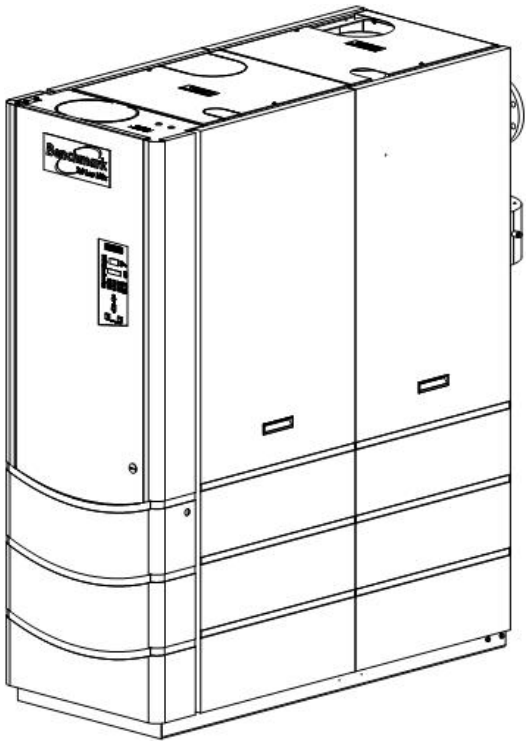
Instruction No. **GF-117**

AERCO INTERNATIONAL, Inc., Northvale, New Jersey, 07647 USA

Installation, Operation & Maintenance Instructions

Benchmark 3.0 Dual-Fuel Series Gas Fired Low NOx Boiler System



Natural Gas and Propane Fired,
Condensing, Forced Draft Hot Water Boiler
3,000,000 BTU/H Input

Applicable to Serial Numbers G-09-0298 and above

Printed in U.S.A.

REVISED APRIL, 2009

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Foreword

The AERCO Benchmark 3.0 Dual-Fuel 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 3.0, with its 15:1 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 Benchmark 3.0 operates at inputs ranging from 200,000 BTU/hr. to 3,000,000 BTU/hr. The output of the boiler is a function of the unit’s firing rate and return water temperature. Output ranges from 198,000 BTU/hr. to 2,900,000 BTU/hr., depending on operating conditions.

When installed and operated on natural gas in accordance with this Instruction Manual, the Benchmark 3.0 Boiler complies with the NOx emission standards outlined in:

- South Coast Air Quality Management District (SCAQMD), Rule 1146.1

Whether used in singular or modular arrangements, the Benchmark 3.0 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: _____

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, CGA B149, 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.

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 THEREFORE MUST BE COMPLETELY SEALED TO PREVENT LEAKAGE OF COMBUSTION PRODUCTS INTO LIVING SPACES.

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 460 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.

CAUTIONS!

Must be observed to prevent equipment damage or loss of operating effectiveness**.**

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

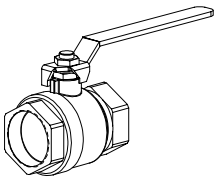
If overheating occurs or the gas supply fails to shut off, close the manual gas shutoff valve (Figure 1-1) located external to the unit.

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 is to identify the emergency shut-off device.



MANUAL GAS SHUTOFF VALVE

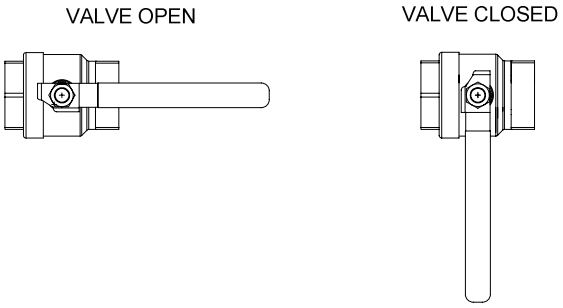


Figure 1-1

Manual Gas Shutoff Valve

CHAPTER 2 INSTALLATION

2.1 INTRODUCTION

This Chapter provides the descriptions and procedures necessary to unpack, inspect and install the AERCO Benchmark 3.0 Dual-Fuel 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 3.0 Dual-Fuel System is shipped as a single crated unit. The shipping weight is approximately 2,170 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. The freight carrier should be notified immediately if any damage is detected.

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

- Pressure/Temperature Gauge
- Spare Spark Igniter
- Spare Flame Detector
- 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 3.0 Dual Fuel Boiler includes:

- Access to AC Input Power corresponding to the ordered power configuration. The available power configurations are:
  - 208 VAC, 3-Phase, 60 Hz @ 20 A
  - 460 VAC, 3-Phase, 60 Hz @ 15 A
- Access to Natural Gas line at a static pressure between 5.7" W.C.(min) and 2 psi (max) for Standard (FM) option
- Access to Natural Gas line at a static pressure between 6.5" W.C. (min.) and 2 psi (max.) for IRI option
- Access to Propane Gas at a static pressure between 3.5" W.C. (min.) and 2 psi (max.) for both Standard (FM) and IRI options

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: 43 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.

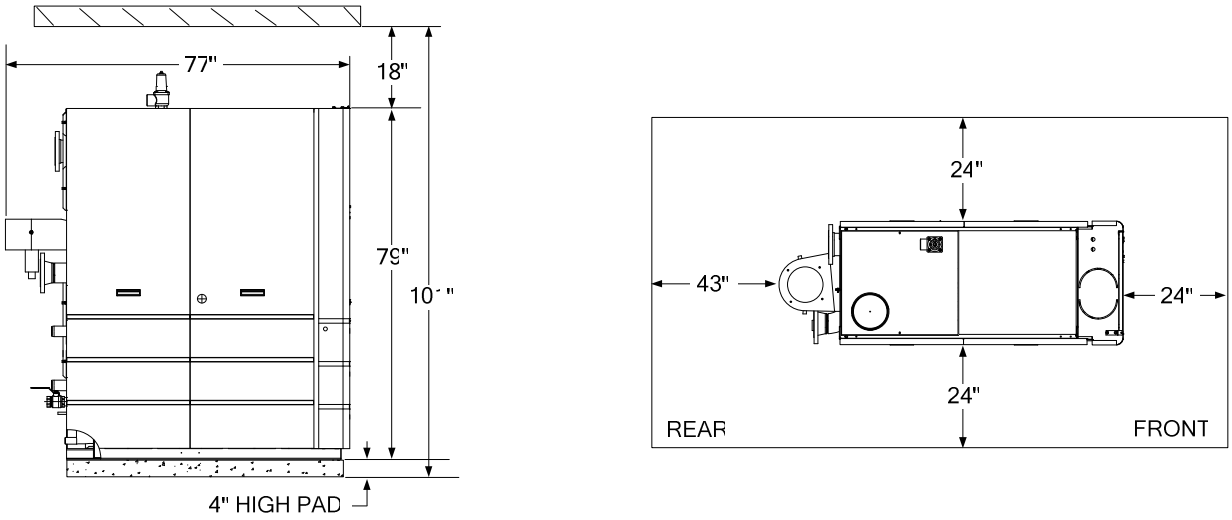


Figure 2-1 Benchmark 3.0 Dual Fuel Boiler Clearances

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.

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. If anchoring the unit, refer to the dimensional drawings in Appendix F for anchor locations. A total of 3 lifting tabs are provided at the top of the primary heat exchanger as shown in Figure 2-2. However, USE ONLY TABS 1 AND 2 SHOWN IN FIGURE 2-2 TO MOVE THE ENTIRE UNIT. Tabs 1 and 3 are used only when removing or replacing the unit's primary heat exchanger. Remove the front top panel from the unit to provide access to the lifting tabs. Remove the four (4) lag screws securing the unit to the shipping skid. Lift the unit off the shipping skid and position it on the 4 inch to 6 inch housekeeping concrete pad (required) in the desired location.

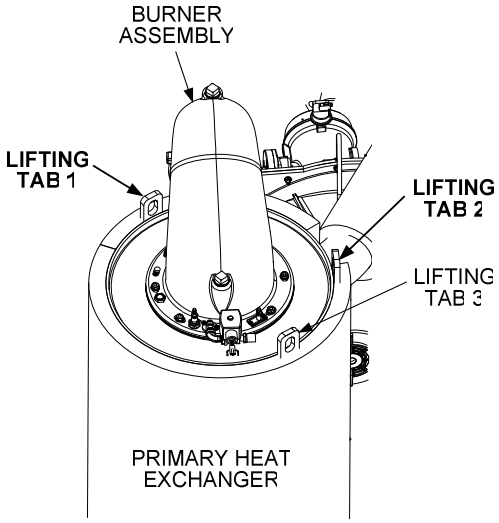


Figure 2-2
Lifting Lug Locations

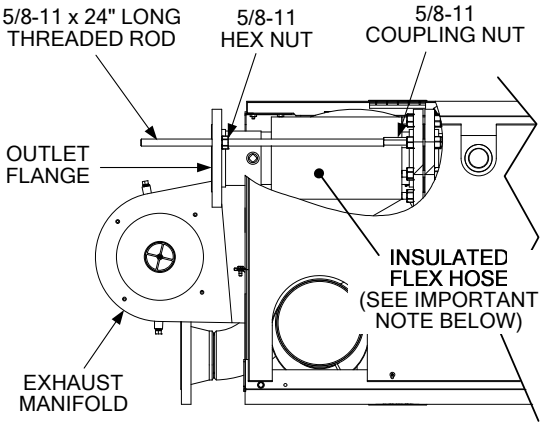
In multiple unit installations, it is important to plan the position of each unit in advance. Sufficient space for piping connections and future service/maintenance requirements must also be taken into consideration. All piping must include ample provisions for expansion**.**

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.

2.4.3 Removal of Support Rod

Prior to installation of water supply and return piping, the 24" threaded rod shown in Figure 2-3 must be removed. This rod is installed prior to shipment from the factory to prevent damage to the insulated metal flex hose on the hot water supply outlet of the boiler. In order to install the water supply piping, this rod must be removed as follows:

1. Refer to Figure 2-3 and back off the hex nut on the outlet side of the flex hose.
2. Next, disconnect the coupling nut from the flange stud.
3. Completely remove the threaded rod, hex nut and coupling nut from the boiler.



PARTIAL TOP VIEW - REAR

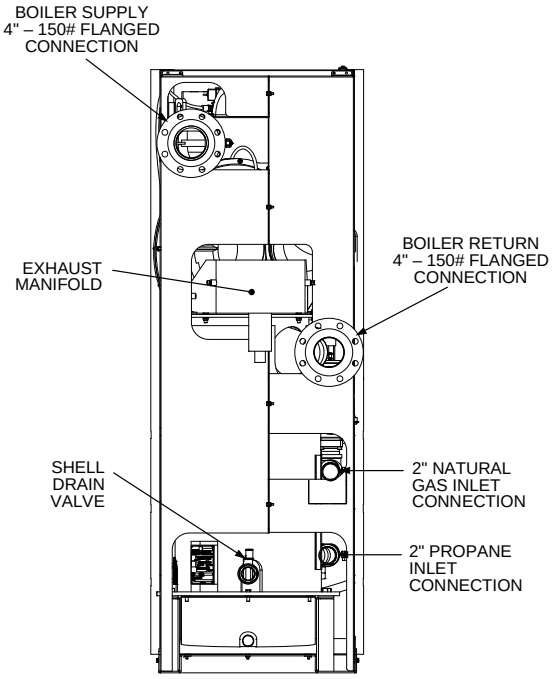
Figure 2-3
Location of Threaded Support Rod

IMPORTANT

THE INSULATED FLEX HOSE SHOWN IN FIGURE 2-3 MUST BE LEVEL OR SLOPING UPWARD AS IT EXITS THE BOILER. FAILURE TO PROPERLY POSITION THIS HOSE MAY CAUSE INEFFECTIVE AIR ELIMINATION RESULTING IN ELE-VATED TEMPERATURES THAT COULD COMPROMISE THE TOP HEAD GASKET.

2.5 SUPPLY AND RETURN PIPING

The Benchmark 3.0 Dual-Fuel 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 2-4. Refer to Appendix F, Drawing AP-A-811 for additional dimensional data.



REAR VIEW

Figure 2-4
Supply and Return Locations

2.6 CONDENSATE DRAINS

The Benchmark 3.0 Dual-Fuel Boiler is designed to condense water vapor from the flue products. Therefore, the installation must have provisions for suitable condensate drainage or collection.

Two condensate drain connections are provided on the rear of the unit as shown in Figure 2-5. One drain connection is located on the exhaust manifold and the other is located on the connecting manifold.

The drain at the bottom of the exhaust manifold also includes a condensate trap containing a float assembly. When condensate collects in the exhaust manifold, the float rises, thereby allowing it to discharge through the drain opening. The drain pipe located on the connecting manifold must be connected to a second condensate trap which is packed separately within the unit's shipping container.

The procedures to install and connect both of the condensate drains are provided in paragraphs 2.6.1 and 2.6.2.

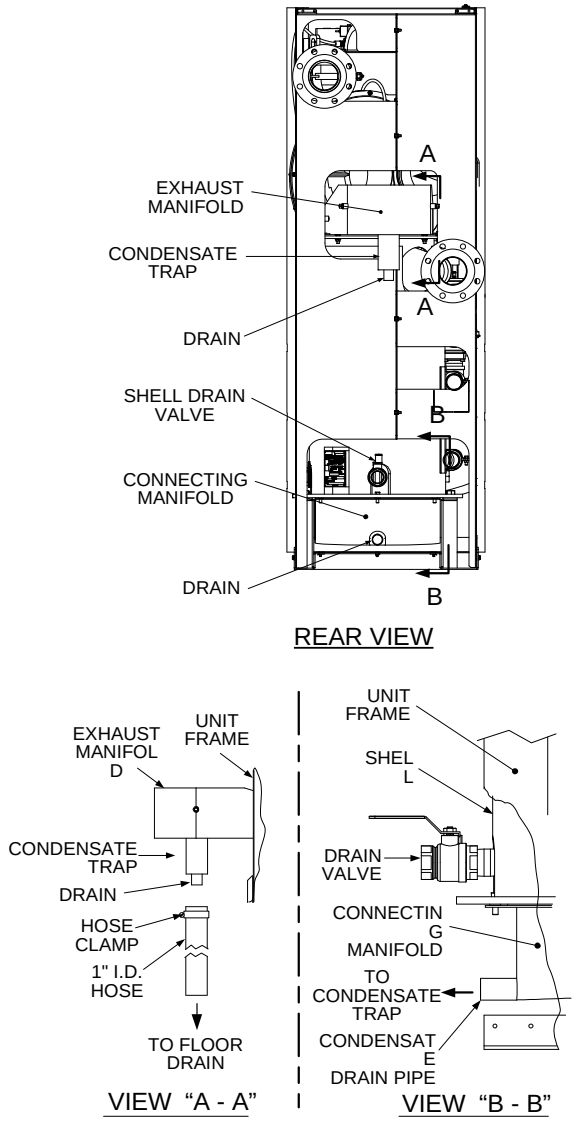


Figure 2-5
Condensate Drain Connection Location

2.6.1 Exhaust Manifold Condensate Drain

Refer to Figure 2-5, View A – A and install as follows:

1. Connect a length of 1 inch I.D. hose (part no. 91030) to the drain on the connecting manifold and secure it in place with a hose clamp.
2. Route the hose to a nearby floor drain.

2.6.2 Connecting Manifold Condensate Drain

The connecting manifold drain pipe shown in Figure 2-5, View B – B must be connected to a separate condensate drain trap external to the unit. Refer to Figure 2-6 and install the trap as follows:

NOTE

The condensate trap described in the following steps can be installed on the floor behind the unit as shown in Figure 2-6. There will be sufficient downward slope from the drain pipe to the trap inlet to drain the condensate by gravity. Ensure that the outlet hose from the trap slopes away (down) from the trap.

1. Position the supplied condensate trap (part no. 24060) on the floor at the rear of the unit.
2. Install 3/4" NPT nipples in the tapped inlet and outlet of the condensate trap.
3. Attach a length of 1½" I.D. hose (part no. GM-123352) between the connecting manifold drain pipe and the inlet side of the condensate trap (Figure 2-6). Secure both ends of the hose with clamps.
4. Connect a second length of 1" I.D. polypropylene hose to the outlet side of the condensate trap and route it to a nearby floor drain.

If desired, a Tee fitting may be used to connect the two drain hoses from the exhaust manifold and the outlet side of the of the condensate trap connected in

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 lines must be removable for routine maintenance; therefore, DO NOT hard pipe.

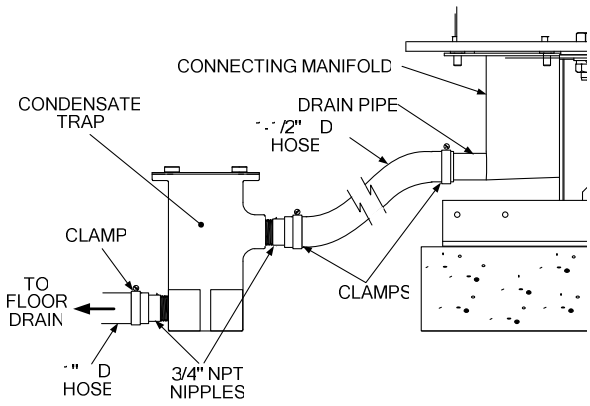


Figure 2-6
Condensate Trap Installation

2.7 GAS SUPPLY PIPING

The AERCO Benchmark 3.0 Gas Components and Supply Design Guide, GF-3030 must be consulted prior to designing or installing any gas supply piping.

WARNING

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

CAUTION

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

NOTE

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

Benchmark 3.0 Dual-Fuel units contain two 2 inch gas inlet connections on the rear of the unit as shown in Figure 2-4. If one of the fuel sources is not being piped due to its unavailability, the inlet must be capped.

Prior to installation, all pipes should be deburred 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 2 psi. 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 gas supply input specifications to the unit for Natural Gas and Propane are as follows:

- **Natural Gas** - The maximum static pressure to the unit must not exceed 2 psi. The minimum operating gas pressure for natural gas is 5.7 inches W.C. for both FM and IRI gas trains when the unit is firing at maximum input. The gas supply pressure to the unit must be of sufficient capacity to provide 3000 cfh while maintaining the gas pressure at 6.5 inches W.C. for FM or IRI gas trains.
- **Propane** - The maximum static pressure to the unit must not exceed 2 psi. The minimum operating gas pressure for propane is 3.5 inches W.C. for both FM and IRI gas trains when the unit is firing at maximum input. The gas supply pressure to the unit must be of sufficient capacity to provide 1200 cfh while maintaining the gas pressure at 3.5 inches W.C. for FM or IRI gas trains.

2.7.2 Manual Gas Shutoff Valve

Two manual shut-off valves must be installed in the gas supply lines upstream of the Boiler as shown in Figure 2-7. Maximum allowable gas pressure to the Boiler for each line is 2 psi

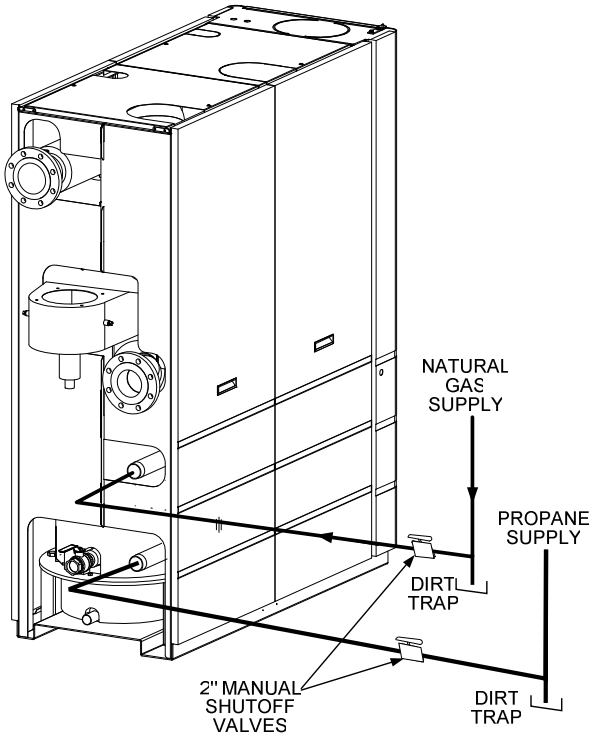


Figure 2-7
Manual Gas Shut-Off Valve Location

2.7.3 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-803 for details.

2.8 AC ELECTRICAL POWER WIRING

The AERCO Benchmark 3.0 Electrical Power Wiring Guide, GF-3060, 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 2-8).

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.

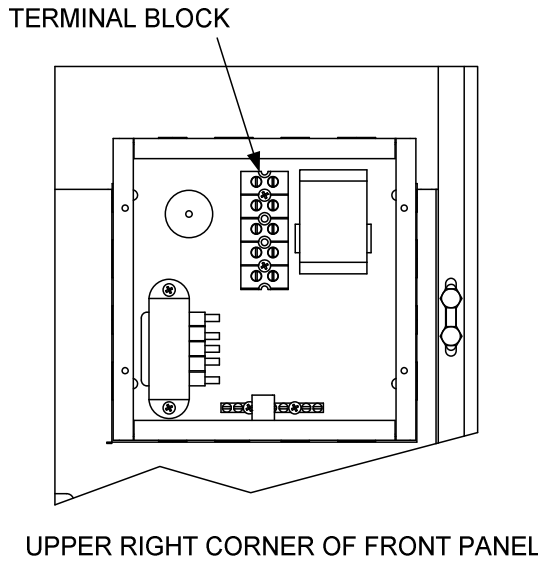


Figure 2-8
AC Input Terminal Block Location

2.8.1 Electrical Power Requirements

The AERCO Benchmark 3.0 Dual-Fuel Boiler is available in two different AC power configurations:

- 208 VAC/3-Phase/60 @20 amps
- 460 VAC/3-Phase/60 Hz @ 15 amps

Each of the power configurations utilize a Power Box with a terminal block that matches the configuration ordered. The two different terminal block configurations are shown in Figure 2-9. A wiring diagram showing the required AC power connections is provided on the front cover of the Power Box.

Each Benchmark 3.0 Dual-Fuel Boiler must be connected to a dedicated electrical circuit. NO OTHER DEVICES SHOULD BE ON THE SAME ELECTRICAL CIRCUIT AS THE BENCHMARK UNIT. A means for disconnecting AC power from the unit (such as a service switch) must be installed near the unit for normal operation and maintenance. All electrical connections should be made in accordance with the National Electrical Code and/or with any applicable local codes.

For electrical power wiring diagrams, see the AERCO Benchmark 3.0 Electrical Power Wiring Guide, (GF-3060).

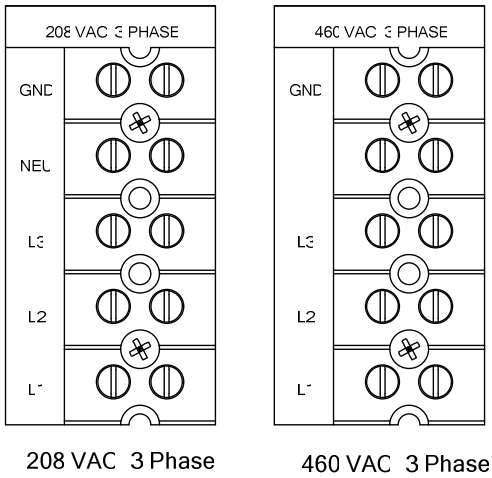


Figure 2-9
AC Terminal Block Configurations

2.9 MODES OF OPERATION AND FIELD CONTROL WIRING

The Benchmark 3.0 Dual-Fuel 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 2-10) 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 2-11) when making all wiring connections.

In addition to the terminal strips shown in Figure 2-10, the I/O Box also contains a pre-wired temperature transmitter which receives inlet air temperature sensor readings and transmits this signal to the variable frequency drive (VFD) contained in the Benchmark 3.0 Dual-Fuel Boiler. The VFD utilizes this input signal to adjust the rotation speed of the blower.

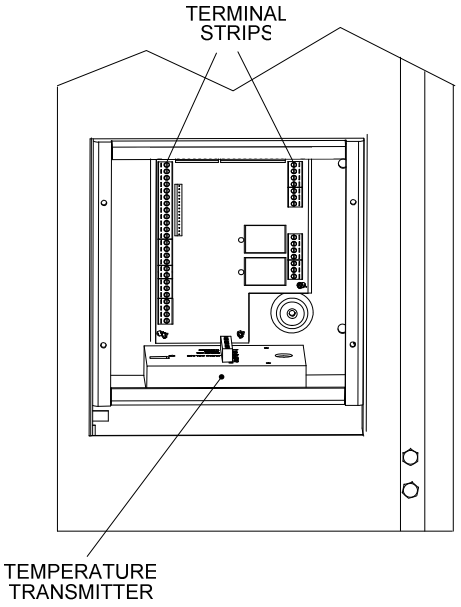


Figure 2-10. Input/Output (I/O) Box Location

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 2.9.1 through 2.9.9. Refer to Chapter 5 for detailed information on the available modes of operation.

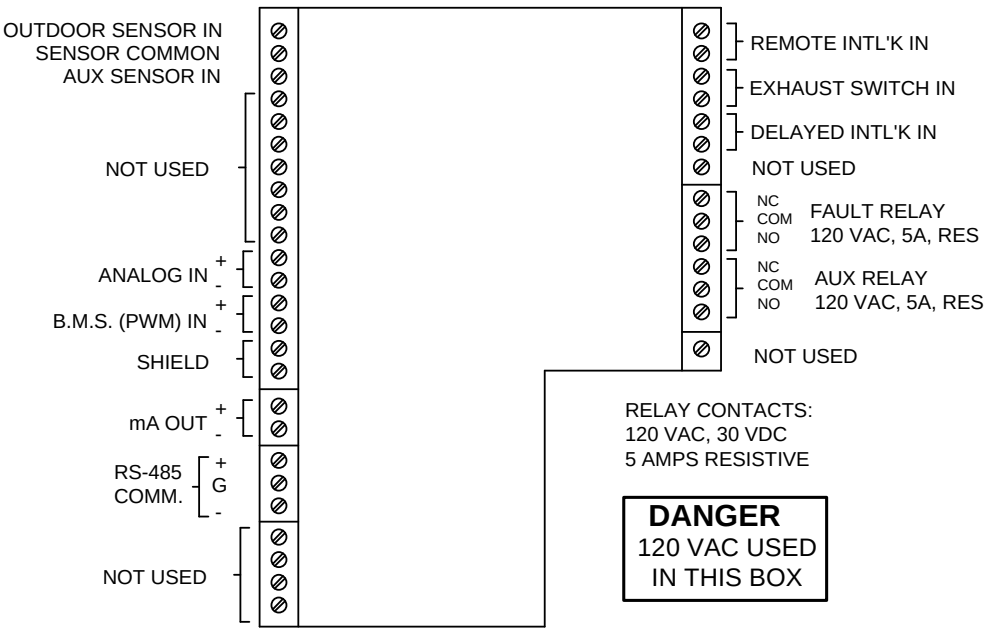


Figure 2-11. I/O Box Terminal Strip

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 or enable/disable interlock wiring can be utilized (see paragraphs 2.9.9.1 and 2.9.10).

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 2-11). 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 can utilize only RS485 signaling to the Boiler.

When using an AERCO Boiler Management System (BMS), the field wiring is connected between the BMS Panel and each Boiler's I/O Box terminal strip (Figure 2-11). 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 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. 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 Model 168) and GF-124 (BMS II Model 5R5-384), BMS -Operations Guides.

2.9.4 Remote Setpoint and Direct Drive Modes

The Benchmark 3.0 Dual-Fuel 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 firing rate (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 para. 2.10.4)
- Network (RS485 Modbus. See para. 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 2.9.3.

2.9.5 Combination Mode

NOTE

Only BMS Model 168 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 Model 168 (Boiler Management System). 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.

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 2-11 are described in the following paragraphs.

CAUTION

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

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 2-10 and 2-11). 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 AUX SENSOR IN

The AUX SENSOR IN 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 AUX SENSOR IN and SENSOR COMMON terminals 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

The ANALOG IN + and – terminals are used when an external signal is used to drive the firing rate (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 firing rate. 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 CPU 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 2-11). 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% firing rate. No scaling for these signals is provided

2.10.4 B.M.S. (PWM) IN

NOTE

Only BMS Model 168 can utilize Pulse Width Modulation (PWM), not the BMS II (Model 5R5-384).

These terminals are used to connect the AERCO Boiler Management System (BMS) Model 168 to the unit. The BMS Model 168 utilizes a 12 millisecond, ON/OFF duty cycle. This duty cycle is Pulse Width Modulated (PWM) to control firing rate. A 0% firing rate = a 5% ON pulse and a 100% firing rate = a 95% ON pulse.

2.10.5 SHIELD

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.

2.10.6 mA OUT

These terminals provide a 4 to 20 mA output to the VFD 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

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

2.10.8 EXHAUST SWITCH IN

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.

2.10.9 INTERLOCKS

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 2-11). 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.

2.10.9.1 REMOTE INTERLOCK IN

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.

2.10.9.2 DELAYED INTERLOCK IN

The delayed interlock is typically used in conjunction with the auxiliary relay described in paragraph 2.10. 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).

2.10.10 FAULT RELAY

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 2-11.

2.11 AUXILIARY RELAY CONTACTS

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 2-11 to locate the AUX RELAY terminals for wiring connections.

2.12 FLUE GAS VENT INSTALLATION

The minimum allowable vent diameter for a single Benchmark 3.0 Dual-Fuel Boiler is 8 inches.

The AERCO Benchmark Venting and Combustion Air Guide, GF-3050, 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-3050, 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.

2.13 COMBUSTION AIR

The AERCO Benchmark Venting and Combustion Air Guide, GF-3050 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, 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 3.0 Dual-Fuel Boiler is UL listed for 100% sealed combustion. It can also be installed using room air, provided there is an adequate supply. (See paragraph 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, consult the AERCO Benchmark Venting and Combustion Air Guide, GF-3050.

2.13.1 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.

2.13.2 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.

2.13.3 Sealed Combustion

The AERCO Benchmark 3.0 Dual-Fuel 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-3050. When using the boiler in a sealed combustion air configuration, each unit must have a minimum 8 inch diameter connection at the unit.

CHAPTER 3 CONTROL PANEL OPERATING PROCEDURES

3.1 INTRODUCTION

The information in this Chapter provides a guide to the operation of the Benchmark 3.0 Dual-Fuel 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.

CAUTION

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.

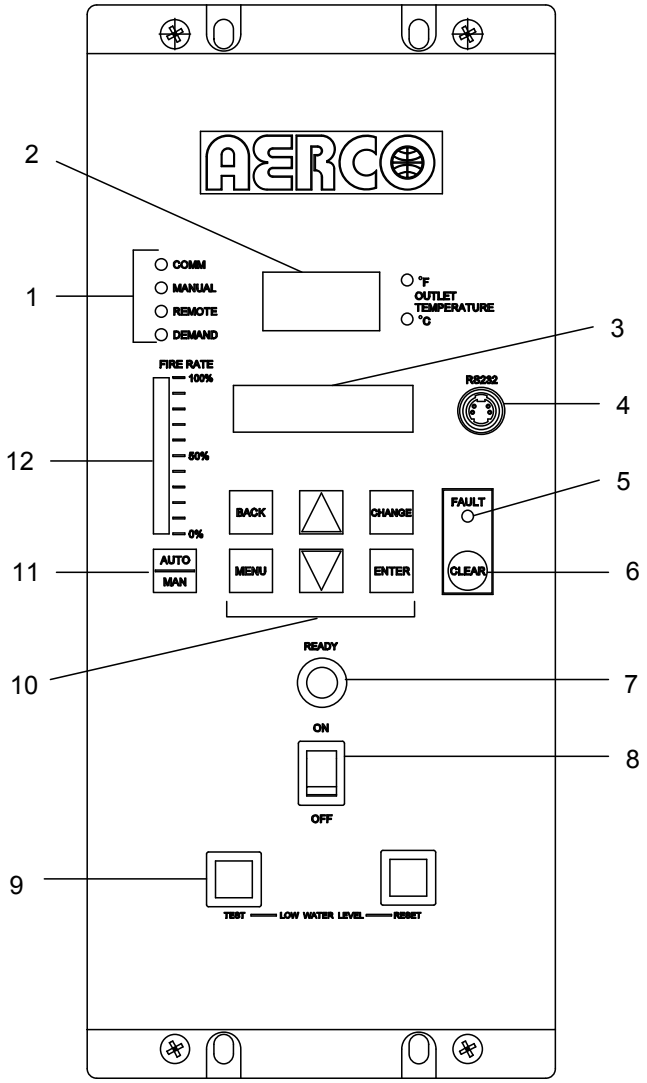


Figure 3-1.
Control Panel Front View

3.2 CONTROL PANEL DESCRIPTION

The Control Panel shown in Figure 3-1 contains all of the controls, indicators and displays necessary to operate, adjust and troubleshoot the Benchmark 3.0 Dual-Fuel Boiler. These operating controls, indicators and displays are listed and described in Table 3-1. Additional information on these items are provided in the individual operating procedures provided in this Chapter.

