AERCO
A WATTS Brand

## Operation and Maintenance Manual

# Benchmark® Boilers – Korea

Natural Gas Fired
Modulating & Condensing Boilers

Models 750 through 3000


**Other documents for this product include:**

OMM-0127, GF-205-K Installation & Startup Manual
TAG-0019, GF-2070 Boiler Application Guide
TAG-0022, GF-2050 Vent-Combustion Air Guide
TAG-0047, GF-2030 Benchmark Gas Guide
TAG-0048, GF-2060 Benchmark Power Guide

**Applies to serial number:**

G-19-0001 and above

**U.S. Patent #: 9,243,848**
**Korea Patent #: 10-1755141**



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# FOREWORD

The AERCO Benchmark (BMK) 750, 1000, 1500, 2000, 2500, and 3000 natural gas fueled boilers are modulating and condensing units. They represent a true industry advance that meets the needs of today's energy and environmental concerns. Designed for application in any closed loop hydronic system, the Benchmark's modulating capability relates energy input directly to fluctuating system loads. These BMK models provide extremely high efficiency operation and are ideally suited for modern low temperature, as well as, conventional heating systems.

The Benchmark models operate within the following input and output ranges:

**Boiler Intake and Output Ranges**

| MODEL | INPUT RANGE (BTU/HR.) | | OUTPUT RANGE (BTU/HR.) | |
|---|---|---|---|---|
| | MINIMUM | MAXIMUM | MINIMUM | MAXIMUM |
| **BMK 750** | 50,000 (14.6 kW) | 750,000 (220 kW) | 47,750 (14 kW) | 716,250 (210 kW) |
| **BMK 1000** | 50,000 (14.6 kW) | 1,000,000 (293 kW) | 48,300 (14.15 kW) | 968,000 (284 kW) |
| **BMK 1500** | 75,000 (22 kW) | 1,500,000 (440 kW) | 64,500 (18.9 kW) | 1,395,000 (409 kW) |
| **BMK 2000** | 100,000 (29.3 kW) | 2,000,000 (586 kW) | 86,000 (25.2 kW) | 1,860,000 (545 kW) |
| **BMK 2500** | 167,000 (48.9 kW) | 2,500,000 (732 kW) | 144,000 (42.2 kW) | 2,395,000 (702 kW) |
| **BMK 3000** | 200,000 (58.6 kW) | 3,000,000 (879 kW) | 174,000 (51.0 kW) | 2,874,000 (842 kW) |

The output of the boiler is a function of the unit's firing rate (valve position) and return water temperature.

Whether used in singular or modular arrangements, the BMK boilers offer the maximum venting flexibility with minimum installation space requirements. These boilers are Category II and IV, positive pressure appliances. Single and/or multiple breeched units are capable of operation in the following vent configurations:

- **Room Combustion Air:**
  - Vertical Discharge
  - Horizontal Discharge
- **Ducted Combustion Air:**
  - Vertical Discharge
  - Horizontal Discharge

These boilers are capable of being vented utilizing Polypropylene and AL29-4C vent systems.

The Benchmark's advanced electronics are available in several selectable modes of operation offering the most efficient operating methods and energy management system integration.

| AERCO Technical Terminology Meanings | |
|---|---|
| **TERMINOLOGY** | **MEANING** |
| A (Amp) | Ampere |
| ACS | AERCO Control System, AERCO's boiler management systems |
| ADDR | Address |
| AGND | Analog Ground |
| ALRM | Alarm |
| ANSI | American National Standards Institute, |
| ASME | American Society of Mechanical Engineers |
| AUX | Auxiliary |
| BAS | Building Automation System, often used interchangeably with EMS (see below) |
| Baud Rate | Symbol rate, or simply the number of distinct symbol changes (signaling events) transmitted per second. It is not equal to bits per second, unless each symbol is 1 bit long. |
| BMK (Benchmark) | AERCO's Benchmark series boilers |
| BMS or BMS II | AERCO Boiler Management Systems |
| BLDG (Bldg) | Building |
| BST | AERCO on-board Boiler Sequencing Technology |
| BTU | British Thermal Unit. A unit of energy approximately equal to the heat required to raise 1 pound (0.45 kg) of water 1°F (0.55 °C) |
| BTU/HR | BTUs per Hour (1 BTU/hr = 0.29 W) |
| CCP | Combination Control Panel |
| CCS | Combination Control System |
| C-More Controller | A control system developed by AERCO and currently used in all Benchmark, Innovation and KC1000 Series product lines. |
| CFH | Cubic Feet per Hour (1 CFH = 0.028 $m^3$/hr) |
| CO | Carbon Monoxide |
| COMM (Comm) | Communication |
| Cal. | Calibration |
| CNTL | Control |
| CPU | Central Processing Unit |
| DBB | Double Block and Bleed, a gas trains containing 2 Safety Shutoff Valves (SSOVs) and a solenoid operated vent valve. |
| DIP | Dual In-Line Package, a type of switch |
| ECU | Electronic Control Unit ($O_2$ sensor) |
| EMS | Energy Management System; often used interchangeably with BAS |
| FM | Factory Mutual. Used to define boiler gas trains. |
| GF-xxxx | Gas Fired (an AERCO document numbering system) |
| GND | Ground |

| AERCO Technical Terminology Meanings | |
|---|---|
| **TERMINOLOGY** | **MEANING** |
| HDR | Header |
| Hex | Hexadecimal Number (0 – 9, A – F) |
| HP | Horse Power |
| HX | Heat Exchanger |
| Hz | Hertz (Cycles Per Second) |
| I.D. | Inside Diameter |
| IGN | Ignition |
| IGST Board | Ignition/Stepper Board, contained in the C-More Controller |
| INTLK (INTL'K) | Interlock |
| I/O | Input/Output |
| I/O Box | Input/Output (I/O) Box currently used on Benchmark, Innovation and KC1000 Series products |
| IP | Internet Protocol |
| ISO | International Organization for Standardization |
| Lbs. | Pounds (1 lb = 0.45 kg) |
| LED | Light Emitting Diode |
| LN | Low Nitrogen Oxide |
| MA (mA) | Milliampere (1 thousand$^{th}$ of an ampere) |
| MAX (Max) | Maximum |
| MBH | 1000 BTUs per Hour |
| MIN (Min) | Minimum |
| Modbus® | A serial, half-duplex data transmission protocol developed by AEG Modicon |
| NC (N.C.) | Normally Closed |
| NO (N.O.) | Normally Open |
| $NO_x$ | Nitrogen Oxide |
| NPT | National Pipe Thread |
| $O_2$ | Oxygen |
| O.D. | Outside Diameter |
| OMM & O&M | Operation and Maintenance Manual |
| onAER | AERCO's on-line remote monitoring system |
| PCB | Printed Circuit Board |
| PMC Board | Primary Micro-Controller (PMC) board, contained in the C-More |
| P/N | Part Number |
| POC | Proof of Closure |
| PPM | Parts per Million |
| PSI | Pounds per Square Inch (1 PSI = 6.89 kPa) |
| PTP | Point-to-Point (usually over RS232 networks) |

| AERCO Technical Terminology Meanings | |
|---|---|
| **TERMINOLOGY** | **MEANING** |
| P&T | Pressure and Temperature |
| ProtoNode | Hardware interface between BAS and a boiler or water heater |
| PVC | Poly Vinyl Chloride, a common synthetic plastic |
| PWM | Pulse Width Modulation |
| REF (Ref) | Reference |
| RES. | Resistive |
| RS232 (or EIA-232) | A standard for serial, full-duplex (FDX) transmission of data based on the RS232 Standard |
| RS422 (or EIA-422) | A standard for serial, full-duplex (FDX) transmission of data based on the RS422 Standard |
| RS485 (or EIA-485) | A standard for serial, half-duplex (HDX) transmission of data based on the RS485 Standard |
| RTN (Rtn) | Return |
| SETPT (Setpt) | Setpoint Temperature |
| SHLD (Shld) | Shield |
| SPDT | Single Pole Double Throw, a type of switch |
| SSOV | Safety Shut Off Valve |
| TEMP (Temp) | Temperature |
| Terminating Resistor | A resistor placed at each end of a daisy-chain or multi-drop network in order to prevent reflections that may cause invalid data in the communication |
| Tip-N-Tell | A device that indicates if a package was tipped during shipping |
| UL | A business that tests and validates products |
| VAC | Volts, Alternating Current |
| VDC | Volts, Direct Current |
| VFD | Vacuum Fluorescent Display, also Variable Frequency Drive |
| W | Watt |
| W.C. | Water Column, a unit of pressure (1 inch W.C. = 249 Pa) |
| µA | Micro amp (1 million$^{th}$ of an ampere) |

# SECTION 1: SAFETY PRECAUTIONS

## 1.1 WARNINGS & CAUTIONS

Installers and operating personnel MUST, at all times, observe all safety regulations. The following warnings and cautions are general and must be given the same attention as specific precautions included in these instructions. In addition to all the requirements included in this AERCO Instruction Manual, the installation of units MUST conform with local building codes. Authorities having jurisdiction should be consulted before installations are made.

**IMPORTANT!**

This manual is an integral part of the product and must be maintained in legible condition. It must be given to the user by the installer and kept in a safe place for future reference.

**WARNING!**

- Do not use matches, candles, flames, or other sources of ignition to check for gas leaks.
- Fluids under pressure may cause injury to personnel or damage to equipment when released. Be sure to shut off all incoming and outgoing water shutoff valves. Carefully decrease all trapped pressures to zero before performing maintenance.
- Before attempting to perform any maintenance on the unit, shut off all gas and electrical inputs to the unit.
- The exhaust vent pipe of the unit operates under a positive pressure and therefore must be completely sealed to prevent leakage of combustion products into living spaces.
- Electrical voltages up to **220** VAC (BMK 750 – 2000) or **220** or **380** VAC (BMK 2500/3000) may be used in this equipment. Therefore the cover on the unit's power box (located behind the front panel door) must be installed at all times, except during maintenance and servicing.
- A three-pole switch must be installed on the electrical supply line of the unit. The switch must be installed in an easily accessible position to quickly and safely disconnect electrical service. Do not affix switch to unit sheet metal enclosures.

**CAUTION!**

- Many soaps used for gas pipe leak testing are corrosive to metals. The piping must be rinsed thoroughly with clean water after leak checks have been completed.
- DO NOT use this boiler if any part has been under water. Call a qualified service technician to inspect and replace any part that has been under water.

## 1.2 EMERGENCY SHUTDOWN

If overheating occurs or the gas supply fails to shut off, close the manual gas shutoff valve (Figure 1-1) located external to the unit.

> NOTE:
> The Installer must identify and indicate the location of the emergency shutdown manual gas valve to operating personnel.


***Figure 1-1: Manual Gas Shutoff Valve***

In addition, to ensure safety an emergency shutdown procedure that addresses the following points should be designed and implement at the site:

- For automatically operated unattended boilers located in a boiler room, provide a manually operated remote shutdown switch or circuit breaker located just inside or outside each boiler room door. Design the system so activation of the emergency shutdown switch or circuit breaker will immediately shut off the fuel supply to the unit(s).
- For automatically operated unattended boilers in a location other than a boiler room, provide a manually operated remote shutdown switch or circuit breaker marked for easy identification at a location readily accessible in the event of boiler mis-operation.
- Design the system so activation of the emergency shutdown switch or circuit breaker will immediately shut off the fuel.
- For boilers monitored and/or operated from a continuously occupied control room, provide an emergency shutdown switch in the control room that is hard-wired to immediately shut off the fuel upon activation.

## 1.3 PROLONGED SHUTDOWN

If there is an emergency, turn off the electrical power supply to the AERCO boiler and close the manual gas valve located upstream from the unit. The installer must identify the emergency shut-off device.

If the unit is being shut down for an extended period of time, such as a year or more, complete the instructions in Section 4.10: *Shutting Boiler Down For Extended Period*.

After prolonged shutdown, it is recommended that the startup procedures and safety device test procedures, described in Section 4 and 5, respectively of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide – Korea,* OMM-0127 (GF-205-K) be performed to verify all system-operating parameters.

# SECTION 2: OPERATION

## 2.1 INTRODUCTION

The information in this section provides a guide to the operation of the Benchmark Boiler using the C-More Controller mounted on the front of the unit. It is imperative that the initial startup of this unit be performed by factory trained personnel. Operation prior to initial startup by factory trained personnel may void the equipment warranty. In addition, the following WARNINGS and CAUTIONS must be observed at all times.

**WARNING!**

- ELECTRICAL VOLTAGES IN THIS SYSTEM INCLUDE **220 VAC (BMK 750 – 2000) and 220 or 380 VAC (BMK 2500/3000) and 24 volts AC**. It must be serviced only by factory certified service technicians.
- **DO NOT ATTEMPT TO DRY FIRE THE UNIT**. Starting the unit without a full water level can seriously damage the unit and may result in injury to personnel or property damage. This situation will void any warranty.

**CAUTION!**

All of the installation procedures in the *Benchmark 750 – 3000 Boiler Installation and Startup Guide*, OMM-0127 (GF-205-K) must be completed before attempting to start the unit.

## 2.2 C-MORE CONTROLLER DESCRIPTION

All Benchmark boilers utilize the C-More Controller shown in Figure 2-1. It contains all of the controls, indicators and displays necessary to operate, adjust and troubleshoot the boiler. These operating controls, indicators and displays are listed and described in Table 2-1. Additional information on these items is provided in the individual operating procedures and menu descriptions provided in this section.

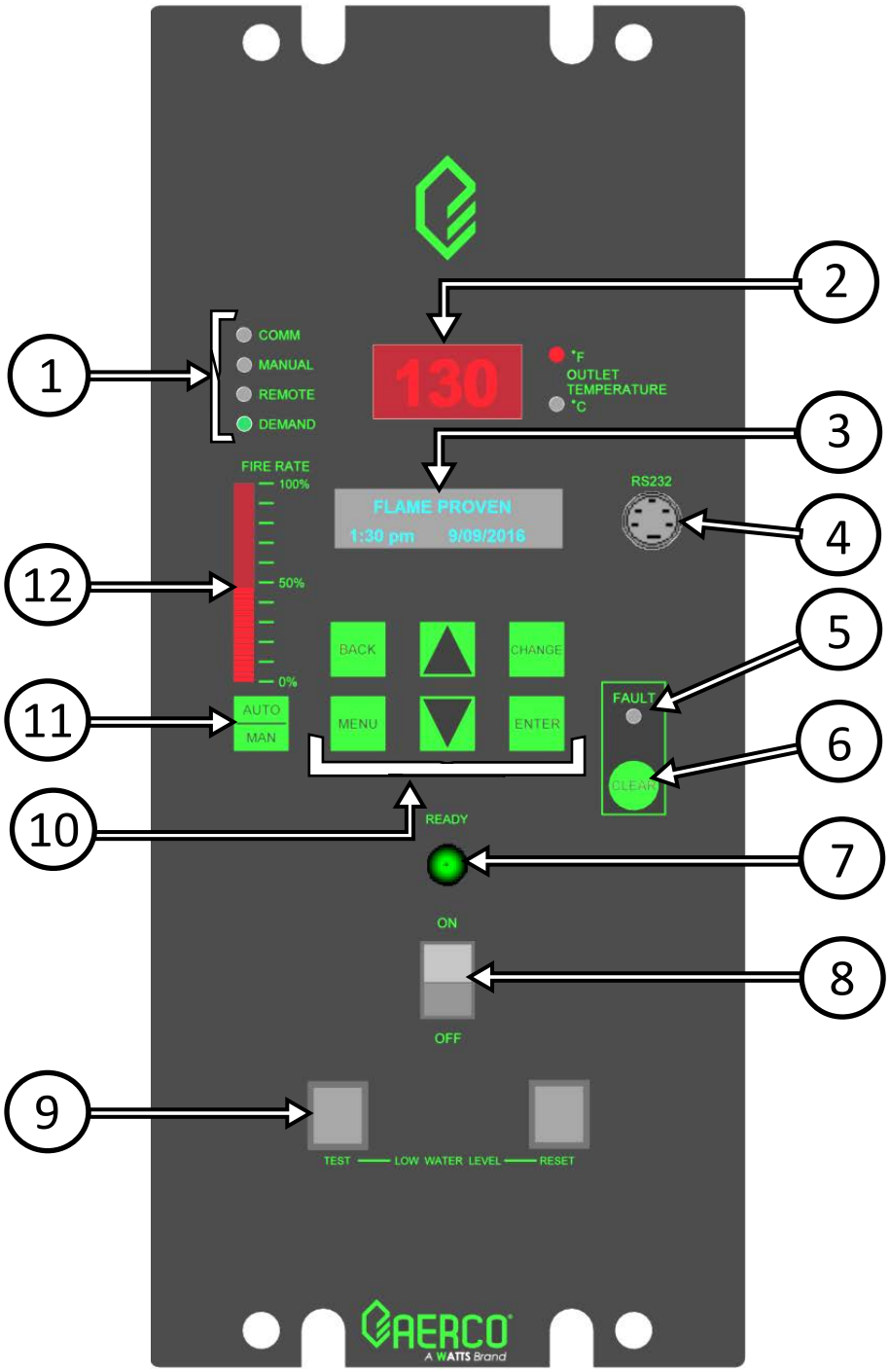



***Figure 2-1: C-More Controller Front View***

| TABLE 2-1: Controls, Indicators, and Displays (ref. Figure 2-1) | | |
|---|---|---|
| **ITEM** | **CONTROL, INDICATOR or DISPLAY** | **FUNCTION** |
| **1** | **LED STATUS INDICATORS**<br>Four Status LEDs indicate the current operating status as follows: | |
| | **COMM =** | Lights when RS232 communication is occurring – see Item 4. |
| | **MANUAL =** | Lights when the valve position (fire rate) is being controlled using the front panel keypad. This mode of operation is for service technician use only. |
| | **REMOTE =** | Lights when the unit is being controlled by an external signal from an Energy Management System. |
| | **DEMAND =** | Lights when there is a demand for heat. |
| **2** | **OUTLET TEMPERATURE** Display | 3–Digit, 7–Segment LED display continuously displays the outlet water temperature. The **°F** or **°C** LED next to the display lights to indicate whether the displayed temperature is in degrees Fahrenheit or degrees Celsius. The **°F** or **°C** blinks when operating in the DEADBAND mode.<br>On a BST Manager, display flashes & shows header temperature. |
| **3** | **VFD** Display | Vacuum Fluorescent Display (VFD) consists of 2 lines each capable of displaying up to 16 alphanumeric characters. The information displayed includes:<br>• Startup Messages<br>• Fault Messages<br>• Operating Status Messages<br>• Menu Selection<br>• BST Messages |
| **4** | **RS232** Port | This port is used only by factory-trained personnel to monitor onAER communications, in combination with the RS232 Adaptor Cable (P/N **124675**). |
| **5** | **FAULT** Indicator | Red **FAULT** LED indicator lights when a boiler alarm condition occurs. An alarm message will appear in the VFD. |
| **6** | **CLEAR** Key | Turns off the **FAULT** indicator and clears the alarm message if the alarm is no longer valid. Lockout type alarms will be latched and cannot be cleared by simply pressing this key. Troubleshooting may be required to clear these types of alarms. |
| **7** | **READY** Indicator | Lights when ON/OFF switch is set to **ON** and when all Pre-Purge conditions have been satisfied. |
| **8** | **ON/OFF** switch | Enables and disables boiler operation. |
| **9** | **LOW WATER LEVEL TEST/RESET** switches | • Allows operator to test operation of the water level monitor.<br>• Pressing **TEST** opens the water level probe circuit and simulates a Low Water Level alarm.<br>• Pressing **RESET** resets the water level monitor circuit.<br>• Pressing the **CLEAR** key (item 6) resets the display. |

**TABLE 2-1: Controls, Indicators, and Displays (ref. Figure 2-1)**

| ITEM | CONTROL, INDICATOR or DISPLAY | FUNCTION |
|---|---|---|
| 10 | **MENU KEYPAD** | Six (6) keys which provide the following functions for the C-More Controller menus: |

| | |
|---|---|
| **MENU** | Steps through the main menu categories shown in Figure 2-2. The menu categories wrap around in the order shown. |
| **BACK** | Allows you to go back to the previous menu level without changing any information. Continuously pressing this key will bring you back to the default status display in the VFD. Also, this key allows you to go back to the top of a main menu category. |
| ▲ (UP) Arrow | When in one of the main menu categories (Figure 2-2), pressing the ▲ arrow key will select the displayed menu category. If the **CHANGE** key was pressed and the menu item is flashing, pressing the ▲ arrow key will increment the selected setting. |
| ▼ (DOWN) Arrow | When in one of the main menu categories (Figure 2-2), pressing this key will select the displayed menu category. If the **CHANGE** key was pressed and the menu item is flashing, pressing the ▼ arrow key will decrement the selected setting. |
| **CHANGE** | Permits a setting to be changed (edited). When the **CHANGE** key is pressed, the displayed menu item will begin to flash. Pressing the ▲ or ▼ arrow key when the item is flashing will increment or decrement the displayed setting. |
| **ENTER** | Saves the modified menu settings in memory. The display will stop flashing. |

| | | |
|---|---|---|
| 11 | **AUTO/MAN** switch | This switch toggles the boiler between the AUTOMATIC and MANUAL modes of operation. When in the MANUAL (**MAN)** mode, the front panel controls are enabled and the **MANUAL** status LED lights. Manual operation is for service only.<br>When in the AUTOMATIC (**AUTO)** mode, the **MANUAL** status LED will be off and the front panel controls disabled. |
| 12 | **VALVE POSITION** Bargraph | 20 segment red LED bargraph continuously shows the Air/Fuel Valve position in 5% increments from 0 to 100% |

# 2.3 C-MORE CONTROLLER MENUS

The C-More Controller incorporates an extensive menu structure which permits the operator to set up, and configure the unit. The menu structure consists of five major menu categories which are applicable to this manual. These categories are shown in Figure 2-2. Each of the menus shown, contain options which permit operating parameters to be viewed or changed. The menus are protected by password levels to prevent unauthorized use.

Prior to entering the correct password, the options contained in the *Operation*, *Setup*, *Configuration* and *Tuning* menu categories can be viewed. However, with the exception of Internal Setpoint Temperature (*Configuration* menu), none of the viewable menu options can be changed.

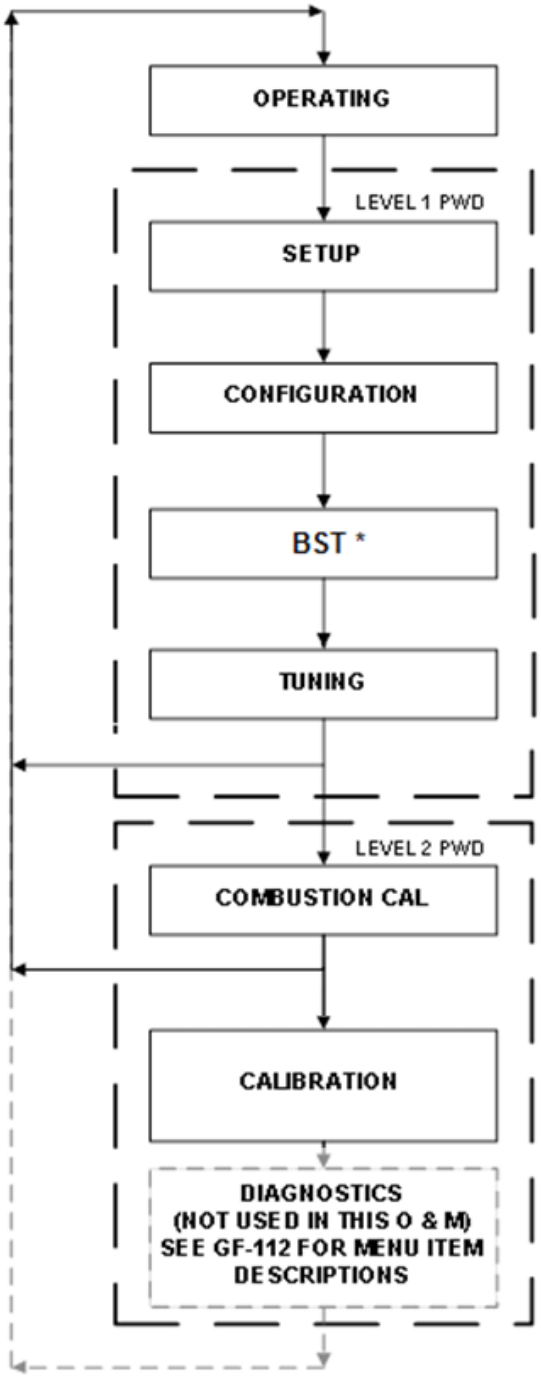
Once the valid **level 1 password (159)** is entered, the options listed in the *Setup*, *Configuration* and *Tuning* menus can be viewed and changed, if desired. The *Combustion Cal* menu is protected by the **level 2 password (6817)**, which is used in initial startup (see Section 4: *Initial Startup* of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide*, OMM-0127 (GF-205-K)), to perform combustion calibration prior to service use.

## 2.3.1 Menu Navigation and Processing Procedure

Accessing and initiating each menu and option is accomplished using the menu keys shown in Figure 2-1. Therefore, it is imperative that you be thoroughly familiar with the following basic steps before attempting to perform specific menu procedures:

### Menu Navigation and Processing Procedure Instructions

1. The C-More Controller will normally be in the *Operating* menu and the VFD will display the current unit status. Pressing the ▲ or ▼ arrow key will display the other available data items in the *Operating* menu.
2. Press the **MENU** key. The display will show the *Setup* menu, which is the next menu category shown in Figure 2-2. This menu contains the Password option which must be entered if other menu options will be changed.
3. Continue pressing the **MENU** key until the desired menu is displayed.
4. With the desired menu displayed, press the ▲ or ▼ arrow key. The first option in the selected menu will be displayed.
5. Continue to press the ▲ or ▼ arrow key until the desired menu option is displayed. Pressing the ▲ arrow key will display the available menu options in the Top-Down sequence. Pressing the ▼ arrow key will display the options in the Bottom-Up sequence. The menu options will wrap-around after the first or last available option is reached.
6. To change the value or setting of a displayed menu option, press the **CHANGE** key. The displayed option will begin to flash. Press the ▲ or ▼ arrow key to scroll through the available menu option choices for the option to be changed. The menu option choices do not wrap around.
7. To select and store a changed menu item, press the **ENTER** key.




* Only if BST (Boiler Sequencing Technology) is enabled. BST is described in detail in Section 6 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide*, OMM-0127 (GF-205-K).

***Figure 2-2: Menu Structure***

NOTE:

The following sections provide brief descriptions of the options contained in each menu. Refer to Appendix A for detailed descriptions of each menu option. Refer to Appendix B for a list and descriptions of startup, status and error messages.

## 2.4 OPERATING Menu

The *Operating* menu displays a number of key operating parameters for the unit. All items in this menu except *O2 Monitor* (item 15) are "Read-Only" and cannot be changed. This menu can be accessed without entering a password.

A full description of each item appears in Appendix A-1.

**TABLE 2-2: OPERATING Menu**

| MENU ITEM DISPLAY | | AVAILABLE CHOICES OR LIMITS | | MUST BE ENABLED IN: |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| **1** | Active Setpoint | 40°F (4.4°C) | 240°F (116°C) | |
| **2** | Outlet Temp | 30°F (-1.1°C) | 240°F (116°C) | Configuration Menu |
| **3** | Inlet Temp | 30°F (-1.1°C) | 240°F (116°C) | |
| **4** | Air Temp | -70°F (-56.7°C) | 245°F (118°C) | |
| **5** | Outdoor Temp | -70°F (-56.7°C) | 130°F (54.4°C) | Configuration Menu |
| **6** | Valve Position In | 0% | 100% | |
| **7** | Valve Position Out | 0% | 100% | Configuration Menu |
| **8** | FFWD Temp | 30°F (-1.1°C) | 240°F (115.6°C) | |
| **9** | Exhaust Temp | Displays current exhaust temperature | | |
| **10** | Flame Strength | 0% | 100% | |
| **11** | Min Flame Str | Not Used | | |
| **12** | O2 Monitor | Enable | Disable | O2 Monitor = Enabled |
| **13** | Oxygen Level | 0% | 21% | |
| **14** | Ignition Time | 0.00 | 10.00 | |
| **15** | SSOV Time to OPN | 0.00 | 10.00 | |
| **16** | Spark Current | 0 amps | 2.5 amps | |
| **17** | Run Cycles | 0 | 999,999,999 | |
| **18** | Run Hours | 0 | 999,999,999 | |
| **19** | Fault Log | 0 | 19 | |

An additional parameter associated with the Operating menu, **Manual Valve Pos** (Min = 0, Max = 100) does not appear in this menu, but can be displayed by pushing the **Auto/Man** button on the C-More Controller's front face.

## 2.5 SETUP Menu

The *Setup* menu permits the operator to enter the unit password (159) which is required to change the menu options. To prevent unauthorized use, the password will time-out after 1 hour. Therefore, the correct password must be reentered when required. In addition to permitting password entries, the *Setup* menu is also used to enter date and time, and units of temperature measurements. A view-only software version display is also provided to indicate the current C-More Controller software version.

A full description of each item appears in Appendix A-2.

**TABLE 2-3: SETUP Menu**

| MENU ITEM DISPLAY | | AVAILABLE CHOICES OR LIMITS | | DEFAULT |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| **1** | Password | 0 | 9999 | 0 |
| **2** | Language | English | | English |
| **3** | Time | 12:00 am | 11:59 pm | 12:00 |
| **4** | Date | 01/01/00 | 12/31/99 | 01/01/00 |
| **5** | Unit of Temp | Fahrenheit or Celsius | | Fahrenheit |
| **6** | Comm Address | 0 | 127 | 0 |
| **7** | Baud Rate | 2400, 4800, 9600, 19.2K | | 9600 |
| **8** | onAER Mode | Ethernet or SD Card | | Ethernet |
| **9** | Min Upload Timer | 0 | 9,999 Sec | 0 |
| **10** | Unit Alpha | E, G, H, R, N or A | | A |
| **11** | Unit Year | 0 | 99 | 0 |
| **12** | Unit Serial # | 0 | 9999 | 0 |
| **13** | Software | Ver 0.00 | Ver 9.99 | Current software version |

## 2.6 CONFIGURATION Menu

The *Configuration* menu permits adjustment of the Internal Setpoint (Setpt) temperature regardless of whether the valid password has been entered. Setpt is required for operation in the CONSTANT SETPOINT mode. The remaining options in this menu require the valid password to be entered, prior to changing existing entries. This menu contains a number of other configuration settings which may or may not be displayed, depending on the current operating mode setting.

A full description of each item appears in Appendix A-3.

> NOTE:
> The *Configuration* menu settings are Factory-Set in accordance with the requirements specified for each individual order. Under normal operating conditions, no changes will be required.

**TABLE 2-4: CONFIGURATION Menu**

| MENU ITEM DISPLAY | | AVAILABLE CHOICES OR LIMITS | | DEFAULT |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| **1** | Internal Setpt | 40°F (4.4°C) | 240°F (115.6°C) | 130°F (54.4°C) |
| **2** | Unit Type | BMK Blr Std, BMK Blr Std Dual, BMK Blr LN, BMK Blr LN Dual | | BMK Boiler LN |
| **3** | Unit Size (Only displays sizes available for the unit) | 750 MBH (220 kW), 1000 MBH (293 kW), 1500 MBH (439.6 kW), 2000 MBH (586.1 kW), 2500 MBH (732.6 kW), 3000 MBH (879.2 kW) | | 750 MBH (220 kW), |
| **4** | Fuel Type | Natural Gas or Propane | | Natural Gas in standard models |
| **5** | Boiler Mode | Constant Setpoint, Remote Setpoint, Direct Drive, Combination, Outdoor Reset | | Constant Setpoint |
| **6** | Remote Signal (If Mode = Remote Setpoint, Direct Drive or Combination) | 4 – 20 mA/1 – 5V<br>0 -20 mA/0 – 5V<br>PWM Input (Legacy BMS), Network | | 4 – 20 mA,<br>1-5V |
| **7** | Outdoor Sensor | Enabled or Disabled | | Disabled |
| **8** | * Bldg Ref Temp (If Mode = Outdoor Reset) | 40°F (4.4°C) | 230°F (110°C) | 70°F (21.1°C) |
| **9** | * Reset Ratio (If Mode = Outdoor Reset) | 0.1 | 9.9 | 1.2 |
| **10** | * System Start Tmp (If Outdoor Sensor = Enabled) | 30°F (-1.1°C) | 100°F (37.8°C) | 60°F (15.6°C) |
| **11** | Setpt Lo Limit | 40°F (4.4°C) | Setpt Hi Limit | 60°F (15.6°C) |

**TABLE 2-4: CONFIGURATION Menu**

| MENU ITEM DISPLAY | | AVAILABLE CHOICES OR LIMITS | | DEFAULT |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| **12** | Setpt Hi Limit | Setpt Lo Limit | 210°F (98.9°C) | 180°F (82.2°C) |
| **13** | Temp Hi Limit | 40°F (4.4°C) | 210°F (98.9°C) | 195°F (90.6°C) |
| **14** | Max Valve Position | 40% | 100% | 100% |
| **15** | Pump Delay Timer | 0 min. | 30 min. | 0 min. |
| **16** | Aux Start On Dly | 0 sec. | 120 sec. | 0 sec. |
| **17** | Failsafe Mode | Shutdown or Constant Setpt | | Constant Setpt |
| **18** | Analog Output | Off, Setpoint, Outlet Temp, Valve Pos 4-20mA, valve Pos 0-10v | | Valve Pos 0-10v (Do NOT change) |
| **19** | Low Fire Timer | 2 sec. | 600 sec. | 2 sec. |
| **20** | Setpt Limiting | Enabled or Disabled | | Disabled |
| **21** | Setpt Limit Band | 0°F (0°C) | 10°F (5.5°C) | 5°F (2.75°C) |
| **22** | Network Timeout | 5 sec. | 999 sec. | 30 sec. |
| **23** | Shutoff Dly Temp | 0°F (0°C) | 25°F (13.75°C) | 10°F (5.5°C) |
| **24** | Demand Offset | 0°F (0°C) | 25°F (13.75°C) | 10°F (5.5°C) |
| **25** | Deadband High | 0°F (0°C) | 25°F (13.75°C) | 5°F (2.75°C) |
| **26** | Deadband Low | 0°F (0°C) | 25°F (13.75°C) | 5°F (2.75°C) |
| **27** | IGST Version | Displays current IGST version | | V2.02 |
| **28** | IGN Time Setting | Displays 4 sec. or 7 sec. depending on wiring harness installed | | |
| **29** | Slow Shutdown | Enabled or Disabled | | Disabled |
| **30** | Slow Sht Duration | 0 sec. | 9,999 sec. | 60 sec. |
| **31** | Slow Sht Threshold | 40% | 100% | 60 |
| **32** | O2 Warnings | Enabled or Disabled | | Disabled |
| **33** | O2 Trim ID | Displays 4 digit AERtrim ID | | |
| **34** | Fixed ID | Displays unit's fixed 4 digit ID | | |
| **35** | O2 Trim Key | Displays AERtrim 4 digit license key | | |
| **36** | O2 Trim Menu | Enabled or Disabled | | Disabled |
| **37** | BST Menu | Enabled or Disabled | | Disabled |

*NOTE:

The *Bldg Ref Temp* and *Reset Ratio* menu Items are only displayed when the *Outdoor Sensor,* item # 7 is set to **Enabled**.

CAUTION!

**DO NOT change** the *Analog Output* menu item from its default setting (Valve Position 0-10V).

## 2.7 TUNING Menu

The *Tuning* menu items are Factory set for each individual unit. Do not change these menu entries unless specifically requested to do so by factory-trained personnel.

A full description of each item appears in Appendix A-4.

**TABLE 2-5: TUNING Menu**

| MENU ITEM DISPLAY | | MINIMUM | MAXIMUM | DEFAULT |
|---|---|---|---|---|
| 1 | Prop Band | 1°F (0.55°C) | 120°F (66°C) | 70°F (38.5°C) |
| 2 | Integral Gain | 0.00 | 2.00 | 1.00 |
| 3 | Derivative Time | 0.0 min | 2.00 min | 0.0min |
| 4 | Warmup Prop Band | 1°F (0.55°C) | 120°F (66°C) | 95 °F (52°C) |
| 5 | Warmup Int Gain | 0.00 | 2.00 | 0.50 |
| 6 | Warmup PID timer | 0 sec. | 240 sec. | 20 sec. |
| 7 | Reset Defaults? | Yes, No, Are You Sure? | | No |

## 2.8 COMBUSTION CAL Menu

The *Combustion Cal* (Calibration) menu is protected by the level 2 password (**6817**) which must be entered to view or change the menu items shown in Table 2-6, 2-7 and 2-8. These menu items are used to vary the speed of the unit's blower motor based on air temperature and air density at prescribed Air/Fuel Valve positions (% open). This is accomplished by providing a DC drive voltage to the motor, which then adjusts the rotational speed of the blower to maximize combustion efficiency and ensure the unit conforms to the Nitrogen Oxide ($NO_x$) and Carbon Monoxide (CO) emissions specified in the combustion calibration instructions in Section 4.3 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K).

CAL Voltage values are factory adjusted for each unit prior to shipping, and so may differ from the defaults shown in the tables below. A full description of each item appears in Appendix A-5.

### 2.8.1 BMK 750/1000 COMBUSTION CAL Menu

**TABLE 2-6: COMBUSTION CAL Menu: BMK 750/1000**

| MENU ITEM DISPLAY | | MINIMUM | MAXIMUM | DEFAULT |
|---|---|---|---|---|
| 1 | CAL Voltage 18% | 0.25 | 10.00 | 2.10 |
| 2 | CAL Voltage 30% | 0.25 | 10.00 | 2.55 |
| 3 | CAL Voltage 45% | 0.25 | 10.00 | 3.10 |
| 4 | CAL Voltage 60% | 0.25 | 10.00 | 3.50 |
| 5 | CAL Voltage 80% | 0.25 | 10.00 | 4.60 |
| 6 | CAL Voltage 100% | 0.25 | 10.00 | 5.60 |
| 7 | SET Valve Position | 0% | 100% | 0% |
| 8 | Blower Output | Monitor Blower Output Voltage | | 0.00 |
| 9 | Set Stdby Volt | 0 V | 10.0 V | 2.00 |
| 10 | Oxygen Level | 0% | 25% | 0.0 |

## 2.8.2 BMK 1500/2000 COMBUSTION CAL Menus

**TABLE 2-7: COMBUSTION CAL Menu: BMK 1500/2000**

| MENU ITEM DISPLAY | | MINIMUM | MAXIMUM | DEFAULTS | |
|---|---|---|---|---|---|
| | | | | BMK 1500 | BMK 2000 |
| 1 | CAL Voltage 16% | 0.25 | 10.00 | 1.80 | – |
| | CAL Voltage 18% | | | – | 1.40 |
| 2 | CAL Voltage 30% | 0.25 | 10.00 | 2.30 | 3.80 |
| 3 | CAL Voltage 40% | 0.25 | 10.00 | 2.50 | 4.30 |
| 4 | CAL Voltage 50% | 0.25 | 10.00 | 2.90 | 5.40 |
| 5 | CAL Voltage 70% | 0.25 | 10.00 | 3.80 | 6.40 |
| 6 | CAL Voltage 100% | 0.25 | 10.00 | 7.90 | 9.50 |
| 7 | SET Valve Position | 0% | 100% | Variable | |
| 8 | Blower Output | Displays current value | | | |
| 9 | Set Stdby Volt | 0 | 10.00 V | 2.00 V | 2.00 V |
| 10 | Oxygen Level | Displays current value | | | |

## 2.8.3 BMK 2500/3000 COMBUSTION CAL Menus

**TABLE 2-8: COMBUSTION CAL Menu: BMK 2500/3000**

| MENU ITEM DISPLAY | | MINIMUM | MAXIMUM | DEFAULTS | |
|---|---|---|---|---|---|
| | | | | BMK 2500 | BMK 3000 |
| 1 | CAL Voltage 16% | 0.25 | 10.00 | 2.20 | – |
| | CAL Voltage 14% | | | – | 2.80 |
| 2 | CAL Voltage 30% | 0.25 | 10.00 | 4.10 | 4.60 |
| 3 | CAL Voltage 40% | 0.25 | 10.00 | 4.80 | 5.00 |
| 4 | CAL Voltage 50% | 0.25 | 10.00 | 5.30 | 5.50 |
| 5 | CAL Voltage 70% | 0.25 | 10.00 | 6.80 | 6.90 |
| 6 | CAL Voltage 100% | 0.25 | 10.00 | 8.50 | 9.10 |
| 7 | SET Valve Position | 0% | 100% | Variable | |
| 8 | Blower Output | Displays current value | | | |
| 9 | Set Stdby Volt | 0 | 10.00 V | 2.00 V | 2.00 V |
| 10 | Oxygen Level | Displays current value | | | |

## 2.9 BST (Boiler Sequencing Technology) Menu

The *BST* menu must be enabled in order to be displayed and accessed. The **BST Menu** item, located at the end of the *Configuration* menu (item 37 in Table 2-4), must be set to **Enabled**.

The *BST* menu contains all of the items required to configure, operate and monitor the functionality of the BST System. There are over 50 items in this menu, and selecting any particular item from the list, for inspection or modification, could be time consuming. As a result, the *BST* menu has been segmented into FIVE logical groups based on functionality.

The five Item groups are:

1. **BST Monitor Items**
2. ***BST SETUP MENU***
3. ***OPERATE MENU***
4. ***TEMP CTRL MENU***
5. ***BST COMM MENU***

These displayed item groups are displayed in UPPER CASE letters, and are bounded by an asterisk * in order to readily identify them within the item list.

The Items contained in group 1 (BST Monitor Items) are *always* displayed within the menu, as these items are critical for proper system operation. Therefore, the BST Monitor Items Header itself is *not* displayed.

The Items contained in groups 2-5 *are not displayed* unless that particular item group has been enabled from the C-More keypad.

**TABLE 2-9: BST Menu**

| MENU ITEM DISPLAY | | AVAILABLE CHOICES OR LIMITS | | | DEFAULT |
|---|---|---|---|---|---|
| | | Minimum | | Maximum | |
| **1** | **BST Mode** | Off | BST Client | BST Manager | Off |
| **2** | BST Setpoint | BST Setpt Lo Limit | | BST Setpt Hi Limit | 130°F (54.4°C) |
| **3** | Header Temp | Read Only – current Header temperature in °F | | | N/A |
| **4** | BST Fire Rate | 0 | | 100% | Fire rate % |
| **5** | BST Ave Fire Rate | 0 | | 100% | Avg Fire Rate % |
| **6** | BST Outdoor Temp | Read Only – current outdoor temperature in °F | | | N/A |
| **7** | Units Available | 0 | | 8 | Units Present |
| **8** | Units Ignited | 0 | | 8 | Units firing |
| **9** | BST Valve State | 0 (CLOSED) | | 1 (OPEN) | 0 |
| **10** | 1 BST Comm Errors 8 | 0 | | 9 | 0 |
| **11** | 1 BST Units 8 | 0 – 8 (see * NOTE below) | | | 0 |
| **12** | ***BST SETUP MENU*** | Disabled | | Enabled | Disabled |
| **13** | BST Setpoint Mode | Constant Setpoint | Remote Setpoint | Outdoor Reset | Constant Setpt |
| **14** | BST Remote Signl | 4-20 mA/1-5 VDC | 0-20 mA/0-5 VDC | Network | Network |

## TABLE 2-9: BST Menu

| MENU ITEM DISPLAY | | AVAILABLE CHOICES OR LIMITS | | DEFAULT |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| **15** | Head Temp Source | Network | FFWD Temp | FFWD Temp |
| **16** | Mdbus Temp Units | Degrees C or Degrees F | | Degrees C |
| **17** | Header Temp Addr | 0 | 255 | 240 |
| **18** | Header Temp Point | 0 | 255 | 14 |
| **19** | BST Outdoor Sens | Disabled | Enabled | Disabled |
| **20** | Outdr Tmp Source | Outdoor Temp | Network | Outdoor Temp |
| **21** | Outdoor Tmp Addr | 0 | 255 | 240 |
| **22** | Outdoor Tmp Pnt | 0 | 255 | 215 |
| **23** | BST Auto Mstr | No | Yes<br>NOTE! A Modbus temperature transmitter must be installed in conjunction with this feature. | No |
| **24** | BST Auto Timer | 10 sec | 120 sec | 30 sec |
| **25** | Remote Intlk Use | Boiler Shutdown | System Shutdown | System Shutdown |
| **26** | One Boiler Mode | Off / On-Outlet Temp / On-Avg Temp | | Off |
| **27** | 1 Blr Threshold | 10 | 35 | 25 |
| **28** | Setpoint Setback | Disable | Enable | Disable |
| **29** | Setback Setpoint | BST Setpt Lo Limit | BST Setpt HI Limit | 130°F (54.4°C) |
| **30** | Setback Start | 12:00am | 11:59pm | 12.00am |
| **31** | Setback End | 12:00am | 11:59pm | 12.00am |
| **32** | Rate Threshold | 1°F (0.55°C) | 30°F (16.5°C) | 15°F (8.25°C) |
| **33** | ***OPERATE MENU*** | Disabled | Enabled | Disabled |
| **34** | BST Next On VP | 16% | 100% | 50% |
| **35** | BST Max Boilers | 1 | 8 | 8 |
| **36** | BST On Delay | 30 sec | 300 sec | 60 sec |
| **37** | BST On Timeout | 15 sec | 300 sec | 60 Sec |
| **38** | Valve Override | Off / Closed / Open | | Off |
| **39** | Valve Off Delay | 0 | 15 min | 1 min |
| **40** | BST Sequencing | Run Hours / Unit Size / Select Lead | | Run Hours |
| **41** | Select Lead Unit | 0 | 127 | 0 |
| **42** | Select Lag Unit | 0 | 127 | 0 |
| **43** | Lead/Lag Hours | 25 hours | 225 hours | 72 hours |
| **44** | ***TEMP CTRL MENU*** | Disabled | Enabled | Disabled |
| **45** | BST Temp Hi Limit | 40°F (4.4°C) | 210°F (98.9°C) | 210°F (98.9°C) |

## TABLE 2-9: BST Menu

| MENU ITEM DISPLAY | | AVAILABLE CHOICES OR LIMITS | | DEFAULT |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| **46** | BST Setpt Lo Limit | 40°F (4.4°C) | BST Setpt HI Limit | 60°F (15.5°C) |
| **47** | BST Setpt HI Limit | BST Setpt Lo Limit | 220°F (104.4°C) | 195°F (90.6°C) |
| **48** | BST Prop Band | 1°F (-17.2°C) | 120°F (48.9°C) | 100°F (37.8°C) |
| **49** | BST Intgral Gain | 0.00 | 2.00 | 0.50 |
| **50** | BST Deriv Time | 0.00 Min | 2.00 Min | 0.10 Min |
| **51** | BST Deadband Hi | 0 | 25 | 1 |
| **52** | BST Deadband Lo | 0 | 25 | 1 |
| **53** | Deadband En Time | 0 | 120 Sec | 30 Sec |
| **54** | BST FR Up Rate | 1 | 120 | 20 |
| **55** | BST Bldg Ref Tmp | 40°F (4.4°C) | 230°F (110°C) | 70°F (21.1°C) |
| **56** | BST Reset Ratio | 0.1 | 9.9 | 1.2 |
| **57** | System Start Tmp | 30°F (-1.1°C) | 120°F (48.9°C) | 60°F (15.6°C) |
| **58** | ***BST COMM MENU*** | Disabled | Enabled | Disabled |
| **59** | Comm Address | 0 | 127 | 0 |
| **60** | BST Min Addr | 1 | 128 | 1 |
| **61** | BST Max Addr | 1 | 128 | 8 |
| **62** | SSD Address | 0 | 250 | 247 |
| **63** | SSD Poll Control | 0 | 1000 | 0 |
| **64** | Err Threshold | 1 | 9 | 5 |
| **65** | SSD Temp Format | Degrees | Points | Degrees |
| **66** | BST Upld Timer | 0 | 9999 sec | 0 |

*** NOTE**:
The **1 BST Units 8** menu option (item 11) shows the current status for each unit controlled by BST, up to a maximum of 8 units. The possible characters displayed are:

- **-** = Off Line
- ***** = Not Available (fault, etc.)
- **0** = Off
- **1** = On,
- **A** = Lead On
- **a** = Lead Off
- **B** = Lag On
- **b** = Lag Off
- **S** = Setpoint Limit Active

The following example shows the status of 5 units being controlled by BST where:

Unit 1 & 3 are **On**
Unit 2 is **Off**
Unit 4 is **Not Available**
Unit 5 is **Lead On**
Unit 6 is **Lag Off**

1 BST Units 8

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 0 | 1 | * | A | b | | |

# 2.10 CALIBRATION MENU

The Calibration menu is used by factory trained service personnel to adjust or reset the parameters listed below.

A full description of each item appears in Appendix A-6.

**TABLE 2-10: Calibration Menu**

| MENU ITEM DISPLAY | | AVAILABLE CHOICES OR LIMITS | | DEFAULT |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| 1 | Stepper Fbk | Cal 0%, Verify 50%, Cal 100% | | Cal 0% |
| 2 | Purge Timer | 5 sec. | 60 sec | Depends on unit type/size |
| 3 | Post Purge Timer | 0 sec. | 60 sec. | 0 sec. |
| 4 | IGN Position | 5% | 60% | Depends on unit type/size |
| 5 | Ign Pos Hold Tmr | 0 sec. | 60 sec. | 0 sec. |
| 6 | FFWD Temp Disply | Enabled or Disabled | | Disabled |
| 7 | Outlet Tmp Dsply | Enabled or Disabled | | Disabled |
| 8 | Inlet Tmp Dsply | Enabled or Disabled | | Disabled |
| 9 | Valv Pos Out Dsp | Enabled or Disabled | | Enabled |
| 10 | Exhaust Tmp Dsp | Enabled or Disabled | | Disabled |
| 11 | Exhaust Safety | Enabled or Disabled | | Enabled |
| 12 | Flue Material | PVC,CPVC; PolyPro; Stainless | | PVC,CPVC |
| 13 | Exhst Fault Temp | 100 °F | 500 °F | 200 °F |
| 14 | Exhst Module Temp | 100 °F | 500 °F | 190 °F |
| 15 | Exhst Warn Temp | 100 °F | 500 °F | 180 °F |
| 16 | Exhst Tmp VP Adj | 0 | 10 | 5 |
| 17 | Exhst Adj Rate | 1 | 600 | 30 |
| 18 | VP Change Rate | 5 | 600 | 25 |
| 19 | VP Up Rate | 0.5 | 60.0 | Depends on unit type/size |
| 20 | VP Down Rate | 0.5 | 60.0 | Depends on unit type/size |
| 21 | Purge Blwr Offst | -1.0 | 8.0 | Depends on unit type/size |
| 22 | 4-20mA Purge Pct | 60% | 100% | 70% |
| 23 | PWM In Adj | -5.0% | 5.0% | 0.0% |
| 24 | Analog In Adj | -5.0% | 5.0% | 0.0% |
| 25 | Flow In Adj | -5.0% | 5.0% | 0.0% |
| 26 | Supply Gas Pressure In Adj | -5.0% | 5.0% | 0.0% |
| 27 | Gas Plate dp In Adj | -5.0% | 5.0% | 0.0% |
| 28 | mA Out Adj | -1.0 mA | 1.0 mA | 0.0 mA |
| 29 | A/F Sensitivity | 1% | 5% | 2% |
| 30 | Power Reset | Automatic or Manual | | Automatic |
| 31 | Water Temp Reset | Automatic or Manual | | Automatic |

**TABLE 2-10: Calibration Menu**

| MENU ITEM DISPLAY | | AVAILABLE CHOICES OR LIMITS | | DEFAULT |
|---|---|---|---|---|
| | | Minimum | Maximum | |
| **32** | Gas Press Reset | Automatic or Manual | | Manual |
| **33** | Min Off Time | 0 Min | 15 Min | 1 Min |
| **34** | Heatr Tuning Dsp | Enabled or Disabled | | Disabled |
| **35** | Heatr Bkpt Dsp | Enabled or Disabled | | Disabled |
| **36** | Stop Level | 0% | Start Level | 16 |
| **37** | Start Level | Stop Level | 40% | 22 |
| **38** | Skip Range Cntr | 10 | 95 | 40 |
| **39** | Skip Range Span | 0 | 3 | 0% |
| **40** | Skip Speed | 0.5 | 2.0 | 0.5% |
| **41** | O2 Gain | 0.500 | 1.500 | 1.000 |
| **42** | O2 Offset | -24.0 | +2.0 | 1.0 |
| **43** | O2 Sensor | Enabled or Disabled | | Depends on unit type/size |
| **44** | Cal Temp Sensors | Off or Start | | Off |
| **45** | FFWD Temp Offset | -20 | +20 | 0 |
| **46** | Exhst Tmp Offset | -20 | +20 | 0 |
| **47** | Outdr Air Offset | -20 | +20 | 0 |
| **48** | Inlet Air Offset | -20 | +20 | 0 |
| **49** | Inlet Wtr Offset | -20 | +20 | 0 |
| **50** | Outlet Wtr Offset | -20 | +20 | 0 |
| **51** | 24 hr Max Cycles | 0 | 9999 | 0 |
| **52** | 24 hr Max Ovrtemp | 0 | 9999 | 0 |
| **53** | 0-10v Out Test | 0.0 | 10.0 | 0.00 |
| **54** | Spark Monitor | Enabled or Disabled | | Depends on unit type/size |
| **55** | Min Spark Amps | 0.0 Amps | 2.5 Amps | 0.10 Amps |
| **56** | Max Spark Amps | 0.0 Amps | 2.5 Amps | 0.40 Amps |

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# SECTION 3: MODES OF OPERATION

## 3.1 INTRODUCTION

The boiler is capable of being operated in any one of six different modes. The following sections provide descriptions of each of these operating modes. Each boiler is shipped from the factory tested and configured for the ordered mode of operation. All temperature related parameters are at their factory default values, which work well in most applications. However, it may be necessary to change certain parameters to customize the unit to the system environment. After reading this section, parameters can be customized to suit the needs of the specific application. A complete listing and descriptions of the temperature related parameters are included in Appendix A, while factory defaults are listed in Sections 2.4 – 2.10, above.

## 3.2 INDOOR/OUTDOOR RESET MODE

This mode of operation is based on outside air temperatures. As the outside air temperature decreases, the supply header temperature will increase and vice versa. For this mode, it is necessary to install an outside air sensor as well as select a building reference temperature and a reset ratio.

### 3.2.1 Reset Ratio

Reset ratio is an adjustable number from 0.1 to 9.9. Once adjusted, the supply header temperature will increase by that number for each degree that the outside air temperature decreases. For instance, if a reset ratio of 1.6 is used, for each degree that outside air temperature decreases the supply header temperature will increase by 1.6 degrees.

### 3.2.2 Building Reference Temperature

This is a temperature from 40°F to 230°F (4.4°C to 110°C). Once selected, it is the temperature that the system references to begin increasing its temperature. For instance, if a reset ratio of 1.6 is used, and we select a building reference temperature of 70°F (21.1°C), then at an outside temperature of 69°F (20.6°C), the supply header temperature will increase by 1.6° to 71.6°F (0.9°C to 22°C).

### 3.2.3 Outdoor Air Temperature Sensor Installation

The outdoor air temperature sensor must be mounted on the North side of the building in an area where the average outside air temperature is expected. The sensor must be shielded from the sun's direct rays, as well as direct impingement by the elements. If a cover or shield is used, it must allow free air circulation. The sensor may be mounted **up to 200 feet (61m)** from the unit. Sensor connections are made at the Input/Output (I/O) Box on the front of the boiler. Connections are made at the terminals labeled *OUTDOOR AIR IN* and *AIR SENSOR COM* inside the I/O Box. Use shielded 18 to 22 AWG wire for connections. A wiring diagram is provided on the cover of the I/O Box. Refer to Section 2.10: *AC Electrical Power Wiring* of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K) for additional information on wiring.

