# INSTALLATION AND SERVICE MANUAL

# BT SERIES ELECTRIC BOILER

**FOR HYDRONIC HEATING APPLICATIONS**

**6 kW to 54 kW, 208 Vac to 600 Vac, Single or Three Phase**

**WARNING**

**Risk of electric shock. This unit may be connected to more than one electrical circuit. Disconnect all electrical circuits before servicing.**

**IMPORTANT**

- The boiler must be installed in accordance with all applicable national, provincial/state, and local codes, laws, regulations, and ordinances.
- This manual must be left with owner and should be located adjacent to the boiler for reference.
- Ensure boiler is full of water before turning on electricity. Elements will burn out immediately without water in the boiler.
- A boiler installed above radiation level (or as required by an Authority having jurisdiction) must be provided with a low-water cut-off device at the time of boiler installation.
- Overcurrent protection between the power supply and the boiler must be provided in accordance with the related national and/or local codes.
- Always ensure power is turned off before servicing.
- Electrical wiring or internal controls must be serviced by a qualified electrician. Any adjustment of the internal controls must be performed by a qualified service technician.

## Post these instructions in a visible place.

**DATE OF INSTALLATION :**

**INSTALLED BY :**

**PHONE :**

**Featuring our newest**

**“BiTronic Control System”**

Manufactured by
**Allied Engineering Company**
Division of E-Z-Rect Manufacturing Ltd.
Manufacturers of Gas and Electric Boilers, Stainless Steel Tanks, Tankless Coils, Electric Boosters
94 Riverside Drive, North Vancouver, B.C. V7H 2M6 • Telephone (604) 929-1214 • FAX (604) 929-5184
Branches: Calgary • Edmonton • Toronto

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(OPTIONAL)

PN4152451

# Dimensions and Specifications Section 1

## 1.1 TECHNICAL SPECIFICATIONS

Maximum Operating Pressure: 90 p.s.i.
Maximum Operating Water Temperature: 210ºF
Water Capacity in Boiler: 6.6 US Gallons
Inlet and Outlet Pipe Size: 1 1/4" NPT
Controller Pump Switch Capacity: 5A Maximum

**Table 1: Super Hot BT Series Electric Boiler Specifications.** (Flange Type Elements)

| Super Hot BT Series Electric Boilers | | | Single Phase | | Three Phase | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 208 Vac | 240 Vac | 208 Vac | 240 Vac | 480 Vac | 600 Vac |
| **Model** | **kW** | **Btu/Hr** | **Amp** | **Amp** | **Amp** | **Amp** | **Amp** | **Amp** |
| 6BT | 6 | 20,474 | 28.9 | 25.0 | 16.7 | 14.4 | 7.2 | 5.8 |
| 9BT | 9 | 30,708 | 43.3 | 37.5 | 25.0 | 21.6 | 10.8 | 8.7 |
| 12BT | 12 | 40,848 | 57.7 | 50.0 | 33.3 | 28.8 | 14.4 | 11.5 |
| 15BT | 15 | 51,185 | 72.1 | 62.5 | 41.6 | 36.0 | 18.0 | 14.4 |
| 18BT | 18 | 61,422 | 86.5 | 75.0 | 54.6* | 47.3* | 23.7* | 18.9* |
| 20BT | 20 | 68,240 | 96.2 | 84.3 | 63.6* | 55.1* | 27.6* | 22.0* |
| 24BT | 24 | 81,895 | 115 | 100 | 66.5 | 57.7 | 28.8 | 23.1 |
| 27BT | 27 | 92,124 | 130 | 113 | 74.9 | 64.9 | 32.4 | 26.0 |
| 30BT | 30 | 102,369 | 144 | 125 | 83.2 | 72.1 | 36.0 | 28.8 |
| 34BT | 34 | 116,008 | 164 | 142 | 100* | 87.0* | 43.5* | 34.8* |
| 38BT | 38 | 129,656 | 183 | 158 | 118* | 102* | 50.5* | 40.4* |
| 42BT | 42 | 143,304 | 202 | 175 | 116 | 101 | 50.5 | 40.4 |
| 45BT | 45 | 153,540 | 216 | 188 | 125 | 108 | 57.7* | 46.2* |
| 48BT | 48 | 163,776 | 231 | 200 | 138* | 119* | 59.6* | 47.7* |
| 54BT | 54 | 184,248 | 260 | 225 | 150 | 130 | 64.9 | 52.0 |

**Note:**

1. Other models of the BT Series Electric Boiler may be available subject to inquiry.
2. * Delta connection (unbalanced load) amperage of high leg indicated.
3. Approximate shipping weights:

| Model | Weight ∓ |
|---|---|
| 6BT & 9BT | 114 lb |
| 12BT to 18BT | 116 lb |
| 20BT & 24BT | 118 lb |
| 27BT to 38BT | 122 lb |
| 42BT to 54BT | 126 lb |

∓ Add 45 lb for package models

## 1.2 WATER TEMPERATURE RISE vs FLOW RATE

NOTE: The boiler should be properly sized for its heating application and maintain an adequate water flow rate during operation. Significantly oversizing the boiler or decreasing boiler water flow rate will cause excessive stage cycling and result in premature failure of the contactors.

