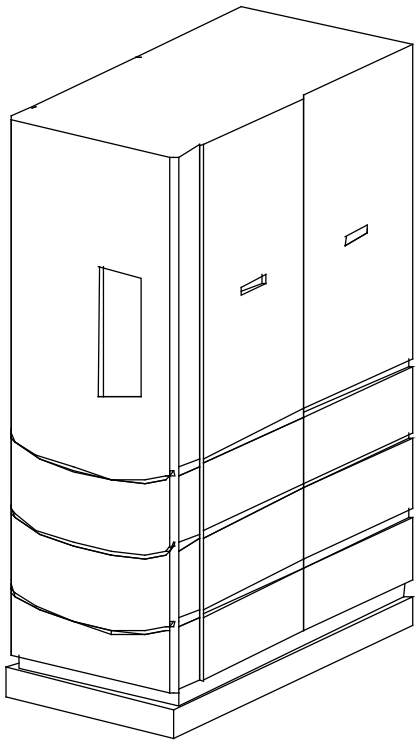
Applicable for Serial Numbers **G-02-533** thru **G-10-1060**

Benchmark 2.0

Gas Fired Boiler System

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



Patent # : 2.155.12

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Operating & Maintenance Instructions

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Foreword

The AERCO Benchmark boiler is 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's 20:1 turn down ratio and condensing capability offers extremely high efficiencies and makes the Benchmark ideally suited for modern low temperature, as well as, conventional heating systems.

Whether used in singular or modular arrangements the Benchmark 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 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 general warnings and cautions must be given the same attention as specific precautions included in these instructions. In addition to all the requirements included in this 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.

See pages 1-2 and 1-3 for important information regarding installation of units within the Commonwealth of Massachusetts.

IMPORTANT

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

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 ANY BOILER 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 the 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

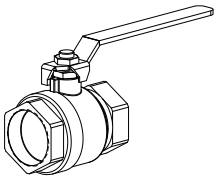
If overheating occurs or the gas supply fails to shut off, close the manual gas shutoff valve (Figure 1-1) located external to the unit.

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 must identify the emergency shut-off device.



MANUAL GAS SHUTOFF VALVE

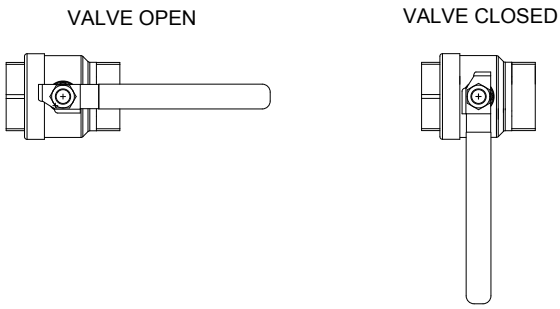


Figure 1-1

Manual Gas Shutoff Valve

IMPORTANT – FOR MASSACHUSETTS INSTALLATIONS

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

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

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

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

monoxide detectors.

Extracted Information From 248 CMR 5.08 (2) – Continued

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Chapter 2 - INSTALLATION

2.1 RECEIVING THE UNIT

Each Benchmark is shipped as a single crated unit. The shipping weight is approximately 1650 pounds, and must be moved with the proper rigging equipment for safety and to avoid damages. The unit should be completely inspected for shipping damage and 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. 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.

2.2 UNPACKING

Carefully unpack the unit taking care not to damage the unit jacket when cutting away packaging materials. A close inspection of the unit should be made to determine if there has been any damage not indicated by the Tip-N-Tell. The freight carrier should be notified immediately if any damage is detected. The following accessories come standard with each unit and are packed separately within the unit's' packing container or are factory installed on the boiler.

- Spare Spark Ignitor
- Spare Flame Detector
- ASME Pressure Relief Valve
- Ignitor Removal Tool (One per Site)
- Regulator Adjustment Tool (One per Site)
- Condensate Drain Trap and Fittings
- A Gas Supply Pressure Regulator

When ordered, optional accessories may be packed separately or within the boiler shipping container, or may be installed on the boiler. Any standard or optional accessories shipped loose should be identified and put in a safe place until ready for installation or use.

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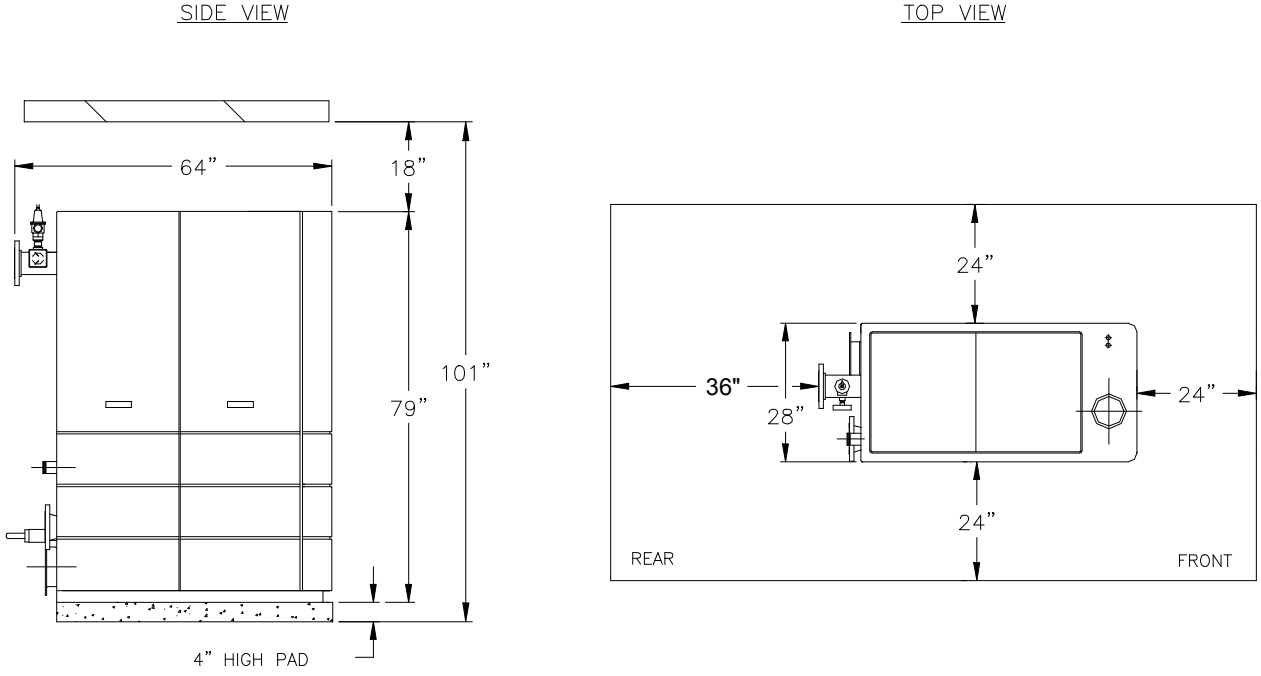


Figure 2.1
Boiler Clearances

2.3 INSTALLATION

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. Local building codes may require additional clearance and take precedence

Minimum clearances required:

Sides	24"
Front	24"
Rear	36"
Top	18"

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

WARNING!

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

CAUTION!

While packaged on the shipping skid the boiler must be moved by pallet jack or forklift from the rear only.

MASSACHUSETTS INSTALLATIONS

For installations within the Commonwealth of Massachusetts, the boiler must be installed by a plumber or gas fitter who is licensed within the Commonwealth.

In addition, the installation must comply with all requirements specified in Chapter 1 (Safety Precautions), pages 1-2 and 1-3.

2.3.1. SETTING THE UNIT

The unit must be installed on a 4 to 6 inch housekeeping pad for proper condensate drainage. If anchoring the unit, see the dimensional drawings in Appendix F for anchor location. Lifting lugs are provided for moving the unit when it has been removed from the shipping skid (See Fig. 2.2). USE ONLY THE LIFTING LUGS TO MOVE THE UNIT. Remove the rear top panel from the unit to provide access to the lifting lugs. Remove the four (4) lag screws securing the boiler to the shipping skid.

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

In multiple unit installations, it is important to plan the position of each unit. Sufficient space for piping connections and future maintenance requirements must be given. All piping must include ample provision for expansion**.**

If installing a Combination Control (CCP) system, it is important to identify and place the Combination Mode units in the proper physical location. If these boilers are not properly located, it will be necessary to reprogram them.

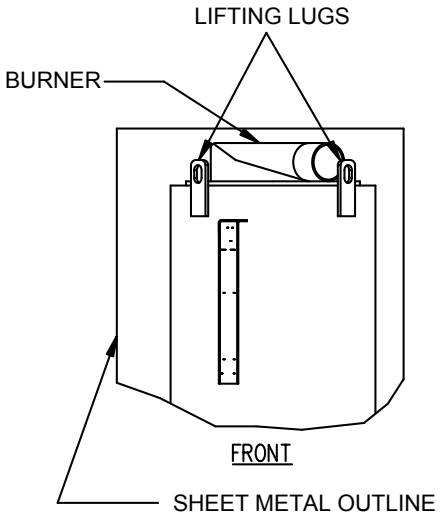


Figure 2.2
Lifting Lug Location

2.3.2 SUPPLY AND RETURN PIPING

The Benchmark 2.0 utilizes 4" 150# flanges for the water system supply and return piping connections. See appendix F for dimensional data. The physical location of the supply and return piping connections is on the rear of the unit (See Fig 2.3 For Details).

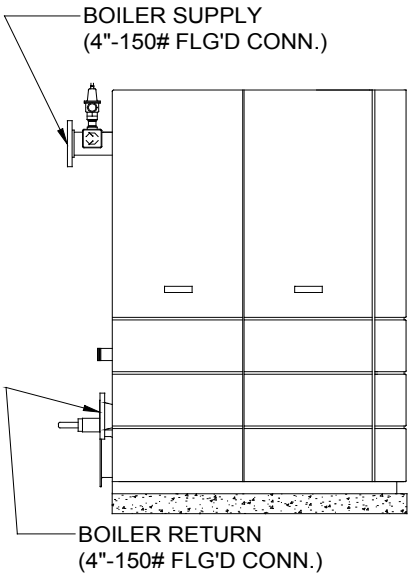


Figure 2.3
Supply and Return Location

2.3.3 CONDENSATE DRAIN & PIPING

The Benchmark Boiler is designed to condense water vapor from the flue products. Therefore, the installation must have provisions for suitable drainage or collection. A 1/2" NPT drain connection is provided on the exhaust manifold (see Fig 2.4). A separate condensate drain trap (part no. 24060) is shipped loose and must be installed on the floor behind the unit. Connect the trap to the exhaust manifold as follows:

1. First, install a 1/2" NPT nipple in the condensate drain port (Fig. 2.4). Next, connect a 3/4-to 1/2" reducer to the 1/2" nipple.

2. On the condensate drain trap, install 3/4" NPT nipples in the tapped inlet and outlet of the trap.

3. Attach a length of 1" I.D. polypropylene hose between the exhaust manifold drain and the inlet side of the condensate trap (Fig 2.5). Secure both ends of the hose with clamps. Drainage from the condensate drain trap outlet must be by gravity to a nearby floor drain via a polypropylene hose or suitable piping**.**

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 11 GPH. The condensate drain trap, associated fittings and drain line must be removable for routine maintenance. Do Not hard pipe.

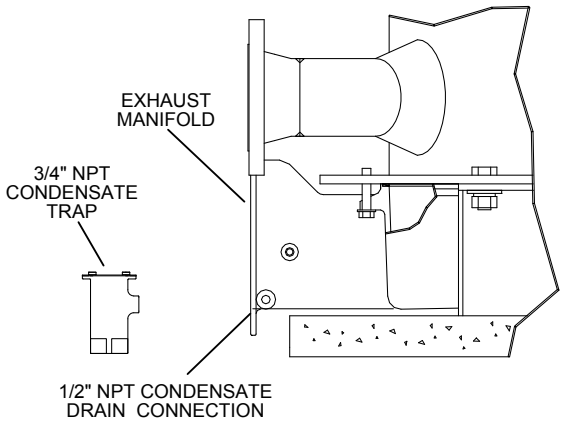


Figure 2.4

Condensate Drain Connection Location

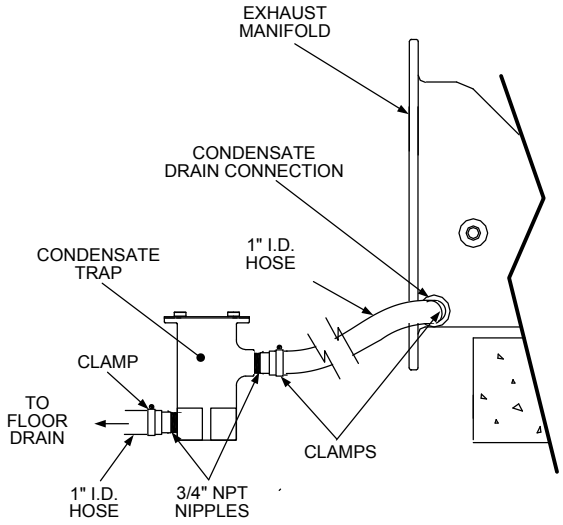


Figure 2.5

Condensate Trap Installation

2.4. GAS SUPPLY PIPING

The AERCO Gas Fired Equipment Gas Components and Supply Design Guide (GF-2030) must be consulted before any gas piping is designed or started.

WARNING!
DO NOT 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. The 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 cover, inhibit service or maintenance, or prevent access between the Unit and walls, or another unit.

The location of the 2" inlet gas connection is located on the rear of the unit as shown in Figure 2.5.

All pipes should be de-burred and internally cleared of any scale or iron chips before installation. No flexible connectors or non-approved gas fittings should be installed. Piping should be supported from floor, ceiling or walls only and must not be secured to the unit.

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

To avoid damage to the unit, when pressure testing gas piping, isolate the unit from the gas supply piping. At no time should there be more than 14" W.C. to the unit. Leak test all external piping thoroughly for leaks using a soap and water solution or suitable equivalent. The gas piping must meet all applicable codes.

2.4.1 GAS SUPPLY SPECIFICATONS AND GAS SUPPLY REGULATORS

- ***Natural Gas:***
  The maximum static pressure to the unit must be no more than 14" W.C. Minimum operating gas pressure for natural gas is 7.0" W.C. for FM gas trains & 7.4" W.C. for IRI gas trains when the unit is firing at maximum input. Proper sizing of the gas supply regulator in delivering the correct gas flow and outlet pressure is mandatory. The gas supply pressure regulator must be of sufficient capacity volume to provide 2000 cfh while maintaining the gas pressure at 7.0" W.C. for FM gas trains & 7.4" W.C. for IRI gas trains and should have no more than 1" droop from minimum to full fire.
- ***Propane for Dual Fuel Unit:***
  The maximum static pressure to the unit must be no more than 14" W.C. Minimum operating gas pressure for propane is 7.0" W.C. for FM gas trains and 7.4" W.C. for IRI gas trains when the unit is firing at maximum input. Proper sizing of the gas supply regulator in delivering the correct gas flow and outlet pressure is mandatory. The gas supply pressure regulator must be of sufficient capacity volume to provide 800 cfh while maintaining the gas pressure at 7.0" W.C. for FM gas trains and 7.4" W.C. for IRI gas trains, and should have no more than 1" droop from minimum to full fire.

A Maxitrol RV-91 gas supply regulator is supplied by AERCO and must be positioned as shown in figure 2.5. For a dual fuel unit, two RV-91 regulators are supplied. Maximum gas pressure to the RV-91 is 14" W.C. If the gas supply pressure will exceed 14" W.C., a lock -up style regulator is required up stream of the RV-91.

When installing the gas supply regulator(s), union connections should be placed in the proper locations to allow for maintenance.

The gas supply regulator must be properly vented to outdoors. Consult the local gas utility for exact requirements concerning venting of supply gas regulators.

NOTE:
If a regulator other than the Maxitrol RV-91 supplied with the boiler is used it must be capable or regulating 2,000,000 BTU/HR of natural gas while maintaining 7" W.C. to the boiler.

CAUTION!
A lockup style regulator must be used when gas supply pressure exceeds 14" W.C.

2.4.2 MANUAL GAS SHUTOFF VALVE

A 2" manual gas shut-off valve is furnished with each unit. The valve should be positioned as shown in Figure 2.5 upstream of the supply regulator in a readily accessible location.

2.4.3 IRI GAS TRAIN KIT

The IRI gas train is an optional gas train required in some areas by code or for insurance purposes. The IRI gas train is factory pre-piped and wired. See Appendix F, Drawing Number AP-A-742, or AP-A-745 (Dual-Fuel).

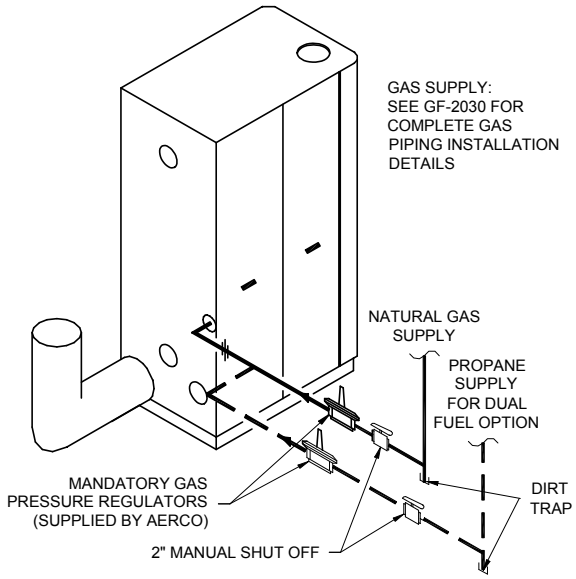


Figure 2.5
Gas Supply Regulator and Manual Shut-Off Valve Location

2.5 ELECTRICAL SUPPLY

The AERCO Gas Fired Equipment Electrical Power Wiring Guide, (GF-2060), must be consulted in addition to the following material before wiring to the unit is started. External AC power connections are made to the unit inside the power box on the front panel of the unit, behind the removable front door (Figure 2.6).