### 3.2.4 Indoor/Outdoor Startup

Startup in the INDOOR/OUTDOOR RESET mode is accomplished as follows:

NOTE:

A design engineer typically provides design outdoor air temperature and supply header temperature data.

#### Indoor / Outdoor Setup Instructions

1. Refer to the Indoor/Outdoor reset ratio charts in Appendix E.
2. Choose the chart corresponding to the desired Building Reference Temperature.
3. Go down the left column of the chart to the coldest design outdoor air temperature expected in your area.
4. Once the design outdoor air temperature is chosen, go across the chart to the desired supply header temperature for the design temperature chosen in step 3.
5. Next, go up that column to the RESET RATIO row to find the corresponding reset ratio.
6. Access the *Configuration* menu and scroll through it until the display shows ***BLDG REF TEMP*** (Building Reference Temperature). If necessary, refer to Section 2.3: *C-More Controller Menus*, above, for detailed instructions on navigating the menus.
7. Press the **CHANGE** key. The display will begin to flash.
8. Use the ▲ and ▼ arrow keys to select the desired Building Reference Temperature.
9. Press **ENTER** to save any changes.
10. Next, scroll through the *Configuration* menu until the display shows ***RESET RATIO***.
11. Press the **CHANGE** key. The display will begin to flash.
12. Use the ▲ and ▼ arrow keys to select the Reset Ratio determined in step 5.
13. Press **ENTER** to save the change.

## 3.3 CONSTANT SETPOINT MODE

The CONSTANT SETPOINT mode is used when a fixed header temperature is desired. Common uses of this mode of operation include water source heat pump loops, and indirect heat exchangers for potable hot water systems or processes.

No external sensors are required to operate in this mode. While it is necessary to set the desired setpoint temperature, it is not necessary to change any other temperature-related functions. The unit is factory preset with settings that work well in most applications. Prior to changing any temperature-related parameters, other than the setpoint, it is suggested that an AERCO representative be contacted. See Appendix A for descriptions of temperature-related functions, and Sections 2.4 – 2.10 for their range of values and factory defaults.

### 3.3.1 Setting the Setpoint

The setpoint temperature of the unit is adjustable from 40°F to 240°F (4.4°C to 115.6°C). To set the unit for operation in the CONSTANT SETPOINT mode, you must set menu items **Internal Setpt** and **Boiler Mode** in the *Configuration* menu as follows:

**TABLE 3-1: Constant Setpoint Mode Settings**

| MENU OPTION | SETTING |
|---|---|
| Internal Setpt | Select desired setpoint using ▲ and ▼ arrow keys (40°F to 240°F, 4.4°C to 115.6°C) |
| Boiler Mode | Constant Setpoint |

See Section 2.3: *C-More Controller Menus* for detailed instructions on changing menu options.

## 3.4 REMOTE SETPOINT MODES

The unit's setpoint can be remotely controlled by an Energy Management System (EMS) or Building Automation System (BAS). The Remote Setpoint can be driven by a current or voltage signal within the following ranges:

- 4-20 mA/1-5 VDC
- 0-20 mA/0-5 VDC

The factory default setting for the REMOTE SETPOINT mode is 4 - 20 mA/1 - 5 VDC. With this setting, a 4 to 20 mA/1 to 5 VDC signal, sent by an EMS or BAS, is used to change the unit's setpoint. The 4 mA/1V signal is equal to a 40°F (4.4°C) setpoint while a 20 mA /5V signal is equal to a 240°F (115.6°C) setpoint. When a 0 to 20 mA/0 to 5 VDC signal is used, 0 mA is equal to a 40°F (4.4°C) setpoint.

In addition to the current and voltage signals described above, the REMOTE SETPOINT mode can also driven by a RS-485 Modbus Network signal from an EMS or BAS.

The REMOTE SETPOINT modes of operation can be used to drive single as well as multiple units.

NOTE:

If a voltage, rather than current signal is used to control the remote setpoint, a DIP switch adjustment must be made on the PMC Board located in the C-More Controller. Contact your local AERCO representative for details.

In order to enable the REMOTE SETPOINT mode, you must set menu items **Boiler Mode** and **Remote Signal** in the *Configuration* menu as follows:

**TABLE 3-2: Remote Setpoint Mode Settings**

| MENU OPTION | SETTING |
|---|---|
| Boiler Mode | Remote Setpoint |
| Remote Signal | 4-20mA/1-5V, 0-20mA/0-5V, or Network |

Refer to Section 2.3: *C-More Controller Menus* for detailed instructions on changing menu options.

If the Network setting is selected for RS-485 Modbus operation, a valid Comm Address must be entered in the *Setup* menu. Refer to Modbus Communication Manual GF-114 for additional information.

While it is possible to change the settings of temperature related functions, the unit is factory preset with settings that work well in most applications. It is suggested that an AERCO representative be contacted, prior to changing any temperature related function settings. See Appendix A for descriptions of temperature-related functions, and Sections 2.4 – 2.10 for their range of options and factory defaults.

### 3.4.1 Remote Setpoint Field Wiring

The only wiring connections necessary for the REMOTE SETPOINT mode are connection of the remote signal leads from the source to the unit's I/O Box. The I/O Box is located on the front panel of the boiler. For either a 4-20mA/0-5V or a 0-20mA/0-5V setting, the connections are made at the ANALOG IN terminals in the I/O Box. For a Network setting, the connections are made at the RS-485 COMM terminals in the I/O Box. The signal must be floating, (ungrounded) at the I/O Box and the wire used must be a two wire shielded pair from 18 to 22 AWG. Polarity must be observed. The source end of the shield must be connected at the source. When driving multiple units, each unit's wiring must conform to the above.

### 3.4.2 Remote Setpoint Startup

Since this mode of operation is factory preset and the setpoint is being externally controlled, no startup instructions are necessary. In this mode, the REMOTE LED will light when the external signal is present.

To operate the unit in the MANUAL mode, press the **AUTO/MAN** switch. The REMOTE LED will go off and the MANUAL LED will light.

To change back to the REMOTE SETPOINT mode, simply press the **AUTO/MAN** switch. The REMOTE LED will again light and the MANUAL LED will go off.

## 3.5 DIRECT DRIVE MODES

The unit's air/fuel valve position (% open) can be changed by a remote signal which is typically sent from an Energy Management System (EMS) or from a Building Automation System (BAS). The Direct Drive mode can be driven by a current or voltage signal within the following ranges:

- 4-20 mA/1-5 VDC
- 0-20 mA/0-5 VDC

The factory default setting for the DIRECT DRIVE mode is 4-20 mA/1-5 VDC. With this setting, a 4 to 20 mA signal, sent by an EMS or BAS is used to change the unit's valve position from 0% to 100%. A 4 mA/1V signal is equal to a 0% valve position, while a 20 mA /5V signal is equal to a 100% valve position. When a 0-20 mA/0-5 VDC signal is used, zero is equal to a 0% valve position.

In addition to the current and voltage signals described above, the DIRECT DRIVE mode can also driven by a RS-485 Modbus Network signal from an EMS or BAS.

When in a DIRECT DRIVE mode, the unit is a slave to the EMS or BAS and does not have a role in temperature control. DIRECT DRIVE can be used to drive single, or multiple units.

NOTE:

If a voltage, rather than current signal is used to control the remote setpoint, a DIP switch adjustment must be made on the CPU Board located in the C-More Controller. Contact your local AERCO representative for details.

To enable the DIRECT DRIVE mode, you must set menu items **Boiler Mode** and **Remote Signal** in the *Configuration* menu as follows:

**TABLE 3-3: Direct Drive Mode Settings**

| MENU OPTION | SETTING |
|---|---|
| Boiler Mode | Direct Drive |
| Remote Signal | 4-20mA/1-5V, 0-20mA/0-5V, or Network |

Refer to Section 2.3: *C-More Controller Menus* for instructions on changing menu options.

If the Network setting is selected for RS-485 Modbus operation, a valid Comm Address must be entered in the *Setup* menu. Refer to Modbus Communication Manual GF-114 for additional information.

## 3.5.1 Direct Drive Field Wiring

The only wiring connections necessary for DIRECT DRIVE mode are connection of the remote signal leads from the source to the unit's I/O Box. For either a 4-20mA/0-5V or a 0-20mA/0-5V setting, the connections are made at the ANALOG IN terminals in the I/O Box. For a Network setting, the connections are made at the RS-485 COMM terminals in the I/O Box. The signal must be floating, (ungrounded) at the I/O Box and the wire used must be a two wire shielded pair from 18 to 22 AWG. Polarity must be observed. The source end of the shield must be connected at the source. When driving multiple units, each unit's wiring must conform to the above.

## 3.5.2 Direct Drive Startup

Since this mode of operation is factory preset and the valve position is being externally controlled, no startup instructions are necessary. In this mode, the REMOTE LED will light when the signal is present.

To operate the unit in MANUAL mode, press the **AUTO/MAN** switch. The REMOTE LED will go off and the MANUAL LED will light.

To change back to the Direct Drive mode, simply press the **AUTO/MAN** switch. The REMOTE LED will again light and the MANUAL LED will go off.

# 3.6 AERCO CONTROL SYSTEM (ACS)

NOTE:

ACS is for installations with 9 or more boilers. It utilizes only RS-485 signaling to the boiler. Installations with 1 to 8 boilers can use Boiler Sequencing Technology (BST), as described in Section 6 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K).

The ACS mode of operation is used in conjunction with an AERCO Control System. The ACS mode is used when it is desired to operate multiple units in the most efficient manner possible. For this mode of operation, an ACS Header Sensor must be installed **between 2 and 10 feet (0.61 and 3m)** downstream of the ***LAST*** boiler in the boiler plant's supply water header. The ACS can control up to 40 boilers; Up to 32 via Modbus (RS-485) network communication. For ACS programming, operation, and Header Sensor installation details, see ACS Operations Guide, GF-131. For operation via an RS-485 Modbus network, refer to Modbus Communication Manual GF-114. To enable the ACS mode, you must set menu items **Boiler Mode** and **Remote Signal** in the *Configuration* menu as follows:

**TABLE 3-4: ACS Mode Settings**

| MENU OPTION | SETTING |
|---|---|
| Boiler Mode | Direct Drive |
| Remote Signal | Network (RS485) |

Refer to Section 2.3: *C-More Controller Menus* for instructions on changing menu options.

## 3.6.1 ACS External Field Wiring

Wiring connections for RS-485 Modbus control are made between the 485 A- and 485 B+ terminals on the ACS (boilers 9 through 40) and the RS-485 COMM terminals in the I/O Box on the front of the boilers.

Wire the units using shielded twisted pair wire between 18 and 22 AWG. Observe the proper polarity for the ACS RS-485 COMM wiring connections. Shields should be terminated only at the ACS and the boiler end must be left floating. Each unit's wiring must conform to the above.

## 3.6.2 ACS Setup and Startup

This mode of operation is factory preset and the ACS controls the firing rate (air/fuel valve % open position). There are no setup instructions for each individual unit.

To operate the unit in MANUAL mode, press the **AUTO/MAN** switch. The REMOTE LED will go off and the MANUAL LED will light

To change back to the ACS mode, simply press the **AUTO/MAN** switch. The REMOTE LED will again light and the MANUAL LED will go off.

# 3.7 COMBINATION CONTROL SYSTEM (CCS)

NOTE:
Only ACS can be utilized for the Combination Control System.

A Combination Control System (CCS) is one that uses multiple boilers to cover both space-heating and domestic hot water needs. The theory behind this type of system is that the maximum space-heating load and the maximum domestic hot water load do not occur simultaneously. Therefore, boilers used for domestic hot water are capable of switching between constant setpoint and ACS control.

For a typical CCS, an adequate number of boilers are installed to cover the space-heating load on the design-day. However, one or more units are used for the domestic hot water load as well. These boilers are the combination units and are referred to as the combo boilers. The combo boilers heat water to a constant setpoint temperature. That water is then circulated through a heat exchanger in a domestic hot water storage tank.

Only the AERCO Control System (ACS) is necessary to configure this system if only a single valve is used to switch from space heating to domestic hot water. However, the ACS Relay Panel is required in combination with the ACS when there are up to two isolation valves, boiler interlocks, and/or a Domestic Hot Water (DHW) pump in a Combination heating plant where AERCO boilers are being used for both Building Heat and Domestic Hot Water heating.

The following two options are available for using a combination system; one that uses only the ACS, and one that requires the optional ACS Relay Box:

- **OPTION 1** - This option is selected when the ACS controls a boiler plant containing up to eight combination boilers that are Domestic Hot Water Priority (DHW PRIORITY) boilers, along with building heat (BLDG HEAT) boilers, and *one* hydronic isolation valve in the main header between the BLDG HEAT boilers and the DHW PRIORITY boilers.
- **OPTION 2** – When this option is selected, the ACS Relay Panel must be used in conjunction with the ACS. For this option, the ACS controls a boiler plant containing up to eight combination boilers that are divided up into Building Priority (BLDG PRIORITY) boilers and Domestic Hot Water Priority (DHW PRIORITY) boilers, along with building heat (BLDG HEAT) boilers, and using *two* hydronic isolation valves in the main header, one between the BLDG HEAT and BLDG PRIORITY boilers, and the other between the BLDG PRIORITY and the DHW PRIORITY boilers.

In Option 2, when the space-heating load is such that when all the space-heating boilers are at the 100% valve position, the ACS will then ask the ACS Relay Box for the domestic boilers to become space-heating boilers. Provided the domestic hot water load is satisfied, the combo (hot water) boilers will then become space-heating boilers. If the domestic hot water load is not satisfied, the combo boiler(s) remain on the domestic hot water load. If the combo boilers switch over to space heating, but there is a call for domestic hot water, the ACS Relay Box switches the combo units back to the domestic load. The ACS in combination with the ACS Relay Box will ask the BLDG PRIORITY boilers to help with domestic hot water heating if the DHW PRIORITY boilers are not able to satisfy the domestic hot water demand.

When the combo units are satisfying the domestic load, they are in the CONSTANT SETPOINT mode of operation. When the combo units switch over to space heating, their mode of operation changes to follow the ACS command. For more information concerning the operation of the ACS, consult the ACS Operations Guide, GF-131. For more information on the ACS Relay Box, see Section 2.14 in the same manual.

## 3.7.1 Combination Control System Field Wiring

Wiring for this system is between the ACS, the ACS Relay Box, and the terminals in the I/O Box. Wire the units using a shielded twisted pair of 18 to 22 AWG wire. When wiring multiple units, each unit's wiring must conform to the above.

## 3.7.2 Combination Control System Setup and Startup

Setup for the COMBINATION mode requires entries to be made in the *Configuration* menu for boiler mode, remote signal type and setpoint (see Section 2.6: *Configuration Menu* for details). The setpoint is adjustable from 40°F to 190°F (4.4°C to 87.8°C).

To enable the COMBINATION mode, you must set menu items **Boiler Mode, Remote Signal** and **Internal Setpt** in the *Configuration* menu as follows:

**TABLE 3-5: Combination Mode Settings**

| MENU OPTION | SETTING |
|---|---|
| Boiler Mode | Combination |
| Remote Signal | Network |
| Internal Setpt | 40°F to 190°F (4.4°C to 87.8°C) |

Refer to Section 2.3: *C-More Controller Menus* for instructions on changing menu options.

While it is possible to change other temperature-related functions for COMBINATION mode, these functions are preset to their factory default values. These default settings work well in most applications. It is suggested that AERCO be contacted prior to changing settings other than the unit's setpoint. For a complete listing of temperature related function defaults, see Sections 2.4 – 2.10.

To set the unit to the MANUAL mode, press the **AUTO/MAN** switch. The MANUAL LED will light.

To set the unit back to the AUTO mode, press the **AUTO/MAN** switch. The MANUAL LED will go off and the REMOTE LED will light.

When the boiler is switched to ACS control, the ACS controls the valve position. There are no setup requirements to the boiler(s) in this mode.

# SECTION 4: Maintenance

## 4.1 MAINTENANCE SCHEDULE

All Benchmark boilers require regular routine maintenance to keep up efficiency and reliability. For best operation and life of the unit, the following routine maintenance procedures should be performed in the time periods specified in Table 4-1. For a complete inspection check list see ASME CSD-1 chart.

The following maintenance kits are available through your local AERCO Sales Representative:

| Model | Kit P/N | Type | Components Serviced |
|---|---|---|---|
| 750-3000 | 58025-01 | 12 Month | Ignitor, Flame Rod & Condensate trap |
| 750-1000 | 58025-08 | 24-Month Water/Fireside | 58025-01 plus: Burner, LWCO, Air Filter replacement |
| | 58025-17 | | Same as 58025-08 except *clean* Air Filter |
| 1500-2000 | 58025-13 | 24-Month Water/Fireside | 58025-01 plus: Burner, LWCO, Air Filter replacement |
| | 58025-19 | | Same as 58025-13 except *clean* Air Filter |
| 2500-3000 | 58025-10 | 24-Month Water/Fireside | 58025-01 plus: Burner, LWCO, Air Filter replacement |
| | 58025-18 | | Same as 58025-10 except *clean* Air Filter |

**WARNING!**

Prior to servicing, ensure that the following guidelines are strictly observed:

- Disconnect the AC power supply by turning off the service switch and AC supply circuit breaker.
- Shut off the gas supply at the manual shut-off valve provided with the unit
- Allow the unit to cool to a safe water temperature to prevent burning or scalding

**TABLE 4-1: Maintenance Schedule**

| SEC | ITEM | 6 MOS. | 12 MOS. | 24 MOS. | LABOR TIME |
|---|---|---|---|---|---|
| **4.2** | Igniter-Injector Kit (P/N **58023**) | *Inspect | Inspect, replace if necessary | Replace | 15 mins. |
| **4.3** | Flame Detector Kit (P/N **24356-1**) | *Inspect | Inspect, replace if necessary | Replace | 15 mins. |
| **4.4** | Lean $O_2$ Sensor (P/N **61026**) | *Inspect | Inspect | | 15 mins. |
| ** | Combustion Calibration | *Check | Check | | 1 hr. |
| **4.5** | Testing of Safety Devices | | See ASME CSD-1 Chart | | 45 mins. |
| **4.6** | Burner | | | Inspect | 2 hrs. |
| **4.7** | Condensate Drain Trap | *Inspect | Inspect, Clean & Replace Gaskets | Inspect, Clean & Replace Gaskets | 30 mins. |
| **4.8** | Air Filter | | Clean | Replace | 15 mins. |

* *Only performed after initial 6 month period after initial startup.*

** *Combustion Calibration instructions are in Section 4.3 of OMM-0127 (GF-205-K)*

## 4.2 IGNITER-INJECTOR

The igniter-injector (Kit P/N **58023**) is located on the burner plate at the top of the boiler. In addition to providing the ignition spark required to light the burner, the igniter-injector also contains a gas injector tube which connects to the staged ignition assembly. Figure 4-1a through Figure 4-1c shows the complete burner assembly removed from the boiler and indicates the location of the igniter-injector flame detector and other related components.

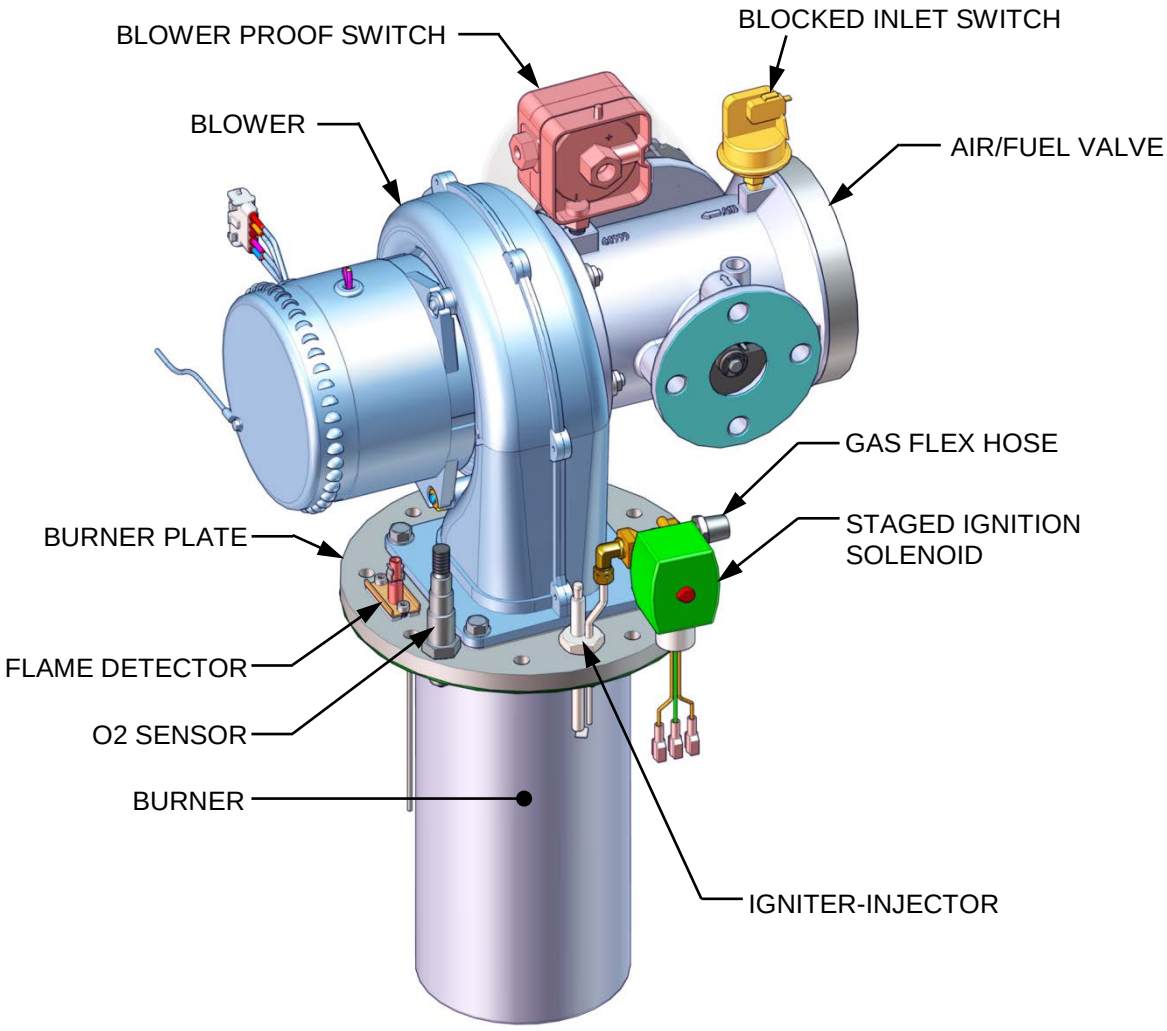


***Figure 4-1a: BMK 750/1000 Burner Assembly***

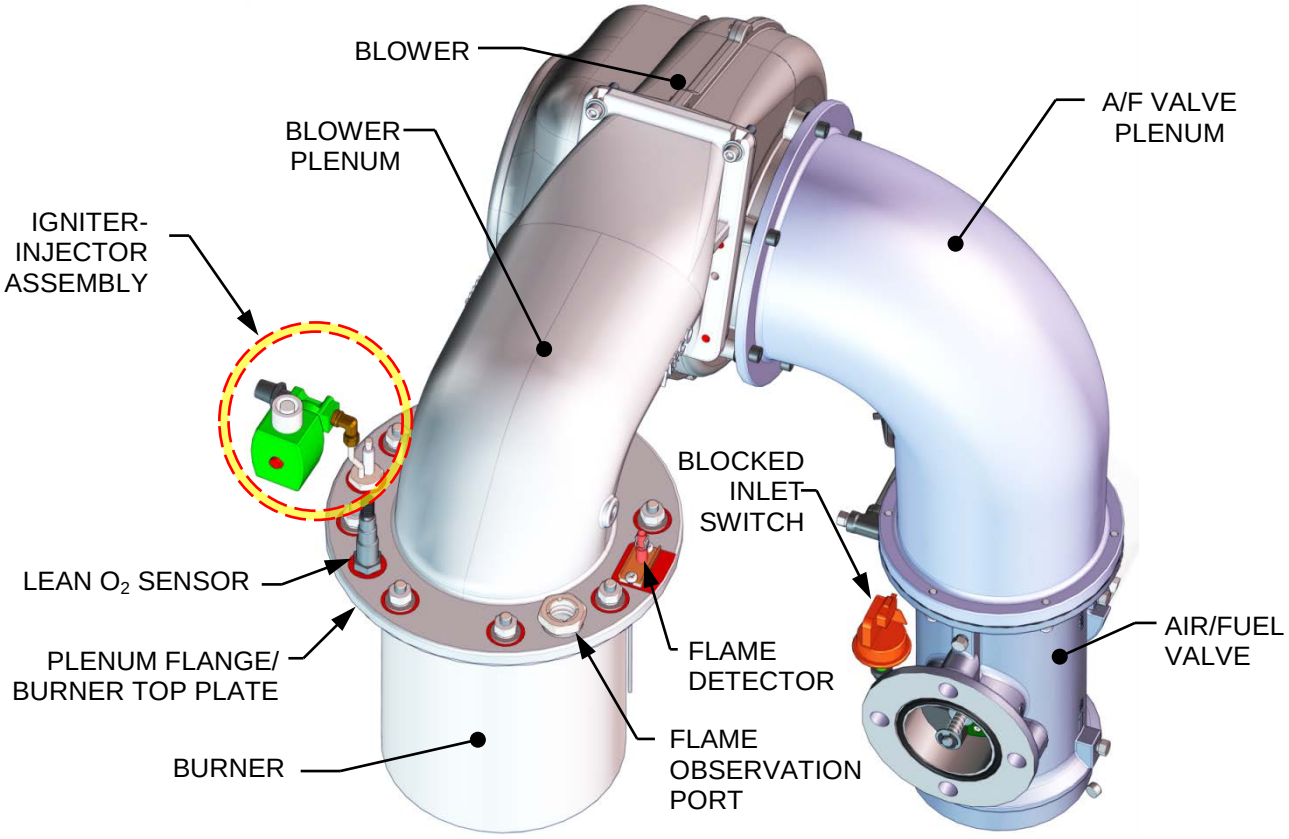


***Figure 4-1b: BMK 1500/2000 Burner Assembly***

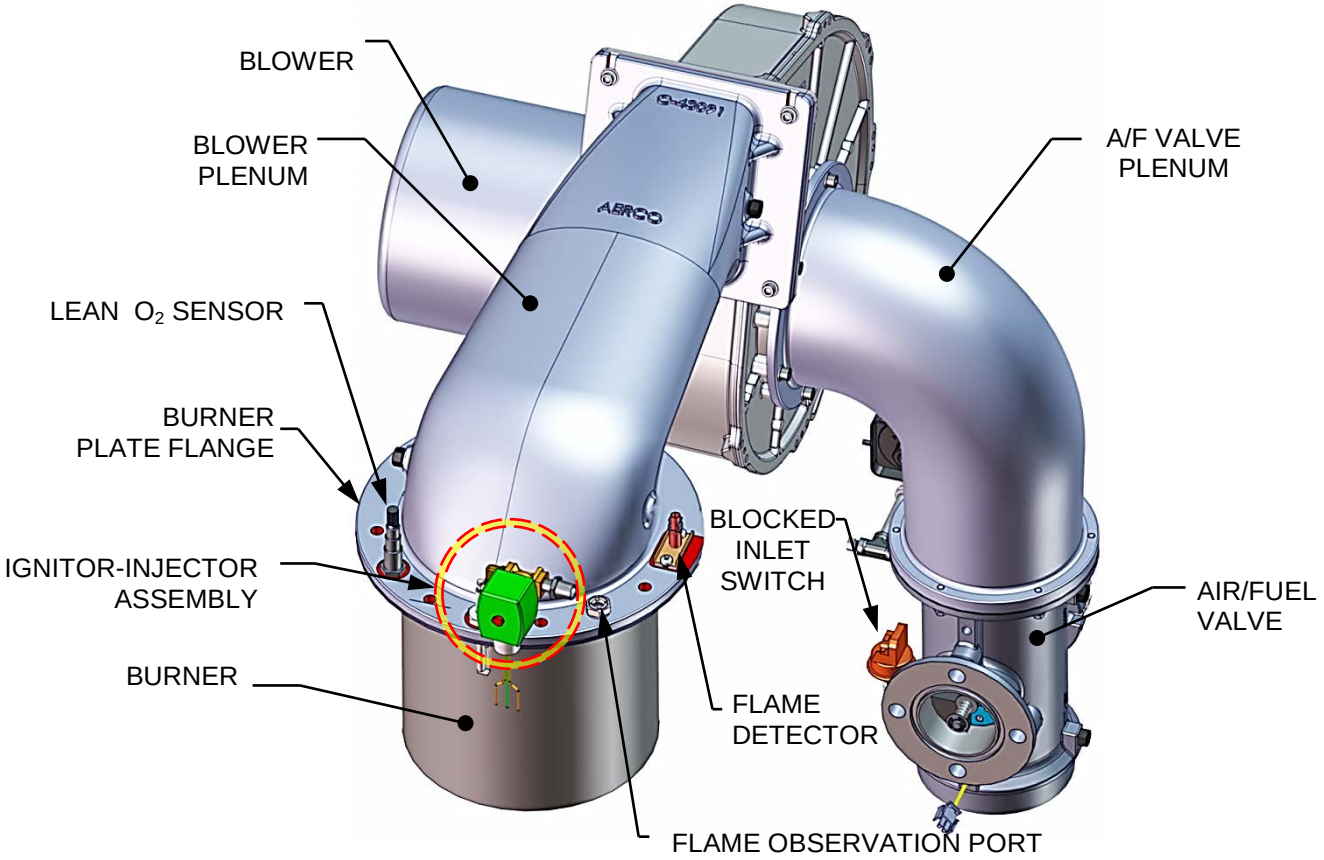


***Figure 4-1c: BMK 2500/3000 Burner Assembly***

The igniter-injector may be hot, therefore, care should be exercised to avoid burns. It is easier to remove the igniter-injector from the unit after the unit has cooled to room temperature. To inspect/replace the Igniter:

## Igniter-Injector Maintenance Procedure Instructions

1. Set the ON/OFF switch on the C-More Controller to the **OFF** position. Disconnect AC power from the unit
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.
3. Disconnect the cable from the igniter-injector (see Figure 4-1a – Figure 4-1c, above).
4. Referring to Figure 4-2a – Figure 4-2c, below, use a 7/16" open-end wrench to disconnect the compression nut securing the gas injector tube of the igniter-injector to the elbow of the staged ignition assembly. Disconnect the staged ignition assembly from the igniter-injector.

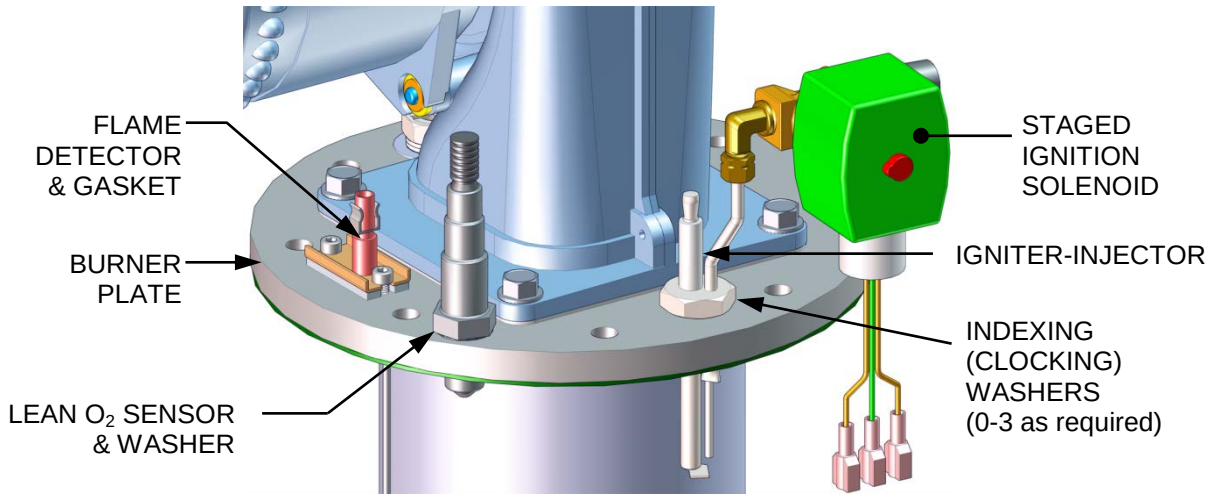


*Figure 4-2a: BMK 750/1000 Igniter-Injector & Flame Detector Mounting Details*

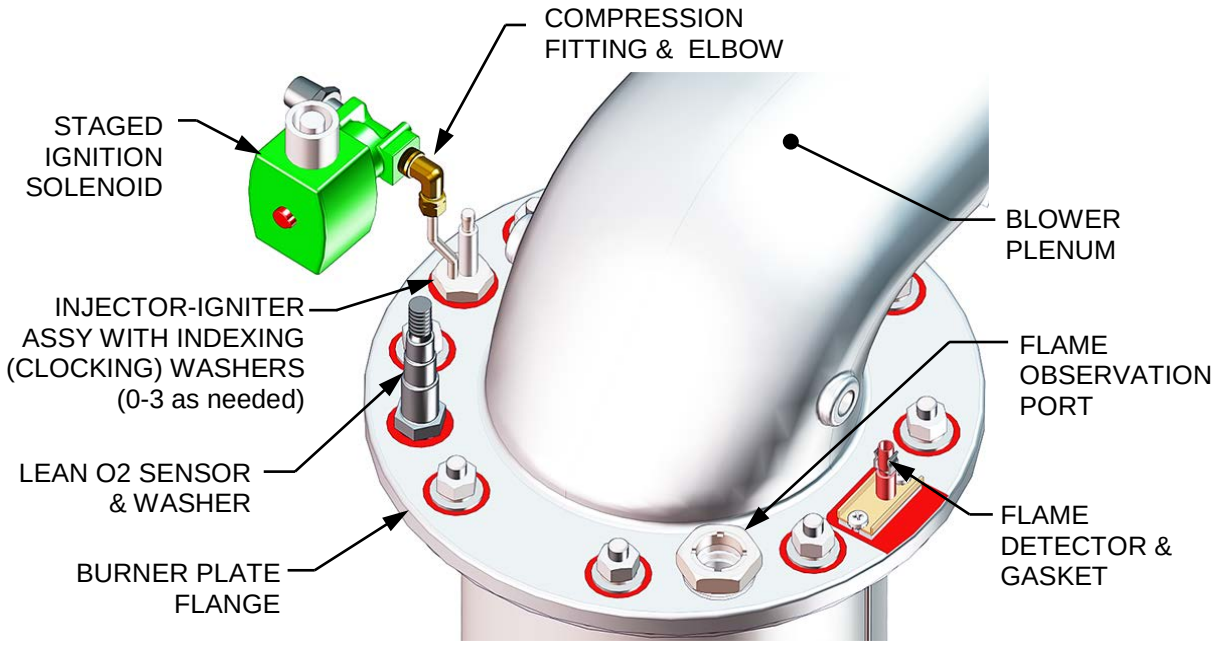


*Figure 4-2b: BMK 1500/2000 Igniter-Injector & Flame Detector Mounting Details*

## Igniter-Injector Maintenance Procedure Instructions

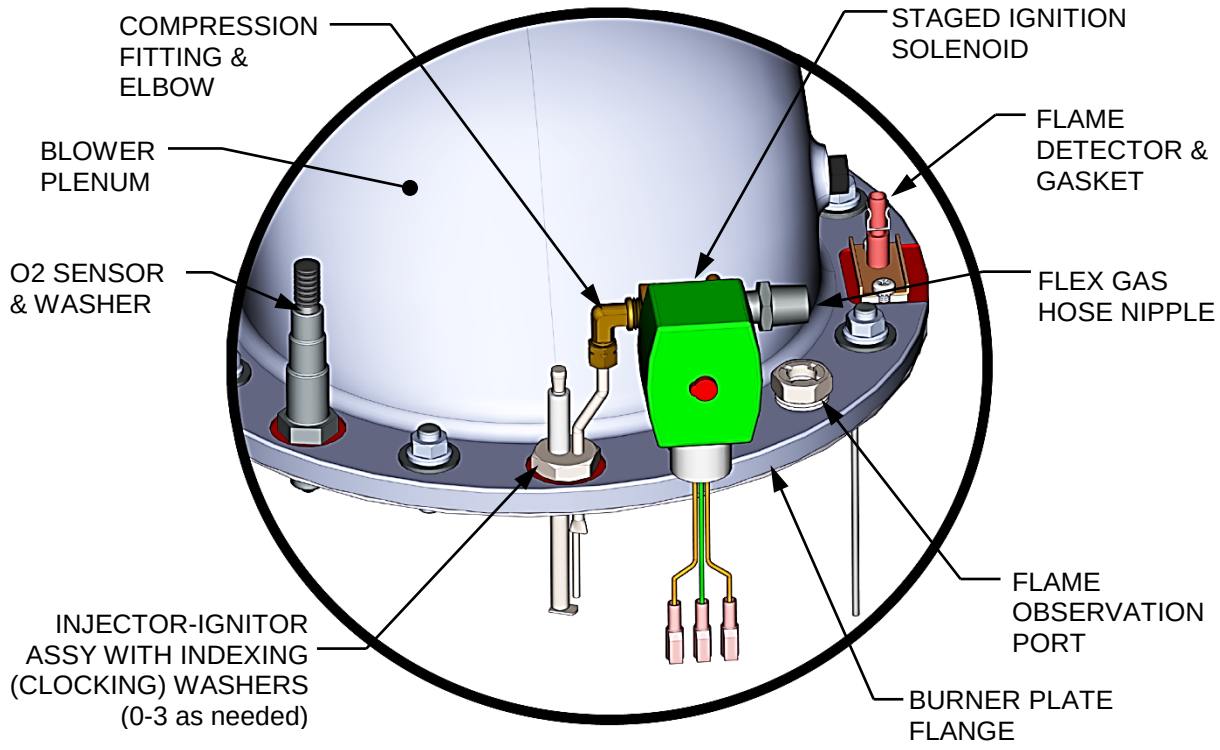


***Figure 4-2c: BMK 2500/3000 Igniter-Injector & Flame Detector Mounting Details***

5. Next, loosen and remove the igniter-injector from the burner plate using a 1" open-end wrench.
6. Check the igniter-injector for evidence of erosion or carbon build-up. If there is evidence of substantial erosion or carbon build-up, the igniter-injector should be replaced. If carbon build-up is present, clean the component using fine emery cloth. Repeated carbon build-up is an indication that the combustion settings of the unit should be checked. To review combustion calibration procedures, refer to Section 4.3 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K).
7. Prior to reinstalling the igniter-injector, apply a high temperature, conductive, anti-seize compound to the threads.
8. Reinstall the igniter-injector in the burner plate using 1 to 3 indexing washers, as needed, so that when the igniter-injector is tightened, its injector tube will be positioned within the approximately 120° arc shown in Figure 4-3a through 4-3c, below. Note, the recommended injection tube positioning differs for the positioning recommended in the past.
9. Torque the igniter-injector to **170 - 180 in-lbs. (19.2 – 20.3 Nm). DO NOT over tighten**.

NOTE:

If a replacement igniter-injector (Kit P/N **58023**) is being installed, a compression nut containing a built-in ferrule and 3 indexing washers are included with the kit.

10. Connect the staged ignition assembly to the gas injector tube of the igniter-injector by securing the compression nut to the elbow of the staged ignition assembly.
11. Reconnect the igniter-injector cable.
12. Reinstall the shroud on the unit.

## Igniter-Injector Maintenance Procedure Instructions

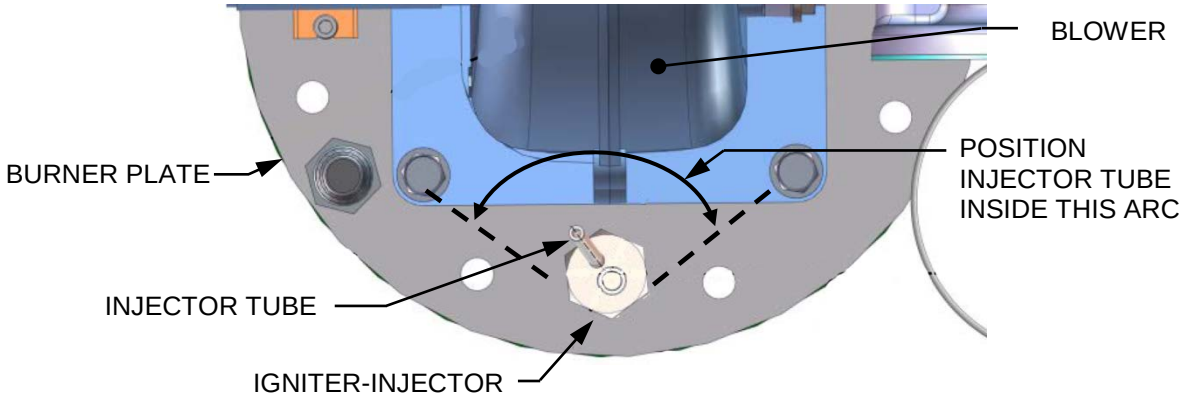


*Figure 4-3a: BMK 750/1000 Igniter-Injector Orientation*

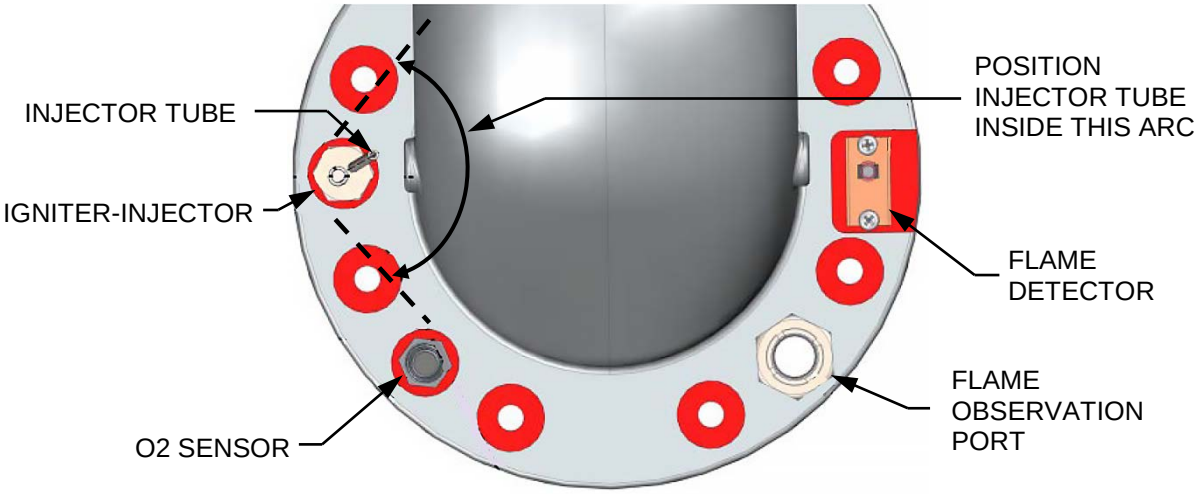


*Figure 4-3b: BMK 1500/2000 Igniter-Injector Orientation*

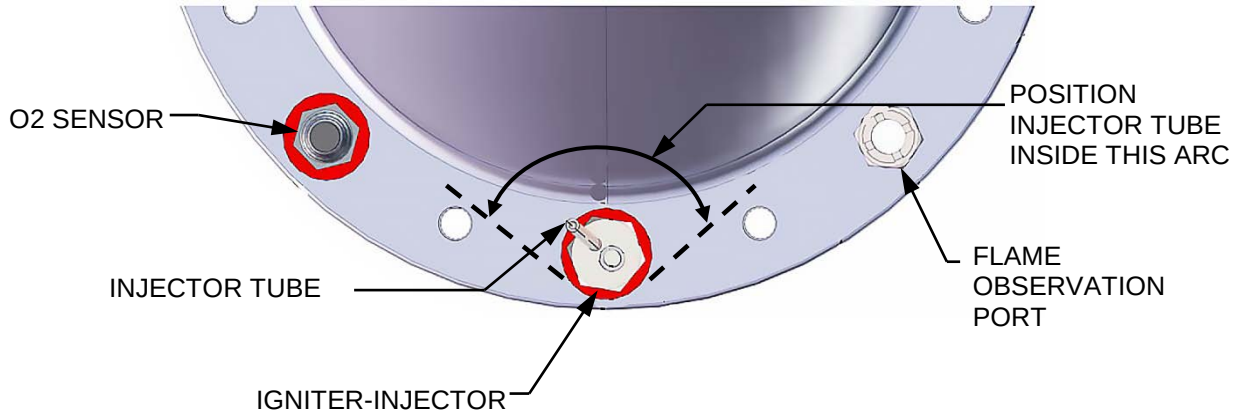


*Figure 4-3c. BMK 2500/3000 Igniter-Injector Orientation*

## 4.3 FLAME DETECTOR

The flame detector (kit P/N **24356-1**) is located on the burner plate at the top of the unit (see Figure 4-1a through 4-1c and 4-2a through 4-2c). The flame detector may be hot. Allow the unit to cool sufficiently before removing the flame detector. Inspect or replace the flame detector as follows:

### Flame Detector Maintenance Instructions

1. Set the C-More Controller ON/OFF switch to the **OFF** position. Disconnect AC power from the unit.
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.
3. Disconnect the flame detector lead wire.
4. Remove the two (2) screws securing the flame detector to the plate (Figure 4-2a – 4-2c).
5. Remove the flame detector and gasket from the burner plate.
6. Thoroughly inspect the flame detector. If eroded, the detector should be replaced. Otherwise clean the detector with a fine emery cloth.
7. Reinstall the flame detector and flame detector gasket.
8. Reconnect the flame detector lead wire.
9. Reinstall the shroud on the unit.

## 4.4 $O_2$ SENSOR

The Lean Oxygen Sensor (P/N **61026**) is located on the burner plate at the top of the unit (see Figure 4-1a through 4-1c and 4-2a through 5-2c, below). The sensor may be hot. Allow the unit to cool sufficiently before removing or replacing the $O_2$ sensor.

### $O_2$ Sensor Maintenance Instructions

1. Set the ON/OFF switch on the C-More Controller to the **OFF** position. Disconnect AC power from the unit.
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.
3. Disconnect the $O_2$ sensor lead wire by pushing in on the release tab and pulling apart the connector.
4. Next, loosen and remove the $O_2$ sensor and crush washer from the burner plate using a 15/16" open-end wrench.
5. Thoroughly inspect the $O_2$ sensor. If eroded, the sensor should be replaced. Otherwise clean the sensor with a fine emery cloth.
6. Reinstall the $O_2$ sensor and crush washer on the burner plate.
7. Reconnect the sensor lead wire.
8. Reinstall the shroud on the unit.

# 4.5 SAFETY DEVICE TESTING

Systematic and thorough tests of the operating and safety devices should be performed to ensure that they are operating as designed. Certain code requirements, such as ASME CSD-1, require that these tests be performed on a scheduled basis. Test schedules must conform to local jurisdictions. The results of the tests should be recorded in a log book.

See The *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K) for a description and instructions for performing these tests.

# 4.6 BURNER INSPECTION

The burner assembly is located at the top of the unit's heat exchanger. The burner assembly may be hot. Therefore, allow the unit to cool sufficiently before removing the burner assembly.

## 4.6.1 BMK 750/1000 BURNER INSPECTION

The following parts are required for reassembly after burner inspection:

**BMK 750/1000 Burner Inspection Parts**

| Part No. | Description |
|---|---|
| 81143 | Burner Gasket |
| 81048 | Flame Detector Gasket |
| 81064 | Blower Gasket |

**BMK 750/1000 Burner Inspection Instructions**

1. Set the ON/OFF switch on the C-More Controller to the **OFF** position. Disconnect AC power from the unit and turn off the gas supply.
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.
3. Disconnect the lead wire from the flame detector installed on the burner plate. See Figure 4-4b.
4. Remove the two (2) screws securing the flame detector to the plate. The flame detector is secured to the burner plate with one (1) #10-32 screw and one (1) #8-32 screw.
5. Remove the flame detector and gasket from the burner plate.
6. Disconnect the cable from the igniter-injector.
7. Using a 7/16” open-end wrench, disconnect the compression nut securing the gas injector tube of the igniter-injector to the elbow of the staged ignition assembly (see Figure 4-1a,). Disconnect the staged ignition assembly from the igniter-injector.

## BMK 750/1000 Burner Inspection Instructions

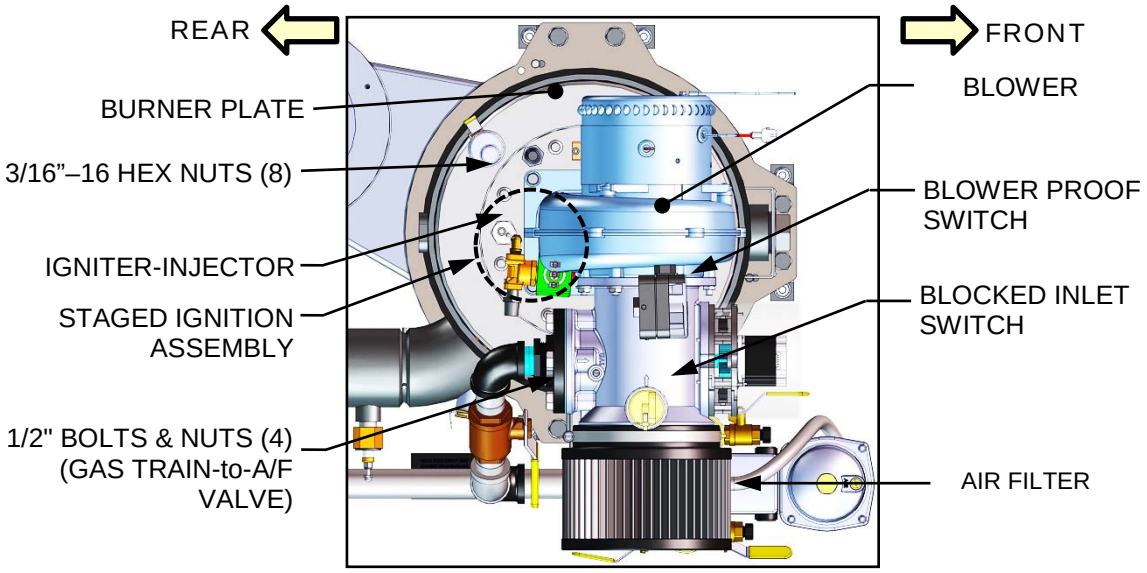


*Figure 4-4a: BMK 750/1000 Burner Assembly Mounting Details (Overhead View)*

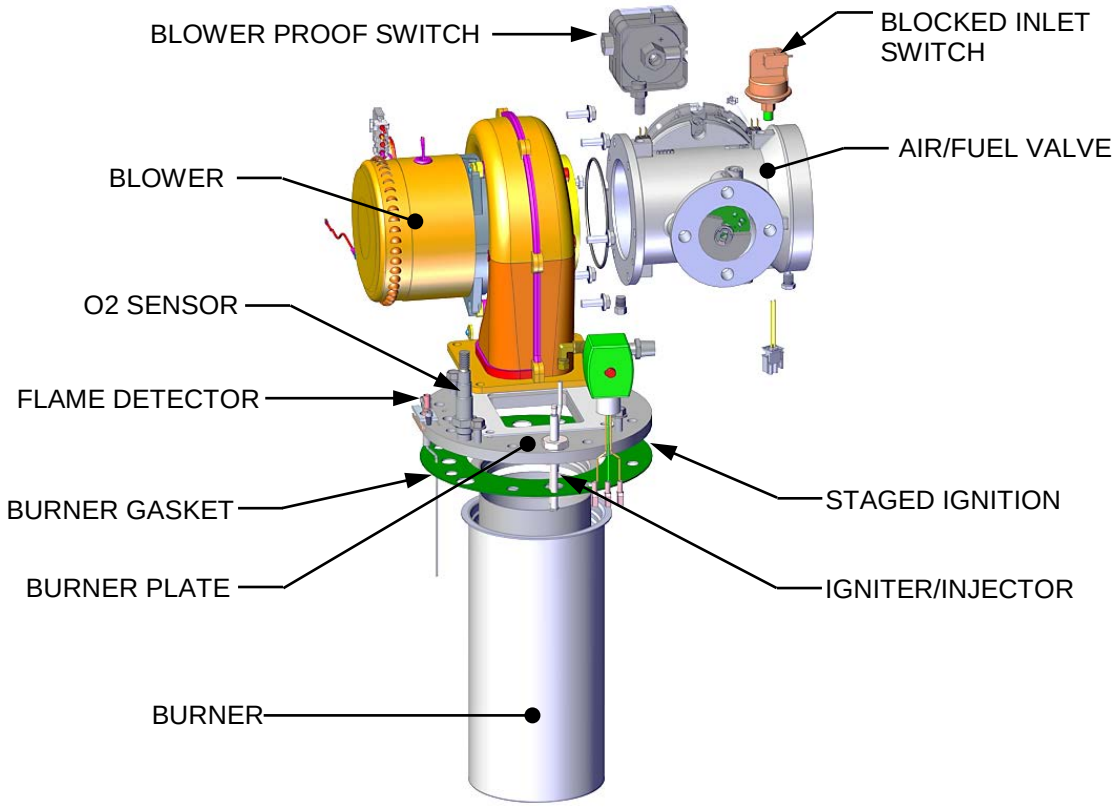


*Figure 4-4b: BMK 750/1000 Burner Assembly (Exploded View)*

8. Next, loosen and remove the igniter-injector from the burner plate using a 1" open-end wrench.

## BMK 750/1000 Burner Inspection Instructions

9. Disconnect the unit wiring harness connectors from the air/fuel valve and blower motor.
10. Disconnect the wire leads connected to the Blower Proof switch and Blocked Inlet switch (Figure 4-4a and Figure 4-4b).
11. Disconnect the gas train from the air/fuel valve by removing the four (4) 1/2” bolts and nuts (Figure 4-4a).
12. Disconnect the flex hose from the air/fuel valve by loosening the hose clamp.
13. Remove the four 5/16-18 hex head screws securing the blower to the burner plate (Figure 4-4b).
14. Remove the blower and air/fuel valve from the burner plate by lifting straight up. Also, remove the blower gasket.
15. Remove the eight (8) 3/8-16 nuts from the burner flange (Figure 4-4a) using a 9/16” wrench.

NOTE:

The burner assembly weighs approximately 25 pounds (11.3 kg).

16. Remove the burner assembly from burner flange by pulling straight up.
17. Remove and replace the burner gasket.

NOTE:

During reassembly, apply a light coating of high-temperature, anti-seize lubricant to the threads of the igniter-injector and grounding screw. Also, ensure that the igniter-injector is properly positioned as indicated in Figure 4-3a. Torque the igniter-injector to **14 - 15 ft-lbs. (19.0 - 20.3 Nm)**.

18. Beginning with the burner assembly removed in step 16, reinstall all the components in the reverse order that they were removed. When reinstalling the burner flange (removed in step 15), tighten the 3/8-16 nuts using a typical torque pattern. For example, loosely tighten one nut, then loosely tighten a second nut on the opposite side, a third at 90 degrees to the first two, and a fourth opposite the third, and then repeat this pattern with the remaining four nuts. Repeat the entire pattern a second time to partially tighten all eight nuts, and then repeat a third time until all eight nuts are fully **torqued to 30 ft. lbs. (40.7 Nm)**.
19. Ensure that the igniter-injector and flame detector cutouts in the burner plate are properly aligned with the heat exchanger top flange.