Water flow rate vs temperature rise formulas in US gallons per minute (GPM) and liters per minute (LPM):

$$GPM = \frac{6.94 \times kW}{\text{Temp. Rise (°F)}} \qquad LPM = \frac{14.6 \times kW}{\text{Temp. Rise (°C)}}$$

**Table 2: Water Temperature Rise vs Flow Rate in GPM (LPM)**

| Model | KW | 10°F (5.6°C) | 20°F (11°C) | 30°F (17°C) | 40°F (22°C) |
|---|---|---|---|---|---|
| 6BT | 6 | 4.2 (16) | 2.1 (8) | 1.4 (5) | 1.0 (4) |
| 9BT | 9 | 6.2 (23) | 3.1 (12) | 2.1 (8) | 1.6 (6) |
| 12BT | 12 | 8.3 (31) | 4.2 (16) | 2.8 (10) | 2.1 (8) |
| 15BT | 15 | 10.4 (39) | 5.2 (20) | 3.5 (13) | 2.6 (10) |
| 18BT | 18 | 12.5 (47) | 6.2 (24) | 4.2 (15) | 3.1 (12) |
| 20BT | 20 | 13.9 (52) | 6.9 (27) | 4.6 (17) | 3.5 (13) |
| 24BT | 24 | 16.6 (63) | 8.3 (32) | 5.5 (21) | 4.2 (16) |
| 27BT | 27 | 18.7 (70) | 9.4 (36) | 6.2 (23) | 4.7 (18) |
| 30BT | 30 | 20.8 (78) | 10.4 (40) | 6.9 (26) | 5.2 (20) |
| 34BT | 34 | 23.6 (89) | 11.8 (45) | 7.9 (29) | 5.9 (23) |
| 38BT | 38 | 26.4 (99) | 13.2 (50) | 8.8 (33) | 6.6 (25) |
| 42BT | 42 | 29.1 (109) | 14.6 (56) | 9.7 (36) | 7.3 (28) |
| 45BT | 45 | 31.2 (117) | 15.6 (60) | 10.4 (39) | 7.8 (30) |
| 48BT | 48 | 33.3 (125) | 16.6 (64) | 11.1 (41) | 8.3 (32) |
| 54BT | 54 | 37.5 (141) | 18.7 (72) | 12.5 (46) | 9.4 (36) |

## 1.3 GENERAL DIMENSIONS

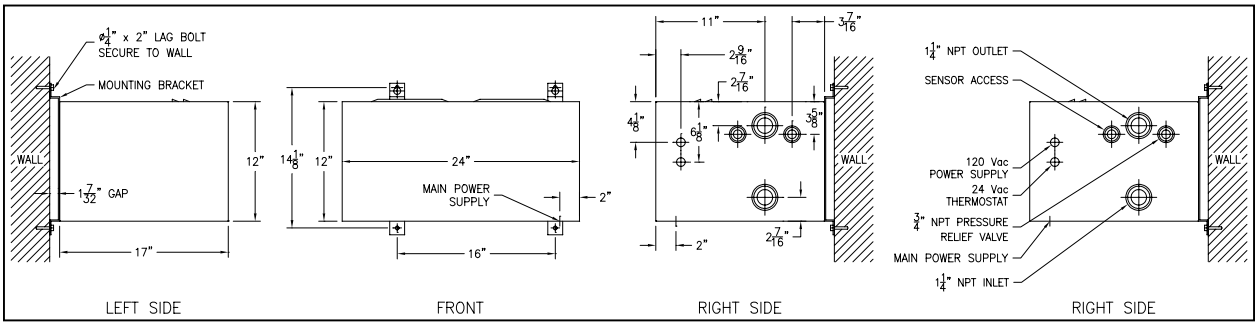


**Figure 1 – General Dimensions**

# Installation Instructions Section 2

## 2.1 RECEIVING

**INSPECT SHIPMENT FOR POSSIBLE DAMAGE.** All goods are carefully manufactured, inspected, checked and packed by experienced workers. The manufacturer's responsibility ceases upon delivery of goods to the carrier in good condition. Any claims for damage, shortage in shipment or non-delivery must be filed immediately against the carrier by the consignee.

## 2.2 INTRODUCTION

Super Hot Electric Boilers are controlled by a three-stage electronic temperature controller. The controller controls the boiler water temperature with three stages and turns stages on based on the heating demand, time delay, and the preset boiler outlet water temperature. The controller also can control 120Vac circulating pumps rated up to 5A or 600VA. When the thermostat calls for heat, the controller will operate the boiler to regulate the water temperature at a pre-selected setpoint. The system pump is on whenever there is a thermostat calling for heat.