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

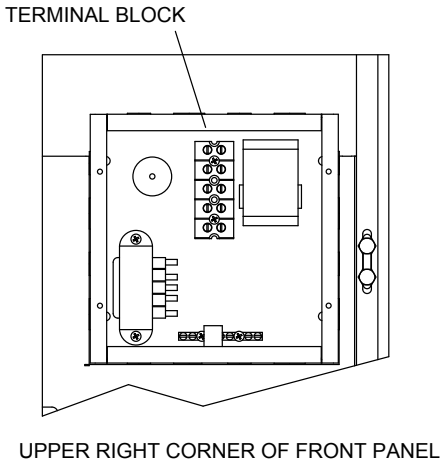


Figure 2.6
AC Input Terminal Location

2.5.1 ELECTRICAL REQUIREMENTS

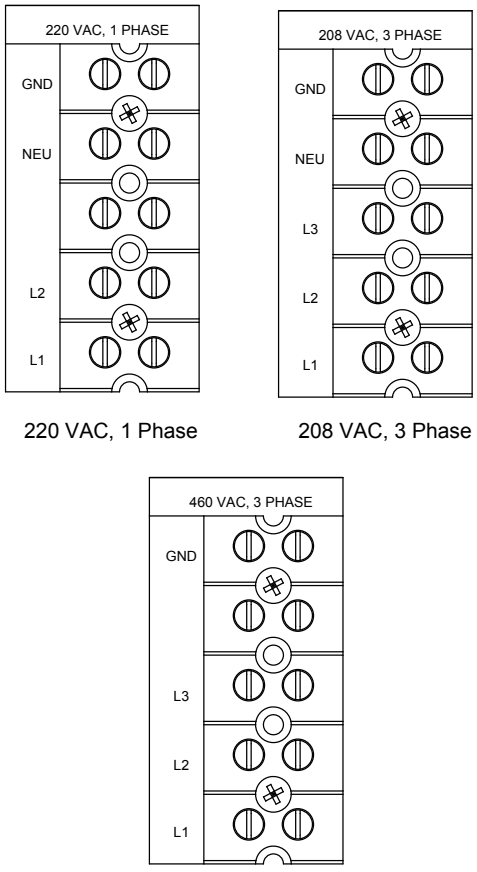
The Benchmark Boiler is available in one three different AC power configurations:

220 Vac/1 Phase/60 Hz @ 20 amps
208 Vac/3-Phase/60 @15 amps
460 Vac/3-Phase/60 Hz @ 15 amps

Each of the above power configurations contain a Power Box with a terminal block which matches the configuration ordered. The three different terminal block configurations are shown in Figure 2.7. A wiring diagram showing the required AC power connections is provided on the front panel of each Power Box.

Each Benchmark Boiler must be connected to a dedicated electrical circuit. No other devices should be on the same electrical circuit as the Benchmark Boiler. 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 Benchmark Electrical, Power Wiring Guide, GF-2060



220 VAC, 1 Phase

208 VAC, 3 Phase

460 VAC, 3 Phase

Figure 2.7
AC Terminal Block Configurations

2.6 MODE OF OPERATION and FIELD CONTROL WIRING

The Benchmark Boiler is available in several different modes of operation. While each unit is factory configured and wired for a particular mode, some field wiring may be required to complete the installation. This wiring is typically run to the Input/Output (I/O) Box located on the front of the unit behind the removable front door (see Fig. 2.8). A brief description of each mode of operation, and their requirements, is described in the following paragraphs. Additional information concerning field wiring is provided in paragraphs 2.7.1 through 2.7.9. For additional information on modes of operation, refer to Chapter 5.

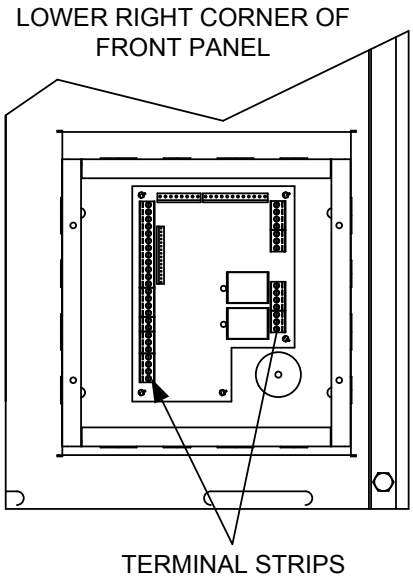


Figure 2.8
I/O Box Terminal Location

2.6.1 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 electrical supply connections are required for this mode. However, if desired, fault monitoring or enable/disable interlock wiring can be utilized (see paragraphs 2.7.9.1 and 2.7.10).

2.6.2 INDOOR/OUTDOOR RESET MODE

This mode of operation increases supply water temperature as outdoor temperatures decrease. An outside air temperature sensor (AERCO PN GM-122791) is required. The sensor MUST BE wired to the I/O Box wiring terminals (see Fig. 2.9). For more information concerning the outside air sensor installation, refer to paragraph 2.7.1

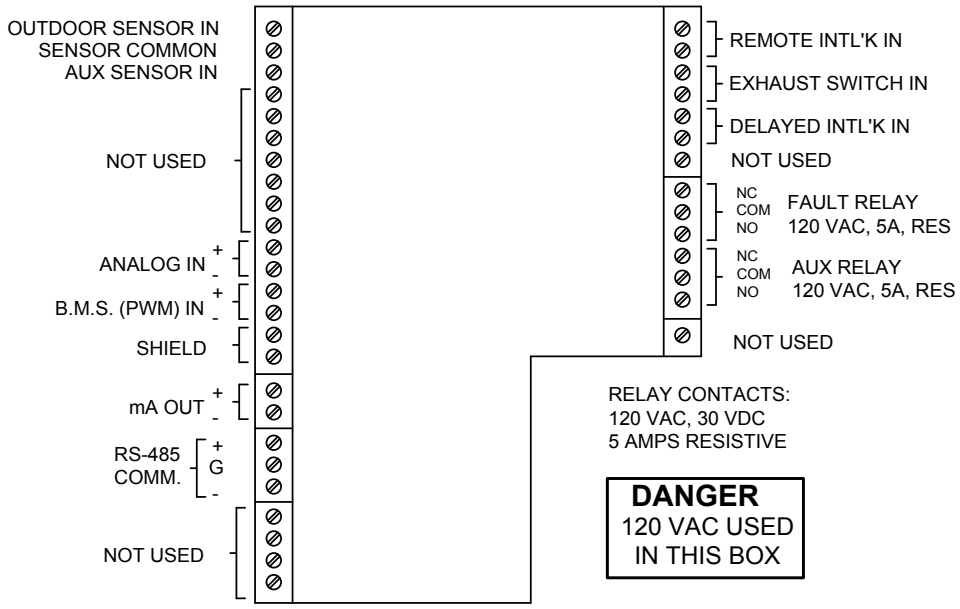


Figure 2.9 I/O Box Terminal Strip

2.6.3 BOILER MANAGEMENT SYSTEM (BMS) 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 2-9). 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 Modbus 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 -Operation Guides.

2.6.4 REMOTE SETPOINT and DIRECT DRIVE MODES

The Benchmark Boiler can accept several types of signal formats from an Energy Management System 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 paragraph 2.7.4)

Network – (RS485 Modbus. See para. 2.7.7)

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 2.7.3.

2.6.5 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 connected 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 done using a shielded twisted pair of 18- 22 AWG wire and 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.

2.7 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 2.9 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.

2.7.1 OUTDOOR SENSOR IN

An outdoor air temperature sensor (AERCO Part No. 122790) will be required mainly 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 choose 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 Figs. 2.8 and 2.9). Wire the sensor using a twisted shielded pair cable of 18-22 AWG wire. There is no polarity when terminating the wires. The shield is to be connected only to the terminals labeled SHEILD 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.

2.7.2 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 and must be similar to AERCO BALCO wire sensor P/N 12449. A resistance chart for this sensor can be found in APPENDIX C.

2.7.3 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 PMC Board located inside the Control Box. Contact the AERCO factory for information on setting DIP switches.

All of the supplied signals must be floating (ungrounded) signals. Connections between the source and the Boiler's I/O Box must be made using twisted shielded pair of 18 –22 AWG wire such as Belden 9841(see Fig. 2.9). Polarity must be maintained and the shield must be connected only at the source end and must be left floating (not connected) at the Boiler's I/O Box.

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

2.7.4 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.

2.7.5 SHIELD

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

2.7.6 mA OUT

These terminals provide a 4 to 20 mA output that can be used to monitor setpoint (40° to 240°F), outlet temperature (30° to 240°F), or fire rate (0% to 100%). This function is enabled in the Configuration Menu (Chapter 3, Table 3.4).

2.7.7 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 or other suitable device.

2.7.8 EXHAUST SWITCH IN

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

2.7.9 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 (Fig. 2.9). 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 labeled 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.

2.7.9.1 REMOTE INTERLOCK IN

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

2.7.9.2 DELAYED INTERLOCK IN

The delayed interlock circuit (DELAYED INTL'K IN) is typically used in conjunction with the auxiliary relay described in paragraph 2.8. 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).

2.7.10 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 2.9

2.8 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 2.9 to locate the AUX RELAY terminals for wiring connections.

2.9 FLUE GAS VENT INSTALLATION

The AERCO Venting and Combustion Air Guide, GF-2050, must be consulted before any flue gas vent or inlet air venting is designed or installed. U/L listed, positive pressure, watertight vent materials as specified in AERCO's GF-2050, must be used for safety and code compliance. Because the unit is capable of discharging low temperature exhaust gases, the flue must be pitched back to the unit a minimum of 1/4" per foot to avoid any condensate pooling and to 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”/+0.25" W.C. These factors must be planned into the vent installation. If the maximum allowable equivalent lengths of piping are exceeded, the unit will not operate properly or reliably.

2.10 COMBUSTION AIR

The AERCO Venting and Combustion Air Guide, GF-2050, MUST be consulted *before* any flue or combustion supply air venting is designed or started. 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 Benchmark is UL listed for 100% sealed combustion and can be ordered with a sealed combustion option, or can be installed using room air as long as there is an adequate supply. (See paragraph 2.10.3 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 blower suction and the knockout at the top of the unit will be and should remain in place.

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

2.10.1 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 boiler input. The free area must take into account restrictions such as louvers and bird screens.

2.10.2 COMBUSTION AIR FROM INSIDE THE BUILDING

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

2.10.3 SEALED COMBUSTION

The BENCHMARK boiler is UL listed for 100%-sealed combustion and can be ordered with a sealed combustion option or without. Units ordered in the sealed combustion configuration will come with an air inlet assembly installed on the blower. The knockout at the top of the boiler must be removed and the combustion air ductwork must be attached to the 6" x 8" adapter that is provided just below the knockout.

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 Venting and Combustion Air Guide, GF-2050. When using the boiler in a sealed combustion air configuration, each unit must have a minimum 8" 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 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 initial installation procedures must be satisfied before attempting to start the unit.

WARNING:

THE ELECTRICAL VOLTAGES IN THIS SYSTEM MAY INCLUDE 460, 220, 120 AND 24 VOLTS AC. IT MUST NOT BE SERVICED OR ACCESSED BY OTHER THAN 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 PERSONNEL INJURY OR PROPERTY DAMAGE. THIS SITUATION WILL VOID ANY WARRANTY.

3.2. CONTROL PANEL DESCRIPTION

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

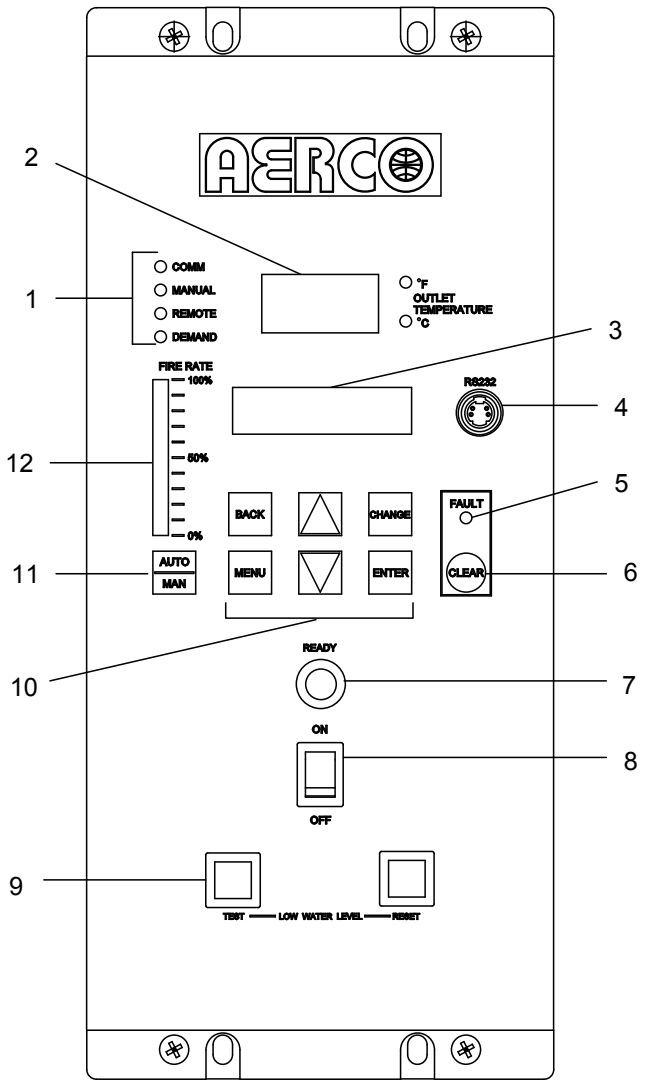


Figure 3-1.

Control Panel Front View

Table 3-1 Operating Controls, Indicators and Displays

ITEM NO.	CONTROL, INDICATOR OR DISPLAY	FUNCTION
1	LED Status Indicators	Four Status LEDs indicate the current operating status as follows:
	COMM	Lights when RS-232 communication is occurring
	MANUAL	Lights when the unit is being controlled using the front panel keypad.
	REMOTE	Lights when the unit is being controlled by an external signal from an Energy Management System
	DEMAND	Lights when there is a demand for heat.
2	**OUTLET TEMPERATURE** Display	3–Digit, 7–Segment LED display continuously displays the outlet water temperature. The **°F** or **°C** LED next to the display lights to indicate whether the displayed temperature is in degrees Fahrenheit or degrees Celsius.
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 boiler 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 when all Pre-Purge conditions have been satisfied.
8	**ON/OFF** Switch	Enables and disables boiler operation.
9	**LOW WATER LEVEL TEST/RESET** Switches	Allows operator to test operation of the water level monitor. Pressing **TEST** opens the water level probe circuit and simulates a Low Water Level alarm. Pressing **RESET** resets the water level monitor circuit. Pressing **CLEAR** 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 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.

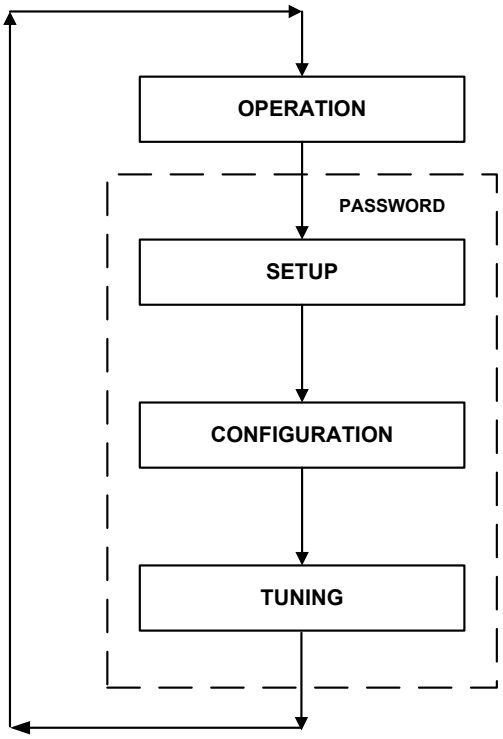


Figure 3-2. Menu Structure

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. Factory Default settings for all menu options are listed in Appendix E. 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 other displayed items. Since this menu is "Read-Only", it can be viewed at any time without entering a password. Press 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, language to be used for display messages, 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 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 Minimum	Maximum	Default
Internal Setpt	Lo Temp Limit	Hi Temp Limit	130°F
Unit Type	Boiler 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 BMS (PWM Input Network		4 – 20 mA, 1-5V
Bldg Ref Temp (If Boiler Mode = Outdoor Reset)	40°F	240°F	70°F
Reset Ratio (If Boiler 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	240°F	200°F
Temp Hi Limit	40°F	240°F	215°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
Failsafe Mode	Shutdown or Constant Setpt		Shutdown
mA Output	Setpoint, Outlet Temp, Fire Rate Out, Off		Off
Lo Fire Timer	2 sec	120 sec	2 sec
Setpt Limiting	Enabled or Disabled		Disabled
Setpt Limit Band	0°F	10°F	5°F

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	2.0 min	0.0 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

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 switch in the Safety Shut-Off Valve (SSOV) is closed shown (Figure 3-3).

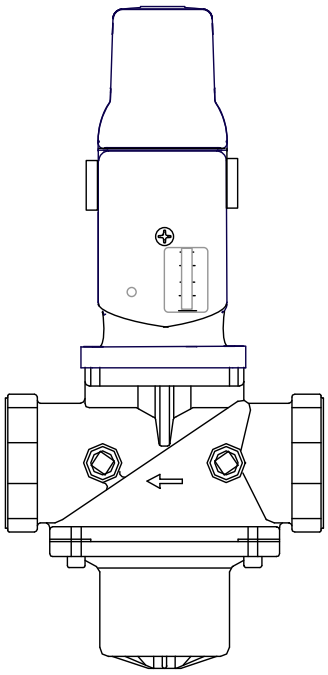


Figure 3-3.

Safety Shut-Off Valve

3. With all required safety switches closed, a purge cycle will be initiated and the following events will occur:

(a) Blower relay energizes and turns on blower.

(b) Air/Fuel Valve rotates to 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%.

