Natural Gas Modulating & Condensing Hot Water Boiler Models:

- **BMK 1500**
- **BMK 2000**

Applicable to Serial Numbers:
G-14-0304 and Above

USER MANUAL

Installation, Operation and Maintenance

BENCHMARK 1500 / 2000

Gas-Fired Boilers

Latest Update: 03/20/2014

GAS-FIRED C UL US LISTED

AHRI CERTIFIED™ www.ahridirectory. Commercial Boilers AHRI Standard BTS-2000

ASME H

AERCO International, Inc. • 100 Oritani Dr. • Blauvelt, NY 10913
Ph.: 800-526-0288

Technical Support
(Mon-Fri, 8am-5pm EST)

1-800-526-0288

www.aerco.com

Disclaimer

The information contained in this manual is subject to change without notice from AERCO International, Inc. AERCO makes no warranty of any kind with respect to this material, including but not limited to implied warranties of merchantability and fitness for a particular application. AERCO International is not liable for errors appearing in this manual. Nor for incidental or consequential damages occurring in connection with the furnishing, performance, or use of this material.

TABLE OF CONTENTS

FOREWORD

The AERCO Benchmark (BMK) 1500 and 2000 MBH 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. The turn down ratios for these boilers is 20:1. These BMK models provide extremely high efficiency operation and are ideally suited for modern low temperature, as well as, conventional heating systems.

The Benchmark Model BMK 1500 and BMK 2000 boilers operate within the following input and output ranges:

Benchmark Model	Input Range (BTU/hr.)		Output Range (BTU/hr.)	
	Minimum	Maximum	Minimum	Maximum
BMK 1500	75,000	1,500,000	64,500	1,395,000
BMK 2000	100,000	2,000,000	86,000	1,860,000

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

When installed and operated in accordance with this Instruction Manual, these boilers comply with the NOx emission standards outlined in:

South Coast Air Quality Management District (SCAQMD), Rule 1146.2

Whether used in singular or modular arrangements, the BMK 1500 and BMK 2000 offer the maximum venting flexibility with minimum installation space requirements. These boilers are Category II, III and IV, positive pressure appliances. Single and/or multiple breeched units are capable of operation in the following vent configurations:

Conventional, Vertical

Conventional, Sidewall

Conventional, Direct Vent, Vertical

Sealed, Direct Vent, Horizontal

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.

IMPORTANT

Unless otherwise specified, all descriptions and procedures provided in this Installation, Operation & Maintenance Manual apply to the Benchmark series of boiler.

Phrases, Abbreviations and Acronyms

Phrase, Abbreviation or Acronym	Meaning
A (Amp)	Ampere
ACS	AERCO Control System
ADDR	Address
AGND	Analog Ground
ALRM	Alarm
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 series boilers
BMS or BMS II	AERCO Boiler Management Systems
BLDG (Bldg)	Building
BST	AERCO on-board Boiler Management Technology
BTU	British Thermal Unit. A unit of energy approximately equal to the heat required to raise 1 pound of water 1° F.
CCP	Combustion Control Panel
C-More Controller (or Control Box)	A control system developed by AERCO and currently used in all Benchmark, Innovation and KC1000 Series product lines.
CO	Carbon Monoxide
COMM (Comm)	Communication
Cal.	Calibration
CNTL	Control
DBB	Double Block and Bleed. Used to define boiler gas trains containing 2 Safety Shutoff Valves (SSOVs) and a solenoid operated vent valve. Also known as IRI gas trains(see below)
DIP	Dual In-Line Package
EMS	Energy Management System; often used interchangeably with BAS
FM	Factory Mutual. Used to define boiler gas trains.
GND	Ground
HDR	Header
HX	Heat Exchanger
Hz	Hertz (Cycles Per Second)
I.D.	Inside Diameter
IGN	Ignition

Phrases, Abbreviations and Acronyms – Continued

Phrase, Abbreviation or Acronym	Meaning
IGST Board	Ignition/Stepper Board contained in C-More Control Box
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
IRI	Industrial Risk Insurers. A now discontinued code used to define gas trains containing two SSOVs and a solenoid operated vent valve.
ISO	Isolated
LED	Light Emitting Diode
LN	Low NOx
MA (mA)	Milliampere (0.001 Amp), one thousandth of an amp
MAX (Max)	Maximum
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
NOx	Nitrogen Oxide
NPT	National Pipe Thread
O2	Oxygen
O.D.	Outside Diameter
PMC Board	A Primary Micro-Controller (PMC) board is contained in the C-More Control Box used on all Benchmark units.
PPM	Parts Per Million
PTP	Point-to-Point (usually over RS-232 networks)
PWM	Pulse Width Modulation
REF (Ref)	Reference
RES.	Resistive
RS-232 (or EIA-232)	A standard for serial, full-duplex (FDX) transmission of data based on the RS-232 Standard
RS-422 (or EIA-422)	A standard for serial, full-duplex (FDX) transmission of data based on the RS-422 Standard
RS-485 (or EIA-485)	A standard for serial, half-duplex (HDX) transmission of data based on the RS-485 Standard
RTN (Rtn)	Return
SETPT (Setpt)	Setpoint Temperature
SHLD (Shld)	Shield

Phrases, Abbreviations and Acronyms – Continued

Phrase, Abbreviation or Acronym	Meaning
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
uA	Microamp (0.000001 amp), one millionth of an amp
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
VFD	Vacuum Fluorescent Display, or Variable Frequency Drive
W	Watt
W.C.	Water Column (W.C.)

CHAPTER 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, or, in the absence of local codes, ANSI Z223.1 (National Fuel Gas Code Publication No. NFPA-54) for gas-fired boilers and ANSI/NFPASB for LP gas-fired boilers. Where applicable, the equipment shall be installed in accordance with the current Installation Code for Gas Burning Appliances and Equipment, CSA B149.1, and applicable Provincial regulations for the class; which should be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

See pages 13 and 14 for important information regarding installation of units within the Commonwealth of Massachusetts.

IMPORTANT

This Instruction 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.

⚠ WARNING ⚠

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.

⚠ WARNING ⚠

BEFORE ATTEMPTING TO PERFORM ANY MAINTENANCE ON THE UNIT, SHUT OFF ALL GAS AND ELECTRICAL INPUTS TO THE UNIT.

⚠ WARNING ⚠

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.

⚠ WARNING ⚠

ELECTRICAL VOLTAGES UP TO 480 VAC 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.

⚠ WARNING ⚠

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.

⚠ CAUTION ⚠

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.

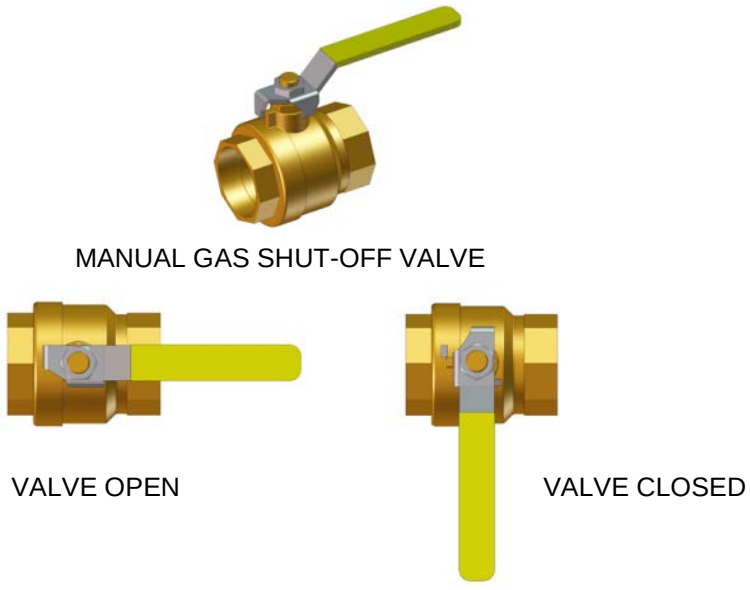


Figure 1-1: Manual Gas Shutoff Valve

1.3 PROLONGED SHUTDOWN

After prolonged shutdown, it is recommended that the startup procedures in Chapter 4 and the safety device test procedures in Chapter 6 of this manual be performed, to verify all system-operating parameters. If there is an emergency, turn off the electrical power supply to the AERCO boiler and close the manual gas valve located upstream the unit. The installer must identify the emergency shut-off device.

IMPORTANT – FOR MASSACHUSETTS INSTALLATIONS

Boiler Installations within the Commonwealth of Massachusetts must conform to the following requirements:

- Boiler must be installed by a plumber or a gas fitter who is licensed within the Commonwealth of Massachusetts.
- Prior to unit operation, the complete gas train and all connections must be leak tested using a non-corrosive soap.
- The vent termination must be located a minimum of 4 feet above grade level. If side-wall venting is used, the installation must conform to the following requirements **extracted from 248 CMR 5.08 (2):**

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

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

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

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

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

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

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

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

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

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

(c) MANUFACTURER REQUIREMENTS - GAS EQUIPMENT VENTING SYSTEM PROVIDED. When the manufacturer of Product Approved side wall horizontally vented gas equipment provides a venting system design or venting system components with the equipment, the instructions provided by the manufacturer for installation of the equipment and the venting system shall include:

1. Detailed instructions for the installation of the venting system design or the venting system components; and

2. A complete parts list for the venting system design or venting system.

(d) MANUFACTURER REQUIREMENTS - GAS EQUIPMENT VENTING SYSTEM NOT PROVIDED. When the manufacturer of a Product Approved side wall horizontally vented gas fueled equipment does not provide the parts for venting the flue gases, but identifies "special venting systems", the following requirements shall be satisfied by the manufacturer:

1. The referenced "special venting system" instructions shall be included with the appliance or equipment installation instructions; and

2. The "special venting systems" shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.

(e) A copy of all installation instructions for all Product Approved side wall horizontally vented gas fueled equipment, all venting instructions, all parts lists for venting instructions, and/or all venting design instructions shall remain with the appliance or equipment at the completion of the installation.

[End of Extracted Information From 248 CMR 5.08 (2)]

CHAPTER 2. INSTALLATION

2.1 INTRODUCTION

This Chapter provides the descriptions and procedures necessary to unpack, inspect and install the AERCO Benchmark Boiler Model BMK 1500 and BMK 2000.

2.2 RECEIVING THE UNIT

Each Benchmark Boiler System is shipped as a single crated unit. The shipping weight for these BMK models is approximately 1800 pounds. The unit must be moved with the proper rigging equipment for safety and to avoid equipment damage. The unit should be completely inspected for evidence of shipping damage and shipment completeness at the time of receipt from the carrier and before the bill of lading is signed.

NOTE

AERCO is not responsible for lost or damaged freight. Each unit has a Tip-N-Tell indicator on the outside of the crate. This indicates if the unit has been turned on its side during shipment. If the Tip-N-Tell indicator is tripped, do not sign for the shipment. Note the information on the carrier's paperwork and request a freight claim and inspection by a claims adjuster before proceeding. Any other visual damage to the packaging materials should also be made clear to the delivering carrier.

2.3 UNPACKING

Carefully unpack the unit taking care not to damage the unit enclosure when cutting away packaging materials

After unpacking, a close inspection of the unit should be made to ensure that there is no evidence of damage not indicated by the Tip-N-Tell indicator. The freight carrier should be notified immediately if any damage is detected.

The following accessories come standard with each unit and are either packed separately within the unit's shipping container or are factory installed on the unit:

- Pressure/Temperature Gauge
- ASME Pressure Relief Valve
- Condensate Drain Trap (part no. 24060)
- 2" Gas Supply Shutoff Valve

When optional accessories are ordered, they may be packed within the unit's shipping container, factory installed on the unit, or packed and shipped in a separate container. Any standard or optional accessories shipped loose should be identified and stored in a safe place until ready for installation or use.

2.4 SITE PREPARATION

Ensure that the site selected for installation of the Benchmark 1500/2000 Boiler includes:

- Access to AC Input Power at 120 VAC, Single-Phase, 60 Hz @ 20 Amps
- Access to Natural Gas line at a minimum pressure of 8 inches W.C. at gas flow for 1,500,000 BTU/hr energy input for the **BMK 1500** OR 2,000,000 BTU/hr energy input for the **BMK 2000**.

2.4.1 Installation Clearances

The Benchmark Model 1500 and 2000 are packaged in an enclosure having identical exterior dimensions. The unit must be installed with the prescribed clearances for service as shown in Figure 2-1a. The minimum clearance dimensions, required by AERCO, are listed below. However, if Local Building Codes require additional clearances, these codes shall supersede AERCO's requirements. Minimum acceptable clearances required are as follows:

- Sides: 24 inches
- Front : 24 inches
- Rear: 24 inches
- Top: 18 inches

All gas piping, water piping and electrical conduit or cable must be arranged so that they do not interfere with the removal of any panels, or inhibit service or maintenance of the unit.

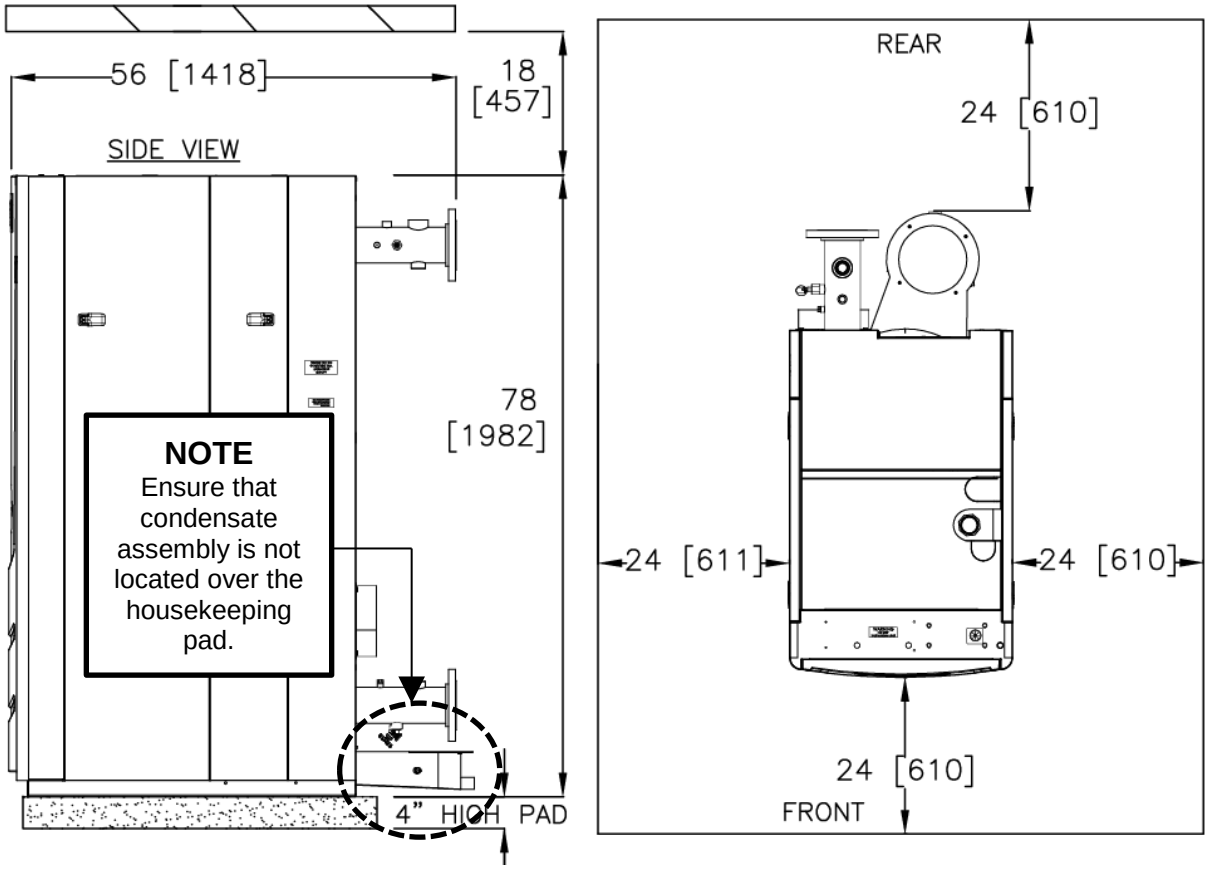


Figure 2-1a: Benchmark Boiler Model 1500/2000 Clearances

⚠ WARNING ⚠

KEEP THE UNIT AREA CLEAR AND FREE FROM ALL COMBUSTIBLE MATERIALS AND FLAMMABLE VAPORS OR LIQUIDS.

⚠ CAUTION ⚠

While packaged in the shipping container, the unit must be moved by pallet jack or forklift from the FRONT ONLY.

FOR MASSACHUSSETTS ONLY:

For Massachusetts installations, the unit must be installed by a plumber or gas-fitter licensed within the Commonwealth of Massachusetts. In addition, the installation must comply with all requirements specified in Chapter 1 (Safety Precautions), pages 11 and 12.

2.4.2 Setting the Unit

The unit must be installed on a 4 inch to 8 inch thick housekeeping pad to ensure proper condensate drainage. If anchoring the unit, refer to Figure 2-1b for anchor locations.

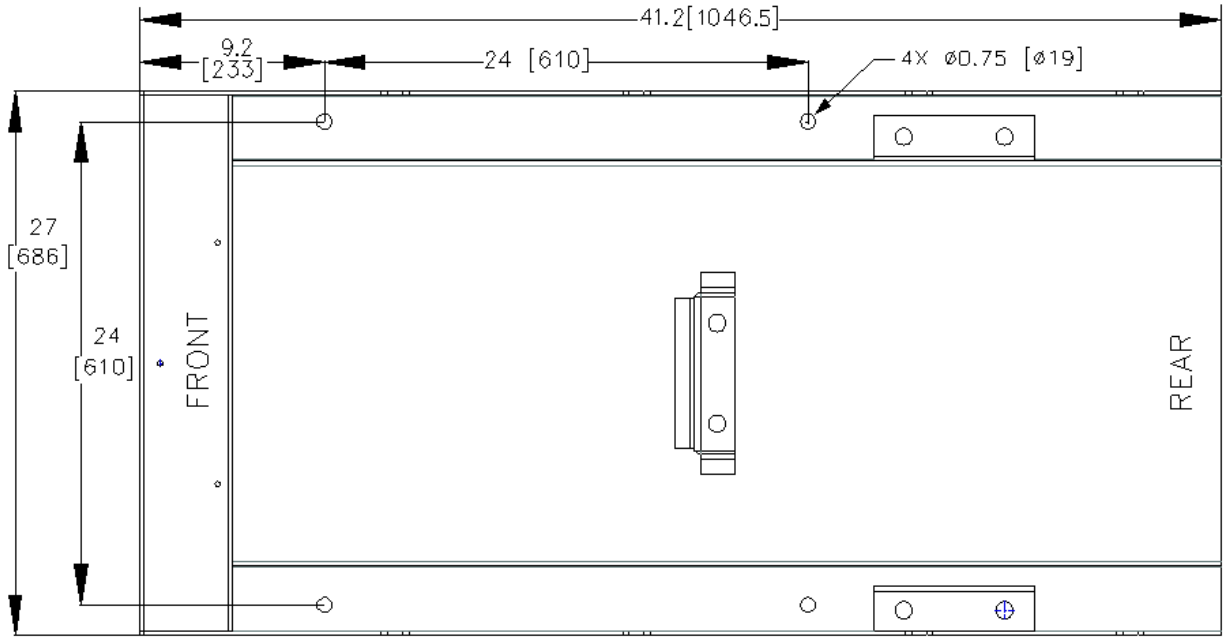


Figure 2-1b: Benchmark 1500/2000 Anchor Bolt Locations

A total of 3 lifting lugs are provided at the top of the primary heat exchanger as shown in Figure 2-2. Remove the front top panel from the unit to provide access to the lifting tabs.

Remove the four (4) lag screws securing the unit to the shipping skid. Lift the unit off the shipping skid and position it on the 4 inch to 6 inch housekeeping concrete pad (required) in the desired location.

⚠ WARNING ⚠

WHEN LIFTING OR MOVING THE BOILER, ***DO NOT*** ATTEMPT TO MANIPULATE THE BOILER USING THE GAS TRAIN OR BLOWER.

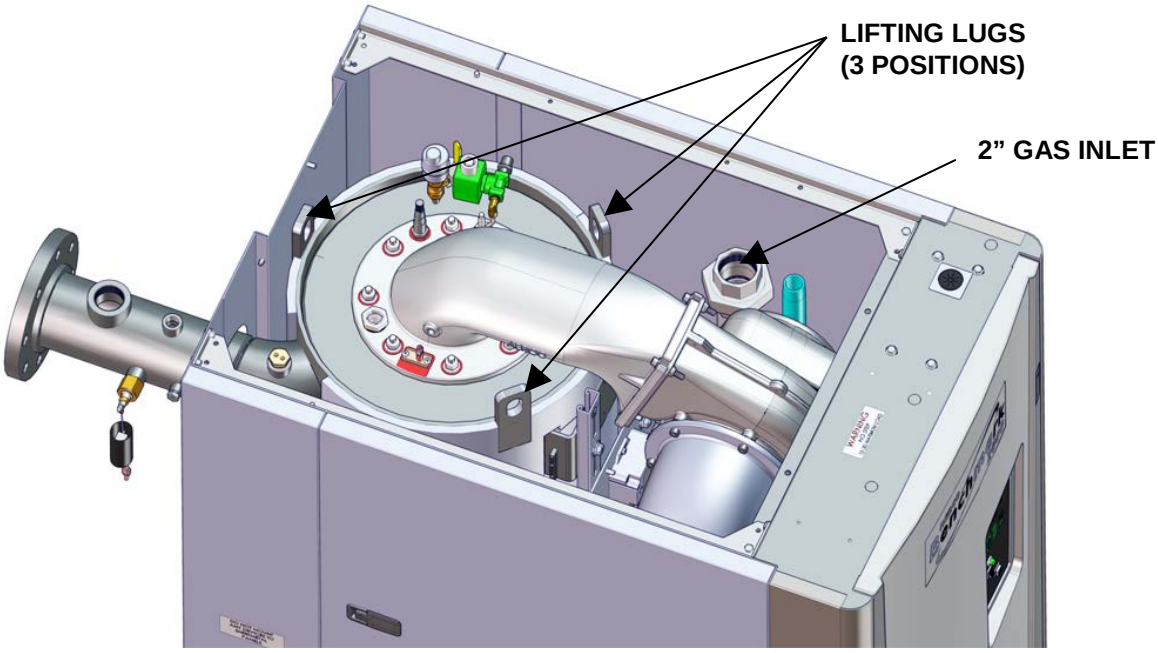


Figure 2-2: Boiler Lifting Provisions

In multiple unit installations, it is important to plan the position of each unit in advance. Sufficient space for piping connections and future service/maintenance requirements must also be taken into consideration. All piping must include ample provisions for expansion**.**

If installing a Combination Control Panel (CCP) system, it is important to identify the Combination Mode Boilers in advance and place them in the proper physical location. Refer to Chapter 5 for information on Combination Mode Boilers.

2.5 SUPPLY AND RETURN PIPING

The Benchmark Boiler utilizes 4" 150# flanges for the water system supply and return piping connections. The physical location of the supply and return piping connections are on the rear of the unit as shown in Figure 2-3.

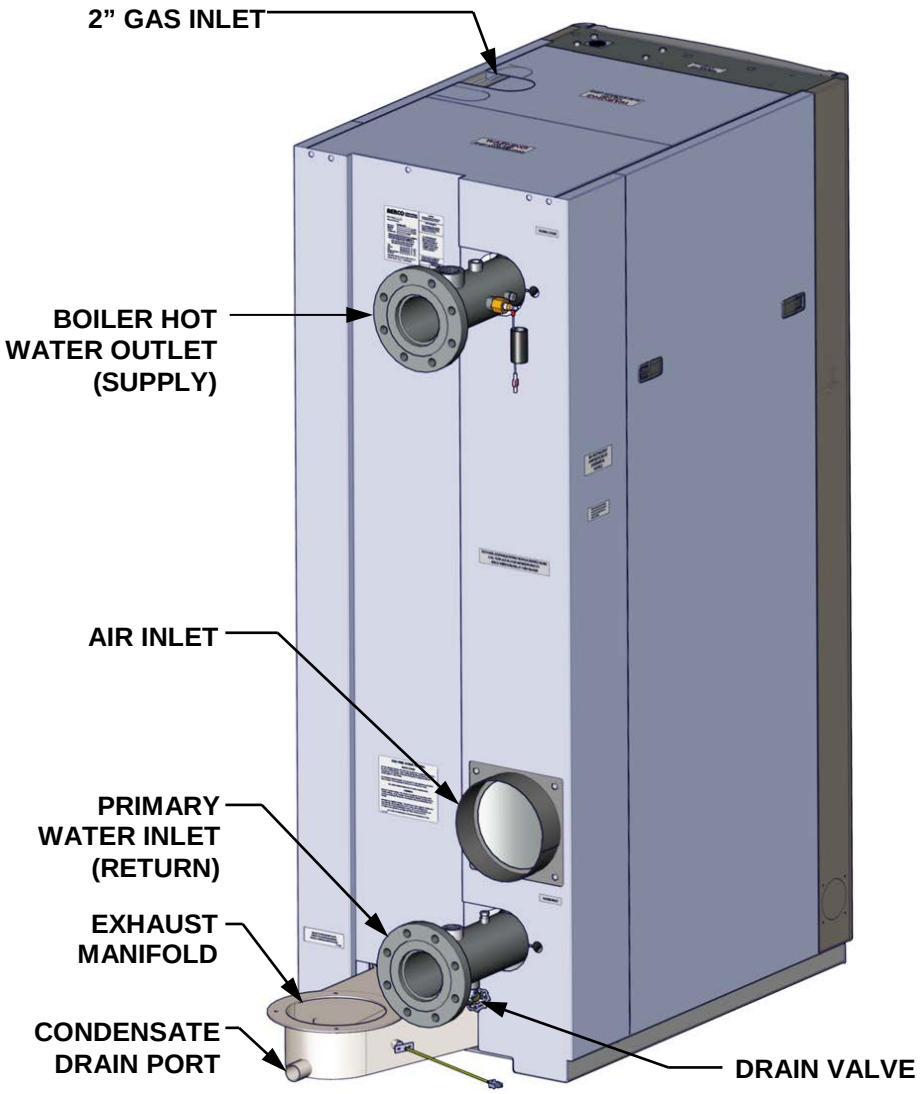


Figure 2-3: Supply and Return Locations

2.6 PRESSURE RELIEF VALVE INSTALLATION

An ASME rated Pressure Relief Valve is supplied with each Benchmark Boiler. The pressure rating for the relief valve must be specified on the sales order. Available pressure ratings range from 30 psi to 160 psi. The relief valve is installed on the hot water outlet of the boiler as shown in Figure 2-4. A suitable pipe joint compound should be used on the threaded connections. Any excess should be wiped off to avoid getting any joint compound into the valve body. The relief valve must be piped to within 12 inches of the floor to prevent injury in the event of a discharge. are allowed in the discharge line. In multiple unit installations the discharge lines must not be manifolded together. Each must be individually run to a suitable discharge location.

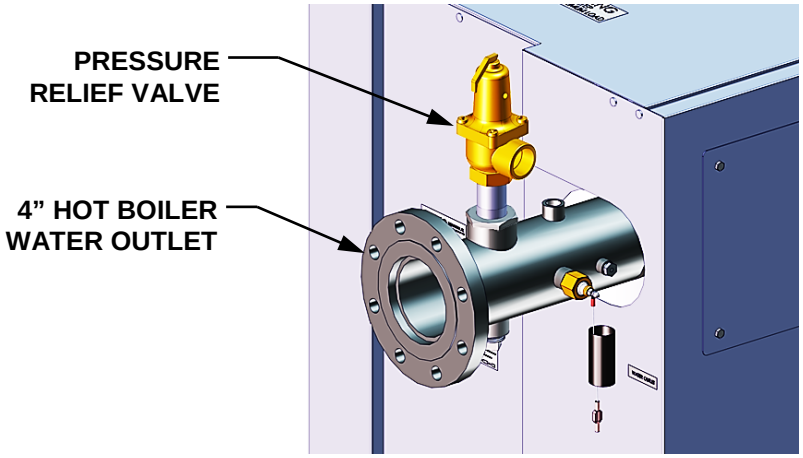


Figure 2-4: P&T Relief Valve Location

2.7 CONDENSATE DRAIN & PIPING

The Benchmark Boiler is designed to condense water vapor from the flue products. Therefore, the installation must have provisions for suitable condensate drainage or collection.

The condensate drain port located on the exhaust manifold (Figure 2-5) must be connected to the condensate trap (P/N 24060) which is packed separately within the unit’s shipping container. The condensate trap inlet features two integral O-rings and a thumbscrew to allow direct connection of the drain port into the trap inlet. See the Condensate trap Installation instructions and Figure 2-6 on the next page.

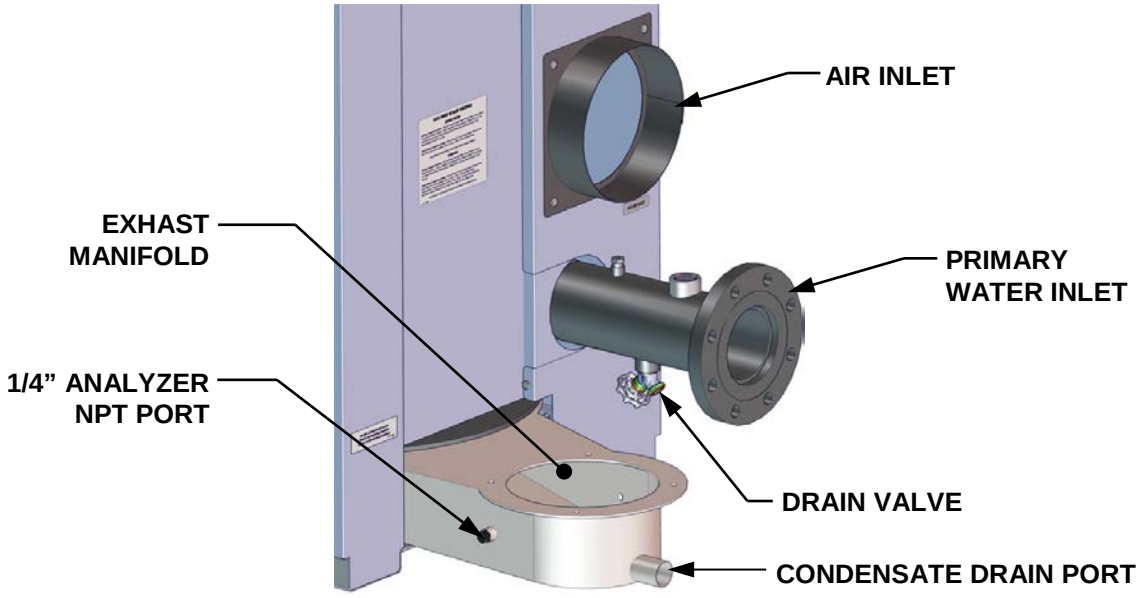


Figure 2-5: Condensate Drain Connection Location

A sample condensate trap installation is shown in Figure 2-6. The following general guidelines must be observed to ensure proper condensate drainage:

- The condensate trap inlet (Figure 2-6) must be level the exhaust manifold drain port.
- The base of the condensate trap must be supported to ensure that it is level (horizontal).
- The trap must be removable for routine maintenance.

While observing the above guidelines, install the condensate trap as follows:

Condensate Trap Installation

1. Connect the condensate trap inlet to the exhaust manifold drain connection by inserting the drain port directly into the trap adaptor inlet, and then tightening the inlet thumbscrew, as shown in Figure 2-6. The inlet features two integral O-rings to prevent leakage.
2. At the condensate trap outlet, install a 3/4" NPT nipple.
3. Connect a length of 1" diameter polypropylene hose to the trap outlet and secure with a hose clamp.
4. Route the hose on the trap outlet to a nearby floor drain.

If a floor drain is not available, a condensate pump can be used to remove the condensate to drain. The maximum condensate flow rate is 30 GPH. The condensate drain trap, associated fittings and drain line must be removable for routine maintenance.

⚠ CAUTION ⚠

Use PVC, stainless steel, aluminum or polypropylene for condensate drain piping (Figure 2-6). DO NOT use carbon or copper components.

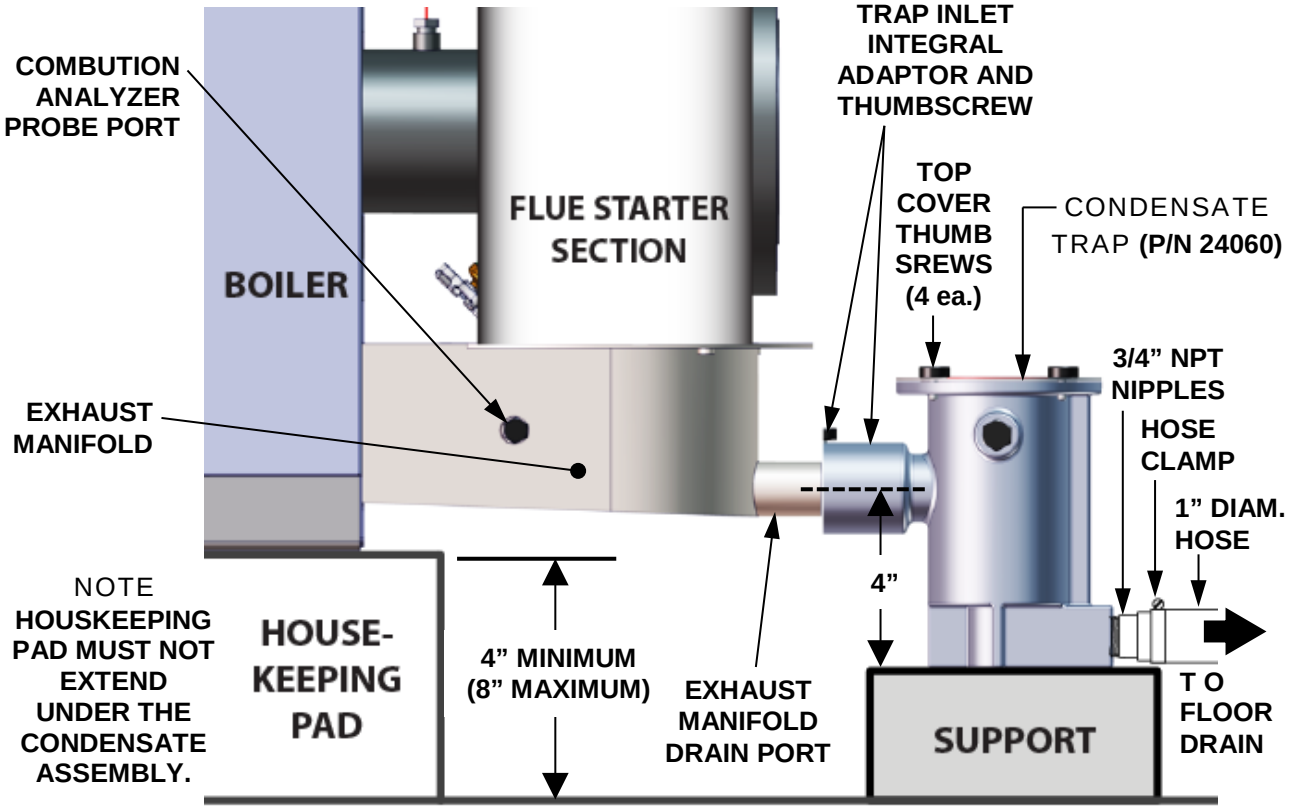


Figure 2-6: Sample Condensate Trap Installation (Right Side View)

2.8 GAS SUPPLY PIPING

The AERCO Benchmark Gas Components and Supply Design Guide, GF-2030 must be consulted prior to designing or installing any gas supply piping.

⚠ WARNING ⚠

NEVER USE MATCHES, CANDLES, FLAMES OR OTHER SOURCES OF IGNITION TO CHECK FOR GAS LEAKS.

⚠ CAUTION ⚠

Many of the soaps used for gas pipe leak testing are corrosive to metals. Therefore, piping must be rinsed thoroughly with clean water after leak checks have been completed.

NOTE

All gas piping must be arranged so that it does not interfere with removal of any covers, inhibit service/maintenance, or restrict access between the unit and walls, or another unit.

Benchmark 1500 MBH and 2000 MBH units contain a 2 inch NPT gas inlet connection on the top of the unit, as shown in Figure 2-2 and 2-3.

Prior to installation, all pipes should be de-burred and internally cleared of any scale, metal chips or other foreign particles. Do Not install any flexible connectors or unapproved gas fittings. Piping must be supported from the floor, ceiling or walls only and must not be supported by the unit.

A suitable piping compound, approved for use with natural gas, should be used. Any excess must be wiped off to prevent clogging of components.

To avoid unit damage when pressure testing gas piping, the unit must be isolated from the gas supply piping. At no time should the gas pressure applied to the unit exceed 14" W.C. A thorough leak test of all external piping must be performed using a soap and water solution or suitable equivalent. The gas piping used must meet all applicable codes.

2.8.1 Gas Supply Specifications.

The gas supply input specifications to the unit for Natural Gas are as follows:

- The maximum static pressure to the unit must not exceed 14" W.C.
- The gas supply piping and pressure to the unit must be of sufficient capacity to provide 2000 cfh while maintaining the gas pressure at 6 inches W.C. for FM gas trains ***operating at maximum capacity***.

2.8.2 Manual Gas Shutoff Valve

A manual shut-off valve must be installed in the gas supply line upstream of the boiler as shown in Figure 2-7. Maximum allowable gas pressure to the boiler is 14" W.C.

2.8.3 External Gas Supply Regulator

An external gas pressure regulator is required on the gas inlet piping under most conditions (see sections 2.8.3.1 and 2.8.3.2, below). Regulators must conform to the following specifications:

- The external natural gas regulator must be capable of regulating 200,000 – 3,180,000 BTU/HR of natural gas while maintaining a gas pressure of 8.0" W.C. minimum to the unit.
- A lock-up style regulator MUST be used when gas supply pressure will exceed 14" W.C.

2.8.3.1 Massachusetts Installations Only

For Massachusetts installations, a mandatory external gas supply regulator must be positioned as shown in Figure 2-7. The gas supply regulator must be properly vented to outdoors. Consult the local gas utility for detailed requirements concerning venting of the supply gas regulator.

2.8.3.2 All Installations (Except Massachusetts)

For multi-unit installations (other than Massachusetts) that EXCEED 7" W.C. gas pressure, a mandatory external gas supply regulator, as shown in Figure 2-7, is highly recommended. No regulator is required for gas pressures below 7" W.C. of pressure. Consult the local gas utility for detailed requirements concerning venting of the supply gas regulator.

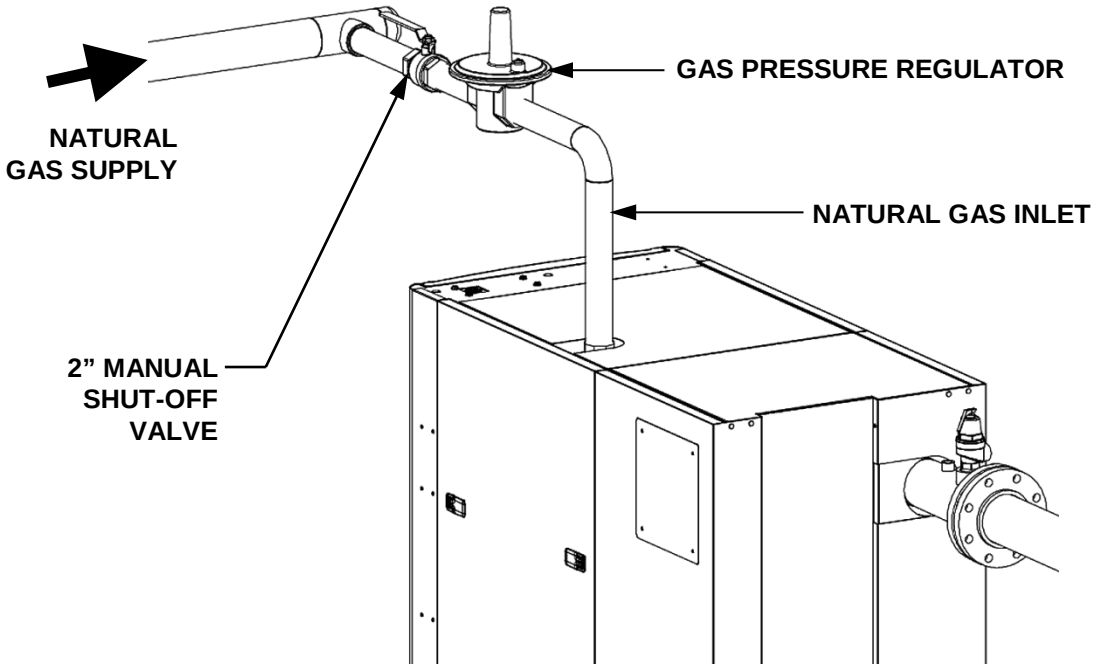


Figure 2-7: Manual Gas Shut-Off Valve Location

NOTE

It is the responsibility of the customer to source and purchase the appropriate gas regulator as described above. However, AERCO offers for sale an appropriate regulator, which may be ordered at the time of unit purchase or separately. Contact AERCO for more information.

2.9 AC ELECTRICAL POWER WIRING

The AERCO Benchmark Electrical Power Wiring Guide, GF-2060, must be consulted prior to connecting any AC power wiring to the unit. External AC power connections are made to the unit inside the Power Box on the front of the unit. Remove the front panel to access the Power Box, which is mounted in the upper right corner of the unit as shown in Figure 2-8. Loosen the two upper screws of the Power Box cover and remove cover to access the internal connections shown in Figure 2-9.

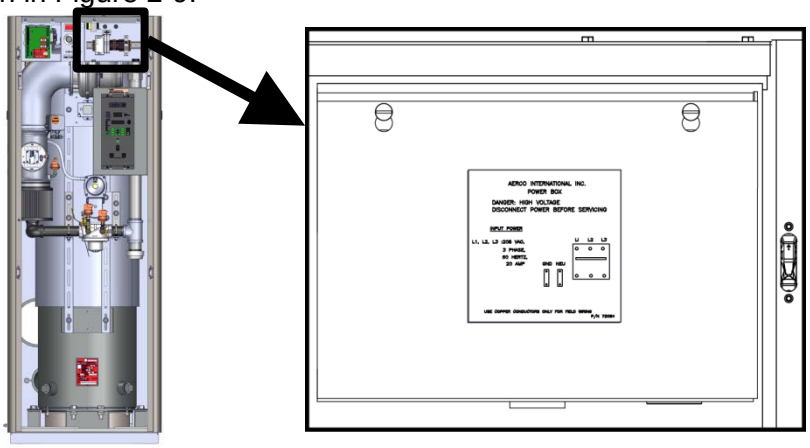


Figure 2-8: Power Box Location with Cover Closed

⚠ WARNING ⚠

THE POWER BREAKER SHOWN IN FIGURE 2-9 DOES **NOT** REMOVE POWER FROM THE TERMINAL BLOCKS.

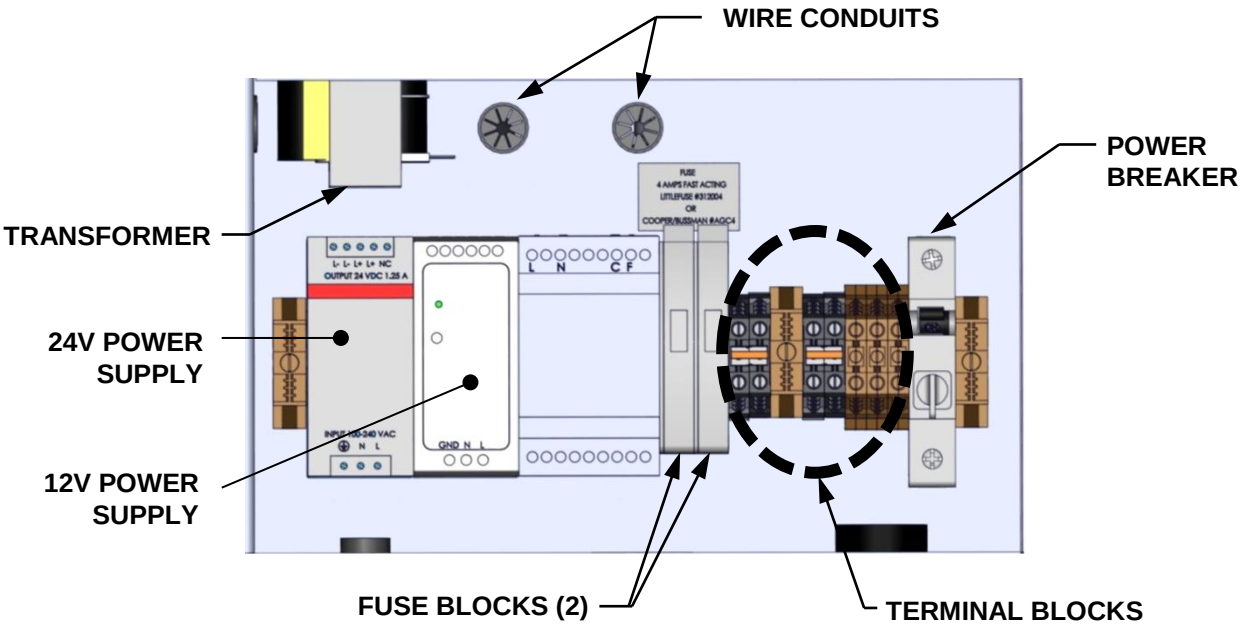


Figure 2-9: Power Box Internal Components

With the exception of the transformer shown in Figure 2-9, all of the components in the Power Box are mounted on a DIN rail.

NOTE

All electrical conduit and hardware must be installed so that it does not interfere with the removal of any unit covers, inhibit service/maintenance, or prevent access between the unit and walls or another unit.

2.9.1 Electrical Power Requirements

The Benchmark 1500 and Benchmark 2000 models are available in one voltage configuration:

- 120 VAC, Single-Phase, 60 Hz @ 20 Amps

The Power Box contains terminal blocks as shown in Figure 2-9. In addition, a label showing the required AC power connections is provided on the front cover of the Power Box as shown in Figure 2-10.

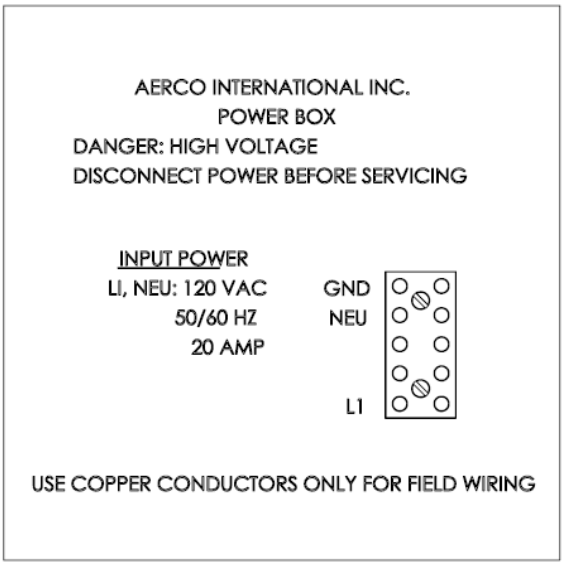


Figure 2-10: Power Box Cover Labels – 120VAC

Each unit must be connected to a dedicated electrical circuit. NO OTHER DEVICES SHOULD BE ON THE SAME ELECTRICAL CIRCUIT AS THE BOILER.

A three-pole switch must be installed on the electrical supply line in an easily accessible location to quickly and safely disconnect electrical service. DO NOT attach the switch to sheet metal enclosures of the unit.

After placing the unit in service, the ignition safety shutoff device must be tested. If an external electrical power source is used, the installed boiler must be electrically bonded to ground in accordance with the requirements of the authority having jurisdiction. In the absence of such requirements, the installation shall conform to National Electrical Code (NEC), ANSI/NFPA 70 and/or the Canadian Electrical Code (CEC) Part I, CSA C22.1 Electrical Code.

For electrical power wiring diagrams, see the AERCO Benchmark Electrical Power Guide, (GF-2060).

2.10 FIELD CONTROL WIRING

Each unit is fully wired from the factory with an internal operating control system. No field control wiring is required for normal operation. However, the C-More Control system used with all Benchmark units does allow for some additional control and monitoring features. Wiring connections for these features are made on the Input/Output (I/O) board located behind the removable front panel assembly of the unit. The I/O board is located in the upper-left portion on the front of the unit as shown in Figure 2-11. The I/O board terminal strip connections are shown in Figure 2-12. All field wiring is installed from the rear of the panel by routing the wires through one of the four bushings provided on the sides of the I/O board.

Refer to the wiring diagram provided below the I/O Box (Figure 2-12) when making all wiring connections.