Multi-stage electric boilers have a number of advantages over conventional on/off single stage boilers. Instead of switching on/off all heating elements using sequencers, each stage of a multi-stage boiler is controlled directly by the controller to minimize both temperature fluctuations and reduce the number of on/off operations of the contactors/heating elements. The on/off times of each of the stages are separated by a pre-determined minimum time interval to avoid a surge in line current. The average “cycle time” of each of the heating elements shall be greatly increased. This ensures better temperature stability, extends the life of the boiler and increases energy efficiency.

## 2.3 BOILER LOCATION

The boiler is intended for indoor installation only and must not be subjected to water spray or leakage. It may be installed in an enclosed space and attached directly to a combustible surface. Allow ample space around the boiler to ensure all connections and controls are readily accessible. The minimum required clearances for service are shown in the following table:

| Minimum Clearance | Provides service access for |
|---|---|
| left side = 18 inches | elements |
| right side = 12 inches | plumbing connections |
| front = 12 inches | electrical components and fuses |

It may be preferred to locate the boiler close to the electrical supply panel.

## 2.4 WALL MOUNTING

**CAUTION:** Failure to correctly position the boiler may result in element burn out.

This boiler must be installed using the attached wall mounting brackets. It is critical that the boiler be installed level and oriented as shown in Figure 2 (below). When correctly positioned, the front panel is vertical and the 1 1/4"NPT outlet connection is directly above the 1 1/4"NPT inlet connection.

The wall mounting brackets on the boiler feature a "key-hole" opening suitable to fit over the head of two previously installed 5/16" lag screws. The key-hole openings are located on 16" centers (i.e. standard stud spacing) on the top side of the hangers. The lag screws must be suitably anchored to safely support the weight of the boiler including water content, piping and wiring.

## 2.5 PIPING

The recommended piping arrangement is shown in Figure 2. Attach pump, expansion tank, drain valve, pressure relief valve, air vent, pressure temperature gauge and flow switch (as required). Air vents should be installed at points just upstream from all drops in elevation of the piping system (high points).

A boiler installed above radiation level, or as required by an authority having jurisdiction, must be provided with a low-water cut-off device at the time of boiler installation.

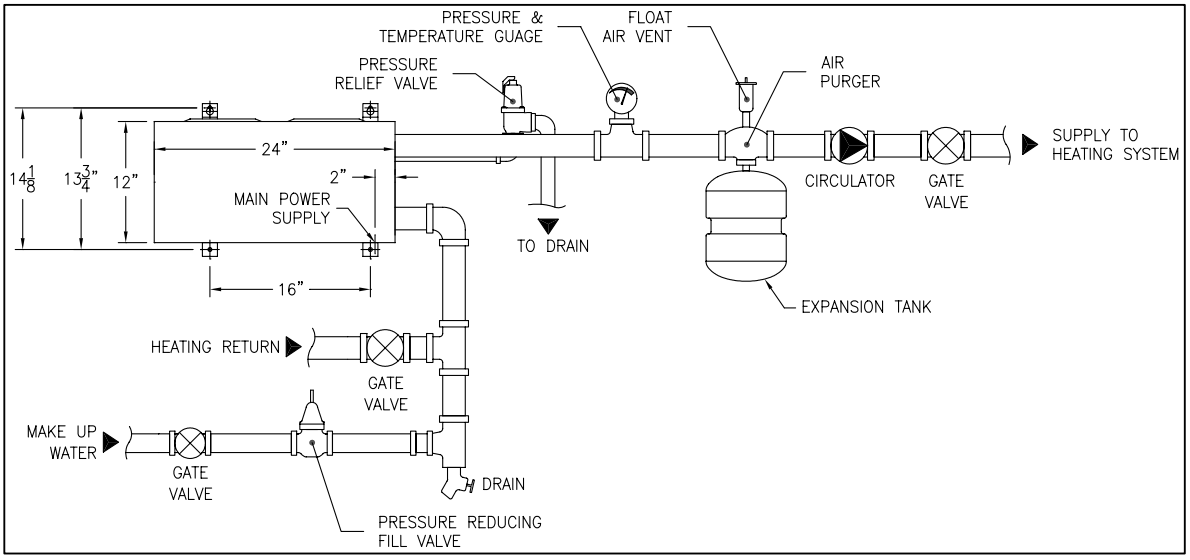


**Figure 2 – Piping Arrangement**

# Wiring Section 3

## 3.1 ELECTRICAL WIRING

All electrical wiring must be done in accordance with the Canadian Electrical Code, CSA C22.1 Part 1, and/or any local regulations and codes in Canada, or the National Electrical code, ANSI/NFPA 70 (latest edition) and/or any local regulations and codes in U.S.A.. Verify the nameplate rating and check the related codes to properly size conductors, switches and overcurrent protection. Several openings are provided on the right and bottom of the casing for different voltage connections. For wire connections refer to the wiring diagram sticker on the back of the boiler front cover.

All circuit breakers ahead of and at the boiler must be OFF. Remove the boiler front cover by removing 4 screws from the sides.