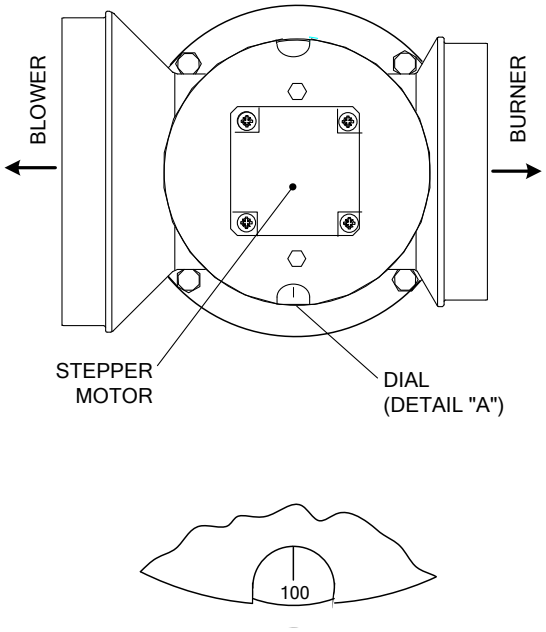


Figure 3-4.
Air/Fuel Valve In Purge Position

4. Next, the blower proof switch (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 7 seconds.

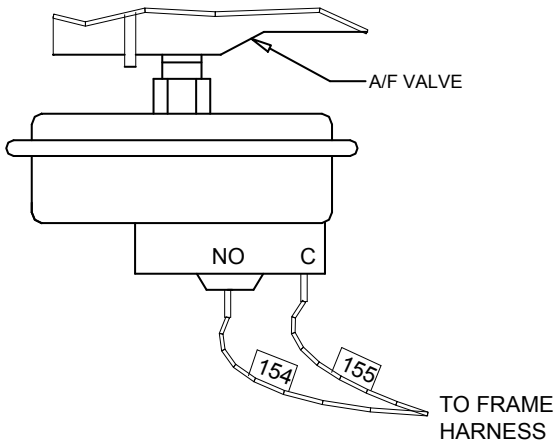


Figure 3-5.
Blower Proof Switch

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

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

   (b) The igniter relay is activated and provides ignition spark.

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

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

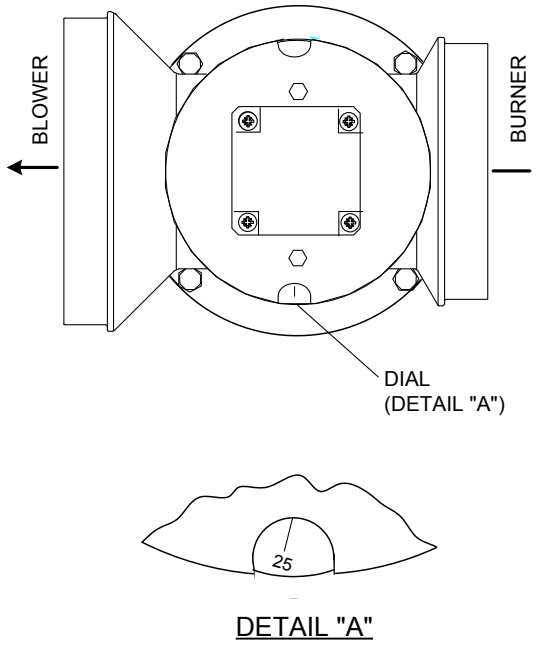


Figure 3-6.
Air/Fuel Valve In Ignition Position

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

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 for natural gas as follows:

- Start Level: 20%
- Stop Level: 16%

Normally, these settings should not require adjustment.

For Dual-Fuel units operating on propane, the start and stop levels must be changed to the following values:

- Start Level: 28%
- Stop Level: 24%

See Appendix K for Dual Fuel switch-over instructions when operating on propane.

Chapter 4 - INITIAL START- UP

4.1 INITIAL START- UP REQUIREMENTS

The initial start-up of the Benchmark Boiler is comprised of the following steps:

- Complete installation
- Perform combustion calibration
- Check proper setting of controls and limits
- Adjust mode of operation settings (see Chapter 5)
- Perform safety device testing (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 for the unit to operate safely, at a high thermal efficiency, and 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 control test procedures in Chapter 6 to complete the initial unit start-up.

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

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

WARNING!
DO NOT ATTEMPT TO FIRE THE BOILER WITHOUT FULL WATER LEVEL. THIS CAN SERIOUSLY DAMAGE THE UNIT AND MAY RESULT IN PERSONAL INJURY OR PROPERTY DAMAGE. THIS IS NOT COVERED BY WARRANTY.

CAUTION!
All 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 AND INSTRUMENTATION

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

1. A digital combustion analyzer with oxygen accuracy to ± 0.2%, and carbon monoxide in PPM.
2. A 16" W.C. manometer or equivalent gauge and plastic tubing.
3. Three, 1/4" NPT to barbed fittings for use with the gas supply and differential manometers (two fittings will be used if differential pressures are taken).
4. AERCO differential gas pressure regulator adjustment tool P/N 123643 for standard units and P/N GM-122643 for Dual Fuel units.
5. Small and large flat blade screwdrivers.
6. Tube of silicone adhesive

4.2.2 INSTALLING THE SUPPLY GAS MANOMETER

1. Close the main manual gas supply valve up stream of the unit.
2. Remove the 1/4" NPT pipe plug from the port on the inlet side of the safety shut off valve (see Figure 4.1).
3. Install a barbed fitting into the pipe plug tapping.
4. Attach one end of a length of plastic tubing to the barbed fitting and one end to the 16" W.C. manometer.

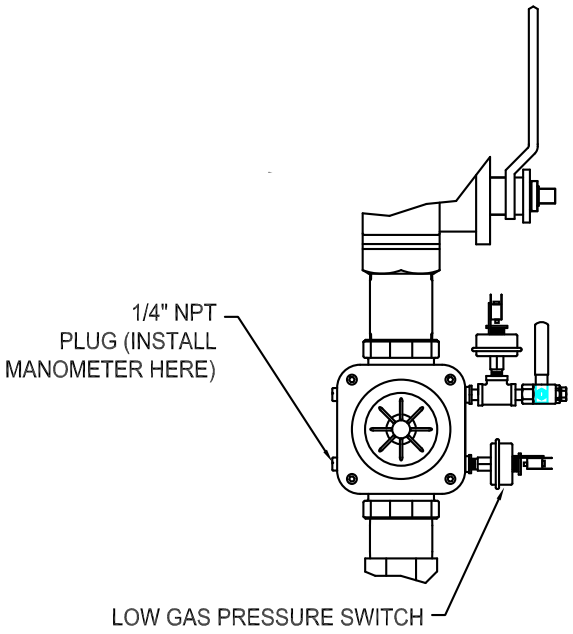


Figure 4.1
1/4" Gas Plug Location
(See Appendix F for IRI Gas Trains)

4.2.3 PREPARING THE FLUE VENT PROBE HOLE

1. If the unit has been installed using the recommended AL29-4C vent, there will be a 3/8" hole, in the center of the starter section (Part #123679). The outer vent section, that covers the vent section connections must be loosened and moved to uncover the hole (see Figure 4.2)

2. Adjust the stop on the combustion analyzer probe, if so equipped, so that it extends approximately midway into the flue gas flow. Do not insert the probe at this time.

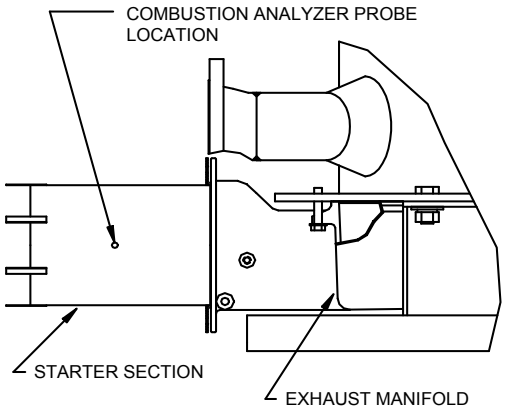


Figure 4.2
Analyzer Probe Hole Location

4.2.4 INSTALLING THE DIFFERENTIAL REGULATOR ADJUSTMENT TOOL FOR NATURAL GAS UNIT.

1. Remove the cap from the differential pressure regulator (see Figure 4.3).

2. Place the gasket from the regulator cap onto the regulator adjustment tool.

3. Prior to installing the tool on the regulator, pull up the screwdriver blade of the tool. Then thread the tool into the regulator and hand tighten.

4. Engage the tool's screwdriver blade into the regulator's adjustment screw slot.

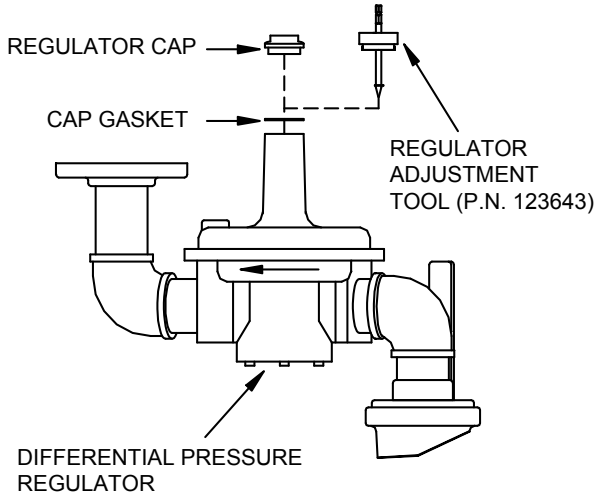


Figure 4.3
Differential Regulator Adjustment Tool Installation For Natural Gas Unit

NOTE:
Gas train drawings for Dual-Fuel units are included in Appendix F.

4.2.5 INSTALLING THE DIFFERENTIAL REGULATOR ADJUSTMENT TOOLS FOR DUAL FUEL UNIT

1. Remove the cap from each differential pressure regulator (see Figure 4.4).

2. Place the gaskets from the regulator caps onto the regulator adjustment tools.

3. Prior to installing the tools on the regulators, pull up the screwdriver blade of each tool to the stop. Next, thread the tool into each regulator and hand tighten.

4. Engage the tool's screwdriver blade into the regulator's adjustment screw slot.

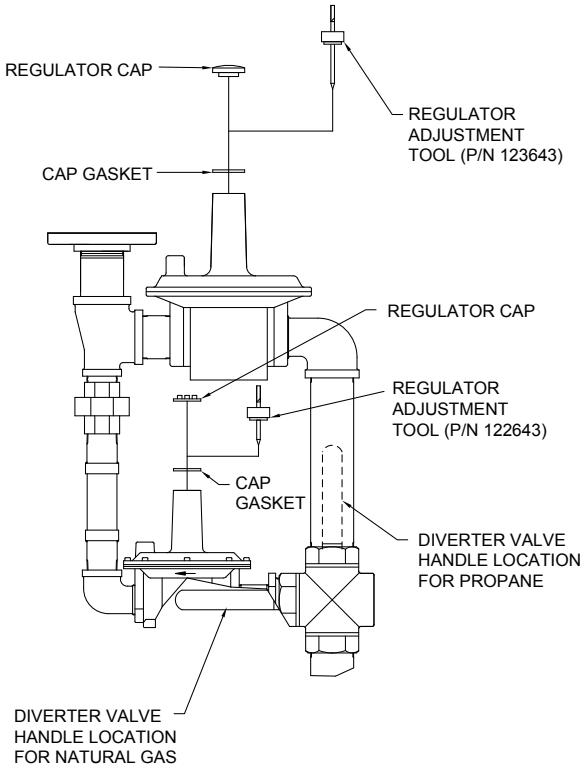


Figure 4.4
Installation of Differential Regulator Adjustment Tools for Dual-Fuel Unit

NOTE:
For Dual Fuel Units, first perform the natural gas combustion calibration procedures in para. 4.3, then perform the propane combustion calibration procedures in para. 4.4.

4.3 NATURAL GAS COMBUSTION CALIBRATION

The Benchmark ships combustion calibrated from the factory. Recalibration as part of a start-up is necessary due to altitude, gas BTU content, gas supply piping and supply regulators. Factory test data sheets are shipped with each unit as a reference.

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

NOTE:
If calibrating a dual fuel unit, ensure that the diverter valve handle is set to the horizontal position for Natural Gas before proceeding.

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. Using the 16" manometer, ensure that there is adequate supply gas pressure. If using a non-lock up regulator, static pressure should be between 9" to 14" WC, but no higher than 14" WC. If using a lock-up style regulator, adjust the static supply gas pressure for approximately 9" WC.

4. Set the **ON/OFF** switch in the **OFF** position. Turn on 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 rate to 0% by pressing the ▼ arrow key.

7. Set the **ON/OFF** switch to the **ON** position. Change the fire rate to 40% using the ▲ arrow key. The unit should begin its start sequence and fire.

8. Next, gradually increase the firing rate to 100% in 20% increments and adjust the supply gas pressure to 7.0" for FM gas trains and 7.4" W.C. for IRI gas trains at 100% firing rate.

9. Lower the firing rate to 40% using the ▼ arrow key. Insert the combustion analyzer probe into the stack and allow enough time for the combustion analyzer to settle. Compare the measured oxygen level to the oxygen range for inlet air temperature in Table 1.

10. If needed, adjust the differential regulator until the oxygen reading is within the specified range in Table 1.

NOTE:
Adjust only the differential regulator at 40% control signal. Do not adjust the iris air damper.

Table 1
Combustion Oxygen Levels for a 40% Firing Rate

Inlet Air Temp	Oxygen (±0.2)	Carbon Monoxide
100°F	5.9%	<50 ppm
80°F	6.3%	<50 ppm
70°F	6.5%	<50 ppm
60°F	6.7%	<50 ppm
50°F	6.9%	<50 ppm
40°F	7.1%	<50 ppm
20°F	7.5%	<50 ppm
0°F	7.9%	<50 ppm
-20°F	8.3%	<50 ppm

11. Once the oxygen level is within the specified range at 40%, lower the firing rate to 16%.

12. Oxygen levels at the 16% firing rate should be as shown in Table 2. No adjustment should be necessary. Contact the Factory if the oxygen or carbon monoxide levels are not within the specified range.

Table 2
Combustion Oxygen Levels for a 16% Firing Rate

Inlet Air Temp	Oxygen	Carbon Monoxide
100°F	12% or less	<100 ppm
80°F	12% or less	<100 ppm
70°F	12% or less	<100 ppm
60°F	12% or less	<100 ppm
50°F	12% or less	<100 ppm
40°F	12% or less	<100 ppm
20°F	12% or less	<100 ppm
0°F	12% or less	<100 ppm
-20°F	12% or less	<100 ppm

13. Raise the firing rate to 100%. Gas pressure should still be 7.0” for FM gas trains and 7.4” W.C. for IRI gas trains. If it is not, readjust as necessary.

14. Allow the combustion analyzer to settle. Compare the measured oxygen level with the levels in Table 3.

15. If the measured oxygen reading is within the specified range shown in Table 3, no further adjustment is necessary.

16. If the measured oxygen level is not within specified range in Table 3, adjust the iris damper as necessary until the measured oxygen reading is within specification. (See Figure 4.5).

Table 3
Combustion Oxygen Levels for 100% Firing Rate

Inlet Air Temp	Oxygen (±0.2)	Carbon Monoxide
100°F	4.8%	<100 ppm
80°F	5.2%	<100 ppm
70°F	5.4%	<100 ppm
60°F	5.6%	<100 ppm
50°F	5.8%	<100 ppm
40°F	6.0%	<100 ppm
20°F	6.4%	<100 ppm
0°F	6.8%	<100 ppm
-20°F	7.2%	<100 ppm

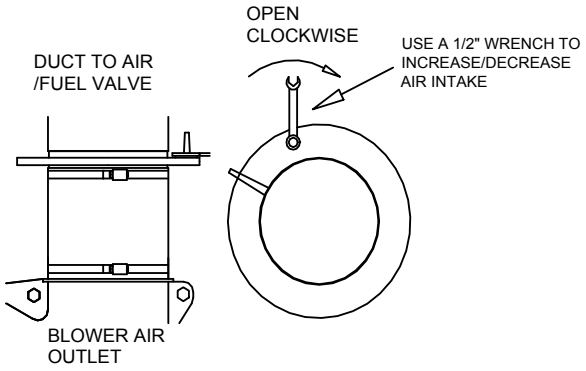


Figure 4.5
Iris Air Damper Location

17. Change the firing rate to 40%. Allow time for the combustion analyzer to settle. Check the measured oxygen reading to insure that it is still within the range as per Table 1.

18. Continue this procedure until oxygen levels at 40%, 16% and 100% firing rates are within the ranges specified in Tables 1, 2 and 3.

NOTE:
Prior to calibrating a Dual-Fuel Unit for propane, ensure that the Start and Stop levels have been set to 28% and 24% using the procedures provided in Appendix K.

4.4 COMBUSTION CALIBRATION FOR PROPANE ON DUAL FUEL UNIT

The Benchmark ships combustion calibrated from the factory. Recalibration as part of a start-up is necessary due to altitude, gas BTU content, gas supply piping and supply regulators. Factory test data sheets are shipped with each unit as a reference.

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

NOTE:
For Dual Fuel Units, ensure that the natural gas combustion calibration procedures in para. 4.3 are performed first, then perform the propane combustion calibration procedures in para. 4.4.

1. Open the water supply and return valves to the unit and ensure that the system pumps are running.
2. Rotate the 3-way gas diverter valve handle to the Propane (Up) position (see Figure 4.4 and Appendix K).
3. Rotate the air injection valve handle to the Propane (Open) position (see Appendix K, Figure 2).
4. Open the propane supply valve(s) to the unit.
5. Using the 16” manometer ensure that there is adequate supply gas pressure. If using a non-lock up regulator, static pressure should be between 9" to 14" WC, but no higher than 14" WC. If using a lock-up style regulator adjust the static supply gas pressure for approximately 9" WC.
6. Set the **ON/OFF** switch to the **OFF** position. Turn on AC power to the unit. The display will show *LOSS OF POWER* and the time and date.
7. Set the unit to the Manual Mode by pressing the **AUTO/MAN** key. A flashing *Manual Fire Rate* message will be displayed, followed by the present rate in **%**. Also, the **MANUAL** LED will light.
8. Adjust the rate to 0% by pressing the ▼ arrow key. Press the **ENTER** key. The display will stop flashing.
9. Set the **ON/OFF** switch to the **ON** position. Change the fire rate to 40% using the ▲ arrow key. The unit should begin its start sequence and fire.
10. Next, gradually increase the firing rate to 100% in 10% increments and adjust the supply gas pressure to 7.0” for FM gas trains & 7.4” W.C. for IRI gas trains.
11. Lower the firing rate to 40%. Insert the combustion analyzer probe into the stack and allow enough time for the combustion analyzer to settle. Compare the measured oxygen level to the oxygen range for inlet air temperature in Table 4.
12. Adjust the propane differential regulator until the Oxygen is within the specified range in Table 4.

