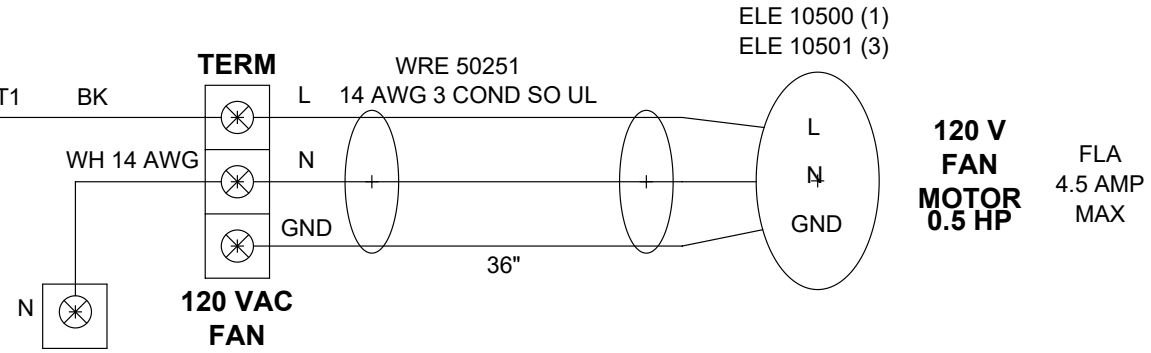
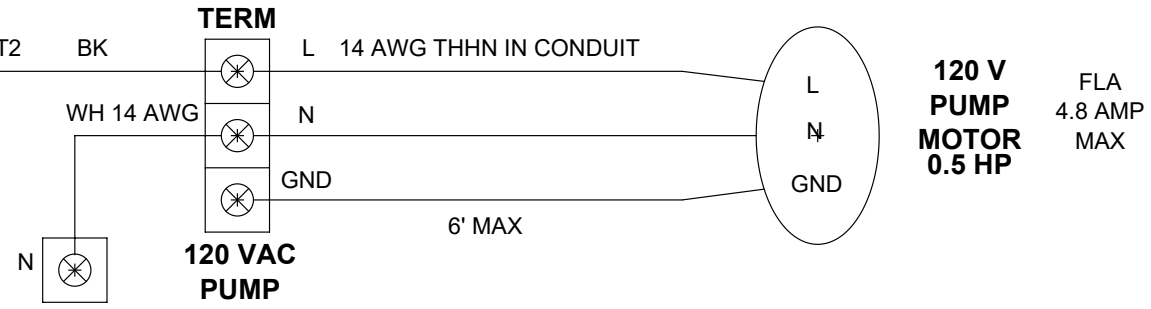
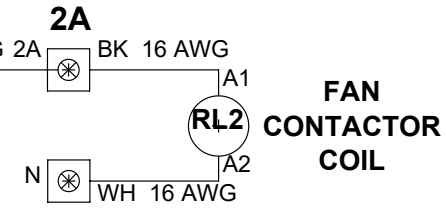
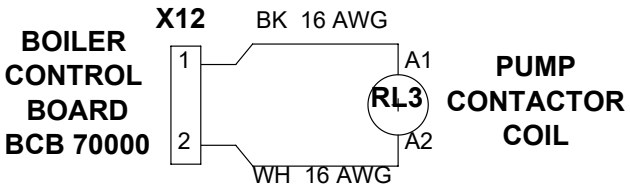
Revision	Revisio
A	Combined D and a
B	Changed dra
C	Changed symb
D	Created w/ d
E	Changed not
F	Added Opti









NOTE: USE THHN WIRE

REVISIONS			
n Description	Revised By	Revision Date	Approved
rawings. Changed dded notes.	XC	12/20/16	
awings and notes.	XC	2/7/17	
CB and Relay ol&Part #	XC	2/23/17	
pump start/stop rawing	XC	3/13/17	
es and description	DH	11/1/17	
onal Flow Switch	DH	6/29/2018	

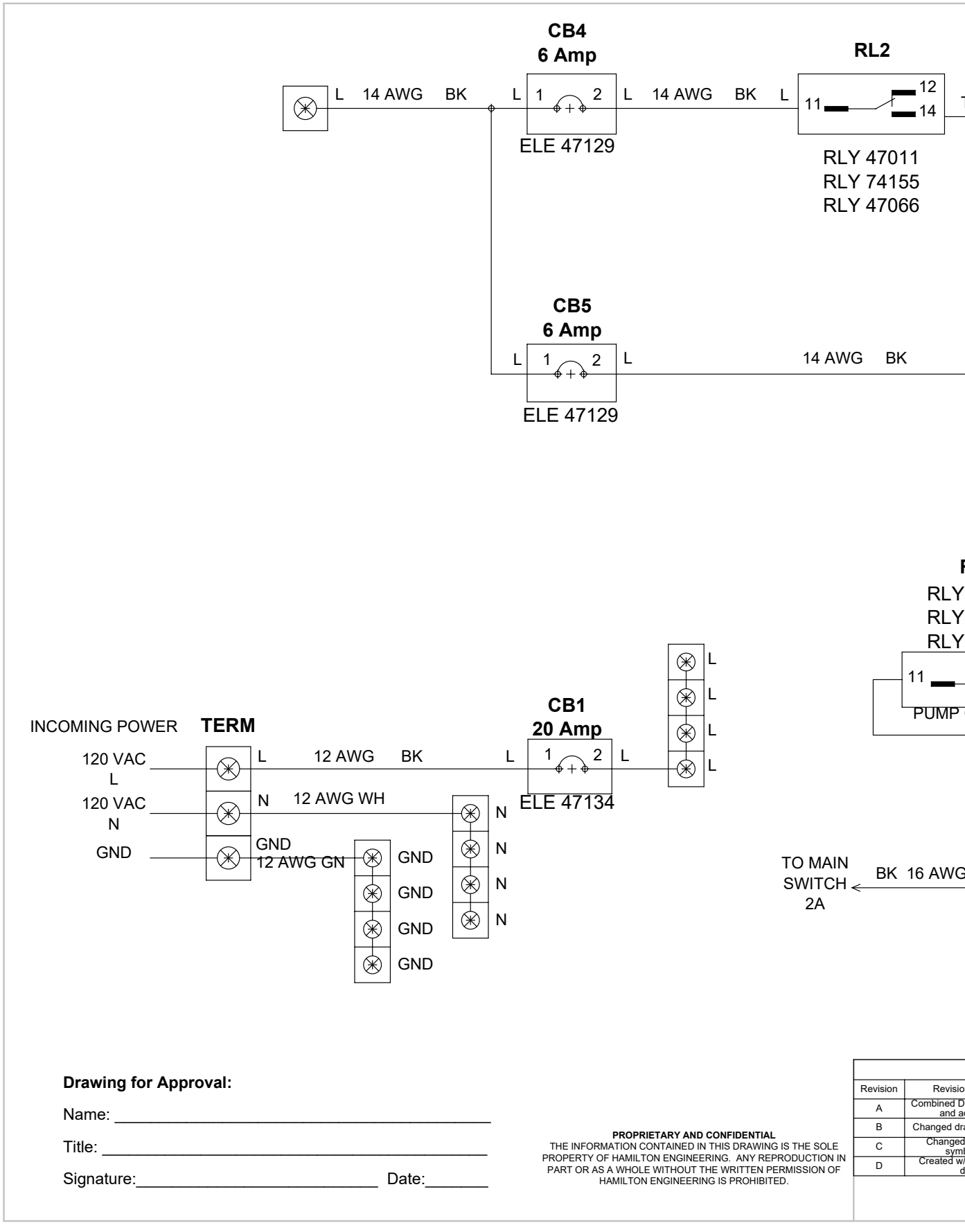
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 1000 120 VAC
ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 2 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

Revision	Revisio
A	Combined D and a
B	Changed dra
C	Changed symb
D	Created w/ d

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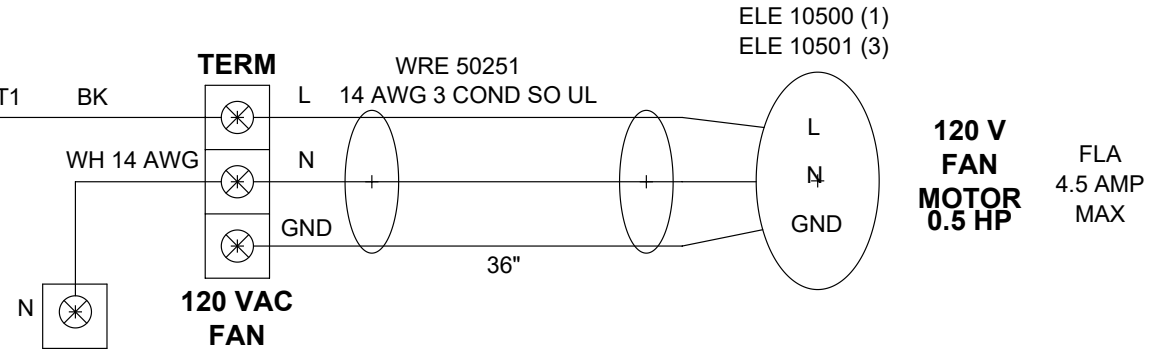
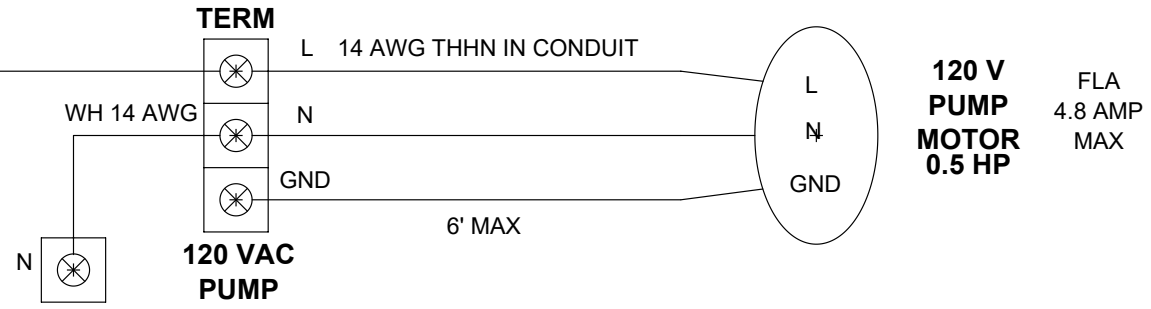
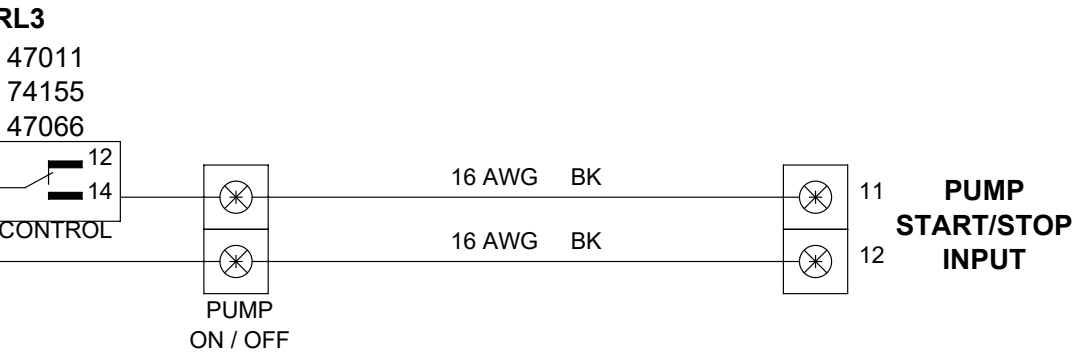
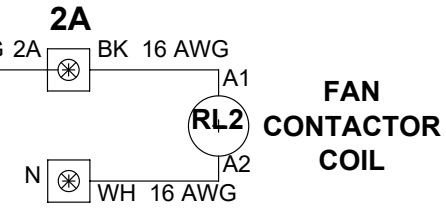
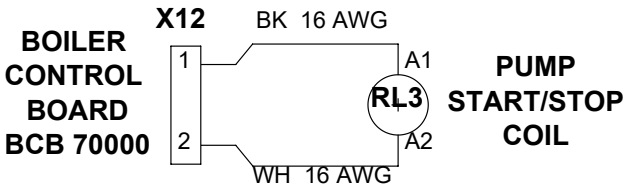










NOTE: USE THHN WIRE

REVISIONS			
n Description	Revised By	Revision Date	Approved
rawings. Changed dded notes.	XC	12/20/16	
awings and notes.	XC	2/7/17	
CB and Relay ol&Part #	XC	2/23/17	
pump start/stop rawing	XC	3/13/17	

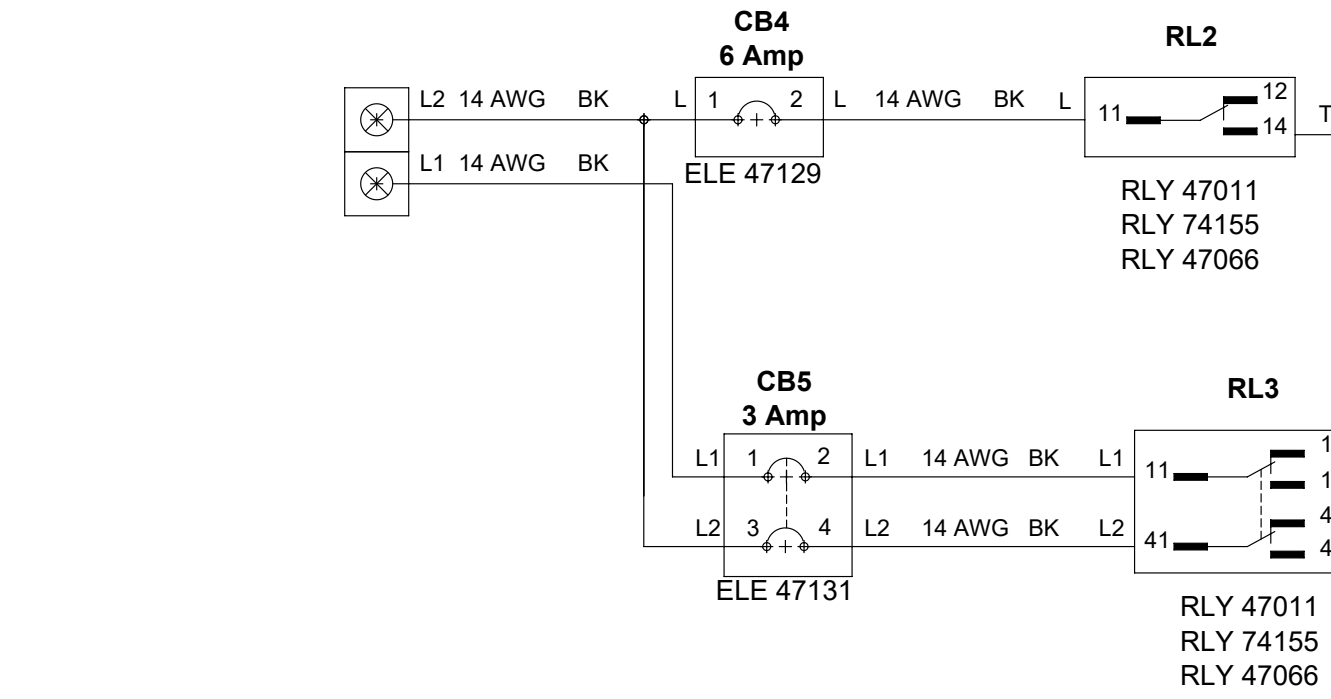
Customer:

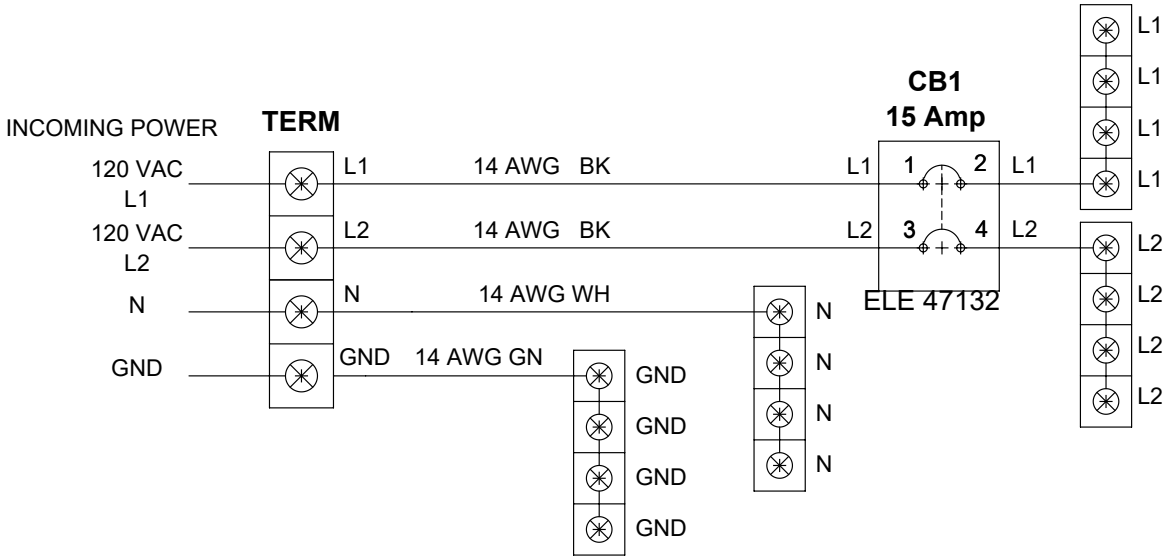
Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 1000 120 VAC W/ PUMP START/STOP INPUT
ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 3 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"





Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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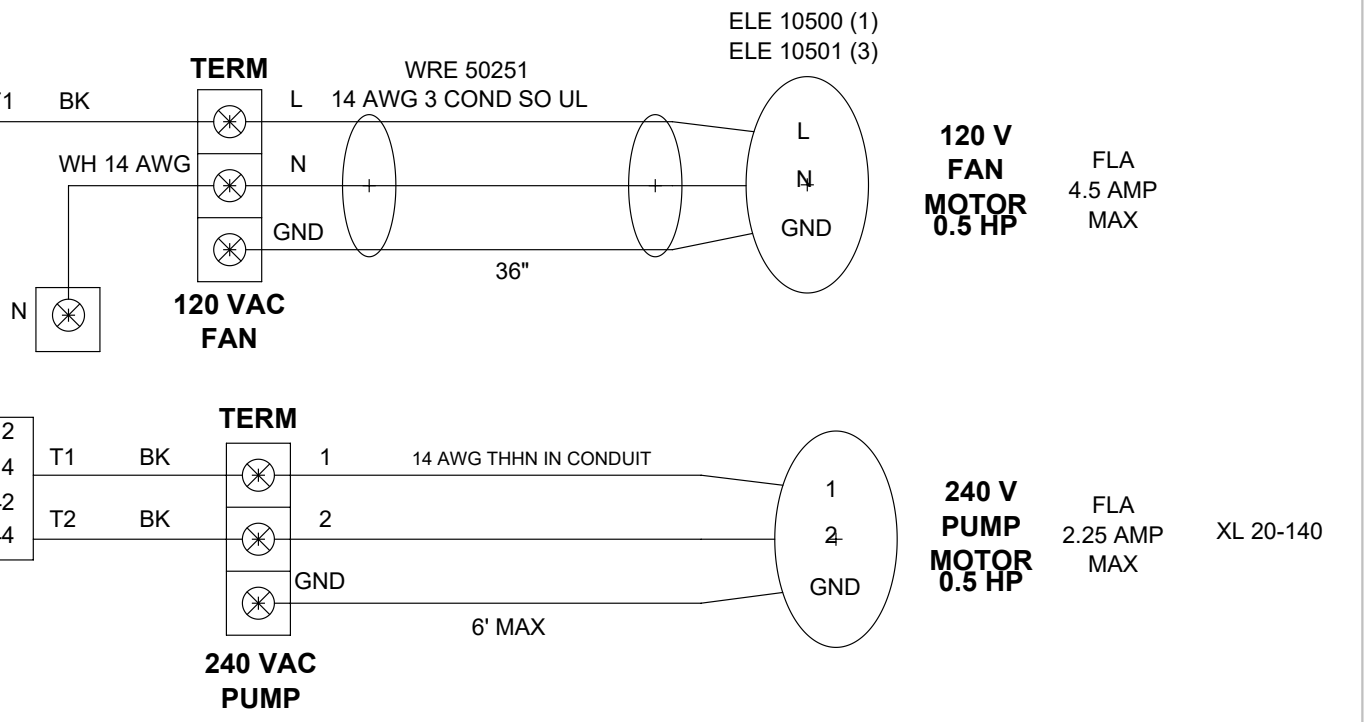
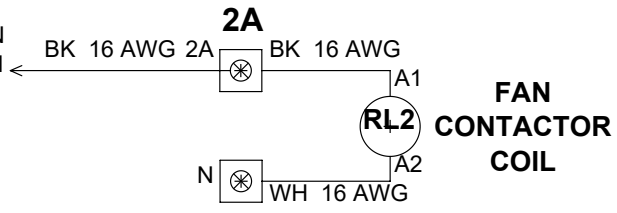
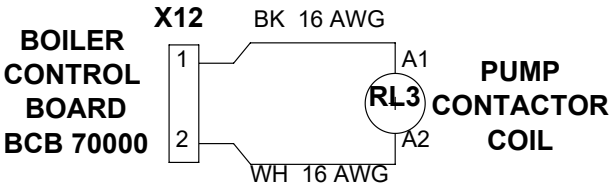
Revision	Revision
A	Combined Dra and ad
B	Changed dra
C	Changed t symb
D	Created w/ p dr
E	Changed note
F	Added Optio







NOTE: USE THHN WIRE

REVISIONS			
Description	Revised By	Revision Date	Approved
awings. Changed ded notes.	XC	12/20/16	
wings and notes.	XC	2/7/17	
CB and Relay ol&Part #	XC	2/23/17	
pump start/stop awing	XC	3/13/17	
s and description	DH	11/1/17	
nal Flow Switch	DH	6/29/2018	