**This completes the Benchmark 750/1000 burner inspection.**

## 4.6.2 BMK 1500 – 3000 BURNER INSPECTION

The following parts are required for reassembly after burner inspection:

**Burner Inspection Parts**

| Description | Part No. | |
|---|---|---|
| | BMK 1500/2000 | BMK 2500/3000 |
| Burner Upper Release Gasket | 81183 | 81173 |
| Burner Middle Gasket | 81166 | 81180 |
| Burner Lower Release Gasket | 81186 | 81185 |
| Flame Detector Gasket (1 each) | 81048 | 81048 |

**BMK 1500-3000 Burner Inspection Instructions**

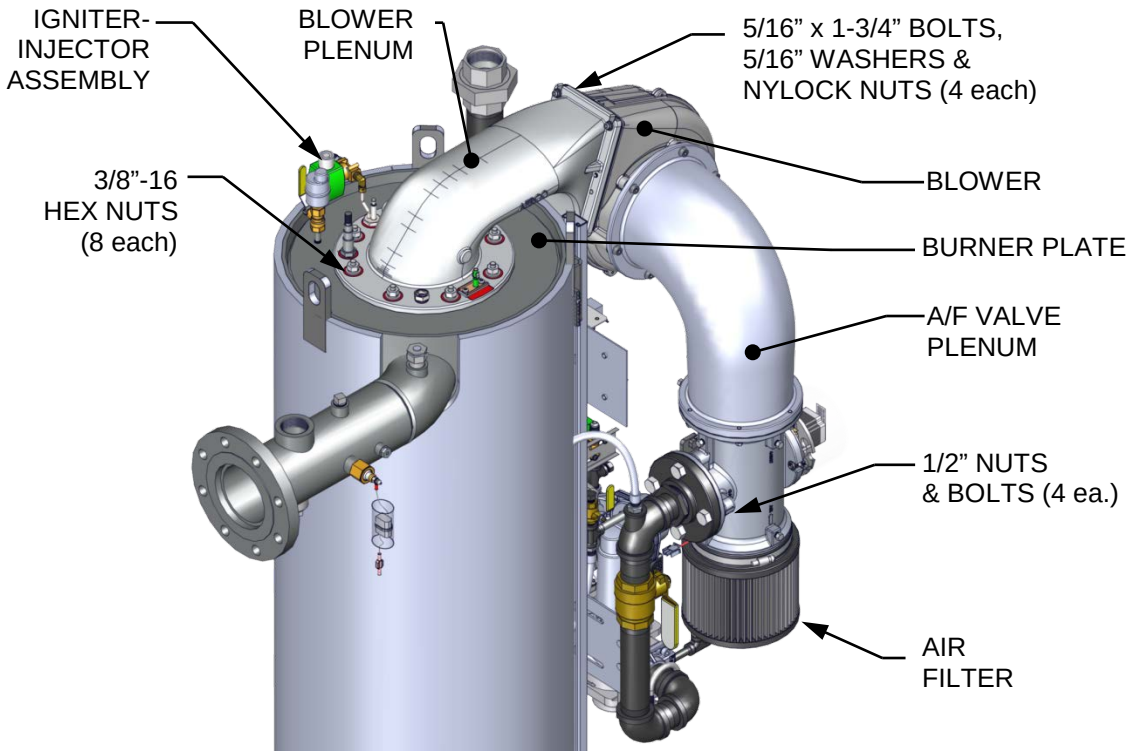


*Figure 4-5a: BMK 1500/2000 Burner Assembly Mounting Details*

## BMK 1500-3000 Burner Inspection Instructions

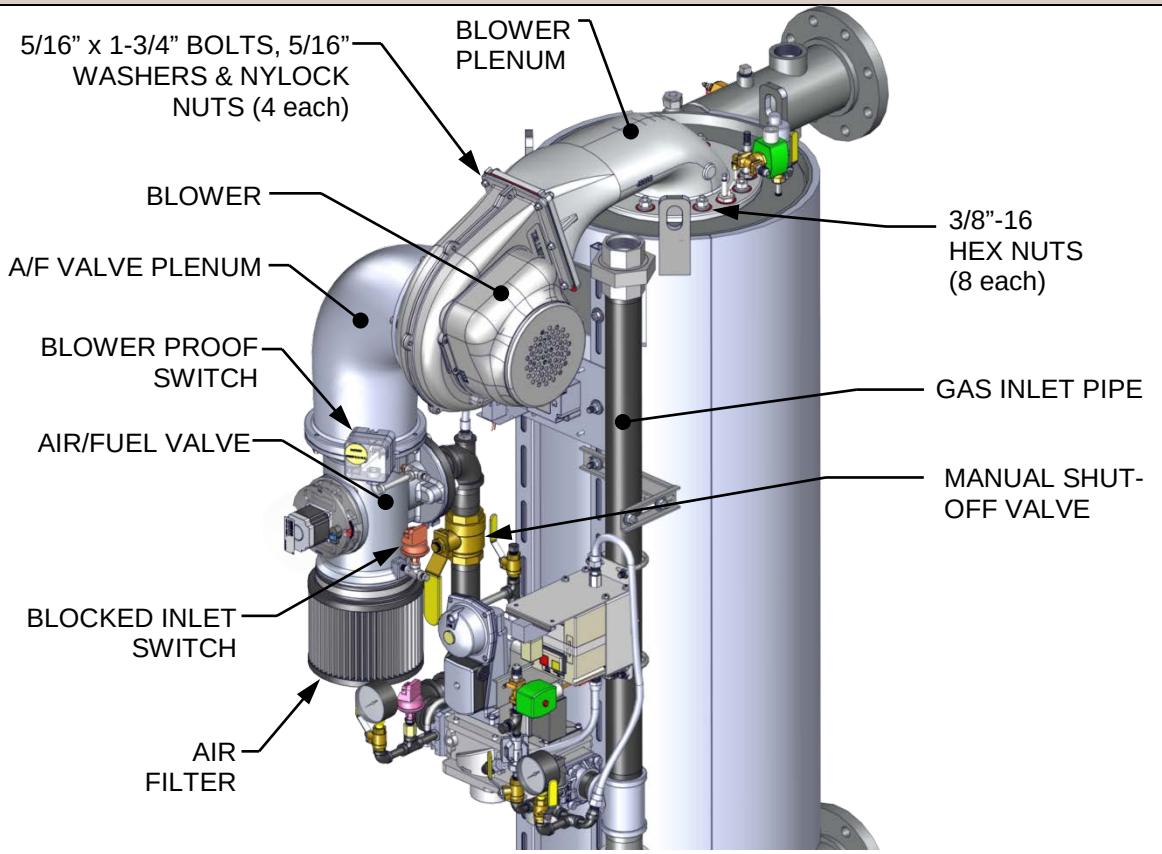


*Figure 4-5b: BMK 1500/2000 Burner Assembly Mounting Details*

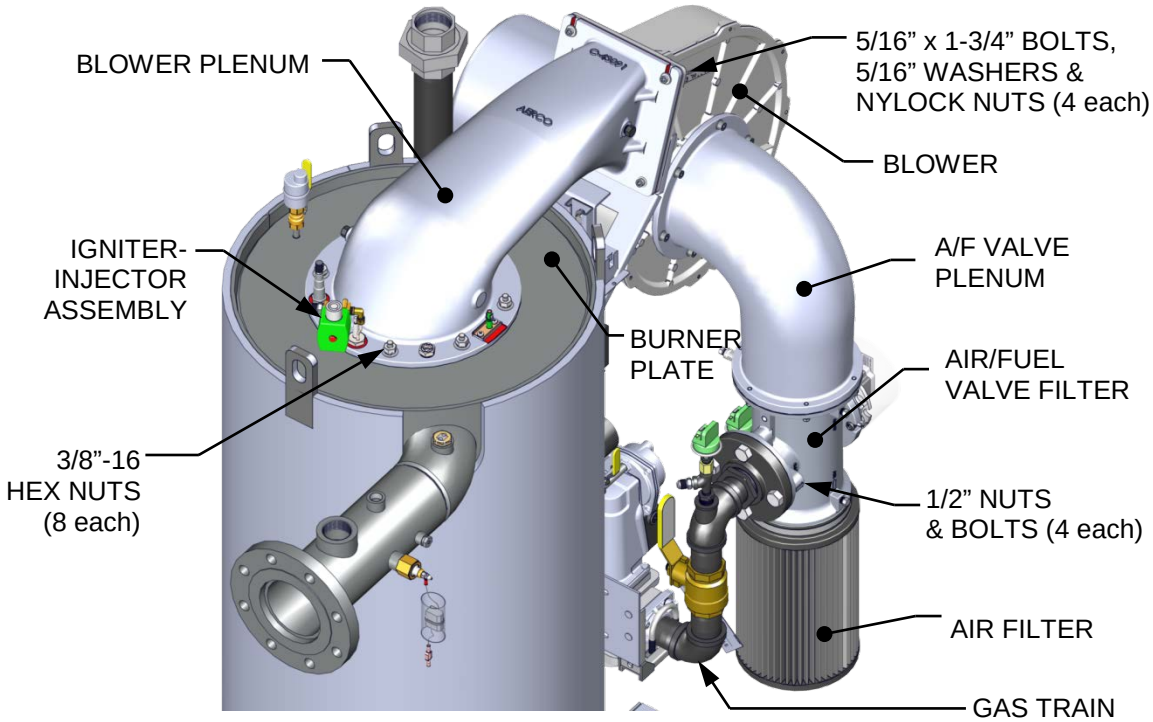


*Figure 4-5c: BMK 2500/3000 Burner Assembly Mounting Details*

## BMK 1500-3000 Burner Inspection Instructions

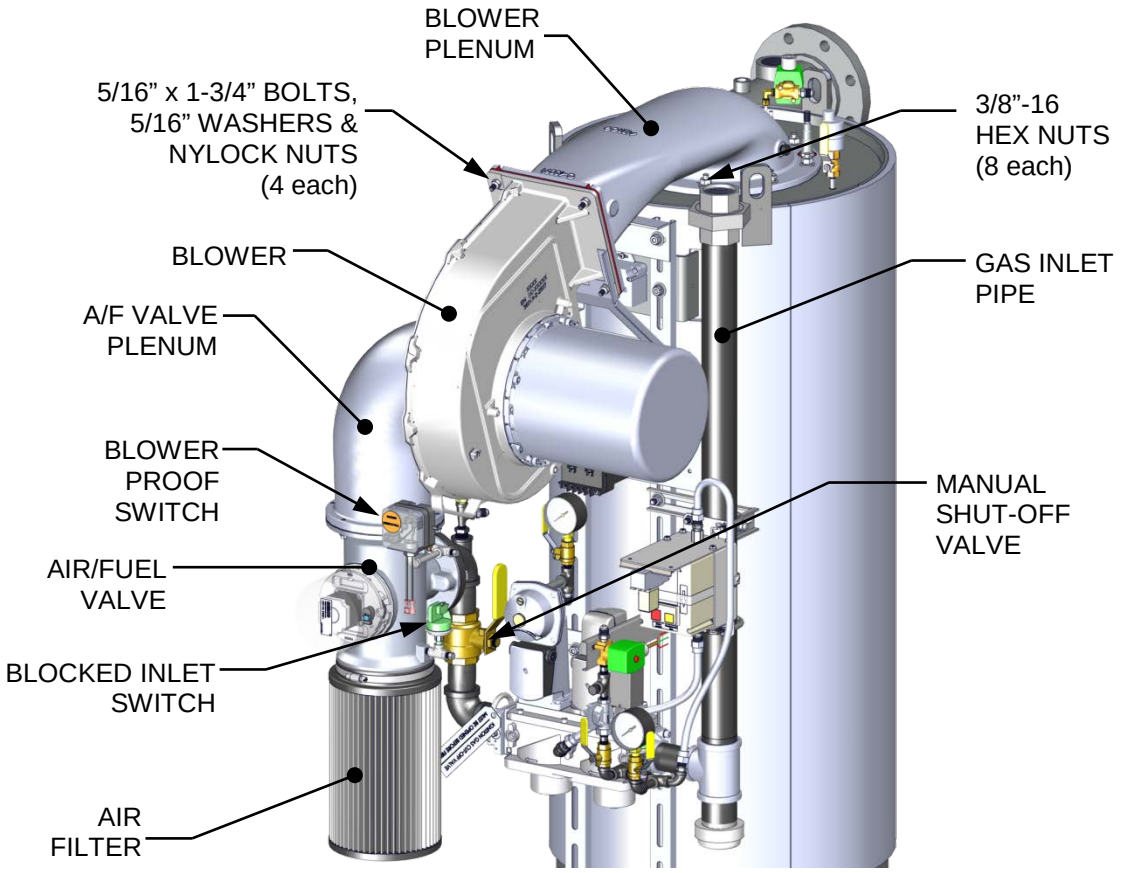


***Figure 4-5d: BMK 2500/3000 Burner Assembly Mounting Details***

1. Set the ON/OFF switch on the C-More Controller to the OFF position. Disconnect AC power from the unit and turn off the gas supply.
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.
3. Disconnect the lead wire from the flame detector installed on the burner plate. See Figure 4-2b (BMK 1500/2000) or Figure 4-2c (BMK 2500/3000).
4. Remove the two (2) screws securing the flame detector to the plate. The flame detector is secured to the burner plate with one (1) #10-32 screw and one (1) #8-32 screw.
5. Remove the flame detector and gasket from the burner plate.
6. Disconnect the cable from the igniter-injector.
7. Using a 7/16” open-end wrench, disconnect the compression nut securing the gas injector tube of the igniter-injector to the elbow of the staged ignition assembly (see Figure 4-2b (BMK 1500/2000) or Figure 4-2c (BMK 2500/3000). Disconnect the staged ignition assembly from the igniter-injector.
8. Next, loosen and remove the igniter-injector from the burner plate using a 1" open-end wrench.
9. Loosen and remove the four 5/16 x 1-3/4” bolts, washers, and nuts from the blower plenum where it attaches to the blower. See Figure 4-5a & 4-5b (BMK 1500/2000) or Figures 4-5c & 4-5d (BMK 2500/3000).

## BMK 1500-3000 Burner Inspection Instructions

10. You must either rig a support for the blower to hold it in place or remove the blower from the unit and set it aside for later reassembly.
11. Remove the eight (8) 3/8-16 nuts, using a 9/16" wrench, attaching the blower plenum to the burner. See Figure 4-5a & 4-5b (BMK 1500/2000) or Figures 4-5c & 4-5d (BMK 2500/3000).
12. Remove the blower plenum from between the blower and the burner and set it aside for later reassembly. The $O_2$ sensor and flame observation port remain assembled to the plenum flange.
13. Remove the burner by pulling straight up. Note, this assembly weighs approximately 65 lbs. (29.5 kg).
14. Remove and replace the burner gasket(s) (see Figure 4-6, below).

**IMPORTANT!**

ALL THREE gaskets provided for maintenance MUST be installed during this procedure, as shown in Figure 4-6, even if there is only one existing gasket being replaced. Note that the LOWER RELEASE GASKET has tabs, which the others do not.

**NOTE:**

During reassembly, apply a light coating of high-temperature, anti-seize lubricant to the threads of the igniter-injector and grounding screw. Also, ensure that the igniter-injector is properly positioned as indicated in Figure 4-3b or Figure 4-3c. Torque the igniter-injector to **14 - 15 ft-lbs. (19.0 - 20.3 Nm)**.

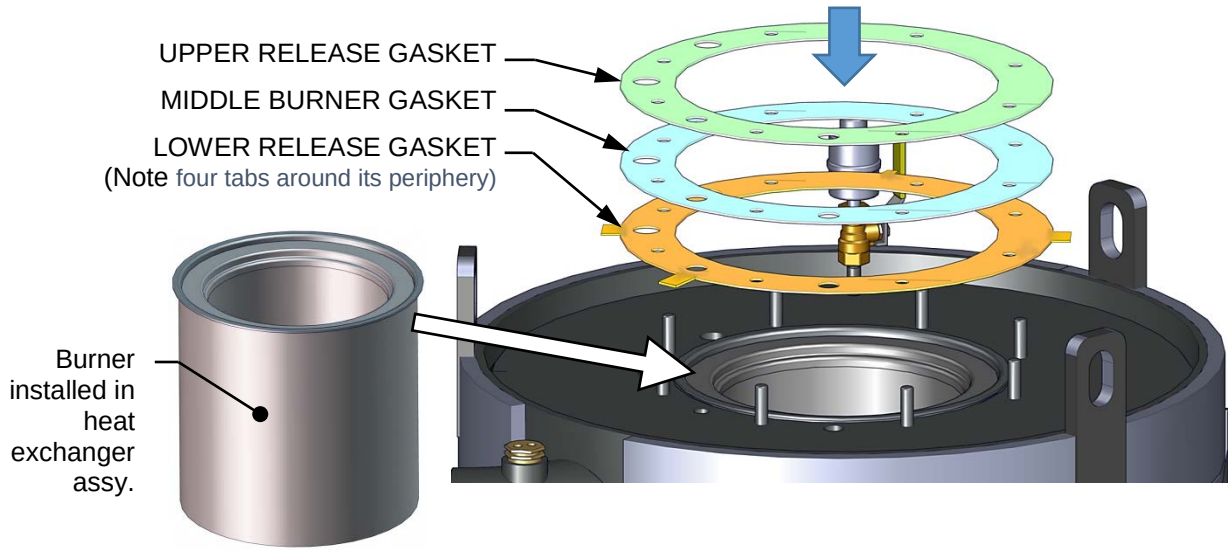


***Figure 4-6: Bare Burner and Replacement Gaskets Location***

15. Beginning with the burner assembly, reinstall all the components in the reverse order that they were removed. When reinstalling the blower plenum (removed in step 11), tighten the 3/8-16 nuts using a typical torque pattern (for example, loosely tighten one nut, then loosely tighten a second nut on the opposite side, a third at 90 degrees to the first two, and a fourth opposite the third, and then repeat this pattern with the remaining four nuts. Repeat the entire pattern a second time to partially tighten all eight nuts, and then repeat a third time until all eight nuts are **fully torqued to 35 ft. lbs. (47.5 Nm).**
16. Ensure that the igniter-injector and flame detector cutouts in the burner plate are properly aligned with the heat exchanger top flange.

# 4.7 CONDENSATE DRAIN TRAP

Benchmark boilers contain a condensate trap (P/N **24441**), located external to the unit and attached to the drain connection from the exhaust manifold at the rear of the unit (shown in Figure 2-6a and 2-6b of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K)). This trap should be inspected and cleaned in accordance with the maintenance schedule shown in Table 4-1, above, to ensure proper operation.

To inspect and clean the trap, proceed as follows:

## Condensate Drain Trap Maintenance Instructions

1. Disconnect the external condensate trap by loosening and then removing connections on the inlet and outlet sides of the condensate trap (see Figure 4-7).
2. Loosen the four (4) thumbscrews securing the trap's cover and then remove the cover and the O-ring from under the cover.
3. Remove the float and then thoroughly clean the trap and float. Also inspect the drain piping for blockage. If the trap cannot be thoroughly cleaned, replace the entire trap (P/N **24441**).
4. Replace the float, install the O-ring (P/N **84017**), and then replace the trap cover.
5. Reassemble all piping and hose connections to the condensate trap inlet and outlet.

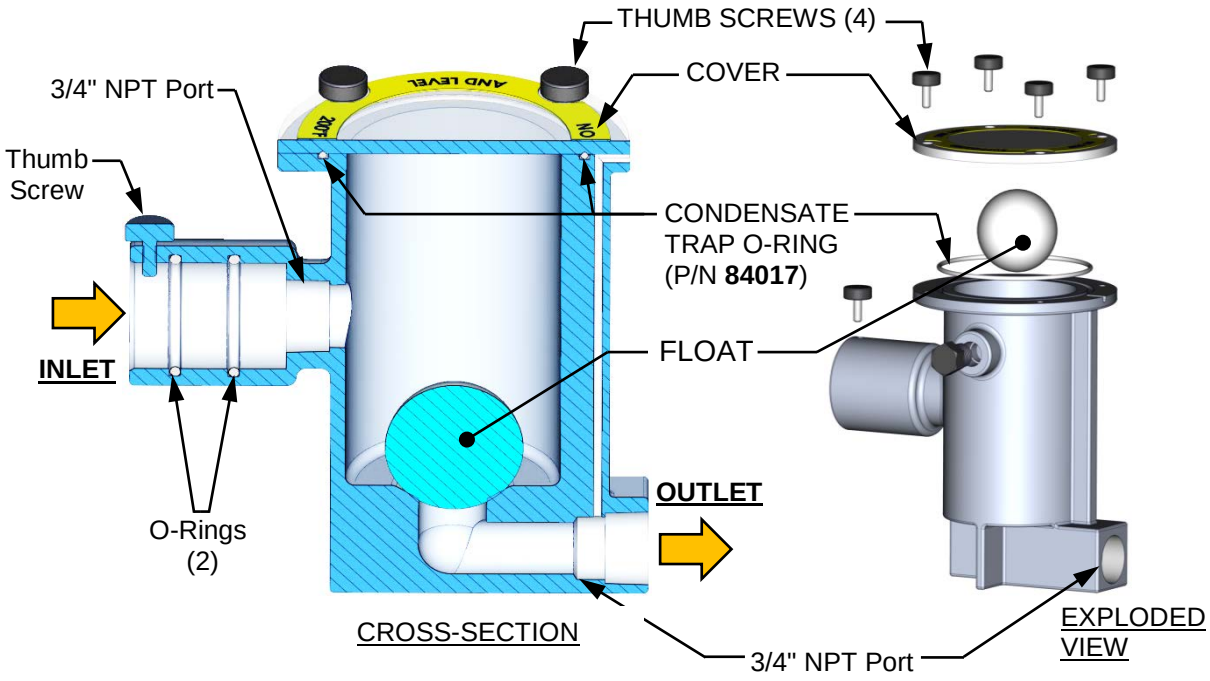


***Figure 4-7: External Condensate Trap – Cross-Section & Exploded View***

# 4.8 AIR FILTER CLEANING and REPLACEMENT

The Benchmark boiler is equipped with an air filter which should be cleaned and re-oiled every 12 months and replaced every 24 months. The air filter is located at the air fuel valve inlet, as shown in Figure 4-8.

**TABLE 4-2: Available Air Filters**

| Benchmark Model | Part Number |
|---|---|
| 750, 1000 | 59139 |
| 1500, 2000 | 59138 |
| 2500, 3000 | 88014 |

To inspect/replace the air filter, proceed as follows:

## Air Filter Cleaning and Replacement Instructions

1. Set the ON/OFF switch on the C-More Controller to the **OFF** position. Disconnect AC power from the unit.
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.
3. Refer to Figure 4-8 and locate the air filter attached to the air/fuel valve inlet.

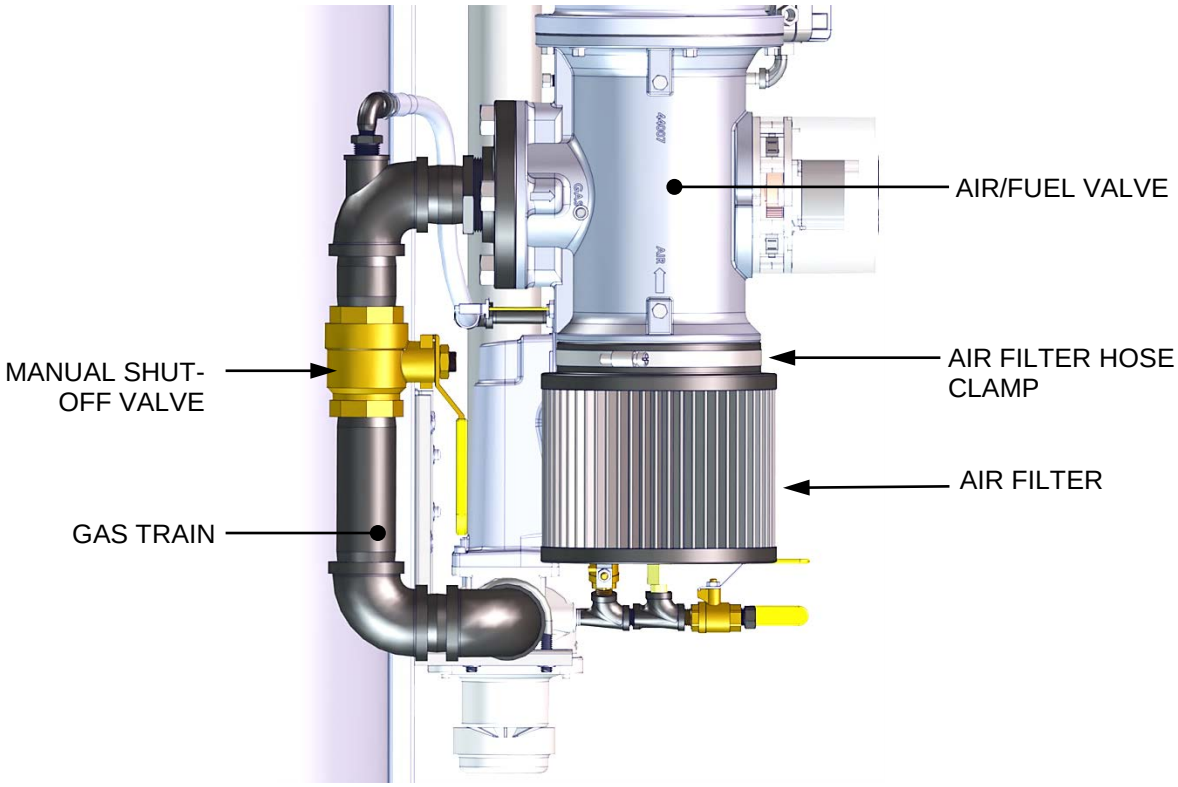


***Figure 4-8: Air Filter Location (BMK 1500/2000 Shown)***

4. Using a flat-tip screwdriver or 5/16" nut driver, loosen the clamp securing the filter to the inlet flange of the air/fuel valve. Remove the filter and clamp.

## Air Filter Cleaning and Replacement Instructions

5. The filter may be cleaned in hot soapy water to remove oil and dirt. It should then be thoroughly dried and then sprayed with a light coating of K&N® Air Filter Oil (or equivalent specifically formulated for air filters) prior to reinstallation. **Do NOT use WD-40**.
6. Each replacement air filter is equipped with its own clamp. Therefore, simply install the replacement air filter on inlet flange of the air fuel valve and tighten the clamp with a flat-tip screwdriver or 5/16" nut driver.
7. Replace the top shroud on the unit and return boiler to service use.

# 4.9 WATER CUTOFF (LWCO) CAPACITOR INTEGRITY TEST

The LWCO capacitor should be tested for electrical shorts every 12 months and replaced, then tested, every 24 months. The LWCO capacitor integrity test consists of two parts as described in the next two sections. The first procedure explains how to test for electrical shorting of the LWCO probe capacitor, while the second procedure instructs how to perform the standard Low Water Cutoff test using the C-More controls.

Refer to Figure 4-9 for an illustration of the LWCO probe assembly and its typical installation.

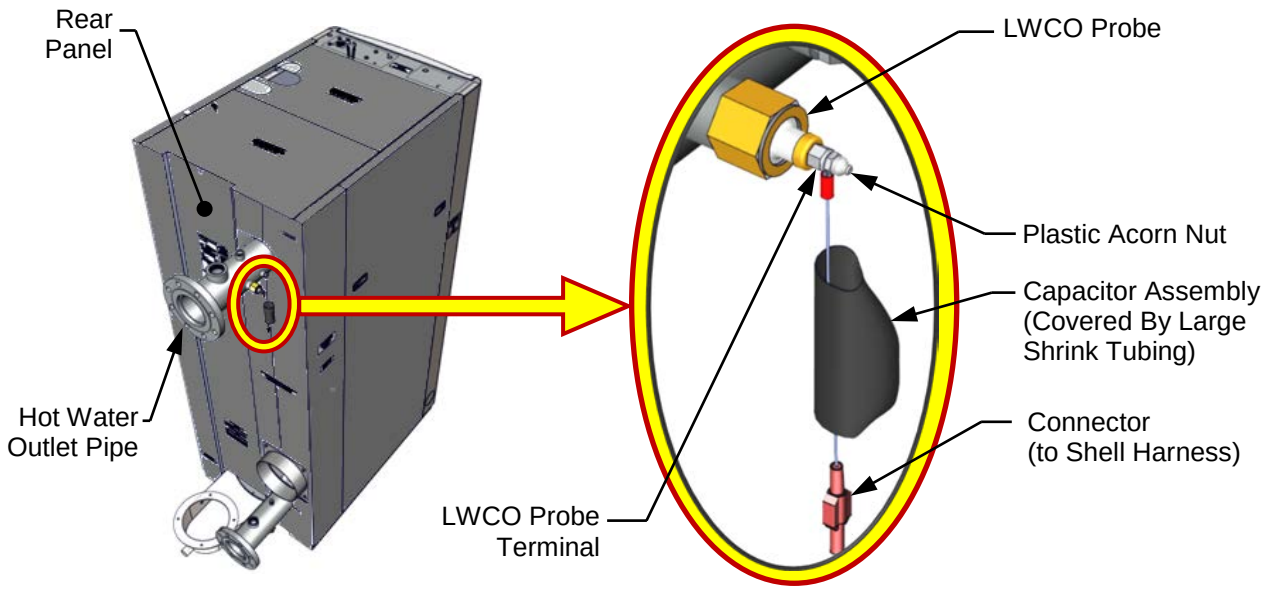


***Figure 4-9: LWCO Probe Location (BMK1500 Shown)***

## 4.9.1 Low Water Cutoff (LWCO) - Capacitor Electrical Short Test

This test determines if there is an electrical short between the LWCO capacitor and the heat exchanger. Perform the capacitor electrical short test as described below.

### Low Water Cutoff – Capacitor Electrical Short Test Instructions

1. Turn the AC power to the unit to OFF.

**WARNING!**

High voltages are used to power these units and so it is required that power applied to these units is removed first before performing the procedure described in this instruction. Serious personal injury or death may occur if this warning is not observed.

2. Remove the Shell Harness Cable (male) connector from the P-5 (female) connector on the rear panel of the C-More Controller (see Figure 4-10).

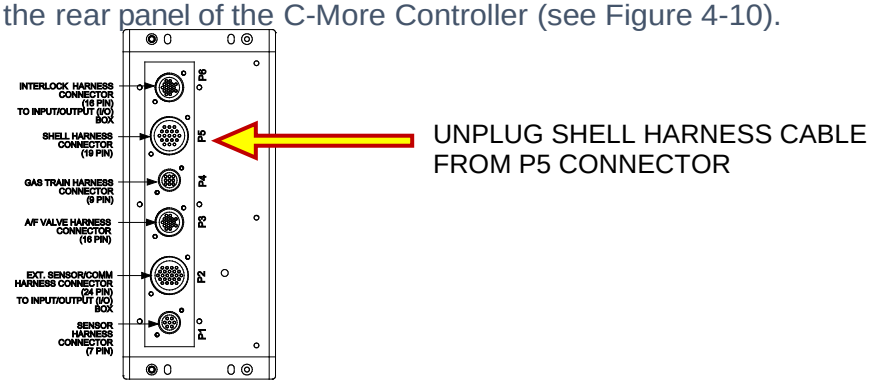


*Figure 4-10: Removing Shell Harness Cable from P5 Conn. on C-More Rear Panel*

3. Using an ohmmeter, connect one ohmmeter probe to the LWCO capacitor terminal on the unit shell as shown on left in Figure 4-11.
4. Connect the second ohmmeter probe to Pin #6 of Shell Harness Connector (removed from the C-More controller) as shown on right in Figure 4-11.

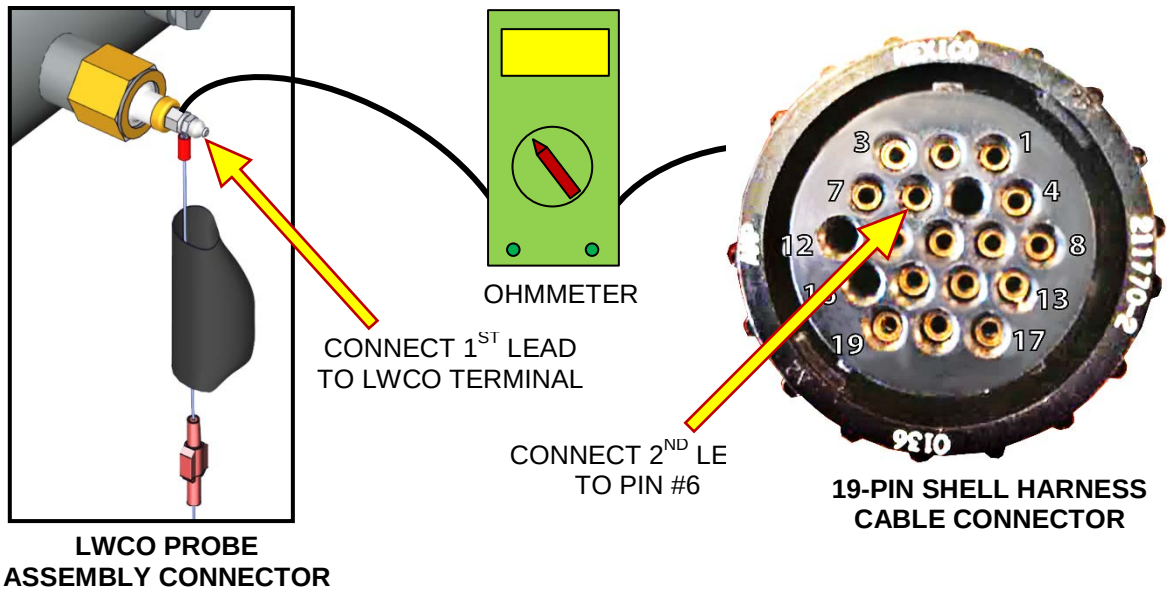


*Figure 4-11: Connecting Ohmmeter between LWCO Probe & Shell Harness Cable*

## 4.9.2 Low Water Cutoff (LWCO) - Standard C-More Test

Perform the standard Low Water Cutoff test using the C-More controls as described below.

### Low Water Cutoff (LWCO) - Standard C-More Test Instructions

1. Turn the AC power to the unit to the **ON** position.
2. Press the TEST switch on the C-More Controller and confirm that the blinking *LOW WATER LEVEL* message appears on the C-More display within 4 seconds.
3. Press the RESET key, followed by the Clear button, and confirm that the *LOW WATER LEVEL* message is cleared.

## 4.10 SHUTTING BOILER DOWN FOR EXTENDED PERIOD

If the boiler is to be taken out of service for an extended period of time (one year or more), the following instructions must be followed.

### Shutting Boiler Down For An Extended Period Instructions

1. Set ON/OFF switch on the C-More Controller to the **OFF** position to shut down the boiler's operating controls.
2. Disconnect AC power from the unit.
3. Close the water supply and return valves to isolate boiler.
4. Close external gas supply valve.
5. Open relief valve to vent water pressure.
6. Open the drain valve and drain all water from the unit.
7. If the temperature in the storage location will ever get below freezing, **for even a short time**, you must drain ***all*** water from the unit ***before*** the temperature falls below freezing. Step 6 is not sufficient, as it leaves some water in the bottom of the heat exchanger chamber. You must then use a suction pump inserted through the inspection ports to remove all water from the bottoms of the heat exchanger chamber and base assembly.

**WARNING!**

If the temperature will ever fall below freezing, failure to drain ***all*** water can cause heat exchanger tubes to crack and fail.

# 4.11 PLACING THE BOILER BACK IN SERVICE AFTER A PROLONGED SHUTDOWN

After a prolonged shutdown (one year or more), the following procedures must be followed:

**Placing The Boiler Back In Service After A Prolonged Shutdown Instructions**

1. Review installation requirements included in Section 2 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K).
2. Inspect all piping and connections to the unit.
3. Inspect exhaust vent and air inlet duct work (if applicable).
4. Perform initial startup per Section 4 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K).
5. Perform scheduled maintenance procedures per Section 4 of this manual and safety device testing per Section 5 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K).

# 4.12 SPARK MONITOR (AC CURRENT TRANSDUCER)

The spark monitor (P/N **61034**) evaluates the strength of the current between the ignition transformer and igniter-injector. Wire# 140, connected to the ignition transformer (see Figure 4-12), passes through the monitor's orifice. If an adequate AC current is not detected in the wire during ignition, the unit automatically shuts down. The monitor's wires are connected to the I/O board's Spark Signal terminals (see Section 2.11.4 in the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K) for details).

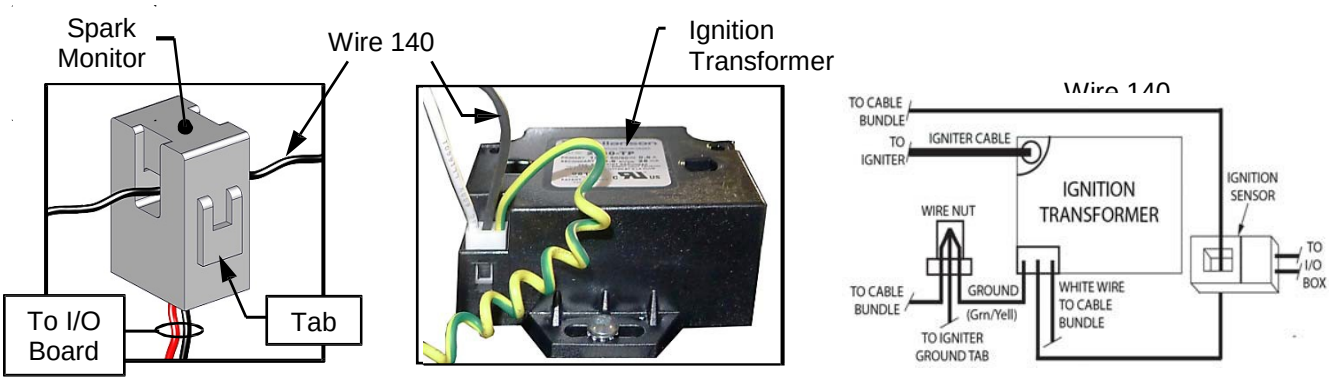


***Figure 4-12: Spark Detector Sensor (AC Current Transducer) P/N 61034***

If the spark monitor needs to be replaced, open the monitor's orifice by pulling on the tab at the side, remove Wire# 140, disconnect the monitor's wires are from the I/O board, remove the old monitor from its position, install a new monitor in its place, route wire# 140 through the new sensor orifice, and connect the wires to the I/O board's Spark Signal terminals, red wire to the positive (+) terminal and black to negative (-).

# SECTION 5: TROUBLESHOOTING GUIDE

## 5.1 INTRODUCTION

This troubleshooting guide is intended to aid service/maintenance personnel in isolating the cause of a fault in Benchmark 750 through 3000 boilers. The troubleshooting procedures contained herein are presented in tabular form on the following pages. These tables are comprised of three columns labeled: Fault Indication, Probable Cause and Corrective Action. The numbered items in the Probable Cause and Corrective Action columns correspond to each other. For example, Probable Cause No. 1 corresponds to Corrective Action No. 1, etc.

When a fault occurs in the unit, proceed as follows to isolate and correct the fault:

### Fault Correction Instructions

1. Observe the fault messages displayed in the C-More Controller display.
2. Refer to the Fault Indication column in Troubleshooting Table 5-1 which follows and locate the Fault that best describes the existing conditions.
3. Proceed to the Probable Cause column and start with the first item (1) listed for the Fault Indication.
4. Perform the checks and procedures listed in the Corrective Action column for the first Probable Cause candidate.
5. Continue checking each additional Probable Cause for the existing fault until the fault is corrected.
6. Section 5-2 contains additional troubleshooting information which may apply when a no fault message is displayed.

If the fault cannot be corrected using the information provided in the Troubleshooting Tables, contact your local AERCO Representative.

NOTE:

The front panel of the C-More Controller contains an RS232 port. This port is used only by factory-trained personnel to monitor onAER communications via a portable computer.

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| TABLE 5-1: Boiler Troubleshooting Procedures | | |
|---|---|---|
| **Fault Indication** | **Probable Causes** | **Corrective Action** |
| AIRFLOW FAULT DURING IGNITION | 1. Blower stopped running due to thermal or current overload.<br>2. Blocked Blower inlet or inlet air filter.<br>3. Blockage in Blower Proof switch.<br>4. Blockage in Blocked Inlet switch.<br>5. Defective Blower Proof switch.<br>6. Defective Blocked Inlet switch.<br>7. Loose temperature to AUX connection in I/O Box.<br>8. Defective temperature sensor.<br>9. Loose wire connection between the 0-10V signal from I/O box to the Blower input.<br>10. Defective I/O Box.<br>11. Wrong 0-10V output selection on the C-More Controller.<br>12. Defective Air-Fuel Valve potentiometer.<br>13. Hard light. | 1. Check combustion blower for signs of excessive heat or high current drain that may trip thermal or current overload devices.<br>2. Inspect the inlet to the combustion blower including the air filter at the air/fuel valve for signs of blockage.<br>3. Remove the Blower Proof switch and inspect for signs of blockage, clean or replace as necessary.<br>4. Remove the Blocked Inlet switch and inspect for signs of blockage, clean or replace as necessary.<br>5. Check the continuity of the Blower Proof switch with the combustion blower running. If there is an erratic resistance reading or the resistance reading is greater than zero ohms, replace the switch.<br>6. Turn off unit and check the continuity of the Blocked Inlet switch. If there is an erratic resistance reading or the resistance reading is greater than zero ohms, replace the switch.<br>7. Check the actual inlet air temperature and measure voltage at AUX input in the I/O Box. Verify that the voltage conforms to the values shown in Appendix C.<br>8. Refer to CORRECTIVE ACTION 7 and verify that the voltage conforms to the values shown in Appendix C.<br>9. Check wire connection from I/O Box 0-10V signal to the Blower Motor.<br>10. Measure voltage at the I/O box 0-10V output. A voltage of 10V equates to a 100% open valve position.<br>11. Check the *Analog Out* option on the C-More *Configuration* menu. ***Valve Position 0-10V*** should be selected.<br>12. Check Air/Fuel Valve position at 0%, 50% and 100% open positions. The positions on the VALVE POSITION bargraph should match the readings on the Air/Fuel Valve dial.<br>13. Check igniter-injector for soot or erosion of electrode. Check injector solenoid valve to insure proper open/close operation. |

| TABLE 5-1: Boiler Troubleshooting Procedures | | |
|---|---|---|
| **Fault Indication** | **Probable Causes** | **Corrective Action** |
| AIRFLOW FAULT DURING PURGE | 1. Blower not running or running too slow.<br>2. Defective Blocked Inlet switch.<br>3. Blockage in air filter or Blocked Inlet switch.<br>4. Blocked blower inlet or inlet ductwork.<br>5. No voltage to Blocked Inlet switch from C-More Controller.<br>6. PROBABLE CAUSES from 3 to 12 for AIRFLOW FAULT DURING IGNITION apply for this fault. | 1. Start the unit. If the blower does not run check the blower solid state relay for input and output voltage. If the relay is OK, check the blower.<br>2. Start the unit. If the blower runs, turn off unit and check the Blocked Inlet switch for continuity. Replace the switch if continuity does not exist.<br>3. Remove the air filter and Blocked Inlet switch and inspect for signs of blockage. Clean or replace as necessary.<br>4. Inspect the inlet to the combustion blower including any ductwork leading up to the combustion blower for signs of blockage.<br>5. During the start sequence, verify that 24 VAC is present between each side of the switch and ground. If 24 VAC is not present, refer fault to qualified service personnel.<br>6. See CORRECTIVE ACTIONS from 3 to 12 for AIRFLOW FAULT DURING IGNITION. |
| AIRFLOW FAULT DURING RUN | 1. Blower stopped running due to thermal or current overload.<br>2. Blocked Blower inlet or inlet ductwork.<br>3. Blockage in air filter or Blocked Inlet switch.<br>4. Defective Blocked Inlet switch.<br>5. Combustion oscillations.<br>6. Probable causes from 3 to 16 for AIRFLOW FAULT DURING IGNITION applies for this fault. | 1. Check combustion blower for signs of excessive heat or high current draw that may trip thermal or current overload devices.<br>2. Inspect the inlet to the combustion blower, including any ductwork leading up to the combustion blower, for signs of blockage.<br>3. Remove the air filter and Blocked Inlet switch and inspect for signs of blockage, clean or replace as necessary.<br>4. Verify that 24 VAC is present between each side of the switch and ground. If 24 VAC is not present at both sides, replace switch.<br>5. Run unit to full fire. If the unit rumbles or runs rough, perform combustion calibration.<br>6. See CORRECTIVE ACTIONS from 3 to 12 for AIRFLOW FAULT DURING IGNITION. |

| TABLE 5-1: Boiler Troubleshooting Procedures | | |
|---|---|---|
| **Fault Indication** | **Probable Causes** | **Corrective Action** |
| DELAYED INTERLOCK OPEN | 1. Delayed Interlock Jumper not properly installed or missing.<br>2. Device proving switch hooked to interlocks is not closed. | 1. Check to insure jumper is properly installed across the delayed interlock terminals in the I/O Box.<br>2. If there are 2 external wires on these terminals, check to see if an end switch for a proving device (such as a pump, louver, etc.) is tied these interlocks. Ensure that the device and/or its end switch is functional. A jumper may be temporarily installed to test the interlock. |
| DIRECT DRIVE SIGNAL FAULT | 1. Direct drive signal is not present:<br>--Not yet installed.<br>--Wrong polarity.<br>--Signal defective at source.<br>--Broken or loose wiring.<br>2. Signal is not isolated (floating).<br>3. C-More Controller signal type selection switches not set for correct signal type (voltage or current). | 1. Check I/O Box to ensure signal is hooked up.<br>--Hook up if not installed.<br>--If installed, check polarity.<br>--Measure signal level.<br>--Check wiring continuity between source and unit.<br>2. Check signal at source to ensure it is isolated.<br>3. Check DIP switch on PMC board to ensure it is set correctly for the type of signal being sent. Check control signal type set in *Configuration* menu. |
| FLAME LOSS DURING IGN | 1. Worn Flame Detector.<br>2. No spark from Spark Igniter.<br>3. Defective Ignition Transformer.<br>4. Defective Ignition/Stepper (IGST) Board.<br>5. Defective SSOV. | 1. Remove and inspect the Flame Detector for signs of wear. Replace if necessary.<br>2. Close the internal gas valve in the unit. Install and arc a spark igniter outside the unit.<br>3. If there is no spark, check for 120VAC at the primary side to the ignition transformer during the ignition cycle.<br>4. If 120VAC is not present, the IGST Board in the C-More Controller may be defective. Refer fault to qualified service personnel.<br>5. While externally arcing the spark igniter, observe the open/close indicator in the Safety Shut-Off Valve to ensure it is opening. If the valve does not open, check for 120VAC at the valve input terminals. If 120VAC is not present, the IGST board in the C-More Controller may be defective. Refer fault to qualified service personnel. |

| TABLE 5-1: Boiler Troubleshooting Procedures | | |
|---|---|---|
| **Fault Indication** | **Probable Causes** | **Corrective Action** |
| FLAME LOSS DURING RUN | 1. Worn Flame Detector or cracked ceramic.<br>2. Defective Regulator.<br>3. Poor combustion calibration.<br>4. Debris on burner.<br>5. Blocked condensate drain. | 1. Remove and inspect the Flame Detector for signs of wear or cracked ceramic. Replace if necessary.<br>2. Check gas pressure readings using a gauge or manometer into and out of the Air/Fuel Valve to ensure that the gas pressure into and out of the valve is correct.<br>3. Check combustion calibration using the procedure in Section 4-3 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K).<br>4. Remove the burner and inspect for any carbon build-up or debris. Clean and reinstall.<br>5. Remove blockage in condensate drain. |
| HEAT DEMAND FAILURE | 1. The Heat Demand Relays on the Ignition/Stepper (IGST) board failed to activate when commanded.<br>2. Relay is activated when not in Demand. | 1. Press **CLEAR** button and restart the unit. If the fault persists, replace Ignition/Stepper (IGST) Board.<br>2. Defective relay. Replace IGST Board. |
| HIGH EXHAUST TEMPERATURE | 1. Poor combustion calibration.<br>2. Carboned heat exchanger due to incorrect combustion calibration. | 1. Check combustion calibration using procedure in Section 4.3 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K).<br>2. If exhaust temperature is greater than 200° F (93.3°C), check combustion calibration. Calibrate or repair as necessary. |
| HIGH GAS PRESSURE | 1. Incorrect supply gas pressure.<br>2. Defective SSOV Actuator.<br>3. Defective **High Gas Pressure** switch. | 1. Check to ensure gas pressure at inlet of SSOV does not **exceed 14" W.C. (3.49 kPa)**.<br>2. If gas supply pressure downstream of SSOV Actuator cannot be lowered to the range specified in Table 4-1 (Natural Gas) of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K), the SSOV Actuator may be defective.<br>3. Remove the leads from the High Gas Pressure switch. Measure continuity across the common (C) and normally closed (NC) terminals with the unit not firing. Replace the switch if continuity does not exist. |

| TABLE 5-1: Boiler Troubleshooting Procedures | | |
|---|---|---|
| **Fault Indication** | **Probable Causes** | **Corrective Action** |
| HIGH WATER TEMP SWITCH OPEN | 1. Faulty Water temperature switch.<br>2. Incorrect PID settings.<br>3. Faulty shell temperature sensor.<br>4. Unit in MANUAL mode.<br>5. Unit setpoint is greater than Over Temperature switch setpoint.<br>6. System flow rate changes are occurring faster than units can respond. | 1. Test the temperature switch to insure it trips at its actual water temperature setting.<br>2. Check PID settings (see Section 2-7: *Tuning Menu,* items 1 -3, for details). If the settings have been changed, record the current readings then reset them to the default values.<br>3. Using the resistance charts in Appendix C, measure the resistance of Shell sensor and BTU sensor at a known water temperature.<br>4. If unit is in MANUAL mode, switch to AUTO mode.<br>5. Check setpoint of unit and setpoint of Temperature switch; Ensure that the temperature switch is set higher than the unit's setpoint.<br>6. If the system is a variable flow system, monitor system flow changes to ensure that the rate of flow change is not faster than what the units can respond to. |
| HIGH WATER TEMPERATURE | 1. See HIGH WATER TEMPERATURE SWITCH OPEN.<br>2. Temp HI Limit setting is too low. | 1. See HIGH WATER TEMPERATURE SWITCH OPEN.<br>2. Check Temp HI Limit setting. |
| IGN BOARD COMM FAULT | 1. Communication fault has occurred between the PMC board and Ignition/Stepper (IGST) board. | 1. Press **CLEAR** button and restart unit. If fault persists, contact qualified Service Personnel. |

| TABLE 5-1: Boiler Troubleshooting Procedures | | |
|---|---|---|
| **Fault Indication** | **Probable Causes** | **Corrective Action** |
| IGN SWTCH CLOSED DURING PURGE | 1. Air/Fuel Valve not rotating. | 1. Start the unit. The Air/Fuel Valve should rotate to the purge (open) position. If the valve does not rotate at all or does not rotate fully open, check the Air/Fuel Valve calibration. If calibration is okay, the problem may be in the Air-Fuel Valve or the C-More Controller. Refer to qualified service personnel. |
| | 2. Defective or shorted switch. | 2. If the Air/Fuel Valve does rotate to purge, check the ignition switch for continuity between the N.O. and COM terminals. If the switch shows continuity when not in contact with the cam replace the switch. |
| | 3. Switch wired incorrectly. | 3. Check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals). If the switch is wired correctly, replace the switch. |
| | 4. Defective Power Supply Board or fuse. | 4. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board. |
| | 5. Defective IGST Board. | 5. Check “Heartbeat” LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board. |
| IGN SWTCH OPEN DURING IGNITION | 1. Air/Fuel Valve not rotating to ignition position. | 1. Start the unit. The Air/Fuel Valve should rotate to the purge (open) position, then back to ignition position (towards closed) during the ignition cycle. If the valve does not rotate back to the ignition position, check the Air/Fuel Valve calibration. If calibration is okay, the problem may be in the Air/Fuel Valve or the C-More Controller. Refer fault to qualified service personnel. |
| | 2. Defective Ignition switch. | 2. If the Air/Fuel Valve does rotate to the ignition position, check the ignition position switch for continuity between the N.O. and COM terminals when in contact with the cam. |
| | 3. Defective Power Supply Board or fuse. | 3. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board. |
| | 4. Defective IGST Board. | 4. Check “Heartbeat” LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board. |

| TABLE 5-1: Boiler Troubleshooting Procedures | | |
|---|---|---|
| **Fault Indication** | **Probable Causes** | **Corrective Action** |
| INTERLOCK OPEN | 1. Interlock jumper not installed or removed.<br>2. Energy Management System does not have unit enabled.<br>3. Device proving switch hooked to interlocks is not closed. | 1. Check for a jumper properly installed across the interlock terminals in the I/O box.<br>2. If there are two external wires on these terminals check any Energy Management system to see if they have the units disabled (a jumper may be temporarily installed to see if the interlock circuit is functioning).<br>3. Check that proving switch for any device hooked to the interlock circuit is closing and that the device is operational. |
| LINE VOLTAGE OUT OF PHASE | 1. Line and Neutral switched in AC Power Box.<br>2. Incorrect power supply transformer wiring. | 1. Check hot and neutral in AC Power Box to ensure they are not reversed.<br>2. Check transformer wiring, in AC Power Box, against the power box transformer wiring diagram to ensure it is wired correctly. |
| LOW GAS PRESSURE | 1. Incorrect supply gas pressure.<br>2. Defective Low Gas Pressure switch. | 1. Measure gas pressure upstream of the SSOV Actuator(s) with the unit firing. Ensure it is above the values in Table 5-1 (BMK 750-2500) or or above the value calculated in step 4 in section 5.2 (BMK 3000) of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K).<br>2. Measure gas pressure at the Low Gas Pressure switch. If it is **greater than 1 inch above the Low Gas Pressure switch setting** in Table 5-1 (BMK 750-2500) or above the value calculated in step 4 in section 5.2.2 (BMK 3000) of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K)) measure continuity across the switch and replace if necessary. |
| LOW WATER LEVEL | 1. Insufficient water level in system.<br>2. Defective water level circuitry.<br>3. Defective water level probe. | 1. Check system for sufficient water level.<br>2. Test water level circuitry using the C-More Controller front panel LOW WATER TEST and RESET buttons. Replace water level circuitry if it does not respond.<br>3. Check continuity of probe end to the shell, change probe if there is no continuity. |
| MODBUS COMMFAULT | Unit not seeing information from Modbus network. | Check network connections. If fault persists, contact qualified Service Personnel. |

| TABLE 5-1: Boiler Troubleshooting Procedures | | |
|---|---|---|
| **Fault Indication** | **Probable Causes** | **Corrective Action** |
| PRG SWTCH CLOSED DURING IGNITION | 1. A/F Valve rotated open to purge and did not rotate to ignition position.<br>2. Defective or shorted switch.<br>3. Switch wired incorrectly.<br>4. Defective Power Supply Board or fuse.<br>5. Defective IGST Board. | 1. Start the unit. The Air/Fuel Valve should rotate to the purge (open) position, then back to ignition position (towards closed) during the ignition cycle. If the valve does not rotate back to the ignition position, check the Air/Fuel Valve calibration. If calibration is okay, the problem may be in the Air/Fuel Valve or the C-More Controller. Refer fault to qualified service personnel.<br>2. If the Air/Fuel Valve does rotate to the ignition position, check the purge switch for continuity between the N.O. and COM terminals. If the switch shows continuity when not in contact with the cam, check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals).<br>3. If the switch is wired correctly, replace the switch.<br>4. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.<br>5. Check “Heartbeat” LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board. |
| PRG SWTCH OPEN DURING PURGE | 1. Defective Purge switch.<br>2. No voltage present at switch.<br>3. Switch wired incorrectly.<br>4. Defective Power Supply Board or fuse<br>5. Defective IGST Board. | 1. If the air-fuel valve does rotate, check Purge switch for continuity when closing. Replace switch if continuity does not exist.<br>2. Measure for 24 VAC from each side of the switch to ground. If 24VAC is not present, refer fault to qualified service personnel.<br>3. Check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals).<br>4. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.<br>5. Check “Heartbeat” LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board. |
| OUTDOOR TEMP SENSOR FAULT | 1. Loose or broken wiring.<br>2. Defective Sensor.<br>3. Incorrect Sensor. | 1. Inspect Outdoor Temperature sensor for loose or broken wiring.<br>2. Check resistance of sensor to determine if it is within specification.<br>3. Ensure that the correct sensor is installed. |

| TABLE 5-1: Boiler Troubleshooting Procedures | | |
|---|---|---|
| **Fault Indication** | **Probable Causes** | **Corrective Action** |
| O2 % OUT OF RANGE | 1. Combustion Calibration incorrect.<br>2. Blocked inlet air duct or louver. | 1. Check Combustion Analyzer and recalibrate the boiler.<br>2. Unblock air inlet and measure open area for combustion air to the room. |
| RECIRC PUMP FAILURE | 1. Internal recirculation pump failed. | 1. Replace recirculation pump. |
| REMOTE SETPT SIGNAL FAULT | 1. Remote setpoint signal not present:<br>Not yet installed.<br>Wrong polarity.<br>Signal defective at source.<br>Broken or loose wiring.<br>2. Signal is not isolated (floating) if 4 to 20 mA.<br>3. C-More Controller signal type selection switches not set for correct signal type (voltage or current). | 1. Check I/O Box to ensure signal is hooked up.<br>Hook up if not installed.<br>If installed, check polarity.<br>Measure signal level.<br>Check continuity of wiring between source and unit.<br>2. Check signal at source to ensure it is isolated.<br>3. Check DIP switch on PMC board to ensure it is set correctly for the type of signal being sent. Check control signal type set in item 6 of the *Configuration* menu (see Section 2.6: *Configuration Menu*). |
| RESIDUAL FLAME | 1. Defective Flame Detector.<br>2. SSOV not fully closed. | 1. Replace Flame Detector.<br>2. Check open/close indicator window of Safety Shut-Off Valve (SSOV) and ensure that the SSOV is fully closed. If not fully closed, replace the valve and or actuator.<br>Close the Gas Shut-Off Valve downstream of SSOV (see Section 1, Figure 1-1). Install a manometer or gauge at the leak detection port between the SSOV and Gas Shut Off Valve. If a gas pressure reading is observed replace the SSOV Valve and/or Actuator. |
| SSOV FAULT DURING PURGE | See SSOV SWITCH OPEN | |
| SSOV FAULT DURING RUN | SSOV switch closed for 15 seconds during run. | 1. Replace actuator. |

| TABLE 5-1: Boiler Troubleshooting Procedures | | |
|---|---|---|
| **Fault Indication** | **Probable Causes** | **Corrective Action** |
| SSOV RELAY FAILURE | 1. SSOV relay failed on IGST board.<br>2. Floating Neutral.<br>3. Hot and Neutral reversed at SSOV. | 1. Press **CLEAR** button and restart unit. If fault persists, replace Ignition/Stepper (IGST) Board.<br>2. The Neutral and Earth Ground are not connected at the source and therefore there is a voltage measured between the two. Normally this measurement should be near zero or no more than a few millivolts.<br>3. Check SSOV power wiring. |
| SSOV SWITCH OPEN | 1. Actuator not allowing for full closure of gas valve.<br>2. SSOV powered when it should not be<br>3. Defective switch or Actuator.<br>4. Incorrectly wired switch. | 1. Observe operation of the Safety Shut-Off Valve (SSOV) through indicator on the Valve actuator and ensure that the valve is fully and not partially closing.<br>2. If the SSOV never closes, it may be powered continuously. Close the gas supply and remove power from the unit. Refer fault to qualified service personnel.<br>3. Remove the electrical cover from the SSOV and check switch continuity. If the switch does not show continuity with the gas valve closed, either adjust or replace the switch or actuator.<br>4. Ensure that the SSOV Proof of Closure switch is correctly wired. |
| STEPPER MOTOR FAILURE | 1. Air/Fuel Valve out of calibration.<br>2. Air/Fuel Valve unplugged.<br>3. Loose wiring connection to the stepper motor.<br>4. Defective Air/Fuel Valve stepper motor.<br>5. Defective Power Supply Board or fuse.<br>6. Defective IGST Board. | 1. Refer to the C-More User Manual OMM-0032 (GF-112) and perform the Stepper Feedback Calibration procedure in Section 6, Section 6.2.1.<br>2. Check that the Air/Fuel Valve is connected to the C-More Controller.<br>3. Inspect for loose connections between the Air/Fuel Valve motor and the wiring harness.<br>4. Replace stepper motor.<br>5. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.<br>6. Check “Heartbeat” LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board. |

## 5.2 ADDITIONAL FAULTS WITHOUT SPECIFIC FAULT MESSAGES

Refer to Table 5-2 to troubleshoot faults which may occur without a specific fault message being displayed.