Table 4
Combustion Oxygen Levels for a 40% Firing Rate

Inlet Air Temp	Oxygen (±0.2)	Carbon Monoxide
100°F	6.1%	<100 ppm
80°F	6.3%	<100 ppm
70°F	6.5%	<100 ppm
60°F	6.7%	<100 ppm
50°F	6.9%	<100 ppm
40°F	7.1%	<100 ppm
20°F	7.3%	<100 ppm
0°F	7.5%	<100 ppm
-20°F	7.7%	<100 ppm

NOTE:
Adjust only the differential regulator at 40% control signal; do not adjust the iris air damper.

13. Once the oxygen level is within the specified range at 40%, lower the firing rate to 24%. Oxygen levels at the 24% firing rate should be as shown in Table 5.

Table 5
Combustion Oxygen Levels for a 24% Firing Rate

Inlet Air Temp	Oxygen	Carbon Monoxide
100°F	12% or less	<200 ppm
80°F	12% or less	<200 ppm
70°F	12% or less	<200 ppm
60°F	12% or less	<200 ppm
50°F	12% or less	<200 ppm
40°F	12% or less	<200 ppm
20°F	12% or less	<200 ppm
0°F	12% or less	<200 ppm
-20°F	12% or less	<200 ppm

14. Raise the firing rate to 100%. Gas pressure should still be 7.0" for FM gas trains and 7.4" W.C. for IRI gas trains. If it is not, adjust as necessary

15. Allow the combustion analyzer to settle. Compare the measured oxygen level with the levels in Table 6.

Table 6
Combustion Oxygen Levels for 100% Firing Rate

Inlet Air Temp	Oxygen (±0.2)	Carbon Monoxide
100°F	5.0%	<200 ppm
80°F	5.2%	<200 ppm
70°F	5.4%	<200 ppm
60°F	5.5%	<200 ppm
50°F	5.6%	<200 ppm
40°F	5.7%	<200 ppm
20°F	6.0%	<200 ppm
0°F	6.2%	<200 ppm
-20°F	6.5%	<200 ppm

16. If the measured oxygen reading is within the specified level in Table 6, no further adjustment is necessary.

17. If the measured oxygen level is not within the range specified in Table 6, adjust the propane supply regulator until the measured oxygen reading is within specification. Do Not change the gas supply pressure more than ±1.0" W.C. from its current setting. Do Not adjust the differential regulator when firing at a 100% firing rate.

18. Change the firing rate back to 40%. Allow time for the combustion analyzer to settle. Check the measured oxygen reading to insure that it is still within the range specified in Table 4.

19. Continue this procedure until oxygen levels at 40%, 24% and 100% firing rates are within the ranges specified in Tables 4, 5, and 6.

20. Set the ON/OFF switch to the OFF position.

21. If the unit will be placed into service using propane, disregard the following steps and proceed to paragraph 4.5.

22. If the unit will be placed into service using natural gas, return the Start and Stop levels to 20% and 16% (see Appendix K).

23. For natural gas service use, set the diverter valve handle to the natural gas (horizontal) position. Close the propane supply valve(s) to the unit and open the natural gas supply valve(s).

4.5 UNIT REASSEMBLY

Once combustion calibration is set properly, the unit can be re-assembled for permanent operation.

1. Set the green ON/OFF switch to the off position. Disconnect the AC power supply to the unit.

2. Shut off the gas supply to the unit.

3. Remove any regulator adjustment tools by first pulling up the screwdriver blade to disengage it from the regulator adjusting screw, and then turning the tool out of the top of the regulator.

4. Apply a drop of silicone adhesive to the regulator adjusting screw to lock its setting.

5. Remove the gasket from the tool and place it back onto the regulator cap.

6. Reinstall the cap and gasket back on the regulator. Tighten the cap using a screwdriver or wrench.

7. Remove all of the manometers and barbed fittings and reinstall the pipe plugs using a suitable thread compound.

8. Remove the combustion analyzer probe from the vent hole. Seal the probe hole and replace the vent connection cover.

9. Replace the unit's panels.

4.6 OVER-TEMPERATURE LIMIT SWITCH

The over-temperature limit switches are located on the plate to the left of the boiler shell. One is a fixed manual reset switch that will shutdown and lock out the boiler if the water temperature reaches 210°F. The other is an adjustable auto reset switch which allows the boiler to restart, once the temperature drops below the temperature setting.

Figure 4.6 shows the location of the over temperature limit switches.

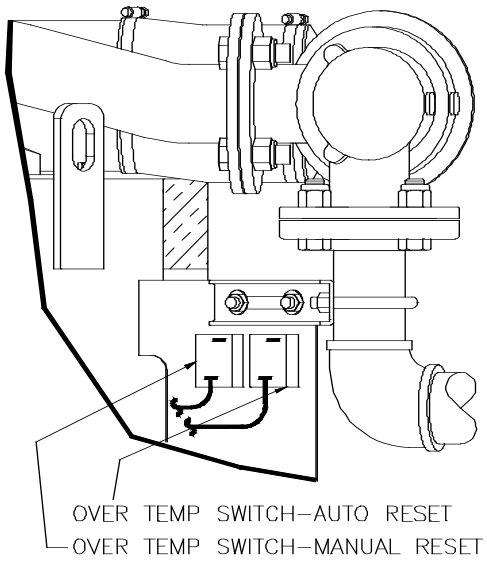


Figure 4.6
Over Temperature Limit Switch Location

CHAPTER 5 MODE OF OPERATION

5.1 INTRODUCTION

The Benchmark 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 unit is shipped from the factory tested and configured for the ordered mode of operation. All temperature related parameters are at their factory default values which work well in most applications. However, it may be necessary to change certain parameters to customize the unit to the system environment. A complete listing and descriptions of the temperature related parameters are included in Appendix A. Factory defaults are listed in Appendix E. After reading this chapter, parameters can be customized to suit the needs of the specific application.

5.2 INDOOR/OUTDOOR RESET MODE

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

5.2.1 Reset Ratio

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

5.2.2 Building Reference Temperature

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

5.2.3 Outdoor Air Temperature Sensor Installation

The outdoor air temperature sensor must be mounted on the North side of the building in an area where the average outside air temperature is expected. The sensor must be shielded from the sun's direct rays, as well as direct impingement by the elements. If a cover or shield is used, it must allow free air circulation. The sensor may be mounted up to two hundred feet from the unit. Sensor connections are made at the Input/Output (I/O) Box on the front of the boiler. Connections are made at the terminals labeled OUTDOOR SENSOR IN and SENSOR COMMON inside the I/O Box. Use shielded 18 to 22 AWG wire for connections. A wiring diagram is provided on the cover of the I/O Box. Refer to Chapter 2, paragraph 2.7.1 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 CPU 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 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 CPU Board located in the Control Box Assembly. Contact your local AERCO representative for details.

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

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

Refer to 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), Operation Guide. For operation via an RS485 Modbus network, refer to the 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 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 unit.

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 simultaneously. Therefore, boilers used for the domestic hot water are capable of switching between constant setpoint and BMS modes of operation. These boilers are the combination units and are referred to as the combo boilers. The combo boilers heat water to a constant setpoint temperature. That water is then circulated through a heat exchanger in a domestic hot water storage tank.

When the space-heating load is such that all the space-heating boilers are at 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 PROCEDURES

6.1 TESTING OF SAFETY DEVICES

Periodic safety device testing is required to ensure that the control system and safety devices are operating as designed. The AERCO control system comprehensively monitors all combustion related safety devices before, during and after the start sequence. The following tests have been chosen to ensure that the system will either not start or will shut-down as intended.

Operating and safety controls should be tested on a regular basis or after a safety device has been serviced or replaced. All testing must conform to local codes such as ASME CSD-1.

NOTE:
MANUAL and AUTO modes 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 sheet metal covers from the unit to perform the following tests.

WARNING!
ELECTRICAL VOLTAGES USED IN THIS SYSTEM MAY INCLUDE 460, 220, 120 AND 24 VOLTS AC. POWER MUST BE REMOVED PRIOR TO PERFORMING WIRE REMOVAL OR OTHER TESTING PROCEDURES THAT CAN RESULT IN ELECTRICAL SHOCK.

6.2 LOW GAS PRESSURE FAULT TEST

1. Referring to Figure 6.1, ensure that the 1/4" leak detection valve located at the high gas pressure switch is closed.

2. Remove the 1/4" plug from the 1/4" leak detection valve.

3. Install a 0-16" W.C. manometer or W.C. gauge where the 1/4" plug was removed.

4. Slowly open the 1/4" leak detection valve.

5. Place the unit in Manual Mode and fire the unit at a firing rate between 25% and 30%.

6. While the unit is firing, slowly close the Manual gas shut-off valve located down-stream of the gas supply regulator. The unit should shut down on a *LOW GAS PRESSURE* fault message at 6" W.C.

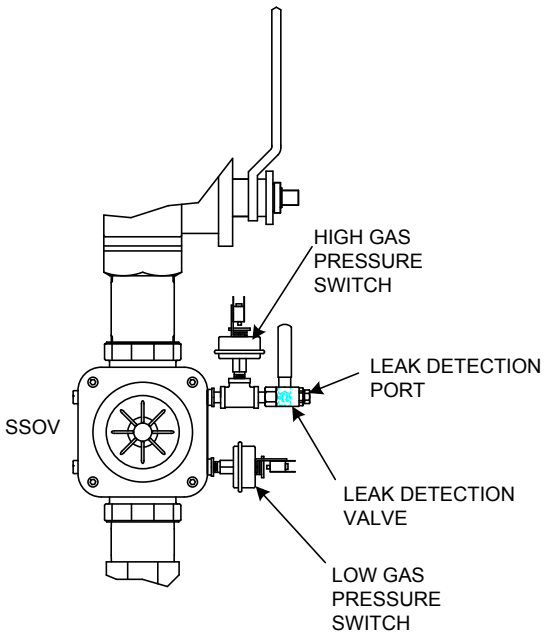


Figure 6.1
1/8" Pipe Plug Position for Manometer Installation & Low Gas Pressure Testing

7. Fully open the manual gas shut-off valve and press the **CLEAR** button on the Control Box.

8. The unit should restart.

NOTE:
After faulting the unit, the fault message will be displayed and the fault indicator light will flash until the CLEAR button is pressed.

6.3 HIGH GAS PRESSURE TEST

1. Start the unit in manual mode and fire between 25% and 30%.

2. Remove either wire # 150 or wire #151 from the high gas pressure switch. See Fig. 6.1.

3. The unit should shut down on a *HIGH GAS PRESSURE FAULT*.

4. Reconnect the wire previously removed from the high gas pressure switch and depress the **CLEAR** button.

5. The unit should restart.

6.4 LOW WATER LEVEL FAULT TEST

1. Place the **ON/OFF** switch in the **OFF** position.

2. Close 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 it is necessary to vent the unit to aid in draining, the unit's relief valve may be opened.

4. Drain the unit until the *LOW WATER LEVEL* fault message is displayed and the **FAULT** LED flashes.

5. Place the unit in the Manual Mode and raise the firing rate above 25%.

6. Set the **ON/OFF** switch to **ON**. 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 to fill the shell.

9. Open the water shut-off valve in the supply piping to the unit.

10. After the shell is full, press the **LOW WATER LEVEL RESET** button to reset the low water cutoff. Press the **CLEAR** switch to reset the **FAULT** LED and clear the displayed error message.

11. Set the **ON/OFF** switch to the **ON** position. The unit is now ready for operation.

6.5 WATER TEMPERATURE FAULT TEST

1. In the normal operating mode, allow the unit to stabilize at its setpoint.

2. Lower the adjustable temperature limit switch setting to match the displayed OUTLET TEMPERATURE. (See Fig. 6.2).

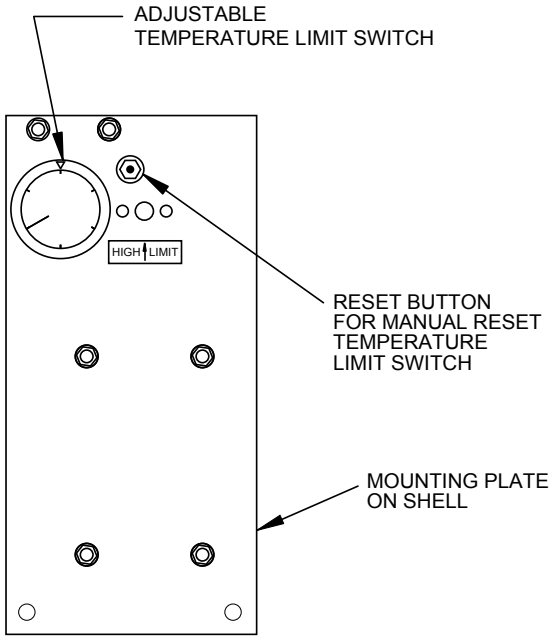


Figure 6.2
Temperature Limit Switch Setting

3. Once the adjustable limit switch setting is approximately at, or just below, the actual outlet water temperature, the unit should shut down. The **FAULT** LED should be flashing and the message *HIGH WATER TEMP SWITCH OPEN* should be displayed. The unit should not start.

4. Reset the adjustable temperature limit switch setting to its prior setting.

5. The unit should start once the adjustable temperature limit switch setting is above the actual outlet water temperature.

6.6 INTERLOCK TESTS

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

6.6.1 REMOTE INTERLOCK

1. Remove the cover from the I/O Box and locate the REMOTE INTL'K IN terminals.

2. Start the unit in manual mode and fire at 25% to 30% firing rate.

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 resume running.

6.6.2 DELAYED INTERLOCK

1. Remove the cover from the I/O Box and locate the DELAYED INTL'K IN terminals.

2. Start the unit in manual mode and fire at a 25% to 30% firing rate.

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 *DELAYED INTERLOCK OPEN.* The **FAULT** LED should be flashing.

5. Once the interlock connection is reconnected, depress the **CLEAR** button. The unit should start.

6.7 FLAME FAULT TEST

1. Place the **ON/OFF** switch in 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 valve located between the safety shut-off valve and the differential regulator (see Fig. 6.3).

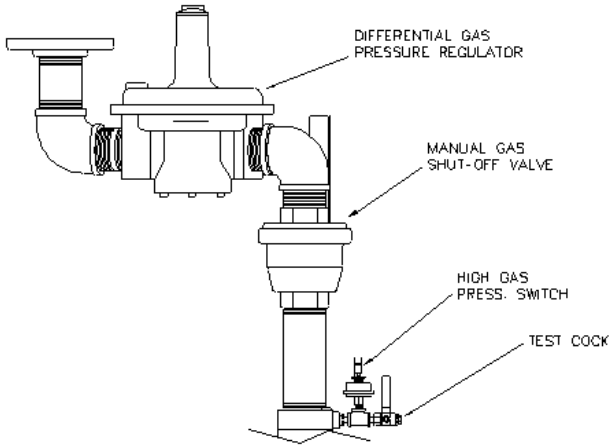


Figure 6.3
Manual Gas Shut-Off Valve Location

4. For dual fuel units, place the diverter valve in the closed position (see Fig. 6.4).

5. Place the **ON/OFF** switch in the **ON** position to start the unit.

6. The unit should shut down after reaching the Ignition cycle and display *FLAME LOSS DURING IGN.*

7. Open the valve previously closed in step 3 or 4 and depress the **CLEAR** button.

8. For dual fuel units, place the diverter valve in the Natural Gas position (see Fig. 6.4).

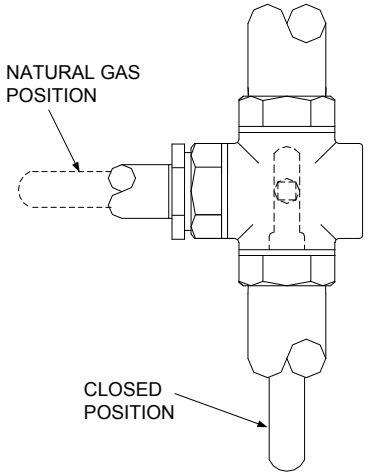


Figure 6.4
Diverter Valve Positions

9. Restart the unit and allow it to prove flame.

10. Once flame is proven, close the manual gas valve located between the safety shut-off valve and the differential regulator.

11. For dual fuel units, place the diverter valve in the closed position (see Fig. 6.4).

12. The unit should shut down and display *FLAME LOSS DURING RUN*.

13. Open the valve previously closed in step 10 or 11 and depress the **CLEAR** button. The unit should restart and fire.

6.8 AIR FLOW FAULT TEST

1. Start the unit in manual mode and set the fire rate between 25% and 30%.

2. Once the unit has proved flame, remove either wire #154 or #155 from the blower proof switch (see Fig. 6.5) located on the air/fuel valve.

3. The unit should shut down and display *AIRFLOW FAULT DURING RUN*.

4. Replace the wire previously removed from the blower-proof switch and depress the **CLEAR** button. The unit should restart.

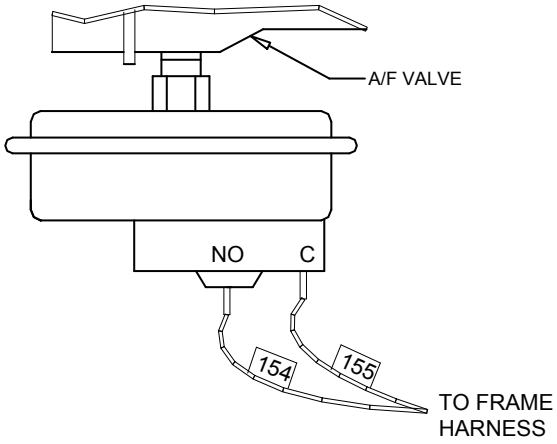


Figure 6.5
Blower Proof Switch Location and Wiring

6.9 SSOV PROOF OF CLOSURE SWITCH

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 Safety Shut-Off Valve (SSOV) cover (see Fig. 6.6). For units with IRI gas trains, access the terminals in the downstream SSOV (see drawing AP-A-742 or AP-A-745 (Dual-Fuel) in Appendix F).