CONTROL PANEL OPERATING PROCEDURES

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.
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	**FIRE RATE** Bargraph	20 segment red LED bargraph continuously shows the Fire Rate 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 four major menu categories as 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 to prevent unauthorized use.

Prior to entering the correct password, the options contained in the Operating, 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 password (159) is entered, the options listed in the Setup. Configuration and Tuning Menus can be viewed and changed, if desired.

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.

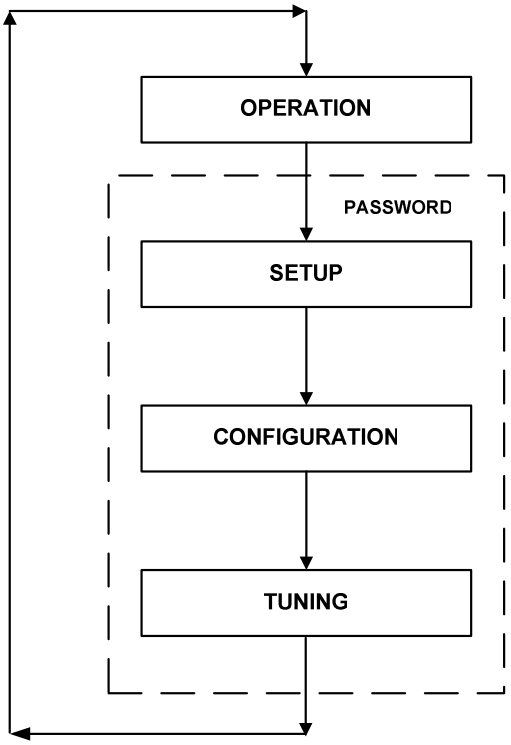


Figure 3-2. Menu Structure

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).

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.

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 Minimum	Maximum	Default
Status Message			
Active Setpoint	40°F	240°F	
Aux Temp	30°F	245°F	
Outdoor Temp*	-70°F	130°F	
Fire Rate In	0%	Max Fire Rate	
Flame Strength	0%	100%	
Run Cycles	0	999,999	
Run Hours	0	999,999	
Fault Log	0	9	0

Table 3-3. Setup Menu

Menu Item Display	Available Choices or Limits Minimum	Maximum	Default
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
Software	Ver 0.00	Ver 9.99	

3.6 CONFIGURATION MENU

The Configuration Menu shown in Table 3-4 permits adjustment of the Internal Setpoint (Setpt) temperature regardless of whether the valid password has been entered. Setpt is required for operation in the Constant Setpoint mode. The remaining options in this menu require the valid password to be entered, prior to changing existing entries. This menu contains a number of other configuration settings which may or may not be displayed, depending on the current operating mode setting.

NOTE

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

Table 3-4. Configuration Menu

Menu Item Display	Available Choices or Limits		Default
	Minimum	Maximum	
Internal Setpt	Lo Temp Limit	Hi Temp Limit	130°F
Unit Type	Boiler or Water Heater		Boiler
Unit Size	0.5 MBTU, 1.0 MBTU 1.5 MBTU, 2.0 MBTU 2.5 MBTU, 3.0 MBTU		1.0 MBTU
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
Setpt Lo Limit	40°F	Setpt Hi Limit	60°F
Setpt Hi Limit	Setpt Lo Limit	220°F	200°F
Temp Hi Limit	40°F	240°F	210°F
Max Fire Rate	40%	100%	100%
Pump Delay Timer	0 min.	30 min.	0 min.
Aux Start On Dly	0 sec.	120 sec.	0 sec.

Table 3-4. Configuration Menu - *Continued*

Menu Item Display	Available Choices or Limits Minimum	Maximum	Default
Failsafe Mode	Shutdown or Constant Setpt		Shutdown
*mA Output (See **CAUTION**)	Setpoint, Outlet Temp, Fire Rate Out, Off		*Fire Rate Out
Low Fire Timer	2 sec.	120 sec.	2 sec.
Setpt Limiting	Enabled or Disabled		Disabled
Setpt Limit Band	0°F	10°F	5°F

***CAUTION**: DO NOT CHANGE mA Output Menu Item from its Default setting.

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 Minimum	Maximum	Default
Prop Band	1°F	120°F	70°F
Integral Gain	0.00	2.00	1.00
Derivative Time	0.0 min	2.00 min	0.00 min
Reset Defaults?	Yes No Are You Sure?		No

3.8 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

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 Safety Shut-Off Valve (SSOV) is closed. See Figure 3-3 for SSOV locations.

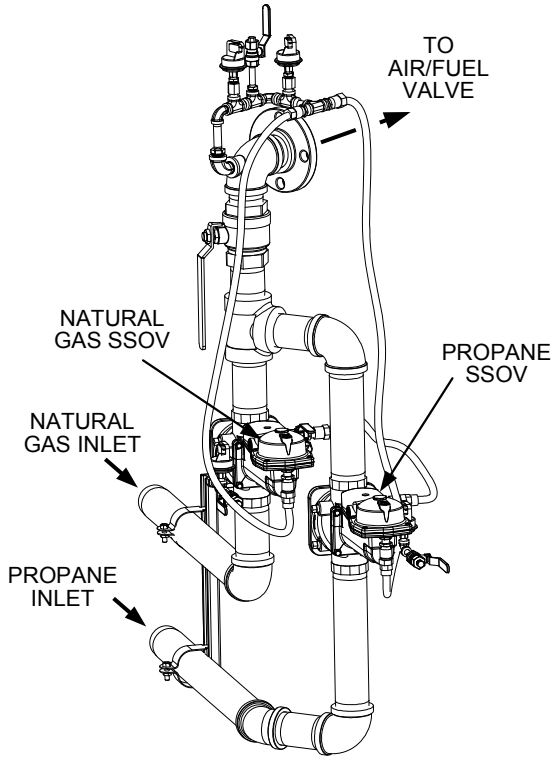


Figure 3-3.
SSOV Locations

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 **FIRE RATE** 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. The normal (default) time for the purge cycle is 10 seconds.

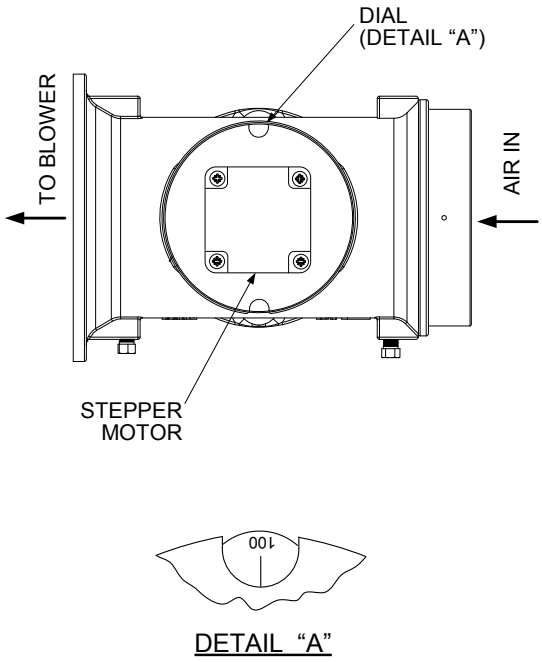


Figure 3-4.
Air/Fuel Valve In Purge Position

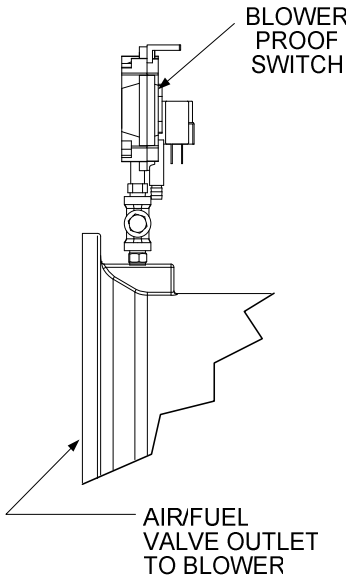


Figure 3-5.
Blower Proof Switch

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

   (a) The Air/Fuel Valve rotates to the low-fire ignition position 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 staged ignition solenoid valve is energized (opened) allowing gas to flow to the staged ignition piece.

   (d) The gas Safety Shut-Off Valve (SSOV) is energized (opened) allowing gas to flow into the Air/Fuel Valve.

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 **FIRE RATE** will be continuously displayed on the front panel bar graph.

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.

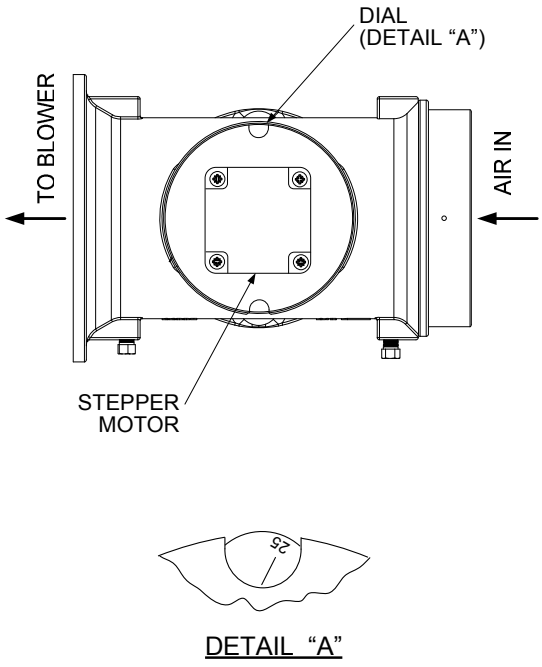


Figure 3-6.
Air/Fuel Valve In Ignition

3.9 START/STOP LEVELS

The start and stop levels are the fire rate percentages that start and stop the unit, based on load. These levels are Factory preset as follows:

Start Level: 20%

Stop Level: 18%

Normally, these settings should not require adjustment.

CHAPTER 4 INITIAL START-UP

4.1 INITIAL START-UP REQUIREMENTS

The requirements for the initial start-up of the Benchmark 3.0 Dual-Fuel Boiler consist of the following:

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

Installation should be fully completed before performing initial start-up; and the start-up must be complete 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 following the steps 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 the initial unit start-up.

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

AERCO International, Inc.
159 Paris Ave.
Northvale, NJ 07647

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.

CAUTION

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.
- 1/8 inch NPT-to-barbed fittings for use with gas supply manometer or gauge.
- Small and large flat blade screwdrivers.
- Tube of silicone adhesive

4.2.2 Installing Gas Supply Manometer

The gas supply manometer is installed in the gas train as follows:

1. Close the main manual gas supply shut-off valve upstream of the unit.
2. Remove the front door and left side panels from the boiler to access the gas train components.
3. Remove the 1/8 inch NPT pipe plug from the leak detection ball valve on the downstream side of the Safety Shut Off Valve (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 inch W.C. manometer.

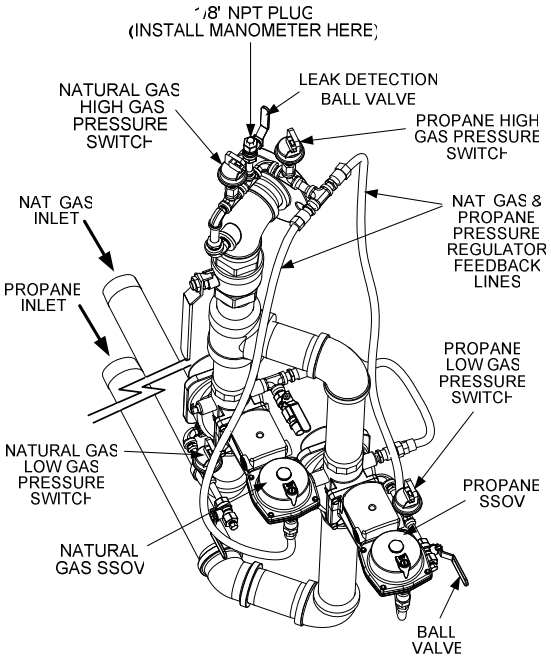


Figure 4-1
1/8 Inch Gas Plug Location

4.2.3 Accessing the Vent Probe Port

The unit contains NPT plugs on both the left and right side of the exhaust manifold at the rear of the unit as shown in Figure 4-2. 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.

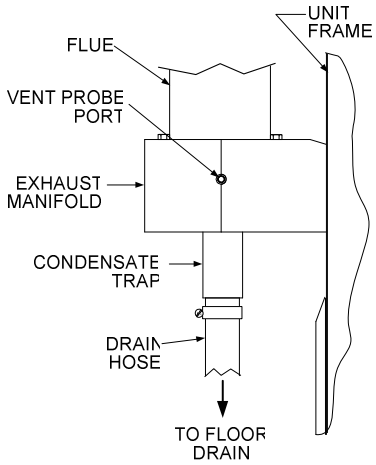


Figure 4-2
Analyzer Probe Hole Location

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.

IMPORTANT

For Dual Fuel units, perform the natural gas combustion calibration procedures in para. 4.3 before performing the propane combustion calibration procedures in para. 4.4.

Refer to Appendix K for switchover instructions when changing from Natural Gas to Propane or from Propane to Natural Gas.

4.3 NATURAL GAS COMBUSTION CALIBRATION

The Benchmark 3.0 Dual Fuel 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 on the control panel. A flashing *Manual Fire Rate* message will be displayed with the present rate in **%**. Also, the **MANUAL** LED will light.
6. Adjust the fire rate to 0% by pressing the ▼ arrow key.
7. Ensure that the leak detection ball valve (Figure 4-1) downstream of the SSOV is open.

8. Ensure that the Fuel Selector Switch (Figure 4-3 is in the NATURAL GAS position.
9. Locate the Variable Frequency Drive (VFD) on the front of the unit behind the panel door (Figure 4-3). Insert the "LogicStick" with the "NATURAL GAS" label in the slot on the front of the VFD.
10. Set the **ON/OFF** switch on the unit control panel to the **ON** position.

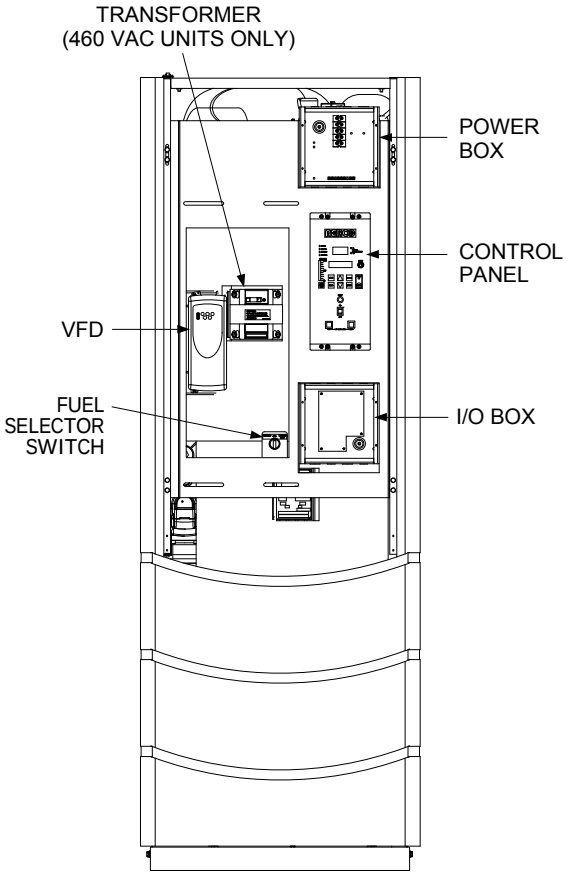


Figure 4-3
Front View With Door Removed

11. Access the control panel Configuration Menu and ensure that the Max Fire Rate is set to 100%. (Refer to Chapter 3, para. 3.3 for instructions on changing menu options).
12. Change the fire rate to 29% using the ▲ arrow key. The unit should begin its start sequence and fire.
13. Next, increase the fire rate to 100%. Verify that the gas pressure downstream of the SSOV is 5" W.C. for both FM and IRI gas trains. If gas pressure adjustment is required, remove the brass hex head cap on the SSOV (Figure 4-4). Make gas regulator adjustments using a short, flat-tip screwdriver to obtain 5" W.C.

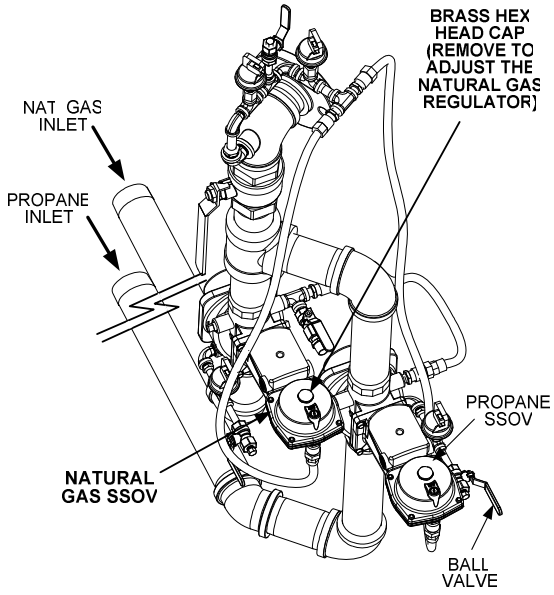


Figure 4-4
Regulator Adjustment Screw Location

14. With the firing rate at 100%, insert the combustion analyzer probe into the flue probe opening and allow enough time for the combustion analyzer to settle.
15. 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% Firing Rate

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

16. 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.
17. Once the oxygen level is within the specified range at 100%, lower the firing rate to 70%.

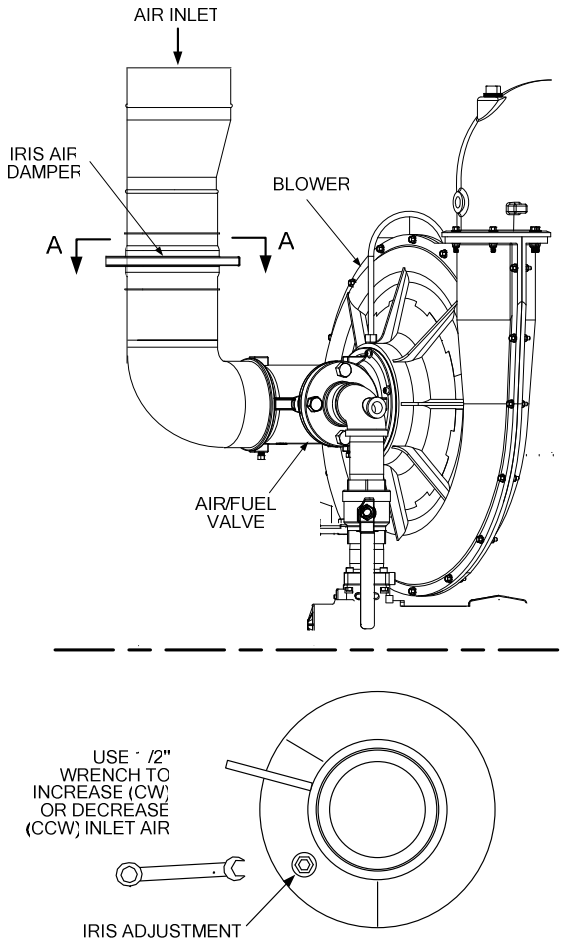


Figure 4-5
Iris Air Damper Location/Adjustment

NOTE

The remaining combustion calibration steps utilize the Variable Frequency Drive (VFD) located behind the front door of the unit. The VFD up (**Λ**) and down (**V**) arrow keys will be used to adjust the oxygen level (%) at firing rates of 85%, 65%, 45%, 30% and 18% as described in the following steps.

18. Locate the Variable Frequency Drive (VFD) behind the front door of the unit (Figure 4-3). Refer to the VFD operating controls shown in Figure 4-6.

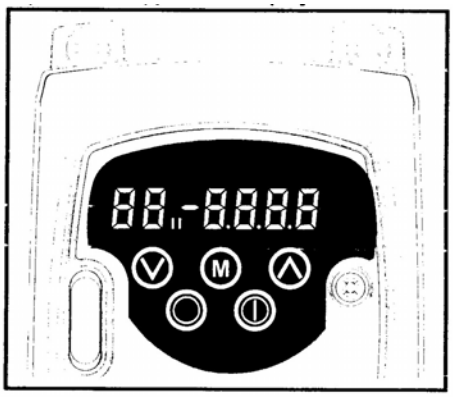


Figure 4-6
VFD Controls and Displays

IMPORTANT

In the following steps, the values appearing in the right part of the VFD display for parameters **65, 64, 63, 62, 61** represent the base frequency (Hz) x 10. For example: a displayed value of 528 corresponds to a frequency of 52.8 Hz.

19. Press the **M** (Menu) programming key on the VFD.
20. Using the up (**Λ**) arrow key, select VFD parameter **65**. The selected parameter will appear in the left part of the display and the frequency (Hz) will appear in the right part of the display (see **IMPORTANT** note above).
21. With the selected VFD parameter display flashing, press the **M** key. **Code** will be displayed, requesting the valid code to be entered. Enter code **59** using the arrow keys. Press the **M** key again to store the valid code.
22. With parameter **65** displayed in the left part of the VFD display, observe the oxygen level (%) on the Combustion Analyzer. The oxygen level at the 85% firing rate should be as shown in the following tabular listing. Also, ensure that the carbon monoxide (CO) and nitrogen oxide (NOx) readings do not exceed the values shown.

Combustion Oxygen Level at 85% Firing Rate

Oxygen % ± 0.2	Carbon Monoxide	NOx
6.0 %	<100 ppm	<30 ppm

23. If the oxygen level is not within the specified range, adjust the level using the up (**Λ**) and down (**V**) arrow keys on the VFD. Using the up (**Λ**) arrow key will increase oxygen level and the down (**V**) arrow key will decrease the oxygen level.

24. Once the oxygen level is within the specified range at 85%, lower the firing rate to 65% and select VFD parameter **64**. The oxygen level at the 65% firing rate should be as shown below.

Combustion Oxygen Level at 65% Firing Rate

Oxygen % ± 0.2	Carbon Monoxide	NOx
6.3 %	<50 ppm	<20 ppm

25. Adjust the oxygen level as necessary to obtain the required reading at the 65% firing rate.

26. Next, set the firing rate to 45% and select VFD parameter **63**. The oxygen level at the 45% firing rate should be as shown below.

Combustion Oxygen Level at 45% Firing Rate

Oxygen % ± 0.2	Carbon Monoxide	NOx
6.5 %	<50 ppm	<20 ppm

27. Adjust the oxygen level as necessary to obtain the required reading at the 45% firing rate.

28. Next, set the firing rate to 30% and select VFD parameter **62**. The oxygen level at the 30% firing rate should be as follows:

Combustion Oxygen Level at 30% Firing Rate

Oxygen % ± 0.2	Carbon Monoxide	NOx
5.6 %	<50 ppm	<20 ppm

29. Adjust the oxygen level as necessary to obtain the required reading at the 30% firing rate.

30. Finally, reduce the firing rate to 18% and select VFD parameter **61**. The oxygen level at the 18% firing rate should be as shown in the following tabular listing:

Combustion Oxygen Level at 18% Firing Rate

Oxygen % ± 0.2	Carbon Monoxide	NOx
6.5 %	<50 ppm	<20 ppm

31. Adjust the oxygen level as necessary to obtain the required reading at the 18% firing rate.

IMPORTANT

Repeat steps 20 through 31 until the VFD does not require adjustment when sequencing from 70% to 14%.

32. This completes the Natural Gas combustion calibration procedures.

IMPORTANT

Refer to Appendix K for switchover instructions when changing from Natural Gas to Propane or from Propane to Natural Gas.

4.4 PROPANE COMBUSTION CALIBRATION

The Benchmark 3.0 Dual Fuel Boiler is combustion calibrated at the factory prior to shipping. 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 propane 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 Fire Rate* message will be displayed with the present rate in **%**. Also, the **MANUAL** LED will light.

6. Adjust the fire rate to 0% by pressing the ▼ arrow key.
7. Ensure that the leak detection ball valve (Figure 4-1) downstream of the propane SSOV is open.
8. Ensure that the Fuel Selector Switch (Figure 4-3 is in the PROPANE position.
9. Locate the Variable Frequency Drive (VFD) on the front of the unit behind the panel door (Figure 4-3). Insert the "LogicStick" with the "PROPANE" label in the slot on the front of the VFD.
10. Set the **ON/OFF** switch on the unit control panel to the **ON** position.
11. Access the Control Panel Configuration Menu and change the Max Fire Rate to 75%. (Refer to Chapter 3, para. 3.3 for instructions on changing menu options).
12. Change the fire rate to 29% using the ▲ arrow key. The unit should begin its start sequence and fire.
13. Next, increase the fire rate to 75%. Verify that the gas pressure downstream of the propane SSOV is 2.1" W.C. for both FM and IRI gas trains. If gas pressure adjustment is required, remove the brass hex head cap on the propane SSOV (Figure 4-7). Make gas regulator adjustments using a flat-tip screwdriver to obtain 2.1" W.C.
14. With the firing rate at 75%, insert the combustion analyzer probe into the flue probe opening and allow enough time for the combustion analyzer to settle.

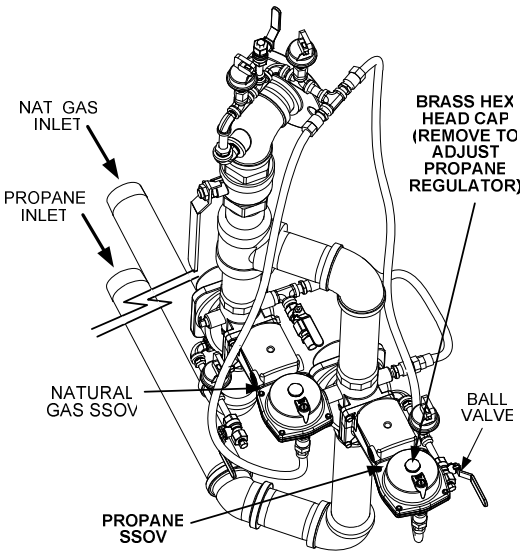


Figure 4-7
Regulator Adjustment Screw Location

NOTE

The combustion calibration steps utilize the Variable Frequency Drive (VFD) located behind the front door of the unit. The VFD up (**Λ**) and down (**V**) arrow keys will be used to adjust the oxygen level (%) at firing rates of 75%, 60%, 45%, 30% and 18% as described in the following steps.

15. Locate the Variable Frequency Drive (VFD) behind the front door of the unit (Figure 4-3). Refer to the VFD operating controls shown in Figure 4-6.

IMPORTANT

In the following steps, the values appearing in the right part of the VFD display for parameters **70**, **69**, **68**, **67**, **66** represent the base frequency (Hz) x 10. For example: a displayed value of 528 corresponds to a frequency of 52.8 Hz.

16. Press the **M** (Menu) programming key on the VFD.
17. Using the up (**Λ**) arrow key, select VFD parameter **70**. The selected parameter will appear in the left part of the display and the frequency (Hz) will appear in the right part of the display (see **IMPORTANT** note above).
18. With the selected VFD parameter display flashing, press the **M** key. **Code** will be displayed, requesting the valid code to be entered. Enter code **59** using the arrow keys. Press the **M** key again to store the valid code.
19. With parameter **70** displayed in the left part of the VFD display, observe the oxygen level (%) on the Combustion Analyzer. The oxygen level at the 75% firing rate should be as shown in the following tabular listing. Also, ensure that the carbon monoxide (CO) reading does not exceed the value shown.

Combustion Oxygen Level at 75% Firing Rate

Oxygen % ± 0.2	Carbon Monoxide
4.0 %	<100 ppm

20. If the oxygen level is not within the specified range, adjust the level using the up (**Λ**) and down (**V**) arrow keys on the VFD. Using the up (**Λ**) arrow key will increase oxygen level and the down (**V**) arrow key will decrease the oxygen level.
21. Once the oxygen level is within the specified range at 75%, lower the firing rate to 60% and select VFD parameter **69**. The oxygen level at the 60% firing rate should be as follows:

Combustion Oxygen Level at 60% Firing Rate

Oxygen % ± 0.2	Carbon Monoxide
5.5 %	<50 ppm

22. Adjust the oxygen level as necessary to obtain the required reading at the 60% firing rate.
23. Next, set the firing rate to 45% and select VFD parameter **68**. The oxygen level at the 45% firing rate should be as shown below.

Combustion Oxygen Level at 45% Firing Rate

Oxygen % ± 0.2	Carbon Monoxide
5.0 %	<100 ppm

24. Adjust the oxygen level as necessary to obtain the required reading at the 45% firing rate.
25. Next, set the firing rate to 30% and select VFD parameter **67**. The oxygen level at the 30% firing rate should be as follows:

Combustion Oxygen Level at 30% Firing Rate

Oxygen % ± 0.2	Carbon Monoxide
5.0 %	<100 ppm

26. Adjust the oxygen level as necessary to obtain the required reading at the 30% firing rate.
27. Finally, reduce the firing rate to 18% and select VFD parameter **66**. The oxygen level at the 18% firing rate should be as shown in the following tabular listing:

Combustion Oxygen Level at 18% Firing Rate

Oxygen % ± 0.2	Carbon Monoxide
5.5 %	<100 ppm

28. Adjust the oxygen level as necessary to obtain the required reading at the 18% firing rate.

IMPORTANT

Repeat steps 17 through 28 until the VFD does not require adjustment when sequencing from 75% to 18%.

29. This completes the Propane combustion calibration procedures.

4.5 UNIT REASSEMBLY

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

1. Access the Control Panel Configuration Menu and ensure that the Max Fire Rate is set to the desired level for the fuel being used for service operation (100% for Natural Gas; 75% for Propane).
2. Set the control panel **ON/OFF** switch to the **OFF** position.
3. Disconnect AC power from the unit.
4. Shut off the gas supply to the unit.
5. Set the Fuel Selector Switch to the corresponding position for the fuel being used for service operation.
6. Install the correct VFD Logic Stick for the fuel being used.
7. Remove the manometer and barbed fittings and reinstall the NPT plug using a suitable pipe thread compound.
8. Remove the combustion analyzer probe from the vent hole. Replace the NPT plug in the vent hole using a suitable pipe joint compound.
9. Replace the unit's side panels and front door.

4.6 OVER-TEMPERATURE LIMIT SWITCHES

The unit contains both automatic and manual reset over-temperature limit switches. These switches are mounted on a plate attached to the boiler shell as shown in Figure 4-6. The switches can be accessed by removing the left side panels 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 RESET button before the boiler can be restarted. The automatic reset over-temperature switch is adjustable and allows the boiler to restart, once the temperature drops below its temperature setting. Set the automatic over-temperature switch to the desired setting.

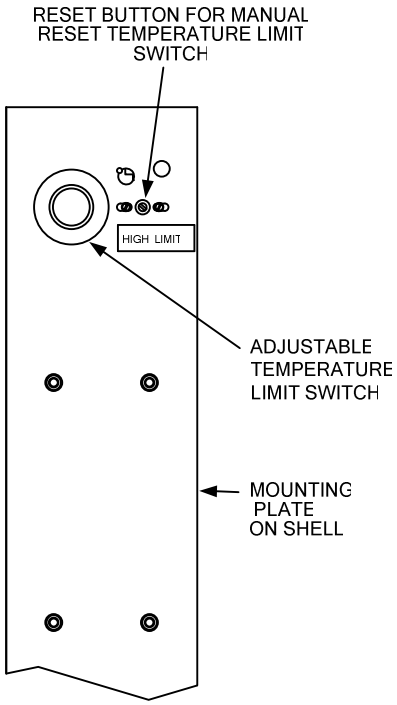


Figure 4-6
Over Temperature Limit Switch Locations

CHAPTER 5 MODE OF OPERATION

5.1 INTRODUCTION

The Benchmark 3.0 Dual-Fuel 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 Benchmark 3.0 Dual-Fuel 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 Benchmark 3.0 Dual-Fuel 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 2.9.1 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.
2. Choose the chart corresponding to the desired Building Reference Temperature.
3. Go down the left column of the chart to the coldest design outdoor air temperature expected in your area.

NOTE

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

4. Once the design outdoor air temperature is chosen, go across the chart to the desired supply header temperature for the design temperature chosen in step 3.
5. Next, go up that column to the Reset Ratio row to find the corresponding reset ratio.
6. Access the Configuration Menu and scroll through it until the display shows *Bldg Ref Temp*. (Building Reference Temperature).