**TABLE 5-2: Boiler Troubleshooting With No Fault Message Displayed**

| Observed Incident | Probable Causes | Corrective Action |
|---|---|---|
| Hard Light-Off | 1. Clogged/damaged Gas Injector on Igniter-Injector (Figure 4-1a through Figure 4-1c).<br>2. Defective Staged Ignition Solenoid (Figure 4-1a through Figure 4-1c). | 1. Disconnect the Staged Ignition Assembly solenoid from the Gas injector Tube of the Igniter-Injector (Figure 4-1a through Figure 4-1c) and inspect Gas Injector to ensure it is not clogged or damaged.<br>2. Close the Manual Shutoff Valve. Attempt to start the unit and listen for a “clicking” sound that the Staged Ignition Solenoid makes during Ignition Trial. If “clicking” sound is not heard after 2 or 3 attempts, replace the Staged Ignition Solenoid. |
| Fluctuating Gas Pressure | 1. Gas pressure going into unit is fluctuating.<br>2. Damping Orifice not installed. | 1. Stabilize gas pressure going into unit. If necessary, troubleshoot Building Supply Regulator.<br>2. Check if the gas train is supposed to have a Damping Orifice, and if so, ensure that it is installed in the SSOV Actuator shown in Figure 5-1, below. For DBB Gas Trains, the Damping Orifice is installed in the downstream SSOV Actuator). |
| Air/Fuel Valve “hunting” at the 70% Valve Position | 1. IGST and Power Supply Boards in C-More Controller are outdated. | 1. Check to ensure that the IGST and Power Supply Boards are Rev. E or higher. |

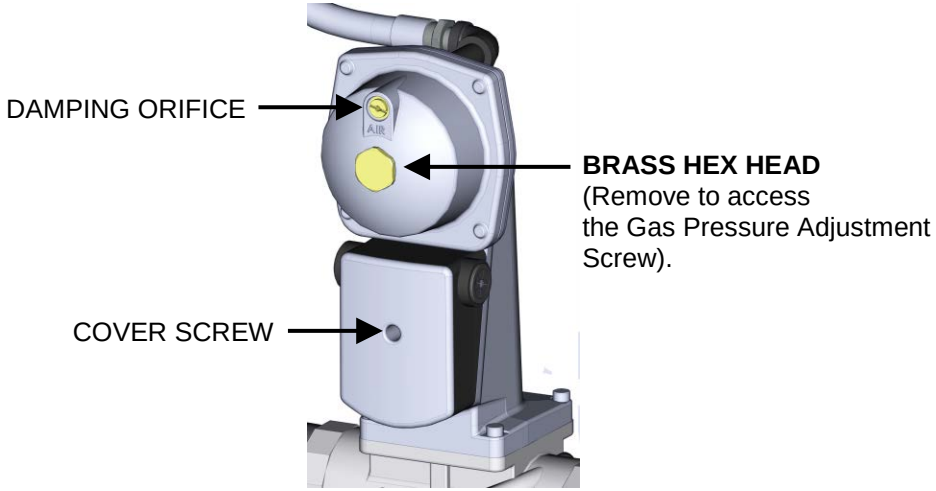


***Figure 5-1: SSOV Actuator With Gas Pressure Adjustment (SKP25)***

# Appendix A: BOILER MENU ITEM DESCRIPTIONS

## TABLE A-1: Operating Menu Item Descriptions

See Section 2-4 OPERATING Menu for a range of choices and the default values.

**TABLE A-1: OPERATING Menu Item Descriptions**

| MENU OPTIONS | | DESCRIPTION |
|---|---|---|
| **1** | Active Setpoint | This is the setpoint temperature to which the control is set when operating in the Constant Setpoint, Remote Setpoint or Outdoor Reset Mode. When in the Constant Setpoint Mode, this value is equal to the Internal Setpoint setting in the Configuration Menu. When in the Remote Setpoint Mode, this value is the setpoint equivalent to the remote analog signal supplied to the unit. When in the Outdoor Reset Mode, this is the derived value from the charts in Appendix E. |
| **2** | Outlet Temp | Displays the outlet water temperature. |
| **3** | Inlet Temp | Displays the inlet water temperature. |
| **4** | Air Temp | Air Temp is the air temperature at the input to the Air/Fuel Valve. This reading is one of the parameters used to control the Blower Motor speed. |
| **5** | Outdoor Temp | Outdoor temperature is displayed in ºF or ºC, only if outdoor temperature sensor is installed and enabled. |
| **6** | Valve Position In | Desired input valve position. This would normally be the same as the fire valve position shown on the bar graph (valve position out) when the boiler is operating. |
| **7** | Valve Position Out | Displays actual real time Valve Position. |
| **8** | FFWD Temp | Displays BST header temperature |
| **9** | Exhaust Temp | Displays the exhaust temperature in °F (default) or ºC. |
| **10** | Flame Strength | Displays flame strength from 0% to 100%. |
| **11** | Min Flame Str | Not Used |
| **12** | O2 Monitor | Enables or disables the O2 Monitor. |
| **13** | Oxygen Level | Displays the real-time combustion oxygen ($O_2$) level (%) measured by the $O_2$ sensor. |
| **14** | Ignition Time | Displays the elapsed time between confirmation of gas valve opening (POC) until a stable flame is detected. |
| **15** | SSOV Time to OPN | Displays the elapsed time between 120VAC being applied to the Gas Valve and confirmation of gas valve opening (POC). |
| **16** | Spark Current | Displays the current going to the ignition transformer. |
| **17** | Run Cycles | Displays the total number of run cycles. |
| **18** | Run Hours | Displays total run time of unit in hours. |

| TABLE A-1: OPERATING Menu Item Descriptions | | |
|---|---|---|
| **MENU OPTIONS** | | **DESCRIPTION** |
| **19** | Fault Log | Displays information on the last 20 faults. |

An additional parameter associated with the Operating menu, **Manual Valve Pos** (Min = 0, Max = 100) does not appear in this menu, but can be displayed by pushing the **Auto/Man** button on the C-More Controller's front face.

## TABLE A-2: Setup Menu Item Descriptions

See Section 2-5 SETUP Menu for a range of choices and the default values.

**TABLE A-2: SETUP Menu Item Descriptions**

| MENU OPTIONS | | DESCRIPTION |
|---|---|---|
| **1** | Password | Allows Level 1 or Level 2 password to be entered.<br>Entering the Level 1 Password (159) allows options in the *Setup*, *Configuration* and *Tuning* menus to be modified.<br>Entering the Level 2 Password (6817) allows options in the Calibration and Diagnostics Menus to be changed or activated, in addition to all Level 1 Menu options. |
| **2** | Language | Permits selection of the language of displayed messages. English is the only option at this time. |
| **3** | Time | Allows user to set the time, from 12:00 am to 11:59 pm. |
| **4** | Date | Allows user to set the date, from 01/01/00 to 12/31/99 |
| **5** | Unit of Temp | Permits selection of temperature displays in degrees Fahrenheit (°F) or degrees Celsius (°C). |
| **6** | Comm Address | For RS-485 communications. RS232 should have its own (programmable) password. |
| **7** | Baud Rate | Allows communications Baud Rate to be set (2400 to 19.2K). Default is 9600. |
| **8** | onAER Mode | Allows selection of either **Ethernet** or **SD Card**. |
| **9** | Min Upload Timer | Mandatory for AERCO onAER Remote Data Collection (ORDC). This parameter enables ORDC and defines the minimum amount of time between heartbeat data uploads in seconds. The COMM LED will light during the upload. |
| **10** | Unit Alpha | Mandatory for AERCO onAER Remote Data Collection. This value must match the first alpha digit on the Code Plate, e.g., **G**-12-1234. |
| **11** | Unit Year | Mandatory for AERCO onAER Remote Data Collection. This value must match the 2-digit year on the Code Plate, e.g., G-**12**-1234. |
| **12** | Unit Serial # | Mandatory for AERCO onAER. Remote Data Collection. This value must match the 4-digit serial # on the Code Plate, e.g., G-12-**1234**. |
| **13** | Software Version | Identifies the current software version of the C-More Controller. |

## TABLE A-3: Configuration Menu Item Descriptions

See Section 2-6 CONFIGURATION Menu for a range of choices and the default values.

The *Configuration* menu settings are Factory-Set in accordance with the requirements specified with each individual order. No changes will be required under normal operating conditions.

**TABLE A-3: CONFIGURATION Menu Item Descriptions**

| MENU OPTIONS | | DESCRIPTION |
|---|---|---|
| **1** | Internal Setpoint | Allows internal setpoint to be set from Lo Temp Limit of 40°F to Hi Temp Limit of 240°F (4.4°C to 115.6°C). |
| **2** | Unit Type | Can be one of the following: BMK Blr Std, BMK Blr Std Dual, BMK Blr LN, BMK Blr LN Dual. |
| **3** | Unit Size | Sets unit size, depending on the Unit Type:<br>750 MBH (220 kW), 1000 MBH (293 kW), 1500 MBH (439.6 kW), 2000 MBH (586.1 kW), 2500 MBH (732.6 kW), 3000 MBH (879.2 kW) |
| **4** | Fuel Type | Allows selection of Natural Gas or Propane. |
| **5** | Boiler Mode | Only available if Unit Type = Boiler. Allows selection of: Constant Setpoint, Remote Setpoint, Direct Drive, Combination, or Outdoor Reset Mode. |
| **6** | Remote Signal | Only available if Mode = Remote Setpoint, Direct Drive or Combination. Used to set the type of external signal which will be used when operating in the Remote Setpoint, Direct Drive or Combination Mode. |
| **7** | Outdoor Sensor | Allows outdoor sensor function to be set to Enabled or Disabled. |
| **8** | Bldg Ref Temp | Only available if Boiler Mode = **Outdoor Reset**. Allows the building reference temperature to be set when operating a boiler in the Outdoor Reset Mode. |
| **9** | Reset Ratio | Only available if Boiler Mode = **Outdoor Reset**. Permits setting of Reset Ratio when operating boiler in the Outdoor Reset Mode. |
| **10** | System Start Tmp | Only if Outdoor Sensor = **Enabled**. This menu item allows the system start temperature to be set. |
| **11** | Setpt Lo Limit | Used to set the *minimum* allowable setpoint, from 40°F (4.4°C) up to the Setpt Hi Limit. |
| **12** | Setpt Hi Limit | Used to set the *maximum* allowable setpoint, from the Setpt Lo Limit up to 210°F (98.9°C). |

| TABLE A-3: CONFIGURATION Menu Item Descriptions | | |
|---|---|---|
| **MENU OPTIONS** | | **DESCRIPTION** |
| **13** | Temp Hi Limit | This is the maximum allowable outlet temperature, up to 210°F (98.9°C). Any temperature above this setting will turn off the unit. The temperature must then drop 5°F (2.75°C) below this setting to allow the unit to run. |
| **14** | Max Valve Position | Sets the maximum allowable valve position for the unit. |
| **15** | Pump Delay Timer | Specifies the amount of time, up to 30 minutes, to keep the pump running after the unit turns off. |
| **16** | Aux Start On Dly | Specifies the amount of time to wait, up to 120 seconds, between activating the Aux Relay (due to a demand) and checking the pre-purge string to start the boiler. |
| **17** | Failsafe Mode | Allows the Failsafe mode to be set to either Constant Setpoint or Shutdown. |
| **18** | Analog Output | Must be set to **Valve Pos 0-10V** for all Benchmark models. **DO NOT CHANGE from its default value**. |
| **19** | Lo Fire Timer | Specifies how long, from 2 to 600 seconds, to remain in the low fire position after ignition, before going to the desired output. |
| **20** | Setpt Limiting | Setpoint Limiting can be Enabled or Disabled. |
| **21** | Setpt Limit Band | The Setpoint Limit Band can be set from **0°F** to **10°F (0°C to 5.5°C)**. |
| **22** | Network Timeout | Specifies the timeout value in seconds before a Modbus fault is declared, up to 999 seconds. |
| **23** | Shutoff Dly Temp | This feature delays the shutdown of a boiler in order to reduce excessive cycling. This specifies the temperature value the Outlet Temperature is permitted to rise above setpoint before being shut down. |
| **24** | Demand Offset | This entry will reduce excessive ON/OFF cycling in AUTO mode. When this entry is a non-zero value, the unit will not turn on again until *Valve Position In* (Operating menu item 7) reaches the Start Level value AND the Outlet Temperature goes below the *Active Setpoint – Demand Offset.* In addition, the boiler will fire at the 29% Valve Position level or below for a period of one minute.<br>When this entry is set to zero, the unit will turn on again as soon as the *Valve Position In* reaches the *Start Level* value (Calibration menu item 37). There will not be a one minute delay when firing at the 29% Valve Position level. |

| TABLE A-3: CONFIGURATION Menu Item Descriptions | | |
|---|---|---|
| **MENU OPTIONS** | | **DESCRIPTION** |
| **25**<br><br>**26** | Deadband High<br><br>Deadband Low | Deadband High and Deadband Low settings create an "Outlet Temperature" Zone in which no Valve Position corrections will be attempted.<br>The Deadband ZONE is defined as operating with an Outlet Temperature between Active Setpoint + Deadband High and Active Setpoint – Deadband Low.<br>When the Outlet Temperature reaches Active Setpoint and remains there for a period of 15 seconds, the unit will go into a DEADBAND MODE at which point no Valve Position corrections will be attempted while the Outlet Temperature remains anywhere within the Deadband ZONE. When the unit is in the DEADBAND MODE, the °F or °C LED will flash on and off. When the Outlet Temperature drifts out of the Deadband ZONE, the DEADBAND MODE will be terminated and the PID LOOP will again attempt Valve Position corrections.<br>Setting range is 0°F (0°C) to 25°F (13.75°C). Default is 5°F (2.75°C) for both Deadband High and Deadband Low). |
| **27** | IGST Version | Displays the version of the IGST Board installed. |
| **28** | IGN Time Setting | Displays the MAX Ignition time of 4 Seconds or 7 Seconds as set in the Safety String Harness. |
| **29** | Slow Shutdown | Set the Slow Shutdown feature to Enabled or Disabled. |
| **30** | Slow Sht Duration | If Slow Shutdown = **Enabled**, sets the time a boiler will continue to run at the Stop Level after running above the Slow Sht Threshold level, up to 9,999 seconds. |
| **31** | Slow Sht Threshold | Sets the Fire Rate above which a boiler will trigger the Slow Shutdown feature. |
| **32** | O2 Warnings | Enables or disables AERtrim warning messages. |
| **33** | O2 Trim ID | Displays 4 digit AERtrim ID number. Pre-populated on all units. Changes each time the unit is powered up. |
| **34** | Fixed ID | Displays the unit's fixed 4 digit ID number. Pre-populated on all units. Does not change. |
| **35** | O2 Trim Key | Displays the value of the AERtrim 4 digit license key. Pre-populated on all units. |
| **36** | O2 Trim Menu | When set to Enabled, the AERtrim menu options appears. |
| **37** | BST Menu | When set to Enabled, the BST menu options appears. |

## TABLE A-4: Tuning Menu Item Descriptions

See Section 2-7 TUNING Menu for a range of choices and the default values.

**TABLE A-4: TUNING Menu Item Descriptions**

| MENU OPTIONS | | DESCRIPTION | |
|---|---|---|---|
| **1** | Prop Band | Generates a fire rate based on the error that exists between the setpoint temperature and the actual outlet temperature. If the actual error is less than the proportional band setting (1°F to 120°F, 0.55°C to 66°C), the fire rate will be less than 100%. If the error is equal to or greater than the proportional band setting, the fire rate will be 100%. | |
| **2** | Integral Gain | This sets the fraction of the output, due to setpoint error, to add or subtract from the output each minute to move towards the setpoint. Gain is adjustable from 0.00 to 1.00 (Default is 1.0). | |
| **3** | Derivative Time | This value (0.0 to 2.0 min.) responds to the rate of change of the setpoint error. This is the time that this action advances the output. | |
| **Warmup –** The feature embodied in menu items 4, 5 and 6 eliminates Temperature Overshoots during the "Warmup" period of a cold ignition cycle on all boilers by temporarily modifying the PID Gain parameter during warmup and for a period defined in the *Tuning* menu. | | | |
| **4** | Warmup Prop Band | Range = 1 – 120°F (0.55°C to 66°C) | Default = 95 (52°C) |
| **5** | Warmup Int Gain | Range = 0.00 – 2.00 | Default = .50 |
| **6** | Warmup PID Timer | Range = 0 - 240 seconds | Default = 20 seconds |
| **7** | Reset Defaults? | Allows *Tuning* menu options to be reset to their Factory Default values. | |

## TABLE A-5: Combustion Calibration Menu Item Descriptions

See Section 2-8 COMBUSTION CAL Menu for a range of choices and the default values.

> NOTE:
> The Level 2 Password must be entered to view the options in the *Combustion Cal* menu. This Menu is used during the Combustion Calibration procedures described in Section 4-3 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K).

**TABLE A-5: COMBUSTION CAL Menu Item Descriptions**

| MENU OPTION | | DESCRIPTION |
|---|---|---|
| **1** | CAL Voltage:<br>BMK 750 = 18%<br>BMK 1000 = 18%<br>BMK 1500 = 16%<br>BMK 2000 = 18%<br>BMK 2500 = 16%<br>BMK 3000 = 14% | Displays the default DC drive voltage provided to the blower at each Air/Fuel Valve position (Items 1 – 6). This drive voltage adjusts the rotational speed of the blower to maximize combustion efficiency. |
| **2** | CAL Voltage 30% | |
| **3** | CAL Voltage 40% | |
| **4** | CAL Voltage 50% | |
| **5** | CAL Voltage 70% | |
| **6** | CAL Voltage 100% | |
| **7** | Set Valve Position | Permits selection of the Air/Fuel Valve position (% open) to be set from 0 to 100%. |
| **8** | Blower Output | Permits the DC drive voltage to the blower to be monitored. |
| **9** | Set Stby V out | Permits the Standby Voltage to be set from 0 to 4.00 Volts. |
| **10** | Oxygen Level | Permits the combustion oxygen level to be displayed (0% to 25%) |

## TABLE A-6: Calibration Menu Item Descriptions

See Section 2-10 CALIBRATION Menu for a range of choices and the default values.

**TABLE A-6: CALIBRATION Menu Item Descriptions**

| MENU OPTION | | DESCRIPTION |
|---|---|---|
| **1** | Stepper Fbk | Allows the Air/Fuel Valve stepper motor feedback current to be calibrated at the 0% (fully closed) and 100% (fully open) positions. Verification can also be accomplished at the 50% position. |
| **2** | Purge Timer | Allows adjustment of the pre-ignition purge time. |
| **3** | Post Purge Timer | Allows adjustment of the purge time when a unit shuts down. |
| **4** | IGN Position | Allows adjustment of the valve position (Fire Rate) during the ignition sequence. |
| **5** | Ign Pos Hold Tmr | |
| **6** | FFWD Temp Disply | Enabled or Disabled. |
| **7** | Outlet Tmp Dsply | Enabled or Disabled. |
| **8** | Inlet Tmp Dsply | Enabled or Disabled. |
| **9** | Valv Pos Out Dsp | Enabled or Disabled. |
| **10** | Exhaust Tmp Dsp | Enabled or Disabled. |
| **11** | Exhaust Safety | Enabled or Disabled. |
| **12** | Flue Material | Select flue material: PVC, Polypropylene, or stainless |
| **13** | Exhst Fault Temp | Fault threshold temperature |
| **14** | Exhst Module Temp | Decreases Valve Position to lower exhaust temperature. |
| **15** | Exhst Warn Temp | Flue temperature high warning |
| **16** | Exhst Tmp VP Adj | VP adjust value |
| **17** | Exhst Adj Rate | VP adjust rate |
| **18** | VP Change Rate | |
| **19** | VP Up Rate | Allows adjustment of the Valve Position (Fire Rate) increase rate when raising the Valve Position. VP Up Rate is defined as Seconds per Step. |
| **20** | VP Down Rate | Allows adjustment of the Valve Position (Fire Rate) decrease rate when lowering the Valve Position. VP Down Rate is defined as Seconds per Step. |
| **21** | Purge Blwr Offst | Allows adjustment of the blower speed (Blower Output Voltage) during the Purge cycle. |
| **22** | 4-20mA Purge Pct | Allows adjustment of the blower speed (Blower Output Voltage) during the Purge cycle when using an Emerson VFD Drive to control the Blower Motor. |
| **23** | PWM In Adj | Allows the Pulse Width Modulation (PWM) duty cycle to be adjusted from -5.0% to +5.0% in 0.1% increments. |
| **24** | Analog In Adj | Allows adjustment of the analog input from -5.0% to +5.0%. |
| **25** | Flow In Adj | Allows adjustment of the water Flow Rate Input from -5.0% to +5.0%. |
| **26** | Supply Gas Pressure | Allows adjustment of the Supply Gas Pressure level from |

| TABLE A-6: CALIBRATION Menu Item Descriptions | | |
|---|---|---|
| **MENU OPTION** | | **DESCRIPTION** |
| | In Adj | -5.0% to +5.0% in 0.1 % increments. |
| **27** | Gas Plate dp In Adj | Allows adjustment of the Gas Plate dp level from -5.0% to +5.0% in 0.1% increments. |
| **28** | mA Out Adj | Allows adjustment of the milliamp output from -5.0 mA to +5.0 mA. |
| **29** | A/F Sensitivity | Allows adjustment of the Air/Fuel (A/F) Valve stepper motor sensitivity to be adjusted from 1% to 5% in 1% increments. |
| **30** | Power Reset | Allows the Power Reset Option to be set to AUTO or MANUAL. |
| **31** | Water Temp Reset | Allows the Water Temperature Reset function to be set to AUTO or MANUAL. |
| **32** | Gas Press Reset | Allows the Gas Pressure Reset function to be set to AUTO or MANUAL. |
| **33** | Min Off Time | Allows the minimum Off time to be set from 0 to 10 minutes. |
| **34** | Heatr Tuning Dsp | Allows Heater Tuning Display to be Enabled or Disabled. |
| **35** | Heatr Bkpt Dsp | Allows Heater Breakpoint Display to be Enabled or Disabled. When Enabled, Breakpoints can be viewed and/or changed. |
| **36** | Stop Level | Allows the Stop Level to be set to a valve position ranging from 0% to the presently set Start Level. |
| **37** | Start Level | Allows the Start Level to be set to a valve position ranging from the presently set Stop Level to a maximum of 40%. |
| **SKIP FEATURE:**<br>Items 38 – 40 embody a feature that allows the user to define a Fire Zone the C-More will avoid. In the rare instance when a unit emits an objectionable noise at a certain Fire Rate and no other remedy solves the problem, a Fire Rate skip zone may be defined to command the C-More to Skip-Over the defined Fire Rate. | | |
| **38** | – Skip Range CNTR | Defines the Center (Fire Rate) of the skip band. |
| **39** | – Skip Range Span | Defines the + and – band of the Skip Zone Size. |
| **40** | – Skip Speed | Defines the speed (Seconds/Fire Rate) at which the band will be skipped. |
| **O2 Settings**:<br>Items 41 – 43 allow calibration of oxygen readings. | | |
| **41** | – O2 Gain | Range = 0.5 to 1.5. (Unity Gain, No Mods) |
| **42** | – O2 Offset | Range = -3.0 to +3.0. |
| **43** | – O2 Sensor | Enables the $O_2$ Sensor |
| **44** | Cal Temp Sensors | Allows calibration of the temperature sensor |
| **Temperature Channel Offset:**<br>Items 45 – 50 embody the feature, which allow the user to field calibrate all six temperature channels by entering an offset corresponding to the desired temperature channel. | | |
| **45** | – FFWD Temp Offset | Range: -20 to + 20 (either ºF or °C) |
| **46** | – Exhst Tmp Ofset | Range: -20 to + 20 (either ºF or °C) |

| TABLE A-6: CALIBRATION Menu Item Descriptions | | |
|---|---|---|
| **MENU OPTION** | | **DESCRIPTION** |
| **47** | – Outdr Air Offset | Range: -20 to + 20 (either ºF or °C) |
| **48** | – Inlet Air Offset | Range: -20 to + 20 (either ºF or °C) |
| **49** | – Inlet Wtr Offset | Range: -20 to + 20 (either ºF or °C) |
| **50** | – Outlet Wtr Offset | Range: -20 to + 20 (either ºF or °C) |
| **51** | 24 hr Max Cycles | Maximum cycles in 24 hour period. |
| **52** | 24 hr Max Ovrtemp | Maximum over-temp in 24 hour period. |
| **53** | 0-10v Out Test | Set the blower voltage at 0-10v for testing. |
| **54** | Spark Monitor | Enables or disables the Spark Monitor function, which displays the AC current on the input of the Ignition Transformer. |
| **56** | Min Spark Amps | Allows the adjustment of the minimum spark current required at the spark transformer input. |
| **56** | Max Spark Amps | Allows the adjustment of the maximum spark current required at the spark transformer input. |

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# Appendix B: STARTUP, STATUS, & FAULT MESSAGES

## Startup and Status Messages

**TABLE B-1: Startup and Status Messages**

| MESSAGE | DESCRIPTION |
|---|---|
| DEMAND DELAY<br>XX sec | Displayed if Demand Delay is active. |
| DISABLED<br>HH:MM pm, pm<br>MM/DD/YY | Displayed if ON/OFF switch is set to **OFF**. The display also shows the time (am or pm) and date that the unit was disabled. |
| FLAME PROVEN | Displayed after flame has been detected for a period of 2 seconds. Initially, the flame strength is shown in %. After 5 seconds has elapsed, the time and date are shown in place of flame strength. |
| IGNITION TRIAL<br>XX sec | Displayed during ignition trial of startup sequence. The duration of cycle counts up in seconds. |
| PURGING<br>XX sec | Displayed during the purge cycle during startup. The duration of the purge cycle counts up in seconds. |
| STANDBY | Displayed when ON/OFF switch is in the **ON** position, but there is no demand for heat. The time and date are also displayed. |
| WAIT | Prompts the operator to wait. |
| WARMUP<br>XX sec | Displayed for 2 minutes during the initial warm-up only. |

## Fault Messages

**TABLE B-2: Fault Messages**

| FAULT MESSAGE | FAULT DESCRIPTION |
|---|---|
| AIRFLOW FAULT DURING PURGE | The Blower Proof switch opened during purge, or air inlet is blocked. |
| AIRFLOW FAULT DURING IGN | The Blower Proof switch opened during ignition. |
| AIRFLOW FAULT DURING RUN | The Blower Proof switch opened during run. |
| DELAYED INTERLOCK OPEN | The Delayed Interlock is open. |
| DIRECT DRIVE SIGNAL FAULT | The direct drive signal is not present or is out of range. |
| FFWD TEMP SENSOR FAULT | The temperature measured by the Feed Forward (FFWD) Sensor is out of range. |
| FLAME LOSS DURING IGN | The Flame signal was not seen during ignition or lost within 5 seconds after ignition. |
| FLAME LOSS DURING RUN | The Flame signal was lost during run. |
| HEAT DEMAND FAILURE | The Heat Demand Relays on the Ignition board failed to activate when commanded. |
| HIGH EXHAUST TEMPERATURE | The Exhaust Temperature has exceeded 200°F (93.3°C). |
| GAS PRESSURE FAULT | The High Gas Pressure Limit switch is open or the Low Gas Pressure Limit switch is open. |
| HIGH WATER TEMPERATURE | The temperature measured by the Outlet Sensor exceeded the Temp Hi Limit setting. |
| HIGH WATER TEMP SWITCH OPEN | The High Water Temperature Limit switch is open. |
| IGN BOARD COMM FAULT | A communication fault has occurred between the PMC board and Ignition board. |
| IGN SWTCH CLOSED DURING PURGE | The Ignition Position Limit switch on the Air/Fuel Valve closed during purge. |
| IGN SWTCH OPEN DURING IGNITION | The Ignition Position Limit switch on the Air/Fuel Valve opened during ignition. |
| INTERLOCK OPEN | The Remote Interlock is open. |
| LINE VOLTAGE OUT OF PHASE | The Line (Hot) and Neutral wires are reversed. |
| LOW WATER LEVEL | The Low Water Cutoff board is indicating low water level. |
| NETWORK COMM FAULT | The RS-485 network information is not present or is corrupted. |

| TABLE B-2: Fault Messages | |
|---|---|
| **FAULT MESSAGE** | **FAULT DESCRIPTION** |
| $O_2$ % OUT OF RANGE | The $O_2$ % has gone below 3% or above 8%. |
| OUTDOOR TEMP SENSOR FAULT | The temperature measured by the Outdoor Air Sensor is out of range. |
| OUTLET TEMP SENSOR FAULT | The temperature measured by the Outlet Sensor is out of range:<br>• OUTLET TEMPERATURE display = SHt Indicates sensor is shorted<br>• OUTLET TEMPERATURE display = Opn indicates sensor is open-circuited |
| PRG SWTCH CLOSED DURING IGNITION | The Purge Position Limit switch on the Air/Fuel Valve closed during ignition. |
| PRG SWTCH OPEN DURING PURGE | The Purge Position Limit switch on the Air/Fuel Valve opened during purge. |
| REMOTE SETPT SIGNAL FAULT | The Remote Setpoint signal is not present or is out of range. |
| RESIDUAL FLAME | The Flame signal was seen for more than 60 seconds during standby. |
| SSOV SWITCH OPEN | The SSOV switch opened during standby. |
| SSOV FAULT DURING PURGE | The SSOV switch opened dug purge. |
| SSOV FAULT DURING IGN | The SSOV switch closed or failed to open during ignition. |
| SSOV FAULT DURING RUN | The SSOV switch closed for more than 15 seconds during run. |
| SSOV RELAY FAILURE | A failure has been detected in one of the relays that control the SSOV. |
| STEPPER MOTOR FAILURE | The Stepper Motor failed to move the Air/Fuel Valve to the desired position. |

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# Appendix C: SENSOR RESISTANCE/VOLTAGE CHART

## TEMPERATURE SENSOR RESISTANCE VOLTAGE CHART (BALCO)

| TEMPERATURE | | RES (OHMS) | VOLTS* |
|---|---|---|---|
| °F | °C | | |
| -40 | -40 | 779.0 | 1.93 |
| -30 | -34.4 | 797.5 | 1.96 |
| -20 | -28.9 | 816.3 | 1.99 |
| -10 | -23.3 | 835.4 | 2.02 |
| 0 | -17.2 | 854.8 | 2.05 |
| 10 | -12.2 | 874.6 | 2.07 |
| 20 | -6.7 | 894.7 | 2.10 |
| 30 | -1.1 | 915.1 | 2.12 |
| 40 | 4.4 | 935.9 | 2.15 |
| 50 | 10 | 956.9 | 2.17 |
| 60 | 15.5 | 978.3 | 2.20 |
| 70 | 21.1 | 1000.0 | 2.23 |
| 80 | 26.7 | 1022.0 | 2.25 |
| 90 | 32.2 | 1044.4 | 2.27 |
| 100 | 37.8 | 1067.0 | 2.30 |
| 110 | 43.3 | 1090.0 | 2.32 |
| 120 | 48.9 | 1113.3 | 2.34 |
| 130 | 54.4 | 1137.0 | 2.36 |
| 140 | 60 | 1160.9 | 2.39 |
| 150 | 65.6 | 1185.2 | 2.41 |
| 160 | 71.1 | 1209.5 | 2.43 |
| 170 | 76.7 | 1234.7 | 2.45 |
| 180 | 82.2 | 1260.0 | 2.47 |
| 190 | 87.8 | 1285.6 | 2.50 |
| 200 | 93.3 | 1311.4 | 2.52 |
| 210 | 98.9 | 1337.7 | 2.54 |
| 220 | 104.4 | 1364.2 | 2.56 |
| 230 | 110 | 1391.0 | 2.58 |
| 240 | 115.6 | 1418.2 | |
| 250 | 121.1 | 1445.7 | |

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# Appendix D: RECOMMENDED PERIODIC TESTING

**WARNING!**

Periodic testing of all boiler controls and safety devices is required to determine that they are operating as designed. Precautions shall be taken while tests are being performed to protect against bodily injury and property damage. The owner or user of an automatic boiler system should set up a formal system of periodic preventive maintenance and testing. Tests should be conducted on a regular basis and the results recorded in a log-book.

## Recommended Periodic Testing

| ITEM | FREQUENCY | ACTION BY | REMARKS |
|---|---|---|---|
| **NOTE: Refer to indicated sections of this manual and the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide* OMM-0127 (GF-205-K) for detailed procedures.** | | | |
| Gauges, monitors and indicators | Daily | Operator | Visual inspection and record readings in operator log |
| Instrument and equipment settings | Daily | Operator | Visual check against factory recommended specifications |
| | Weekly | Operator | Verify factory settings |
| Firing Rate Control | Semi-Annually | Service Technician | Verify factory settings |
| | Annually | Service Technician | Check with combustion calibration test equipment (see Section 4-3 of the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K)), and the $O_2$ sensor in Section 4.4 of this guide. |
| Flue, vent, stack or intake air duct | Monthly | Operator | Visually inspection condition and check for obstructions |
| Spark Igniter-Injector | Weekly | Operator | See Section 4.2. |
| Air/Fuel Valve position | Weekly | Operator | Check position indicator dial. See Section 3.2 in the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K). |
| SSOV Leakage test | Annually | Service Technician | Check for leakage in accordance with the SSOV manufacturer's (Siemens) recommendations. |
| Flame failure | Weekly | Operator | Close manual gas shutoff valve and check safety shutdown. See Section 5.7 in the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K). |
| Flame signal strength | Weekly | Operator | Check flame strength using the C-More Controller's *Operating* menu (see Section 2.4). |

## Recommended Periodic Testing

| ITEM | FREQUENCY | ACTION BY | REMARKS |
|---|---|---|---|
| Low water level cut off and alarm | Weekly | Operator | See Section 5.4 in the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K). |
| Slow drain test | Semi-Annually | Operator | Perform a slow drain test in accordance with ASME Boiler and Pressure Vessel Code, Section IV. |
| High water temp. safety control test | Annually | Service Technician | See Section 5.5 in the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K). |
| Operating controls | Annually | Operator | See Section 2.2. |
| Low air flow | Monthly | Operator | See Section 5.8 in the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K). |
| High and low gas pressure interlocks | Monthly | Operator | See Sections 5.2 and 5.3 in the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K). |
| Air/Fuel Valve purge position switch | Annually | Service Technician | See Section 5.10 in the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K). |
| Air/Fuel Valve ignition position switch | Annually | Service Technician | See Section 5.11 in the *Benchmark 750 – 3000 Boiler Installation and Startup Guide Guide*, OMM-0127 (GF-205-K). |
| Safety valves | As required | Operator | Check per A.S.M.E. Boiler and Pressure Vessel Code, Section IV. |
| Inspect burner components | Semi-Annually | Service Technician | See Section 4.6. |
| Condensate Trap | Semi-Annually | Operator | See Section 4.7. |
| Oxygen ($O_2$) Level | Monthly | Operator | Verify oxygen level is between 3% and 8% during boiler operation. |

# Appendix E: INDOOR/OUTDOOR RESET RATIO CHARTS

## Header Temperature for a Building Reference Temperature = 50°F (10.0°C)

| AIR TEMP | | RESET RATIO | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °C | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 |
| 50 | 10.0 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 | 50 |
| 45 | 7.2 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 60 | 62 |
| 40 | 4.4 | 56 | 58 | 60 | 62 | 64 | 66 | 68 | 70 | 72 | 74 |
| 35 | 1.7 | 59 | 62 | 65 | 68 | 71 | 74 | 77 | 80 | 83 | 86 |
| 30 | -1.1 | 62 | 66 | 70 | 74 | 78 | 82 | 86 | 90 | 94 | 98 |
| 25 | -3.9 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 |
| 20 | -6.7 | 68 | 74 | 80 | 86 | 92 | 98 | 104 | 110 | 116 | 122 |
| 15 | -9.4 | 71 | 78 | 85 | 92 | 99 | 106 | 113 | 120 | 127 | 134 |
| 10 | -12.2 | 74 | 82 | 90 | 98 | 106 | 114 | 122 | 130 | 138 | 146 |
| 5 | -15.0 | 77 | 86 | 95 | 104 | 113 | 122 | 131 | 140 | 149 | 158 |
| 0 | -17.8 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 |
| -5 | -20.6 | 83 | 94 | 105 | 116 | 127 | 138 | 149 | 160 | 171 | 182 |
| -10 | -23.3 | 86 | 98 | 110 | 122 | 134 | 146 | 158 | 170 | 182 | 194 |
| -15 | -26.1 | 89 | 102 | 115 | 128 | 141 | 154 | 167 | 180 | 193 | 206 |
| -20 | -28.9 | 92 | 106 | 120 | 134 | 148 | 162 | 176 | 190 | 204 | 218 |

## Header Temperature for a Building Reference Temperature = 60°F (15.6°C)

| AIR TEMP | | RESET RATIO | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °C | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 |
| 60 | 15.6 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 | 60 |
| 55 | 12.8 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 |
| 50 | 10.0 | 66 | 68 | 70 | 72 | 74 | 76 | 78 | 80 | 82 | 84 |
| 45 | 7.2 | 69 | 72 | 75 | 78 | 81 | 84 | 87 | 90 | 93 | 96 |
| 40 | 4.4 | 72 | 76 | 80 | 84 | 88 | 92 | 96 | 100 | 104 | 108 |
| 35 | 1.7 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 |
| 30 | -1.1 | 78 | 84 | 90 | 96 | 102 | 108 | 114 | 120 | 126 | 132 |
| 25 | -3.9 | 81 | 88 | 95 | 102 | 109 | 116 | 123 | 130 | 137 | 144 |
| 20 | -6.7 | 84 | 92 | 100 | 108 | 116 | 124 | 132 | 140 | 148 | 156 |
| 15 | -9.4 | 87 | 96 | 105 | 114 | 123 | 132 | 141 | 150 | 159 | 168 |
| 10 | -12.2 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 |
| 5 | -15.0 | 93 | 104 | 115 | 126 | 137 | 148 | 159 | 170 | 181 | 192 |
| 0 | -17.8 | 96 | 108 | 120 | 132 | 144 | 156 | 168 | 180 | 192 | 204 |
| -5 | -20.6 | 99 | 112 | 125 | 138 | 151 | 164 | 177 | 190 | 203 | 216 |
| -10 | -23.3 | 102 | 116 | 130 | 144 | 158 | 172 | 186 | 200 | 214 | |
| -15 | -26.1 | 105 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | | |
| -20 | -28.9 | 108 | 124 | 140 | 156 | 172 | 188 | 204 | | | |

## Header Temperature for a Building Reference Temperature = 65°F (18.3°C)

| AIR TEMP | | RESET RATIO | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °C | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 |
| 65 | 18.3 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 | 65 |
| 60 | 15.6 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 |
| 55 | 12.8 | 71 | 73 | 75 | 77 | 79 | 81 | 83 | 85 | 87 | 89 |
| 50 | 10.0 | 74 | 77 | 80 | 83 | 86 | 89 | 92 | 95 | 98 | 101 |
| 45 | 7.2 | 77 | 81 | 85 | 89 | 93 | 97 | 101 | 105 | 109 | 113 |
| 40 | 4.4 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 |
| 35 | 1.7 | 83 | 89 | 95 | 101 | 107 | 113 | 119 | 125 | 131 | 137 |
| 30 | -1.1 | 86 | 93 | 100 | 107 | 114 | 121 | 128 | 135 | 142 | 149 |
| 25 | -3.9 | 89 | 97 | 105 | 113 | 121 | 129 | 137 | 145 | 153 | 161 |
| 20 | -6.7 | 92 | 101 | 110 | 119 | 128 | 137 | 146 | 155 | 164 | 173 |
| 15 | -9.4 | 95 | 105 | 115 | 125 | 135 | 145 | 155 | 165 | 175 | 185 |
| 10 | -12.2 | 98 | 109 | 120 | 131 | 142 | 153 | 164 | 175 | 186 | 197 |
| 5 | -15.0 | 101 | 113 | 125 | 137 | 149 | 161 | 173 | 185 | 197 | 209 |
| 0 | -17.8 | 104 | 117 | 130 | 143 | 156 | 169 | 182 | 195 | 208 | |
| -5 | -20.6 | 107 | 121 | 135 | 149 | 163 | 177 | 191 | 205 | 219 | |
| -10 | -23.3 | 110 | 125 | 140 | 155 | 170 | 185 | 200 | 215 | | |
| -15 | -26.1 | 113 | 129 | 145 | 161 | 177 | 193 | 209 | | | |
| -20 | -28.9 | 116 | 133 | 150 | 167 | 201 | 218 | | | | |

## Header Temperature for a Building Reference Temperature = 70°F (21.1°C)

| AIR TEMP | | RESET RATIO | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °C | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 |
| 70 | 21.1 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 | 70 |
| 65 | 18.3 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 | 81 | 82 |
| 60 | 15.6 | 76 | 78 | 80 | 82 | 84 | 86 | 88 | 90 | 92 | 94 |
| 55 | 12.8 | 79 | 82 | 85 | 88 | 91 | 94 | 97 | 100 | 103 | 106 |
| 50 | 10.0 | 82 | 86 | 90 | 94 | 98 | 102 | 106 | 110 | 114 | 118 |
| 45 | 7.2 | 85 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 | 130 |
| 40 | 4.4 | 88 | 94 | 100 | 106 | 112 | 118 | 124 | 130 | 136 | 142 |
| 35 | 1.7 | 91 | 98 | 105 | 112 | 119 | 126 | 133 | 140 | 147 | 154 |
| 30 | -1.1 | 94 | 102 | 110 | 118 | 126 | 134 | 142 | 150 | 158 | 166 |
| 25 | -3.9 | 97 | 106 | 115 | 124 | 133 | 142 | 151 | 160 | 169 | 178 |
| 20 | -6.7 | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 | 190 |
| 15 | -9.4 | 103 | 114 | 125 | 136 | 147 | 158 | 169 | 180 | 191 | 202 |
| 10 | -12.2 | 106 | 118 | 130 | 142 | 154 | 166 | 178 | 190 | 202 | 214 |
| 5 | -15.0 | 109 | 122 | 135 | 148 | 161 | 174 | 187 | 200 | 213 | |
| 0 | -17.8 | 112 | 126 | 140 | 154 | 168 | 182 | 196 | 210 | | |
| -5 | -20.6 | 115 | 130 | 145 | 160 | 175 | 190 | 205 | | | |
| -10 | -23.3 | 118 | 134 | 150 | 166 | 182 | 198 | 214 | | | |
| -15 | -26.1 | 121 | 138 | 155 | 172 | 189 | 206 | | | | |
| -20 | -28.9 | 124 | 142 | 160 | 178 | 196 | 214 | | | | |

## Header Temperature for a Building Reference Temperature = 75°F (23.9°C)

| AIR TEMP | | RESET RATIO | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °C | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 |
| 75 | 23.9 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 | 75 |
| 70 | 21.1 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 | 87 |
| 65 | 18.3 | 81 | 83 | 85 | 87 | 89 | 91 | 93 | 95 | 97 | 99 |
| 60 | 15.6 | 84 | 87 | 90 | 93 | 96 | 99 | 102 | 105 | 108 | 111 |
| 55 | 12.8 | 87 | 91 | 95 | 99 | 103 | 107 | 111 | 115 | 119 | 123 |
| 50 | 10.0 | 90 | 95 | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 |
| 45 | 7.2 | 93 | 99 | 105 | 111 | 117 | 123 | 129 | 135 | 141 | 17 |
| 40 | 4.4 | 96 | 103 | 110 | 117 | 124 | 131 | 138 | 145 | 152 | 159 |
| 35 | 1.7 | 99 | 107 | 115 | 123 | 131 | 139 | 147 | 155 | 163 | 171 |
| 30 | -1.1 | 102 | 111 | 120 | 129 | 138 | 147 | 156 | 165 | 174 | 183 |
| 25 | -3.9 | 105 | 115 | 125 | 135 | 145 | 155 | 165 | 175 | 185 | 195 |
| 20 | -6.7 | 108 | 119 | 130 | 141 | 152 | 163 | 174 | 185 | 196 | 207 |
| 15 | -9.4 | 111 | 123 | 135 | 147 | 159 | 171 | 183 | 195 | 207 | 219 |
| 10 | -12.2 | 114 | 127 | 140 | 153 | 166 | 179 | 192 | 205 | 218 | |
| 5 | -15.0 | 117 | 131 | 145 | 159 | 173 | 187 | 201 | 215 | | |
| 0 | -17.8 | 120 | 135 | 150 | 165 | 180 | 195 | 210 | | | |
| -5 | -20.6 | 123 | 139 | 155 | 171 | 187 | 203 | 219 | | | |
| -10 | -23.3 | 126 | 143 | 160 | 177 | 194 | 211 | | | | |
| -15 | -26.1 | 129 | 147 | 165 | 183 | 201 | 219 | | | | |

## Header Temperature for a Building Reference Temperature = 80°F (26.7°C)

| AIR TEMP | | RESET RATIO | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| °F | °C | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 |
| 80 | 26.7 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 |
| 75 | 23.9 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 |
| 70 | 21.1 | 86 | 88 | 90 | 92 | 94 | 96 | 98 | 100 | 102 | 104 |
| 65 | 18.3 | 89 | 92 | 95 | 98 | 101 | 104 | 107 | 110 | 113 | 116 |
| 60 | 15.6 | 92 | 96 | 100 | 104 | 108 | 112 | 116 | 120 | 124 | 128 |
| 55 | 12.8 | 95 | 100 | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 |
| 50 | 10.0 | 98 | 104 | 110 | 116 | 122 | 128 | 134 | 140 | 146 | 152 |
| 45 | 7.2 | 101 | 108 | 115 | 122 | 129 | 136 | 143 | 150 | 157 | 164 |
| 40 | 4.4 | 104 | 112 | 120 | 128 | 136 | 144 | 152 | 160 | 168 | 176 |
| 35 | 1.7 | 107 | 116 | 125 | 134 | 143 | 152 | 161 | 170 | 179 | 188 |
| 30 | -1.1 | 110 | 120 | 130 | 140 | 150 | 160 | 170 | 180 | 190 | 200 |
| 25 | -3.9 | 113 | 124 | 135 | 146 | 157 | 168 | 174 | 190 | 201 | 212 |
| 20 | -6.7 | 116 | 128 | 140 | 152 | 164 | 176 | 188 | 200 | 212 | |
| 15 | -9.4 | 119 | 132 | 145 | 158 | 171 | 184 | 197 | 210 | | |
| 10 | -12.2 | 122 | 136 | 150 | 164 | 178 | 192 | 206 | | | |
| 5 | -15.0 | 125 | 140 | 155 | 170 | 185 | 200 | 215 | | | |
| 0 | -17.8 | 128 | 144 | 160 | 176 | 192 | 208 | | | | |
| -5 | -20.6 | 131 | 148 | 165 | 182 | 199 | 216 | | | | |
| -10 | -23.3 | 134 | 152 | 170 | 188 | 206 | | | | | |

## Header Temperature for a Building Reference Temperature = 90°F (32.2°C)

| AIR TEMP | | RESET RATIO | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **°F** | **°C** | **0.6** | **0.8** | **1.0** | **1.2** | **1.4** | **1.6** | **1.8** | **2.0** | **2.2** | **2.4** |
| **90** | **32.2** | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 | 90 |
| **85** | **29.4** | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 | 101 | 102 |
| **80** | **26.7** | 96 | 98 | 100 | 102 | 104 | 106 | 108 | 110 | 112 | 114 |
| **75** | **23.9** | 99 | 102 | 105 | 108 | 111 | 114 | 117 | 120 | 123 | 126 |
| **70** | **21.1** | 102 | 106 | 110 | 114 | 118 | 122 | 126 | 130 | 134 | 138 |
| **65** | **18.3** | 105 | 110 | 115 | 120 | 125 | 130 | 135 | 140 | 145 | 150 |
| **60** | **15.6** | 108 | 114 | 120 | 126 | 132 | 138 | 144 | 150 | 156 | 162 |
| **55** | **12.8** | 111 | 118 | 125 | 132 | 139 | 146 | 153 | 160 | 167 | 174 |
| **50** | **10.0** | 114 | 122 | 130 | 138 | 146 | 154 | 162 | 170 | 178 | 186 |
| **45** | **7.2** | 117 | 126 | 135 | 144 | 153 | 162 | 171 | 180 | 189 | 198 |
| **40** | **4.4** | 120 | 130 | 140 | 150 | 160 | 170 | 180 | 190 | 200 | 210 |
| **35** | **1.7** | 123 | 134 | 145 | 156 | 167 | 178 | 189 | 200 | | |
| **30** | **-1.1** | 126 | 138 | 150 | 162 | 174 | 186 | 198 | 210 | | |
| **25** | **-3.9** | 129 | 142 | 155 | 168 | 181 | 194 | 207 | | | |
| **20** | **-6.7** | 132 | 146 | 160 | 174 | 188 | 202 | 216 | | | |
| **15** | **-9.4** | 135 | 150 | 165 | 180 | 195 | 210 | | | | |
| **10** | **-12.2** | 138 | 154 | 170 | 186 | 202 | 218 | | | | |
| **5** | **-15.0** | 141 | 158 | 175 | 192 | 209 | | | | | |
| **0** | **-17.8** | 144 | 162 | 180 | 198 | 216 | | | | | |

