A Watts Water Technology Company

Benchmark 2.0LN
Low NOx Boiler

USER MANUAL
Installation, Operation and Maintenance

Natural Gas Fired
Modulating, Condensing,
Forced Draft, Hot Water Boiler
2,000,000 BTU/H Input



Applicable to Serial Numbers
G-12-0800 and above

GAS-FIRED
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Commercial Boilers
AHRI Standard BTS-2000

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Foreword

The AERCO Benchmark 2.0 Low NOx (LN) Boiler is a modulating unit. It represents 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 Benchmark 2.0LN, with its 20:1 turn down ratio and condensing capability, provides extremely high efficiencies and makes it ideally suited for modern low temperature, as well as, conventional heating systems.

The boiler operates at inputs ranging from 100,000 BTU/hr. to 2,000,000 BTU/hr. The output of the boiler is a function of the unit's firing rate and return water temperature. Output ranges from 99,000 BTU/hr. to 1,933,000 BTU/hr., depending on operating conditions.

When installed and operated on natural gas in accordance with this Instruction Manual, the Benchmark 2.0LN Boiler complies 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 Benchmark 2.0LN offers the maximum flexibility in venting with minimum installation space requirements. The Benchmark's advanced electronics are available in several selectable modes of operation offering the most efficient operating methods and energy management system integration.

For service or parts, contact your local sales representative or AERCO INTERNATIONAL.

NAME: _____

ORGANIZATION: _____

ADDRESS: _____

TELEPHONE: _____

INSTALLATION DATE: _____

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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). Where ASME CSD-1 is required by local jurisdiction, the installation must conform to CSD-1.

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.

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

WARNINGS MUST BE OBSERVED TO PREVENT SERIOUS INJURY**.**

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 THERE-FORE MUST BE COMPLETELY SEALED TO PREVENT LEAKAGE OF COMBUSTION PRODUCTS INTO LIVING SPACES.

WARNING

A DOUBLE-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 DIS-CONNECT ELECTRICAL SERVICE. DO NOT AFFIX SWITCH TO UNIT SHEET METAL ENCLOSURES.

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

ELECTRICAL VOLTAGES UP TO 120 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.

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.

IMPORTANT

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

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.

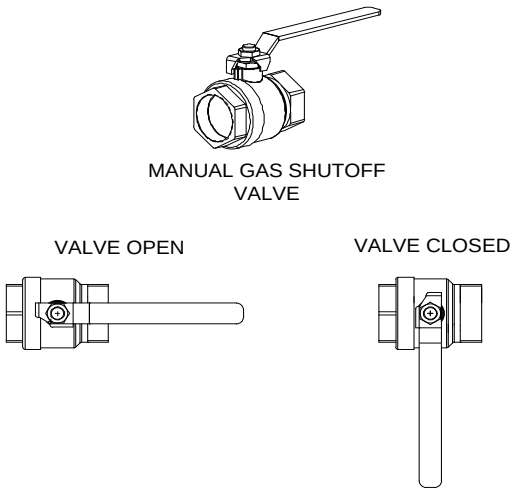


Figure 1-1: Manual Gas Shutoff Valve

IMPORTANT – FOR MASSACHUSETTS INSTALLATIONS ONLY

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.
- If a glycol solution is used as anti-freeze protection, a backflow preventer must be installed upstream of the Fill/Makeup Valve.
- 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 the Product Approved side wall horizontally vented gas fueled equipment and all the venting instructions, parts lists and/or design instructions for the venting system shall remain with the appliance or equipment at the completion of the installation.

End of Extracted Information From 248 CMR 5.08 (2)

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CHAPTER 2. INSTALLATION

2.1 INTRODUCTION

This Chapter provides the descriptions and procedures necessary to unpack, inspect and install the AERCO Benchmark 2.0LN Boiler. Brief descriptions are also provided for each available mode of operation. Detailed procedures for implementing these modes are provided in Chapter 5.

2.2 RECEIVING THE UNIT

Each Benchmark 2.0LN System is shipped as a single crated unit. The shipping weight is approximately 1600 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

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. Notify the freight carrier immediately if any damage is detected.

IMPORTANT

After unpacking, take off the unit top panel and remove the strap and packing material at the top of the heat exchanger. The packing material is located in the area of the igniter and staged ignition solenoid on the burner assembly.

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

- Pressure/Temperature Gauge
- ASME Pressure Relief Valve
- Condensate Drain Trap
- 2" Gas Supply Shutoff Valve

When ordered, optional accessories may be packed separately, packed within the boiler shipping container, or may be installed on the boiler. 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 2.0LN Boiler includes:

- Access to AC Input Power at 120 VAC, Single-Phase, 60 Hz @ 20A
- Access to line at a Minimum supply gas pressure of 4" W.C. (2000 cfh for Natural Gas).

2.4.1 Installation Clearances

The unit must be installed with the prescribed clearances for service as shown in Figure 2-1. 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:

- Sides: 24 inches
- Front : 24 inches
- Rear: 30 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.

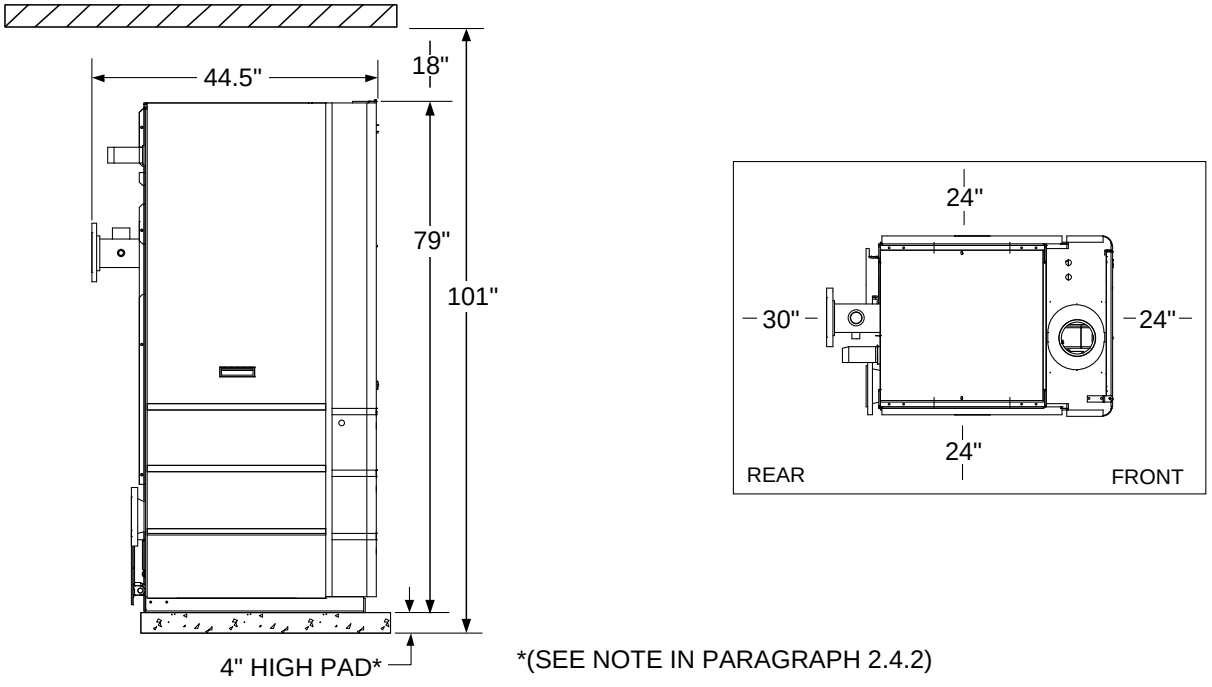


Figure 2-1: Benchmark 2.0LN Boiler Clearances

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 boiler must be moved by pallet jack or forklift from the FRONT ONLY.

FOR MASSACHUSSETTS ONLY

For Massachusetts installations, the boiler must be installed by a plumber or gas fitter who is licensed within the Commonwealth of Massachusetts. In addition, the installation must comply with all requirements specified in Chapter 1 (Safety Precautions).

2.4.2 Setting the Unit

The unit must be installed on a 4 inch to 6 inch housekeeping pad to ensure proper condensate drainage (see NOTE below). If anchoring the unit, refer to the dimensional drawings in Appendix F for anchor locations. Two lifting tabs are provided at the top of the heat exchanger. Figure 2-2 shows the location of the tab on the top-left side. The second tab is located on the top-right side of the heat exchanger. USE THESE TWO TABS TO LIFT AND MOVE THE UNIT. Remove the 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.

NOTE

When using the AERCO Condensate Neutralizer Tank for proper condensate drainage, the Neutralizer Tank must be stored in a pit, OR the boiler and AERCO Condensate Trap must be elevated higher than 4" above the floor. See Condensate Tank instructions in TID-0074 for details.

WARNING

WHEN LIFTING OR MOVING THE BOILER:

- DO NOT MANIPULATE THE BOILER USING THE GAS TRAIN OR BLOWER
- WHEN USING THE LIFTING TABS, ENSURE THERE IS NO LOAD PLACED ON THE GAS TRAIN OR BLOWER

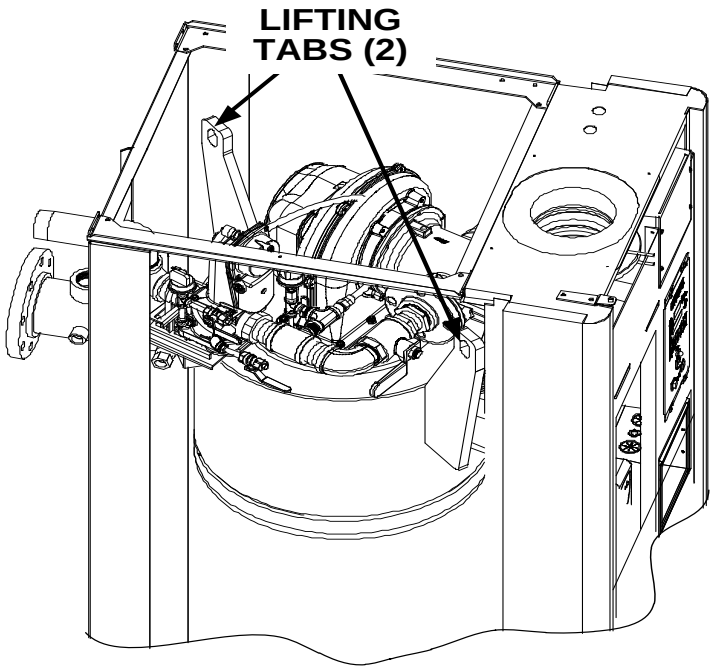


Figure 2-2: Partial Top View Showing Lifting Tab Location

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 2.0LN 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. Refer to Appendix F, Drawing AP-A-798 for additional dimensional data.

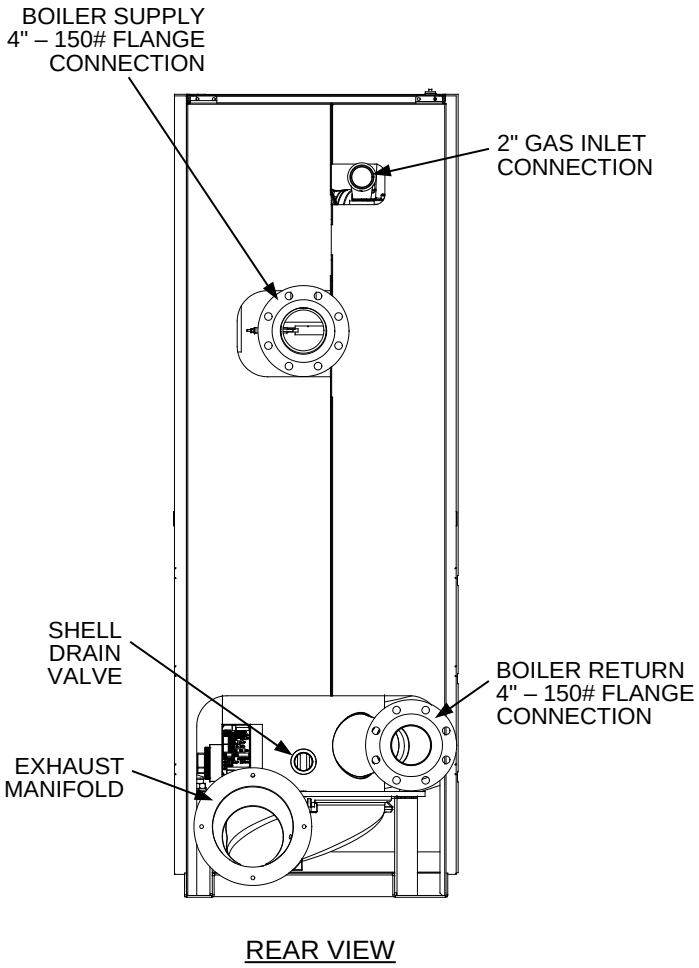


Figure 2-3: Supply and Return Locations

2.6 CONDENSATE DRAIN AND PIPING

The Benchmark 2.0LN 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 pipe located on the exhaust manifold (Figure 2-4) must be connected to a condensate trap which is packed separately within the unit's shipping container.

The procedure to install and connect the condensate drain is provided in paragraph 2.6.1.

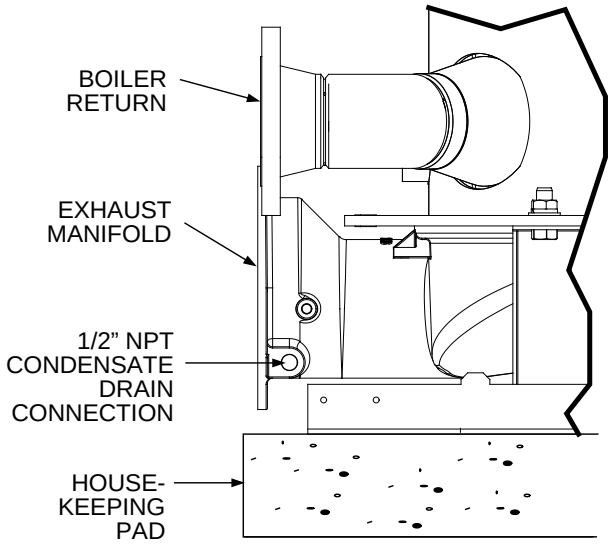


Figure 2-4: Condensate Drain Connection Location

2.6.1 Exhaust Manifold Condensate Drain

A condensate drain trap (part no. 24060) is shipped loose and must be installed at the rear of the unit. The trap inlet and outlet contain tapped 3/4" NPT ports. The actual installation details for the condensate trap will depend on the available clearances, housekeeping pad height/dimensions and other prevailing conditions at the site. However, the following guidelines must be observed to ensure proper condensate trap operation:

- The condensate trap inlet (Figure 2-5) must be level with, or lower than the exhaust manifold drain port.
- The condensate trap must be supported to ensure that its base is level (horizontal).
- The trap must be removable for routine maintenance. AERCO recommends that a union be utilized between the exhaust manifold condensate drain port and the trap inlet port.

While observing the above guidelines, connect the condensate trap inlet to the exhaust manifold drain connection using the appropriate piping components (nipples, reducers, elbows, etc.) for the boiler installation site. Connect as follows:

Condensate Trap Installation

1. At the condensate trap outlet, install a 3/4" NPT nipple.
2. Connect a length of 1" I.D polypropylene hose to the trap outlet and secure with a hose clamp.
3. Route the hose on the trap outlet to a nearby floor drain.
4. 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 20 GPH. The condensate drain trap, associated fittings and drain line must be removable for routine maintenance.

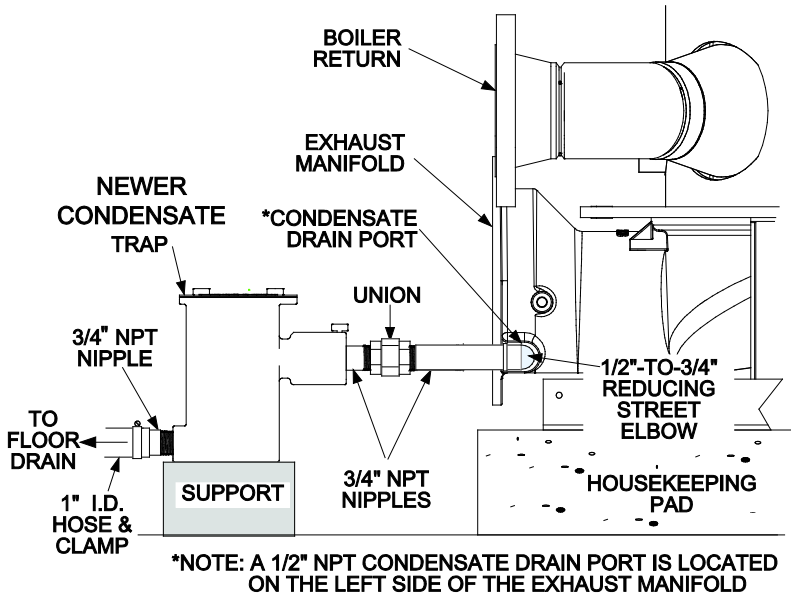


Figure 2-5: Condensate Trap Installation

2.7 GAS SUPPLY PIPING

The AERCO Benchmark 2.0LN 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.

WARNING

Many soaps used for gas pipe leak testing are corrosive to metals. There-fore, 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.

A 2 inch gas inlet connection is located on the rear of the unit as shown in Figure 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, isolate the unit from the gas supply piping. At no time should the gas pressure applied to the unit exceed 14" W.C. Leak test all external

piping thoroughly using a soap and water solution or suitable equivalent. The gas piping used must meet all applicable codes.

2.7.1 Gas Supply Specifications.

The specifications for natural gas are as follows:

- The maximum static pressure to the unit must not exceed 14" W.C.
- The gas supply pressure to the unit must be of sufficient capacity to provide 2000 cfh while maintaining the gas pressure at 4.0" W.C. for FM or 5.0" W.C. for IRI gas trains.

2.7.2 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 2-6. Maximum allowable gas pressure to the Boiler is 14" W.C.

NOTE

Paragraph 2.7.3 applies only to boiler installations within the Commonwealth of Massachusetts.

2.7.3 External Gas Supply Regulator

For Massachusetts installations, a mandatory external gas supply regulator must be positioned as shown in Figure 2-6. 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.

NOTE

The external regulator must be capable of regulating 1,500,000 BTU/HR of natural gas while maintaining a gas pressure of 4.0" W.C. to the boiler.

CAUTION

A lock-up style regulator MUST be used when gas supply pressure will exceed 14" W.C.

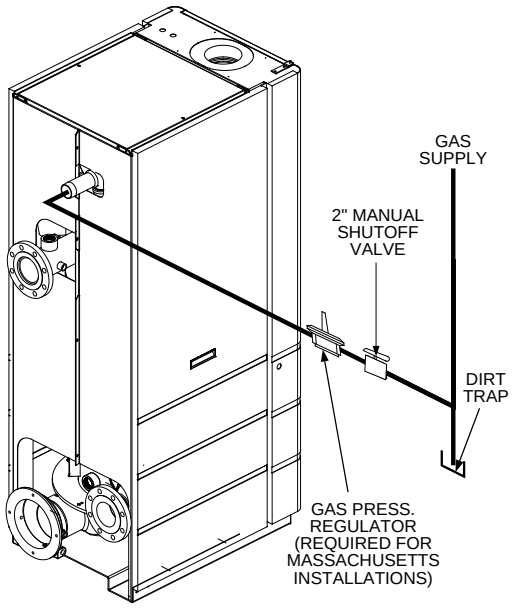


Figure 2-6: Manual Gas Shut-Off Valve Location

2.7.4 IRI Gas Train Kit

The IRI gas train is an optional gas train configuration which is required in some areas for code compliance or for insurance purposes. The IRI gas train is factory pre-piped and wired. See Appendix F, Drawing AP-A-843 for details.

2.8 AC ELECTRICAL POWER WIRING

The AERCO Benchmark 2.0LN Electrical Power Wiring Guide, GF-2060LN, 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 panel of the unit. Remove the front door of the unit to access the Power Box mounted directly above the Control Box. Loosen the four Power Box cover screws and remove cover to access the AC terminal connections inside the Power Box (Figure 2-7).

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.

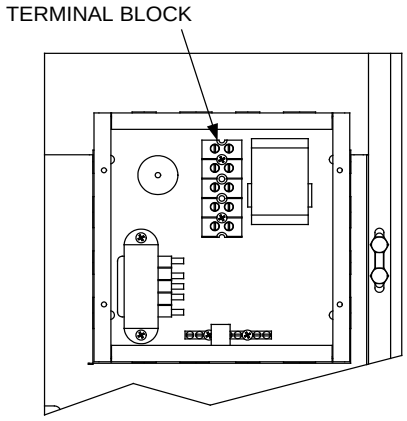


Figure 2-7: AC Input Terminal Block Location

2.8.1 Electrical Power Requirements

The AERCO Benchmark 2.0LN Boiler accepts 120 VAC, single-phase, 60 Hz @ 20A. The Power Box contains a terminal block as shown in Figure 2-8. In addition, a wiring diagram showing the required AC power connections is provided on the front cover of the Power Box.

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

A double-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 boiler 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 2.0LN Electrical Power Wiring Guide, (GF-2060LN).

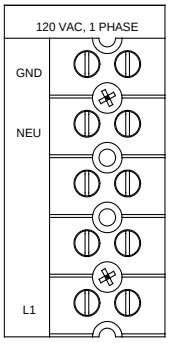


Figure 2-8: AC Terminal Block Configurations

2.9 MODES OF OPERATION AND FIELD CONTROL WIRING

The Benchmark 2.0 Boiler is available in several different modes of operation. While each unit is factory configured and wired for its intended mode, some additional field wiring may be required to complete the installation. This wiring is typically connected to the Input/Output (I/O) Box located on the lower portion of the unit front panel (Figure 2-9) behind the removable front door.

To access the I/O Box terminal strips shown in Figure 2-10, loosen the four cover screws and remove the cover. All field wiring is installed from the rear of the panel by routing the wires through one of the four bushings provided.

Refer to the wiring diagram provided on the cover of the I/O Box (Figure 2-10) when making all wiring connections.

Brief descriptions of each mode of operation, and their wiring requirements, are provided in the following paragraphs. Additional information concerning field wiring is provided in paragraphs 2.10.1 through 2.10.13. Refer to Chapter 5 for detailed information on the available modes of operation.

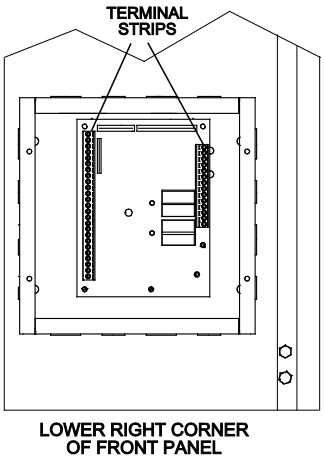


Figure 2-9: Input/Output (I/O) Box Location

2.9.1 Constant Setpoint Mode

The Constant Setpoint Mode is used when it is desired to have a fixed setpoint that does not deviate. No wiring connections, other than AC electrical power connections, are required for this mode. However, if desired, fault monitoring (see paragraph 2.10.12) or enable/disable interlock wiring can be utilized (see paragraph 2.10.11).

2.9.2 Indoor/Outdoor Reset Mode

This mode of operation increases supply water temperature as outdoor temperatures decrease. An outside air temperature sensor (AERCO Part No. 122790) is required. The sensor MUST BE wired to the I/O Box wiring terminals (see Figure 2-10). Refer to paragraph 2.10.1 for additional information on outside air temperature sensor installation.

2.9.3 Boiler Management System Mode

NOTE

BMS Model 168 can utilize either pulse width modulation (PWM) or RS485 Modbus signaling to the Boiler. BMS II Model 5R5-384 and the AERCO Control System (ACS) can utilize only RS485 signaling to the Boiler.

When using an AERCO BMS, BMS II, or ACS (AERCO Control System), the field wiring is connected between the BMS/BMS II/ACS Panel and each Boiler's I/O Box terminal strip (Figure 2-10). Twisted shielded pair wire from 18 to 22 AWG must be utilized for the connections. The BMS Mode can utilize either pulse width modulation (PWM) signaling, or RS485 Modbus signaling. For PWM signaling, connections are made from the AERCO Boiler Management System to the B.M.S. (PWM) IN terminals on the I/O Box terminal strip. For RS485 Modus signaling, connections are made from the BMS/BMS II/ACS to the RS485 COMM terminals on the I/O Box terminal strip. Polarity must be maintained and the shield must be connected only at the AERCO BMS/BMS II/ACS. The boiler end of the shield must be left floating.

For additional instructions, refer to Chapter 5, paragraph 5.6 in this manual. Also, refer to GF-108M (BMS), GF-124 (BMS II Model 5R5-384), and GF-131 (ACS) operation manuals.

2.9.4 Remote Setpoint and Direct Drive Modes

The Benchmark 2.0LN Boiler can accept several types of signal formats from an Energy Management System (EMS), Building Automation System (BAS) or other source, to control either the setpoint (Remote Setpoint Mode) or air/fuel valve position (Direct Drive Mode) of the Boiler. These formats are:

- 4 to 20 mA/1 to 5 VDC
- 0 to 20 mA/0 to 5 VDC
- PWM – (Pulse Width Modulated signal. See paragraph 2.10.4)
- Network (RS-485 Modbus. See paragraph 2.10.7)

While it is possible to control a boiler or boilers using one of the previously described modes of operation, it may not be the method best suited for the application. Prior to selecting one of these modes of operation, it is recommended that you consult with your local AERCO representative or the factory for the mode of operation that will work best with your application. For more information on wiring the 4 to 20 mA / 1to 5VDC or the 0 to 20 mA / 0 to 5 VDC, see paragraph 2.10.3.

2.9.5 Combination Mode

NOTE

Only BMS Model 168 and ACS can be utilized for the Combination Mode, not the BMS II (Model 5R5-384).

With a Combination Mode unit, field wiring is between the unit's I/O Box wiring terminals, the CCP (Combination Control Panel), and the BMS (Boiler Management System). For ACS applications, the wiring is between the ACS panel, the ACS Relay panel (optional, depending on applications), and the RS-485 Comm terminals in the I/O box. The wiring must be accomplished using twisted-shielded pair wire from 18 to 22 AWG. Polarity must be maintained. For further instructions and wiring diagrams, refer to the GF-108 Boiler Management System Operations Guide and the CCP-1 data sheet (BMS 168 applications)/GF-131 and TAG-0050 (ACS applications).

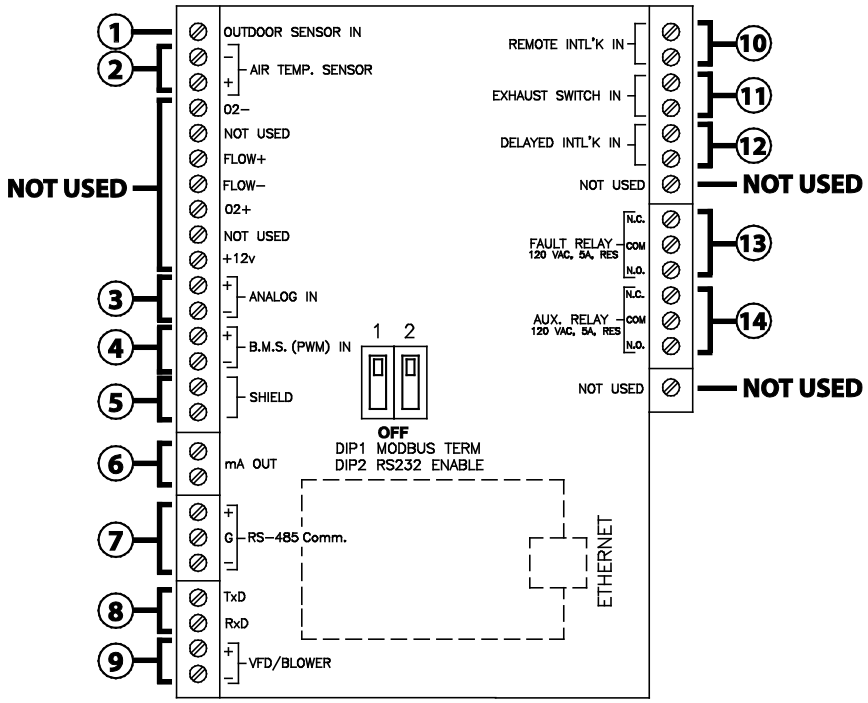


Figure 2-10. I/O Box Terminal Locations and Functions

2.10 I/O BOX CONNECTIONS

The types of input and output signals and devices to be connected to the I/O Box terminals shown in Figure 2-10 are described in the following paragraphs.

NOTE

Older I/O PCBs are wired the same as new ones, even if silk-screen designations differ.

NOTE

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

2.10.1 Outdoor Sensor In (1)

An outdoor air temperature sensor (AERCO Part No. 122790) will be 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 SENSOR IN and SENSOR COMMON terminals in the I/O Box (see Figures 2-9 and 2-10). 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. 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 Air temp. Sensor (2)

The Air Temperature Sensor is connected to the positive (+) and negative (-) terminals of the AIR TEMP. SENSOR on the I/O board. This sensor measures the temperature of the air input to the Air/Fuel Valve. This temperature reading is one of the components used to calculate the rotational speed of the blower used in the combustion Calibration process (Chapter 4).

The AIR TEMP. SENSOR terminals can be used to add an additional temperature sensor for monitoring purposes. This input is always enabled and is a view-only input that can be seen in the Operating Menu. The sensor must be wired to the positive (+) and negative (-) terminals of the AIR TEMP. SENSOR and must be similar to AERCO BALCO wire sensor Part No. 12449. A resistance chart for this sensor is provided in Appendix C.

2.10.3 Analog In (3)

The ANALOG IN + and – terminals are used when an external signal is used to drive the air/fuel valve position (Direct Drive Mode) or 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 setpoint or 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 Control Box. Contact the AERCO factory for information on setting DIP switches.