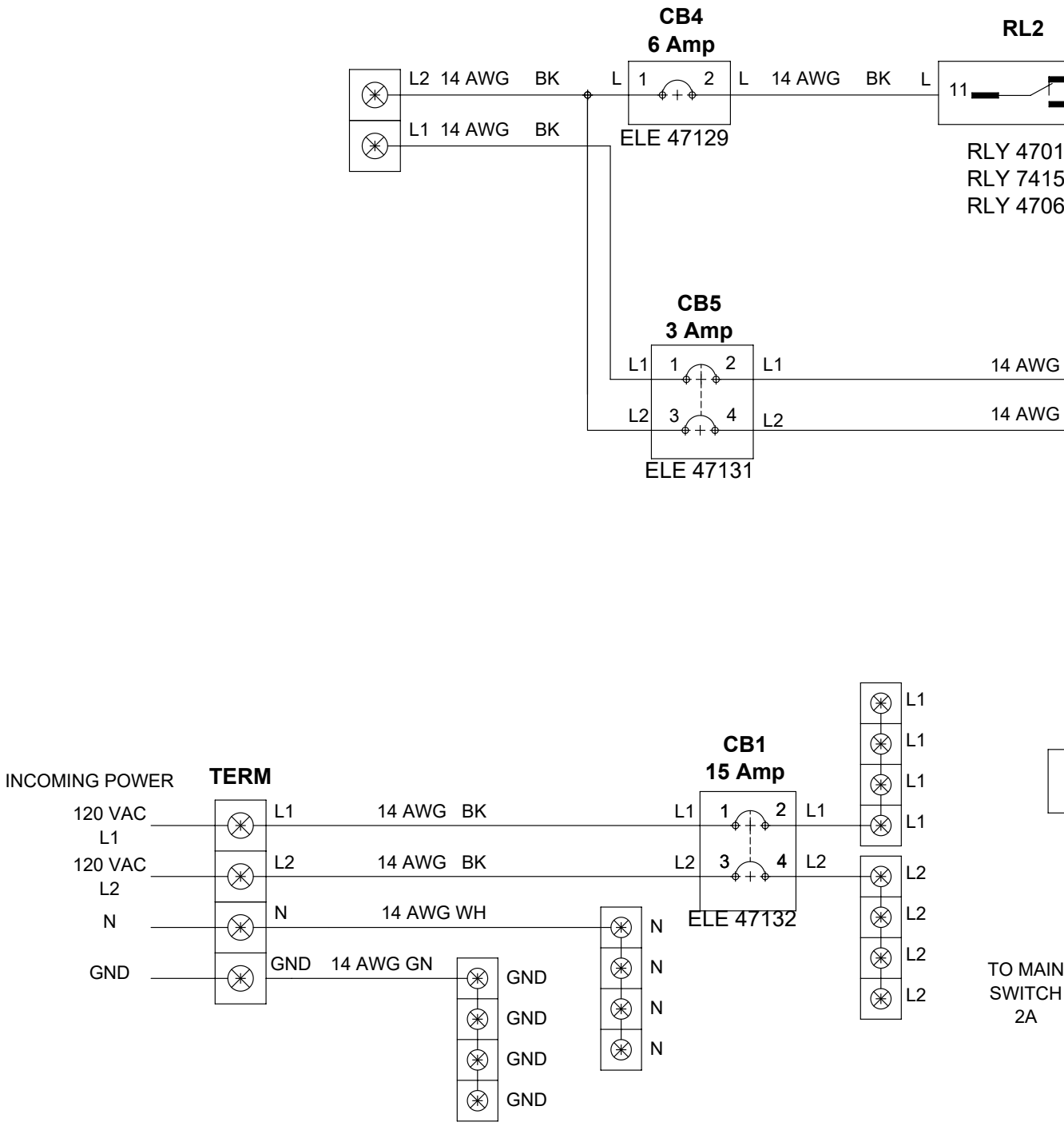
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 1000 120 VAC FAN / 240 VAC PUMP ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:			
		9/8/2016	XC	SHEET 4 OF 20	1:50	Reference Dimensions are ± 10% Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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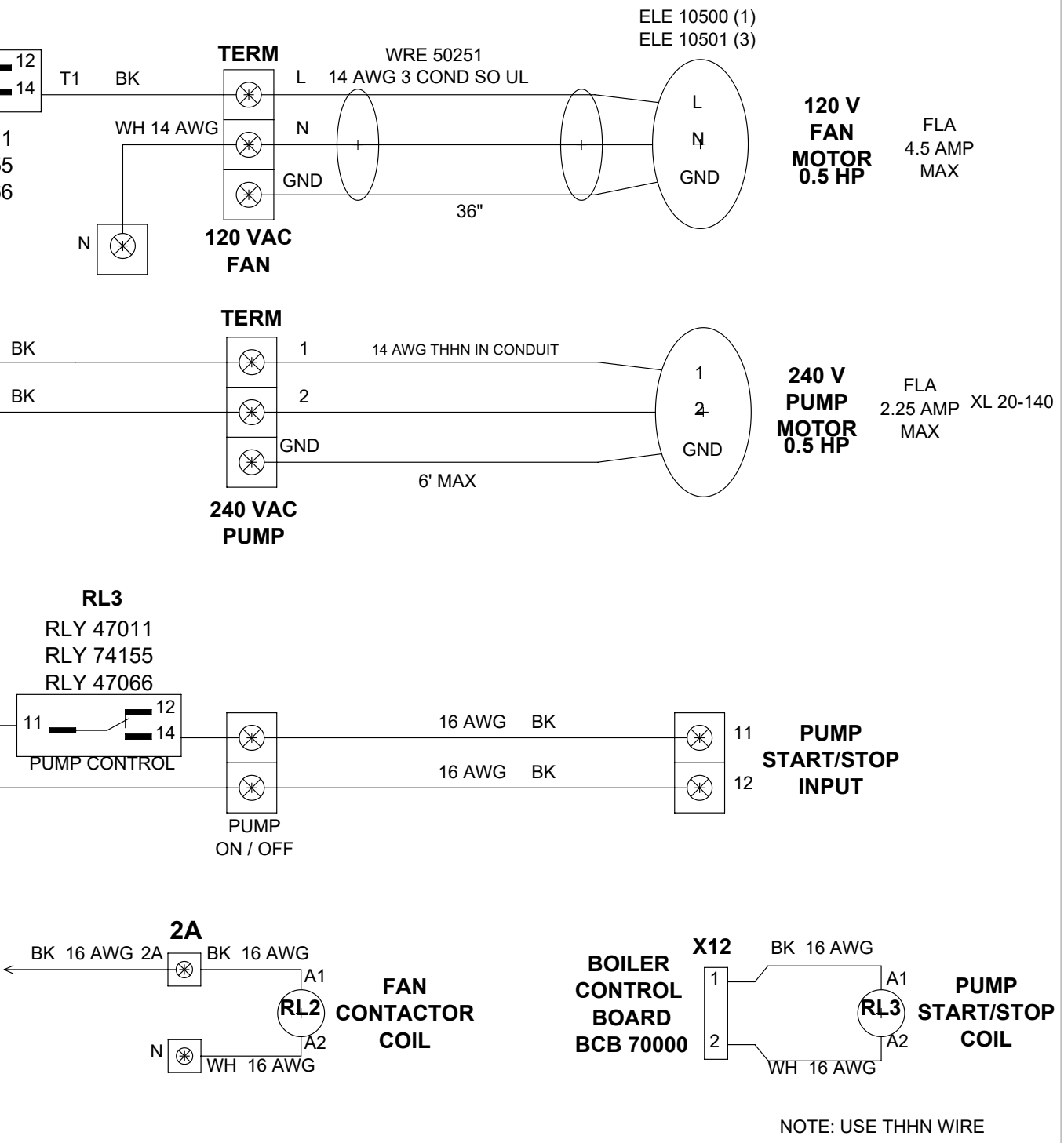
Revision	Revision
A	Combined Dra and adc
B	Changed draw
C	Changed C symbo
D	Created w/ p dra



NOTE: USE THHN WIRE

REVISIONS			
Description	Revised By	Revision Date	Approved
wings. Changed led notes.	XC	12/20/16	
wings and notes.	XC	2/7/17	
CB and Relay ol&Part #	XC	2/23/17	
pump start/stop wing	XC	3/13/17	

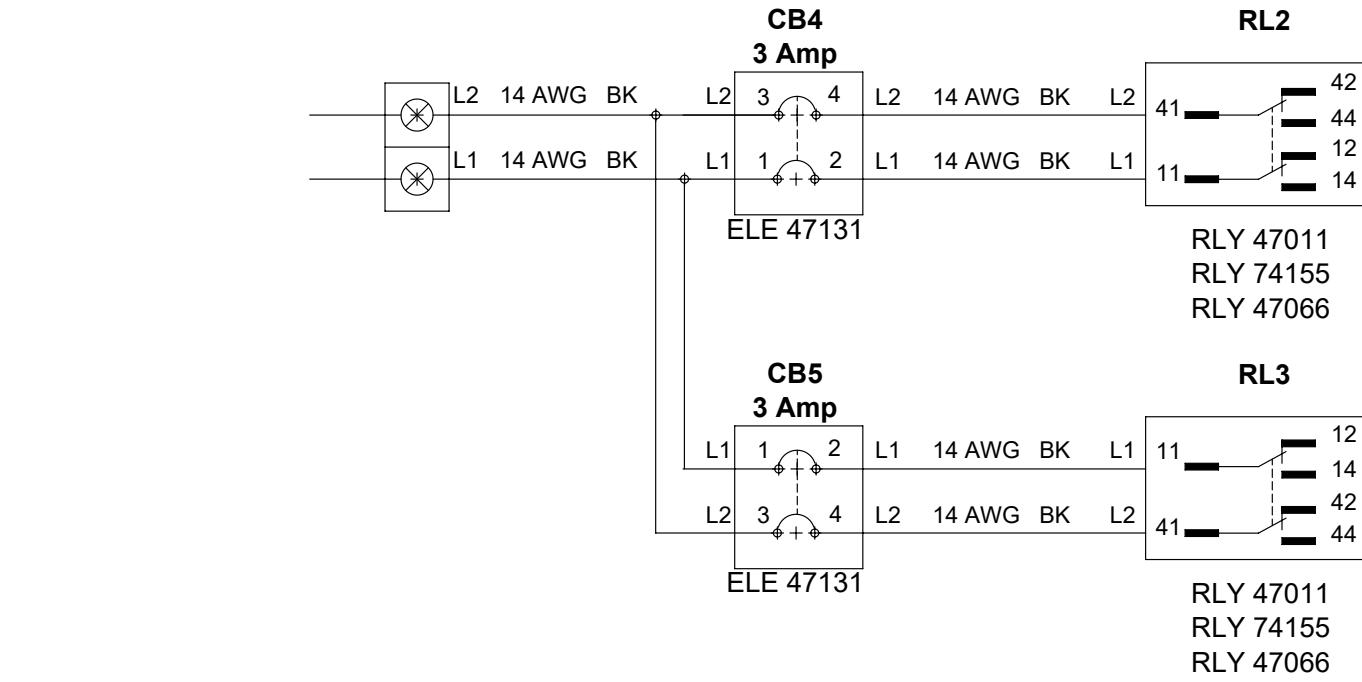
Customer:

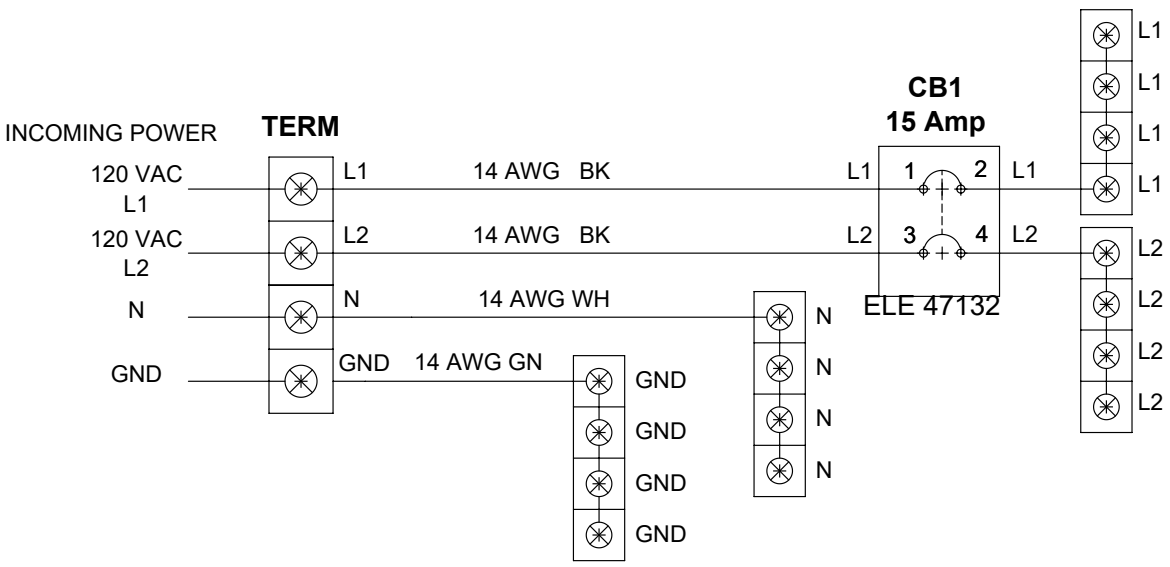
Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 1000 120 VAC FAN / 240 VAC PUMP W/ START/STOP INPUT ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 5 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"





Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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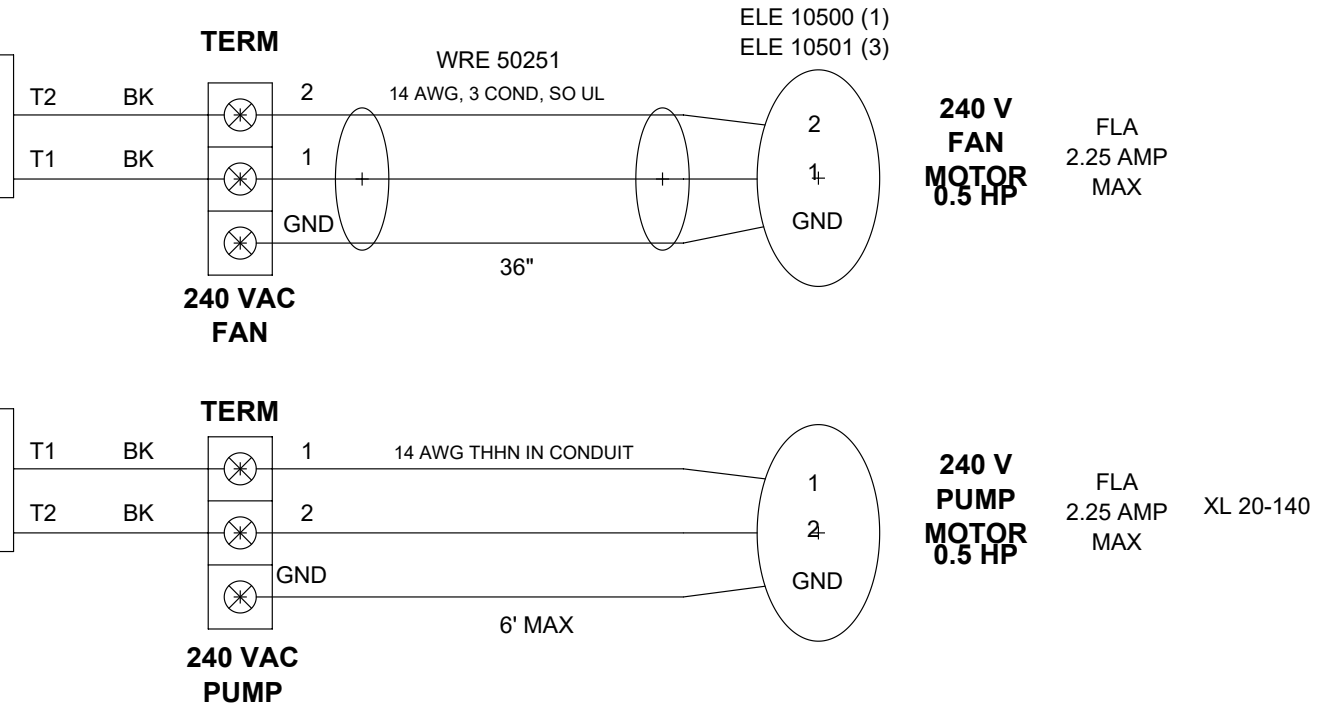
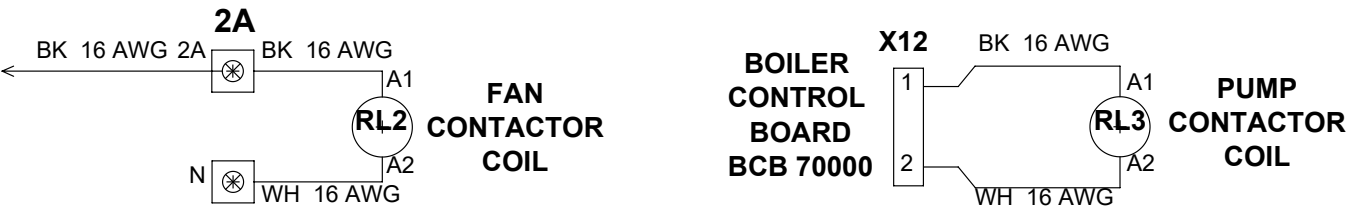
Revision	Revision
A	Combined Dr and ad
B	Changed dra
C	Changed symb
D	Created w/ dr
E	Changed note
F	Added Optic





NOTE: USE THHN WIRE

REVISIONS			
Description	Revised By	Revision Date	Approved
awings. Changed ded notes.	XC	12/20/16	
wings and notes.	XC	2/7/17	
CB and Relay ol&Part #	XC	2/23/17	
pump start/stop awing	XC	3/13/17	
es and description	DH	11/1/17	
onal Flow Switch	DH	6/29/2018	

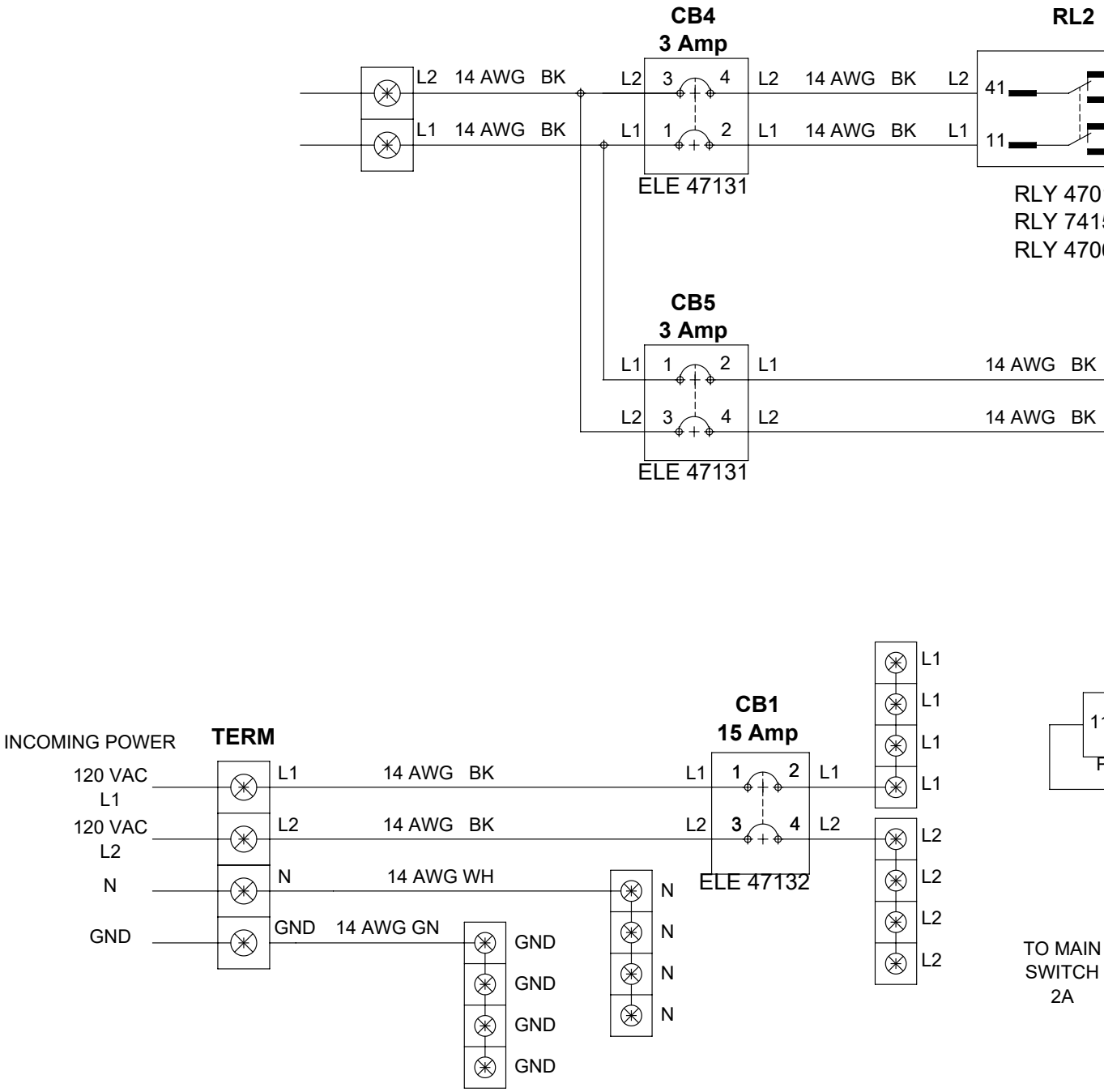
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 1000 240 VAC
ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 6 OF 20	1:50		Reference Dimensions are ± 10%
		9/8/2016	XC				Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

Revision	Revision
A	Combined Dr and ad
B	Changed dra
C	Changed symb
D	Created w/ dr

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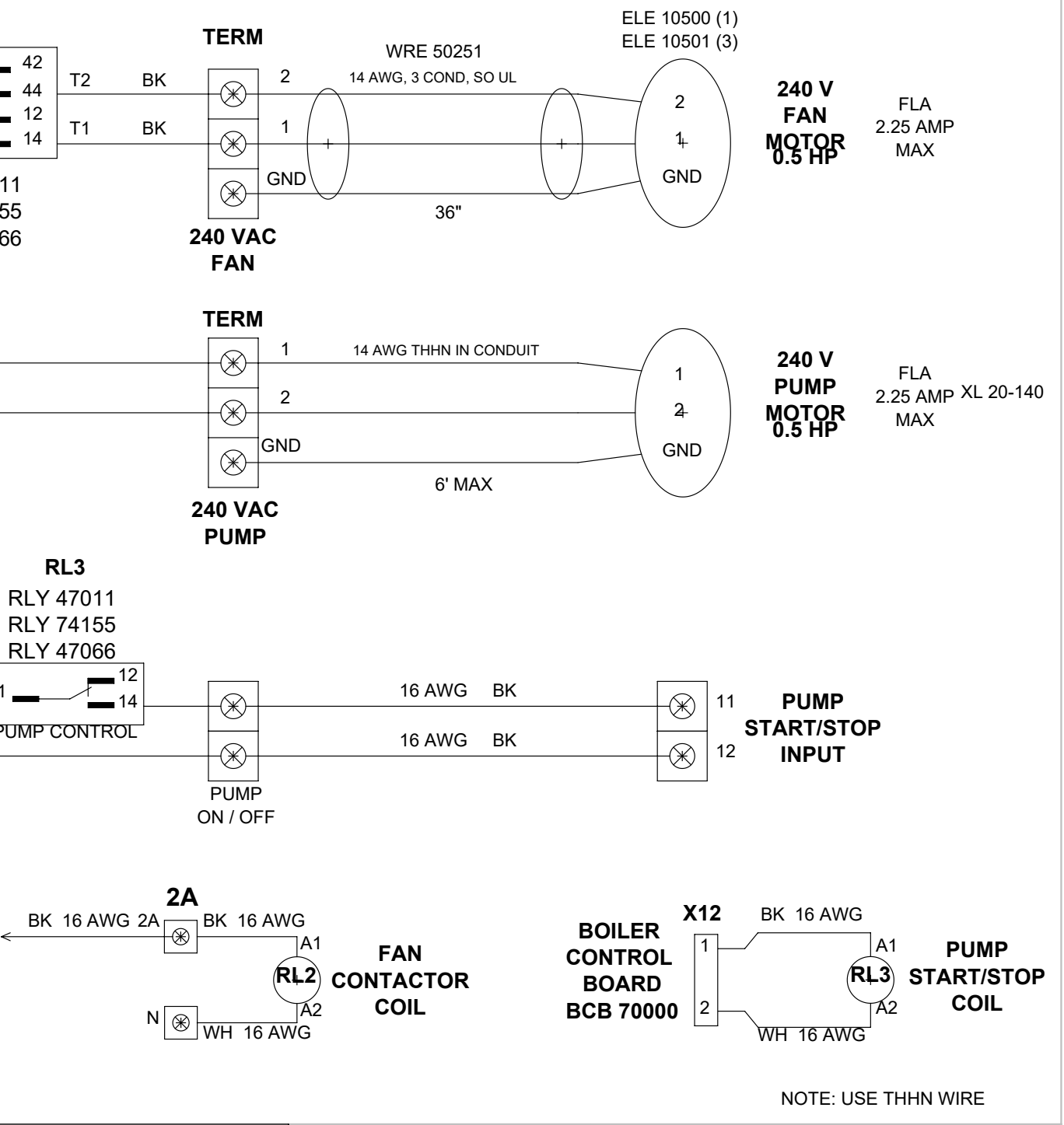