**a. Wiring on Controller**

**Line Voltage:**

Connect (if not pre-wired) only 120 Vac, 60 Hz, single phase power to terminals L1 and L2 on the controller. Strip wire ends before inserting into terminal block. Tighten terminal screw clamps.

**Pump:**

Connect only 120 Vac, 1/6 HP (maximum) pump to terminals P1 and P2 on the controller. Strip wire ends before inserting into terminal block. Tighten terminal screw clamps. If a pump horsepower larger than 1/6 HP is used, change the pump fuse on the controller based on the pump rating. Do not use a pump requiring greater than 5A or 600 VA.

**Thermostat:**

Connect thermostat or zone valve end switch to terminals T1 and T2 (**DO NOT apply any power to these terminals!**). Strip wire ends before inserting into terminal block. Tighten terminal screw clamps.

**Water Temperature Control Sensors:**

Pre-wired (factory wiring) high-limit temperature sensor to terminals HL and CL (common). Strip wire ends before inserting into terminal block. Tighten terminal screw clamps.

Pre-wired (factory wiring) operating temperature sensor to terminals OL and CL (common). Strip wire ends before inserting into terminal block. Tighten terminal screw clamps.

**b. Power Supply to Heaters**

The supply cable has to be sized based on the amperage in Table 1 and the cables used.

Connect only specified line voltage and phase power to main terminal block on the control panel. Strip wire ends before inserting into terminal block. Tighten terminal screw clamps. Attach ground wire to ground terminal block on the bottom control panel.

NOTE: "Outdoor Reset" controllers must not be connected to the Bitronic Control System. Outdoor Reset controllers will interfere with the Bitronic controller's normal staging routine, and lead to excessive stage cycling and premature failure of the contactors.

# Startup Instructions Section 4

## 4.1 WARNING

**WARNING**

**The following instructions are intended as a guide for qualified persons. Before switching the power on, fill the system with water and vent air. Check for and repair any leaks in the water piping.**

## 4.2 STARTUP

### a. Fill System

Figure 2 shows the suggested set-up for a make-up water supply using a pressure regulator (not supplied by manufacturer). Do not apply full line make-up water pressure to the system. Fill the system to approximately 12 psi (cold water) if the expansion tank is pressurized at 12 psi. The expansion tank should be sized to provide the system with enough volume for thermal expansion and contraction while maintaining operating pressures within safe and reasonable limits. There should be no significant pressure fluctuations in systems having both an effective automatic fill valve and a properly sized expansion tank or expansion tank arrangement. The standard pressure relief valve supplied with the boiler is rated at 30 psi, or as required by order, but the maximum working pressure cannot exceed 90 psi for CSA or A.S.M.E. approved boiler. Once the system is filled with water, all trapped air must be removed to avoid air locks, which can reduce flow rate and cause thermal shock. Figure 2 also illustrates the connections to the air purger (not supplied by manufacturer) and expansion tank in the line from the boiler to the radiation units. Additional air purgers should be installed at high points in the system to assist in removing air which can accumulate from the water supply line. All high points must be vented.

### b. Startup Procedure

Perform the following procedure as a check for proper boiler and system operation:

1. Set the boiler operating temperature to the designed heating water temperature by adjusting the dial of potentiometer located on the bottom-left of the controller (Figure 3). Use a small screwdriver to adjust the arrow on the temperature adjustment dial to the water temperature required. (This boiler is also equipped with a non-adjustable, high-limit temperature device set at 230°F as safety limit control. The high limit temperature device has an automatic reset function.)
2. The stage 1, stage 2, and stage 3 contactors are each connected in series with Anti-Cycle Cubes. Use a small screwdriver to adjust the arrow on the Cube adjustment dial to the required stage time delay. The recommended Anti-Cycle Cube settings are two minutes for stage 1, five minutes for stage 2 and eight minutes for stage 3. **Minimum Settings:** The stage 1 Cube should be set at a minimum of **one minute.** The stage 2 Cube should always be set a minimum of **two minutes longer than stage 1**. The stage 3 Cube should always be set a minimum of **two minutes longer than stage 2**.
3. Turn up all room thermostats above room temperature.
4. When power is supplied to the controller, the power indicator LED (green) is always on. When the thermostat calls for heat, the pump will be energized immediately and the pump indicator LED (yellow) will light up. Next, the three stages are energized along with the stage indicator LEDs (yellow), one after another, in sequence and based on the time delay which is user-set by the Anti-Cycle Cubes. Once the boiler water temperature reaches the set point on the temperature adjustment dial, the controller will regulate the boiler water temperature with three stages. The number of stages which stay on is based on the heating demand and the set point of the boiler water temperature. After all room thermostats are satisfied with the heat, the controller de-energizes the three stages one after another, in sequence, and then switches the pump off.
5. Current may be checked by a qualified electrician at the feeder panel and compared to the values shown in Table 1.