7. Press the **CHANGE** key. The display will begin to flash.
8. Use the ▲ and ▼ arrow keys to select the desired Building Reference Temperature.
9. Press **ENTER** to save any changes.
10. Next, scroll through the Configuration Menu until the display shows *Reset Ratio*.
11. Press the **CHANGE** key. The display will begin to flash.
12. Use the ▲ and ▼ arrow keys to select the Reset Ratio determined in step 5.
13. Press **ENTER** to save the change.

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. 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 Benchmark 3. Dual-Fuel 0 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 fire rate 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 fire rate from 0% to 100%. A 4 mA/1V signal is equal to a 0% fire rate, while a 20 mA /5V signal is equal to a 100% fire rate. When a 0-20 mA/0-5 Vdc signal is used, zero is equal to a 0% fire rate.

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 fire rate 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. BMS II Model 5R5-384 can utilize only RS485 signaling to the Boiler.

The BMS mode of operation is used in conjunction with an AERCO Boiler Management System. The BMS mode is used when it is desired to operate multiple units in the most efficient manner possible. 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 programming and operation, see GF-108M (BMS Model 168) and GF-124 (BMS II Model 5R5-384), BMS Operations Guides. 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 Benchmark 3.0 Dual-Fuel 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) and the RS485 COMM terminals in the I/O Box on the front of the Benchmark 3.0 Dual-Fuel 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 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 controls the firing rate. 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 BMS Model 168 can be utilized for the Combination Mode, not the BMS II (Model 5R5-384).

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) 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 simul-taneously.+ 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 100% firing rate, the BMS will then ask the Combination Control Panel for the domestic boilers to become space-heating boilers. Provided the domestic hot water load is satisfied, the combo (hot water) boilers will then become space-heating boilers. If the domestic hot water load is not satisfied, the combo boiler(s) remain on the domestic hot water load. If the combo boilers switch over to space heating, but there is a call for domestic hot water, the CCP switches the combo units back to the domestic load.

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.

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. 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.

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	SETTING
Boiler Mode	Combination
Remote Signal	BMS (PWM Input)
Internal Setpt	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, thes 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 controls the firing rate. There are no setup requirements to the boiler(s) in this mode

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 Benchmark 3.0 Dual-Fuel 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 460, 220, 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 NATURAL GAS LOW GAS PRESSURE SWITCH TEST

Refer to Figure 6-1 and ensure that the leak detection ball valve located at the top of the gas train by the high gas pressure switches is closed.

1. Ensure that the Fuel Selector Switch (Figure 4-3) is set to the NATURAL GAS position.
2. Remove the 1/8 " plug from the ball valve at the natural gas low gas pressure switch shown in the lower-left portion of Figure 6-1.
3. Install a 0 – 16 " W.C. manometer or a W.C. gauge where the 1/8" plug was removed.
4. Slowly open the ball valve near the low gas pressure switch.
5. Place the unit in Manual Mode and adjust the firing rate between 25 and 30%.
6. While the unit is firing, slowly close the external manual gas shut-off valve.
7. The unit should shut down and display a *LOW GAS PRESSURE* fault message at approximately 2.6" W.C. The **FAULT** indicator should also start flashing.

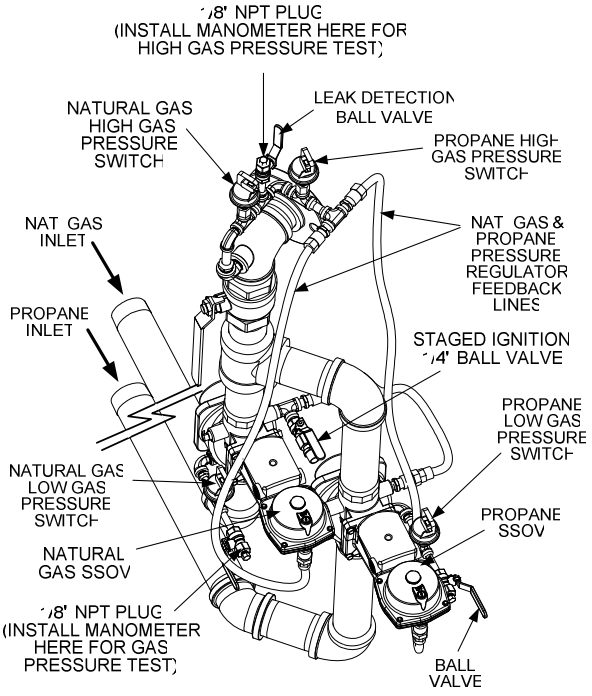


Figure 6-1
Low & High Gas Pressure Testing

8. Fully open the external manual gas shut-off valve and press the **CLEAR** button on the Control Box.
9. The fault message should clear and the **FAULT** indicator should go off. The unit should restart.
10. Upon test completion, close the ball valve and remove the manometer. Replace the 1/8 " plug removed in step 2.

6.3 PROPANE LOW GAS PRESSURE SWITCH TEST

Refer to Figure 6-1 and ensure that the leak detection ball valve located at the top of the gas train by the high gas pressure switches is closed.

1. Ensure that the Fuel Selector Switch (Figure 4-3) is set to the PROPANE position.
2. Remove the 1/8“ plug from the ball valve at the propane low gas pressure switch shown in the lower-right portion of Figure 6-1.
3. Install a 0 – 16 “ W.C. manometer or a W.C. gauge where the 1/8" plug was removed.
4. Slowly open the ball valve near the low gas pressure switch.
5. Place the unit in Manual Mode and adjust the firing rate between 25 and 30%.
6. While the unit is firing, slowly close the external manual gas shut-off valve.
7. The unit should shut down and display a *LOW GAS PRESSURE* fault message at approximately 2.6” W.C. The **FAULT** indicator should also start flashing.
8. Fully open the external manual gas shut-off valve and press the **CLEAR** button on the Control Box.
9. The fault message should clear and the **FAULT** indicator should go off. The unit should restart.
10. Upon test completion, close the ball valve and remove the manometer. Replace the 1/8 “ plug removed in step 2.

6.4 NATURAL GAS HIGH GAS PRESSURE SWITCH TEST

To simulate a natural gas high gas pressure fault, refer to Figure 6-1 and proceed as follows:

1. Ensure that the Fuel Selector Switch (Figure 4-3) is set to the NATURAL GAS position.
2. Remove the 1/8“ plug from the leak detection ball valve shown in the upper portion of Figure 6-1.
3. Install a 0 – 16” W.C. manometer (or W.C. gauge) where the 1/8” plug was removed.
4. Slowly open the leak detection ball valve.
5. Start the unit in Manual mode at a firing rate between 25 and 30%.
6. Slowly increase the gas pressure using the adjustment screw on the natural gas SSOV.
7. The unit should shut down and display a *HIGH GAS PRESSURE* fault message when the gas pressure exceeds 7” W.C. The **FAULT** indicator should also start flashing.
8. Reduce the gas pressure back to 5” W.C.
9. Press the **CLEAR** button on the Control Box to clear the fault.
10. The fault message should clear and the **FAULT** indicator should go off. The unit should restart.
11. Upon test completion, close the ball valve and remove the manometer. Replace the 1/8“plug removed in step 2.

6.5 PROPANE HIGH GAS PRESSURE SWITCH TEST

To simulate a propane high gas pressure fault, refer to Figure 6-1 and proceed as follows:

1. Ensure that the Fuel Selector Switch (Figure 4-3) is set to the PROPANE position.
2. Remove the 1/8“ plug from the leak detection ball valve shown in the upper portion of Figure 6-1.
3. Install a 0 – 16” W.C. manometer (or W.C. gauge) where the 1/8” plug was removed.
4. Slowly open the leak detection ball valve.
5. Start the unit in Manual mode at a firing rate between 25 and 30%.
6. Slowly increase the gas pressure using the adjustment screw on the propane SSOV.
7. The unit should shut down and display a *HIGH GAS PRESSURE* fault message when the gas pressure exceeds 3.5” W.C. The **FAULT** indicator should also start flashing.
8. Reduce the gas pressure back to 2.1” W.C.
9. Press the **CLEAR** button on the Control Box to clear the fault.

10. The fault message should clear and the **FAULT** indicator should go off. The unit should restart.

11. Upon test completion, close the ball valve and remove the manometer. Replace the 1/8“ plug removed in step 2.

6.6 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 firing rate 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.

6.7

WATER TEMPERATURE FAULT TEST

A high water temperature fault is simulated by adjusting the automatic over-temperature switch. This switch is accessible from the left side 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 over-temperature switch setting to match the displayed OUTLET TEMPERATURE.
3. Once the adjustable over-temperature switch setting is approximately at, or just below, the actual outlet water temperature, the unit should shut down. The **FAULT** indicator should start flashing and a *HIGH WATER TEMP SWITCH OPEN* fault message should be displayed. It should not be possible to restart the unit.
4. Reset the adjustable over-temperature switch to its original setting.
5. The unit should start once the adjustable temperature limit switch setting is above the actual outlet water temperature.
6. Once the adjustable over-temperature switch setting is approximately at, or just below, the actual outlet water temperature, the unit should shut down. The **FAULT** indicator should start flashing and a *HIGH WATER TEMP SWITCH OPEN* fault message should be displayed. It should not be possible to restart the unit.
7. Reset the adjustable over-temperature switch to its original setting.
8. The unit should start once the adjustable temperature limit switch setting is above the actual outlet water temperature.

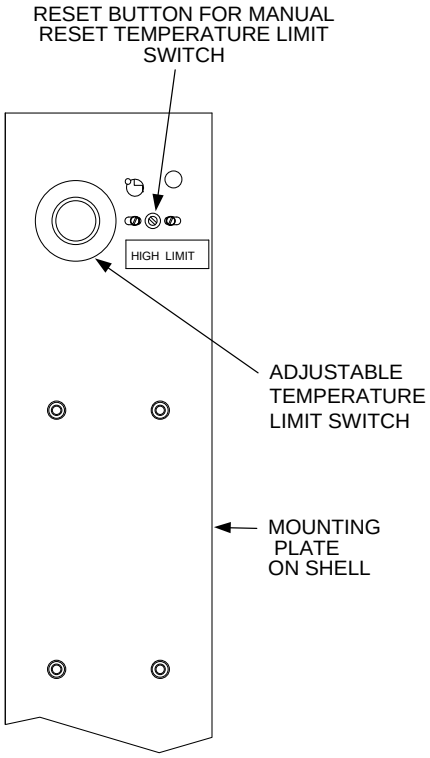


Figure 6-2
Temperature Limit Switch Setting

6.8 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.

6.8.1 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 firing rate 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.

6.8.2 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 firing rate 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.

6.9 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 firing rate 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 and the Air/Fuel Valve.
9. The unit should shut down and display *FLAME LOSS DURING RUN*.
10. Open the valve previously closed in step 8.
11. Press the **CLEAR** button. The unit should restart and fire.

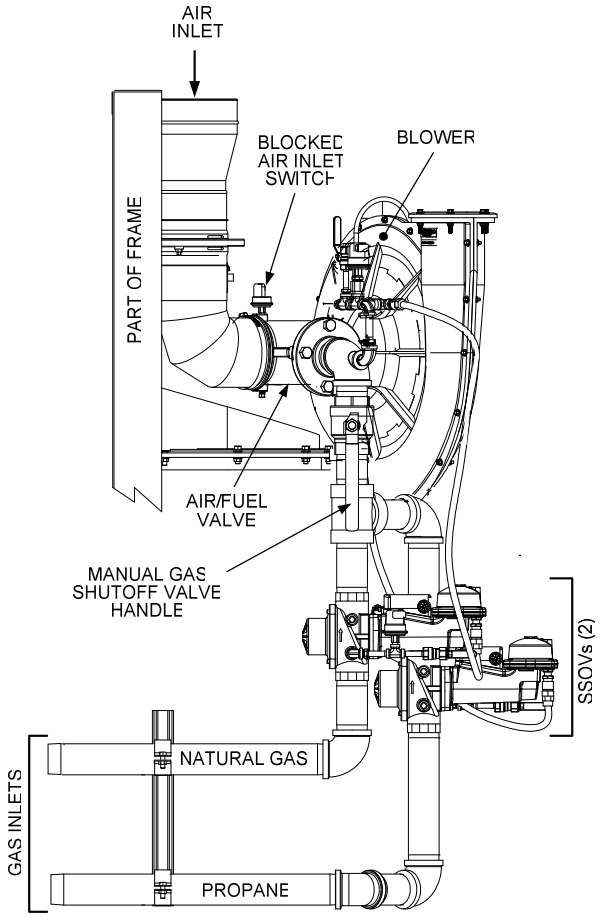


Figure 6-3
Manual Gas Shut-Off Valve Location

6.10 AIR FLOW FAULT TESTS

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

1. Start the unit in the Manual Mode at a firing rate between 25% and 30%.
2. Once the unit has proved flame, remove the memory stick from the Variable Frequency Drive (VFD).
3. The Blower Proof Switch will open and the blower should stop. The unit should shut down and display *AIRFLOW FAULT DURING RUN*.
4. Replace the memory stick in the VFD.
5. Press the **CLEAR** button. The unit should restart.
6. Next, check the Blocked Inlet Switch by closing the Iris Air Damper to position 8.
7. .The unit should shut down and again display *AIRFLOW FAULT DURING RUN*.
8. Return the Iris Air Damper to its previous setting.
9. Press the **CLEAR** button. The unit should restart.

6.11 SSOV PROOF OF CLOSURE SWITCH

This test can be performed when the unit is set up to run on either natural gas or proane fuel. Downstream SSOVs #1 (natural gas) and #3 (propane) shown in Figure 6-1 contain the proof of closure switches. 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 firing rate between 25% and 30%
3. Refer to Figure 6-1 and locate downstream SSOV #1(natural gas).
4. Remove the cover from SSOV #1 by loosening the screw shown in Figure 6-4. Lift off the cover to access the terminal wiring connections.
5. Disconnect wire #148 from SSOV #1 to "open" the proof of closure switch circuit. When wire #148 is disconnected, it opens the proof of closure switch circuit for both the natural gas and propane downstream SSOVs.
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 SSOV #1 and press the **CLEAR** button. The unit should restart.

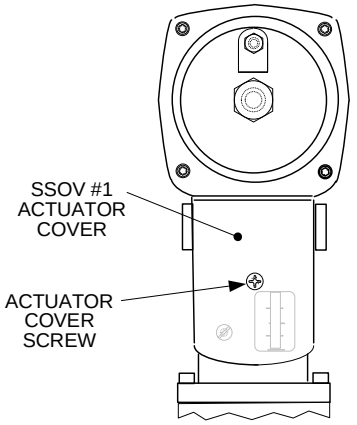


Figure 6-4
SSOV #1 Actuator Cover Location

6.12 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 fire rate 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.

6.13 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 firing rate 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 it's 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.

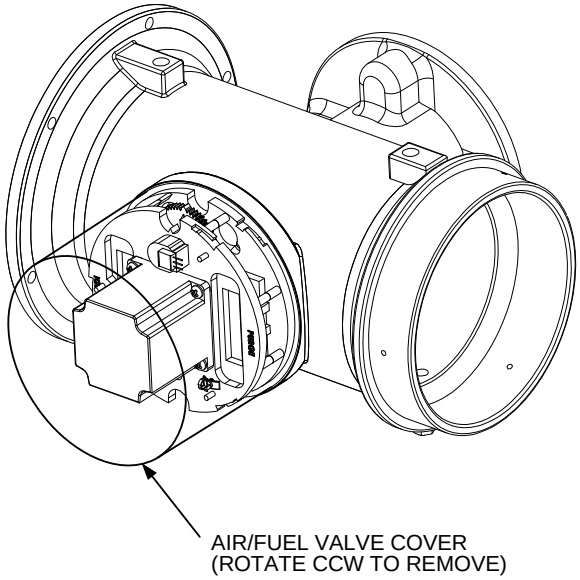


Figure 6-5
Air/Fuel Valve Cover Location

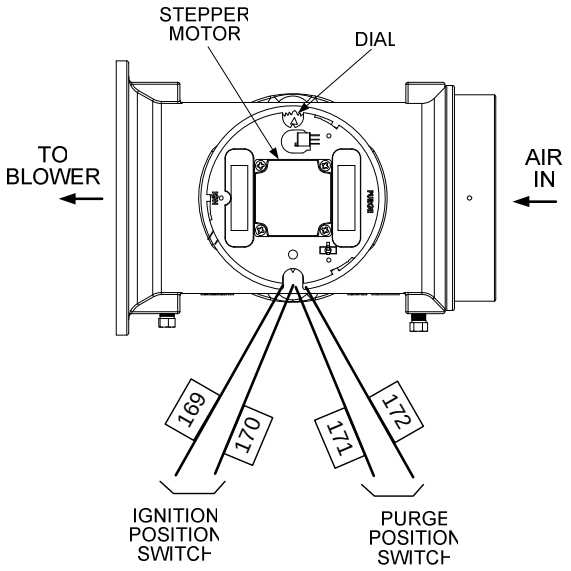


Figure 6-6
Air/Fuel Valve Purge and Ignition Switch Locations

6.14 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 carried out in the time periods specified in Table 7-1. See Appendix I for a complete CSD-1 inspection check list.

WARNING

TO AVOID PERSONAL, PRIOR TO SERVICING:

- 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

7.2 SPARK IGNITER

The spark igniter, part no. GP-122435-S, is located in the body of the burner (see Figure 7-1). The igniter may be HOT. Care should be exercised. It is easier to remove the igniter from the unit after the unit has cooled to room temperature.

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 igniter cable from the igniter.
4. Using a 15/16” wrench, unscrew the igniter from the burner head. Remove the igniter from the burner shell, by grasping the contact end of the igniter.
5. The igniter is gapped at 1/8-inch. If there is a substantial erosion of the spark gap or ground electrode, the igniter should be replaced. If carbon build-up is present, clean the igniter using fine emery cloth. Repeated carbon build-up on the igniter is an indication that a check of the combustion settings is required (see Chapter 4 for combustion calibration.
6. Prior to reinstalling the igniter, a high temperature anti-seize compound must be applied to the igniter threads.
7. Reinstall the igniter. Do not over tighten the igniter. A slight snugging up is sufficient. Reconnect the igniter cable.
8. Reinstall the side and top panels on the unit.

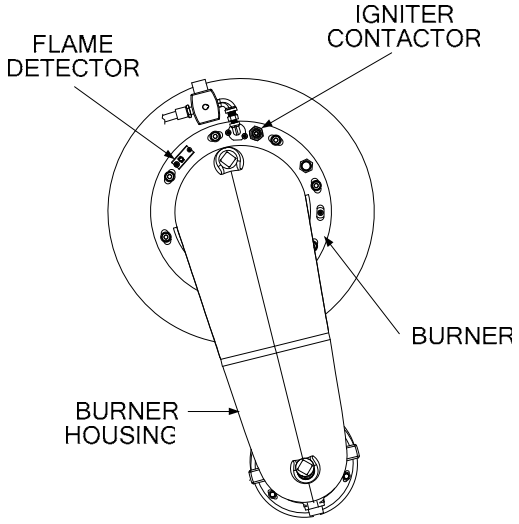


Figure 7-1
Spark Igniter and Flame Detector Location – Top View

MAINTENANCE

Table 7-1 - Maintenance Schedule

PARAGRAPH	ITEM	6 Mos.	12 Mos.	24 Mos.	Labor Time
7.2	Spark Igniter (GP-122435-S)	*Inspect	Inspect	Replace	15 mins.
7.3	Flame Detector (66006)	*Inspect	Inspect	Replace	15 mins.
7.4	Combustion Calibration	*Check	Check		1 hr.
7.5	Testing of Safety Devices		See CSD-1 Chart in Appendix I		20 mins.
7.6	Burner			Inspect	2 hrs.
7.7	Condensate Drain Traps	*Inspect	Inspect & Clean		1 hr.

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

7.3 FLAME DETECTOR

The flame detector, part no. 66006, is located in the body of the burner (see Fig. 7-1). 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 top panels from the unit.
3. Disconnect the flame detector lead wire. Unscrew the flame detector and remove it. (See Fig 7-2)
4. Inspect the detector thoroughly. If eroded, the detector should be replaced. Otherwise clean the detector with a fine emery cloth.
5. Reinstall the flame detector and flame detector gasket, if removed.
6. Reconnect the flame detector lead wire.
7. Reinstall the side and top panels on the unit.

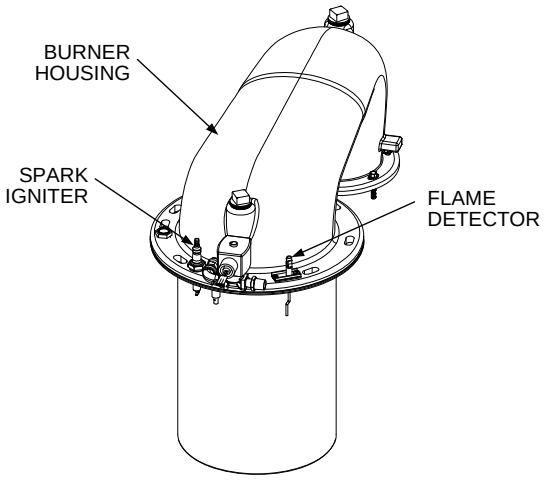


Figure 7-2
Spark Igniter and Flame Detector Location Cut-Away View

7.4 COMBUSTION CALIBRATION

Combustion settings must be checked at the intervals shown in Table 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

The burner assembly is located at the top front of the unit. The burner assembly may be HOT. Allow the unit to cool sufficiently before removing the burner assembly.

The following parts will be necessary for reassembly after inspection:

Part No.	Description
81030	Burner Gaskets (Qty=2)
81047	Gas Injector Gasket (Qty=1)

To inspect or replace the burner assembly:

8. 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.
9. Remove the side and top panels from the unit.
10. Disconnect the lead wire from the flame detector. Unscrew the flame detector.
11. Disconnect the igniter cable from the igniter contactor. Unscrew the igniter.
12. Remove the two (2) 10-32 screws securing the gas injector to the burner. Separate the gas injector and gasket from the burner.
13. Disconnect the burner housing from the blower by removing the six (6) 1/4-20 screws using a 3/8" wrench.
14. Remove the eight (8) 3/8-16 nuts from the burner flange (Figure 7-3) using a 9/16" wrench.

NOTE

The burner housing is heavy, weighing approximately 20 pounds.

15. Remove the burner housing from burner flange by pulling straight up.
16. Remove the grounding screw.

    If there is an extension ring around the burner, remove it.
17. Remove the burner by pulling straight up.
18. Remove and replace the burner gaskets.
19. Beginning with the burner removed in step 11, reinstall all the components in the reverse order that they were removed. However, if the burner was replaced, follow the instructions in step 14.
20. If the burner is being replaced, measure the outside diameter (O.D.) of the new burner flange. If the O.D. is approximately 13", do not reinstall the extension ring. However, if the O.D. of the new burner flange is approximately 12.4", the extension ring must be reinstalled.
21. Make sure to align the Spark Igniter (S/I) and Flame Rod (F/R) slots in the burner with the heat exchanger top head.
22. Check to ensure that the grounding screw is reinstalled.

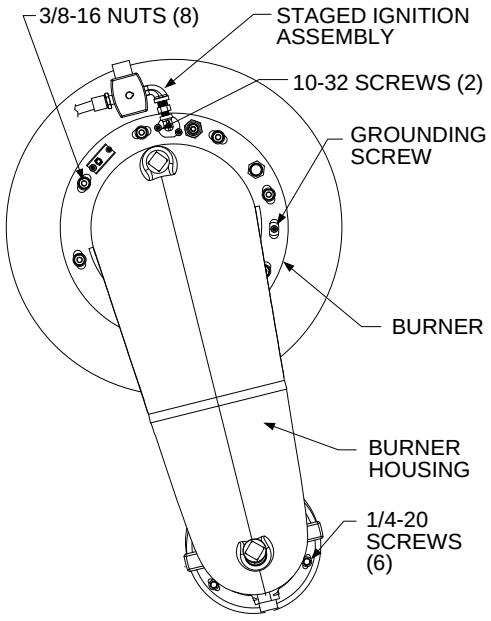


Figure 7-3
Burner Disassembly Diagram

7.7 CONDENSATE DRAIN TRAPS

The Benchmark 3.0 Dual-Fuel Boiler contains two condensate traps as shown in Figure 2-5. One trap is located external to the unit and attached to the drain pipe from the connecting manifold. The other trap is an integral part of the exhaust manifold. These traps should be inspected and, if necessary, cleaned to ensure proper operation. Follow the procedures in paragraphs 7.7.1 and 7.7.2.

7.7.1 Connecting Manifold Condensate Trap

To inspect and clean the trap, proceed as follows:

1. Disconnect the external condensate trap by loosening the hose clamps between the trap and the connecting manifold drain pipe.
2. Remove the connections on the inlet and outlet sides of the condensate trap shown in Figure 7-4.
3. Loosen the four (4) thumbscrews securing the cover on the condensate trap. Remove the cover.
4. Remove the float from the condensate trap.
5. Remove the orifice gasket from the trap.
6. Thoroughly clean the trap, float and gasket. Also inspect the drain piping for blockage. If the trap cannot be thoroughly cleaned, replace the trap.
7. After the above items have been inspected and thoroughly cleaned, replace the orifice gasket and float in the condensate trap and replace the trap cover.
8. Reassemble all piping and hose connections to the condensate trap inlet and outlet. Reconnect trap to connecting manifold drain pipe.

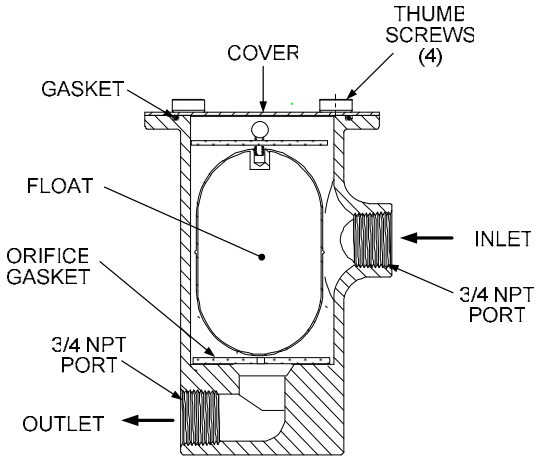


Figure 7-4
External Condensate Trap

7.7.2 Exhaust Manifold Condensate Trap

The exhaust manifold condensate trap also contains a float and orifice gasket identical to those shown in Figure 7-4. To inspect and clean the trap, refer to Figure 7-5 and proceed as follows:

1. Loosen the clamp securing the hose to the condensate drain (Figure 7-5). Disconnect the hose.
2. Remove the four bolts securing the flue to the top of the exhaust manifold. Separate the flue from the exhaust manifold.
3. From the top of the exhaust manifold, remove the float and orifice gasket from the condensate trap.
4. Thoroughly clean the trap, float and gasket. Also, inspect the drain hose for blockage.
5. After the above items have been inspected and cleaned, replace the gasket and float in the condensate trap. Also, resecure the hose to the exhaust manifold condensate drain.

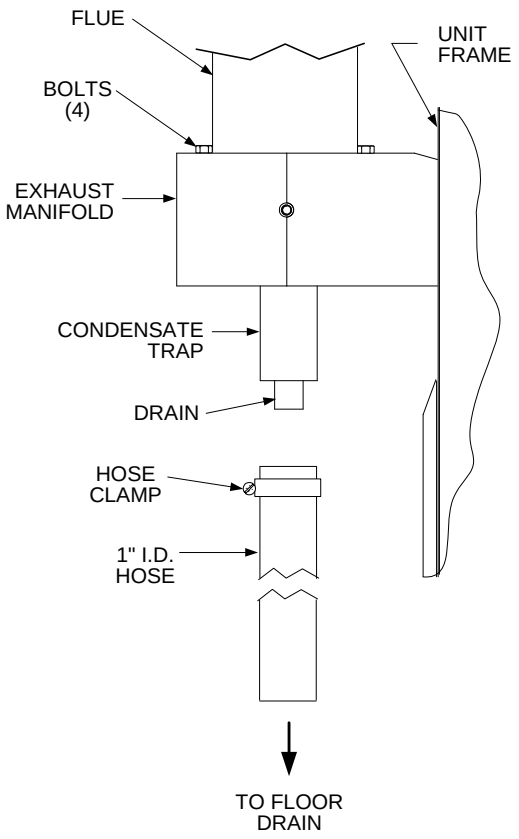


Figure 7-5
Exhaust Manifold Condensate Trap & Drain

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 the scheduled maintenance procedures per Chapters 6 and 7 of this manual.

Chapter 8- TROUBLESHOOTING GUIDE

8.1 INTRODUCTION

This troubleshooting guide is intended to aid service/maintenance personnel in isolating the cause of a fault in a Benchmark 3.0 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.

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.

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 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 transmitter to VFD's analog input wire connection	7. Check the actual inlet air temperature and measure voltage at temperature transmitter and VFD analog input. Verify that the voltage conforms to Table 8-3 for the inlet air temperature.
	8. Loose temperature sensor to temperature transmitter wire connection.	8. Refer to CORRECTIVE ACTION 7 and verify that the resistance conforms to Table 8-3.
	9. Defective temperature transmitter	9. See CORRECTIVE ACTION 7.
	10. Defective temperature sensor	10. See CORRECTIVE ACTION 8.
	11. Loose wire connection between the 4-20 mA signal from I/O box to VFD analog input	11. Measure amperage at the I/O box output and VFD analog input, 4mA equates to 0% fire rate and 20 mA equates to 100% fire rate
	12. Defective I/O box	12. See CORRECTIVE ACTION 11.
	13. Wrong 4-20 mA output selection on the control box	13. Check C-More configuration menu, mA OUT – Fire Rate should be selected
	14. Defective air-fuel valve potentiometer	14. Check air fuel valve position at 0%, 50% and 100% fire rates, the position on the c-more barograph should match the valve
	15. Defective or missing VFD's logic stick	15. Confirm that the logic stick is securely mounted on the VFD.
	16. Defective program on the logic stick or Defective VFD.	16. Check the following VFD parameters: Max Hz = 67, Min Hz = 0, parameter 59 & 60 should be set

TABLE 8-1. BOILER TROUBLESHOOTING – Continued

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
(continued)	17.Fuel Selector Switch set to incorrect position for fuel used or wrong Logic Stick is installed in VFD.	17. Check position of Fuel Selector Switch and the VFD Logic Stick installed.
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 17 for **AIRFLOW FAULT DURING IGNITION** applies for this fault	6. See **CORRECTIVE ACTION** from 3 to 16 for **AIRFLOW FAULT DURING IGNITION**
AIRFLOW FAULT DURING RUN	1. Blower stopped running due to thermal or current overload	1. Check combustion blower for signs of excessive heat or high current draw that may trip thermal or current overload devices.
	2. Blocked Blower inlet or inlet ductwork	2. Inspect the inlet to the combustion blower including any ductwork leading up to the combustion blower for signs of blockage.
	3. 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** apply for this fault	6. **PROBABLE CAUSES** from 3 to 16 for **AIRFLOW FAULT DURING IGNITION** apply for this fault.
	7. Unit set for propane operation, but Max Fire Rate was not changed to 75%.	7. Check Max Fire Rate setting in Configuration Menu.

TABLE 8-1. BOILER TROUBLESHOOTING – Continued

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
DELAYED INTERLOCK OPEN	1. Delayed Interlock Jumper not installed or removed. 2. Device proving switch hooked to interlocks is not closed	1. Check for a jumper properly installed across the delayed interlock terminals in the I/O box. 2. If there are 2 external wires on these terminals, check to see if an end switch for a 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)
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 is closed.	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 ignitor 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 ignitor, 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. Check position of staged ignition ball valve on gas train. See Figure 8-1 near end of this Chapter.