All of the supplied signals must be floating (ungrounded) signals. Connections between the signal source and the Boiler's I/O Box must be made using twisted shielded pair wire from 18 to 22 AWG, such as Belden 9841 (see Figure 2-10). Polarity must be maintained. The shield must be connected only at the source end and must be left floating (not connected) at the Boiler's I/O Box.

Regardless of whether voltage or current is used for the drive signal, they are linearly mapped to a 40°F to 240°F setpoint or a 0% to 100% valve position. No scaling for these signals is provided.

2.10.4 B.M.S. (PWM) IN (4)

NOTE

Only BMS Model 168 can utilize Pulse Width Modulation (PWM), not the BMS II or ACS (AERCO Control System).

These terminals are used to connect the AERCO Boiler Management System (BMS) to the unit. The BMS utilizes a 12 millisecond, ON/OFF duty cycle. This duty cycle 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.

2.10.5 Shield (5)

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

IMPORTANT

DO NOT USE the mA OUT output to remotely monitor Setpoint, Outlet Temp or Fire Rate Out.

2.10.6 mA Out (6)

These terminals provide a 4 to 20 mA output to the VFD (if so equipped) to control the rotational speed of the blower. This function is enabled in the Configuration Menu (Chapter 3, Table 3-4).

2.10.7 RS-485 COMM (7)

These terminals are used for RS-485 MODBUS serial communication between the unit and an external “Master” such as a Boiler Management System (BMS), AERCO Control System (ACS), Energy Management System (EMS), Building Automation System (BAS) or other suitable device.

2.10.8 TxD, RxD (8)

These terminals provide a parallel connection to the connector on the C-More Controller front panel, for connecting a computer or laptop.

2.10.9 VFD/Blower (9)

These terminals provide a 0 to 10 volt output to control the rotational speed of the blower. This function is enabled in the Configuration Menu (Chapter 3, Table 3-4).

2.10.10 Exhaust Switch In (11)

These terminals permit an external exhaust switch to be connected to the exhaust manifold of the boiler. The exhaust switch should be a normally open type switch (such as AERCO Part No. 123463) that closes (trips) at 500°F.

2.10.11 Interlocks (10, 12)

The unit offers two interlock circuits for interfacing with Energy Management Systems and auxiliary equipment such as pumps or louvers. These interlocks are called the Remote Interlock and Delayed Interlock (Figure 2-10). The wiring terminals for these interlocks are located inside the I/O Box on the unit front panel. The I/O Box cover contains a wiring diagram which shows the terminal strip locations for these interlocks (REMOTE INTL’K IN and DELAYED INTL’K IN). Both interlocks, described below, are factory wired in the closed position.

NOTE

Both the Delayed Interlock and Remote Interlock MUST be in the closed position to allow the unit to fire.

2.10.11.1 Remote Interlock In (10)

The remote interlock circuit is provided to remotely start (enable) and stop (disable) the Boiler, if desired. The circuit is labeled REMOTE INTL'K IN and is located inside the I/O Box on the front panel. The circuit is 24 VAC and is factory pre-wired in the closed (jumpered) position.

2.10.11.2 Delayed Interlock In (12)

The delayed interlock is typically used in conjunction with the auxiliary relay described in paragraph 2.10.13. 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 Boiler's auxiliary relay. The delayed interlock must be closed for the boiler to fire.

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 boiler long enough for a proving switch to make can be programmed. Should the proving switch not prove within the programmed time frame, the boiler will shut down. The Aux Start On Dly can be programmed from 0 to 120 seconds. This option is locate in the Configuration Menu (Chapter 3, Table 3-4).

2.10.12 Fault Relay (13)

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 2-10.

2.10.13 Auxiliary Relay Contacts (14)

Each Boiler 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 Boiler status indictor (firing or not firing). Its contacts are rated for 120 VAC @ 5 amps. Refer to Figure 2-10 to locate the AUX RELAY terminals for wiring connections.

2.11 FLUE GAS VENT INSTALLATION

The minimum allowable vent diameter for a single Benchmark 2.0LN Boiler is 8 inches.

The AERCO Benchmark Venting and Combustion Air Guide, GF-2050, must be consulted before any flue gas vent or inlet air venting is designed or installed. U/L listed, positive pressure, watertight vent materials as specified in AERCO's GF-2050, must be used for safety and code compliance. Since the unit is capable of discharging low temperature exhaust gases, horizontal sections of the flue vent system must be pitched back to the unit a minimum of 1/4 inch per foot to avoid condensate pooling and allow for proper drainage.

The combined pressure drop of vent and combustion air systems must not exceed 140 equivalent feet of 8 inch ducting. 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 inch 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 Heatfab Division of the Selkirk Corporation provides vent systems which conform to all applicable requirements for installations within the Commonwealth of Massachusetts. Contact information for this supplier is as follows:

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

2.12 COMBUSTION AIR

The AERCO Benchmark Venting and Combustion Air Guide, GF-2050 MUST be consulted *before* any flue or combustion supply air venting is designed or implemented. Combustion 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.

The AERCO Benchmark 2.0LN Boiler is UL listed for 100% sealed combustion. It can also be installed using room air, provided there is an adequate supply. (See para. 2.13.3 for more information concerning sealed combustion air). If the sealed combustion air option is not being used, an inlet screen will be attached at the air inlet on the top of the unit

The more common methods of supplying combustion air are outlined below. For more information concerning combustion air, refer to the AERCO Benchmark Venting and Combustion Air Guide, GF-2050.

2.12.1 Combustion Air From Outside the Building

Air supplied from outside the building must be provided through two permanent openings. Each opening must have a free area of not less than one square inch for each 4000 BTU/H boiler input. 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, 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 BTU/H of total boiler input. The free area must take into account any restrictions such as louvers.

2.12.3 Sealed Combustion

The AERCO Benchmark 2.0LN Boiler is UL listed for 100%-sealed combustion. For sealed combustion installations, the screen on the air inlet duct of the unit must be removed. The inlet air ductwork must then be attached directly to the unit's air inlet.

In a sealed 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 boiler in a sealed combustion air configuration, each unit must have a minimum 6 inch diameter connection at the unit.

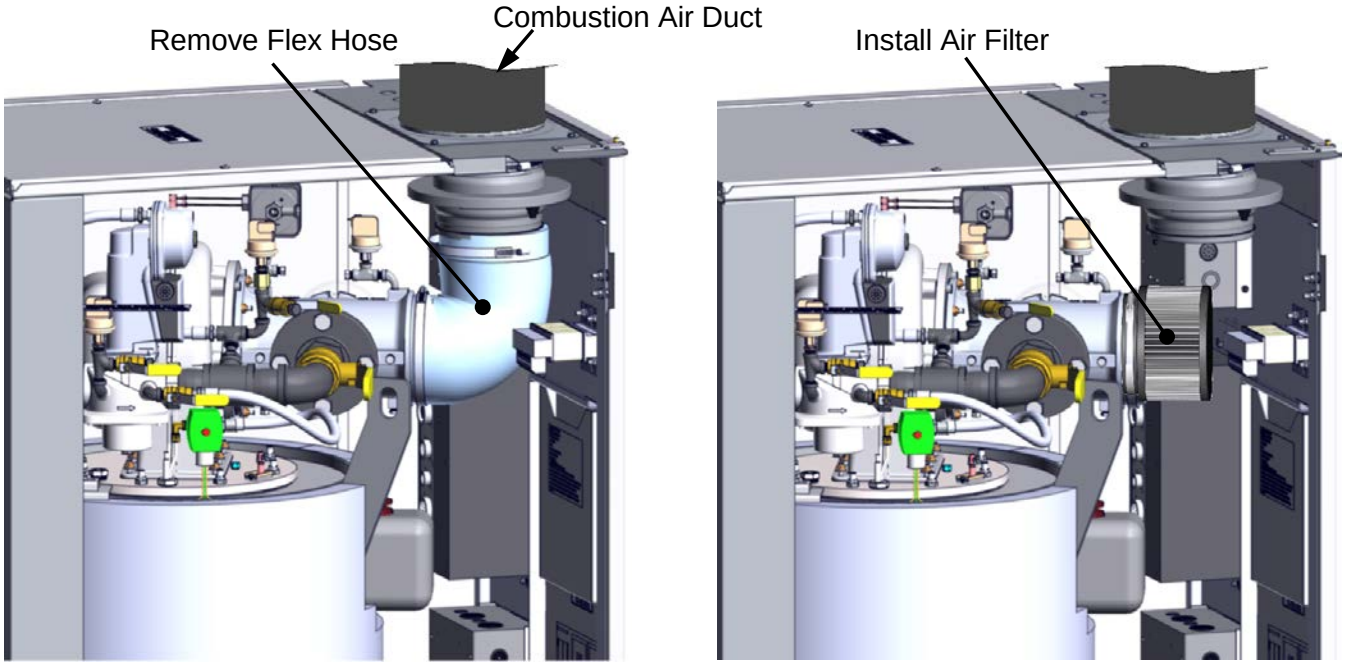
2.12.4 Ducted Combustion Air

For ducted combustion air installations, the air ductwork is 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.

In order to implement this option, you must remove the internal flex hose between the air inlet iris and the air/fuel valve and install an air filter (AERCO part number 59138) on the air/fuel valve's inlet, as shown in the right-hand image in Figure 2-11.

Once the hose has been replaced with the air filter, you must now repeat the combustion calibration procedure, as described in Chapter 4, section 4.3, below.



PARTIAL LEFT SIDE VIEW – FRONT & LEFT SIDE COVERS REMOVED

Figure 2-11: Location of Ducted Combustion Air Components

2.12.5 Temporary Combustion Air Filtering During Construction

When the Benchmark 2.0LN Boiler is used to provide heat temporarily during ongoing building construction, accumulated drywall dust, sawdust and similar particles can accumulate in the unit's combustion air intake filter and block combustion air flow. In these situations, AERCO recommends that a disposable air intake filter be installed, temporarily, above the boiler combustion air inlet.

AERCO recommends that the temporary air filter be cut from a McMaster-Carr part no. 2122K315 Polyester Air Filter Roll Tackfield, ½" thick, 16" wide, or equivalent. Cover the Benchmark 2.0LN air inlet with the blue side of the filter material facing outward to hold the dust on the outside surface. Maximize the surface area of the filter covering the 8" diameter opening by creating a dome out of the filter material.

Cover the flared duct opening with the blue side facing outward. During construction check the filter for dust accumulation and replace it when the accumulation becomes noticeable.

2.13 BENCHMARK PUMP RELAY OPTION

An optional Benchmark pump relay allows the user to turn a pump on/off and open/close a motorized valve as the boiler cycles on and off on demand. The Pump Delay Timer feature allows the user to keep the pump running and keep the motorized valve open for up to 30 minutes after the boiler has shut down and the demand is satisfied.

The Benchmark pump relay (SPDT) contact is rated for:

- 10 A Resistive @ 277 VAC/28 VDC
- 1/3 HP N/O @ 120/240 VAC
- 1/6 HP N/C @ 120/240 VAC
- 480 VA Pilot Duty @ 240-277 VAC

If pump/valve load exceeds the above contact ratings, use a separate contact relay. See Diagrams 2-1a and 2-1b.

To identify if the boiler is equipped with the BMK Pump Relay Option (part no. 69102), look for the label and relay as shown in Figure 2-12.

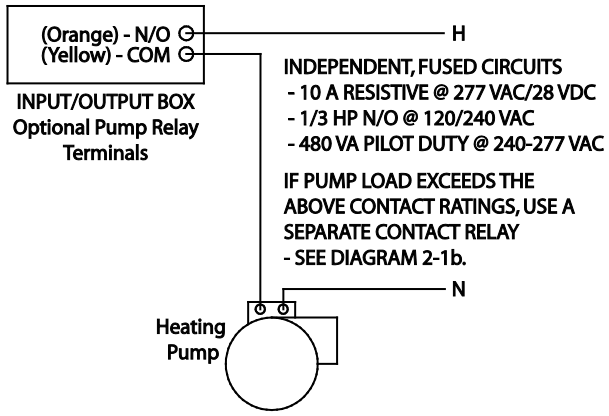


Diagram 2-1a: Schematic – System Pump Start using Boiler Pump Relay

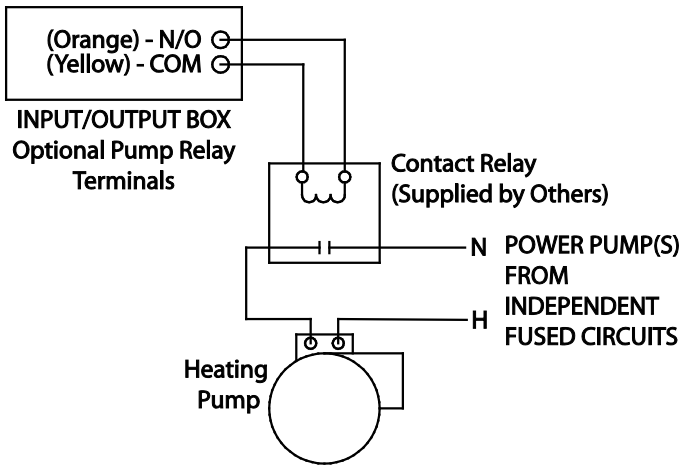


Diagram 2-1b: Schematic – System Pump Start using a Separate Contact Relay

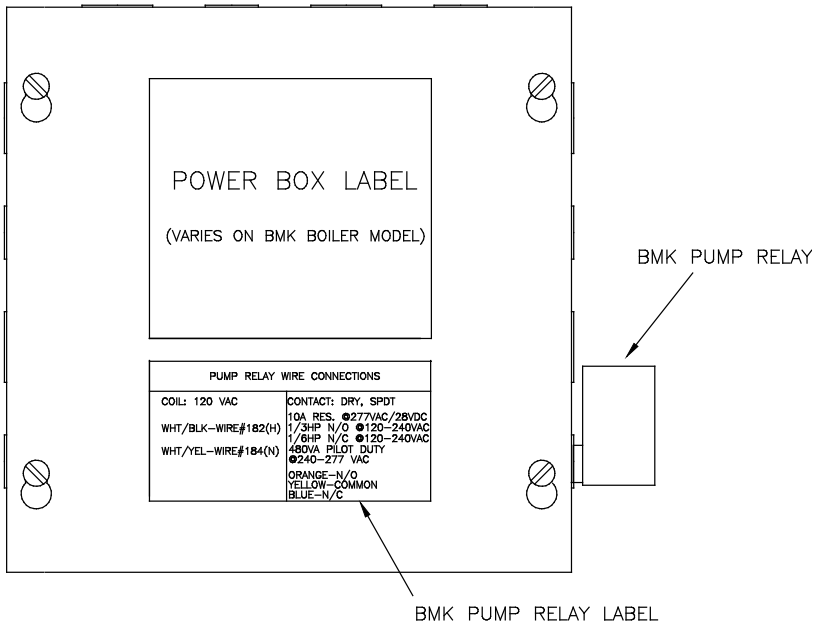


Figure 2-12: Identifying the Presence of BMK Pump Relay Option 69102

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CHAPTER 3. OPERATION

3.1 INTRODUCTION

The information in this Chapter provides a guide to the operation of the Benchmark 2.0LN 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 will void the equipment warranty. In addition, the following WARNINGS and CAUTIONS must be observed at all times.

IMPORTANT!

All of the installation procedures in Chapter 2 must be completed before attempting to start the unit.

WARNING

ELECTRICAL VOLTAGES IN THIS SYSTEM MAY INCLUDE 460, 208 AND 24 VOLTS AC. IT MUST BE SERVICED only BY FACTORY CERTIFIED SERVICE TECHNICIANS

WARNING

DO NOT ATTEMPT TO DRY FIRE THE BOILER. 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.

3.2 CONTROL PANEL DESCRIPTION

The Benchmark 2.0LN Control Panel shown in Figure 3-1 contains all of the controls, indicators and displays necessary to operate, adjust and troubleshoot the Benchmark 2.0LN 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 provided in this Chapter.

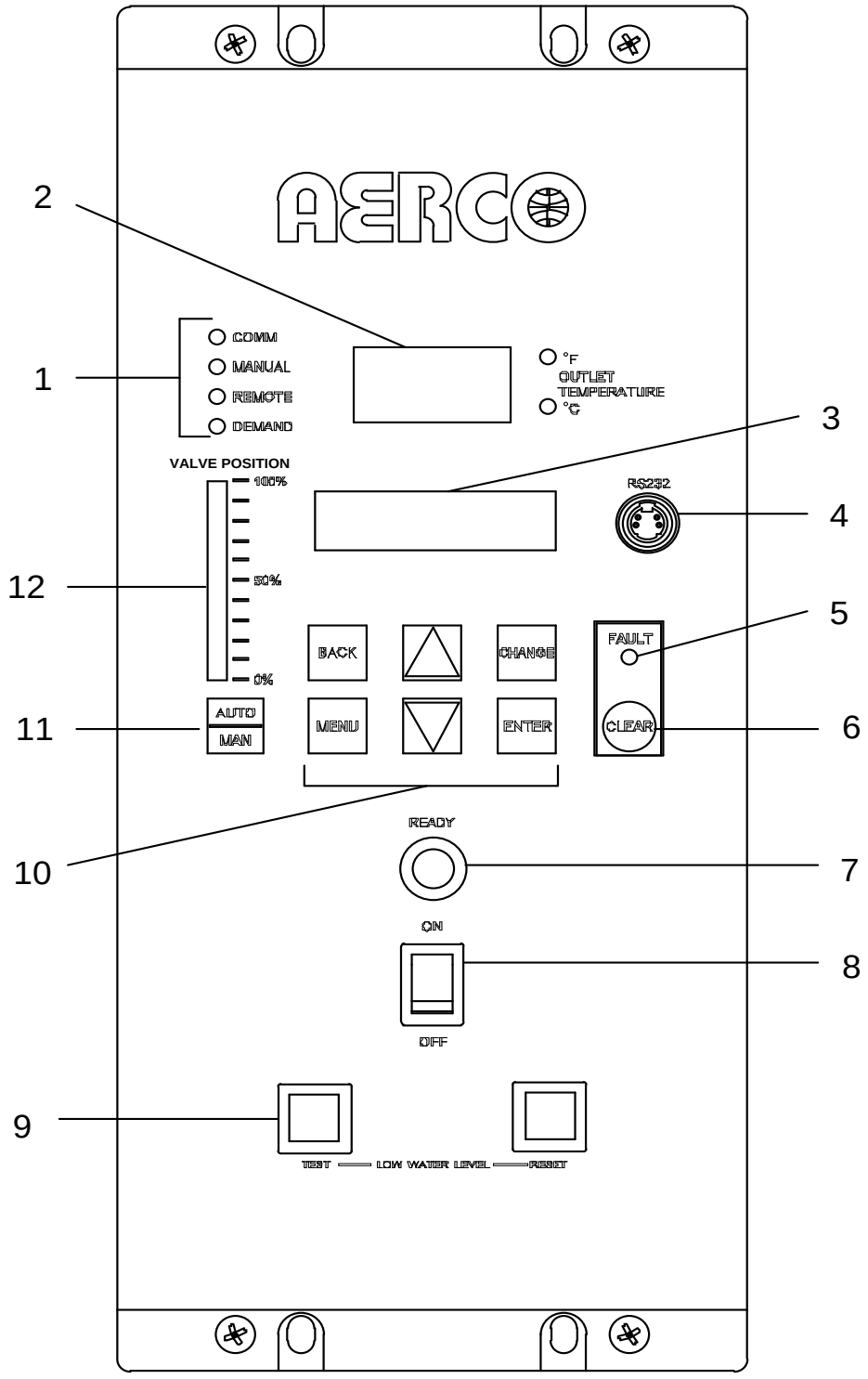


Figure 3-1: Control Panel Front View

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 unit is being controlled using the front panel keypad.
	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.
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
4	**RS-232** Port	Port permits a Laptop Computer or External Modem to be connected to the unit's Control Panel.
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	Consists of 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. 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 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.

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.

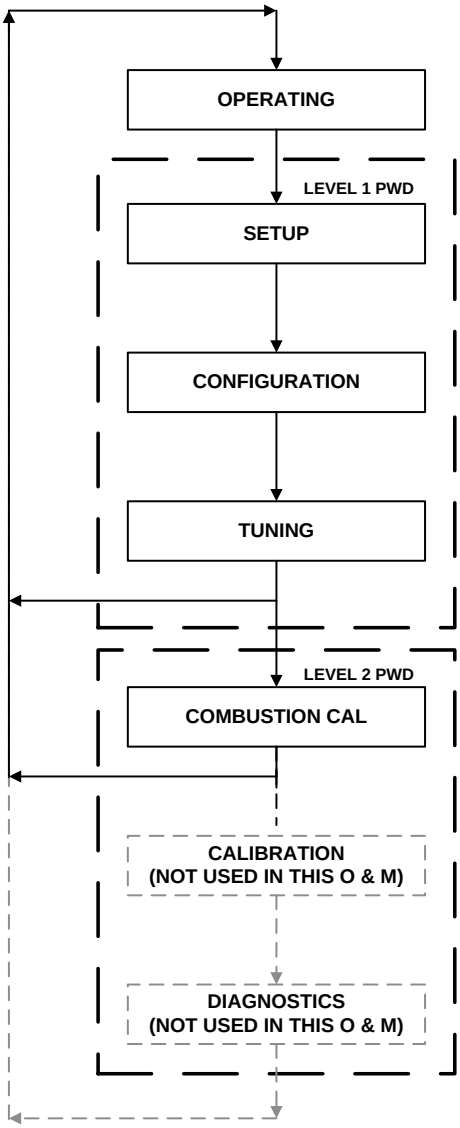


Figure 3-2: Control Panel Menu Structure

NOTE

The following paragraphs 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).

NOTE

The Outdoor Temp display item 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).

Table 3-2: Operating Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Active Setpoint	40°F	240°F	
AIR Temp	-70°F	245°F	
Outdoor Temp*	-70°F	130°F	
Valve Position In	0%	100% Valve Position	
Flame Strength	0%	100%	
Run Cycles	0	999,999,999	
Run Hours	0	999,999,999	
Fault Log	0	19	0

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
Min. Upload Timer	30	9999	0
Unit Alpha	A	Z	E
Unit Year	00	99	00
Unit Serial #	0000	9999	0000
Software	Ver. 0.0	Ver. 9.9	Current

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 Boiler Dual, KC Water Heater, KC Wtr Heater LN, Innovation WH		BMK Boiler LN
Unit Size (See **NOTE** at end of Table 3-4)	750 MBH, 1000 MBH, 1500 MBH, 2000 MBH, 3000 MBH		2000 MBH (2.0 MBTU)
Fuel Type	Natural Gas, 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 (BMS) Network		4 – 20 mA, 1-5V
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
Outdoor Sensor	Enabled or Disabled		Disabled
System Start Tmp (If Outdoor Sensor = Enabled)	30°F	100°F	60°F

Table 3-4. Configuration Menu - *Continued*

Menu Item Display	Available Choices or Limits Minimum	Maximum	Default
Setpt Lo Limit	40°F	Setpt Hi Limit	60°F
Setpt Hi Limit	Setpt Lo Limit	195°F	195°F
Temp Hi Limit	40°F	210°F	195°F
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
*Analog Output (See CAUTION at end of Table 3-4)	Off, Setpoint, Outlet Temp, Valve Position 4-20 mA, Valve Position 0-10V		*Valve Position 0-10V
Low Fire Timer	2 sec.	600 sec.	2 sec.
Setpt Limiting	Enabled or Disabled		Disabled
Setpt Limit Band	0°F	10°F	5°F
Network Timeout	5 Sec	999 Sec	30 Sec
HI DB Setpt EN	0%	100%	30%
Demand Offsert	0	25	10
Deadband High	0	25	2
Deadband Low	0	25	2
Spark Monitor	Enabled or Disabled		Disabled
Spark Current	Display		

NOTE

Only the Unit Sizes applicable to the selected Unit Type will be displayed.

***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	70°F
Integral Gain	0.00	2.00	1.00
Derivative Time (if Unit Type = Boiler	0.00 min	2.00 min	0.00 min
Warmup Prop Band	Range = 1 - 120		95
Warmup Int Gain	Range = 1 - 200		50
Warmup PID Timer	Range = 1 - 240		20
Reset Defaults	Yes, No, Are You Sure		No

3.8 COMBUSTION CAL MENU

The Combustion Cal (Calibration) 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. Differences exist in the Combustion Cal test points and default drive voltages for natural gas and propane units. Therefore, separate listing are provided in Table 3-6 are provided The valve positions (% open) and default drive voltages are listed in Table 3-6.

Refer to the Combustion Calibration procedures in Chapter 4 for the procedures applicable to the type of fuel being used.

Table 3-6: Combustion Cal Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
CAL Voltage 18%	.25	10.0v	1.00v
CAL Voltage 30%	.25	10.0v	2.30v
CAL Voltage 45%	.25	10.0v	2.95v
CAL Voltage 60%	.25	10.0v	3.60v
CAL Voltage 80%	.25	10.0v	5.30v
CAL Voltage 100%	.25	10.0v	9.10v
SET Valve Position	0%	100%	0%
Blower Output	Monitor Blower Output Voltage		.00v

3.9 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 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 fault 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.

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 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%.
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.
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 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 igniter relay is activated and provides ignition spark.
    c) The gas Safety Shut-Off Valve (SSOV) is energized (opened) allowing gas to flow into the Air/Fuel Valve.

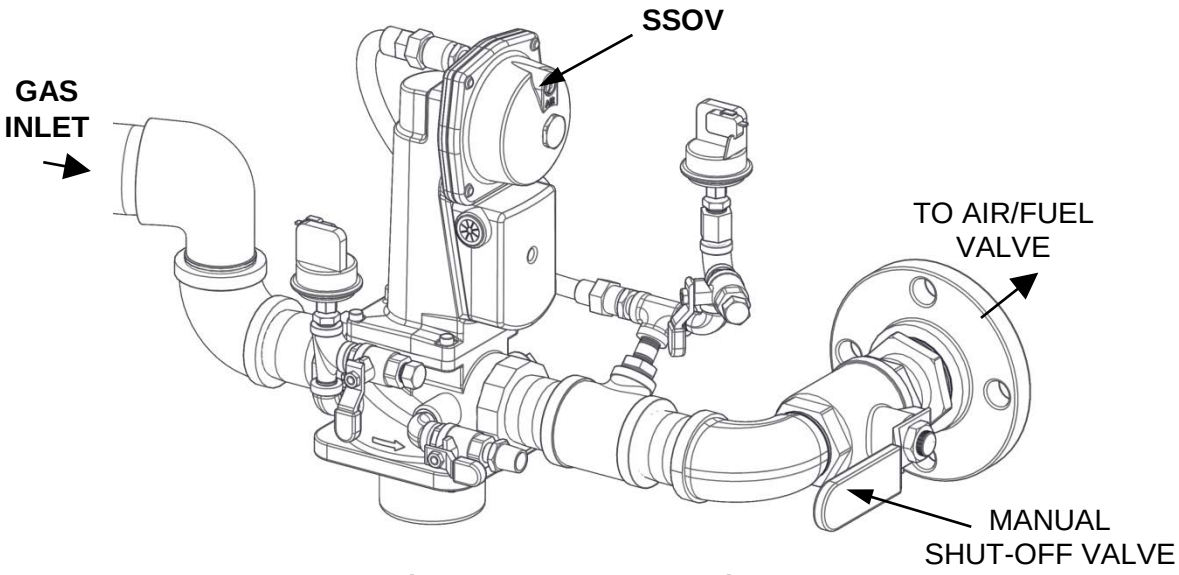


Figure 3-3: SSOV Location

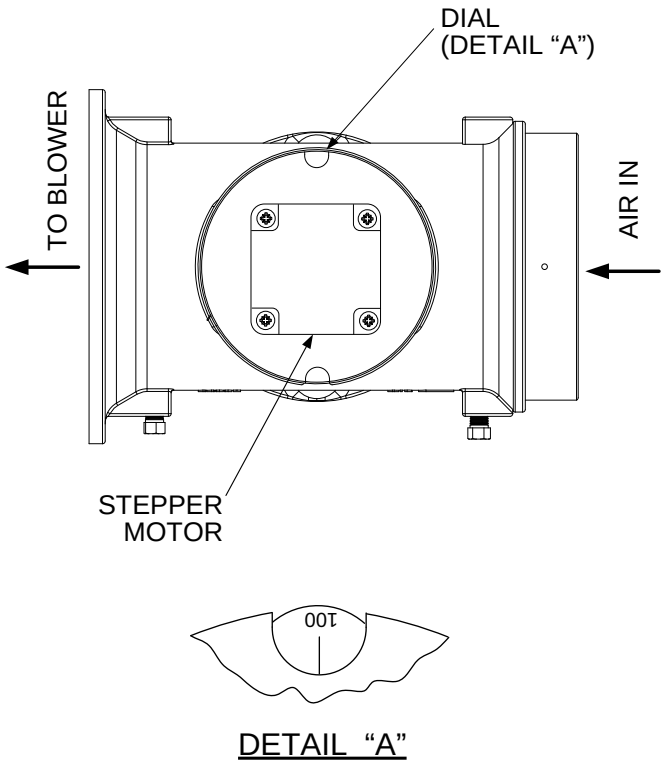


Figure 3-4: Air/Fuel Valve In Purge Position

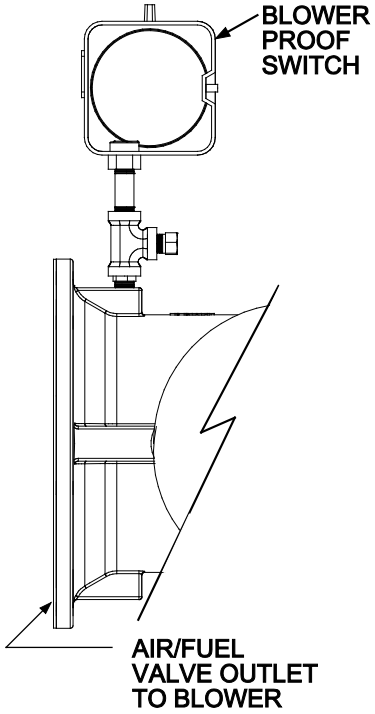


Figure 3-5: Blower Proof Switch

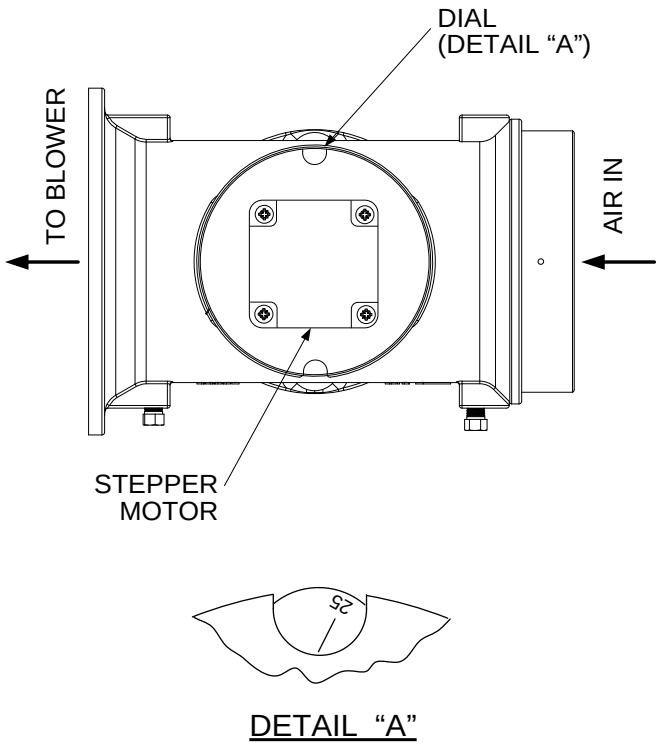


Figure 3-6: Air/Fuel Valve In Ignition Position

6. Up to 7 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 dual SSOV gas valves. The blower relay will be deactivated and the Air/Fuel Valve will be closed. *Standby* will be displayed.