3. Remove either wire #149 or #148 from the SSOV.

4. The unit should fault and display *SSOV SWITCH OPEN.*

5. Replace the wire previously removed and depress the **CLEAR** button.

6. Start the unit.

7. Remove the wire again when the unit reaches the purge cycle.

8. The unit should shut down and display *SSOV FAULT DURING PURGE.*

9. Replace the wire on the SSOV and depress the **CLEAR** button. The unit should restart.

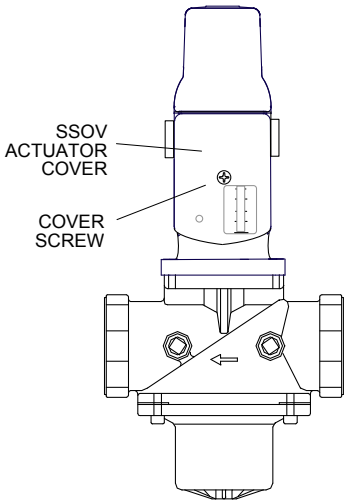


Figure 6.6
SSOV Actuator Cover Screw Location

6.10 PURGE SWITCH OPEN DURING PURGE

1. Set the unit's ON/OFF switch to the **OFF** position. Place the unit in manual mode and set the fire rate between 25% and 30%.
2. Remove the air/fuel valve cover by rotating the cover counterclockwise to unlock it and then pulling it towards you (see Fig. 6.7).
3. Remove one of the two wires from the purge position switch (Fig. 6.8) and start the unit.
4. The unit should begin to start, then shut down and display *PRG SWITCH OPEN DURING PURGE.*
5. Replace the wire on the purge position switch and depress the **CLEAR** button. The unit should restart.

6.11 IGNITION SWITCH OPEN DURING IGNITION

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 (Fig. 6.7) by rotating the cover counterclockwise to unlock it then pulling it towards you.
3. Remove one of the two wires from the ignition position switch (Fig. 6.8) and start the unit.
4. The unit should begin to start then shut down and display *IGN SWITCH OPEN DURING IGNITION.*
5. Replace the wire on the ignition position switch and depress the **CLEAR** button. The unit should restart.

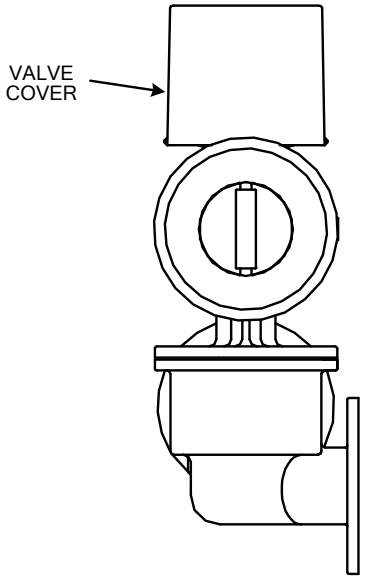


Figure 6.7
Air/Fuel Valve Cover Location

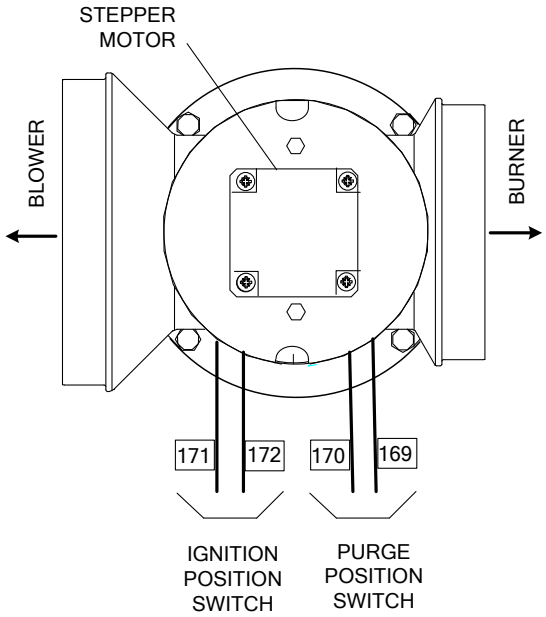


Figure 6.8
Air/Fuel Valve Purge and Ignition Switch Locations

6.12 SAFETY PRESSURE RELIEF VALVE TEST

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

Chapter 7 - MAINTENANCE

7.1 MAINTENANCE SCHEDULE

The unit requires regular routine maintenance to keep up efficiency and reliability. For best operation and life of the unit, the following routine maintenance procedures should be 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 INJURY, BEFORE SERVICING:
***(A)** DISCONNECT THE AC SUPPLY BY TURNING OFF THE SERVICE SWITCH AND AC SUPPLY CIRCUIT BREAKER*
***(B)** SHUT OFF THE GAS SUPPLY AT THE MANUAL SHUT-OFF VALVE PROVIDED WITH THE UNIT*
***(C)** ALLOW THE UNIT TO COOL TO A SAFE 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 Fig. 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 contactor and pull the igniter bushing from the burner shell.
4. Insert the igniter removal tool into the burner shell, where the igniter bushing was removed. Fit the hexagonal end of the tool over the igniter. (See Fig. 7.2) Unscrew the igniter from the burner head. Remove the igniter from the burner shell, by grasping the contact end of the igniter.

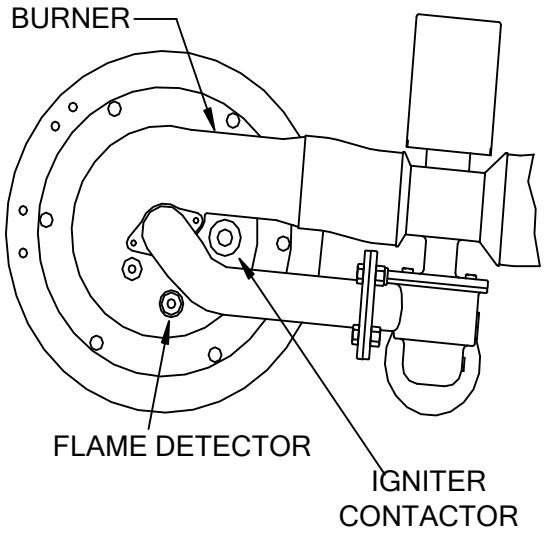


Figure 7.1
Spark Igniter and Flame Detector Location
Top View

CAUTION!

The igniter may be hot. Allow time for it to cool before touching.

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, an anti-seize compound must be applied to the igniter threads.

CAUTION!

The igniter must be removed and installed using the igniter removal tool provided with the unit(s). Damage to the burner due to using a socket for removal and installation of the igniter is not covered under warranty.

7. Reinstall the igniter using the igniter removal tool. Do not over tighten the igniter. A slight snugging up is sufficient. Reinstall the igniter

bushing over the contactor and reconnect the igniter cable.

8. Reinstall the side and top panels on the unit.

Table 7-1 - Maintenance Schedule

PARAGRAPH	ITEM	6 Mos.	12 Mos.	24 Mos.	Labor Time
7.2	Spark Igniter (GP-122435-S)	*Inspect	Replace		15 mins.
7.3	Flame Detector (123970)	*Inspect	Replace		15 mins.
7.4	Combustion Adj.	*Check	Check		1 hr.
7.5	Testing of Safety Devices		See CSD-1 Chart in Appendix		20 mins.
7.6	Burner			Inspect	2 hrs.
7.7	Condensate Drain Trap	Inspect	Inspect & Clean	Inspect & clean if necessary	1 hr.

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

7.3 FLAME DETECTOR

The flame detector (part no. 123970) 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 side and 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 hand tight only.
6. Reconnect the flame detector lead wire.
7. Reinstall the side and top panels on the unit.

7.4 COMBUSTION CALIBRATION

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

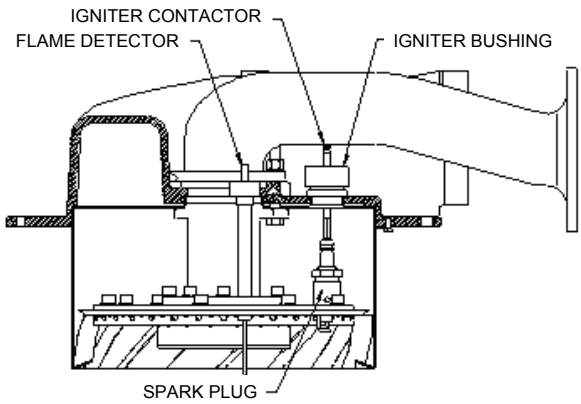


Figure 7.2
Spark Igniter and Flame Detector Location
Cut-Away View

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 logbook. See Chapter 6-Safety Device Testing Procedures.

7.6 BURNER

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

The following parts will be required for reassembly after Burner Assembly inspection or replacement:

161432	Burner Gasket
161433	Burner Release Gasket

To inspect or replace the Burner Assembly, proceed as follows:

1. Set the **ON/OFF** switch on the control panel, to the **OFF** position and disconnect AC power to the unit and turn off the gas supply.
2. Remove the side and top panels from the unit.
3. Disconnect the lead wire from the flame detector.
4. Disconnect the igniter cable from the igniter contactor.
5. Disconnect the combustion air hose from the burner by loosening the hose clamp. (See Fig. 7.3)
6. Remove the four (4) 5/8-11 nuts and bolts from the gas outlet side of the Air/Fuel Valve. (See Fig 7.3).

NOTE:
Do not remove the gas inlet pipe from the Burner Assembly (See Fig. 7.3).

7. Remove the six (6) 5/16-16 bolts from the burner flange. (See Fig 7.3)

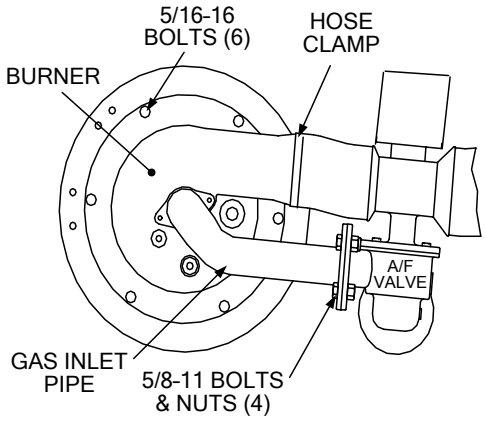


Figure 7.3
Burner Disassembly Diagram

NOTE:
The Burner Assembly is heavy and weighs approximately 25 pounds. Use care when removing.

8. Remove the Burner Assembly from burner flange by lifting it straight up.
9. Following Burner inspection and/or replacement, remove and replace the Burner Release Gasket (161433) and Burner Gasket (161432).
10. Prior to reinstalling the Burner Assembly, ensure that the O-ring is properly inserted in the groove on the gas outlet flange of the Air/Fuel Valve.
11. Replace the Burner Assembly and align it with the tapped holes in the burner flange. Secure the Burner to the flange using the six 5/16-16 bolts. DO NOT fully tighten these bolts at this time.

CAUTION
It is imperative that the Gas Inlet Pipe on the Burner Assembly (Figure 7.3) be properly aligned with the four bolt holes on the gas outlet flange of the Air/Fuel Valve. Failure to observe this precaution may cause physical damage to the Gas Inlet Pipe resulting in cracks and/or gas leaks.

12. While observing the above CAUTION, ensure that the Gas Inlet Pipe is properly aligned with the four bolt holes on the gas outlet flange of the Air/Fuel Valve. When properly aligned, the four 5/8-11 bolts can be easily inserted in the bolt holes. If gas

train realignment is required, loosen the support brackets/U-bolts at the upper and lower portions of the gas train as shown in Figure 7.4.

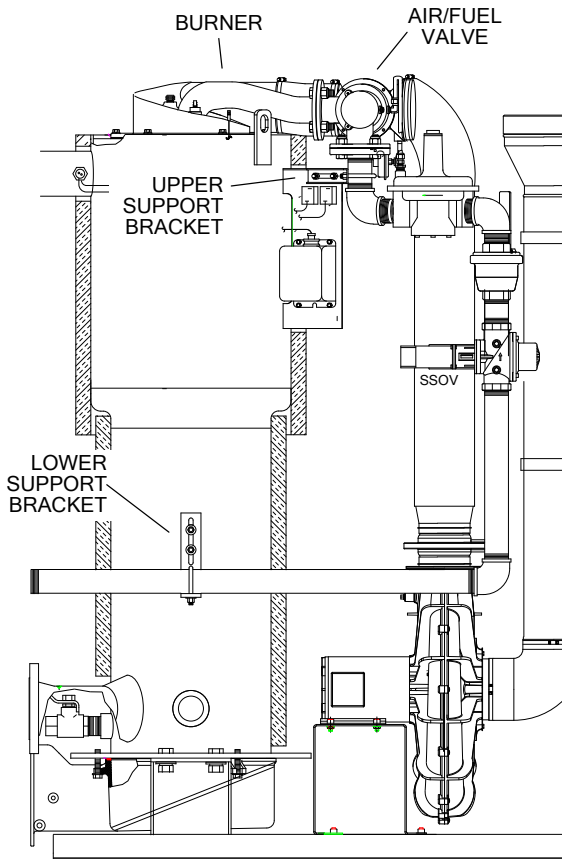


Figure 7.4
Gas Train Support Bracket Locations

13. After the gas train is properly aligned, tighten and secure the upper and lower support brackets/U-bolts.
14. Secure the Gas Inlet Pipe to the gas outlet flange of the Air/Fuel Valve using the four 5/8-11 bolts and hex nuts. Fully tighten the bolts and nuts.
15. Next, fully tighten the six 5/16-16 bolts previously installed in step 11.
16. Reconnect and secure the combustion air hose to the Burner Assembly by tightening the hose clamp (Fig. 7.3).
17. Reconnect the wire leads to the igniter contactor and flame detector.
18. Replace the top and side panels on the unit.
19. Reapply AC power and return the unit to service use.

7.7 CONDENSATE DRAIN TRAP

The boiler contains a condensate drain trap connected to the drain line of the exhaust manifold (see Figures 2.4 & 2.5). The trap should be inspected and, if necessary, cleaned to ensure proper operation. Proceed as follows:

1. Disconnect the external condensate trap by loosening the hose clamps between the trap and the condensate drain connection on the exhaust manifold of the boiler (Figure 2.5).
2. Remove the connections on the inlet and outlet sides of the condensate trap shown in Figure 7.5.
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. Check the condensate drain tapped hole in the exhaust manifold (Figure 2.4) to ensure it is clear of blockage.
8. 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.
9. Reassemble all piping and hose connections to the condensate trap inlet and outlet. Reconnect trap to condensate drain connection on the exhaust manifold.

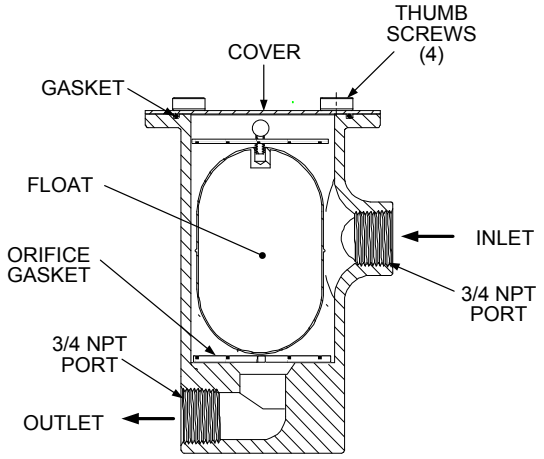


Figure 7.5
External Condensate Trap

7.8 SHUTTING THE BOILER DOWN FOR AN EXTENDED PERIOD OF TIME

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

1. Set **ON/OFF** switch on the front panel to the **OFF** position to shut down the boiler's operating control.
2. Disconnect AC power from the unit.
3. Close 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 (a year or more), the following procedures must be followed:

1. Review installation requirements as shown in Chapter 2.
2. Inspect all piping and connection to the unit.
3. Inspect exhaust vent, air duct (if applicable) and gas regulator vent lines at their termination points. Check that they are clear and free of debris or pests.
4. Perform initial startup per Chapter 4.
5. Perform safety device testing and 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 Series 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 the following troubleshooting tables 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. 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 2. Blocked Blower inlet or inlet ductwork 3. Blocked airflow switch 4. Defective airflow switch	1. Check combustion blower for signs of excessive heat or high current drain that may trip thermal or current overload devices. 2. Inspect the inlet to the combustion blower including any ductwork leading up to the combustion blower for signs of blockage. 3. Remove the airflow switch and inspect for signs of blockage, clean or replace as necessary. 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.
AIRFLOW FAULT DURING PURGE	1. Blower not running or running too slow 2. Defective Air Flow Switch 3. Blocked Air flow Switch 4. Blocked Blower inlet or inlet ductwork. 5. No voltage to switch from control box.	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. Start the unit. If the blower runs, check the airflow switch for continuity. Replace the switch if there is no continuity. 3. Remove the air flow switch and inspect for signs of blockage, clean or replace as necessary. 4. Inspect the inlet to the combustion blower including any ductwork leading up to the combustion blower for signs of blockage. 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.
AIRFLOW FAULT DURING RUN	1. Blower stopped running due to thermal or current overload 2. Blocked Blower inlet or inlet ductwork 3. Blocked airflow switch 4. Defective airflow switch 5. Combustion oscillations	1. Check combustion blower for signs of excessive heat or high current draw that may trip thermal or current overload devices. 2. Inspect the inlet to the combustion blower including any ductwork leading up to the combustion blower for signs of blockage. 3. Remove the airflow switch and inspect for signs of blockage, clean or replace as necessary. 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. Run unit to full fire. If the unit rumbles or runs rough, perform combustion calibration.