# Appendix F: BENCHMARK 750/1000 PART LIST

## Benchmark 750 and Benchmark 1000 Part List

| Item # | Qty | Part # | Description |
|---|---|---|---|
| **EXHAUST MANIFOLD** | | | |
| 1 | 1 | 43086 | MANIFOLD: EXHAUST |
| 2 | 1 | 84045 | SEAL: EXHAUST MANIFOLD |
| 3 | 1 | 9-22 | PIPE PLUG: 1/4" NPT: STEEL |
| **GAS TRAIN ASSEMBLY** | | | |
| 4 | 1 | 22140-1 | FM GAS TRAIN ASSY |
| 5 | 1 | 81155 | GASKET: 1 1/4" PIPE FLANGE |
| **BURNER, AIR/FUEL VALVE, HEAT EXCHANGER** | | | |
| 8 | 1 | 24276-TAB | BURNER A/F ASSEMBLY |
| 10 | 1 | 46026 | BURNER |
| 12 | 1 | 24367-1 | BMK 1000 A/F Valve **Replacement Kit** |
| | | 24367-2 | BMK 750 A/F Valve **Replacement Kit** |
| 13 | 1 | 24277 | STAGED IGNITION ASSY |
| 14 | 1 | 81143 | GASKET: BURNER |
| 17 | 1 | 28576 | BMK 750 HEAT EXCHANGER (Single Inlet) |
| | | 28586 | BMK 1000 HEAT EXCHANGER (Single Inlet) |
| **HOSES & INSULATION** | | | |
| 18 | 1 | 97087-20 | TUBE: FLEXIBLE GAS 20" (50.8 cm) |
| 19 | 1 | 80080 | INSULATION: SHELL |
| **BLOWER** | | | |
| 20 | 1 | 58061 | BLOWER **Replacement Kit** |
| 24 | 1 | 24356-1 | FLAME DETECTOR **Replacement Kit** |
| 25 | 1 | 61026 | LEAN OXYGEN SENSOR |
| 26 | 1 | 58023 | IGNITER-INJECTOR **Replacement Kit** |
| 27 | 1 | 59139 | AIR FILTER: 6" X 4.5 (11.4 cm) LG |
| **CONTROLS** | | | |
| 28 | 1 | 123966 | SWITCH: OVER TEMP-AUTO RESET |
| 29 | 1 | 123552 | SWITCH: OVER TEMP-MANUAL RESET |
| 30 | 1 | 60011-4 | BLOWER PROOF SWITCH ASSY: |
| 31 | 1 | 61002-5 | BLOCKED INLET SWITCH -4.5 W.C. |
| 32 | 1 | 65085 | IGNITION TRANSFORMER |
| 33❶ | 1 | 61034 | SPARK MONITOR (AC Transducer) |
| 34 | 1 | 60026 | CIRCUIT BREAKER 2 POLE 20A |
| 35 | 1 | 64081 | ECU |
| 36 | 1 | 65011 | TRANSFORMER 115V/24V 100VA |
| 37 | 1 | 65109 | 12V POWER SUPPLY |
| 39 | 2 | 65120 | TERMINAL BLOCK: DIN MOUNTED: BLK |
| 40 | 2 | 65121 | TERMINAL BLOCK: DIN MOUNTED: WHT |
| 41 | 3 | 65122 | TERMINAL GROUND BLOCK: DIN MOUNTED |
| 42 | 2 | 65118 | FUSE TERMINAL: DIN MOUNTED |
| 43 | 1 | 64088 | LIMIT CONTROL TEMPERATURE |
| 45 | 1 | 24502 | POWER SUPPLY COVER ASSY. (International) |
| 46 | 1 | 69102-2 | BENCHMARK PUMP RELAY |
| 47❶ | 2 | 124512 | FUSE: 4 AMP |
| 48 | 2 | 123449 | SENSOR: TEMPERATURE |
| 49 | 1 | 58132 | THERMOWELL **Replacement Kit** |
| 51 | 1 | 69186-4 | C-MORE CONTROLLER |
| 52 | 1 | 69172 | I/O (PCB) ASSEMBLY |
| 60 | 1 | 65156 | FLAME ROD SIGNAL AMPLIFIER |
| 61 | 1 | 61030 | OUTLET TEMP SENSOR |
| 62 | 1 | 61024 | AIR INLET TEMPERATURE SENSOR |
| 66 | 1 | 24468 | 210 TO 120 V TRANSFORMER ASSY |
| 69 | 1 | 65162 | 24V POWER SUPPLY (SEQUENCING VALVE) |
| **SHEET METAL/PANEL ASSEMBLY** | | | |
| 70 | 1 | 37155 | PANEL: LEFT (Black) |
| 71 | 1 | 37156 | PANEL: RIGHT (Black) |
| 72 | 1 | 37154 | TOP COVER ASSY (Black) |
| 73 | 1 | 25087 | FRONT FRAME ASSY. (Black) |
| 74 | 1 | 25085-TAB | FRONT PANEL |
| 76 | 2 | 59179 | HANDLE, CONCEALED PULL |
| 77 | 4 | 59133 | LATCH: COMPRESSION |
| 78 | 1 | 50010 | LATCH: DRAW |
| 79 | 1 | 50011 | KEEPER: DRAW LATCH |
| 82 | 1 | 39217 | AIR INLET ADAPTER: 6" PVC (Black) |
| **OTHER ACCESSORIES / PARTS** | | | |
| 89 | 1 | 122843 | LOW WATER CUTOFF |
| 90 | 1 | 123863 | VALVE: BALL 1/8" NPT |
| 91 | 1 | 92094 | BOILER DRAIN VALVE: 3/4 MNPT x GHT |
| 94 | 1 | 59178 | VENT: AIR 1/8 NPT |

❶ Not shown on drawing

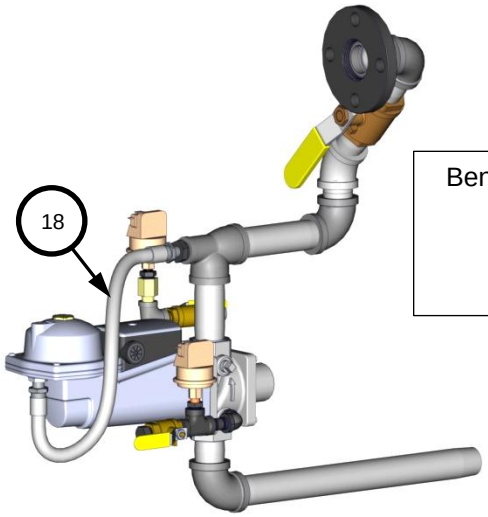
| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 750/1000 Part List** | 09/28/2017 |
| | **Benchmark 750 P/N 28321-TAB rev F**<br>**Benchmark 1000 P/N 28253-TAB rev F** | Sheet 1 of 6 |

| Benchmark 750/1000 Spare Parts Kit P/N 58037-TAB | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Part Number** | **Description** | 58037-1 30 PSI Apollo | 58037-2 50 PSI Conbraco | 58037-3 75 PSI Apollo | 58037-4 100 PSI Watts | 58037-5 150 PSI Watts | 58037-6 60 PSI Watts | 58037-7 125 PSI Watts | 58037-8 160 PSI Kunkle |
| 24286 | 6" Exhaust Kit | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 24441 | Condensate Trap Assy. | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 92006-5 | 1" Ball Valve | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 123675-2 | Tridicator | 1 | 1 | | | | | | |
| 123675-3 | Tridicator | | | 1 | 1 | | 1 | 1 | |
| 123675-4 | Tridicator | | | | | 1 | | | 1 |
| 92014 | Pressure Relief Valve | | 1 | | | | | | |
| 92015-13 | Pressure Relief Valve | | | | | | 1 | | |
| 92015-15 | Pressure Relief Valve | | | | 1 | | | | |
| 92015-16 | Pressure Relief Valve | | | | | | | 1 | |
| 92015-20 | Pressure Relief Valve | | | 1 | | | | | |
| 92015-484 | Pressure Relief Valve | | | | | | | | 1 |
| 92015-361 | Pressure Relief Valve | 1 | | | | | | | |
| 123659 | Pressure Relief Valve | | | | | 1 | | | |
| 9-234 | ¾" Close Nipple | 1 | | 1 | 1 | 1 | 1 | 1 | 1 |

| Wiring Harnesses (not shown in figures below) | |
|---|---|
| **Part #** | **Description** |
| 63182 | HARNESS: SHELL |
| 63083 | HARNESS: O2 SENSOR |
| 63085 | HARNESS: CONTROL |
| 63090 | HARNESS: TEMPERATURE LIMIT CONTROL |
| 63097 | HARNESS: I/O SENSOR/COMM |
| 63147 | HARNESS: WIRING: GAS TRAIN |
| 63150 | HARNESS: FLAME ROD |
| 65104 | CABLE: H.V. IGNITION |
| 124327 | HARNESS: INTERLOCK |

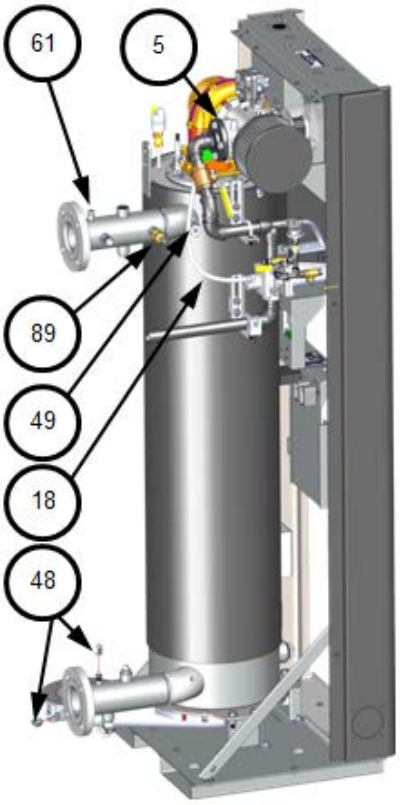
| Additional Benchmark 750/1000 Kits Available | |
|---|---|
| **Part #** | **Description** |
| 27086-1 | ACTUATOR: SSOV w/o P.O.C. SWITCH **Replacement Kit** |
| 64048 | SSOV WITH PRESSURE REGULATOR **Replacement Kit** |

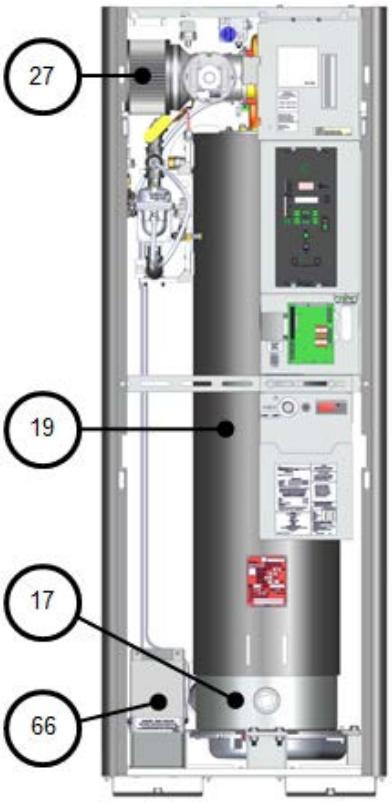
| Other Accessories / Parts (Optional) | |
|---|---|
| **Part #** | **Description** |
| 92084-6 | MOTORIZED SEQUENCING VALVE |



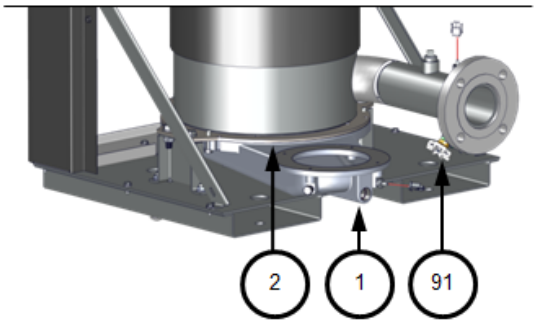

Benchmark 750/1000
Gas Trains

4



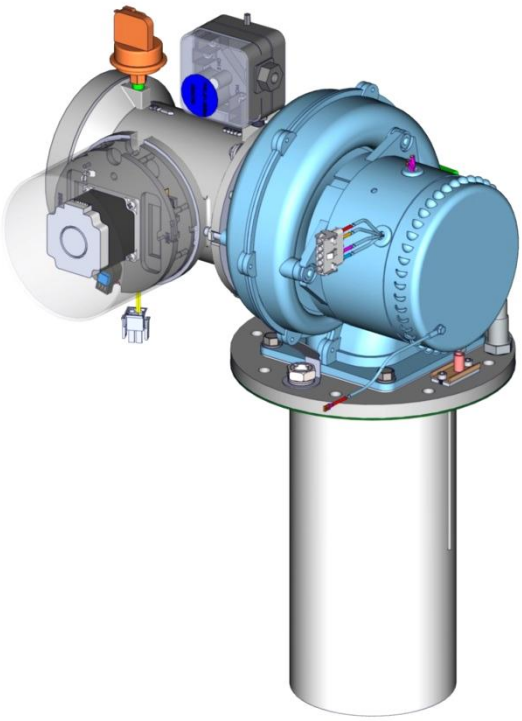



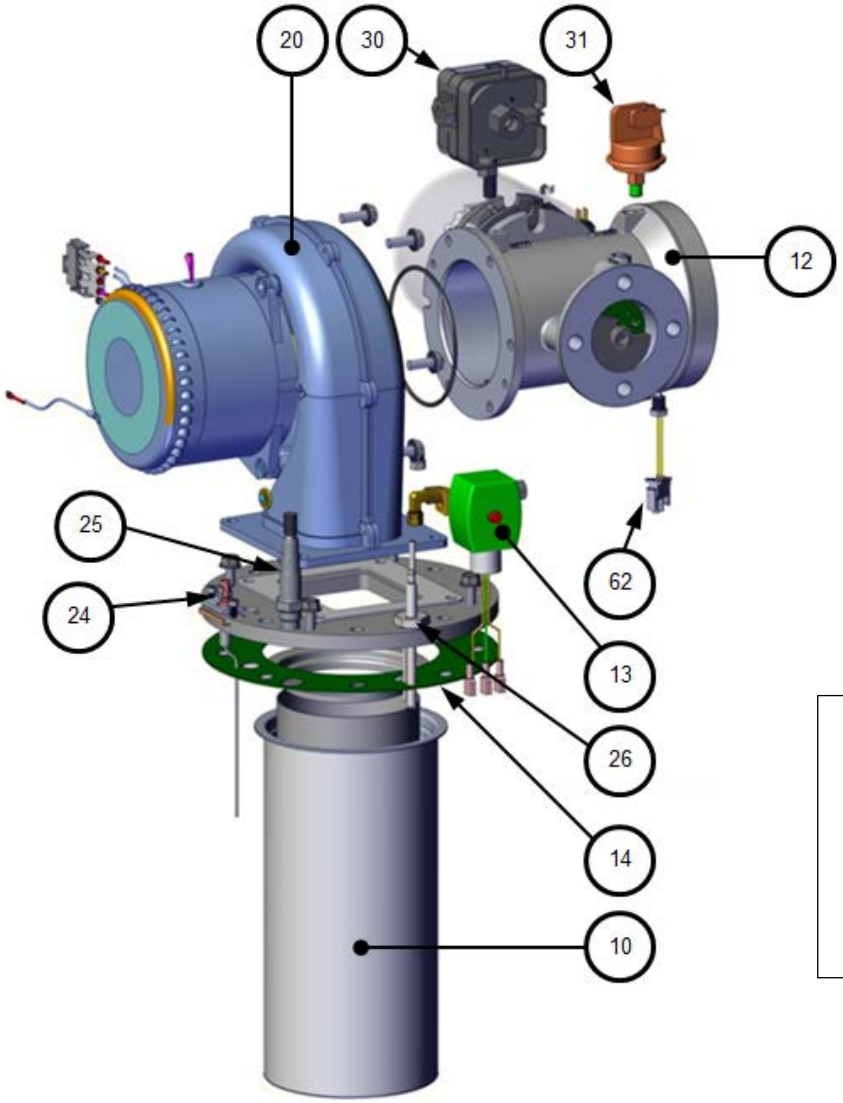





LEFT-REAR VIEW FRONT VIEW RIGHT-REAR VIEW

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 750/1000 Part List** | 09/28/2017 |
| | **Benchmark 750 P/N 28321-TAB rev F**<br>**Benchmark 1000 P/N 28253-TAB rev F** | Sheet 3 of 6 |



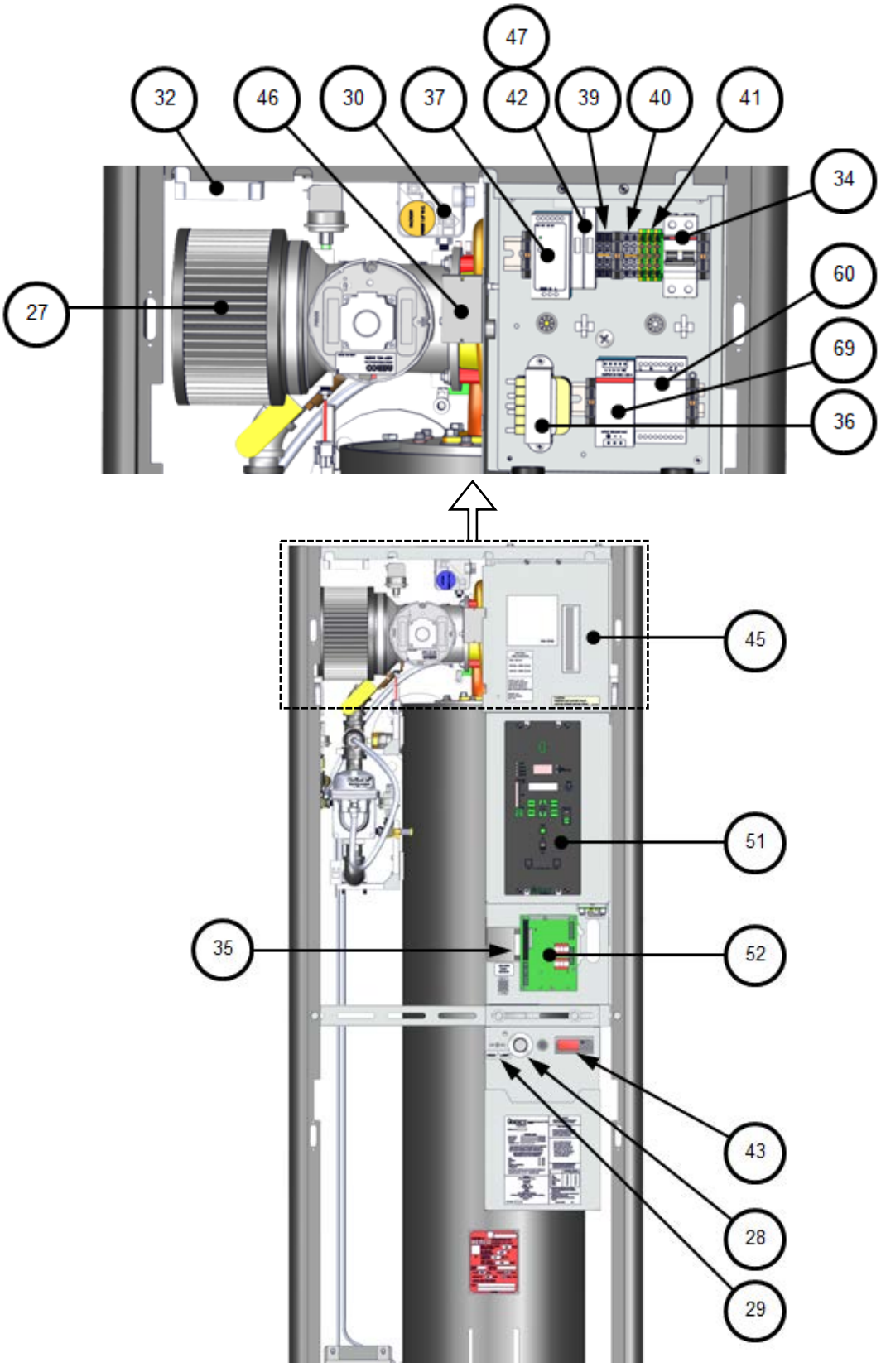



8

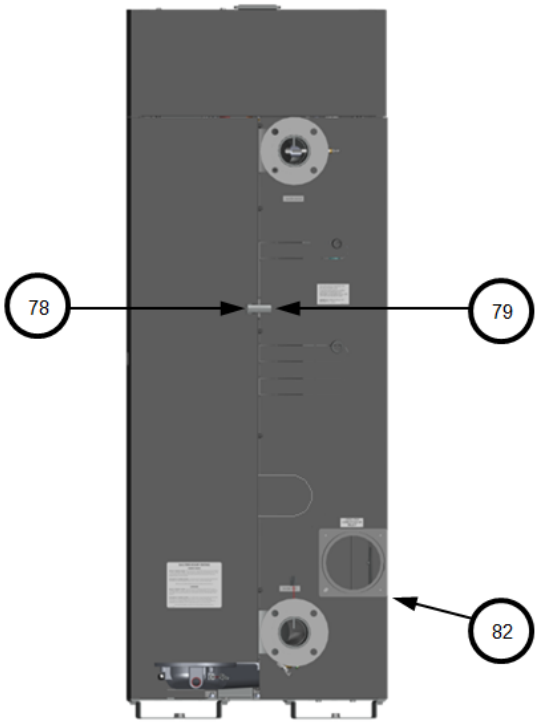
Benchmark 750/1000
Burner – Air/Fuel Valve Assembly
P/N **24276-TAB**

Full Diagram Below

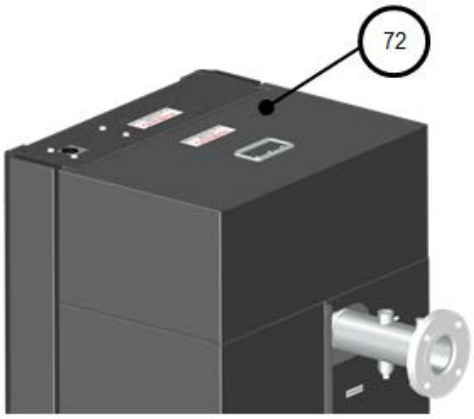
| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 750/1000 Part List** | 09/28/2017 |
| | **Benchmark 750 P/N 28321-TAB rev F**<br>**Benchmark 1000 P/N 28253-TAB rev F** | Sheet 4 of 6 |



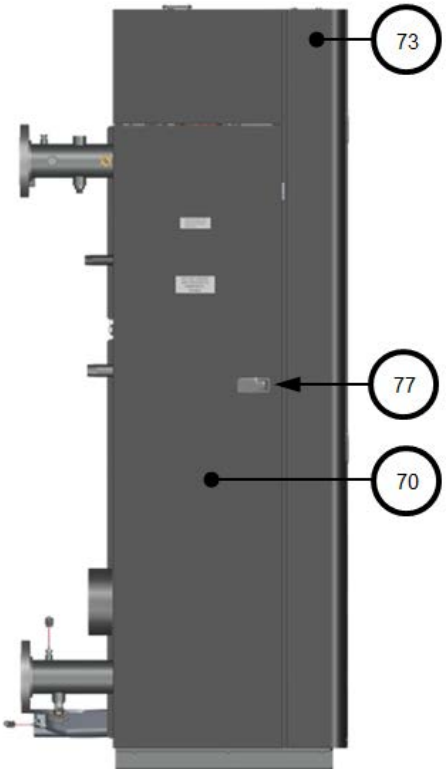

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 750/1000 Part List** | 09/28/2017 |
| | **Benchmark 750 P/N 28321-TAB rev F**<br>**Benchmark 1000 P/N 28253-TAB rev F** | Sheet 5 of 6 |



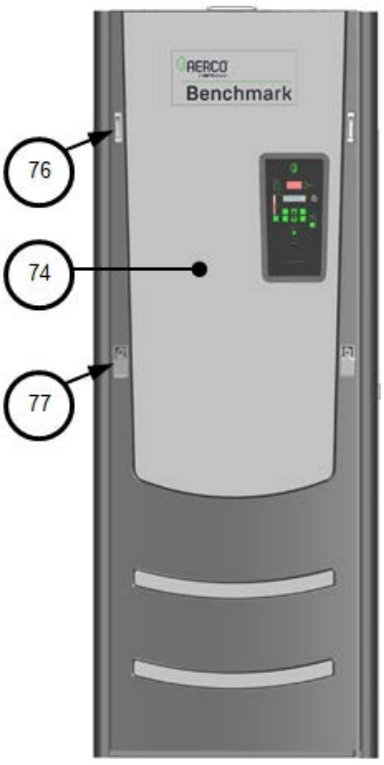

REAR VIEW



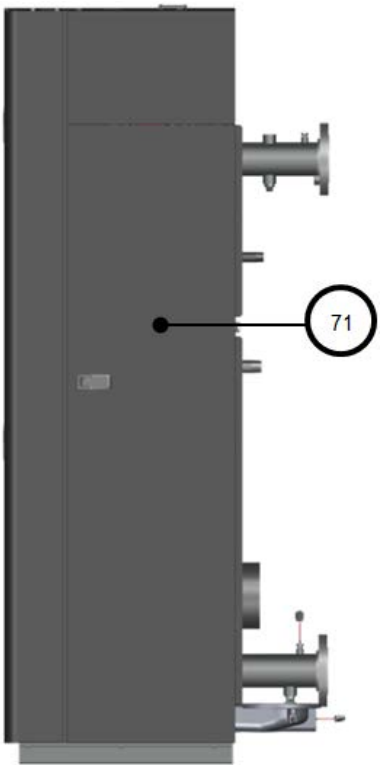

TOP VIEW




LEFT SIDE VIEW




FRONT VIEW

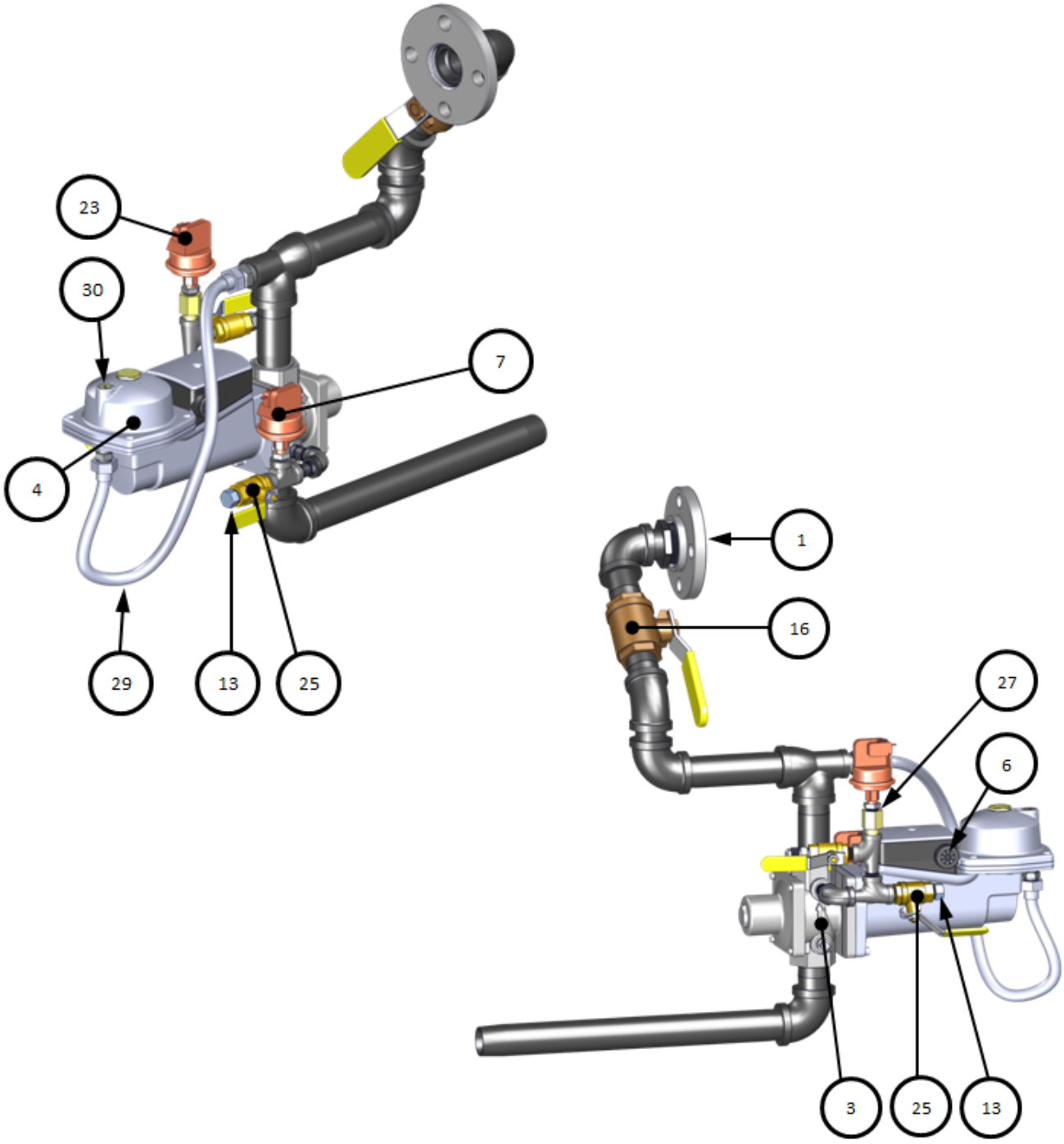



RIGHT SIDE VIEW

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 750/1000 Part List** | 09/28/2017 |
| | **Benchmark 750 P/N 28321-TAB rev F**<br>**Benchmark 1000 P/N 28253-TAB rev F** | Sheet 6 of 6 |

## Benchmark 750/1000 FM Gas Train – P/N 22140-1

| Item | Qty | Part # | Description | Item | Qty | Part # | Description |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 95026 | 1.25"NPT 125#: THREADED FLANGE | 16 | 1 | 92006-5 | VALVE: BALL 1" NPT |
| 3 | 1 | 92036 | VALVE: SSOV 1" NPT | 23 | 1 | 61002-12 | HIGH GAS PRESSURE SWITCH 4.7" W.C. |
| 4 | 1 | 64048 | ACTUATOR: SSOV W/ REGULATOR | 25 | 3 | 92077 | 1/4" NPT MXF BRASS BALL VALVE |
| 6 | 2 | 12951-2 | BUSHING: CONTROL BOX | 27 | 1 | 99017 | SNUBBER: PRESSURE: 1/4" |
| 7 | 1 | 61002-1 | LOW PRESSURE SWITCH: 2.6" W.C. FALL N.O. | 29 | 1 | 97087-20 | TUBE: FLEXIBLE GAS 20" (50.8 cm) LG |
| 13 | 2 | 9-22 | PIPE PLUG: 1/4" NPT: STEEL | 30 | 1 | 99015 | DAMPING ORIFICE: SSOV |

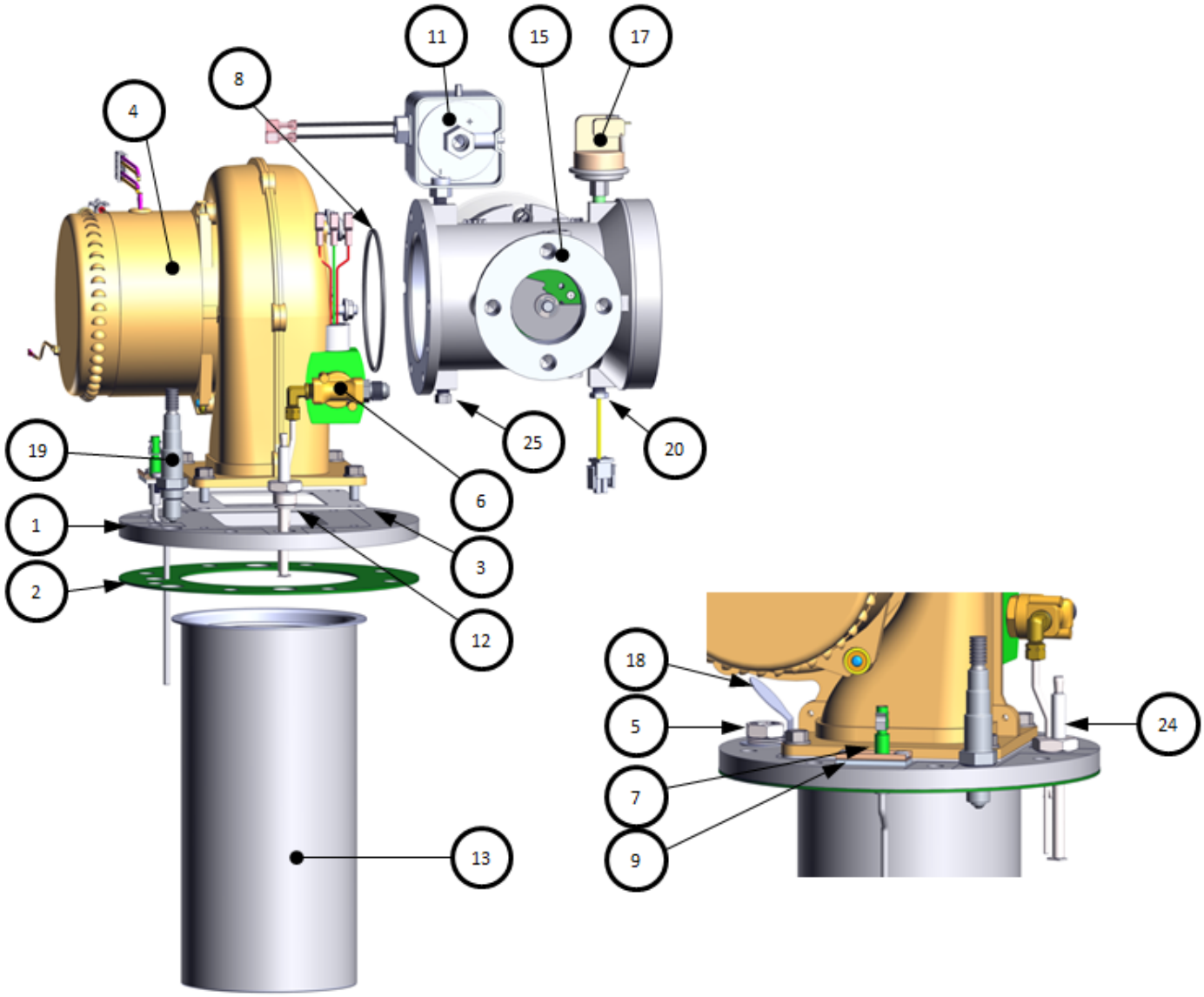



| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 750/1000 FM Gas Train** | 04/11/2017 |
| | **22140-1 rev G** | Sheet 1 of 1 |

## Benchmark 750/1000 Burner, Blower, Air/Fuel Valve Assy. – P/N 24276-TAB

| Item | Qty | Part # | Description | Item | Qty | Part # | Description |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 42140 | PLATE: BURNER | 12 | 3 | 53033 | WASHER: CLOCKING |
| 2 | 1 | 81143 | GASKET: BURNER | 13 | 1 | 46026 | BURNER: BMK 1.0 |
| 3 | 1 | 81064 | GASKET: BLOWER | 15 | 1 | **See Table** | A/F VALVE ASSY |
| 4 | 1 | 24111 | BLOWER: AMETEK 8.9" | 17 | 1 | 61002-5 | BLOCKED INLET SWITCH -4.5" W.C. |
| 5 | 1 | 59104 | OBSERVATION PORT | 18 | 1 | 59171 | REFLECTOR: SIGHT GLASS |
| 6 | 1 | 24277 | STAGED IGNITION ASSY | 19 | 1 | 61026 | O2 SENSOR |
| 7 | 1 | 66034 | FLAME ROD | 20 | 1 | 61024 | AIR INLET TEMPERATURE SENSOR |
| 8 | 1 | 88004 | O-RING #2-244 BUNA-N | 24 | 1 | 66026 | IGNITOR-INJECTOR |
| 9 | 1 | 81048 | GASKET: FLAME ROD LOW $NO_x$ | 25 | 1 | 9-21 | PLUG: HEX HD 1/8 NPT |
| 11 | 1 | 60011-4 | SWITCH ASSY: BLOWER PROOF | | | | |

| Part # | Qty | Item 15 | Description |
|---|---|---|---|
| 24276 | 1 | 24298 | A/F VALVE ASSY BMK 1000 |
| 24276-1 | 1 | 24298-1 | A/F VALVE ASSY BMK 750 |




| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 750/1000 Burner Assembly** | 08/15/2017 |
| | **24276-TAB Rev K** | Sheet 1 of 1 |

# Appendix G: BENCHMARK 1500/2000 PART LIST

## Benchmark 1500 and Benchmark 2000 Part List

| Item # | Qty | Part # | Description |
|---|---|---|---|
| **EXHAUST MANIFOLD** | | | |
| 1 | 1 | 39187 | EXHAUST MANIFOLD |
| 2 | 1 | 81165 | EXHAUST MANIFOLD SEAL |
| 3 | 1 | 9-22 | PIPE PLUG - EXHAUST MANIFOLD |
| **GAS TRAIN ASSEMBLY** | | | |
| 4 | 1 | 22240 | BMK 1500/2000 GAS TRAIN ASSY |
| **BURNER, AIR/FUEL VALVE, HEAT EXCHANGER** | | | |
| 8 | 1 | 24378 | BMK 1500 BURNER ASSY |
| | | 24378-1 | BMK 2000 BURNER ASSY |
| 10 | 1 | 46042 | BURNER, BMK 1500 |
| | | 46044 | BURNER, BMK 2000 |
| 11 | 1 | 24277 | STAGED IGNITION ASSY |
| 14 | 1 | 43090 | AIR FUEL VALVE PLENUM |
| 15 | 1 | 24311-3 | AIR/FUEL VALVE ASSY, BMK 1500, **Replacement Kit** |
| | | 24311-10 | AIR/FUEL VALVE ASSY, BMK 2000, **Replacement Kit** |
| **HOSES & INSULATION** | | | |
| 16 | 1 | 97087-72 | FLEX GAS TUBE 72" |
| 17 | 1 | 80089 | SHELL INSULATION |
| **BLOWER** | | | |
| 18 | 1 | 58038 | BLOWER **Replacement Kit** |
| 21 | 1 | 24356-1 | FLAME DETECTOR KIT - **Replacement Kit** |
| 22 | 1 | 61026 | LEAN OXYGEN SENSOR |
| 24 | 1 | 58023 | IGNITER-INJECTOR **Replacement Kit** |
| 25 | 1 | 59138 | AIR FILTER, 6” |
| 26 | 1 | 43095 | BLOWER PLENUM, BMK 1500-2000 |
| **CONTROLS** | | | |
| 27 | 1 | 123966 | SWITCH: OVER TEMP-AUTO RESET |
| 28 | 1 | 123552 | SWITCH: OVER TEMP-MANUAL RESET |
| 29 | 1 | 60011-4 | BMK 1500 BLOWER PROOF SWITCH |
| | | 60011-2 | BMK 2000 BLOWER PROOF SWITCH |
| 30 | 1 | 61002-5 | BLOCKED INLET SWITCH -4.5" W.C. |
| 31 | 1 | 69186-4 | C-MORE CONTROLLER |
| 32 | 1 | 65085 | IGNITION TRANSFORMER |
| 34 | 1 | 93230 | SNUBBER - AIR/FUEL VALVE |
| 35 | 1 | 64081 | ECU, $O_2$ SENSOR |
| 36 | 1 | 65011 | TRANSFORMER 115V/24V 100VA |
| 37 | 1 | 65109 | 12V POWER SUPPLY |
| 38 | 3 | 69141 | DIN RAIL MOUNT END STOP |
| 39 | 2 | 65120 | TERMINAL BLOCK: DIN MOUNTED: BLK |
| 40 | 2 | 65121 | TERMINAL BLOCK: DIN MOUNTED: WHT |
| 41 | 3 | 65122 | TERMINAL GROUND BLOCK: DIN MOUNTED |
| 42 | 2 | 65118 | FUSE TERMINAL: DIN MOUNTED |
| 43 | 1 | 64088 | LIMIT CONTROL TEMPERATURE |
| 44 | 1 | 60026 | CIRCUIT BREAKER |
| 45 | 1 | 65156 | FLAME DETECTOR SIGNAL AMPLIFIER |
| 46 | 1 | 65162 | 24V POWER SUPPLY (Sequencing Valve) |
| 47 ❶ | 2 | 124512 | FUSE: 4 AMP |
| 48 | 2 | 123449 | SENSOR: TEMPERATURE |
| 49 | 1 | 58132 | THERMOWELL **Replacement Kit** |
| 54 | 1 | 33170 | MOUNTING PANEL |
| 55 | 1 | 124324 | GROUND BAR |
| 59 | 1 | 61024 | AIR INLET TEMPERATURE SENSOR |
| 60 | 1 | 69102-3 | PUMP RELAY |
| 61 | 1 | 61030 | SENSOR: OUTLET TEMPERATURE |
| 62 | 1 | 69172 | INPUT/OUTPUT (PCB) ASSY |
| 63 | 1 | 24468 | 220 TO 110 V TRANSFORMER |
| 67❶ | 1 | 61034 | SPARK MONITOR (Current Transducer) |
| **SHEET METAL/PANEL ASSEMBLY** | | | |
| 70❶ | 1 | 38035 | I/O PANEL COVER |
| 71❶ | 1 | 38036 | POWER PANEL COVER |
| 72 | 1 | 37157 | BACK PANEL: RIGHT (Black) |
| 73 | 1 | 37158 | BACK PANEL: LEFT (Black) |
| 74 | 2 | 35029 | TOP RAIL (Black) |
| 75 | 1 | 25087 | FRONT FRAME ASSEMBLY (Black) |
| 76 | 1 | 25085-3 | FRONT PANEL ASSEMBLY |
| 78 | 2 | 59179 | HANDLE, CONCEALED PULL |
| 79 | 4 | 59133 | LATCH, COMPRESSION |
| 80 | 1 | 37159 | TOP PANEL: FRONT (Black) |
| 81 | 1 | 37160 | TOP PANEL: BACK (Black) |
| 82 | 2 | 30155 | SIDE PANEL (Black) |
| 84 | 1 | 39215 | 8" AIR INLET ADAPTER, BMK 2000 (Black) |
| | | 39218 | 6" AIR INLET ADAPTER, BMK 1500 (Black) |
| **OTHER ACCESSORIES & PARTS** | | | |
| 90 | 1 | 69126 | LOW WATER CUTOFF/CAPACITOR ASSY |
| 91 | 1 | 123863 | 1/8" NTP BALL VALVE |
| 92 | 1 | 92094 | 3/4" DRAIN VALVE |
| 95 | 1 | 59178 | 1/8" AIR VENT |

❶ Not shown on drawing

| Spare Parts Kits: BMK 1500 P/N 58088-TAB, BMK 2000 P/N 58087-TAB | |
|---|---|
| **Part #** | **Description** |
| 123540 | External 2" Ball Valve |
| 24441 | Condensate Trap |
| See Table Below | Pressure Relief Valve |
| See Table Below | Pressure/Temp Gauge |

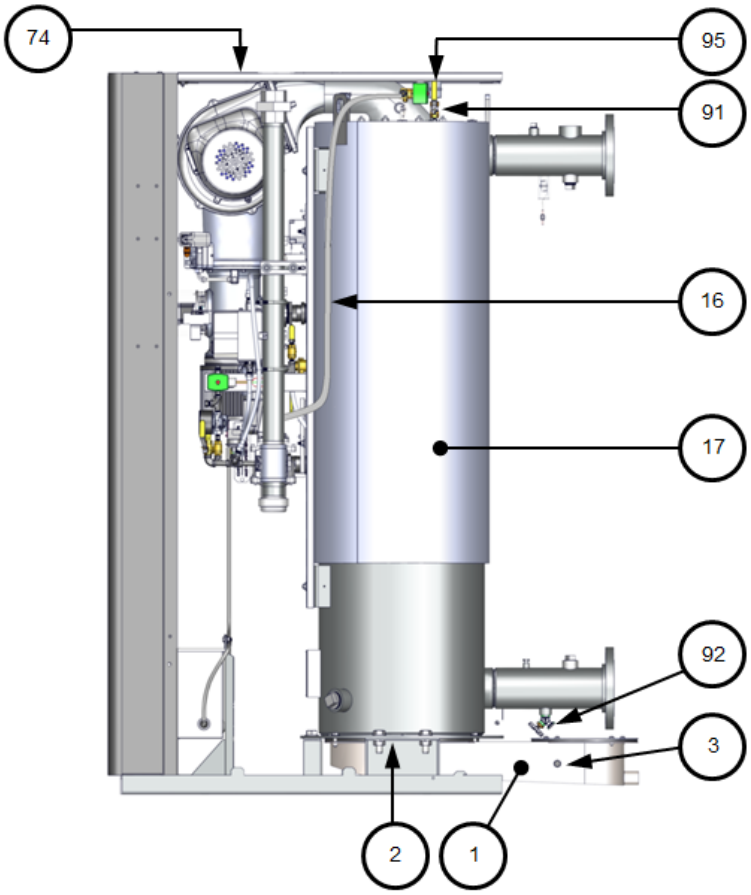
| Benchmark 1500 Spare Parts Kits P/N 58088-TAB | | | |
|---|---|---|---|
| **Kit Number *** | **Description** | **Pressure Relief Valve** | **Pressure/ Temp Gauge** |
| 58088-C30 | 30 PSI (207 kPa) KIT (CONBRACO) | 92023-1 | 123675-5 |
| 58088-C50 | 50 PSI (345 kPa) KIT (CONBRACO) | 92023-2 | 123675-5 |
| 58088-C60 | 60 PSI (414 kPa) KIT (CONBRACO) | 92023-3 | 123675-6 |
| 58088-C75 | 75 PSI (517 kPa) KIT (CONBRACO) | 92023-4 | 123675-6 |
| 58088-C100 | 100 PSI (689 kPa) KIT (CONBRACO) | 92023-5 | 123675-6 |
| 58088-C125 | 125 PSI (862 kPa) KIT (CONBRACO) | 92023-6 | 123675-6 |
| 58088-C150 | 150 PSI (1034 kPa) KIT (CONBRACO) | 92023-7 | 123675-7 |
| 58088-W30 | 30 PSI (207 kPa) KIT (WATTS) | 92023-8 | 123675-5 |
| 58088-W50 | 50 PSI (345 kPa) KIT (WATTS) | 92023-9 | 123675-5 |
| 58088-W60 | 60 PSI (414 kPa) KIT (WATTS) | 92023-10 | 123675-6 |
| 58088-W75 | 75 PSI (517 kPa) KIT (WATTS) | 92023-11 | 123675-6 |
| 58088-W100 | 100 PSI (689 kPa) KIT (WATTS) | 92023-12 | 123675-6 |
| 58088-W125 | 125 PSI (862 kPa) KIT (WATTS) | 92023-13 | 123675-6 |
| 58088-W150 | 150 PSI (1034 kPa) KIT (WATTS) | 92023-14 | 123675-7 |
| 58088-K160 | 160 PSI (1103 kPa) KIT (KUNKLE) | 92023-15 | 123675-7 |

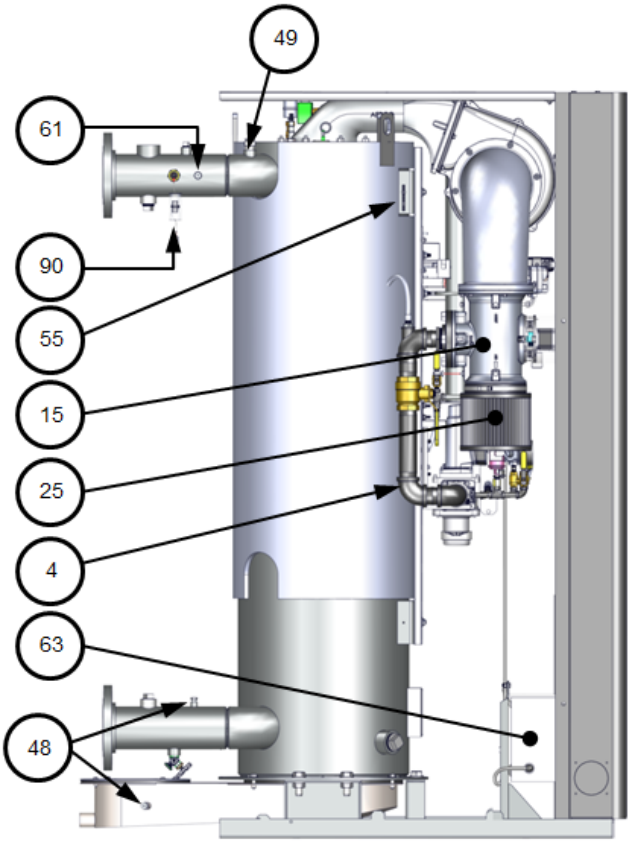
| Benchmark 2000 Spare Parts Kits P/N 58087-TAB | | | |
|---|---|---|---|
| **Kit Number *** | **Description** | **Pressure Relief Valve** | **Pressure/ Temp Gauge** |
| 58087-1 | 30 PSI (207 kPa) | 123620-W30 | 123675-5 |
| 58087-2 | 50 PSI (345 kPa) | 123620-W50 | 123675-5 |
| 58087-3 | 75 PSI (517 kPa) | 123620-W75 | 123675-6 |
| 58087-4 | 100 PSI (689 kPa) | 123620-W100 | 123675-6 |
| 58087-5 | 150 PSI (1034 kPa) | 123620-W150 | 123675-7 |
| 58087-6 | 60 PSI (414 kPa) | 123620-W60 | 123675-6 |
| 58087-7 | 125 PSI (862 kPa) | 123620-W125 | 123675-6 |
| 58087-8 | 160 PSI (1103 kPa) | 123620-K160 | 123675-7 |
| 58087-9 | 40 PSI (276 kPa) | 92015-45 | 123675-5 |

| Wiring Harnesses (not shown in figures below) | |
|---|---|
| **Part #** | **Description** |
| 63057 | HARNESS: BLOWER POWER |
| 63058 | HARNESS: BLOWER SIGNAL |
| 63083 | HARNESS: O2 SENSOR |
| 63090 | HARNESS, TEMP LIMIT CONTROL |
| 63103 | HARNESS: SHELL |
| 63104 | HARNESS: I/O INTERLOCK |
| 63105 | HARNESS: I/O SENSOR/COMM |
| 63111 | HARNESS: CONTROL |
| 63150 | HARNESS: FLAME DETECTOR |
| 63156 | POWER CABLE, 24V SEQUENCE VALVE |
| 65104 | CABLE, H.V. IGNITION |

| Additional Benchmark 1500/2000 Kits Available | |
|---|---|
| **Part #** | **Description** |
| 27086-2 | ACTUATOR: SSOV w/o P.O.C. SWITCH **Replacement Kit** |
| 64048 | SSOV WITH PRESSURE REGULATOR **Replacement Kit** |

| Other Accessories / Parts (Optional) | |
|---|---|
| **Part #** | **Description** |
| 92084-6 | MOTORIZED SEQUENCING VALVE |



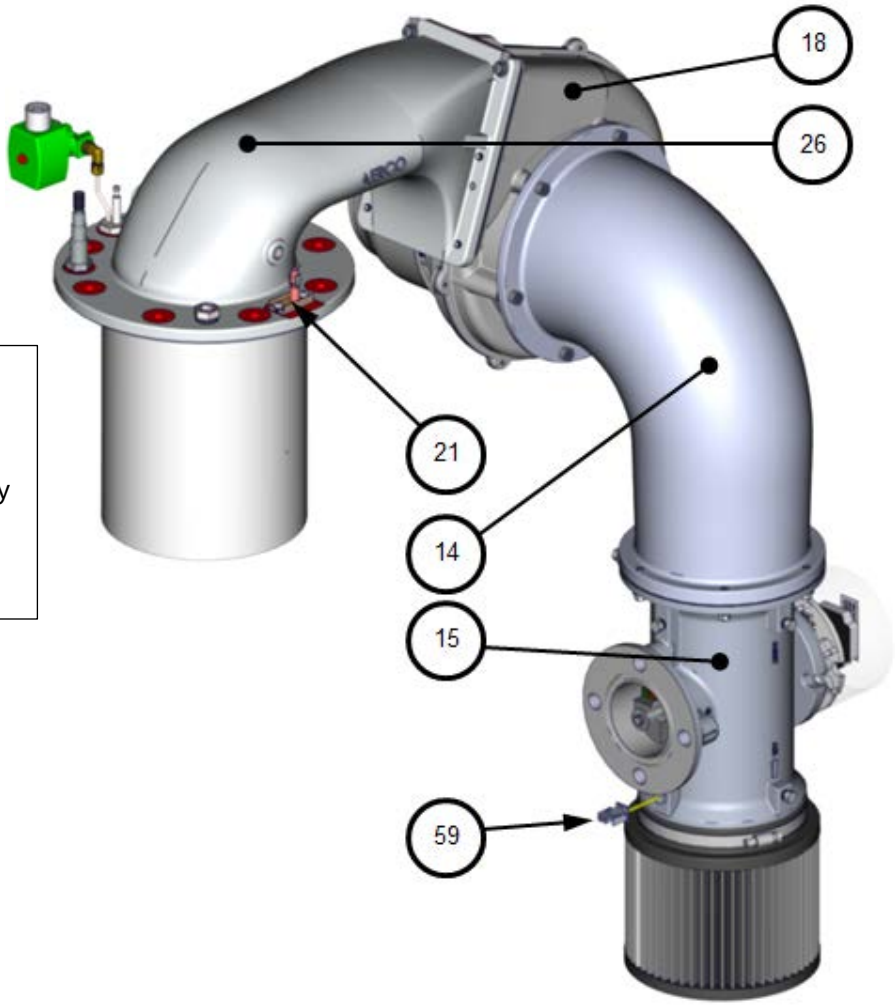



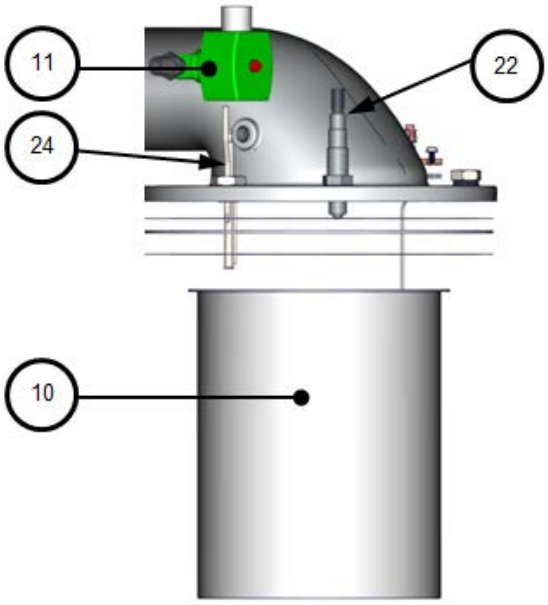

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 1500/2000 Part List** | 10/02/2017 |
| | **Benchmark 1500 29313-TAB rev G**<br>**Benchmark 2000 29337-TAB rev G** | Sheet 3 of 7 |

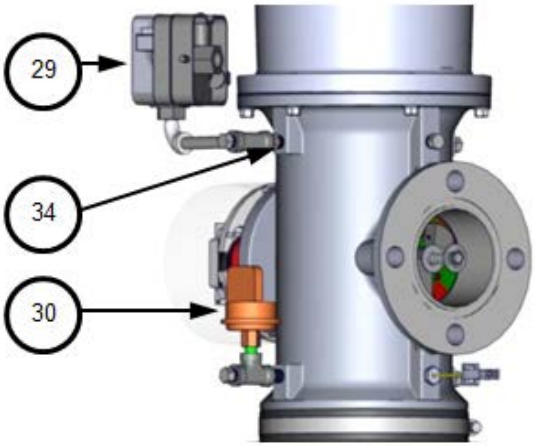
8

Benchmark 1500/2000
Burner-Air/Fuel Valve Assembly
P/N **24378** & **24378-1**

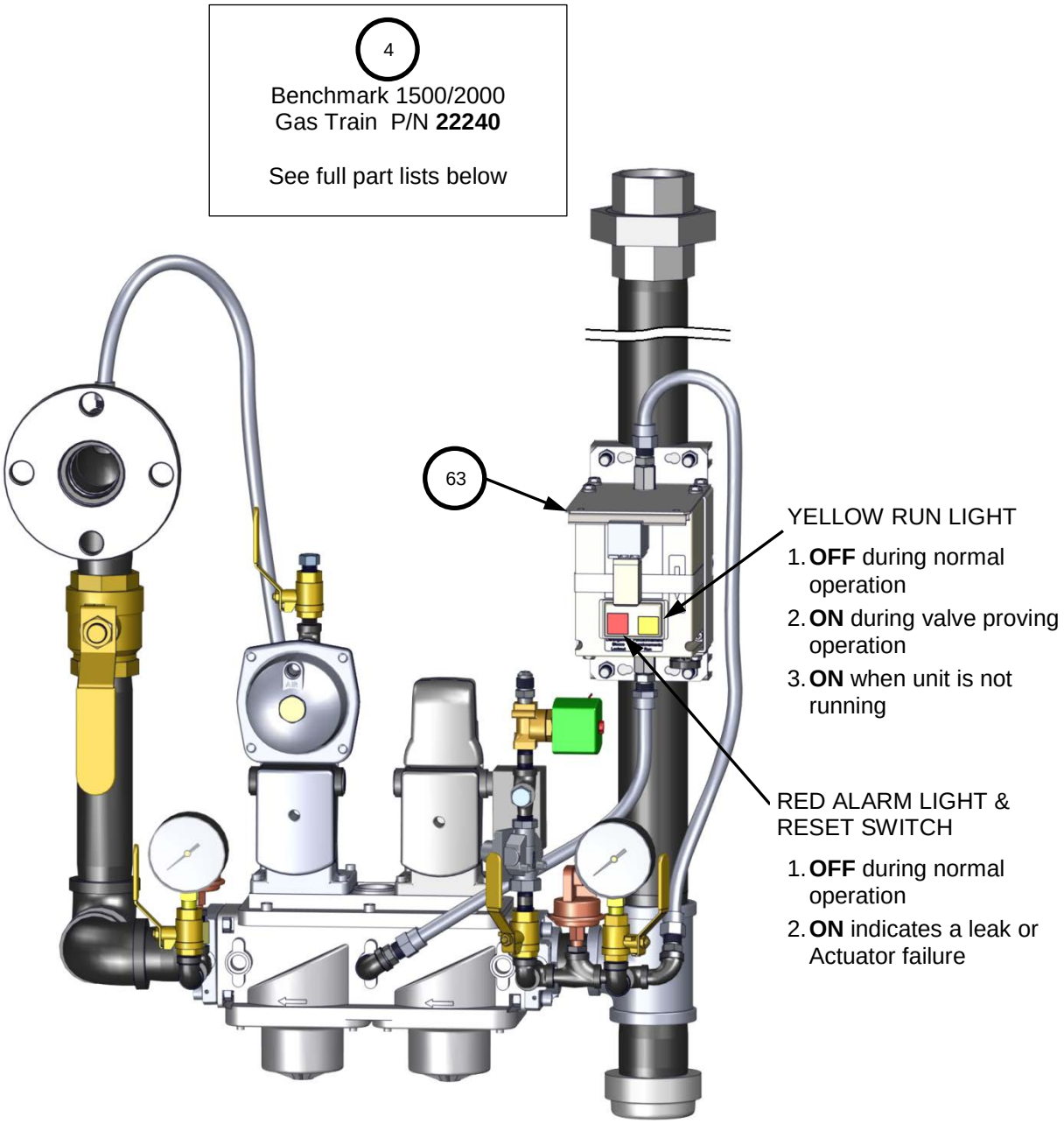
Full part lists below




| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 1500/2000 Part List** | 10/02/2017 |
| | **Benchmark 1500 29313-TAB rev G**<br>**Benchmark 2000 29337-TAB rev G** | Sheet 4 of 7 |

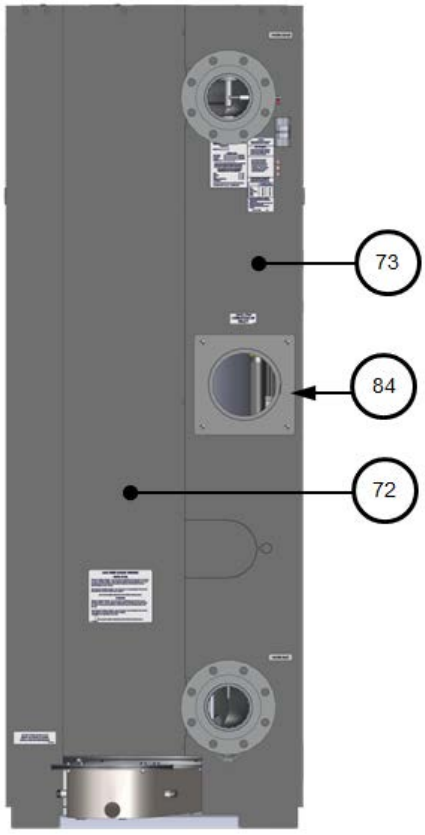



The Benchmark 1500/2000 gas train (P/N **22240**) contain a Valve Proving device (P/N **24629-2**):

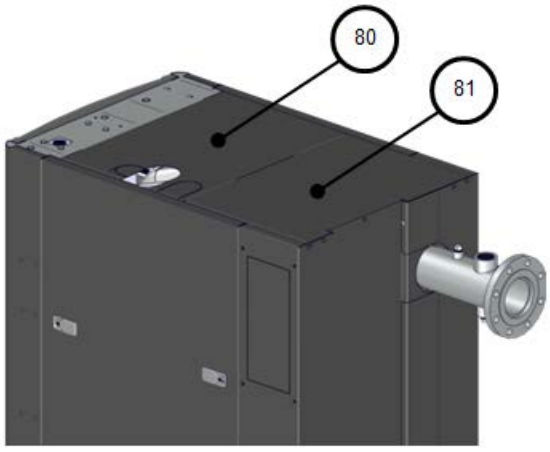
This device monitors the gas pressure on both sides of the Actuator. If the pressure difference falls below a fixed value, indicating the failure of the Actuator or leakage in the gas line, it triggers the shutdown of the boiler..