3.10 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:

- Start Level: 22%
- Stop Level: 18%

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 3-7 for the relationship between the energy input and Air/Fuel Valve position for a unit running on natural gas.

Table 3-7. Relationship Between Air/Fuel Valve Position and Energy Input For Unit Running On Natural Gas

Air/Fuel Valve Position (% Open)	Energy Input (BTU/Hr)	Boiler Energy Input (% of Full Capacity)
0	0	0
10%	0	0
18% (Stop Level)	100,000	5.0%
20%	134,000	7%
30%	349,000	17%
40%	631,000	32%
50%	893,000	45%
60%	1,150,000	58%
70%	1,410,000	71%
80%	1,610,000	81%
90%	1,830000	92%
100%	2,000,000	100%

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CHAPTER 4. INITIAL START-UP

4.1 INITIAL START-UP REQUIREMENTS

The requirements for the initial start-up of the Benchmark 2.0LN Boiler consists of the following:

- Complete installation (Chapter 2)
- Set proper controls and limits (Chapter 3)
- Perform combustion calibration (Chapter 4)
- Set up mode of operation (Chapter 5)
- Test safety devices (see Chapter 6)

All applicable Installation procedures in Chapter 2 must be fully completed before performing initial start-up. 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 is to 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 Mode of Operation settings in Chapter 5, and the Safety Device Testing procedures in Chapter 6 to complete all initial start-up requirements.

AERCO Gas Fired Startup Sheets, included with each Benchmark Boiler, must be completed for each unit for warranty validation. A copy of these sheets must be returned promptly to AERCO at:

AERCO International, Inc.
100 Oritani Drive.
Blauvelt, NY 10913

WARNING

DO NOT ATTEMPT TO DRY FIRE THE BOILER. 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 paragraphs 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" 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 calibrate the gas pressure to be monitored on the downstream side of the SSOV during the Combustion Calibration procedures described in paragraph 4.4.

The gas supply manometer is installed at the downstream location on the 1/4” NPT port shown in Figure 4-1. Note that a 1/4” plug must be removed from the port in order to install the manometer.

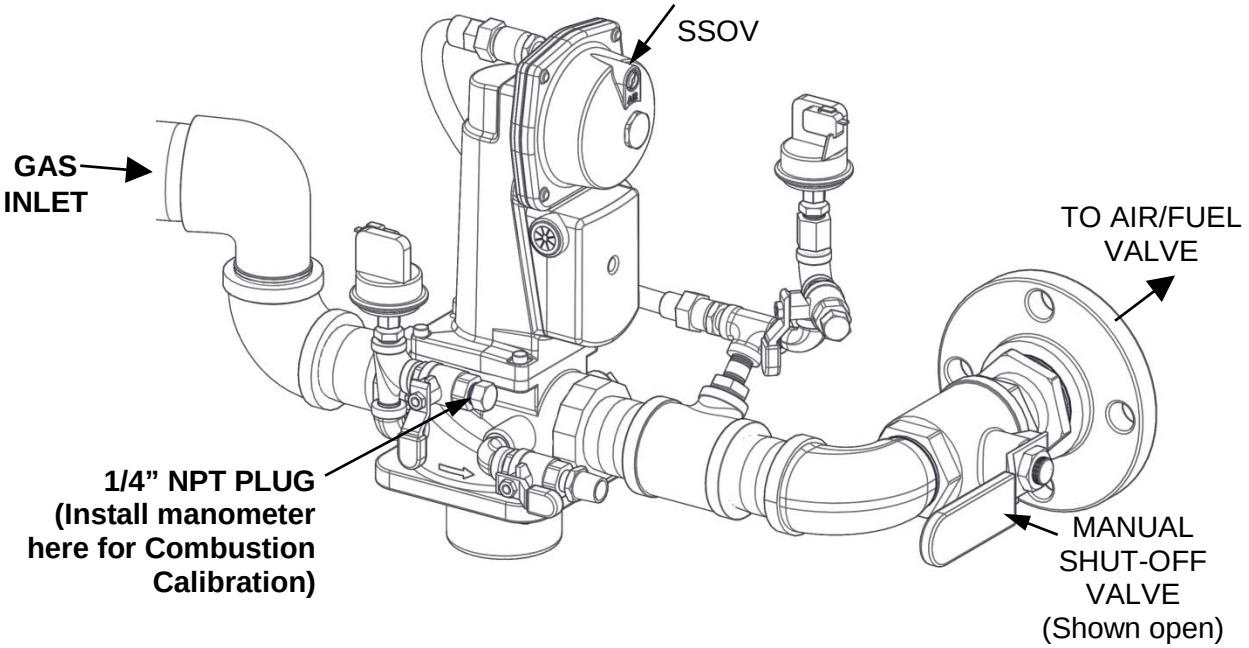


Figure 4-1: Manometer Installation Location

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

1. Turn off the main gas supply upstream of the unit.
2. Remove the top panel and left or right side 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 (paragraph 4.4), 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 NPT plugs on the left and right side of the exhaust manifold at the rear of the unit as shown in Figure 4-1. Prepare the port for the combustion analyzer probe as follows:

1. Remove the plug from the probe port on the left or right side of the exhaust manifold.
2. If necessary, adjust the stop on the combustion analyzer probe so that it will extend mid-way into the flue gas flow. DO NOT install the probe at this time.

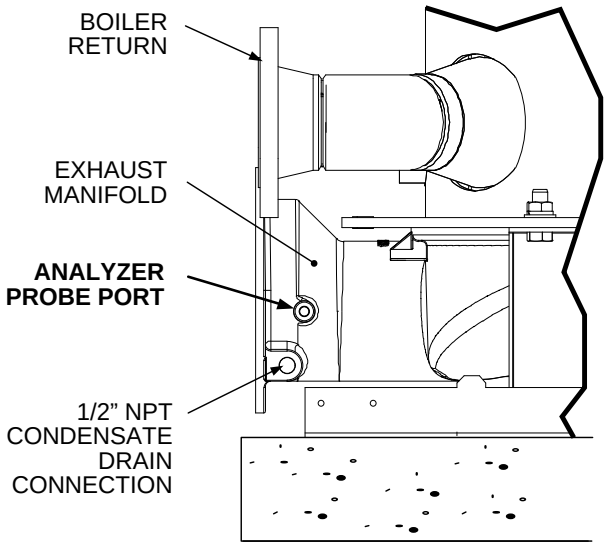


Figure 4.2: Analyzer Probe Hole Location

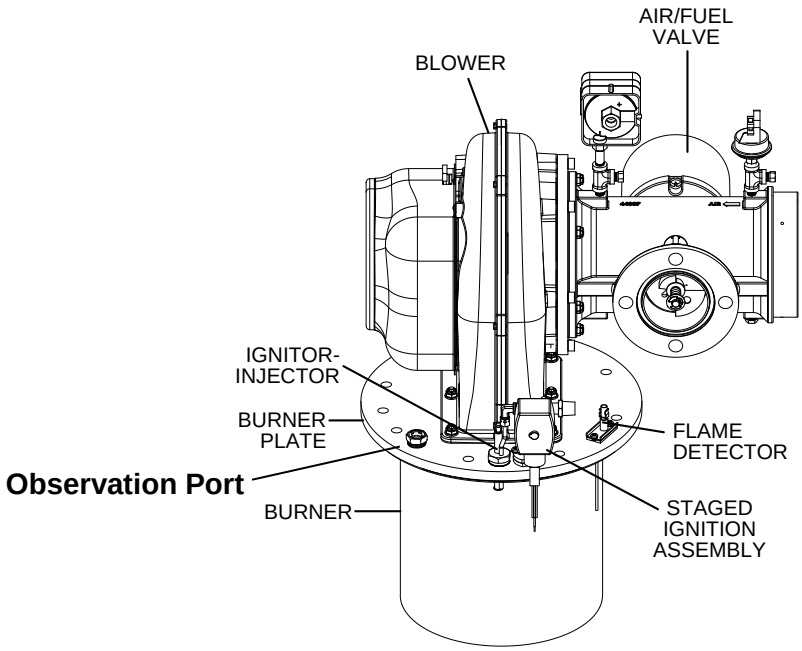


Figure 4-3: Observation Port Location

4.3 COMBUSTION CALIBRATION

The Benchmark 2.0LN Boiler is combustion calibrated at the factory prior to shipping. However, 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. Factory 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.

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(s) 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 rate 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 down-stream of the SSOV is open.
8. Set the **ON/OFF** switch to the **ON** position.
9. Change the valve position to 29% 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 2.8" W.C. for both FM and IRI gas trains. If gas pressure adjustment is required, remove the brass hex nut on the downstream SSOV actuator (IRI gas train) to access the gas pressure adjustment screw (Figure 4-4). Make gas pressure adjustments using a flat-tip screwdriver to obtain 2.8" W.C.

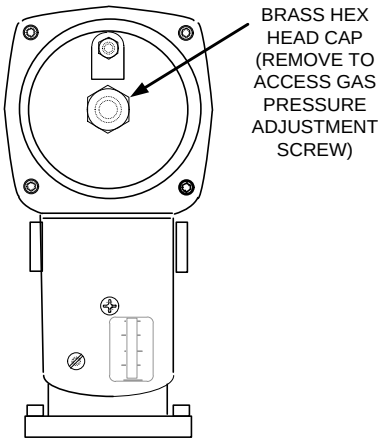


Figure 4-4: Gas Pressure Adjustment Screw Location

11. Increase the valve open position to 100% and verify that the gas pressure downstream of the SSOV remains at 2.8" W.C. Readjust 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 measured oxygen level to the oxygen range for the inlet air temperature shown in Table 4-1. Also, ensure that the carbon monoxide (CO) and nitrogen oxide (NOx) readings do not exceed the values shown.

Table 4-1: Combustion Oxygen Levels for a 100% Air/Fuel Valve Position

Inlet Air Temp	Oxygen % ± 0.2	Carbon Monoxide	NOx
≥100°F	4.8 %	<100 ppm	<30 ppm
90°F	5.0 %	<100 ppm	<30 ppm
80°F	5.2 %	<100 ppm	<30 ppm
≤70°F	5.3 %	<100 ppm	<30 ppm

14. If necessary, adjust the iris air damper shown in Figure 4-5 until the oxygen level is within the range specified in Table 4-1.
15. Once the oxygen level is within the specified range at 100%, lower the valve position to 80%.

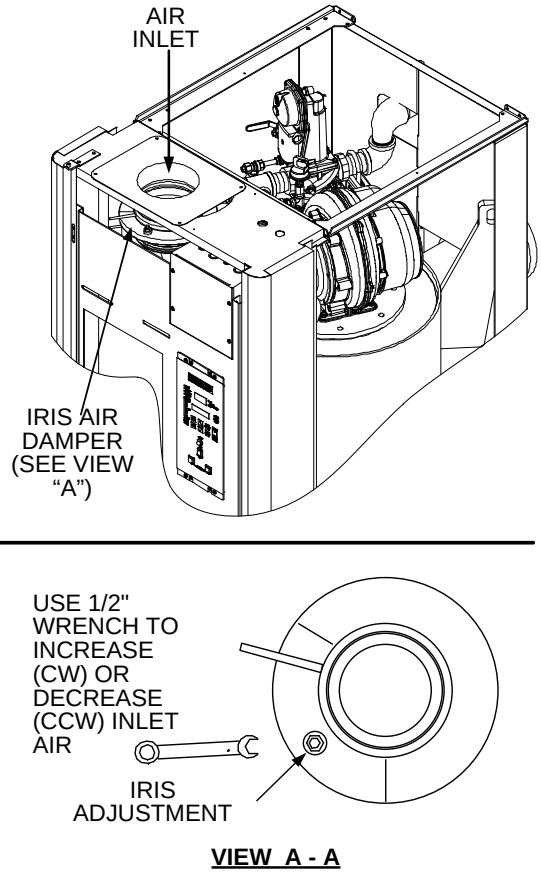


Figure 4-5: Iris Air Damper Location/Adjustment

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 air/fuel 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.

16. 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.
17. Press the **MENU** key on the front panel of the C-MORE until *Combustion Cal Menu* appears on the C-More display.
18. Press the ▲ arrow key until *SET Valve Position* appears on the C-MORE display.
19. Press the **CHANGE** key. *SET Valve Position* will begin to flash.
20. Press the ▲ arrow key until the *SET Valve Position* reads *80%*. Press the **ENTER** key.
21. Next, press the down (▼) arrow key until *CAL Voltage 80%* is displayed.
22. Press the **CHANGE** key and observe that *CAL Voltage 80%* is flashing.
23. The oxygen level at the 80% valve position should be as shown below. Also, ensure that the carbon monoxide (CO) and nitrogen oxide (NOx) readings do not exceed the values shown.

Table 4-2: Combustion Oxygen Levels for a 80% Air/Fuel Valve Position

Oxygen % ± 0.2	Carbon Monoxide	NOx
5.2 %	<100 ppm	<30 ppm

24. 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.
25. 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.

NOTE

The remaining steps basically repeat the procedures in steps 18 through 25 for valve positions of 60%, 45%, 30% and 18%. However, since oxygen levels vary, these steps are repeated in their entirety. When performing these steps, also ensure that the carbon monoxide (CO) and nitrogen oxide (NOx) readings do not exceed the values shown for each valve position.

26. Press the ▲ arrow key until *SET Valve Position* appears on the C-MORE display.
27. Press the **CHANGE** key. *SET Valve Position* will begin to flash.
28. Press the ▼ arrow key until the *SET Valve Position* reads *60%* and press the **ENTER** key.
29. Press the down ▼ arrow key until *CAL Voltage 60%* is displayed.
30. Press the **CHANGE** key. *CAL Voltage 60%* will begin to flash.
31. The oxygen level at the 60% valve position should be as shown below. Also, ensure that the carbon monoxide (CO) and nitrogen oxide (NOx) readings do not exceed the values shown.

Table 4-3: Combustion Oxygen Levels for a 60% Air/Fuel Valve Position

Oxygen % ± 0.2	Carbon Monoxide	NOx
5.7 %	<50 ppm	<30 ppm

32. 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 ▼ arrow key decreases the oxygen level.
33. Once the oxygen level is within the specified range at 60%, press the **ENTER** key to store the selected blower output voltage for the 60% valve position.
34. Press the ▲ arrow key until *SET Valve Position* appears on the C-MORE display.
35. Press the **CHANGE** key. *SET Valve Position* will begin to flash.
36. Press the ▼ arrow key until the *SET Valve Position* reads *45%*, then press the **ENTER** key.
37. Press the ▼ arrow key until *CAL Voltage 45%* is displayed.
38. Press the **CHANGE** key. *CAL Voltage 45%* will begin to flash.
39. The oxygen level at the 45% valve position should be as shown below. Also, ensure that the carbon monoxide (CO) and nitrogen oxide (NOx) readings do not exceed the values shown.

Table 4-4: Combustion Oxygen Levels for a 45% Air/Fuel Valve Position

Oxygen % ± 0.2	Carbon Monoxide	NOx
7.2 %	<50 ppm	<30 ppm

40. 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 ▼ arrow key decreases the oxygen level.
41. Once the oxygen level is within the specified range at 45%, press the **ENTER** key to store the selected blower output voltage for the 45% valve position.
42. Press the ▲ arrow key until *SET Valve Position* appears on the C-MORE display.
43. Press the **CHANGE** key. *SET Valve Position* will begin to flash.
44. Press the ▼ arrow key until the *SET Valve Position* reads *30%*, then press the **ENTER** key.
45. Press the ▼ arrow key until *CAL Voltage 30%* is displayed.
46. Press the **CHANGE** key. *CAL Voltage 30%* will begin to flash.
47. The oxygen level at the 30% valve position should be as shown in Table 4-5. Also, ensure that the carbon monoxide (CO) and nitrogen oxide (NOx) readings do not exceed the values shown.

Table 4-5: Combustion Oxygen Levels for a 30% Air/Fuel Valve Position

Oxygen % ± 0.2	Carbon Monoxide	NOx
8.0 %	<50 ppm	<30 ppm

48. 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 ▼ arrow key decreases the oxygen level.
49. Once the oxygen level is within the specified range at 30%, press the **ENTER** key to store the selected blower output voltage for the 30% valve position.
50. Press the ▲ arrow key until *SET Valve Position* appears on the C-MORE display.
51. Press the **CHANGE** key. *SET Valve Position* will begin to flash.
52. Press the ▼ arrow key until the *SET Valve Position* reads *16%*, then press the **ENTER** key.
53. Press the ▼ arrow key until *CAL Voltage 18%* is displayed.
54. Press the **CHANGE** key. *CAL Voltage 18%* will begin to flash.
55. The oxygen level at the 18% valve position should be as shown below. Also, ensure that the carbon monoxide (CO) and nitrogen oxide (NOx) readings do not exceed the values shown.

Table 4-6: Combustion Oxygen Levels for a 18% Air/Fuel Valve Position

Oxygen % ± 0.2	Carbon Monoxide	NOx
8.0 %	<50 ppm	<30 ppm

56. 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 ▼ arrow key decreases the oxygen level.
57. Once the oxygen level is within the specified range at 16%, press the ENTER key to store the selected blower output voltage for the 16% valve position.
58. This completes the Natural Gas Combustion Calibration procedure.

IMPORTANT

The unit is shipped from the factory set up for either Natural Gas or Propane as specified by the Style No. on the Sales Order.

4.4 UNIT REASSEMBLY

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

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 vent hole. Replace the NPT plug in the vent hole using a suitable pipe joint compound.
6. Replace the unit's side panels and front door.

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 4-6. 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 4-6 before the boiler can be restarted.

The rotary dial temperature limit switch is manually adjustable from 32ºF - 212ºF (0ºC – 100ºC). 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 4-6 and 4-7 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 paragraph 4.5.1.

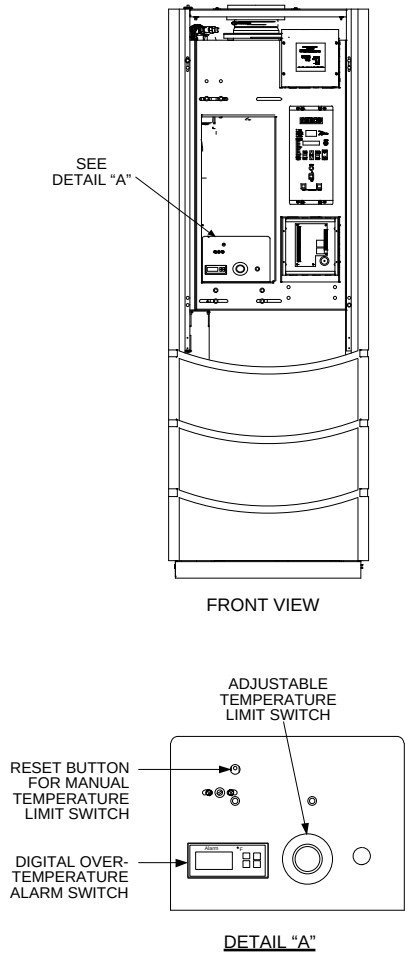


Figure 4-6: Over Temperature Limit Switch Locations

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 in Figure 4-7 and described and Table 4-7.

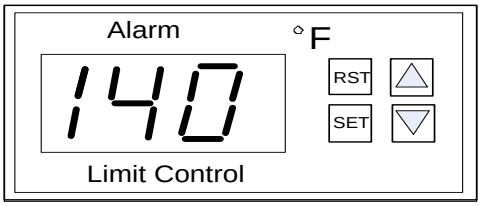


Figure 4-7: Digital Alarm Switch Front Panel

Table 4-7: 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:

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.

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CHAPTER 5. MODE OF OPERATION

5.1 INTRODUCTION

The boiler is capable of being operated in any one of six different modes. The following paragraphs 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 E. 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 SENSOR IN and SENSOR COMMON 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, paragraph 2.10.1 for additional wiring information.

5.2.4 Indoor/ Outdoor Startup

Startup in the Indoor/Outdoor Reset Mode is accomplished as follows:

1. Refer to the Indoor/Outdoor reset ratio charts in Appendix D.

5. Choose the chart corresponding to the desired Building Reference Temperature.
6. Go down the left column of the chart to the coldest design outdoor air temperature expected in your area.

NOTE

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

1. 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.
2. Next, go up that column to the Reset Ratio row to find the corresponding reset ratio.
3. Access the Configuration Menu and scroll through it until the display shows Bldg Ref Temp. (Building Reference Temperature).
4. Press the **CHANGE** key. The display will begin to flash.
5. Use the ▲ and ▼ arrow keys to select the desired Building Reference Temperature.
6. Press **ENTER** to save any changes.
7. Next, scroll through the Configuration Menu until the display shows Reset Ratio.
8. Press the **CHANGE** key. The display will begin to flash.
9. Use the ▲ and ▼ arrow keys to select the Reset Ratio determined in step 5.
10. Press **ENTER** to save the change.

Refer to paragraph 3.3 for detailed instructions on menu changing.

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 paragraph 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 RS485 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. Refer to Appendix D of C-More Manual GF-112, or 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 paragraph 3.3 for detailed instructions on changing menu options.

If the Network setting is selected for RS485 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 RS485 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 PMC 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 paragraph 3.3 for instructions on changing menu options.

If the Network setting is selected for RS485 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 BOILER MANAGEMENT SYSTEM (BMS)

NOTE

BMS Model 168 can utilize either pulse width modulation (PWM) or RS485 Modbus signaling to the Boiler. The BMS II and the ACS (AERCO Control System) can utilize only RS485 signaling to the Boiler.

The BMS mode of operation is used in conjunction with an AERCO Boiler Management System (BMS or BMS II) and the AERCO Control System (ACS). The BMS mode is used when it is desired to operate multiple units in the most efficient manner possible. For this mode of operation, a BMS Header Sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the boiler plant's supply water header. The BMS can control up to 40 boilers; 8 via pulse width modulation (PWM) and up to 32 via Modbus (RS485) network communication. For BMS/BMS II/ACS programming, operation, and Header Sensor installation details, see GF-108M (BMS Model 168), GF-124 (BMS II Model 5R5-384), and GF-131 (ACS) Operations Manuals. For operation via an RS485 Modbus network, refer to Modbus Communication Manual, GF-114.

To enable the BMS Mode, the following menu settings must be made in the Configuration Menu:

MENU OPTION	SETTING
Boiler Mode	Direct Drive
Remote Signal	BMS (PWM Input) or Network (RS485)

Refer to paragraph 3.3 for instructions on changing menu options.

5.6.1 BMS External Field Wiring

Wiring connections for BMS control using PWM signaling are made between connector JP2 on the BMS panel (boilers 1 through 8), and the B.M.S. (PWM) IN terminals in the I/O Box on the front of the boilers. Refer to the wiring diagram provided on the cover of the I/O Box.

Wiring connections for RS485 Modbus control are made between connector JP11 on the BMS (boilers 9 through 40) or JP6 on BMS II/ACS (boilers 1-32) and the RS485 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 B.M.S. (PWM) IN and/or RS485 COMM wiring connections. Shields should be terminated only at the BMS/BMS II/ACS and the boiler end must be left floating. Each unit's wiring must conform to the above.

5.6.2 BMS Setup and Startup

This mode of operation is factory preset and the AERCO BMS/BMS II/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 BMS 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 the BMS and ACS can be utilized for the Combination Mode, but not the BMS II.

A Combination Control System (CCS) is one that uses multiple boilers to cover both space-heating and domestic hot water needs. An AERCO Boiler Management System (BMS) Model 168 and a Combination Control Panel (CCP) or an ACS and an ACS Relay Panel (optional, depending on applications) are necessary to configure this system. Typically, 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.

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 the domestic hot water are capable of switching between constant setpoint and BMS modes of operation. 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.

When the space-heating load is such that all the space-heating boilers are at the 100% valve position, the BMS/ACS will then operate the domestic boilers to become space-heating boilers, provided the domestic hot water load is satisfied. 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 combo units will resume heating water for domestic needs.

When the combo units are satisfying the domestic load they are in constant setpoint mode of operation. When the combo units switch over to space heating, their mode of operation changes to the BMS mode. For more information concerning the operation of the Combination Control Panel see the AERCO CCP-1 literature (BMS 168 applications) and TAG-0050 (ACS).

5.7.1 Combination Control System Field Wiring

Wiring for this system is between the BMS Model 168 panel, the CCP and the B.M.S. (PWM) IN terminals in the I/O Box. For ACS applications, the wiring is between the ACS Panel, the ACS Relay Panel (optional, depending on application), and the RS485 Comm 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. For a complete CCP system wiring diagram, see the AERCO CCP-1 literature (BMS 168 applications) and TAG-0050 (ACS).

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 240°F.

Enter the following settings in the Configuration Menu:

MENU OPTION	SETTINGS	
	BMS 168 Applications	ACS Applications
Boiler Mode	Combination	Combination
Remote Signal	BMS (PWM Input)	Network (RS485)
Internal Setpt	40°F to 240°F	40°F to 240°F

Refer to paragraph 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 E.

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 BMS mode, the AERCO BMS/ACS controls the valve position. There are no setup requirements to the boiler(s) in this mode.

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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 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

Refer to Figure 6-1 and ensure that the leak detection ball valve located at the high gas pressure switch is closed.

1. Remove the 1/4“ plug from the ball valve at the low gas pressure switch shown in the lower portion of Figure 6-1.
2. Install a 0 – 16 “ W.C. manometer or a W.C. gauge where the 1/4" plug was removed.
3. Slowly open the ball valve near the low gas pressure switch.
4. Place the unit in Manual Mode and adjust the air/fuel valve position (% open) between 25 and 30%.
5. While the unit is firing, slowly close the external manual gas shut-off valve.
6. The unit should shut down and display a LOW GAS PRESSURE fault message at approximately 2.6” W.C. The FAULT indicator should also start flashing.

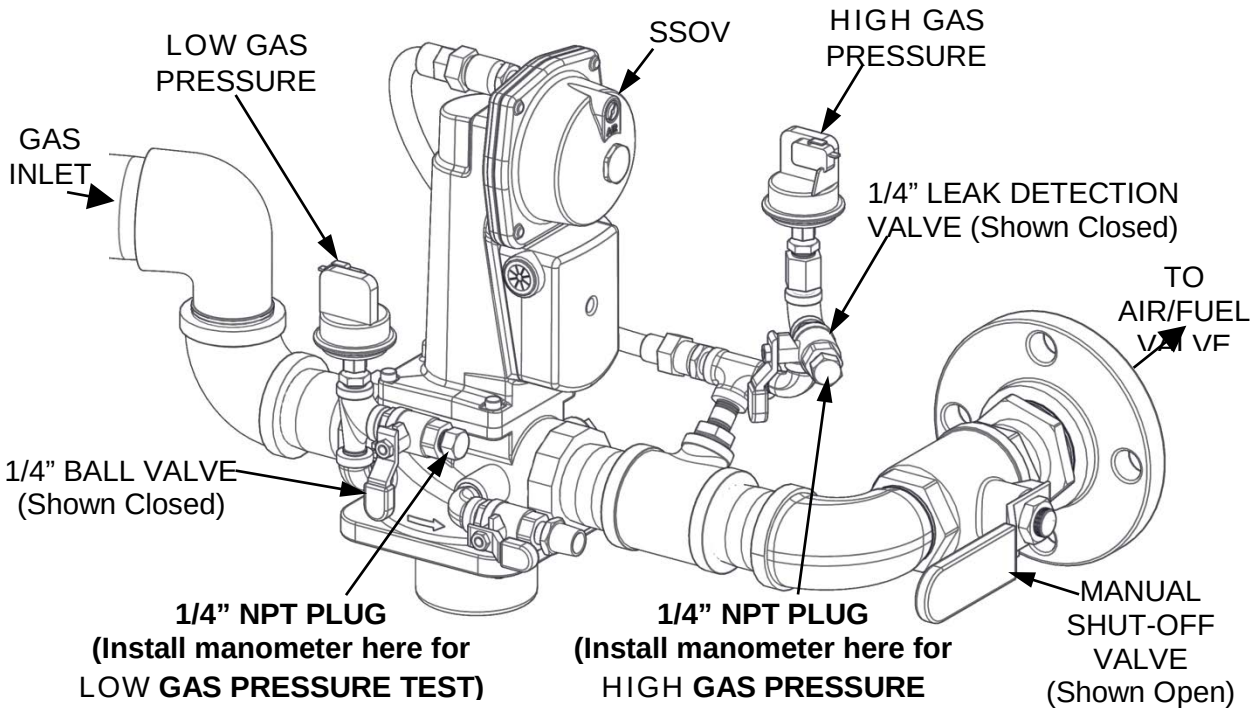


Figure 6-1: Low & High Gas Pressure Testing

7. Fully open the external manual gas shut-off valve and press the CLEAR button on the Control Box.
8. The fault message should clear and the FAULT indicator should go off. The unit should restart.
9. 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 6-1 and proceed as follows:

1. Remove the 1/4" plug from the leak detection ball valve shown in Figure 6-1.
2. Install a 0 – 16" W.C. manometer (or W.C. gauge) where the 1/4" plug was removed.
3. Slowly open the leak detection ball valve
4. Start the unit in Manual mode at a valve position (firing rate) between 25 and 30%.
5. Slowly increase the gas pressure using the adjustment screw on the SSOV (see Figure 4-3).
6. The unit should shut down and display a HIGH GAS PRESSURE fault message when the gas pressure exceeds 4.7" W.C. The FAULT indicator should also start flashing.
7. Reduce the gas pressure back to 3.0" W.C.
8. Press the CLEAR button on the Control Box to clear the fault.