TABLE 8-1. BOILER TROUBLESHOOTING – Continued

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
(continued)	8. Carbon or other debris on Burner	8. Remove the burner and inspect for any carbon or debris. Clean and reinstall
FLAME LOSS DURING RUN	1. Worn Flame Detector or cracked ceramic.	1. Remove and inspect the Flame Detector for signs of wear or cracked ceramic. Replace if necessary.
	2. Defective Differential Regulator.	2. Check gas pressure readings using a gauge or manometer into and out of the Air/Fuel Valve to ensure that the gas pressure into and out of the valve is correct.
	3. Poor combustion calibration.	3. Check combustion calibration. Adjust as necessary.
	4. Debris on burner.	4. Remove the burner and inspect for any carbon or debris. Clean and reinstall.
	5. Blocked condensate drain.	5. Remove blockage in condensate drain.
HEAT DEMAND FAILURE	1. The Heat Demand Relays on the Ignition/Stepper board failed to activate when commanded	1. Press CLEAR button and restart the unit. If the fault persists, replace Ignition/Stepper (IGST) Board.
	2. Relay is activated when not in Demand	2. Defective relay. Replace IGST Board.
HIGH EXHAUST TEMPERATURE	1. Defective exhaust sensor.	1. Measure the actual exhaust temperature and continuity of the exhaust sensor. If the exhaust temperature is less than 475 ^{o}F and the exhaust sensor shows continuity replace the sensor.
	2. Carboned heat exchanger due to incorrect combustion calibration	2. If exhaust temperature is greater than 500 ^{o}F, check combustion calibration. Calibrate or repair as necessary.
HIGH GAS PRESSURE	1. Incorrect supply gas pressure.	1. Check to ensure gas pressure at inlet of SSOV is 2 psig maximum.
	2. Defective SSOV Supply Regulator.	2. If gas supply pressure downstream of SSOV cannot be lowered, to 1.5” W.C. (see para. 4.3, step 10), the SSOV Supply Regulator may be defective.

TABLE 8-1. BOILER TROUBLESHOOTING – Continued

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
continued	3. Defective High Gas Pressure Switch	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. Gas pressure snubber not installed.	4. See Figure 8-1. Ensure that the gas pressure snubber is installed at the high gas pressure switch.
HIGH WATER TEMP SWITCH OPEN	1. Faulty Water temperature switch.	1. Test the temperature switch to insure it trips at its actual water temperature setting.
	2. Incorrect PID settings.	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. Faulty shell temperature sensor.	3. Using the resistance charts in the Appendix C, Measure the resistance of Shell sensor and BTU sensor at a known water temperature.
	4. Unit in Manual mode	4. If unit is in Manual Mode switch to Auto Mode.
	5. Unit setpoint is greater than Over Temperature Switch setpoint.	5. Check setpoint of unit and setpoint of Temperature Switch; Ensure that the temperature switch is set higher than the unit's setpoint.
	6. Boiler Management System PID or other settings not correctly setup.	6. Check the BMS for changes to PID default values, correct as necessary.
	7. No interlock to boiler or BMS to disable boiler(s) in event that system pumps have failed.	7. If system pump is controlled by Energy Management System other than BMS or pumps are individually controlled by boiler, check to see if there are flow switches interlocked to the BMS or boiler.
	8. System flow rate changes are occurring faster than boilers can respond.	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.	1. See HIGH WATER TEMPERATURE SWITCH OPEN.
	2. Temp HI Limit setting is too low.	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.
INTERLOCK OPEN	1. Interlock jumper not installed or removed	1. Check for a jumper properly installed across the interlock terminals in the I/O box
	2. Energy Management System does not have boiler enabled.	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. Device proofing switch hooked up to interlocks is not closed.	3. Verify that the proving switch for any device hooked to the interlock circuit is closing and that the device is operational.

TABLE 8-1. BOILER TROUBLESHOOTING – Continued

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
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 3. Fuel Selector Switch is in the OFF position or was changed while the unit was running.	1. Measure gas pressure upstream of the supply gas regulator with the unit firing. Refer to paragraph 2.7.1 to ensure 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. 3. Check Fuel Selector Switch position.
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 2. Defective or shorted switch. 3. Switch wired incorrectly. 4. Defective Power Supply Board or fuse 5. Defective IGST Board	1. Start the unit. The Air/Fuel Valve should rotate to the purge (open) position, then back to ignition position (towards closed) during the ignition cycle. If the valve does not rotate back to the ignition position, check the Air/Fuel Valve calibration. If calibration is okay, the problem may be in the Air/Fuel Valve or the Control Box. Refer fault to qualified service personnel. 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. If the switch is wired correctly, replace the switch. 4. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board. 5. 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
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.
	3. Control Box signal type selection switches not set for correct signal type (voltage or current).	3. Check DIP switch on PMC board to ensure it is set correctly for the type of signal being sent. Check control signal type set in Configuration Menu.
RESIDUAL FLAME	1. SSOV not fully closed.	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.

TABLE 8-1. BOILER TROUBLESHOOTING – Continued

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
(continued)	2. Defective Flame Detector	2. Replace Flame Detector.
SSOV FAULT DURING PURGE	3. 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.	1. Press CLEAR button and restart unit. If fault persists, replace Ignition/Stepper (IGST) Board.
SSOV SWITCH OPEN	1. Actuator not allowing for full closure of gas valve	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. SSOV powered when it should not be	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. Defective Switch or Actuator	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. Incorrectly wired switch.	4. Ensure that the SSOV Proof of Closure switch is correctly wired.
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 FIRE RATE 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, para. 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 Valve 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 Staged Ignition 1/4" Ball Valve on the downstream side of the Natural Gas SSOV (see Figure 8-1). 2. Remove and inspect Gas Injector to ensure it is not clogged or damaged. 3. Close the 2" Shutoff Valve and the Staged Ignition 1/4" Ball Valve on the downstream side of the Natural Gas SSOV (see Figure 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 Propane SSOV, or Natural Gas SSOV depending on the type of fuel being used (Figure 8-3).
Air/Fuel Valve "hunting" at 80% Firing Rate	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.

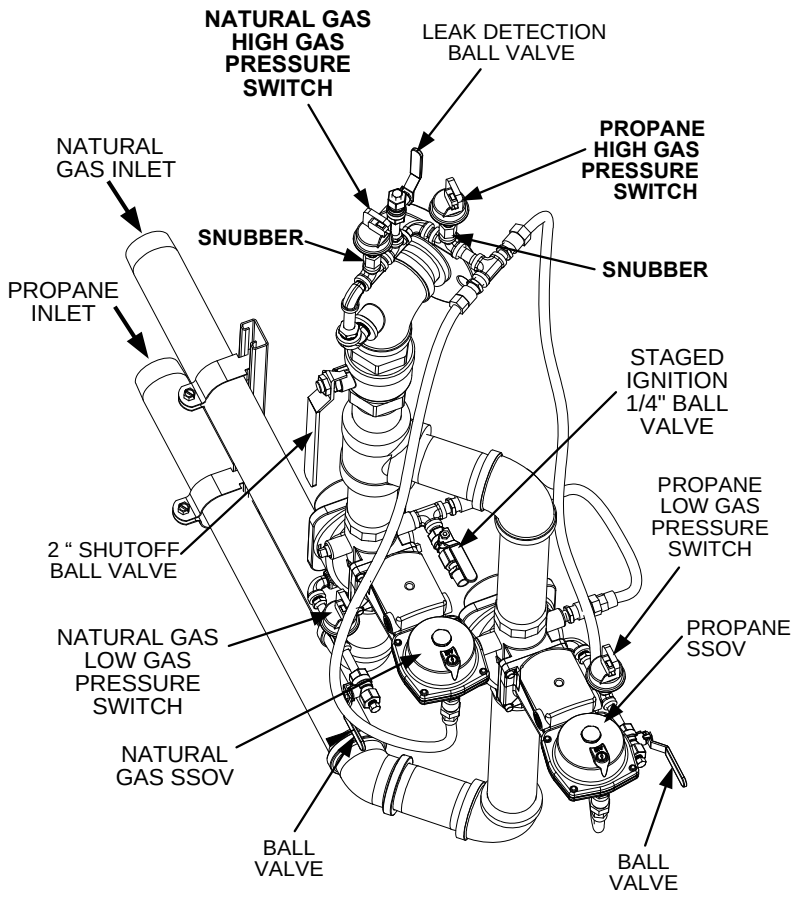


Figure 8-1
High Pressure Gas Switch & Snubber Locations

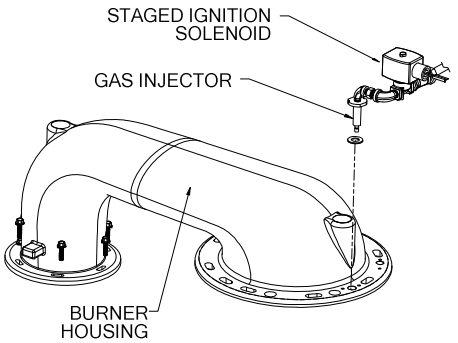


Figure 8-2
Staged Ignition Solenoid Location

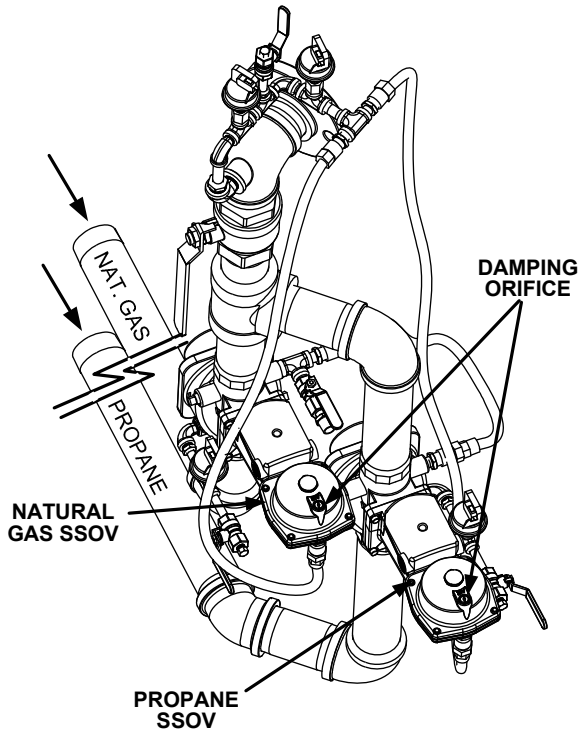


Figure 8-3
Damping Orifice Location

Table 8-3

BMK 3.0 LN (3.3 KΩ) Temperature Sensor and Temperature Transmitter Outputs								
TEMP ºC	TEMP ºF UA33	Resistance Ohm	Volts outputs UA33		TEMP ºC	TEMP ºF UA33	Resistance Ohm	Volts outputs UA33
-40	-40	111177	0.289		28	82.4	2915	6.16
-30	-22	58443	0.523		29	84.2	2787	6.31
-20	-4	32814	0.904		30	86	2659	6.470
-10	14	18200	1.560		31	87.8	2549	6.610
-5	23	13972	1.972		32	89.6	2443	6.760
0	32	10775	2.459		33	91.4	2343	6.900
1	33.8	10240	2.564		34	93.2	2247	7.040
2	35.6	9735	2.680		35	95	2156	7.180
3	37.4	9256	2.791		36	96.8	2068	7.320
4	39.2	8806	2.906		37	98.6	1984	7.460
5	41	8380	3.022		38	100.4	1905	7.600
6	42.8	7977	3.143		39	102.2	1830	7.730
7	44.6	7595	3.267		40	104	1758	7.860
8	46.4	7234	3.387		41	105.8	1688	8.000
9	48.2	6891	3.514		42	107.6	1622	8.130
10	50	6566	3.643		43	109.4	1559	8.250
11	51.8	6260	3.772		44	111.2	1499	8.490
12	53.6	5969	3.900		45	113	1441	8.510
13	55.4	5692	4.040		46	114.8	1386	8.630
14	57.2	5432	4.170		47	116.6	1334	8.750
15	59	5184	4.310		48	118.4	1283	8.960
16	60.8	4972	4.440		49	120.2	1234	8.980
17	62.6	4759	4.570		50	122	1189	9.100
18	64.4	4547	4.710		51	123.8	1145	9.210
19	66.2	4334	4.860		52	125.6	1102	9.320
20	68	4122	5.020		53	127.4	1061	9.430
21	69.8	3958	5.150		54	129.2	1023	9.530
22	71.6	3793	5.290		55	131	986	9.640
23	73.4	3629	5.520		56	132.8	950	9.740
24	75.2	3464	5.580		57	134.6	916	9.840
25	77	3300	5.740		58	136.4	883	9.920
26	78.8	3172	5.870		59	138.2	852	10.030
27	80.6	3044	6.010		60	140	821	10.120

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.
Aux Temp	For monitoring purposes only
Outdoor Temp	Displayed only if outdoor sensor is installed and enabled.
Fire Rate In	Desired input fire rate. This would normally be the same as the fire rate shown on the bar-graph (fire rate 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 9 faults.

APPENDIX A - BOILER MENU ITEM DESCRIPTIONS - Continued

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	Permits selection of English, Spanish or French for displayed messages. Default is English.
Time	Displays time from 12:00 am to 11:59 pm.
Date	Displays dates from 01/01/00 to 12/31/99
Unit of Temp	Permits selection of temperature displays in degrees Fahrenheit (°F) or degrees Celsius (°C). Default is °F.
Comm Address	For RS-485 communications (0 to 127). Default address is 0. RS-232 should have its own (programmable) password.
Baud Rate	Allows communications Baud Rate to be set (2400 to 19.2K). Default is 9600.
Software Version	Identifies the current software version of the control box (Ver 0.0 to Ver 9.9).
CONFIGURATION MENU	
Internal Setpoint	Allows internal setpoint to be set . Default is 130°F.
Unit Type	Allows selection of Boiler or Water Heater.
Unit Size	Sets unit size from 0.5 to 3.0 MBTUs. Default is 1.0 MBTU.
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.

APPENDIX A - BOILER MENU ITEM DESCRIPTIONS - Continued

MENU LEVEL & OPTION	DESCRIPTION
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 240°F). Default is 200°F.
Temp Hi Limit	This is the maximum allowable outlet temperature (40 to 240°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 210°F.
Max Fire Rate	Sets the maximum allowable fire rate for the unit (40% to 100%). Default is 100%.
Pump Delay Timer	Specifies the amount of time (0 to 30 min.) to keep the pump running after the unit turns off. Default is zero.
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.
mA Output	Must be set to Fire Rate Out for Benchmark 3.0LN.
Lo Fire Timer	Specifies how long (2 to 600 sec.) to remain in the low fire position after ignition, before going to the desired output. Default is 2 sec.

APPENDIX A - BOILER MENU ITEM DESCRIPTIONS - Continued

MENU LEVEL & OPTION	DESCRIPTION
TUNING MENU	
Prop Band	Generates a fire rate based on the error that exists between the setpoint temperature and the actual outlet temperature. If the actual error is less than the proportional band setting (1 to 120°F), the fire rate will be less than 100%. If the error is equal to or greater than the proportional band setting, the fire rate will be 100%.
Integral Gain	This sets the fraction of the output, due to setpoint error, to add or subtract from the output each minute to move towards the setpoint. Gain is adjustable from 0.00 to 1.00 (Default is 0.10).
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.
Reset Defaults?	Allows Tuning Menu options to be reset to their Factory Default values.

APPENDIX B - STARTUP, STATUS AND FAULT MESSAGES

TABLE B-1. STARTUP AND STATUS MESSAGES

MESSAGE	DESCRIPTION
DISABLED HH:MM pm MM/DD/YY	Displayed if ON/OFF switch is set to OFF. The display also shows the time and date that the unit was disabled.
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.
DEMAND DELAY XX sec	Displayed if Demand Delay is active.
PURGING XX sec	Displayed during the purge cycle during startup. The duration of the purge cycle counts up in seconds.
IGNITION TRIAL XX sec	Displayed during ignition trial of startup sequence. The duration of cycle counts up in seconds.
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.
WARMUP XX sec	Displayed for 2 minutes during the initial warmup only.
WAIT	Prompts the operator to wait.

APPENDIX B

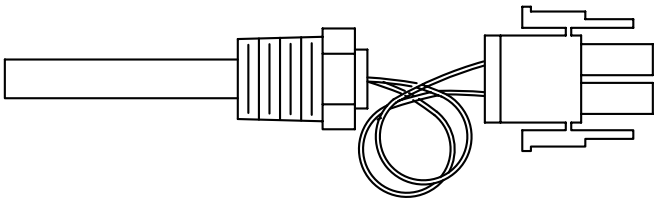
TABLE B-2. FAULT MESSAGES

FAULT MESSAGE	FAULT DESCRIPTION
HIGH WATER TEMP SWITCH OPEN	The High Water Temperature Limit Switch is open.
LOW WATER LEVEL	The Water Level Control board is indicating low water level.
LOW GAS PRESSURE	The Low Gas Pressure Limit Switch is open.
HIGH GAS PRESSURE	The High Gas Pressure Limit Switch is open.
INTERLOCK OPEN	The Remote Interlock is open.
DELAYED INTERLOCK OPEN	The Delayed Interlock is open.
AIRFLOW FAULT DURING PURGE	The Blower Proof Switch opened during purge, or air inlet is blocked.
PRG SWTCH OPEN DURING PURGE	The Purge Position Limit switch on the air/fuel valve opened during purge.
IGN SWTCH OPEN DURING IGNITION	The Ignition Position Limit switch on the air/fuel valve opened during ignition.
IGN SWTCH CLOSED DURING PURGE	The Ignition Position Limit switch on the air/fuel valve closed during purge.
PRG SWTCH CLOSED DURING IGNITION	The Purge Position Limit switch on the air/fuel valve closed during ignition.
AIRFLOW FAULT DURING IGN	The Blower Proof Switch opened during ignition.
AIRFLOW FAULT DURING RUN	The Blower Proof Switch opened during run.
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.
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.
HIGH EXHAUST TEMPERATURE	The High Exhaust Temperature Limit Switch is closed.
LOSS OF POWER	A power loss had occurred. The time and date when power was restored is displayed.

TABLE B-2. **FAULT MESSAGES** - Continued

FAULT MESSAGE	FAULT DESCRIPTION
RESIDUAL FLAME	The Flame signal was seen for more than 60 seconds during standby.
HEAT DEMAND FAILURE	The Heat Demand Relays on the Ignition board failed to activate when commanded.
IGN BOARD COMM FAULT	A communication fault has occurred between the PMC board and Ignition board.
DIRECT DRIVE SIGNAL FAULT	The direct drive signal is not present or is out of range.
REMOTE SETPT SIGNAL FAULT	The remote setpoint signal is not present or is out of range.
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.
FFWD TEMP SENSOR FAULT	The temperature measured by the FFWD Sensor is out of range.
HIGH WATER TEMPERATURE	The temperature measured by the Outlet Sensor exceeded the Temp Hi Limit setting.
LINE VOLTAGE OUT OF PHASE	The High AC voltage is out of phase from the low AC voltage.
STEPPER MOTOR FAILURE	The stepper motor failed to move the valve to the desired position.
NETWORK COMM FAULT	The RS-485 network information is not present or is corrupted.

TEMPERATURE SENSOR RESISTANCE CHART (BALCO)



TEMPERATURE SENSOR
AERCO PART NO. 123449

R = RESISTANCE (OHMS) T = TEMPERATURE (°F)
R=.00161T^2+1.961T+854.841

TEMP (°F)	RES. (OHMS)
-40	779.0
-30	797.5
-20	816.3
-10	835.4
0	854.8
10	874.6
20	894.7
30	915.1
40	935.9
50	956.9
60	978.3
70	1000.0
80	1022.0
90	1044.4
100	1067.0
110	1090.0
120	1113.3
130	1137.0
140	1160.9
150	1185.2
160	1209.5
170	1234.7
180	1260.0
190	1285.6
200	1311.4
210	1337.7
220	1364.2
230	1391.0
240	1418.2
250	1445.7

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 Temperatrure 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			

APPENDIX D

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					

APPENDIX D

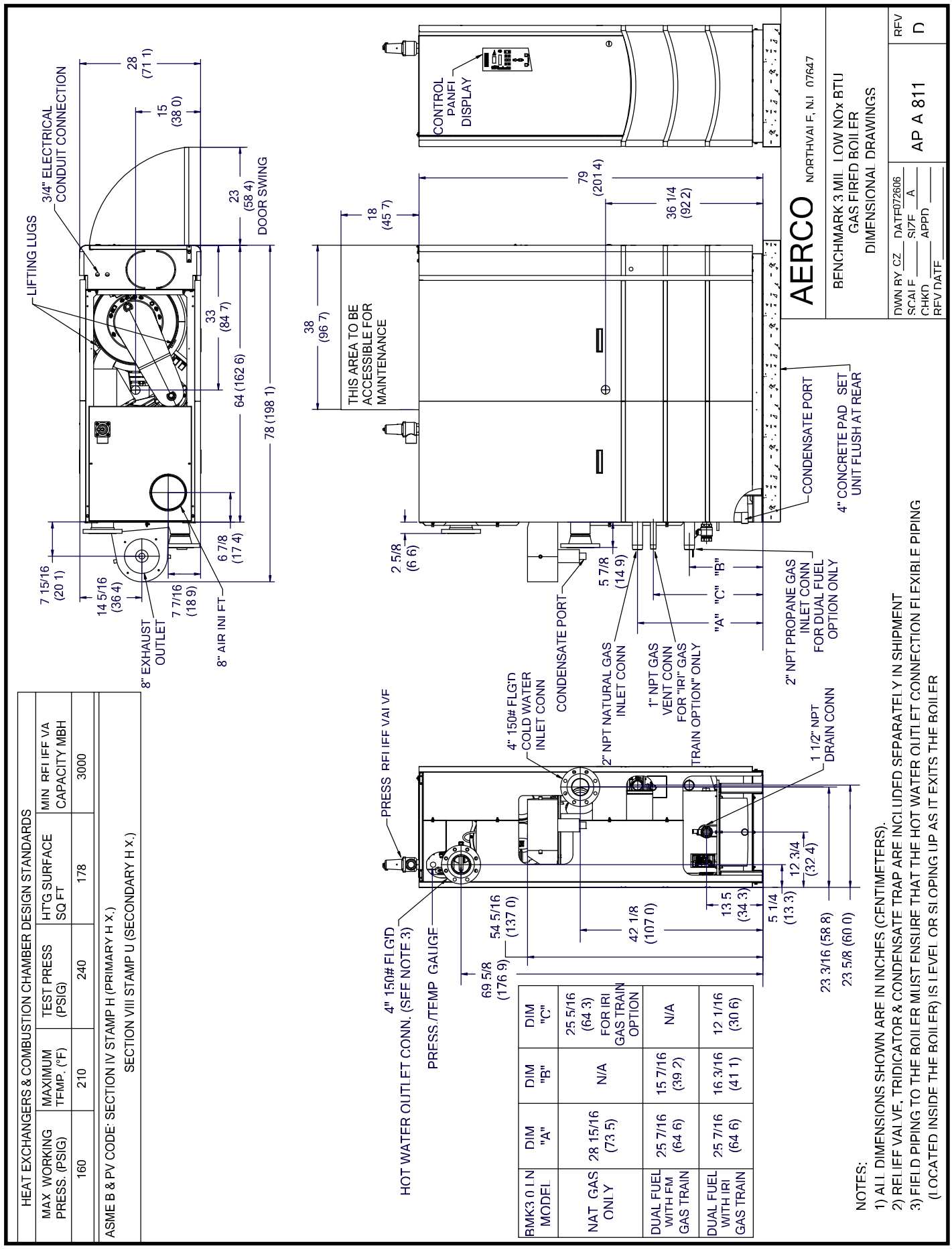
Table D-7. Header Temperature for a Building Reference Temperature of 90F

	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					

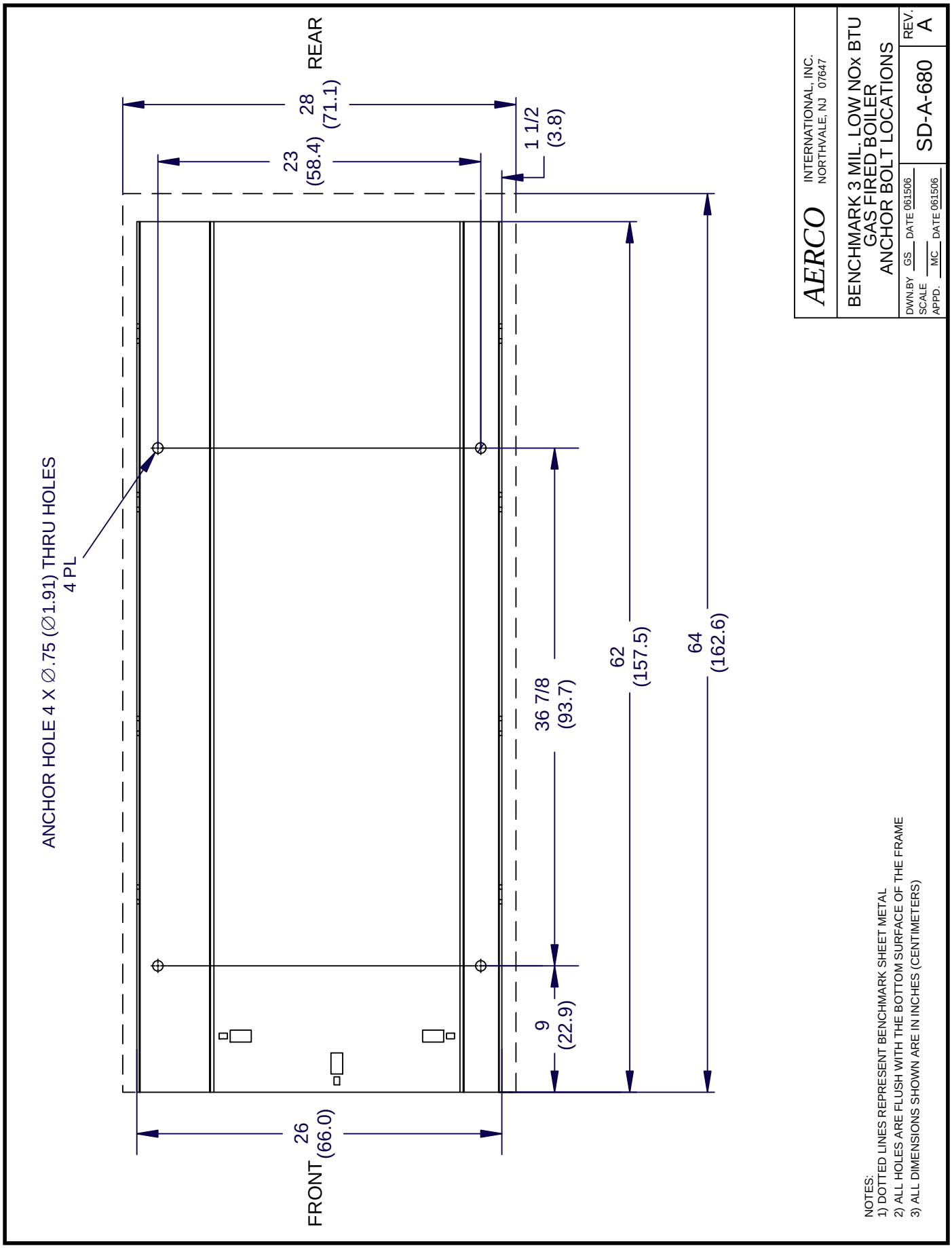
APPENDIX E

BOILER DEFAULT SETTINGS

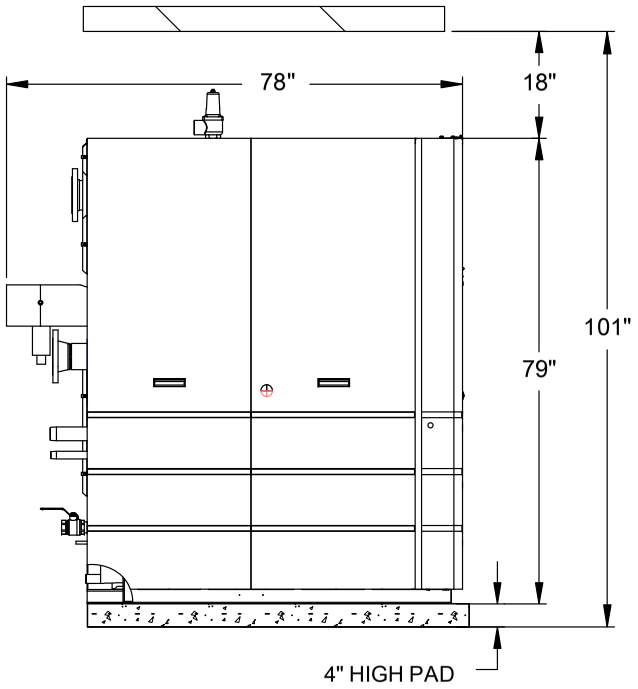
MENU & OPTION	FACTORY DEFAULT
Setup Menu	
Password	0
Language	English
Unit of Temp	Fahrenheit
Comm Address	0
Baud Rate	9600
Configuration Menu	
Internal Setpt	130°F
Unit Type	Boiler
Unit Size	3.0 MBTU
Boiler Mode	Constant Setpoint
Remote Signal (If Mode = Remote Setpoint, Direct Drive or Combination)	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	200°F
Temp Hi Limit	215°F
Max Fire Rate	100%
Pump Delay Timer	0 min
Aux Start On Dly	0 sec
Failsafe Mode	Shutdown
mA Output	Fire Rate Out **CAUTION:** DO NOT Change
Lo Fire Timer	2 sec
Setpt Limit Band (If Setpt Limiting = Enabled)	5°F
Tuning Menu	
Prop Band	70°F
Integral Gain	1.00
Derivative Time	0.0 min


HEAT EXCHANGERS & COMBUSTION CHAMBER DESIGN STANDARDS
MAX WORKING PRESS. (PSIG) | MAXIMUM TEMP. (°F) | TEST PRESS (PSIG) | HTG SURFACE SQ FT | MIN RFI IFF VA CAPACITY MBH
160 | 210 | 240 | 178 | 3000
ASME B & PV CODE: SECTION IV STAMP H (PRIMARY H X.)
SECTION VIII STAMP U (SECONDARY H X.)
LIFTING LUGS
3/4" ELECTRICAL CONDUIT CONNECTION
28 (71 1)
15 (38 0)
23 (58 4) DOOR SWING
33 (84 7)
64 (162 6)
78 (198 1)
7 15/16 (20 1)
14 5/16 (36 4)
7 7/16 (18 9)
6 7/8 (17 4)
8" EXHAUST OUTLET
8" AIR INLET
CONTROL PANEL DISPLAY
79 (201 4)
36 1/4 (92 2)
18 (45 7)
38 (96 7)
THIS AREA TO BE ACCESSIBLE FOR MAINTENANCE
2 5/8 (6 6)
5 7/8 (14 9)
CONDENSATE PORT
CONDENSATE PORT
4" CONCRETE PAD SET UNIT FLUSH AT REAR
"A" "C" "B"
2" NPT PROPANE GAS INLET CONN FOR DUAL FUEL OPTION ONLY
1" NPT GAS VENT CONN FOR "IRI" GAS TRAIN OPTION ONLY
2" NPT NATURAL GAS INLET CONN
4" 150# FLG'D COLD WATER INLET CONN
1 1/2" NPT DRAIN CONN
PRESS RELIEF VALVE
HOT WATER OUTLET CONN. (SEE NOTE 3)
PRESS./TEMP GAUGE
4" 150# FLG'D
69 5/8 (176 9)
54 5/16 (137 0)
42 1/8 (107 0)
13.5 (34 3)
5 1/4 (13 3)
12 3/4 (32 4)
23 3/16 (58 8)
23 5/8 (60 0)
RMK3 0 LN MODEL | DIM "A" | DIM "B" | DIM "C"
NAT GAS ONLY | 28 15/16 (73 5) | N/A | 25 5/16 (64 3) FOR IRI GAS TRAIN OPTION
DUAL FUEL WITH FM GAS TRAIN | 25 7/16 (64 6) | 15 7/16 (39 2) | N/A
DUAL FUEL WITH IRI GAS TRAIN | 25 7/16 (64 6) | 16 3/16 (41 1) | 12 1/16 (30 6)
NOTES:
1) ALL DIMENSIONS SHOWN ARE IN INCHES (CENTIMETERS).
2) RELIEF VALVE, TRIDICATOR & CONDENSATE TRAP ARE INCLUDED SEPARATELY IN SHIPMENT
3) FIELD PIPING TO THE BOILER MUST ENSURE THAT THE HOT WATER OUTLET CONNECTION FLEXIBLE PIPING (LOCATED INSIDE THE BOILER) IS LEVEL OR SLOPING UP AS IT EXITS THE BOILER
AERCO NORTHVALE, NJ 07647
BENCHMARK 3 MIL LOW NOx BTU GAS FIRED BOILER
DIMENSIONAL DRAWINGS
DWN BY CZ DATE 072606
SCALE SIZE A
CHKD APPD
RFV DATE
AP A 811
RFV D

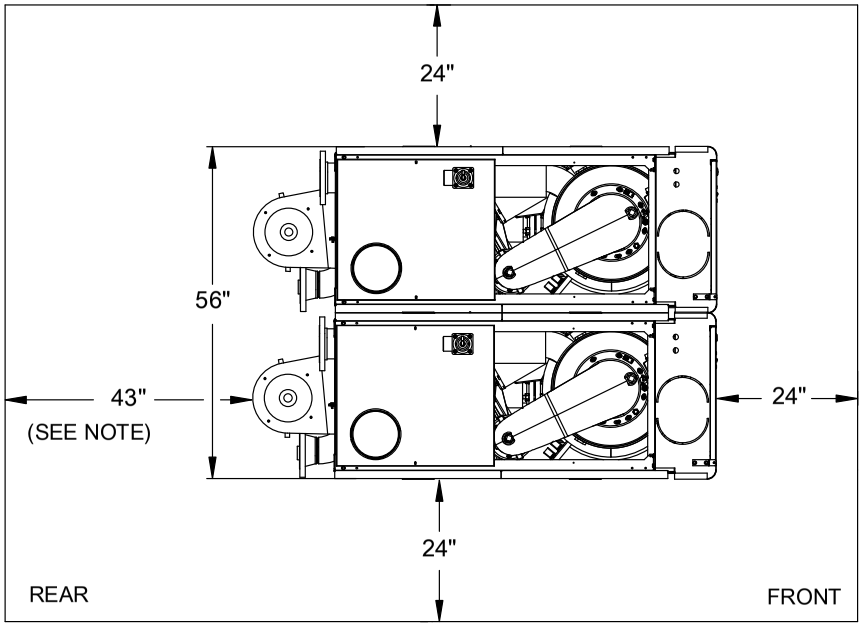
APPENDIX F


REAR
28
(71.1)
23
(58.4)
1 1/2
(3.8)
ANCHOR HOLE 4 X ∅.75 (∅1.91) THRU HOLES
4 PL
36 7/8
(93.7)
62
(157.5)
64
(162.6)
9
(22.9)
26
(66.0)
FRONT
NOTES:
1) DOTTED LINES REPRESENT BENCHMARK SHEET METAL
2) ALL HOLES ARE FLUSH WITH THE BOTTOM SURFACE OF THE FRAME
3) ALL DIMENSIONS SHOWN ARE IN INCHES (CENTIMETERS)
AERCO
INTERNATIONAL, INC.
NORTHVALE, NJ 07647
BENCHMARK 3 MIL. LOW NOx BTU
GAS FIRED BOILER
ANCHOR BOLT LOCATIONS
DWN.BY GS DATE 061506
SCALE
APPD. MC DATE 061506
SD-A-680
REV. A

SIDE VIEW



TOP VIEW



INSTALLATION CLEARANCES

1) THIS APPLIANCE MAY BE INSTALLED ON COMBUSTIBLE FLOORING

2) MINIMUM CLEARANCES TO ADJACENT CONSTRUCTION ARE AS FOLLOWS:

LEFT AND RIGHT SIDES: 24"
FRONT: 24"
REAR: 43" (SEE NOTE)
CEILING HEIGHT: 101"

3) THE INNER SIDE PANELS MUST BE REMOVED FROM BOTH UNITS FOR ZERO SIDE CLEARANCE INSTALLATIONS

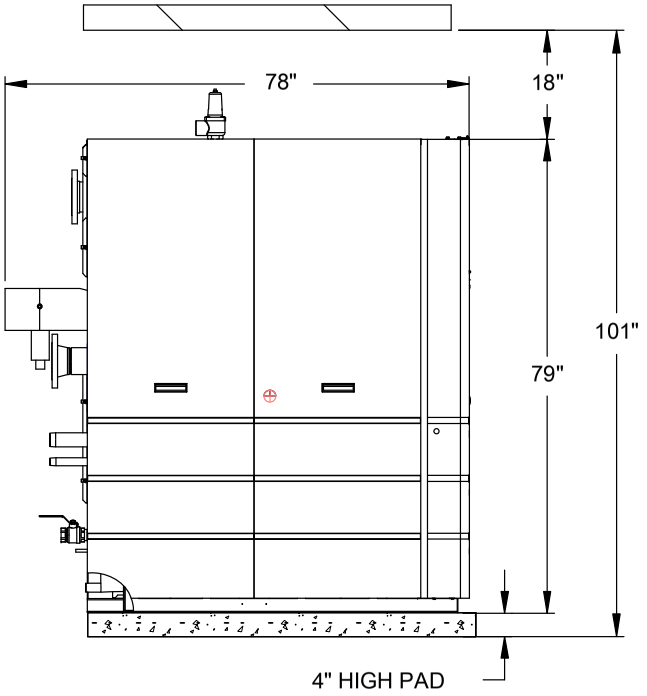
4) THE ZERO SIDE CLEARANCE OPTION CAN ONLY BE EMPLOYED IN TWO UNIT SETS

NOTE:
REAR CLEARANCE MAY BE REDUCED TO 24" DEPENDENT UPON PIPING AND VENTING COMPONENT SELECTION, ARRANGEMENT, AND LOCAL CODE REQUIREMENTS. HOWEVER, WHEN USING A REAR CLEARANCE OF LESS THAN 43", A 57" FRONT CLEARANCE WILL BE NEEDED TO ALLOW THE REMOVAL OF EXHAUST CONNECTING MANIFOLD.