Once the problem has been diagnosed and corrected, the Valve Proving device must be reset by pressing the red Reset switch before the unit is restarted.

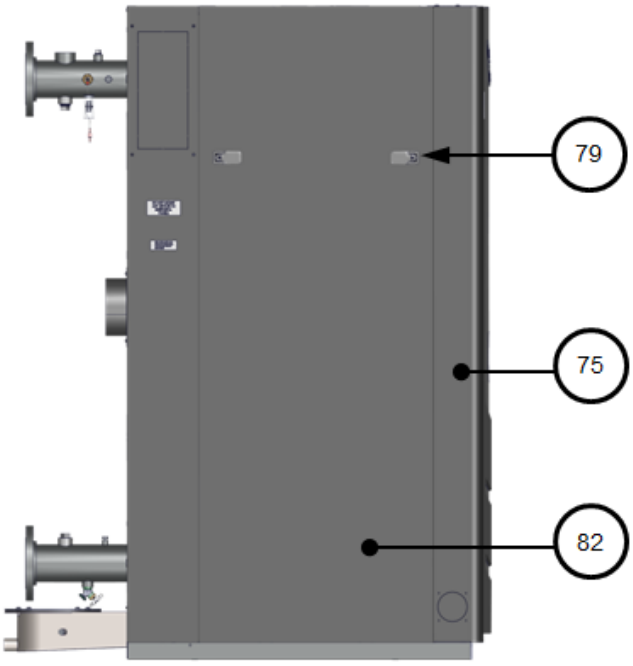
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 1500/2000 Part List** | 10/02/2017 |
|---|---|---|
| | **Benchmark 1500 29313-TAB rev G**<br>**Benchmark 2000 29337-TAB rev G** | Sheet 5 of 7 |



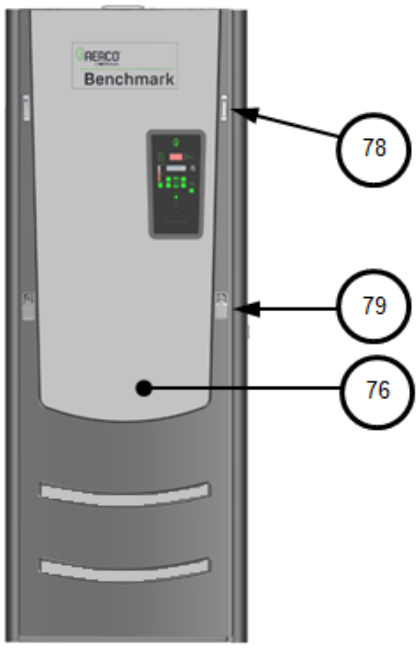

REAR VIEW




TOP VIEW

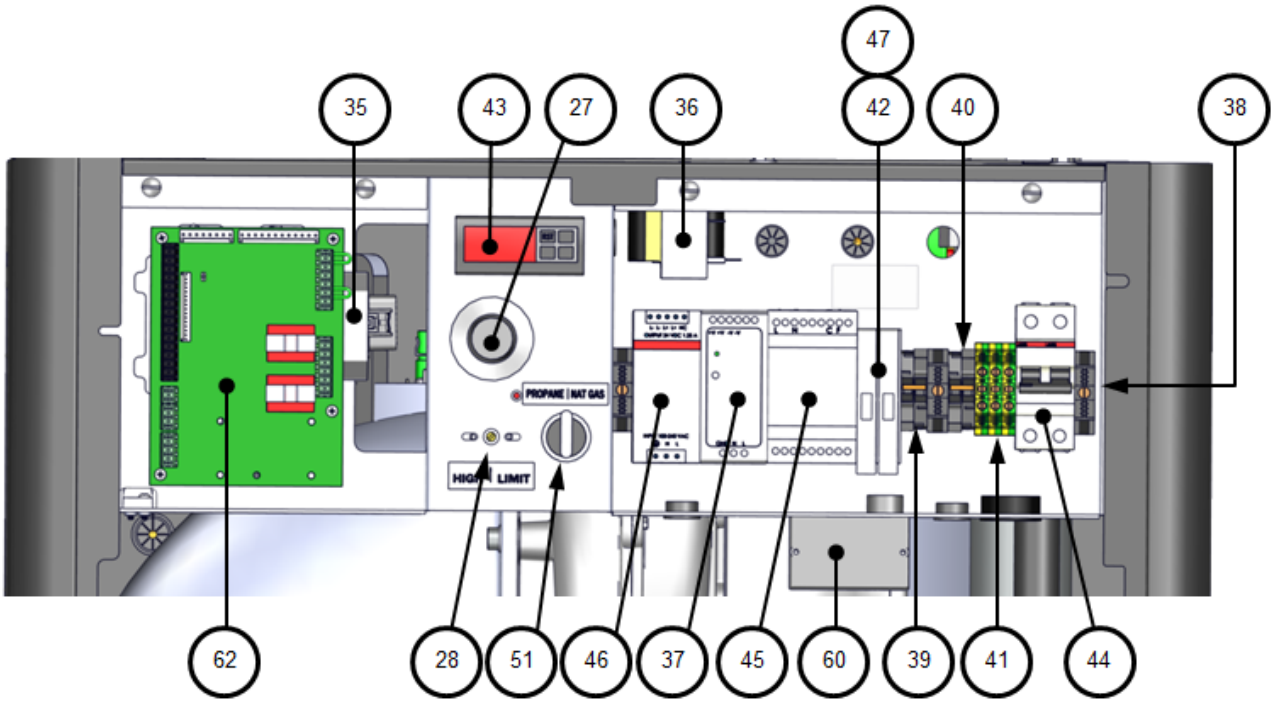


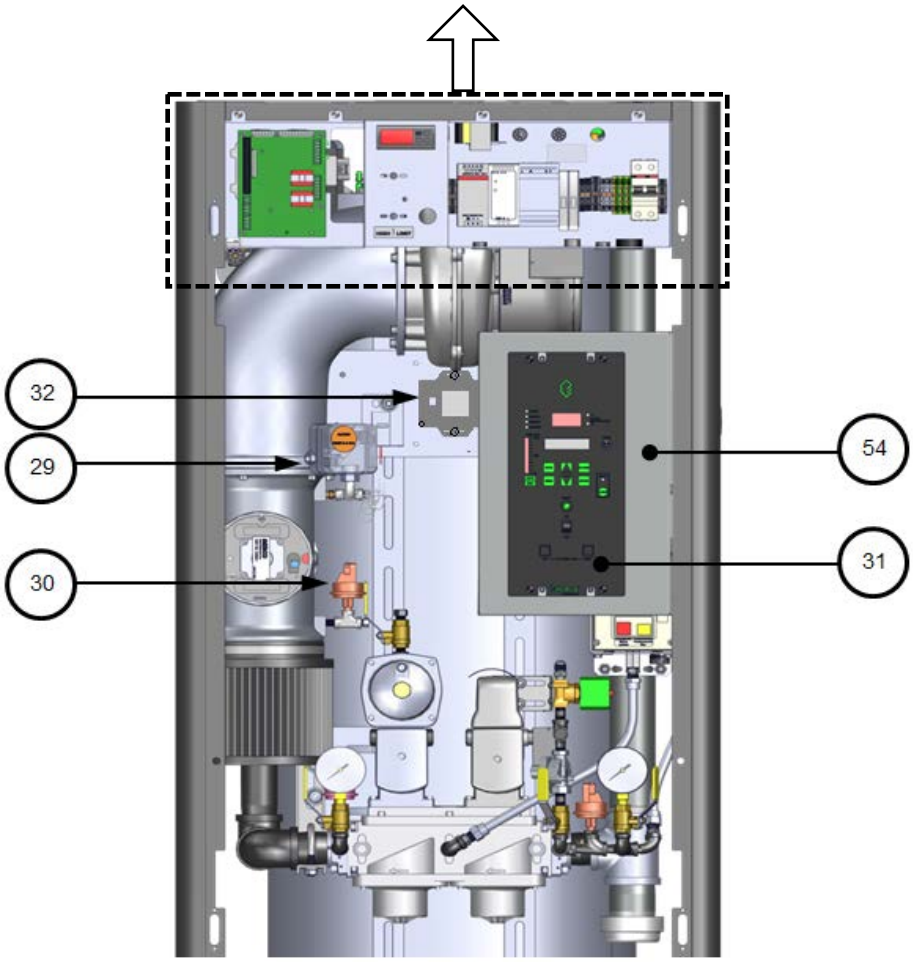

LEFT SIDE VIEW




FRONT VIEW

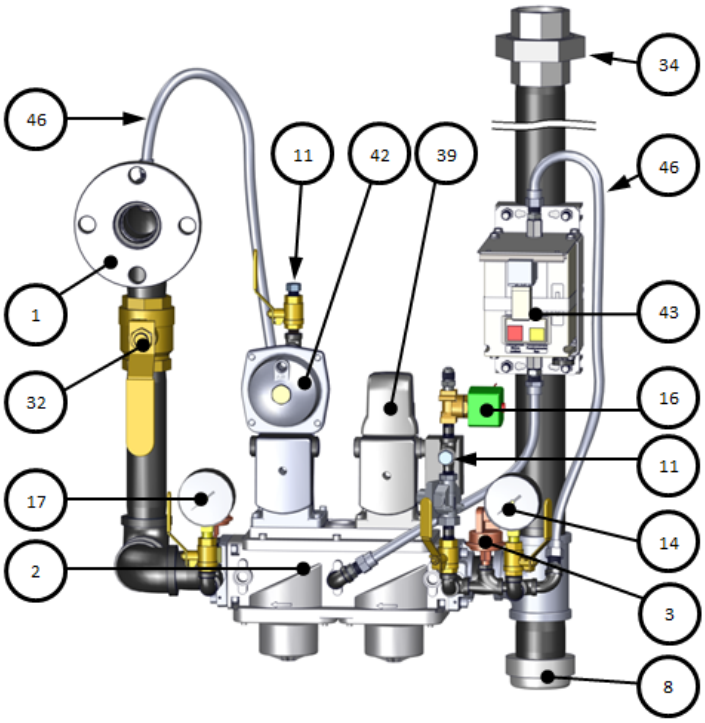
| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 1500/2000 Part List** | 10/02/2017 |
| | **Benchmark 1500 29313-TAB rev G**<br>**Benchmark 2000 29337-TAB rev G** | Sheet 6 of 7 |

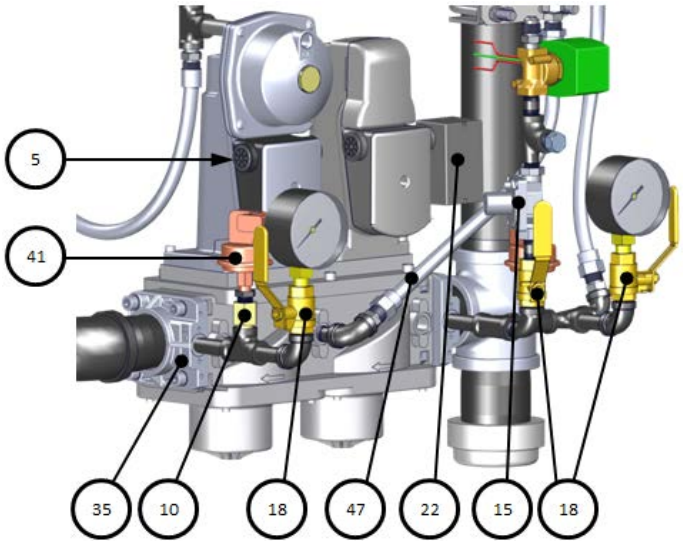


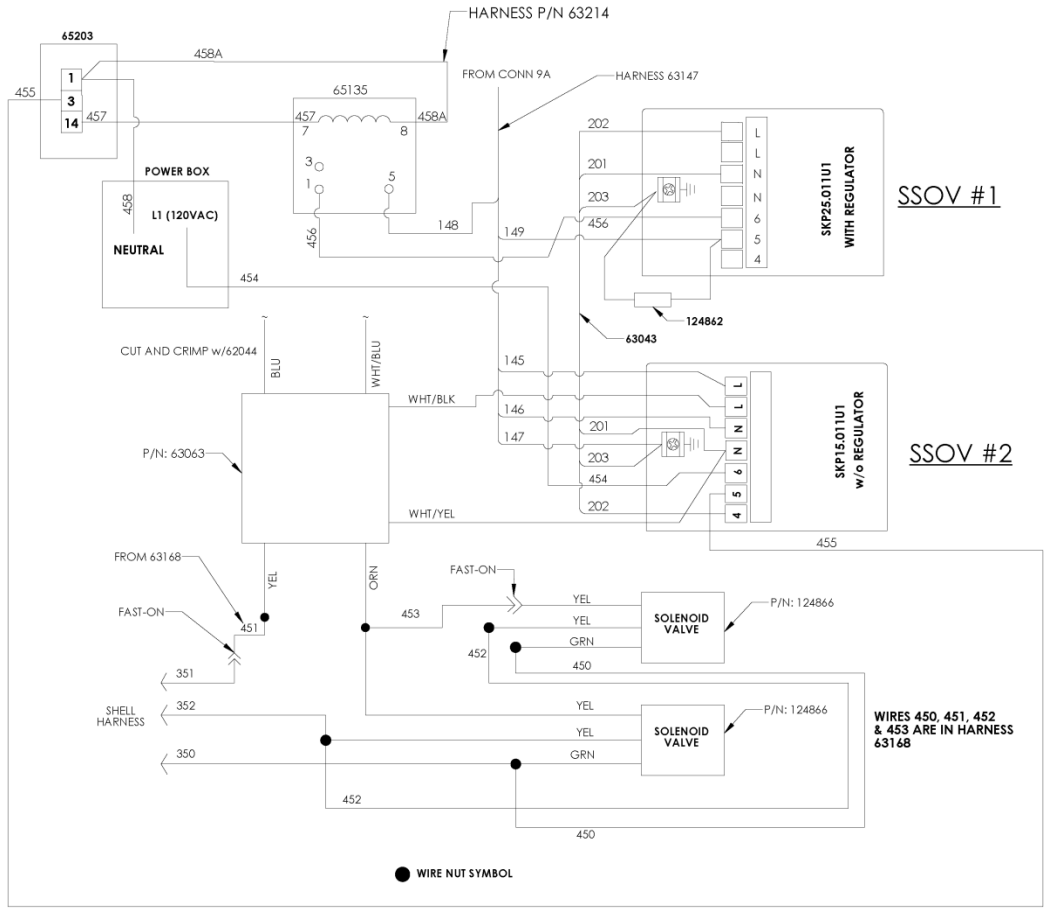

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 1500/2000 Part List** | 10/02/2017 |
| | **Benchmark 1500 29313-TAB rev G**<br>**Benchmark 2000 29337-TAB rev G** | Sheet 7 of 7 |

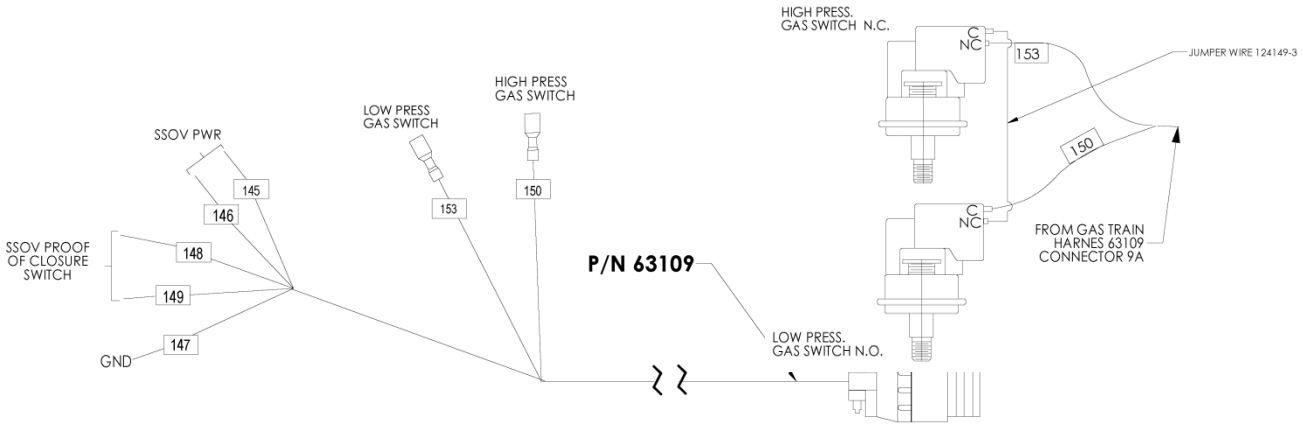
| Benchmark 1500/2000 Natural Gas Gas Train – 22240 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Item** | **Qty** | **Part #** | **Description** | **Item** | **Qty** | **Part #** | **Description** |
| 1 | 1 | 123542 | FLANGE 2" 125# 2" NPT | 18 | 4 | 92077 | 1/4" NPT MXF BRASS BALL VALVE |
| 2 | 1 | 124142 | VALVE: SSOV: DOUBLE BODY: 2" NPT | 22 | 1 | 63063 | RELAY |
| 3 | 1 | 61002-1 | PRESSURE SWITCH: 2.6" W.C. FALL N.O. | 32 | 1 | 92006-7 | VALVE: BALL BRASS 1-1/2" NPT |
| 5 | 3 | 12951-2 | BUSHING: CONTROL BOX | 34 | 1 | 9-294 | UNION: 2" NPT 300# |
| 8 | 1 | 93382 | 2'' NPT CAP | 35 | 2 | 95029 | FLANGE: SSOV 1 1/2" NPT |
| 10 | 1 | 99017 | SNUBBER: PRESSURE: 1/4" | 39 | 1 | 124138 | ACTUATOR: SSOV |
| 11 | 2 | 9-22 | PIPE PLUG: 1/4" NPT: STEEL | 41 | 1 | 61002-12 | HIGH GAS PRESSURE SWITCH 4.7" W.C. |
| 14 | 1 | 67007 | GAGE: LOW PRESSURE 0-15 in./H2O | 42 | 1 | 64048 | ACTUATOR: SSOV W/ REGULATOR |
| 15 | 1 | 64083 | REGULATOR: GAS PRESSURE WITH VENT LIMITING ORIFICE | 43 | 1 | 24629-2 | VALVE PROVING SYSTEM ASSEMBLY |
| 16 | 1 | 124866 | SOLENOID VALVE: 1/4" NPT | 46 | 2 | 97087-26 | TUBING: FLEXIBLE 26" |
| 17 | 1 | 67006 | GAGE: LOW PRESSURE 0-10 in./H2O | 47 | 1 | 97087-16 | TUBING: FLEXIBLE 16" |




| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 1500/2000 Gas Train** | 04/17/2017 |
| | **P/N 22240 rev D** | Sheet 1 of 2 |



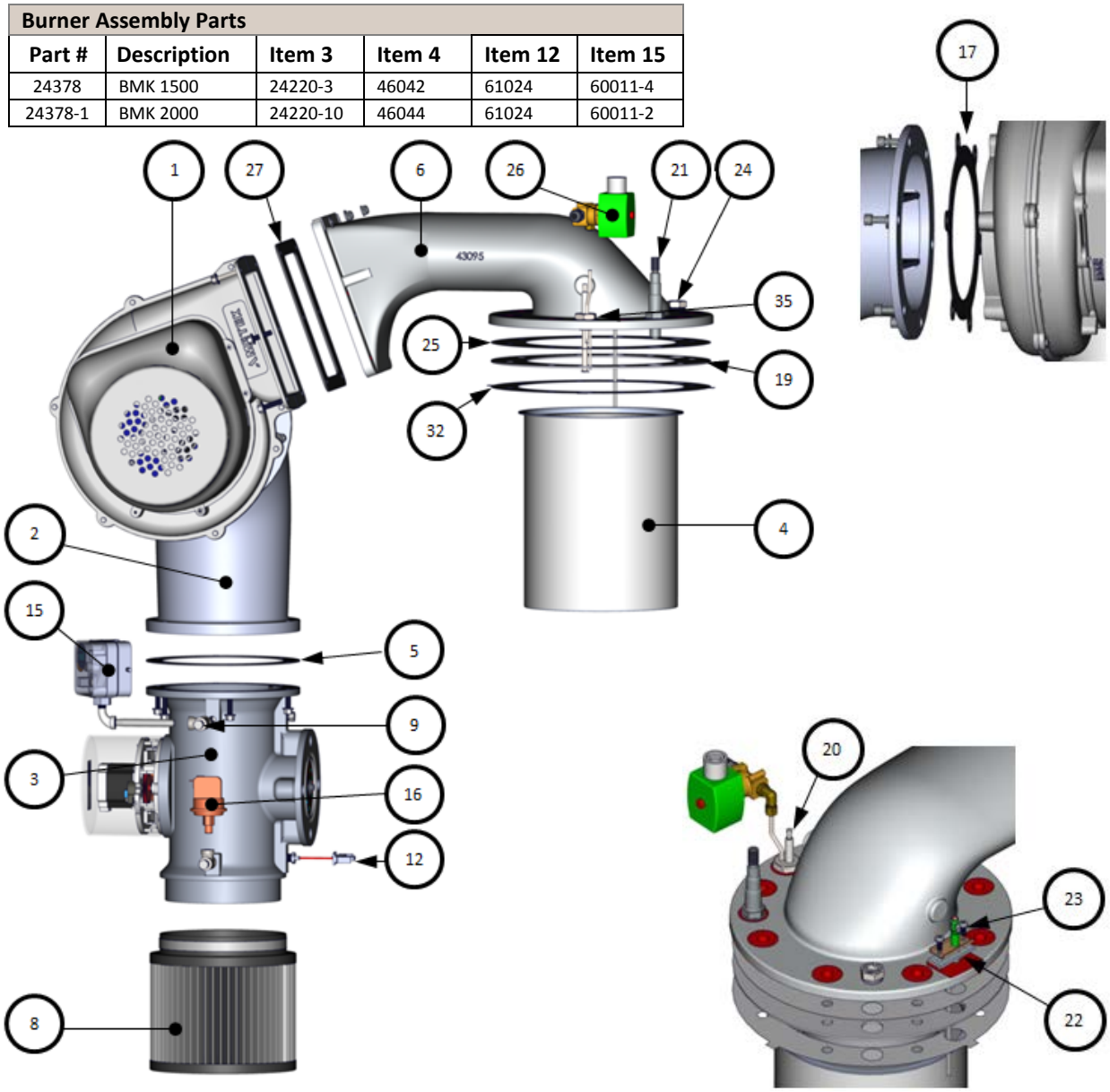

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 1500/2000 Gas Train** | 04/17/2017 |
| | **P/N 22240 rev D** | Sheet 2 of 2 |

## Benchmark 1500/2000 Burner Assembly – P/N 24378-TAB

| Item | Qty | Part # | Description | Item | Qty | Part # | Description |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 69078 | BLOWER: AMETEK 12.3" | 19 | 1 | 81166 | BURNER GASKET |
| 2 | 1 | 43090 | AIR FUEL VALVE PLENUM | 20 | 1 | 66026 | IGNITOR-INJECTOR |
| 3 | 1 | **See Table** | AIR/FUEL VALVE ASSEMBLY | 21 | 1 | 61026 | $O_2$ SENSOR |
| 4 | 1 | **See Table** | BURNER | 22 | 1 | 81048 | GASKET: FLAME ROD LOW $NO_x$ |
| 5 | 1 | 81057 | GASKET: BLOWER | 23 | 1 | 66034 | FLAME ROD |
| 6 | 1 | 43095 | BLOWER PLENUM | 24 | 1 | 59104 | OBSERVATION PORT |
| 8 | 1 | 59138 | FILTER: AIR 6" | 25 | 1 | 81183 | BURNER GASKET: UPPER RELEASE |
| 9 | 5 | 9-21 | PLUG: HEX HD 1/8 NPT | 26 | 1 | 24277 | STAGED IGNITION ASSY |
| 12 | 1 | **See Table** | AIR INLET TEMPERATURE SENSOR | 27 | 1 | 81184 | GASKET: BLOWER |
| 15 | 1 | **See Table** | BLOWER PROOF SWITCH ASSEMBLY | 32 | 1 | 81186 | BURNER GASKET: LOWER RELEASE |
| 16 | 1 | 61002-5 | BLOCKED INLET SWITCH -8.0" W.C. | 35 | 1 | 53033 | WASHER: CLOCKING |
| 17 | 1 | 81100 | GASKET: BLOWER 12.3" | | | | |

**Burner Assembly Parts**

| Part # | Description | Item 3 | Item 4 | Item 12 | Item 15 |
|---|---|---|---|---|---|
| 24378 | BMK 1500 | 24220-3 | 46042 | 61024 | 60011-4 |
| 24378-1 | BMK 2000 | 24220-10 | 46044 | 61024 | 60011-2 |




| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 1500/2000 Burner Assembly** | 08/09/2017 |
|---|---|---|
| | **24378-TAB rev G** | Sheet 1 of 1 |

# Appendix H: BENCHMARK 2500/3000 PART LIST

## Benchmark 2500 and Benchmark 3000 Part List

| Item # | Qty | Part # | Description |
|---|---|---|---|
| **EXHAUST MANIFOLD** | | | |
| 1 | 1 | 39156 | MANIFOLD: EXHAUST |
| 2 | 1 | 84040 | SEAL: MANIFOLD |
| 3 | 6 | 9-22 | PIPE PLUG: 1/4" NPT: STEEL |
| **GAS TRAIN ASSEMBLY** | | | |
| 4 | 1 | 22244 | BMK 2500 GAS TRAIN ASSY |
| | | 22215 | BMK 3000 GAS TRAIN ASSY |
| **BURNER, AIR/FUEL VALVE AND HEAT EXCHANGER** | | | |
| 8 | 1 | 26015-1 | BMK 2500 BURNER ASSY 460 VAC |
| | | 26015-2 | BMK 2500 BURNER ASSY 208 VAC |
| | | 26014-1 | BMK 3000 BURNER ASSY 460 VAC |
| | | 26014-2 | BMK 3000 BURNER ASSY 208 VAC |
| 10 | 1 | 46039 | BMK 2500 BURNER |
| | | 46038 | BMK 3000 BURNER |
| 11 | 1 | 24277 | STAGED IGNITION ASSY. |
| 14 | 1 | 43090 | AIR/FUEL VALVE PLENUM |
| 15 | 1 | 24311-1 | AIR/FUEL VALVE ASSY, BMK 3000 **Replacement Kit** |
| | | 24311-8 | AIR/FUEL VALVE ASSY, BMK 2500 **Replacement Kit** |
| **HOSES, GASKETS & INSULATION** | | | |
| 16 | 1 | 97087-72 | FLEX TUBE 72" LG |
| 17 | 1 | 80081 | SHELL INSULATION |
| **BLOWER** | | | |
| 18 | 1 | 58063-1❷ | BLOWER 460V **Replacement Kit** |
| | | 58063-2 | BLOWER 208V **Replacement Kit** |
| 21 | 1 | 24356-1 | FLAME DETECTOR **Replacement Kit** |
| 22 | 1 | 61026 | LEAN OXYGEN SENSOR |
| 24 | 1 | 58023 | IGNITOR-INJECTOR **Replacement Kit** |
| 25 | 1 | 88014 | AIR FILTER |
| 26 | 1 | 43091 | BLOWER PLENUM |
| 27 | 1 | 123966 | ADJUSTABLE TEMP LIMIT SWITCH |
| 28 | 1 | 123552 | OVER TEMP-MANUAL RESET SWITCH |
| 29 | 1 | 60011-2 | BMK 3000 BLOWER PROOF SWITCH |
| | | 60011-5 | BMK 2500 BLOWER PROOF SWITCH |
| 30 | 1 | 61002-5 | BLOCKED INLET SWITCH -4.5" W.C. |
| 31 | 1 | 69186-4 | C-MORE CONTROLLER |
| 32 | 1 | 65085 | IGNITION TRANSFORMER |
| 34 | 1 | 93230 | SNUBBER - AIR/FUEL VALVE |
| 35 | 1 | 64081 | ECU, $O_2$ SENSOR |
| 36 | 1 | 65011 | TRANSFORMER 115V/24V 100VA |
| 37 | 1 | 65109 | 12V POWER SUPPLY |
| 38 | 3 | 69141 | DIN RAIL MOUNT END STOP |
| 39 | 2 | 65120 | TERMINAL BLOCK: DIN MOUNTED: BLK |
| 40 | 2 | 65121 | TERMINAL BLOCK: DIN MOUNTED: WHT |
| 41 | 3 | 65122 | TERMINAL GROUND BLOCK: DIN MOUNTED |
| 42 | 2 | 65118 | FUSE TERMINAL: DIN MOUNTED |
| 43 | 1 | 64088 | LIMIT CONTROL TEMPERATURE |
| 44 | 1 | 65128 | 3 POLE 20A BREAKER |
| 46 | 1 | 65162 | 24V POWER SUPPLY (Sequencing Valve) |
| 47❶ | 2 | 124512 | FUSE: 4 AMP |
| 48 | 2 | 123449 | SENSOR: TEMPERATURE |
| 49 | 1 | 58132 | THERMOWELL **Replacement Kit** |
| 53❷ | 1 | 124310 | TRANSFORMER – **460V ONLY** |
| 54 | 1 | 33170 | MOUNTING PANEL |
| 55 | 1 | 124324 | GROUND BAR |
| 60 | 1 | 69102-3 | PUMP RELAY |
| 61 | 1 | 61030 | SENSOR: OUTLET TEMPERATURE |
| 62 | 1 | 69172 | INPUT/OUTPUT (PCB) ASSY |
| 67❶ | 1 | 61034 | SPARK MONITOR (Current Transducer) |
| **SHEET METAL/PANEL ASSEMBLY** | | | |
| 69❶ | 1 | 38035 | I/O PANEL COVER |
| 70❶ | 1 | 38036 | POWER PANEL COVER |
| 71 | 2 | 59179 | HANDLE, CONCEALED PULL |
| 72 | 1 | 37148 | BACK PANEL RIGHT |
| 73 | 1 | 37149 | BACK PANEL: LEFT |
| 74 | 2 | 35046 | TOP RAIL |
| 75 | 1 | 25087 | FRONT FRAME ASSEMBLY |
| 76 | 1 | 25085-3 | FRONT PANEL |
| 79 | 4 | 59133 | LATCH, COMPRESSION |
| 80 | 1 | 30156 | TOP PANEL, FRONT |
| 81 | 1 | 30157 | TOP PANEL, BACK |
| 82 | 2 | 30155 | SIDE PANEL |
| 84 | 1 | 39215 | AIR INLET ADAPTER, 8” |
| 85 | 2 | 38044 | AIR INLET COVER PANEL |
| **OTHER ACCESSORIES & PARTS** | | | |
| 90 | 1 | 69126 | LOW WATER CUTOFF/CAPACITOR ASSY |
| 91 | 1 | 123863 | 1/8" NTP BALL VALVE |
| 92 | 1 | 92094 | 3/4" DRAIN VALVE |
| 95 | 1 | 59178 | 1/8" AIR VENT |

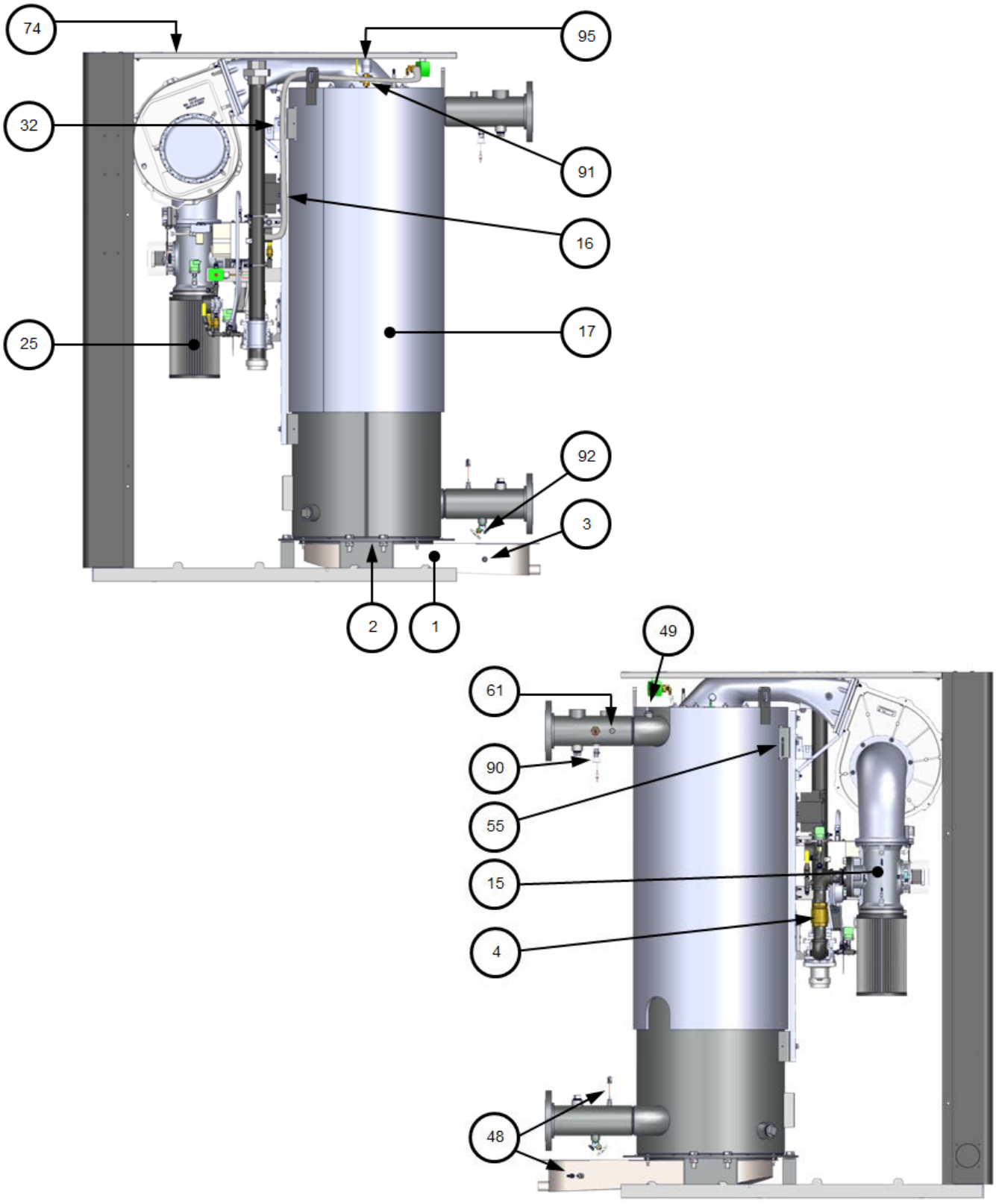
❶ Not shown on drawing
❷ Only used in 460 v units

| Benchmark 2500/3000 Spare Parts Kit – P/N 58048-TAB | | | | | |
|---|---|---|---|---|---|
| **Kit Number** | **Description** | **Pressure Relief Valve Kit** | **Pressure/Temp Gauge** | **Condensate Trap Assy.** | **2" Ball Valve** |
| 58048-C30 | 30 PSI (207 kPa) KIT (CONBRACO) | 92016-1 | 123675-5 | 24441 | 123540 |
| 58048-C50 | 50 PSI (345 kPa) KIT (CONBRACO) | 92016-2 | 123675-5 | | |
| 58048-C60 | 60 PSI (414 kPa) KIT (CONBRACO) | 92016-3 | 123675-6 | | |
| 58048-C75 | 75 PSI (517 kPa) KIT (CONBRACO) | 92016-4 | 123675-6 | | |
| 58048-C100 | 100 PSI (689 kPa) KIT (CONBRACO) | 92016-5 | 123675-6 | | |
| 58048-C125 | 125 PSI (862 kPa) KIT (CONBRACO) | 92016-6 | 123675-6 | | |
| 58048-C150 | 150 PSI (1034 kPa) KIT (CONBRACO) | 92016-7 | 123675-7 | | |
| 58048-W50 | 50 PSI (345 kPa) KIT (WATTS) | 92016-8 | 123675-5 | | |
| 58048-W60 | 60 PSI (414 kPa) KIT (WATTS) | 92016-9 | 123675-6 | | |
| 58048-W75 | 75 PSI (517 kPa) KIT (WATTS) | 92016-10 | 123675-6 | | |
| 58048-W100 | 100 PSI (689 kPa) KIT (WATTS) | 92016-11 | 123675-6 | | |
| 58048-W125 | 125 PSI (862 kPa) KIT (WATTS) | 92016-12 | 123675-6 | | |
| 58048-W150 | 150 PSI (1034 kPa) KIT (WATTS) | 92016-13 | 123675-7 | | |
| 58048-K160 | 160 PSI (1103 kPa) KIT (KUNKLE) | 92016-14 | 123675-7 | | |

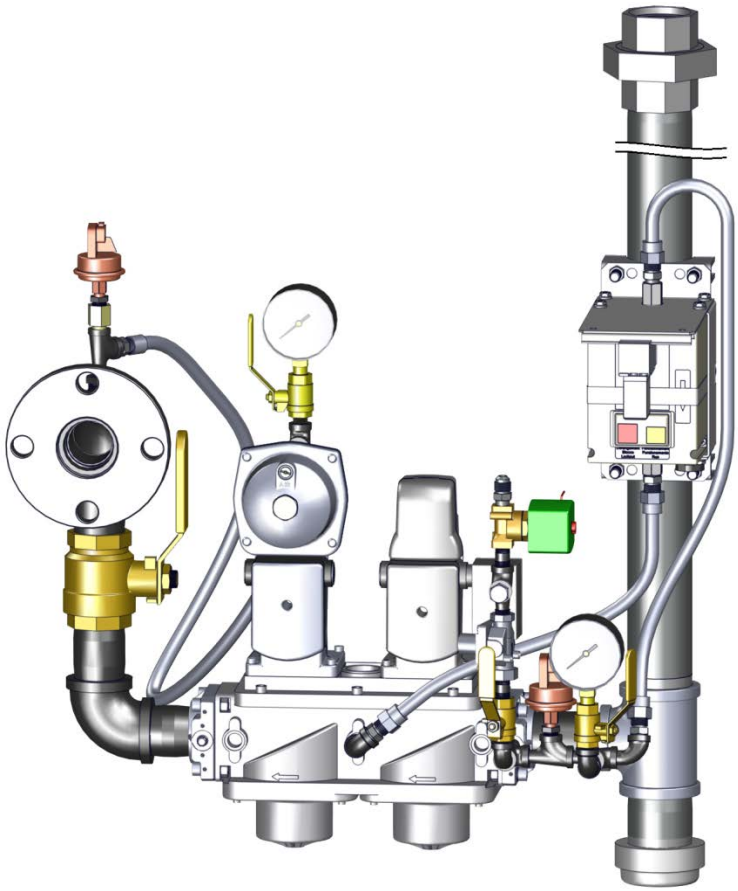
| Wiring Harnesses (not shown in figures below) | |
|---|---|
| **Part #** | **Description** |
| 63004 | HARNESS: 460V TRANSFORMER – **460 V only** |
| 63059 | HARNESS: DRIVE REACTOR BMK 3.0 |
| 63083 | HARNESS: O2 SENSOR |
| 63090 | HARNESS: TEMP LIM CONTROL |
| 63103 | HARNESS: SHELL |
| 63104 | HARNESS: I/O INTERLOCK |
| 63105 | HARNESS: I/O SENSOR/COMM |
| 63109 | HARNESS: GAS TRAIN |
| 63111 | HARNESS: CONTROL |
| 65104 | CABLE, H.V. IGNITION |

| Benchmark 2500/3000 Kits Available | |
|---|---|
| **Part #** | **Description** |
| 27086-2 | ACTUATOR: SSOV w/o P.O.C. SWITCH **Replacement Kit** |
| 64048 | SSOV WITH PRESSURE REGULATOR **Replacement Kit** |

| Other Accessories / Parts (Optional) | |
|---|---|
| **Part #** | **Description** |
| 92084-6 | MOTORIZED SEQUENCING VALVE |



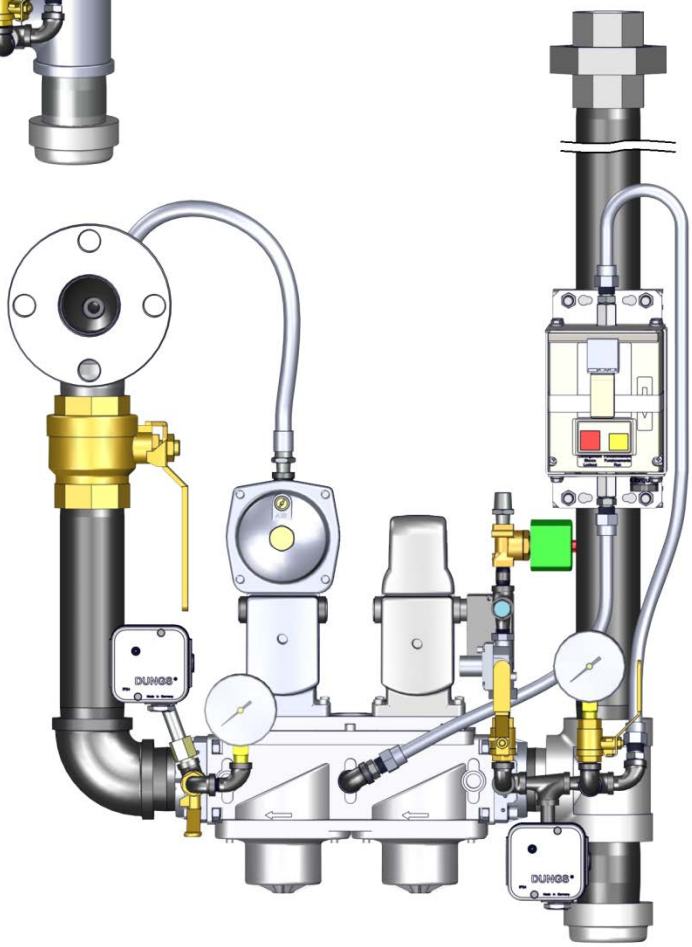

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 2500/3000 Part List** | 10/09/2017 |
| | **Benchmark 2500 28536-TAB rev E**<br>**Benchmark 3000 28382-TAB rev F** | Sheet 3 of 8 |



4

Benchmark 2500
Gas train
P/N **22244**

Full part lists below



4

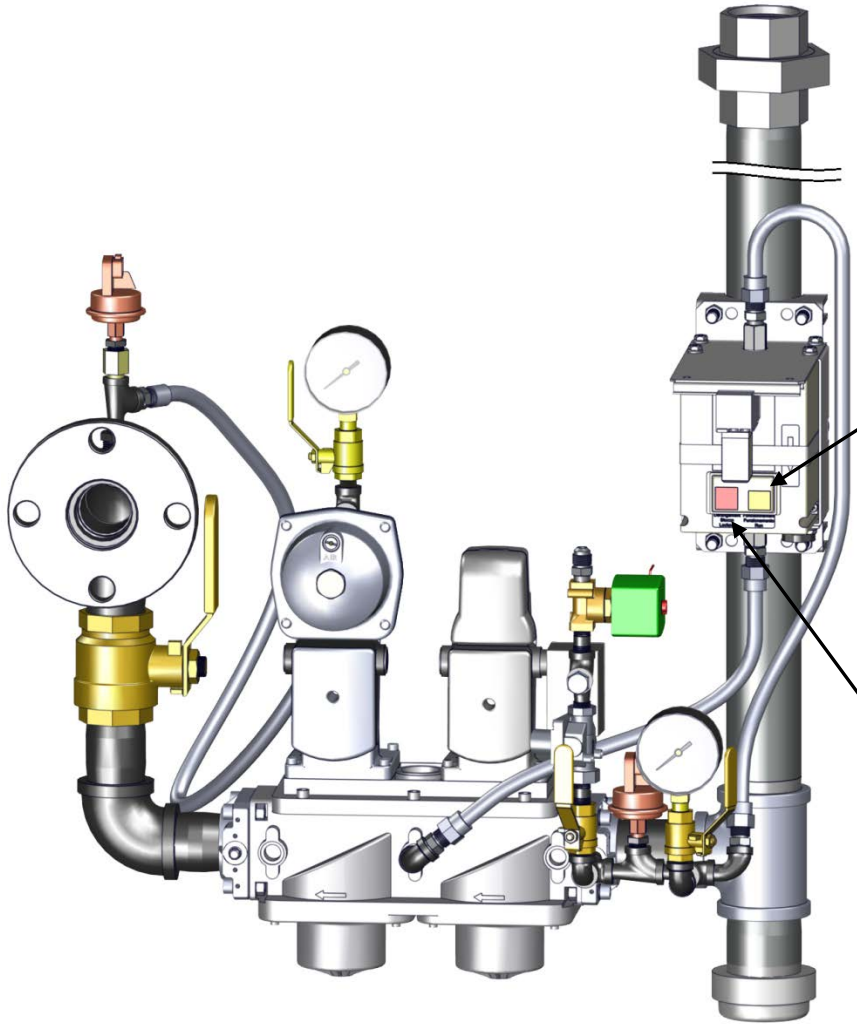
Benchmark 3000
Gas train
P/N **22215**

Full part lists below

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 2500/3000 Part List** | 10/09/2017 |
| | **Benchmark 2500 28536-TAB rev E**<br>**Benchmark 3000 28382-TAB rev F** | Sheet 4 of 8 |

The Benchmark 2500 and 3000 gas trains (P/N **22244** and **22215)** contain a Valve Proving device (P/N **24629-2**). This device monitors the gas pressure on both sides of the Actuator. If the pressure difference falls below a fixed value, indicating the failure of the Actuator or leakage in the gas line, it triggers the shutdown of the boiler.

Once the problem has been diagnosed and corrected, the Valve Proving device must be reset by pressing the red Reset switch before the unit is restarted.