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.

6.4 LOW WATER LEVEL FAULT TEST

To simulate a 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 using the adjustable temperature limit switch. This switch is accessible from the front of the unit as shown in Figure 6-2.

1. Start the unit in the normal operating mode. Allow the unit to stabilize at its setpoint.
2. Lower the adjustable temperature limit switch setting to match the displayed OUTLET TEMPERATURE.
3. Once the adjustable temperature limit 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 temperature limit switch to its original setting.
5. The unit should start once the adjustable temperature limit switch setting is above the actual outlet water temperature.

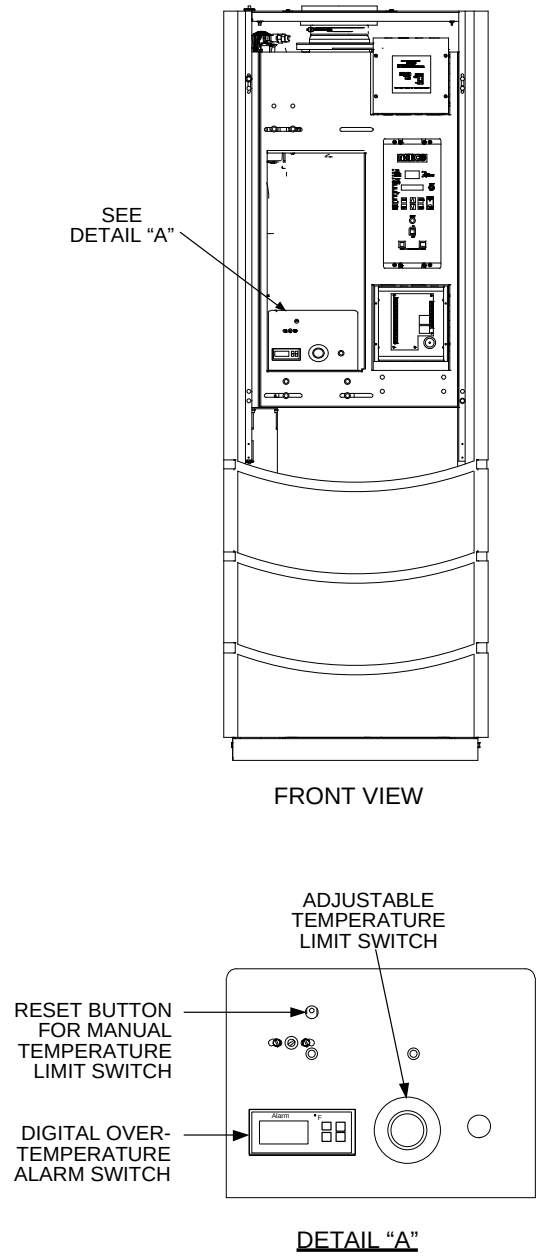


Figure 6-2: Temperature Limit Switch Setting

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 2-9) 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

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

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

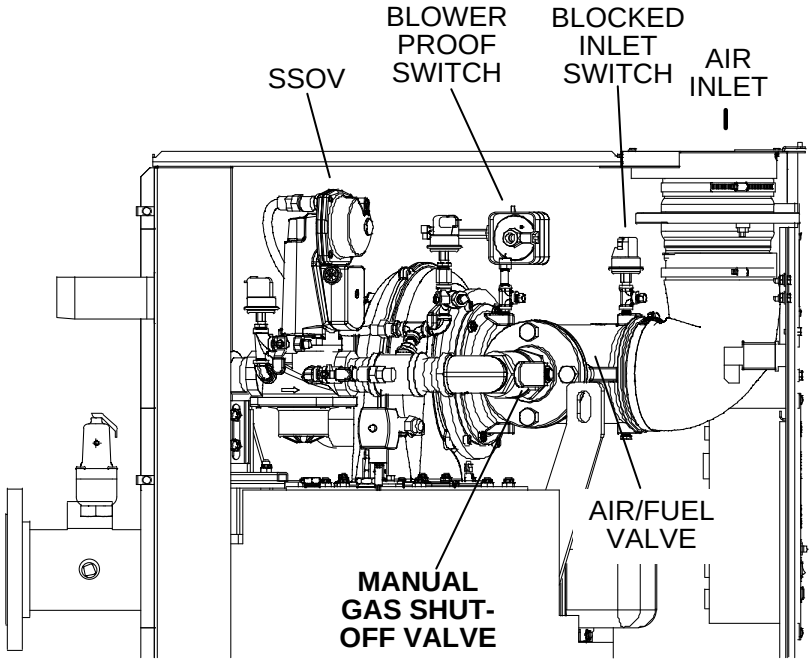
Flame faults can occur during ignition or while the unit is already running. To simulate each of these fault conditions, proceed as follows:

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 shut down after reaching the 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 execute an IGNITION RETRY cycle by performing the following steps:
    a) The unit will execute a shutdown purge cycle for a period of 15 seconds and display *WAIT FAULT PURGE*.

b) The unit will execute a 30 second re-ignition delay and display *WAIT RETRY PAUSE.*

c) The unit will then execute a standard ignition sequence and display *WAIT IGNITION RETRY*.

10. Since the manual gas shutoff valve is still closed, the unit will fail the ignition retry sequence. Therefore, it will shut down and display *FLAME LOSS DURING IGNITION* following the failed ignition retry cycle.
11. Open the valve previously closed in step 8.
12. Press the CLEAR button. The unit should restart and fire.



PARTIAL LEFT SIDE VIEW

Figure 6-3: Manual Gas Shut-Off Valve Location

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.

1. Disable the blower output drive voltage as follows:
   a) Press the MENU key until CONFIGUR-ATION MENU is displayed.
   b) Press the ▲ arrow key until the ANA-LOG 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 execute an IGNITION RETRY cycle by performing the following steps:

a) The unit will execute a 30 second re-ignition delay and display *WAIT RETRY PAUSE.*
b) The unit will then execute a standard ignition sequence and display *WAIT IGNITION RETRY*.

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.
6. Once the unit has proved flame, turn off the blower 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.
9. Press the CLEAR button. The unit should restart.
10. Next, check the Blocked Inlet Switch by first noting the current position of the Iris Air Damper and then closing the Damper to position 8.
11. .The unit should shut down and again display AIRFLOW FAULT DURING RUN.
12. Return the Iris Air Damper to its previous setting.
13. Press the CLEAR button. The unit should restart.

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:

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 6-4. 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 ON 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.

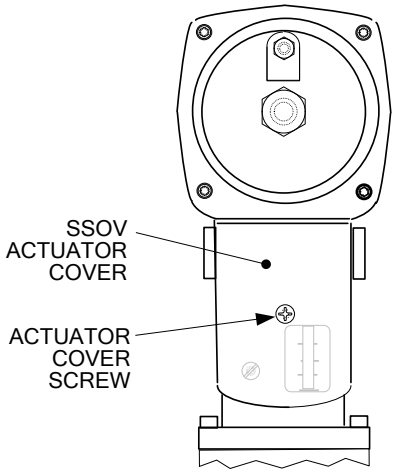


Figure 6-4: SSOV Actuator Cover Location

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:

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 and then lift up (see Figure 6-5).
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 it's 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:

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 6-5) 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 6-6).
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.

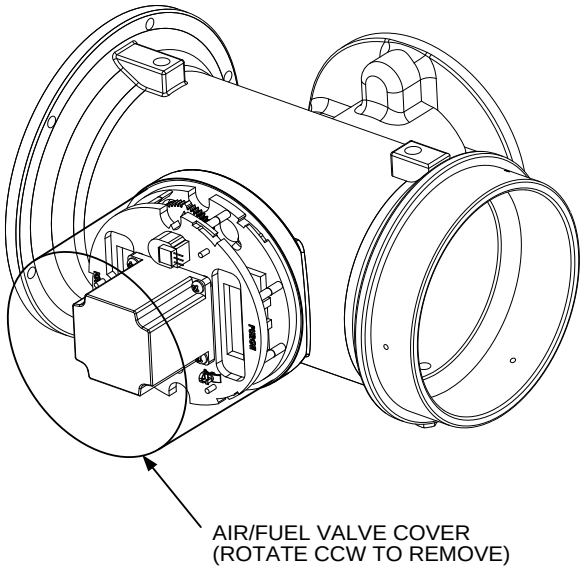


Figure 6-5: Air/Fuel Valve Cover Location

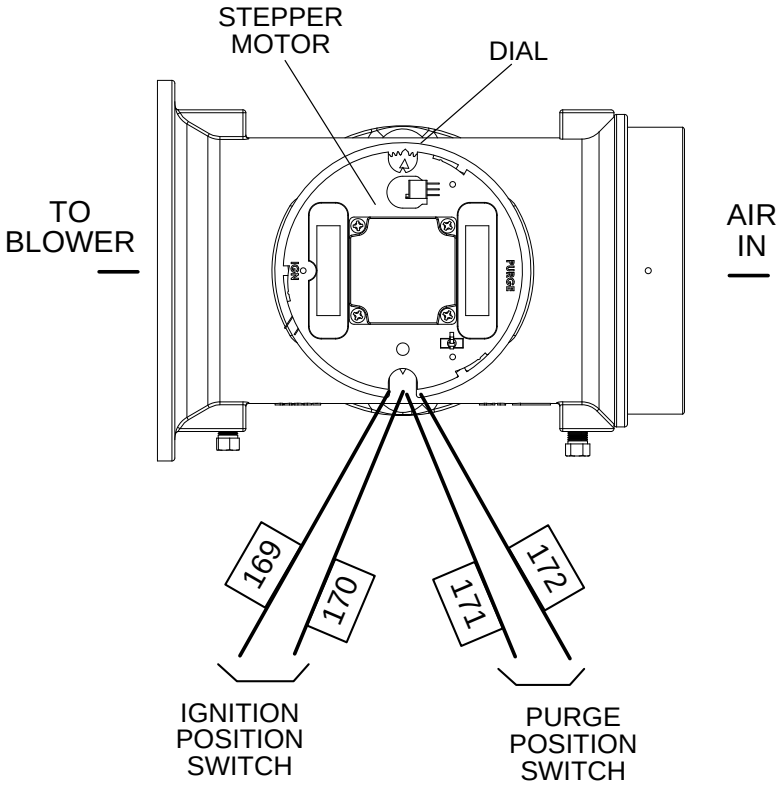


Figure 6-6: Air/Fuel Valve Purge and Ignition Switch Locations

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:

- Annual Maintenance Kits:
  - Staged Ignition (ASCO valve) – Part No. 58025-01
  - AERLite Ignition (Burkert valve) – Part No. 58131-01
- 24-Month Waterside/Fireside Inspection Kit (see NOTE below):
  - Staged Ignition (ASCO valve) – Part No. 58025-06
  - AERLite Ignition (Burkert valve) – Part No. 58131-06

NOTE

The 24-Month Waterside/Fireside Inspection Kit also includes the items contained in the Annual Maintenance Kit. Therefore, only Kit Part No. 58025-06 or 58131-06 is required for the waterside/fireside inspection.

Appendix K contains recommended spare parts lists for maintenance of the boiler.

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	AERLite Igniter (58130)	Replace	Replace	Replace	15 mins.
	Igniter-Injector (58023)	*Inspect	Inspect	Replace	15 mins.
7.3	Flame Detector (24356-1)	*Inspect	Inspect	Replace	15 mins.
7.5	Testing of Safety Devices	-	See CSD-1 Chart	-	20 mins.
7.6	Burner	-	-	Inspect	2 hrs.
7.7	Condensate Drain Trap	*Inspect	Inspect & Clean	-	30 mins.

* *Only performed 6 months after initial startup.*

7.2 IGNITION MAINTENANCE

The igniter (either igniter-injector P/N 58023 or AERLite Igniter P/N 58130) 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 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, flame detector and other related components.

The igniter may be hot, therefore, care should be exercised to avoid burns. It is easier to remove the igniter from the unit after the unit has cooled to room temperature.

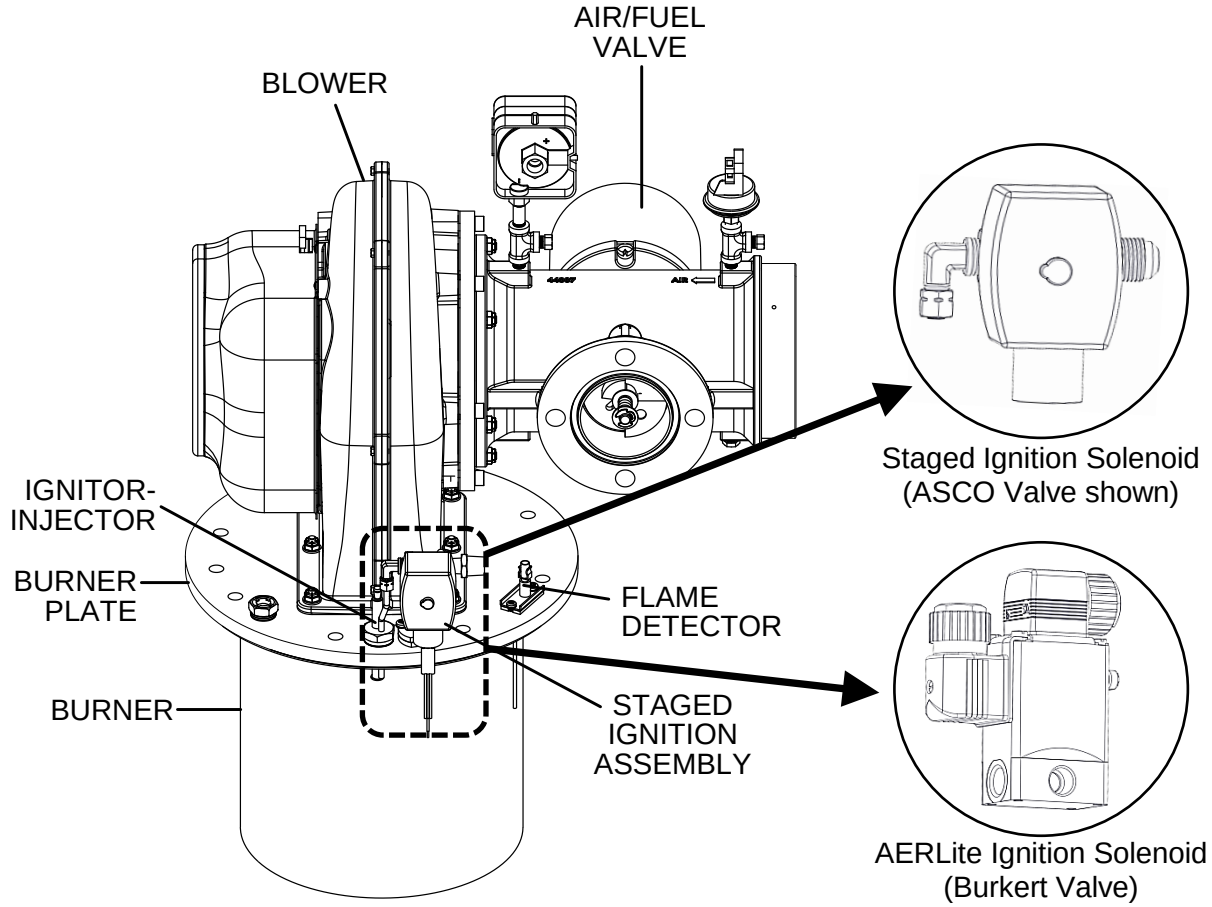


Figure 7-1: Benchmark 2.0LN Burner Assembly (Shown Removed from Boiler)

To inspect/replace the igniter:

1. Set the ON/OFF switch on the control panel, to the **OFF** position. Disconnect AC power from the unit
2. Remove the side and top panels from the unit.
3. Disconnect the cable from the igniter (Figure 7-1).
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 to the elbow of the staged ignition assembly. Disconnect the staged ignition assembly from the igniter.

IMPORTANT

Prior to removing the igniter, note the position of the gas injector tube relative to the burner plate and blower. This is necessary to ensure that the igniter injector is reinstalled in the proper orientation when it is reconnected to the staged ignition assembly.

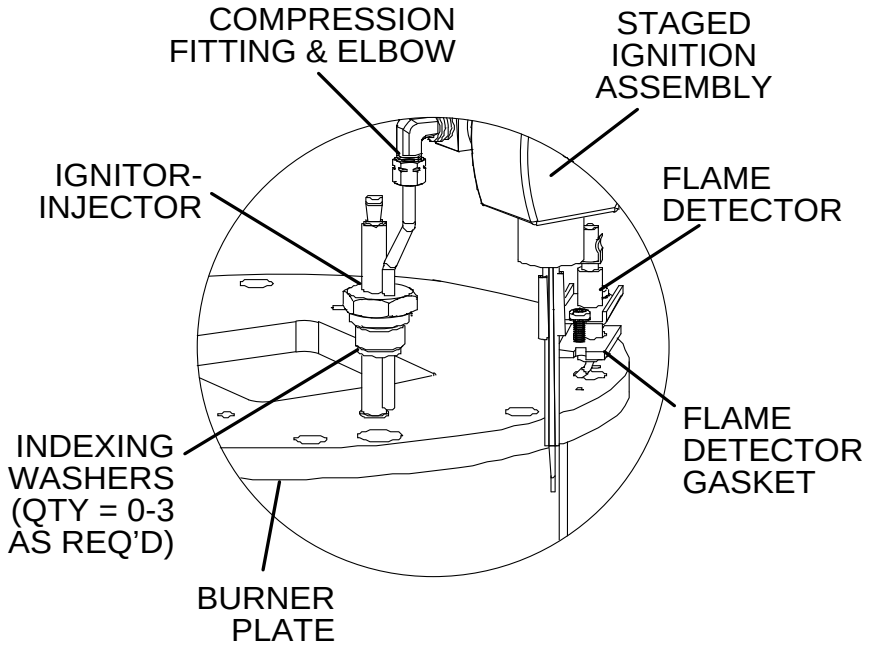


Figure 7-2: Igniter & Flame Detector Mounting Details

5. Next, loosen and remove the igniter from the burner plate using a 1" open-end wrench.
6. Check the igniter for evidence of erosion or carbon build-up. If there is evidence of substantial erosion or carbon build-up, the igniter 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.
7. Prior to reinstalling the igniter, a high temperature, conductive, anti-seize compound must be applied to the threads.

NOTE

If a replacement igniter (igniter-injector P/N 58023 or AERLite Igniter P/N 58130) is being installed, a compression nut containing a built-in ferrule will be included with the replacement part. If needed, three indexing washers are also included These washers may be needed to properly position the gas injector tube of the igniter within the 120° angle range shown in Figure 7-3.

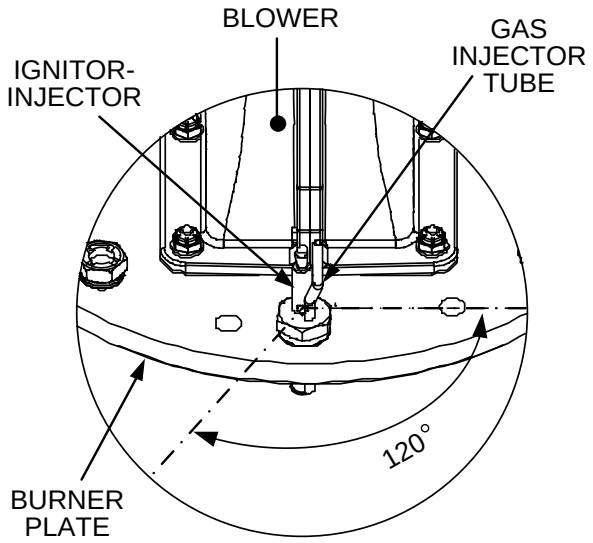


Figure 7-3: Igniter Orientation

8. Reinstall the igniter in the burner plate. Torque to 15 ft-lbs. Do not over tighten.
9. Connect the staged ignition assembly to the gas injector tube of the igniter by securing the compression nut to the elbow of the staged ignition assembly.
10. Reconnect the igniter cable.
11. Reinstall the side and top panels on the unit.

7.3 FLAME DETECTOR

The flame detector (part no. 24356-1) 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.

To inspect or replace the flame detector:

1. Set the ON/OFF switch on the control panel, to the OFF position. Disconnect AC power from the unit.
2. Remove the side and top panels from the unit.
3. Disconnect the flame detector lead wire.
4. Remove the two (2) screws securing the flame detector to the plate (Figure 7-2 on previous page). 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. 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 side and top panels on the unit.

7.4 COMBUSTION CALIBRATION

The Combustion Calibration settings must be checked at the intervals shown in Table 7-1 as part of the maintenance requirements. Refer to Chapter 4 for combustion calibration instructions.

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 (part no. 24176) 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. It should be noted that the complete burner assembly also includes the blower and air/fuel valve in addition to the Benchmark 2.0 Low NOx burner. The following parts will be required for reassembly after burner inspection:

Part No.	Description
81101	Burner Gaskets (2)
81048	Flame Detector Gasket
81068	Blower Gasket

To inspect or replace the burner assembly:

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 side and top panels from the unit.
3. Disconnect the lead wire from the flame detector installed on the burner plate. See Figure 7-4.

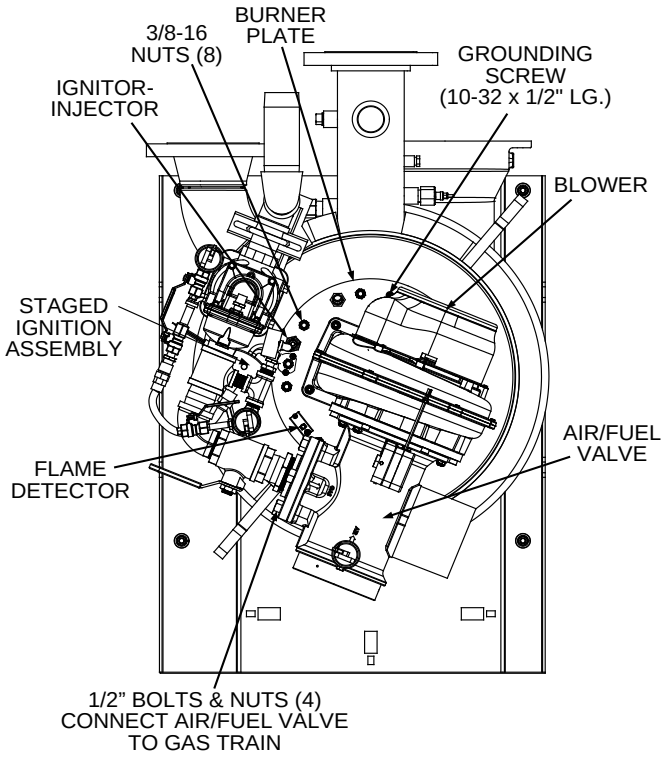


Figure 7-4: Burner Assembly Mounting Details

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.
7. Using a 7/16" open-end wrench, disconnect the compression nut securing the gas injector tube of the igniter to the elbow of the staged ignition assembly (see Figure 7-2). Disconnect the staged ignition assembly from the igniter.

IMPORTANT

Prior to removing the igniter, note the position of the gas injector tube relative to the burner plate and blower. This is necessary to ensure that the igniter injector is reinstalled in the proper orientation when it is reconnected to the staged ignition assembly.

8. Next, loosen and remove the igniter from the burner plate using a 1" open-end wrench.
9. Disconnect the unit wiring harness connectors from the air/fuel valve and blower motor.
10. Disconnect the wire leads connected to the blower proof switch and blocked inlet switch (Figure 7-5).
11. Remove the 10-32 x 1/2" long grounding screw from the burner plate (Figure 7-4).
12. Disconnect the gas train from the air/fuel valve by removing the four (4) 1/2" bolts and nuts (Figure 7-4).
13. Disconnect the inlet air flex hose from the air/fuel valve by loosening the hose clamp.

14. Remove the six (6) 1/4-20 hex nuts and flat washers securing the blower to the burner plate (Figure 7-5).
15. Remove the blower and air/fuel valve from the burner plate by lifting straight up. Also, remove the blower gasket, which will be replaced with a new gasket.
16. Remove the eight (8) 3/8-16 nuts from the burner flange (Figure 7-5) using a 9/16" wrench.

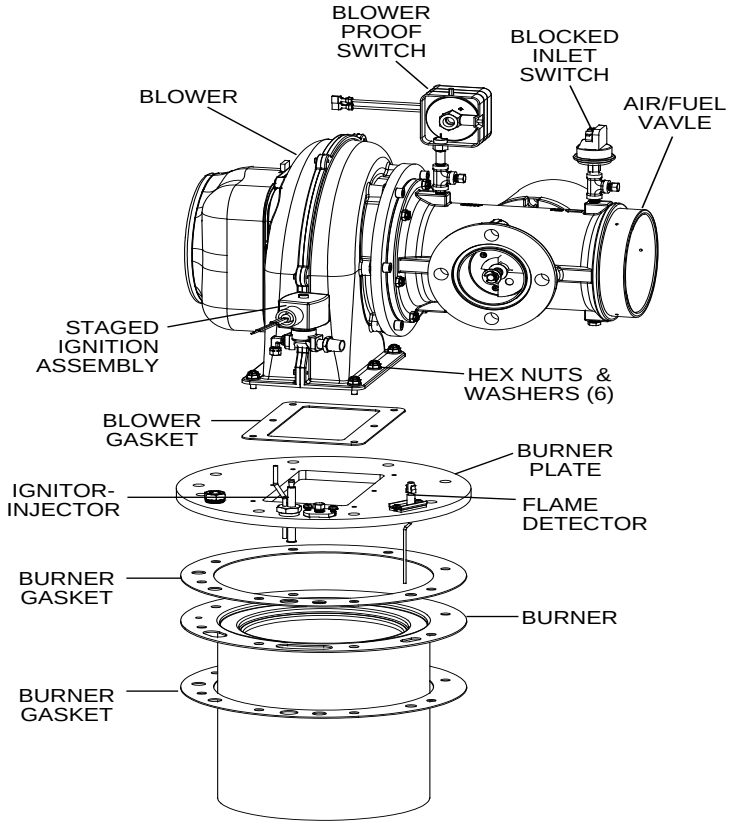


Figure 7-5: Burner Assembly Exploded View

NOTE

The burner assembly is heavy, weighing approximately 30 pounds.

17. Remove the burner assembly from burner flange by pulling straight up.
18. Remove and replace the two (2) burner gaskets.

NOTE

During reassembly, apply high-temperature, anti-seize lubricant to the threads of the igniter and grounding screw. Also, ensure that the igniter is properly positioned as indicated in Figure 7-3. Torque the igniter to 15 ft-lbs.

19. Beginning with the burner assembly removed in step 17, reinstall all the components in the reverse order that they were removed. During re-assembly, replace the gaskets for the blower and flame detector with new ones.

20. Be sure to align the igniter and flame detector tapped holes in the burner plate with the heat exchanger top head.
21. Check to ensure that the grounding screw is installed.

7.7 CONDENSATE DRAIN TRAP

The Benchmark 2.0LN Boiler contains a condensate trap as shown in Chapter 2, Figure 2-5. The trap is located external to the unit and attached to the drain pipe from the exhaust manifold. This trap should be inspected and, if necessary, cleaned to ensure proper operation.

To inspect and clean the trap, proceed as follows:

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. Thoroughly clean the trap and float. Also inspect the drain piping for blockage. If the trap cannot be thoroughly cleaned, replace the trap.
6. After the above items have been inspected and thoroughly cleaned, replace the float in the condensate trap and replace the trap cover.
7. Reassemble all piping and hose connections to the condensate trap inlet and outlet. Reconnect trap to exhaust manifold drain.

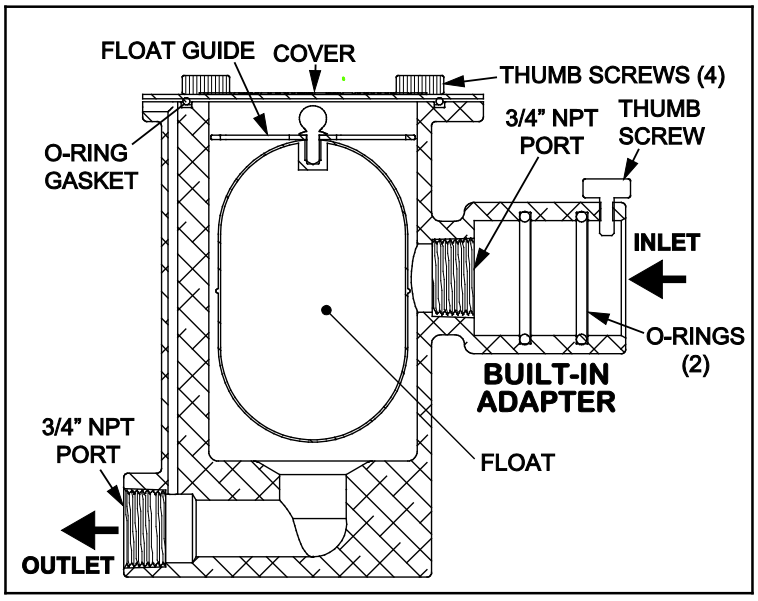


Figure 7-6: External Condensate Trap

7.8 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.