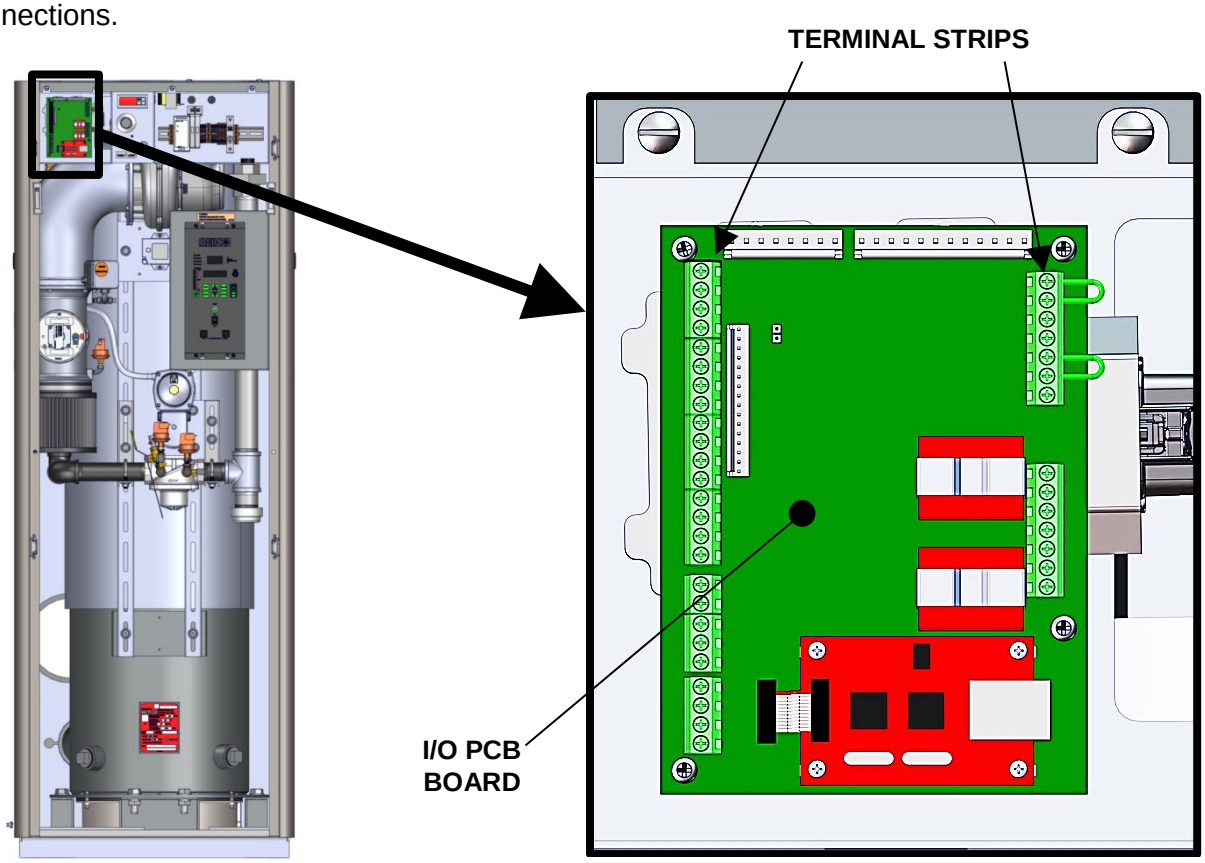


Figure 2-11: Input/Output (I/O) Box Location

NOTE

Use Figure 2-12 to determine the functions of the I/O PCB connections. Do not use the silkscreened labels on the PCB itself, as these may not match the function names.

There is a diagram of the connection functions on the cover of the I/O Box as well.

⚠ CAUTION ⚠

DO NOT make any connections to the I/O Box terminals labeled "NOT USED". Attempting to do so may cause equipment damage.

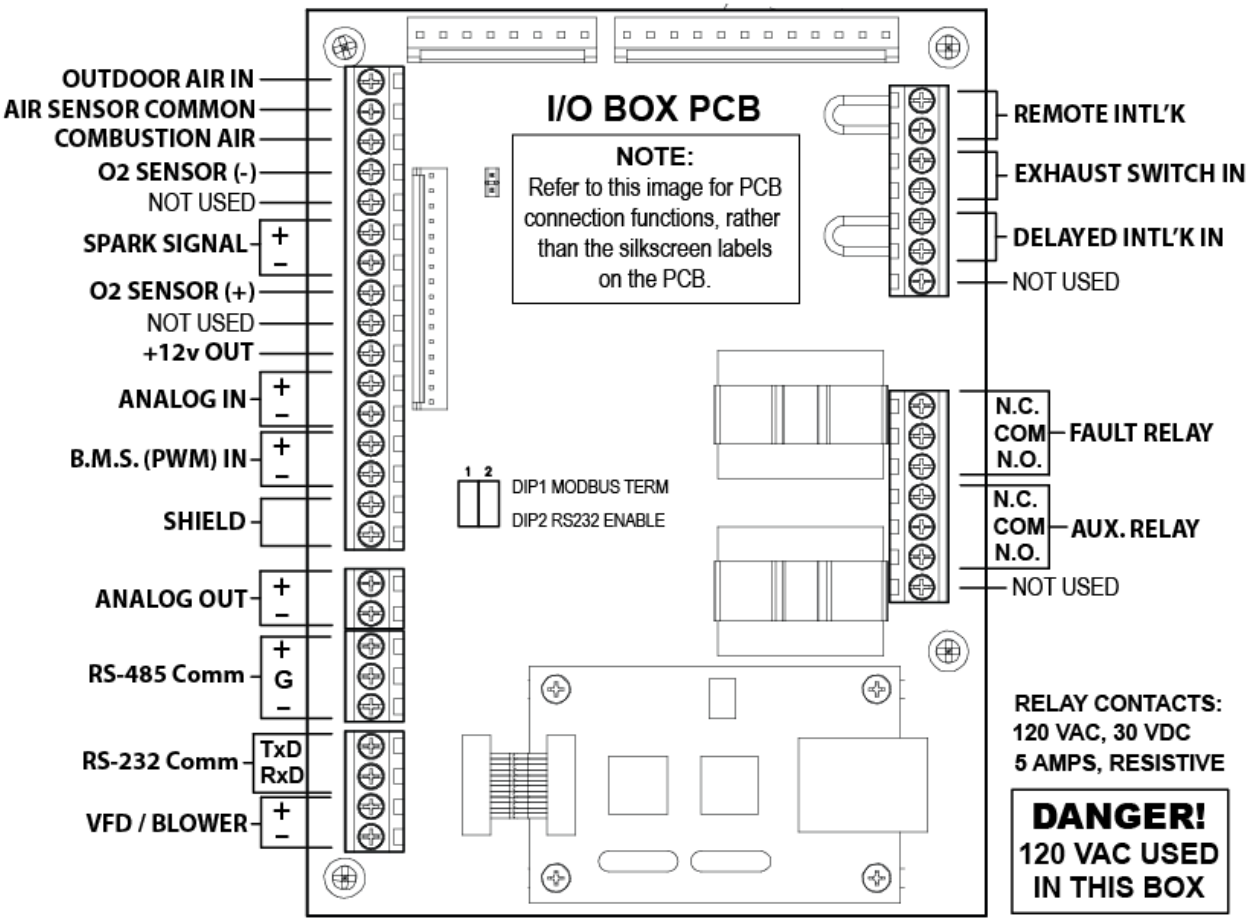


Figure 2-12: I/O Box Terminal Strips

2.10.1 Outdoor Air In (OUT) & Air Sensor Common (COM)

The OUTDOOR AIR IN terminal is used for connecting an outdoor temperature sensor (AERCO P/N GM-123525) as required primarily for the Indoor/Outdoor reset mode of operation. It can also be used with another mode if it is desired to use the outdoor sensor enable/disable feature. This feature allows the boiler to be enabled or disabled based on the outdoor air temperature.

The factory default for the outdoor sensor is DISABLED. To enable the sensor and/or select an enable/disable outdoor temperature, see the Configuration Menu in Chapter 3.

The outdoor sensor may be wired up to 200 feet from the boiler. It is connected to the OUTDOOR AIR IN and AIR SENSOR COMMON terminals of the I/O PCB (Figure 2-12). Wire the sensor using a twisted shielded pair wire from 18 to 22 AWG. There is no polarity to observe when terminating these wires. The shield is to be connected only to the terminals labeled SHIELD in the I/O Box PCB. The sensor end of the shield must be left free and ungrounded.

When mounting the sensor, it must be located on the North side of the building where an average outside air temperature is expected. The sensor must be shielded from direct sunlight as well as impingement by the elements. If a shield is used, it must allow for free air circulation.

2.10.2 COMBUSTION AIR Terminal

The COMBUSTIAN AIR terminal is used to monitor the combustion air temperature sensor. This input is always enabled and is a “to view only” input that can be seen in the operating menu. The sensor is an AERCO BALCO wire sensor P/N 12449. A resistance chart for this sensor is provided in APPENDIX C. This sensor is an active part of the combustion control system and must be operational for accurate air/fuel mixing control.

2.10.3 O_2 SENSOR (O2+ & O2-)

The O_2 SENSOR (+) and O_2 SENSOR (–) terminals are used to connect an integrated oxygen sensor to the I/O Box PCB. The O_2 concentration is displayed in the operating menu of the C-More Control system after a 60 second warm-up period.

2.10.4 SPARK SIGNAL (FLW+ & FLW-)

The two SPARK SIGNAL terminals permit an external current sensor to be connected for ignition spark monitoring purposes. If no spark is present during the ignition sequence, the controller will shut down and display a fault message.

2.10.5 Analog In (+ & -)

The two ANALOG IN terminals are used when an external signal is used to change the setpoint (Remote Setpoint Mode) of the boiler.

Either a 4 to 20 mA /1 to 5 VDC or a 0 to 20 mA/ 0 to 5 VDC signal may be used to vary the set-point or air/fuel valve position. The factory default setting is for 4 to 20 mA / 1 to 5 VDC, however this may be changed to 0 to 20 mA / 0 to 5 VDC using the Configuration Menu described in Chapter 3.

If voltage rather than current is selected as the drive signal, a DIP switch must be set on the PMC Board located inside the C-More Control Box. Contact the AERCO factory for information on setting DIP switches.

All supplied signals must be floating (ungrounded) signals. Connections between the source and the boiler’s I/O PCB (Figure 2-12) must be made using twisted shielded pair of 18–22 AWG wire such as Belden 9841. Polarity must be maintained and the shield must be connected only at the source end and must be left floating (not connected) at the Boiler’s I/O PCB.

Whether using voltage or current for the drive signal, they are linearly mapped to a 40°F to 240°F setpoint or a 0% to 100% air/fuel valve position. No scaling for these signals is provided

2.10.6 B.M.S. (PWM) In (BMS+ & BMS-)

These terminals are only used to connect to legacy AERCO Boiler Management Systems (BMS), which utilize a 12 millisecond, ON/OFF duty cycle and is Pulse Width Modulated (PWM) to control valve position. A 0% valve position = a 5% ON pulse and a 100% valve position = a 95% ON pulse. Note that these connections cannot be used with the AERCO Control System (ACS).

2.10.7 Shield (SHLD & SHLD)

The SHIELD terminals are used to terminate any shields used on sensor wires connected to the unit. Shields must only be connected to these terminals.

2.10.8 Analog Output (+ & -)

The ANALOG OUT terminals (+ & -) output from 0 to 20 mA and may be used to monitor Setpoint, Outlet Temperature, Valve Position 4-20 mA, Valve Position 0-10v or be set to OFF. Default setting in the C-More controller is Valve Position 0-10v and settings behave as follows:

- When 0-10VDC is selected, the voltage output is used by the controller to modulate the combustion blower via the I/O Box terminals labeled VFD/Blower (Section 2.10.11).
- If On Board Boiler Sequencing Technology (BST) is enabled, the Analog Output terminals are used to drive the isolation valve, open and closed.
- When the 4-20mA is selected for the Analog Output, the 0-10VDC is disabled at the VFD/Blower terminals, and the selected output is available at the terminals labeled Analog Output +/-.

2.10.9 RS-485 Comm (+, GND, & -)

The RS-485 communication terminals are used when the boiler plant is being controlled by an Energy Management System (EMS) or an AERCO Control System (ACS) using Modbus (RS-485) communication.

2.10.10 RS-232 Comm (TxD & RxD)

The RS-232 communication terminals permit a laptop computer or other suitable terminal to be connected to the boiler. The RS-232 communication feature permits viewing or changing of Control Panel menu options and also provides access to data logs showing fault and sensor log displays.

2.10.11 VFD/Blower (0-10 & AGND)

These terminals (0-10 & AGND) send an analog signal to control the blower speed. When any of the 4-20mA options is selected for the Analog Outputs (Section 2.10.8), the output from the VFD/Blower terminals is disabled.

2.10.12 Interlocks

The unit offers two interlock circuits for interfacing with Energy Management Systems and auxiliary equipment such as pumps or louvers or other accessories. These interlocks are called the Remote Interlock and Delayed Interlock ((REMOTE INTL'K IN and DELAYED INTL'K IN in Figure 2-12). Both interlocks, described below, are factory wired in the closed position (using jumpers).

NOTE

Both the Delayed Interlock and Remote Interlock must be in the closed position for the unit to fire.

2.10.12.1 Remote Interlock In (OUT & IN)

The remote interlock circuit is provided to remotely start (enable) and stop (disable) the unit if desired. The circuit is 24 VAC and comes factory pre-wired closed (jumped).

2.10.12.2 Delayed Interlock In (OUT & IN)

The Delayed Interlock terminals can be used in one of two ways:

- In conjunction with the optional external sequencing valve (see section 2.14 and Chapter 10 – BST), a component of AERCO's on-board Boiler Sequencing Technology (BST) solution. By default a cable of the boiler's wiring harness is connected to these terminals. If BST is implemented, the other end of that cable is connected to the sequencing valve.
- If BST is *NOT* implemented, the second use is typically in conjunction with the AUXILIARY RELAY CONTACTS described in section 2.10.14. This interlock circuit is located in the purge section of the start string. It can be connected to the proving device (end switch, flow switch etc.) of an auxiliary piece of equipment started by

the unit's auxiliary relay. If the delayed interlock is connected to a proving device that requires time to close (make), a time delay (AUX START ON DLY) that holds the start sequence of the unit long enough for a proving switch to make (close) can be programmed.

To use this option, you must disconnect the harness from the Delayed Interlock terminals and connect the proving device in its place.

Should the proving switch not prove within the programmed time frame, the unit will shut down. The AUX START ON DLY can be programmed from 0 to 120 seconds. This option is located in the Configuration Menu (Chapter 3).

2.10.13 Fault Relay (NC, COM, & NO)

The fault relay is a single pole double throw (SPDT) relay having a normally open and normally closed set of relay contacts that are rated for 5 amps at 120 VAC and 5 amps at 30 VDC. The relay energizes when any fault condition occurs and remains energized until the fault is cleared and the **CLEAR** button is depressed. The fault relay connections are shown in Figure 2-12.

2.10.14 Auxiliary Relay Contacts (NC, COM, & NO)

Each unit is equipped with a single pole double throw (SPDT) relay that is energized when there is a demand for heat and de-energized after the demand for heat is satisfied. The relay is provided for the control of auxiliary equipment, such as pumps and louvers, or can be used as a unit status indictor (firing or not firing). Its contacts are rated for 120 VAC @ 5 amps. Refer to Figure 2-12 to locate the AUXILLIARY RELAY terminals for wiring connections.

2.11 FLUE GAS VENT INSTALLATION

AERCO Gas Fired Venting and Combustion Air Guide, GF-2050 must be consulted before any flue or combustion air venting is designed or installed. Suitable, U/L approved, positive pressure, watertight vent materials MUST be used for safety and UL certification. Because the unit is capable of discharging low temperature exhaust gases, the flue must be pitched back towards the unit a minimum of 1/4" per foot to avoid any condensate pooling and to allow for proper drainage.

While there is a positive flue pressure during operation, the combined pressure drop of vent and combustion air systems must not exceed 140 equivalent feet or 0.8" W.C. Fittings as well as pipe lengths must be calculated as part of the equivalent length. For a natural draft installation the draft must not exceed - 0.25" W.C. These factors must be planned into the vent installation. If the maximum allowable equivalent lengths of piping are exceeded, the unit will not operate properly or reliably.

For Massachusetts installations, the following companies provide vent systems which conform to all applicable requirements for installations within the Commonwealth of Massachusetts. Contact information is as follows:

Selkirk Corporation - Heatfab Division
130 Industrial Blvd.
Turners Falls, MA 01376
Phone: 1-800-772-0739
www.heat-fab.com

Watertown Supply
33Grove St.
Watertown, MA 02472
Phone: (617) 924-2840
http://www.watertownsupply.com/

M. A. Peacard
1250 Massachusetts Ave.
Boston MA 02125-1689
Phone: (617) 288-0629
www.mapeacard.com

Glover Sheet Metal, Inc.
44 Riverdale Ave.
Newton, MA 02485
Phone: (617) 527-8178
www.gloversheetmetal.com

2.12 COMBUSTION AIR

The AERCO Benchmark Boiler Venting and Combustion Air Guide, GF-2050 MUST be consulted before any flue or inlet air venting is designed or installed. Air supply is a direct requirement of ANSI 223.1, NFPA-54, CSA B149.1 and local codes. These codes should be consulted before a permanent design is determined.

The combustion air must be free of chlorine, halogenated hydrocarbons or other chemicals that can become hazardous when used in gas-fired equipment. Common sources of these compounds are swimming pools, degreasing compounds, plastic processing, and refrigerants. Whenever the environment contains these types of chemicals, combustion air MUST be supplied from a clean area outdoors for the protection and longevity of the equipment and warranty validation.

The more common methods of combustion air supply are outlined in the following sections. For combustion air supply from ducting, consult the AERCO GF-2050, Gas Fired Venting and Combustion Air Guide.

2.12.1 Combustion From Outside the Building

Air supplied from outside the building must be provided through two permanent openings. For each unit these two openings must have a free area of not less than one square inch for each 4000 BTUs input of the equipment or 375 square inches of free area for the BMK 1500 or 500 square inches of free area for the BMK 2000. The free area must take into account restrictions such as louvers and bird screens. For Canada installations, refer to the requirements specified in CSA B149.1-10, sections 8.4.1 and 8.4.3.

2.12.2 Combustion Air from Inside the Building

When combustion air is provided from within the building, it must be supplied through two permanent openings in an interior wall. Each opening must have a free area of not less than one square inch per 1000 BTUH of total input or 3000 square inches of free area. The free area must take into account any restrictions, such as louvers.

2.13 DUCTED COMBUSTION AIR

For ducted combustion air installations, the air ductwork must then be attached directly to the air inlet connection on the sheet metal enclosure.

In a ducted combustion air application, the combustion air ducting pressure losses must be taken into account when calculating the total maximum allowable venting run. See the AERCO Benchmark Venting and Combustion Air Guide, GF-2050. When using the unit in a ducted combustion air configuration, each unit must have a minimum 8 inch diameter connection at the unit.

2.14 SEQUENCING VALVE INSTALLATION

All Benchmark units are shipped with a connection for an optional motorized external sequencing valve (p/n 92084-TAB) included in the shipping container. This valve is an integral component of the AERCO's on-board Boiler Sequencing Technology (BST) solution. BST allows sites with multiple boilers to have one boiler, acting as a "master" to manage the other boilers at the site in such a way that the efficiency of the entire boiler array is maximized.

The implementation of BST, and the installation and use of this valve is optional.

The boiler IS pre-wired to accept the sequencing valve. Installation consists of installing the sequencing valve in the hot water outlet pipe, and then connecting it into the shell harness, as described below.

1. Install the sequencing valve in the boiler's hot water outlet pipe.

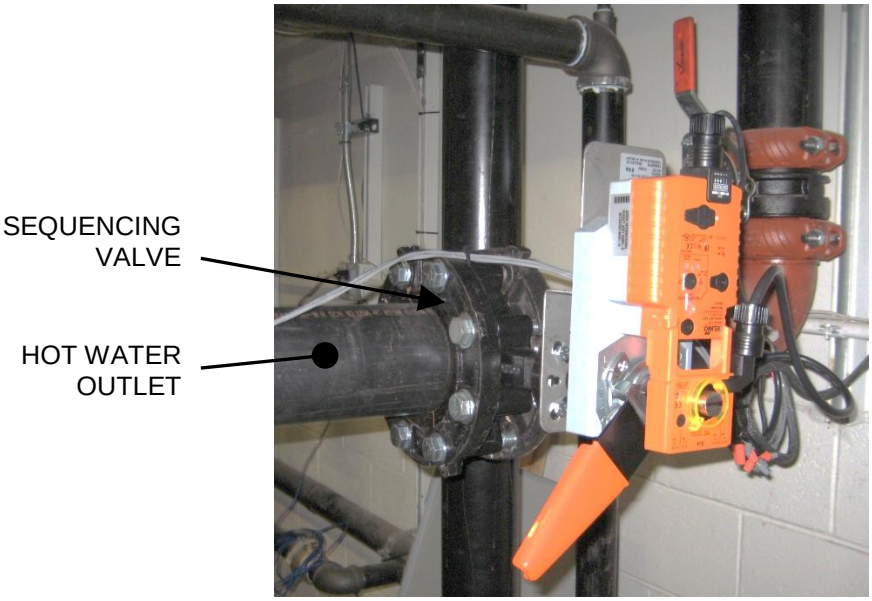


Figure 2-13: Sequencing Valve Installed

2. The boiler's shell harness has one unused cable. One end of this cable is connected to the DELAYED INTERLOCK IN terminals in the I/O board (see Figure 2-14) while the other end contains a Molex connector with a jumper wire inserted in it (this jumper wire allows units that do not have a sequencing valve to operate normally). Find the free end of this cable inside the unit's enclosure.

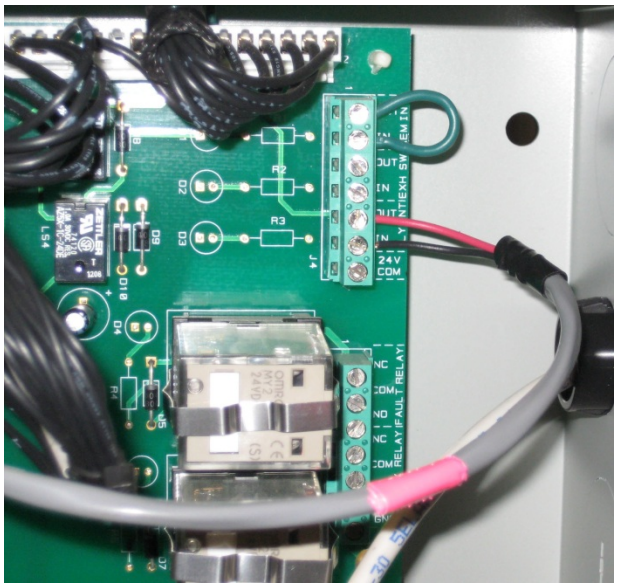


Figure 2-14: Sequencing Valve Installed

3. Remove the jumper wire from the Molex connector and then plug it into the sequencing valve's connector.

CHAPTER 3. OPERATION

3.1 INTRODUCTION

The information in this Chapter provides a guide to the operation of the Benchmark Boiler using the Control Panel 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 120 AND 24 VOLTS AC. IT MUST BE SERVICED ONLY BY FACTORY CERTIFIED SERVICE TECHNICIANS.

⚠ WARNING ⚠

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 Chapter 2 must be completed before attempting to start the unit.

3.2 CONTROL PANEL DESCRIPTION

All Benchmark boilers utilize the C-More Control Panel shown in Figure 3-1. This panel 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 3-1. Additional information on these items is provided in the individual operating procedures and menu descriptions provided in this Chapter.

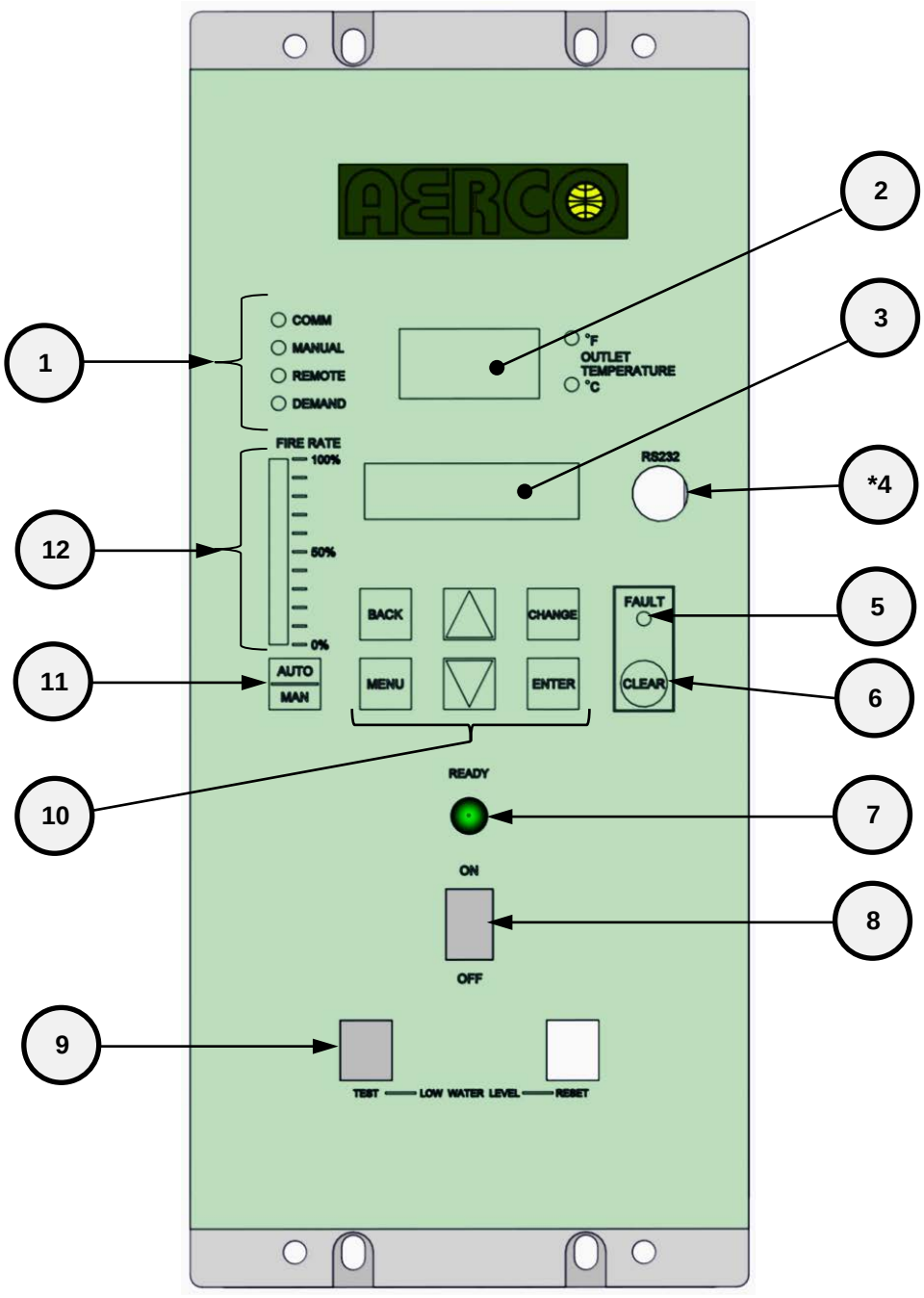


Figure 3-1: Control Panel Front View

*NOTE

If there is a requirement to use the RS232 port (Item 4) on the C-More controller front panel, contact AERCO to purchase the RS232 Adaptor Cable (P/N 124675), which is designed for this purpose. This cable features a DB9 connector for connection to older computers with serial ports or can be used with a Serial-to-USB adaptor for use in modern computer USB ports.

Table 3-1: Operating Controls, Indicators and Displays

ITEM NO.	CONTROL, INDICATOR OR DISPLAY	FUNCTION
1	LED Status Indicators Four Status LEDs indicate the current operating status as follows:	
	COMM	Lights when RS-232 communication is occurring
	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. On a BST Master, 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: • Startup Messages • Fault Messages • Operating Status Messages • Menu Selection • BST Messages
4	**RS-232** Port	Port permits a Laptop Computer or External Modem to be connected to the unit's Control Panel. AERCO offers for purchase the RS232 Adaptor Cable (P/N 124675), which is designed to work with this port. This cable features a DB9 connector for connection to older computers with serial ports or can be used with a Serial-to-USB adaptor for use in modern computer USB ports.
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 **ON/OFF** switch is set to **ON** and 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. Pressing **TEST** opens the water level probe circuit and simulates a Low Water Level alarm. Pressing **RESET** resets the water level monitor circuit. Pressing the **CLEAR** key (item 6) resets the display.

***Table 3-1: Operating Controls, Indicators and Displays** – Continued*

ITEM NO.	CONTROL, INDICATOR OR DISPLAY	FUNCTION
10	MENU Keypad Six (6) keys which provide the following functions for the Control Panel Menus:	
	MENU	Steps through the main menu categories shown in Figure 3-2. 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 3-2), 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 3-2), 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. 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%

3.3 CONTROL PANEL MENUS

The Control Panel 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 3-2. Each of the menus shown, contain options which permit operating parameters to be viewed or changed. The menus are protected by a 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.

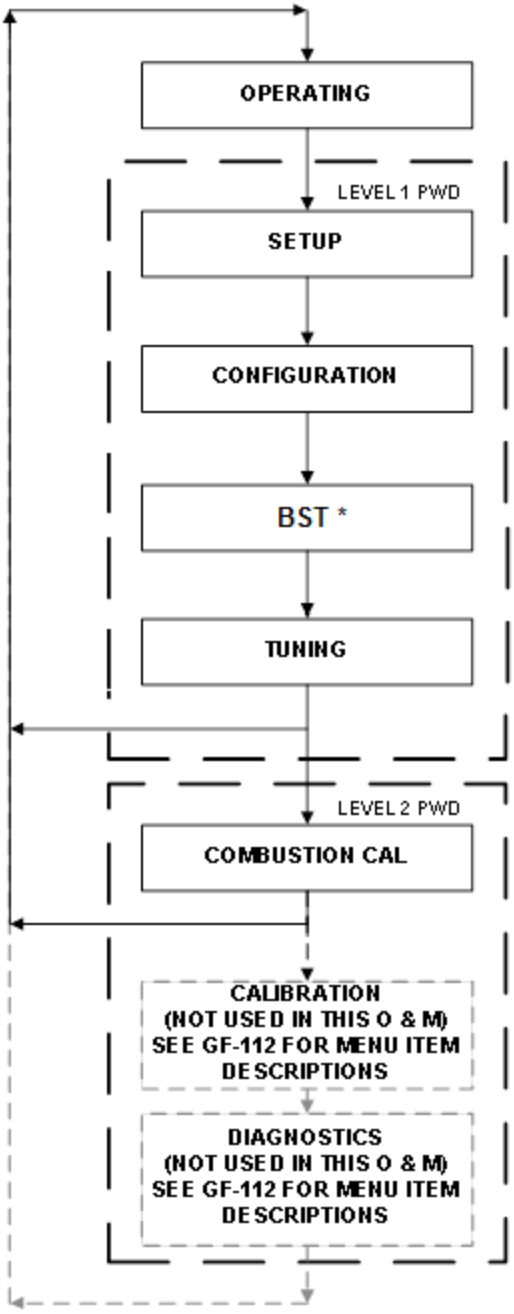
Once the valid level 1 password (159) is entered, the options listed in the Setup. Configuration and Tuning Menus can be viewed and changed, if desired. The Combustion Cal Menu is protected by the level 2 password (6817) which is used in Chapter 4 to perform combustion calibration prior to service use.

3.3.1 Menu Processing Procedure

Accessing and initiating each menu and option is accomplished using the Menu Keys shown in Figure 3-1. Therefore, it is imperative that you be thoroughly familiar with the following basic steps before attempting to perform specific menu procedures:

Menu Processing Procedure

1. The Control Panel 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 3-2. 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 is enabled (see Chapter 10)

Figure 3-2: 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 listings and descriptions of displayed startup, status and error messages.

3.4 OPERATING MENU

The Operating Menu displays a number of key operating parameters for the unit as listed in Table 3-2. This menu is "Read-Only" and does not allow personnel to change or adjust any displayed items. Since this menu is "Read-Only", it can be viewed at any time without entering a password. Pressing the ▲ arrow key to display the menu items in the order listed (Top-Down). Pressing the ▼ arrow key will display the menu items in reverse order (Bottom-Up).

Table 3-2: Operating Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Status Message			
Active Setpoint	40°F	240°F	
Inlet Temp	40°F	140°F	
Air Temp	-70°F	245°F	
Outdoor Temp*	-70°F	130°F	
Valve Position In	0%	100%	
Valve Position Out*	0%	100%	
Exhaust Temp	°F	°F	
Flame Strength	0%	100%	
Oxygen Level	0%	21%	
Run Cycles	0	999,999,999	
Run Hours	0	999,999,999	
Fault Log	0	19	0

*NOTE

The Outdoor Temp and Valve Position Out display items shown with an asterisk in Table 3-2 will not be displayed unless the Outdoor Sensor function has been enabled in the Configuration Menu (Table 3-4).

3.5 SETUP MENU

The Setup Menu (Table 3-3) 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, units of temperature measurements and entries required for external communication and control of the unit via the RS-232 port. A view-only software version display is also provided to indicate the current Control Box software version.

Table 3-3: Setup Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Passsword	0	9999	0
Language	English		English
Time	12:00 am	11:59 pm	
Date	01/01/00	12/31/99	
Unit of Temp	Fahrenheit or Celsius		Fahrenheit
Comm Address	0	127	0
Baud Rate	2400, 4800, 9600, 19.2K		9600
Upload Timer	0		0
Unit Alpha	A	Z	A
Unit Serial #	0000	9999	0000
Unit Year	0	99	00
C-More Year	0	99	11
C-More Serial #	0	9999	0000
C-More Alpha	A	Z	A
Software	Ver 0.00	Ver 9.99	

3.6 CONFIGURATION MENU

The Configuration Menu shown in Table 3-4 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.

NOTE

The Configuration Menu settings shown in Table 3-4 are Factory-Set in accordance with the requirements specified for each individual order. Therefore, under normal operating conditions, no changes will be required.

Table 3-4: Configuration Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Internal Setpt	Lo Temp Limit	Hi Temp Limit	130°F
Unit Type	KC Boiler, KC Boiler LN, BMK Boiler Std, BMK Boiler LN, BMK Blr Std Dual, BMK Blr LN, KC Water Heater, KC Wtr Heater LN, Innovation WH, BMK Blr LN Dual		BMK Boiler LN
Unit Size (Only the unit sizes available for the Unit Type will be displayed)	750 MBH, 800 MBH 1000 MBH, 1500 MBH, 2000 MBH, 2500 MBH, 3000 MBH, 6000 MBH		1500 MBH or 2000 MBH
Fuel Type	Natural Gas or Propane		Natural Gas
Boiler Mode	Constant Setpoint, Remote Setpoint, Direct Drive, Combination, Outdoor Reset		Constant Setpoint
Remote Signal (If Mode = Remote Setpoint, Direct Drive or Combination)	4 – 20 mA/1 – 5V, 0 -20 mA/0 – 5V, PWM Input (Legacy BMS), Network		4 – 20 mA, 1-5V
Outdoor Sensor	Enabled or Disabled		Disabled
*Bldg Ref Temp (If Mode = Outdoor Reset)	40°F	230°F	70°F
*Reset Ratio (If Mode = Outdoor Reset)	0.1	9.9	1.2
*System Start Tmp (If Outdoor Sensor = Enabled)	30°F	100°F	60°F
Setpt Lo Limit	40°F	Setpt Hi Limit	60°F
Setpt Hi Limit	Setpt Lo Limit	210°F	140°F
Temp Hi Limit	40°F	210°F	160°F

*NOTE

The Bldg Ref Temp and Reset Ratio Menu Items are only displayed when the Outdoor Sensor is set to “Enabled”.

Table 3-4: Configuration Menu - *Continued*

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Max Valve Position	40%	100%	100%
Pump Delay Timer	0 min.	30 min.	0 min.
Aux Start On Dly	0 sec.	120 sec.	0 sec.
Failsafe Mode	Shutdown or Constant Setpt		Shutdown
Low Fire Timer	2 sec.	600 sec.	2 sec.
Setpt Limiting	Enabled or Disabled		Disabled
Setpt Limit Band	0°F	10°F	0
Network Timeout	5 Sec	999 Sec	30 Sec
HI DB Setpt EN	0%	100%	30%
Demand Offsert	0	25	0
Deadband High	0	25	0
Deadband Low	0	25	0

⚠ CAUTION ⚠

DO NOT **CHANGE** the Analog Output Menu Item from its Default setting (Valve Position 0-10V).

3.7 TUNING MENU

The Tuning Menu items in Table 3-5 are Factory set for each individual unit. Do not change these menu entries unless specifically requested to do so by factory-trained personnel.

Table 3-5: Tuning Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Prop Band	1°F	120°F	8°F
Integral Gain	0.00	2.00	1.6
Derivative Time	0.0 min	2.00 min	0.10 min
Warmup Prop Band	0°F	120°F	95°F
Warmup Int Gain	0	2.00	0.50
Warmup PID timer	0 sec.	240 sec.	20 sec.
Reset Defaults?	Yes, No, Are You Sure?		No

3.8 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 3-6. 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 adjusts the rotational speed of the blower to maximize combustion efficiency and ensure the unit conforms to the Nitrogen Oxide (NOx) and Carbon Monoxide (CO) emissions specified in Chapter 4. The valve positions (%) and default drive voltages are listed in Table 3-6.

Table 3-6: Combustion Cal Menu

Menu Item Display	
BMK 1500	BMK 2000
CAL Voltage 16%	CAL Voltage 14%
CAL Voltage 30%	CAL Voltage 30%
CAL Voltage 45%	CAL Voltage 45%
CAL Voltage 60%	CAL Voltage 60%
CAL Voltage 80%	CAL Voltage 80%
CAL Voltage 100%	CAL Voltage 100%
SET Valve Position	SET Valve Position
Blower Output	Blower Output
Set Stdby Volt	Set Stdby Volt
Oxygen Level	Oxygen Level

3.9 BST (Boiler Sequencing Technology) Menu

The BST Menu must be Enabled in order to be displayed and accessed. The BST Enable item is located at the end of the Configuration Menu.

The Boiler Sequencing Technology (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 3-7: BST Menu

Menu Item Display	Available Choices or Limits			Default
	Minimum		Maximum	
BST Mode	Off	BST Slave	BST Master	Off
BST Setpoint	BST Setpt Lo Limit		BST Setpt Hi Limit	130°F
Header Temp	NA			Header Temp (°F)
BST Fire Rate	0		100%	Fire rate %
BST Ave Fire Rate	0		100%	Avg Fire Rate %
BST Outdoor Temp	NA			Outdoor Temp (°F)
Units Available	0		8	Units Present
Units Ignited	0		8	Units firing
BST Valve State	0 (CLOSED)		1 (OPEN)	0
1 Comm Errors 8	0		9	0
1 BST Units 8	0 (see table)		0 (see table)	0
BST SETUP MENU	Disabled		Enabled	Disabled
BST Setpoint Mode	Constant Setpoint	Remote Setpoint	Outdoor Reset	Constant Setpt
Head Temp Source	Network		FFWD Temp	FFWD Temp
Header Temp Addr	0		255	240
Header Temp Point	0		255	14
BST Outdoor Sens	Disabled		Enabled	Disabled
Outdr Tmp Source	Outdoor Temp		Network	Outdoor Temp
Outdoor Tmp Addr	0		255	240
Outdoor Tmp Pnt	0		255	215
BST Remote Signal	4-20 mA/1-5 Vdc;	0-20 mA/0-5 Vdc;	Network	Network
BST Auto Mstr	No		Yes NOTE! A Modbus temperature transmitter must be installed in conjunction with this feature.	No
BST Auto Timer	10 sec		120 sec	30 sec
Remote Intlk Use	Boiler Shutdown		System Shutdown	System Shutdown
One Boiler Mode	Off	On-Outlet Temp	On-Avg Temp	Off
1 Blr Threshold	10		35	25
Setpoint Setback	Disable		Enable	Disable

Menu Item Display	Available Choices or Limits			Default
	Minimum		Maximum	
Setback Setpoint	BST Setpt Lo Limit		BST Setpt HI Limit	130°F
Setback Start	12:00am		11:59pm	12.00am
Setback End	12:00am		11:59pm	12.00am
Rate Threshold	1°F		30°F	15°F
BST OPERATE MENU	Disabled		Enabled	Disabled
BST Next On VP	16%		100%	50%
BST Max Boilers	1		8	8
BST On Delay	30 sec		300 sec	60 sec
BST On Timeout	15 sec		300 sec	60 Sec
Valve Override	Off	Closed	Open	Off
Valve Off Delay	0		15 min	1 min
BST Sequencing	Run Hours	Unit Size	Select Lead	Run Hours
Select Lead Unit	0		127	0
Select Lag Unit	0		127	0
Lead/Lag Hours	25 hours		225 hours	72 hours
BST TEMP CTRL MENU	Disabled		Enabled	Disabled
BST Temp Hi Limit	40°F		210°F	210°F
BST Setpt Lo Limit	40°F		BST Setpt HI Limit	60°F
BST Setpt HI Limit	BST Setpt Lo Limit		220°F	195°F
BST Prop Band	1°F		120°F	100°F
BST Intgral Gain	0.00		2.00	0.50
BST Deriv Time	0.00 Min		2.00 Min	0.10 Min
BST Deadband Hi	0		25	1
BST Deadband Lo	0		25	1
Deadband En Time	0		120 Sec	30 Sec
BST FR Up Rate	1		120	20
BST Bldg Ref Tmp	40°F		230°F	70°F
BST Reset Ratio	0.1		9.9	1.2
System Start Tmp	30°F		120°F	60°F
BST COMM MENU	Disabled		Enabled	Disabled
Comm Address	0		127	0
BST Min Addr	1		128	1
BST Max Addr	1		128	8
SSD Address	0		250	247
SSD Poll Control	0		1000	0

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Err Threshold	1	9	5
SSD Temp Format	Degrees	Points	Degrees
BST Upld Timer	0	9999 sec	0

3.10 START SEQUENCE

When the Control Box **ON/OFF** switch is set to the **ON** position, it checks all pre-purge safety switches to ensure they are closed. These switches include:

- Safety Shut-Off Valve (SSOV) Proof of Closure (POC) switch
- Low Water Level switch
- High Water Temperature switch
- High Gas Pressure switch
- Low Gas Pressure switch
- Blower Proof switch
- Blocked Inlet switch

If all of the above switches are closed, the **READY** light above the **ON/OFF** switch will light and the unit will be in the Standby mode.

When there is a demand for heat, the following events will occur:

NOTE

If any of the Pre-Purge safety device switches are open, the appropriate fault message will be displayed. Also, the appropriate messages will be displayed throughout the start sequence, if the required conditions are not observed.

1. The **DEMAND** LED status indicator will light.
2. The unit checks to ensure that the Proof of Closure (POC) switch in the downstream Safety Shut-Off Valve (SSOV) is closed. See Figure 3-3 for SSOV location.

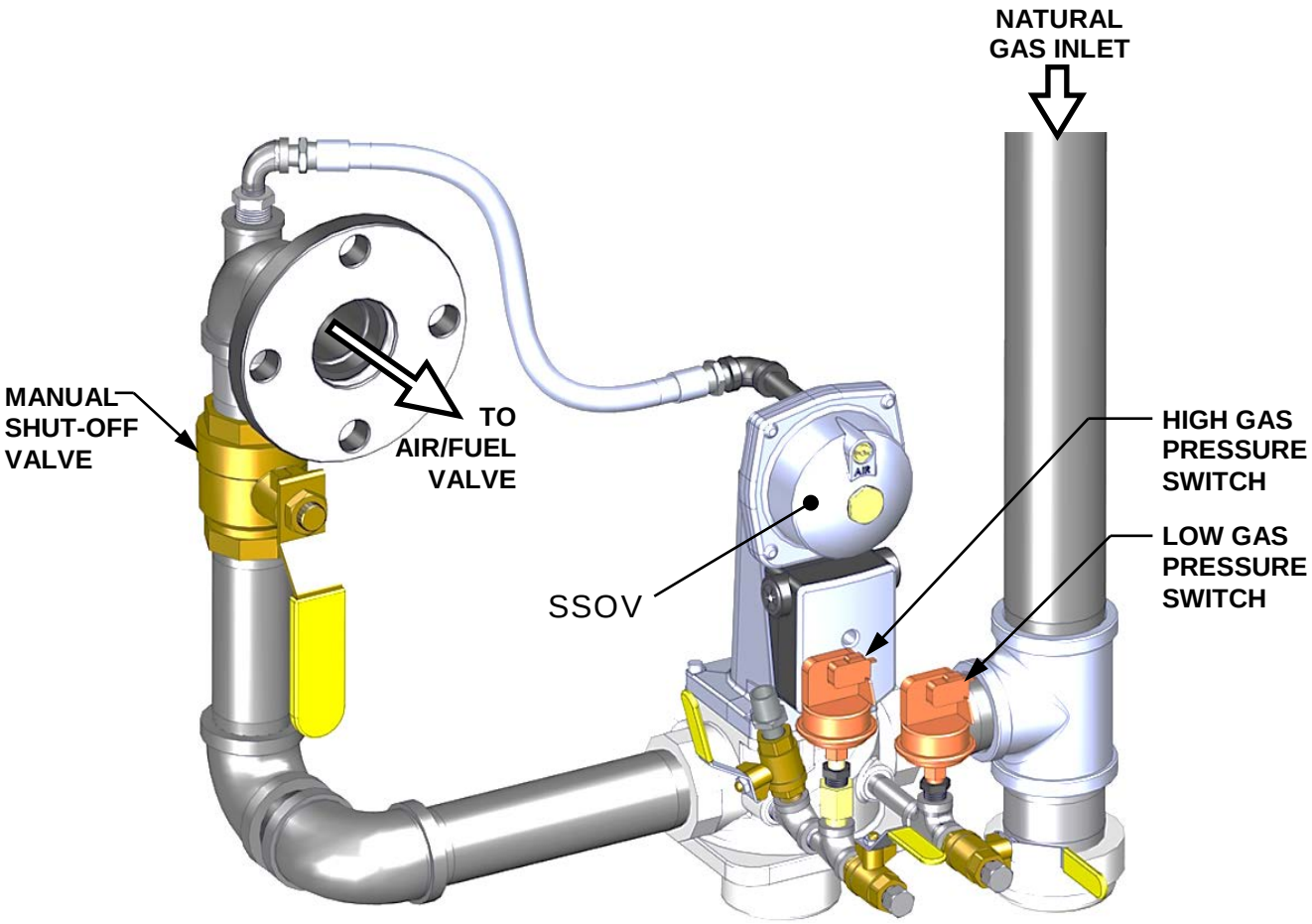


Figure 3-3: *BMK 1500/2000:* ***SSOV Location***

3. With all required safety device switches closed, a purge cycle will be initiated and the following events will occur:
    a. The Blower relay energizes and turns on the blower.
    b. The Air/Fuel Valve rotates to the full-open purge position and closes purge position switch. The dial on the Air/Fuel Valve (Figure 3-4) will read **100** to indicate that it is full-open (100%).

c. The **VALVE POSITION** bargraph will show 100%.

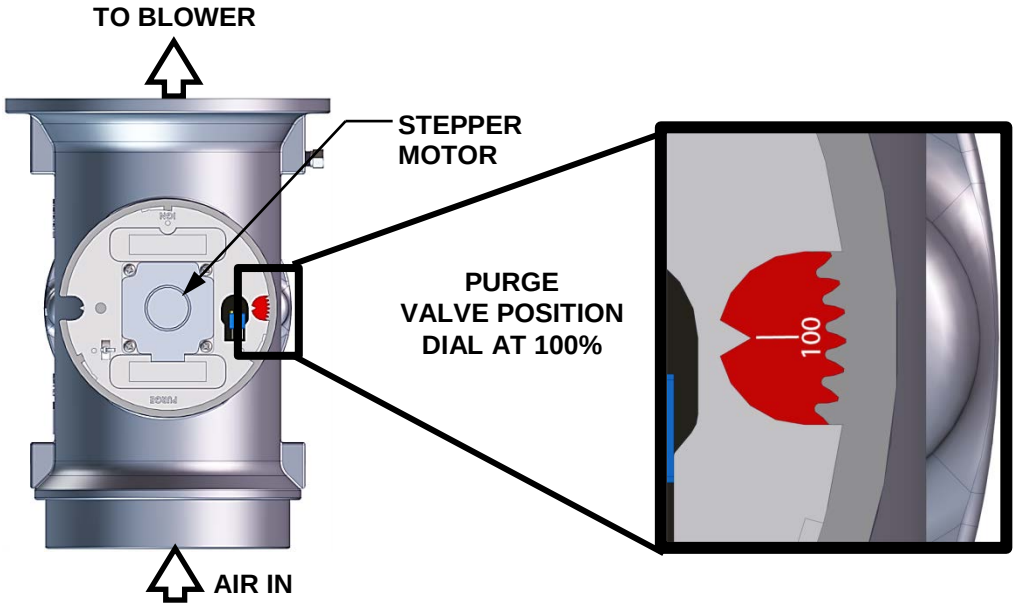


Figure 3-4: Air/Fuel Valve In Purge Position

4. Next, the blower proof switch on the Air/Fuel Valve (Figure 3-5) closes. The display will show *Purging* and indicate the elapsed time of the purge cycle in seconds.

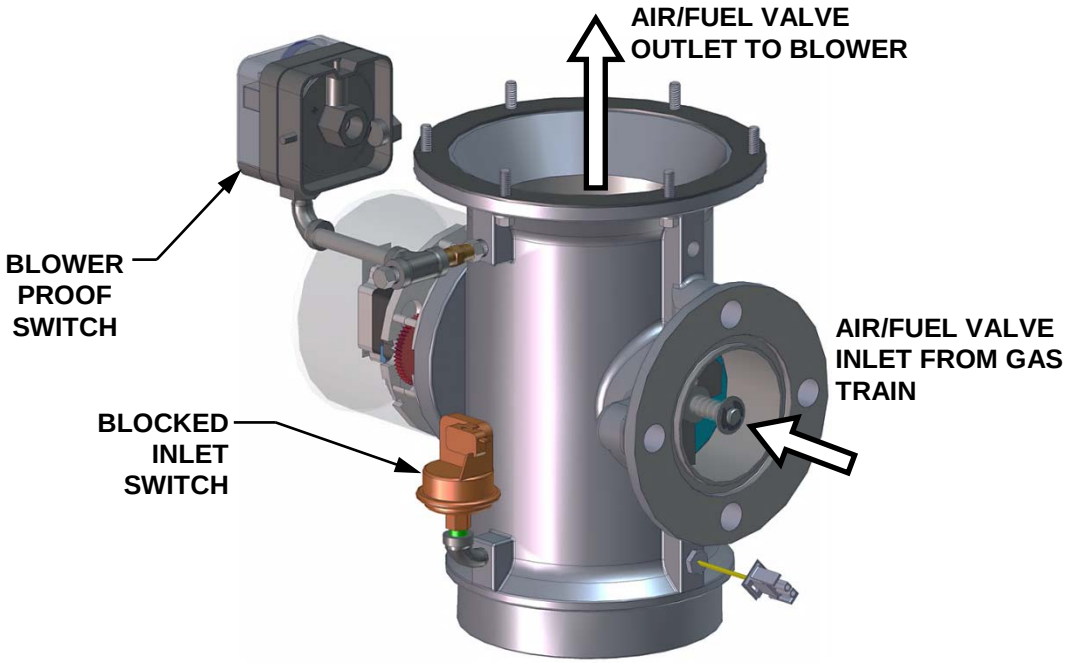


Figure 3-5: Blower Proof Switch

5. Upon completion of the purge cycle, the Control Box initiates an ignition cycle and the following events occur:

   (a) The Air/Fuel Valve rotates to the low-fire (Ignition Position) position and closes the ignition switch. The Dial on the Air/Fuel Valve (Figure 3-6) will read between **25** and **35** to indicate that the valve is in the low fire position.