NOTE: USE THHN WIRE

REVISIONS			
Description	Revised By	Revision Date	Approved
awings. Changed ded notes.	XC	12/20/16	
wings and notes.	XC	2/7/17	
CB and Relay ol&Part # pump start/stop awing	XC	2/23/17	
	XC	3/13/17	

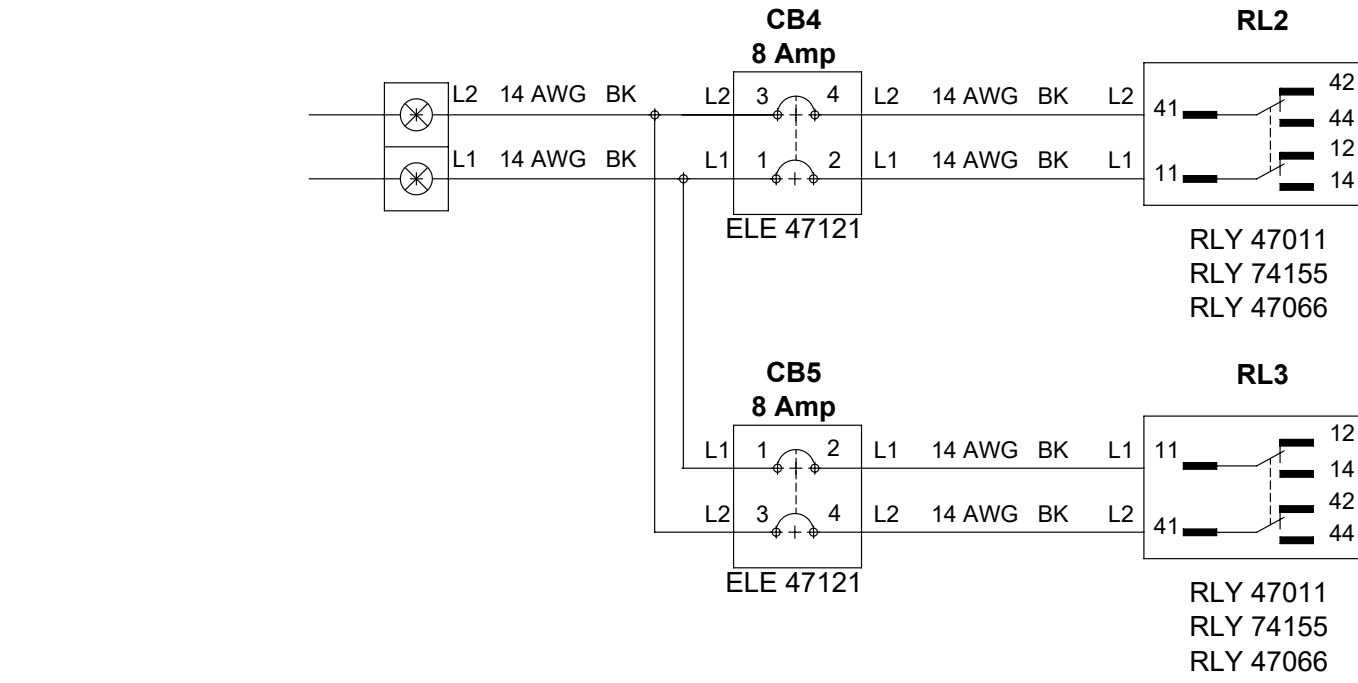
Customer:

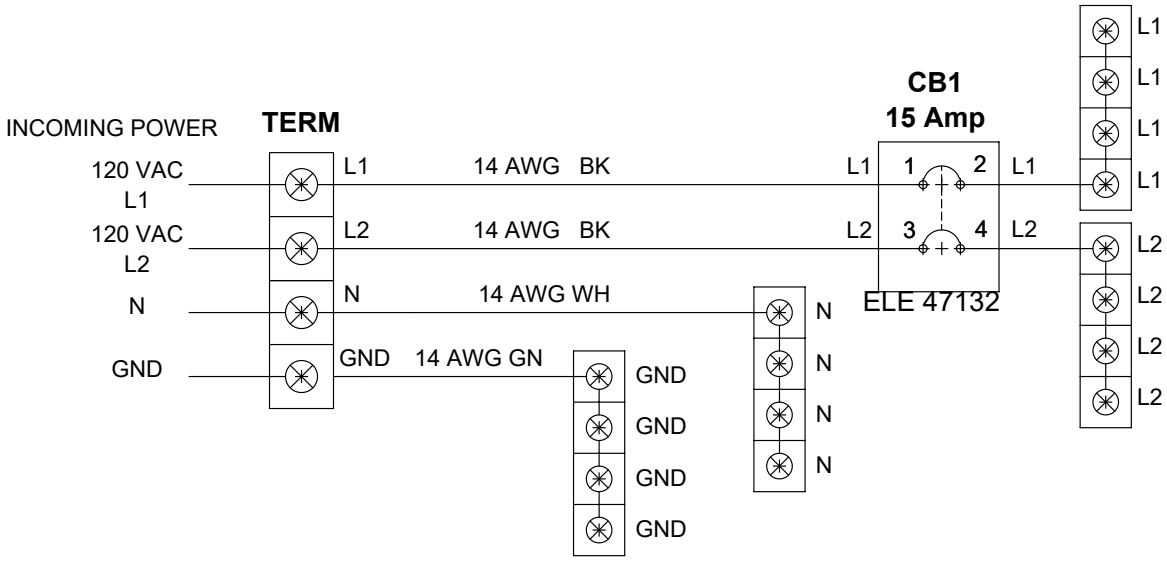
Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 1000 240 VAC W/ PUMP START/STOP INPUT
ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 7 OF 20	1:50		Reference Dimensions are ± 10%
		9/8/2016	XC				Dimensions are ± 1"





Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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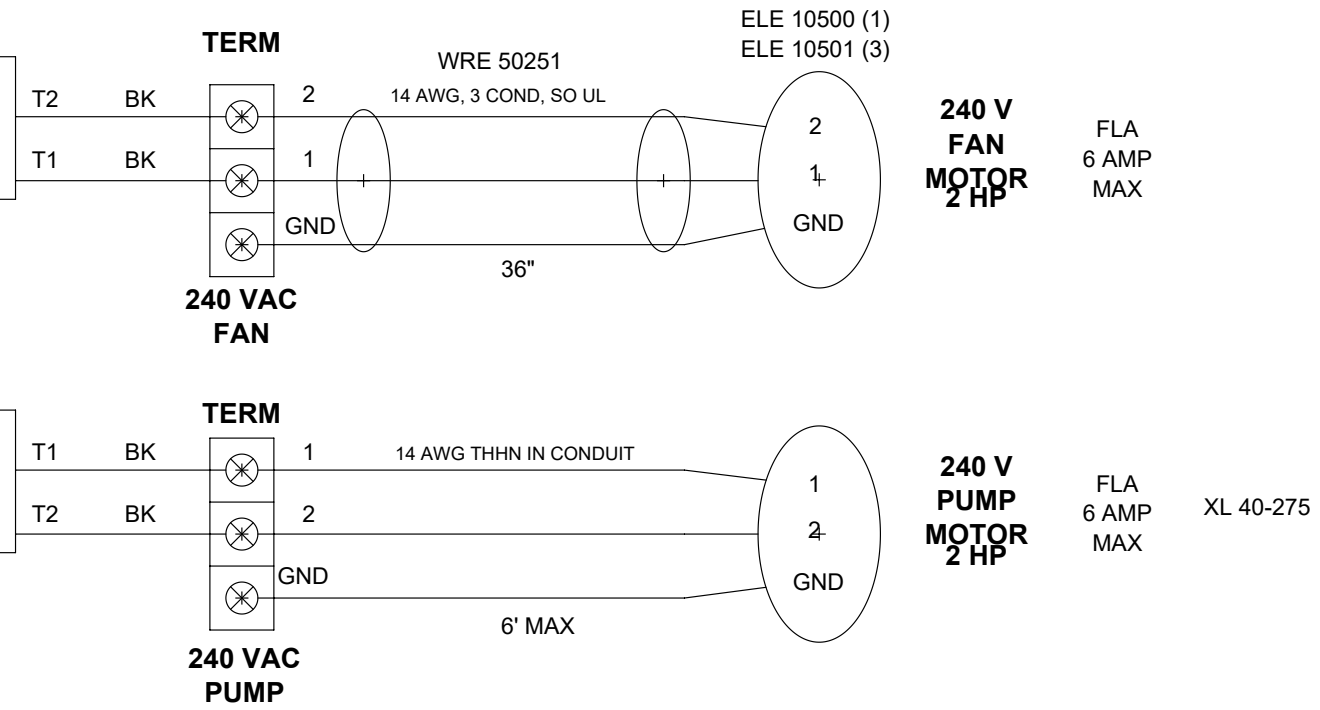
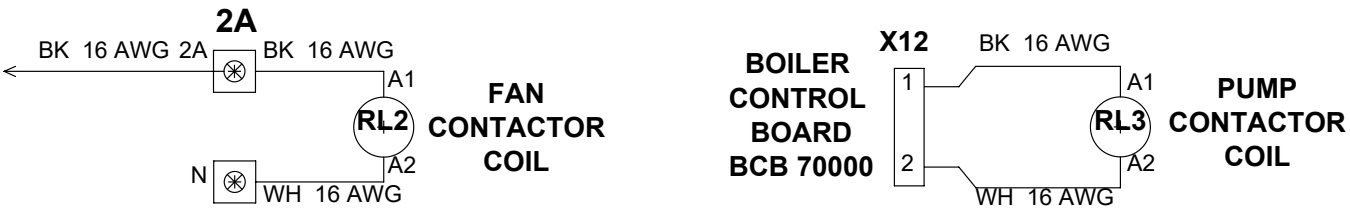
Revision	Revision
A	Add
B	Added Wi
C	Edite
D	Add 3000





NOTE: USE THHN WIRE

REVISIONS			
Description	Revised By	Revision Date	Approved
ed Note	XC	12/20/16	
re Size Table	XC	3/10/17	
ed Notes	XC	3/13/17	
Wire Diagram	JL	6/2/17	

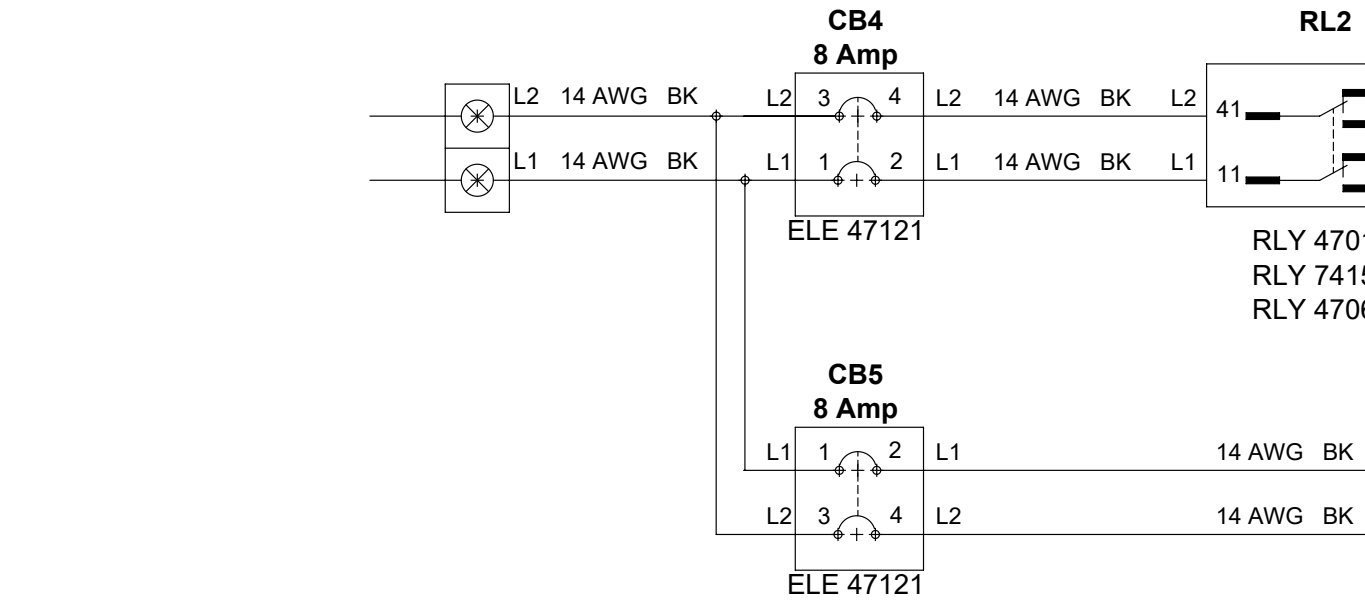
Customer:

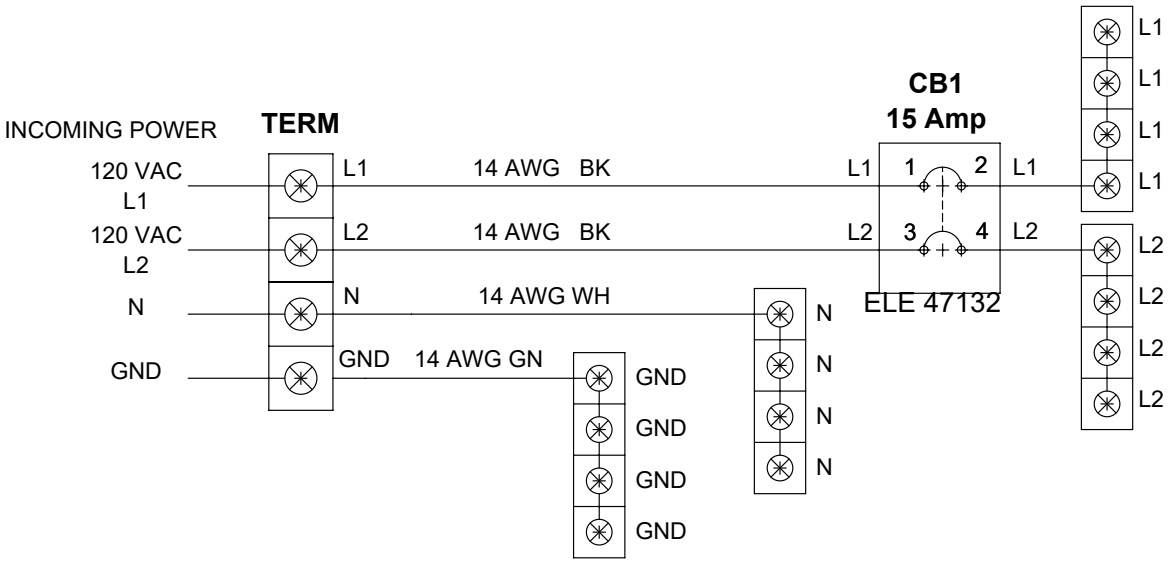
Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
3000 240 VAC
ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 8 OF 20	1:50		Reference Dimensions are ± 10%
		9/8/2016	XC				Dimensions are ± 1"





Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

Revision	Revision
A	Add
B	Added W
C	Edit
D	Add 3000

PROPRIETARY AND CONFIDENTIAL
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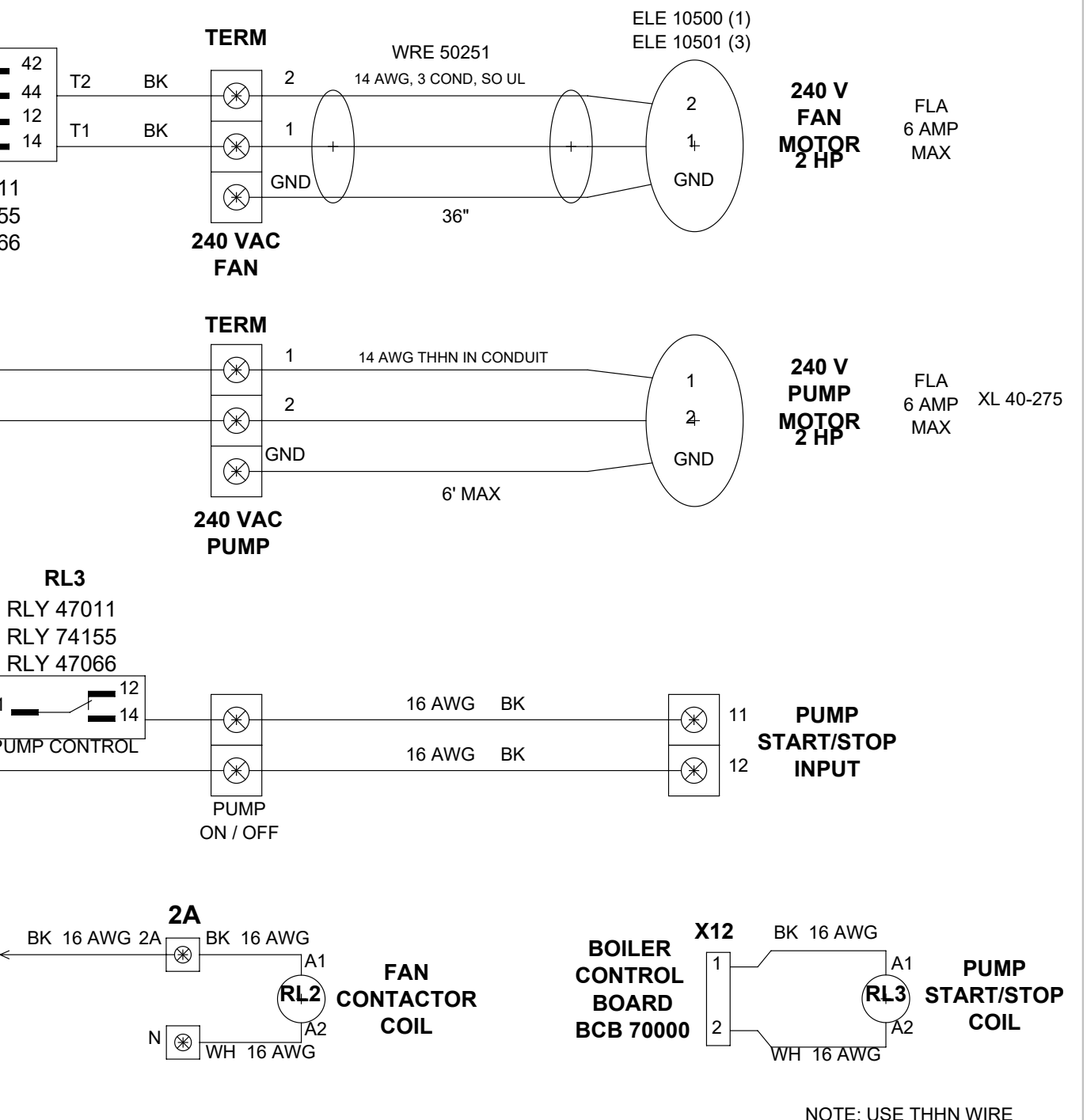


NOTE: USE THHN WIRE

REVISIONS			
Description	Revised By	Revision Date	Approved
ed Note	XC	12/20/16	
ire Size Table	XC	3/10/17	
ed Notes	XC	3/13/17	
Wire Diagram	JL	6/2/17	

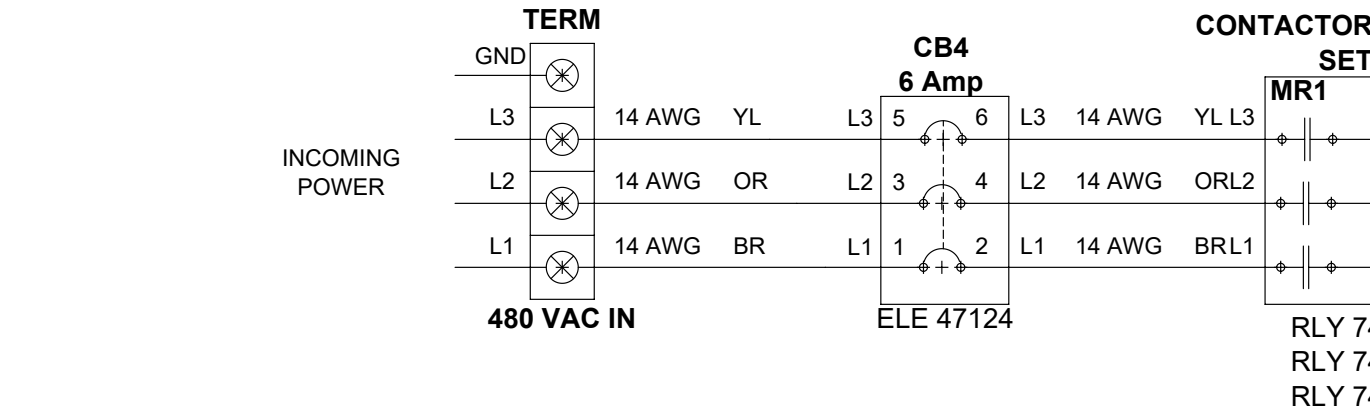
Customer:

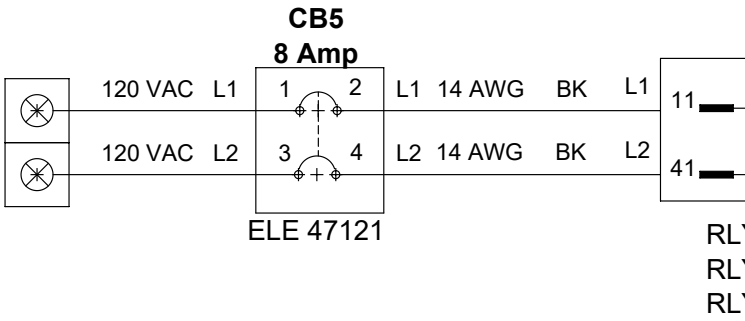
Job Name:

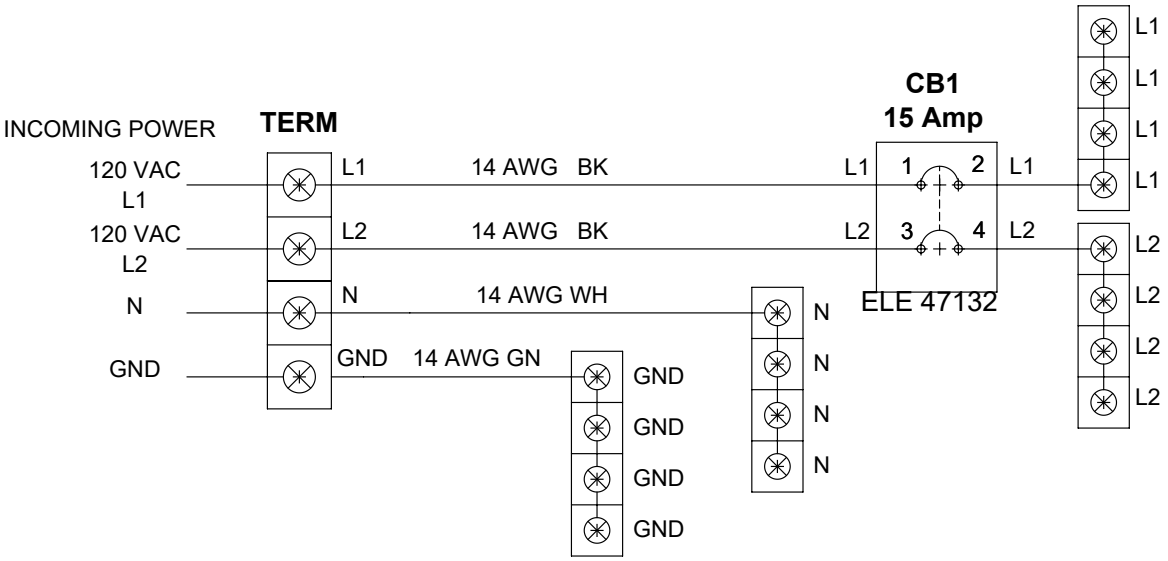
Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
3000 240 VAC W/ PUMP START/STOP INPUT
ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 9 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"







Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

PROPRIETARY AND CONFIDENTIAL
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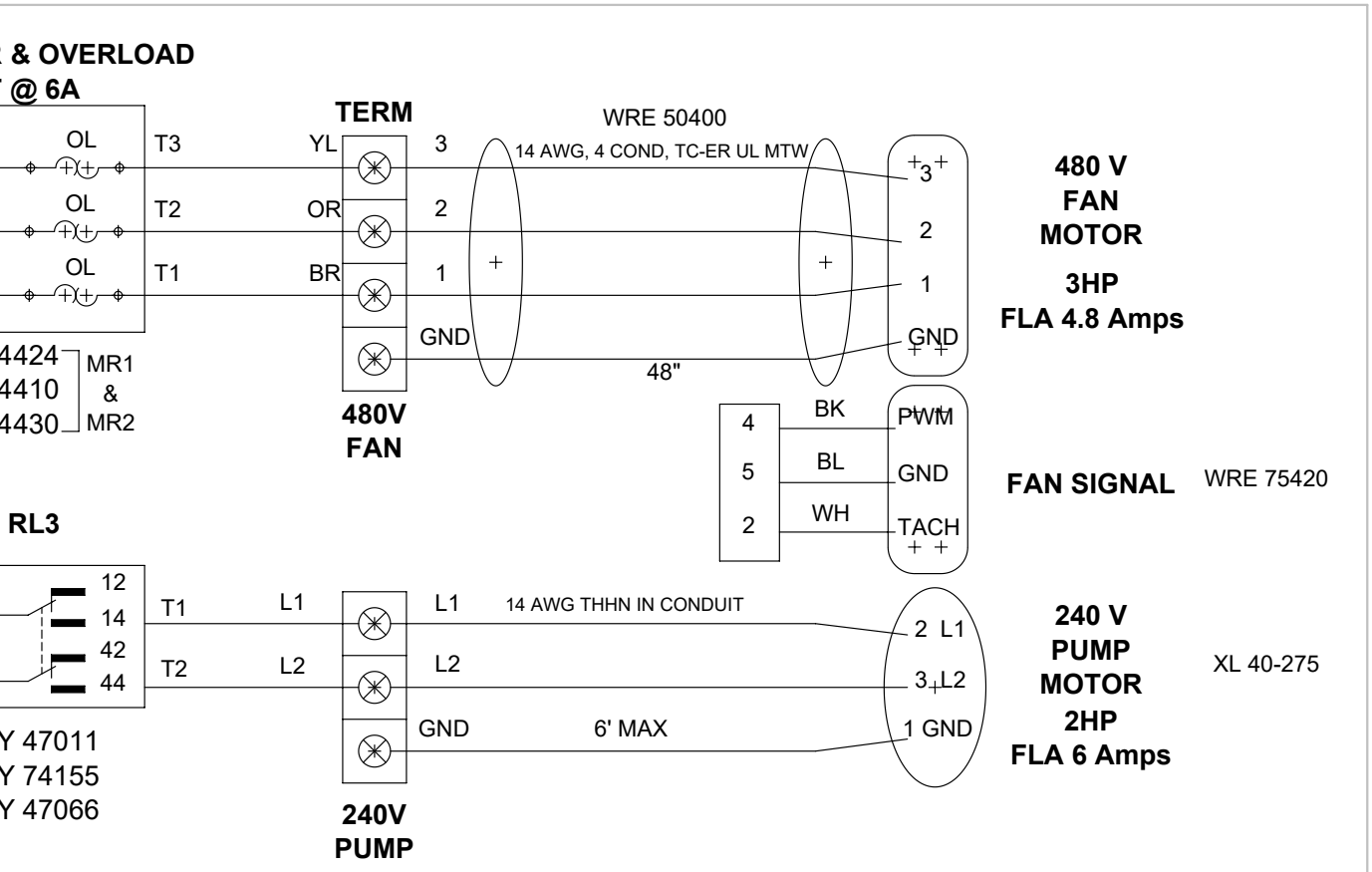
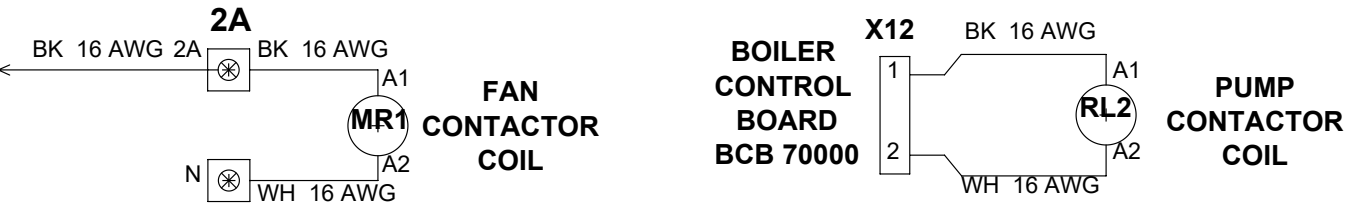
Revision	Revisio
A	Combined D and a
B	Changed dr
C	Changed sym
D	Changed nc
E	Chang





NOTE: USE THHN WIRE

REVISIONS			
on Description	Revised By	Revision Date	Approved
Drawings. Changed added notes.	XC	12/20/16	
awings and notes.	XC	2/7/17	
d CB and Relay bol&Part #	XC	2/23/17	
tes and added two pages	XC	3/9/17	
ed description	DH	11/1/17	

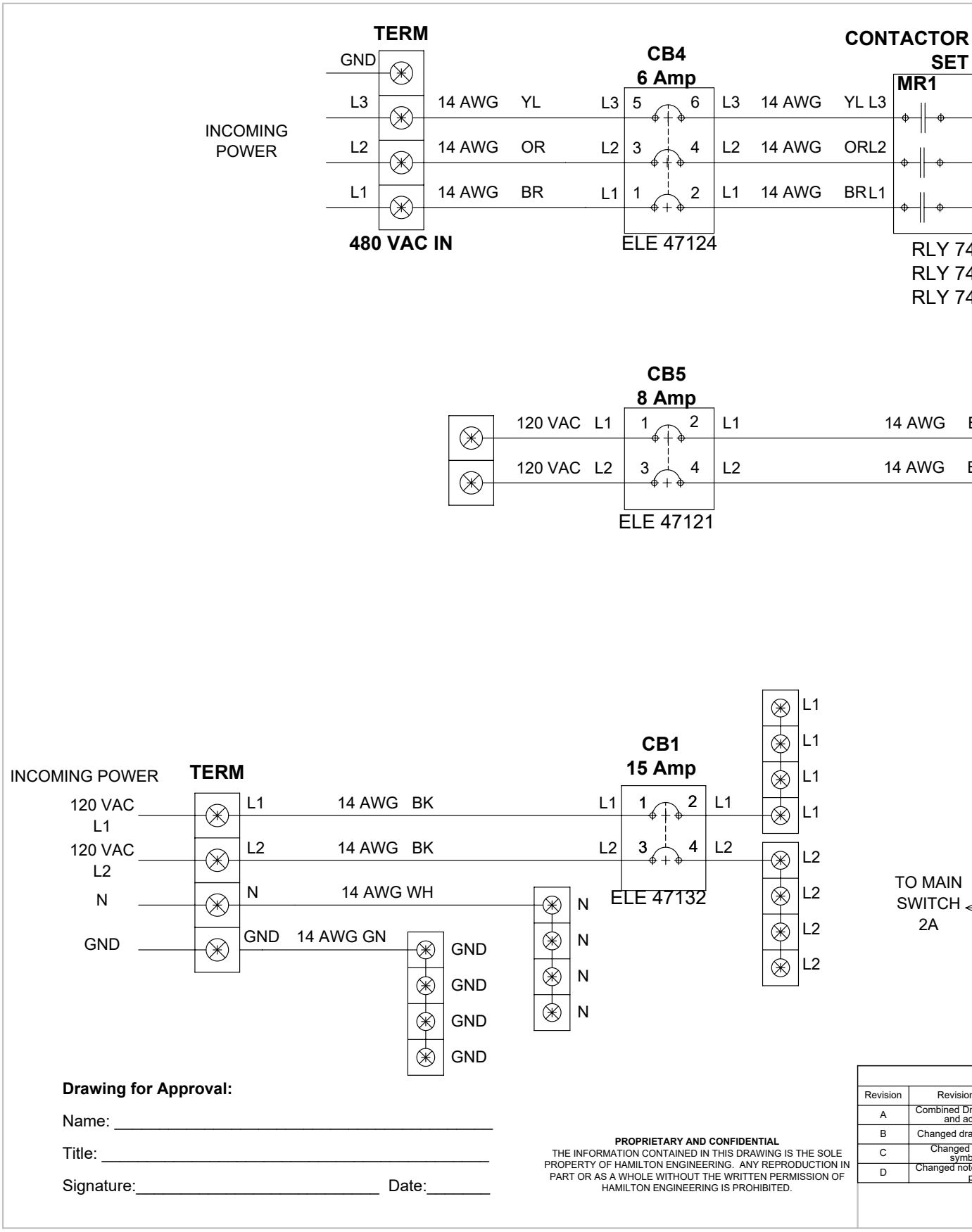
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
3500 - 4000 480 VAC FAN/240 VAC PUMP INPUT ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 10 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"


TERM
GND
L3
L2
L1
INCOMING POWER
480 VAC IN
14 AWG YL
14 AWG OR
14 AWG BR
CB4
6 Amp
ELE 47124
CONTACTOR SET
MR1
RLY 74
RLY 74
RLY 74
CB5
8 Amp
120 VAC L1
120 VAC L2
ELE 47121
INCOMING POWER
120 VAC L1
120 VAC L2
N
GND
TERM
14 AWG BK
14 AWG BK
14 AWG WH
14 AWG GN
CB1
15 Amp
ELE 47132
TO MAIN SWITCH 2A
Drawing for Approval:
Name:
Title:
Signature:
Date:
PROPRIETARY AND CONFIDENTIAL
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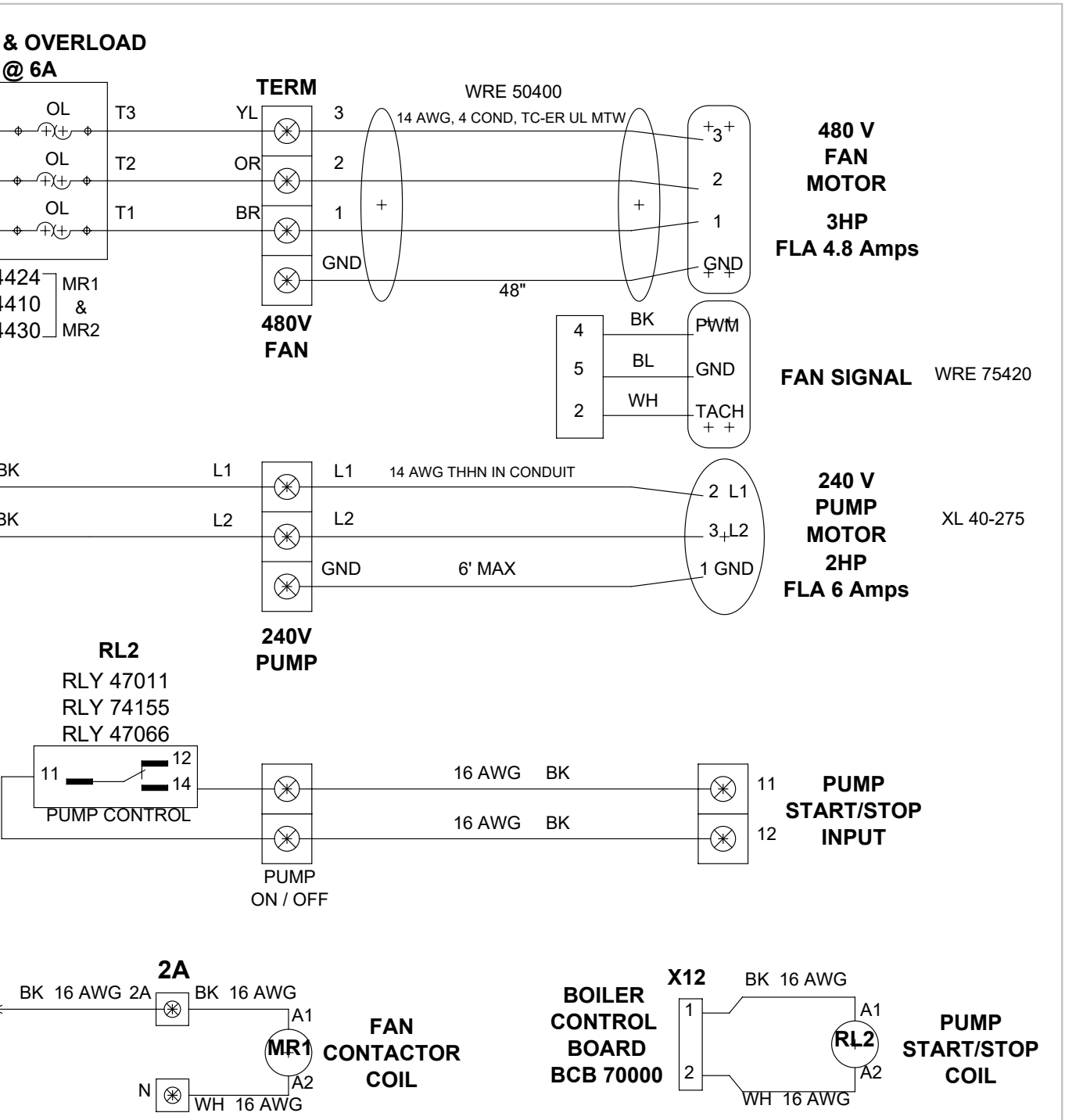
Revision
A
B
C
D
Combined Dr and ac
Changed dra
Changed symb
Changed not



NOTE: USE THHN WIRE

REVISIONS			
n Description	Revised By	Revision Date	Approved
awings. Changed lded notes.	XC	12/20/16	
wings and notes.	XC	2/7/17	
CB and Relay ol&Part #	XC	2/23/17	
es and added two ages	XC	3/9/17	

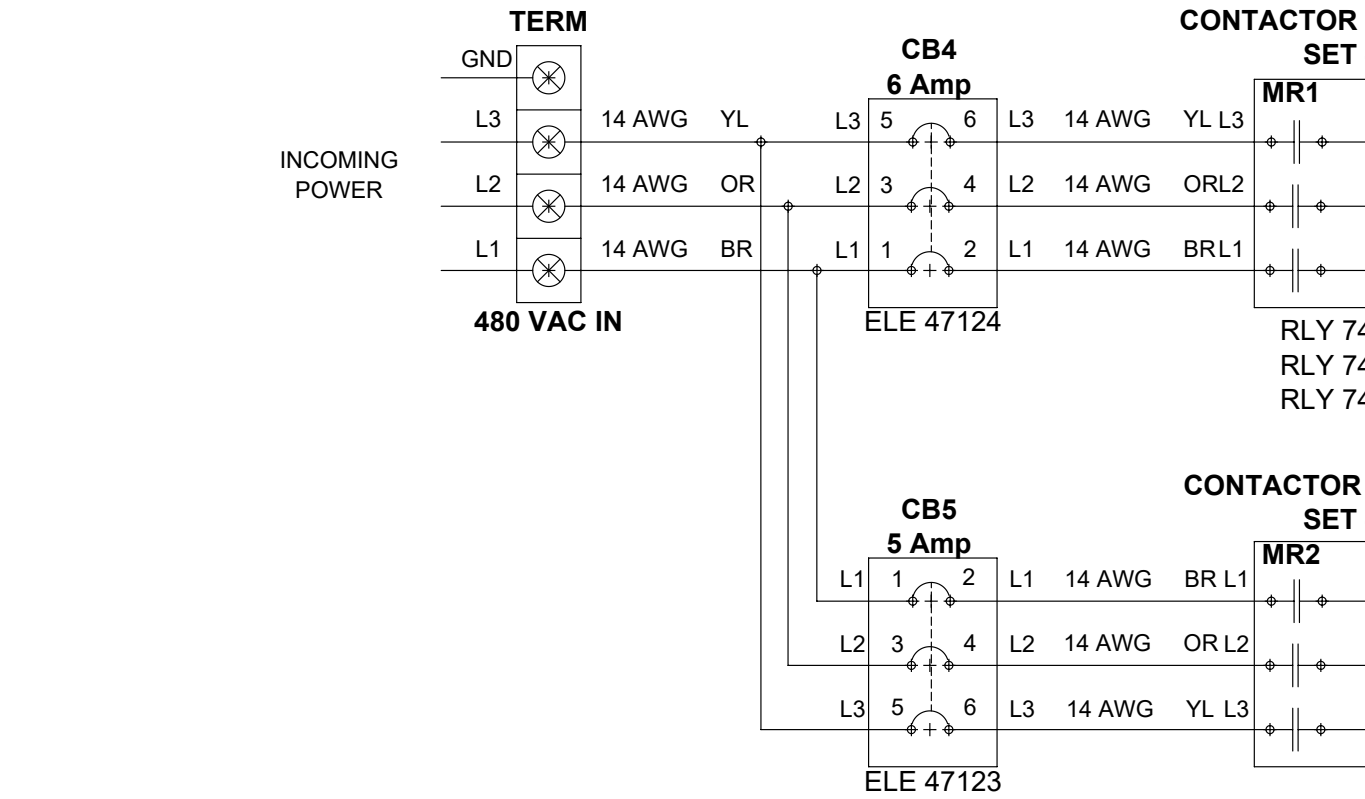
Customer:

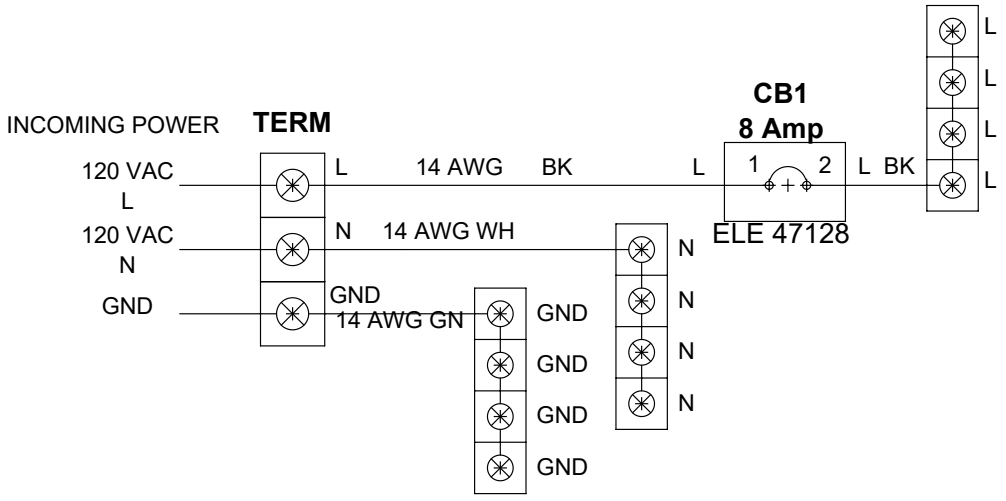
Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
3500 - 4000 480 VAC/240 VAC W/ PUMP START/STOP INPUT ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 11 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"





Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

PROPRIETARY AND CONFIDENTIAL
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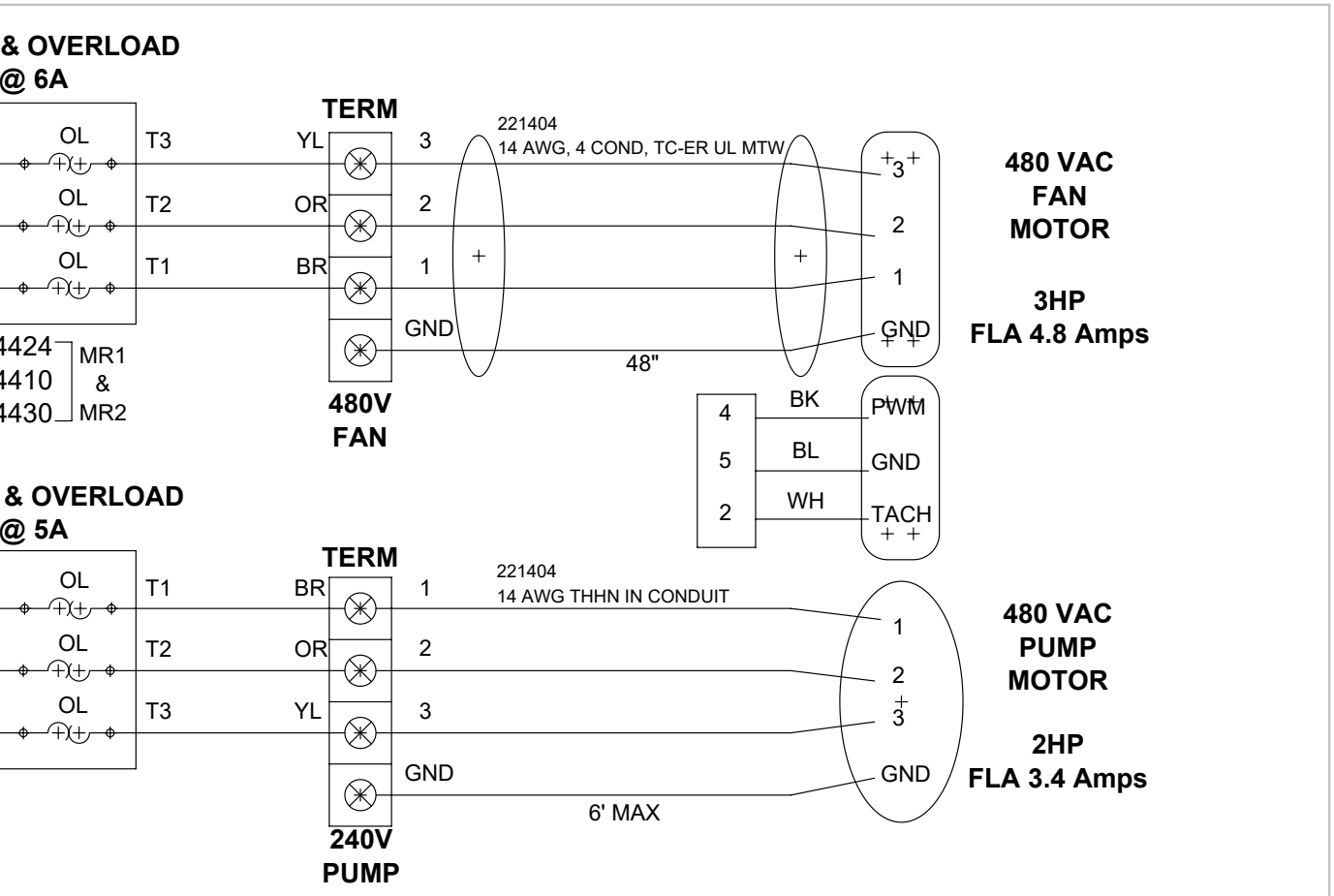
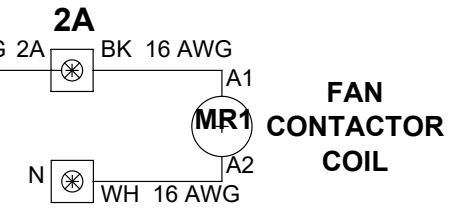
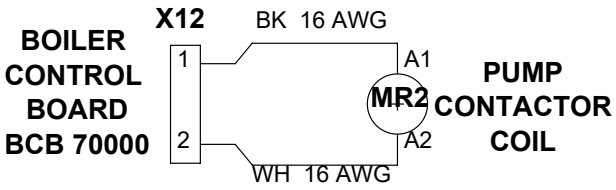
Revision	Revision
A	Combined Di and ad
B	Changed dra
C	Changed symb
D	Created w/ d
E	Changed not
F	Added Opti