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.

7.9 PLACING THE BOILER BACK IN SERVICE AFTER A PROLONGED SHUTDOWN

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

1. Review installation requirements included in Chapter 2.
2. Inspect all piping and connections to the unit.
3. Inspect exhaust vent, air duct (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.

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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 2.0LN Boiler. 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 RS232 port which can be interfaced to a laptop computer or other suitable device. This RS232 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 RS232 communication set-up and procedures.

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

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. Paragraph 8.2 and Table 8-2 contain additional troubleshooting information which may apply when no fault message is displayed.
7. If the fault cannot be corrected using the information provided in the Troubleshooting Tables, contact your local AERCO Representative.

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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 ductwork	2. Inspect the inlet to the combustion blower including any ductwork leading up to the combustion blower for signs of blockage.
	3. Blocked Blower Proof switch	3. Remove the Blower Proof switch and inspect for signs of blockage, clean or replace as necessary.
	4. Blocked Air inlet switch	4. Remove the Blocked-Air Inlet switch and inspect for signs of blockage, clean or replace as necessary.
	5. Defective Blower Proof switch	5. Measure the Blower Proof switch for continuity 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-air inlet switch	6. Measure the blocked-air inlet switch for continuity with the combustion blower running. 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 Motor 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 8.2V 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 select.
	12. Defective Air/Fuel potentiometer	12. Check Air/Fuel Valve position at 0%, 50% and 100% open positions. The positions on the VALVE POSITION bargraph should match the dial readings on the Air/Fuel Valve dial.

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 okay, check the blower.
	2. Defective Air Flow Switch	2. Start the unit. If the blower runs, check the airflow switch for continuity. Replace the switch if there is no continuity.
	3. Blocked Air flow Switch	3. Remove the air flow 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 switch from control box.	5. Measure for 24 VAC during start sequence from each side of the switch to ground. If 24VAC is not present refer to qualified service personnel.
	6. **PROBABLE CAUSES** from 3 to 12 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
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. Blocked airflow switch	3. Remove the airflow switch and inspect for signs of blockage, clean or replace as necessary.
	4. Defective airflow switch	4. Measure the airflow switch for continuity with the combustion blower running. If there is an erratic resistance reading or the resistance reading is greater than zero ohms, replace the 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 16 for AIRFLOW FAULT DURING IGNITION.
DELAYED INTERLOCK OPEN	1. Delayed Interlock Jumper not installed or removed.	1. Check for a jumper properly installed across the delayed interlock terminals in the I/O box.
	2. Device proving switch hooked to interlocks is not closed	2. If there are 2 external wires on these terminals, check to see if an end switch for a device such as a pump, louver, etc. is tied these interlocks. Ensure that the device and or its end switch are functional. (jumper may be temporarily installed to test interlock)

TABLE 8-1. BOILER TROUBLESHOOTING (Continued)

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
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 continuity of wiring between source and boiler. 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. Burner Ground Screw not installed or loose. 2. Worn flame detector 3. No spark from Spark Plug 4. Defective Ignition Transformer 5. Defective Ignition/Stepper (IGST) Board 6. Defective SSOV 7. Staged ignition ball valve closed. 8. Staged ignition solenoid valve does not open. 9. Clogged staged ignition piece.	1. Inspect and install/retighten Burner Ground Screw. 2. Remove and inspect the flame detector for signs of wear. Replace if necessary. 3. Close the internal gas valve in the boiler. Install and arc a spark igniter outside the unit. 4. If there is no spark, check for 120VAC at the primary side to the ignition transformer during the ignition cycle. 5. If 120VAC is not present, the IGST Board in the Control Box may be defective. Refer fault to qualified service personnel. 6. 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 valves input terminals. If 120VAC is not present, the IGST board in the Control Box may be defective. Refer fault to qualified service personnel. 7. Open ball valve downstream of the SSOV (see Figure 7-1) 8. When unit goes to ignition, listen to SSOV for a clicking sound to ensure it is opening. 9. Remove and inspect staged ignition piece for blockage.

TABLE 8-1. BOILER TROUBLESHOOTING (Continued)

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
FLAME LOSS DURING IGN (continued)	10. Unstable gas pressure. 11. Carbon or other debris on Burner.	10. Refer to "Gas Pressure Requirements" section of GF-2030: BMK Gas Supply Design Guide. 11. Remove the burner and inspect for any carbon or debris. Clean and reinstall.
FLAME LOSS DURING RUN	1. Worn Flame Detector or cracked ceramic. 2. Defective Regulator. 3. Poor combustion calibration. 4. Debris on burner. 5. Blocked condensate drain.	1. Remove and inspect the Flame Detector for signs of wear or cracked ceramic. Replace if necessary. 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. Check combustion calibration. Adjust as necessary. 4. Remove the burner and inspect for any carbon or debris. Clean and reinstall. 5. Remove blockage in condensate drain.
HEAT DEMAND FAILURE	1. The Heat Demand Relays on the Ignition/ Stepper board failed to activate when commanded. 2. Relay is activated when not in Demand	1. Press CLEAR button and restart the unit. If the fault persists, replace Ignition/Stepper (IGST) Board. 2. Defective relay. Replace IGST Board.
HIGH GAS PRESSURE	1. Incorrect supply gas pressure. 2. Defective gas pressure adjustment in SSOV Actuator. 3. Defective High Gas Pressure Switch 4. Gas pressure snubber not installed.	1. Check to ensure gas pressure at inlet of SSOV is 14" w.c. maximum. 2. If gas supply pressure downstream of SSOV Actuator cannot be lowered, to 2.8" W.C., using the gas pressure adjustment screw (see para. 4.3, step 10), the SSOV Actuator gas pressure adjustment mechanism may be defective. See para. 4.3, Step 10. 3. Remove the leads from the high gas pressure switch and measure continuity across the common and normally closed terminals with the unit not firing. Replace the switch if it does not show continuity. 4. See Figure 8-1. Ensure that the gas pressure snubber is installed at the high gas pressure switch.

TABLE 8-1: BOILER TROUBLESHOOTING (Continued)

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
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. Boiler Management System/AERCO Control System PID or other settings not correctly setup. 7. No interlock to boiler or BMS/ACS to disable boiler(s) in event that system pumps have failed. 8. System flow rate changes are occurring faster than boilers 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 the Appendix. 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. Check the BMS/ACS for changes to PID default values, correct as necessary. 7. If system pump is controlled by Energy Management System other than BMS/ACS or pumps are individually controlled by boiler, check to see if there are flow switches interlocked to the BMS/ACS or boiler. 8. 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 boilers 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 boiler 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 supply gas regulator with the unit firing. Refer to paragraph 2.7.1 to ensure that the gas pressure is correct for the type of fuel and gas train being used. 2. Measure gas pressure at the low gas pressure switch. If it is greater than 2.6" W.C., 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 COMM FAULT	1. Boiler not seeing information from Modbus network	1. 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
PRG SWTCH CLOSED DURING IGNITION (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 the 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.
REMOTE SETPT SIGNAL FAULT	1. Remote setpoint signal not present: Not yet installed. Wrong polarity. Signal defective at source. Broken or loose wiring.	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 boiler.
	2. Signal is not isolated (floating) if 4 to 20 mA.	2. Check signal at source to ensure it is isolated.

TABLE 8-1. BOILER TROUBLESHOOTING (Continued)

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
RESIDUAL FLAME	1. SSOV not fully closed. 2. Defective Flame Detector	1. 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 gas shut-off valve downstream of SSOV. Install a manometer or gauge in a gas test port between the SSOV and the gas shut off valve. If a gas pressure reading is observed replace the SSOV valve and or actuator.2. 2. Replace Flame Detector.
SSOV FAULT DURING PURGE	See SSOV SWITCH OPEN	
SSOV FAULT DURING RUN	1. SSOV switch closed for 15 seconds during run.	1. Replace or adjust microswitch in SSOV actuator. If fault persists, replace actuator.
SSOV RELAY FAILURE	1. SSOV relay failed on 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.
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 wire 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.

TABLE 8-1. BOILER TROUBLESHOOTING (Continued)

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
STEPPER MOTOR FAILURE	1. Air/Fuel Valve out of calibration.	1. Refer to GF-112 and perform Stepper Test (para. 6.3.5) to ensure stepper motor rotates properly between the 0% (fully closed) and 100% (fully open) positions. Verify that the VALVE POSITION bargraph and the dial on the Air/Fuel Valve track each other to indicate proper operation. If operation is not correct, perform the Stepper Feedback Calibration (GF-112, paragraph 6.2.1).
	2. Air/Fuel Valve unplugged.	2. Check that the Air/Fuel Valve is connected to the Control Box.
	3. Loose wiring connection to the stepper motor.	3. Inspect for loose connections between the Air/Fuel motor and the wiring harness.
	4. Defective Air/Fuel Valve stepper motor.	4. Replace stepper motor.
	5. Defective Power Supply Board or fuse	5. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board
	6. Defective IGST 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. Staged Ignition Ball Valve closed. 2. Clogged/damaged Gas Injector (Figure 8-2). 3. Defective Staged Ignition Solenoid (Figure 8-2).	1. Open the 1/4” Ball Valve downstream of the SSOV (Fig. 8-1). 2. Remove and inspect Gas Injector to ensure it is not clogged or damaged. 3. Close the 2” and the 1/4” Ball Valve downstream of the SSOV (Fig. 8-1). 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 8-3. (For IRI 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.

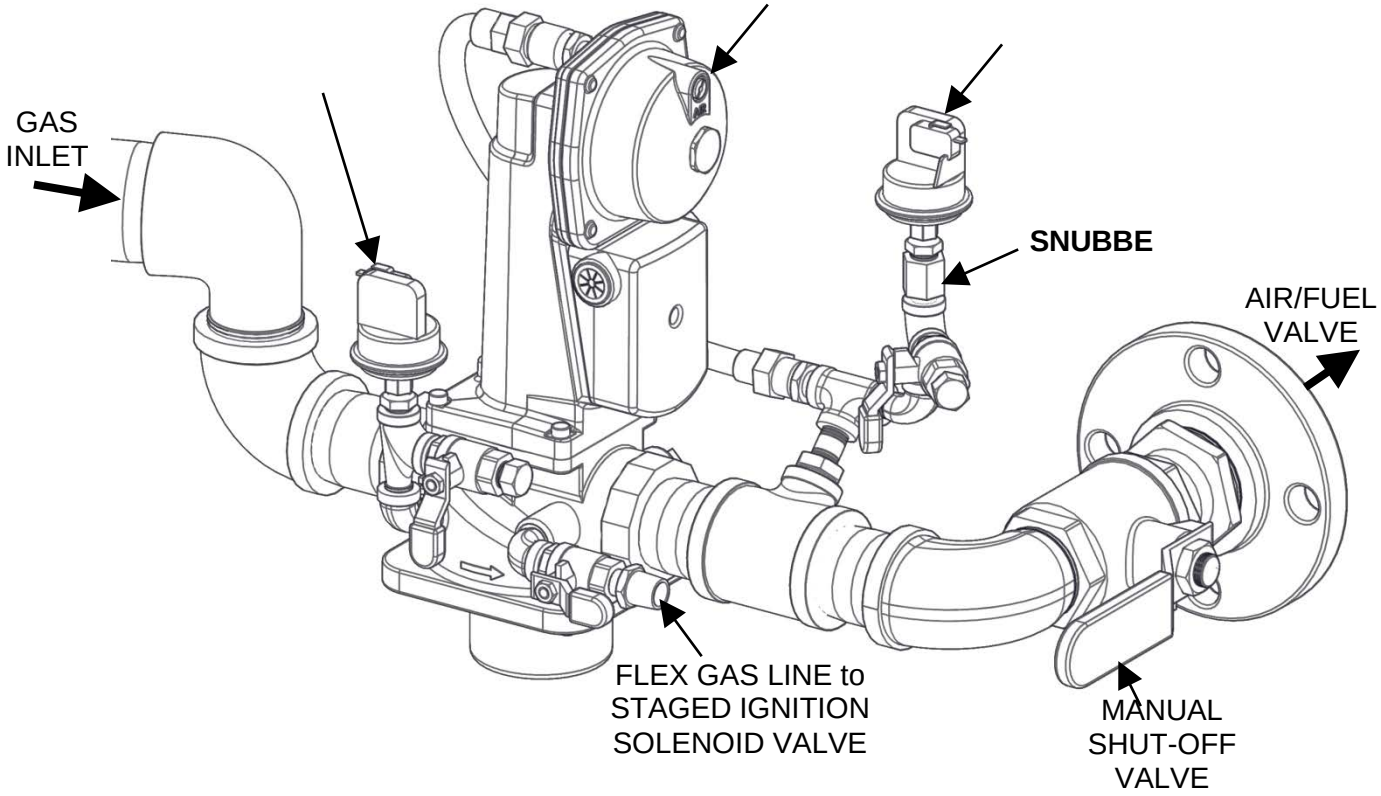


Figure 8-1: High Gas Pressure Switch & Snubber Locations

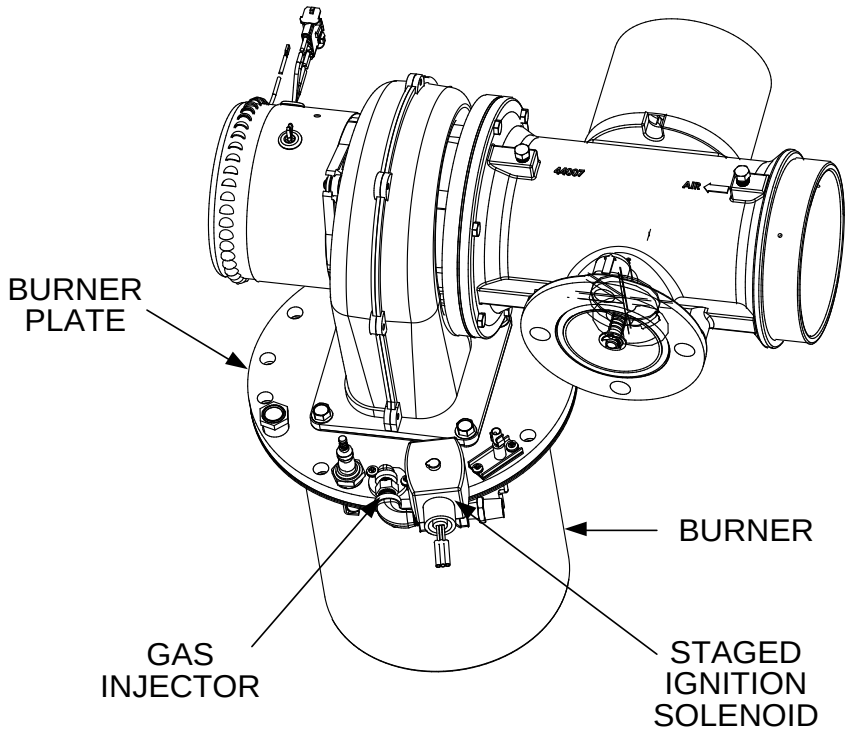


Figure 8-2: Staged Ignition Solenoid Location

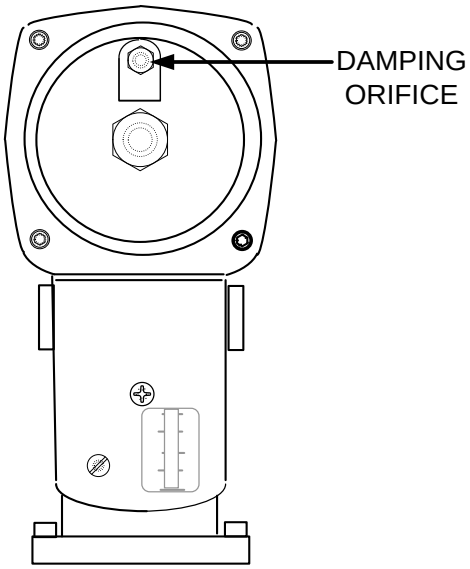


Figure 8-3: Damping Orifice Location

CHAPTER 9. RS232 COMMUNICATION

9.1 INTRODUCTION

The RS232 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.

The RS232 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 RS232 adapter cable. RS232 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 here:

9.1.1 Aquiring 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.

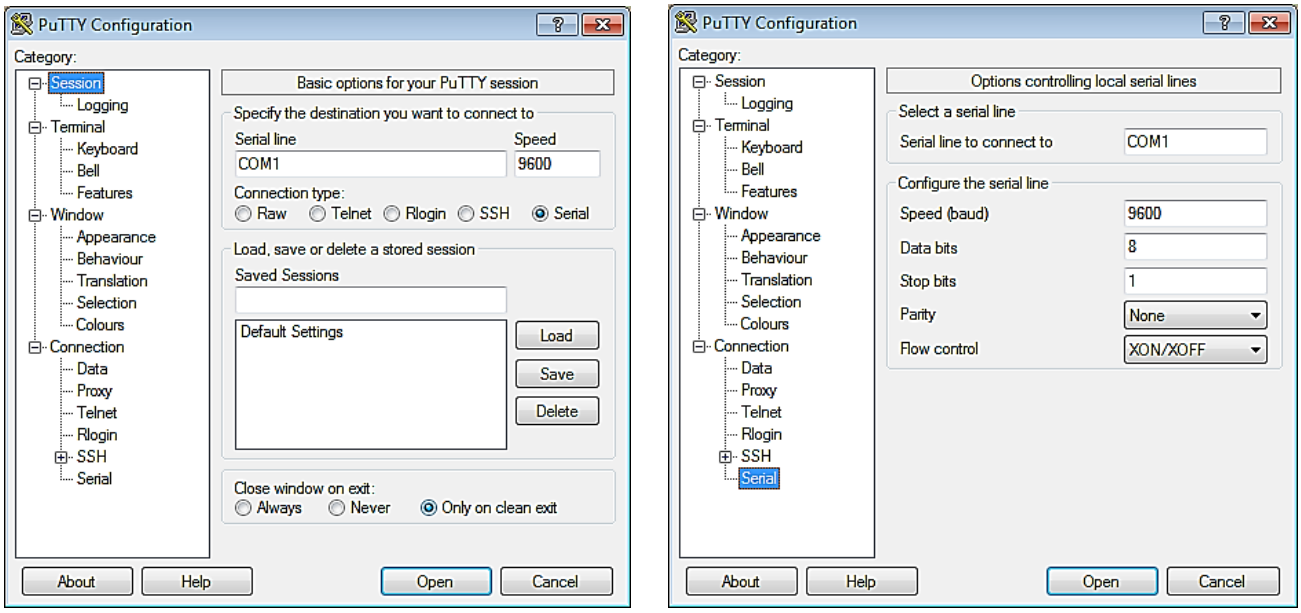


Figure 9-1: PuTTY GUI: Basic Serial Session (L) and Serial Options (R)

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.

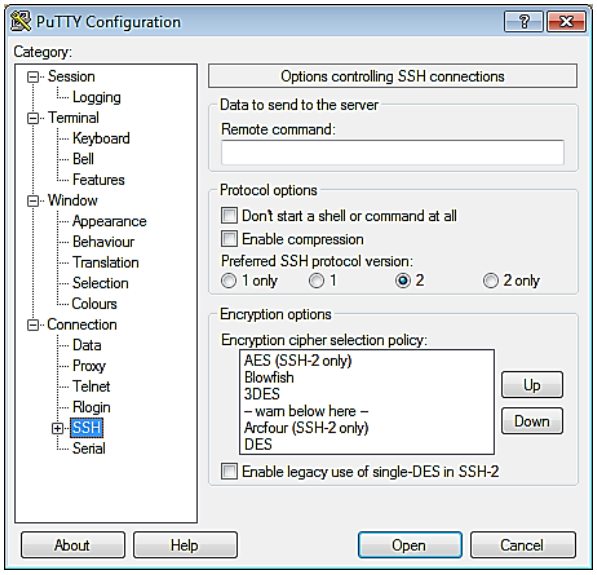
Now, to connect to the remote server, simply click the **Open** button at the bottom of the dialog box. A new terminal window will pop up and ask you to log in.

To avoid having 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:

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:



4. Into the textbox titled, Remote command type the full command line you wish to have executed on the remote machine.
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 RS232 COMMUNICATION SETUP

Regardless of the terminal emulation utilized, the following guidelines must be adhered to when setting up the RS232 communicati on 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 and either Xon/Xoff or No flow control.

9.3 MENU PROCESSING UTILIZING RS232 COMMUNICATION

Viewing data logs and viewing or changing Control Panel menu options using RS232 communication is accomplished as follows:

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 RS232 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

   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.

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:
   a) Enter **C**, followed by the number to the right of the displayed option to be changed, and then press **<Rtn>**.
   b) 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).
   c) 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 paragraph 9.4 for descriptions and samples of these data logs.
11. To log off and terminate the RS232 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 or water heater system. Descriptions of these data logs are provided in the following paragraphs. The basic procedure for accessing each data log is described in paragraph 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 RS232 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.

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 RS232 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.

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 9-1. 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

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

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

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 D.
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	Displayed 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.
Flame Strength	Displays flame strength from 0% to 100%.
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.

MENU LEVEL & OPTION	DESCRIPTION
SETUP MENU	
Password	Allows password to be entered. Once the valid password (159) is entered, options in the Setup, Configuration and Tuning Menus can be modified.
Language	Default language 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 to 2400, 4800, 9600, or 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).

MENU LEVEL & OPTION	DESCRIPTION
CONFIGURATION MENU	
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. Default is BMK Boiler LN.
Unit Size	Sets unit size from 600 MBH to 6000 MBH depending on the selected Unit Type.
Fuel Type	Allows selection of Natural Gas or Propane
Boiler Mode	It allows selection of: Constant Setpoint, Remote Setpoint, Direct Drive, Combination, or Outdoor Reset Mode. Default is Constant Setpoint Mode.
Remote Signal	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	Allows the building reference temperature to be set when operating a boiler in the Outdoor Reset Mode. Default is 70°F.
Reset Ratio	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, 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 195°F). Default is 195°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 195°F.
Max Valve Position	Sets the maximum allowable valve position for the unit (40% to 100%). Default is 100%.

MENU LEVEL & OPTION	DESCRIPTION
CONFIGURATION MENU (Cont.)	
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.
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 2.0LN.
Low 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	Allows Setpoint Limiting to be set to Enabled or Disabled. Default is Disabled.
Setpt Limit Band	When Setpt Limiting is enabled, this menu item allows the Setpt Limit Band to be set from 0ºF to 10ºF. Default is 5ºF.
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.
HI DB Setpt EN	Operating at a Valve Position below this value will inhibit the DEADBAND feature. When operating at a Valve Position below this value, the effective Setpoint is equal to Active Setpoint + DEADBAND HIGH. Setting range is from 0 to 100. (Default is 30)
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)

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)
Spark Monitor	Enables or disables the Spark Monitor function, which displays the AC current on the input of the Ignition Transformer.
Spark Current	Displays the AC current on the input of the Ignition Transformer.

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 2.00. Default is 1.00 for boilers.	
Derivative Time	This value (0.0 to 20.0 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 following 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.	

MENU LEVEL & OPTION	DESCRIPTION
COMBUSTION CAL MENU	
CAL Voltage 18% or Cal Voltage 20%	Allows for the selection of the Blower Motor output voltage at 18% (Natural Gas)
CAL Voltage 30%	Allows for the selection of the Blower Motor output voltage at 30%
CAL Voltage 45%	Allows for the selection of the Blower Motor output voltage at 45%
CAL Voltage 60%	Allows for the selection of the Blower Motor output voltage at 60%
CAL Voltage 80%	Allows for the selection of the Blower Motor output voltage at 80%
CAL Voltage 100%	Allows for the selection of the Blower Motor output voltage at 100%
Set Valve Position	Allows for setting of VALVE POSITION (% Open).
Blower Output	Allows for the monitoring of Blower Output Voltage.
Set Stdby V Out	The Blower Motor remains “ON” in STANDBY Mode. The motor speed is defined by setting this parameter to a value of 0.00 Volts.

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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 High Exhaust Temperature Limit Switch is closed.
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.

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.

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APPENDIX C – SENSOR TEMPERATURE RESISTANCE

TABLE C-1: 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	

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APPENDIX D – INDOOR/OUTDOOR RESET RATIO CHARTS

Table D-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 D-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 D-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 D-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 D-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 D-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 D-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 E – BOILER DEFAULT SETTINGS

Table E-1: 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	2000 MBH (2.0 MBTU)
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%

Table E-1: Boiler Default Settings (Continued)

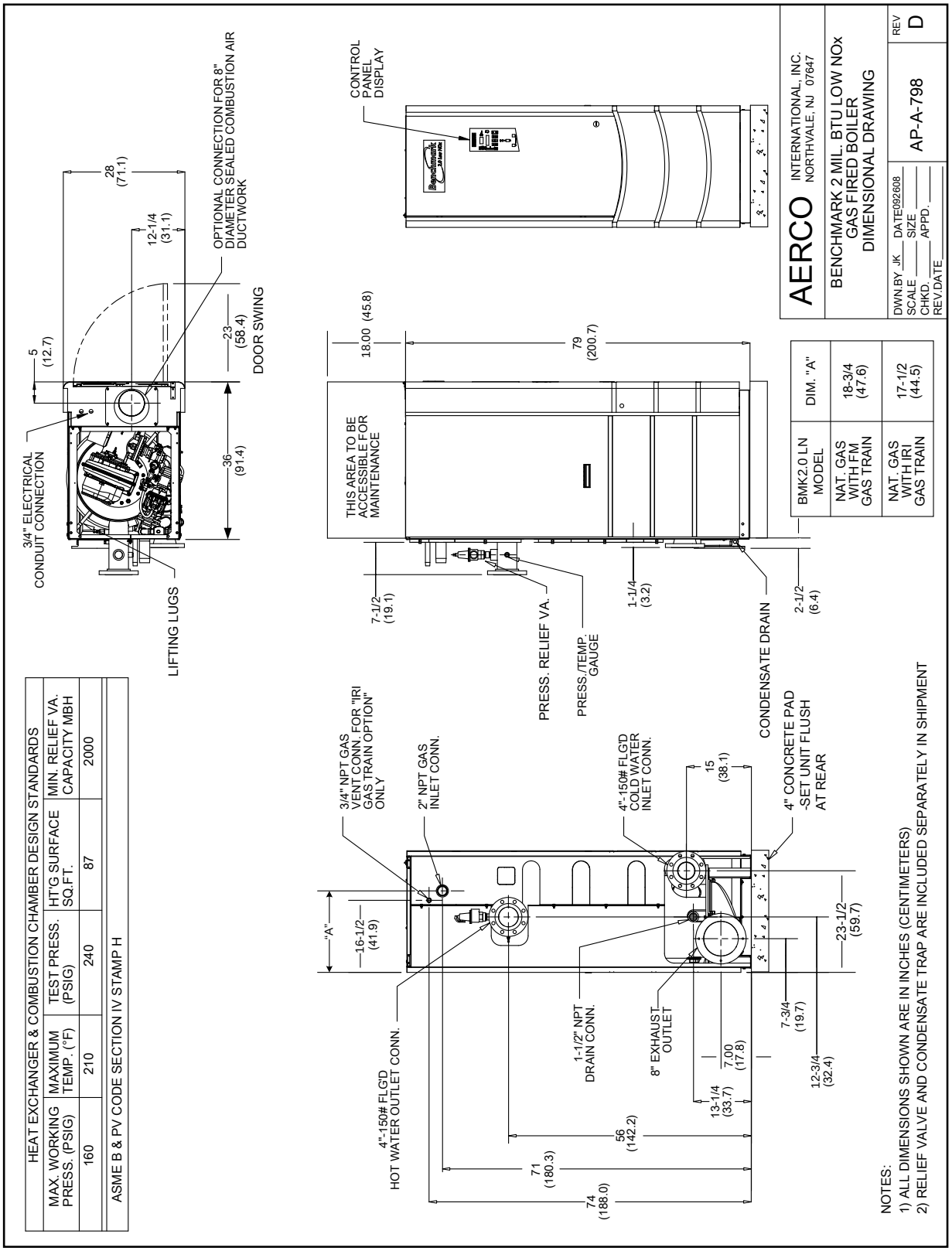
MENU & OPTION	FACTORY DEFAULT
Configuration Menu - Continued	
Pump Delay Timer	0 min
Aux Start On Dly	0 sec
Failsafe Mode	Shutdown
Analog Output	Valve Position 0-10V CAUTION: DO NOT Change
Low Fire Timer	2 sec
Setpt Limiting	Disabled
Setpt Limit Band (If Setpt Limiting = Enabled)	5°F
Network Timeout	30 seconds
Hi DB Setpt En	30
Demand Offset	10
Deadband High	2
Deadband Low	2
Spark Monitor	Disabled
Spark Current	0
Tuning Menu	
Prop Band	70°F
Integral Gain	1.00
Derivative Time	0.00 min
Warmup Prop Band	95
Warmup Int Gain	50
Warmup PID Timer	20
Reset Defaults	No

Table E-1: Boiler Default Settings (Continued)