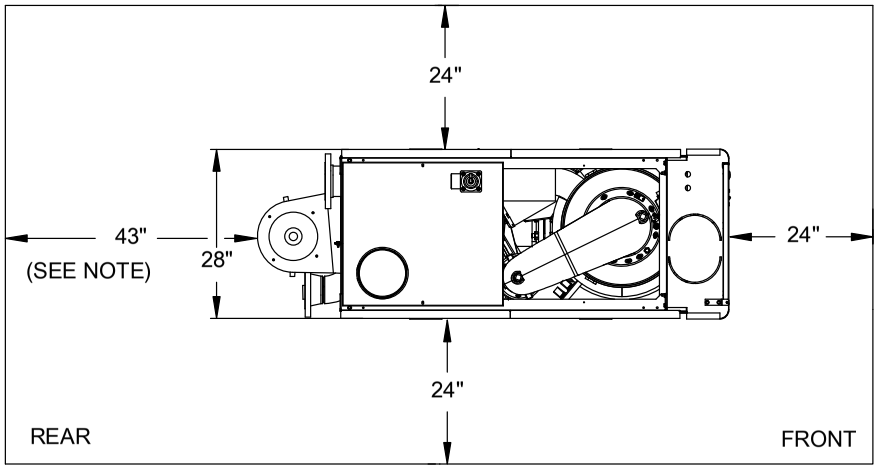
AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647		
BENCHMARK 3 MIL. BTU LOW NOx GAS FIRED BOILER ZERO SIDE CLEARANCE INSTALLATION		
DWN.BY GS DATE 061506 SCALE _____ APPD. MC DATE _____	SD-A-683	REV. C

F-3

SIDE VIEW



TOP VIEW



INSTALLATION CLEARANCES

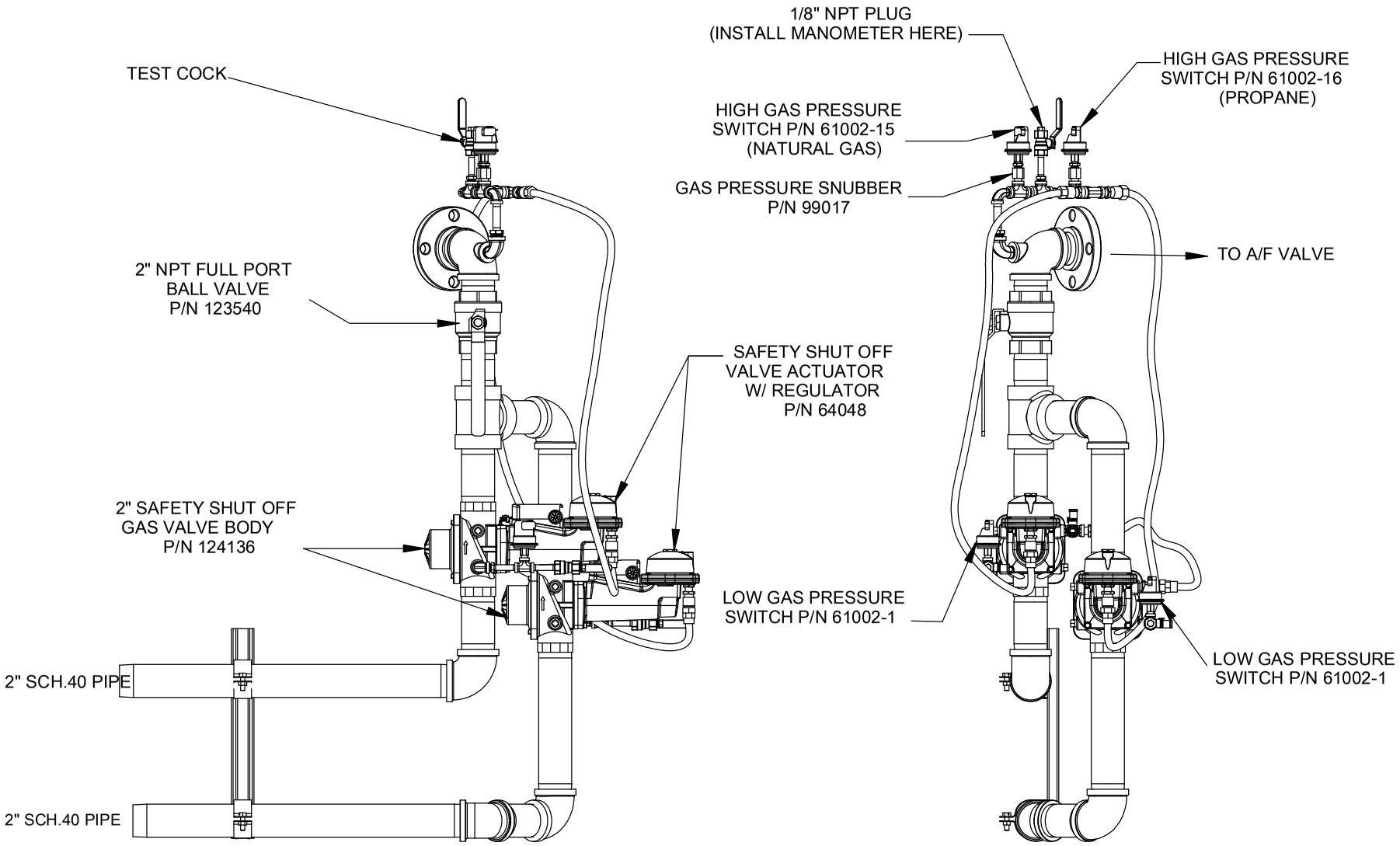
1) THIS APPLIANCE MAY BE INSTALLED ON COMBUSTIBLE FLOORING

2) MINIMUM CLEARANCES TO ADJACENT CONSTRUCTION ARE AS FOLLOWS:

LEFT AND RIGHT SIDES: 24"
FRONT: 24"
REAR: 43" (SEE NOTE)
CEILING HEIGHT: 101"

NOTE:
REAR CLEARANCE MAY BE REDUCED TO 24" DEPENDENT UPON PIPING AND VENTING COMPONENT SELECTION, ARRANGEMENT, AND LOCAL CODE REQUIREMENTS. HOWEVER, WHEN USING A REAR CLEARANCE OF LESS THAN 43", A 57" FRONT CLEARANCE WILL BE NEEDED TO ALLOW THE REMOVAL OF EXHAUST CONNECTING MANIFOLD.

AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647		
BENCHMARK 3 MIL. BTU LOW NOx GAS FIRED BOILER INSTALLATION CLEARANCES		
DWN.BY GS DATE 061506 SCALE ____ APPD. MC DATE ____	SD-A-686	REV. B



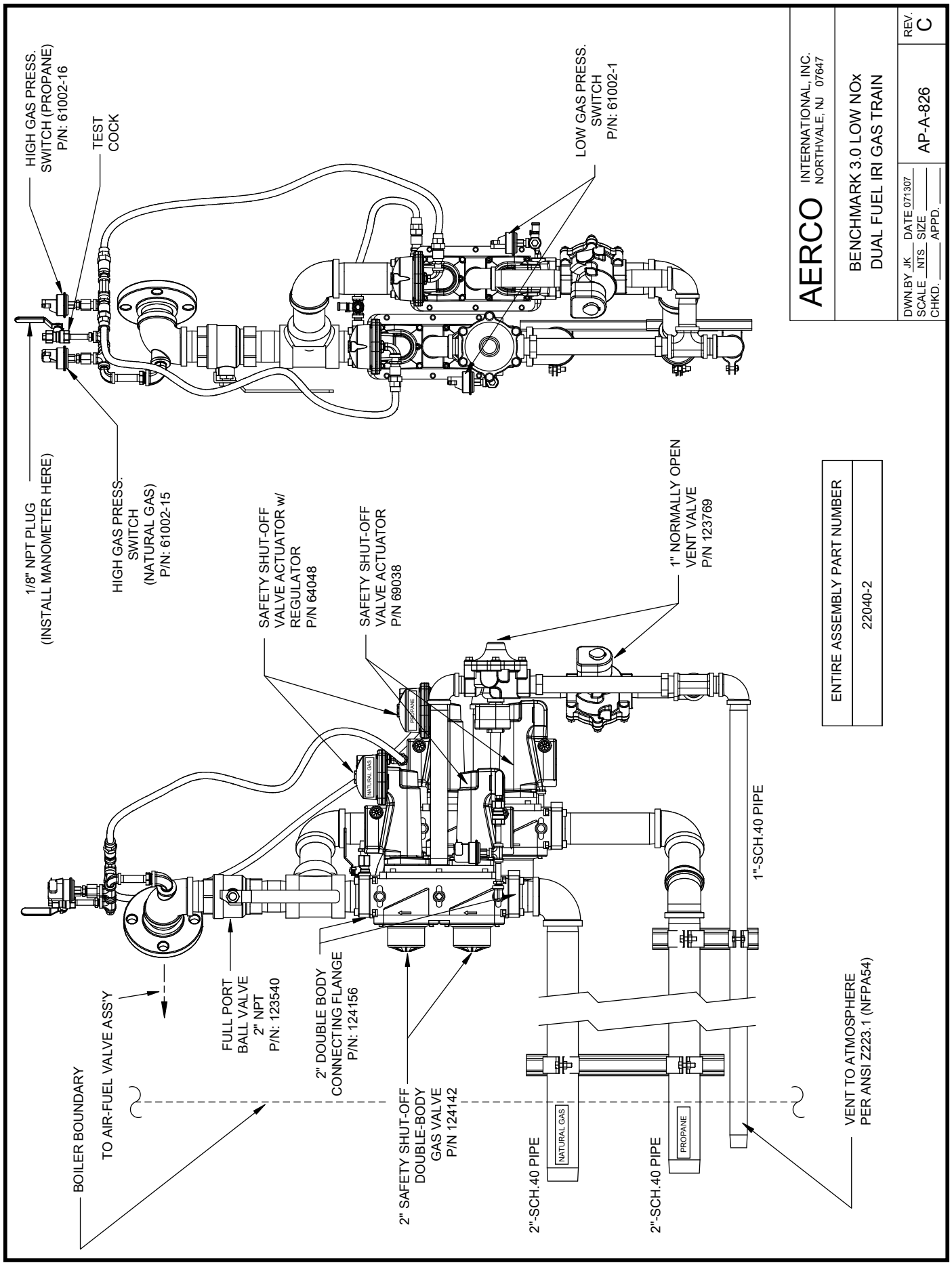
BMK3.0 LN FM DUAL FUEL GAS TRAIN ASSY. P/N 22040-1

AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647

BENCHMARK 3.0 LOW NOx
DUAL FUEL FM GAS TRAIN

DRWN BY:SJD DATE:3/23/09 *NOT TO SCALE*	AP - A - 845	REV A

APPENDIX F



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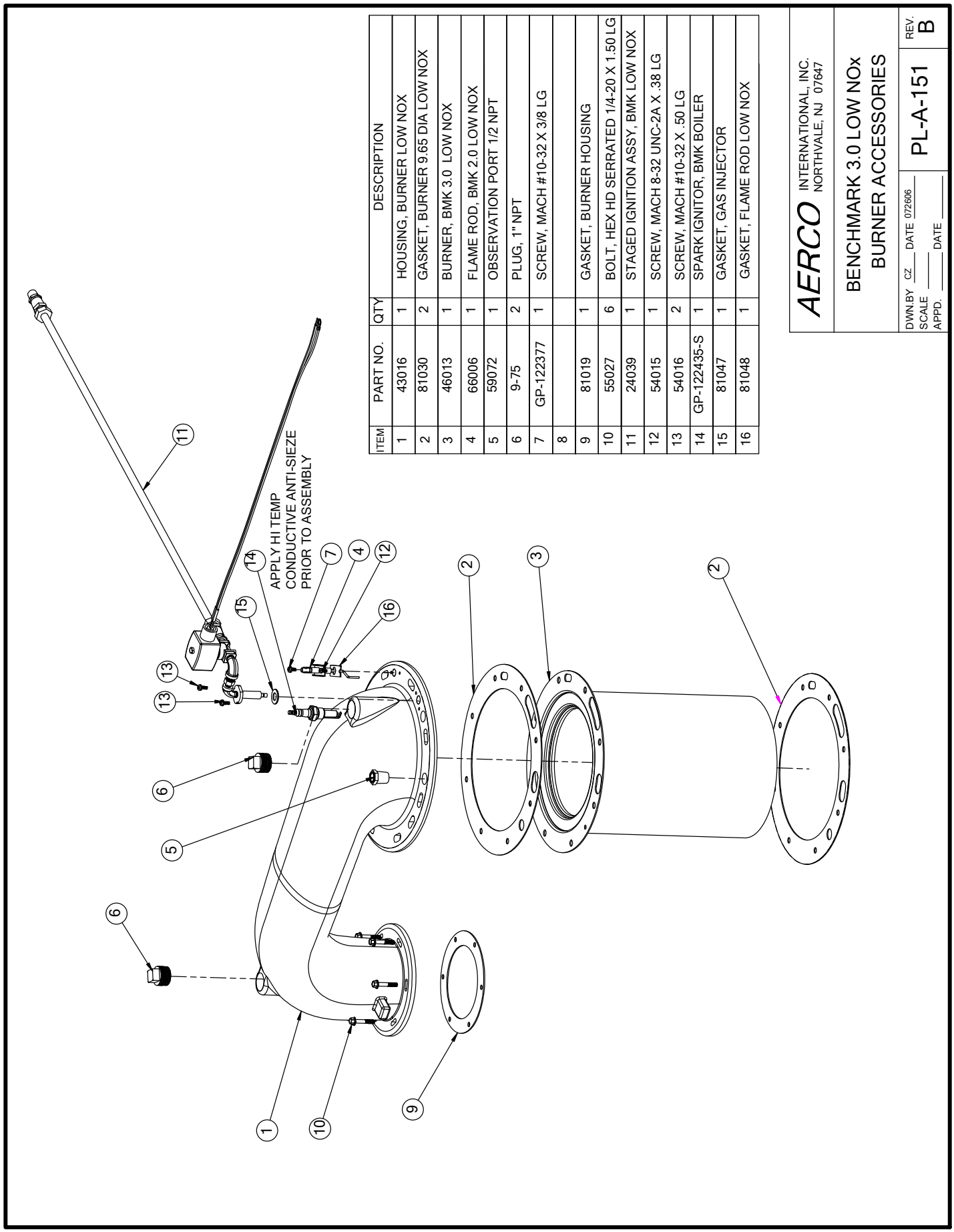
APPENDIX F



ITEM	PART NO.	QTY	DESCRIPTION
1	43016	1	HOUSING, BURNER LOW NOX
2	81030	2	GASKET, BURNER 9.65 DIA LOW NOX
3	46013	1	BURNER, BMK 3.0 LOW NOX
4	66006	1	FLAME ROD, BMK 2.0 LOW NOX
5	59072	1	OBSERVATION PORT 1/2 NPT
6	9-75	2	PLUG, 1" NPT
7	GP-122377	1	SCREW, MACH #10-32 X 3/8 LG
8			
9	81019	1	GASKET, BURNER HOUSING
10	55027	6	BOLT, HEX HD SERRATED 1/4-20 X 1.50 LG
11	24039	1	STAGED IGNITION ASSY, BMK LOW NOX
12	54015	1	SCREW, MACH 8-32 UNC-2A X .38 LG
13	54016	2	SCREW, MACH #10-32 X .50 LG
14	GP-122435-S	1	SPARK IGNITOR, BMK BOILER
15	81047	1	GASKET, GAS INJECTOR
16	81048	1	GASKET, FLAME ROD LOW NOX

AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647

BENCHMARK 3.0 LOW NOx
BURNER ACCESSORIES

DWN.BY CZ DATE 072606
SCALE _____ DATE _____
APPD. _____ DATE _____

PL-A-151

REV. B

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APPENDIX F

EXHAUST MANIFOLD			
ITEM	PART NO.	QTY	DESCRIPTION
1	39033	1	EXHAUST MANIFOLD
2	49102	3	EXHAUST MANIFOLD SEAL
3	39036	1	CONNECTING MANIFOLD
4	81098	1	EXHAUST MANIFOLD ORIFICE GASKET

GAS TRAIN ASSEMBLY				
	ITEM	PART NO.	QTY	DESCRIPTION
(3)	5	22026-1	1	STD FM GAS TRAIN ASSY
		22026-2		IRI GAS TRAIN ASSY
		22040-1		DUAL FUEL FM GAS TRAIN
		22040-2		DUAL FUEL IRI GAS TRAIN

BURNER & AIR/FUEL VALVE			
ITEM	PART NO.	QTY	DESCRIPTION
6	24030	1	BURNER ASSEMBLY (SEE PL-A-151)
7	24010	1	A/F VALVE ASSEMBLY
	24010-1		DUEL FUEL A/F VALVE ASSY.
8	24039	1	BMK3.0LN STAGED IGNITION ASSY. (PART OF BURNER ASSY.)
9	81030	2	BURNER GASKET (PART OF BURNER ASS'Y)
10	81019	1	BURNER HOUSING GASKET (PART OF BURNER ASS'Y)

HEAT EXCHANGER			
ITEM	PART NO.	QTY	DESCRIPTION
11	80018	1	PRIMARY HEAT EXCH. UPPER INSULATION
12	80019	1	PRIMARY HEAT EXCH. LOWER INSULATION
13	80020	1	SECONDARY HEAT EXCH. INSULATION
14	28030	1	PRIMARY HEAT EXCH.
15	28029	1	SECONDARY HEAT EXCH.

BLOWER			
ITEM	PART NO.	QTY	DESCRIPTION
16	24045	1	BLOWER ASSEMBLY
17	123815	1	IRIS AIR DAMPER
18	123681	1	8"x6" REDUCING COUPLING
19	33028	1	BLOWER BRACKET
20	124245	4	5/16 DAMPENER
21	81057	1	BLOWER GASKET
22	96006	1	6" 90 DEG ELBOW
23	96009	1	6" DIAM. x 4" LG DUCT W/PORT
24	96008	1	6" DIAM. x 4" LG DUCT
25	123990	1	REDUCER OFFSET COVER
26	123583	1	CLAMP HOSE SAE #96

HOSES,GASKETS, & INSULATION			
ITEM	PART NO.	QTY	DESCRIPTION
27	88003	1	O-RING #2-339
28	59041	1	HOSE ASSEMBLY, 4"
29	80024-8	1	INSULATION 4" FLEX PIPE 8 LONG
30	80024-12	1	INSULATION 4" FLEX PIPE 12" LONG
31	80021-12	1	INSULATION 4" PIPE 12" LONG
32	80022	1	CONNECTING INSULATION
33	80023	2	TOP MANIFOLD INSULATION
34	4-58	3	4" FLANGE GASKET
35	62005	1	CORD GRIP
36	59030	1	HOSE ASSY, 4" (FLEXIBLE)
37			

AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647		
BENCHMARK 3.0 LOW NOx BOILER PARTS LIST		
DRAWN BY SJD	PL - A - 150 (SHEET 1 OF 7)	F
DATE 2/18/09		

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APPENDIX F

CONTROLS			
ITEM	PART NO.	QTY	DESCRIPTION
38	123966	1	OVER TEMP SWITCH AUTO
39	123552	1	OVER TEMP SWITCH MANUAL
40	61014	1	BLOWER PROOF SWITCH
41	61002-5	1	BLOCKED INLET SWITCH
42	161560	1	I /O WIRING BOX
43	181197	1	C-MORE CONTROL BOX
44	GP-122464	1	IGNITION TRANSFORMER
45	33030	1	VFD MOUNTING BRACKET
46	64012-1	1	VFD (208-230 V)
	64012-2		VFD (460V)
47	93230	1	ORIFICE SNUBBER
(4) 48	124310	1	460V TRANSFORMER
(4) 49	124380	1	500 VAC, 4 AMP FUSE
(4) 50	58009	1	460V Terminal Cover Kit
(4) 52	79002	1	460V TRANSFORMER LABEL
53	61011	1	AIR TEMP SENSOR
54	64018	1	TEMPERATURE TRANSMITTER
55	GP- 122569	1	IGNITION CABLE ASSY.
56	63016	1	BMK3.0LN SHELL HARNESS
57	124320	1	BLOWER HARNESS
58	24065	1	PROGRAMMED LOGICSTICK (NON DUAL FUEL)
	24065-2		DUAL FUEL, NAT. GAS - STICK
	24065-3		DUAL FUEL, PROPANE - STICK
59	64016	1	208V POWER WIRING BOX
	64017		460V POWER WIRING BOX
(1)(6) 60	63015	1	BMK3.0LN GAS TRAIN WIRING HARNESS
61	122843	1	LOW WATER CUT-OFF
62	123449	1	SHELL TEMP. SENSOR
63	161521	1	THERMOWELL, DUAL AQUASTAT BULB
(7) 64	61002-1	1	LOW GAS PRESSURE SWITCH
65	61002-3	1	HIGH GAS PRESSURE SWITCH (NON DUAL FUEL)
(6)(8)	61002-15		DUAL FUEL HGPS - NAT. GAS
	61002-16		DUAL FUEL HGPS - PROPANE

OTHER ACCESORIES / PARTS			
ITEM	PART NO.	QTY	DESCRIPTION
(1)(2) 66	69087 - □	1	PRESS./TEMP. GAUGE
67	SEE SD-A-700	1	PRESSURE RELIEF VALVE
(1)(7) 68	123540	1	EXT. MANUAL SHUT-OFF VALVE
(1) 69	91030	1	1" DRAIN HOSE, 60" LG
70	12820-11	1	1-1/2" NPT BALL VALVE
71	59043	1	CONDENSATE FLOAT
(1) 72	24060	1	COND. TRAP ASSEMBLY

OTHER DUAL FUEL COMPONENTS			
ITEM	PART NO.	QTY	DESCRIPTION
(1)(5) 73	72031	1	"PROPANE" LABEL
(1)(5) 74	72032	1	"NAT. GAS" LABEL
(5)(6) 75	63032	1	DOUBLE GAS TRAIN WIRING HARNESS
(5) 76	65024	1	FUEL SELECTOR SWITCH
(5) 77	33036	1	FUEL SELECTOR SWITCH MOUNTINGBRACKET
(5) 78	72030	1	FUEL SELECTOR SWITCH LABEL
(5) 79	63034	1	DUAL FUEL WIRING HARNESS

SHEET METAL / PANEL ASSEMBLY			
ITEM	PART NO	QTY	DESCRIPTION
80	37004	1	LEFT REAR PANEL
81	37003	1	RIGHT REAR PANEL
82	49028	2	TOP RAIL
83	201233	1	MOUNTING PANEL
84	201113	1	FRONT PANEL ENCLOSURE
85	201120	1	FRONT DOOR ASSY.
86	GP-122620	4	HANDLE
87	30022	2	TOP PANEL
88	37002	4	SIDE PANEL
89	74004	1	BMK3.0LN LOGO

OTHER PARTS			
ITEM	PART NO	QTY	DESCRIPTION
90	99017	1	GAS PRESSURE SNUBBER - PART OF GAS TRAIN

NOTES:

(1) NOT SHOWN IN DRAWING
(2) -5 (30 AND 50 PSI RELIEF VALVE SETTING)
-6 (60,75,100 & 125 PSI RELIEF VALVE SETTING)
-7 (150 PSI RELIEF VALVE SETTING)
(3) FOR PICTORAL PURPOSES ONLY,
IRI GAS TRAIN (NON DUAL FUEL) IS SHOWN
(4) FOR 460 V OPTION ONLY
(5) ONLY NEEDED ON DUAL FUEL
(6) PART OF GAS TRAIN ASSY.
(7) TWO (2) REQUIRED FOR DUAL FUEL BMK3.0 LN
(8) SEE DRAWING AP-A-826 FOR DUAL FUEL DETAILS

AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647		
BENCHMARK 3.0 LOW NOx BOILER PARTS LIST		
DRAWN BY SJD	PL - A - 150	F
DATE 2/18/09	(SHEET 2 OF 7)	

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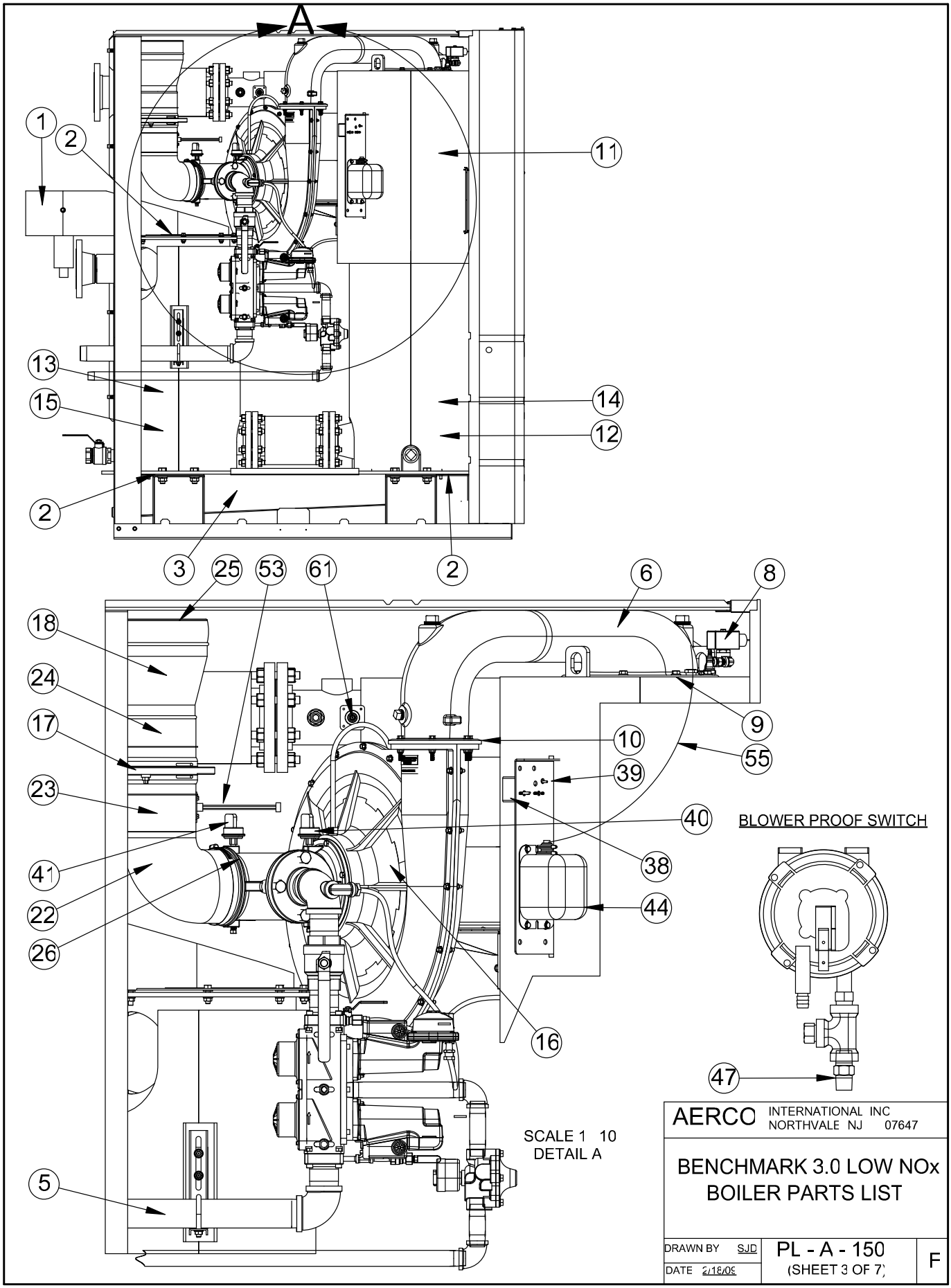
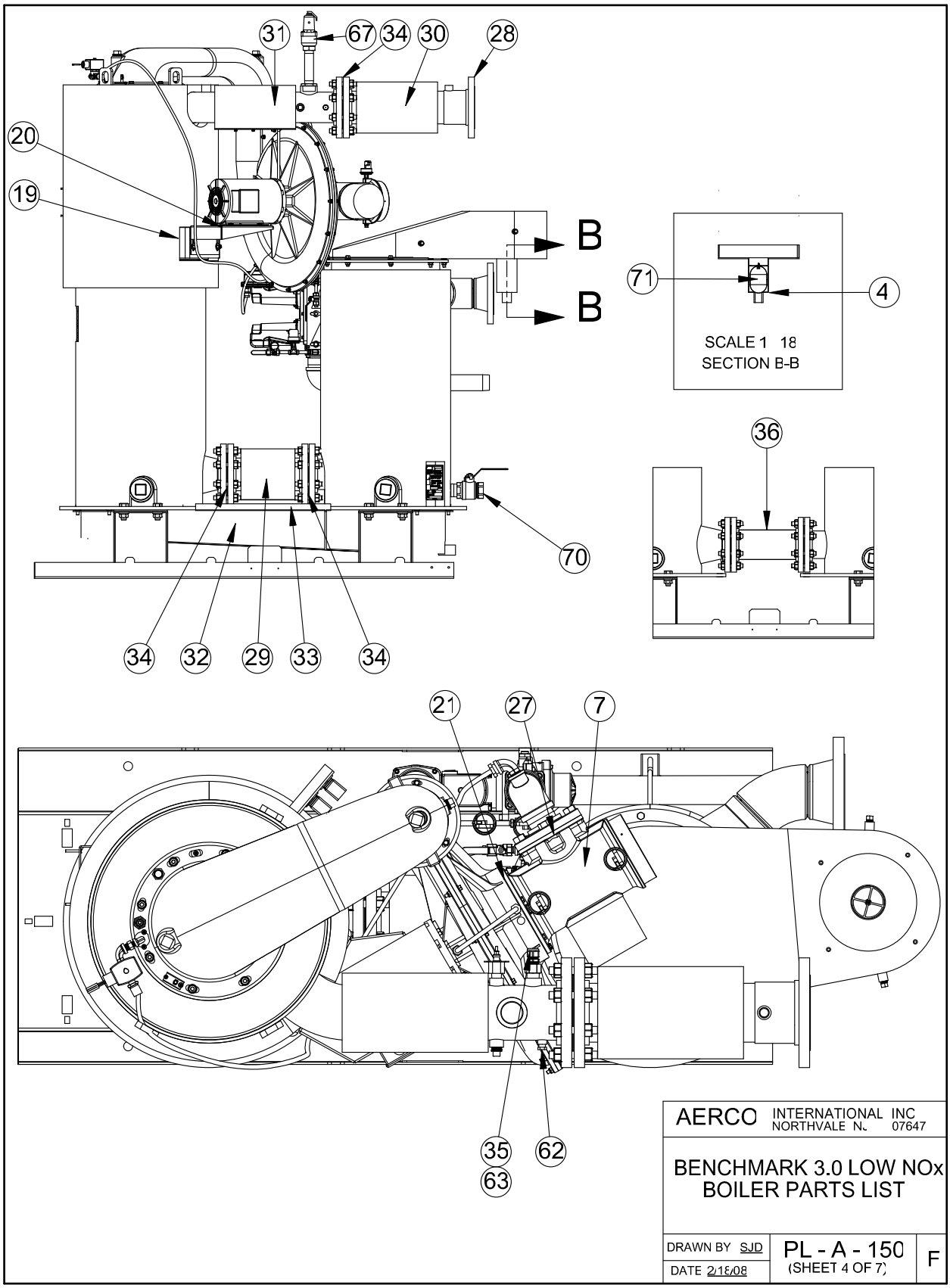
APPENDIX F