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 (i.e. a pump, louver, etc.) is tied to these interlocks. Ensure that the device and 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. Defective Differential Pressure Regulator. 8. Carbon or other debris on Burner.	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 gas pressure using gauge or manometer into and out of the Air/Fuel Valve to ensure gas is getting to burner. 8. Remove burner and inspect for any carbon or debris. Clean and reinstall

TABLE 8-1. BOILER TROUBLESHOOTING – Continued

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
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. If using a non-lock up style regulator for the gas supply, measure static gas pressure downstream, it should be 14”WC or less. Adjust as necessary.
	2. Defective Supply Regulator or Wrong Style Regulator	2. If gas supply pressure cannot be lowered, a lock-up style regulator may be required or the supply regulator may be defective.
	3. Defective High Gas Pressure Switch	3. Remove the leads from the high gas pressure switch. Measure continuity across the common and normally closed terminals with the unit not firing. Replace the switch if it does not show continuity.

TABLE 8-1. BOILER TROUBLESHOOTING – Continued

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
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 proving switch hooked to interlocks is not closed.	3. Check that 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 or incorrectly sized Gas Supply Regulator. 3. Defective Low Pressure Gas Switch	1. Measure gas pressure upstream of the supply gas regulator with the unit firing ensure it is 14” WC or greater. 2. Measure gas pressure downstream of the supply regulator with unit firing and adjust the gas supply regulator to increase the outlet gas pressure; if outlet gas pressure cannot be increased, check the sizing of the Supply regulator. 3. Measure gas pressure at the low gas pressure switch, if it is greater than 5” WC, measure continuity across the switch and replace if necessary.
LOW WATER LEVEL	1. Insufficient water level in system 2. Defective water level circuitry. 3. Defective water level probe.	1. Check system for sufficient water level. 2. Test water level circuitry using the Control Box front panel LOW WATER TEST and RESET buttons. Replace water level circuitry if it does not respond. 3. Check continuity of probe end to the shell, change probe if there is no continuity.
MODBUS COMM FAULT	1. Boiler not seeing information from Modbus network	1. Check network connections. If fault persists, contact qualified Service Personnel.
PRG SWTCH CLOSED DURING IGNITION	1. A/F Valve rotated open to purge and did not rotate to ignition position 2. Defective or shorted switch. 3. Switch wired incorrectly. 4. Defective Power Supply Board or fuse	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.

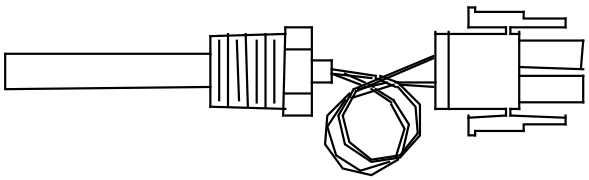
TABLE 8-1. BOILER TROUBLESHOOTING – Continued

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
continued	5. Defective IGST Board	5. Check "Heartbeat" LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.
PRG SWTCH OPEN DURING PURGE	1. Defective purge switch. 2. No voltage present at switch. 3. Switch wired incorrectly. 4. Defective Power Supply Board or fuse 5. Defective IGST Board	1. If the air-fuel valve does rotate, check the purge switch for continuity when closing. Replace switch if continuity does not exist. 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. Check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals). 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.
OUTDOOR TEMP SENSOR FAULT	1. Loose or broken wiring. 2. Defective Sensor. 3. Incorrect Sensor.	1. Inspect Outdoor Temperature sensor for loose or broken wiring. 2. Check resistance of sensor to determine if it is within specification. 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. 2. Signal is not isolated (floating) if 4 to 20 mA. 3. Control Box signal type selection switches not set for correct signal type (voltage or current).	1. Check I/O Box to ensure signal is hooked up. Hook up if not installed. If installed, check polarity. Measure signal level. Check continuity of wiring between source and 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.
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 Detecto	2. Replace Flame Detector.
SSOV FAULT DURING PURGE	See SSOV SWITCH OPEN	
SSOV FAULT DURING RUN	1. SSOV switch closed for 15 seconds during run.	1. Replace SSOV actuator.
SSOV RELAY FAILURE	1. SSOV relay failed on board.	1. Ensure that Neutral and Earth Ground are connected at the source and there is no voltage measured between them. Measurement should indicate near zero or no more than a few millivolts. 2. Check the SSOV power wiring. 3. 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 2. SSOV powered when it should not be 3. Defective Switch or Actuator 4. Incorrectly wired switch.	1. Observe operation of the Safety Shut-Off Valve (SSOV) through indicator on the Valve actuator and ensure that the valve is fully and not partially closing. 2. If the SSOV never closes, it may be powered continuously. Close the gas supply and remove power from the unit. Refer fault to qualified service personnel. 3. Remove the electrical cover from the SSOV and check switch continuity. If the switch does not show continuity with the gas valve closed, either adjust or replace the switch or actuator. 4. Ensure that the SSOV Proof of Closure switch is correctly wired.
STEPPER MOTOR FAILURE	1. Air/Fuel Valve out of calibration. 2. Air/Fuel Valve unplugged. 3. Loose wiring connection to the stepper motor. 4. Defective Air/Fuel Valve stepper motor. 5. Defective Power Supply Board or fuse 6. Defective IGST Board	1. Refer to GF-112 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. Check that the Air/Fuel Valve is connected to the Control Box. 3. .Inspect for loose connections between the Air/Fuel Valve motor and the wiring harness. 4. Replace stepper motor. 5. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board. 6. Check “Heartbeat” LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.

Temperature Sensor Resistance Chart
(Balco)



TEMPERATURE SENSOR
AERCO PN 123449

TEMP. °F	Resistance 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

R(Ohms)=.00161T^2+1.961T+854.841
T=°F

INDOOR/OUTDOOR RESET RATIO CHARTS

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

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

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				

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				

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				

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

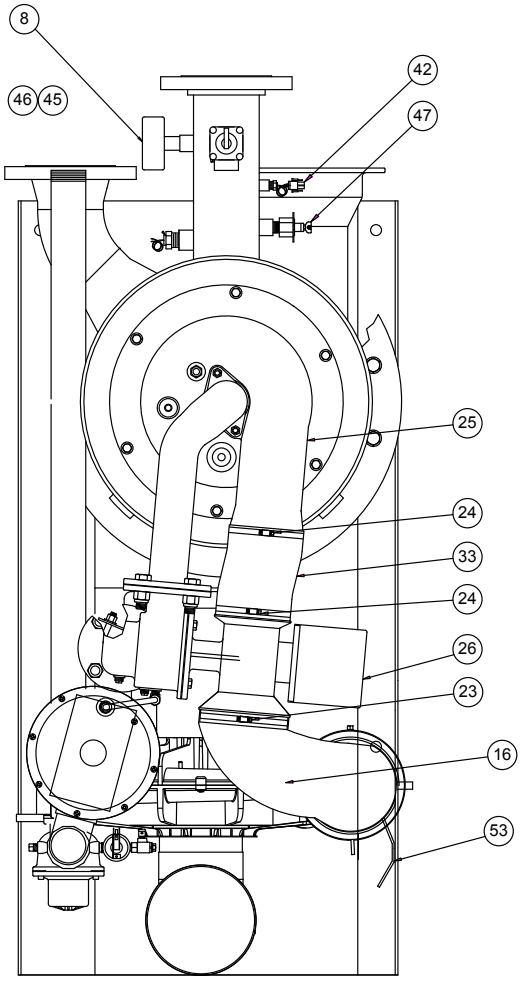
Header Temperature for a Building Reference Temperature of 90F

	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	1.0 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	210°F
Max Fire Rate	100%
Pump Delay Timer	0 min
Aux Start On Dly	0 sec
Failsafe Mode	Shutdown
mA Output	Off
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



BLOWER			
ITEM	PART NO.	QTY	DESCRIPTION
14	27003-1	1	COMBUSTION AIR BLOWER (1 PHASE)
	27003-3		COMBUSTION AIR BLOWER (3 PHASE)
15	99008-5	1	5" IRIS AIR DAMPER
16	123585	1	A/F VA. INLET HOSE
17	96003	1	INCREASER, 5" TO 6"
(5) 18	123681 (SEE NOTE 5)	1	8" INLET ADAPTOR
19	96004-2	1	POLY BLOWER INLET DUCT
20	123990	1	OFFSET REDUCER COVER
21	123764	1	AIR INLET HOSE
22	96004-1	1	POLY BLOWER OUTLET DUCT
23	123583	4	A/F VA. 6" HOSE CLAMP

BURNER AND AIR/FUEL VALVE			
ITEM	PART NO.	QTY	DESCRIPTION
24	123689	2	A/F VA. 5" HOSE CLAMP
25	201118	1	BURNER ASS'Y (NATURAL GAS)
	24069		BURNER ASS'Y (DUAL-FUEL)
			(INCLUDES ASSOCIATED LABELS)
26	201212	1	A/F VALVE ASS'Y
27	123586	1	3/8 O.D. TUBE X 1/4NPT90°COMP. FITTING
28	GP-122535	1	3/8 O.D. TUBE X 1/4NPT COMP. FITTING
29	9-43	1	1/2 X 1/4 NPT RED. BUSHING
30	161447	1	GAS PRESS. CONTROL TUBE
31	161432	1	BURNER GASKET
32	161433	1	BURNER RELEASE GASKET
33	123584	1	A/F VA. OUTLET HOSE

CONTROLS			
ITEM	PART NO.	QTY	DESCRIPTION
34	161577	1	POWER BOX ASS'Y (220V SINGLE PH.)
	161558		POWER BOX ASS'Y (208-230V 3 PH.)
	64005		POWER BOX ASS'Y (460V 3 PH.)
35	GP-122464	1	IGNITION TRANSFORMER
36	GP-122569	1	IGNITION CABLE ASSEMBLY
37	161560	1	INPUT/OUTPUT (I/O) BOX ASSEMBLY
38	181197	1	CONTROL BOX ASSEMBLY
(1) 39	161450	1	GAS TRAIN WIRING HARNESS
40	61002-14	1	BLOWER PROOF SWITCH
41	123866	1	LOW PRESSURE GAS SWITCH
42	123449	1	TEMPERATURE SENSOR
43	123966	1	OVER TEMP. SWITCH - AUTO RESET
44	123552	1	OVER TEMP. SWITCH - MANUAL RESET
45	161521	1	THERMOWELL, DUAL AQUASTAT BULB
46	62005	1	CORD GRIP
47	122843	1	LOW WATER CUT-OFF
(1) 48	161617	1	SHELL WIRING HARNESS
49	GP-122412	1	HIGH PRESS. GAS SWITCH
50	124141	1	BALL VALVE ASSEMBLY
(4) 62	124310	1	460 V TRANSFORMER
(4) 63	124380	1	4 AMP FUSE FOR 460 V TRANSFORMER
(4) 64	124437-1	1	460 V TRANFORMER TOP TERM. COVER
(4) 65	124437-2	1	460 V TRANSFORMER BOT. TERM. COVER
(4) 66	79002	1	460 V TRANSFORMER LABEL

HEAT EXCHANGER			
ITEM	PART NO.	QTY	DESCRIPTION
1	161519	1	COMBUSTION CHAMBER INSULATION
2	161520	1	HEAT EXCHANGER INSULATION
3	28042	1	COMB. CHAMBER / HEAT EXCH. ASS'Y

EXHAUST MANIFOLD			
ITEM	PART NO.	QTY	DESCRIPTION
4	201216	1	FLOW DIVERTER PLATE EXHAUST PLENUM
5	201283	1	EXHAUST MANIFOLD
6	123612	51"	EXHAUST MANIFOLD SEAL
(1) 7	24060	1	CONDENSATE TRAP ASSEMBLY

OTHER ACCESSORIES			
ITEM	PART NO.	QTY	DESCRIPTION
(2) 8	123675-□	1	PRESS./TEMP. GAUGE
9	12820-11	1	1-1/2 NPT DRAIN BALL VALVE
10	SEE SD-A-613	1	PRESSURE RELIEF VALVE
(1) 11	123628	1	EXT. GAS SUPPLY REGULATOR (RV-91)
(1) 12	123540	1	EXT. MANUAL SHUT-OFF VALVE

GAS TRAIN			
ITEM	PART NO.	QTY	DESCRIPTION
13	201181	1	GAS TRAIN ASSY (NATURAL GAS FM)
	201117		GAS TRAIN ASSY (NATURAL GAS IRI)
	201218		GAS TRAIN ASSY (DUAL-FUEL FM)
	201219		GAS TRAIN ASSY (DUAL-FUEL IRI)

BLOWER (CONTINUED)			
ITEM	PART NO.	QTY	DESCRIPTION
51	95006	1	ANGLE RING, 6" DIAM. WITH 1" SLEEVE
52	161445	2	INLET DUCT MOUNTING BRACKET
53	33019	1	OUTLET DUCT MOUNTING BRACKET

NOTES:

(1) NOT SHOWN IN THE DRAWING

(2) -2 (30 AND 50 PSI RELIEF VALVE SETTING)
-3 (75 AND 100 PSI RELIEF VALVE SETTING)
-4 (150 PSI RELIEF VALVE SETTING)

(3) FOR PICTORIAL PURPOSES ONLY, NATURAL GAS FM GAS TRAIN IS SHOWN IN THE DRAWING.

(4) FOR 460V OPTION ONLY

(5) IF AN AIR INLET ATTENUATOR IS INSTALLED INSIDE THE BMK2.0 AND THE BOILER SERIAL NUMBER IS G-07-0814 OR AFTER, USE AIR INLET ADAPTOR PART NUMBER 39055.

AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647

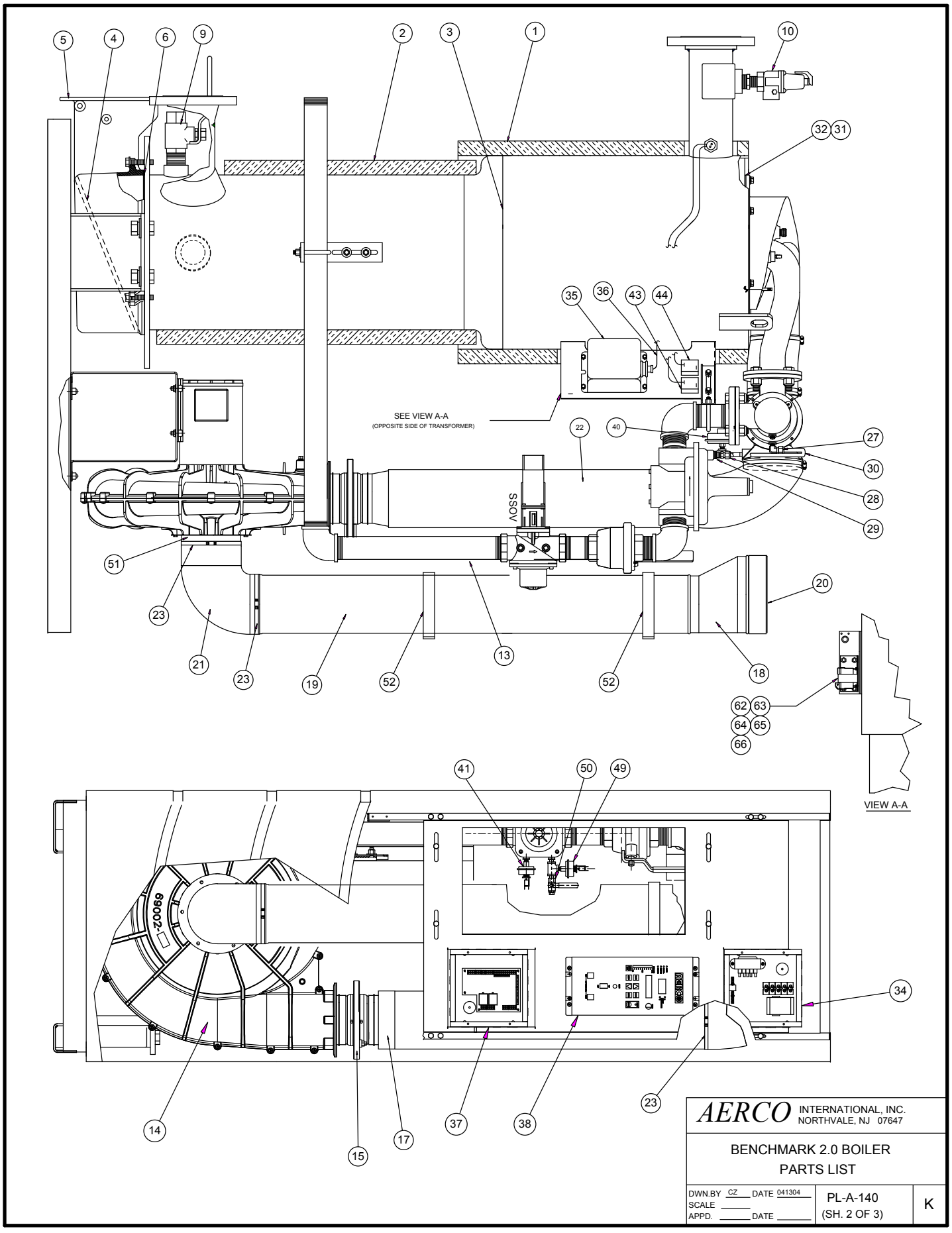
BENCHMARK 2.0 BOILER
PARTS LIST

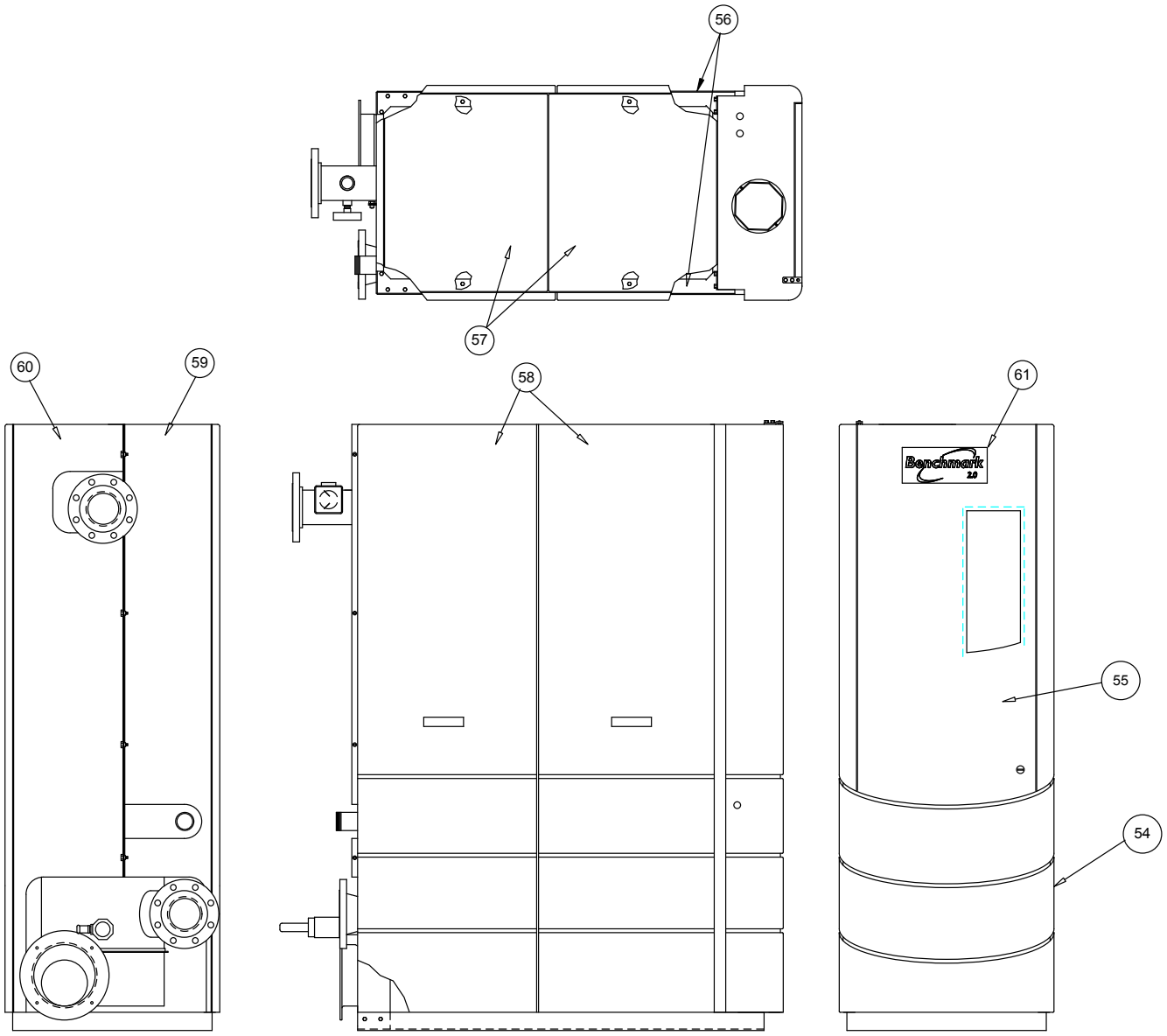
DWN.BY CZ DATE 041304
SCALE _____
APPD. _____ DATE _____

PL-A-140
(SH. 1 OF 3)

K

APPENDIX F


SEE VIEW A-A
(OPPOSITE SIDE OF TRANSFORMER)
SSOV
VIEW A-A
69002-1
AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647
BENCHMARK 2.0 BOILER
PARTS LIST
DWN.BY CZ DATE 041304
SCALE
APPD. DATE
PL-A-140
(SH. 2 OF 3)
K



BENCHMARK SHEET METAL ENCLOSURE PARTS LIST			
ITEM	PART NO.	QTY	DESCRIPTION
54	201113	1	FRONT PANEL ENCLOSURE
55	201120	1	FRONT DOOR ASSEMBLY
56	161464	2	TOP RAIL
57	161463	2	TOP PANEL
58	181144	4	SIDE PANEL ASSEMBLY
59	201126	1	RIGHT REAR PANEL
60	201127	1	LEFT REAR PANEL
61	74005	1	BMK2.0 LOGO

AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647

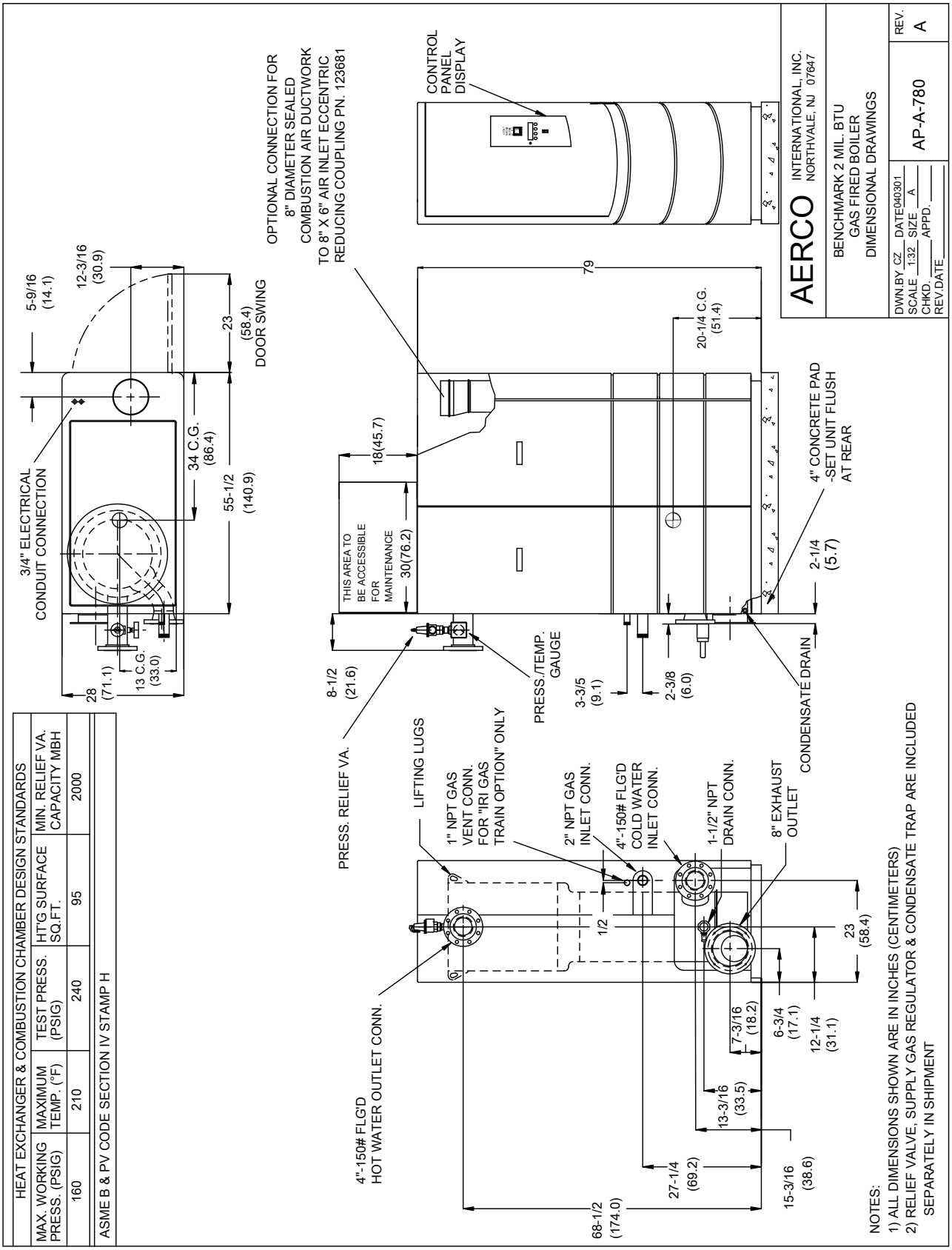
BENCHMARK 2.0 BOILER
PARTS LIST

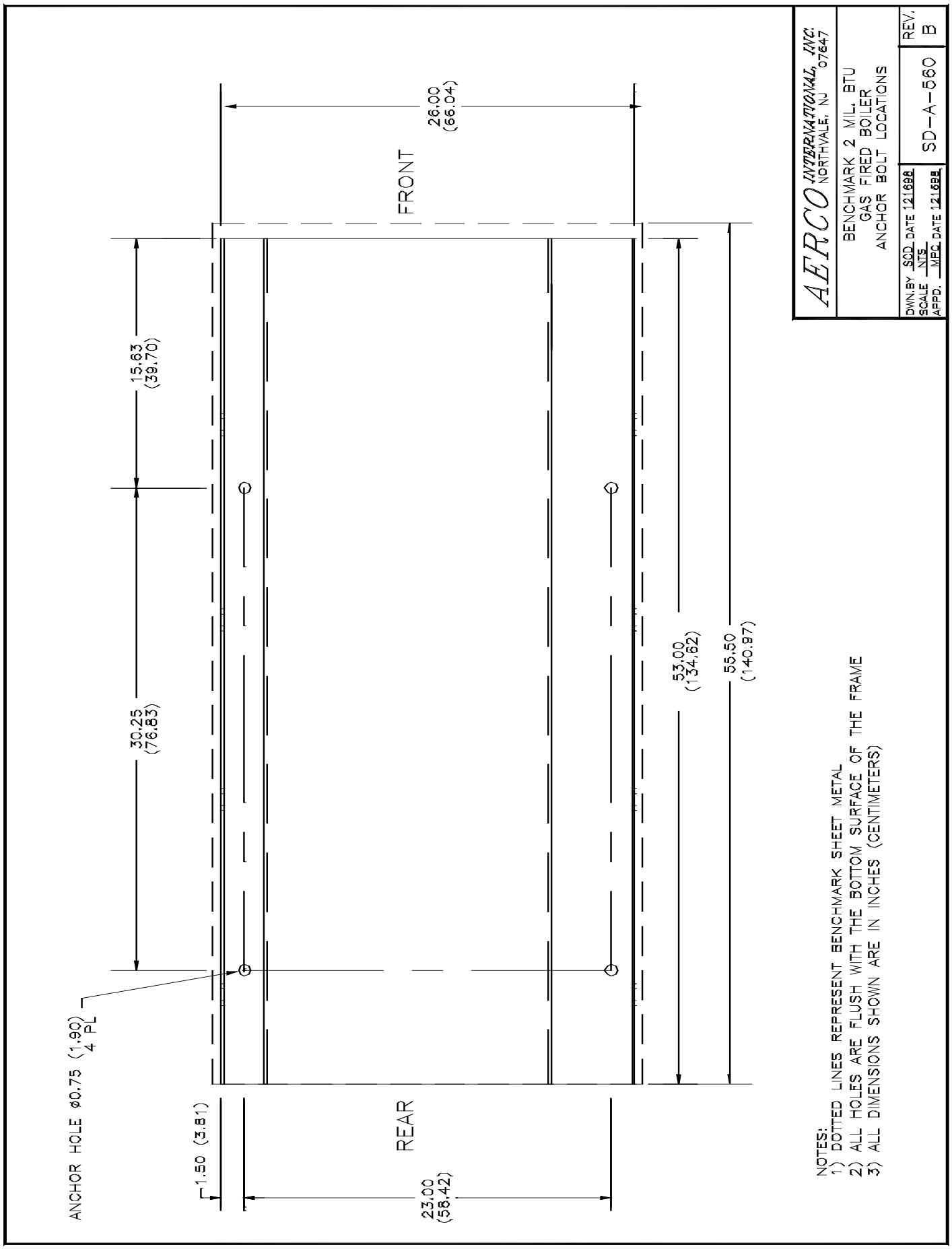
DWN.BY CZ DATE 041304
SCALE _____
APPD. _____ DATE _____

PL-A-140
(SH. 3 OF 3)