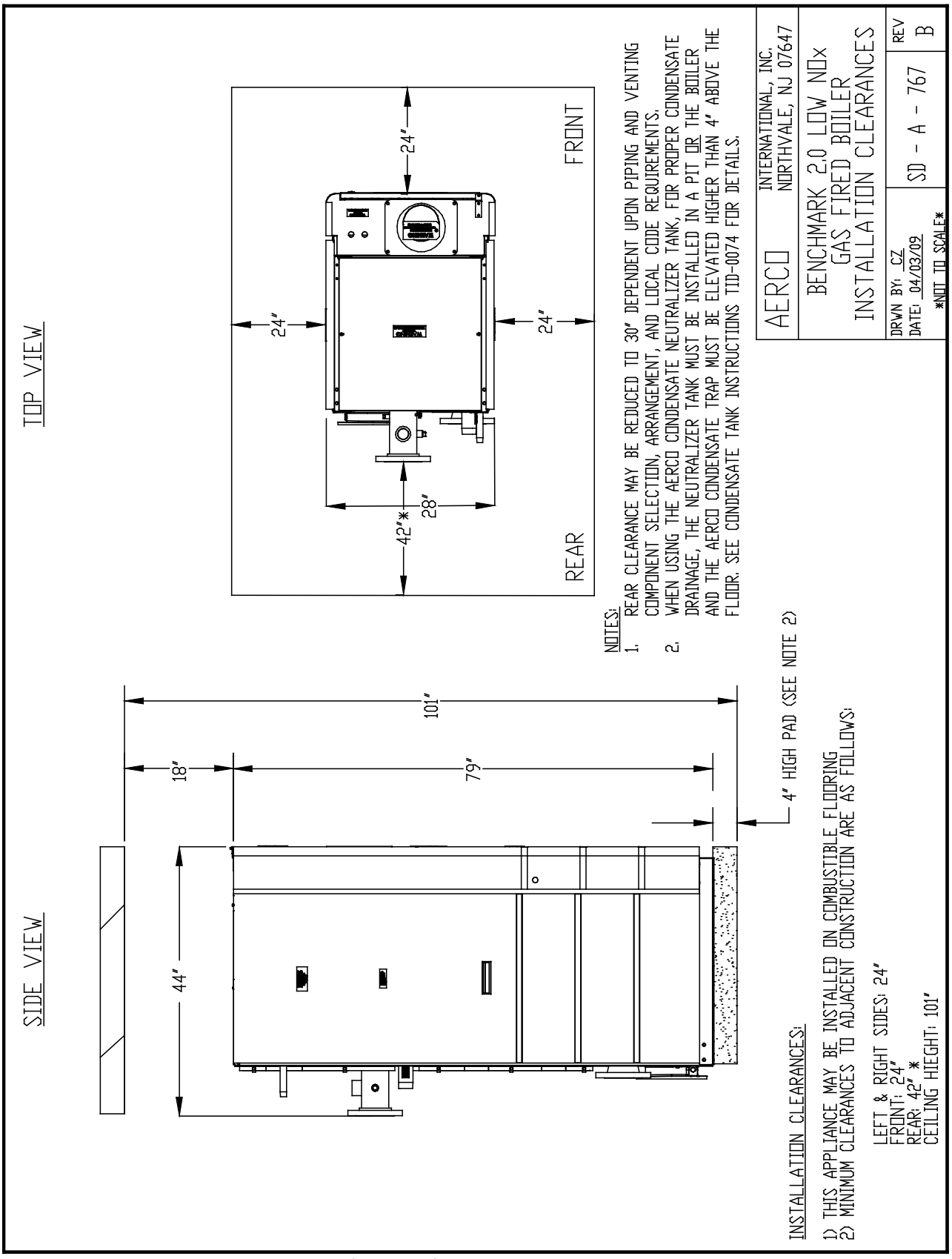
MENU & OPTION	FACTORY DEFAULT
Combustion Cal	
CAL Voltage 18%	1.00v
CAL Voltage 30%	2.30v
CAL Voltage 45%	2.95v
CAL Voltage 60%	3.60v
CAL Voltage 80%	5.30v
CAL Voltage 100%	9.10v
SET Valve Position	0%
Blower Output	.00v

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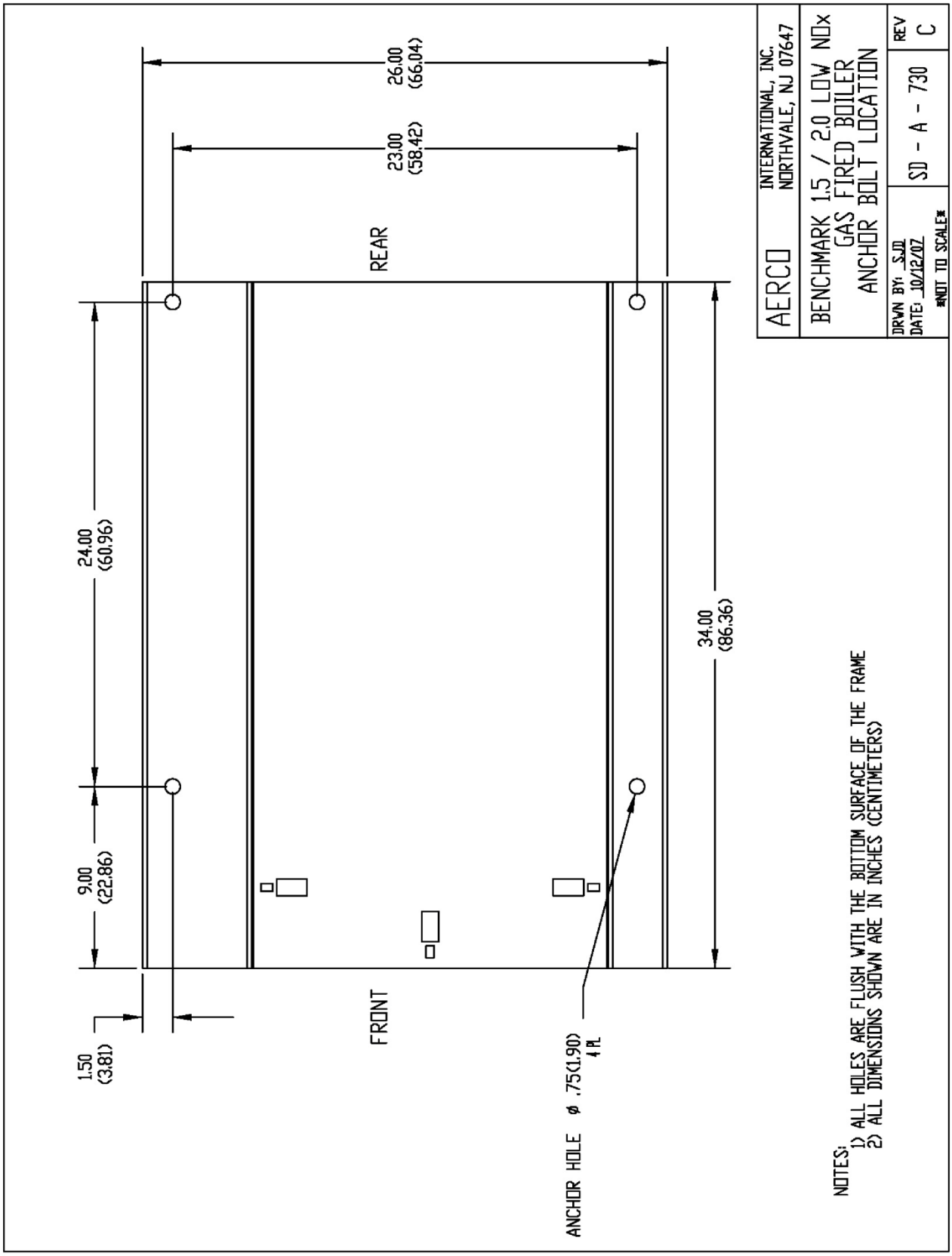
APPENDIX F – PARTS AND DIMENSIONAL DRAWINGS



Drawing Number: AP-A-798 rev D



Drawing Number: SD-A-767 rev B



Drawing Number: SD-A-730 rev C

ITEM NO.	EXPLODED VIEW/QTY.	PART NUMBER	DESCRIPTION
1	1	123542	FLANGE 2" 125# 2"NPT
2	1	124150	VALVE, SSOV 1-1/2" NPT
3	1	12607-8	NIPPLE, 1-1/2" X 2" LG
4	1	93069	BUSHING, REDUCING 1-1/2" TO 2" NPT
5	1	92006-7	VALVE, BALL BRASS 1-1/2" NPT
6	2	94060-2.50	NIPPLE, 1-1/2 NPT X 2.50 LG
7	1	94060-3	NIPPLE, 1-1/2 NPT X 3.00 LG
8	1	64048	ACTUATOR, SSOV W/ REGULATOR
9	1	99015	DAMPING ORIFICE, SSOV
10	3	99014	NIPPLE, HEX 1/4 NPT X 3/8 NPT
11	2	12951-2	BUSHING, CONTROL BOX
12	1	61002-1	PRESSURE SWITCH, 2.6" W.C. FALL N.O.
13	1	61002-12	HIGH GAS PRESSURE SWITCH 4.7" W.C.
14	1	99017	SNUBBER, PRESSURE, 1/4"
15	1	124083	TEE 1/4" NPT, 150#
16	2	123536	BUSHING, REDUCING 1/4 X 1/8 NPT
17	1	124862	RESISTOR ASSY
18	1	161450	HARNESS, WIRING, GAS TRAIN
19	1	93070	TEE, 1-1/2 X 1/2 X 1-1/2
20	1	124151	1/4" NPT SCH. 40 X 1-1/2" LG NIPPLE
21	1	9-43	BUSHING, REDUCING 1/2 X 1/4 NPT
22	2	93035	ELBOW, STREET 1/4 NPT
23	1	93147	ELBOW, STREET 1-1/2" M X 2" F
24	1	94027-24	NIPPLE 2" NPT TBE X 6.00 LG
25	1	9-323	ELBOW, 90 DEGREE 1-1/2"
26	1	93146	STREET ELBOW, 1-1/2" NPT
27	3	92077	1/4" NPT MXF BRASS BALL VALVE
29	4	93290	TEE MXFXF BLACK IRON 1/4" NPT
30	3	9-22	PIPE PLUG, 1/4" NPT, STEEL
31	1	97005-5	TUBE, FLEXIBLE GAS 18"
32	1	124162	NIPPLE, 1/4" NPT X 2" LG
33	1	64083	REGULATOR, GAS 1/4"
34	1	124866	SOLENOID VALVE, 1/4" NPT
35	1	12607-2	CLOSE NIPPLE, 1/4" NPT SCH.40, C.S.

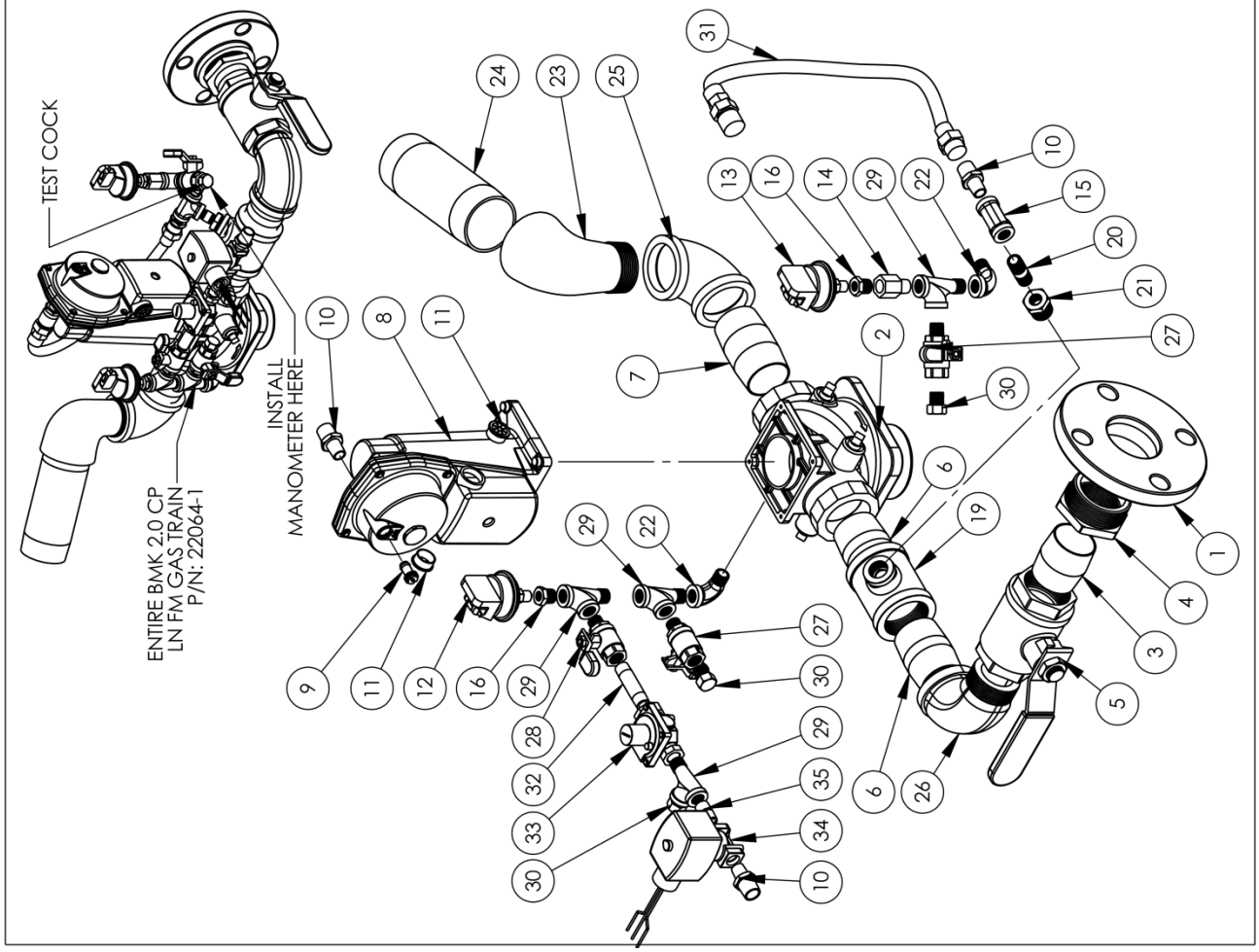
AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647

BENCHMARK 2.0 CP
LOW NOx FM GAS TRAIN

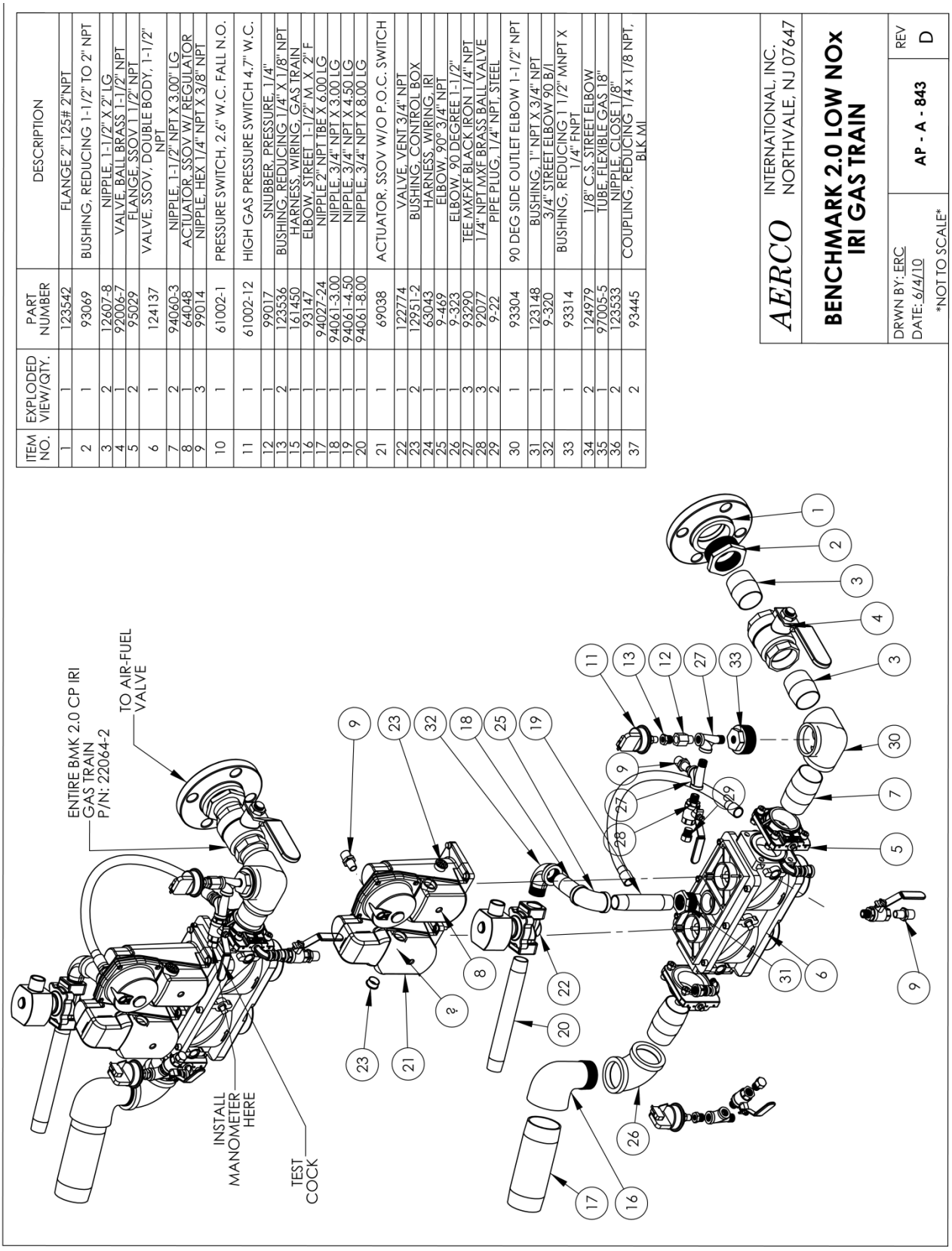
DRWN BY: ERC
DATE: 6/7/11
NOT TO SCALE

AP - A - 842

REV **C**

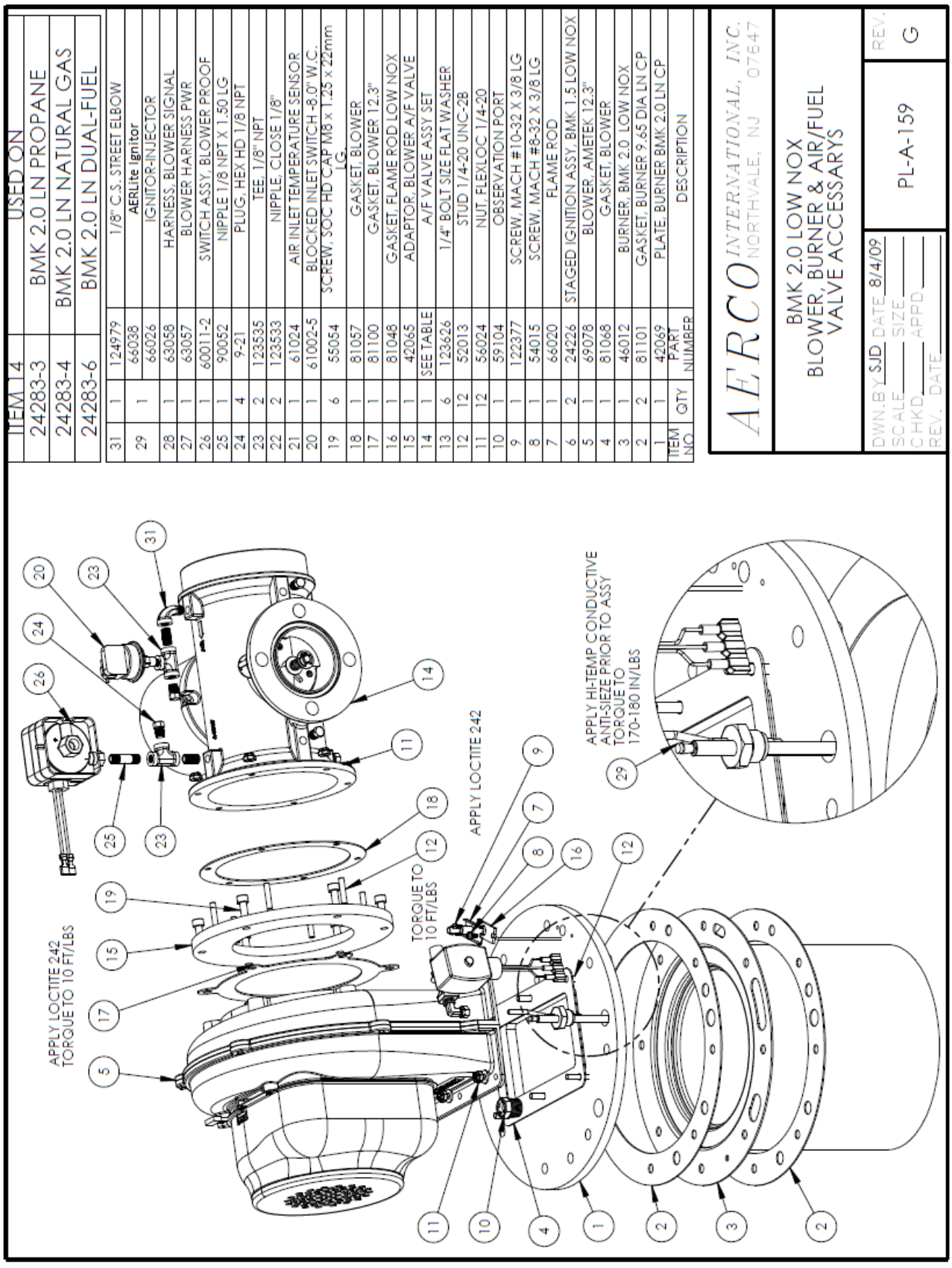


Drawing AP-A-842 rev C



ITEM NO.	EXPLODED VIEW/QTY.	PART NUMBER	DESCRIPTION
1	1	123542	FLANGE 2" 125# 2"NPT
2	1	93069	BUSHING, REDUCING 1-1/2" TO 2" NPT
3	2	12607-8	NIPPLE, 1-1/2" X 2" LG
4	1	92006-7	VALVE, BALL BRASS 1-1/2" NPT
5	2	95029	FLANGE, SSOV 1 1/2" NPT
6	1	124137	VALVE, SSOV, DOUBLE BODY, 1-1/2" NPT
7	2	94060-3	NIPPLE, 1-1/2" NPT X 3.00" LG
8	1	64048	ACTUATOR, SSOV W/ REGULATOR
9	3	99014	NIPPLE, HEX 1/4" NPT X 3/8" NPT
10	1	61002-1	PRESSURE SWITCH, 2.6" W.C. FALL N.O.
11	1	61002-12	HIGH GAS PRESSURE SWITCH 4.7" W.C.
12	1	99017	SNUBBER, PRESSURE, 1/4"
13	2	123536	BUSHING, REDUCING 1/4" X 1/8" NPT
15	1	161450	HARNESS, WIRING, GAS TRAIN
16	1	93147	ELBOW, STREET 1-1/2" M X 2" F
17	1	94027-24	NIPPLE 2" NPT TBE X 6.00 LG
18	1	94061-3.00	NIPPLE, 3/4" NPT X 3.00 LG
19	1	94061-4.50	NIPPLE, 3/4" NPT X 4.50 LG
20	1	94061-8.00	NIPPLE, 3/4" NPT X 8.00 LG
21	1	69038	ACTUATOR, SSOV W/O P.O.C. SWITCH
22	1	122774	VALVE, VENT 3/4" NPT
23	2	12951-2	BUSHING, CONTROL BOX
24	1	63043	HARNESS, WIRING, IRI
25	1	9-469	ELBOW, 90° 3/4" NPT
26	1	9-323	ELBOW, 90 DEGREE 1-1/2"
27	3	93290	TEE MXFXF BLACK IRON 1/4" NPT
28	3	92077	1/4" NPT MXF BRASS BALL VALVE
29	2	9-22	PIPE PLUG, 1/4" NPT, STEEL
30	1	93304	90 DEG SIDE OUTLET ELBOW 1-1/2" NPT
31	1	123148	BUSHING, 1" NPT X 3/4" NPT
32	1	9-320	3/4" STREET ELBOW 90 B/I
33	1	93314	BUSHING, REDUCING 1 1/2" MNPT X 1/4" FNPT
34	2	124979	1/8" C.S. STREET ELBOW
35	1	97005-5	TUBE, FLEXIBLE GAS 18"
36	2	123533	NIPPLE, CLOSE 1/8"
37	2	93445	COUPLING, REDUCING 1/4 x 1/8 NPT, BLK MI

Drawing Number: AP-A-843 rev D



Drawing Number: PL-A-159 rev G

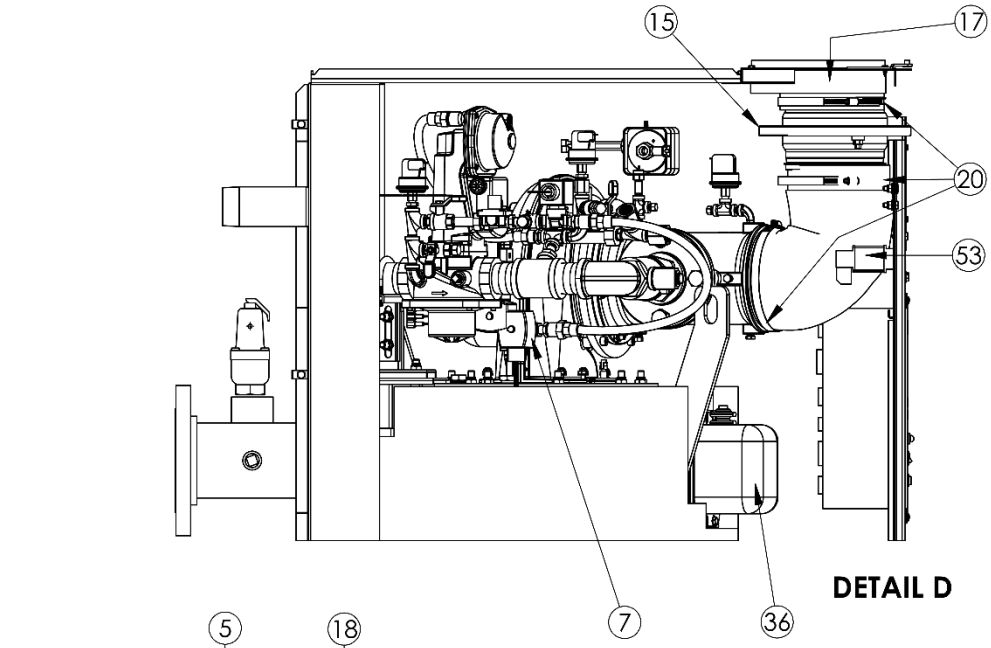
Item #	Qty	Part #	Description
EXHAUST MANIFOLD			
1	1	201283	MANIFOLD: EXHAUST: MACH
2	1	123612	SEAL: EXHAUST MANIFOLD
GAS TRAIN ASSEMBLY			
4 ❸	1	22064-1	STANDARD FM GAS TRAIN
		22064-2	IRI GAS TRAIN ASSEMBLY
		22067	DUEL FUEL FM GAS TRAIN
		22075	DUEL FUEL IRI GAS TRAIN
BLOWER, BURNER & AIR/FUEL VALVE			
5	1	69078	BLOWER: AMETEK 12.3"
6	1	24311-4	A/F VALVE ASSY (NAT. GAS)
		24311-5	A/F VALVE ASSY (PROPANE)
		24311-6	A/F VALVE ASSY (DUAL FUEL)
7	1	24226	STAGED IGNITION ASSY
		24187	DUAL FUEL STAGED IGNITION ASSY
		21022	AERLite IGNITOR ASSY
		21003	AERLite DUAL FUEL IGNITOR ASSY
8	2	81101	GASKET: BURNER 9.65 DIA LN CP
9 ❶	1	46012	BURNER: BMK 2.0 LOW NOX
HEAT EXCHANGER			
10	1	80041	INSULATION-UPPER BMK 2.0 LN CP
11	1	80040	INSULATION-LOWER
		80040-1	DUAL FUEL INSULATION-LOWER
12	1	28071	HEAT EXCHANGER ASSY
BLOWER			
15	1	123815	IRIS: AIR DAMPER
16	1	81068	GASKET: BLOWER
17	1	39071	ADAPTOR: AIR INLET
18	1	39093	CAP: SCREENED 8" AIR INLET
19	1	97004-18	HOSE: FLEXIBLE
20	3	123583	CLAMP: HOSE SAE#96 3.3"-6.5"DIA RANGE
21	1	81057	GASKET: BLOWER
22	1	42065	ADAPTOR: BLOWER A/F VALVE
23	1	81100	GASKET: BLOWER 12.3"
HOSES, GASKETS & INSULATION			
25	1	88003	O-RING #2-339 (A/F VALVE)
26 ❶	1	62005	CORD GRIP

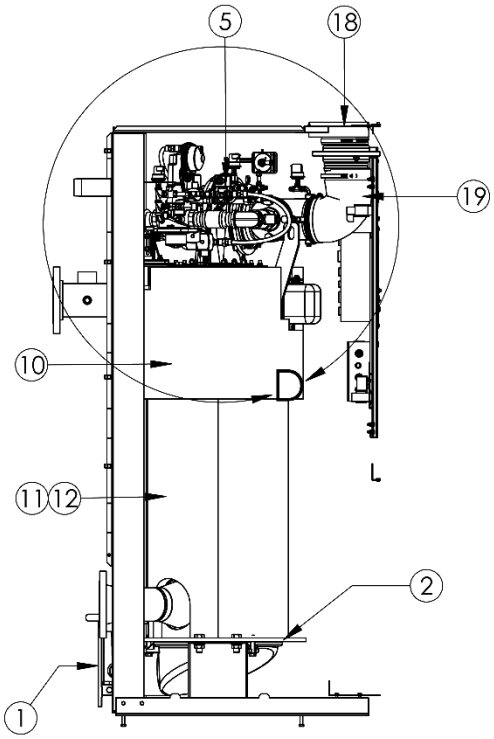
Item #	Qty	Part #	Description
CONTROLS			
30	1	123966	SWITCH: OVER TEMP-AUTO RESET
31	1	123552	SWITCH: OVER TEMP-MANUAL RESET
32	1	61002-5	BLOCKED INLET SWITCH -8.0" W.C.
33	1	60011-2	SWITCH ASSY: BLOWER PROOF
34	1	161560	I/O BOX
35	1	181197	CONTROL BOX: C-MORE
36	1	122464	TRANSFORMER: IGNITION
37	1	33117	BRACKET: OVER TEMP
39 ❶	1	61024	AIR INLET TEMPERATURE SENSOR
41 ❶	1	122569	IGNITION CABLE ASSY
42 ❶	1	63016-1	HARNESS: SHELL BENCHMARK
46	1	64059	POWER WIRING BOX
47 ❶❺	1	161450	HARNESS: WIRING: GAS TRAIN
48	1	69126	LWCO / CAPACITOR ASSY KIT
49 ❶	1	123449	SENSOR: TEMPERATURE
50 ❶	1	161521	THERMOWELL: DUAL AQUASTAT BULB
51 ❻	1	61002-1	LOW GAS PRESSURE SWITCH (non Dual Fuel)
		61002-18	LOW GAS PRESSURE SWITCH, Dual Fuel - Nat Gas
		61002-18	LOW GAS PRESSURE SWITCH, Dual Fuel - Propane
52 ❺❼	1	61002-12	HIGH GAS PRESSURE SWITCH (non Dual Fuel)
		61002-17	HIGH GAS PRESSURE SWITCH, Dual Fuel - Nat Gas
		61002-16	HIGH GAS PRESSURE SWITCH, Dual Fuel - Propane
53	1	65090	REACTOR: DRIVE
OTHER ACCESSORIES / PARTS			
56 ❶❷	1	See ❷	Pressure/Temp. Gauge
57	1	See SD-A-613	PRESSURE RELIEF VALVE
58 ❶❻	1	92006-7	EXT. MANUAL SHUT-OFF VALVE
59 ❶	1	91030	1" DRAIN HOSE, 60" LG
60	1	92006-7	VALVE: BALL BRASS 1-1/2" NPT
61 ❶	1	24060	CONDENSATE TRAP ASSEMBLY