NOTE: USE THHN WIRE

REVISIONS			
n Description	Revised By	Revision Date	Approved
rawings. Changed dded notes.	XC	12/20/16	
wings and notes.	XC	2/7/17	
CB and Relay ol&Part #	XC	2/23/17	
pump start/stop rawing	XC	3/13/17	
es and description	DH	11/1/17	
onal Flow Switch	DH	6/29/2018	

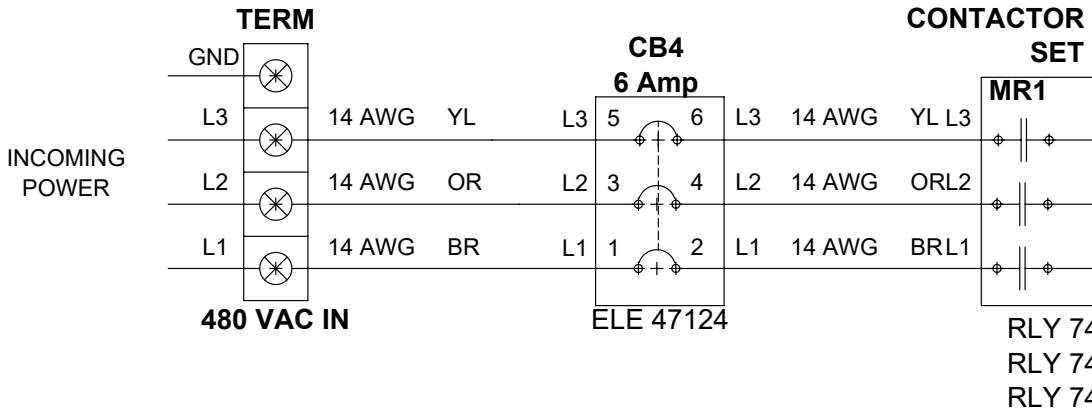
Customer:

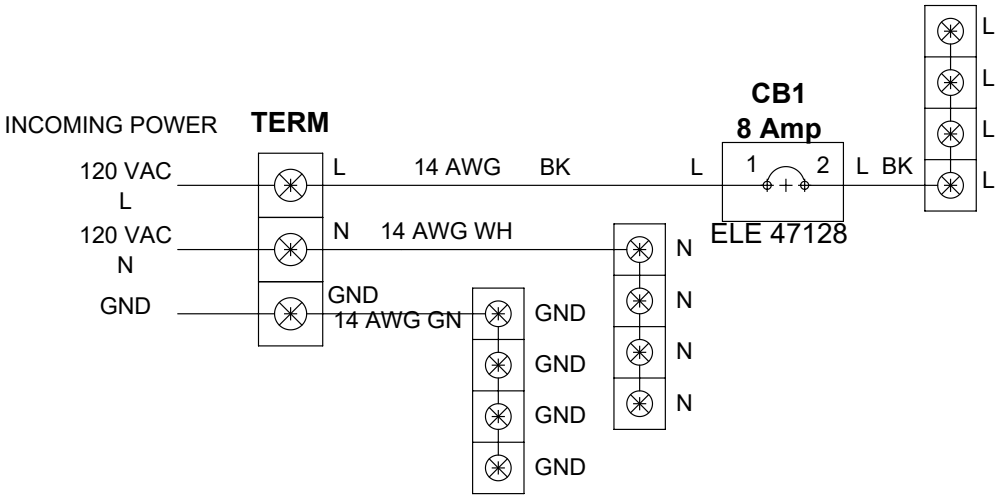
Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
3500 - 4000 480 VAC FAN/480 VAC PUMP ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 12 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"





Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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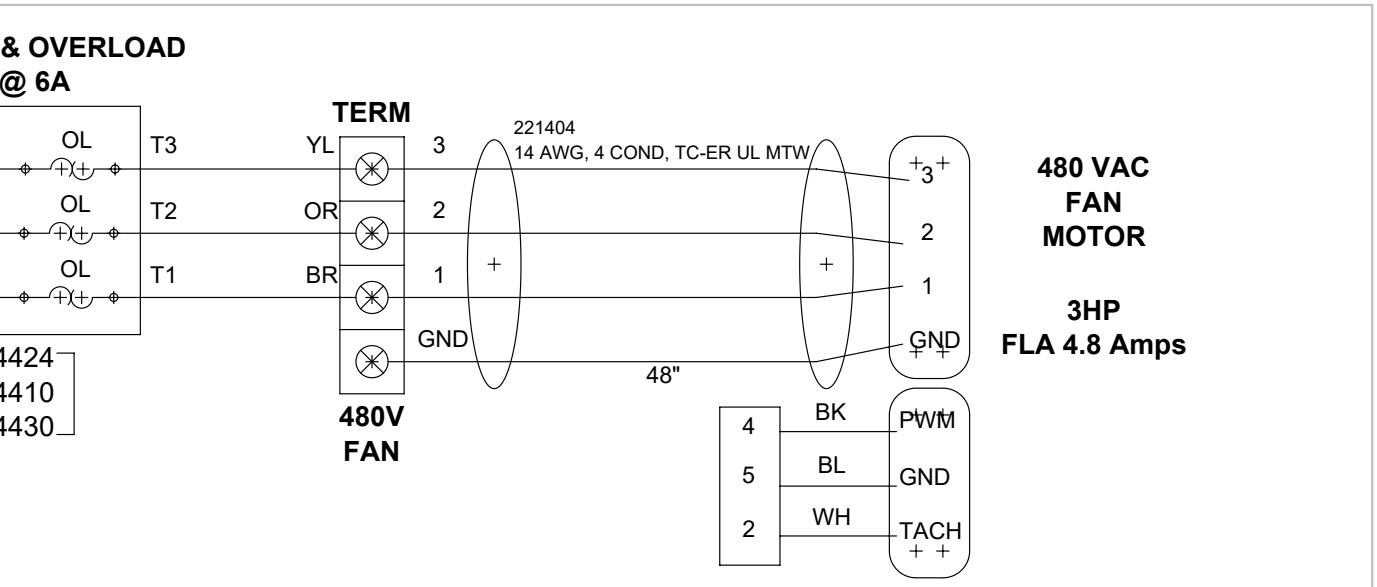
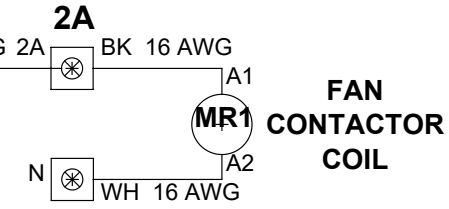
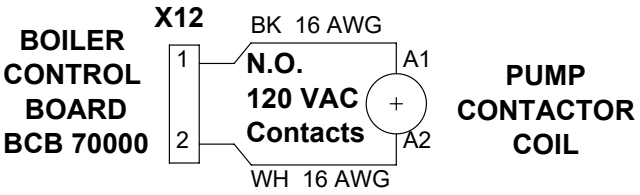
Revision	Revision
A	Combined Di and ad
B	Changed dra
C	Changed symb
D	Created w/ d
E	Changed not
F	Created 480 w/ N







NOTE: USE THHN WIRE

REVISIONS			
n Description	Revised By	Revision Date	Approved
rawings. Changed dded notes.	XC	12/20/16	
wings and notes.	XC	2/7/17	
CB and Relay ol&Part #	XC	2/23/17	
pump start/stop rawing	XC	3/13/17	
es and description	DH	11/1/17	
VAC Fan Drawing No Pump	DH	3/2/18	

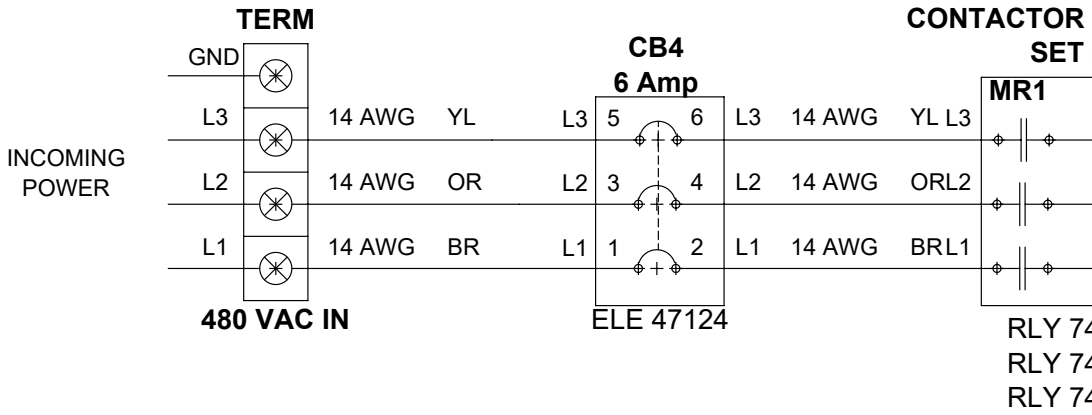
Customer:

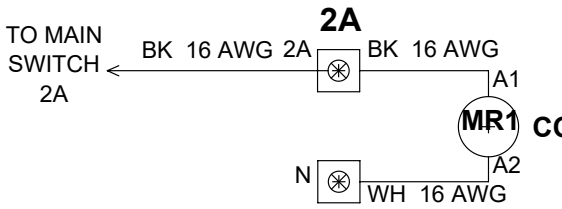
Job Name:

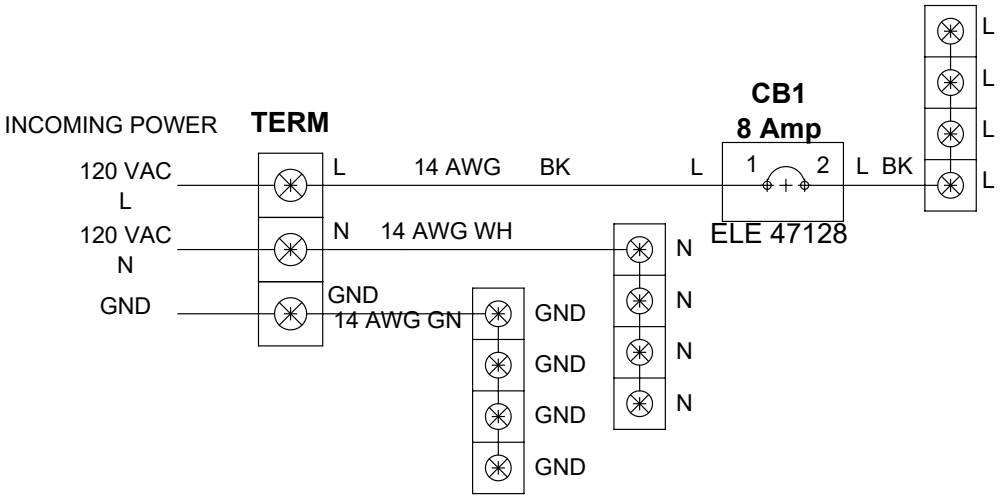
Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
3500 - 4000 480 VAC FAN/NO PUMP
ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 13 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"







BOILER CONTROL BOARD BCB 70000

Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

Revision	Revision
C	Changed symb
D	Created w/ d
E	Changed not
F	Created 480 w/ N
G	Added Pump Only

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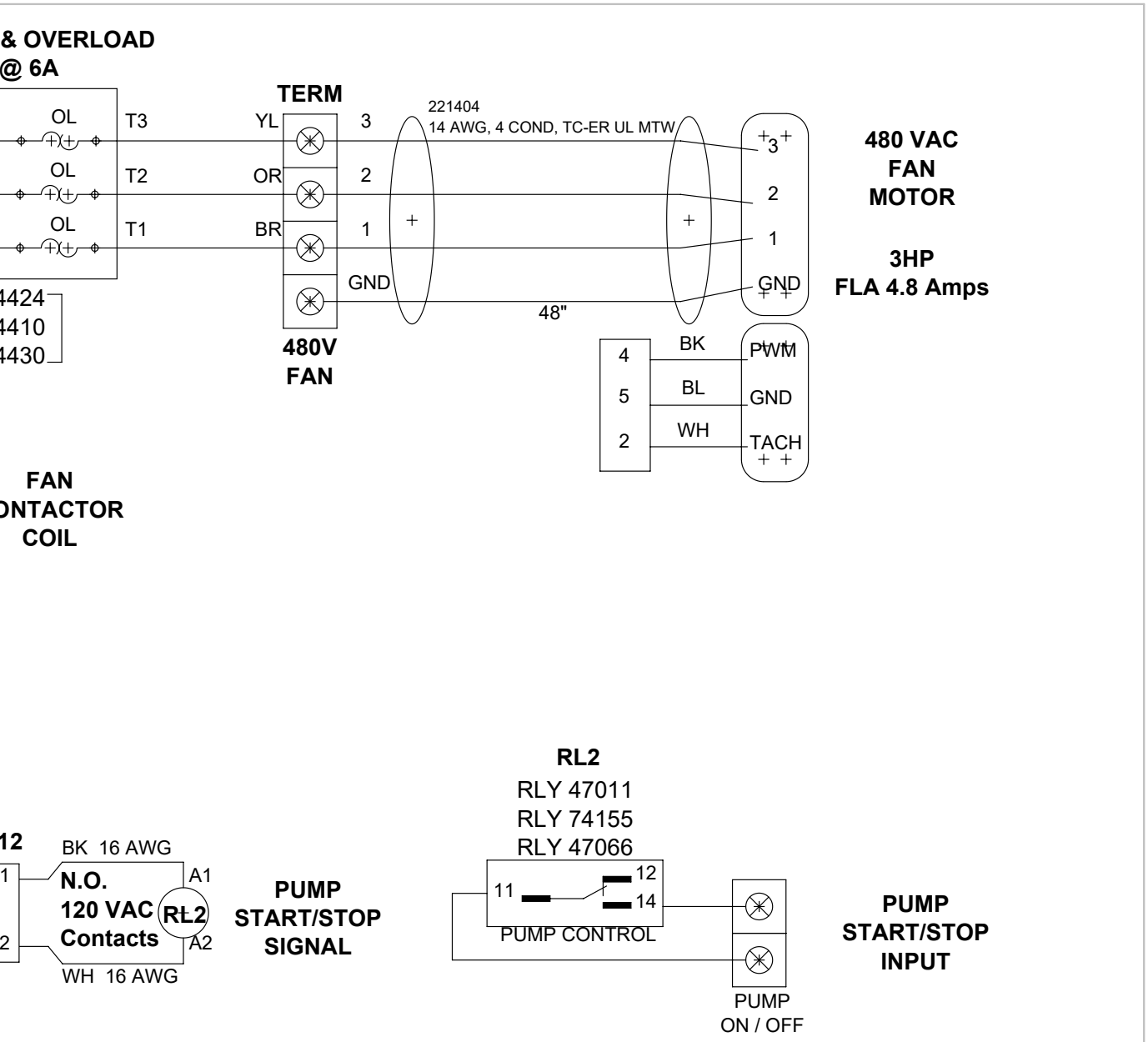


PUMP
START/STOP
SIGNAL

PUMP
START/STOP
INPUT

NOTE: USE THHN WIRE

REVISIONS			
n Description	Revised By	Revision Date	Approved
CB and Relay ool&Part #	XC	2/23/17	
pump start/stop rawing	XC	3/13/17	
es and description	DH	11/1/17	
VAC Fan Drawing No Pump	DH	3/2/18	
o Start/Stop Input Sheet 14	DH	5/4/2018	

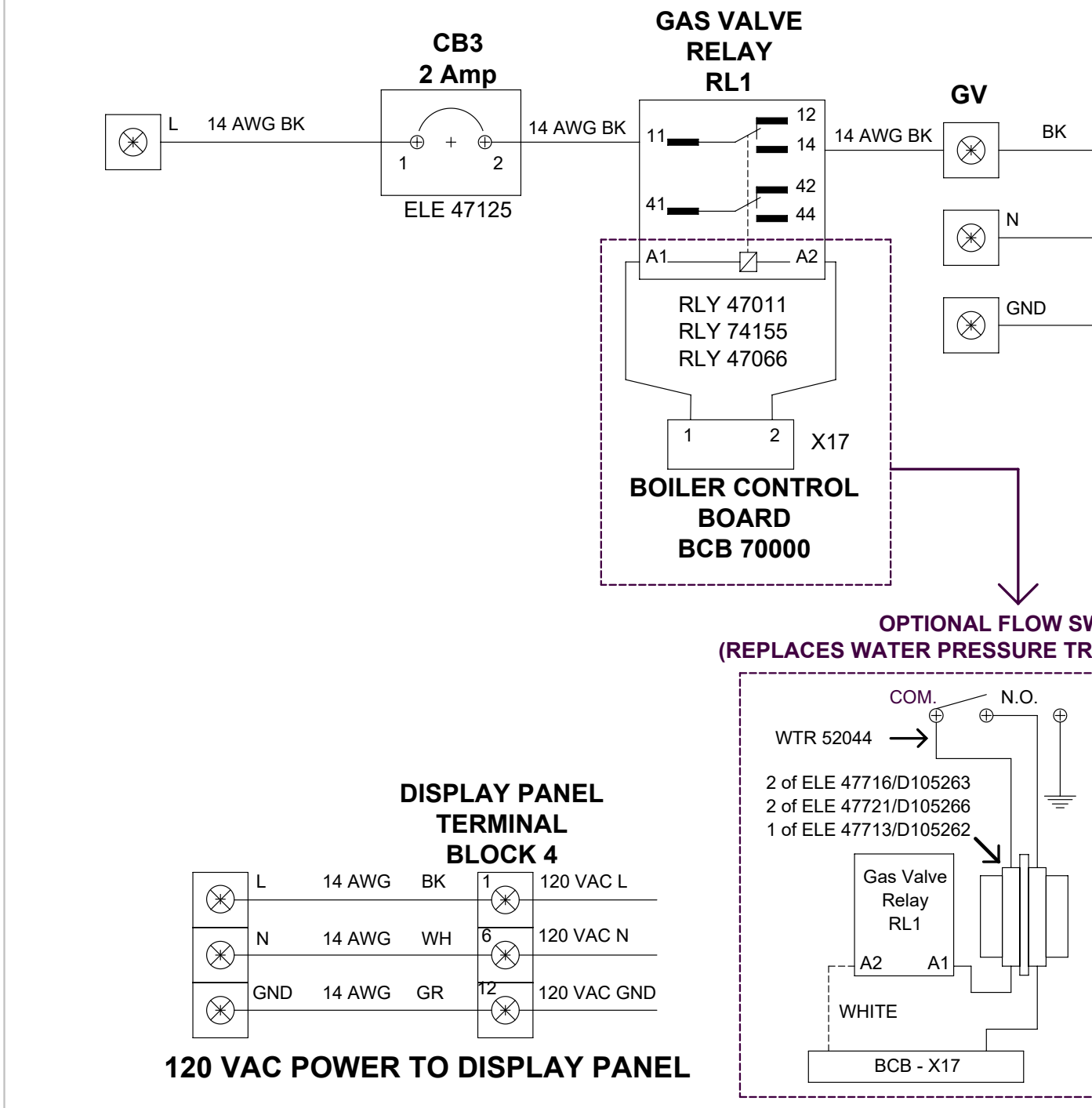
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
3500 - 4000 480 VAC FAN/PUMP
START/STOP INPUT ONLY

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 14 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

PROPRIETARY AND CONFIDENTIAL
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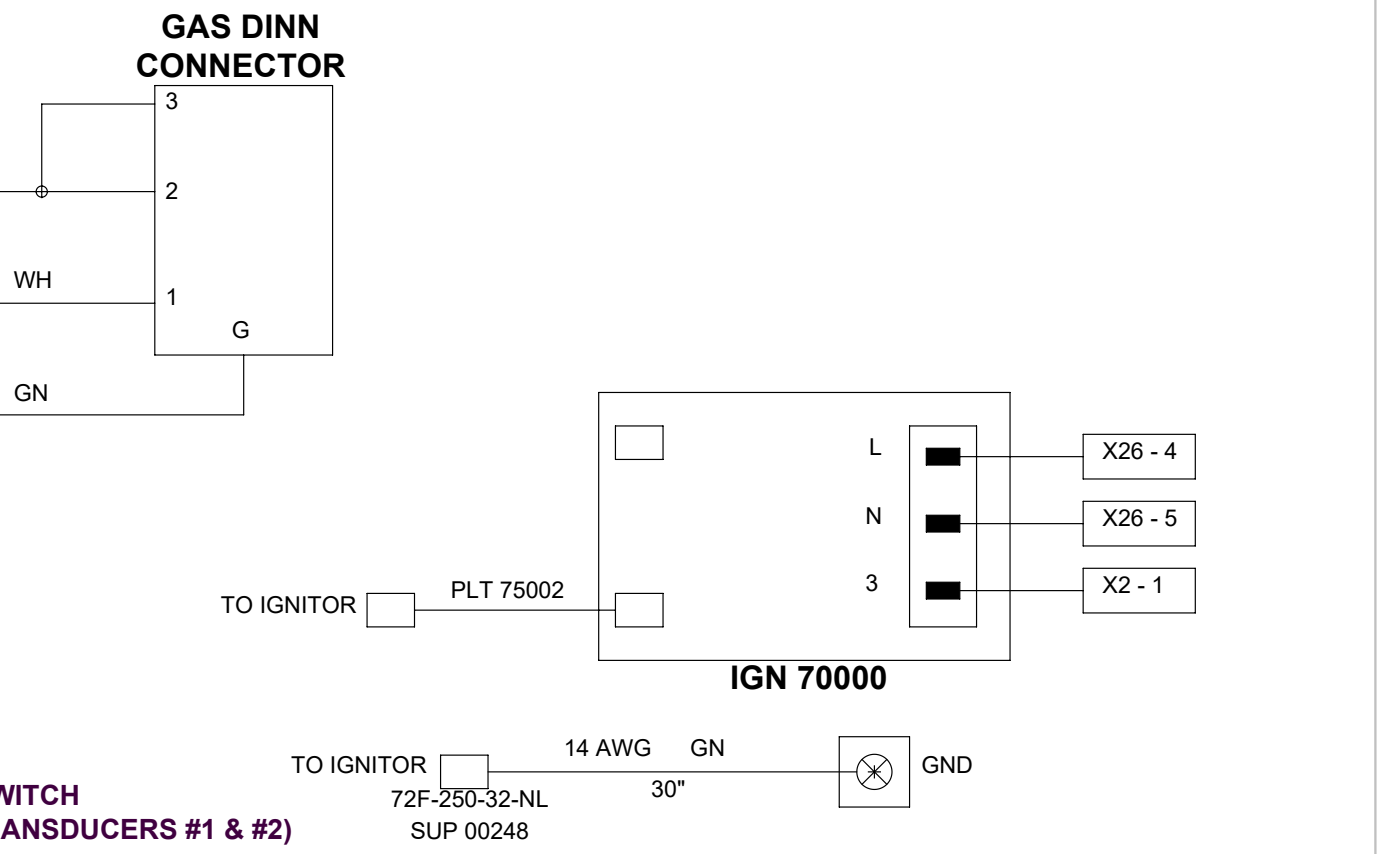
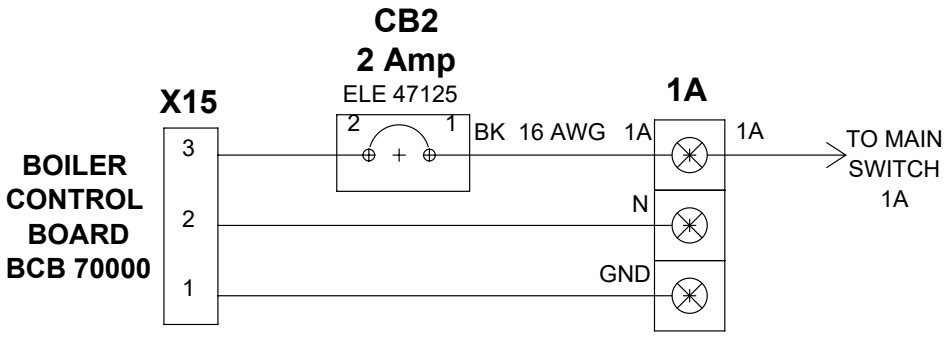
Revision	Revisio
A	Combined D and a
B	Changed dra
C	Changed symb
D	Created w/ d
E	Changed not
F	Added Opti