F-10

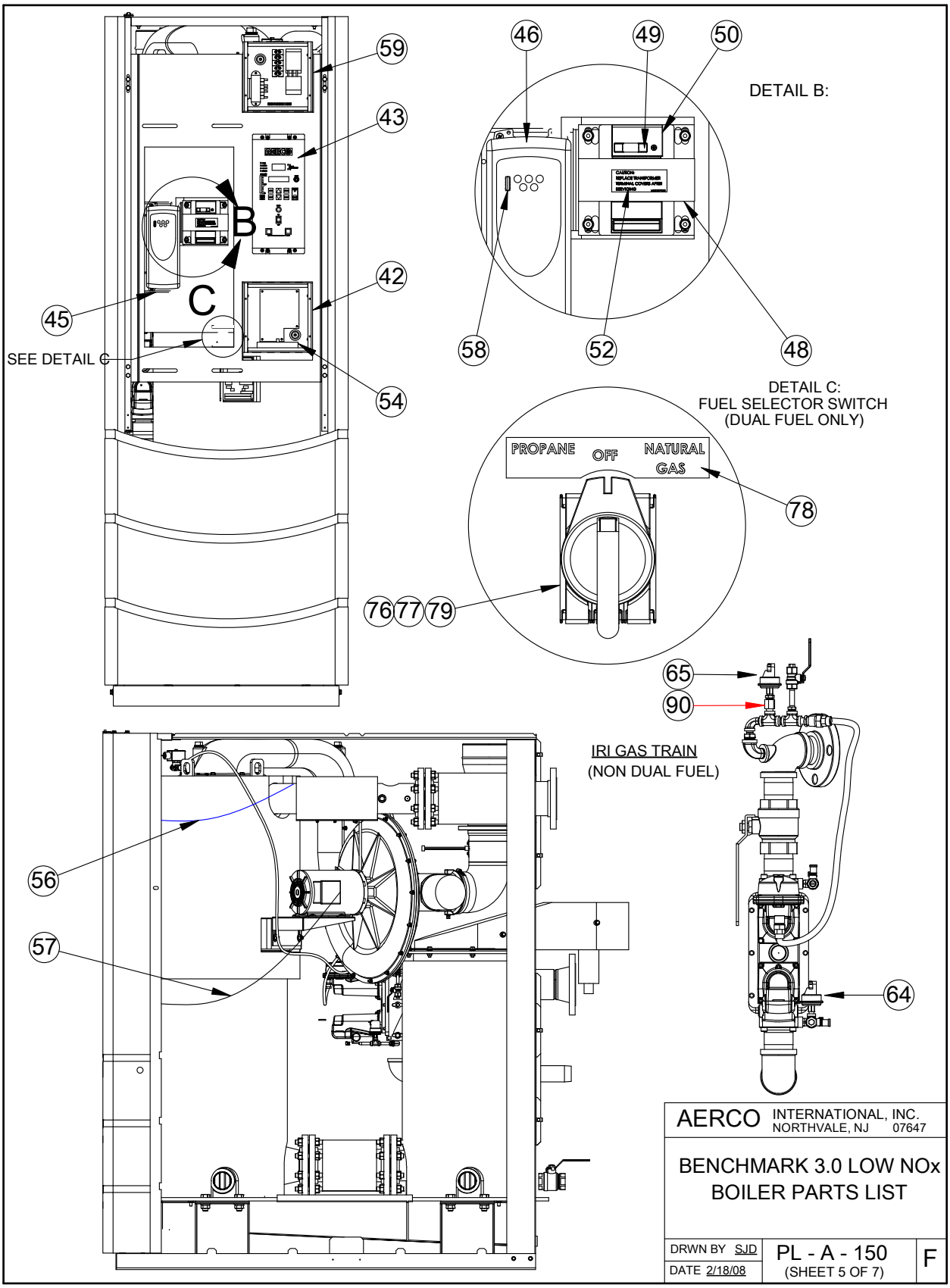
APPENDIX F



AERCO INTERNATIONAL INC NORTHVALE N. 07647		
BENCHMARK 3.0 LOW NOx BOILER PARTS LIST		
DRAWN BY SJD DATE 2/18/08	PL - A - 150 (SHEET 4 OF 7)	F

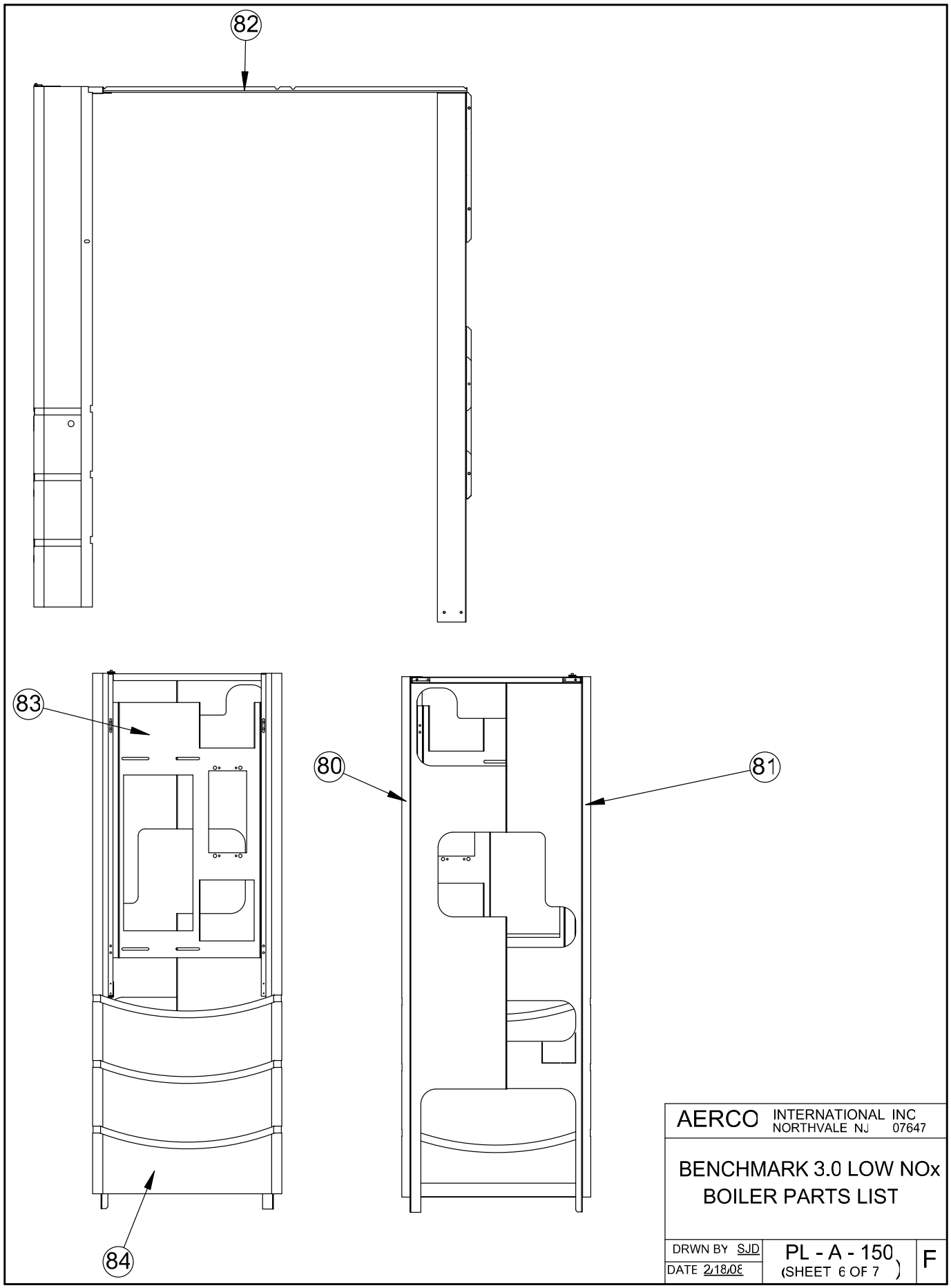
F-11

APPENDIX F

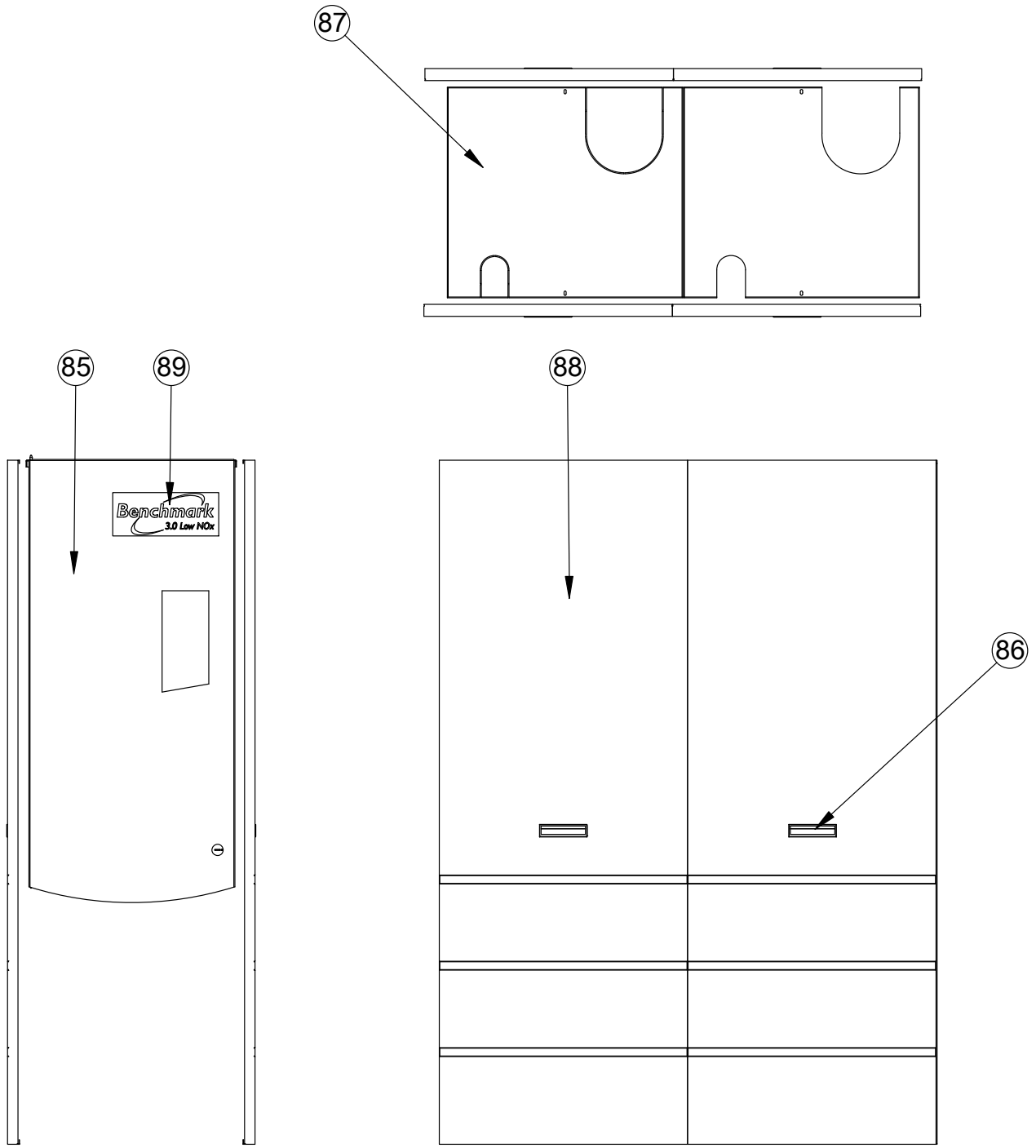


F-12

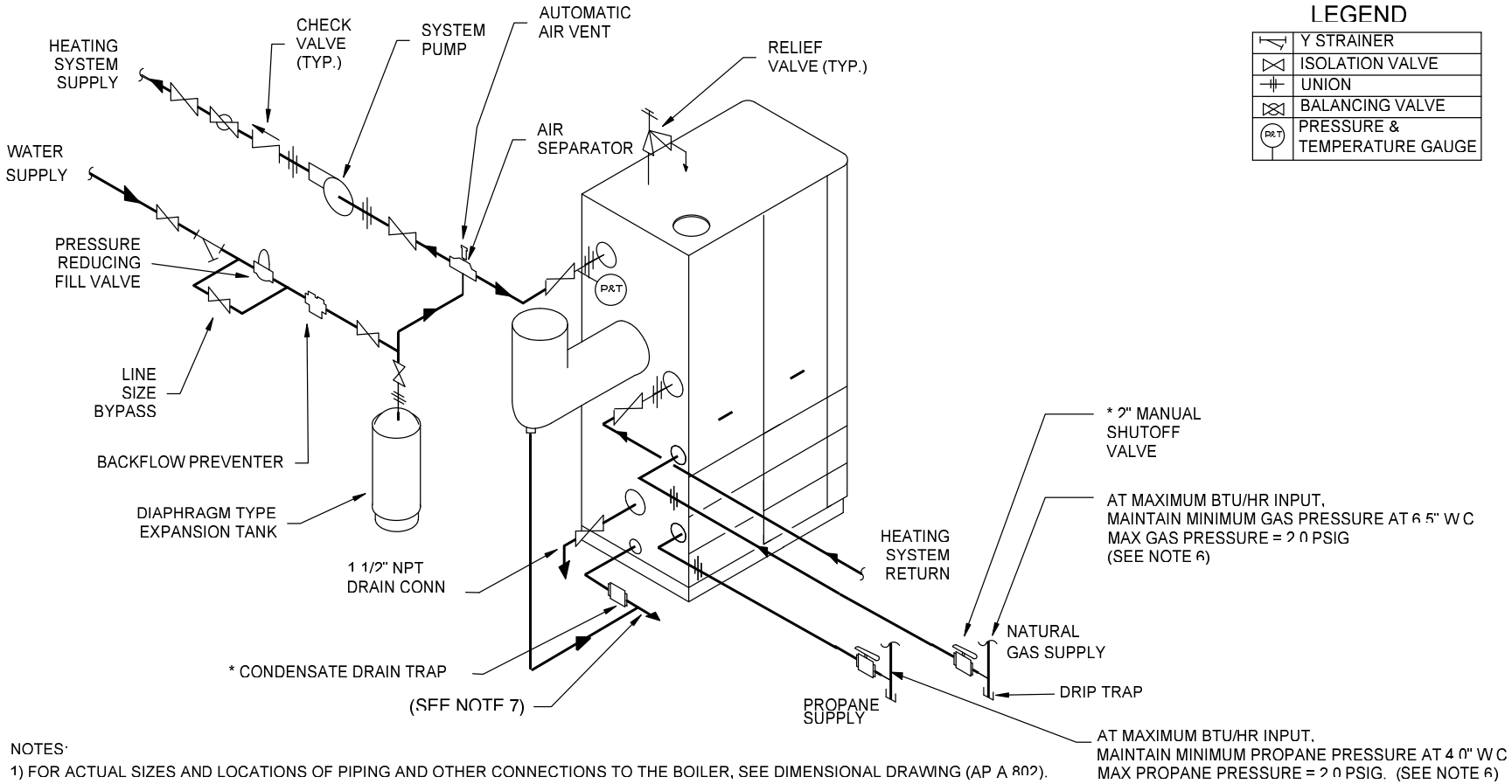
APPENDIX F



F-13



AERCO	INTERNATIONAL, INC. NORTHVALE, NJ 07647
BENCHMARK 3.0 LOW NOx BOILER PARTS LIST	
DRWN BY SJD DATE 2/18/08	PL - A - 150 (SHEET 7 OF 7) F



NOTES:

1) FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE BOILER, SEE DIMENSIONAL DRAWING (AP A 802).
2) SHELL DRAIN VALVE AND CONDENSATE DRAIN TRAP SHOULD BE ARRANGED TO PERMIT THE FLUIDS TO DRAIN FREELY, BY GRAVITY, TO A CONVENIENT FLOOR DRAIN. RELIEF VALVE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE FLOOR
3) ALL (*) ITEMS ARE INCLUDED SEPARATELY IN SHIPMENT FROM FACTORY
4) LOCATE WATER INLET AND OUTLET FITTINGS (i.e. UNIONS, ELBOWS, ETC.) A MINIMUM OF 6" FROM BOILER FITTINGS TO PREVENT INTERFERENCE WITH REMOVAL OF BOILER PANELS AND COVERS. ALL PIPING AND ELECTRIC CONNECTIONS (SERVICE SWITCHES, CONDUIT BOXES) SHOULD LIKEWISE BE 6" AWAY FROM SIDE PANELS
5) THIS IS A TYPICAL INSTALLATION DRAWING. LOCAL CODES AND AUTHORITIES SHOULD BE CONSULTED
6) WHEN AVAILABLE GAS PRESSURE IS GREATER THAN 2.0 PSIG, A LOCK UP STYLE REGULATOR MUST BE INSTALLED DOWNSTREAM OF THE 2" MANUAL SHUTOFF VALVE TO BRING THE GAS PRESSURE DOWN TO 2.0 PSIG
7) EACH CONDENSATE PORT CAN BE PIPED INDIVIDUALLY TO MAIN DRAIN

AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647

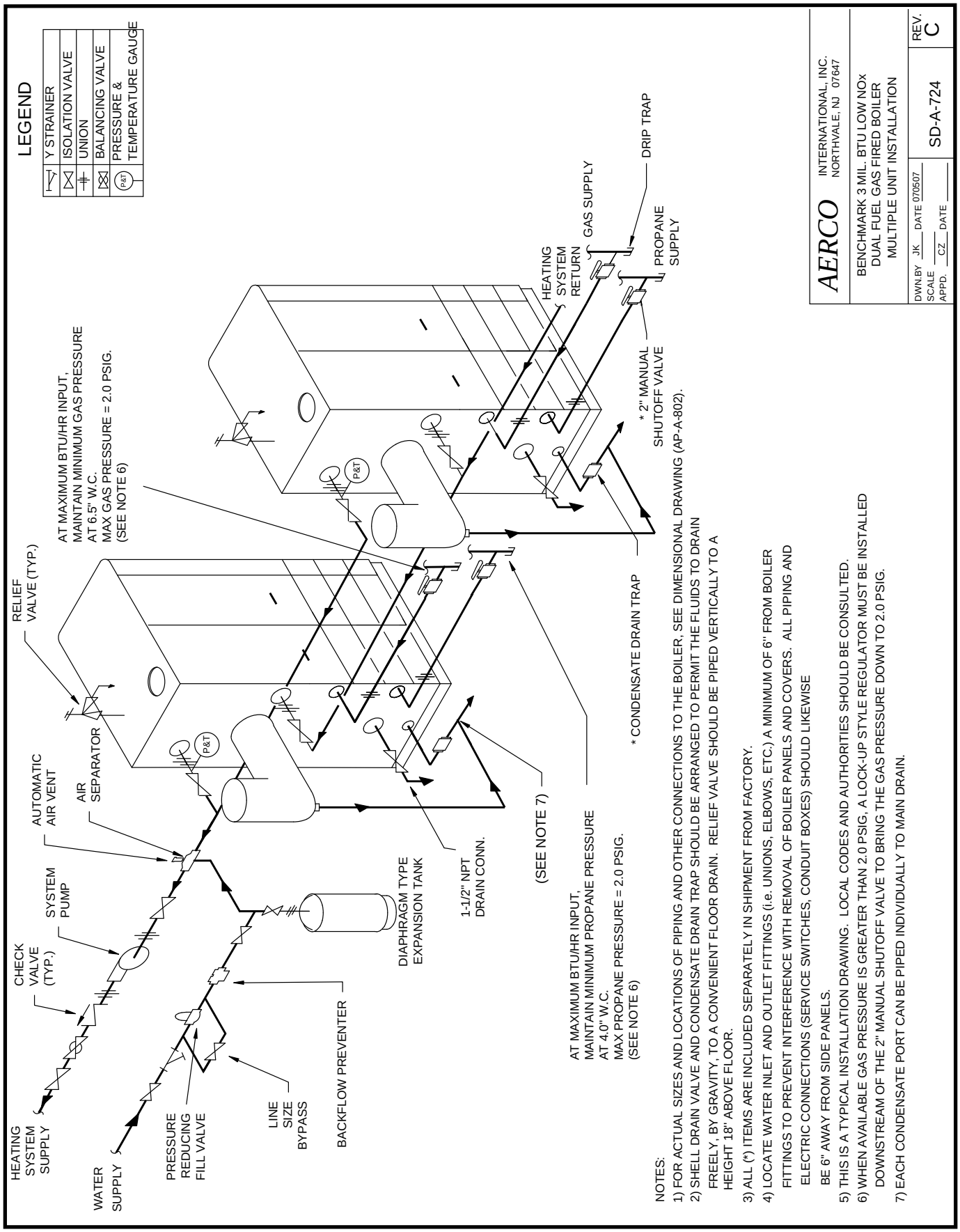
BENCHMARK 3 MIL BTU LOW NOx
DUAL FUEL GAS FIRED BOILER
SINGLE UNIT INSTALLATION

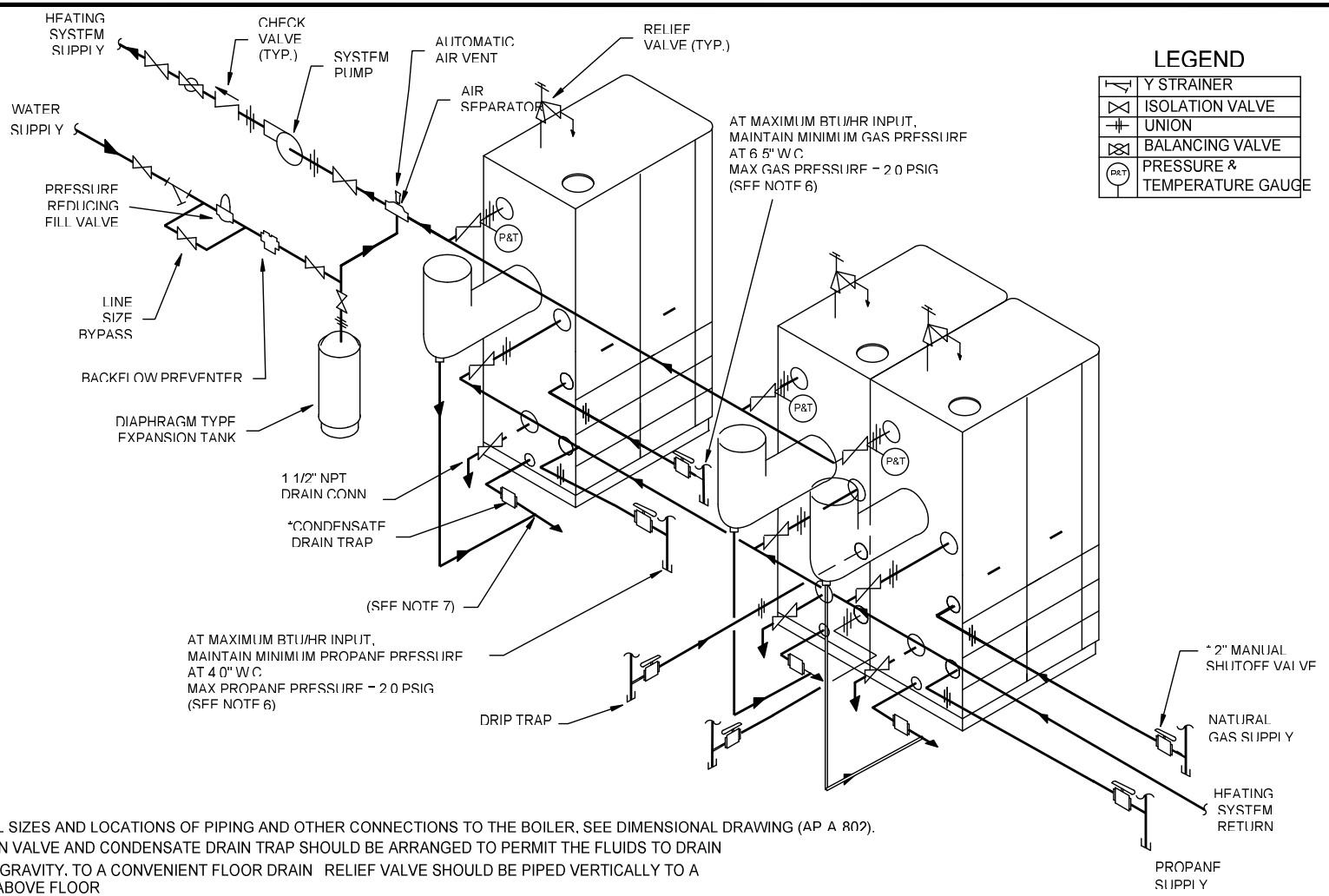
DWN BY JK DATE 070207
SCALE
APPD CZ DATE

SD A 723

REV C

APPENDIX G


LEGEND
Y STRAINER
ISOLATION VALVE
UNION
BALANCING VALVE
PRESSURE & TEMPERATURE GAUGE
HEATING SYSTEM SUPPLY
WATER SUPPLY
CHECK VALVE (TYP.)
SYSTEM PUMP
AUTOMATIC AIR VENT
AIR SEPARATOR
RELIEF VALVE (TYP.)
AT MAXIMUM BTU/HR INPUT, MAINTAIN MINIMUM GAS PRESSURE AT 6.5" W.C. MAX GAS PRESSURE = 2.0 PSIG. (SEE NOTE 6)
PRESSURE REDUCING FILL VALVE
LINE SIZE BYPASS
BACKFLOW PREVENTER
DIAPHRAGM TYPE EXPANSION TANK
1-1/2" NPT DRAIN CONN.
(SEE NOTE 7)
AT MAXIMUM BTU/HR INPUT, MAINTAIN MINIMUM PROPANE PRESSURE AT 4.0" W.C. MAX PROPANE PRESSURE = 2.0 PSIG. (SEE NOTE 6)
* CONDENSATE DRAIN TRAP
* 2" MANUAL SHUTOFF VALVE
HEATING SYSTEM RETURN
GAS SUPPLY
PROPANE SUPPLY
DRIP TRAP
P&T
NOTES:
1) FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE BOILER, SEE DIMENSIONAL DRAWING (AP-A-802).
2) SHELL DRAIN VALVE AND CONDENSATE DRAIN TRAP SHOULD BE ARRANGED TO PERMIT THE FLUIDS TO DRAIN FREELY, BY GRAVITY, TO A CONVENIENT FLOOR DRAIN. RELIEF VALVE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE FLOOR.
3) ALL (*) ITEMS ARE INCLUDED SEPARATELY IN SHIPMENT FROM FACTORY.
4) LOCATE WATER INLET AND OUTLET FITTINGS (i.e. UNIONS, ELBOWS, ETC.) A MINIMUM OF 6" FROM BOILER FITTINGS TO PREVENT INTERFERENCE WITH REMOVAL OF BOILER PANELS AND COVERS. ALL PIPING AND ELECTRIC CONNECTIONS (SERVICE SWITCHES, CONDUIT BOXES) SHOULD LIKEWISE BE 6" AWAY FROM SIDE PANELS.
5) THIS IS A TYPICAL INSTALLATION DRAWING. LOCAL CODES AND AUTHORITIES SHOULD BE CONSULTED.
6) WHEN AVAILABLE GAS PRESSURE IS GREATER THAN 2.0 PSIG, A LOCK-UP STYLE REGULATOR MUST BE INSTALLED DOWNSTREAM OF THE 2" MANUAL SHUTOFF VALVE TO BRING THE GAS PRESSURE DOWN TO 2.0 PSIG.
7) EACH CONDENSATE PORT CAN BE PIPED INDIVIDUALLY TO MAIN DRAIN.
AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647
BENCHMARK 3 MIL. BTU LOW NOx DUAL FUEL GAS FIRED BOILER MULTIPLE UNIT INSTALLATION
DWN.BY JK DATE 070507
SCALE
APPD. CZ DATE
SD-A-724
REV. C



NOTES:

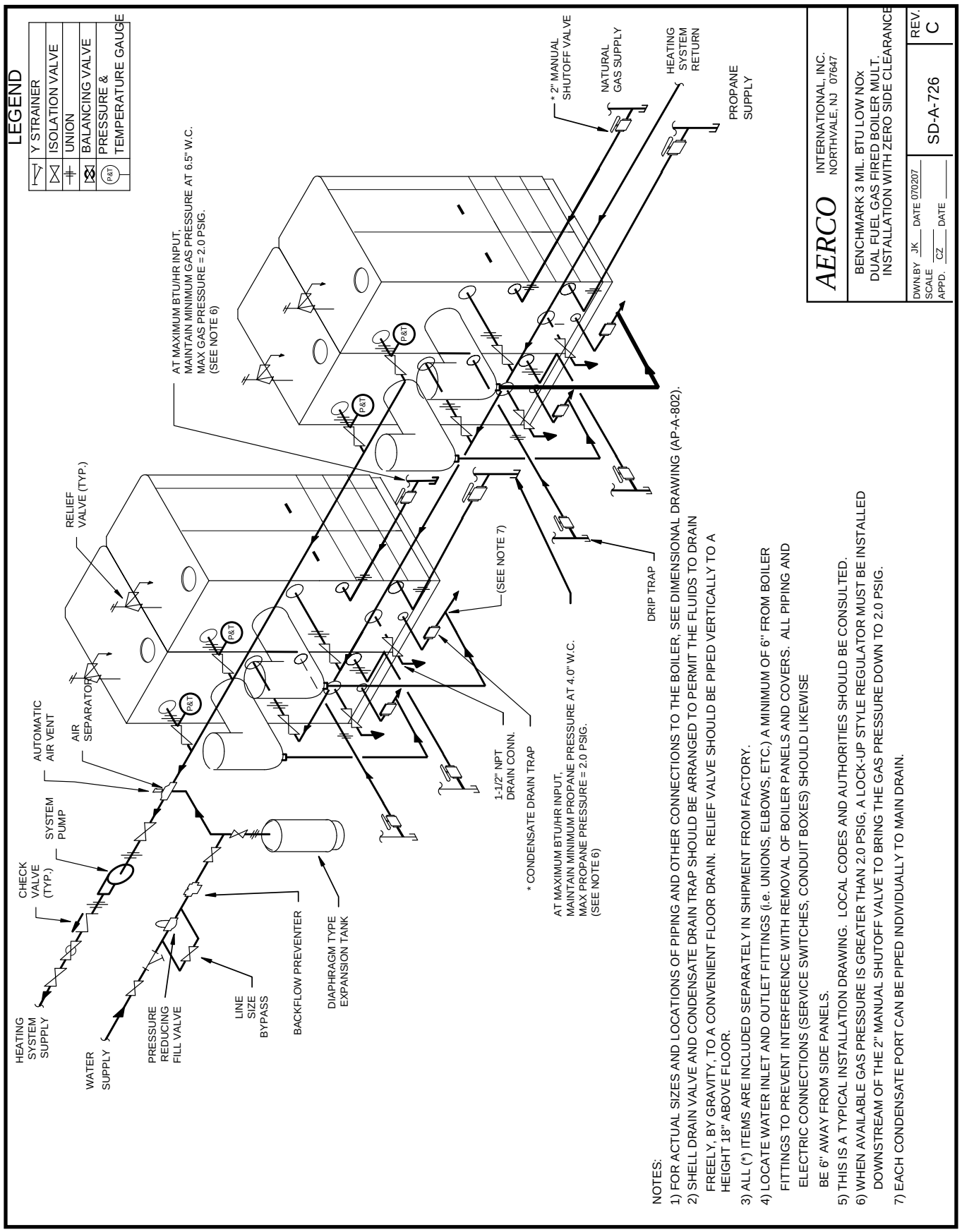
1) FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE BOILER, SEE DIMENSIONAL DRAWING (AP A 802).
2) SHELL DRAIN VALVE AND CONDENSATE DRAIN TRAP SHOULD BE ARRANGED TO PERMIT THE FLUIDS TO DRAIN FREELY, BY GRAVITY, TO A CONVENIENT FLOOR DRAIN. RELIEF VALVE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE FLOOR
3) ALL (*) ITEMS ARE INCLUDED SEPARATELY IN SHIPMENT FROM FACTORY
4) LOCATE WATER INLET AND OUTLET FITTINGS (i.e. UNIONS, ELBOWS, ETC.) A MINIMUM OF 6" FROM BOILER FITTINGS TO PREVENT INTERFERENCE WITH REMOVAL OF BOILER PANELS AND COVERS. ALL PIPING AND ELECTRIC CONNECTIONS (SERVICE SWITCHES, CONDUIT BOXES) SHOULD LIKEWISE BE 6" AWAY FROM SIDE PANELS
5) THIS IS A TYPICAL INSTALLATION DRAWING. LOCAL CODES AND AUTHORITIES SHOULD BE CONSULTED
6) WHEN AVAILABLE GAS PRESSURE IS GREATER THAN 2.0 PSIG, A LOCK UP STYLE REGULATOR MUST BE INSTALLED DOWNSTREAM OF THE 2" MANUAL SHUTOFF VALVE TO BRING THE GAS PRESSURE DOWN TO 2.0 PSIG
7) EACH CONDENSATE PORT CAN BE PIPED INDIVIDUALLY TO MAIN DRAIN

AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647

BENCHMARK 3 MI BTU LOW NOx
DUAL FUEL GAS FIRED BOILER
MULTIPLE INSTALLATION
(2 ZERO SIDE & 1 SEPARATE)

DWN BY JK	DATE 070207	SD A 725	REV C
SCALE			
APPD CZ	DATE		

APPENDIX G


LEGEND
Y STRAINER
ISOLATION VALVE
UNION
BALANCING VALVE
PRESSURE & TEMPERATURE GAUGE
HEATING SYSTEM SUPPLY
WATER SUPPLY
CHECK VALVE (TYP.)
SYSTEM PUMP
PRESSURE REDUCING FILL VALVE
LINE SIZE BYPASS
BACKFLOW PREVENTER
DIAPHRAGM TYPE EXPANSION TANK
AUTOMATIC AIR VENT
AIR SEPARATOR
RELIEF VALVE (TYP.)
AT MAXIMUM BTU/HR INPUT, MAINTAIN MINIMUM GAS PRESSURE AT 6.5" W.C. MAX GAS PRESSURE = 2.0 PSIG. (SEE NOTE 6)
* 2" MANUAL SHUTOFF VALVE
NATURAL GAS SUPPLY
HEATING SYSTEM RETURN
PROPANE SUPPLY
(SEE NOTE 7)
1-1/2" NPT DRAIN CONN.
* CONDENSATE DRAIN TRAP
AT MAXIMUM BTU/HR INPUT, MAINTAIN MINIMUM PROPANE PRESSURE AT 4.0" W.C. MAX PROPANE PRESSURE = 2.0 PSIG. (SEE NOTE 6)
DRIP TRAP
P&T
NOTES:
1) FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE BOILER, SEE DIMENSIONAL DRAWING (AP-A-802).
2) SHELL DRAIN VALVE AND CONDENSATE DRAIN TRAP SHOULD BE ARRANGED TO PERMIT THE FLUIDS TO DRAIN FREELY, BY GRAVITY, TO A CONVENIENT FLOOR DRAIN. RELIEF VALVE SHOULD BE PIPED VERTICALLY TO A HEIGHT 18" ABOVE FLOOR.
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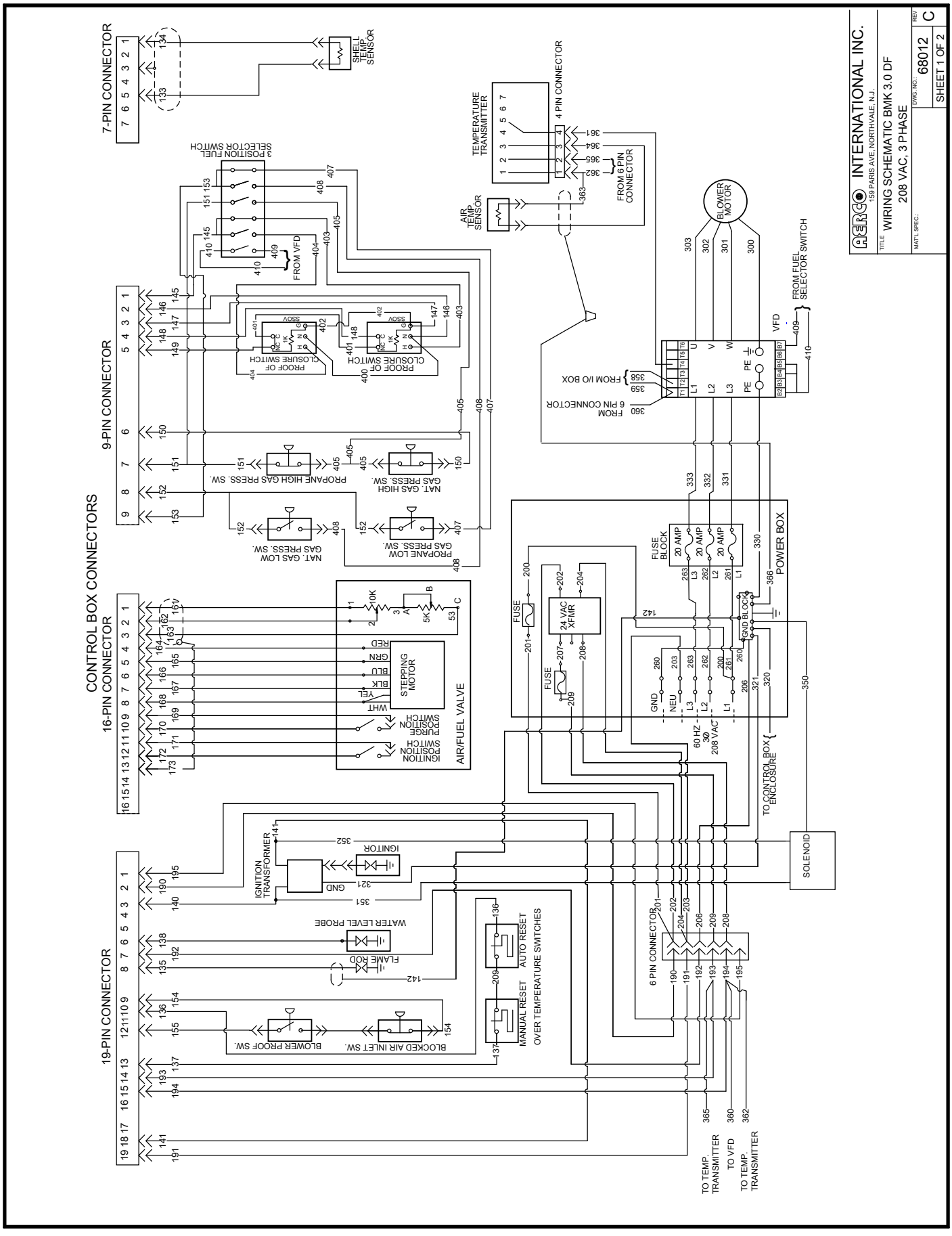
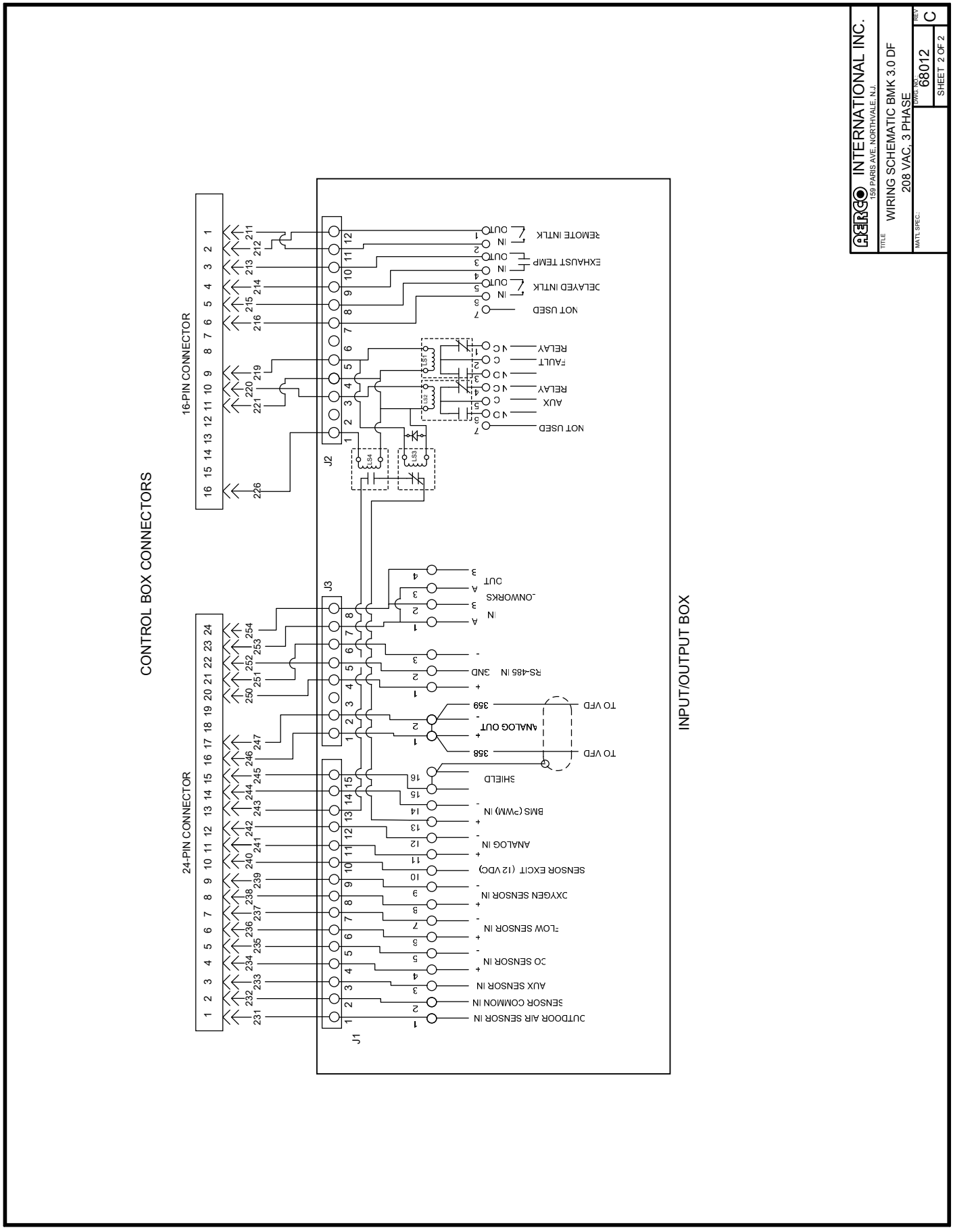
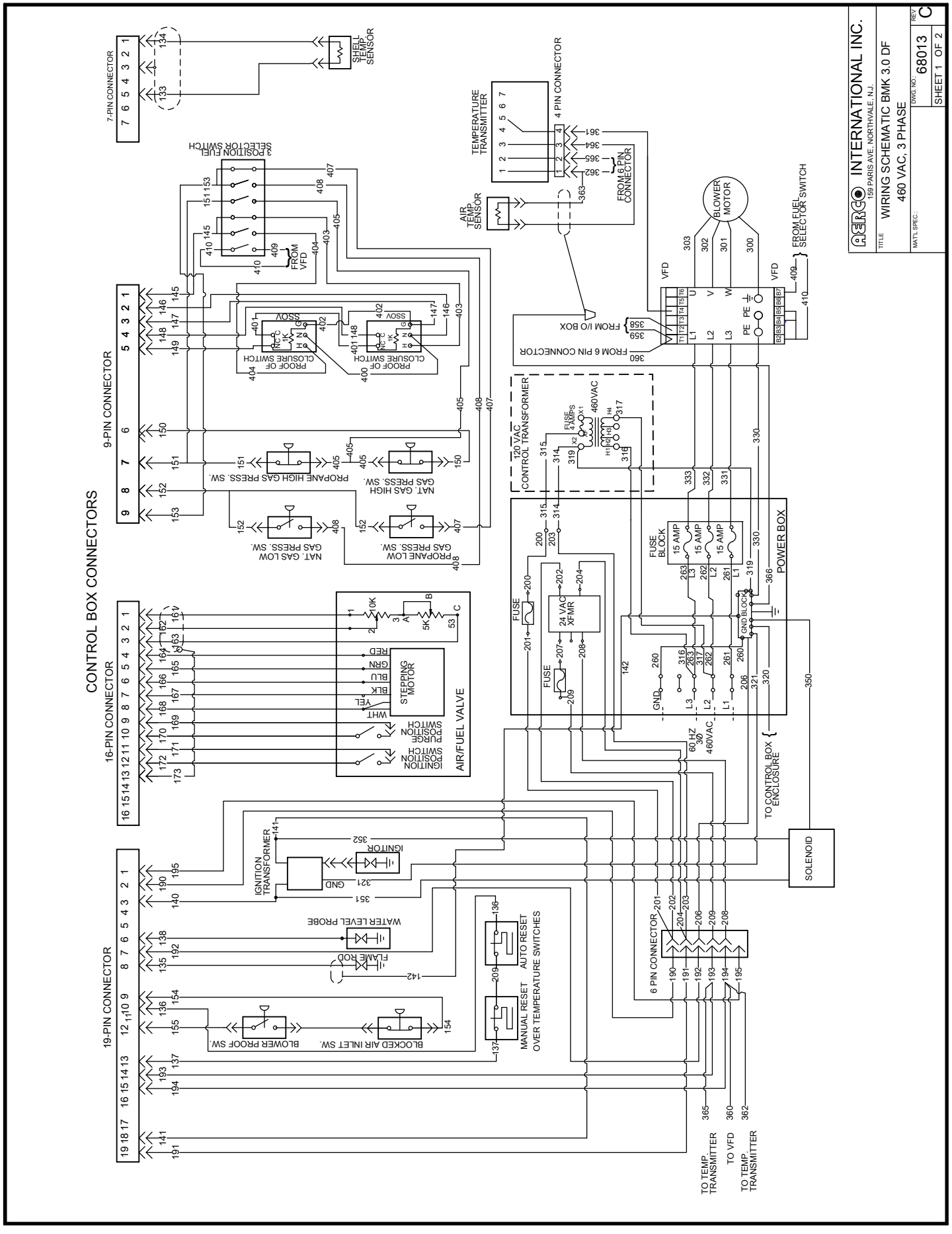
7) EACH CONDENSATE PORT CAN BE PIPED INDIVIDUALLY TO MAIN DRAIN.
AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647
BENCHMARK 3 MIL. BTU LOW NOx DUAL FUEL GAS FIRED BOILER MULT. INSTALLATION WITH ZERO SIDE CLEARANCE
DWN.BY JK DATE 070207
SCALE
APPD. CZ DATE
SD-A-726
REV. C


AERCO INTERNATIONAL INC.
159 PARIS AVE, NORTHVALE, N.J.
TITLE WIRING SCHEMATIC BMK 3.0 DF
208 VAC, 3 PHASE
DWG. NO. 68012
REV. C
SHEET 1 OF 2
MATL SPEC.
CONTROL BOX CONNECTORS
16-PIN CONNECTOR
9-PIN CONNECTOR
19-PIN CONNECTOR
7-PIN CONNECTOR
SHELL TEMP SENSOR
3 POSITION FUEL SELECTOR SWITCH
FROM VFD
TEMPERATURE TRANSMITTER
4 PIN CONNECTOR
FROM 6 PIN CONNECTOR
AIR TEMP SENSOR
BLOWER MOTOR
FROM FUEL SELECTOR SWITCH
VFD
FROM I/O BOX
FROM 6 PIN CONNECTOR
PROOF OF CLOSURE SWITCH
PROPANE HIGH GAS PRESS. SW.
NAT. GAS HIGH GAS PRESS. SW.
PROPANE LOW GAS PRESS. SW.
NAT. GAS LOW GAS PRESS. SW.
AIR/FUEL VALVE
STEPPING MOTOR
IGNITION POSITION SWITCH
PURGE POSITION SWITCH
10K
5K
FUSE BLOCK
20 AMP
POWER BOX
FUSE
24 VAC XFMR
GND BLOCK
60 HZ 30 208 VAC
TO CONTROL BOX ENCLOSURE
SOLENOID
IGNITION TRANSFORMER
IGNITOR
WATER LEVEL PROBE
FLAME ROD
AUTO RESET
MANUAL RESET
OVER TEMPERATURE SWITCHES
BLOWER PROOF SW.
BLOCKED AIR INLET SW.
6 PIN CONNECTOR
TO TEMP. TRANSMITTER
TO VFD
TO TEMP. TRANSMITTER

APPENDIX H


CONTROL BOX CONNECTORS
16-PIN CONNECTOR
24-PIN CONNECTOR
INPUT/OUTPUT BOX
J1
J2
J3
OUTDOOR AIR SENSOR IN
SENSOR COMMON IN
AUX SENSOR IN
CO SENSOR IN
FLOW SENSOR IN
OXYGEN SENSOR IN
SENSOR EXCIT (12 VDC)
ANALOG IN
BMS (PWM) IN
SHIELD
TO VFD
ANALOG OUT
TO VFD
RS-485 IN GND
LONWORKS IN
LONWORKS OUT
NOT USED
AUX RELAY
FAULT RELAY
NOT USED
DELAYED INTLK
EXHAUST TEMP
REMOTE INTLK
CARGO INTERNATIONAL INC.
159 PARIS AVE, NORTHVALE, N.J.
TITLE
WIRING SCHEMATIC BMK 3.0 DF
208 VAC, 3 PHASE
DWG. NO.
68012
REV
C
SHEET 2 OF 2
MATL SPEC.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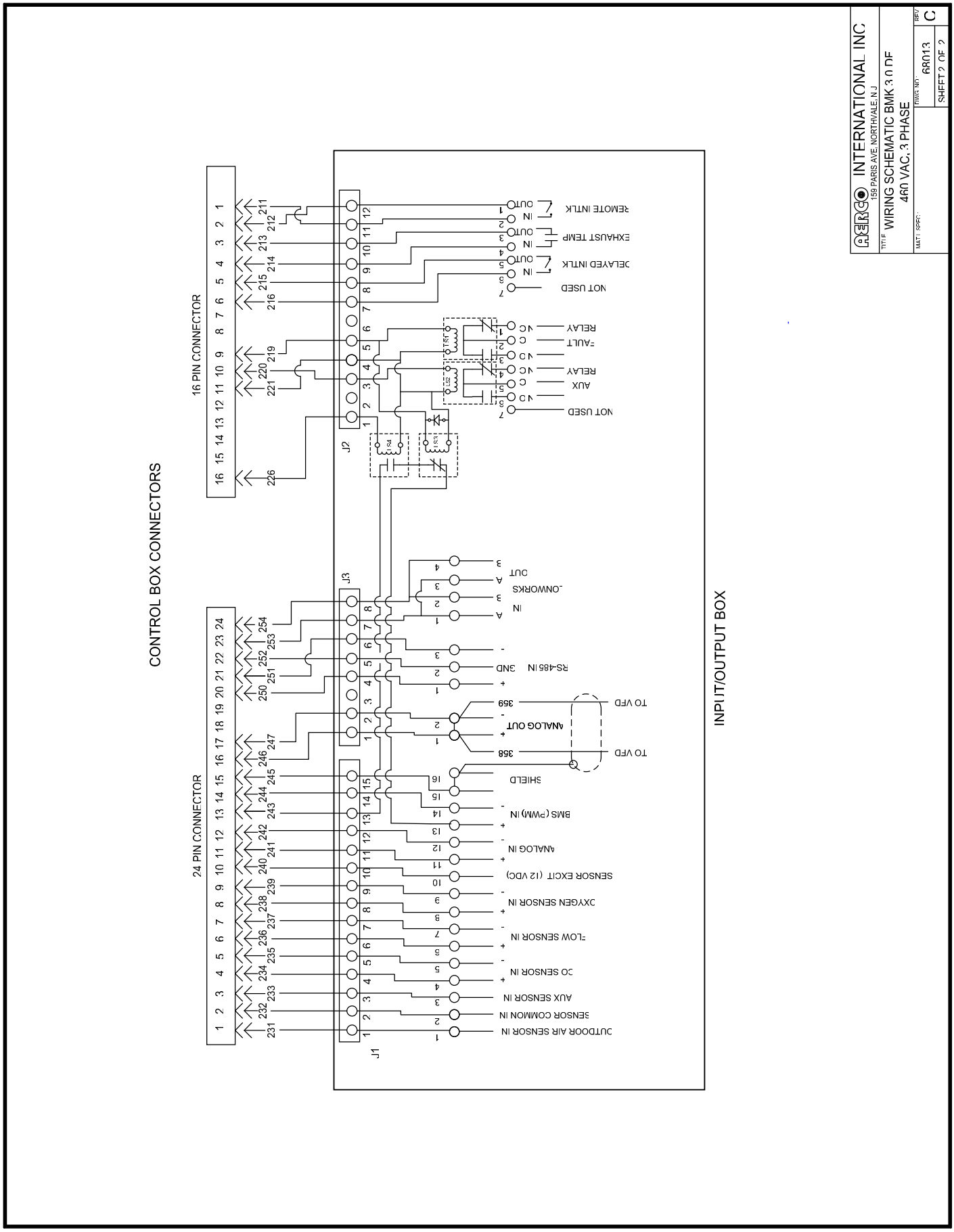
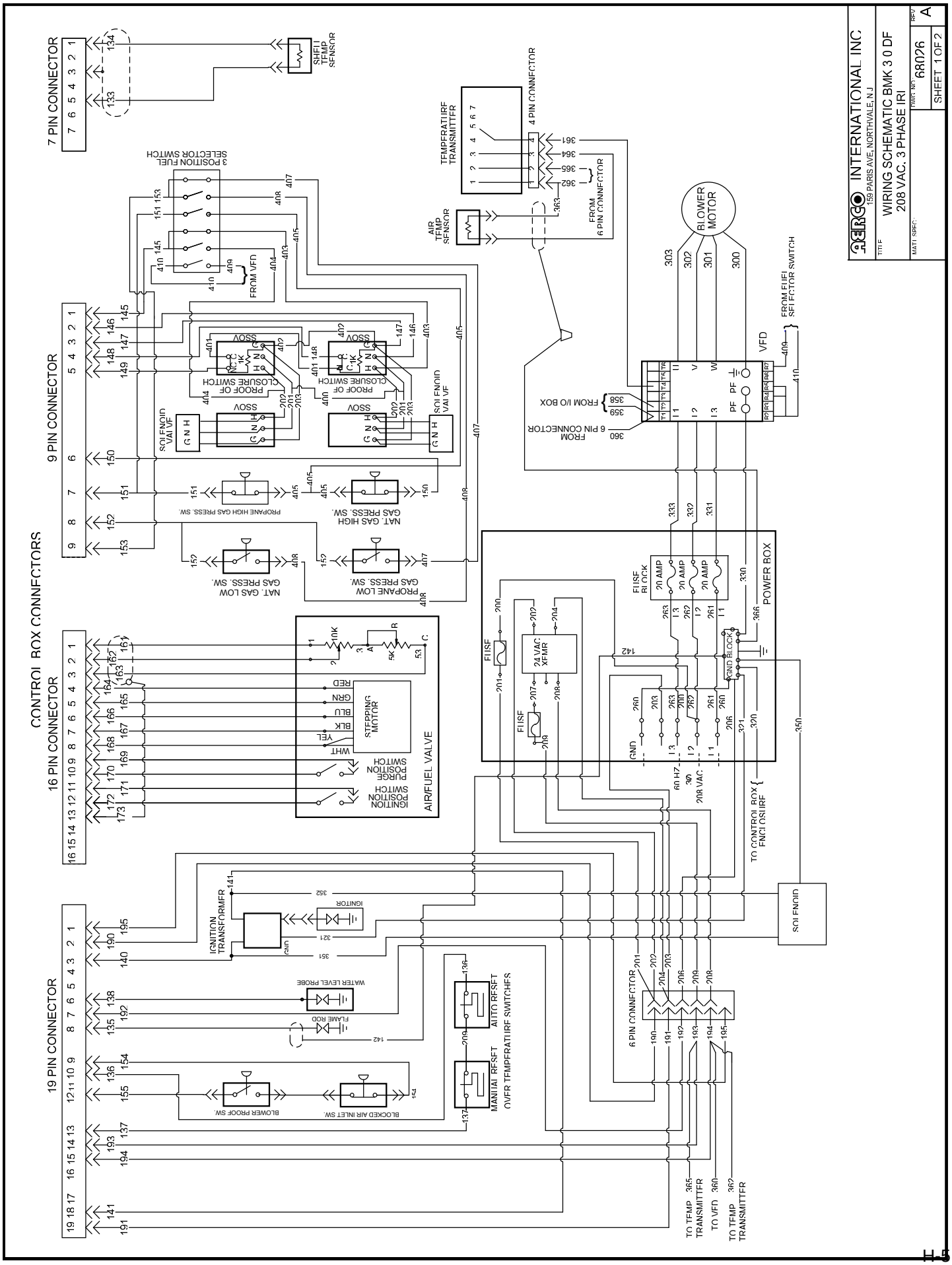
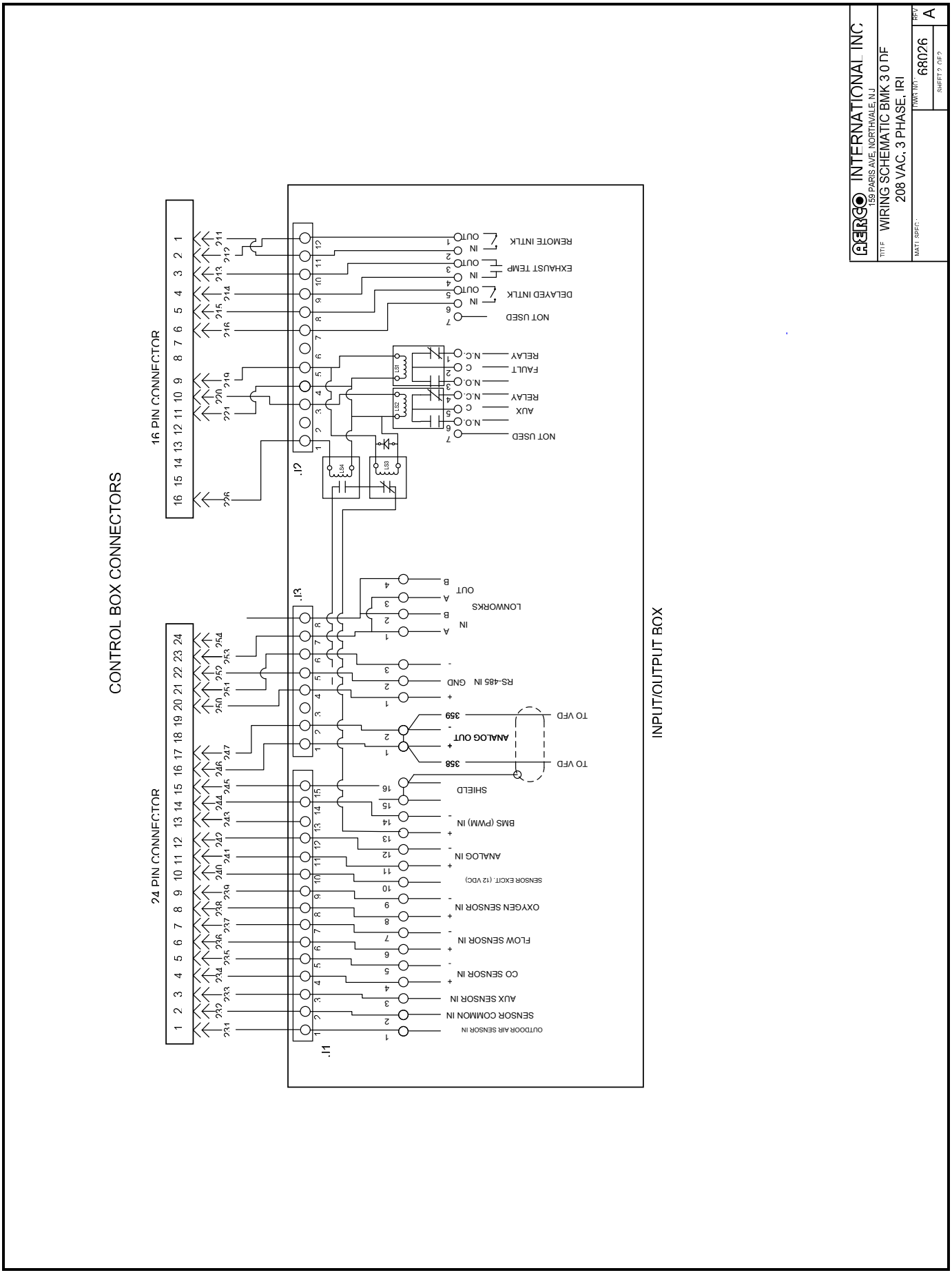
16-PIN CONNECTOR
9-PIN CONNECTOR
7-PIN CONNECTOR
AIR/FUEL VALVE
STEPPING MOTOR
IGNITION TRANSFORMER
IGNITOR
WATER LEVEL PROBE
FLAME ROD
AUTO RESET
MANUAL RESET
OVER TEMPERATURE SWITCHES
BLOCKED AIR INLET SW.
BLOWER PROOF SW.
PROPANE HIGH GAS PRESS. SW.
NAT. GAS HIGH GAS PRESS. SW.
PROPANE LOW GAS PRESS. SW.
NAT. GAS LOW GAS PRESS. SW.
PROOF OF CLOSURE SWITCH
SSOV
FROM VFD
3 POSITION FUEL SELECTOR SWITCH
SHIELD TEMP SENSOR
TEMPERATURE TRANSMITTER
4 PIN CONNECTOR
AIR TEMP SENSOR
FROM 6 PIN CONNECTOR
FROM I/O BOX
FROM 6 PIN CONNECTOR
VFD
BLOWER MOTOR
FROM FUEL SELECTOR SWITCH
120 VAC CONTROL TRANSFORMER
FUSE 4 AMPS
460VAC
FUSE BLOCK
15 AMP
POWER BOX
FUSE
24 VAC XFMR
GND BLOCK
60 HZ 3Ø 460VAC
TO CONTROL BOX ENCLOSURE
SOLENOID
6 PIN CONNECTOR
TO TEMP. TRANSMITTER
TO VFD
TO TEMP. TRANSMITTER
IGNITION POSITION SWITCH
PURGE POSITION SWITCH
10K
5K
RED
GRN
BLU
BLK
YEL
WHT
GND
L1
L2
L3
PE
INTERNATIONAL INC.
159 PARIS AVE, NORTHVALE, N.J.
TITLE
WIRING SCHEMATIC BMK 3.0 DF
460 VAC, 3 PHASE
MATL SPEC.:
DWG NO: 68013
REV C
SHEET 1 OF 2