(b) The "Spark Cycle Time" item in the Factory menu can be set to either 0 Sec, 2 Sec or 7 Sec to define the duration of the Spark Element Cleaning Cycle. This cycle turns on the spark transformer to produce a spark (with no gas flowing) to clean the spark element of moisture or carbon buildup.

For the duration of this cycle, the C-More will display the "CLEANING IGNITER" message.

(c) Following the Spark Element Cleaning Cycle, power is applied to the Gas Safety Shut-off Valve (SSOV) and the C-More displays the "PRE IGNITION" message. When the SSOV indicates the Gas Valve is OPEN (POC), the C-More displays the "IGNITION TRIAL" message.

(d) If no spark is present 3 seconds into the IGNITION TRIAL, the C-More will abort the Ignition Cycle and shut down the boiler. Refer to **Chapter 8: Troubleshooting** for guidance if this occurs.

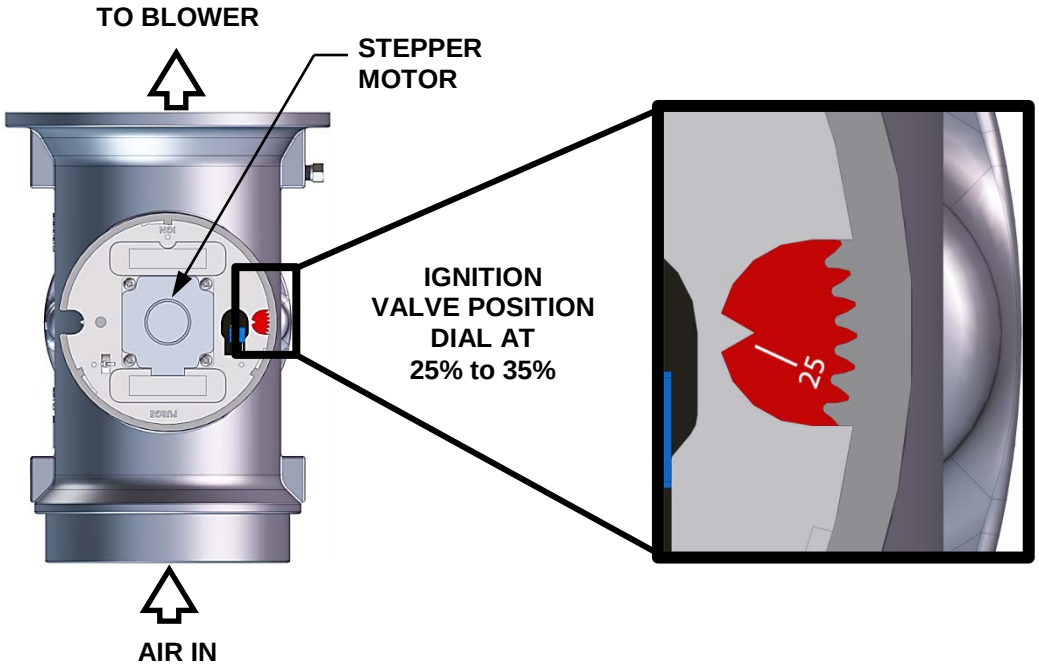


Figure 3-6: Air/Fuel Valve In Ignition Position

6. Up to 4 seconds will be allowed for ignition to be detected. The igniter relay will be turned off one second after flame is detected.
7. After 2 seconds of continuous flame, *Flame Proven* will be displayed and the flame strength will be indicated. After 5 seconds, the current date and time will be displayed in place of the flame strength.
8. With the unit firing properly, it will be controlled by the temperature controller circuitry. The boiler's **VALVE POSITION** will be continuously displayed on the front panel bargraph.

Once the demand for heat has been satisfied, the Control Box will turn off the SSOV gas valve. The blower relay will be deactivated and the Air/Fuel Valve will be closed. *Standby* will be displayed.

3.11 START/STOP LEVELS

The start and stop levels are the Air/Fuel Valve positions (% open) that start and stop the unit, based on load. These levels are Factory preset as follows:

	BMK 1500	BMK 2000
Start Level:	24%	24%
Stop Level:	16%	16%

Normally, these settings should not require adjustment.

Note that the energy input of the boiler is not linearly related to the Air/Fuel Valve position. Refer to Table 3-8 for the relationship between the energy input and Air/Fuel Valve position for a BMK 1500 MBH boiler running on natural gas.

Table 3-8a: *BMK 1500:* ***Relationship Between Air/Fuel Valve Position and Energy Input Running On Natural Gas***

Air/Fuel Valve Position (% Open)	Energy Input (BTU/Hr)	Boiler Energy Input (% of Full Capacity)
16% (Stop Level)	76,000	5.0%
20%	127,000	8.5%
30%	366,000	24.4%
40%	629,000	41.9%
50%	822,000	54.7%
60%	977,000	65.0%
70%	1,119,000	74.5%
80%	1,255,000	83.5%
90%	1,396,000	92.9%
100%	1,502,000	100%

Table 3-8b: *BMK 2000:* ***Relationship Between Air/Fuel Valve Position and Energy Input Running On Natural Gas***

Air/Fuel Valve Position (% Open)	Energy Input (BTU/Hr)	Boiler Energy Input (% of Full Capacity)
16% (Stop Level)	100,000	6.7%
20%	143,000	11%
30%	388,000	23%
40%	759,000	37%
50%	1,069,000	51%
60%	1,283,000	61%
70%	1,476,000	74%
80%	1,675,000	83%
90%	1,833,000	93%
100%	2,000,000	100%

CHAPTER 4. INITIAL START-UP

4.1 INITIAL START-UP REQUIREMENTS

The requirements for the initial start-up of the Benchmark boiler consists of the following:

- Complete installation (Chapter 2)
- Set proper controls and limits (Chapter 3)
- Perform combustion calibration (Chapter 4)
- Test safety devices (Chapter 6)

All applicable installation procedures in Chapter 2 must be fully completed prior to performing the initial start-up of the unit. The initial start-up must be successfully completed prior to putting the unit into service. Starting a unit without the proper piping, venting, or electrical systems can be dangerous and may void the product warranty. The following start-up instructions should be followed precisely in order to operate the unit safely and at a high thermal efficiency, with low flue gas emissions.

Initial unit start-up must be performed ONLY by AERCO factory trained start-up and service personnel. After performing the start-up procedures in this Chapter, it will be necessary to perform the Safety Device Testing procedures specified in Chapter 6 to complete all initial unit start-up requirements.

An AERCO Gas Fired Startup Sheet, included with each Benchmark, must be completed for each unit for warranty validation and a copy must be returned promptly to AERCO at:

AERCO International, Inc.
100 Oritani Drive
Blauvelt, New York 10913
(FAX: 845-580-8090)

⚠ WARNING ⚠

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.

NOTE

ALL APPLICABLE INSTALLATION PROCEDURES IN CHAPTER 2 MUST BE COMPLETED BEFORE ATTEMPTING TO START THE UNIT.

4.2 TOOLS AND INSTRUMENTATION FOR COMBUSTION CALIBRATION

To properly perform combustion calibration, the proper instruments and tools must be used and correctly attached to the unit. The following sections outline the necessary tools and instrumentation as well as their installation.

4.2.1 Required Tools & Instrumentation

The following tools and instrumentation are necessary to perform combustion calibration of the unit:

- Digital Combustion Analyzer: Oxygen accuracy to ± 0.4%; Carbon Monoxide (CO) and Nitrogen Oxide (NOx) resolution to 1PPM.
- 16 inch W.C. manometer or equivalent gauge and plastic tubing.
- 1/4 inch NPT-to-barbed fittings for use with gas supply manometer or gauge.
- Small and large flat blade screwdrivers.
- Tube of silicone adhesive

4.2.2 Installing Gas Supply Manometer

The gas supply manometer (or gauge) is used to monitor the gas pressure on the downstream side of the SSOV during the Combustion Calibration procedures described in section 4.3.

The gas supply manometer is installed at the upstream and/or downstream location shown in Figure 4-1.

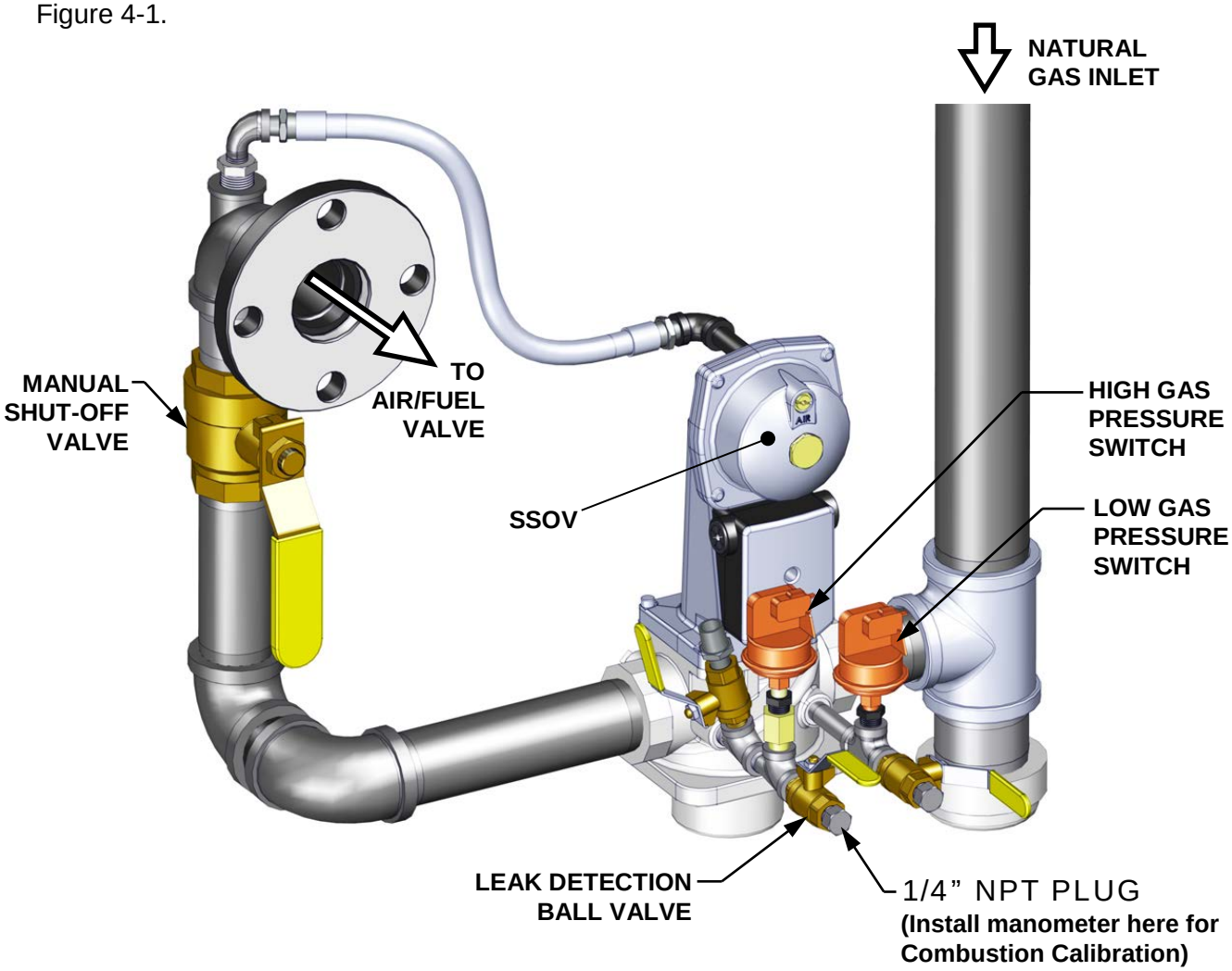


Figure 4-1: BMK 1500/2000: ***1/4 Inch Gas Plug Location for Combustion Calibration***

Install the 16” W.C. manometer(s) as described in the following steps:

Installing Gas Supply Manometer

1. Turn off the main gas supply upstream of the unit.
2. Remove the top panel and front panel from the boiler to access the gas train components.
3. To monitor the gas pressure on the downstream side of the SSOV during Combustion Calibration (section 4.3), remove the 1/4” NPT plug from the leak detection ball valve on the downstream side of the SSOV as shown in Figure 4-1.
4. Install a NPT-to-barbed fitting into the tapped plug port.
5. Attach one end of the plastic tubing to the barbed fitting and the other end to the 16” W.C. manometer.

4.2.3 Accessing the Analyzer Probe Port

The unit contains a 1/4” NPT port on the side of the exhaust manifold as shown in Figure 4-2. Prepare the port for the combustion analyzer probe as follows:

Accessing the Analyzer Probe Port

1. Refer to Figure 4-2 and remove the 1/4” NPT plug from the exhaust manifold.
2. If necessary, adjust the stop on the combustion analyzer probe so it will extend mid-way into the flue gas flow. DO NOT install the probe at this time.

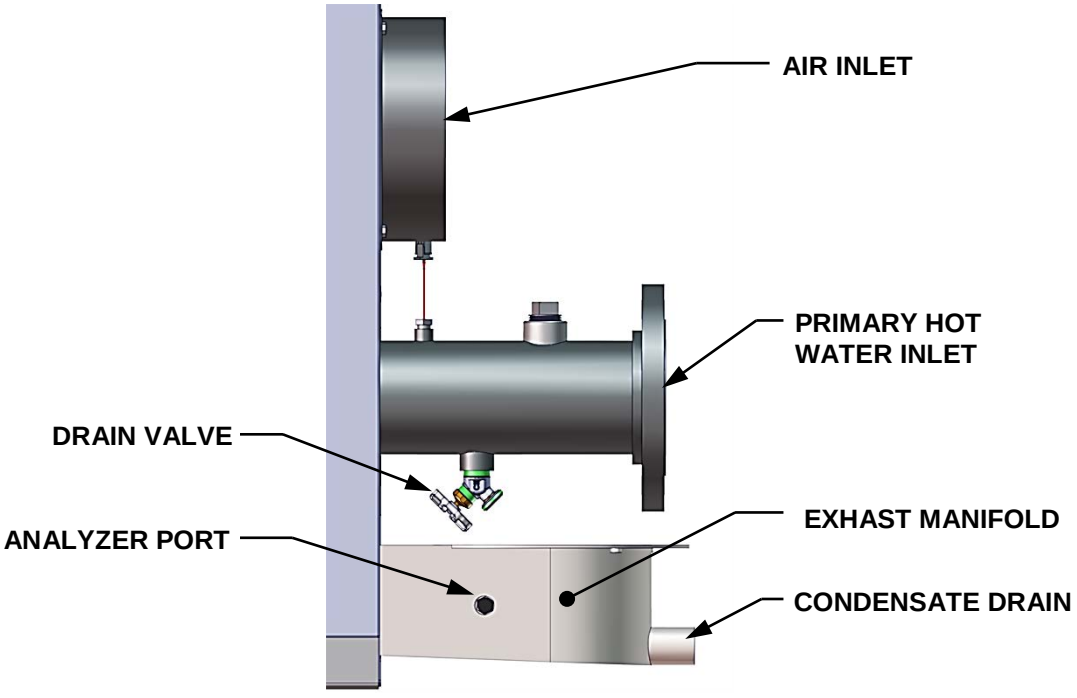


Figure 4-2: Analyzer Probe Port Location (Right Side Partial View)

4.3 NATURAL GAS COMBUSTION CALIBRATION

The Benchmark boiler is combustion calibrated at the factory prior to shipping. This gas pressure must be within the following ranges for each model of boiler **at full fire**:

BMK Boiler Model	Nominal Gas Pressure
BMK 1500	3.6" W.C. ±0.2" W.C.
BMK 2000	3.9" W.C. ±0.2" W.C.

Recalibration as part of initial start-up is necessary due to changes in the local altitude, gas BTU content, gas supply piping and supply regulators. Combustion Calibration Test Data sheets are shipped with each unit. These sheets must be filled out and returned to AERCO for proper Warranty Validation.

It is important to perform the following procedure as outlined. This will keep readjustments to a minimum and provide optimum performance.

Instructions for natural gas combustion calibration follow, with the BMK 1500 instructions first, followed by the BMK 2000 instructions.

BMK 1500 Natural Gas Combustion Calibration

1. Open the water supply and return valves to the unit and ensure that the system pumps are running.
2. Open the natural gas supply valve to the unit.
3. Set the control panel **ON/OFF** switch to the **OFF** position
4. Turn on external ac power to the unit. The display will show loss of power and the time and date.
5. Set the unit to the manual mode by pressing the **AUTO/MAN** key. A flashing manual valve position message will be displayed with the present position in %**.** Also, the **MANUAL** LED will light.
6. Adjust the air/fuel valve position to 0% by pressing the ▼ arrow key.
7. Ensure that the leak detection ball valve downstream of the SSOV is open.
8. Set the **ON/OFF** switch to the **ON** position**.**
9. Change the valve position to 30% using the ▲ arrow key. The unit should begin its start sequence and fire.
10. Next, verify that the gas pressure downstream of the SSOV is set to 3.6 ± 0.2" W.C. If gas pressure adjustment is required, remove the brass hex nut on the SSOV actuator to access the gas pressure adjustment screw (Figure 4-3). Make gas pressure adjustments using a flat-tip screwdriver to obtain a gas pressure approximately 3.6" W.C. ± 0.2" W.C.
11. Using the ▲ arrow key, increase the valve open position to 100%. Verify that the gas pressure on the downstream side of the SSOV settles within the range of 3.6 ± 0.1" W.C. Readjust the gas pressure if necessary.
12. With the valve position at 100%, insert the combustion analyzer probe into the flue probe opening and allow enough time for the combustion analyzer reading to stabilize.

BMK 1500 Natural Gas Combustion Calibration (Cont.)

13. Compare the oxygen readings on the combustion analyzer to the on-board O_2 sensor value displayed in the Operating Menu of the C-More Control Panel. If the values differ by more than ±1.5% and your combustion analyzer is correctly calibrated, the on-board O2 sensor may be defective and need to be replaced.
14. Compare the measured oxygen level to the oxygen range shown below. Also, ensure that the nitrogen oxide (NOx) and carbon monoxide (CO) readings do not exceed the values shown. If you are not in a "NOx-limited" area and/or do not have a NOx measurement in your analyzer, set the oxygen (O_2) at 5.5% ± 0.5%.

Combustion Calibration Readings – 100% valve Position

Valve Position	Oxygen (O_2) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
100%	5.0% - 6.0%	≤20 ppm	<100 ppm

15. If the oxygen level is not within the required tolerance, the gas pressure on the downstream side of the SSOV must be adjusted using the gas pressure adjustment screw on the SSOV (Figure 4-3). Slowly rotate the gas pressure adjustment (approximately 1/4-turn increments). Allow the combustion analyzer to stabilize following each adjustment. Clockwise rotation reduces the oxygen level, while counterclockwise rotation increases the oxygen level.
16. Once the oxygen level is within the specified range at 100%, record the O_2, NOx and CO readings on the Combustion Calibration Data Sheets provided with the unit.
17. Lower the valve position to 80% using the ▼arrow key.

NOTE

The remaining combustion calibration steps are performed using the *Combustion Cal Menu* included in the C-More Control System. The combustion calibration control functions will be used to adjust the oxygen level (%) at valve positions of 80%, 60%, 45%, 30% and 16% as described in the following steps. These steps assume that the inlet air temperature is within the range of 50°F to 100°F. If NOx readings exceed the target values shown, increase the O_2 level up to 1% higher than the listed calibration range. Record the increased O_2 value on the Combustion Calibration sheet.

18. Press the **MENU** key on the front panel of the C-MORE and access the *Setup* menu. Enter password 6817 and then press the **ENTER** key.
19. Press the **MENU** key on the front panel of the C-MORE until *Combustion Cal Menu* appears on the display.
20. Press the ▲ arrow key until *SET Valve Position* appears on the display.
21. Press the **CHANGE** key. *SET Valve Position* will begin to flash.
22. Press the ▲ arrow key until the *SET Valve Position* reads *80%*. Press the **ENTER** key.
23. Next, press the down (▼) arrow key until *CAL Voltage 80%* is displayed.
24. Press the **CHANGE** key and observe that *CAL Voltage 80%* is flashing.

BMK 1500 Natural Gas Combustion Calibration (Cont.)

25. The oxygen level at the 80% valve position should be as shown below. Also, ensure that the nitrogen oxide (NOx) and carbon monoxide (CO) readings do not exceed the following values:

Combustion Calibration Readings – 80% valve Position

Valve Position	Oxygen (O_2) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
80%	5.9% ± 0.5%	≤20 ppm	<100 ppm

26. If the oxygen level is not within the specified range, adjust the level using the ▲ and ▼ arrow keys. This will adjust the output voltage to the blower motor as indicated on the display. Pressing the ▲ arrow key increases the oxygen level and pressing the down ▼ arrow key decreases the oxygen level.
27. Once the oxygen level is within the specified range at 80%, press the **ENTER** key to store the selected blower output voltage for the 80% valve position. Record all readings on the Combustion Calibration Sheets provided.
28. Repeat steps 20 through 27 for valve positions of 60%, 45%, 30% and 16%. The oxygen (O_2), nitrogen oxide (NOx) and carbon monoxide (CO) should remain within the same limits for all valve positions as shown in the following table.

NOTE

If NOx readings exceed the target values shown (<20 ppm), increase the O_2 level up to 1% higher than the listed calibration range shown in the table. Record the increased O_2 value on the Combustion Calibration sheet.

Combustion Calibration Readings

Valve Position	Oxygen (O_2) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
60%	6.0% ± 0.5	<20 ppm	<100 ppm
45%	6.3% ± 0.5	<20 ppm	<100 ppm
30%	6.3% ± 0.5	<20 ppm	<100 ppm
16%	6.0% ± 0.5	<20 ppm	<100 ppm

29. If the oxygen level at the 16% valve position is too high and the Blower voltage is at the minimum value, you can adjust the idle screw (TAC valve) which is recessed in the top of the Air/Fuel Valve (see Figure 4-4). Rotate the screw 1/2 turn clockwise (CW) to add fuel and reduce the O_2 to the specified level. Recalibration MUST be performed again from 60% down to 16% after making a change to the idle screw (TAC valve).
30. **This completes the BMK 1500 Natural Gas combustion calibration procedures.**

Figure 4-3: Gas Pressure Adjustment Screw Location

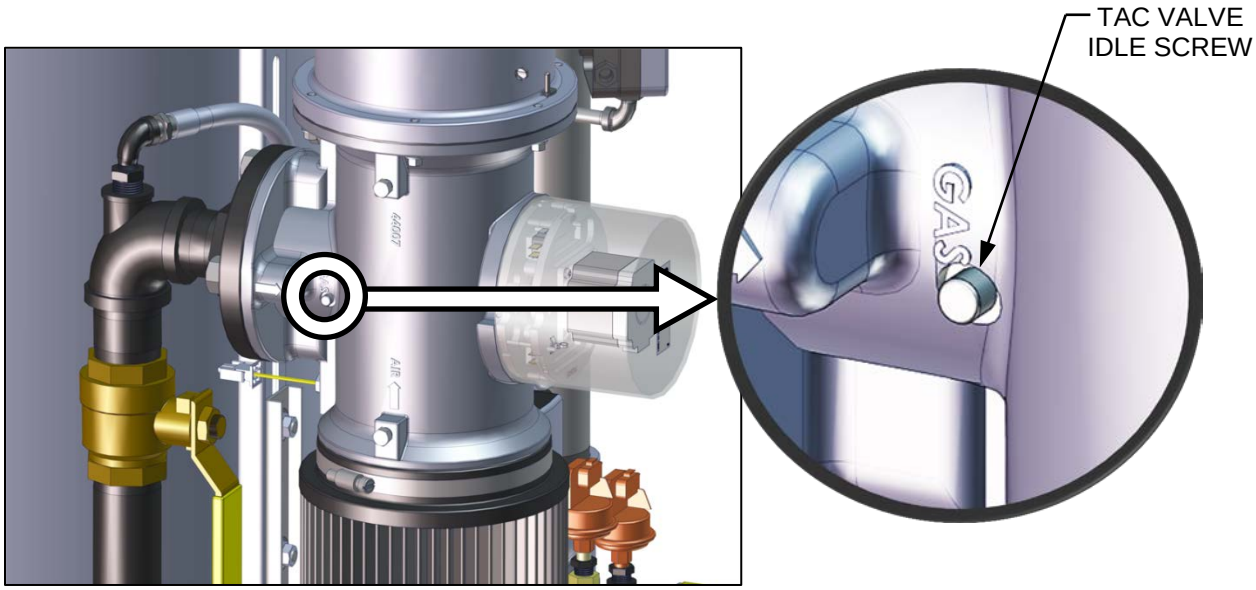


Figure 4-4: TAC Valve Adjust (Idle Screw)

BMK 2000 Natural Gas Combustion Calibration

1. Open the water supply and return valves to the unit and ensure that the system pumps are running.
2. Open the natural gas supply valve to the unit.
3. Set the control panel **ON/OFF** switch to the **OFF** position
4. Turn on external ac power to the unit. The display will show loss of power and the time and date.
5. Set the unit to the manual mode by pressing the **AUTO/MAN** key. A flashing manual valve position message will be displayed with the present position in %**.** Also, the **MANUAL** LED will light.
6. Adjust the air/fuel valve position to 0% by pressing the ▼ arrow key.
7. Ensure that the leak detection ball valve downstream of the SSOV is open.
8. Set the **ON/OFF** switch to the **ON** position**.**
9. Change the valve position to 30% using the ▲ arrow key. The unit should begin its start sequence and fire.
10. Next, verify that the gas pressure downstream of the SSOV is set to 3.9 ± 0.2" W.C. If gas pressure adjustment is required, remove the brass hex nut on the SSOV actuator to access the gas pressure adjustment screw (Figure 4-3). Make gas pressure adjustments using a flat-tip screwdriver to obtain a gas pressure within the range of 3.9" W.C. ± 0.2" W.C.
11. Using the ▲ arrow key, increase the valve open position to 100%. Verify that the gas pressure on the downstream side of the SSOV settles within the range of 3.9 ± 0.2" W.C. Readjust the gas pressure if necessary.
12. With the valve position at 100%, insert the combustion analyzer probe into the flue probe opening and allow enough time for the combustion analyzer reading to stabilize.
13. Compare the oxygen readings on the combustion analyzer to the on-board O_2 sensor value displayed in the Operating Menu of the C-More Control Panel. If the values differ by more than ±1.5% and your combustion analyzer is correctly calibrated, the on-board O2 sensor may be defective and need to be replaced.
14. Compare the measured oxygen level to the oxygen range shown below. Also, ensure that the nitrogen oxide (NOx) and carbon monoxide (CO) readings do not exceed the values shown. If you are not in a "NOx-limited" area and/or do not have a NOx measurement in your analyzer, set the oxygen (O_2) at 5.5% ± 0.5%.

Combustion Calibration Readings – 100% valve Position

Valve Position	Oxygen (O_2) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
100%	5.0% - 6.0%	≤20 ppm	<100 ppm

BMK 2000 Natural Gas Combustion Calibration (Cont.)

15. If the oxygen level is not within the required tolerance, the gas pressure on the downstream side of the SSOV must be adjusted using the gas pressure adjustment screw on the SSOV (Figure 4-3). Slowly rotate the gas pressure adjustment (approximately 1/4-turn increments). Allow the combustion analyzer to stabilize following each adjustment. Clockwise rotation reduces the oxygen level, while counterclockwise rotation increases the oxygen level.
16. Once the oxygen level is within the specified range at 100%, record the O_2, NOx and CO readings on the Combustion Calibration Data Sheets provided with the unit.
17. Lower the valve position to 80% using the ▼arrow key.

NOTE

The remaining combustion calibration steps are performed using the *Combustion Cal Menu* included in the C-More Control System. The combustion calibration control functions will be used to adjust the oxygen level (%) at valve positions of 80%, 50%, 40%, 30% and 14% as described in the following steps. These steps assume that the inlet air temperature is within the range of 50°F to 100°F. If NOx readings exceed the target values shown, increase the O_2 level up to 1% higher than the listed calibration range. Record the increased O_2 value on the Combustion Calibration sheet.

18. Press the **MENU** key on the front panel of the C-MORE and access the *Setup* menu. Enter password 6817 and then press the **ENTER** key.
19. Press the **MENU** key on the front panel of the C-MORE until *Combustion Cal Menu* appears on the display.
20. Press the ▲ arrow key until *SET Valve Position* appears on the display.
21. Press the **CHANGE** key. *SET Valve Position* will begin to flash.
22. Press the ▲ arrow key until the *SET Valve Position* reads *80%*. Press the **ENTER** key.
23. Next, press the down (▼) arrow key until *CAL Voltage 80%* is displayed.
24. Press the **CHANGE** key and observe that *CAL Voltage 80%* is flashing.
25. The oxygen level at the 80% valve position should be as shown below. Also, ensure that the nitrogen oxide (NOx) and carbon monoxide (CO) readings do not exceed the following values:

Combustion Calibration Readings @ 80% Valve Position

Valve Position	Oxygen (O_2) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
80%	5.9% ± 0.5%	≤20 ppm	<100 ppm

26. If the oxygen level is not within the specified range, adjust the level using the ▲ and ▼ arrow keys. This will adjust the output voltage to the blower motor as indicated on the display. Pressing the ▲ arrow key increases the oxygen level and pressing the down ▼ arrow key decreases the oxygen level.

BMK 2000 Natural Gas Combustion Calibration (Cont.)

27. Once the oxygen level is within the specified range at 80%, press the **ENTER** key to store the selected blower output voltage for the 80% valve position. Record all readings on the Combustion Calibration Sheets provided.
28. Repeat steps 20 through 27 for valve positions of 80%, 50%, 40%, 30% and 14%. The oxygen (O_2), nitrogen oxide (NOx) and carbon monoxide (CO) should remain within the same limits for all valve positions as shown in the following table.

NOTE

If NOx readings exceed the target values shown (<20 ppm), increase the O_2 level up to 1% higher than the listed calibration range shown in the table. Record the increased O_2 value on the Combustion Calibration sheet.

Combustion Calibration Readings

Valve Position	Oxygen (O_2) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
60%	6.0% ± 0.5	<20 ppm	<100 ppm
45%	6.3% ± 0.5	<20 ppm	<100 ppm
30%	6.3% ± 0.5	<20 ppm	<100 ppm
16%	6.0% ± 0.5	<20 ppm	<100 ppm

29. If the oxygen level at the 14% valve position is too high and the Blower voltage is at the minimum value, you can adjust the idle screw (TAC valve) which is recessed in the top of the Air/Fuel Valve (see Figure 4-4). Rotate the screw 1/2 turn clockwise (CW) to add fuel and reduce the O_2 to the specified level. Recalibration MUST be performed again from 60% down to 16% after making a change to the idle screw (TAC valve).
30. **This completes the BMK 2000 Natural Gas combustion calibration procedures.**

4.4 REASSEMBLY

Once the combustion calibration adjustments are properly set, the unit can be reassembled for service operation.

Reassembly

1. Set the **ON/OFF** switch in the **OFF** position.
2. Disconnect AC power from the unit.
3. Shut off the gas supply to the unit.
4. Remove the manometer and barbed fittings and reinstall the NPT plug using a suitable pipe thread compound.
5. Remove the combustion analyzer probe from the 1/4” vent hole in the exhaust manifold. Replace the 1/4” NPT plug in the manifold.
6. Replace all previously removed sheet metal enclosures on the unit.
7. **This concludes reassembly of the unit after combustion calibration.**

4.5 OVER-TEMPERATURE LIMIT SWITCHES

The unit contains three (3) types of over-temperature limit switches. These switches consist of a manual reset switch, a rotary dial adjustable switch and a digital alarm switch. These switches are mounted on a plate as shown in Figure 4-5. The switches can be accessed by opening the front panel door of the unit.

The manual reset switch is not adjustable and is permanently fixed at 210°F. This switch will shut down and lock out the boiler if the water temperature exceeds 210°F. Following an over-temperature condition, it must be manually reset by pressing the manual reset button shown in Figurer 4-5 before the boiler can be restarted.

The rotary dial over-temperature switch is manually adjustable from xxx to yyy ºF. This switch allows the boiler to restart, once the temperature drops below the selected temperature setting on the dial. Set the dial on this over-temperature switch to the desired setting.

The digital alarm switch shown in Figures 4-5 and 4-6 is preset at the factory to 210ºF and should not be changed. If an over-temperature condition is detected, this switch automatically shuts down the boiler and sounds an audible alarm. If desired, the over-temperature alarm switch settings can be checked or adjusted using the procedure in section 4.5.1.

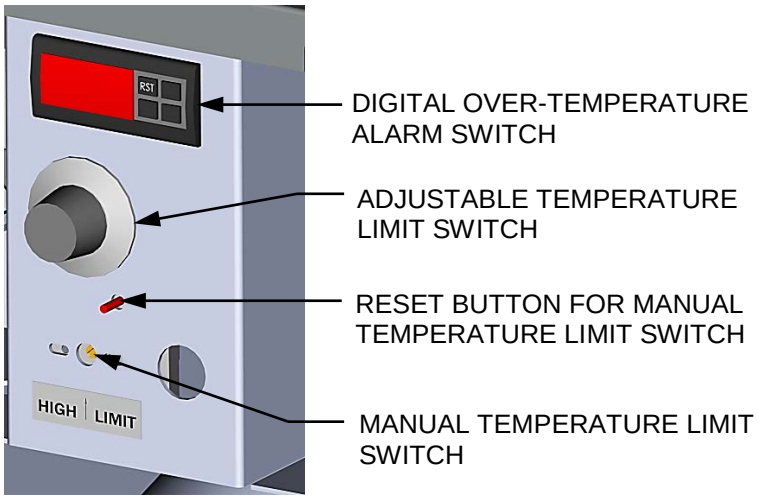


Figure 4-5: Over-Temperature Limit Switch Locations

4.5.1 Digital Alarm Switch Checks and Adjustments

The digital alarm switch settings can be checked or adjusted using the controls and display on the front panel of the switch illustrated and described in Figure 4-6 and Table 4-1.

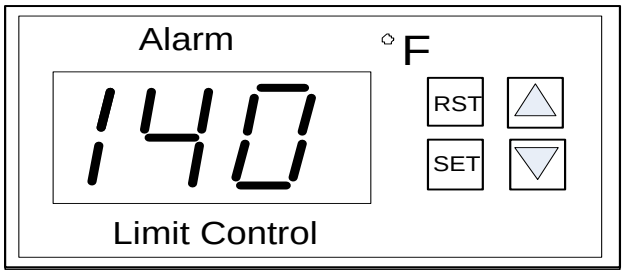


Figure 4-6: Digital Over-Temperature Alarm Switch Front Panel

Table 4-1: Digital Alarm Switch Controls and Display

CONTROL OR DISPLAY	MEANING	FUNCTION
LED Display	TEMP status	Displays current water temperature or setpoint.
RST	RESET Button	Resets the unit after an alarm condition.
△	UP Button	Increases the displayed temperature.
▽	DOWN Button	Decreases the displayed temperature.
SET	SET Button	Used to access and store parameters in the unit.

Perform the following steps to check or adjust the digital alarm switch settings:

Digital Alarm Settings

1. Set the **ON/OFF** to the ON position.
2. Press the **SET** button on the Digital Alarm Switch. *SP* will appear in the display.
3. Press the **SET** button again. The current over-temperature limit value stored in memory will be displayed. (default = 210°F).
4. If the display does not show the required over-temperature alarm setting, press the ▲ or ▼ arrow button to change the display to the desired temperature setting.
5. Once the desired over-temperature alarm setting (210ºF) is displayed, press the **SET** button to store the setting in memory.
6. To calibrate the offset (P1), press and hold the **SET** button for 8 seconds on the Digital Alarm Switch. Access code value 0 should appear in the display. The switch comes from the factory with the code set at 0. AERCO recommends that you do not change this code.
7. Press the **SET** button again to enter the code. The first parameter label (*SP*) will appear in the display.
8. Using the ▲ and ▼ arrow keys, select parameter P1.
9. Press **SET** to view the value stored in memory.
10. If the desired value is not displayed, modify the setting using the ▲ and ▼ arrow keys. The value can be changed from -10° to +10° offset. Press **SET** to enter the value and exit to the text parameter.
11. To exit the programming mode, press the **SET** and ▼ buttons simultaneously, or simply wait one minute and the display will automatically exit the programming mode.
12. Once the programming mode has been exited, the display will show the current outlet water temperature of the boiler.

CHAPTER 5. MODE OF OPERATION

5.1 INTRODUCTION

The boiler is capable of being operated in any one of six different modes. The following sections in this Chapter 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. A complete listing and descriptions of the temperature related parameters are included in Appendix A. Factory defaults are listed in Appendix D. After reading this chapter, parameters can be customized to suit the needs of the specific application.

5.2 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.

5.2.1 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.

5.2.2 Building Reference Temperature

This is a temperature from 40°F to 230°F. 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, then at an outside temperature of 69°F, the supply header temperature will increase by 1.6° to 71.6°F.

5.2.3 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 two hundred feet 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 Chapter 2, section 2.9.1 for additional wiring information.

5.2.4 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 Startup

1. Refer to the Indoor/Outdoor reset ratio charts in Appendix F.
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 3.3 for detailed instructions on menu changing.
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. This completes

5.3 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. For descriptions of temperature-related functions and their factory defaults, see Appendices A and E.

5.3.1 Setting the Setpoint

The setpoint temperature of the unit is adjustable from 40°F to 240°F. To set the unit for operation in the Constant Setpoint Mode, the following menu settings must be made in the Configuration Menu:

Menu Option	Setting
Boiler Mode	Constant Setpoint
Internal Setpt	Select desired setpoint using ▲ and ▼ arrow keys (40°F to 240°F)

Refer to section 3.3 for detailed instructions on changing menu options.

5.4 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 setpoint while a 20 mA /5V signal is equal to a 240°F setpoint. When a 0 to 20 mA/0 to 5 Vdc signal is used, 0 mA is equal to a 40°F 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 Control Panel Assembly. Contact your local AERCO representative for details.

In order to enable the Remote Setpoint Mode, the following menu setting must be made in the Configuration Menu:

Menu Option	Setting
Boiler Mode	Remote Setpoint
Remote Signal	4-20mA/1-5V, 0-20mA/0-5V, or Network

Refer to section 3.3 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. For descriptions of temperature-related functions and their factory defaults, refer to Appendices A and E.

5.4.1 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.

5.4.2 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.

5.5 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 Control Box Assembly. Contact your local AERCO representative for details.

To enable the Direct Drive Mode, the following menu setting must be made in the Configuration Menu:

Menu Option	Setting
Boiler Mode	Direct Drive
Remote Signal	4-20mA/1-5V, 0-20mA/0-5V, or Network

Refer to section 3.3 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.

5.5.1 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.

5.5.2 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.

5.6 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 BST (see Chapter 10).

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 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, the following menu settings must be made in the Configuration Menu:

Menu Option	Setting
Boiler Mode	Direct Drive
Remote Signal	Network (RS-485)

Refer to section 3.3 for instructions on changing menu options.

5.6.1 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.

5.6.2 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.

5.7 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.

5.7.1 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.

5.7.2 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. The setpoint is adjustable from 40°F to 190°F.

Enter the following settings in the Configuration Menu:

Menu Option	Setting
Boiler Mode	Combination
Remote Signal	Network
Internal Setpt	40°F to 190°F

Refer to section 3.3 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 Appendix D.

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.

(This Page Is Intentionally Blank)

CHAPTER 6. SAFETY DEVICE TESTING

6.1 TESTING OF SAFETY DEVICES

Periodic safety device testing is required to ensure that the control system and safety devices are operating properly. The boiler control system comprehensively monitors all combustion-related safety devices before, during and after the start sequence. The following tests check to ensure that the system is operating as designed.

Operating controls and safety devices should be tested on a regular basis or following service or replacement. All testing must conform to local codes such as ASME CSD-1.

NOTE

MANUAL and AUTO modes of operation are required to perform the following tests. For a complete explanation of these modes, see Chapter 3.

NOTE

It will be necessary to remove the front door and side panels from the unit to perform the following tests.

⚠ WARNING ⚠

ELECTRICAL VOLTAGES IN THIS SYSTEM MAY INCLUDE 208-230 OR 460, 120 AND 24 VOLTS AC. POWER MUST BE REMOVED PRIOR TO PERFORMING WIRE REMOVAL OR OTHER TEST PROCEDURES THAT CAN RESULT IN ELECTRICAL SHOCK.

6.2 LOW GAS PRESSURE FAULT TEST

To simulate a low gas pressure fault, refer to Figure 6-1a and perform the following steps:

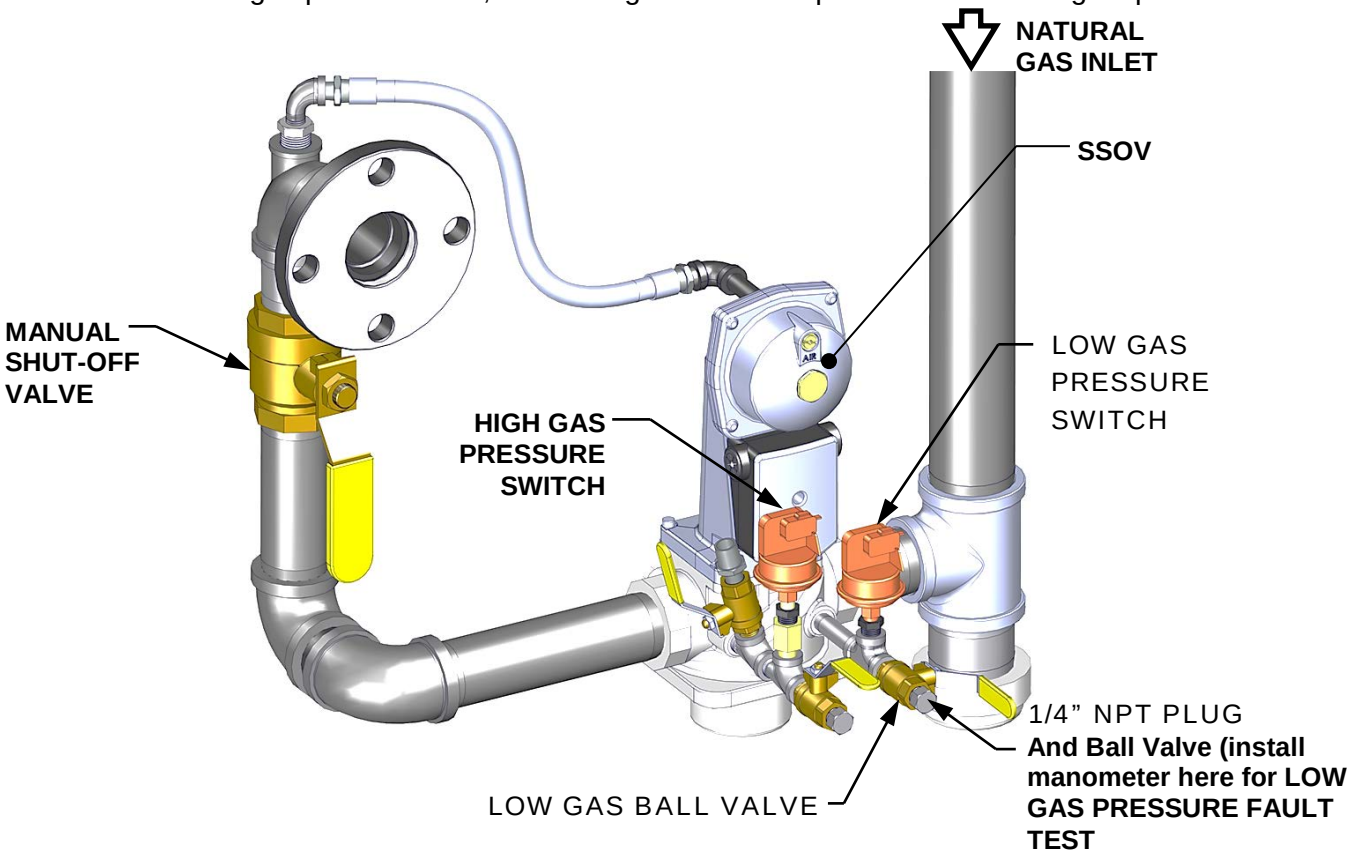


Figure 6-1a: BMK 1500/2000: ***Low Gas Pressure Test***

Low Gas Pressure Fault Test

1. Close the leak detection ball valve located at the low gas pressure switch (see Figure 6-1a).
2. Remove the 1/4“ plug from the ball valve at the low gas pressure switch shown in the lower portion of Figure 6-1a.
3. Install a 0 – 16“ W.C. manometer or a W.C. gauge where the 1/4" plug was removed.
4. Slowly open the ball valve near the low gas pressure switch.
5. Place the unit in Manual Mode and adjust the Air/Fuel Valve position (% open) between 25 and 30%.
6. While the unit is firing, slowly close the external manual gas shut-off valve.
7. The unit should shut down and display a *GAS PRESSURE* fault message at approximately: **3.6” W.C.** for both **BMK 1500 and BMK 2000**.
8. Fully open the external manual gas shut-off valve and press the **CLEAR** button on the Control Box.
9. The fault message should clear and the **FAULT** indicator should go off. The unit should restart.
10. Upon test completion, close the ball valve and remove the manometer. Replace the 1/4“ plug removed in step 1.

6.3 HIGH GAS PRESSURE TEST

To simulate a high gas pressure fault, refer to Figure 6-1b and perform the following steps:

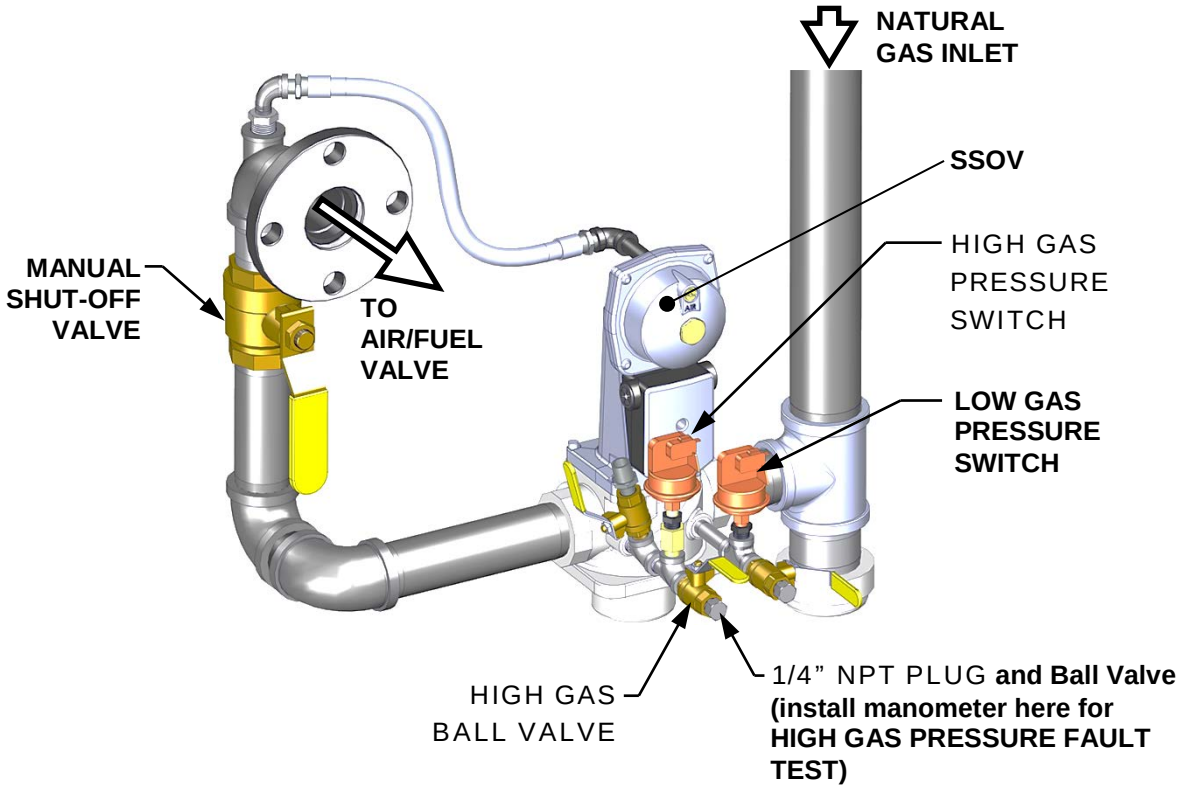


Figure 6-1b: BMK 1500/2000: ***High Gas Pressure Fault Test***

High Gas Pressure Test

1. Close the leak detection ball valve located at the high gas pressure switch (see Figure 6-1b).
2. Remove the 1/4“ plug from the leak detection ball valve shown in Figure 6-1b.
3. Install a 0 – 16” W.C. manometer (or W.C. gauge) where the 1/4” plug was removed.
4. Slowly open the leak detection ball valve.
5. Start the unit in Manual mode at a valve position (firing rate) between 25 and 30%.
6. With the unit running, monitor the gas pressure on the manometer installed in step 2 and record the gas pressure reading.
7. Slowly increase the gas pressure using the adjustment screw on the SSOV (see Figure 4-3).
8. The unit should shut down and display a *HIGH GAS PRESSURE* fault message when the gas pressure exceeds **4.7” W.C.** for both **BMK 1500 and BMK 2000.** The **FAULT** indicator should also start flashing.
9. Reduce the gas pressure back to the value recorded in step 5. This pressure should be within the range of **3.6” ± 0.2” W.C. for BMK 1500** and **3.9” ± 0.2” W.C. for BMK 2000**.
10. Press the **CLEAR** button on the Control Box to clear the fault.
11. The fault message should clear and the **FAULT** indicator should go off. The unit should restart.
12. Upon test completion, close the ball valve and remove the manometer. Replace the 1/4“ plug removed in step 1.