WITCH
ANSDUCERS #1 & #2)



NOTE: USE THHN WIRE

REVISIONS			
n Description	Revised By	Revision Date	Approved
rawings. Changed dded notes.	XC	12/20/16	
awings and notes.	XC	2/7/17	
CB and Relay ool&Part #	XC	2/23/17	
pump start/stop rawing	XC	3/13/17	
es and description	DH	11/1/17	
onal Flow Switch	DH	6/29/2018	

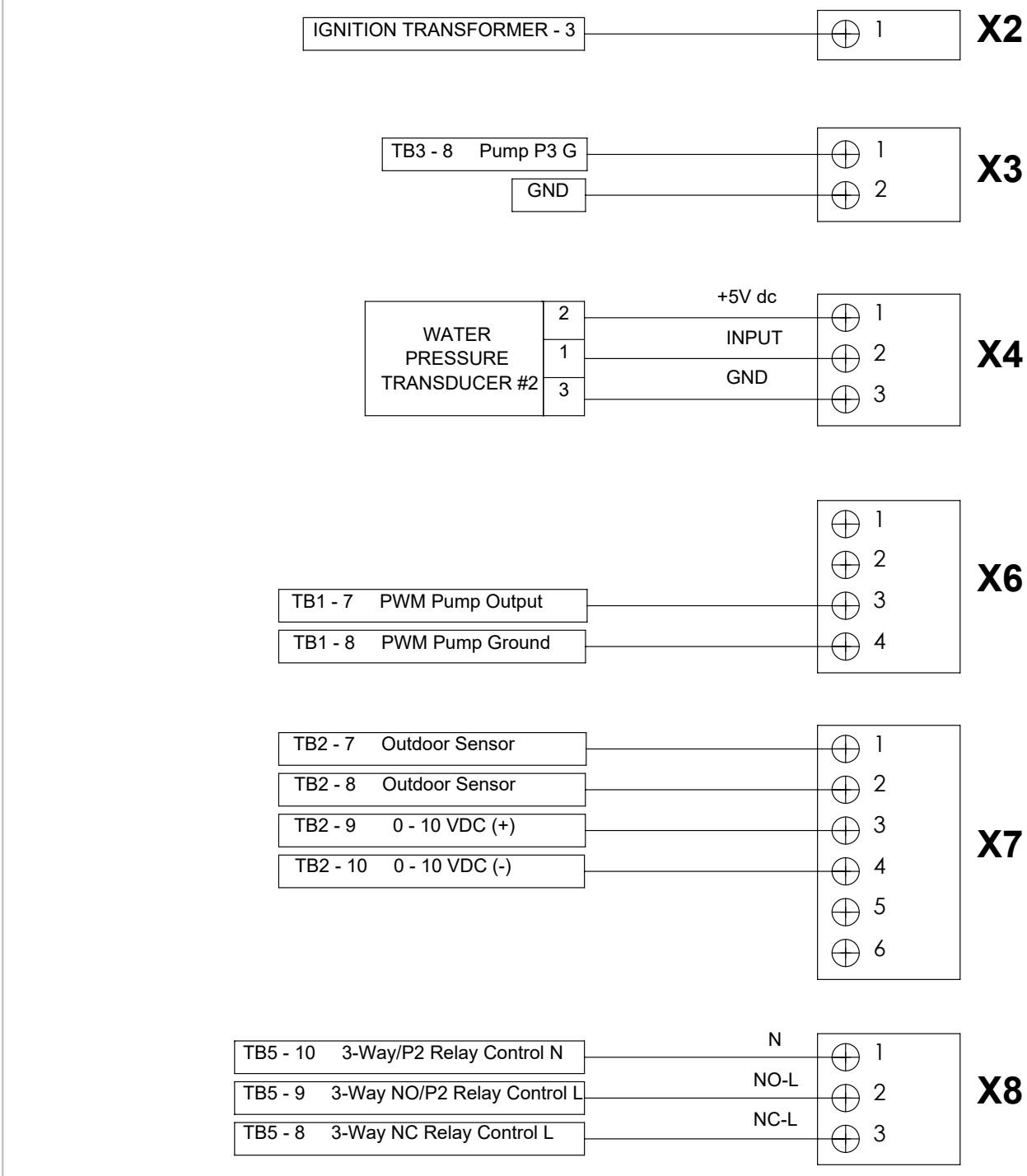
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 4000 ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 15 OF 20	1:30	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

PROPRIETARY AND CONFIDENTIAL
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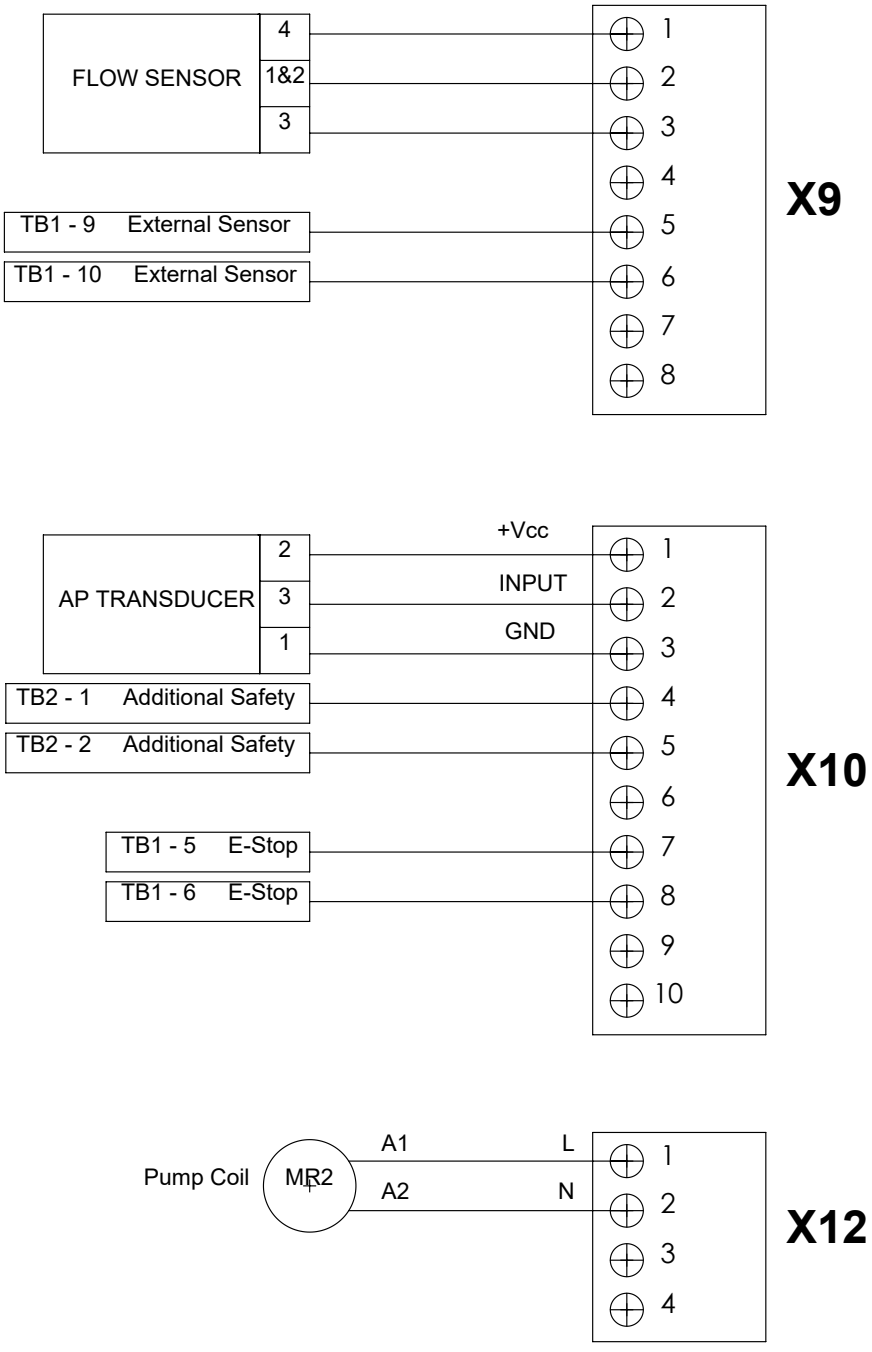
Revision	Revi
A	Combined an
B	Changed
C	Chang sy
D	Created
E	Changed
F	Added C



BCB 70000 BOARD CONNECTION

REVISIONS			
sion Description	Revised By	Revision Date	Approved
d Drawings. Changed d added notes.	XC	12/20/16	
drawings and notes.	XC	2/7/17	
ged CB and Relay ymbol&Part #	XC	2/23/17	
w/ pump start/stop drawing	XC	3/13/17	
notes and description	DH	11/1/17	
Optional Flow Switch	DH	6/29/2018	

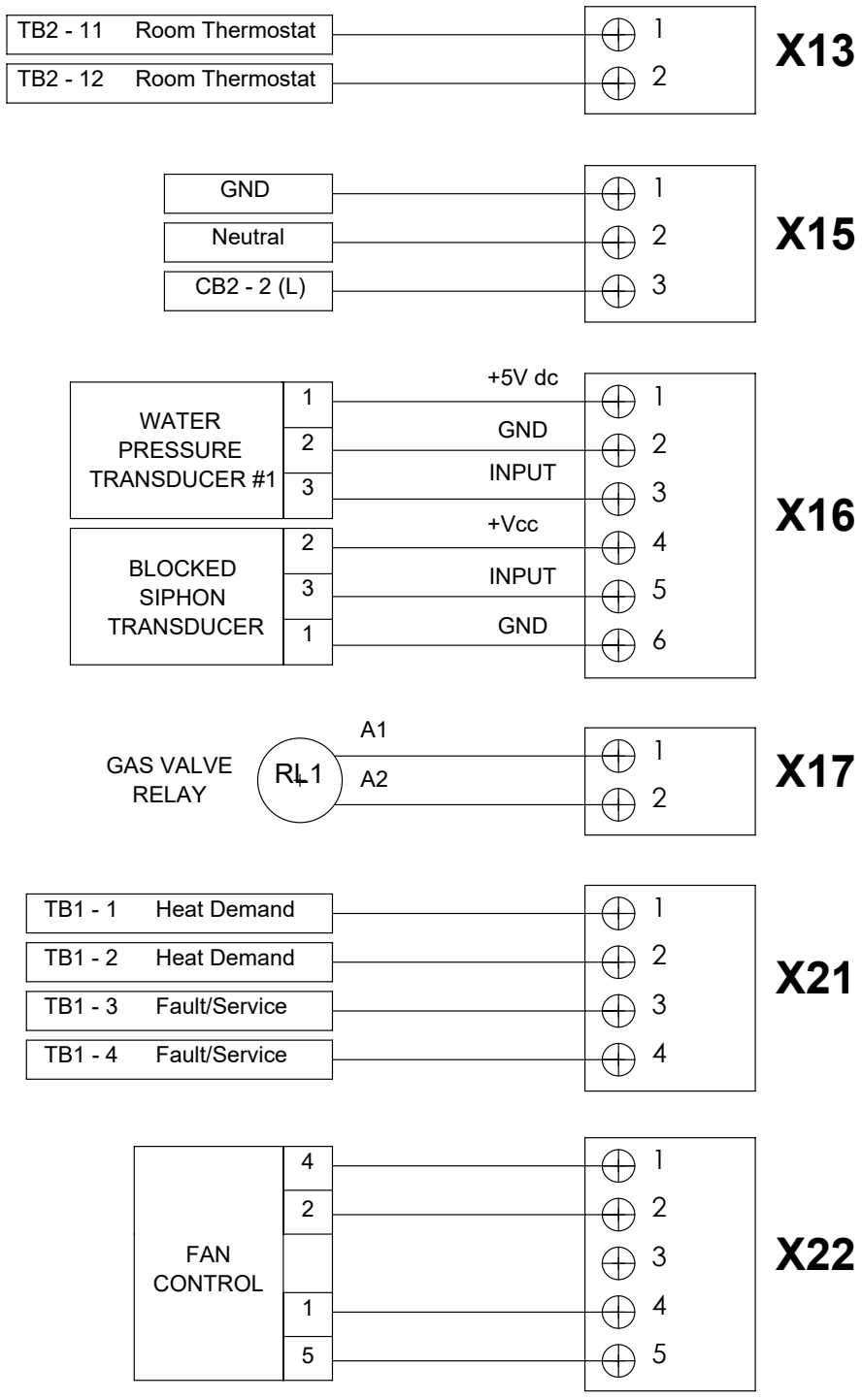
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 4000 ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 16 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

PROPRIETARY AND CONFIDENTIAL
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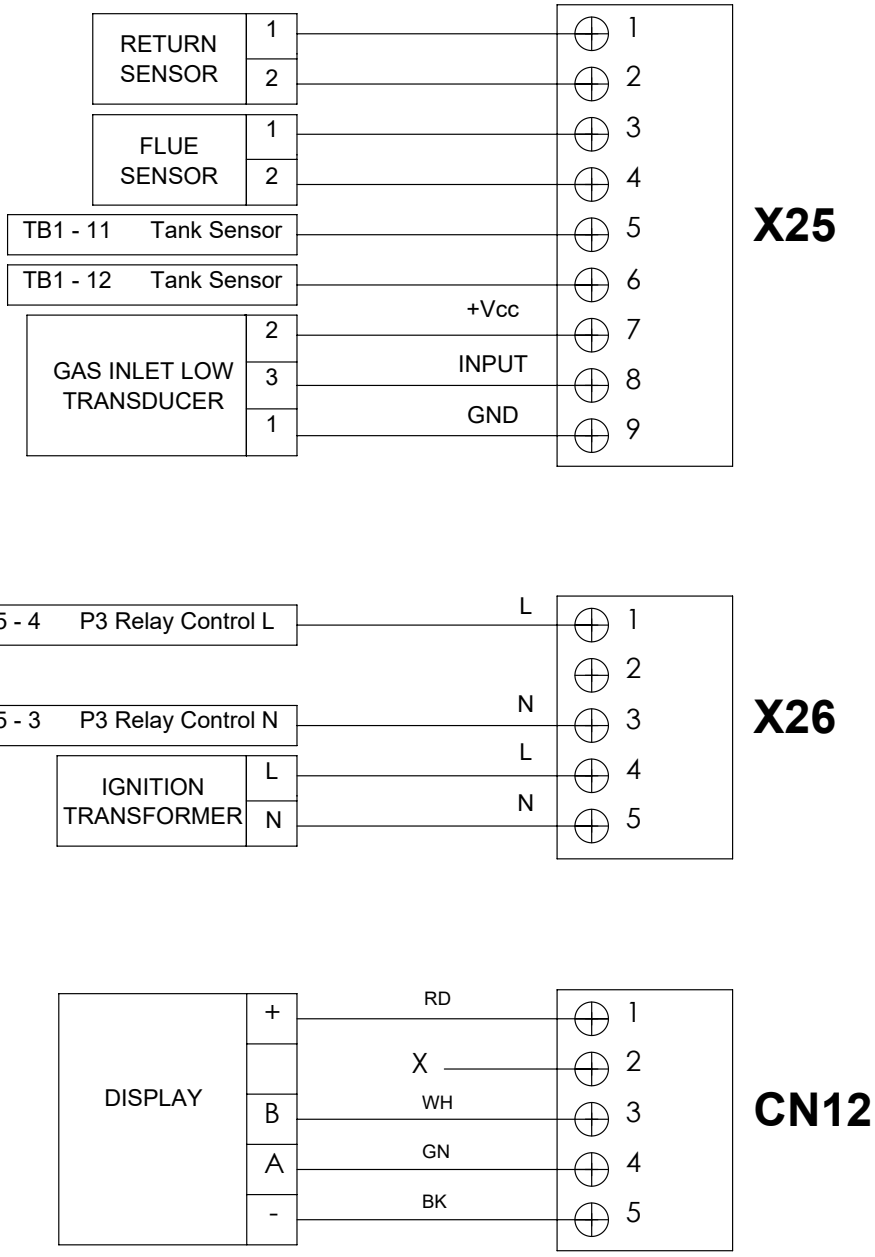
Revision	Revisio
A	Combined D and a
B	Changed dra
C	Changed symb
D	Created w/ d
E	Changed not
F	Added Opti



BCB 70000 BOARD CONNECTION

REVISIONS			
n Description	Revised By	Revision Date	Approved
rawings. Changed dded notes.	XC	12/20/16	
awings and notes.	XC	2/7/17	
CB and Relay ool&Part #	XC	2/23/17	
pump start/stop rawing	XC	3/13/17	
es and description	DH	11/1/17	
onal Flow Switch	DH	6/29/2018	

Customer:

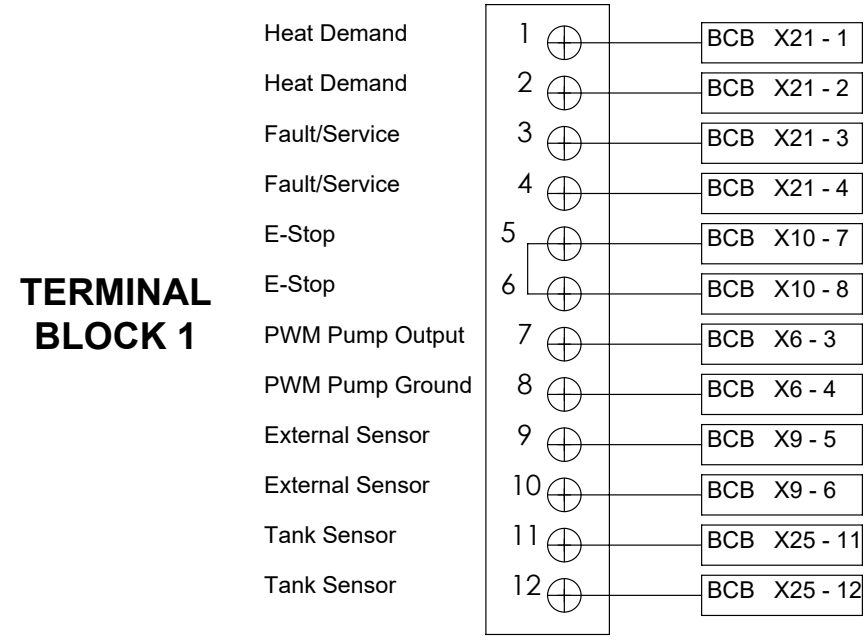
Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

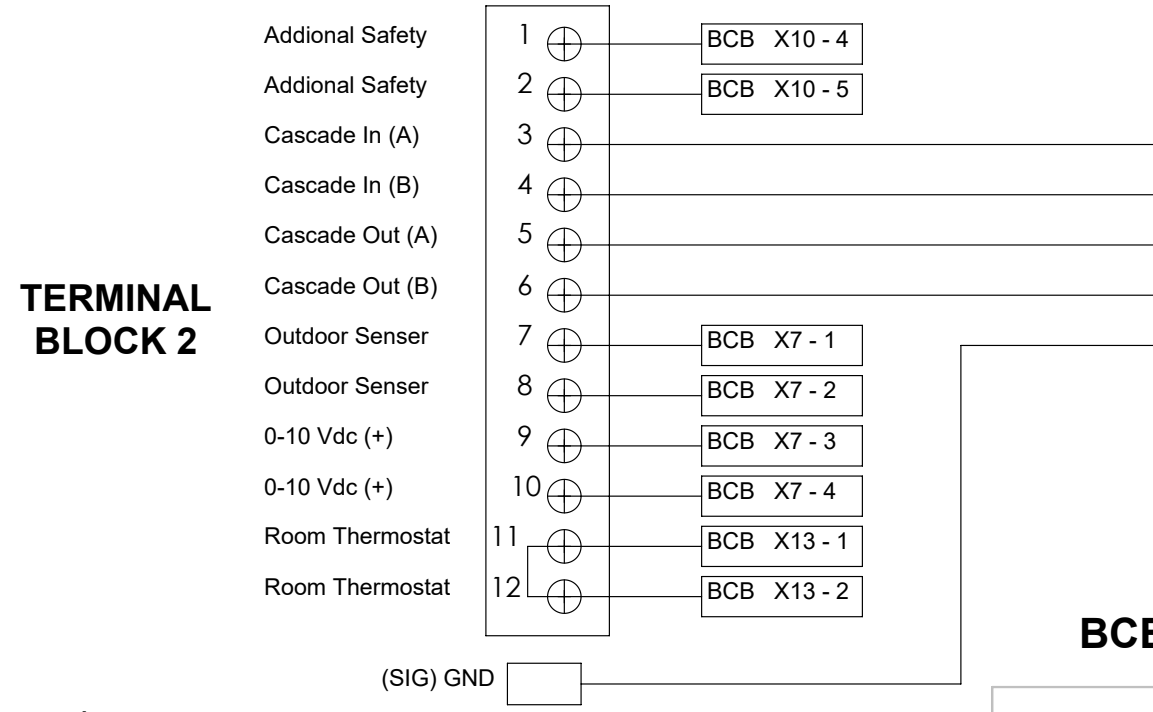
Drawing Description:
750 - 4000 ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 17 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"