Item #	Qty	Part #	Description
OTHER DUAL FUEL COMPONENTS			
63 ❶❹	1	72031	"PROPANE" LABEL
64 ❶❹	1	72032	"NAT. GAS" LABEL
65 ❶❹❺	1	63032	DOUBLE GAS TRAIN WIRING HARNESS
66 ❹	1	65024-1	FUEL SELECTOR SWITCH
68 ❹	1	72030	FUEL SELECTOR SWITCH LABEL
69 ❶❹	1	63034-1	DUEL FUEL WIRING HARNESS
SHEET METAL / PANEL ASSEMBLY			
71	1	37024	LEFT REAR: PANEL
72	1	37023	RIGHT REAR: PANEL
73	2	49064	TOP RAIL: ENCLOSURE
74	1	201233	PANEL: MOUNTING BMK
75	1	201113	FRONT PANEL
76	1	201120	FRONT DOOR ASSY
77	2	122620	HANDLE: FLUSH PULL SNAP IN
78	1	37019	TOP PANEL
79	2	37002	PANEL: SIDE
80	1	74002	LOGO: BMK 2.0 LOW NOX
OTHER PARTS			
81	1	99017	GAS PRESSURE SNUBBER: PRESSURE: 1/4"

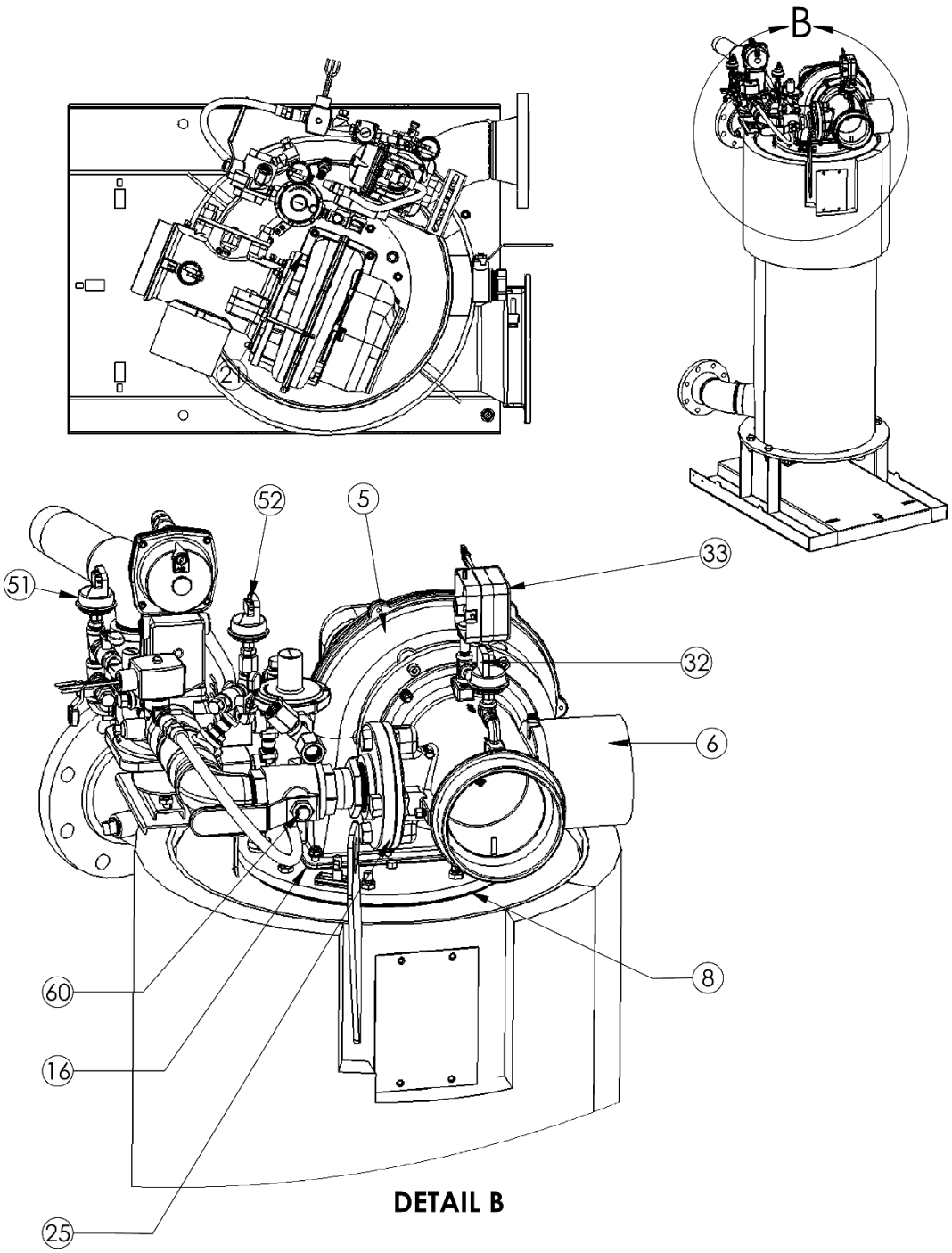
NOTES:

❶	Not shown on drawing
❷	69087-5 – 30 & 50 PSI Relief valve setting 69087-6 – 60, 75, 100 & 125 PSI Relief valve setting 69087-7 – 150 PSI Relief valve setting
❸	For pictorial purposes only, FM Gas Train (not Dual Fuel) is shown
❹	Only needed for Dual Fuel
❺	Part of Gas Train Assembly
❻	Two (2) required for Dual Fuel BMK 2.0 LN
❼	See Drawing AP-A-872 For Dual Fuel details



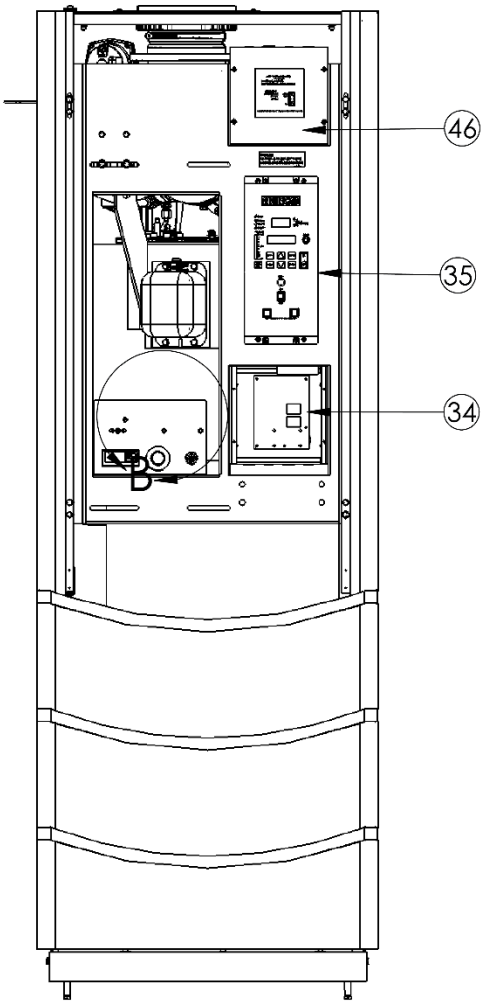


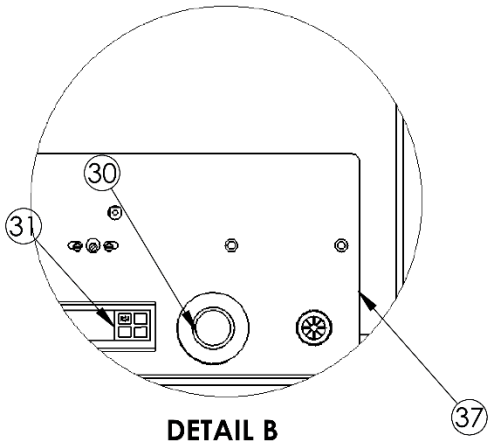
AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 2.0 LN Part List**	07/11/2013
	28073-1 rev G (PL-A-158)	Sheet 3 of 7



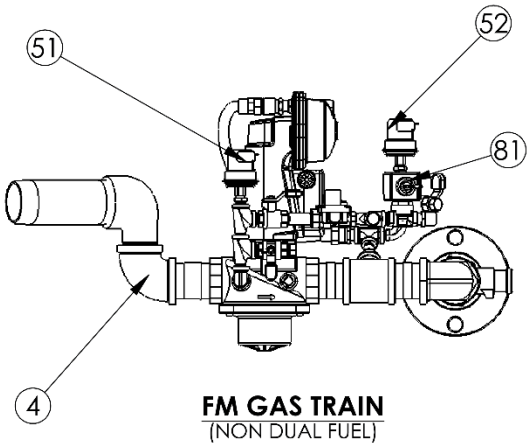
DETAIL B

AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 2.0 LN Part List**	07/11/2013
	28073-1 rev G (PL-A-158)	Sheet 4 of 7

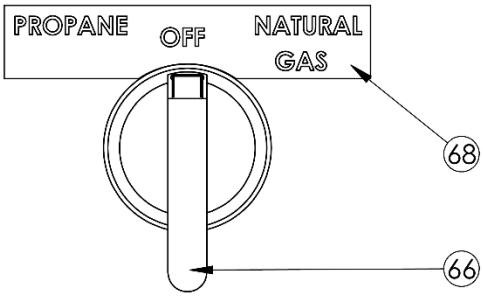


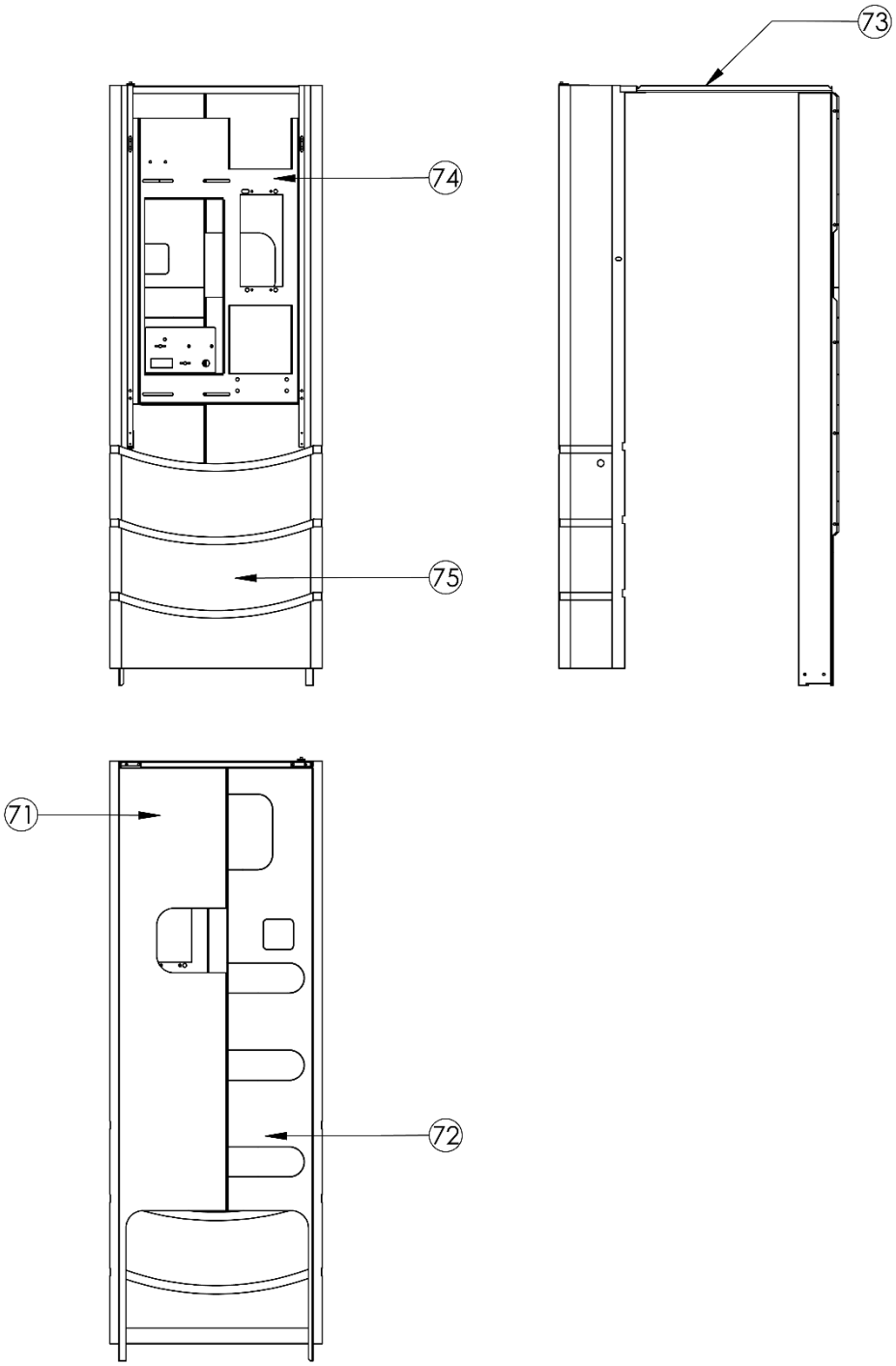


DETAIL B

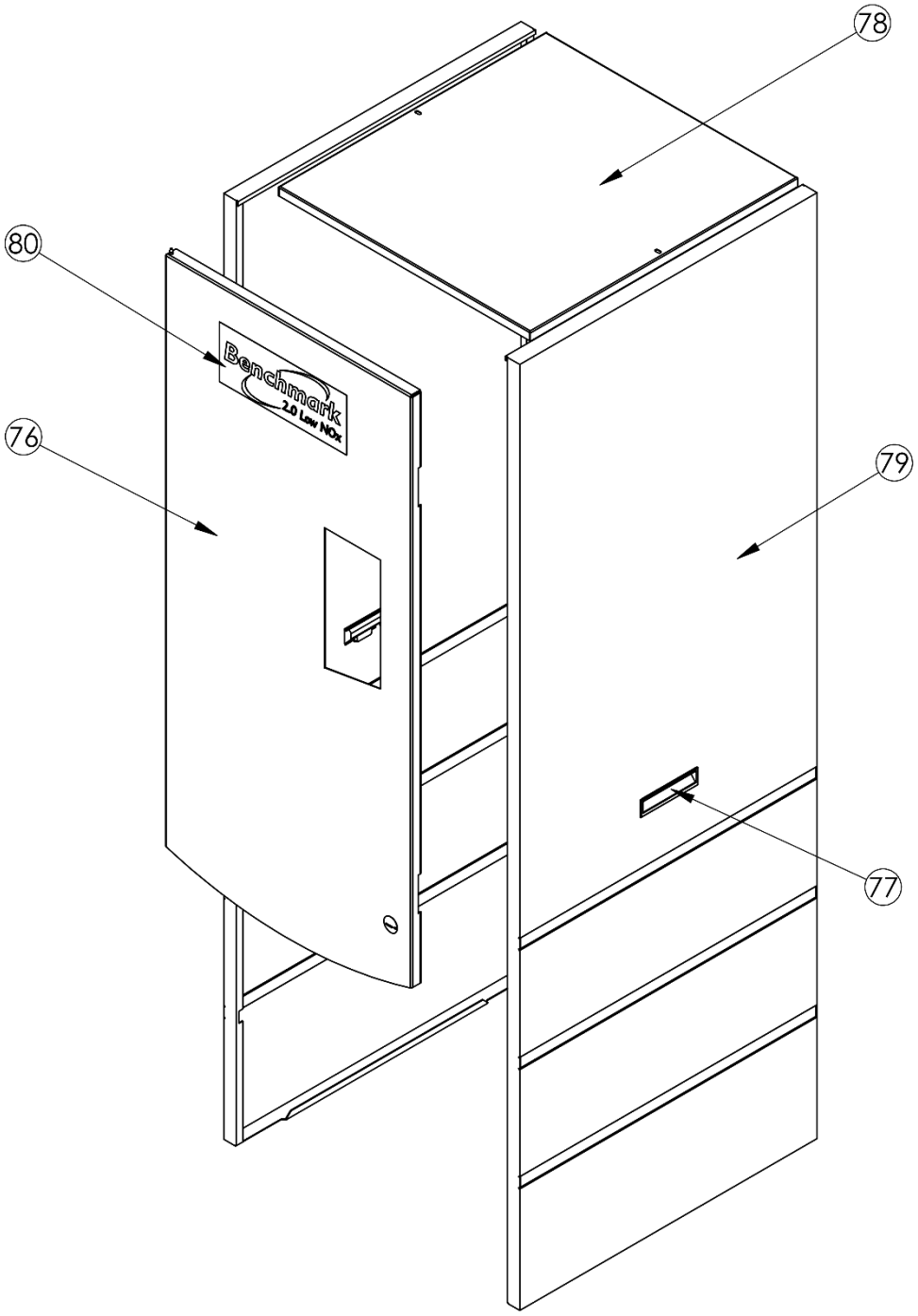


FM GAS TRAIN
(NON DUAL FUEL)





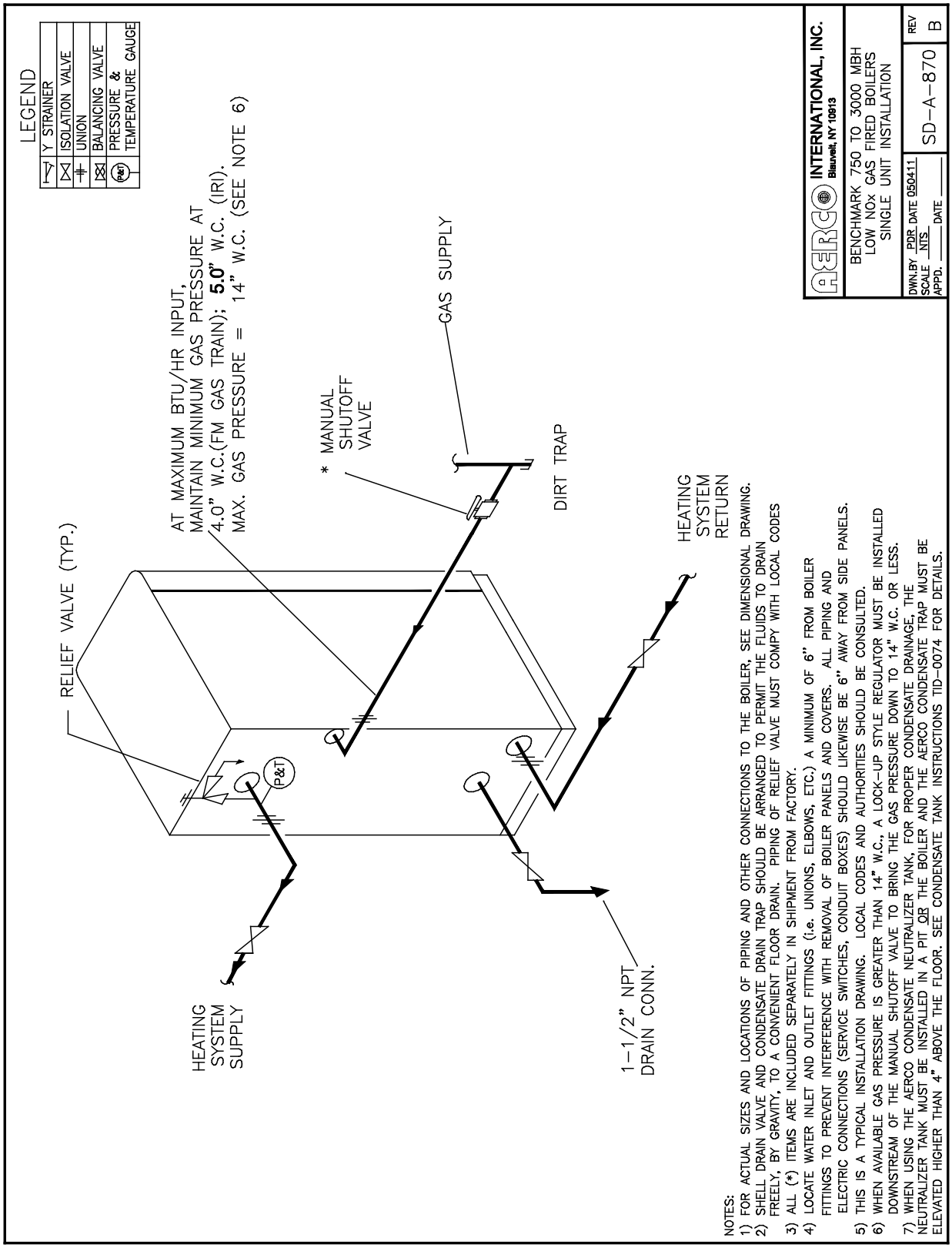
AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 2.0 LN Part List**	07/11/2013
	28073-1 rev G (PL-A-158)	Sheet 6 of 7



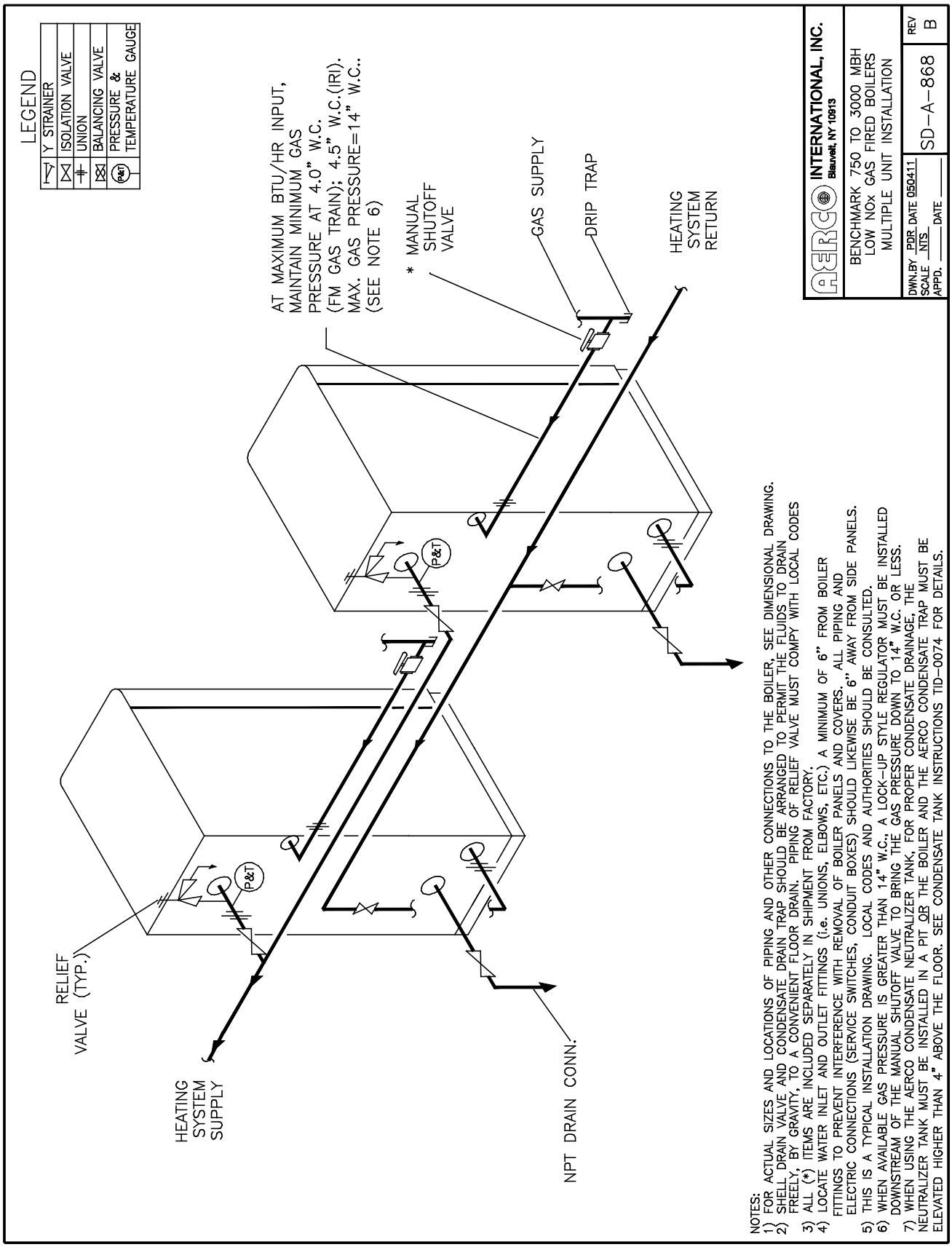
AERCO International, Inc. Blauvelt, NY 10913	**Benchmark 2.0 LN Part List**	07/11/2013
	28073-1 rev G (PL-A-158)	Sheet 7 of 7

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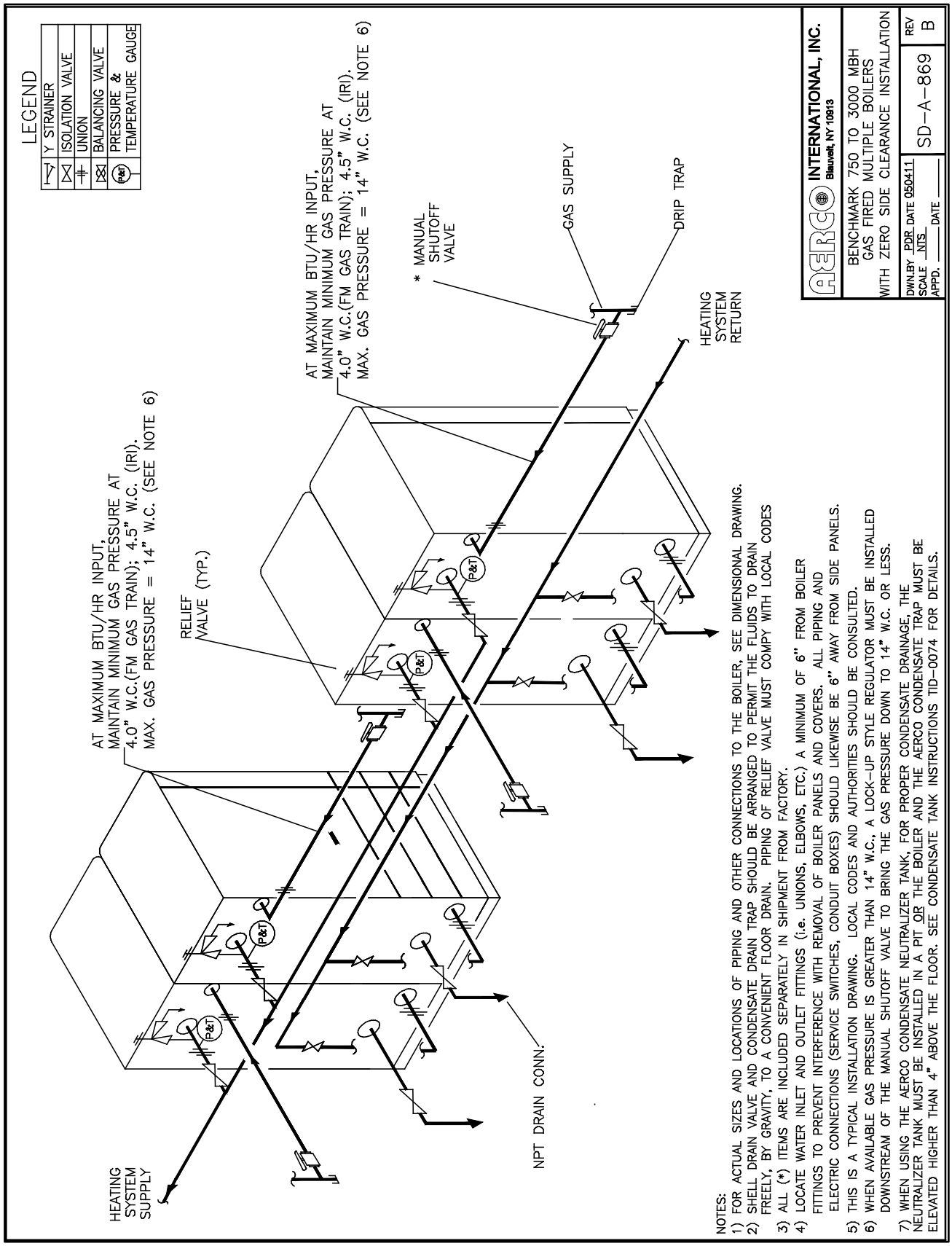
APPENDIX G – PIPING DRAWINGS