6.4 LOW WATER LEVEL FAULT TEST

To simulate a low water level fault, proceed as follows:

Low Water Level Fault

1. Set the **ON/OFF** switch to the **OFF** position
2. Close the water shut-off valves in the supply and return piping to the unit.
3. Slowly open the drain valve on the rear of the unit. If necessary the unit's relief valve may be opened to aid in draining.
4. Continue draining the unit until a *LOW WATER LEVEL* fault message is displayed and the **FAULT** indicator flashes.
5. Place the unit in the Manual Mode and raise the valve position above 30%.
6. Set the **ON/OFF** switch to the **ON** position. The **READY** light should remain off and the unit should not start. If the unit does start, shut the unit off immediately and refer fault to qualified service personnel.
7. Close the drain and pressure relief valve used in draining the unit.
8. Open the water shut-off valve in the return piping to the unit.
9. Open the water supply shut-off valve to the unit to refill.
10. After the shell is full, press the **LOW WATER LEVEL RESET** button to reset the low water cutoff.
11. Press the **CLEAR** button to reset the **FAULT** LED and clear the displayed error message.
12. Set the ON/OFF switch to the ON position. The unit is now ready for operation.

6.5 WATER TEMPERATURE FAULT TEST

A high water temperature fault is simulated by adjusting the automatic over-temperature switch. This switch is accessible from the front of the unit as shown in Figure 6-2.

Water Temperature Fault Test

1. Start the unit in the normal operating mode. Allow the unit to stabilize at its setpoint.
2. Lower the adjustable over-temperature switch setting to match the displayed OUTLET TEMPERATURE.
3. Once the adjustable over-temperature switch setting is approximately at, or just below, the actual outlet water temperature, the unit should shut down. The **FAULT** indicator should start flashing and a *HIGH WATER TEMP SWITCH OPEN* fault message should be displayed. It should not be possible to restart the unit.
4. Reset the adjustable over-temperature switch to its original setting.
5. The unit should start once the adjustable temperature limit switch setting is above the actual outlet water temperature.
6. Once the adjustable over-temperature switch setting is approximately at, or just below, the actual outlet water temperature, the unit should shut down. The **FAULT** indicator should start flashing and a *HIGH WATER TEMP SWITCH OPEN* fault message should be displayed. It should not be possible to restart the unit.
7. Reset the adjustable over-temperature switch to its original setting.
8. The unit should start once the adjustable temperature limit switch setting is above the actual outlet water temperature.

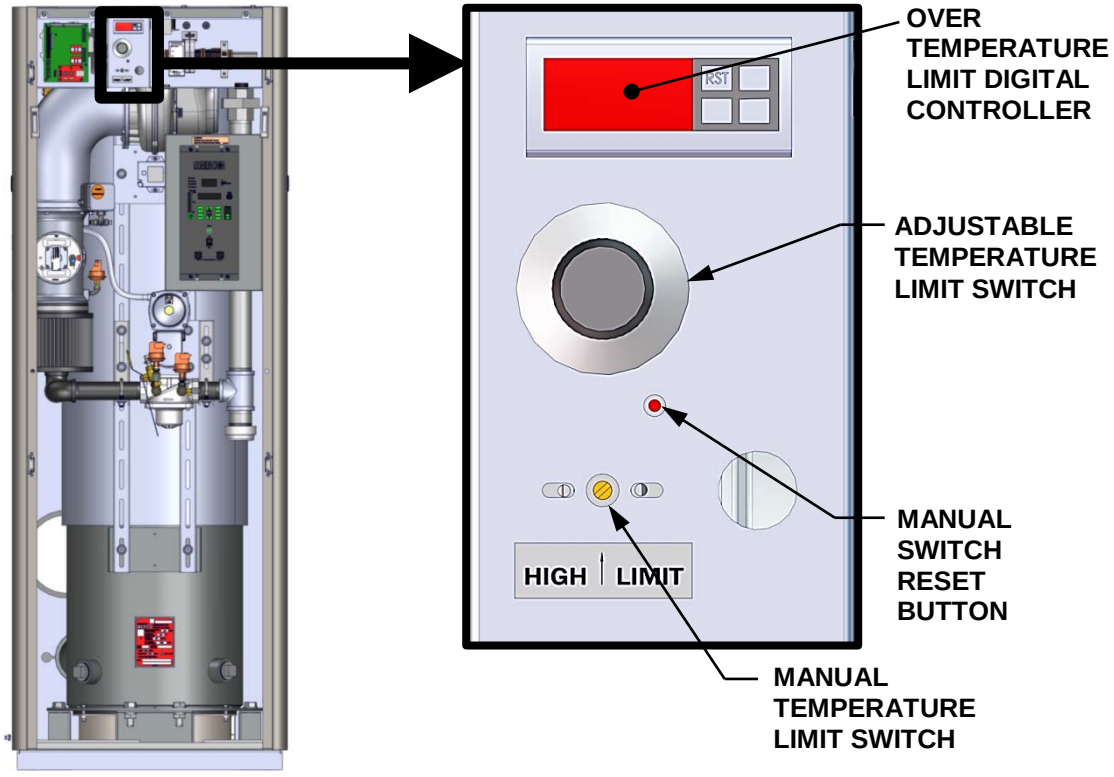


Figure 6-2: Temperature Limit Switch Location

6.6 INTERLOCK TESTS

The unit is equipped with two interlock circuits called the Remote Interlock and Delayed Interlock. Terminal connections for these circuits are located in the I/O Box (Figure 2-13) and are labeled REMOTE INTL'K IN and DELAYED INTL'K IN. These circuits can shut down the unit in the event that an interlock is opened. These interlocks are shipped from the factory jumpered (closed). However, each of these interlocks may be utilized in the field as a remote stop and start, an emergency cut-off, or to prove that a device such as a pump, gas booster, or louver is operational.

6.6.1 Remote Interlock Test

Remote Interlock Test

1. Remove the cover from the I/O Box and locate the REMOTE INTL'K IN terminals.
2. Start the unit in the Manual Mode and set the valve position between 25% and 30%.
3. If there is a jumper across the REMOTE INTL'K IN terminals, remove one side of the jumper. If the interlock is being controlled by an external device, either open the interlock via the external device or disconnect one of the wires leading to the external device.
4. The unit should shut down and display INTERLOCK OPEN.
5. Once the interlock connection is reconnected, the INTERLOCK OPEN message should automatically clear and the unit should restart.

6.6.2 Delayed Interlock Test

Delayed Interlock Test

1. Remove the cover from the I/O Box and locate the DELAYED INTL'K IN terminals.
2. Start the unit in the Manual Mode at a valve position between 25% and 30%.
3. If there is a jumper across the DELAYED INTL'K IN terminals, remove one side of the jumper. If the interlock is connected to a proving switch of an external device, disconnect one of the wires leading to the proving switch.
4. The unit should shut down and display a *DELAYED INTERLOCK OPEN* fault message. The **FAULT** LED should be flashing.
5. Reconnect the wire or jumper removed in step 3 to restore the interlock.
6. Press the **CLEAR** button to reset the fault
7. The unit should start.

6.7 FLAME FAULT TESTS

Flame faults can occur during ignition or while the unit is already running. To simulate each of these fault conditions, proceed as follows:

Flame Fault Tests

1. Set the **ON/OFF** switch to the **OFF** position.
2. Place the unit in the Manual Mode and set the valve position between 25% and 30%.
3. Close the manual gas shutoff valve located between the Safety Shut-Off Valve (SSOV) and the Air/Fuel Valve (see Figure 6-3).
4. Set the **ON/OFF** switch to the **ON** position to start the unit.
5. The unit should purge and light the Pilot Flame, then it should shut down after reaching the main burner ignition cycle and display *FLAME LOSS DURING IGN.*
6. Open the valve previously closed in step 3 and press the **CLEAR** button.
7. Restart the unit and allow it to prove flame.
8. Once flame is proven, close the manual gas valve located between the SSOV (Figure 6-3) and the Air/Fuel Valve.
9. The unit should shut down and Lockout, flashing FLDR in the display.
10. Open the valve previously closed in step 8.
11. Press the **CLEAR** button. The unit should restart and fire.

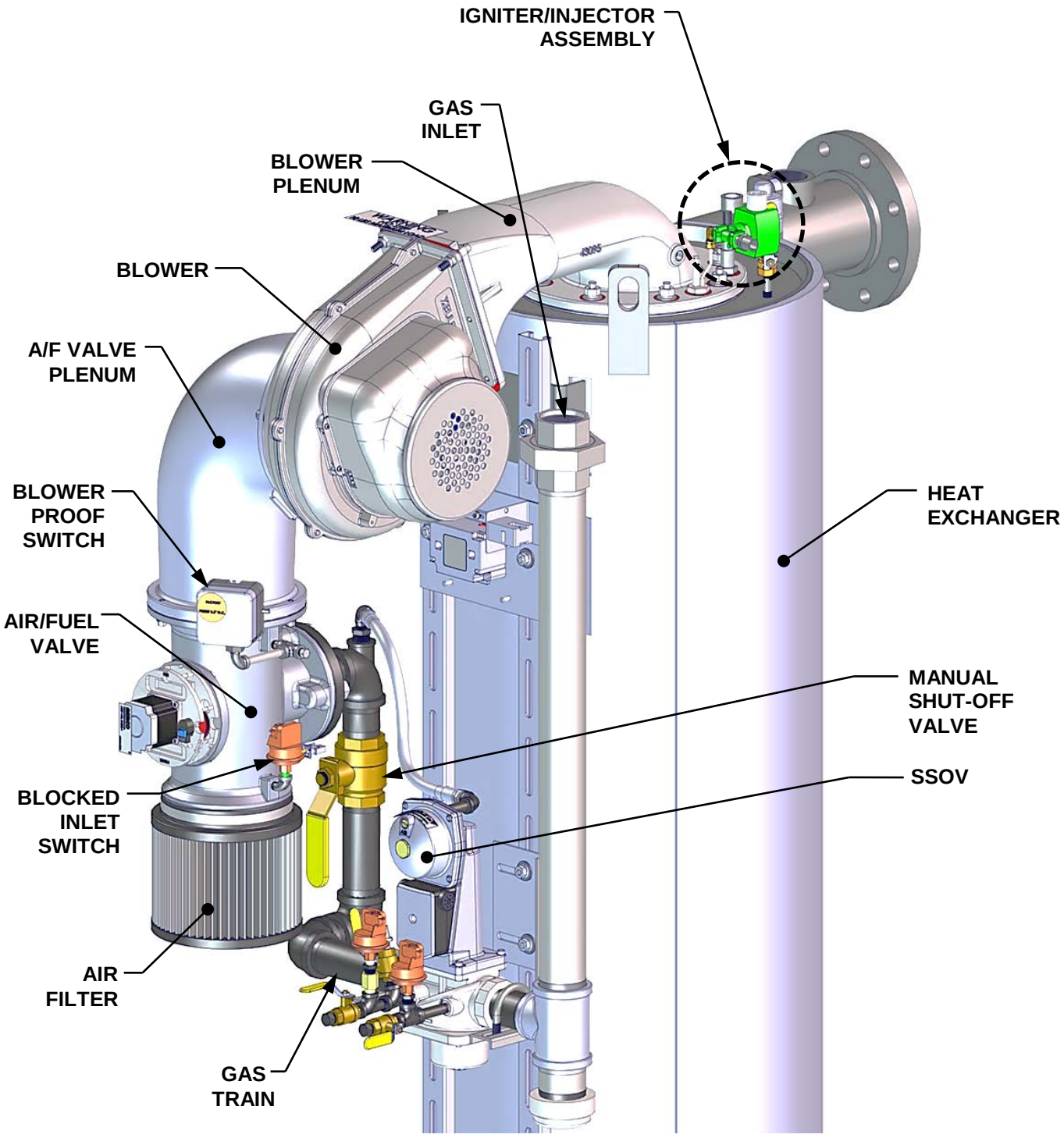


Figure 6-3: Bare Boiler – Partial View (BMK 1500/2000)

6.8 AIR FLOW FAULT TESTS

These tests check the operation of the Blower Proof Switch and Blocked Inlet Switch shown in Figure 6-3.

6.8.1 Blower Proof Switch Test

Blower Proof Switch Test

1. Disable the blower output drive voltage as follows:
   (a) Press the **MENU** key until *CONFIGURATION MENU* is displayed.
   (b) Press the ▲ arrow key until the *ANALOG OUTPUT* function is displayed, then press the **CHANGE** key.
   (c) Press the ▼ arrow key until *OFF* is displayed, then press the **ENTER** key.
2. Start the unit in the Manual Mode at a valve position between 25% and 30%.
3. The unit should shut down and lockout, showing *AIRFLOW FAULT DURING PURGE* in the display.
4. The unit should perform one *IGNITION RETRY* cycle and then shut down, since the blower is disabled. The unit will then display *AIRFLOW FAULT DURING PURGE.*
5. Re-enable the blower output drive voltage by performing the following steps:
   (a) Press the **MENU** key until *CONFIGURATION MENU* is displayed.
   (b) Press the ▲ arrow key until the *ANALOG OUTPUT* function is displayed, then press the **CHANGE** key.
   (c) Press the ▲ arrow key until *VALVE POSITION 0-10V* is displayed, then press the **ENTER** key.
   (d) Press the **CLEAR** button to clear the airflow fault.
6. Once the unit has proved flame, turn off the blower again by going to the Configuration Menu, *Analog Output* menu item and select *OFF*.
7. The Blower Proof Switch will open and the blower should stop. The unit should shut down and display *AIRFLOW FAULT DURING RUN*.
8. Go to the Configuration Menu, *Analog Output* item and select ***VALVE POSITION 0-10v***.

6.8.2 Blocked Inlet Switch Test

This test will be run in simulated fire mode, with the Blocked Inlet Switch isolated from the rest of the control circuitry.

Blocked Inlet Switch Test

1. Turn off the main ON/OFF switch on the front of the Control Panel.
2. For units that get combustion air from a Combustion Air Duct, remove that duct, located on the rear panel of the boiler (see Figure 6.4, below). For units that have an air filter in place of a Combustion Air Duct (not shown), remove the air filter.

Blocked Inlet Switch Test – Continued

WARNING

THE BLOWER SUCTION IS VERY STRONG AND CAN PULL NEARBY OBJECTS INTO THE BLOWER'S FAN BLADES. DO ALLOW ANYTHING TO BE PULLED INTO THE BLOWER. DO NOT WEAR ANYTHING THAT COULD GET CAUGHT AND PULL YOU INTO THE BLOWER.

3. Turn off the gas supply ball valve to the boiler and then complete the following steps:
   (a) Use jumper wires to jump out the Low Gas Pressure Switch and the Blower Proof Switch.
   (b) Remove the black connector boot from the Flame Detector.
   (c) Connect the Flame Signal Generator to the black connector boot.

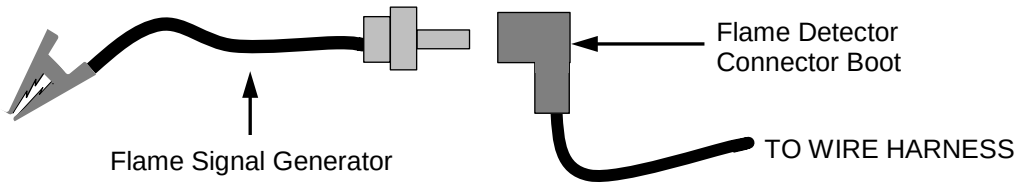


Figure 6.3a: Connecting the Flame Signal Generator

   (d) Keep the alligator clip away from bare metal parts until step 4c.
4. Complete the following with the boiler operating in Manual mode:
   (a) Ramp the boiler up to 100% fire rate and then turn on the main ON/OFF switch on the front of the Control Panel.
   (b) Push the **BACK** button three (3) times to return to the upper level menu.
   (c) When the Controller gets into the ignition phase, the Control Panel will show *IGNITION TRIAL*. At that point attach the alligator clip (see Figure 6.3a) to any bare metal surface or ground. The C-More display should now show *FLAME PROVEN* and begin to ramp up to 100% fire rate. Note that no gas or flame is present in the boiler at this time.
5. Wait for the boiler to ramp up to at least 90% before continuing.
6. Cover the combustion air inlet opening with a solid, flat object, such as a piece of thick plywood or a thick metal plate.
7. The unit should shut down and display *AIRFLOW FAULT DURING RUN*. This step confirms proper operation of the Blocked Inlet Switch.
8. Remove the cover from the air inlet opening and reinstall the Combustion Air Duct or air filter.
9. Remove the jumper wires installed in step 2 and replace the black connector boot on the Flame Detector.
10. Press the **CLEAR** button. The unit should restart.

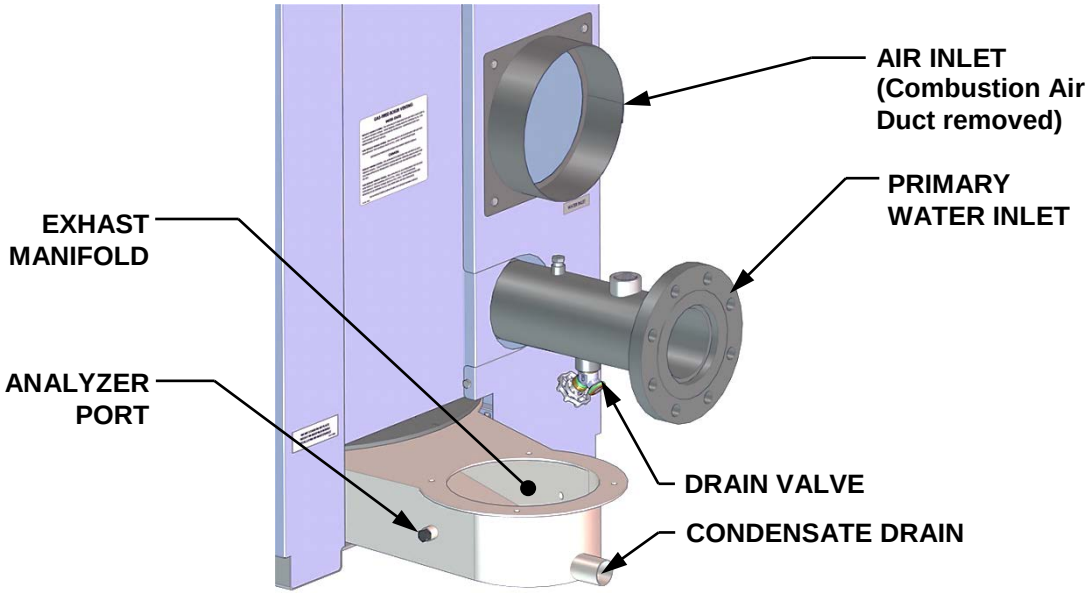


Figure 6-4: Boiler Rear View Showing Air Inlet Location

6.9 SSOV PROOF OF CLOSURE SWITCH

The SSOV shown in Figure 6-1 contains the proof of closure switch. The proof of closure switch circuit is checked as follows:

SSOV Proof of Closure Switch

1. Set the unit's **ON/OFF** switch to the **OFF** position.
2. Place the unit in Manual Mode and set the valve position between 25% and 30%
3. Refer to Figure 6-1 and locate the SSOV.
4. Remove the cover from the SSOV by loosening the screw shown in Figure 6-5. Lift off the cover to access the terminal wiring connections.
5. Disconnect wire #148 from the SSOV to "open" the proof of closure switch circuit.
6. The unit should fault and display *SSOV SWITCH OPEN.*
7. Replace wire #148 and press the **CLEAR** button.
8. Set the **ON/OFF** switch to the **ON** position to start the unit.
9. Remove the wire again when the unit reaches the purge cycle and *PURGING* is displayed.
10. The unit should shut down and display *SSOV FAULT DURING PURGE.*
11. Replace the wire on the SSOV and press the **CLEAR** button. The unit should restart.

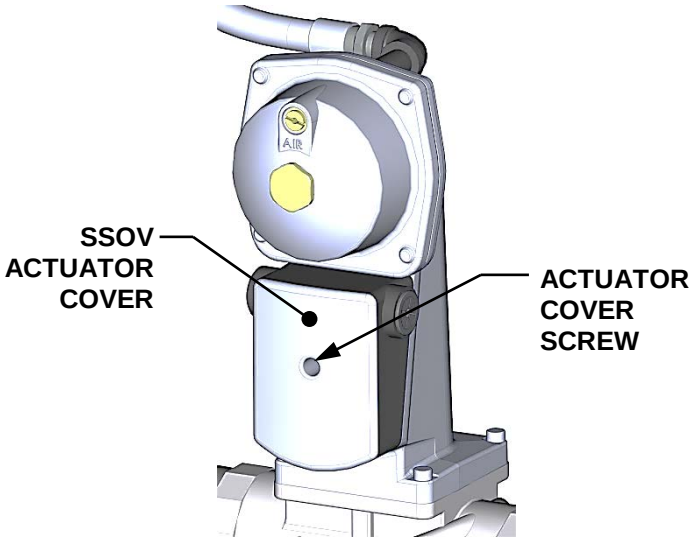


Figure 6-5: SSOV Actuator Cover Location

6.10 PURGE SWITCH OPEN DURING PURGE

The Purge Switch (and Ignition Switch) is located on the Air/Fuel Valve. To check the switch, proceed as follows:

Purge Switch Open During Purge

1. Set the unit's ON/OFF switch to the **OFF** position. Place the unit in manual mode and set the valve position between 25% and 30%.
2. Remove the Air/Fuel Valve cover by rotating the cover counterclockwise to unlock it (see Figure 6-6).
3. Remove one of the two wires (#171 or #172) from the Purge Switch (Figure 6-6).
4. Initiate a unit start sequence.
5. The unit should begin its start sequence, then shut down and display PRG SWITCH OPEN DURING PURGE.
6. Replace the wire on the Purge Switch and depress the CLEAR button. The unit should restart.

6.11 IGNITION SWITCH OPEN DURING IGNITION

The Ignition Switch (and the Purge Switch) is located on the Air/Fuel Valve. To check the switch, proceed as follows:

Ignition Switch Open During Ignition

1. Set the unit's **ON/OFF** switch to the **OFF** position.
2. Place the unit in Manual Mode and set the valve position between 25% and 30%.
3. Remove the Air/Fuel Valve cover (Figure 6-6) by rotating the cover counterclockwise to unlock and lift up to remove.
4. Remove one of the two wires (#169 or #170) from the Ignition Switch (Figure 6-7).
5. Initiate a unit start sequence.
6. The unit should begin its start sequence and then shut down and display *IGN SWITCH OPEN DURING IGNITION.*
7. Replace the wire on the Ignition Switch and press the **CLEAR** button. The unit should restart.

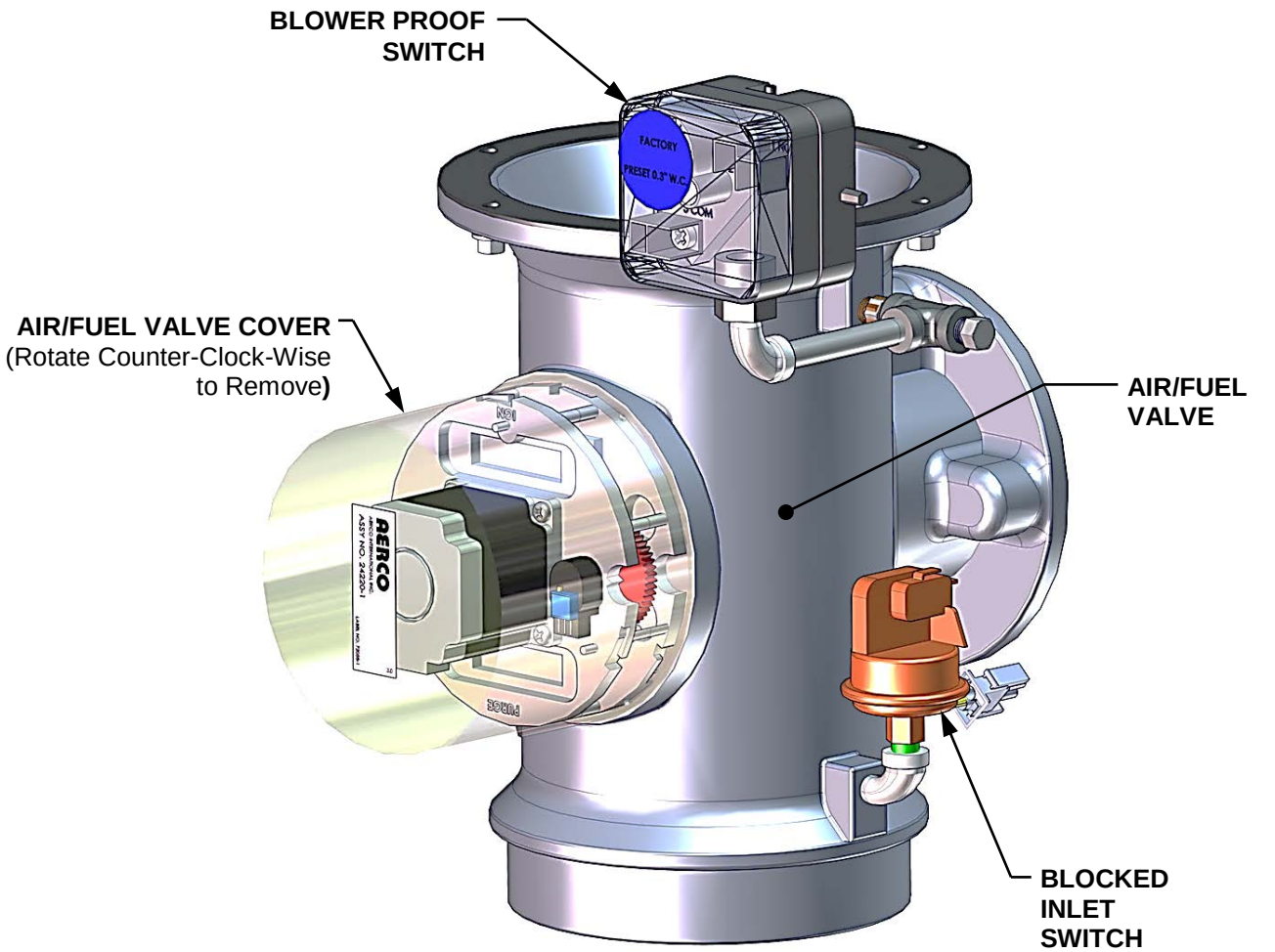


Figure 6-6: Air/Fuel Valve Cover Location

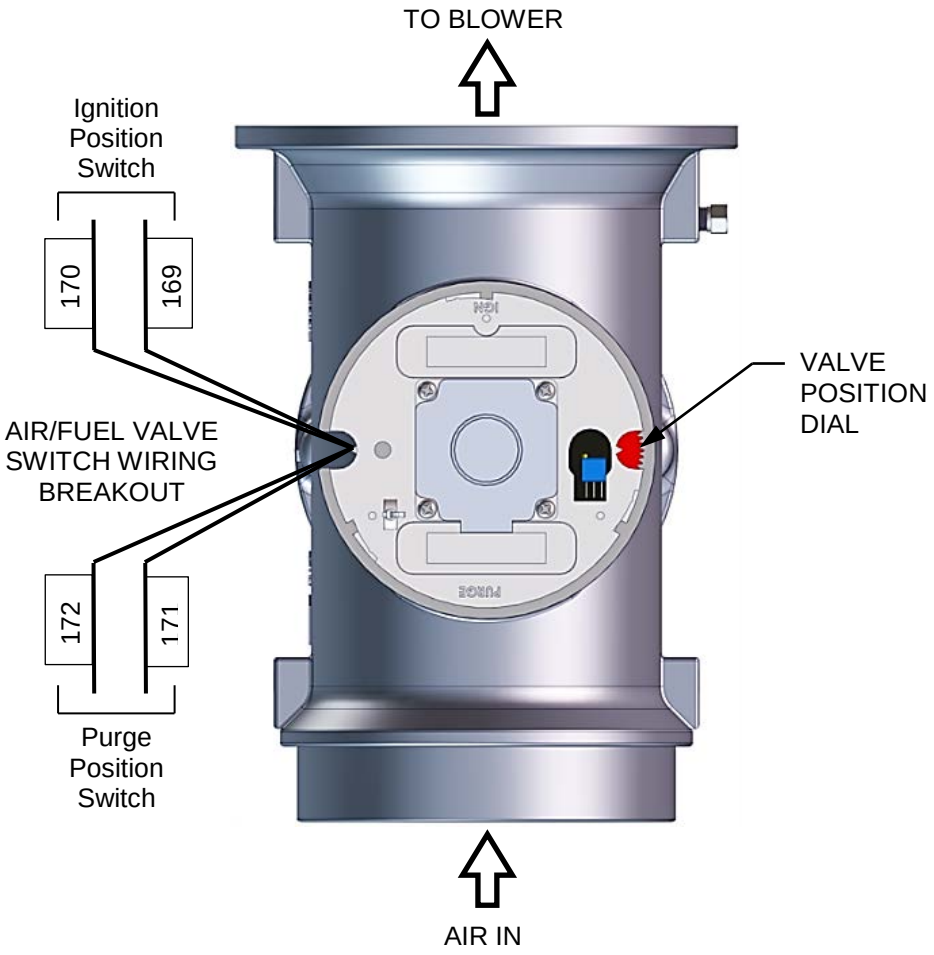


Figure 6-7: Air/Fuel Valve Purge and Ignition Switch Locations

6.12 SAFETY PRESSURE RELIEF VALVE TEST

Test the safety Pressure Relief Valve in accordance with ASME Boiler and Pressure Vessel Code, Section VI.

CHAPTER 7. MAINTENANCE

7.1 MAINTENANCE SCHEDULE

The unit requires 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 7-1. For a complete inspection check list see ASME CSD-1 chart.

In order to perform the maintenance tasks specified in Table 7-1, the following maintenance kits are available through your local AERCO Sales Representative:

- 12 Month Maintenance Kit, Part No. 58025-01
- 24-Month Waterside/Fireside Inspection Kit, Part No. 58025-13 (See NOTE below)

NOTE:

The 24-Month Waterside/Fireside Inspection Kit also includes the items contained in the Annual Maintenance Kit (58025-01). Therefore, only Kit Part No. 58025-13 is required when performing the waterside/fireside inspections. Refer to Appendix L for recommended spare

⚠ WARNING ⚠

TO AVOID PERSONAL INJURY, PRIOR TO SERVICING ENSURE THAT THE FOLLOWING GUIDELINES ARE STRICTLY OBSERVED:

- DISCONNECT THE AC 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 7-1: Maintenance Schedule

Section	Item	6 Mos.	12 Mos.	24 Mos.	Labor Time
7.2	Igniter-Injector (66013)	*Inspect	Inspect	Replace	15 mins.
7.3	Flame Detector (66020)	*Inspect	Inspect	Replace	15 mins.
7.4	O_2 Sensor (61026)	*Inspect	Inspect		15 mins.
4.3	Combustion Calibration	*Check	Check		1 hr.
7.5	Testing of Safety Devices		See ASME CSD-1 Chart		45 mins.
7.6	Burner			Inspect	2 hrs.
7.7	Condensate Drain Trap	*Inspect	Inspect, Clean & Replace Gaskets	Inspect, Clean & Replace Gaskets	30 mins.
7.8	Air Filter (59138)		Clean	Replace	15 mins.

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

7.2 IGNITER-INJECTOR

The igniter-injector (part no. 66026) 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 7-1 shows the complete burner assembly removed from the boiler and indicates the location of the igniter-injector flame detector and other related components.

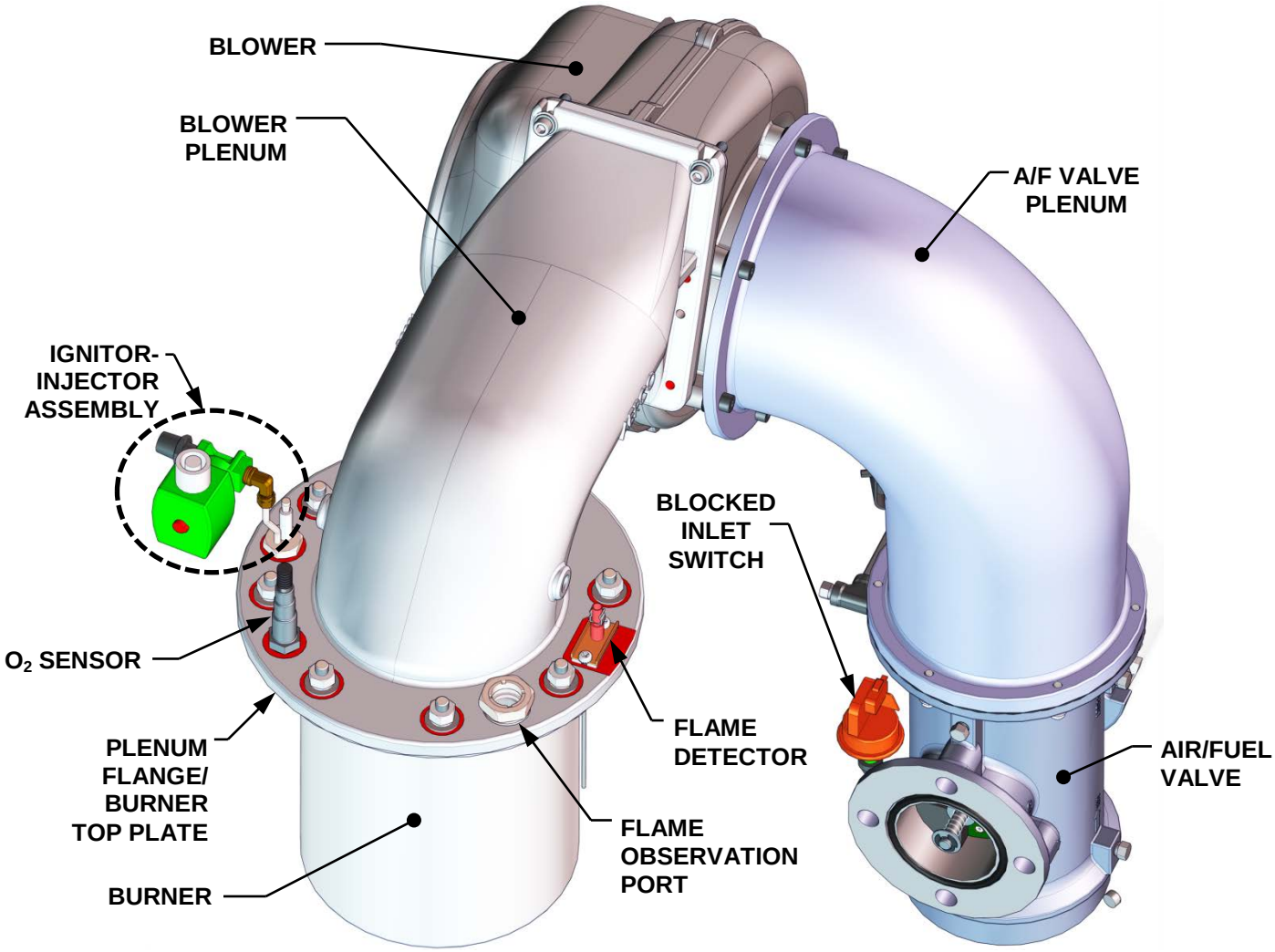


Figure 7-1: Benchmark 1500/2000 Burner Assembly (Removed from Boiler)

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 Procedures

1. Set the **ON/OFF** switch on the control panel, 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 (Figure 7-1).

Igniter-Injector Maintenance Procedures – Continued

4. Refer to the partial exploded view in Figure 7-2. 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. Disconnect the staged ignition assembly from the igniter-injector.
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. Refer to Chapter 4 for combustion calibration procedures.

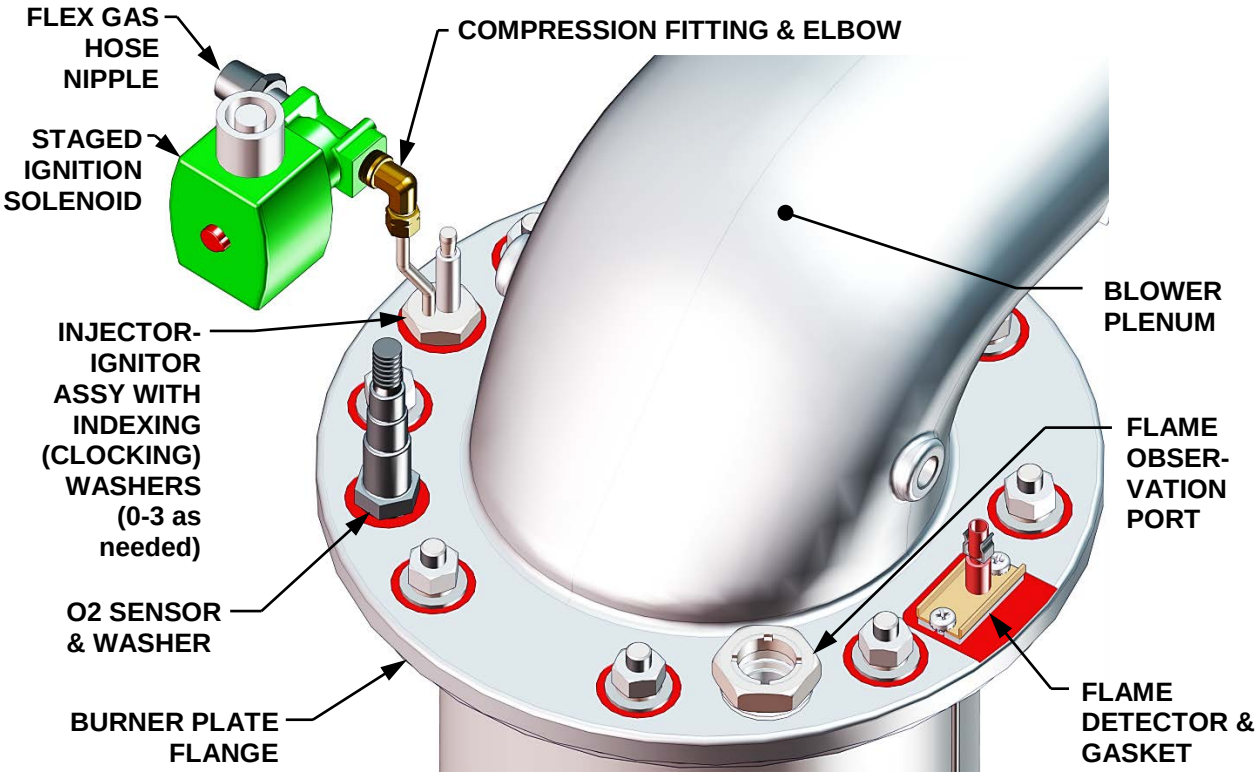


Figure 7-2: Igniter-Injector & Flame Detector Mounting Details

7. Next, loosen and remove the igniter-injector from the burner plate using a 1" open-end wrench.
8. 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. Refer to Chapter 4 for combustion calibration procedures.
9. Prior to reinstalling the igniter-injector, a high temperature, conductive, anti-seize compound must be applied to the threads.

IGNITER-INJECTOR MAINTENANCE PROCEDURES – Continued

NOTE

If a replacement igniter-injector (part no. 66026) is being installed, a compression nut containing a built-in ferrule will be included with the replacement part. If needed, 3 indexing washers are also included These washers may be needed to properly position the gas injector tube of the igniter-injector within the 120° angle range shown in Figure 7-3.

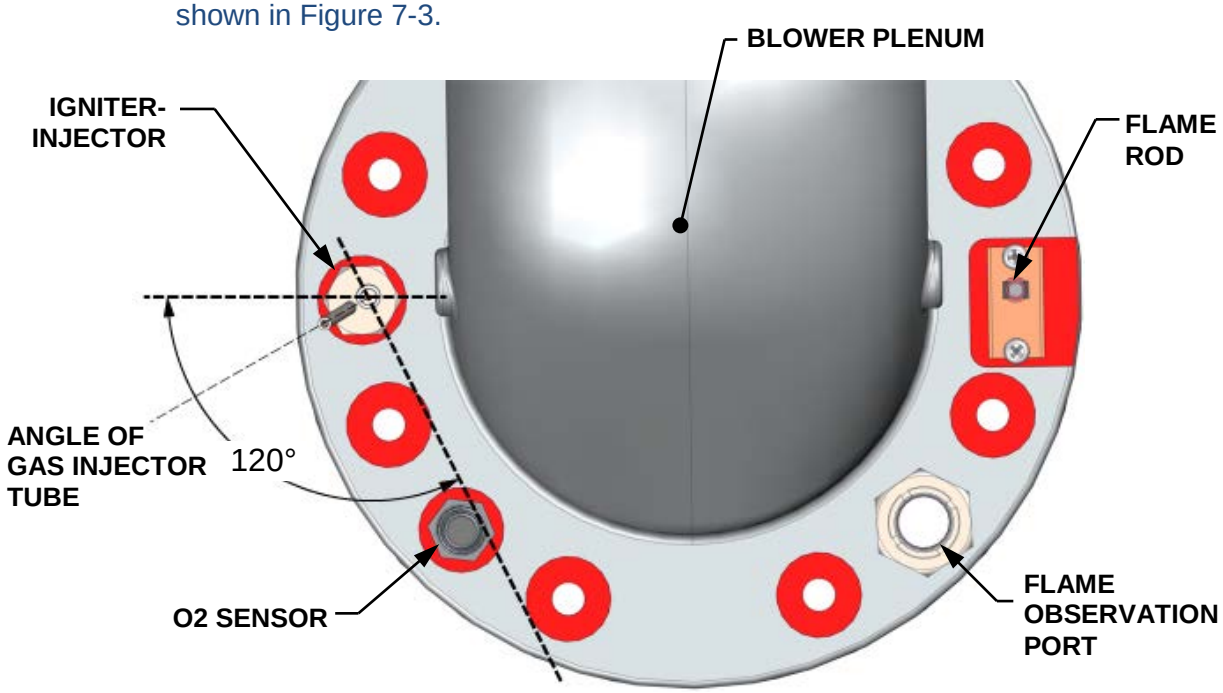


Figure 7-3: Igniter-Injector Orientation (Viewed Looking Down from Above)

10. Reinstall the igniter-injector in the burner plate. Torque to 170 - 180 in-lbs. DO NOT over tighten.
11. 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.
12. Reconnect the igniter-injector cable.
13. Reinstall the shroud on the unit.

7.3 FLAME DETECTOR

The flame detector (part no. 66020) is located on the burner plate at the top of the unit (see Figures 7-1 and 7-2). 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

1. Set the control panel **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.

Flame Detector Maintenance – Continued

3. Disconnect the flame detector lead wire.
4. Remove the two (2) screws securing the flame detector to the plate (Figure 7-2). The flame detector is secured to the burner plate with one #10-32 screw and one #8-32 screw.
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.

7.4 O_2 SENSOR

The O_2 sensor (part no. 61026) is located on the burner plate at the top of the unit (see Figures 7-1 and 7-2). The sensor may be hot. Allow the unit to cool sufficiently before removing or replacing the O_2 sensor.

O_2 Sensor Maintenance Procedures

1. Set the **ON/OFF** switch on the control panel, 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.

7.5 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 Chapter 6-Safety Device Testing Procedures.

7.6 BURNER ASSEMBLY 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.

NOTE

In order to do this procedure most efficiently with a minimum of steps, a simple support rig has been designed to hold up the blower and Air/Fuel Valve assembly while the blower plenum is removed to allow the burner assembly to be removed for maintenance. Using this support will relieve the blower's weight from bearing down upon the connection to the gas train. This support rig prevents having to dismantle the entire blower and A/V Valve assembly from the gas train. The support rig is available as an after-market part.

The following parts will be required for reassembly after burner inspection:

Part No.	Description
81166	Burner Gasket (1 each)
88183	Burner Release Gasket (1 each)
81186	Burner Lower Release Gasket (1 each)
81048	Flame Detector Gasket (1 each)

To inspect or replace the burner assembly, proceed as follows:

Burner Assembly Inspection and Maintenance Procedures

1. Set the **ON/OFF** switch on the control panel, 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 7-2.
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 7-2). 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. Retrieve the blower support rig and attach it to the blower and unit as described in the instructions provided with the rig.
10. Loosen and remove the four 5/16x1-3/4" bolts, washers, and nuts from the burner plenum where it is attached to the blower (see Figure 7-4a & 7-4b).

Burner Assembly Inspection and Maintenance Procedures (Cont.)

11. Remove the eight (8) 3/8-16 nuts, using a 9/16" wrench, attaching the blower plenum to the burner beneath (see Figure 7-4a & 7-4b).
12. Remove the blower plenum from between the blower and the burner and set aside for later reassembly. O2 sensor and flame observation port remain assembled to the plenum flange.

NOTE

The burner assembly is heavy, weighing approximately 65 lbs.

13. Remove the burner by pulling straight up.
14. Remove and replace the burner gasket(s) (see Figure 7-5).

IMPORTANT!

ALL THREE gaskets provided for maintenance MUST be installed during this procedure, as shown in Figure 7-5, 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 7-3. Torque the igniter-injector to 170 - 180 in-lbs.

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 22 ft. lbs).
16. Ensure that the igniter-injector and flame detector cutouts in the burner plate are properly aligned with the heat exchanger top flange.

Burner Assembly Inspection and Maintenance Procedure (Cont.)

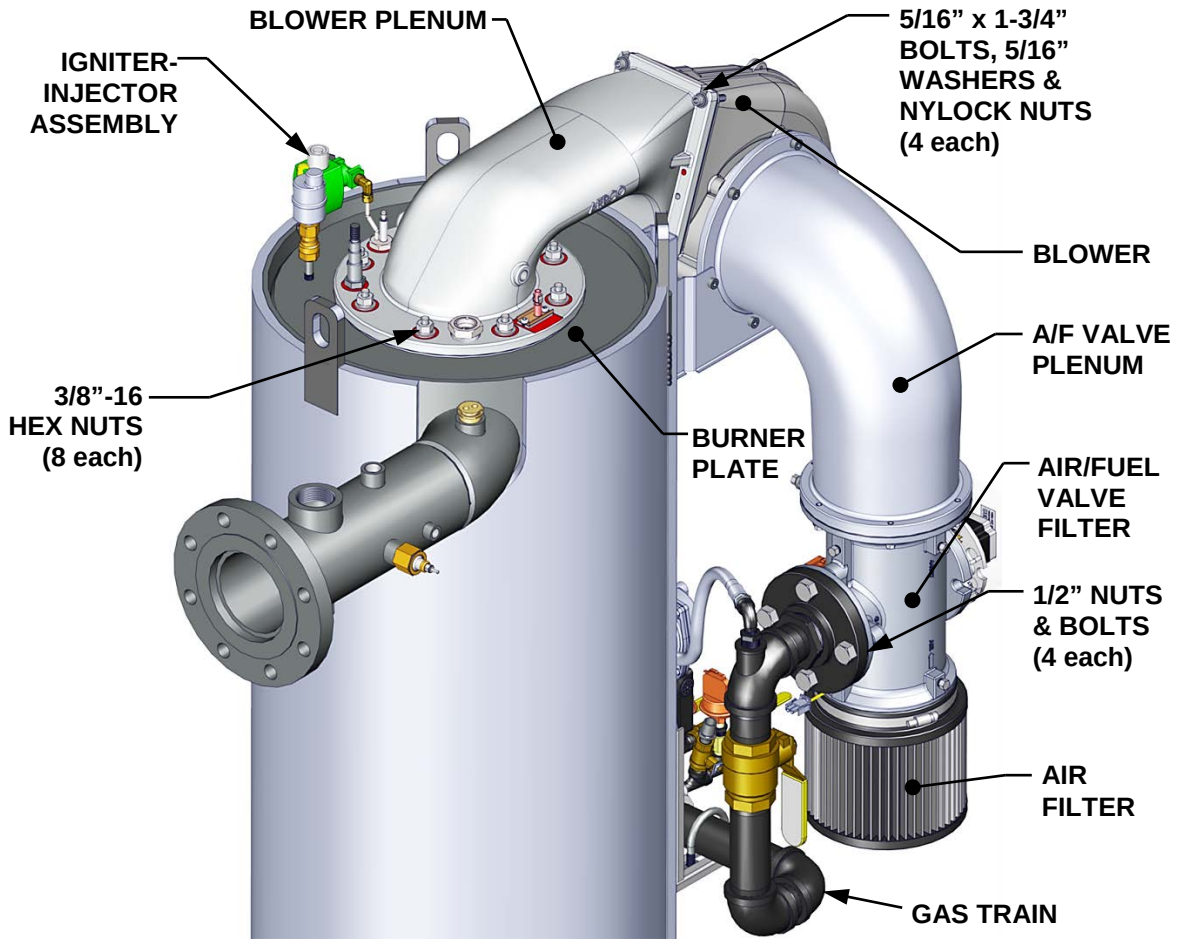


Figure 7-4a: Burner Assembly Mounting Details

Burner Assembly Inspection and Maintenance Procedure – Continued

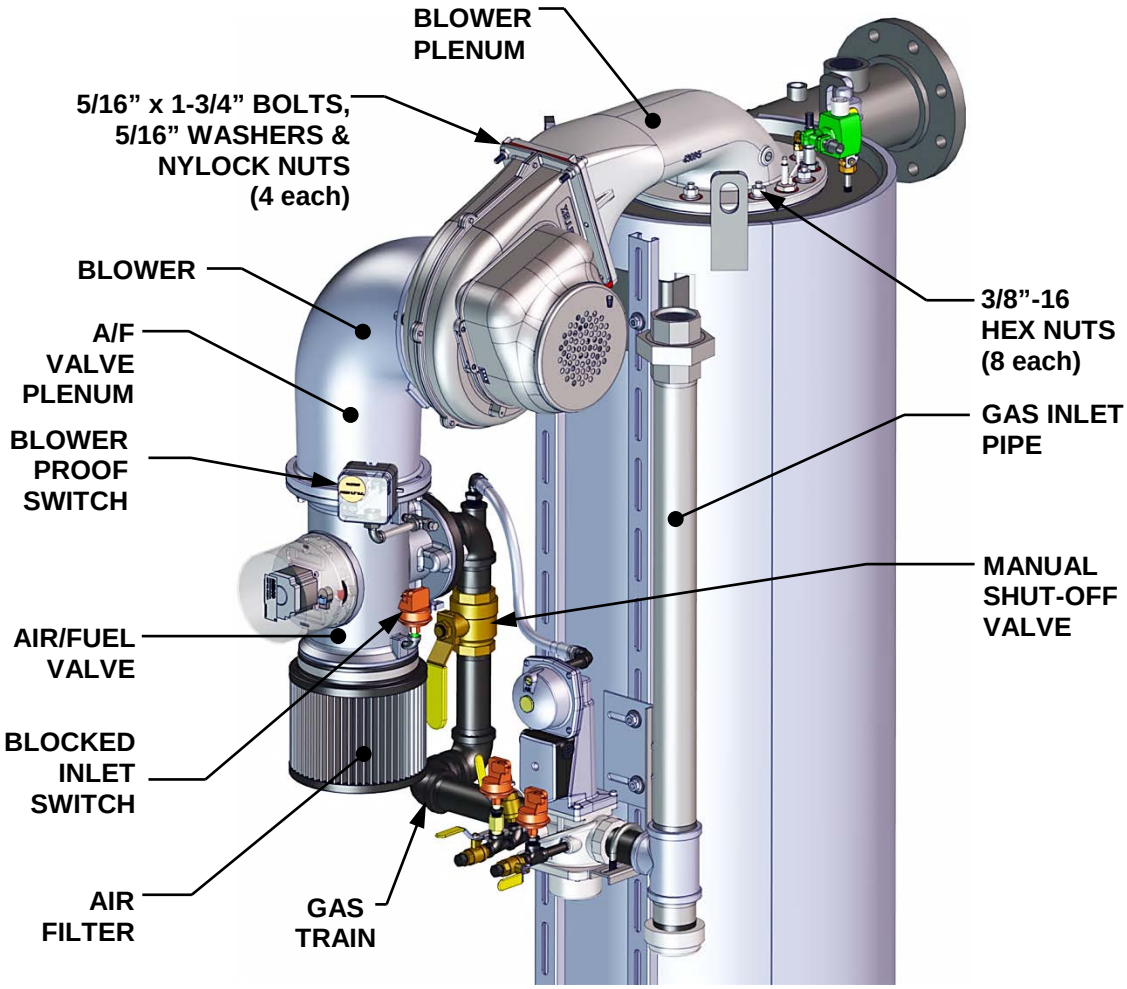


Figure 7-4b: Burner Assembly Mounting Details

NOTE
The LOWER RELEASE GASKET (P/N 81186) features four tabs around its periphery.