TERMINAL BLOCK 1



TERMINAL BLOCK 2



(SIG) GND

SUP 00248
72F-250-32-NL

Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

PROPRIETARY AND CONFIDENTIAL
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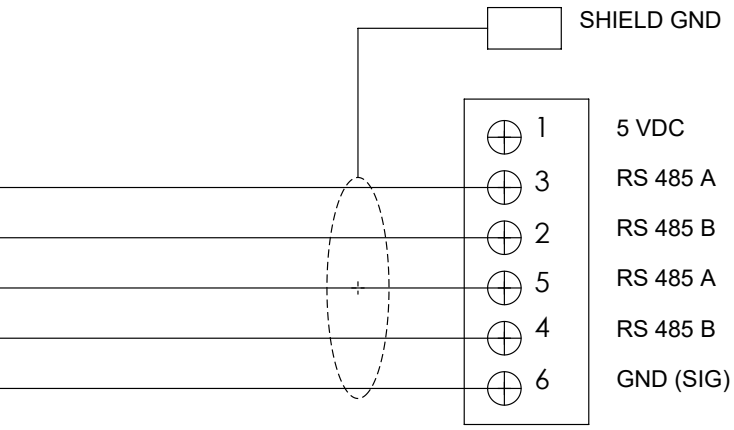
BCE

Revision	Revisio
A	Combined D and a
B	Changed dra
C	Changed symb
D	Created w/ d
E	Changed not
F	Added Opti



J15A
(On BCB 70000 Board)

B 70000 AND TERMINAL BLOCK CONNECTION 1

REVISIONS			
n Description	Revised By	Revision Date	Approved
rawings. Changed dded notes.	XC	12/20/16	
awings and notes.	XC	2/7/17	
CB and Relay ool&Part #	XC	2/23/17	
pump start/stop rawing	XC	3/13/17	
es and description	DH	11/1/17	
onal Flow Switch	DH	6/29/2018	

Customer:

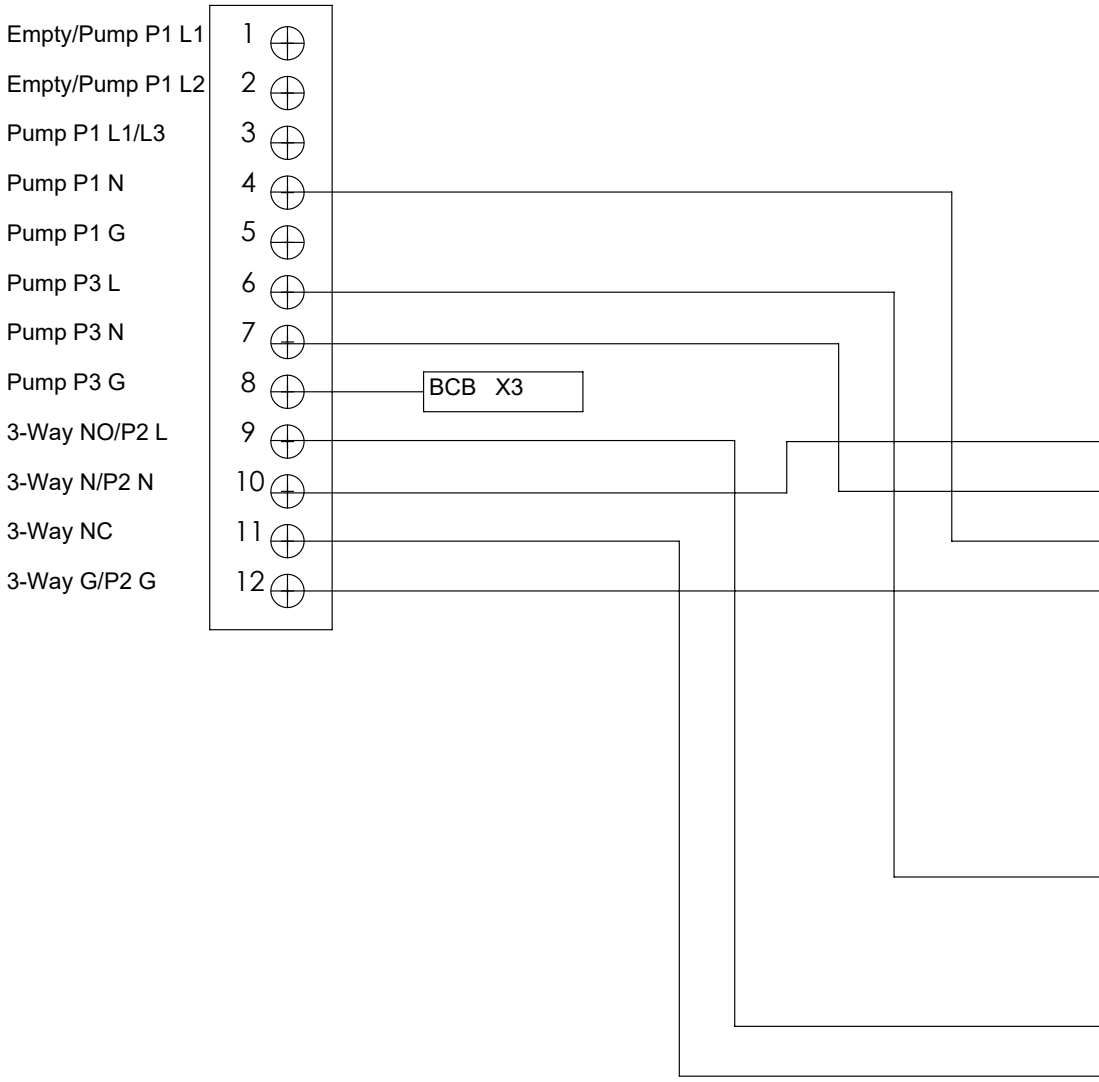
Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 4000 ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 18 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"

TERMINAL BLOCK 3



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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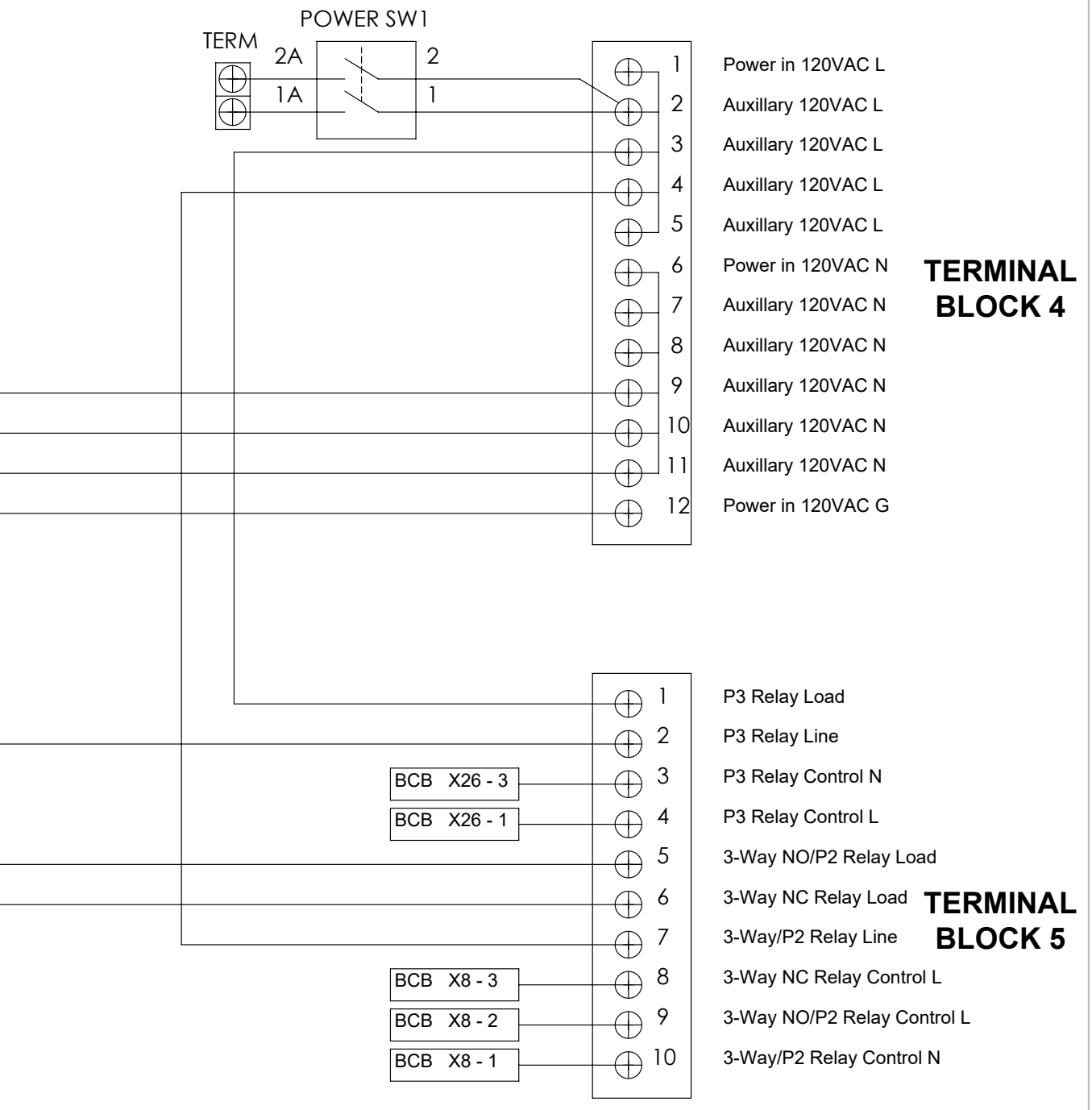
Revision	Revision
A	Combined Dra and add
B	Changed draw
C	Changed C symbo
D	Created w/ p dra
E	Changed notes
F	Added Optior



BCB 70000 AND TERMINAL BLOCK CONNECTION 2

REVISIONS			
Description	Revised By	Revision Date	Approved
wings. Changed ed notes.	XC	12/20/16	
ings and notes.	XC	2/7/17	
B and Relay l&Part #	XC	2/23/17	
ump start/stop wing	XC	3/13/17	
s and description	DH	11/1/17	
al Flow Switch	DH	6/29/2018	

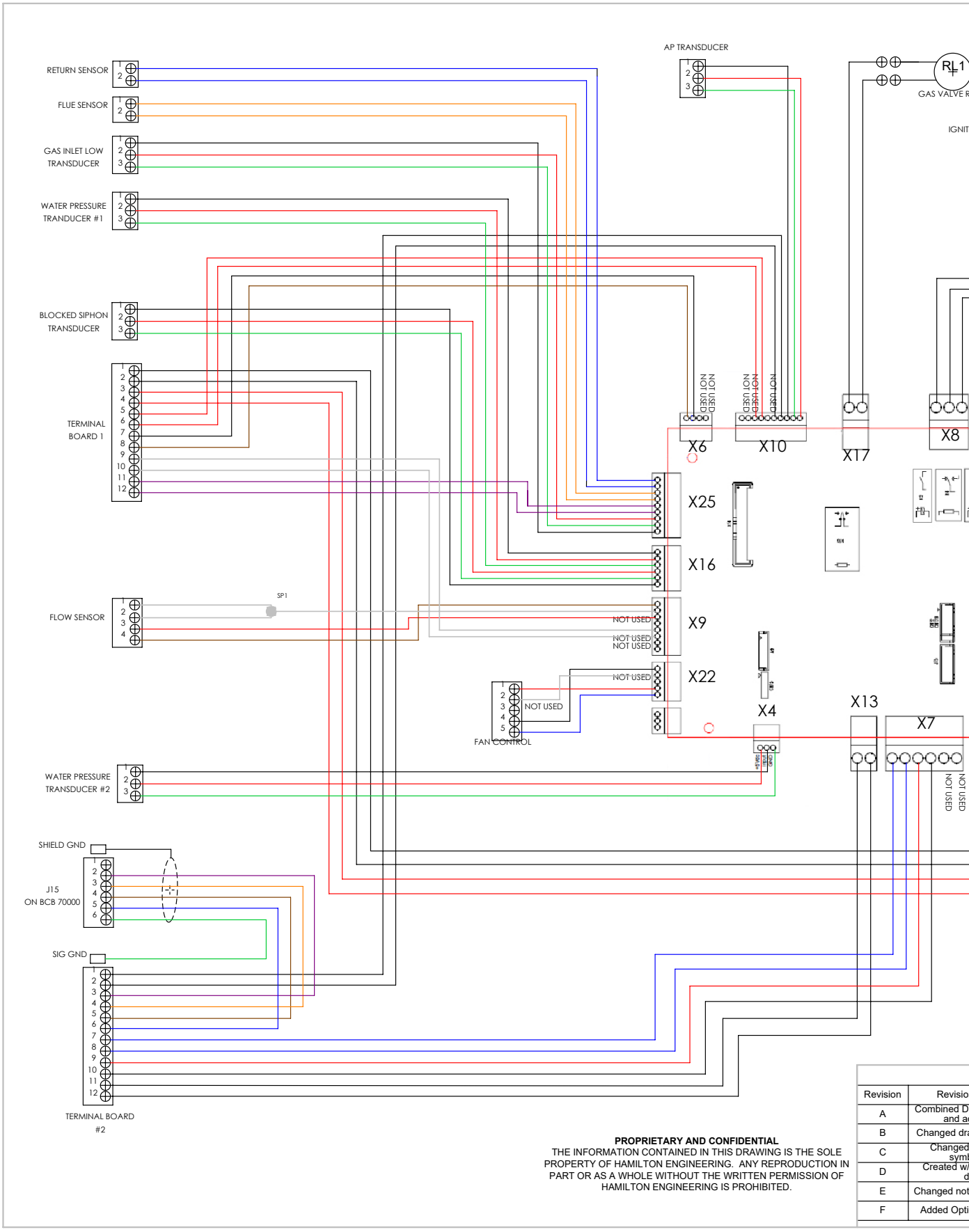
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 4000 ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 19 OF 20	1:50	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"



Revision	Revisio
A	Combined D and ac
B	Changed dra
C	Changed symb
D	Created w/ d
E	Changed not
F	Added Opti

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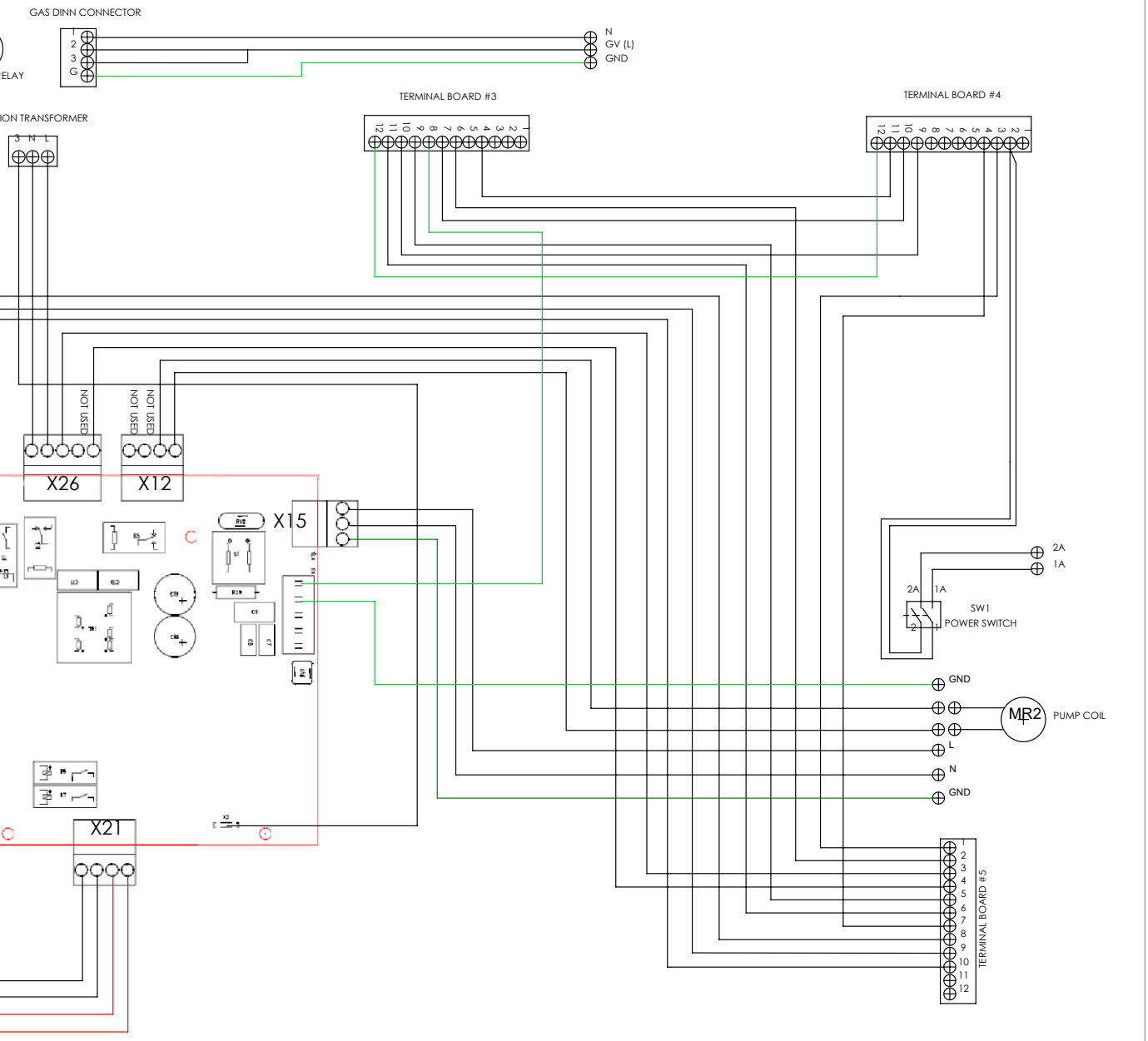


REVISIONS

n Description	Revised By	Revision Date	Approved
rawings. Changed dded notes.	XC	12/20/16	
awings and notes.	XC	2/7/17	
CB and Relay ool&Part #	XC	2/23/17	
pump start/stop rawing	XC	3/13/17	
es and description	DH	11/1/17	
onal Flow Switch	DH	6/29/2018	

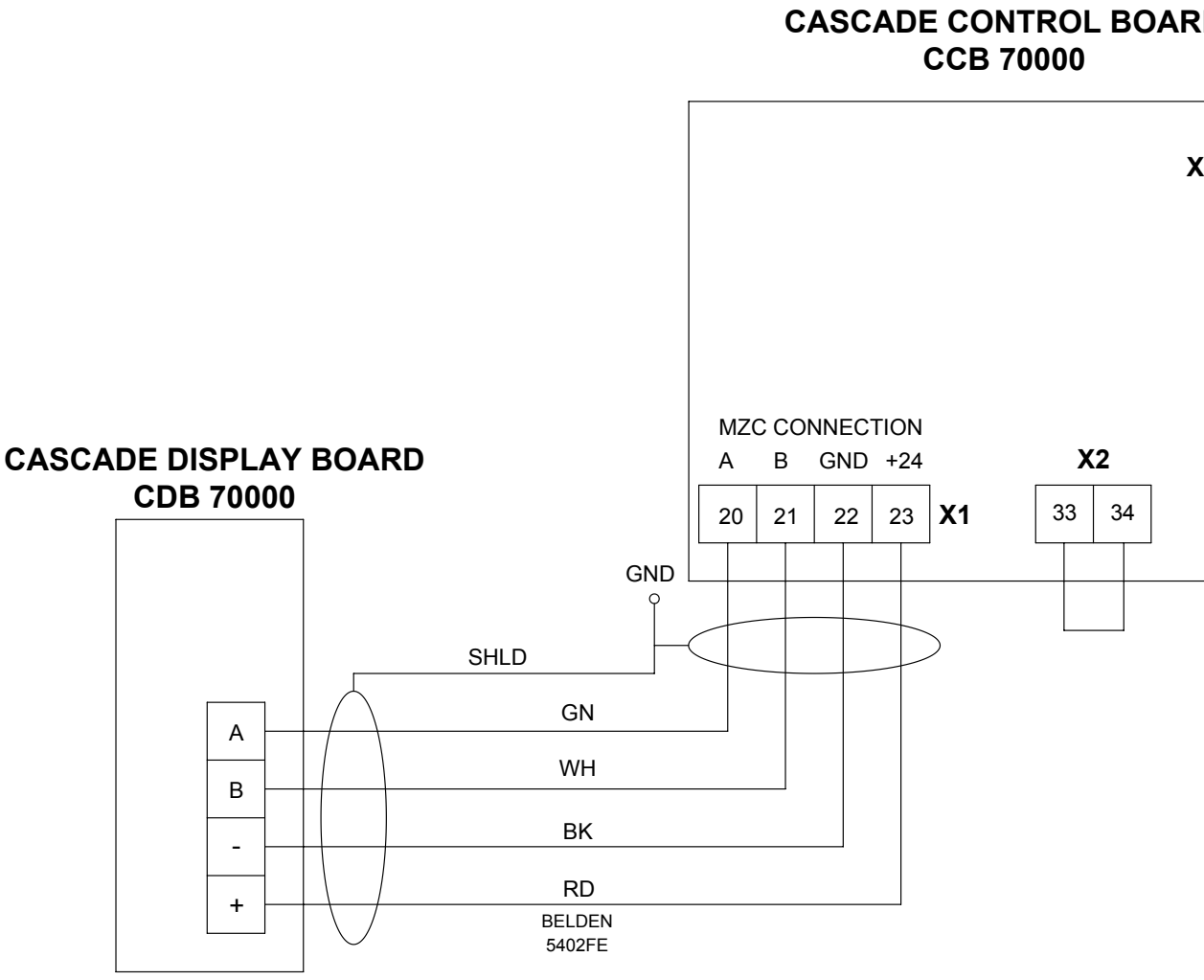
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
750 - 4000 ELECTRICAL SCHEMATIC

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 20 OF 20	1:1	Reference Dimensions are ± 10%
		9/8/2016	XC			Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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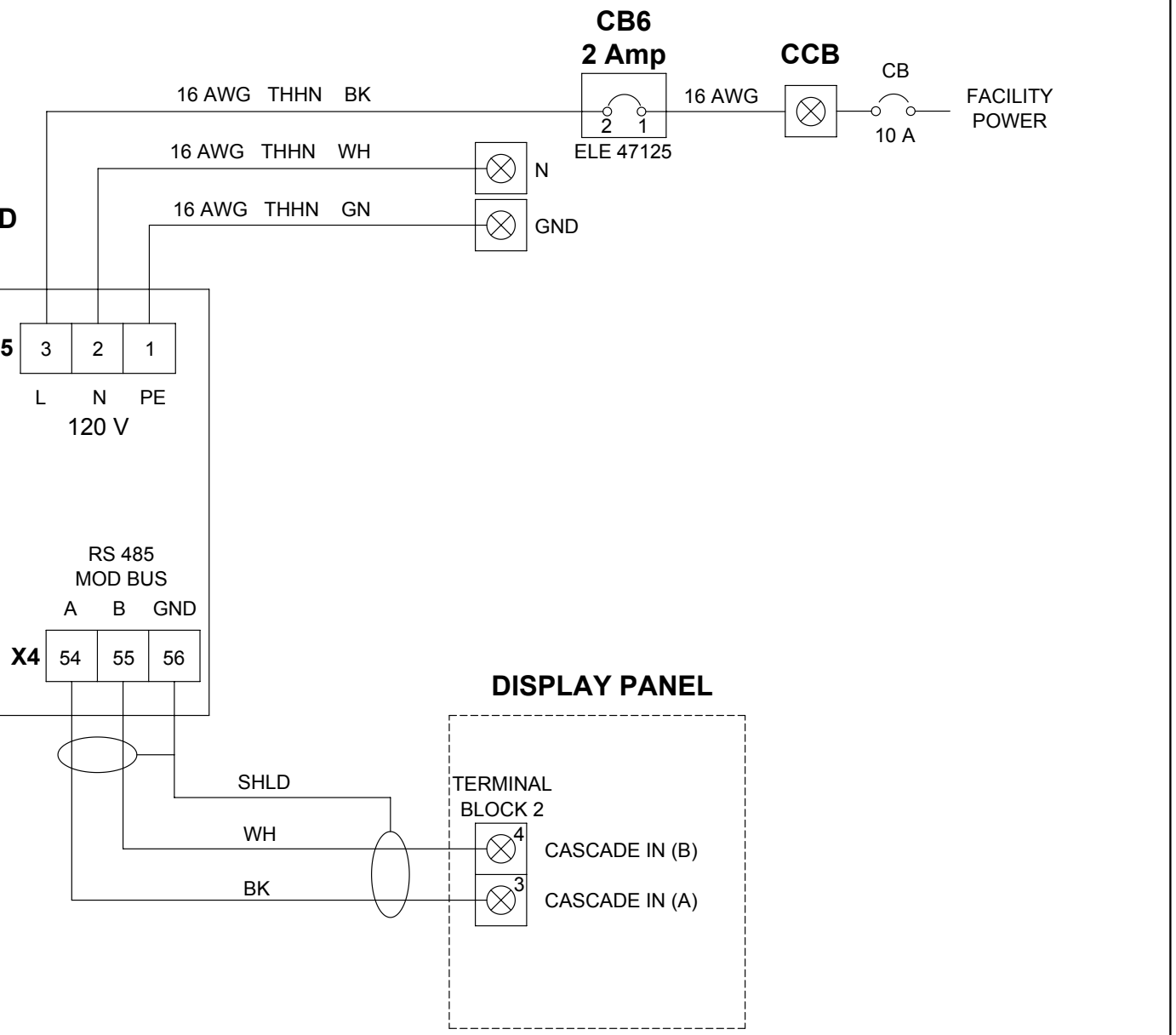
Revision	Revisio
A	Add
B	Change
C	Added jumpe