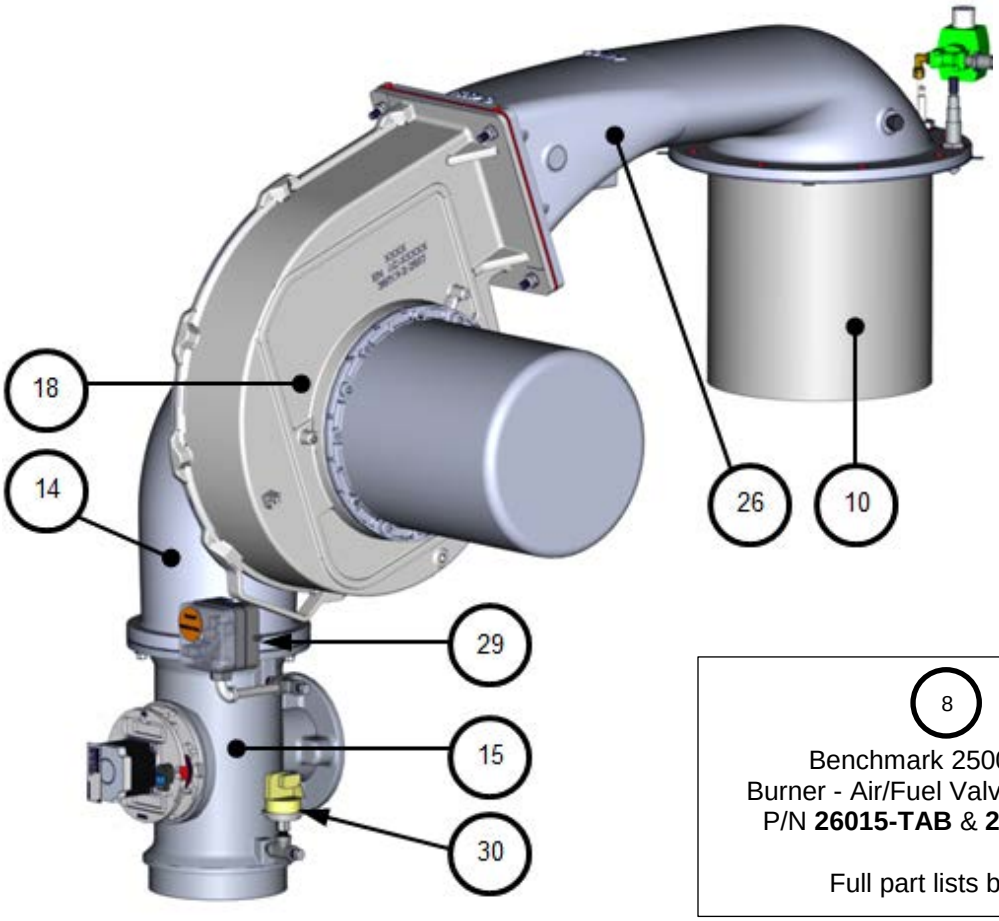
YELLOW RUN LIGHT

- **OFF** during normal operation
- **ON** during valve proving operation
- **ON** when unit is not running

RED ALARM LIGHT & RESET SWITCH

- **OFF** during normal operation
- **ON** indicates a leak or Actuator failure

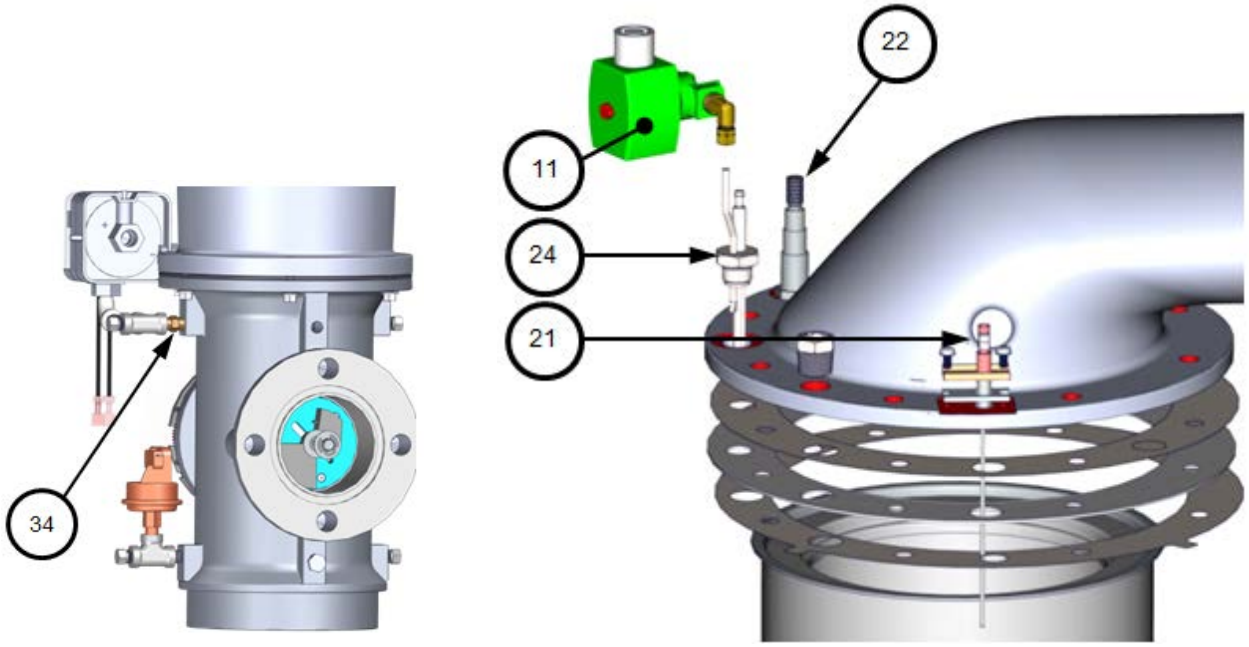
| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 2500/3000 Part List** | 10/09/2017 |
| | **Benchmark 2500 28536-TAB rev E**<br>**Benchmark 3000 28382-TAB rev F** | Sheet 5 of 8 |



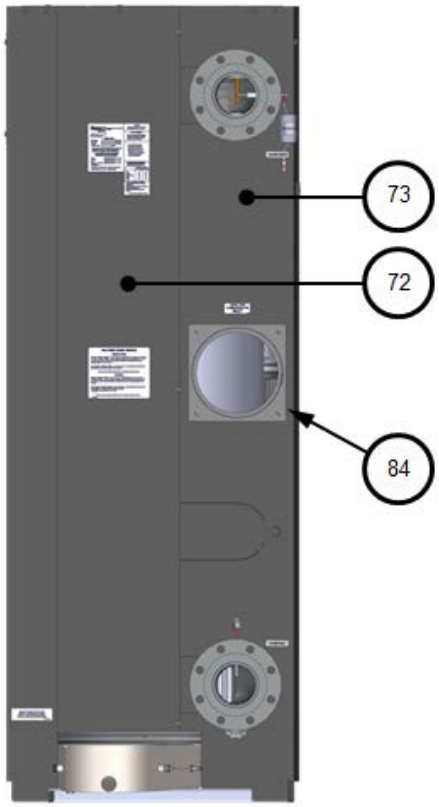

8

Benchmark 2500/3000
Burner - Air/Fuel Valve Assembly
P/N **26015-TAB** & **26014-TAB**

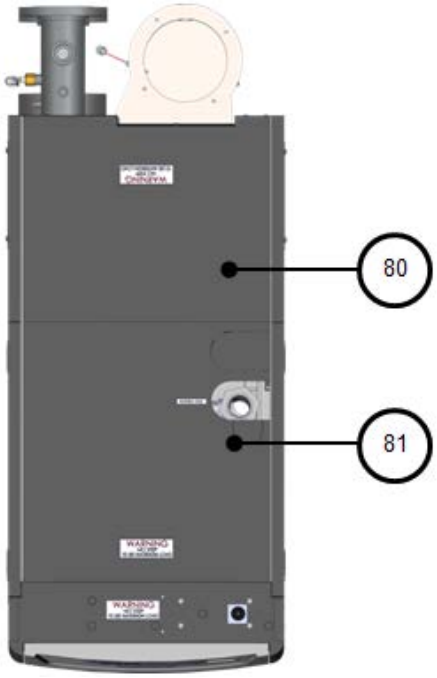
Full part lists below



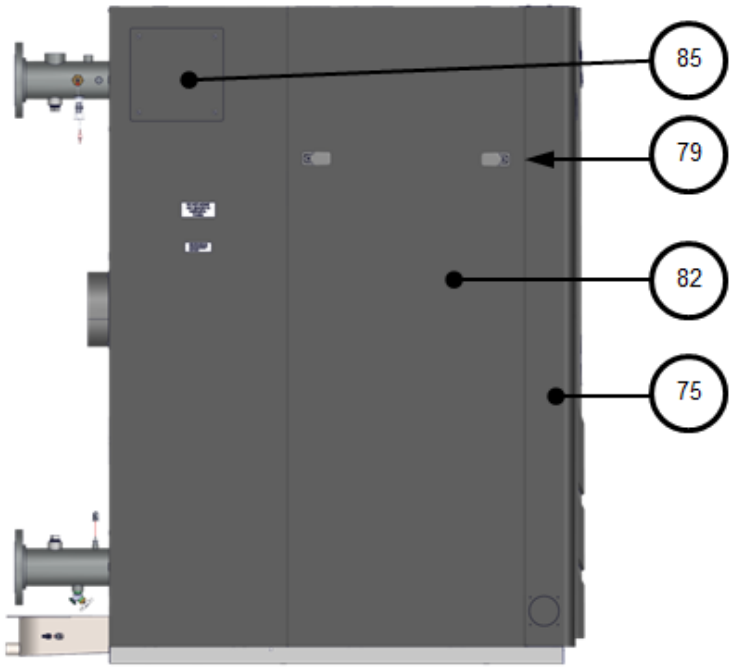

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 2500/3000 Part List** | 10/09/2017 |
| | **Benchmark 2500 28536-TAB rev E**<br>**Benchmark 3000 28382-TAB rev F** | Sheet 6 of 8 |



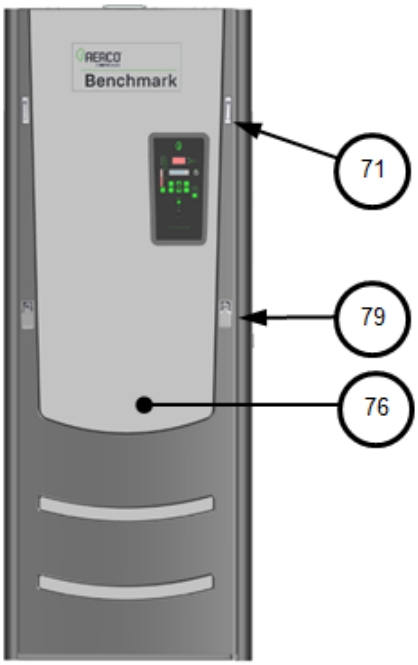

REAR VIEW




TOP VIEW

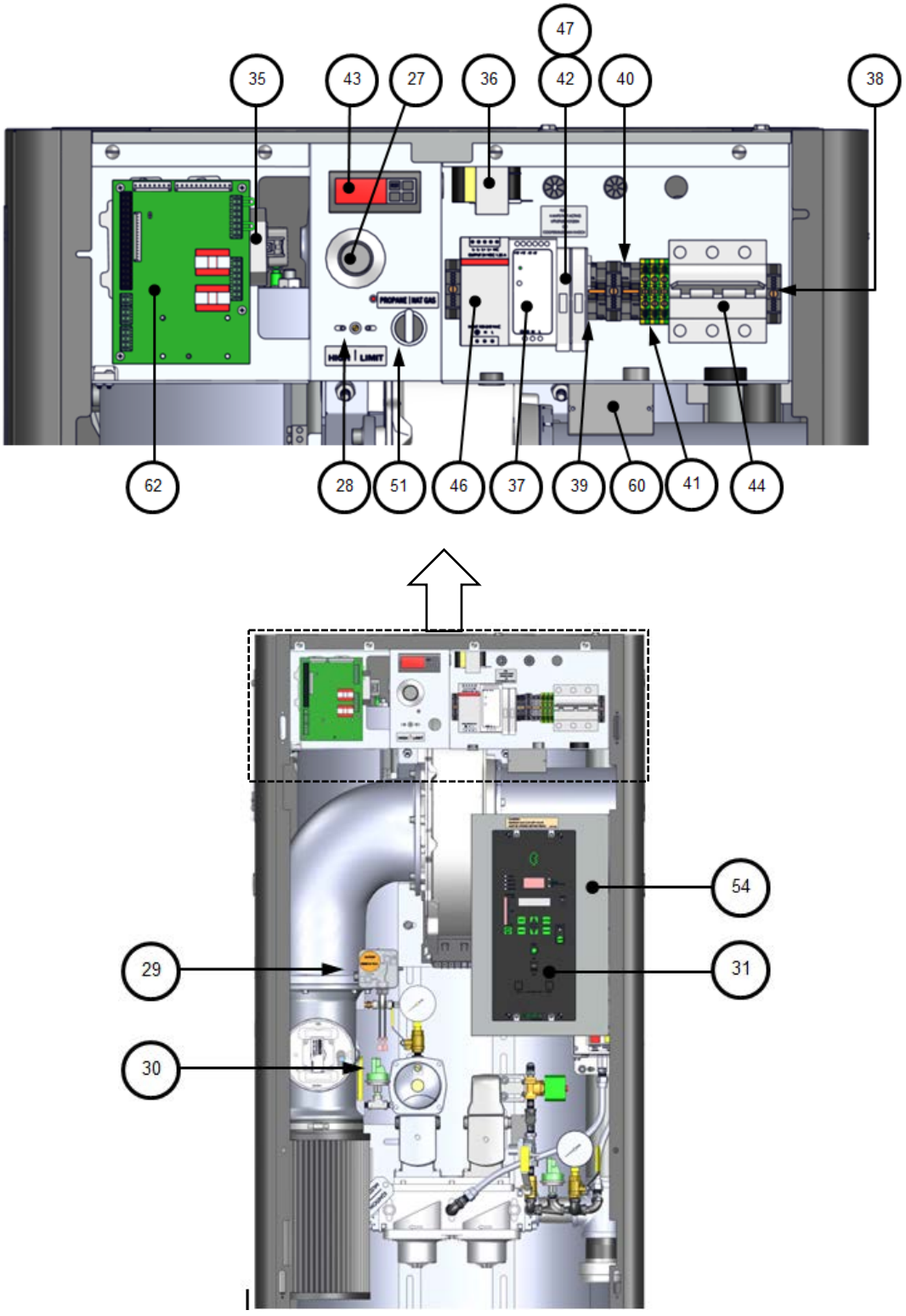



LEFT SIDE VIEW




FRONT VIEW

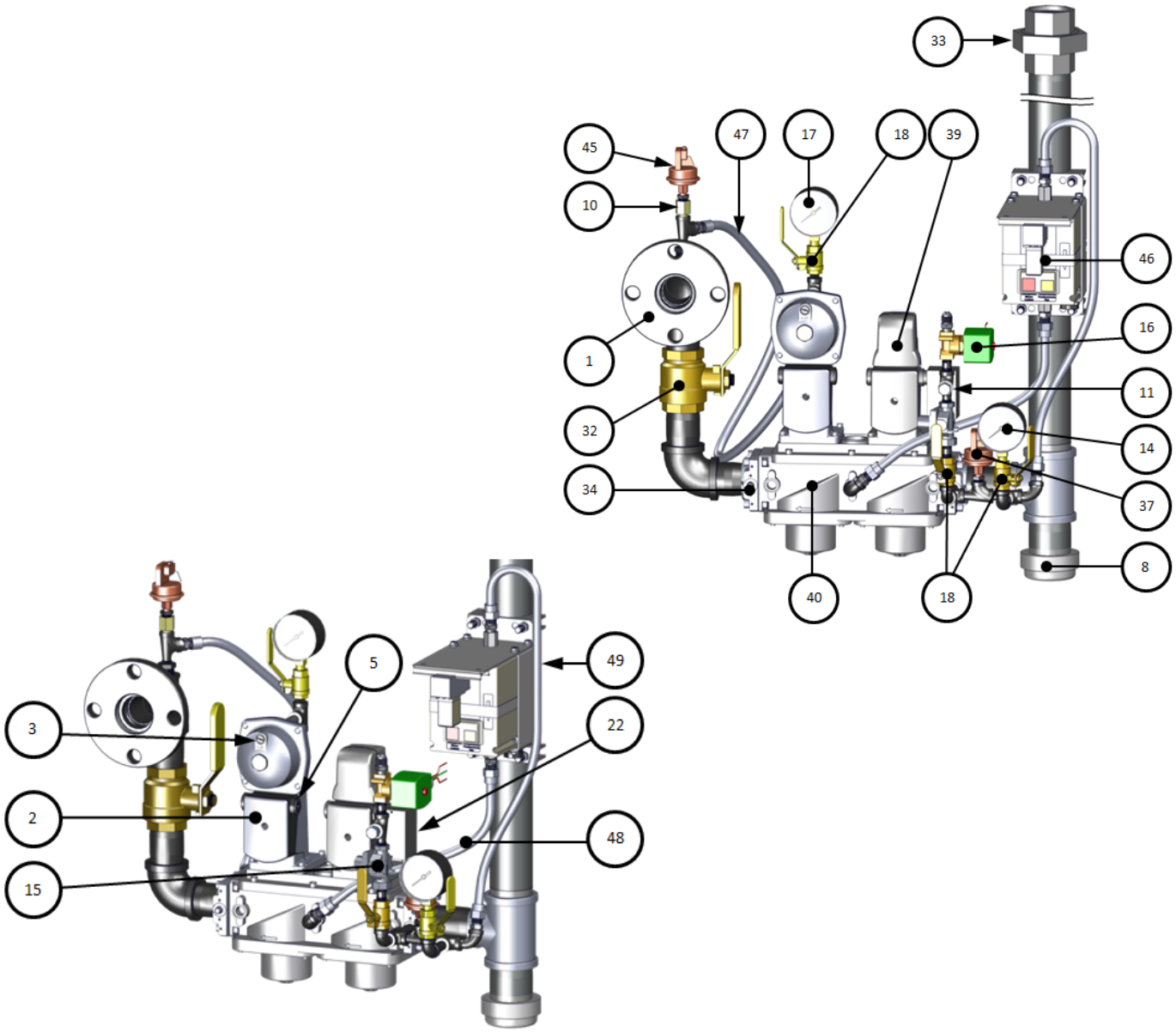
| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 2500/3000 Part List** | 10/09/2017 |
| | **Benchmark 2500 28536-TAB rev E**<br>**Benchmark 3000 28382-TAB rev F** | Sheet 7 of 8 |



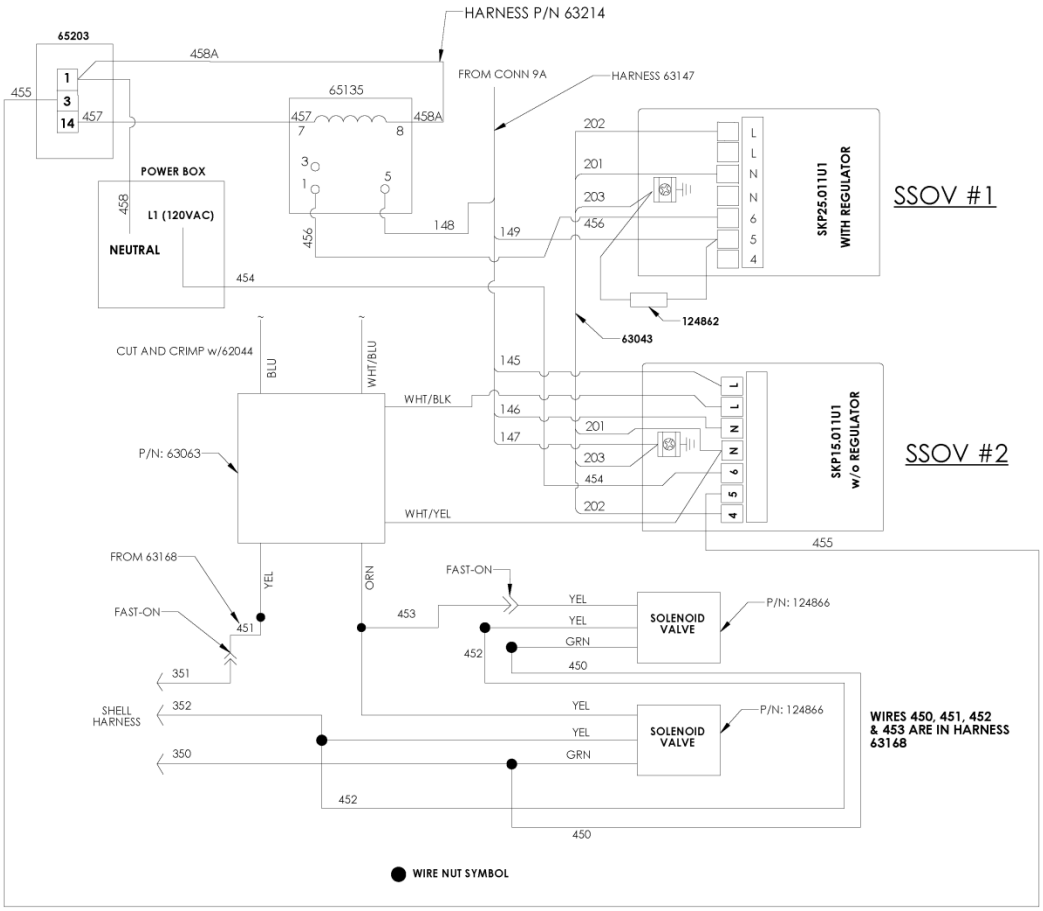

PARTIAL FRONT VIEW – FRONT PANEL REMOVED

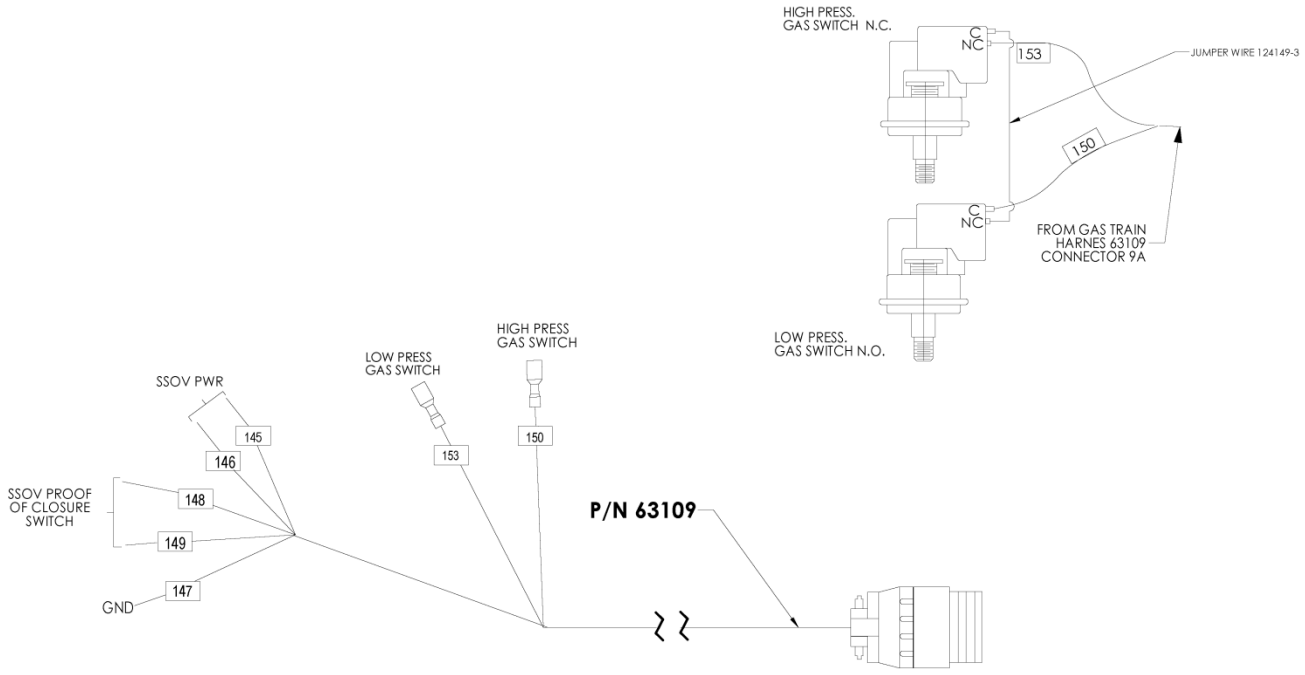
| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 2500/3000 Part List** | 10/09/2017 |
| | **Benchmark 2500 28536-TAB rev E**<br>**Benchmark 3000 28382-TAB rev F** | Sheet 8 of 8 |

| Benchmark 2500 Natural Gas Gas Train – P/N 22244 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Item** | **Qty** | **Part #** | **Description** | **Item** | **Qty** | **Part #** | **Description** |
| 1 | 1 | 123542 | FLANGE 2" 125# 2" NPT | 22 | 1 | 63063 | RELAY |
| 2 | 1 | 64048 | ACTUATOR: SSOV W/ REGULATOR | 32 | 1 | 92006-7 | VALVE: BALL BRASS 1-1/2" NPT |
| 3 | 1 | 99015 | DAMPING ORIFICE: SSOV | 33 | 1 | 9-294 | UNION: 2" NPT 300# |
| 5 | 3 | 12951-2 | BUSHING: CONTROL BOX | 34 | 2 | 95029 | FLANGE: SSOV 1 1/2" NPT |
| 8 | 1 | 93382 | 2'' NPT CAP | 37 | 1 | 61002-11 | LOW GAS PRESSURE SWITCH 3.6" W.C. |
| 10 | 1 | 99017 | SNUBBER: PRESSURE: 1/4" | 39 | 1 | 124138 | ACTUATOR: SSOV |
| 11 | 1 | 9-22 | PIPE PLUG: 1/4" NPT: STEEL | 40 | 1 | 124137 | VALVE: SSOV: DOUBLE BODY: 1-1/2" NPT |
| 14 | 1 | 67007 | GAGE: LOW PRESSURE 0-15 in./H2O | 45 | 1 | 61002-22 | HIGH GAS PRESSURE SWITCH: 3.0" W.C. |
| 15 | 1 | 64083 | REGULATOR: GAS PRESSURE WITH VENT LIMITING ORIFICE | 46 | 1 | 24629-2 | VALVE PROVING SYSTEM ASSEMBLY |
| 16 | 1 | 124866 | SOLENOID VALVE: 1/4" NPT | 47 | 1 | 97087-12 | TUBING: FLEXIBLE 12" |
| 17 | 1 | 67006 | GAGE: LOW PRESSURE 0-10 in./H2O | 48 | 1 | 97087-20 | TUBING: FLEXIBLE 20" |
| 18 | 3 | 92077 | 1/4" NPT MXF BRASS BALL VALVE | 49 | 1 | 97087-26 | TUBING: FLEXIBLE 26" |



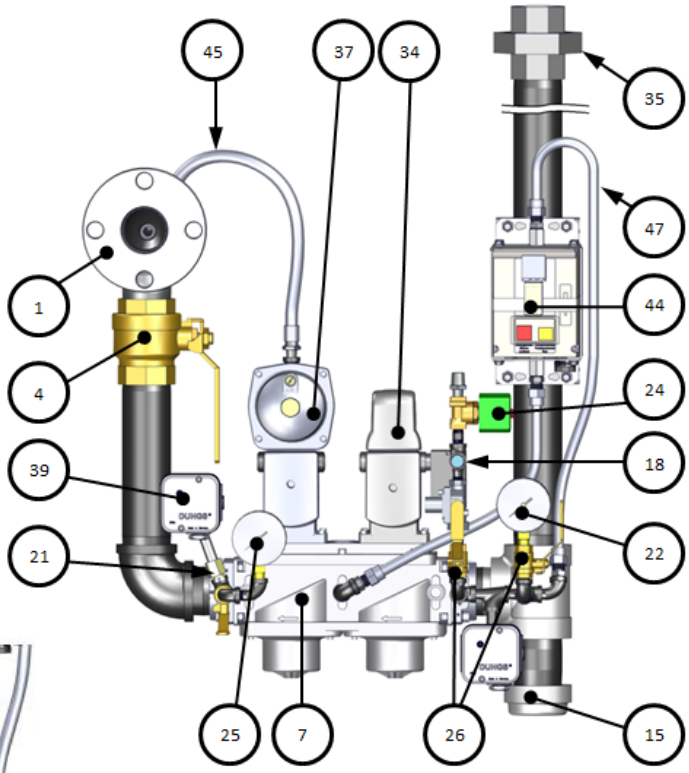

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 2500 Gas Train** | 04/17/2017 |
| | **P/N 22244 rev F** | Sheet 1 of 2 |

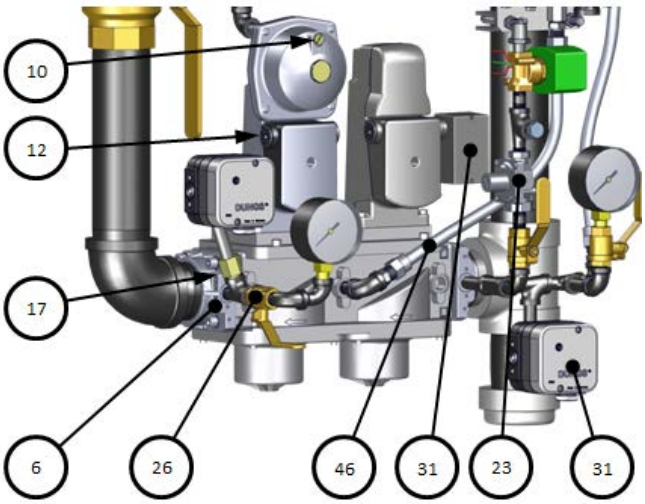


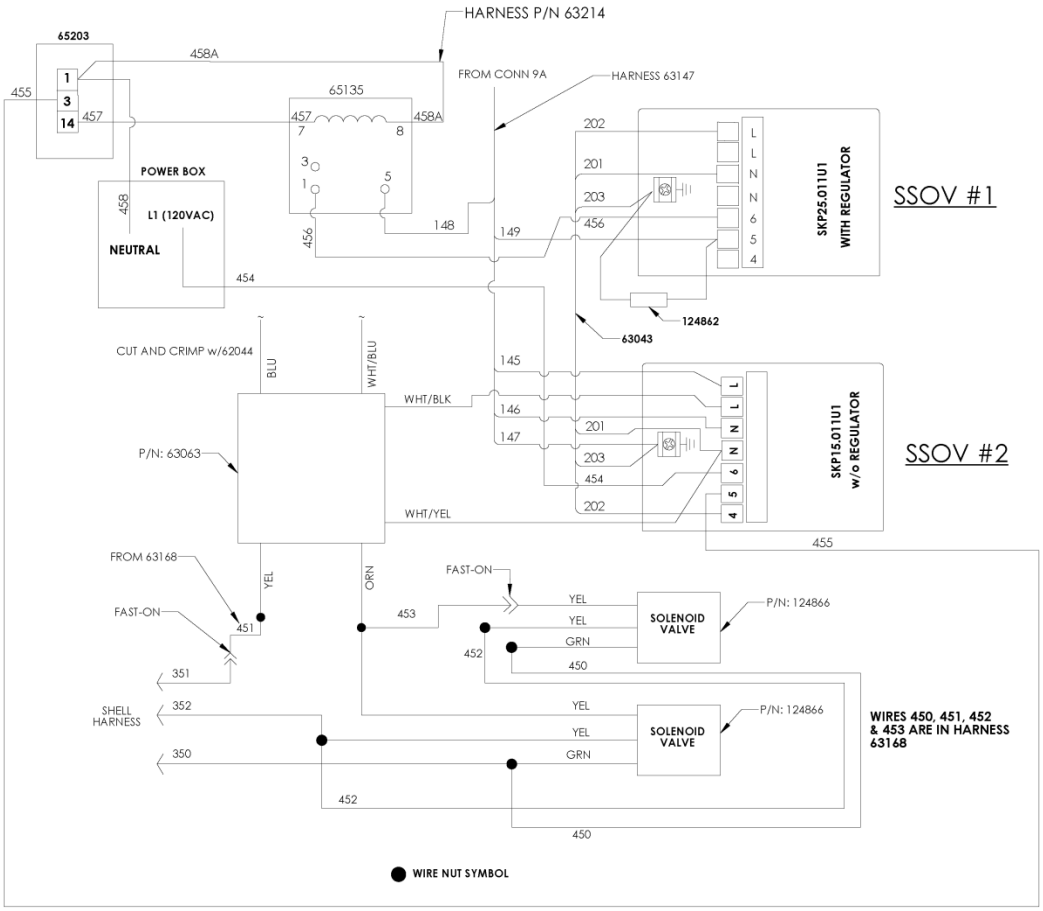

| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 2500 Gas Train** | 04/17/2017 |
| | **P/N 22244 rev F** | Sheet 2 of 2 |

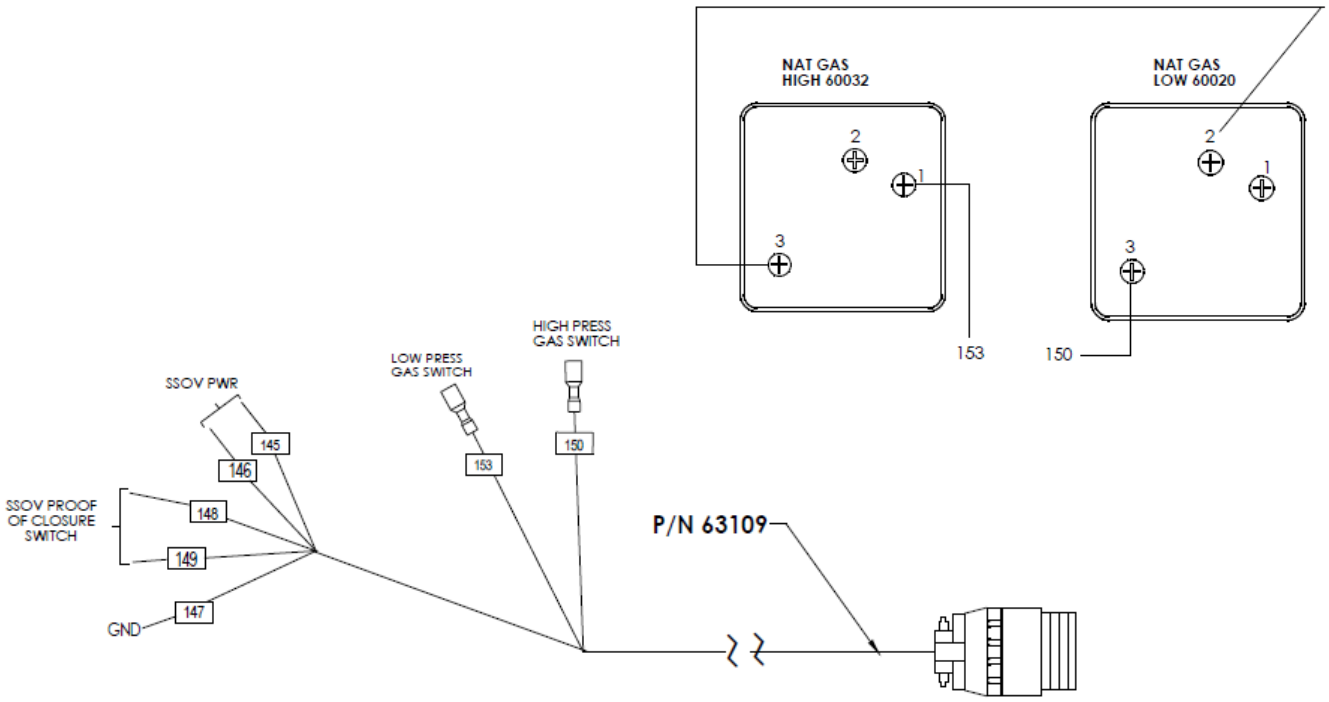
| Benchmark 3000 Natural Gas Gas Train – P/N 22215 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Item** | **Qty** | **Part #** | **Description** | **Item** | **Qty** | **Part #** | **Description** |
| 1 | 1 | 123542 | FLANGE 2" 125# 2 "NPT | | | | |
| 4 | 1 | 123540 | VALVE: BALL 2" FULL PORT | 26 | 3 | 92077 | 1/4" NPT MXF BRASS BALL VALVE |
| 6 | 2 | 95030 | FLANGE: SSOV 2" NPT | 31 | 1 | 60020 | SWITCH: GAS PRESSURE 2-20" W.C. |
| 7 | 1 | 124142 | VALVE: SSOV: DOUBLE BODY: 2" NPT | 31 | 1 | 63063 | RELAY |
| 10 | 1 | 99015 | DAMPING ORIFICE: SSOV | 34 | 1 | 124138 | ACTUATOR: SSOV |
| 12 | 3 | 12951-2 | BUSHING: CONTROL BOX | 35 | 1 | 9-294 | UNION: 2" NPT 300# |
| 15 | 1 | 93382 | 2'' NPT CAP | 37 | 1 | 64048 | ACTUATOR: SSOV W/ REGULATOR |
| 17 | 1 | 99017 | SNUBBER: PRESSURE: 1/4" | 39 | 1 | 60032-1 | SWITCH: GAS PRESSURE 2-20" W.C. |
| 18 | 1 | 9-22 | PIPE PLUG: 1/4" NPT: STEEL | 44 | 1 | 24629-2 | VALVE PROVING SYSTEM ASSEMBLY |
| 22 | 1 | 67007 | GAGE: LOW PRESSURE 0-15 in./H2O | 45 | 1 | 97087-16 | TUBE FLEXIBLE GAS 16" |
| 23 | 1 | 64083 | REGULATOR: GAS PRESSURE WITH VENT LIMITING ORIFICE | 46 | 1 | 97087-16 | TUBING, FLEXIBLE, 16" |
| 24 | 1 | 124866 | SOLENOID VALVE: 1/4" NPT | 47 | 1 | 97087-26 | TUBING, FLEXIBLE, 26" |
| 25 | 1 | 67006 | GAGE: LOW PRESSURE 0-10 in./H2O | | | | |




| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 3000 Gas Train** | 04/17/2017 |
| | **P/N 22215 rev H** | Sheet 1 of 2 |



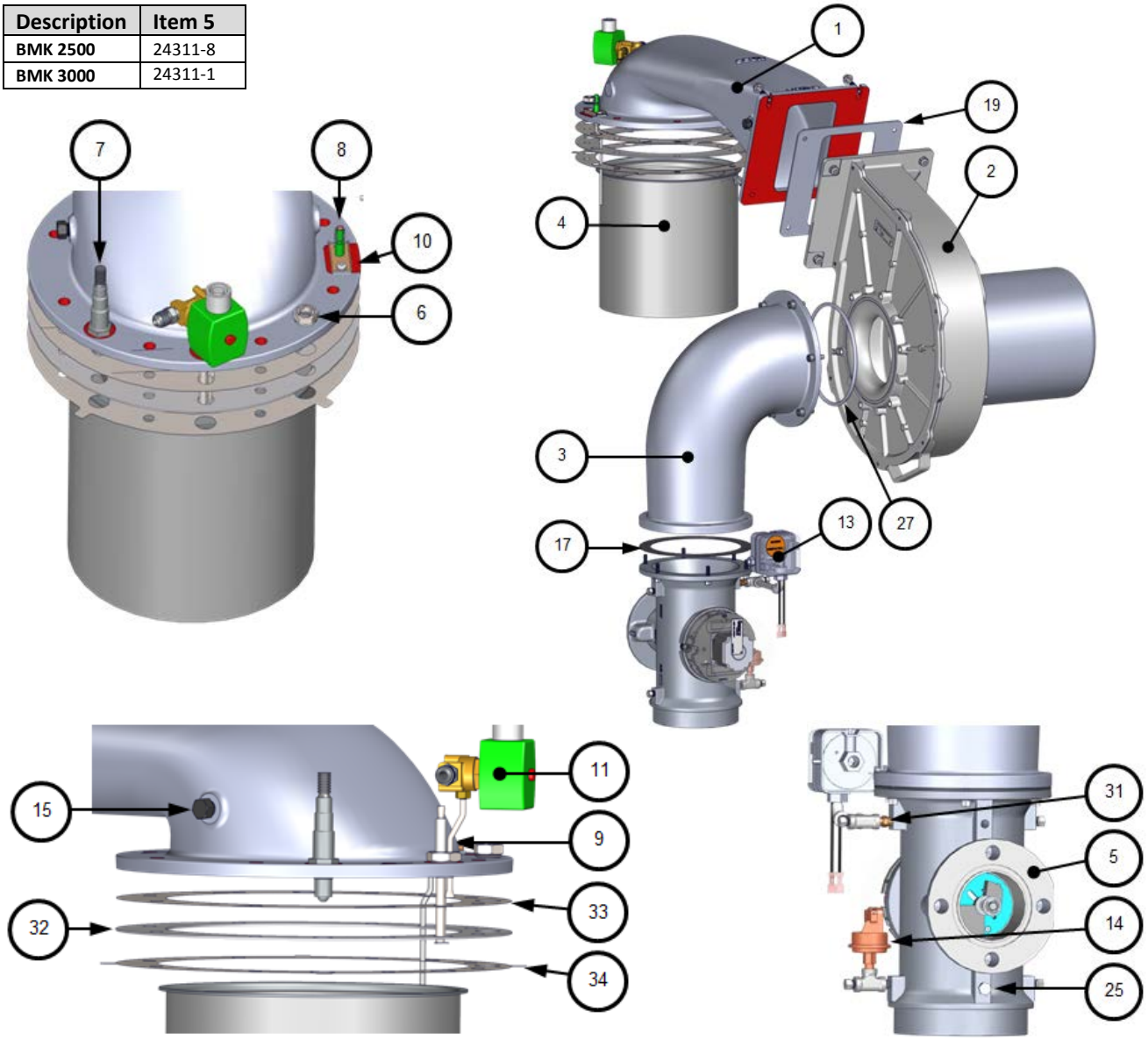




| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 3000 Gas Train** | 04/17/2017 |
|---|---|---|
| | **P/N 22215 rev H** | Sheet 2 of 2 |

## Burner Assembly: BMK 2500 P/N 26015-TAB, BMK 3000 P/N 26014-TAB

| Item | Qty | Part # | Description | Item | Qty | Part # | Description |
|---|---|---|---|---|---|---|---|
| 1 | 1 | 43091 | BLOWER PLENUM (MACHINING) | 13 | 1 | 60011-5 | BLOWER PROOF SWITCH, BMK 2500 |
| 2 | 1 | 58063-1 | 460 VAC BLOWER **Replacement Kit** | | | 60011-2 | BLOWER PROOF SWITCH, BMK 3000 |
| | | 58063-2 | 208 VAC BLOWER **Replacement Kit** | | | | |
| 3 | 1 | 43090 | AIR FUEL VALVE PLENUM | 14 | 1 | 61002-5 | BLOCKED INLET SWITCH -4.5" W.C. |
| 4 | 1 | 46039 | BURNER: BMK 2500 | 15 | 2 | 9-22 | PIPE PLUG: 1/4" NPT: STEEL |
| | | 46038 | BURNER: BMK 3000 | 17 | 1 | 81057 | GASKET: BLOWER |
| 5 | 1 | **See Table** | A/F VALVE ASSY **Replacement Kit** | 19 | 1 | 81157 | BLOWER GASKET |
| 6 | 1 | 59104 | OBSERVATION PORT | 25 | 1 | 61024 | AIR INLET TEMPERATURE SENSOR |
| 7 | 1 | 61026 | LEAN OXYGEN SENSOR | 27 | 1 | 88015 | O RING, 3/16 x 7” |
| 8 | 1 | 66034 | FLAME ROD | 31 | 1 | 93230 | SNUBBER |
| 9 | 1 | 66026 | IGNITOR-INJECTOR | 32 | 1 | 81180 | GASKET: BURNER |
| 10 | 1 | 81048 | GASKET: FLAME ROD LOW NOX | 33 | 1 | 81173 | RELEASE GASKET |
| 11 | 1 | 24277 | STAGED IGNITION ASSY | 34 | 1 | 81185 | RELEASE GASKET: LOWER |

| Description | Item 5 |
|---|---|
| **BMK 2500** | 24311-8 |
| **BMK 3000** | 24311-1 |




| | | |
|---|---|---|
| AERCO International, Inc. Blauvelt, NY 10913 | **Benchmark 2500 - 3000 Burner Assembly** | 08/10/2017 |
| | **BMK 2500 – 26015-TAB rev E**<br>**BMK 3000 – 26014-TAB rev K** | Sheet 1 of 1 |

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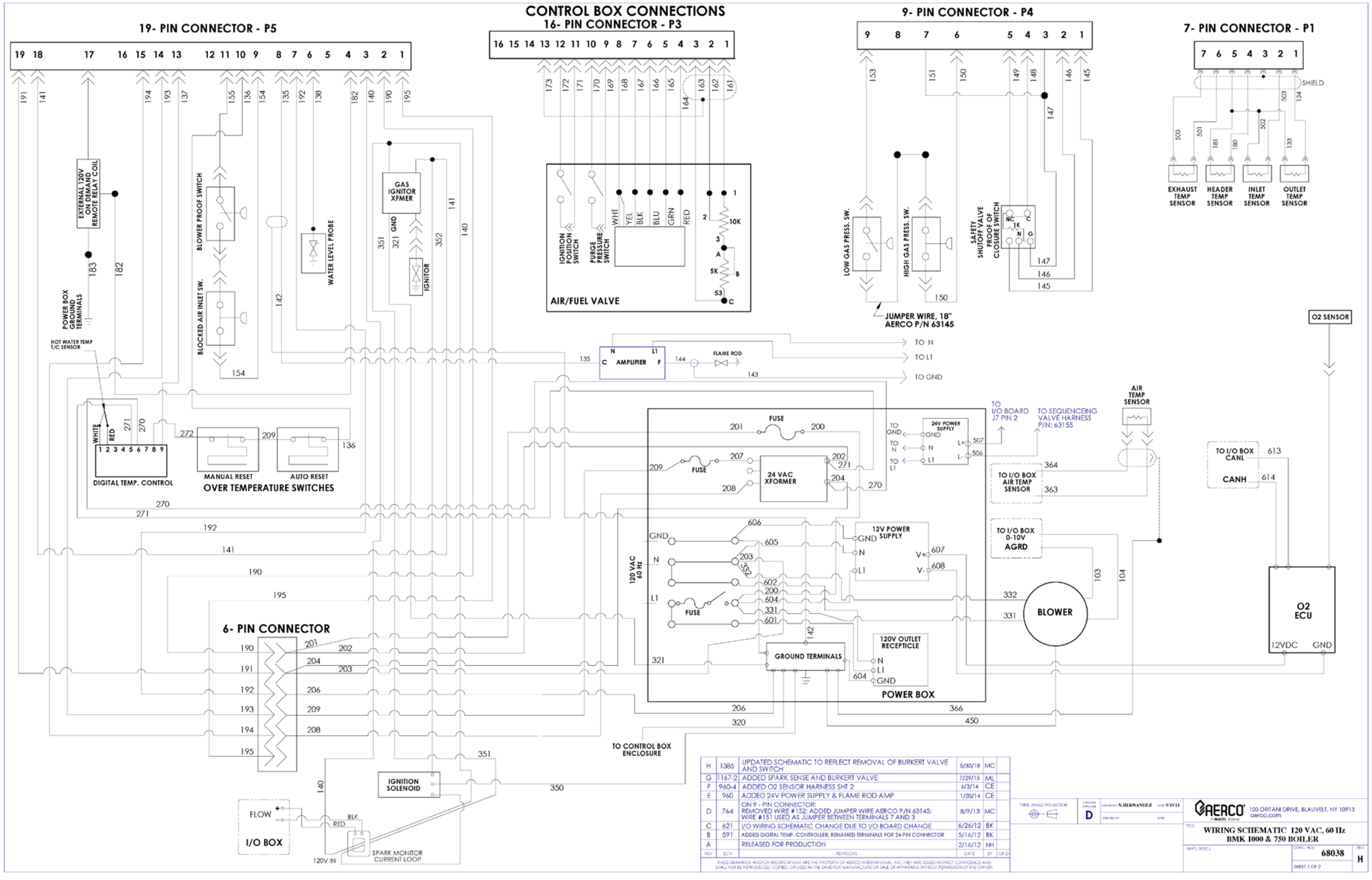
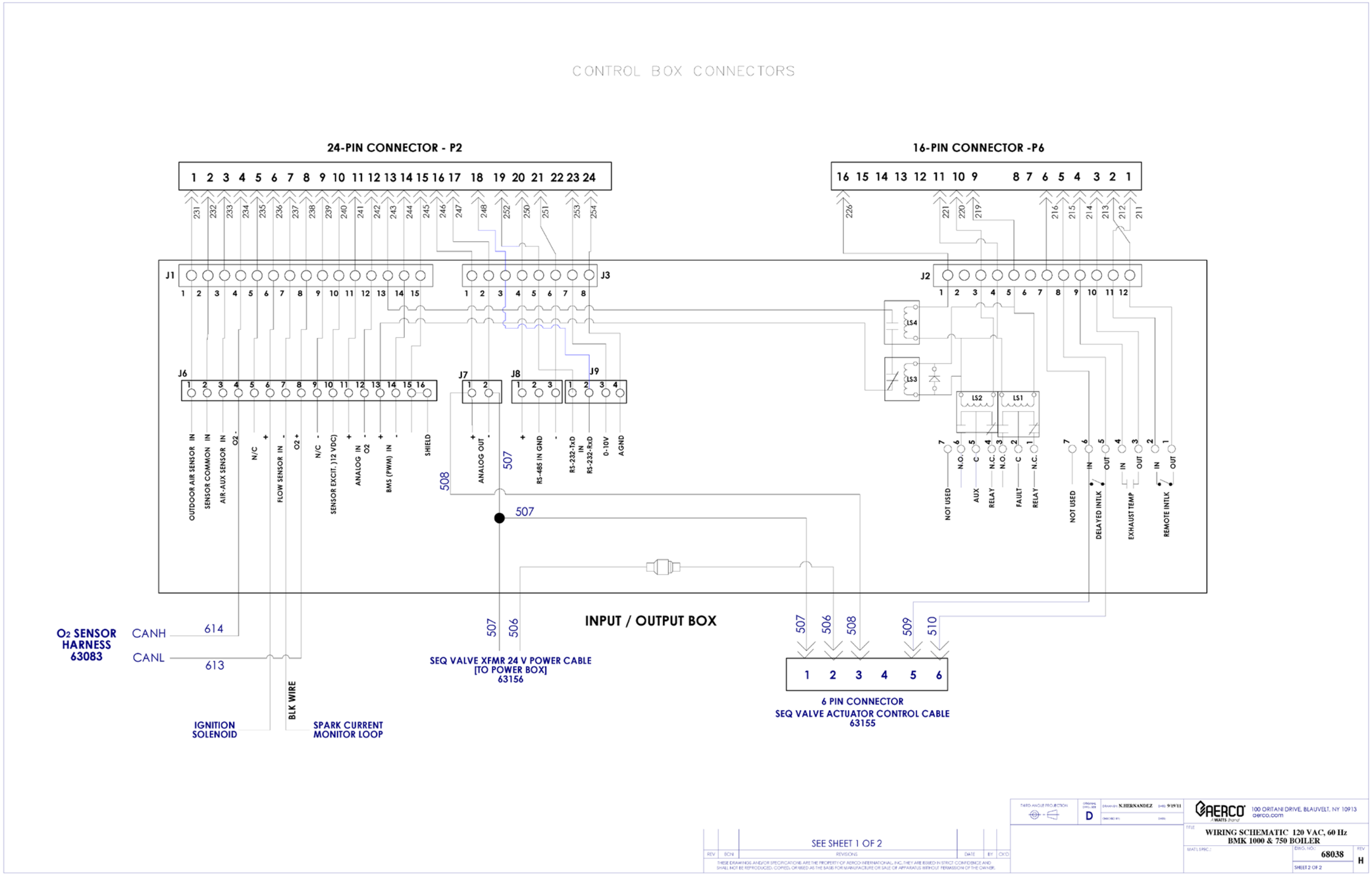
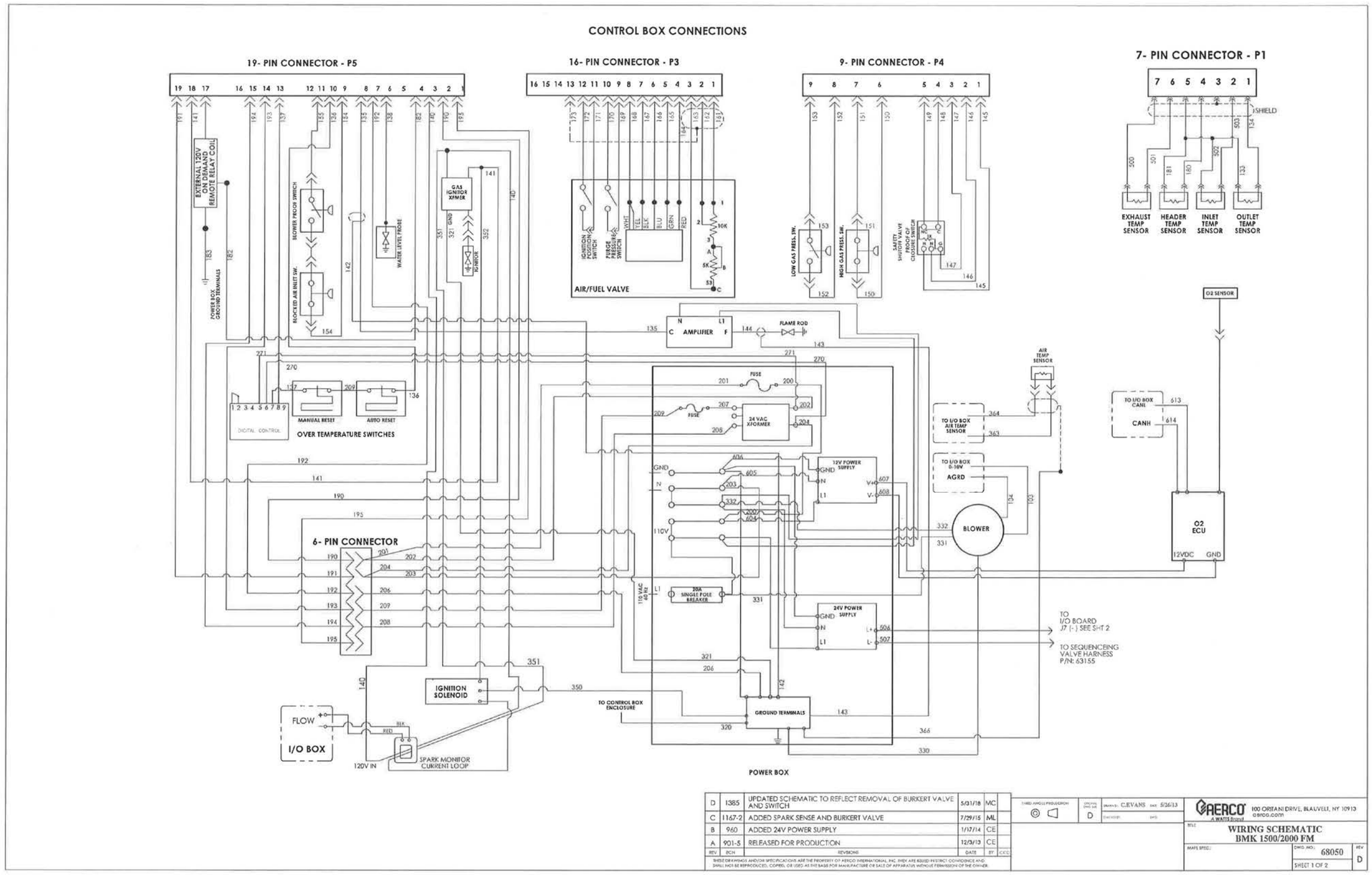
# Appendix I: WIRING DIAGRAMS