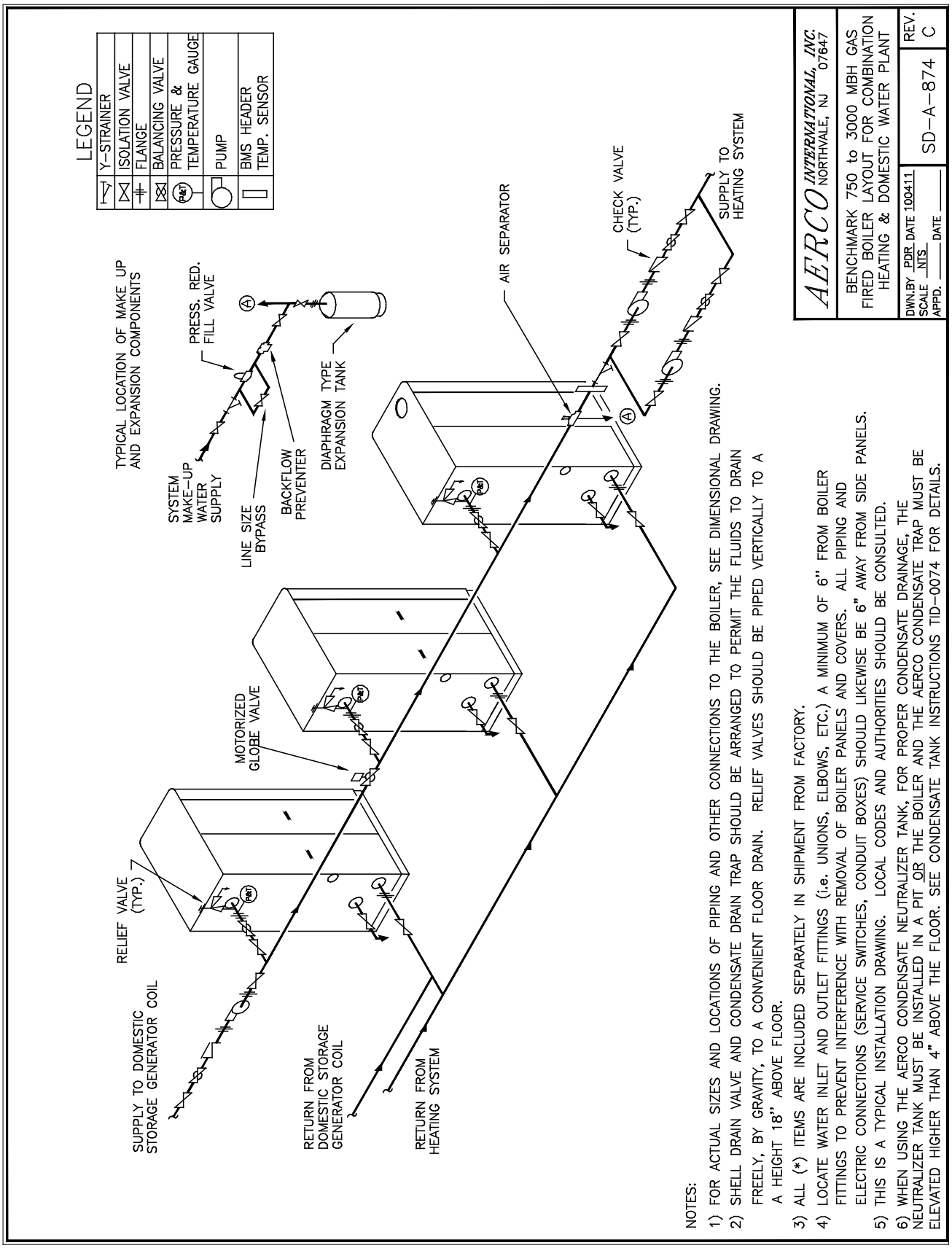
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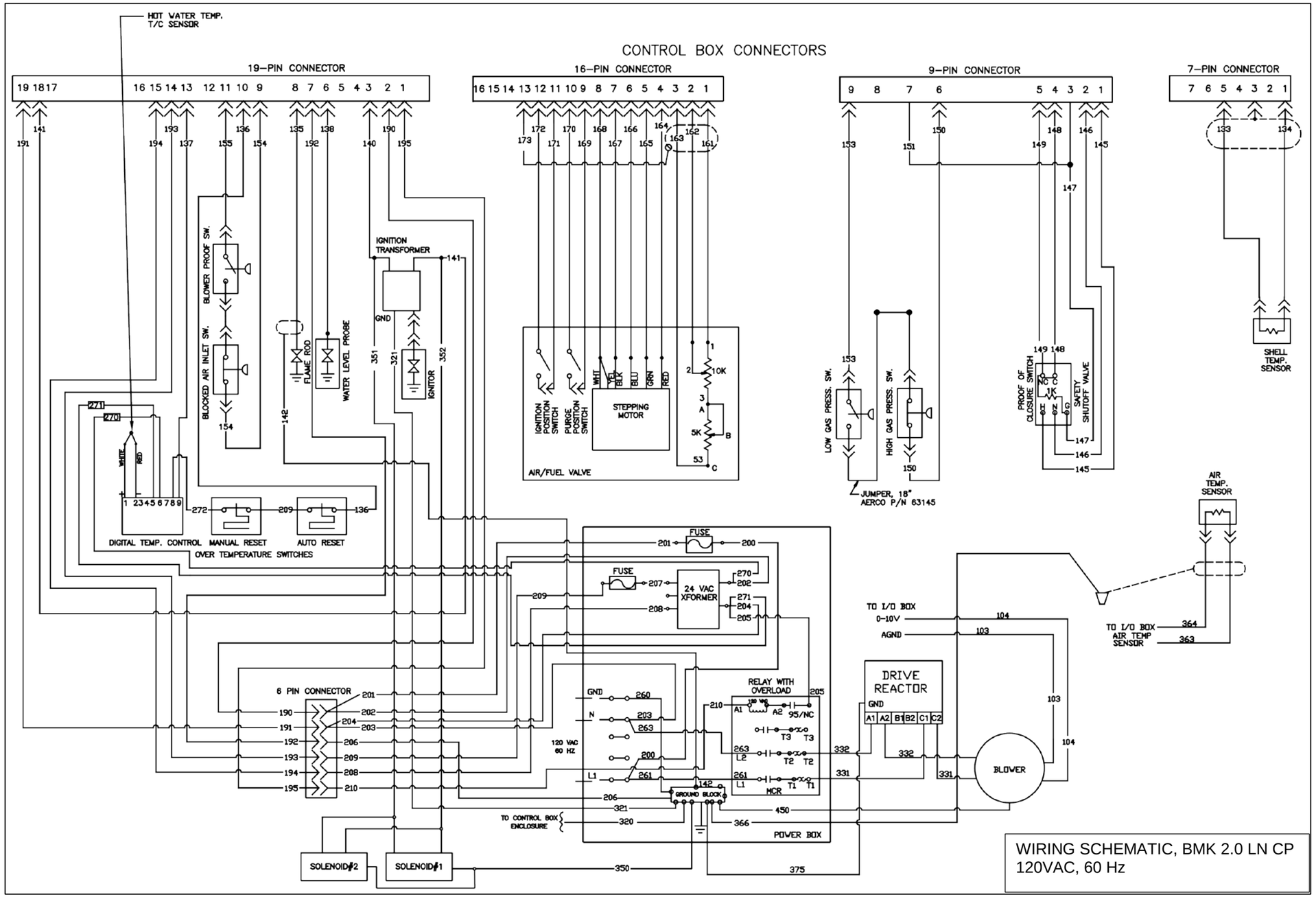
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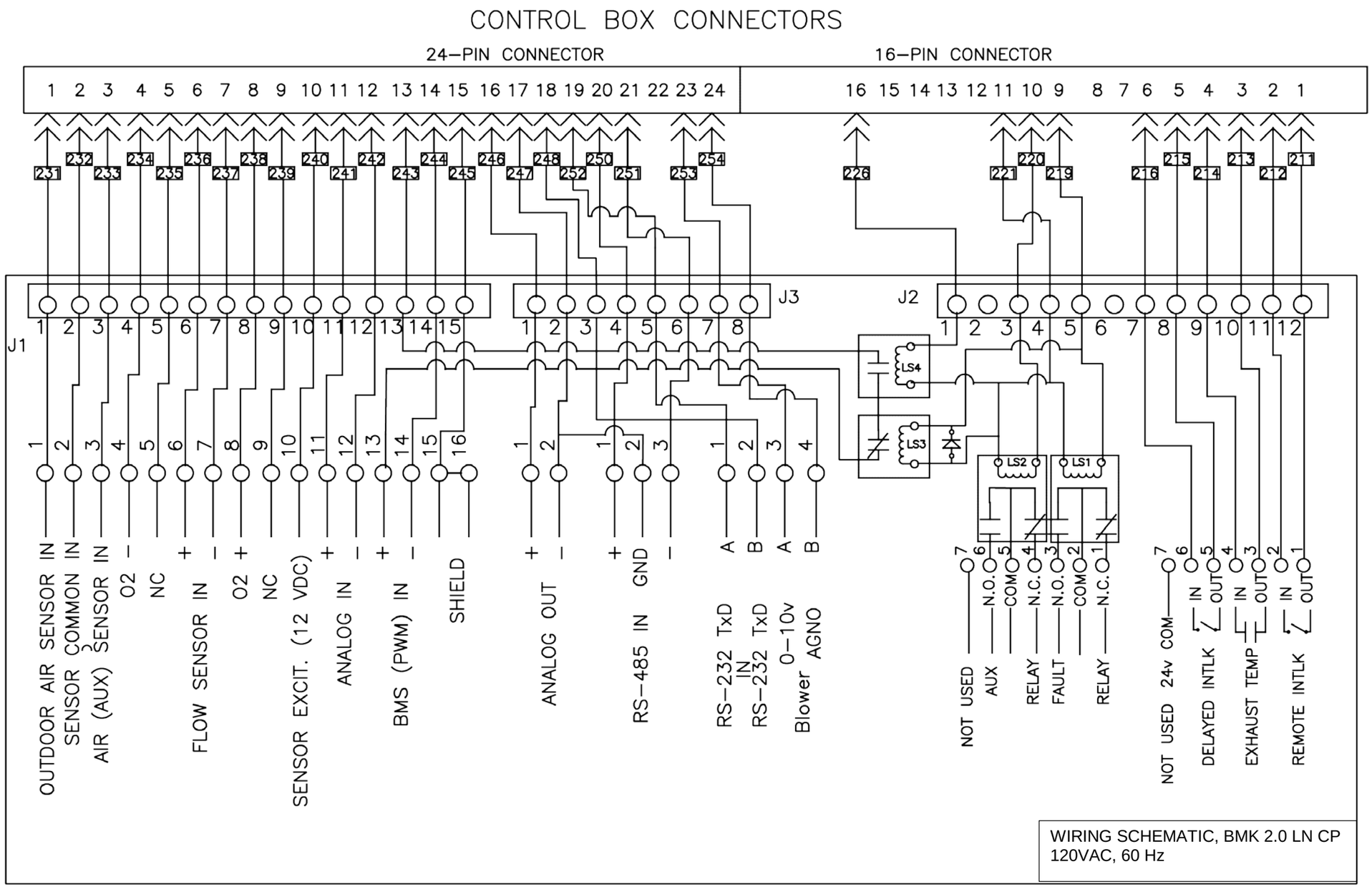
APPENDIX H – WIRING SCHEMATICS

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Drawing Number: 68023 rev G – Sheet 1 of 2

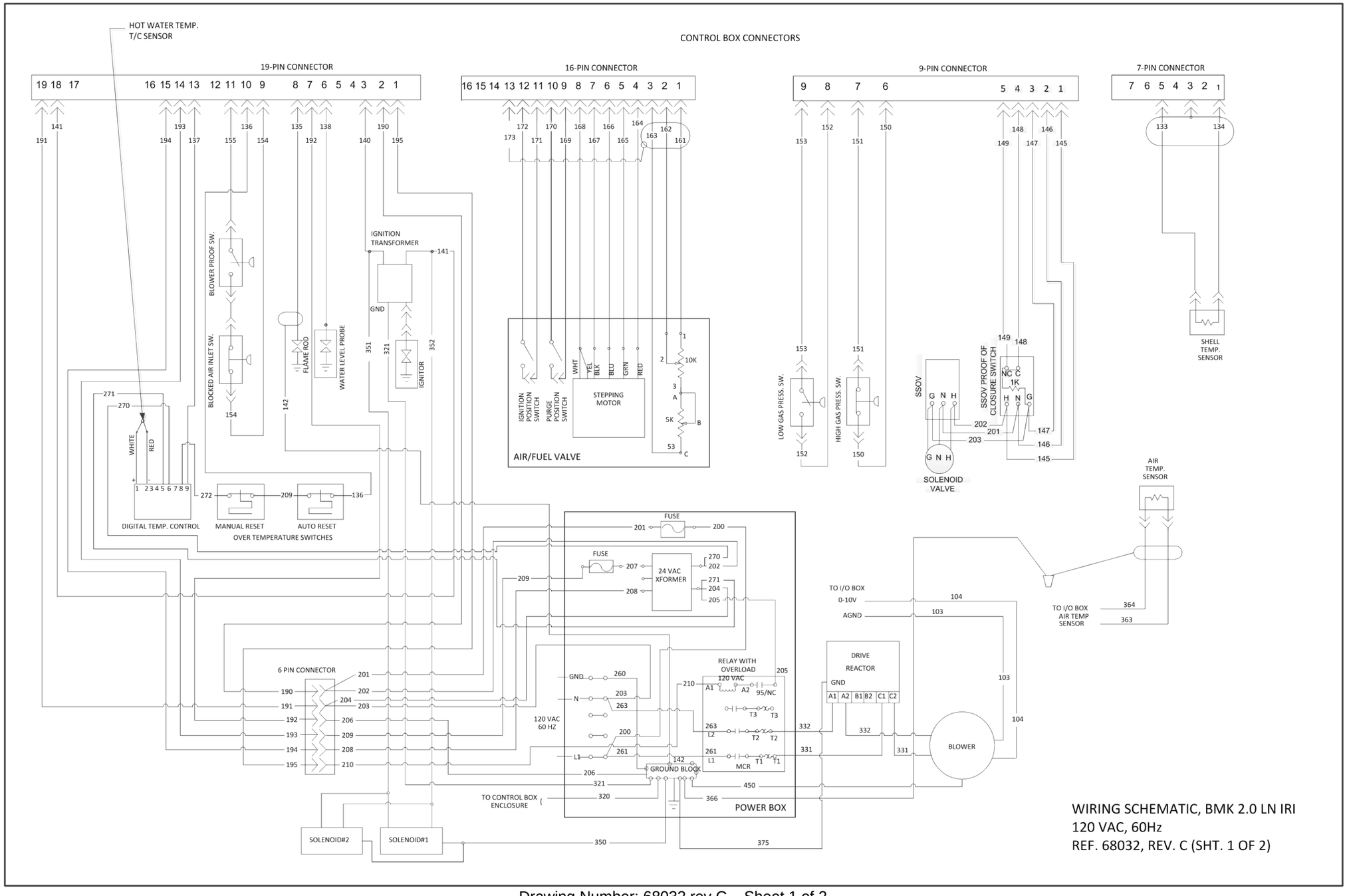
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INPUT/OUTPUT BOX

Drawing Number: 68023 rev G – Sheet 2 of 2

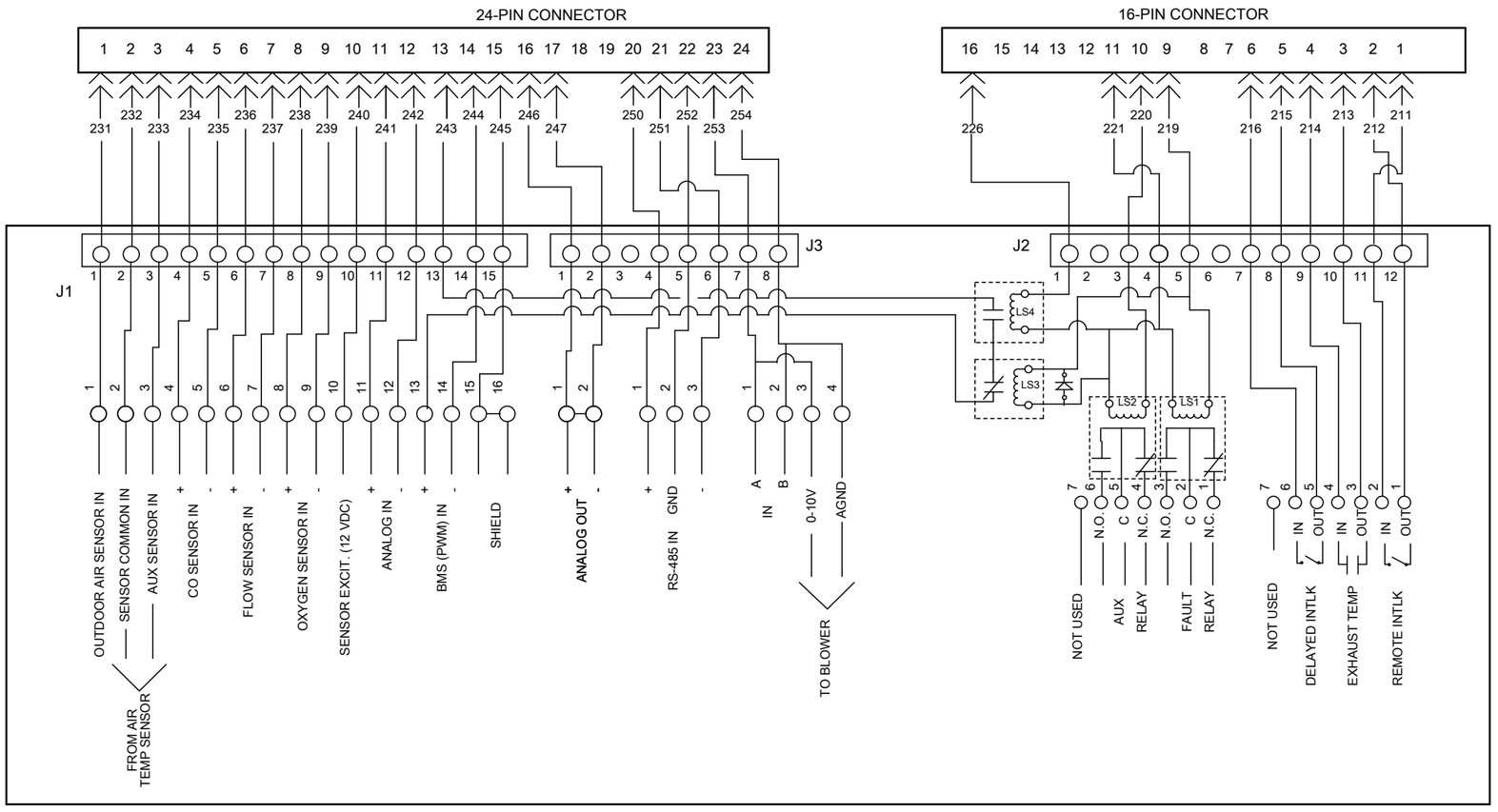
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Drawing Number: 68032 rev C – Sheet 1 of 2

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CONTROL BOX CONNECTORS



INPUT/OUTPUT BOX

WIRING SCHEMATIC, BMK 2.0LN IRI
120 VAC, 60 Hz

REF: 68032 REV. C (SHT. 2 OF 2)

Drawing Number: 68032 rev C – Sheet 2 of 2

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APPENDIX I – RECOMMENDED PERIODIC TESTING CHECK LIST

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	Provided By	Remarks
Refer to indicated paragraphs 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 Tech.	Verify factory settings
	Annually	Service Tech.	Check with combustion calibration test equipment. See paragraph 7.4 and Chapter 4.
Flue, vent, stack or intake air duct	Monthly	Operator	Visually inspection condition and check for obstructions
Spark Igniter	Weekly	Operator	See paragraph 7.2
Air/Fuel Valve position	Weekly	Operator	Check position indicator dial (paragraph 3.9)
SSOV Leakage test	Annually	Service Tech.	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 paragraph 6.7
Flame signal strength	Weekly	Operator	Check flame strength using the Control Panel Operating Menu. See paragraph 3.4.
Low water level cut off and alarm	Weekly	Operator	See paragraph 6.4

RECOMMENDED PERIODIC TESTING CHECK LIST – *Continued*

Item	Frequency	Provided By	Remarks
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 Tech.	See paragraph 6.5
Operating controls	Annually	Operator	See paragraph 3.2
Low air flow	Monthly	Operator	See paragraph 6.8
High and low gas pressure interlocks	Monthly	Operator	See paragraphs 6.2 and 6.3
Air/Fuel Valve purge position switch	Annually	Service Tech.	See paragraph 6.10
Air/Fuel Valve ignition position switch	Annually	Service Tech.	See paragraph 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 Tech.	See paragraph 7.6
Condensate Trap	Semi-Annually	Operator	See paragraph 7.7

APPENDIX J – BENCHMARK CONTROL PANEL FEATURES

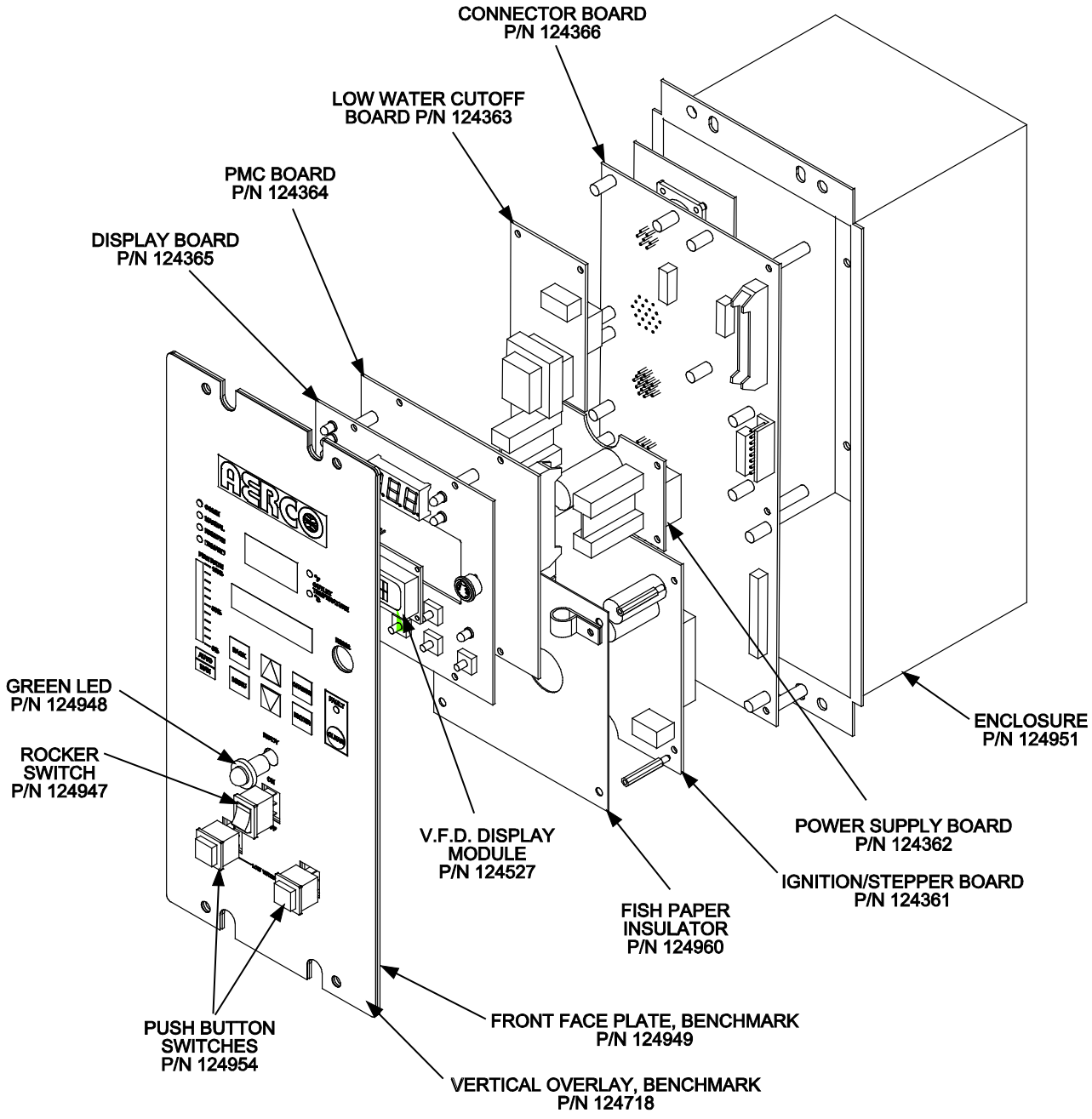


Figure J-1: Control Panel Exploded View

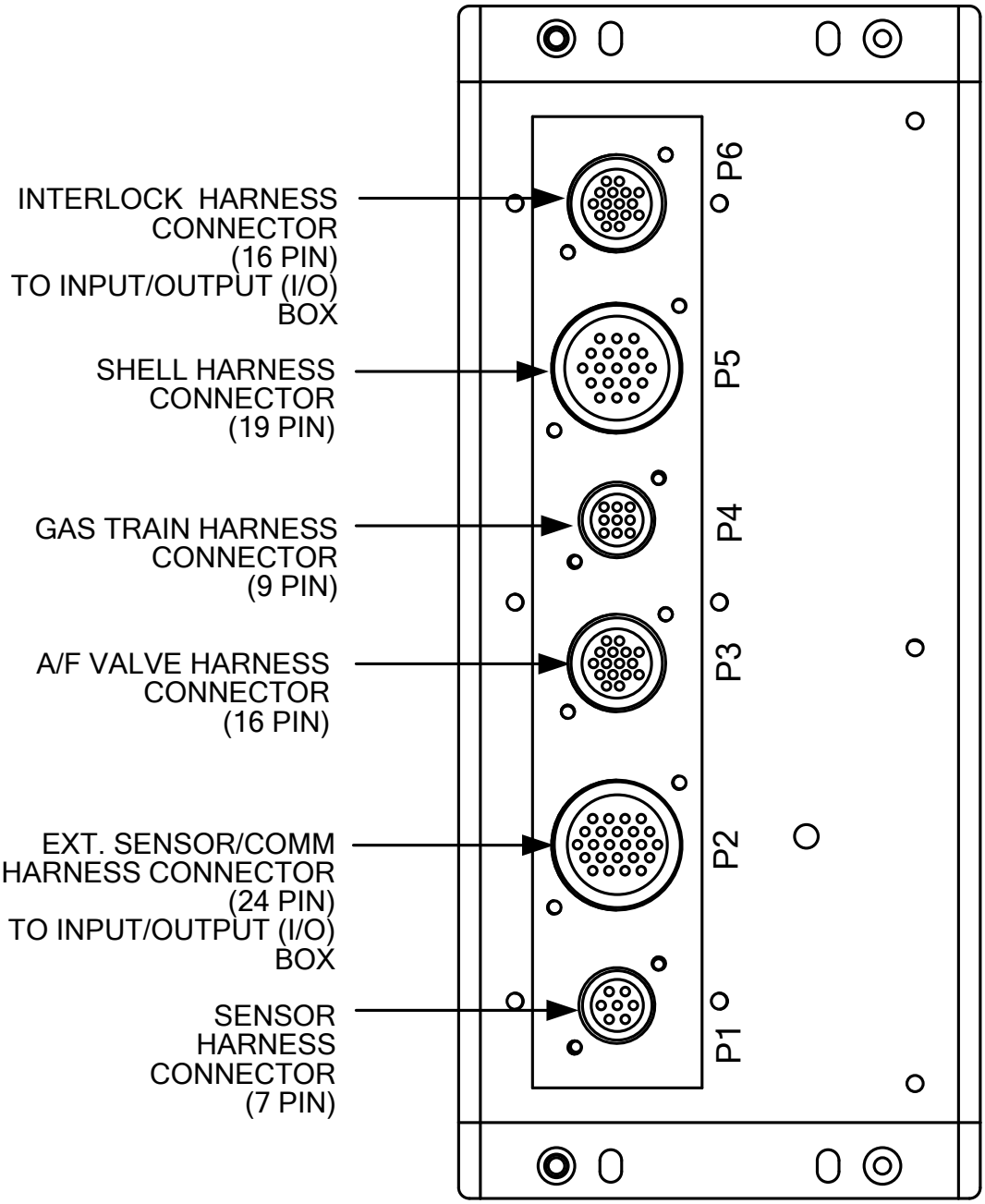


Figure J-2: Control Panel Rear Panel

APPENDIX K – RECOMMENDED SPARE PARTS LISTS

NOTE

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

Table K-1: Recommended Emergency Spare Parts

Description	Part Number
120 VAC/Single-Phase Blower	58038
SSOV Actuator/Regulator Combo - Used on: • ALL FM gas train models • **Downstream** SSOV of IRI gas train models	64048
SSOV Actuator Without Proof of Closure Switch - Used on: • **Upstream** SSOV of IRI gas train models	69038
Temperature Switch - Manual Reset (See **Note 1**)	123552
Regulated Staged Ignition Solenoid	124866

Table K-2. Spare Parts Recommended for Maintenance

Description	Ignition Type – Kit Part Number
Annual Maintenance Kits	Staged Ignition – 58025-01
	AERLite Ignition – 58131-01
24-month Waterside/Fireside Inspection Kits	Staged Ignition – 58025-06
	AERLite Ignition – 58131-06

Table K-3. Optional Spare Parts

Description	Part Number
C-More Control Box	181197
Burner	46012
Temperature Switch - Auto Reset (See **Note 1**)	123966
Limit Control – Temperature Digital Controller	69177

NOTE 1

If boiler is installed in the State of Kentucky, contact your local AERCO Sales Representative for Temperature Switch rated for 200°F.

Change Log

Date	Description	Changed By
02/25/2013	Rev H:	Chris Blair
06/18/2015	Rev J: **PIR 793**: Revised wiring diagram in Appendix H, updated drawing PL-A-159 in Appendix F, addition of Time Delay Relay, replaced Flame Rod with s/n 66020, replaced drawing AP-A-843. **PIR 934-123**: Added new section 2.12.4 – Ducted Combustion Air, added Direct Spark to Table 7.1 and section 7.2.2. **DIR 196**: Added AERLight ignition & Burkert valve proving circuit	Chris Blair

A Watts Water Technology Company

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