# Maintenance Instructions — Section 5

## 5.1 SERVICE HINTS

a. This boiler has been designed to provide years of trouble free performance under normal operating conditions. However, the owner should conduct a general external examination at the beginning of each heating season and at mid-heating season to assure good working performance is continued. In addition, a qualified service technician should examine the boiler at least once every year.

b. Do not store anything against the boiler or allow dirt or debris to accumulate in the area immediately surrounding the boiler.

c. Elements will burn out if the boiler is not filled with water when electrical power is turned on. Do not connect thermostat wires until system has been filled with water. Water should be drained out from system only when absolutely necessary to make repairs or prevent freeze-up during extended cold weather shutdown.

d. The pressure & temperature gauge on the system should be checked frequently. During normal operating conditions, pressure should be relatively stable throughout the heating season. If pressure under normal operating conditions consistently rises and falls over a period of time, this can indicate a fill valve leak, system leak or expansion tank malfunction. Leaks anywhere in the system must be repaired without delay. If any leaks or significant pressure fluctuations are observed, call for service immediately.

# Controller Information — Section 6

## 6.1 BiTRONIC CONTROLLER INFORMATION

**BiTronic Control Board Specifications**

| | |
|---|---|
| BiTronic Controller Layout: | see figure 3 |
| Dimensions: | 8 1/2" (L) x 3 1/4" (W) x 1 3/4" (H) |
| High Limit Control Outlet Water Temperature: | 230 °F (fixed) |
| Operating Control Outlet Water Temperature: | 100 - 210 °F (adjustable) |
| Controller Input Voltage: | 120 Vac |
| Controller Output Voltage: | 24 Vac (stage relays)<br>120 Vac (pump terminal) |

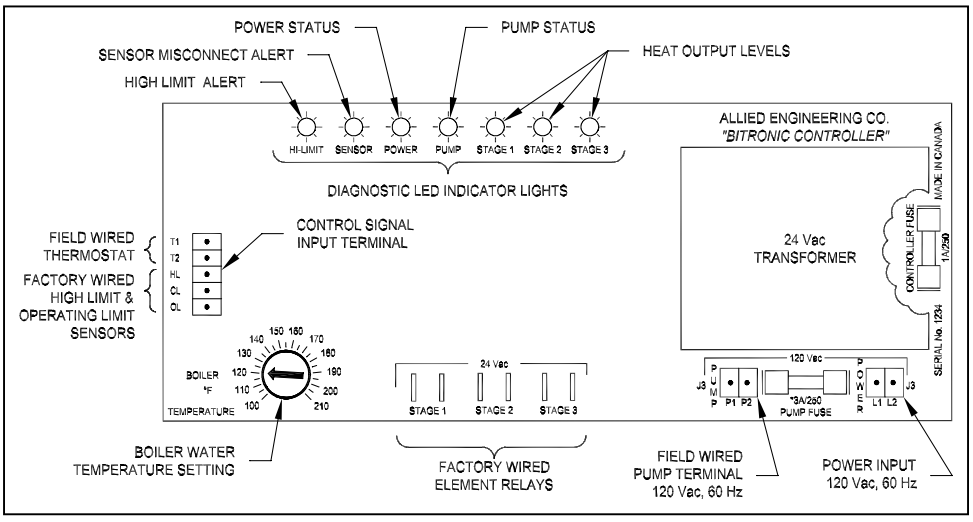


**Figure 3 – BiTronic Controller Layout**

**Transformer:**

Power Rating: 40 VA
Input Voltage: 120 Vac, 60 Hz, single phase
Output Voltage: 24 Vac, 60 Hz

**Power Output:**

1. Three 24 Vac, 3 AMP relays drive stage 1, stage 2 and stage 3. Maximum load of the individual drive or the total load of three relays should not exceed 1.33 A or 32 VA.
2. One 120 Vac pump output is switched by using a 10A relay. The load current of this output is also limited by the pump fuse selected (controller supplied with 3 A fuse) and must not exceed 5 A or 600 VA.

**Power Consumption:**

Controller (internal): 4 watts maximum
24 Vac contactor drive: depends on the contactors

**LED Displays:**

A total of seven indicator lights display the following information:

1. Hi-limit (red): High-limit or high-limit sensor error. LED is lit when either the boiler water temperature reaches the high-limit of 230°F or the high-limit sensor is faulty, disconnected or misconnected.
2. Sensor (red): Operating sensor error. LED is lit when operating sensor is faulty, disconnected or misconnected.
3. Power (green): Power on/off.
4. Pump (yellow): Pump relay on/off.
5. Stage 1 (yellow): Boiler first stage on/off (low heat).
6. Stage 2 (yellow): Boiler second stage on/off (medium heat).
7. Stage 3 (yellow): Boiler third stage on/off (high heat).

**Signal/Control Input:**

T1 and T2: Thermostat or zone valve end switch, switching input, closed is activation.
HL: High-limit temperature sensor.
CL: Common return of the high-limit and the operating temperature sensors.
OL: Operating temperature sensor.