IMPORTANT!
Use ALL THREE gaskets provided, even if there is only one existing gasket being replaced.

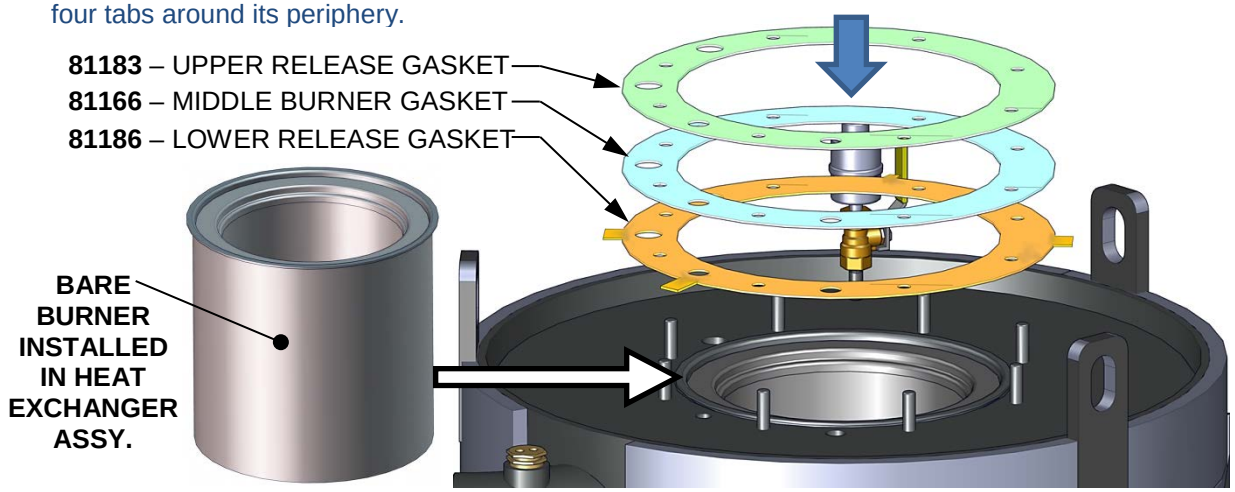


Figure 7-5: Bare Burner and Replacement Gaskets Location

7.7 CONDENSATE DRAIN TRAP

Benchmark boilers contain a condensate trap as shown in Chapter 2, Figure 2-6. The trap is located external to the unit and attached to the drain pipe from the exhaust manifold. This trap should be inspected and cleaned in accordance with the maintenance schedule shown in Table 7-1 to ensure proper operation. To inspect and clean the trap, proceed as follows:

Condensate Drain Trap Maintenance Procedure

1. Disconnect the external condensate trap by loosening the union pipe connection between the trap and the exhaust manifold drain pipe.
2. Remove the connections on the inlet and outlet sides of the condensate trap shown in Figure 7-6.
3. Loosen the four (4) thumbscrews securing the cover on the condensate trap. Remove the cover.
4. Remove the float from the condensate trap.
5. Remove the O-ring and orifice gaskets from the trap. AERCO recommends that these items be replaced annually.
6. Thoroughly clean the trap and float. Also inspect the drain piping for blockage. If the trap cannot be thoroughly cleaned, replace the trap.
7. After the above items have been inspected and thoroughly cleaned, replace the O-ring (84017) and orifice gasket (81092) with new parts.
8. Reassemble all piping and hose connections to the condensate trap inlet and outlet. Reconnect trap to exhaust manifold drain.

NOTE

There are two slightly different types of condensate traps that may be used in your configuration; an older style with a separate inlet adapter, and a newer style with a built-in adapter. Maintenance is the same, except that the newer style does not need an orifice gasket (Step 5).

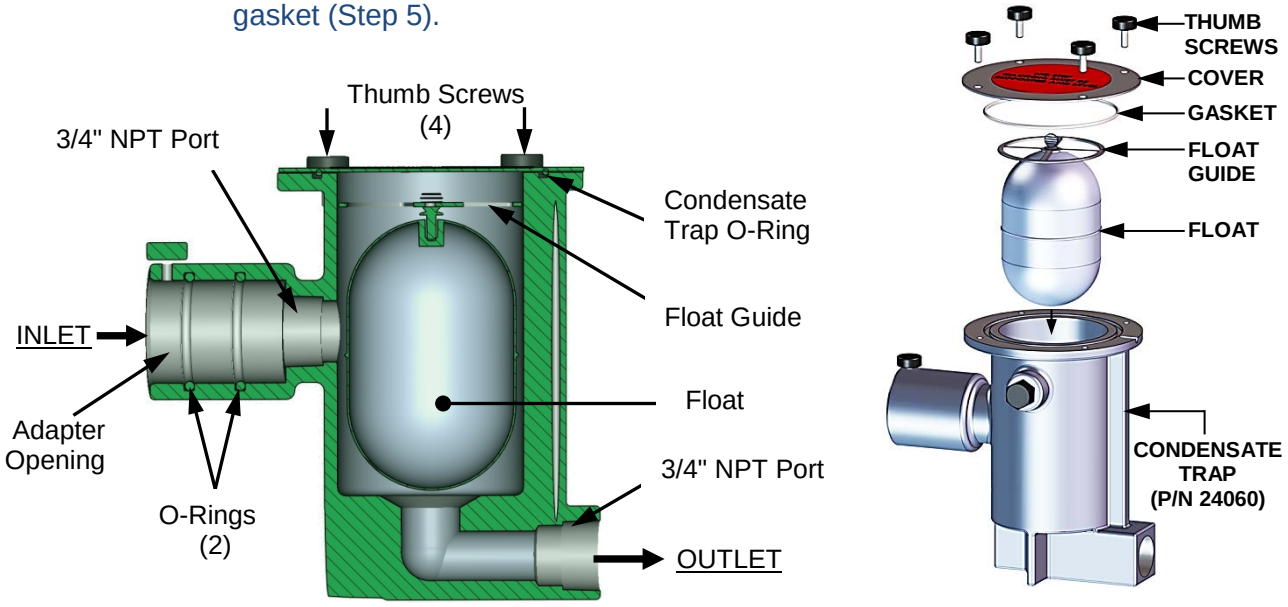


Figure 7-6: External Condensate Trap: Cutaway and Exploded Views

7.8 AIR FILTER CLEANING & REPLACEMENT

The Benchmark boiler is equipped with an air filter (part no. 88014) which should be cleaned and re-oiled every 12 months and replaced every 24 months. The air filter is located at the inlet of the air fuel valve at the top of the boiler as shown in Figure 7-7.

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

Air Filter Cleaning & Replacement Procedures

1. Set the **ON/OFF** switch on the control panel, 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 7-7 and locate the air filter attached to the air/fuel valve inlet.
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.
5. The filter may be cleaned in hot soapy water to remove oil and dirt. The filter should be thoroughly dried and then sprayed with a light coating of oil, such as WD-40, prior to reinstallation.
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.

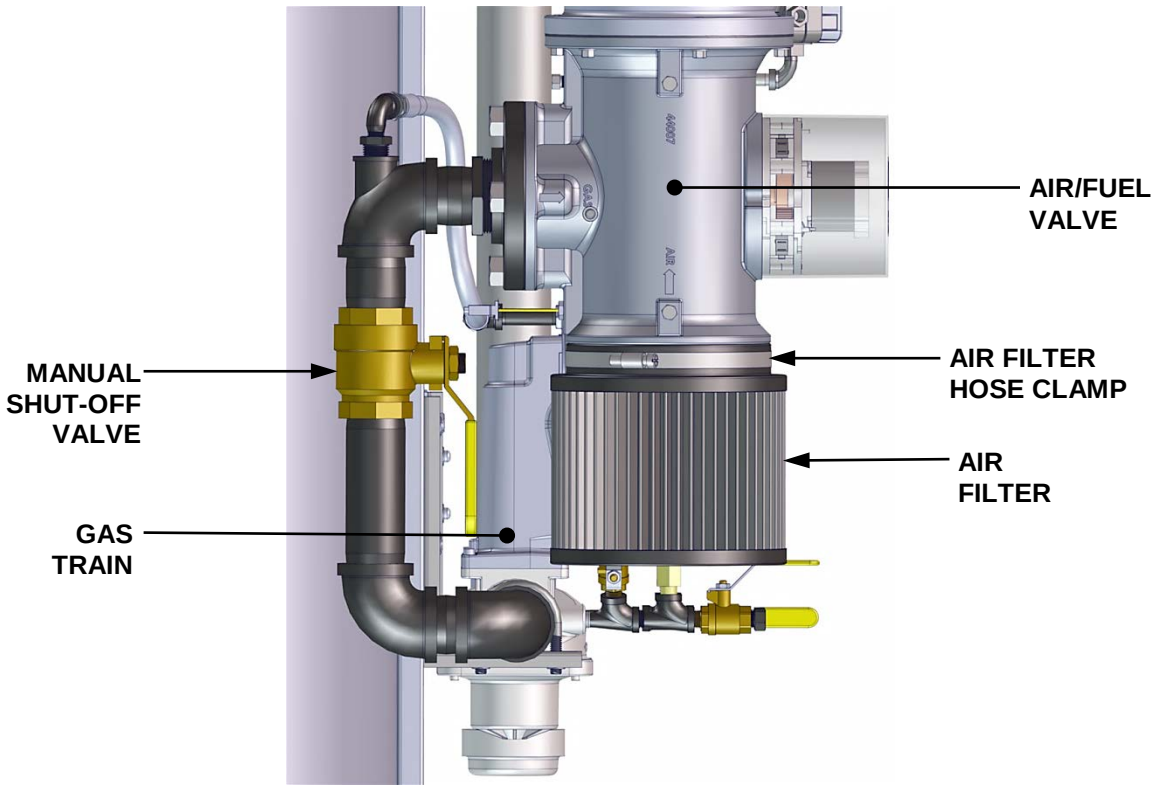


Figure 7-7: Air Filter Location

7.9 SHUTTING THE BOILER DOWN FOR AN EXTENDED PERIOD OF TIME

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 Extended Period

1. Set **ON/OFF** switch on the front panel 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.

7.10 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 Boiler in Service After Long Shutdown

1. Review installation requirements included in Chapter 2.
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 Chapter 4.
5. Perform safety device testing and scheduled maintenance procedures per Chapters 6 and 7 of this manual.

CHAPTER 8. TROUBLESHOOTING GUIDE

8.1 INTRODUCTION

This troubleshooting guide is intended to aid service/maintenance personnel in isolating the cause of a fault in a Benchmark 1500 MBH and 2000 MBH 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.

NOTE

The front panel of the C-More Control Box contains an RS-232 port which can be interfaced to a laptop computer or other suitable device. This RS-232 communication feature permits service personnel to view menu items and data logs which can be useful in isolating faults. Refer to Chapter 9 of this manual for detailed RS-232 communication set-up and procedures.

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

Fault Correction

1. Observe the fault messages displayed in the Control Box display.
2. Refer to the Fault Indication column in Troubleshooting Table 8-1 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 8.2 and Table 8-2 contain 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.

(This page left intentionally blank)

TABLE 8-1: BOILER TROUBLESHOOTING

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
AIRFLOW FAULT DURING IGNITION	1. Blower stopped running due to thermal or current overload.	1. Check combustion blower for signs of excessive heat or high current drain that may trip thermal or current overload devices.
	2. Blocked Blower inlet or inlet air filter.	2. Inspect the inlet to the combustion blower including the air filter at the air/fuel valve for signs of blockage.
	3. Blockage in Blower Proof switch.	3. Remove the Blower Proof switch and inspect for signs of blockage, clean or replace as necessary.
	4. Blockage in Blocked Inlet switch.	4. Remove the Blocked Inlet switch and inspect for signs of blockage, clean or replace as necessary.
	5. Defective Blower Proof switch.	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.
	6. Defective Blocked Inlet switch.	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.
	7. Loose temperature to AUX connection in I/O Box.	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 the tabular listing provided in Appendix C.
	8. Defective temperature sensor.	8. Refer to CORRECTIVE ACTION 7 and verify that the voltage conforms to the values shown in Appendix C.
	9. Loose wire connection between the 0-10V signal from I/O box to the Blower input.	9. Check wire connection from I/O Box 0-10V signal to the Blower Motor.
	10. Defective I/O Box.	10. Measure voltage at the I/O box 0-10V output. A voltage of 10V equates to a 100% open valve position.
	11. Wrong 0-10V output selection on the control box.	11. Check the *Analog Out* option on the C-More Configuration Menu. *Valve Position 0-10V* should be selected.
	12. Defective Air-Fuel Valve potentiometer.	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.
	13. Hard light.	13. Check igniter-injector for soot or erosion of electrode. Check injector solenoid valve to insure proper open/close operation.

***TABLE 8-1: BOILER TROUBLESHOOTING** – Continued*

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
AIRFLOW FAULT DURING PURGE	1. Blower not running or running too slow.	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.
	2. Defective Blocked Inlet switch.	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.
	3. Blockage in air filter or Blocked Inlet switch.	3. Remove the air filter and Blocked Inlet switch and inspect for signs of blockage. Clean or replace as necessary.
	4. Blocked blower inlet or inlet ductwork.	4. Inspect the inlet to the combustion blower including any ductwork leading up to the combustion blower for signs of blockage.
	5. No voltage to Blocked Inlet switch from C-More Control Box.	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.
	6. PROBABLE CAUSES from 3 to 12 for AIRFLOW FAULT DURING IGNITION apply for this fault.	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.	1. Check combustion blower for signs of excessive heat or high current draw that may trip thermal or current overload devices.
	2. Blocked Blower inlet or inlet ductwork.	2. Inspect the inlet to the combustion blower, including any ductwork leading up to the combustion blower, for signs of blockage.
	3. Blockage in air filter or Blocked Inlet switch.	3. Remove the air filter and Blocked Inlet switch and inspect for signs of blockage, clean or replace as necessary.
	4. Defective Blocked Inlet switch.	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.
	5. Combustion oscillations.	5. Run unit to full fire. If the unit rumbles or runs rough, perform combustion calibration.
	6. Probable causes from 3 to 16 for AIRFLOW FAULT DURING IGNITION applies for this fault.	6. See CORRECTIVE ACTIONS from 3 to 12 for AIRFLOW FAULT DURING IGNITION.

***TABLE 8-1: BOILER TROUBLESHOOTING** – Continued*

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
DELAYED INTERLOCK OPEN	1. Delayed Interlock Jumper not properly installed or missing. 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. 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: --Not yet installed. --Wrong polarity. --Signal defective at source. --Broken or loose wiring. 2. Signal is not isolated (floating). 3. Control Box signal type selection switches not set for correct signal type (voltage or current).	1. Check I/O Box to ensure signal is hooked up. --Hook up if not installed. --If installed, check polarity. --Measure signal level. --Check wiring continuity between source and unit. 2. Check signal at source to ensure it is isolated. 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. 2. No spark from Spark Igniter. 3. Defective Ignition Transformer. 4. Defective Ignition/Stepper (IGST) Board. 5. Defective SSOV.	1. Remove and inspect the Flame Detector for signs of wear. Replace if necessary. 2. Close the internal gas valve in the unit. Install and arc a spark igniter outside the unit. 3. If there is no spark, check for 120VAC at the primary side to the ignition transformer during the ignition cycle. 4. If 120VAC is not present, the IGST Board in the Control Box may be defective. Refer fault to qualified service personnel. 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 Control Box may be defective. Refer fault to qualified service personnel.

***TABLE 8-1: BOILER TROUBLESHOOTING** – Continued*

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
(continued)	6. Carbon or other debris on Burner.	6. Remove View-Port and inspect Burner with Boroscope. If it is fouled or black with soot, remove the Burner and inspect for any carbon build-up or debris. Clean and reinstall.
	7. Staged ignition solenoid valve doesn't open.	7. When unit goes to ignition, listen for a clicking sound at the staged ignition solenoid valve to ensure it is opening.
	8. Clogged staged ignition piece.	8. Remove and inspect staged ignition piece for blockage.
FLAME LOSS DURING RUN	1. Worn Flame Detector or cracked ceramic.	1. Remove and inspect the Flame Detector for signs of wear or cracked ceramic. Replace if necessary.
	2. Defective Regulator.	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.
	3. Poor combustion calibration.	3. Check combustion calibration using procedures in Chapter 4.
	4. Debris on burner.	4. Remove the burner and inspect for any carbon build-up or debris. Clean and reinstall.
	5. Blocked condensate drain.	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.	1. Press **CLEAR** button and restart the unit. If the fault persists, replace Ignition/Stepper (IGST) Board.
	2. Relay is activated when not in Demand.	2. Defective relay. Replace IGST Board.
HIGH EXHAUST TEMPERATURE	1. Poor combustion calibration.	1. Check combustion calibration using procedures in Chapter 4.
	2. Carboned heat exchanger due to incorrect combustion calibration.	2. If exhaust temperature is greater than 200^{o} F, check combustion calibration. Calibrate or repair as necessary.

***TABLE 8-1: BOILER TROUBLESHOOTING** – Continued*

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
HIGH GAS PRESSURE	1. Incorrect supply gas pressure. 2. Defective SSOV Actuator. 3. Defective High Gas Pressure Switch.	1. Check to ensure gas pressure at inlet of SSOV does not exceed 14" W.C. 2. If gas supply pressure downstream of SSOV Actuator cannot be lowered to the range of **3.6" ± 0.2" W.C.** for BMK1500 or **3.9" ± 0.2" W.C.** for BMK2000 using the gas pressure adjustment screw (see section 4.3.1 or 4.3.2, step 10), the SSOV Actuator may be defective. 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.
HIGH WATER TEMP SWITCH OPEN	1. Faulty Water temperature switch. 2. Incorrect PID settings. 3. Faulty shell temperature sensor. 4. Unit in Manual mode. 5. Unit setpoint is greater than Over Temperature Switch setpoint. 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. 2. Check PID settings against Menu Default settings in Appendix D. If the settings have been changed, record the current readings then reset them to the default values. 3. Using the resistance charts in the Appendix C, Measure the resistance of Shell sensor and BTU sensor at a known water temperature. 4. If unit is in Manual Mode switch to Auto Mode. 5. Check setpoint of unit and setpoint of Temperature Switch; Ensure that the temperature switch is set higher than the unit's setpoint. 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. 2. Temp HI Limit setting is too low.	1. See HIGH WATER TEMPERATURE SWITCH OPEN. 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 8-1: BOILER TROUBLESHOOTING** – Continued*

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 Control Box. 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 Control Box. 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 8-1: BOILER TROUBLESHOOTING** – Continued*

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
INTERLOCK OPEN	1. Interlock jumper not installed or removed. 2. Energy Management System does not have unit enabled. 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. 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). 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. 2. Incorrect power supply transformer wiring.	1. Check hot and neutral in AC Power Box to ensure they are not reversed. 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. 2. Defective Low Pressure Gas Switch.	1. Measure gas pressure upstream of the SSOV Actuator(s) with the unit firing. For FM gas trains, ensure it is between **6.0" W.C. and 14" W.C.** For DBB gas trains, ensure it is between **6.5" W.C. and 14" W.C.** (see section. 4.3). 2. Measure gas pressure at the low gas pressure switch. If it is greater than **4.7" W.C.** (for both BMK 1500 and BMK 2000), measure continuity across the switch and replace if necessary.
LOW WATER LEVEL	1. Insufficient water level in system. 2. Defective water level circuitry. 3. Defective water level probe.	1. Check system for sufficient water level. 2. Test water level circuitry using the Control Box front panel LOW WATER TEST and RESET buttons. Replace water level circuitry if it does not respond. 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.
PRG SWTCH CLOSED DURING IGNITION	1. A/F Valve rotated open to purge and did not rotate 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 Control Box. Refer fault to qualified service personnel.

***TABLE 8-1: BOILER TROUBLESHOOTING** – Continued*

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
(continued)	2. Defective or shorted switch.	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).
	3. Switch wired incorrectly.	3. 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.
PRG SWTCH OPEN DURING PURGE	1. Defective purge switch.	1. If the air-fuel valve does rotate, check purge switch for continuity when closing. Replace switch if continuity does not exist.
	2. No voltage present at switch.	2. Measure for 24 VAC from each side of the switch to ground. If 24VAC is not present, refer fault to qualified service personnel.
	3. Switch wired incorrectly.	3. Check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals).
	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.
OUTDOOR TEMP SENSOR FAULT	1. Loose or broken wiring.	1. Inspect Outdoor Temperature sensor for loose or broken wiring.
	2. Defective Sensor.	2. Check resistance of sensor to determine if it is within specification.
	3. Incorrect Sensor.	3. Ensure that the correct sensor is installed.
O2 % OUT OF RANGE	1. Combustion Calibration incorrect.	1. Check Combustion Analyzer and recalibrate the boiler.
	2. Blocked inlet air duct or louver.	2. Unblock air inlet and measure open area for combustion air to the room.

***TABLE 8-1: BOILER TROUBLESHOOTING** – Continued*

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
RECIRC PUMP FAILURE	1. Internal recirculation pump failed.	1. Replace recirculation pump.
REMOTE SETPT SIGNAL FAULT	1. Remote setpoint signal not present: Not yet installed. Wrong polarity. Signal defective at source. Broken or loose wiring. 2. Signal is not isolated (floating) if 4 to 20 mA. 3. Control Box signal type selection switches not set for correct signal type (voltage or current).	1. Check I/O Box to ensure signal is hooked up. Hook up if not installed. If installed, check polarity. Measure signal level. Check continuity of wiring between source and unit. 2. Check signal at source to ensure it is isolated. 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.
RESIDUAL FLAME	1. Defective Flame Detector. 2. SSOV not fully closed.	1. Replace Flame Detector. 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. Close the 2” Gas Shut-Off Valve downstream of SSOV (Figure 2-7). 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 or adjust micro-switch in SSOV actuator. If fault persists, replace actuator.
SSOV RELAY FAILURE	1. SSOV relay failed on IGST board. 2. Floating Neutral. 3. Hot and Neutral reversed at SSOV.	1. Press CLEAR button and restart unit. If fault persists, replace Ignition/Stepper (IGST) Board. 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. 3. Check SSOV power wiring.

***TABLE 8-1: BOILER TROUBLESHOOTING** – Continued*

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
SSOV SWITCH OPEN	1. Actuator not allowing for full closure of gas valve. 2. SSOV powered when it should not be. 3. Defective Switch or Actuator. 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. 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. 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. 4. Ensure that the SSOV Proof of Closure switch is correctly wired.
STEPPER MOTOR FAILURE	1. Air/Fuel Valve out of calibration. 2. Air/Fuel Valve unplugged. 3. Loose wiring connection to the stepper motor. 4. Defective Air/Fuel Valve stepper motor. 5. Defective Power Supply Board or fuse. 6. Defective IGST Board.	1. Refer to GF-112 (C-More O & M) and perform the Stepper Feedback Calibration procedure in Section 6, section 6.2.1. 2. Check that the Air/Fuel Valve is connected to the Control Box. 3. .Inspect for loose connections between the Air/Fuel Valve motor and the wiring harness. 4. Replace stepper motor. 5. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board. 6. Check “Heartbeat” LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.

8.2 ADDITIONAL FAULTS WITHOUT SPECIFIC FAULT MESSAGES

Refer to Table 8-2 to troubleshoot faults which may occur without a specific fault message being displayed.

TABLE 8-2: 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 8-1). 2. Defective Staged Ignition Solenoid (Figure 8-1).	1. Disconnect the Staged Ignition Assembly solenoid from the Gas injector Tube of the Igniter-Injector (Figure 8-1) and inspect Gas Injector to ensure it is not clogged or damaged. 2. Close the 2" 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. 2. Damping Orifice not installed.	1. Stabilize gas pressure going into unit. If necessary, troubleshoot Building Supply Regulator. 2. Check to ensure that the Damping Orifice is installed in the SSOV Actuator shown in Figure 8-2. (For IRI (DBB) Gas Trains, the Damping Orifice is installed in the downstream SSOV Actuator).
Air/Fuel Valve "hunting" at the 80% Valve Position	1. IGST and Power Supply Boards in Control Box are outdated.	1. Check to ensure that the IGST and Power Supply Boards are Rev. E or higher.

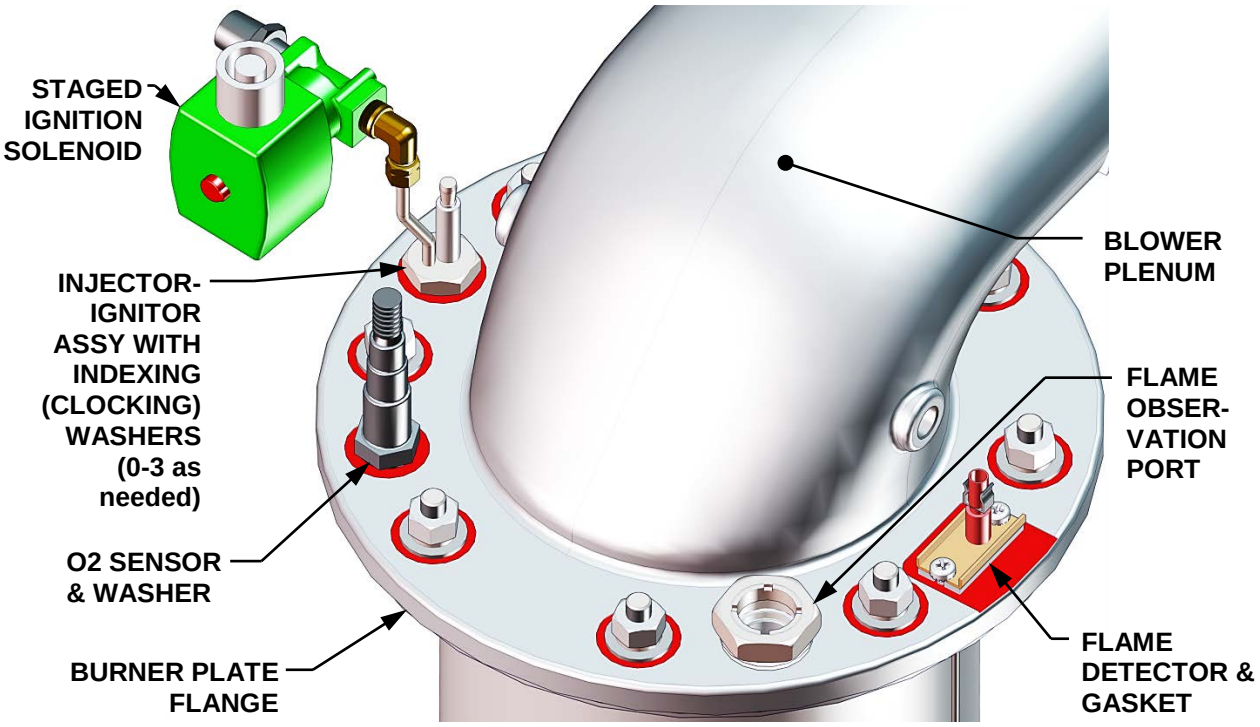


Figure 8-1: Igniter-Injector & Flame Detector Mounting Details

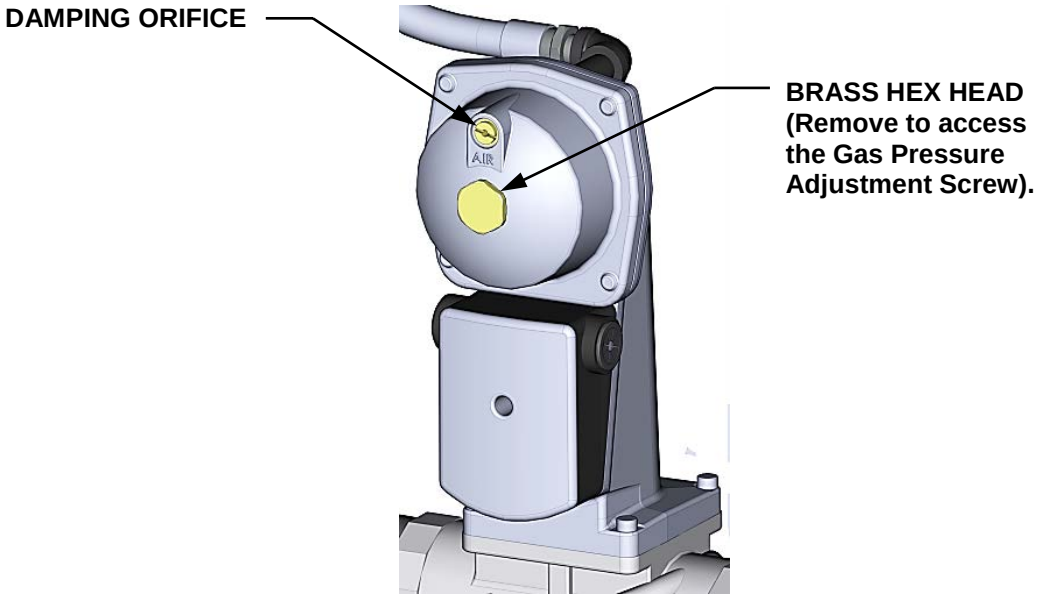


Figure 8-2: SSOV Actuator with Gas Pressure Adjustment

CHAPTER 9. RS-232 COMMUNICATION

9.1 INTRODUCTION

The RS-232 communication feature permits viewing or changing of Control Panel menu options and also provides access to data logs showing Event Time Line, Fault and Sensor log displays.

NOTE

The information in this chapter does not apply when implementing BST.

The RS-232 port on the front panel of the C-More Control Box (Figure 3-1) can be interfaced to a laptop computer or other suitable terminal using a RS-232 adapter cable. RS-232 communication can be accomplished using any “Dumb Terminal” emulation, such as “PuTTY” which is not included with Microsoft Windows, but can be downloaded for free on the internet. Source and instructions for using Putty are provided below.

9.1.1 Acquiring the PuTTY Application

Download the **putty.exe** program to your desktop from:
www.chiark.greenend.org.uk/~sgtatham/putty/download.html

You can use PuTTY to logon to remote computers as well as run a single command on a remote server. PuTTY does not need to be installed, so just clicking the downloaded executable will start it.

9.1.2 Logging on to a Remote Machine Using PuTTY

To use **PuTTY** to logon to a remote machine, bring up the PuTTY application by double-clicking its icon. You will see the main window as shown in left image of Figure 9-1.

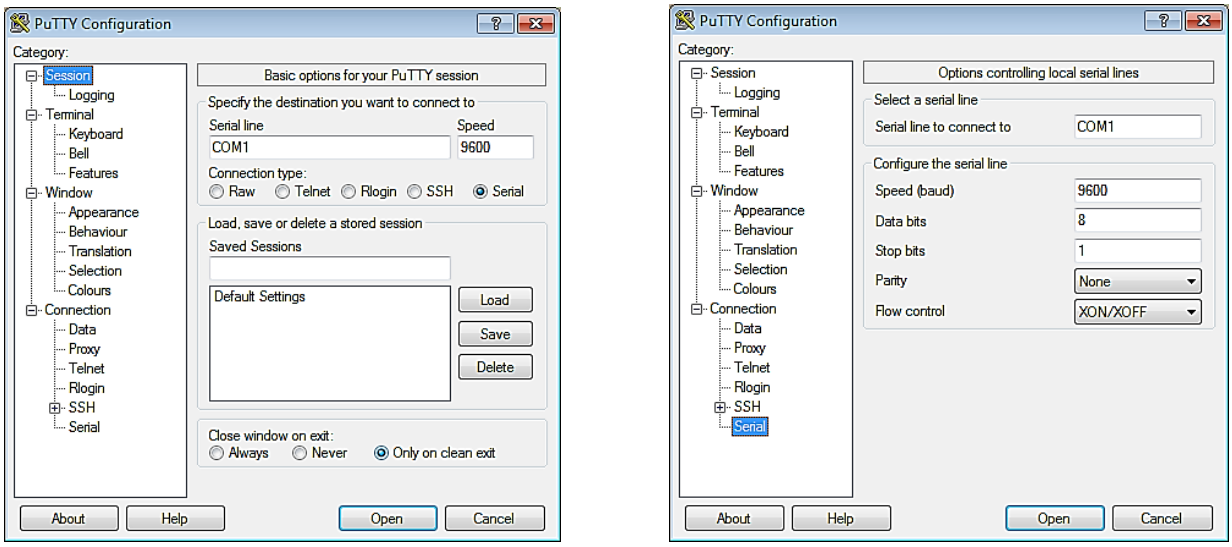


Figure 9-1: PuTTY GUI: Basic Serial Session (L) and Serial Options (R)

In Serial mode, text typed into the PuTTY window will be sent straight out of your computer's serial port, and data received through that port will be displayed in the PuTTY window.

To create a Serial connection, click the radio button labeled **Serial**. The **Serial line** and **Speed** fields will then be automatically filled in as shown in ***left*** image of Figure 9-1, but will allow you to specify the serial line to use (if your computer has more than one) and what speed (baud rate) to use when transferring data. For further configuration options (data bits, stop bits, parity,

flow control), you can use the **Serial Configuration** panel (***right*** image in Figure 9-1) by selecting “Serial” in the left navigation pane.

Now, to connect to the remote server, simply click the **Open** button at the bottom of the dialog box. A new terminal window will pop up and ask you to log in.

So that you don't have to enter this information every time you wish to connect to your server, you can save this configuration by typing an appropriate *name* in the **Saved Sessions** text box in the PuTTY “Basic Options” window (left image of Figure 9-1) and then clicking the **Save** button. In the future, you can select the *name* you chose in the list box and click the **Load** button to initialize this particular configuration.

9.1.3 Running a Command on a Remote Machine Using PuTTY

PuTTY may also be used to run some command residing on the remote server. After specifying the command line you want to run, you will be asked for your account name and password, and then the command you specified will execute. When it completes, your session will terminate, and your window will either close or remain open depending on how you configure the session. Here are the steps:

Running a Command on a Remote Machine Using PuTTY

1. Bring up the PuTTY application and select the server you wish to connect to.
2. At the bottom of the Basic Options dialog box (left image of Figure 9-1) in the section titled: **Close window on exit**, select the **Never** radio button. This will keep the window open after the command has finished executing so that you can see any results in the terminal window.
3. In the menu bar along the left side of the dialog box, click the **SSH** menu near the bottom. The following screen will be presented:

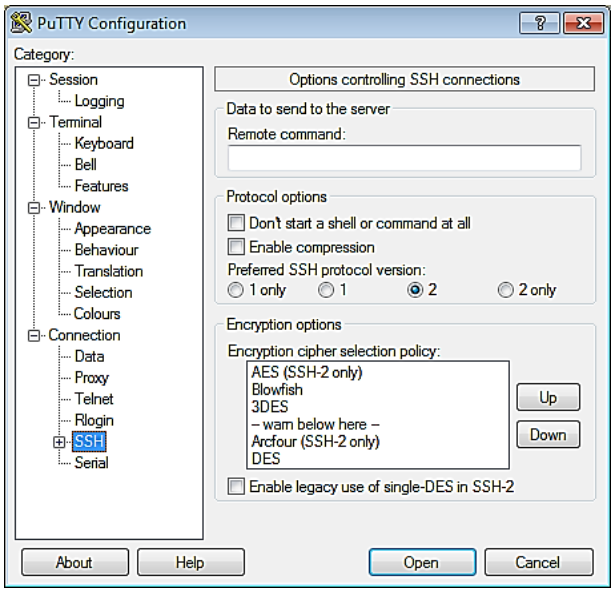


Figure 9-2: PuTTY GUI: Basic SSH Options for Running Remote Commands

4. Into the textbox titled, **Remote command** type the full command line you wish to have executed on the remote machine.

Running a Command on a Remote Machine Using PuTTY – Continued

5. You are now ready to execute this command on the remote machine, simply click the **Open** button at the bottom of the dialog.
6. You will have to provide an account name and password in the terminal window to complete the process.

9.2 RS-232 COMMUNICATION SETUP

Regardless of the terminal emulation utilized, the following guidelines must be adhered to when setting up the RS-232 communication link:

- Baud Rate – The baud rates which can be used with the C-More Control Panel are:
  - 2400
  - 4800
  - 9600 (Default)
  - 19.2K
- Data Format – The program must be set for:
  - 8 data bits
  - 1 stop bit
  - no parity
  - either Xon/Xoff or No flow control

9.3 MENU PROCESSING UTILIZING RS-232 COMMUNICATION

Viewing data logs and viewing or changing Control Panel menu options using RS-232 communication is accomplished as follows:

Menu Processing Utilizing Rs-232 Communication

1. Start the emulator software program and ensure that the specified baud rate and data formats have been entered.
2. Press the **Enter** key on the laptop. An asterisk (*) prompt should appear.
3. At the prompt, enter the valid RS-232 password (jaguar) in lower case letters and press Enter.
4. “Welcome to Aerco” will appear in the laptop or “dumb terminal” display with a listing of the following available entry choices:

   M = Display next Menu
   D = Display menu items
   N = Display next menu items
   Cxx = Change item xx
   F = Fault log display
   S = Sensor log display
   T = Time line display
   L = Log off

MENU PROCESSING UTILIZING RS-232 COMMUNICATION – Continued

NOTE

The Level 1 password (**159**) must be entered to change options in the Setup, Configuration and Tuning Menus. The Level 2 password (**6817**) must be entered to view or change options in the Calibration and Diagnostics Menus.

With the exception of the password entry, all other keyboard entries can be made using either upper or lower case.

5. To view the available menus in the top-down sequence shown in Figure 3-2, enter ***M <Rtn>***. The Menu title and first 10 options will be displayed.
6. When viewing menus containing more than 10 options, enter ***N <Rtn>*** to display the remaining options.

Menu Processing Utilizing Rs-232 Communication

7. Shortcut keys are also available to go directly to a specific menu. These shortcut keys are:

   m0 = Default (Operating) Menu
   m1 = Setup Menu
   m2 = Configuration Menu
   m3 = Tuning Menu
   m4 = Calibration Menu
   m5 = Diagnostic Menu

8. To change a value or setting for a displayed menu option, proceed as follows:

   (d) Enter **C**, followed by the number to the right of the displayed option to be changed, and then press ***<Rtn>***.

   (e) Enter the desired value or setting for the option and press ***<Rtn>***. Refer to Chapter 3, Tables 3-2 through 3-5 for allowable entry ranges and settings for the Operating, Setup, Configuration and Tuning Menus. (The Calibration and Diagnostic Menus should only be used by Factory-Trained service personnel).

   (f) Menu changes will be stored in non-volatile memory.

9. To redisplay the menu and view the option which was just changed in step 5, enter **D** and press ***<Rtn>.***
10. To display the Fault (F) Log, Sensor (S) Log or Time (T) Line Log, press **F**, **S** or **T** followed by ***<Rtn>.*** Refer to section 9.4 for descriptions and samples of these data logs.
11. To log off and terminate the RS-232 communication link, press **L** followed by ***<Rtn>.***

9.4 DATA LOGGING

During operation, the C-More Control Panel continuously monitors and logs data associated with operational events, faults and sensor readings associated with the boiler system. Descriptions of these data logs are provided in the following sections. The procedure for accessing specific data logs is described in section 9.3 step 10.

9.4.1 Fault Log

The C-More Control Panel logs the last 20 faults (0 – 19) starting with the most recent (#0). They can be viewed in the front panel display or via the RS-232 port. The Fault Log cannot be cleared. If the Fault Log already contains 10 faults, the earliest fault is overwritten when a new fault occurs. A sample Fault Log display is shown in Table 9-1.

Table 9-1: Sample Fault Log Display

No.	Fault Message	Cycle	Date	Time
0	Direct Drive Signal Fault	609	1/10/02	8:42am
1	Low Gas Pressure	366	7/04/01	5:29pm
2	Loss of Power	0	1/01/01	11:50am

NOTE

The Operation Time (T) Log can store thousands of records. Therefore, to view the most recently logged record, enter "T" followed by 0 (zero) and press Enter (i.e. T0 <Enter>). To view earlier records in reverse chronological order, enter T and press Enter. To go back 200 or 1000 records, enter T200 or T1000, etc. and press Enter.

9.4.2 Operation Time Log

The Operation Time Log consists of a string of ASCII records stored in non-volatile memory within the C-More Control Panel. Events such as power-up, ignition and turn-off are time stamped. Data logged while the unit is running are run-length encoded. Data is logged or the run-length incremented every 30 seconds. For a new run record to be logged, the fire rate or flame strength must change by more than 5%, or the run mode must change. At steady-state, the run-length is allowed to reach a maximum of 30 minutes before the record is logged. This means that no more than 30 minutes of data can be lost if the unit loses power. Table 9-2 shows a sample Operation Time Log for a boiler:

The Operation Time Log can only be accessed through the RS-232 interface using a laptop or other terminal device. Ten operation time records are displayed for each T command entry. The operation time log can be cleared ONLY by factory authorized personnel using the Clear Log option in the Factory menu.

Table 9-2: Sample Operation Time Log Display

Status	Fire Rate	Flame	Run Length	Date	Time
Off, Direct Drive	0	0	8	1/15/02	2:35pm
Run, Direct Drive	38	100	34	1/15/02	2:27pm
Run, Direct Drive	31	100	30	1/15/02	1:53am
Run, Direct Drive	35	100	2	1/15/02	1:23pm
Run, Direct Drive	29	100	0	1/15/02	1:21pm
Ignition	0	0	0	1/15/02	1:20pm
Off, Switch	0	0	35	1/15/02	12:30pm
Run, Manual	40	100	0	1/15/02	11:55am
Ignition	0	0	0	1/15/02	11:55am
Power-up	0	0	0	1/15/02	11:50am

NOTE

The Sensor (S) Log can store up to 1200 records. Therefore, to view the most recently logged record, enter "S" followed by 0 (zero) and then press Enter (i.e. S0 <Enter>). To view earlier records in reverse chronological order, enter S and press Enter. To go back 200 or 700 records, enter S200 or S700, etc. and press Enter.

9.4.3 Sensor Log

The sensor values can be logged at a different rate if needed by setting the Sensor Log Interval in the Diagnostics Menu. The log interval can vary from once every minute to once every day. Table 9-3 shows a sample Sensor Log every 5 minutes for a boiler running in Constant Setpoint mode.

Table 9-3: Sample Sensor Log Display

Setpt	Outlet	Outdr	FFWD	Aux	Inlet	Exhst	CO	O2	Flow	Date	Time
130	181	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:51pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:46pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:41pm
130	179	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:36pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:31pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:26pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:21pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:16pm
130	179	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:11pm
130	180	OPEN	OPEN	OPEN	OPEN	OPEN	0	.0	0	1/15/02	5:06pm

CHAPTER 10. BOILER SEQUENCING TECHNOLOGY

10.1 INTRODUCTION

The C-More on-board Boiler Sequencing Technology system (BST) is an integrated 8 boiler control system designed into the C-More controller. The BST has its own sophisticated PID control system designed to simultaneously control the light off and modulation of up to 8 boilers while achieving maximum operational efficiency.

BST is designed to ensure that all Boilers in the system operate at maximum efficiency. This is accomplished by lighting off boilers only if all ignited boilers reach or exceed a defined Valve Position (Fire Rate). Operating all boilers below the defined Fire Rate “Next on VP” (for Next Turn on Valve Position) insures that they are firing at their most efficient Fire Rate. One C-More unit is defined as the MASTER unit and all other C-More units on the BST Modbus Network are defined as SLAVE units. The Master unit will monitor the system Header Temperature, monitor all Slave units’ status information and efficiently control all units in order to achieve and maintain the required BST Setpoint Temperature.

When there is a demand, the Master unit will light off one of the boilers based on the BST Sequencing selection in the BST menu. As system load increases and the valve position of the ignited units reach the Next On VP (% valve position), the BST master will light off the next available unit. A simplified block diagram of multiple Boilers connected to a BST is shown in Figure 9-1 below.

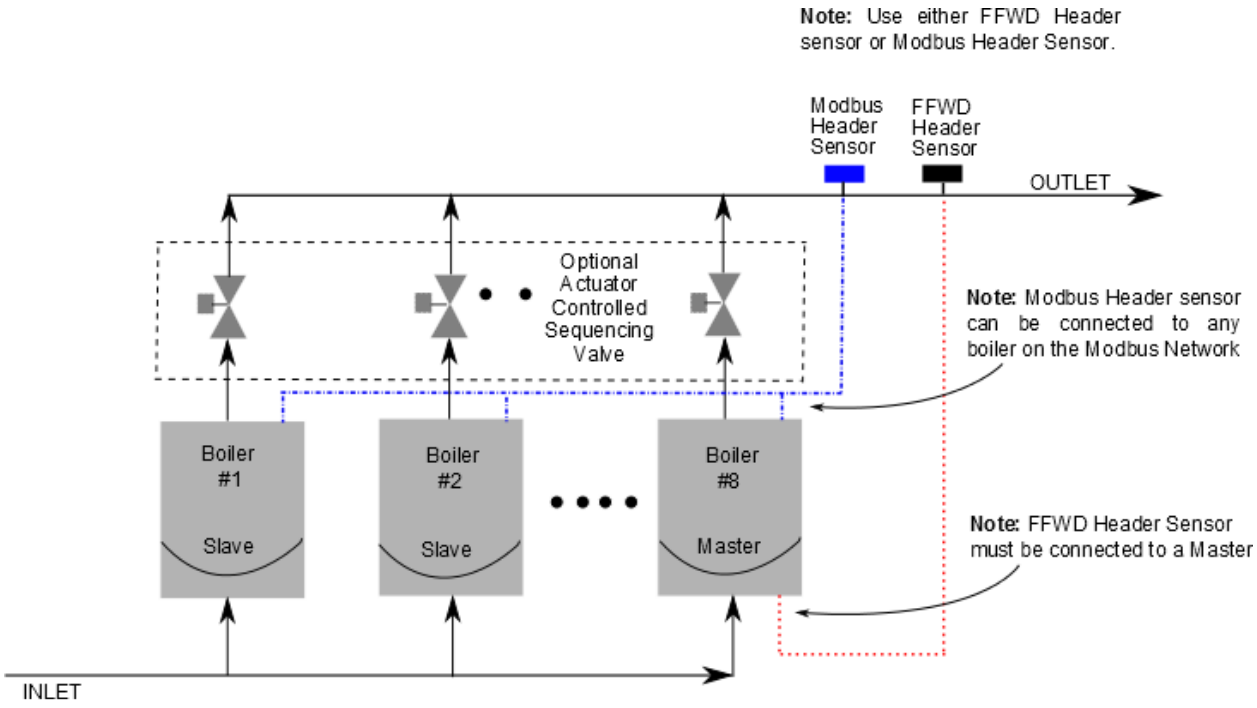


Figure 10-1. Simplified BST Block Diagram

10.2 AERCO BST Quick Start Chart

Select the single option that suites your installation and then complete the instructions in the corresponding sub-sections of section 10.3 BST Implementation Instructions.