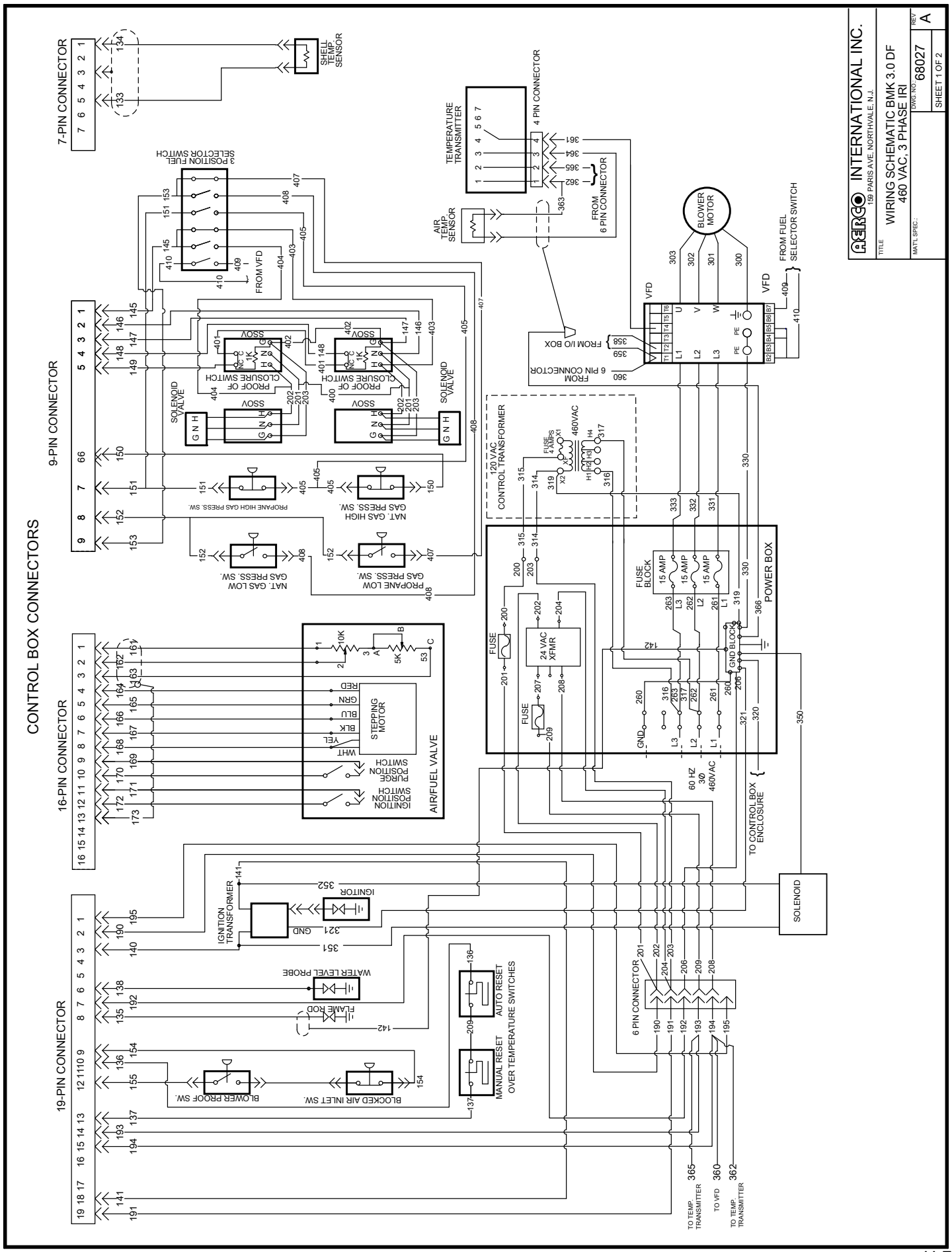
APPENDIX H


CONTROL BOX CONNECTORS
16 PIN CONNECTOR
24 PIN CONNECTOR
INPUT/OUTPUT BOX
J1
J2
J3
OUTDOOR AIR SENSOR IN
SENSOR COMMON IN
AUX SENSOR IN
CO SENSOR IN
FLOW SENSOR IN
OXYGEN SENSOR IN
SENSOR EXCIT (12 VDC)
ANALOG IN
BMS (PWM) IN
SHIELD
ANALOG OUT
TO VFD
TO VFD
RS-485 IN
GND
IN
LONWORKS
OUT
NOT USED
DELAYED INTLK
EXHAUST TEMP
REMOTE INTLK
NOT USED
AUX
RELAY
FAULT
RELAY
INTERNATIONAL INC
159 PARIS AVE, NORTHVALE, N.J.
WIRING SCHEMATIC BMK 3.0 DF
460 VAC, 3 PHASE
DWG. NO. 68013
REV. C
SHEET 2 OF 2

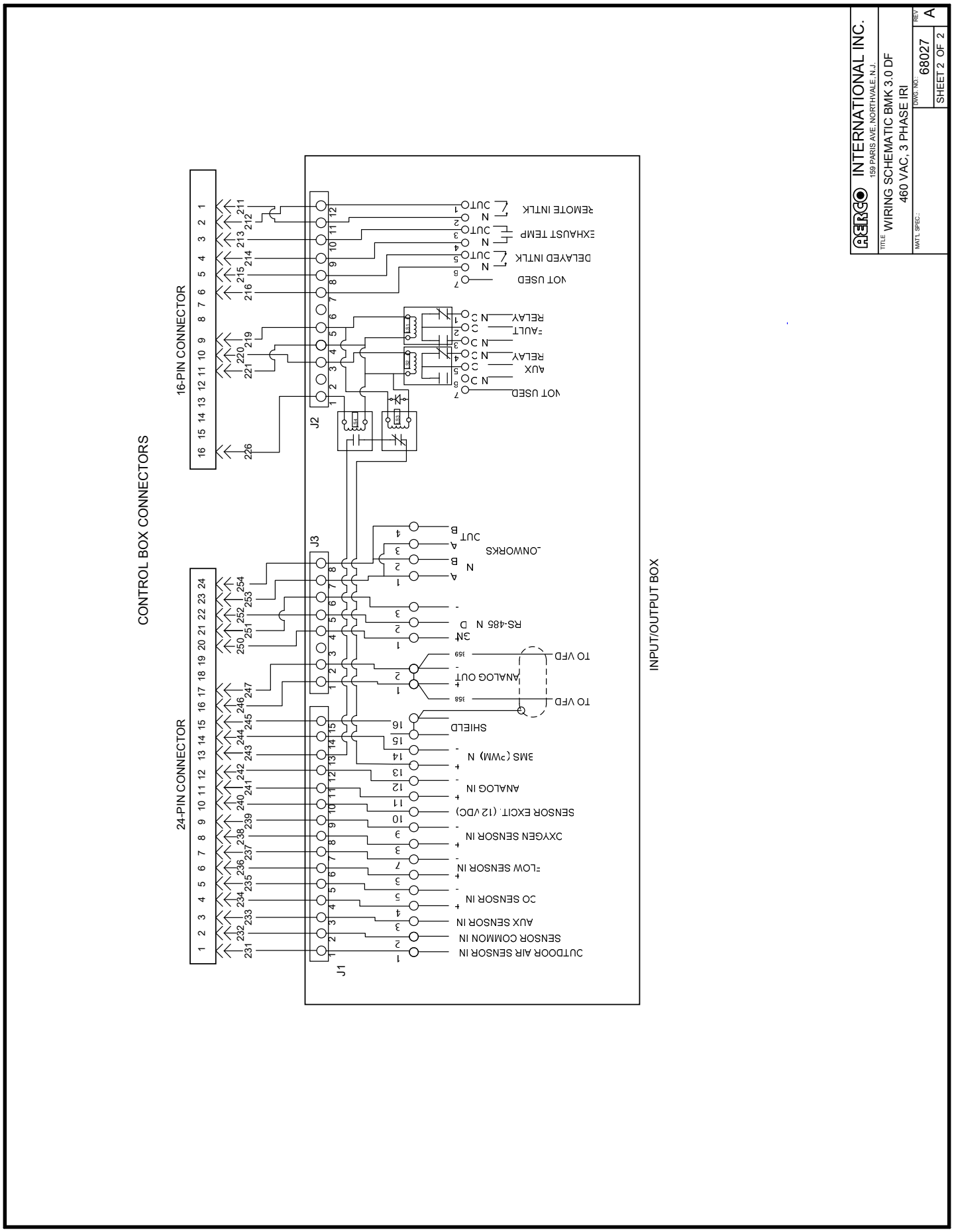

INTERNATIONAL INC
159 PARIS AVE, NORTHVALE, N J
TITLE
WIRING SCHEMATIC BMK 3 0 DF
208 VAC, 3 PHASE IRI
PART NO 68026
REV A
SHEET 1 OF 2
MATL SPEC
7 PIN CONNECTOR
9 PIN CONNECTOR
16 PIN CONNECTOR
19 PIN CONNECTOR
CONTROL BOX CONNECTORS
SHELL TEMP SENSOR
3 POSITION FUEL SELECTOR SWITCH
TEMPERATURE TRANSMITTER
4 PIN CONNECTOR
AIR TEMP SENSOR
FROM 6 PIN CONNECTOR
BLOWER MOTOR
FROM FUEL SELECTOR SWITCH
VFD
FROM I/O BOX
6 PIN CONNECTOR
PROOF OF CLOSURE SWITCH
SSOV
SOLENOID VALVE
NAT. GAS HIGH GAS PRESS. SW.
PROPANE HIGH GAS PRESS. SW.
NAT. GAS LOW GAS PRESS. SW.
PROPANE LOW GAS PRESS. SW.
AIR/FUEL VALVE
STEPPING MOTOR
IGNITION POSITION SWITCH
PURGE POSITION SWITCH
POWER BOX
FUSE BLOCK
20 AMP
24 VAC XFMR
FUSE
GND BLOCK
60 HZ 3Φ 208 VAC
TO CONTROL BOX ENCLOSURE
IGNITION TRANSFORMER
IGNITOR
WATER LEVEL PROBE
FLAME ROD
AUTO RESET
MANUAL RESET
OVER TEMPERATURE SWITCHES
BLOWER PROOF SW.
BLOCKED AIR INLET SW.
6 PIN CONNECTOR
SOLENOID
TO TEMP TRANSMITTER
TO VFD
TO TEMP TRANSMITTER

APPENDIX H


CONTROL BOX CONNECTORS
16 PIN CONNECTOR
24 PIN CONNECTOR
INPUT/OUTPUT BOX
J1
J2
J3
REMOTE INTLK
EXHAUST TEMP
DELAYED INTLK
NOT USED
RELAY
FAULT
AUX
OUTDOOR AIR SENSOR IN
SENSOR COMMON IN
AUX SENSOR IN
CO SENSOR IN
FLOW SENSOR IN
OXYGEN SENSOR IN
SENSOR EXCIT. (12 VDC)
ANALOG IN
BMS (PWM) IN
SHIELD
ANALOG OUT
TO VFD
LONWORKS
RS-485 IN GND
CERGO INTERNATIONAL INC
159 PARIS AVE, NORTHVALE, NJ
WIRING SCHEMATIC BMK 3.0 DF
208 VAC, 3 PHASE, IRI
68026
A


CONTROL BOX CONNECTORS
19-PIN CONNECTOR
16-PIN CONNECTOR
9-PIN CONNECTOR
7-PIN CONNECTOR
AIR/FUEL VALVE
STEPPING MOTOR
IGNITION POSITION SWITCH
PURGE POSITION SWITCH
SSOV
SOLENOID VALVE
PROOF OF CLOSURE SWITCH
PROPANE LOW GAS PRESS. SW.
NAT. GAS LOW GAS PRESS. SW.
PROPANE HIGH GAS PRESS. SW.
NAT. GAS HIGH GAS PRESS. SW.
BLOWER PROOF SW.
BLOCKED AIR INLET SW.
MANUAL RESET OVER TEMPERATURE SWITCHES
AUTO RESET
WATER LEVEL PROBE
FLAME ROD
IGNITION TRANSFORMER
IGNITOR
SHELL TEMP. SENSOR
3 POSITION FUEL SELECTOR SWITCH
FROM VFD
TEMPERATURE TRANSMITTER
4 PIN CONNECTOR
AIR TEMP. SENSOR
FROM 6 PIN CONNECTOR
FROM I/O BOX
6 PIN CONNECTOR
VFD
BLOWER MOTOR
FROM FUEL SELECTOR SWITCH
120 VAC CONTROL TRANSFORMER
FUSE 4 AMPS
460VAC
POWER BOX
FUSE BLOCK
15 AMP
24 VAC XFMR
FUSE
GND BLOCK
60 HZ 3Ø 460VAC
TO CONTROL BOX ENCLOSURE
SOLENOID
TO TEMP. TRANSMITTER
TO VFD
TO TEMP. TRANSMITTER
INTERNATIONAL INC.
159 PARIS AVE, NORTHVALE, N.J.
TITLE
WIRING SCHEMATIC BMK 3.0 DF
460 VAC, 3 PHASE IRI
MAT'L SPEC.:
DWG NO. 68027
REV A
SHEET 1 OF 2

APPENDIX H


INTERNATIONAL INC.
159 PARIS AVE., NORTHVALE, N.J.
TITLE
WIRING SCHEMATIC BMK 3.0 DF
460 VAC, 3 PHASE IRI
MAT'L SPEC.:
DWG. NO.:
68027
REV
A
SHEET 2 OF 2
CONTROL BOX CONNECTORS
16-PIN CONNECTOR
24-PIN CONNECTOR
INPUT/OUTPUT BOX
J1
J2
J3
OUTDOOR AIR SENSOR IN
SENSOR COMMON IN
AUX SENSOR IN
CO SENSOR IN
FLOW SENSOR IN
OXYGEN SENSOR IN
SENSOR EXCIT. (12 VDC)
ANALOG IN
3MS (PWM) N
SHIELD
TO VFD
ANALOG OUT
TO VFD
3NT
RS-485 N D
LONWORKS
N
OUT
NOT USED
AUX RELAY
FAULT RELAY
NOT USED
REMOTE INTLK
EXHAUST TEMP
DELAYED INTLK
NOT USED

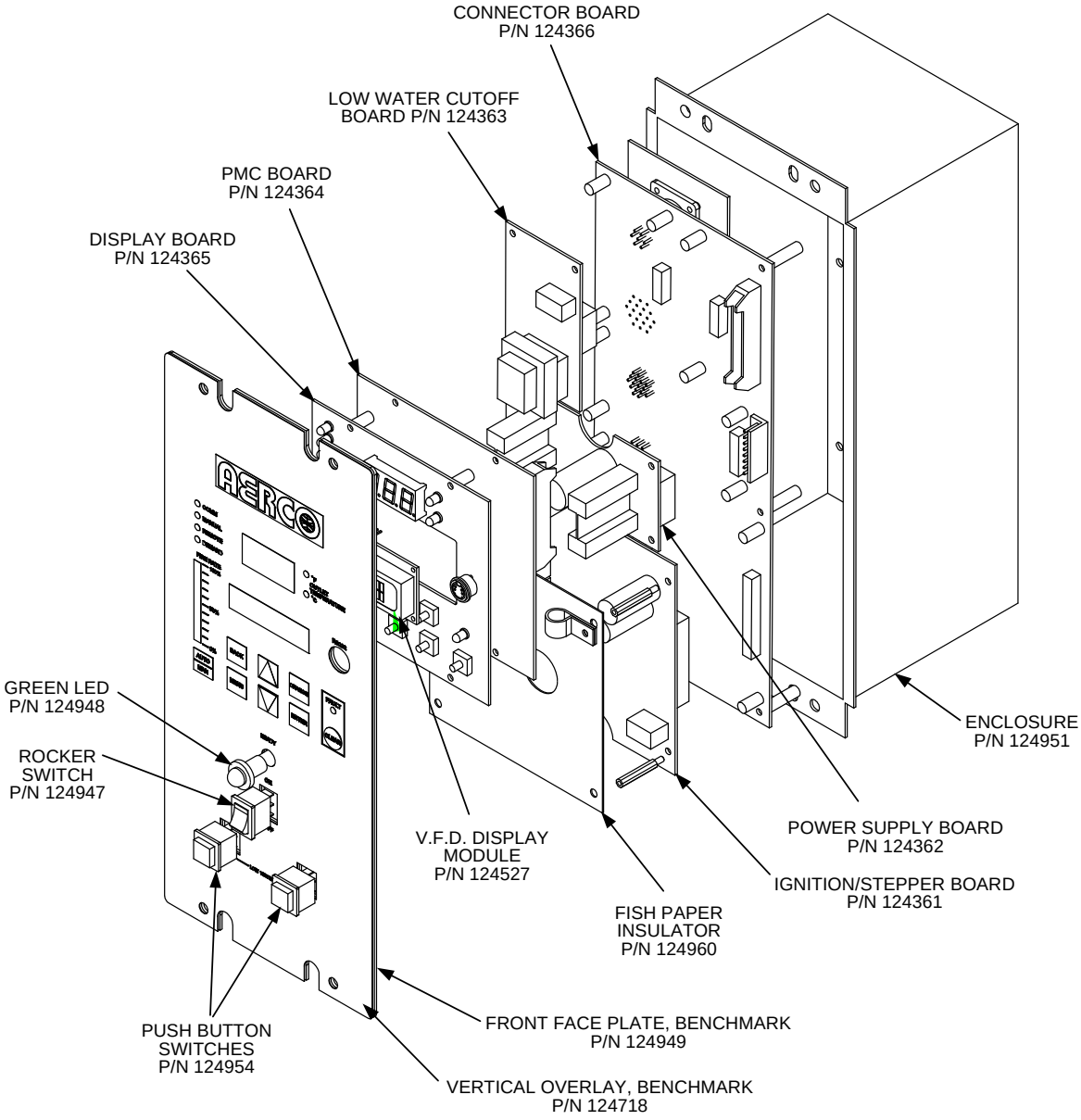
APPENDIX I

RECOMMENDED PERIODIC TESTING CHECK LIST

WARNING

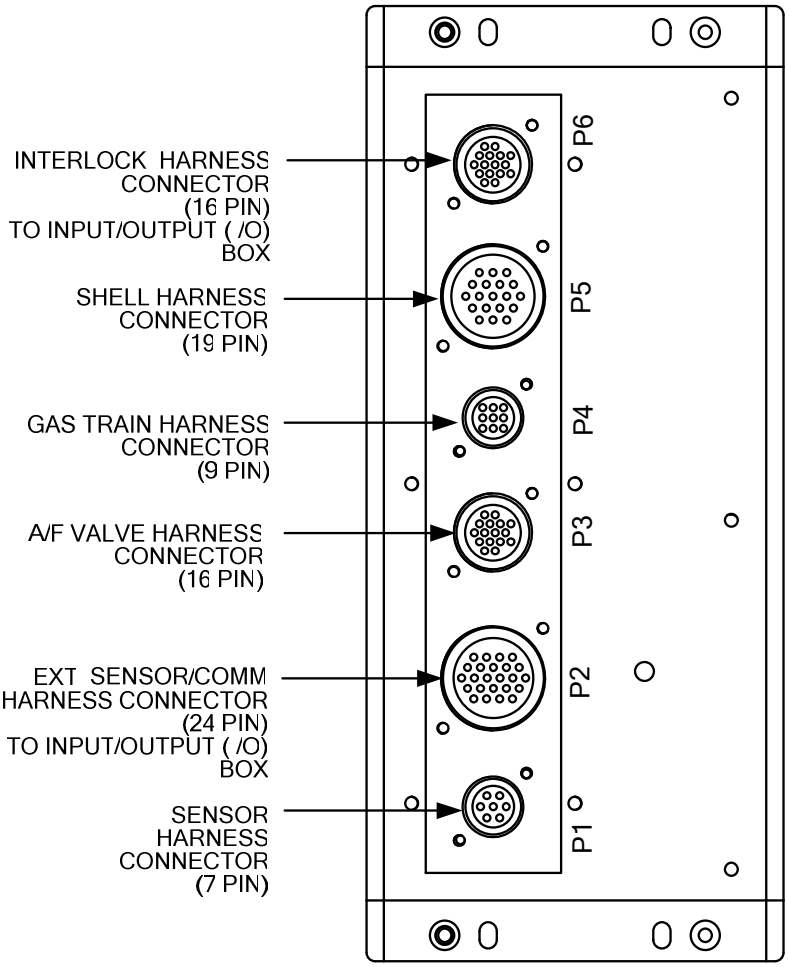
NOTE: Periodic testing of all boiler controls and safety devices is required to determine that they are operating as designed. Precautions shall be taken while tests are being performed to protect against bodily injury and property damage. The owner or user of an automatic boiler system should set up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

Item	Frequency	Accomplished By	Remarks
Refer to indicated 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 Technician	Verify factory settings
	Annually	Service Technician	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
Igniter	Weekly	Operator	See paragraph 7.2
Air/Fuel Valve position	Weekly	Operator	Check position indicator dial (paragraph 3.8)
SSOV Leakage test	Annually	Service Technician	Check for leakage in accordance with the SSOV manufacturer's (Siemens) recommendations.
Flame failure	Weekly	Operator	Close manual gas shutoff valve and check safety shutdown. See 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
Slow drain test	Semi-Annually	Operator	Perform a slow drain test in accordance with ASME Boiler and Pressure Vessel Code, Section IV.
High water temperature safety control test	Annually	Service Technician	See paragraph 6.4
Operating controls	Annually	Operator	See paragraph 3.2
Low air flow	Monthly	Operator	See paragraph 6.6
High and low gas pressure interlocks	Monthly	Operator	See paragraphs 6.2 and 6.3
Air/Fuel Valve purge position switch	Annually	Service Technician	See paragraph 6.10
Air/Fuel Valve ignition position switch	Annually	Service Technician	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 Technician	See paragraph 7.6



BENCHMARK CONTROL PANEL EXPLODED VIEW

APPENDIX J



BENCHMARK CONTROL PANEL REAR VIEW

APPENDIX K

BENCHMARK 3.0 DUAL-FUEL SWITCHOVER INSTRUCTIONS

Prior to operating a Benchmark 3.0 Dual-Fuel Unit on either Natural Gas or Propane, a number of checks and procedural steps must be performed prior to performing the initial start-up and combustion calibration. These checks and procedures

- Installing the proper LogicStick in the Variable Frequency Drive (VFD)
- Adjusting the Max Fire Rate setting in the Configuration Menu of the C-More Control Box

Detailed instructions for performing these tasks are presented in the following Sections

SWITCHOVER FROM NATURAL GAS TO PROPANE

To switch from Natural Gas to Propane operation, proceed as follows:

1. Refer to Figure K-1 and locate the Fuel Selector Switch on the front of the unit.
2. Set the Fuel Selector Switch to the PROPANE position. A Low Gas pressure Fault message will be displayed on the Control Box.
3. Clear the Low Gas Pressure Fault by pressing the CLEAR key.
4. Refer to Figure K-1 and locate the Variable Frequency Drive (VFD) installed behind the front panel door of the unit.
5. Install the VFD Logic Stick labeled “PROPANE” in the slot on the front of the VFD.
6. Set the **ON/OFF** switch on the C-More /control Box to the **ON** position.
7. Press the **MENU** key once. *Setup Menu* will be displayed.
8. Press the ▲ arrow key once. *Password* will be displayed.
9. Press the **CHANGE** key. *Password* will begin to flash.
10. Using the ▲ arrow key, increment the display and stop at *159.*
11. Press the **ENTER** key to store the displayed password.
12. *Password 1* will be displayed, indicating that the valid Level 1 password has been stored.
13. Next, access the *Configuration Menu* by pressing the **MENU** key once.
14. Using the ▲ and ▼ arrow keys, scroll through the *Configuration Menu* and stop at *Max Fire Rate*.
15. Press the **CHANGE** key. The *Max Fire Rate* will begin to flash.
16. Press the ▼ arrow key and decrease the *Max Fire Rate* to 75%.
17. Press the **ENTER** key to store the *75% Max Fire Rate.*
18. This completes the steps necessary to switch from Natural Gas to Propane operation.

APPENDIX K

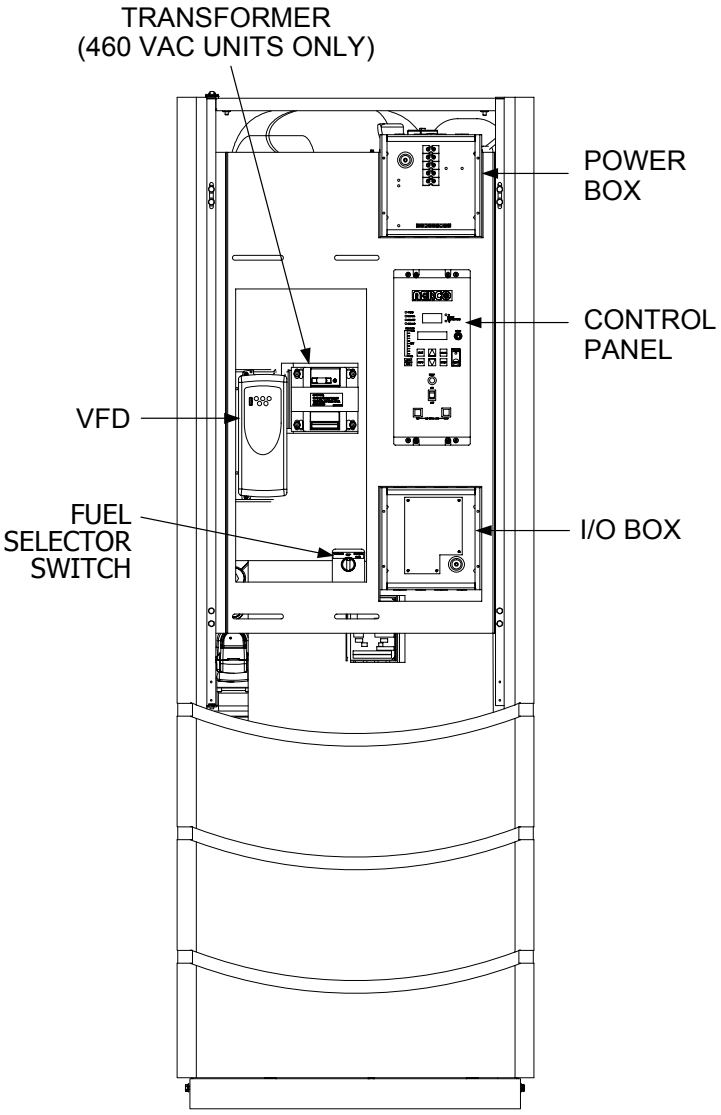


FIGURE K-1. BENCHMARK 3.0 DUAL FRONT VIEW – DOOR REMOVED

SWITCHOVER FROM PROPANE TO NATURAL GAS

To switch from Propane to Natural Gas operation, proceed as follows:

1. Refer to Figure K-1 and locate the Fuel Selector Switch on the front of the unit.
2. Set the Fuel Selector Switch to the NATURAL GAS position. A Low Gas pressure Fault message will be displayed on the Control Box.
3. Clear the Low Gas Pressure Fault by pressing the CLEAR key.
4. Refer to Figure K-1 and locate the Variable Frequency Drive (VFD) installed behind the front panel door of the unit.
5. Install the VFD Logic Stick labeled “NATURAL GAS” in the slot on the front of the VFD.
6. Apply AC power to the Benchmark 3.0 Dual Fuel Boiler.
7. Press the **MENU** key once. *Setup Menu* will be displayed.
8. Press the ▲ arrow key once. *Password* will be displayed.
9. Press the **CHANGE** key. *Password* will begin to flash.
10. Using the ▲ arrow key, increment the display and stop at *159.*
11. Press the **ENTER** key to store the displayed password.
12. *Password 1* will be displayed, indicating that the valid Level 1 password has been stored.
13. Next, access the *Configuration Menu* by pressing the **MENU** key once.
14. Using the ▲ and ▼ arrow keys, scroll through the *Configuration Menu* and stop at *Max Fire Rate*.
15. Press the **CHANGE** key. The *Max Fire Rate* will begin to flash.
16. Press the ▲ arrow key and increase the *Max Fire Rate* to 100%.
17. Press the **ENTER** key to store the *100% Max Fire Rate.*
18. This completes the steps necessary to switch from Natural Gas to Propane operation.

PRESSURE VESSEL/HEAT EXCHANGER: 10 YEARS FROM SHIPMENT

The pressure vessel/heat exchanger shall carry a 10-year prorated, limited warranty from shipment against any failure due to condensate corrosion, thermal stress, mechanical defects or workmanship. Operation of the boiler using contaminated air will void the warranty. The pressure vessel/heat exchanger shall not be warranted from failure due to scaling, liming, corrosion, or erosion due to water or installation conditions. **AERCO** will repair, rebuild or exchange, at its option the heat exchanger/combustion chamber according to the following schedule:

Year	Discount From Then Prevailing List Price
1 through 7	100%
8	70%
9	40%
10	25%

"C-MORE" CONTROL PANEL: 2 YEARS FROM SHIPMENT

AERCO labeled control panels are conditionally warranted against failure for (2) two years from shipment.

OTHER COMPONENTS: 18 MONTHS FROM SHIPMENT
All other components, with the exception of the ignitor and flame detector, are conditionally guaranteed against any failure for 18 months from shipment.

AERCO shall accept no responsibility if such item has been improperly installed, operated, or maintained or if the buyer has permitted any unauthorized modification, adjustment, and/or repairs to the item.

The warranty as set forth on the back page of the Operations & Maintenance Manual is in lieu of and not in addition to any other express or implied warranties in any documents, or under any law. No salesman or other representative of **AERCO** has any authority to expand warranties beyond the face of the said warranty and purchaser shall not rely on any oral statement except as stated in the said warranty. An Officer of AERCO must do any modifications to this warranty in writing. **AERCO MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE OR ANY OTHER EXPRESS OR IMPLIED WARRANTIES.** AERCO disclaims all responsibility for any special, incidental or consequential damages. Any claim relating to the product must be filed with **AERCO** not later than 14 days after the event-giving rise to such claim. Any claims relating to this product shall be limited to the sale price of the product at the time of sale. The sale of the product is specifically conditioned upon acceptance of these terms.

CONDITIONS OF WARRANTY

Should an AERCO gas-fired Hydronic boiler fail for any of the above reasons within the specified time period from the date of original shipment(s), AERCO shall, at its option, modify, repair or exchange the defective item. AERCO shall have the option of having the item returned, FOB its factory, or to make field replacements at the point of installation. In no event shall AERCO be held liable for replacement labor charges or for freight or handling charges.

AERCO shall accept no responsibility if such item has been improperly installed, operated, or maintained or if the buyer has permitted any unauthorized modification, adjustment, and/or repairs to the item. The use of replacement parts not manufactured or sold by AERCO will void any warranty, express or limited.

In order to process a warranty claim a formal purchase order number is required prior to shipment of any warranty item. In addition, the returned item must include a Returned Goods Authorization (RGA) label, attached to the shipping carton, which identifies the item's return address, register number and factory authorized RGA number.

Warranty coverage for all components and equipment mentioned in said warranty are not valid unless the Hydronic boiler is started up by a factory certified SST (Service, Start-Up and Troubleshooting) Technician and an AERCO start-up sheet is completed.

This warranty coverage is only applicable within the United States and Canada. All other geographical areas carry a standard warranty of 18 months from date of shipment or 12 months from startup, whichever comes first.