**Temperature Control Ranges:**

| | |
|---|---|
| Temperature notation: | degrees Fahrenheit |
| Pre-set operating temperature range: | 100°F to 210°F |
| Fixed high-limit temperature: | 230°F |
| All stages on/off temperature differential: | ±4°F |

**Operating Temperature Adjustment:**

Internal temperature potentiometer on the controller or external temperature potentiometer (optional extra).

**Anti-Cycle Cube (external):**

| | |
|---|---|
| Delay "On Make" Time Range: | 0.1 to 8 minutes (adjustable) |
| Input Voltage: | 24 V |
| Maximum Load Current: | 1 Amp |

## 6.2 CONTROLLER OPERATION

When the controller is powered-up, the green “Power” light will come on. If no sensor or high limit errors are present, the controller enters the operating mode. Once in operating mode, the controller uses the operating sensor to continuously monitor the boiler water temperature.

When the thermostat calls for heat, the controller will switch on the system pump and the yellow “Pump” light. The control system will switch on the each stage(s) with yellow “Stage” light(s) in sequence followed between each stage with an interstage delay as set by the Anti-Cycle Cube. When the yellow "Stage" light for stage 2 or stage 3 switches on, the Anti-Cycle Cube will begin counting delay time to energize its stage contactor(s) and will energize its stage contactor(s) only after the time delay has elapsed. This feature prevents "short cycling", which can quickly wear out contactors and cause rapid temperature fluctuations.

The elements will stay on until the supply water temperature reaches the temperature dial setting. When the water temperature setpoint is reached, the control will automatically cycle the stage(s) of the boiler on or off, as necessary, to maintain the supply water temperature. The required number of stages which are activated is determined by the heating demand (difference between boiler water temperature and design temperature setpoint). After the call for heat has been satisfied, the stage(s) of the boiler, along with the "Stage" light(s), will switch off in sequence, followed by the pump.

All stage outputs will shut off within 15 seconds upon a sensor short circuit. The shut down sequence will switch off one activated element at a time and then the pump. All stage outputs will shut off immediately followed by the pump after a delay, if the high-limit temperature is reached or there is a sensor open circuit. The controller has a built-in automatic reset function upon power interruption.

## 6.3 TEMPERATURE SETTING

The water temperature adjustment dial on the controller should always be set at the designed boiler water temperature. A small screwdriver should be used to adjust the arrow on the temperature adjustment dial.

## 6.4 ANTI-CYCLE CUBE SETTING

The stage 1, stage 2, and stage 3 contactors are each connected in series with Anti-Cycle Cubes. Use a small screwdriver to adjust the arrow on the Cube adjustment dial to the required stage time delay. The recommended Anti-Cycle Cube settings are two minutes for stage 1, five minutes for stage 2 and eight minutes for stage 3. **Minimum Settings: The stage 1 Cube should be set at a minimum of one minute. The stage 2 Cube should always be set a minimum of two minutes longer than stage 1. The stage 3 Cube should always be set a minimum of two minutes longer than stage 2.**

## 6.5 CONTROLLER MOUNTING

The controller mounts on the boiler control panel using six #6 sheet metal screws and 1/2" high plastic standoffs. The indicator LEDs are visible on the top of the boiler casing.

## 6.6 PROTECTION FROM LIQUIDS

The controller and other components located within the control panel are sensitive to water and other liquids. Measures must be taken to fully protect components on the control panel from contact with liquids. This especially applies to overhead pipes which may leak or condensate causing damage.

# Troubleshooting Guide — Section 7

## 7.1 TROUBLESHOOTING – For Use of Licensed Electricians Only

**WARNING**

**RISK OF ELECTROCUTION – HIGH VOLTAGE - ALWAYS SHUT OFF MAIN POWER TO THE ELEMENT HEATING CIRCUIT BEFORE TROUBLESHOOTING! Also, be careful of 120V power while troubleshooting near Line-in terminals (L1&L2), Pump terminals (P1&P2) and other areas of the controller.**

This section is meant to assist the service technician when troubleshooting the electric boiler. As in any troubleshooting procedure, it is important to isolate a problem as much as possible before proceeding. Often the controller error message LEDs can be a great help in identifying the cause of a problem. If you suspect a wiring fault, carefully check all external wiring and wiring connections following the wiring diagram sticker on the back of the boiler's door. An additional wiring diagram is enclosed with this manual.