Constant Setpoint (choose option 1 or 2)

Option 1 – Direct Wired Header — Complete section 10.3.1

OR

Option 2 – Modbus Header — Complete section 10.3.2

Outdoor Reset (choose option 3 or 4)

Option 3 – Direct Wired Header AND Direct Wired Outdoor Air — Complete section 10.3.3

OR

Option 4 – Modbus Header AND Modbus Outdoor Air — Complete section 10.3.4

Remote Setpoint (choose option 5 through 8)

Option 5 – 4-20ma Drive AND Direct Wired Header — Complete section 10.3.5

OR

Option 6 – Modbus Drive AND Direct Wired Header — Complete section 10.3.6

OR

Option 7 – 4-20ma Drive AND Modbus Header — Complete section 10.3.7

OR

Option 8 – Modbus Drive AND Modbus Header — Complete section 10.3.8

10.3 BST Implementation Instruction

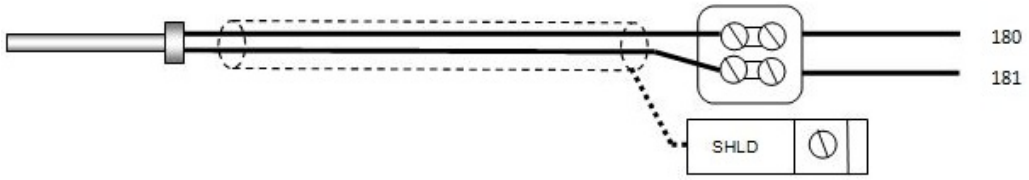
10.3.1 Option 1 - Constant Setpoint with DIRECT Wired Header Sensor

Step 1: Direct Wired Header Sensor Wiring

1. On the MASTER Unit, Connect the Header Temperature Sensor (**AERCO PN 61040**) to the Feed Forward (FFWD) terminals on the P-1 Harness Via the terminal block labeled “Header Temp sensor” in the I/O Box.

NOTES:

- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant’s supply water header.
- Shielded pair 18 - 22 AWG cable is recommended for header sensor wiring. There is no polarity to be observed. The ground for the shield is at the “SHLD” terminal in the I/O the Box. The sensor end of the shield must be left free and ungrounded.



Step 2: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the desired Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select Constant **Setpoint**.
6. Go to the **Head Temp Source** item and select **FFWD Temp**.

When ALL C-More units have been configured:

7. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

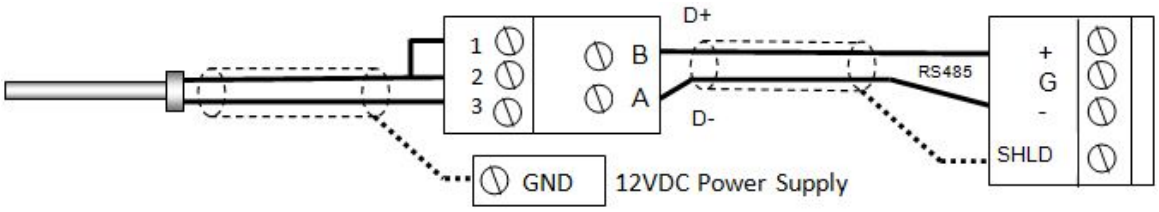
10.3.2 Option 2 - Constant Setpoint with MODBUS Wired Header Sensor

Step 1: MODbus Header Sensor Wiring

1. Using Shielded pair 18 - 22 AWG cable, connect the Temperature Transmitter (**AERCO P/N 65169**) terminal Pin B to the RS485+ terminal on the I/O Box of any of the Boiler units, and Pin A of the Temperature Transmitter to the RS485- terminal on the I/O Box of any of the Boiler units.
2. Using Shielded pair 18 - 22 AWG cable, connect the Modbus Header Temperature Sensor (**AERCO PN 24410**) to pins 2 and 3 of the Temperature Transmitter.
3. Install a jumper wire between pins 1 and 2 of the Temperature Transmitter**.**

NOTES:

- Polarity must be observed for the RS485 connections.
- The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- There is no polarity to be observed. The ground for the shield is at the power supply ground. The sensor end of the shield must be left free and ungrounded.



Temp Sensor PN 24410 Modbus Transmitter I/O Box

Step 2: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the desired Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select Constant **Setpoint**.
6. Go to the **Head Temp Source** item and select **Network**.
7. Go to the **Header Temp Addr** item and enter the Modbus Address (240).
8. Go to the **Header Temp Point** item and enter the Modbus Point (14).

When ALL C-More units have been configured:

9. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

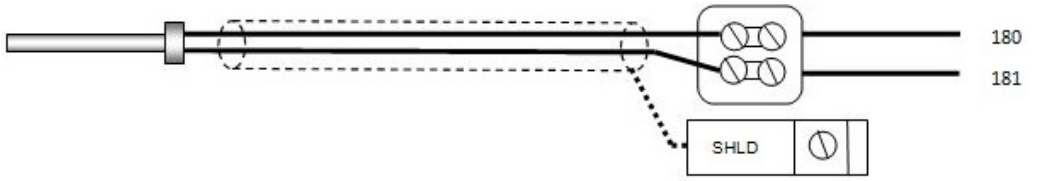
10.3.3 Option 3 - Outdoor Reset with DIRECT WIRED Header Sensor AND DIRECT WIRED Outdoor Sensor

NOTE: Both Header Sensor AND Outdoor Sensor must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1 - Direct Wired Header Sensor Wiring

1. On the MASTER Unit, connect the Header Temperature Sensor (**AERCO PN 61040**) to the Feed Forward (FFWD) terminals on the P-1 Harness Via the terminal block labeled “Header Temp sensor” in the I/O Box.

NOTES: The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant’s supply water header. Shielded pair 18 - 22 AWG cable is recommended for header sensor wiring. There is no polarity to be observed. The ground for the shield is at the “SHLD” terminal in the I/O the Box. The sensor end of the shield must be left free and ungrounded.

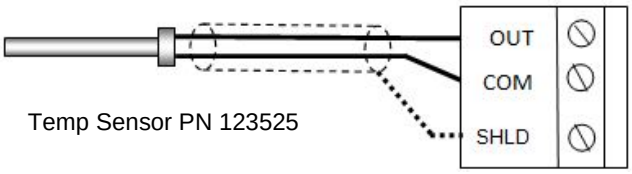


Step 2 - Direct Wired Outdoor Sensor

1. On the MASTER Unit, Connect the Outdoor Temperature Sensor (**AERCO PN 123525**) to the “OUT” and “COM” terminals in the I/O Box.

NOTES:

- Twisted shielded pair 18 - 22 AWG cable is recommended for header sensor wiring. There is no polarity to be observed. The ground for the shield is at the “SHLD” terminal in the I/O the Box. The sensor end of the shield must be left free and ungrounded.
- When mounting the Outdoor sensor, it must be located on the North side of the building where an average outside air temperature is expected. The sensor must be shielded from direct sunlight as well as impingement by the elements. The outdoor sensor may be wired up to 200 feet from the boiler.



Option 3 – Continued

Step 3 - Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the Failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select **Outdoor Reset**.
6. Go to the **Head Temp Source** item and select **FFWD Temp**.
7. Go to the **BST Outdoor Sens** item and select **Enabled**.
8. Go to the **Outdoor Temp Source** item and select **Outdoor Temp**.

When ALL C-More units have been configured:

9. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

10.3.4 Option 4 - Outdoor Reset with MODBUS Header Sensor AND MODBUS Outdoor Sensor

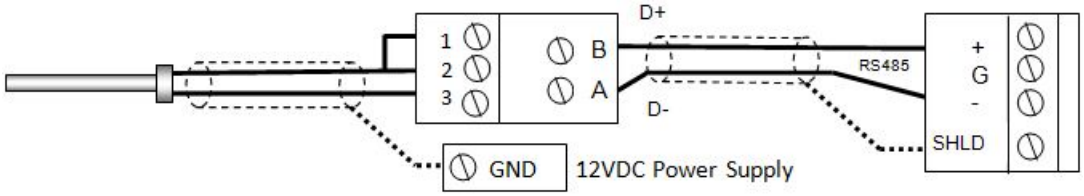
NOTE: Both Header Sensor AND Outdoor Sensor must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1 - Modbus Header Sensor Wiring

1. Using Shielded pair 18 - 22 AWG cable, connect the Temperature Transmitter (**AERCO P/N 65169**) terminal Pin B to the RS485+ terminal on the I/O Box of any of the Boiler units, and Pin A of the Temperature Transmitter to the RS485- terminal on the I/O Box of any of the Boiler units.
2. Using Shielded pair 18 - 22 AWG cable, connect the Modbus Header Temperature Sensor (**AERCO PN 24410**) to pins 2 and 3 of the Temperature Transmitter.
3. Install a jumper wire between pins 1 and 2 of the Temperature Transmitter**.**

NOTES:

- Polarity must be observed for the RS485 connections. The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- There is no polarity to be observed. The ground for the shield is at the power supply ground. The sensor end of the shield must be left free and ungrounded.



Temp Sensor PN 24410 Modbus Transmitter I/O Box

Step 2 - Modbus Outdoor Sensor Wiring

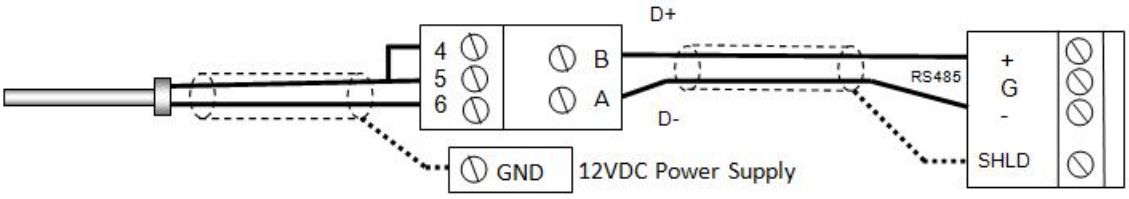
1. If you have not already done so when installing the Modbus Header Sensor, use Shielded pair 18 - 22 AWG cable to connect the Temperature Transmitter terminal Pin B to the RS485+ terminal on the I/O Box of any of the Boiler units, and Pin A of the Temperature Transmitter to the RS485- terminal on the I/O Box of any of the Boiler units.
2. Using Shielded pair 18 - 22 AWG cable, connect the Modbus Header Temperature Sensor (**AERCO PN 24410**) to pins 2 and 3 of the Temperature Transmitter.
3. Install a jumper wire between pins 1 and 2 of the Temperature Transmitter**.**

NOTES:

- Polarity must be observed for the RS485 connections. The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- When mounting the Outdoor sensor, it must be located on the North side of the building where an average outside air temperature is expected. The sensor must be shielded from direct sunlight as well as impingement by the elements. The outdoor sensor may be wired up to 200 feet from the boiler.

Option 4 – Continued

- There is no polarity to be observed. The ground for the shield is at the power supply ground. The sensor end of the shield must be left free and ungrounded.



Temp Sensor PN 61043 Modbus Transmitter I/O Box

Step 3 - Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu item to Enabled**.
2. Go to the **BST Menu** and set the **BST Mode item** to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the Failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select **Outdoor Reset**.
6. Go to the **Head Temp Source** item and select **Network**.
7. Go to the **Header Temp Addr** item and enter the Modbus Address (240).
8. Go to the **Header Temp Point** item and enter the Modbus Point (14).
9. Go to the **BST Outdoor Sens** item and select **Enabled**.
10. Go to the **Outdoor Temp Source** item and select **Network**.
11. Go to the **Outdoor Temp Addr** item and enter the Modbus Address (240).
12. Go to the **Outdoor Temp Point item** and enter the Modbus Point (15).

When ALL C-More units have been configured:

13. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

10.3.5 Option 5 - Remote Setpoint with DIRECT WIRED Header Sensor AND 4-20ma Setpoint Drive

NOTE: Both Header Sensor AND 4-20ma Direct Drive must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1: Direct Wired Header Sensor Wiring

1. On the MASTER Unit, Connect the Header Temperature Sensor (**AERCO PN 61040**) to the Feed Forward (FFWD) terminals on the P-1 Harness Via the terminal block labeled “Header Temp sensor” in the I/O Box.

NOTES:

- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant’s supply water header.
- Shielded pair 18 - 22 AWG cable is recommended for header sensor wiring.
- There is no polarity to be observed.
- The ground for the shield is at the “SHLD” terminal in the I/O the Box.
- The sensor end of the shield must be left free and ungrounded.

Step 2: Direct Wired 0-20ma or 4-20ma Wiring

1. Connect the 4-20ma or 0-20ma terminals from the Direct Drive source to the Ain+ and Ain- terminals on the Master Unit’s I/O Box.

NOTE:

- Shielded pair 18 - 22 AWG cable is recommended for this connection. Polarity must be observed.
- The ground for the shield is at the driver signal source.

Step 3: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the Failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select **Remote Setpoint**.
6. Go to the **Head Temp Source** item and select **FFWD Temp**.
7. Go to the **BST Remote Signal** and select either **4-20ma** or **0-20ma**.

When ALL C-More units have been configured:

8. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

10.3.6 Option 6 - Remote Setpoint with DIRECT WIRED Header Sensor AND MODBUS Setpoint Drive

NOTE: Both Header Sensor AND the ProtoNode SSD Device must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1: Direct Wired Header Sensor Wiring

1. On the MASTER Unit, Connect the Header Temperature Sensor (**AERCO PN 61040**) to the Feed Forward (FFWD) terminals on the P-1 Harness Via the terminal block labeled "Header Temp sensor" in the I/O Box.

NOTES:

- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- Shielded pair 18 - 22 AWG cable is recommended for header sensor wiring. There is no polarity to be observed. The ground for the shield is at the "SHLD" terminal in the I/O the Box. The sensor end of the shield must be left free and ungrounded.

Temp Sensor PN 61040 Header Temp Sensor I/O Box

Step 2: Remote Setpoint with Network

1. Configure and Connect the SSD Device (ProtoNode) per the AERCO Manual (GF129).

Step 3: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On Master only:

3. Go to the **BST Setpoint** item and enter the Failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select **Remote Setpoint**.
6. Go to the **Head Temp Source** item and select **FFWD Temp**.
7. Go to the **BST Remote Signal** item and select **Network**.

When ALL C-More units have been configured:

8. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

10.3.7 Option 7 - Remote Setpoint with MODBUS Header Sensor AND 4-20ma Setpoint Drive

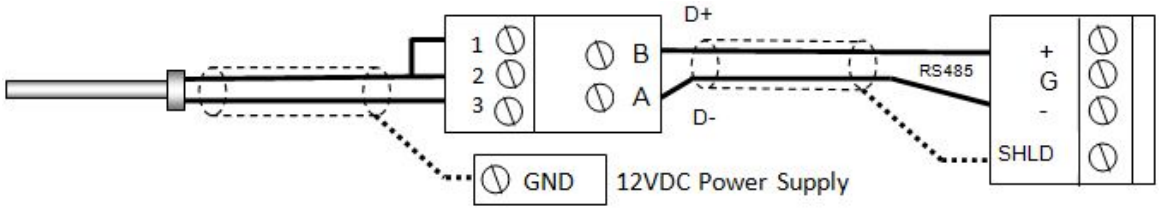
NOTE: Both Header Sensor AND 4-20ma Direct Drive must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1: MODbus Header Sensor

1. Using Shielded pair 18 - 22 AWG cable, Connect the Temperature Transmitter (**AERCO P/N 65169**) terminal Pin B to the RS485+ terminal on the I/O Box of any of the Boiler units, and Pin A of the Temperature Transmitter to the RS485- terminal on the I/O Box of any of the Boiler units.
2. Using Shielded pair 18 - 22 AWG cable, connect the Modbus Header Temperature Sensor (**AERCO PN 24410**) to pins 2 and 3 of the Temperature Transmitter.
3. Install a jumper wire between pins 1 and 2 of the Temperature Transmitter.

NOTES:

- Polarity must be observed for the RS485 connections. The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- There is no polarity to be observed. The ground for the shield is at the power supply ground. The sensor end of the shield must be left free and ungrounded.



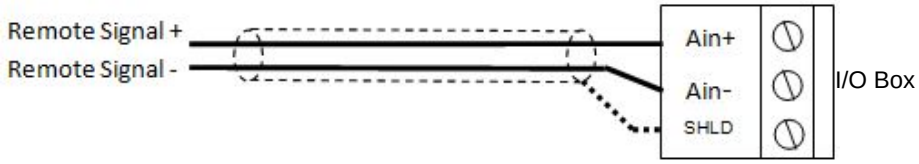
Temp Sensor PN 24410 Modbus Transmitter I/O Box

Step 2: Direct Wired 0-20ma or 4-20ma Wiring

1. Connect the 4-20ma or 0-20ma terminals from the Direct Drive source to the Ain+ and Ain- terminals on the Master.

NOTES:

- Unit's I/O Box. Shielded pair 18 - 22 AWG cable is recommended for this connection. Polarity must be observed.
- The ground for the shield is at the driver signal source.



Option 7 – Continued

Step 3: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the Failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select Remote **Setpoint**.
6. Go to the **BST Remote Signal** and select either **4-20ma** or **0-20ma**.
7. Go to the **Head Temp Source** item and select **Network**.
8. Go to the **Header Temp Addr** item and enter the Modbus Address (240).
9. Go to the **Header Temp Point** item and enter the Modbus Point (14).

When ALL C-More units have been configured:

10. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

10.3.8 Option 8 - Remote Setpoint with MODBUS Header Sensor AND MODBUS Setpoint Drive

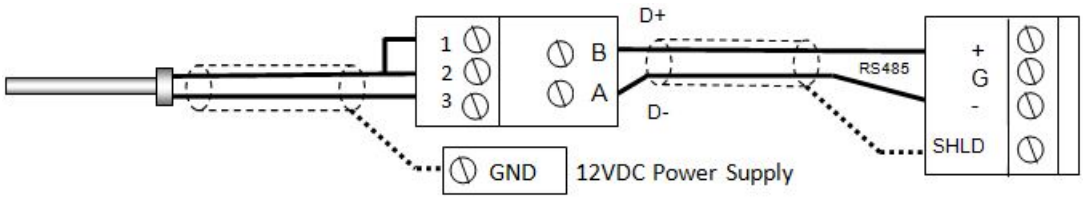
NOTE! Both Header Sensor AND ProtoNode SSD Device must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

Step 1: MODbus Header Sensor

1. Using Shielded pair 18 - 22 AWG cable, Connect the Temperature Transmitter (**AERCO P/N 65169**) terminal Pin B to the RS485+ terminal on the I/O Box of any of the Boiler units, and Pin A of the Temperature Transmitter to the RS485- terminal on the I/O Box of any of the Boiler units.
2. Using Shielded pair 18 - 22 AWG cable, connect the Modbus Header Temperature Sensor (**AERCO PN 24410**) to pins 2 and 3 of the Temperature Transmitter.
3. Install a jumper wire between pins 1 and 2 of the Temperature Transmitter**.**

NOTES:

- Polarity must be observed for the RS485 connections. The ground for the shield is at the "SHLD" terminal in the I/O the Box.
- The header sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the plant's supply water header.
- There is no polarity to be observed. The ground for the shield is at the power supply ground. The sensor end of the shield must be left free and ungrounded.



Temp Sensor PN 24410 Modbus Transmitter I/O Box

Step 2: Remote Setpoint with Network

1. Configure and Connect the SSD Device (ProtoNode) per the AERCO Manual (GF129).

Step 3: Configure ALL C-More Units

On ALL Boilers:

1. Go to the **Configuration Menu** and set the **BST Menu** item to **Enabled**.
2. Go to the **BST Menu** and set the **BST Mode** item to **BST Slave** (for now).

On MASTER only:

3. Go to the **BST Setpoint** item and enter the failsafe Setpoint.
4. Go to the **BST Setup Menu** item and set to **Enabled**.
5. Go to the **BST Setpoint Mode** item and select Remote **Setpoint**.
6. Go to the **BST Remote Signal** and select either **Network**.
7. Go to the **Head Temp Source** item and select **Network**.
8. Go to the **Header Temp Addr** item and enter the Modbus Address (240).
9. Go to the **Header Temp Point** item and enter the Modbus Point (14).

When ALL C-More units have been configured:

10. Go to the **BST Menu** of the desired **Master** unit and set the **BST Mode** item to **BST MASTER**.

(This Page Is Intentionally Blank)

Appendix A: BOILER MENU ITEM DESCRIPTIONS

MENU LEVEL & OPTION	DESCRIPTION
OPERATING MENU	
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 F.
Inlet Water Temp	Displays the inlet water temperature in ºF or ºC. Default is ºF
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.
Outdoor Temp	Outdoor temperature is displayed in ºF (default) or ºC only if outdoor sensor is installed and enabled.
Valve Position In	Desired input valve position. This would normally be the same as the fire valve position shown on the bargraph (valve position out) when the boiler is operating.
Exhaust Temp	Displays the exhaust temperature in °F (default), or ºC.
Flame Strength	Displays flame strength from 0% to 100%.
Oxygen Level	Displays the real-time combustion oxygen (O_2) level (%) measured by the O_2 sensor.
Run Cycles	Displays the total number of run cycles from 0 to 999,999.
Run Hours	Displays total run time of unit in hours from 0 to 9,999,999.
Fault Log	Displays information on the last 20 faults.

APPENDIX A: BOILER MENU ITEM DESCRIPTIONS – Continued

MENU LEVEL & OPTION	DESCRIPTION
SETUP MENU	
Password	Allows Level 1 or Level 2 password to be entered. Entering the Level 1 Password (159) allows options in the Setup, Configuration and Tuning Menus to be modified. 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.
Language	Permits selection of English, Spanish or French for displayed messages. Default is English.
Time	Displays time from 12:00 am to 11:59 pm.
Date	Displays dates from 01/01/00 to 12/31/99
Unit of Temp	Permits selection of temperature displays in degrees Fahrenheit (°F) or degrees Celsius (°C). Default is °F.
Comm Address	For RS-485 communications (0 to 127). Default address is 0. RS-232 should have its own (programmable) password.
Baud Rate	Allows communications Baud Rate to be set (2400 to 19.2K). Default is 9600.
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.
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.
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.
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**.
Software Version	Identifies the current software version of the control box (Ver 0.0 to Ver 9.9).
Internal Setpoint	Allows internal setpoint to be set. Default is 130°F.
Unit Type	Allows selection of KC Boiler, KC Boiler LN, BMK Boiler Std, BMK Blr Std Dual, BMK Boiler LN, BMK Blr LN Dual, KC Water Heater, KC Wtr Heater LN, Innovation WH

APPENDIX A: BOILER MENU ITEM DESCRIPTIONS – Continued

MENU LEVEL & OPTION	DESCRIPTION
CONFIGURATION MENU	
Internal Setpoint	Allows internal setpoint to be set (40°F to 240°F). Default is 130°F.
Unit Size	Sets unit size from 600 MBH to 6000 MBH depending on the Unit Type.
Fuel Type	Allows selection of Natural Gas or Propane
Boiler Mode (If Unit Type = Boiler)	It allows selection of: Constant Setpoint, Remote Setpoint, Direct Drive, Combination, or Outdoor Reset Mode. Default is Constant Setpoint Mode.
Remote Signal (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. The factory default is 4-20 mA/1-5V.
Bldg Ref Temp (If Boiler Mode = Outdoor Reset)	Allows the building reference temperature to be set when operating a boiler in the Outdoor Reset Mode. Default is 70°F.
Reset Ratio (If Boiler Mode = Outdoor Reset)	Permits setting of Reset Ratio when operating boiler in the Outdoor Reset Mode. Reset Ratio is adjustable from 0.1 to 9.9. Default is 1.2.
Outdoor Sensor	Allows outdoor sensor function to be enabled or disabled. Default is disabled.
System Start Tmp (If Outdoor Sensor is Enabled)	If outdoor sensor is enabled, this menu item allows the system start temperature to be set from 30 to 100°F. Default is 60°F.
Setpoint Lo Limit	Used to set the minimum allowable setpoint (40°F to Setpoint Hi Limit). Default is 60°F
Setpoint Hi Limit	Used to set the maximum allowable setpoint (Setpoint Lo Limit to 210°F). Default is 140°F.
Temp Hi Limit	This is the maximum allowable outlet temperature (40 to 210°F). Any temperature above this setting will turn off the unit. The temperature must then drop 5° below this setting to allow the unit to run. Default Hi Limit is 160°F.
Max Valve Position	Sets the maximum allowable valve position for the unit (40% to 100%). Default is 100%.
Pump Delay Timer	Specifies the amount of time (0 to 30 min.) to keep the pump running after the unit turns off. Default is zero.

APPENDIX A: BOILER MENU ITEM DESCRIPTIONS – Continued

MENU LEVEL & OPTION	DESCRIPTION
CONFIGURATION MENU (Cont.)	
Aux Start On Dly	Specifies the amount of time to wait (0 to 120 sec.) between activating the Aux Relay (due to a demand) and checking the pre-purge string to start the boiler. Default is 0 sec.
Failsafe Mode	Allows the Failsafe mode to be set to either Constant Setpoint or Shutdown. Default is Shutdown.
Analog Output	Must be set to Valve Pos 0-10V for BMK 1500 & 2000.
Lo Fire Timer	Specifies how long (2 to 600 sec.) to remain in the low fire position after ignition, before going to the desired output. Default is 2 sec.
Setpt Limiting	Setpoint Limiting can be Enables or Disablled. The default setting is Enabled.
Setpt Limit Band	The Setpoint Limit Band can be set from 0 to 10. The default setting is 5.
Network Timeout	Specifies the timeout value (seconds) before a Modbus fault is declared. Available settings range from 5 to 999 seconds. Default is 30 seconds.
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. Span is 0 to 25, Default is 10.
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* 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. 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. There will not be a one minute delay when firing at the 29% Valve Position level. Setting range is 0 to 25. (Default is 10)

APPENDIX A: BOILER MENU ITEM DESCRIPTIONS – Continued

MENU LEVEL & OPTION	DESCRIPTION
CONFIGURATION MENU (Cont.)	
Deadband High Deadband Low	Deadband High and Deadband Low settings create an "Outlet Temperature" Zone in which no Valve Position corrections will be attempted. The Deadband ZONE is defined as operating with an Outlet Temperature between Active Setpoint + Deadband High and Active Setpoint – Deadband Low. 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. Setting range is 0 to 25. (Default is 2 for both Deadband High and Deadband Low)
IGST Version	Displays the version of the IGST Board installed.
IGN Time Setting	Displays the MAX Ignition time of 4 Seconds or 7 Seconds as set in the Safety String Harness.
Slow Shutdown	Enables or Disables the slow shutdown feature. Default is Disabled.
Slow Sht Duration	With the Slow Shutdown feature Enabled, sets the time a boiler will continue to run at the Stop Level after running above the Slow Sht Threshold level for 60 Seconds. Span is 0 to 9999 Seconds, Default is 60 Seconds.
Slow Sht Threshold	Sets the Fire Rate above which a boiler will trigger the Slow Shutdown feature. Span is 40% to 100%, Default is 60%.

APPENDIX A: BOILER MENU ITEM DESCRIPTIONS – Continued

MENU LEVEL & OPTION	DESCRIPTION	
TUNING MENU		
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 to 120°F), 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%.	
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).	
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 the next three menu items 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.	
Warmup Prop Band	Range = 1-120	Default = 95
Warmup Int Gain	Range = 1-200	Default = 50
Warmup PID Timer	Range = 1-240	Default = 20
Reset Defaults?	Allows Tuning Menu options to be reset to their Factory Default values.	

Appendix B: STARTUP, STATUS & DISPLAY MESSAGES

Table B-1: Startup And Status Messages

MESSAGE	DESCRIPTION
DEMAND DELAY XX sec	Displayed if Demand Delay is active.
DISABLED HH:MM pm, pm 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 XX sec	Displayed during ignition trial of startup sequence. The duration of cycle counts up in seconds.
PURGING 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 XX sec	Displayed for 2 minutes during the initial warm-up only.

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.
HIGH GAS PRESSURE	The High 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 GAS PRESSURE	The Low Gas Pressure Limit Switch is open.
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.
O_2 % OUT OF RANGE	The O_2 % has gone below 3% or above 8%.

***Table B-2: Fault Messages** – Continued*

FAULT MESSAGE	FAULT DESCRIPTION
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: • OUTLET TEMPERATURE display = SHt Indicates sensor is shorted • 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 during 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.

This Page Is Intentionally Blank

Appendix C: SENSOR RESISTANCE/VOLTAGE CHART

Temperature Sensor Resistance Voltage Chart (Balco)

TEMP (°F)	RES (OHMS)	VOLTS*
-40	779.0	1.93
-30	797.5	1.96
-20	816.3	1.99
-10	835.4	2.02
0	854.8	2.05
10	874.6	2.07
20	894.7	2.10
30	915.1	2.12
40	935.9	2.15
50	956.9	2.17
60	978.3	2.20
70	1000.0	2.23
80	1022.0	2.25
90	1044.4	2.27
100	1067.0	2.30
110	1090.0	2.32
120	1113.3	2.34
130	1137.0	2.36
140	1160.9	2.39
150	1185.2	2.41
160	1209.5	2.43
170	1234.7	2.45
180	1260.0	2.47
190	1285.6	2.50
200	1311.4	2.52
210	1337.7	2.54
220	1364.2	2.56
230	1391.0	2.58
240	1418.2	
250	1445.7	

This Page Is Intentionally Blank

Appendix D: BOILER DEFAULT SETTINGS

Appendix D: Boiler Default Settings

MENU & OPTION	FACTORY DEFAULT
Setup Menu	
Password	0
Language	English
Unit of Temp	Fahrenheit
Comm Address	0
Baud Rate	9600
Configuration Menu	
Internal Setpt	130°F
Unit Type	BMK Boiler LN
Unit Size	1500 MBH or 2000 MBH
Fuel Type	Natural Gas
Boiler Mode	Constant Setpoint
Remote Signal (If Mode = Remote Setpoint, Direct Drive or Combination)	4 – 20 mA / 1-5V
Bldg Ref Temp (If Boiler Mode = Outdoor Reset)	70°F
Reset Ratio (If Boiler Mode = Outdoor Reset)	1.2
Outdoor Sensor	Disabled
System Start Tmp (If Outdoor Sensor = Enabled)	60°F
Setpt Lo Limit	60°F
Setpt Hi Limit	195°F
Temp Hi Limit	195°F
Max Valve Position	100%
Pump Delay Timer	0 min
Aux Start On Dly	0 sec
Failsafe Mode	Shutdown
Analog Output	Valve Position 0-10V CAUTION: DO NOT Change
Lo Fire Timer	2 sec

Appendix D: Boiler Default Settings

MENU & OPTION	FACTORY DEFAULT
Configuration Menu (Cont.)	
Setpt Limit Band (If Setpt Limiting = Enabled)	5°F
Network Timeout	30 seconds
Hi DB Setpt En	30
Demand Offset	10
Deadband High	2
Deadband Low	2
Tuning Menu	
Prop Band	70°F
Integral Gain	1.00
Derivative Time	0.0 min

Appendix E: 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.

Item	Frequency	Accomplished By	Remarks
Refer to indicated sections of this manual 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 sections 4.3 and 7.4.
Flue, vent, stack or intake air duct	Monthly	Operator	Visually inspection condition and check for obstructions
Spark Igniter-Injector	Weekly	Operator	See section 7.2
Air/Fuel Valve position	Weekly	Operator	Check position indicator dial (section 3.11)
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 6.7
Flame signal strength	Weekly	Operator	Check flame strength using the Control Panel Operating Menu. See section 3.4.
Low water level cut off and alarm	Weekly	Operator	See section 6.4
Slow drain test	Semi-Annually	Operator	Perform a slow drain test in accordance with ASME Boiler and Pressure Vessel Code, Section IV.
High water temperature safety control test	Annually	Service Technician	See section 6.5
Operating controls	Annually	Operator	See section 3.2
Low air flow	Monthly	Operator	See section 6.8
High and low gas pressure interlocks	Monthly	Operator	See sections 6.2 and 6.3
Air/Fuel Valve purge position switch	Annually	Service Technician	See section 6.10
Air/Fuel Valve ignition position switch	Annually	Service Technician	See section 6.11
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 7.6
Condensate Trap	Semi-Annually	Operator	See section 7.7
Oxygen (O_2) Level	Monthly	Operator	Verify oxygen level is between 3% and 8% during boiler operation

This Page Is Intentionally Blank

Appendix F: INDOOR/OUTDOOR RESET RATIO CHARTS

Table F-1: Header Temperature for a Building Reference Temperature of 50F

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

Table F-2: Header Temperature for a Building Reference Temperature of 60F

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

Table F-3: Header Temperature for a Building Reference Temperature of 65F

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

Table F-4: Header Temperature for a Building Reference Temperature of 70F

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

Table F-5: Header Temperature for a Building Reference Temperature of 75F

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

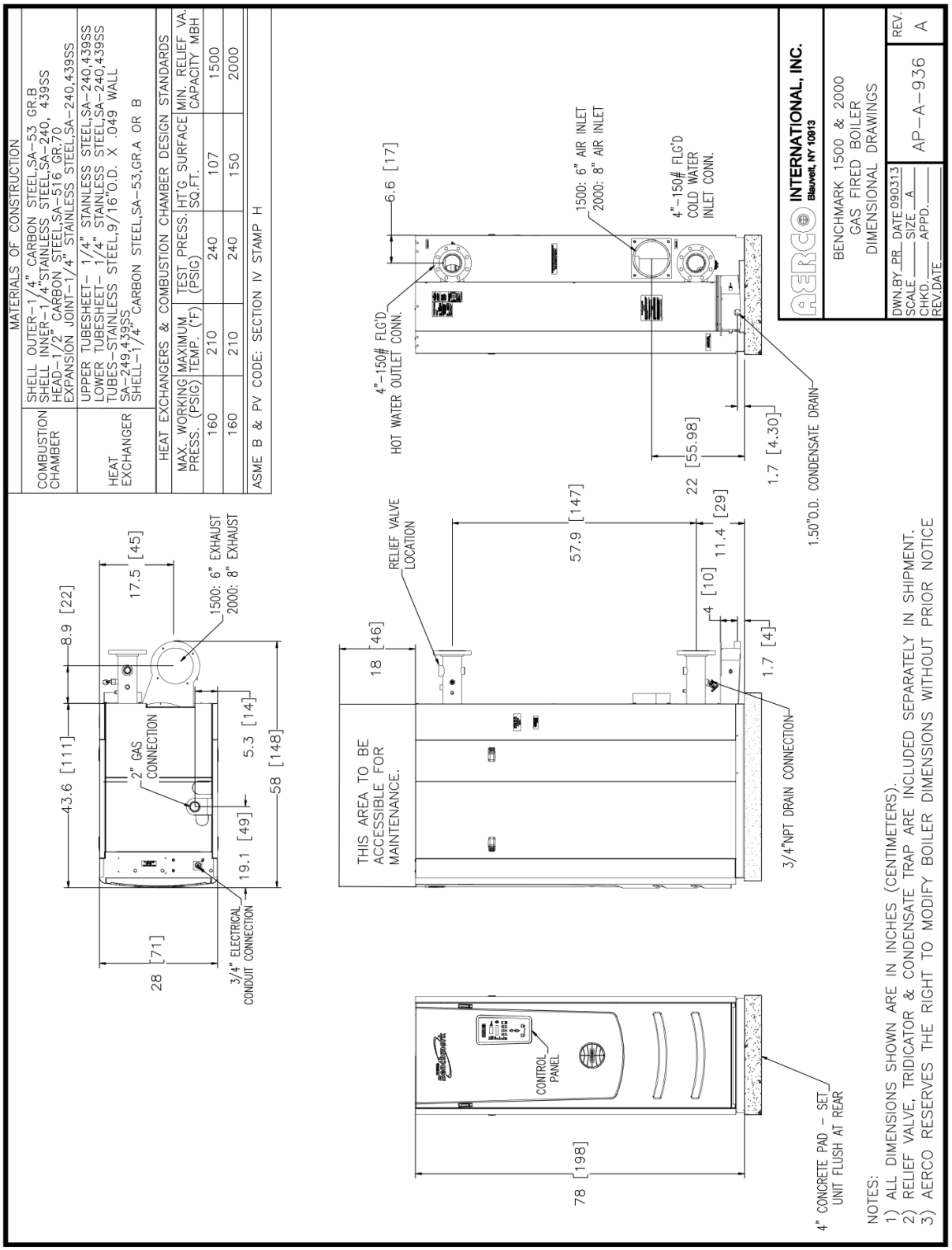
Table F-6: Header Temperature for a Building Reference Temperature of 80F

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

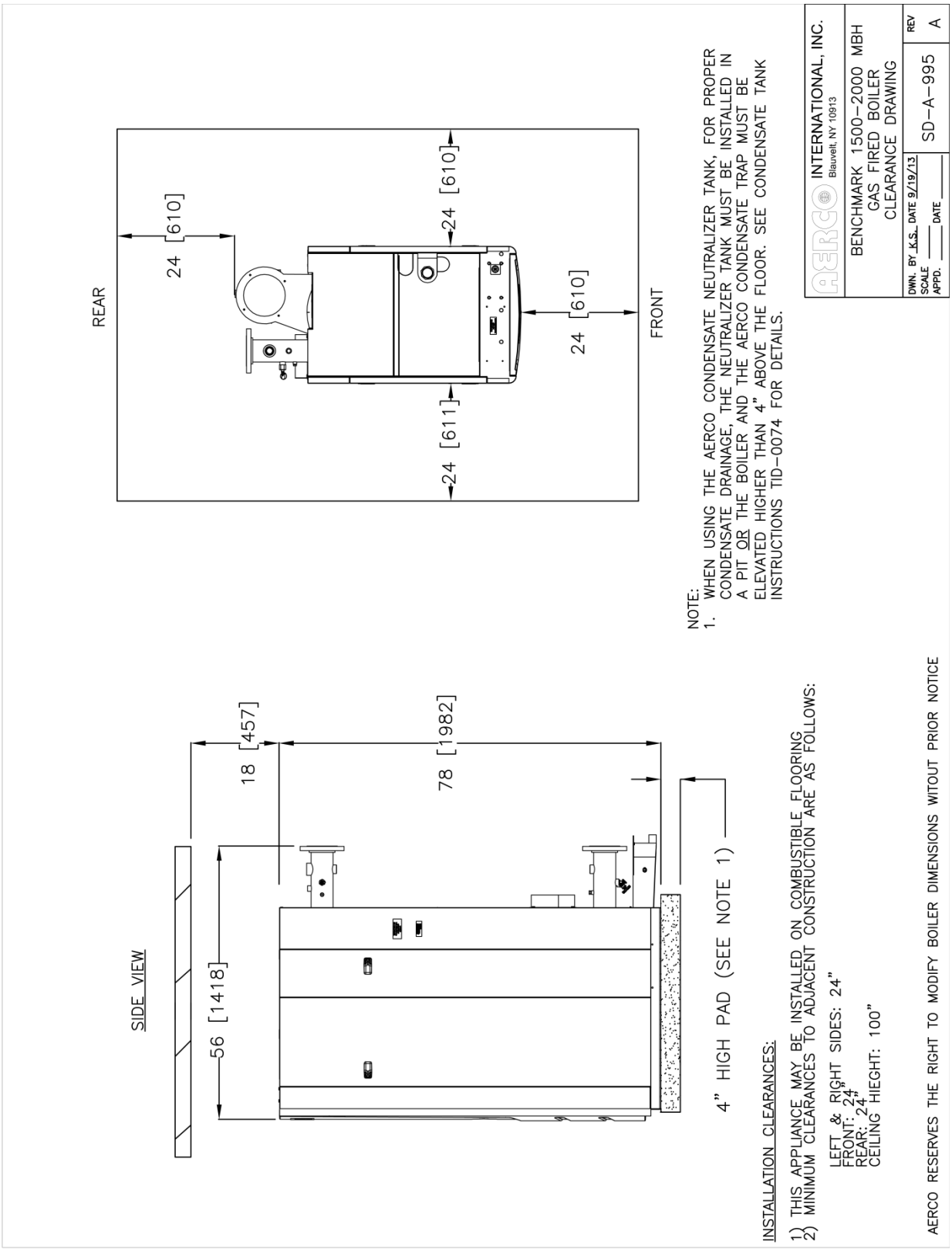
Table F-7: Header Temperature for a Building Reference Temperature of 90F

	RESET RATIO									
Air Temp	**0.6**	**0.8**	**1.0**	**1.2**	**1.4**	**1.6**	**1.8**	**2.0**	**2.2**	**2.4**
90F	90	90	90	90	90	90	90	90	90	90
85F	93	94	95	96	97	98	99	100	101	102
80F	96	98	100	102	104	106	108	110	112	114
75F	99	102	105	108	111	114	117	120	123	126
70F	102	106	110	114	118	122	126	130	134	138
65F	105	110	115	120	125	130	135	140	145	150
60F	108	114	120	126	132	138	144	150	156	162
55F	111	118	125	132	139	146	153	160	167	174
50F	114	122	130	138	146	154	162	170	178	186
45F	117	126	135	144	153	162	171	180	189	198
40F	120	130	140	150	160	170	180	190	200	210
35F	123	134	145	156	167	178	189	200		
30F	126	138	150	162	174	186	198	210		
25F	129	142	155	168	181	194	207			
20F	132	146	160	174	188	202	216			
15F	135	150	165	180	195	210				
10F	138	154	170	186	202	218				
5F	141	158	175	192	209					
0F	144	162	180	198	216					

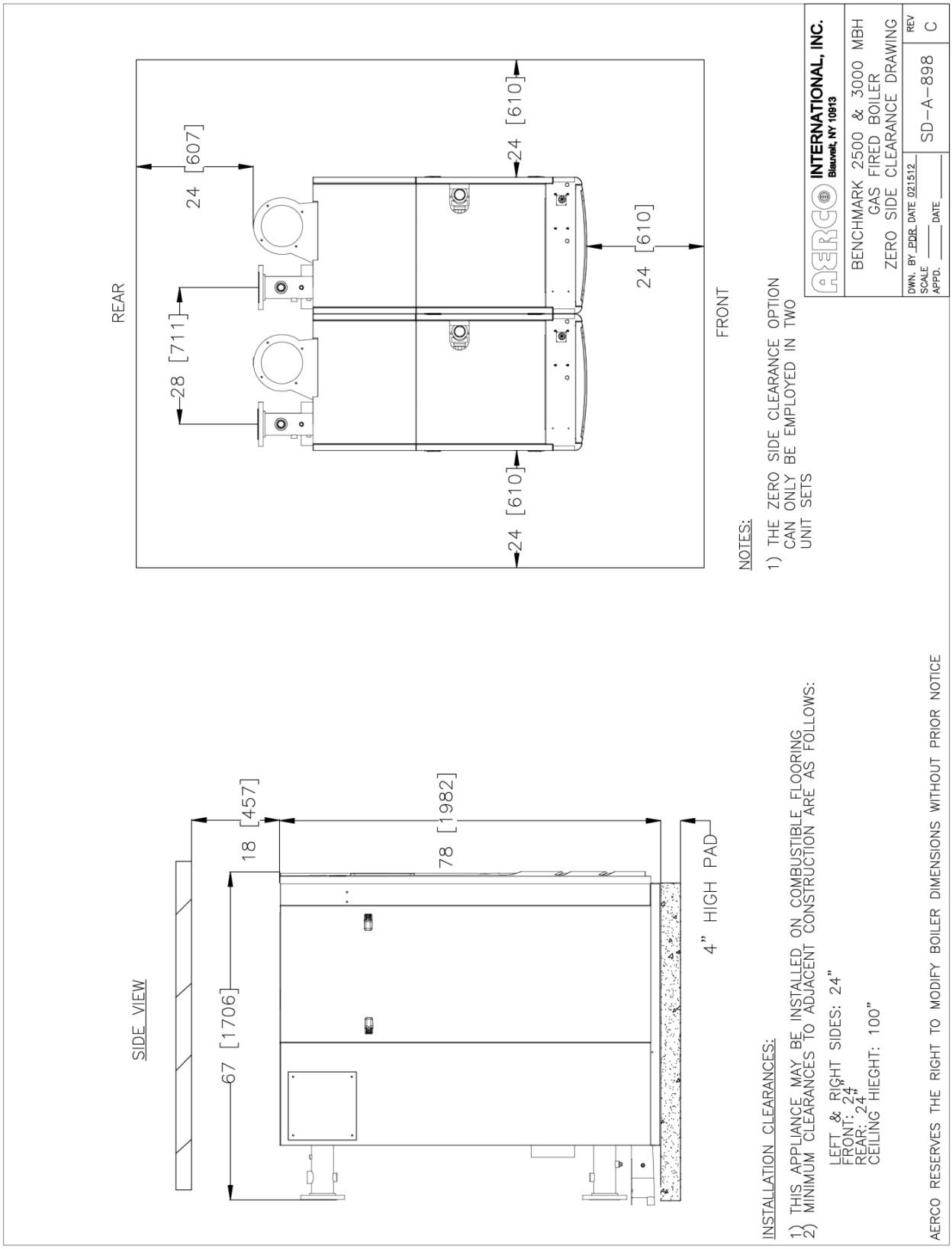
Appendix G: DIMENSIONAL AND CLEARANCE DRAWINGS



Drawing Number: AP-A-936 rev A



Drawing Number: AP-A-995 rev A



Drawing Number: AP-A-898 rev C

This Page Is Intentionally Blank

Appendix H: PART DRAWINGS

Benchmark 1500 - 2000 Part List

Item #	Qty	Part #	Description
EXHAUST MANIFOLD			
1	1	39187	MANIFOLD: EXHAUST
2	1	81165	MANIFOLD: SEAL
3	6	9-22	PIPE PLUG: 1/4" NPT: STEEL
GAS TRAIN			
4	1	22188	BMK 1500 STANDARD GAS TRAIN ASSY
		22199	BMK 1500-2000 DBB GAS TRAIN
BURNER, AIR/FUEL VALVE AND HEAT EXCHANGER			
9	1	24378	BURNER ASSY, BMK 1500
	1	24388	BURNER ASSY, BMK 2000
10	1	46042	BURNER, BMK 1500
	1	46044	BURNER, BMK 2000
11	1	24277	STAGED IGNITION ASSY
12	1	81166	BURNER GASKET
13	2	81183	BURNER RELEASE GASKET
14	1	43090	AIR FUEL VALVE PLENUM
15	1	24220-3	AIR FUEL VALVE ASSY, BMK 1500
	1	24220-10	AIR FUEL VALVE ASSY, BMK 2000
HOSES & INSULATION			
16	1	97005-9	FLEX GAS TUBE 48"
17	1	80089	SHELL INSULATION
BLOWER			
18	1	69078	BLOWER
19	1	81057	BLOWER GASKET
20	1	81100	GASKET, BLOWER MOTOR
21	1	66020	FLAME DETECTOR
22	1	61026	SENSOR: O2
23	1	59104	OBSERVATION PORT
24	1	66026	IGNITOR-INJECTOR
25	1	59138	AIR FILTER
26	1	43095	BLOWER PLENUM
CONTROLS			
27	1	123966	SWITCH: OVER TEMP-AUTO RESET
28	1	123552	SWITCH: OVER TEMP-MANUAL RESET
29	1	60011-2	BLOWER PROOF SWITCH
30	1	61002-5	BLOCKED INLET SWITCH -8.0" W.C.
31	1	181197	CONTROL BOX: C-MORE
32	1	65085	TRANSFORMER: IGNITION
33 ❶	1	63108	SSOV/RELAY JUMPER
34	1	93230	SNUBBER

Item #	Qty	Part #	Description
CONTROLS (Continued)			
35	1	64081	ECU
36	1	65011	TRANSFORMER 115V/24V 100VA
37	1	65109	12V POWER SUPLY
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, DIGITAL CONTROLLER
44	1	60019	DISCONNECT, FUSIBLE
45	1	65156	FLAME ROD SIGNAL AMPLIFIER
46	1	65162	24V POWER SUPLY (SEQUENCING VALVE)
47 ❶	2	124512	FUSE: 4 AMP
48	1	123449	SENSOR: TEMPERATURE
49	1	93359	THERMOWELL
50 ❶	1	63105	I/O SENSOR/COMM HARNESS
51 ❶	1	63104	I/O INTERLOCK HARNESS
52 ❶	1	63090	HARNESS ASSY: TEMP LIM CONT PWR
53 ❶	1	63150	HARNESS: FLAME ROD
54	1	33170	MOUNTING PANEL
55	1	124324	GROUND BAR
56 ❶	1	63156	POWER CABLE, 24V SEQUENCE VALVE
57 ❶	1	63103	SHELL HARNESS
58 ❶	1	63109	GAS TRAIN HARNESS: BMK 3000
59	1	61024	AIR INLET TEMPERATURE SENSOR
60	1	123449	SENSOR: TEMPERATURE
61	1	61030	SENSOR: OUTLET TEMPERATURE
62	1	69151	PCB ASSY
64 ❶	1	65104	CABLE, H.V. IGNITION
65 ❶	1	63058	HARNESS: BLOWER SIGNAL
66 ❶	1	63083	HARNESS: O2 SENSOR
67 ❶	1	63111	HARNESS: CONTROL
69	1	69151	PCB ASSY
70❶	1	38035	I/O PANEL COVER
71❶	1	38036	POWER PANEL COVER

❶ Not shown on drawing

Benchmark 1500 - 2000 Part List – Continued

Item #	Qty	Part #	Description	Item #	Qty	Part #	Description
SHEET METAL/PANEL ASSEMBLY				**OTHER ACCESSORIES & PARTS**			
72	1	37117	BACK PANEL: LEFT	87 ❶	1	SEE TABLE A	PRESSURE/TEMP GAUGE
73 ❶	1	37118	BACK PANEL RIGHT	88 ❶	1	SEE TABLE A	PRESSSURE RELIEF VALVE
74	2	35029	TOP RAIL	89 ❶	1	123540	EXT. MANUAL SHUT-OFF VALVE
75	1	25078	ASSEMBLY: FRONT PANEL	90	1	69126	LOW WATER CUTOFF/CAPACITOR ASSY
76	1	25072	FRONT PANEL ASSY	91	1	123863	1/8" NTP BALL VALVE
77	1	72068	DOME LABEL	92	1	92094	3/4" DRAIN VALVE
78	2	59179	HANDLE, CONCEALED	93 ❶	1	59043	CONDENSATE FLOAT
79	4	59133	LATCH	94 ❶	1	24060	COND. TRAP ASSY
80	1	37119	FRONT TOP PANEL	95	1	59178	1/8" AIR VENT
81	1	37120	BACK TOP PANEL	96	1	90052	NIPPLE 1/8" X 1.50 LG
82	2	30117	SIDE PANEL	97	1	24386	I/O- POWER BOX ASSY, 110 V
83	1	74031	BMK 1500 LOGO				
	1	74033	BMK 2000 LOGO	100 ❶	1	92084-6	MOTORIZED SEQUENCING VALVE (OPTIONAL)
84	1	39164	AIR INLET ADAPTER				