REVISIONS			
n Description	Revised By	Revision Date	Approved
ed parts.	XC	2/7/17	
d CB symbol	XC	2/23/17	
er between 33 and 34	XC	3/9/17	

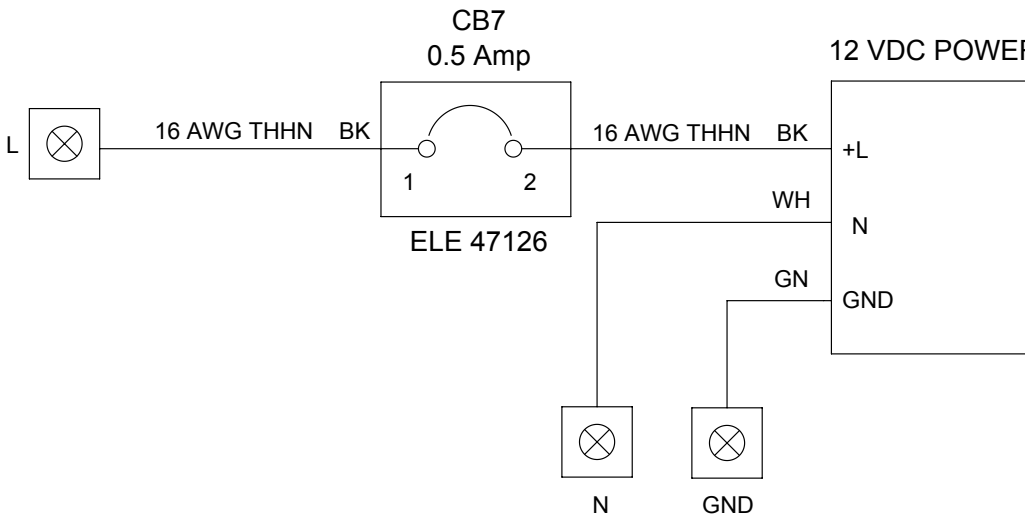
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
CASCADE CONVERSION (RLY 93000)

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 1 OF 1	1:50	Reference Dimensions are ± 10%
		9/9/16	XC			Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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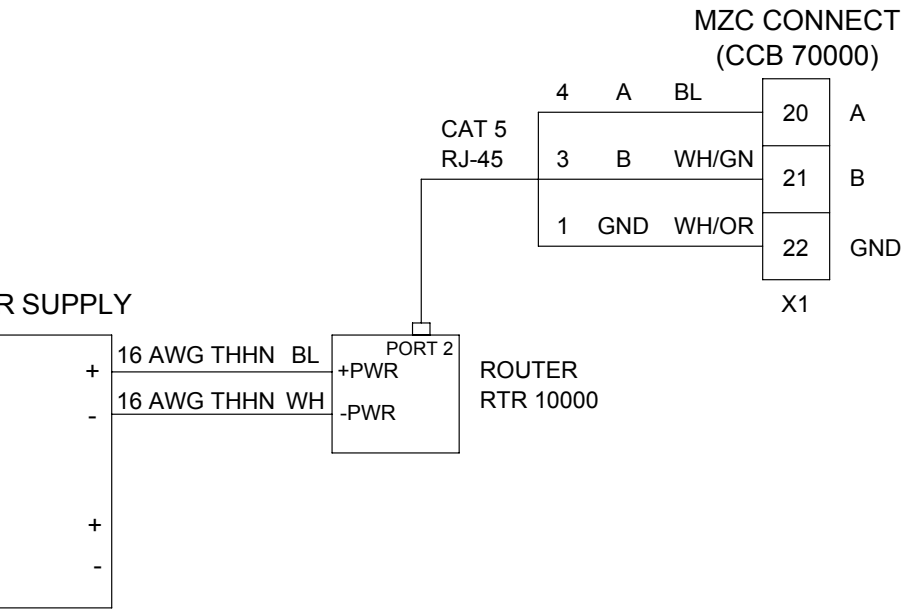
Revision	Revision
D	Deleted Pr
E	Change Pr



REVISIONS			
n Description	Revised By	Revision Date	Approved
otonode optional	XC	3/13/17	
rotonode Option	JL	3/27/17	

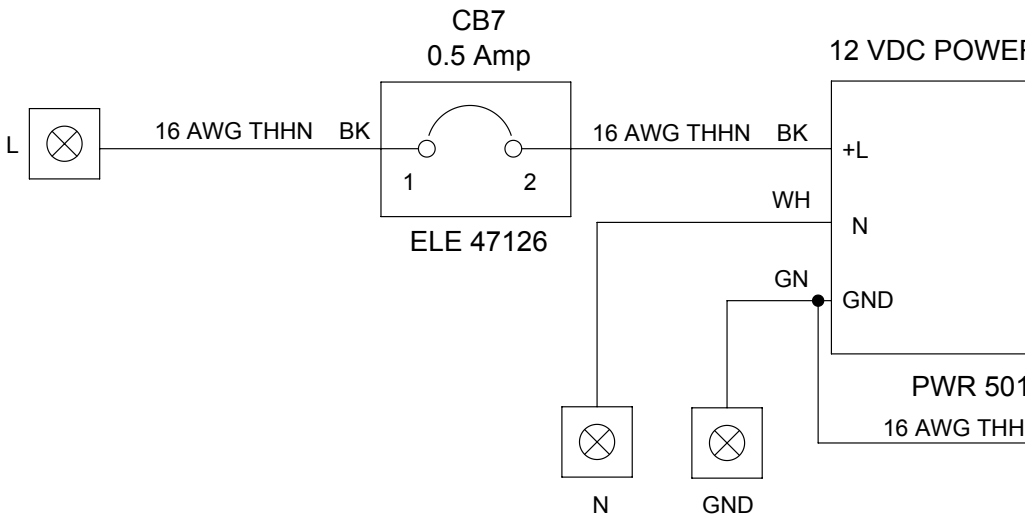
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
ROUTER CONVERSION (RTR 90000)

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 1 OF 1	1:30		Reference Dimensions are ± 10%
		11/28/16	XC				Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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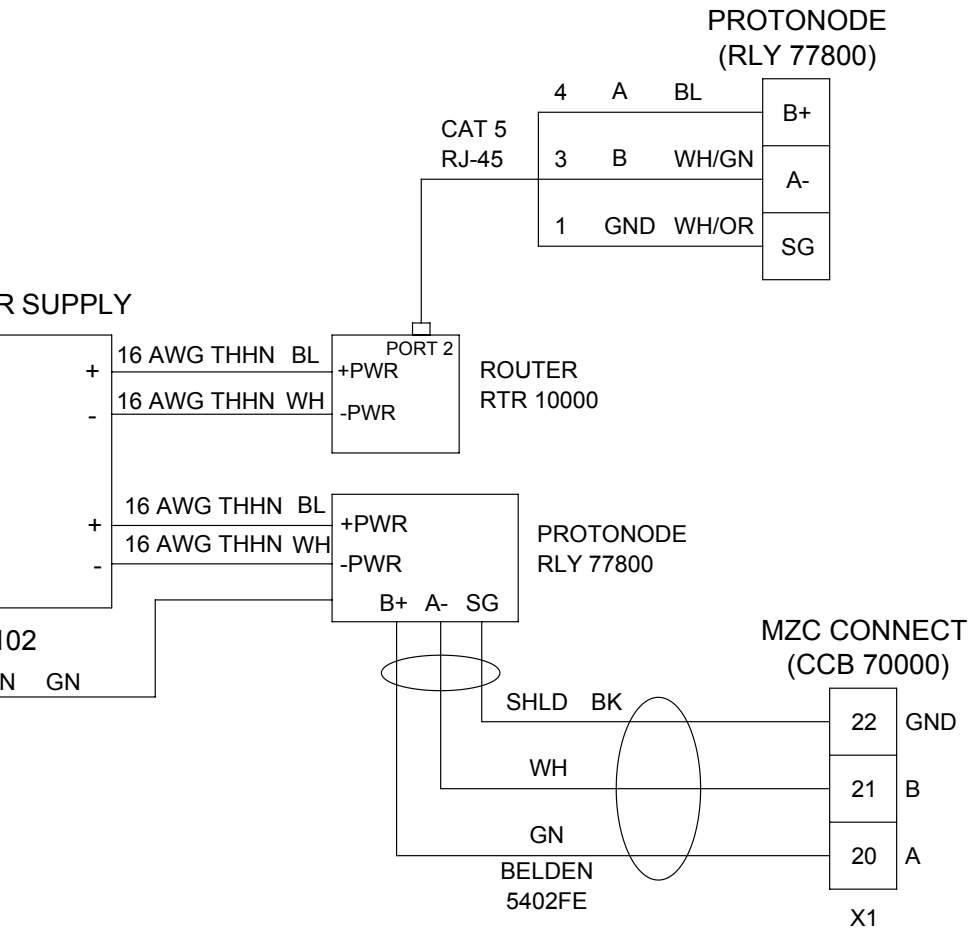
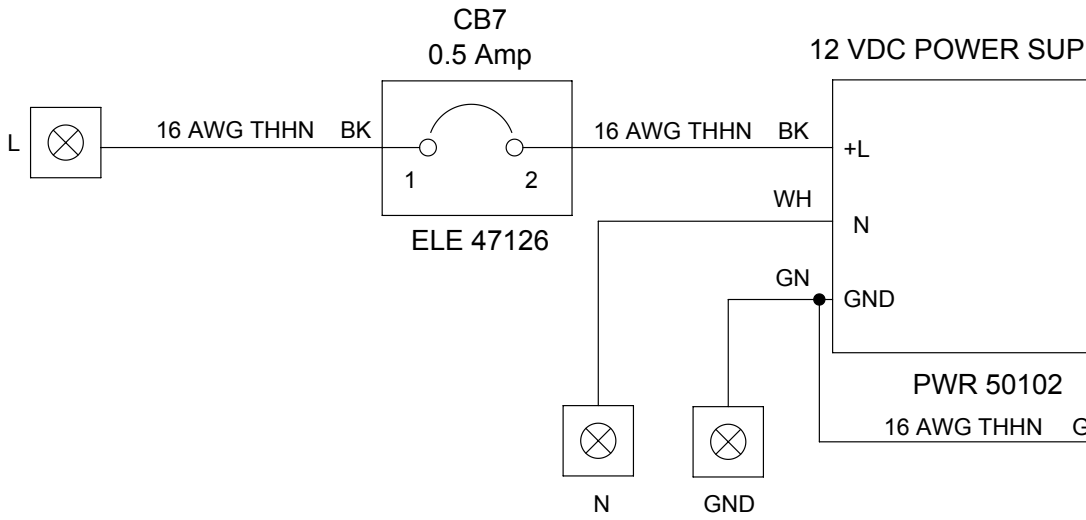


	Customer:				Hamilton Engineering, Inc. Innovative Hot Water Solutions 800.968.5530 • www.hamiltonengineering.com		
	Job Name:				**Drawing Description:** ROUTER CONVERSION W/ PROTONODE		
Approved	**Dwg No.**	**Drawn Date:** 3/13/17	**Drawn By:** XC	**SHEET 1 OF 1**	**1:30**		Reference Dimensions are ± 10% Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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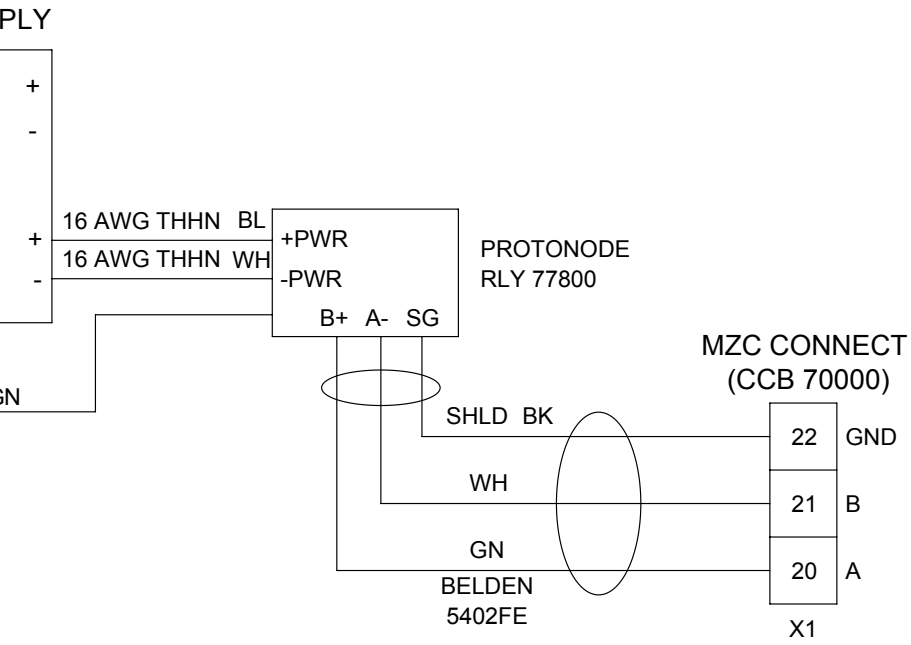
Revision	Revisio
A	Chan
B	Chan
C	Change
D	Deleted F



REVISIONS			
n Description	Revised By	Revision Date	Approved
nged Notes	XC	12/20/16	
nged notes	XC	2/7/17	
ed CB symbol	XC	2/23/17	
Router Optional	XC	3/13/17	

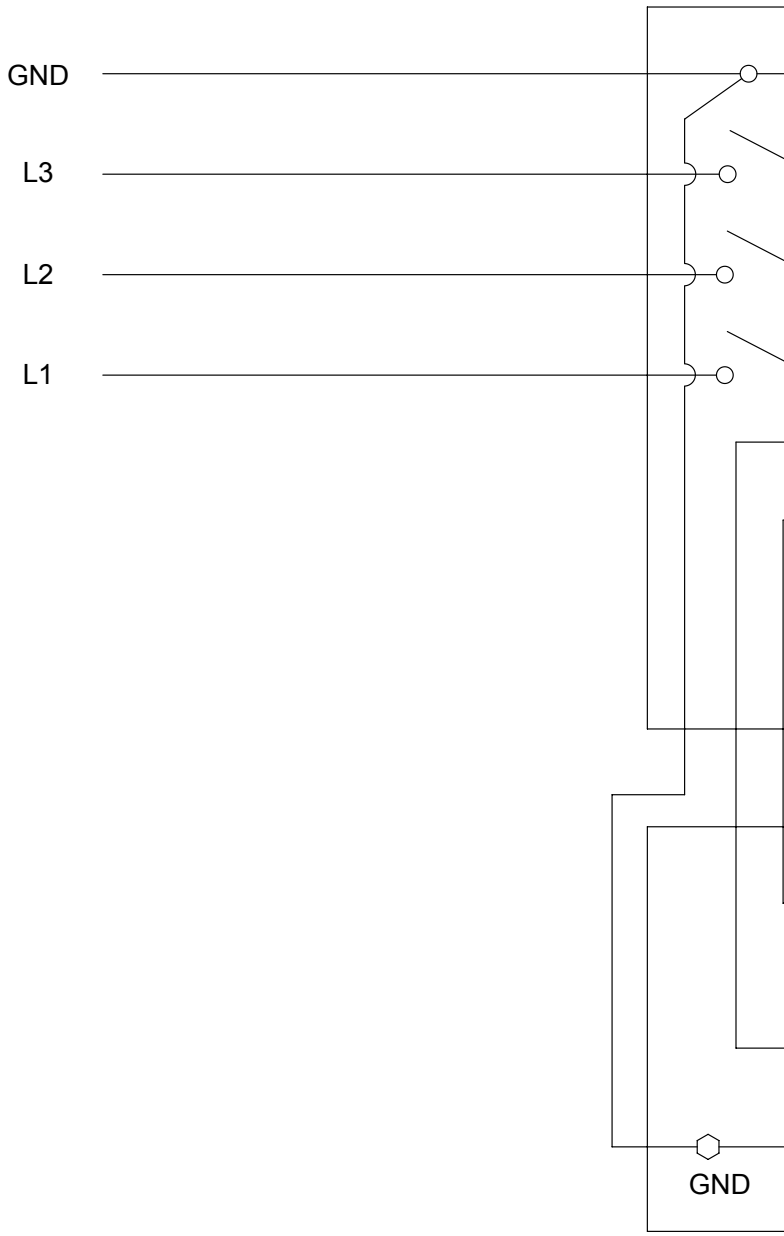
Customer:

Job Name:

Hamilton Engineering, Inc.
Innovative Hot Water Solutions
800.968.5530 • www.hamiltonengineering.com

Drawing Description:
PROTONODE CONVERSION (RLY 97800)

Approved	Dwg No.	Drawn Date:	Drawn By:	SHEET 1 OF 1	1:30		Reference Dimensions are ± 10%
		11/28/16	XC				Dimensions are ± 1"



Drawing for Approval:

Name: _____

Title: _____

Signature:_____ Date:_____

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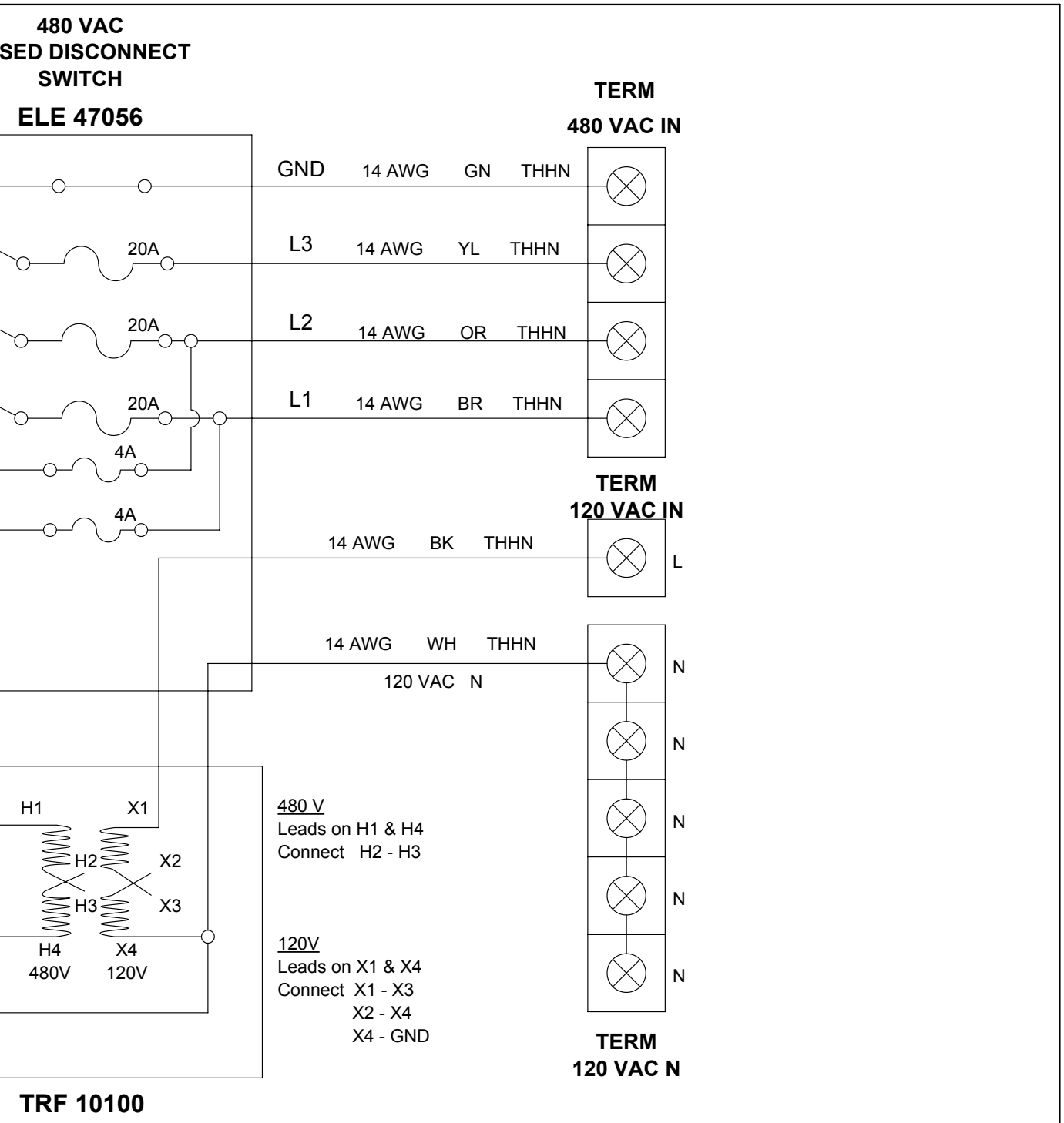

	Customer:	Hamilton Engineering, Inc. Innovative Hot Water Solutions 800.968.5530 • www.hamiltonengineering.com
	Job Name:	**Drawing Description:** 3500 - 4000 480 VAC/120 VAC ELECTRICAL PACKAGE (ELE 92001)
	Approved **Dwg No.** **Drawn Date:** **Drawn By:**	**SHEET 1 OF 1** **1:30** Reference Dimensions are ± 10% Dimensions are ± 1"

WARRANTY INFORMATION

A. WARRANTY CONTACT INFORMATION

Hamilton Engineering Company, Inc. warrants each 3VO Water Heater and Boiler to be free from defects in material and workmanship according to terms, conditions and time periods. *Unless otherwise noted, these warranties commence on the date of installation.*

Warranty information specific to each model can be found on our website ***www.hamiltonengineering.com***, requested via email at ***info@hamiltonengineering.com***, or in our printed Product Catalogs.

If you have any questions or comments, please contact us at **800.968.5530**. If you need emergency technical support after hours, we are available 24 hours a day, 7 days a week by calling this number.

Please keep the following information on hand when calling about warranty information:

Model: _____ Serial #: _____

Installer Name: _____ Phone #: _____ Install Date: _____