| PROBLEM | CAUSE | SOLUTION / CHECK |
|---|---|---|
| Power LED (green) is not lit. | • Incorrect supply power. | • Check for 115V (AC) across L1 and L2. |
| | • Controller fuse blown. | • Check fuse and replace if necessary. |
| | • Internal control fault. | • Replace controller. |
| High-Limit LED (red) on controller is lit. | • High-limit wire is disconnected or misconnected | • Red wire of sensor must be connected to HL. |
| | • Operating sensor fault (allows water temperature to reach the high-limit) | • Perform "Sensor Check" described in 7.2 and replace sensor if necessary. |
| | • High-limit sensor fault | • Perform "Sensor Check" described in 7.2 and replace sensor if necessary. |
| | • Internal control fault | • Perform "Sensor Check" described in 7.2 and replace control board if necessary. |
| Sensor LED (red) on controller is lit. | • Operating sensor wire is disconnected or misconnected. | • White wire of sensor must be connected to OL. |
| | • Operating sensor fault. | • Perform "Sensor Check" described in 7.2 and replace sensor if necessary. |
| | • Internal control fault. | • Perform "Sensor Check" described in 7.2 and replace control board if necessary. |
| Both High-Limit and Sensor LEDs (red) on controller are lit. | • Neutral wire of sensors is disconnected or misconnected. | • Black wire of sensors must be connected to CL. |
| | • High-limit or operator sensor fault. | • Perform "Sensor Check" described in 7.2 and replace sensor if necessary. |
| | • Internal control fault. | • Perform "Sensor Check" described in 7.2 and replace control board if necessary. |
| No heat when called by thermostat and stage LEDs are NOT lit. | • Thermostat fault. | • Disconnect thermostat from controller, turn thermostat to maximum setting, and check continuity. |
| | • Internal control fault. | • With thermostat disconnected from board, voltmeter should read 24V (**DC**) across terminals T1 and T2. |

| PROBLEM | CAUSE | SOLUTION / CHECK |
|---|---|---|
| No heat when called by thermostat and stage LEDs are lit. | • Main fuses blown (if applicable). | • Check main fuses and replace if blown. |
| | • Internal control fault. | • Turn stage LEDs on by adjusting thermostat to maximum setting and check for 24V (AC) across stages 1, 2, and 3. |
| | • Anti-Cycle Cube fault | With corresponding Stage powered, place a jumper wire across the Anti-Cycle Cube terminals. If the main contactor(s) does not close, perform main contactor check.<br>If the main contactor(s) are working, test for voltage across Anti-Cycle Cube terminals using AC voltmeter. Voltage should read 24 V (AC) before the delay time has elapsed and approximately 2.5 V (AC) after delay time has elapsed. Replace Anti-Cycle Cube if necessary. |
| | • Main contactor(s) fault. | • Check each contactor coil's terminals for a supplied voltage of 24V (AC). If present, main contactor(s) are faulty and must be replaced. If not present, wiring continuity fault exists – check and repair. |
| | • Element fault. | RISK OF ELECTROCUTION! – MAIN POWER TO ELEMENTS MUST BE DISCONNECTED! Next, disconnect element wires from main contactor(s) and check for continuity. If no continuity, replace element. If continuity, the contactor is defective. (To confirm contactor defect, check for continuity across main contactor when closed.) |
| Pump runs constantly when there is no call for heat. | • Internal control fault. | • Replace controller. |
| Pump will not run. | • Pump ceased or burnt out. | • Repair or replace. |
| | • Pump wiring fault. | • Check and repair wiring. |
| | • Pump fuse blown. | • Check pump fuse and replace if necessary. |
| | • Internal control fault. | • Replace controller. |
| Controller does not operate normally. | • Internal control fault. | • Replace controller. |
| Pressure relief valve discharges water. | • Relief valve not reseating properly. | • Quickly lift and release manual discharge lever on relief valve to assist proper reseating. If this fails, replace pressure relief valve. |
| | • Pressure reducing valve set too high. | • Reduce setting of pressure reducing valve. |
| Water leaking from electric boiler. | • Element or sensor threads leaking. | • Turn off all electricity to the boiler. Remove wires from element terminals and tighten elements (with correct socket wrench). Turn off water, drain, remove and apply sealant if necessary. |
| | • Plumbing connections leaking. | • Tighten incoming pipes and pressure relief valve. Turn off water, drain and remove and apply sealant if necessary. (Be sure to turn off electricity before draining or elements will burn out.) |

## 7.2 SENSOR CHECK

1. *SHUT OFF MAIN POWER TO THE ELEMENT HEATING CIRCUIT BEFORE TROUBLESHOOTING!* Also, be careful of 120 Vac power while troubleshooting near Line-in terminals (L1&L2), Pump terminals (P1&P2) and other areas of the Controller.
2. Control Board should be powered with green "power" LED on. Confirm 120 Vac power at L1&L2 using an AC voltmeter.
3. Confirm correct sensor wiring: red wire to HL, black wire to CL, and white wire to OL.
4. Test hi-limit sensor by using a DC voltmeter to measure voltage across HL&CL and record voltage.
5. Test operator sensor by using a DC voltmeter to measure voltage across OL&CL and record voltage.
6. A sensor at room temperature (68°F) should measure approximately 2.93 Vdc. If the sensor is not at room temperature use the following formula to calculate the expected voltage reading:

$$\text{DC voltage} = \frac{(\text{Sensor Temperature in } °F + 459.4)}{180}$$

   The voltage drop across HL&CL and OL&CL should be approximately equal when both sensors are working properly.

   NOTE: A measured voltage of 24 Vdc indicates an open circuit or faulty sensor. Check for loose connections and wire continuity before replacing sensor.