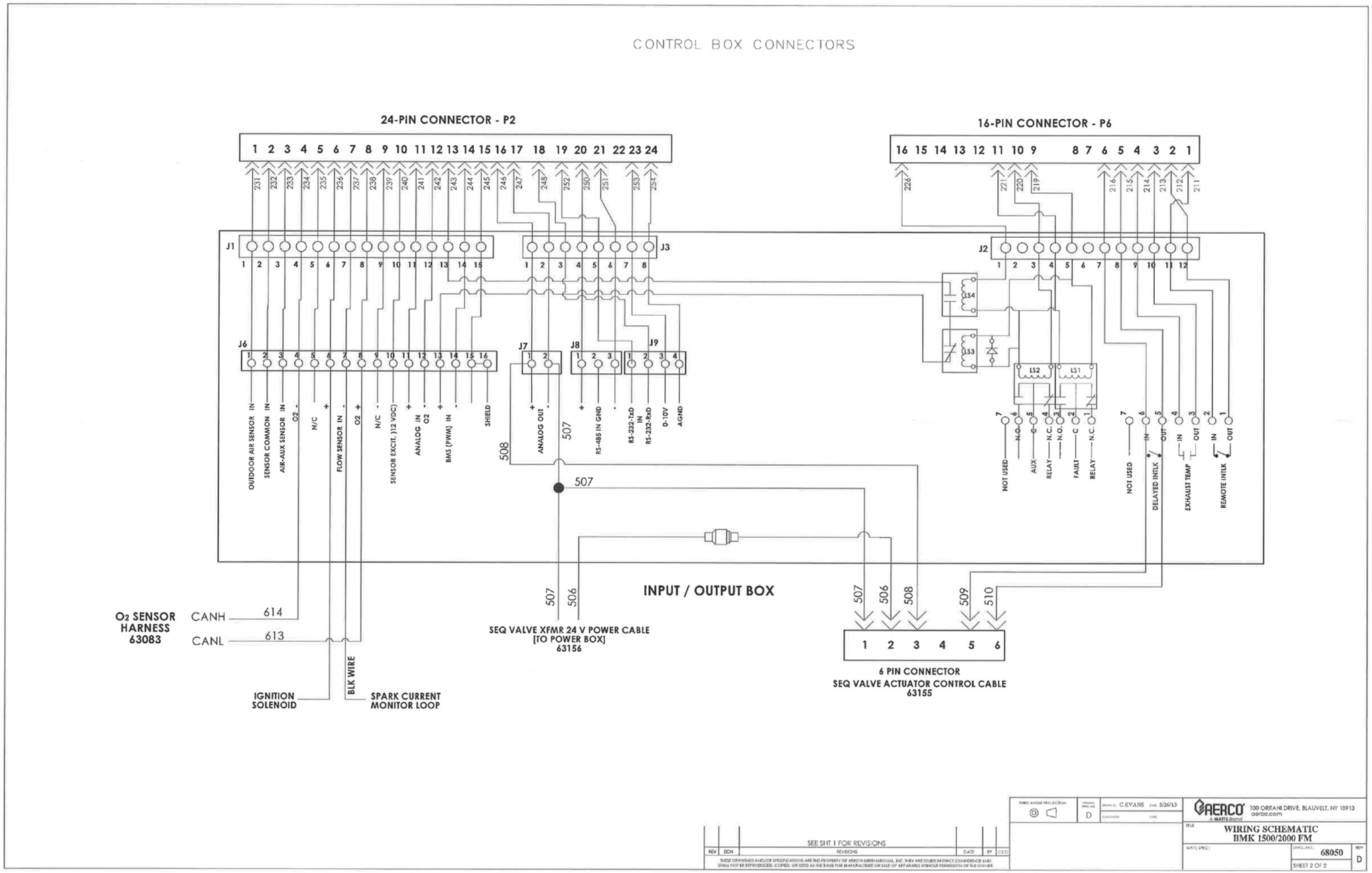

Benchmark 750/1000 – Drawing Number: 68038 rev H Sheet 1 of 2



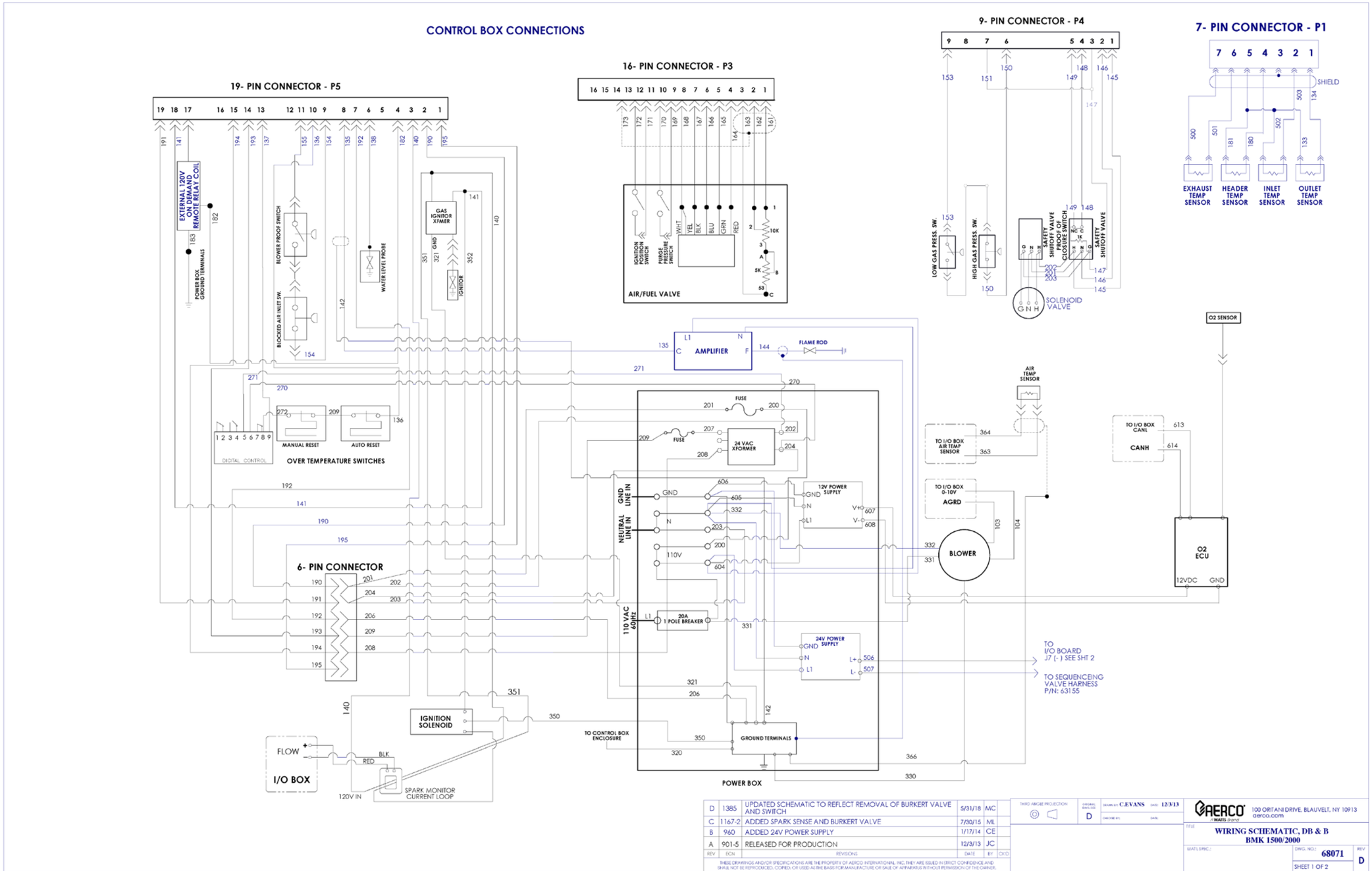

Benchmark 750/1000 – Drawing Number: 68038 rev H Sheet 2 of 2



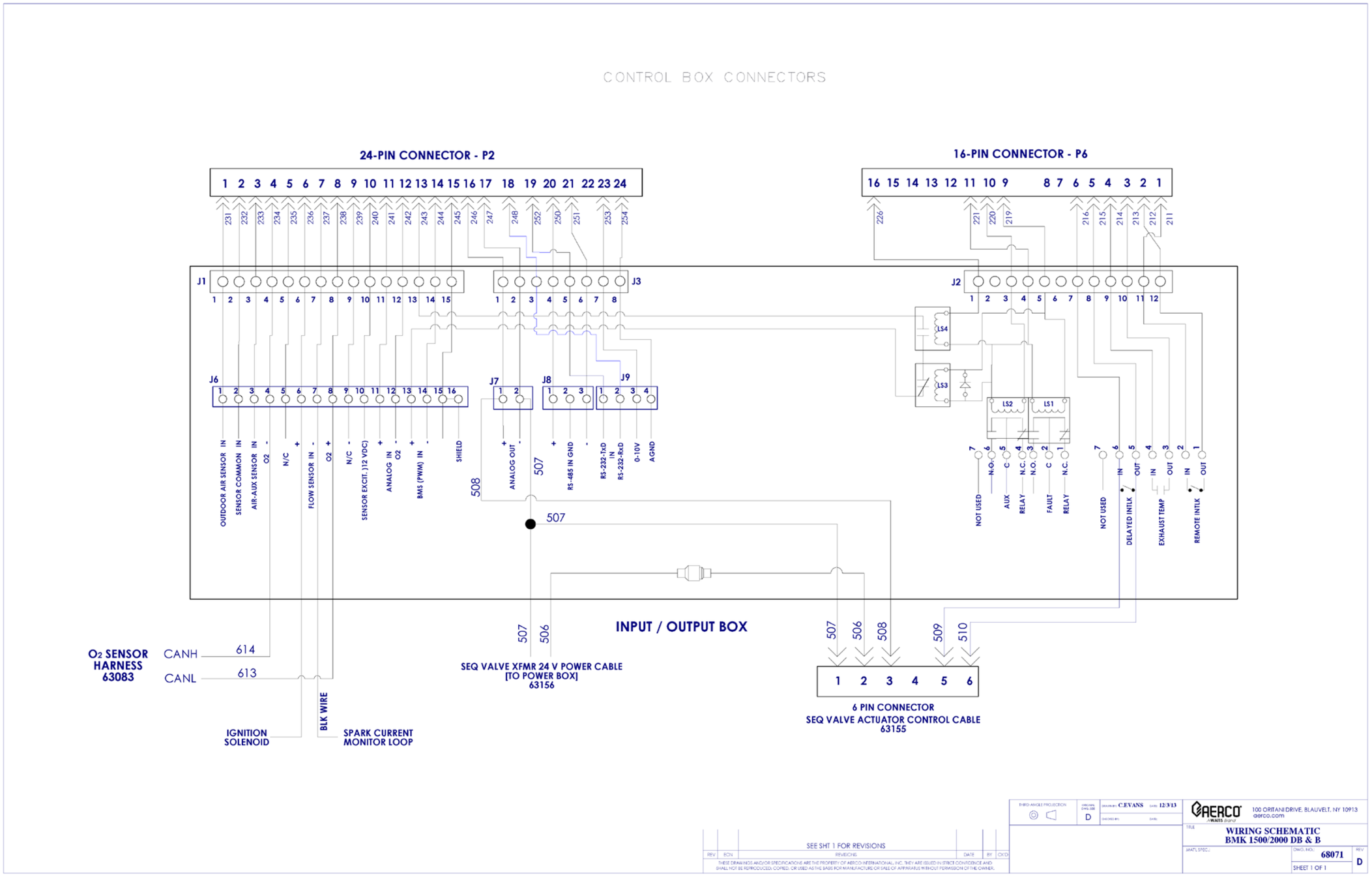

Benchmark 1500/2000 – Drawing Number 68050 rev D page 1 of 2



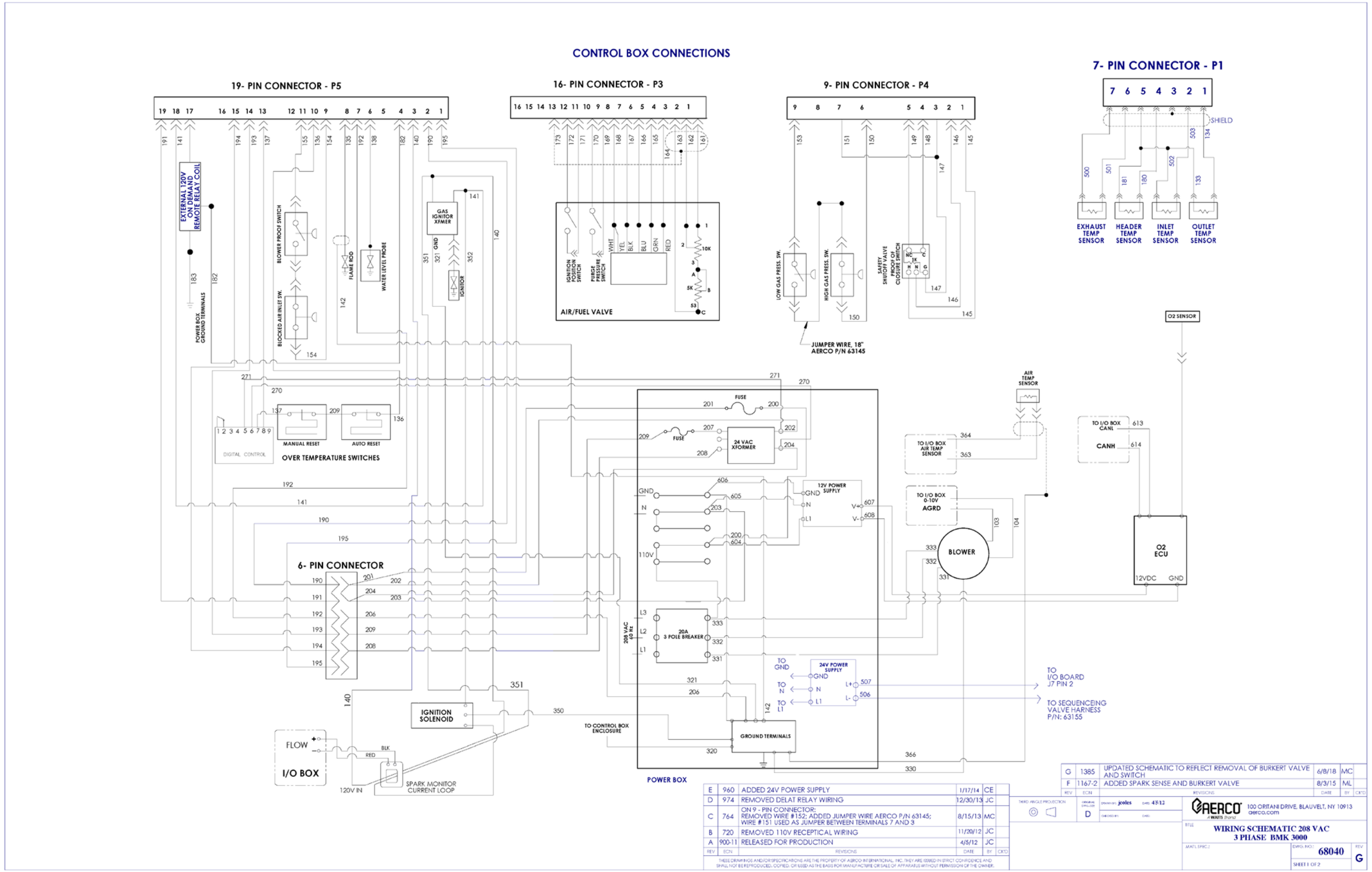

Benchmark 1500/2000 – Drawing Number 68050 rev D page 2 of 2



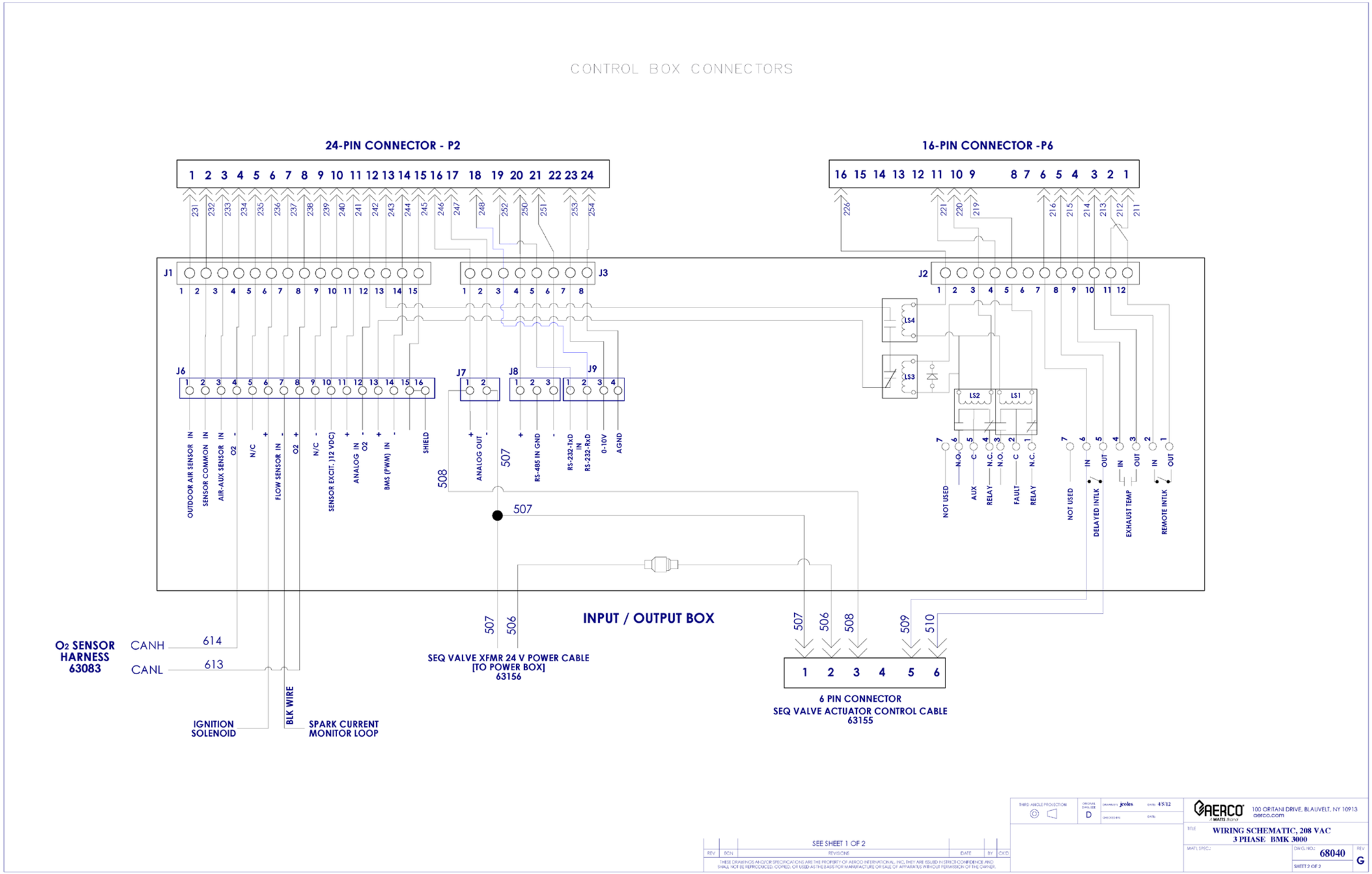

Benchmark 1500/2000 DBB – Drawing Number 68071 rev D page 1 of 2



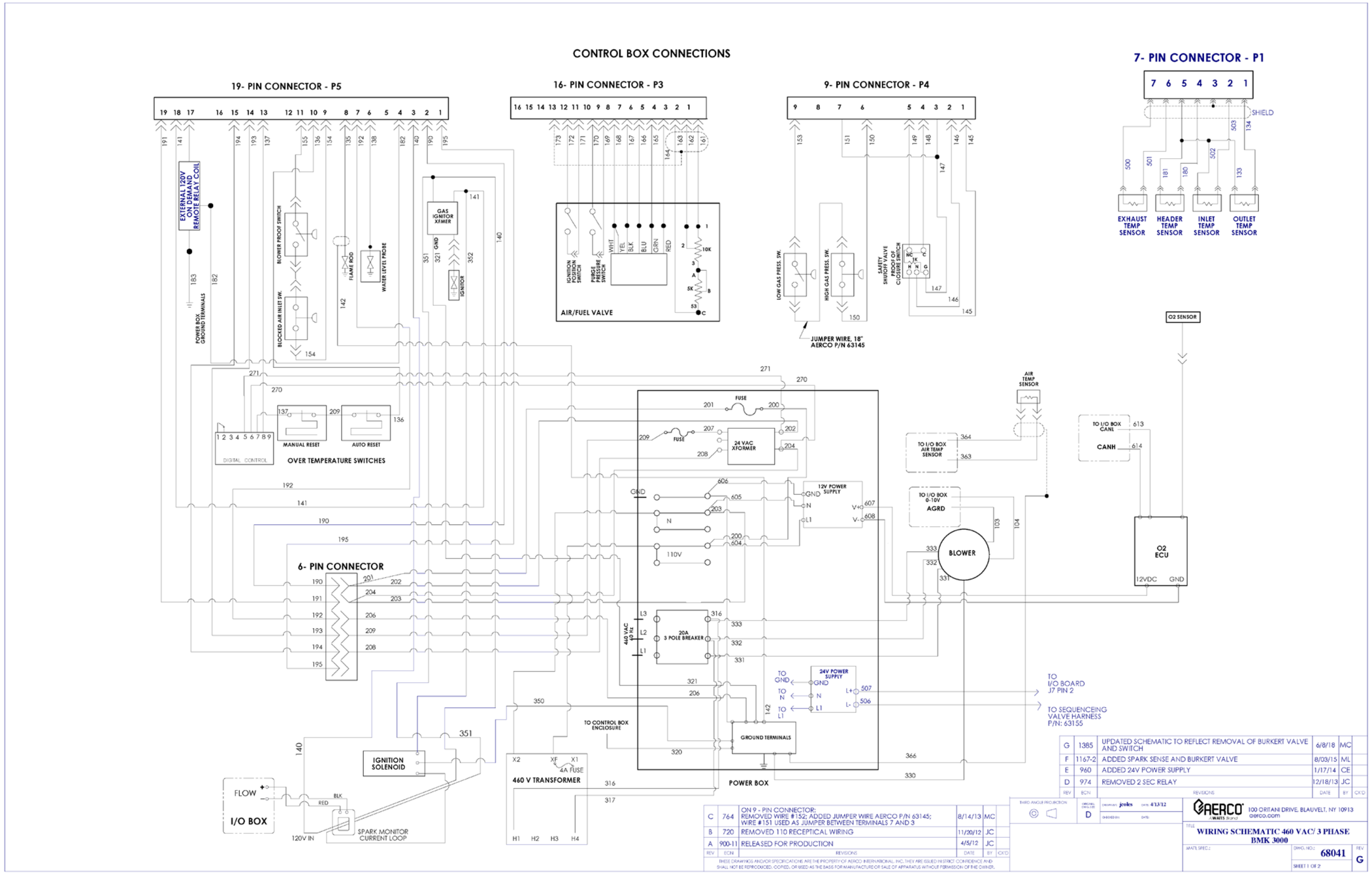

Benchmark 1500/2000 DBB – Drawing Number 68071 rev D page 2 of 2



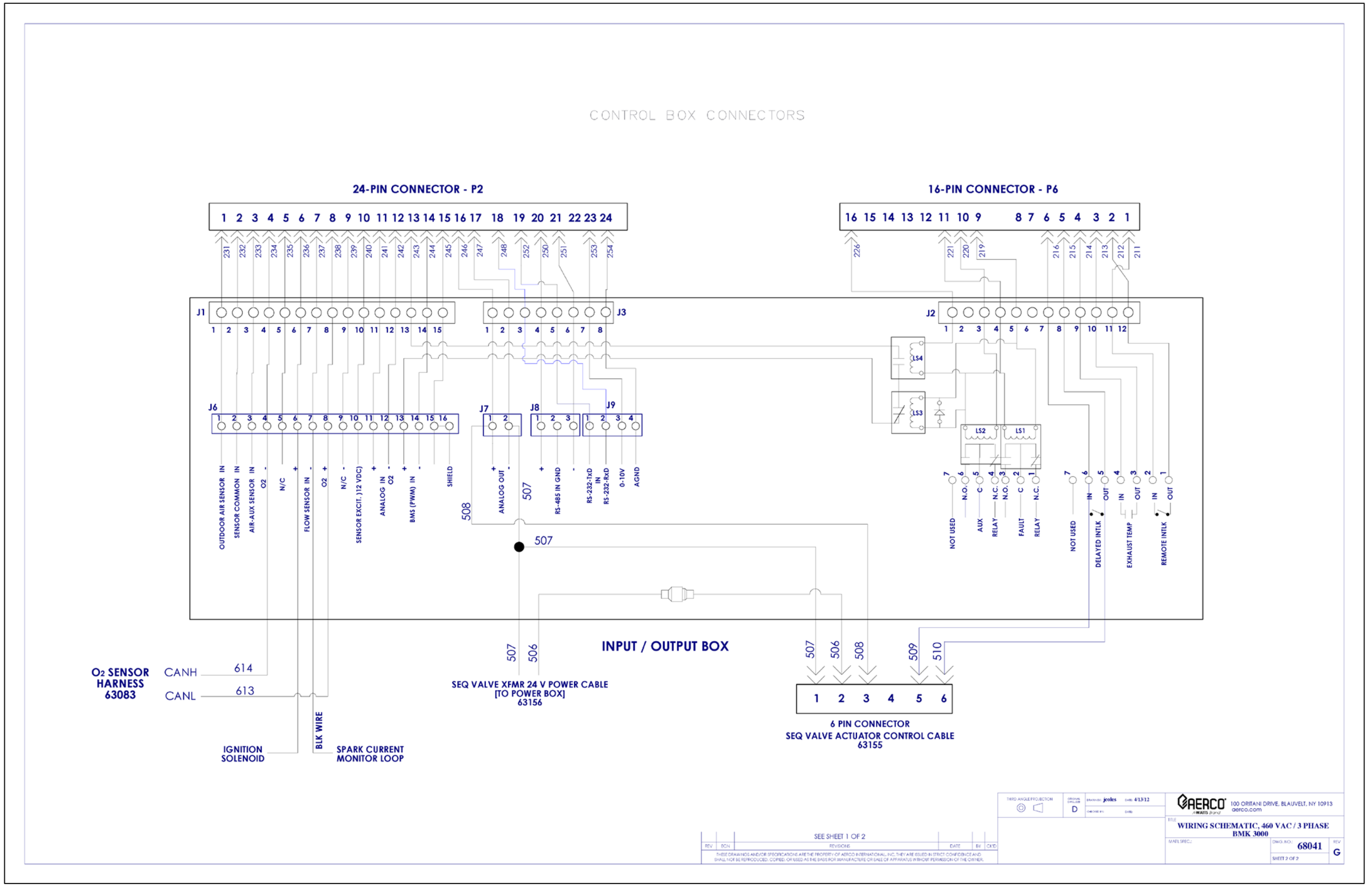

Benchmark 3000 208 VAC – Diagram 68040 rev G, Sheet 1 of 2



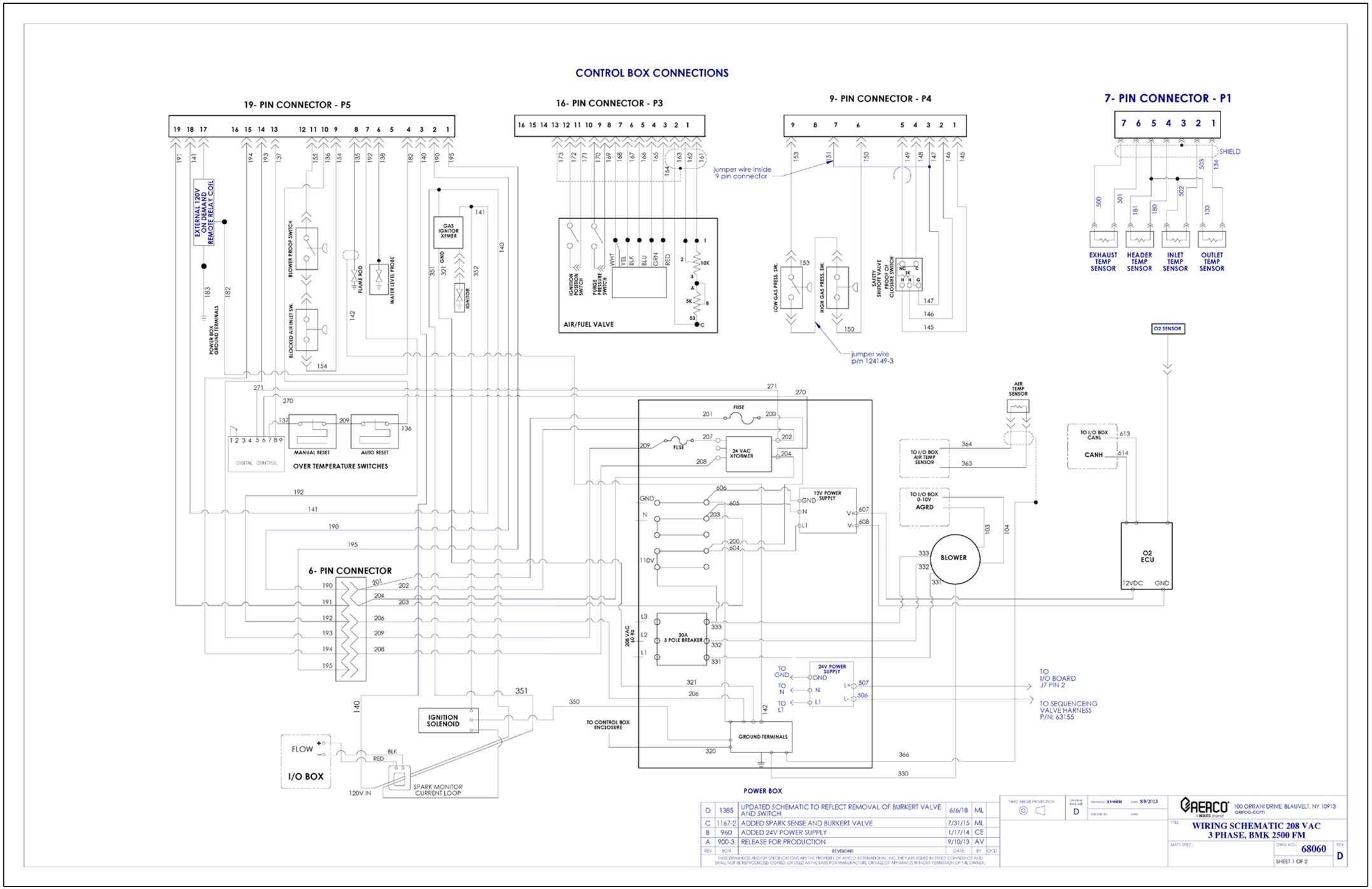

Benchmark 3000 208 VAC – Drawing Number: 68040 rev G, Sheet 2 of 2



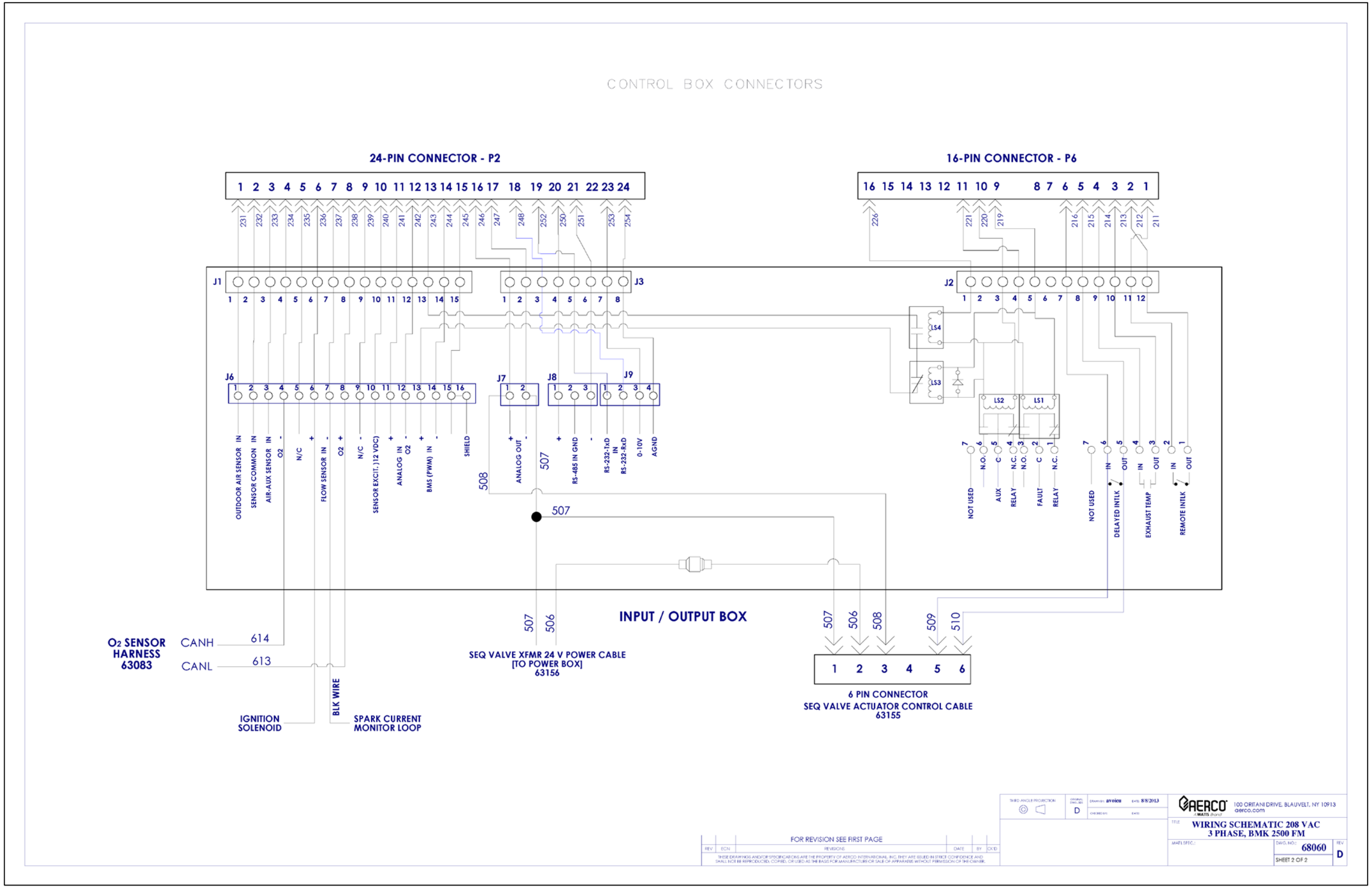

Benchmark 3000 460 VAC – Drawing Number: 68041 rev G Sheet 1 of 2



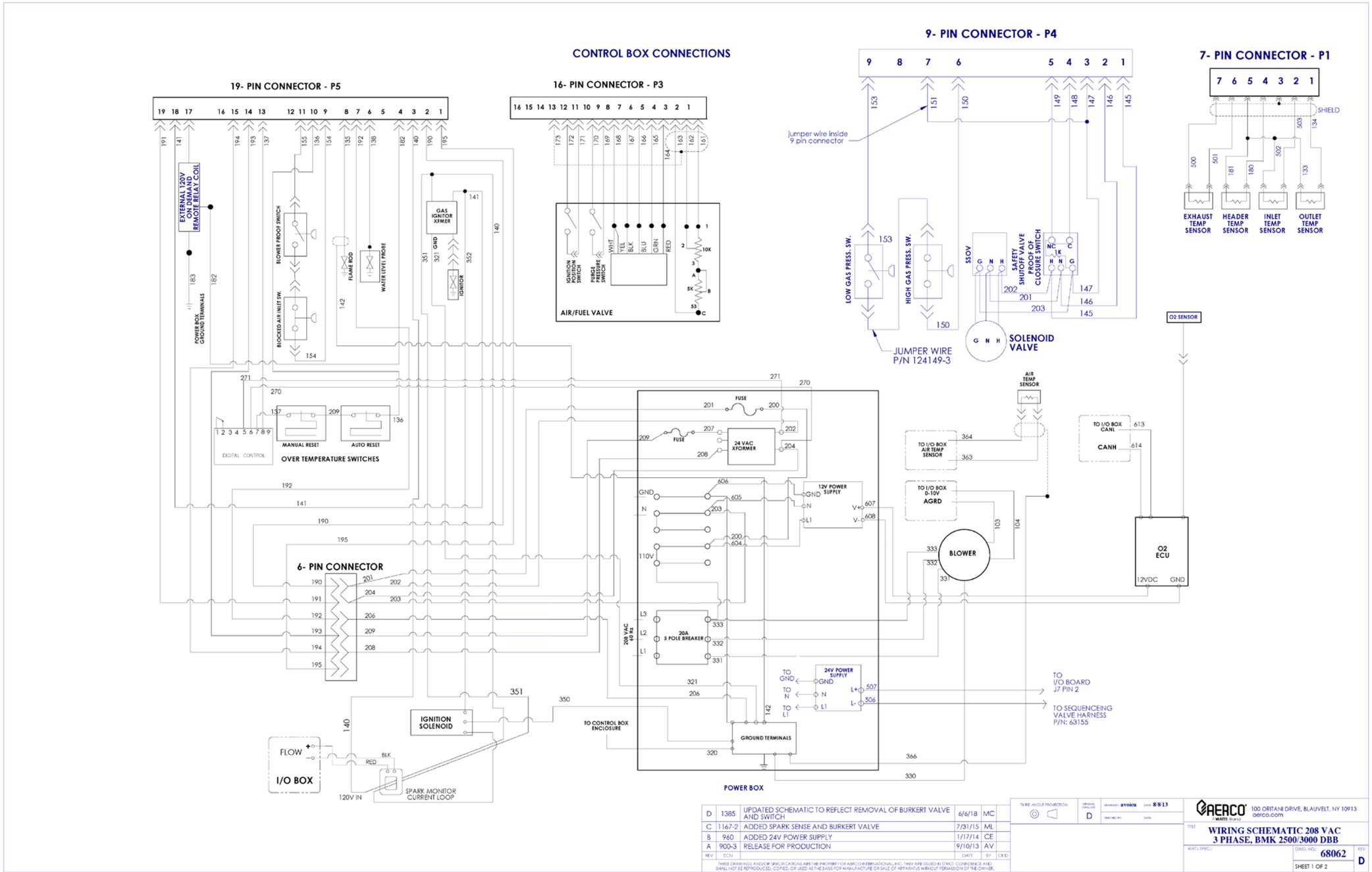

Benchmark 3000 460 VAC – Drawing Number: 68041 rev G Sheet 2 of 2



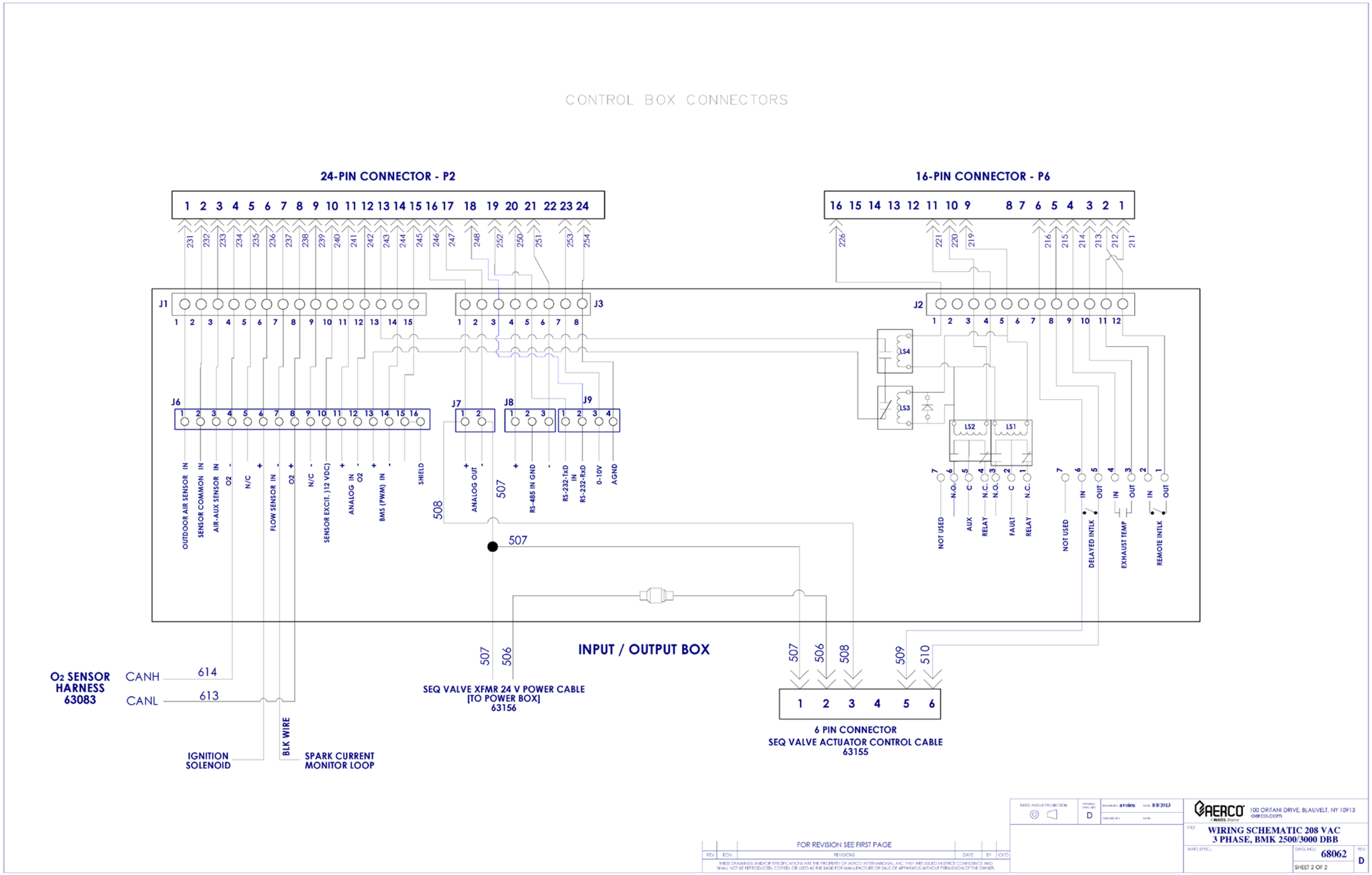

Benchmark 2500 208 VAC – Drawing Number: 68060 rev D Sheet 1 of 2



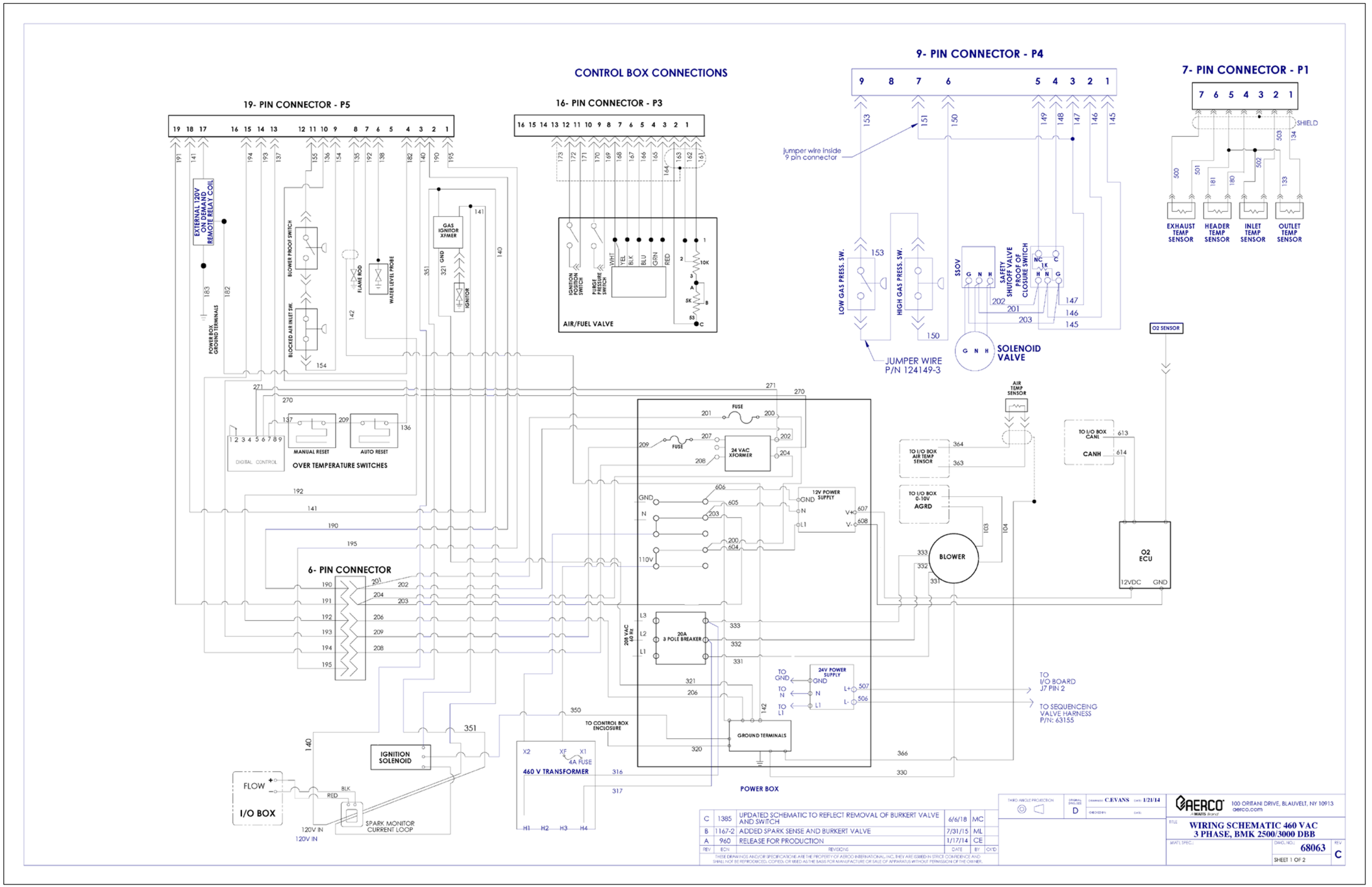

Benchmark 2500 208 VAC – Drawing Number: 68060 rev D Sheet 2 of 2



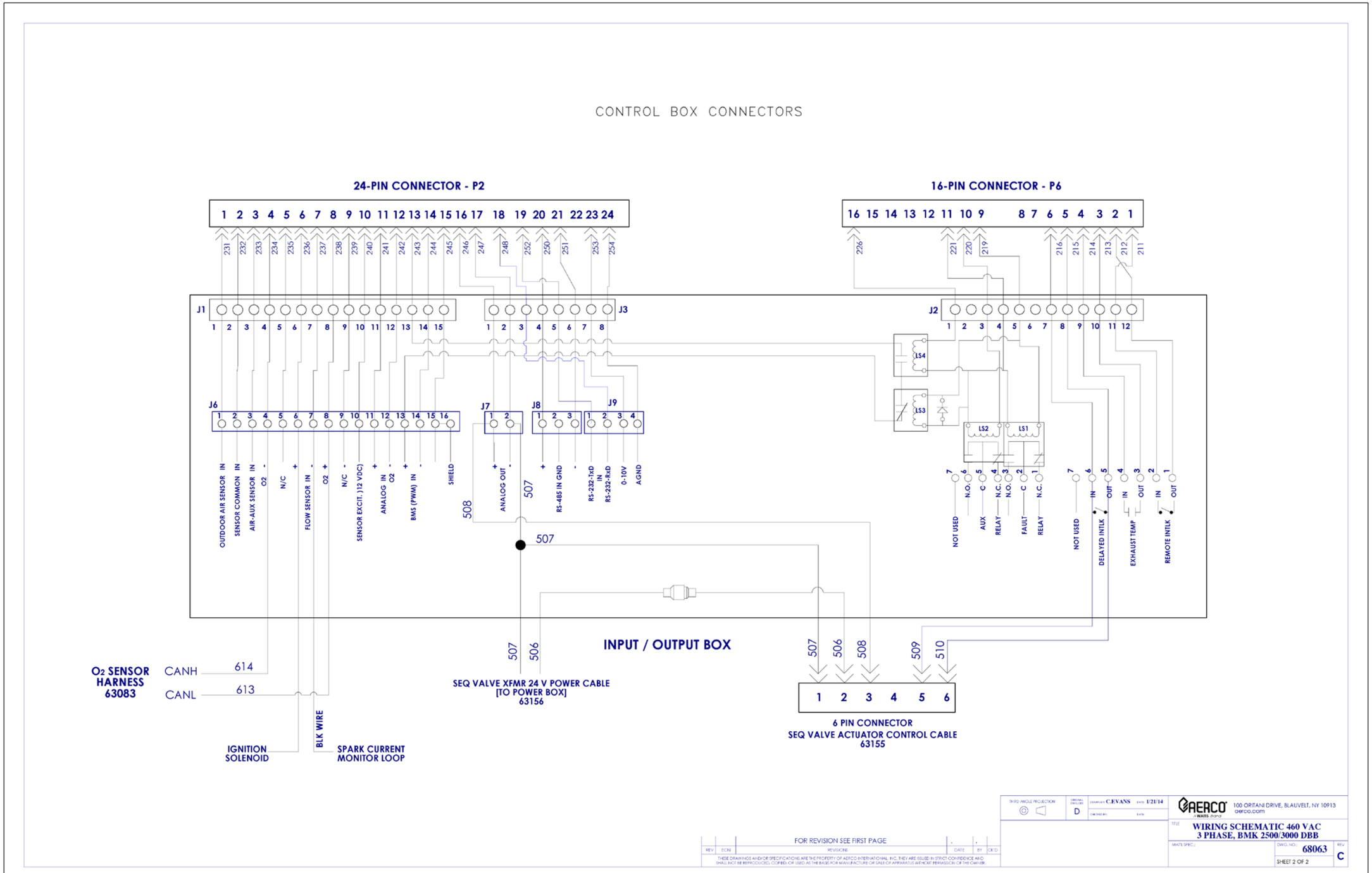

Benchmark 2500/3000 208 VAC DBB – Drawing Number: 68062 rev D Sheet 1 of 2




Benchmark 2500/3000 208 VAC DBB – Drawing Number: 68062 rev D Sheet 2 of 2




Benchmark 2500/3000 460 VAC DBB – Drawing Number: 68063 rev C Sheet 1 of 2




Benchmark 2500/3000 460 VAC DBB – Drawing Number: 68063 rev C Sheet 2 of 2

# Appendix J: C-MORE CONTROLLER VIEWS

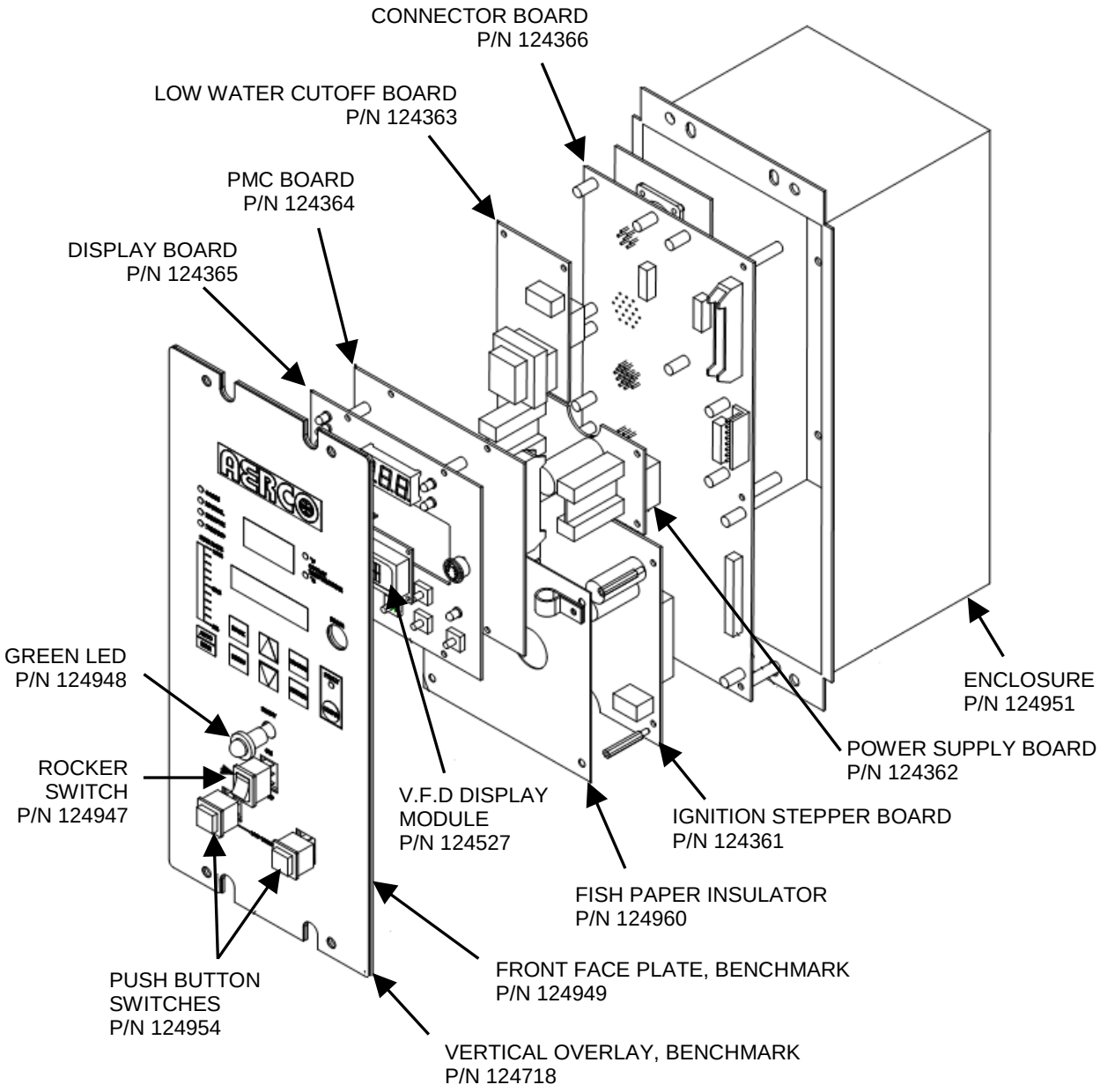



***Figure J-1 – C-More Controller - Exploded View***

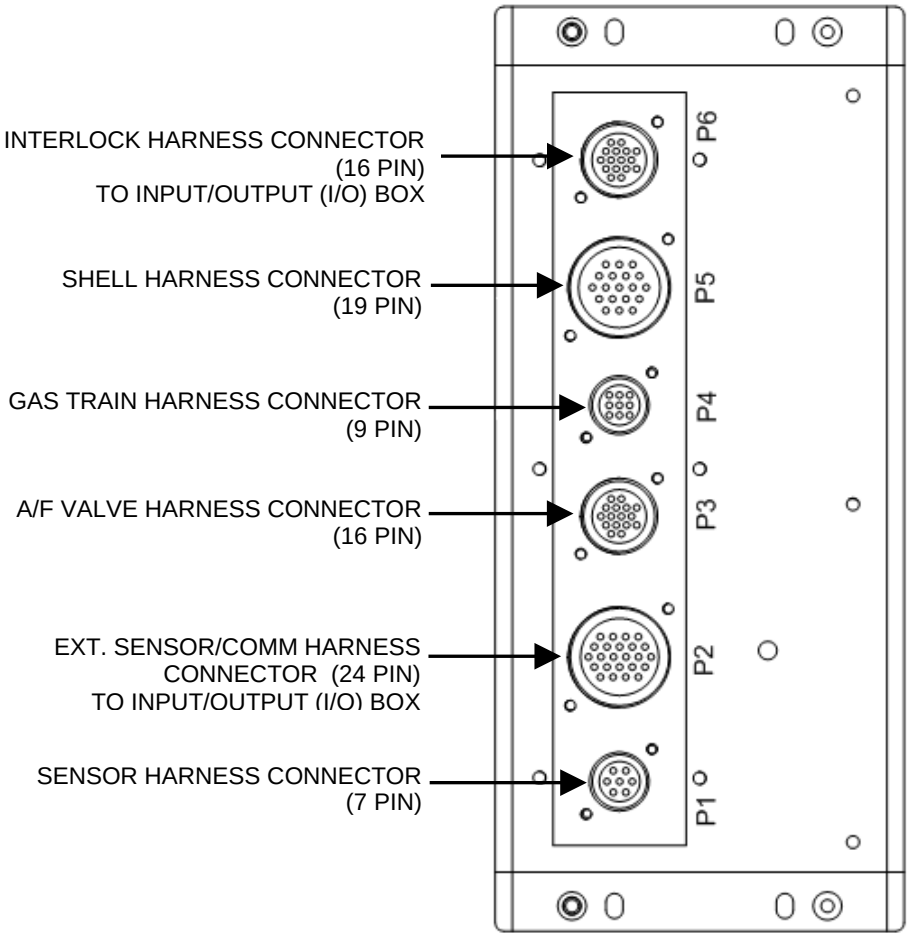



***Figure J-2: C-More Controller Rear View***

# Appendix K: RECOMMENDED SPARES

NOTE:

Refer to the Parts List Illustrations in Appendix F – H for the locations of the recommended and optional spare parts listed in the following tables.

## TABLE K-1: Recommended Emergency Spare Parts

| DESCRIPTION | BMK 750/1000 | BMK 1500/2000 | BMK 2500/3000 |
|---|---|---|---|
| 120 VAC Blower Replacement Kit | 58061 | 58038 | 58063-1 – 460V<br>58063-2 – 208V |
| SSOV Actuator/Regulator Combo - Used on:<br>• ALL FM gas trains<br>• ***Downstream*** SSOV on DBB gas trains | 64048 | 64048 | 64048 |
| SSOV Actuator Without Proof of Closure Switch - Used on:<br>• ***Upstream*** SSOV on DBB gas trains | 27086-1 | 27086-1 | 27086-1 |
| Temperature Switch - Manual Reset | 123552 | 123552 | 123552 |

## TABLE K-2: Recommended Spare Parts For Maintenance

| DESCRIPTION | PART NUMBER |
|---|---|
| Annual Maintenance Kit | BMK 750 – 3000: 58025-01 |
| 24-month Waterside/Fireside Inspection Kit | BMK 750/1000: 58025-08 |
| | BMK 1500/2000: 58025-13 |
| | BMK 2500/3000: 58025-10 |

## TABLE K-3: Optional Spare Parts

| DESCRIPTION | | PART NUMBER |
|---|---|---|
| C-More Controller | | 69186-4 |
| Burner | BMK 750/1000 | 46026 |
| | BMK 1500 | 46042 |
| | BMK 2000 | 46044 |
| | BMK 2500 | 46039 |
| | BMK 3000 | 46038 |
| Lean Oxygen Sensor | | 61026 |

## Change Log:

| Date | Description | Changed By |
|---|---|---|
| 11/29/2017 | **Rev C:**<br>**DIR 17-070**: Removed manufacturer name from high gas pressure switch<br>**PIR 1459**: Updated enclosure panels in Appendix F, H and H. (reference 17-076)<br>**DIR 17-080:** Verified and corrected part numbers in Appendix F through G. | Chris Blair |
| 5/9/2019 | **Rev D:**<br>**DIR 18-05**: Replaced BMK 2500-3000 schematic 68062<br>**DIR 18-45:** Changed part number of Gas Pressure Switch 60032 to 60032-1.<br>**DIR-19-04**: Added additional requirements to Section 1.2: Emergency Shutdown.<br>**DIR 19-19**: Expanded instructions for long-term shutdown (Section 4.10). | Chris Blair |