❶ Not shown on drawing

TABLE A – Benchmark 1500

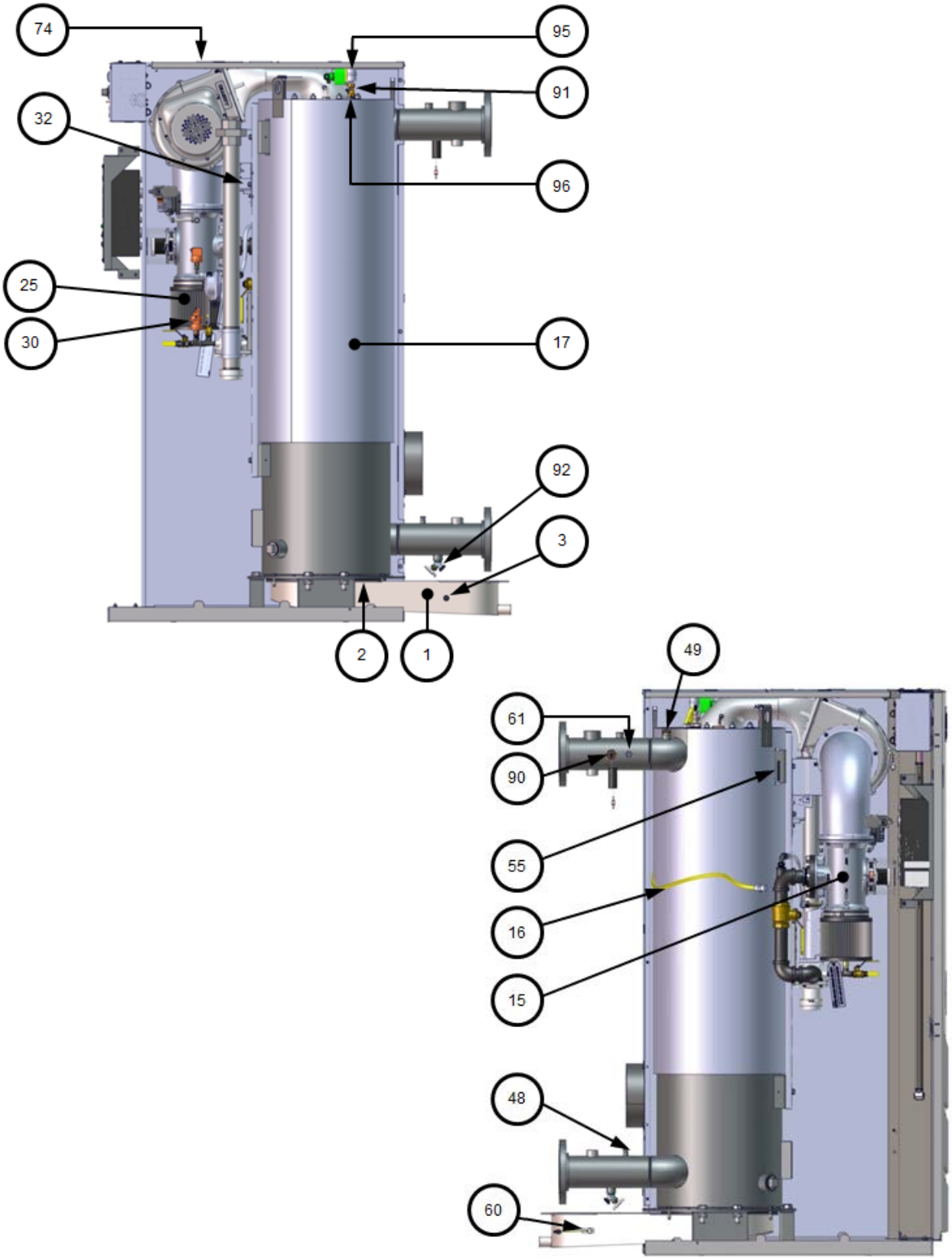
Part No.	Description	Item 88	Item 87
58088-C30	30 PSI KIT (CONBRACO)	92023-1	69087-2
58088-C50	50 PSI KIT (CONBRACO)	92023-2	69087-2
58088-C60	60 PSI KIT (CONBRACO)	92023-3	69087-3
58088-C75	75 PSI KIT (CONBRACO)	92023-4	69087-3
58088-C100	100 PSI KIT (CONBRACO)	92023-5	69087-3
58088-C125	125 PSI KIT (CONBRACO)	92023-6	69087-3
58088-C150	150 PSI KIT (CONBRACO)	92023-7	69087-4
58088-W30	30 PSI KIT (WATTS)	92023-8	69087-2
58088-W50	50 PSI KIT (WATTS)	92023-9	69087-2
58088-W60	60 PSI KIT (WATTS)	92023-10	69087-3
58088-W75	75 PSI KIT (WATTS)	92023-11	69087-3
58088-W100	100 PSI KIT (WATTS)	92023-12	69087-3
58088-W125	125 PSI KIT (WATTS)	92023-13	69087-3
58088-W150	150 PSI KIT (WATTS)	92023-14	69087-4
58088-W160	160 PSI KIT (KUNKLE)	92023-15	69087-4

TABLE A – Benchmark 2000

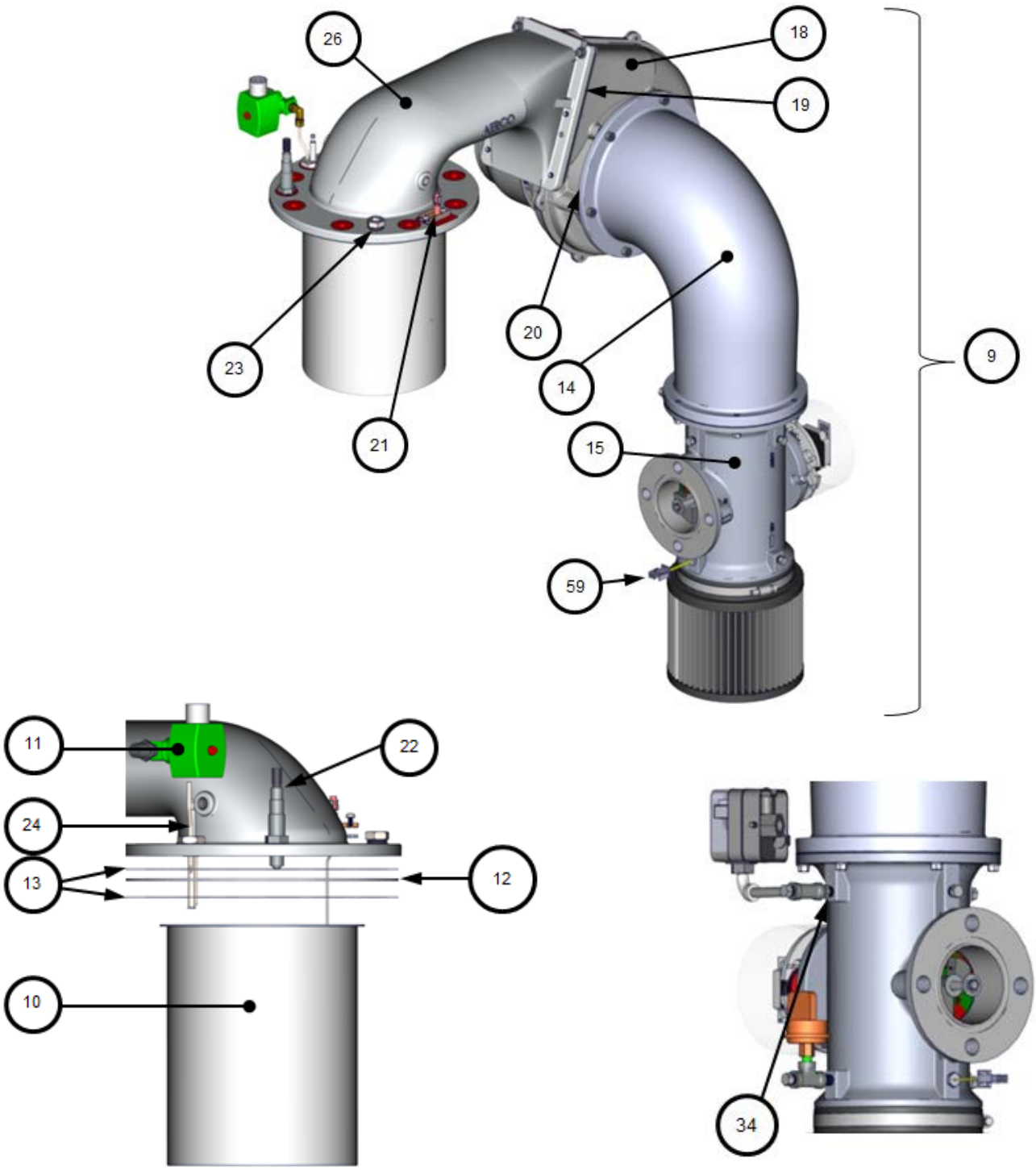
Part No.	Description	Item 88	Item 87
58087-1	30 PSI	123260-W30	69087-2
58087-2	50 PSI	123260-W50	69087-2
58087-3	75 PSI	123260-W75	69087-3
58087-4	100 PSI	123260-W100	69087-3
58087-5	150 PSI	123260-W150	69087-4
58087-6	60 PSI	123260-W60	69087-3
58087-7	125 PSI	123260-W125	69087-3
58087-8	160 PSI	123260-K160	69087-4

Benchmark 1500-2000 Kits Available	
Part #	**Description**
24311-4	AIR/FUEL VALVE KIT – BMK 2000
24311-3	AIR/FUEL VALVE KIT – BMK 1500
24356-1	FLAME DETECTOR KIT
58023	IGNITOR-INJECTOR REPLACEMENT KIT

AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 1500-2000 Part List**	02/01/2014
	Whole Boiler 29313-1 – 29337-1	Sheet 2 of 7



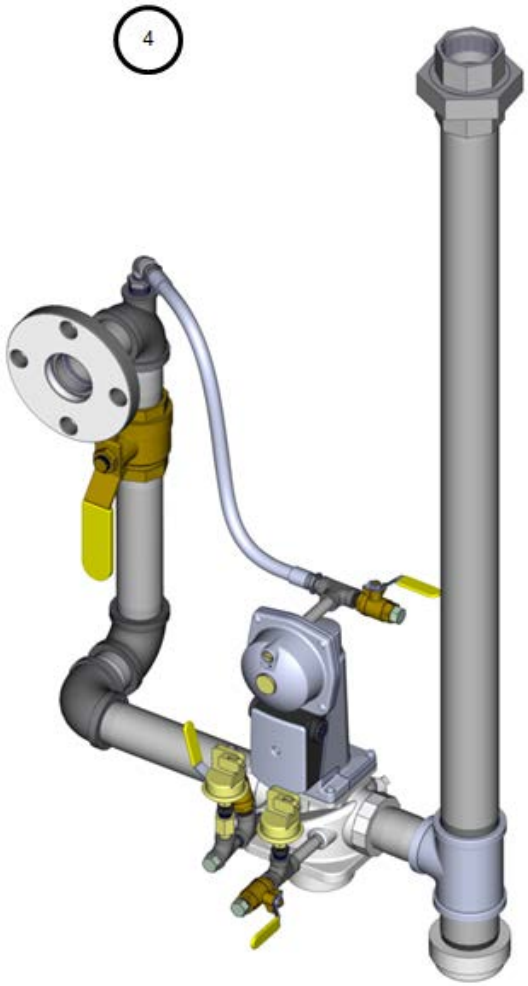
AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 1500-2000 Part List**	02/01/2014
	Whole Boiler 29313-1 – 29337-1	Sheet 3 of 7



Benchmark 1500/2000
Burner-Air/Fuel Valve Assembly
P/N 24378 & 24388

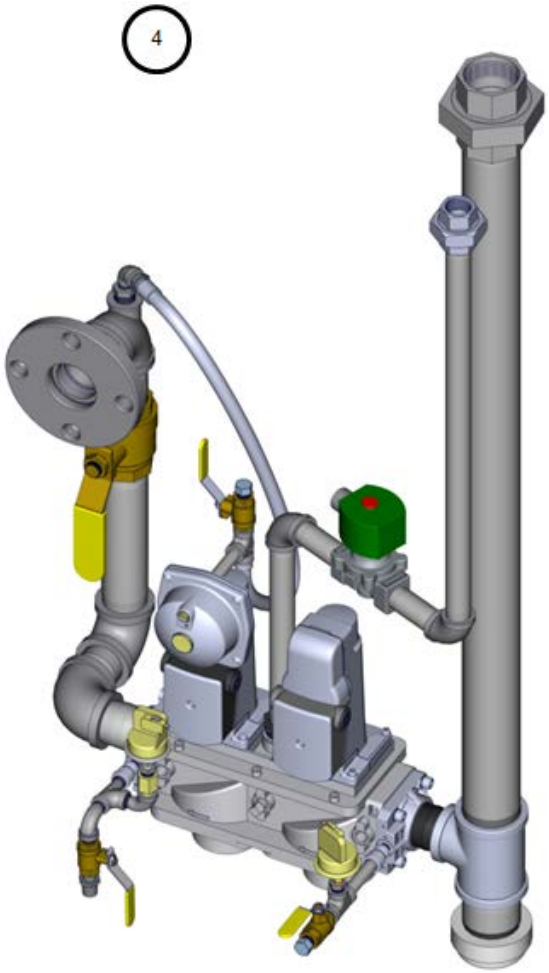
See full part lists below

AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 1500-2000 Part List**	02/01/2014
	Whole Boiler 29313-1 – 29337-1	Sheet 4 of 7



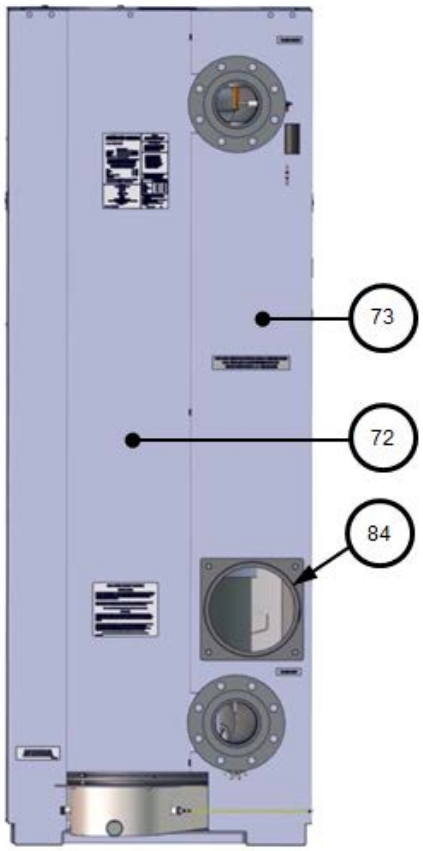
Benchmark 1500/2000
Standard FM Gas Train
P/N 22188

See full part lists below

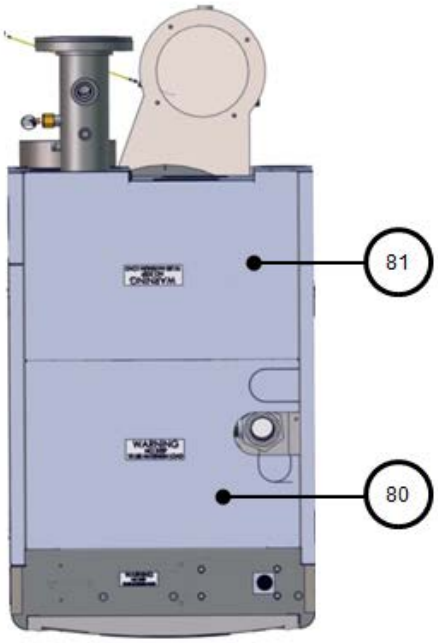


Benchmark 1500/2000
Double Block & Bleed Gas Train
P/N 22199

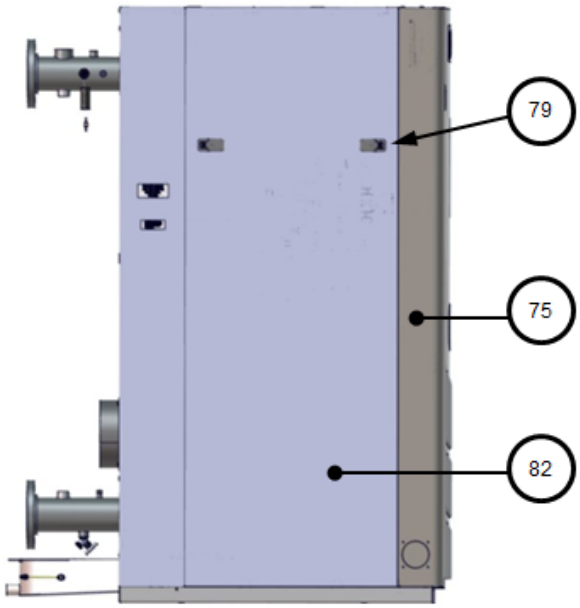
See full part lists below



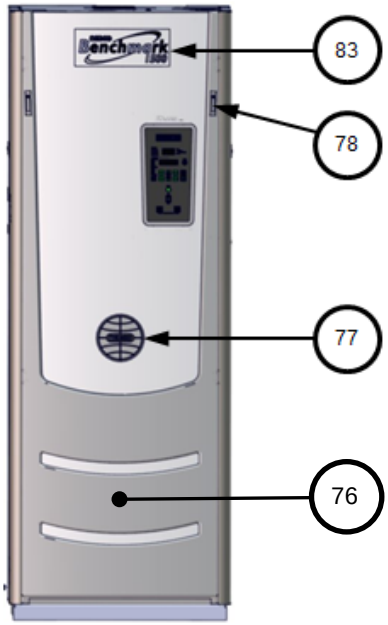
REAR VIEW



TOP VIEW

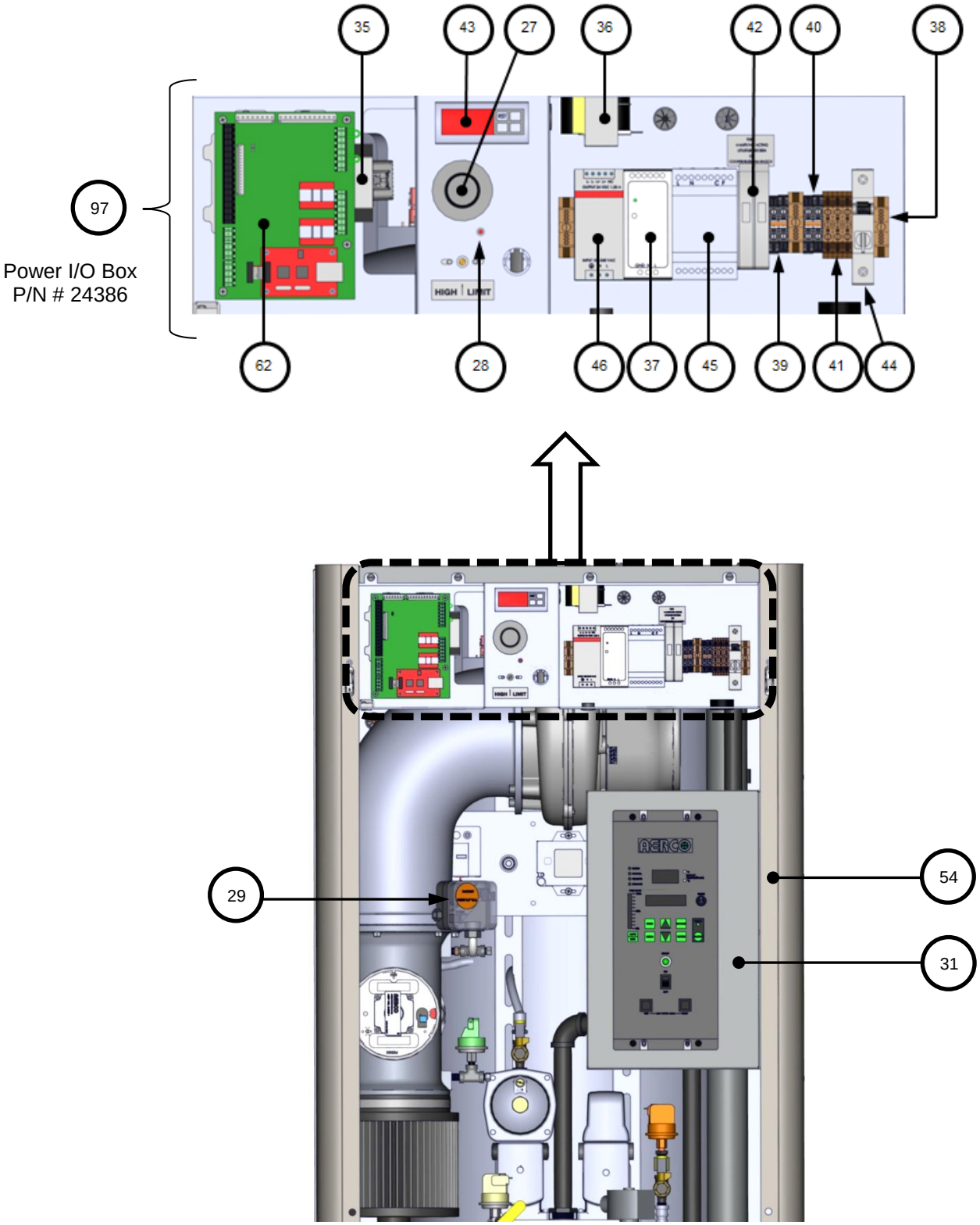


LEFT SIDE VIEW



FRONT VIEW

AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 1500-2000 Part List**	02/01/2014
	Whole Boiler 29313-1 – 29337-1	Sheet 6 of 7



PARTIAL FRONT VIEW

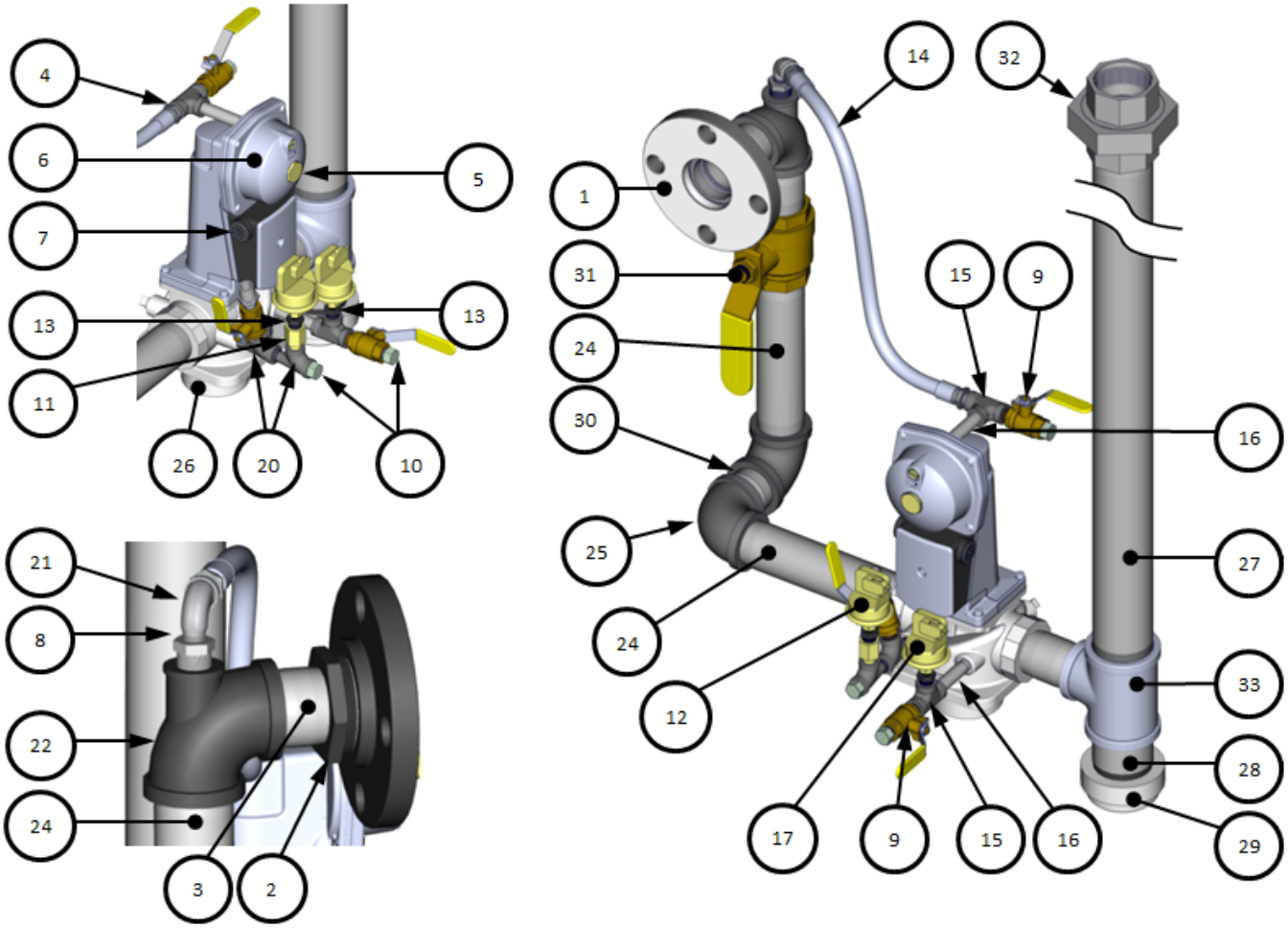
AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 1500-2000 Part List**	02/01/2014
	Whole Boiler 29313-1 – 29337-1	Sheet 7 of 7

Benchmark 1500 - 2000 Standard Gas Train – p/n 22188 rev B

Item	Qty	Part #	Description	Item	Qty	Part #	Description
1	1	123542	FLANGE 2" 125# 2"NPT	18❶	1	63109	GAS TRAIN HARNESS
2	1	93069	BUSHING: REDUCING 1-1/2" TO 2" NPT	19❷	1	124862	RESISTOR ASSY
3	1	94060-2.50	NIPPLE: 1-1/2 NPT X 2.50 LG	20	2	93290	TEE MXFXF BLACK IRON 1/4" NPT
4	3	99014	NIPPLE: HEX 1/4" NPT X 3/8" NPT	21	1	93035	ELBOW: STREET 1/4" NPT
5❷	1	99015	DAMPING ORIFICE: SSOV	22	1	9-420	TEE: REDUCING 1-1/2 X 1/2 X 1-1/2
6	1	64048	ACTUATOR: SSOV W/ REGULATOR ASSY	23	2	94060-3	NIPPLE: 1-1/2" NPT X 3.00" LG
7	2	12951-2	BUSHING: CONTROL BOX	24	2	94060-8	NIPPLE: 1-1/2 NPT X 8.00" LG
8	1	9-43	BUSHING: REDUCING 1/2 X 1/4 NPT	25	2	9-323	ELBOW: 90 DEGREE 1-1/2"
9	3	92077	1/4" NPT MXF BRASS BALL VALVE	26	1	124150	VALVE: SSOV 1-1/2" NPT
10	3	9-22	PIPE PLUG: 1/4" NPT: STEEL	27	1	94027-144	NIPPLE: 2" NPT TBE X 36" LG
11	1	99017	SNUBBER: PRESSURE: 1/4"	28	1	94027-12	NIPPLE: 2" NPT TBE X 3.00 LG
12	1	61002-12	HIGH GAS PRESSURE SWITCH 4.7" W.C.	29	1	93382	2'' NPT CAP
13	2	123536	BUSHING: REDUCING 1/4" X 1/8" NPT	30	2	94060-2	NIPPLE: 1-1/2" NPT X 2.00 LG
14	1	97005-5	FLEXIBLE GAS TUBING 18" LONG	31	1	92006-7	VALVE: BALL BRASS 1-1/2" NPT
15	2	124083	TEE 1/4" NPT: 150#	32	1	9-294	UNION: 2" NPT 300#
16	2	124088	NIPPLE: 1/4" NPT: C.S. 2 1/2" LONG	33	1	93456	TEE: REDUCING 2x1.5x2
17	1	61002-8	LOW GAS PRESSURE SWITCH 4.4" W.C.	34❶	1	124149-3	WIRE ASSY, JUMPER O.T. SWITCHES

❶ Not shown on drawing

❷ A component of item 6, p/n 64048, ACTUATOR: SSOV W/ REGULATOR



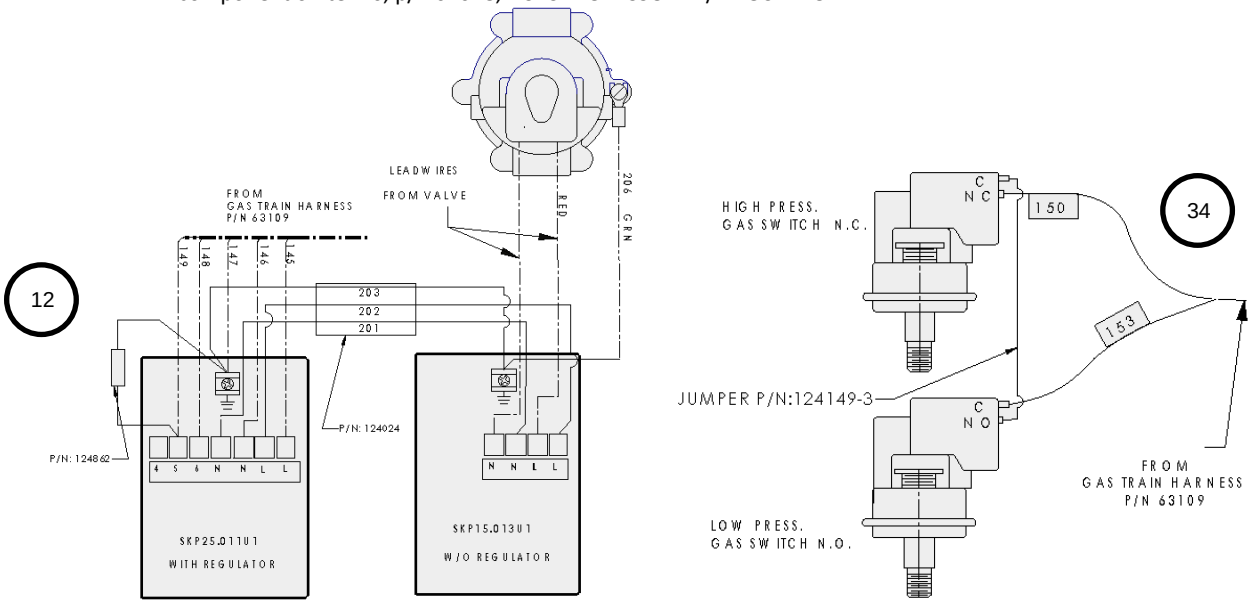
AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 1500-2000 Gas Train**	10/30/2013
	22188 rev B	Sheet 1 of 1

Benchmark 1500/2000 DBB Gas Train – p/n 22199 rev A

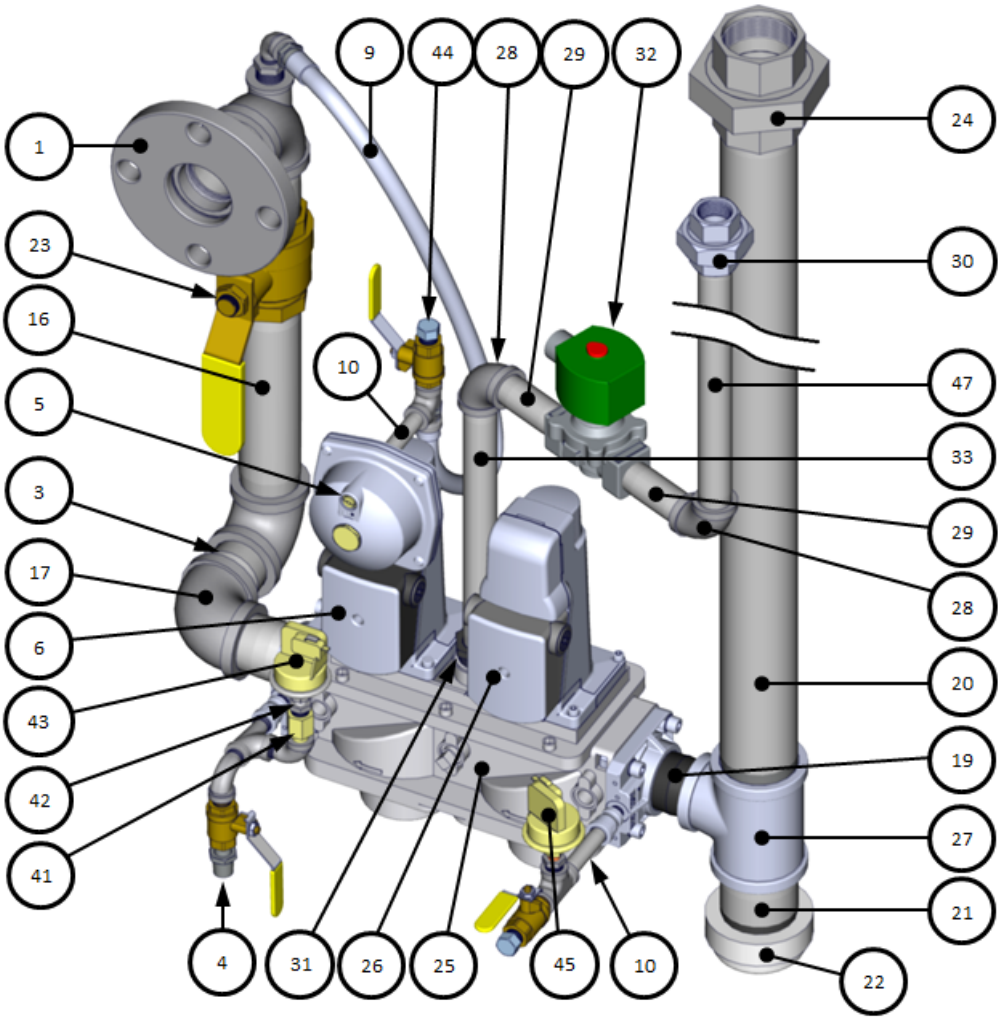
Item	Qty	Part #	Description	Item	Qty	Part #	Description
1	1	123542	FLANGE 2" 125# 2"NPT	25	1	124142	VALVE: SSOV: DOUBLE BODY: 2" NPT
2	1	93069	BUSHING: REDUCING 1-1/2" TO 2" NPT	26	1	69038	ACTUATOR: SSOV W/O P.O.C. SWITCH
3	2	94060-2	NIPPLE: 1-1/2" NPT X 2.00 LG	27	1	93456	TEE: REDUCING 2x1.5x2
4	3	99014	NIPPLE: HEX 1/4" NPT X 3/8" NPT	28	2	9-469	ELBOW: 90° 3/4" NPT
5❷	1	99015	DAMPING ORIFICE: SSOV	29	2	94061-3.00	NIPPLE: 3/4" NPT X 3.00 LG
6	1	64048	ACTUATOR: SSOV W/ REGULATOR	30	1	124094	UNION: 3/4" NPT #150
7	2	12951-2	BUSHING: CONTROL BOX	31	1	123148	BUSHING: 1" NPT X 3/4" NPT
8	1	9-43	BUSHING: REDUCING 1/2 X 1/4 NPT	32	1	122774	VALVE: VENT 3/4" NPT
9	1	97005-2	TUBING, FLEXIBLE GAS, 12”	33	1	94061-10.00	NIPPLE: 3/4" NPT
10	1	124088	NIPPLE: 1/4" NPT C.S. 2 1/2" LG	34	1	124149-3	WIRE ASSY: JUMPER O.T. SWITCHES
11❶	1	63109	GAS TRAIN HARNESS: BMK 3000	35❶	1	124024	HARNESS: WIRING: IRI
12❷	1	124862	RESISTOR ASSY	36	2	95029	FLANGE: SSOV 1 1/2" NPT
13	3	93035	ELBOW: STREET 1/4" NPT	37	2	123533	NIPPLE: CLOSE 1/8"
14	1	9-420	TEE: REDUCING 1-1/2 X 1/2 X 1-1/2	38	2	93445	COUPLING: REDUCING 1/4 x 1/8 NPT: BLK MI
15	1	94060-3	NIPPLE: 1-1/2" NPT X 3.00" LG	39	1	93290	TEE MXFXF BLACK IRON 1/4" NPT
16	2	94060-6	NIPPLE: 1-1/2 NPT X 6.00" LG	40	3	92077	1/4" NPT MXF BRASS BALL VALVE (OPEN)
17	1	9-323	ELBOW: 90 DEGREE 1-1/2"	41	1	99017	SNUBBER: PRESSURE: 1/4"
18	1	94060-2.50	NIPPLE: 1-1/2" NPT X 2.50" LG	42	2	123536	BUSHING: REDUCING 1/4" X 1/8" NPT
19	1	12607-8	NIPPLE: 1-1/2" X 2" LG	43	1	61002-16	HIGH GAS PRESSURE SWITCH 3.5" W..C.
20	1	94027-108	NIPPLE: 2" NPT TBE X 27" LG	44	2	9-22	PIPE PLUG: 1/4" NPT: STEEL
21	1	94027-12	NIPPLE: 2" NPT TBE X 3.00 LG	45	1	61002-1	PRESSURE SWITCH: 2.6" W.C. FALL N.O.
22	1	93382	2'' NPT CAP	46	1	124083	TEE 1/4" NPT: 150#
23	1	92006-7	VALVE: BALL BRASS 1-1/2" NPT	47	1	94061-22	NIPPLE: 3/4" NPT X 22.00 LG
24	1	9-294	UNION: 2" NPT 300#				

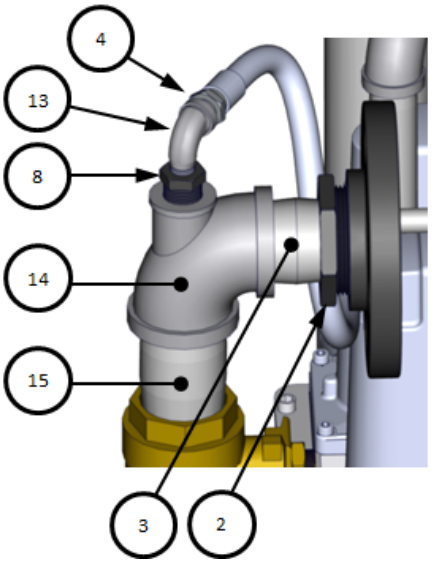
❶ Not shown on drawing

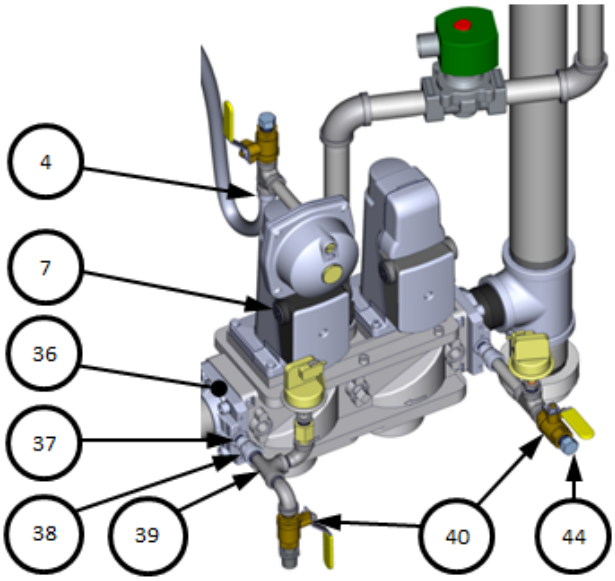
❷ A component of item 6, p/n 64048, ACTUATOR: SSOV W/ REGULATOR



AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 1500/2000 DBB Gas Train**	10/31/2013
	22199 rev A	Sheet 1 of 2



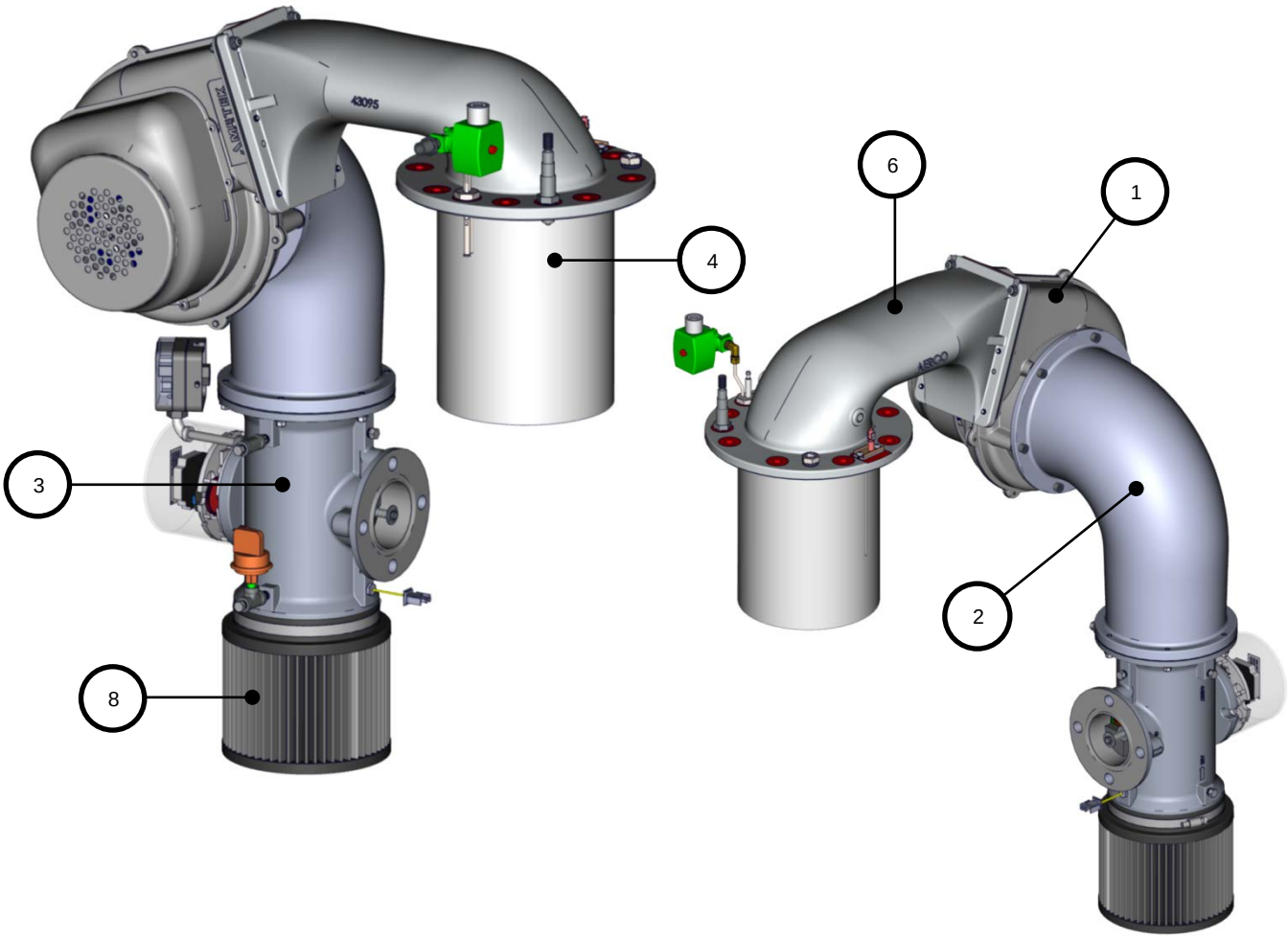




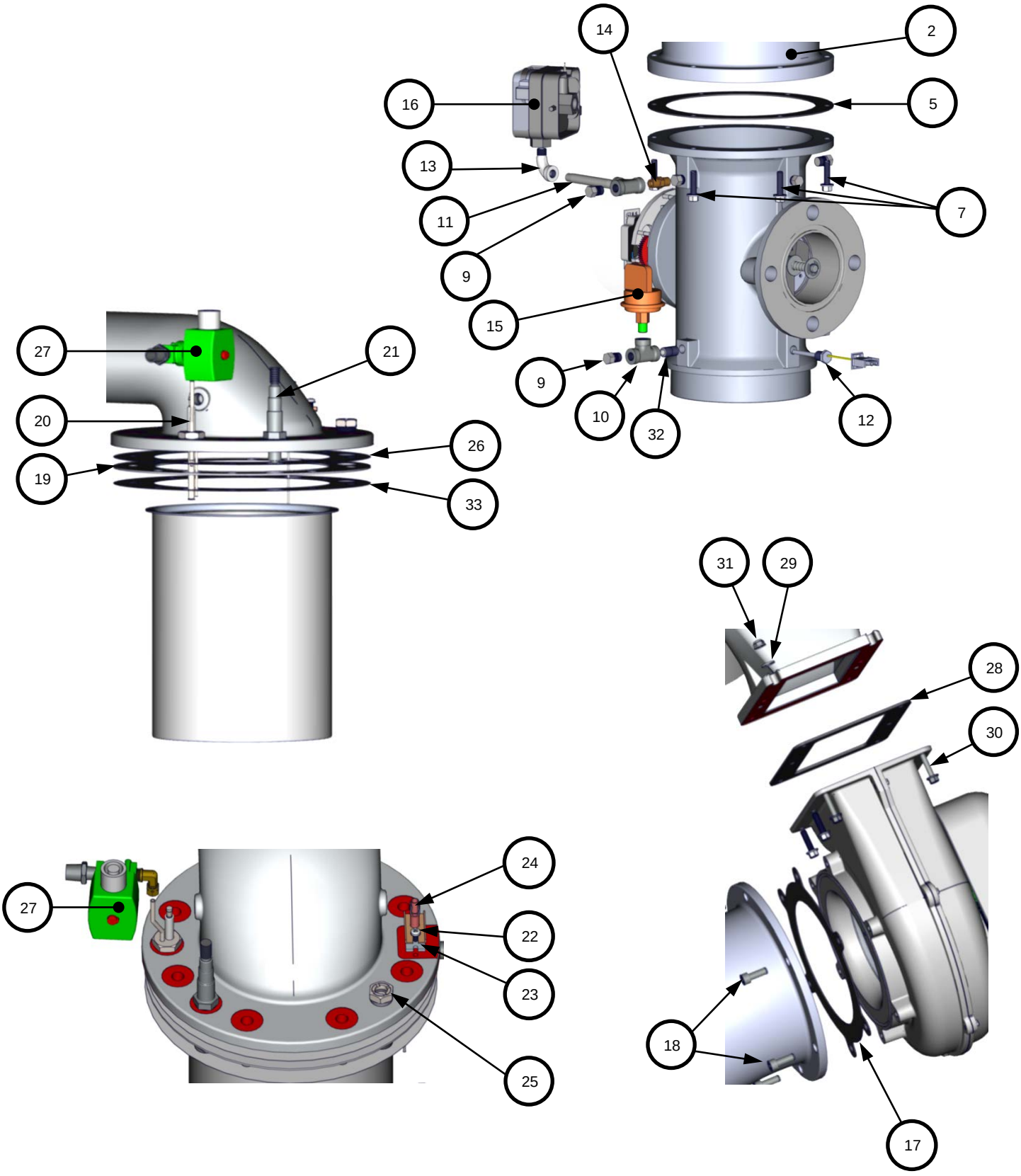
AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 1500/2000 DBB Gas Train**	10/31/2013
	22199 rev A	Sheet 2 of 2

Benchmark 1500 – 2000 Burner Assembly, p/n 24378 – 24388 rev A

Item	Qty	Part #	Description	Item	Qty	Part #	Description
1	1	69078	BLOWER: AMETEK 12.3"	17	1	81100	GASKET: BLOWER 12.3"
2	1	43090	AIR FUEL VALVE PLENUM	18	6	55054	SCREW: SOC HD CAP M8 x 1.25 x 22mm
3	1	24220-3	A/F VALVE ASSY: BMK 1500	19	1	81166	GASKET: BURNER
	1	24220-10	A/F VALVE ASSY: BMK2000	20	1	66026	IGNITOR-INJECTOR
4	1	46042	BURNER: BMK 1500	21	1	61026	O_2 SENSOR
	1	46044	BURNER: BMK 2000	22	2	122377	SCREW: MACH #10-32 X 3/8 LG
5	1	81057	GASKET: BLOWER	23	1	81048	GASKET: FLAME ROD LOW NOX
6	1	43095	BLOWER PLENUM	24	1	66020	FLAME DETECTOR
7	10	55025	BOLT: LOCKING 1/4-20 X 1.00 LG	25	1	59104	OBSERVATION PORT
8	1	59138	FILTER: AIR 6"	26	1	81183	RELEASE GASKET
9	5	9-21	PLUG: HEX HD 1/8 NPT	27	1	24277	STAGED IGNITION ASSY
10	2	123535	TEE: 1/8" NPT	28	1	81184	GASKET: BLOWER
11	1	124008	NIPPLE: 1/8 NPT X 3.00" LG	29	2	123626	1/4" BOLT SIZE FLAT WASHER
12	1	61024	AIR INLET TEMPERATURE SENSOR	30	2	55026	BOLT: HEX 1/4-20 X 1.25 LG
13	1	124979	1/8" C.S. STREET ELBOW	31	2	56005	NUT: FLANGE NYLOCK 1/4-20
14	1	93230	SNUBBER	32	1	123533	NIPPLE: CLOSE 1/8"
15	1	61002-5	BLOCKED INLET SWITCH -8.0" W.C.	33	1	81186	LOWER RELEASE GASKET: BMK2000
16	1	60011-2	SWITCH ASSY: BLOWER PROOF				