7. Disconnect sensor from HL, CL, and OL terminals. Confirm 24 Vdc at HL&CL and OL&CL using a DC voltmeter.
8. If both sensors are operating properly (step 6) and sensor or hi-limit error light is on, replace controller.

# Replacement Parts Section 8

## 8.1 ORDERING

Replacement parts or a replacement electric boiler may be purchased through any Allied Engineering Company distributor – call us if you need help locating a distributor near your area. If you require any technical assistance or have any comments about our product, please write or phone us at:

Service Department
Allied Engineering Company
94 Riverside Drive
North Vancouver, B.C. CANADA
V7H 2M6
Tel (604) 929-1214 Fax (604) 929-5184
Email: sales@alliedboilers.com

| NO. | DESCRIPTION |
|---|---|
| 1 | LEFT PANEL |
| 2 | FLANGE TYPE ELEMENT |
| 3 | GASKET FOR FLANGE TYPE ELEMENT |
| 4 | TANK ASSEMBLY (SHOWN WITH FLANGE ELEMENTS) |
| 5 | MOUNTING BRACKET |
| 6 | CASING |
| 7 | TERMINAL BLOCK (TB3 – SOME MODELS) |
| 8 | GROUND LUG (TB2) |
| 9 | CONTACTOR |
| 10 | CONTROLLER MOUNTING PLATE |
| 11 | BITRONIC CONTROLLER |
| 12 | FUSE BLOCK (SOME MODELS) |
| 13 | FUSE (SOME MODELS) |
| 14 | ANTI–CYCLING CUBE |
| 15 | MAIN POWER SUPPLY TERMINAL BLOCK (TB1) |
| 16 | FRONT CASING PANEL |
| 17 | HIGH LIMIT & OPERATING SENSOR ASSEMBLY |
| 18 | RIGHT PANEL |

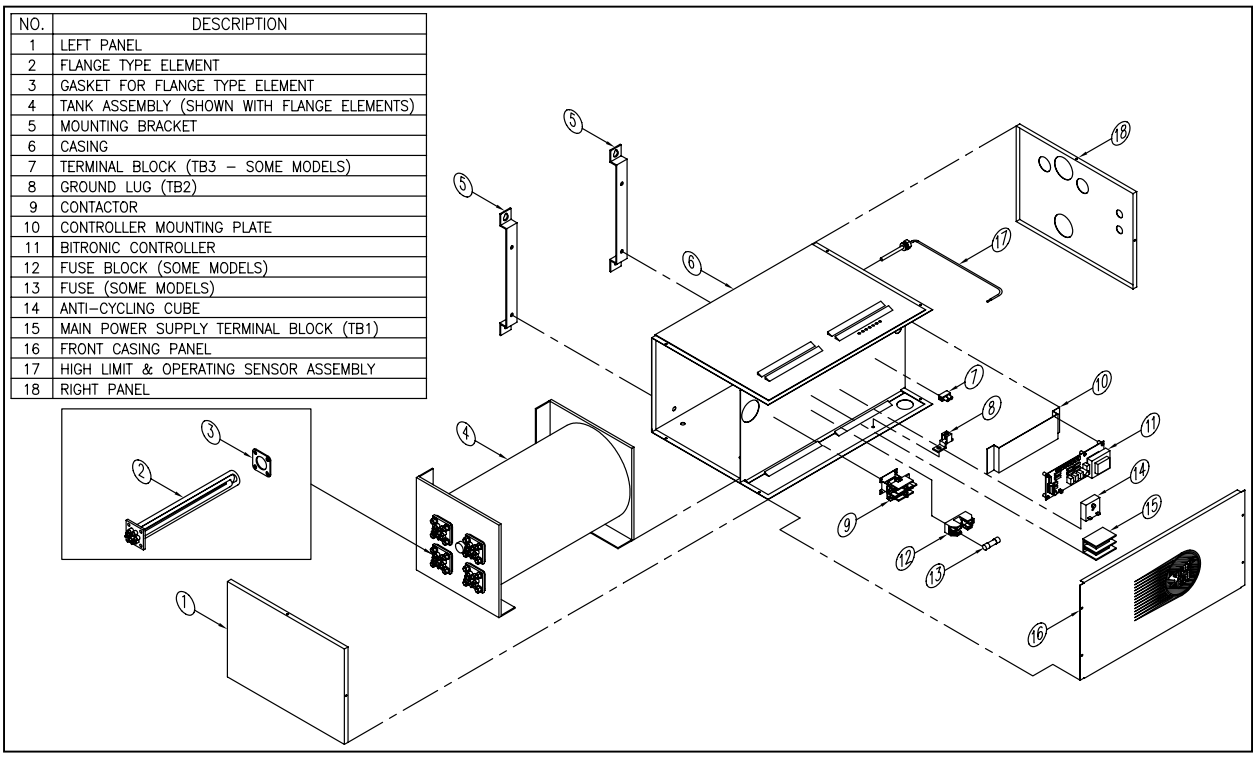

**Figure 4 – Replacement Parts**

## Notes Section 9

# Index Section 10

## 11.0 INDEX