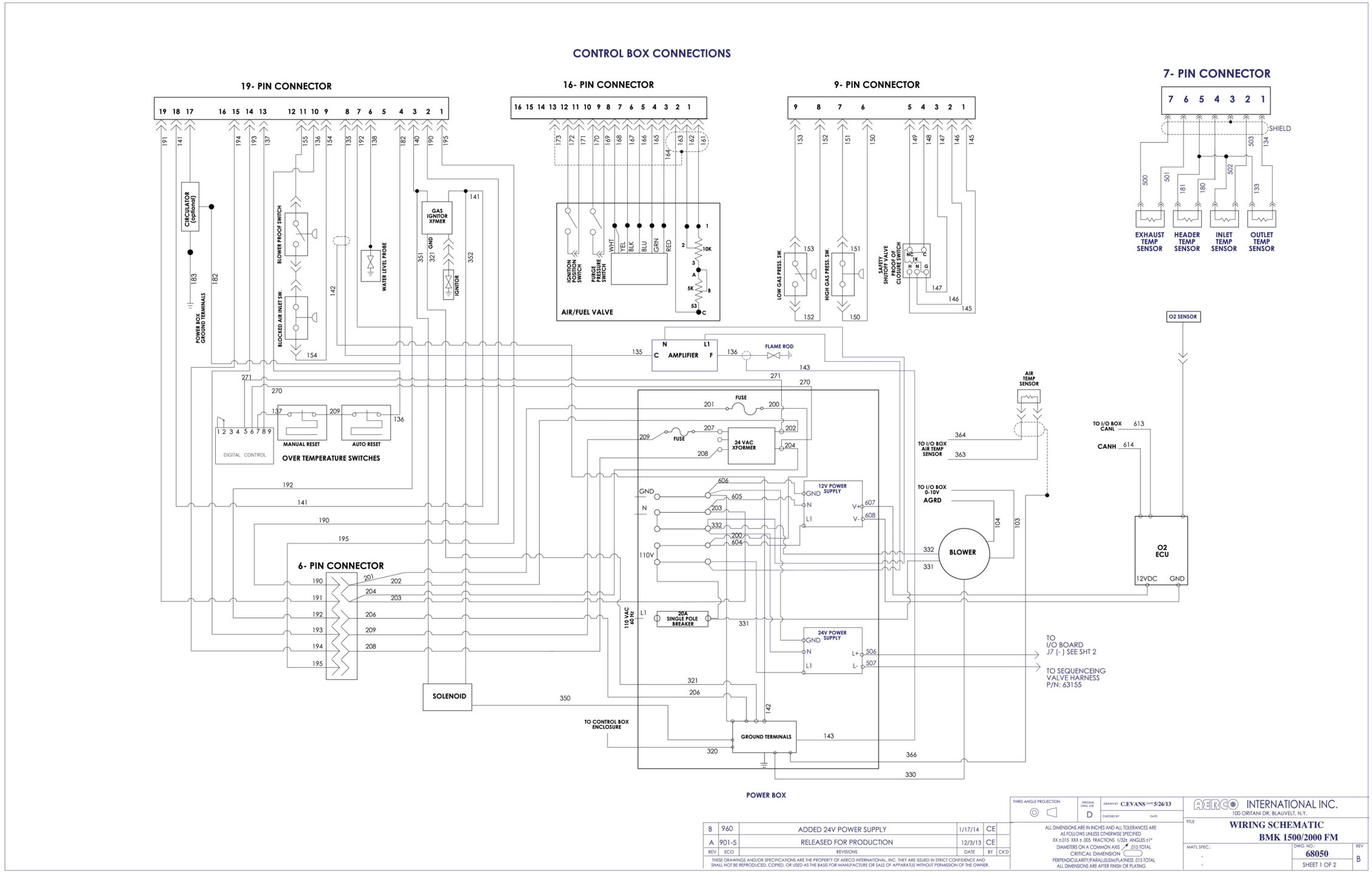


AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 1500 - 2000 Burner Assembly**	10/18/2013
	24378 - 24388 rev A	Sheet 1 of 2



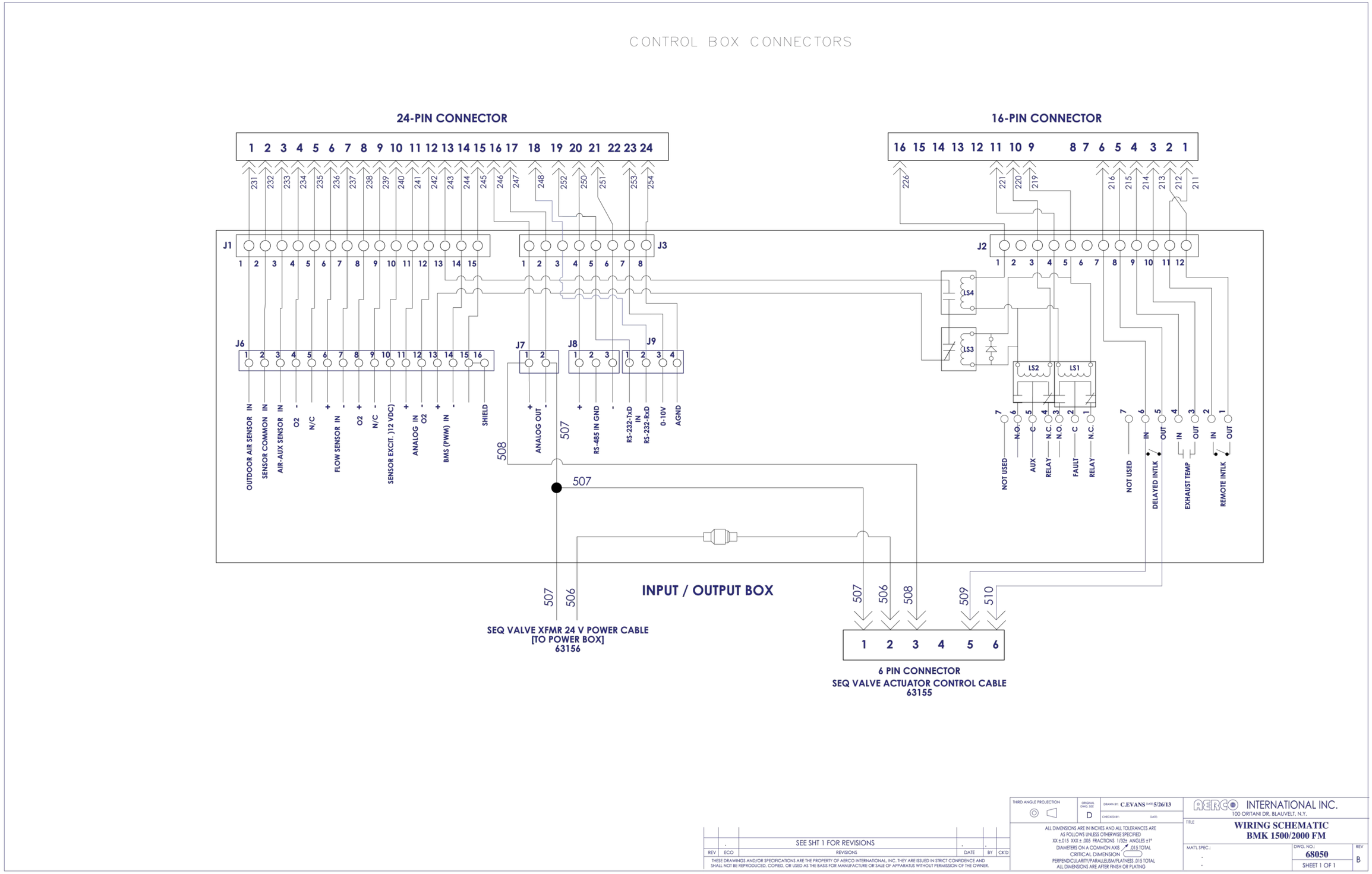
AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 1500 – 2000 Burner Assembly**	10/18/2013
	24378 – 24388 rev A	Sheet 2 of 1

Appendix I: WIRING DIAGRAMS



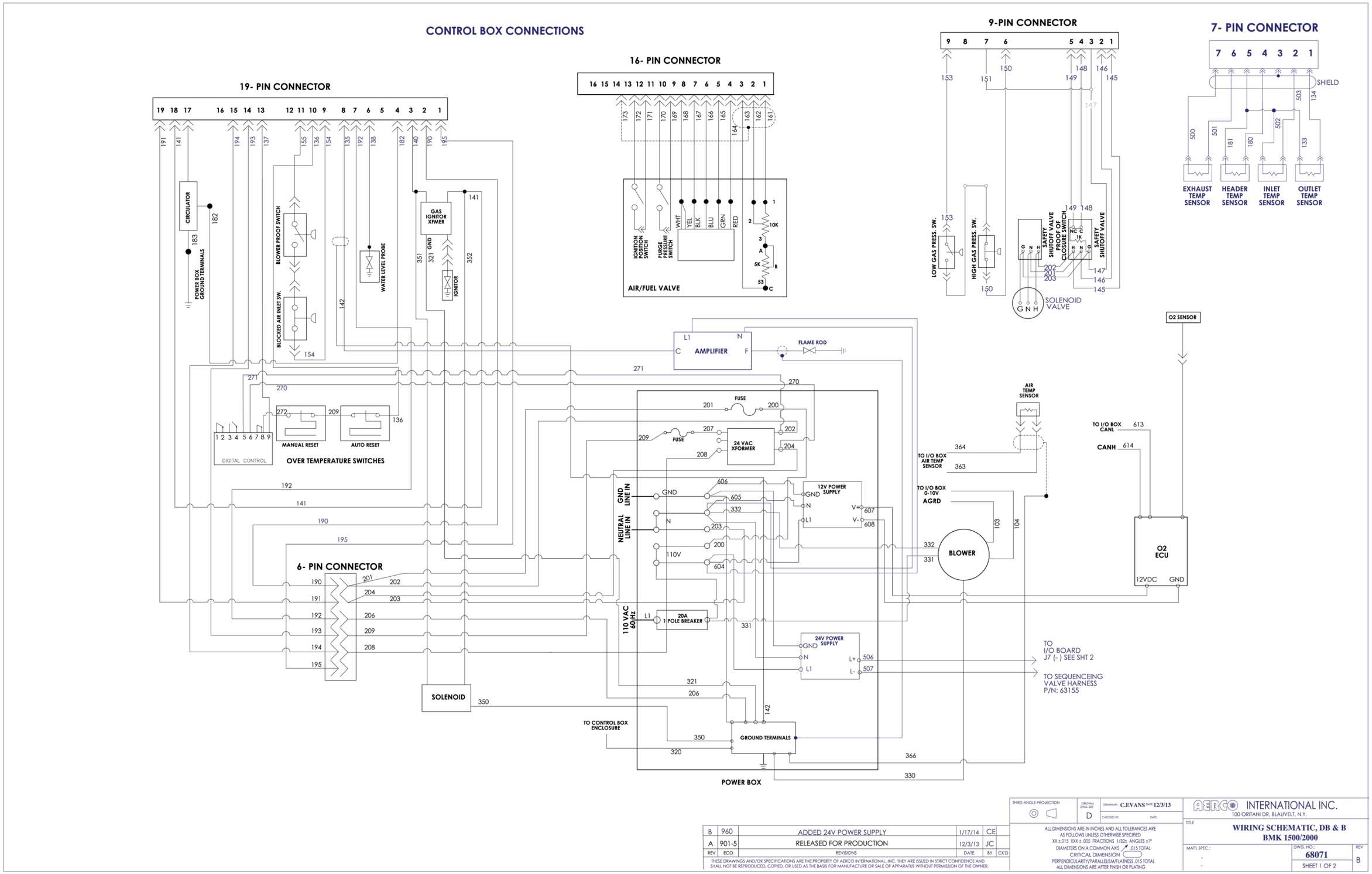
Drawing Number 68050 rev B page 1 of 2

(This page intentionally blank)



Drawing Number 68050 rev B page 2 of 2

(This page intentionally blank)



REV	ECO	REVISIONS	DATE	BY	CK'D
B	960	ADDED 24V POWER SUPPLY	1/17/14	CE	
A	901-5	RELEASED FOR PRODUCTION	12/3/13	JC	

THESE DRAWINGS AND/OR SPECIFICATIONS ARE THE PROPERTY OF AERCO INTERNATIONAL, INC. THEY ARE ISSUED IN STRICT CONFIDENCE AND SHALL NOT BE REPRODUCED, COPIED, OR USED AS THE BASIS FOR MANUFACTURE OR SALE OF APPARATUS WITHOUT PERMISSION OF THE OWNER.

THIRD ANGLE PROJECTION | ORIGINAL DWG. SIZE: D | DRAWN BY: C.EVANS DATE 12/3/13 | CHECKED BY: DATE:

ALL DIMENSIONS ARE IN INCHES AND ALL TOLERANCES ARE AS FOLLOWS UNLESS OTHERWISE SPECIFIED
XX ±.015 XXX ± .005 FRACTIONS 1/32± ANGLES ±1°
DIAMETERS ON A COMMON AXIS .015 TOTAL
CRITICAL DIMENSION
PERPENDICULARITY/PARALLELISM/FLATNESS .015 TOTAL
ALL DIMENSIONS ARE AFTER FINISH OR PLATING

AERCO INTERNATIONAL INC.
100 ORITANI DR. BLAUVELT, N.Y.

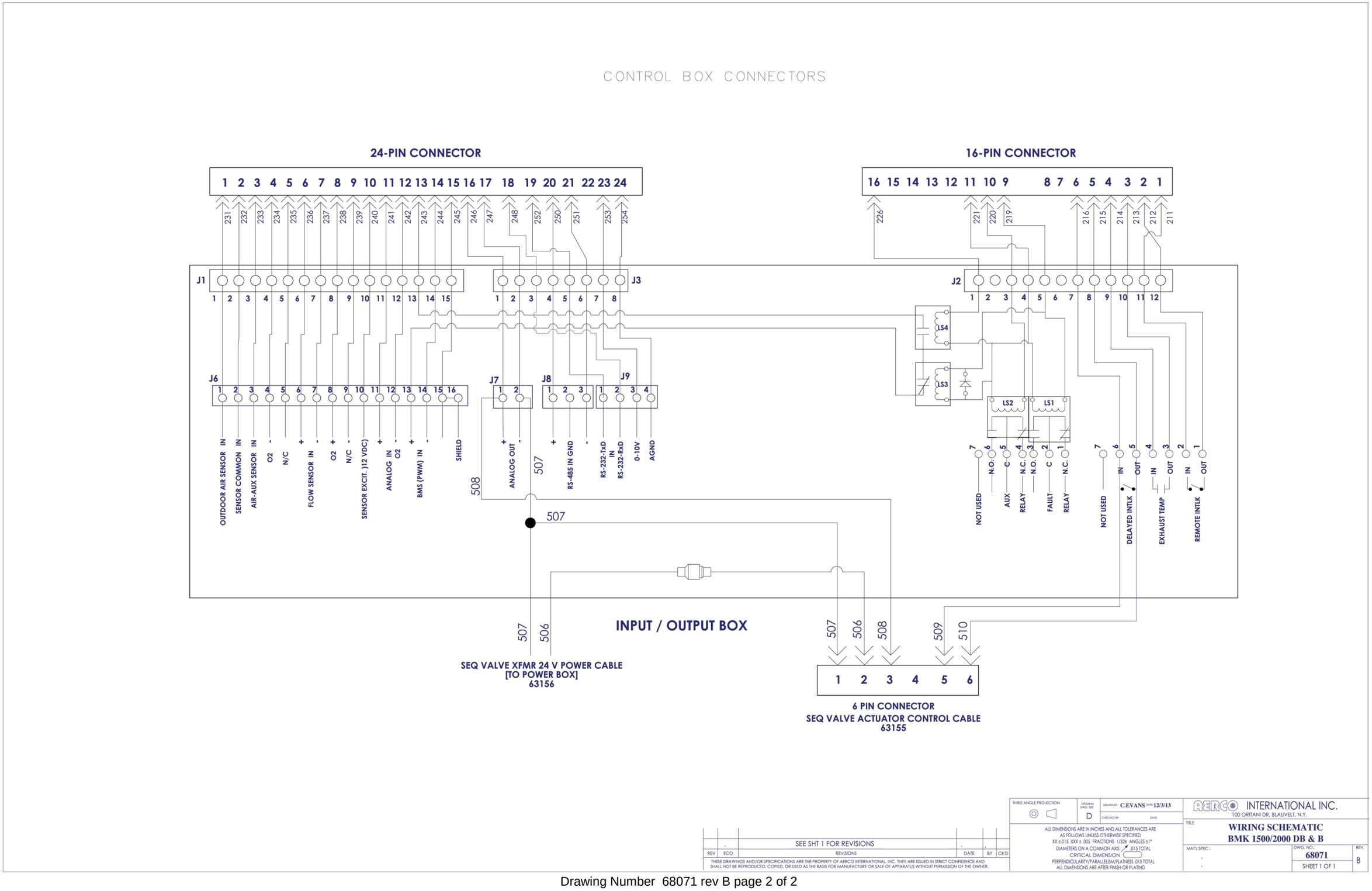
TITLE: **WIRING SCHEMATIC, DB & B BMK 1500/2000**

MATL SPEC.: - -

DWG. NO.: **68071** | REV: B | SHEET 1 OF 2

Drawing Number 68071 rev B page 1 of 2

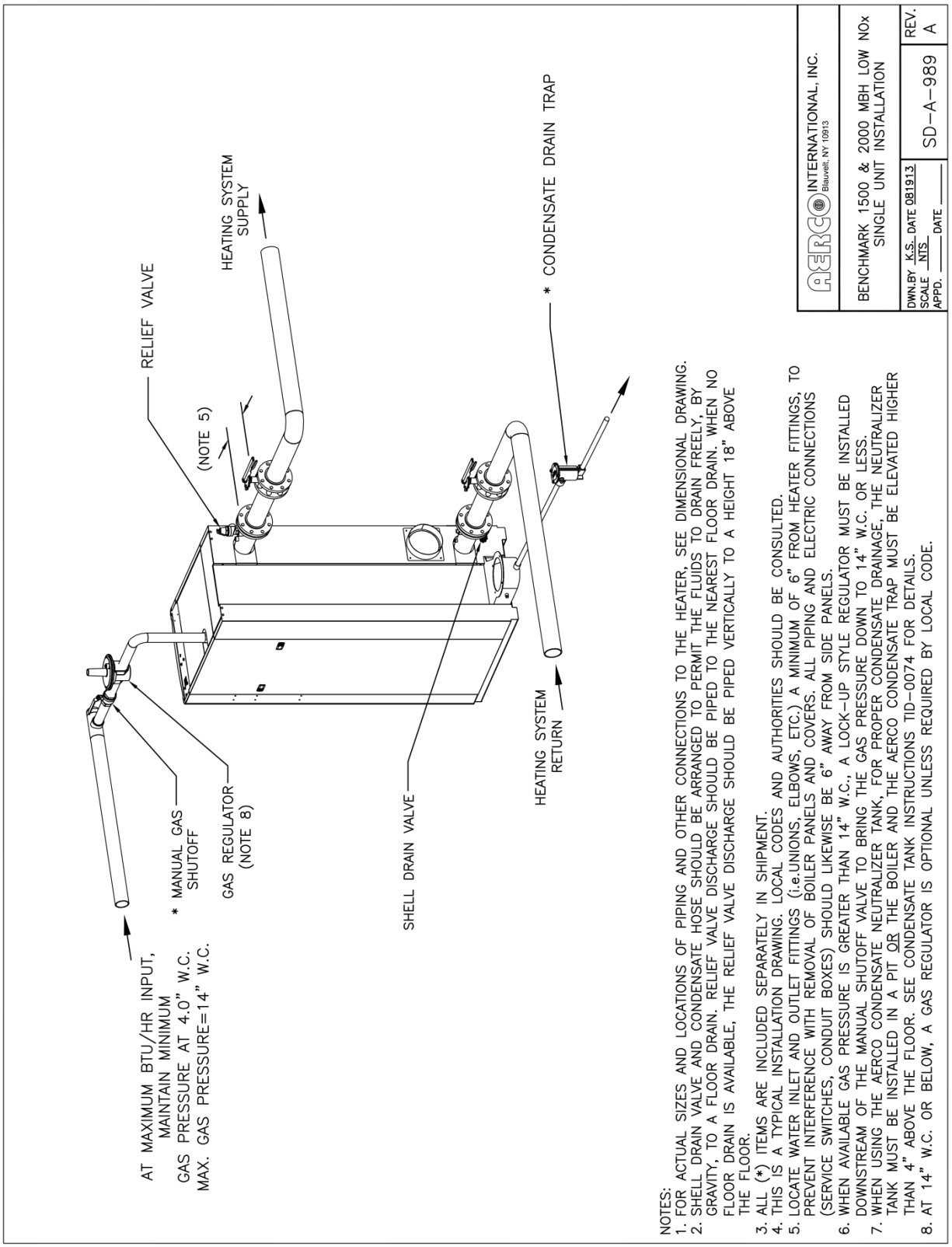
(This page intentionally blank)



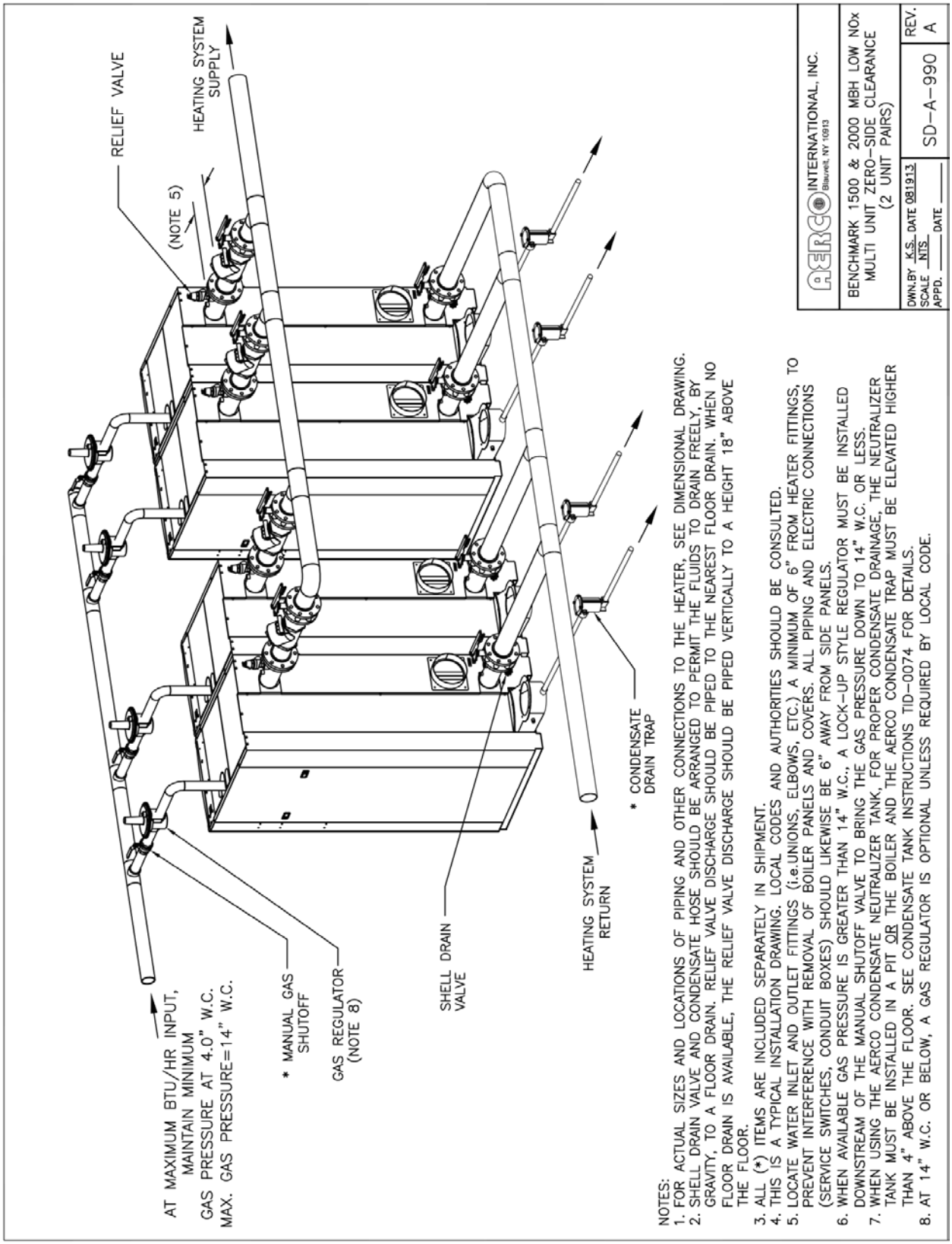
Drawing Number 68071 rev B page 2 of 2

(This Page Is Intentionally Blank)

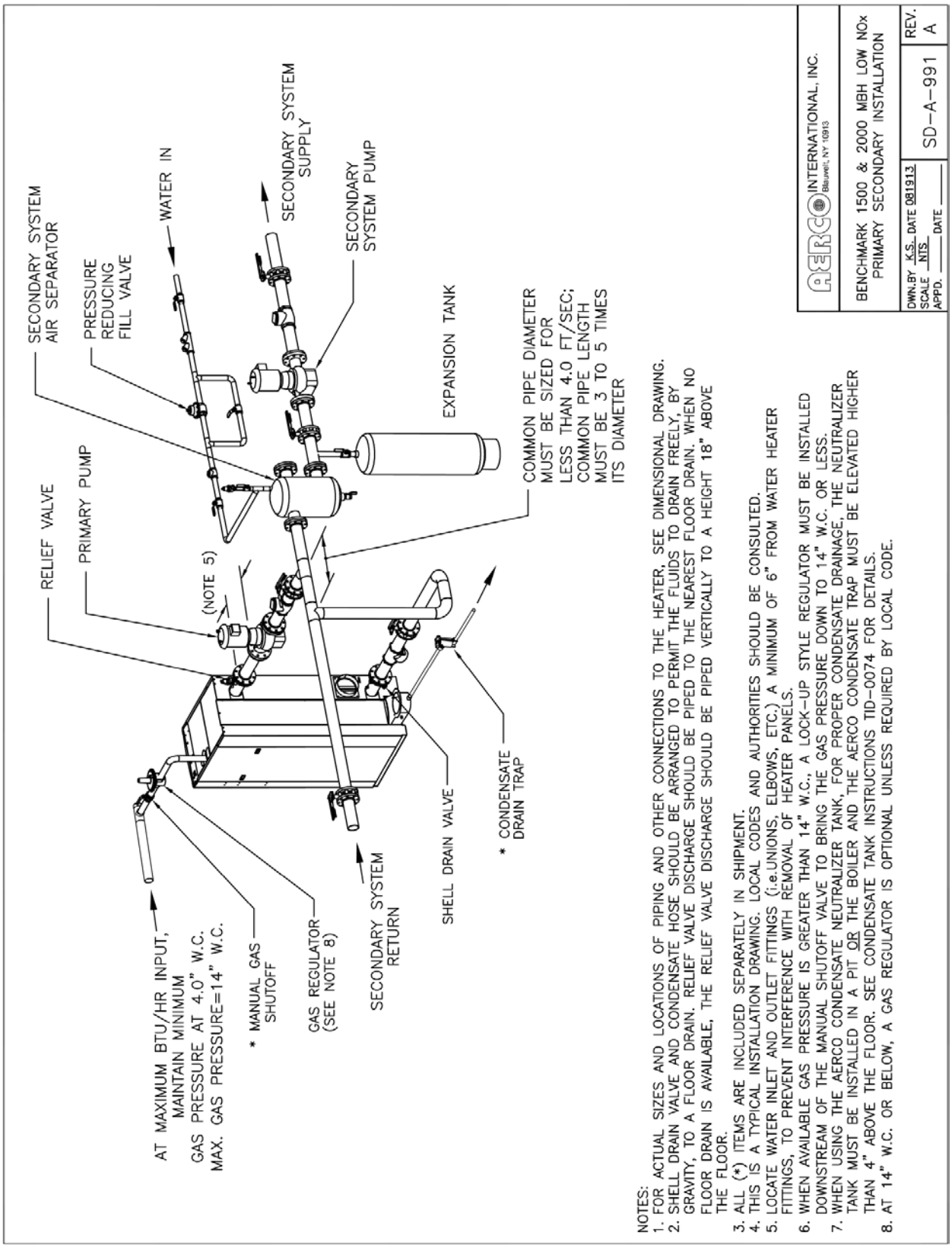
Appendix J: PIPING DRAWINGS



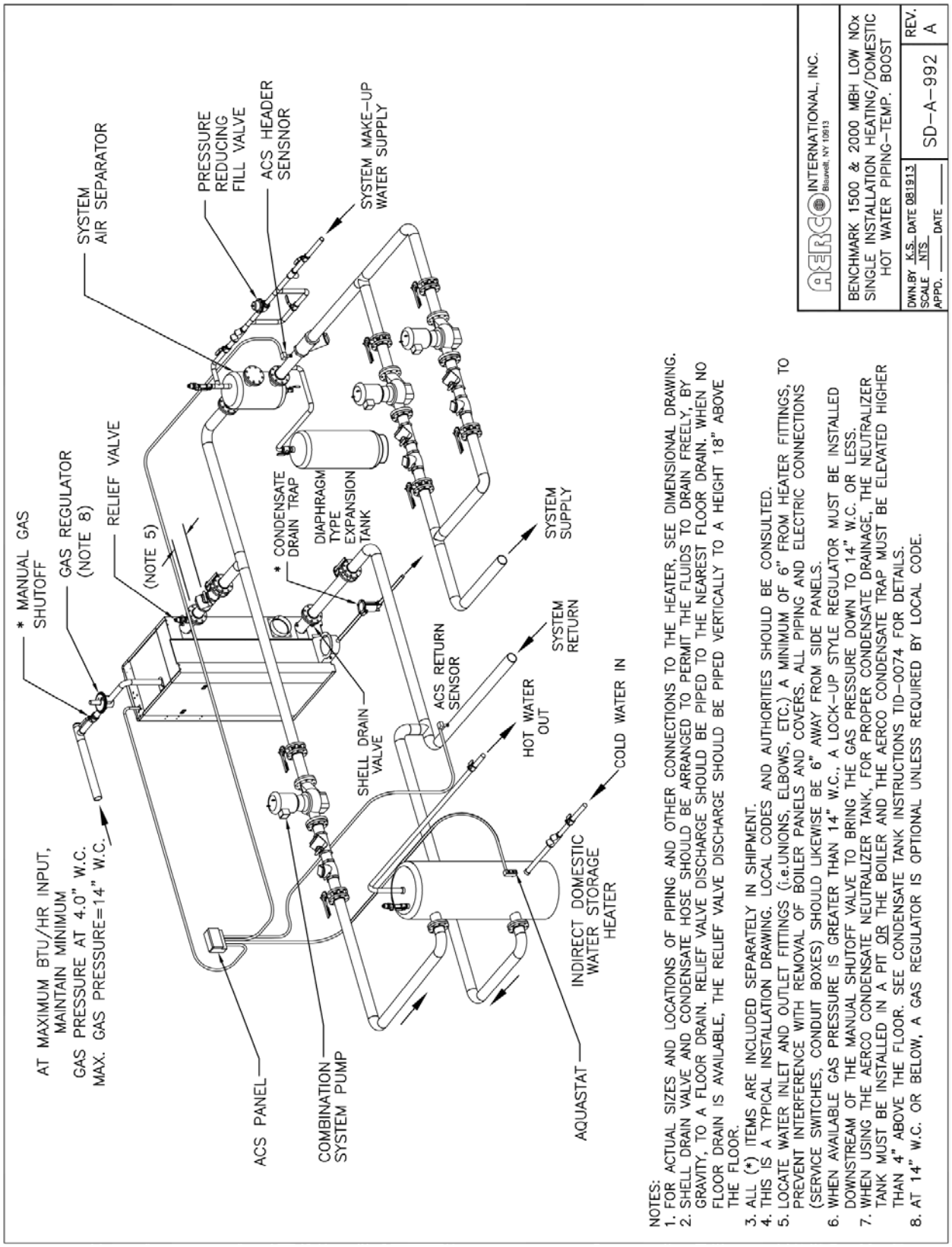
Drawing Number: SD-A-989 rev A



Drawing Number: SD-A-990 rev A

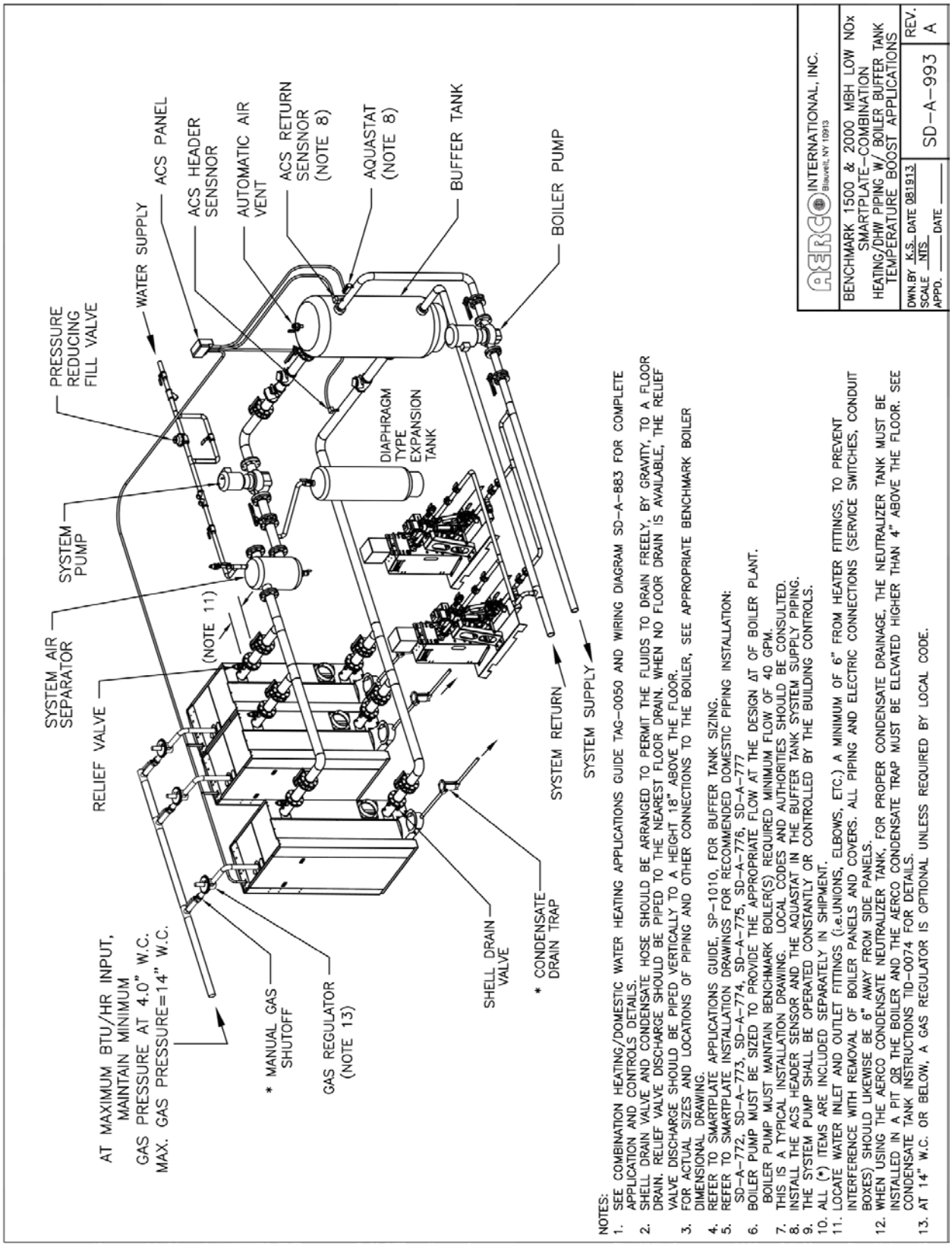


Drawing Number: SD-A-991 rev A

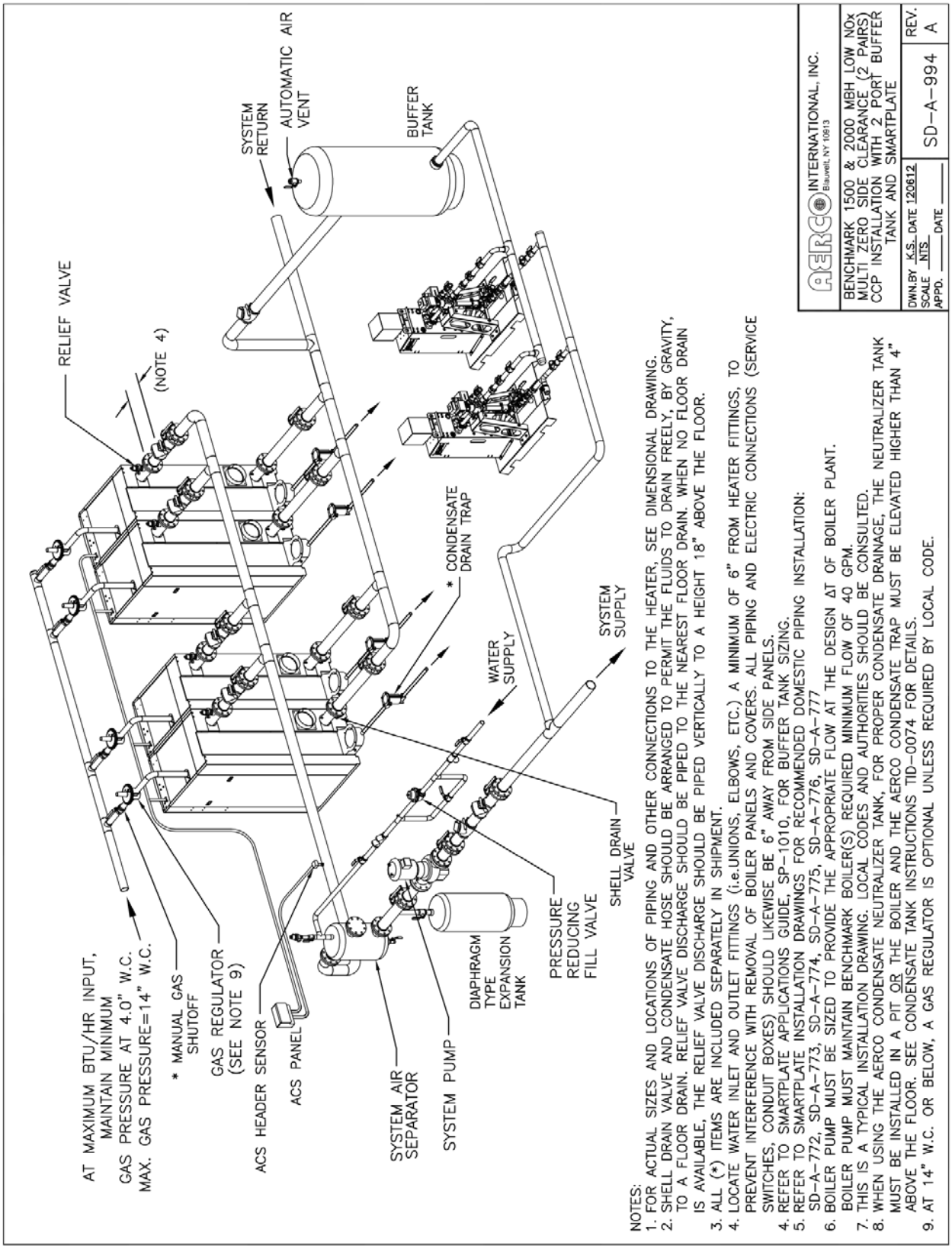


NOTES:
1. FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE HEATER, SEE DIMENSIONAL DRAWING.
2. SHELL DRAIN VALVE AND CONDENSATE HOSE SHOULD BE ARRANGED TO PERMIT THE FLUIDS TO DRAIN FREELY, BY GRAVITY, TO A FLOOR DRAIN. RELIEF VALVE DISCHARGE SHOULD BE PIPED TO THE NEAREST FLOOR DRAIN. WHEN NO FLOOR DRAIN IS AVAILABLE, THE RELIEF VALVE DISCHARGE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE THE FLOOR.
3. ALL (*) ITEMS ARE INCLUDED SEPARATELY IN SHIPMENT.
4. THIS IS A TYPICAL INSTALLATION DRAWING. LOCAL CODES AND AUTHORITIES SHOULD BE CONSULTED.
5. LOCATE WATER INLET AND OUTLET FITTINGS (i.e.UNIONS, ELBOWS, ETC.) A MINIMUM OF 6" FROM HEATER FITTINGS, TO PREVENT INTERFERENCE WITH REMOVAL OF BOILER PANELS AND COVERS. ALL PIPING AND ELECTRIC CONNECTIONS (SERVICE SWITCHES, CONDUIT BOXES) SHOULD LIKEWISE BE 6" AWAY FROM SIDE PANELS.
6. WHEN AVAILABLE GAS PRESSURE IS GREATER THAN 14" W.C., A LOCK-UP STYLE REGULATOR MUST BE INSTALLED DOWNSTREAM OF THE MANUAL SHUTOFF VALVE TO BRING THE GAS PRESSURE DOWN TO 14" W.C. OR LESS.
7. WHEN USING THE AERCO CONDENSATE NEUTRALIZER TANK, FOR PROPER CONDENSATE DRAINAGE, THE NEUTRALIZER TANK MUST BE INSTALLED IN A PIT OR THE BOILER AND THE AERCO CONDENSATE TRAP MUST BE ELEVATED HIGHER THAN 4" ABOVE THE FLOOR. SEE CONDENSATE TANK INSTRUCTIONS TID-0074 FOR DETAILS.
8. AT 14" W.C. OR BELOW, A GAS REGULATOR IS OPTIONAL UNLESS REQUIRED BY LOCAL CODE.

Drawing Number: SD-A-992 rev A



Drawing Number: SD-A-993 rev A



Drawing Number: SD-A-994 rev A

Appendix K: C-MORE CONTROL PANEL VIEWS

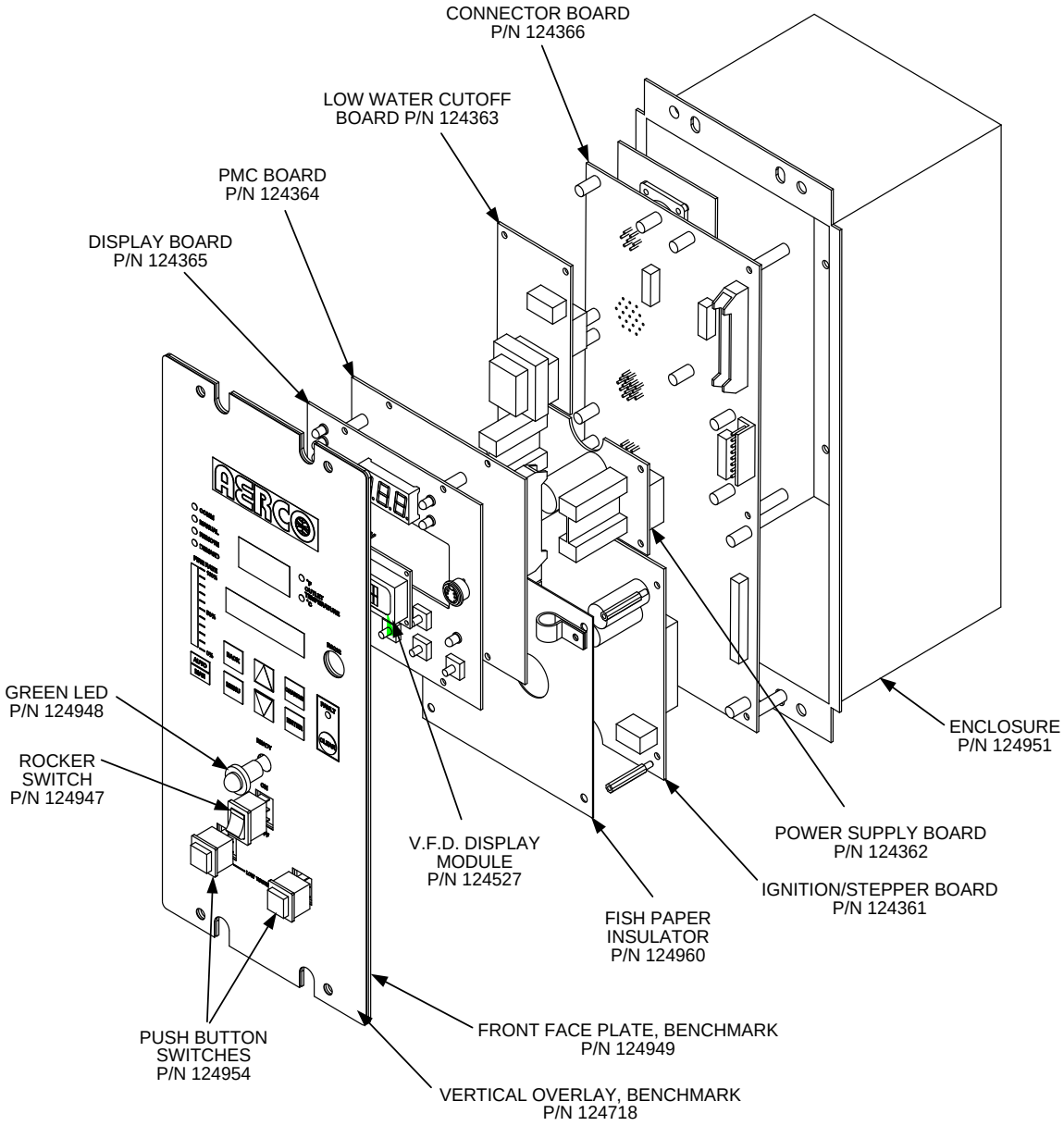


Figure K-1: Benchmark Control Panel Exploded View

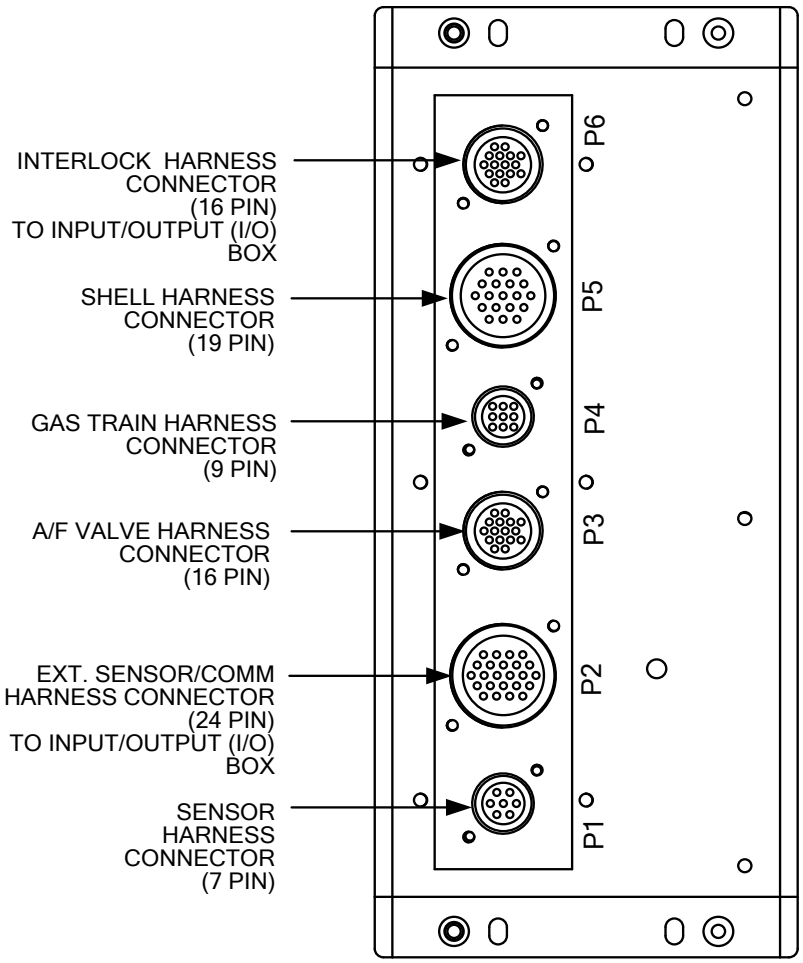


Figure K-2: Benchmark Control Panel Rear View

Appendix L: RECOMMENDED SPARES

NOTE

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

Table L-1: Recommended Emergency Spare Parts

DESCRIPTION	PART NUMBER
120 VAC Blower	69078
SSOV Actuator/Regulator Combo - Used on: • ALL FM gas train models • **Downstream** SSOV of IRI gas train models	69005
SSOV Actuator Without Proof of Closure Switch - Used on: • **Upstream** SSOV of IRI gas train models	69038
Temperature Switch - Manual Reset	123552

Table L-2: Spare Parts Recommended for Maintenance

DESCRIPTION	PART NUMBER
Annual Maintenance Kit	58025-01
24-month Waterside/Fireside Inspection Kit	58025-13

NOTE: Kits ending in **-xx** were not available at the time this guide was printed. Contact AERCO for availability.

Table L-3: Optional Spare Parts

DESCRIPTION	PART NUMBER
C-More Control Box	181197
Burner	**BMK 1500:** 46042
	BMK 2000: 46044
O_2 Sensor	61026

This page left intentionally blank

NOTES:

Change Log:

Date	Description	Changed By
11/21/2013	Rev C: **PIR 934-5**: Revised the regulator requirements. **PIR 934-2**: revised Analog Output & VFD/Blower terminal descriptions. **PIR 934-2**: changed "sealed" combustion to "ducted" combustion. **PIR 934-5**: added AERCO RS-232 cable info to C-More section. **PIR 934-8**: changed p/n 122790 to GM-123525 in section 2.10.1 **Misc**: Updated graphics and format; updated Warranty to version 11/22/13	Curtis Harvey
03/20/2014	Rev D: **PIR 780**: replaced mechanical latch with magnetic **PIR 934-14**: Corrected labels of Blower Proof and Blocked Inlet switches in diagrams in chapter 7 **PIR-960**: Addition of two sub-sections in 2.10.12; addition of section 2.15 Sequencing Valve Installation; addition of section 3.9 _BST Menu; addition of Chapter 10 – Boiler Sequencing Technology; replaced all wiring schematics in Appendix I, addition of 24V Sequencing Valve & Flame Rod Amplifier. **PIR-934-33**: Modified step 13 in Combustion Calibration regarding defective O_2 Sensor. **PIR-934-37**: Modified Blocked Inlet Switch Test instructions, section 6.8.2. **PIR-1005:** Changed Maintenance Kit part numbers	Curtis Harvey & Chris Blair