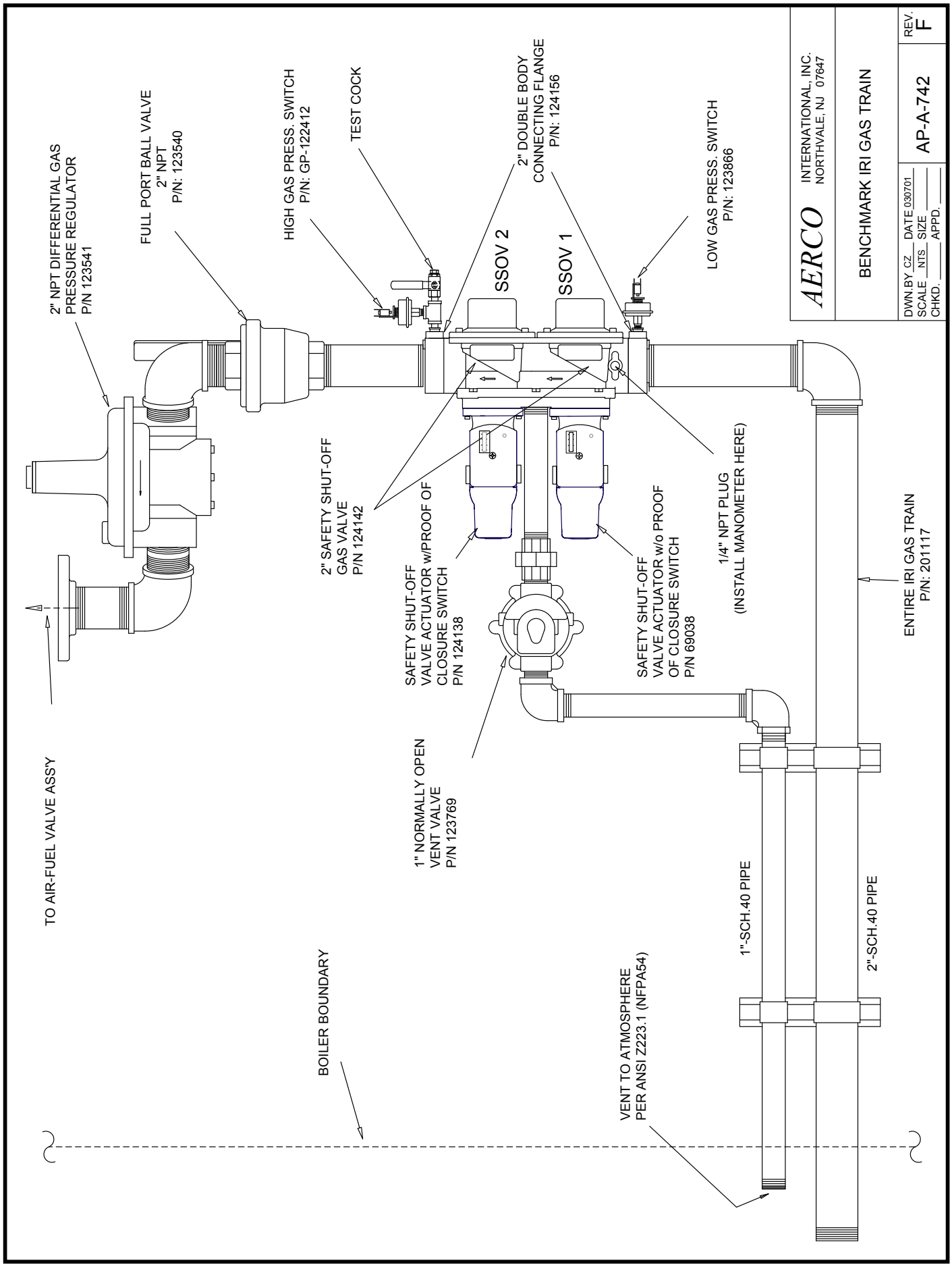
K

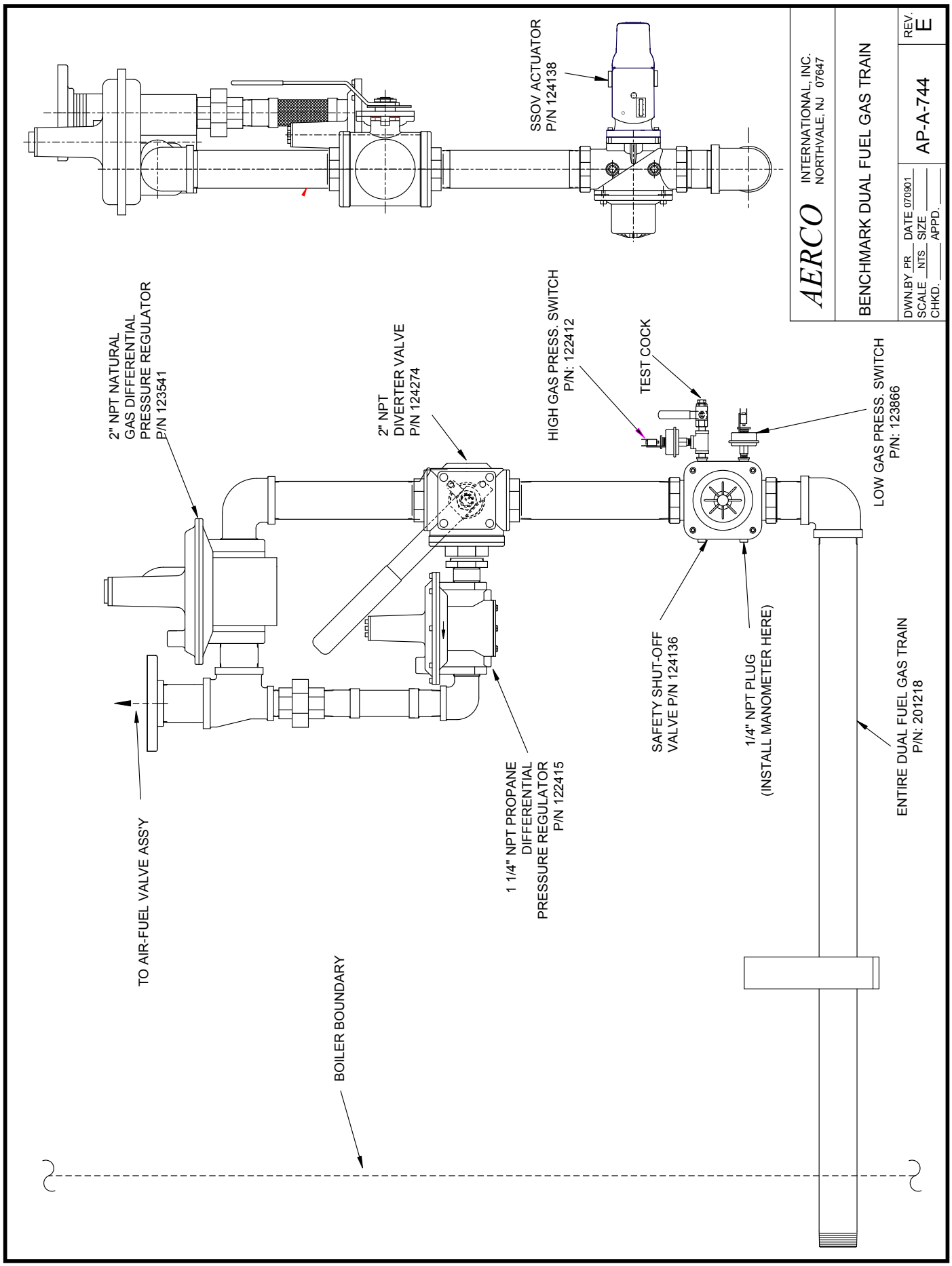
APPENDIX F


HEAT EXCHANGER & COMBUSTION CHAMBER DESIGN STANDARDS
MAX. WORKING PRESS. (PSIG) | MAXIMUM TEMP. (°F) | TEST PRESS. (PSIG) | HT'G SURFACE SQ.FT. | MIN. RELIEF VA. CAPACITY MBH
160 | 210 | 240 | 95 | 2000
ASME B & PV CODE SECTION IV STAMP H
AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647
BENCHMARK 2 MIL. BTU GAS FIRED BOILER DIMENSIONAL DRAWINGS
AP-A-780
REV. A
DWN.BY CZ DATE040301
SCALE 1/32 SIZE A
CHKD. APPD.
REV.DATE
CONTROL PANEL DISPLAY
OPTIONAL CONNECTION FOR 8" DIAMETER SEALED COMBUSTION AIR DUCTWORK TO 8" X 6" AIR INLET ECCENTRIC REDUCING COUPLING PN. 123681
3/4" ELECTRICAL CONDUIT CONNECTION
5-9/16 (14.1)
12-3/16 (30.9)
23 (58.4) DOOR SWING
34 C.G. (86.4)
55-1/2 (140.9)
28 (71.1)
13 C.G. (33.0)
79
20-1/4 C.G. (51.4)
18(45.7)
THIS AREA TO BE ACCESSIBLE FOR MAINTENANCE 30(76.2)
4" CONCRETE PAD -SET UNIT FLUSH AT REAR
2-1/4 (5.7)
8-1/2 (21.6)
PRESS./TEMP. GAUGE
3-3/5 (9.1)
2-3/8 (6.0)
CONDENSATE DRAIN
PRESS. RELIEF VA.
LIFTING LUGS
1" NPT GAS VENT CONN. FOR "IRI GAS TRAIN OPTION" ONLY
2" NPT GAS INLET CONN.
4"-150# FLG'D COLD WATER INLET CONN.
1-1/2" NPT DRAIN CONN.
8" EXHAUST OUTLET
1/2
23 (58.4)
4"-150# FLG'D HOT WATER OUTLET CONN.
6-3/4 (17.1)
7-3/16 (18.2)
12-1/4 (31.1)
13-3/16 (33.5)
27-1/4 (69.2)
15-3/16 (38.6)
68-1/2 (174.0)
NOTES:
1) ALL DIMENSIONS SHOWN ARE IN INCHES (CENTIMETERS)
2) RELIEF VALVE, SUPPLY GAS REGULATOR & CONDENSATE TRAP ARE INCLUDED SEPARATELY IN SHIPMENT

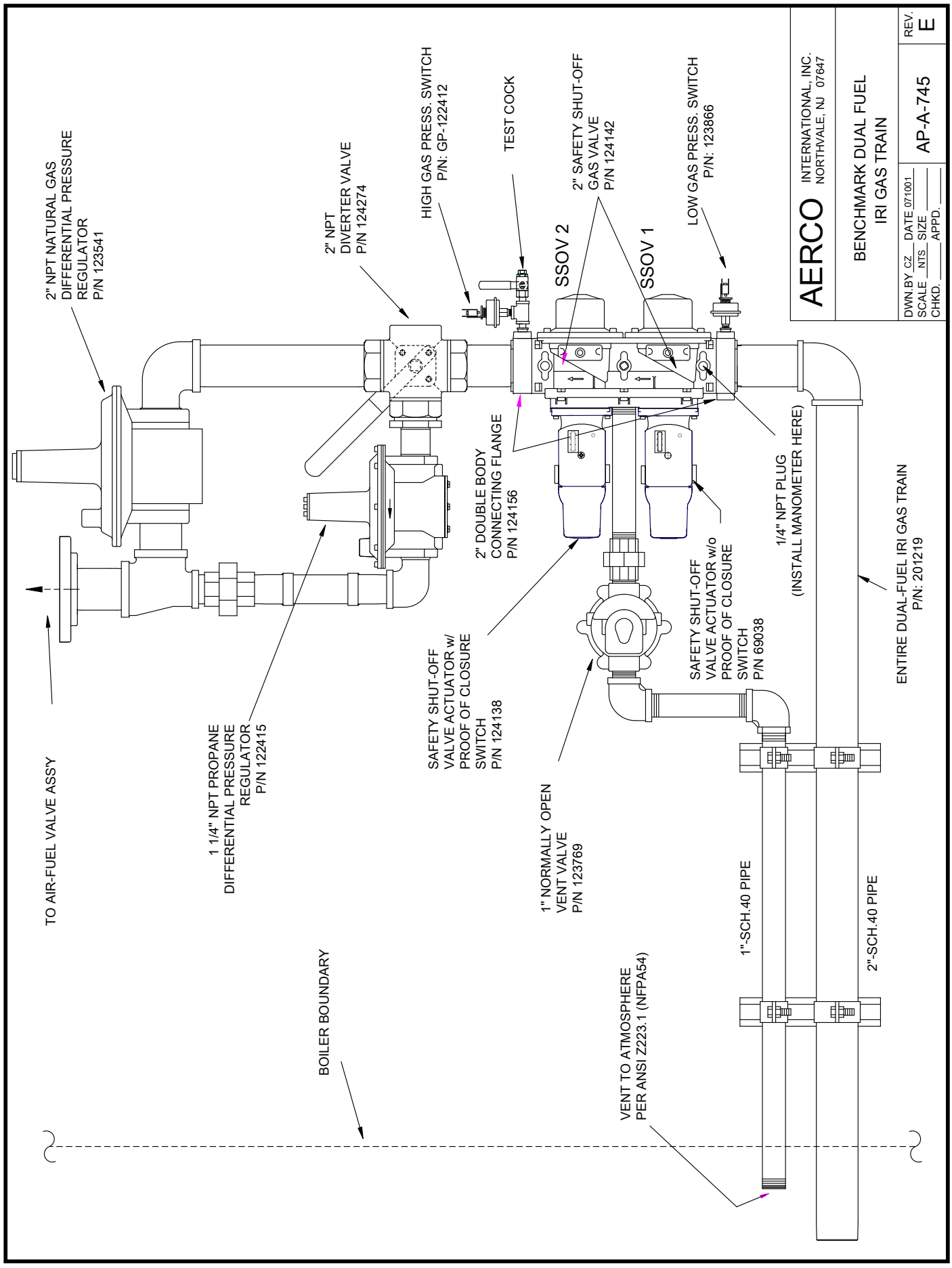

AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647
BENCHMARK 2 MIL. BTU
GAS FIRED BOILER
ANCHOR BOLT LOCATIONS
DWN. BY SCD DATE 12/1/00
SCALE NTS
APPD. MPC DATE 12/1/00
SD-A-560
REV. B
FRONT
REAR
26.00 (66.04)
15.63 (39.70)
30.25 (76.83)
53.00 (134.62)
55.50 (140.97)
23.00 (58.42)
1.50 (3.81)
ANCHOR HOLE ø0.75 (1.90) 4 PL
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)

APPENDIX F

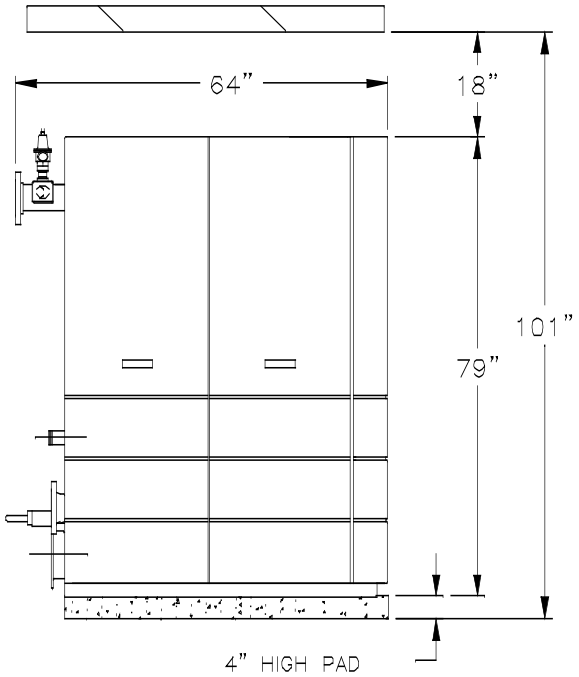

2" NPT DIFFERENTIAL GAS PRESSURE REGULATOR P/N 123541
FULL PORT BALL VALVE 2" NPT P/N: 123540
HIGH GAS PRESS. SWITCH P/N: GP-122412
TEST COCK
2" DOUBLE BODY CONNECTING FLANGE P/N: 124156
LOW GAS PRESS. SWITCH P/N: 123866
SSOV 2
SSOV 1
2" SAFETY SHUT-OFF GAS VALVE P/N 124142
SAFETY SHUT-OFF VALVE ACTUATOR w/PROOF OF CLOSURE SWITCH P/N 124138
SAFETY SHUT-OFF VALVE ACTUATOR w/o PROOF OF CLOSURE SWITCH P/N 69038
1/4" NPT PLUG (INSTALL MANOMETER HERE)
ENTIRE IRI GAS TRAIN P/N: 201117
TO AIR-FUEL VALVE ASS'Y
1" NORMALLY OPEN VENT VALVE P/N 123769
1"-SCH.40 PIPE
2"-SCH.40 PIPE
BOILER BOUNDARY
VENT TO ATMOSPHERE PER ANSI Z223.1 (NFPA54)
AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647
BENCHMARK IRI GAS TRAIN
DWN.BY CZ DATE 030701
SCALE NTS SIZE
CHKD. APPD.
AP-A-742
REV. F


SSOV ACTUATOR
P/N 124138
AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647
BENCHMARK DUAL FUEL GAS TRAIN
REV. E
DWN.BY PR DATE 070901
SCALE NTS SIZE
CHKD. APPD.
AP-A-744
2" NPT NATURAL
GAS DIFFERENTIAL
PRESSURE REGULATOR
P/N 123541
2" NPT
DIVERTER VALVE
P/N 124274
HIGH GAS PRESS. SWITCH
P/N: 122412
TEST COCK
LOW GAS PRESS. SWITCH
P/N: 123866
TO AIR-FUEL VALVE ASS'Y
1 1/4" NPT PROPANE
DIFFERENTIAL
PRESSURE REGULATOR
P/N 122415
SAFETY SHUT-OFF
VALVE P/N 124136
1/4" NPT PLUG
(INSTALL MANOMETER HERE)
ENTIRE DUAL FUEL GAS TRAIN
P/N: 201218
BOILER BOUNDARY

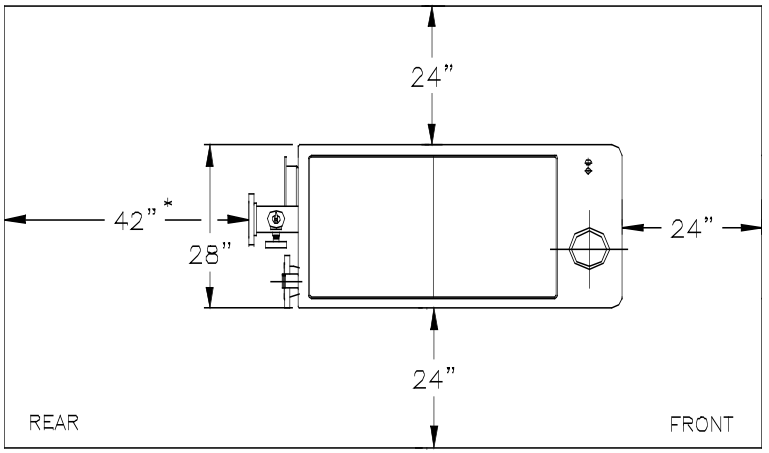
APPENDIX F


2" NPT NATURAL GAS
DIFFERENTIAL PRESSURE
REGULATOR
P/N 123541
2" NPT
DIVERTER VALVE
P/N 124274
HIGH GAS PRESS. SWITCH
P/N: GP-122412
TEST COCK
SSOV 2
2" SAFETY SHUT-OFF
GAS VALVE
P/N 124142
SSOV 1
LOW GAS PRESS. SWITCH
P/N: 123866
AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647
BENCHMARK DUAL FUEL
IRI GAS TRAIN
DWN.BY CZ DATE 071001
SCALE NTS SIZE
CHKD. APPD.
AP-A-745
REV. E
2" DOUBLE BODY
CONNECTING FLANGE
P/N 124156
1/4" NPT PLUG
(INSTALL MANOMETER HERE)
ENTIRE DUAL-FUEL IRI GAS TRAIN
P/N: 201219
SAFETY SHUT-OFF
VALVE ACTUATOR w/o
PROOF OF CLOSURE
SWITCH
P/N 69038
SAFETY SHUT-OFF
VALVE ACTUATOR w/
PROOF OF CLOSURE
SWITCH
P/N 124138
1" NORMALLY OPEN
VENT VALVE
P/N 123769
1 1/4" NPT PROPANE
DIFFERENTIAL PRESSURE
REGULATOR
P/N 122415
TO AIR-FUEL VALVE ASS'Y
BOILER BOUNDARY
VENT TO ATMOSPHERE
PER ANSI Z223.1 (NFPA54)
1"-SCH.40 PIPE
2"-SCH.40 PIPE

SIDE VIEW



TOP VIEW



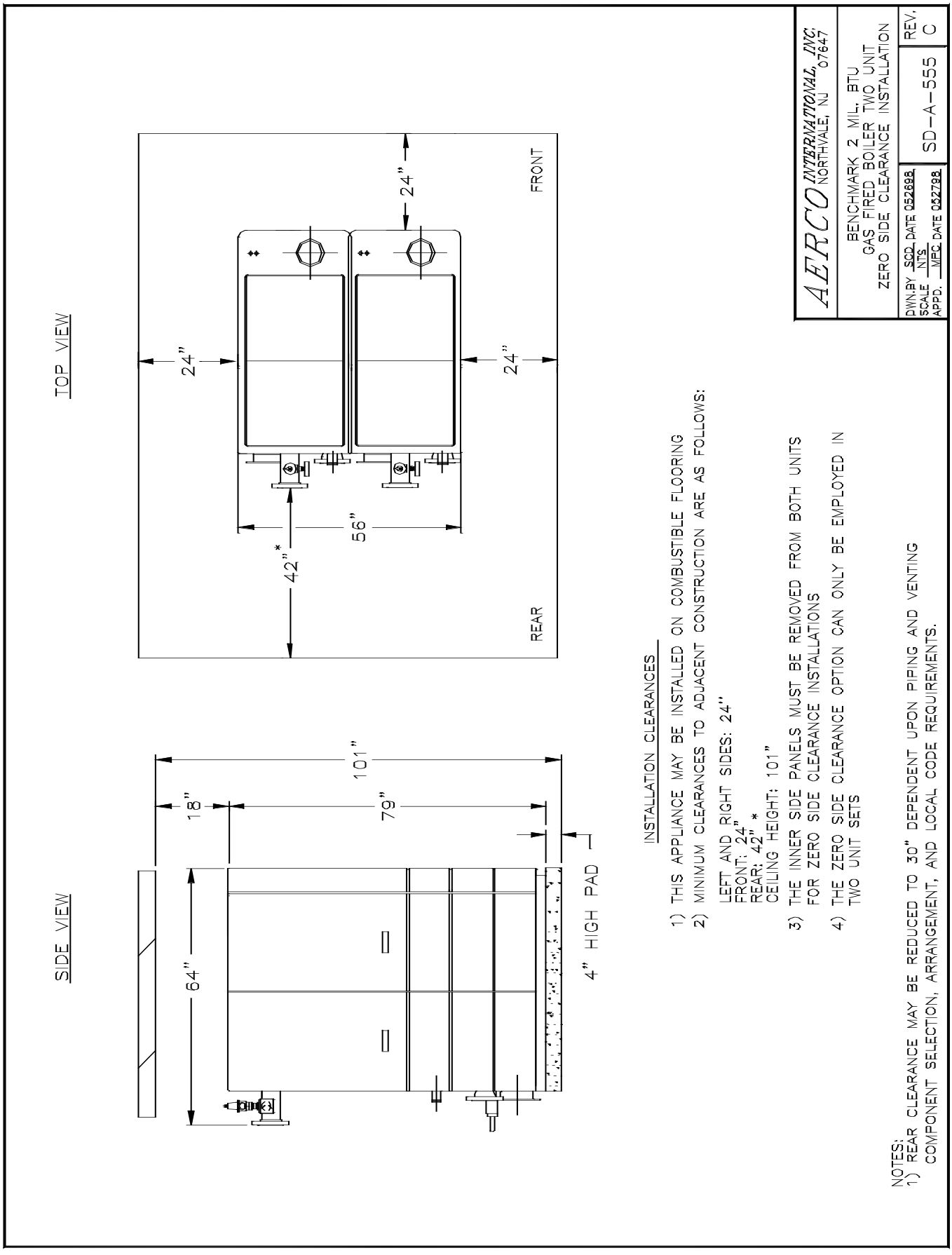
INSTALLATION CLEARANCES

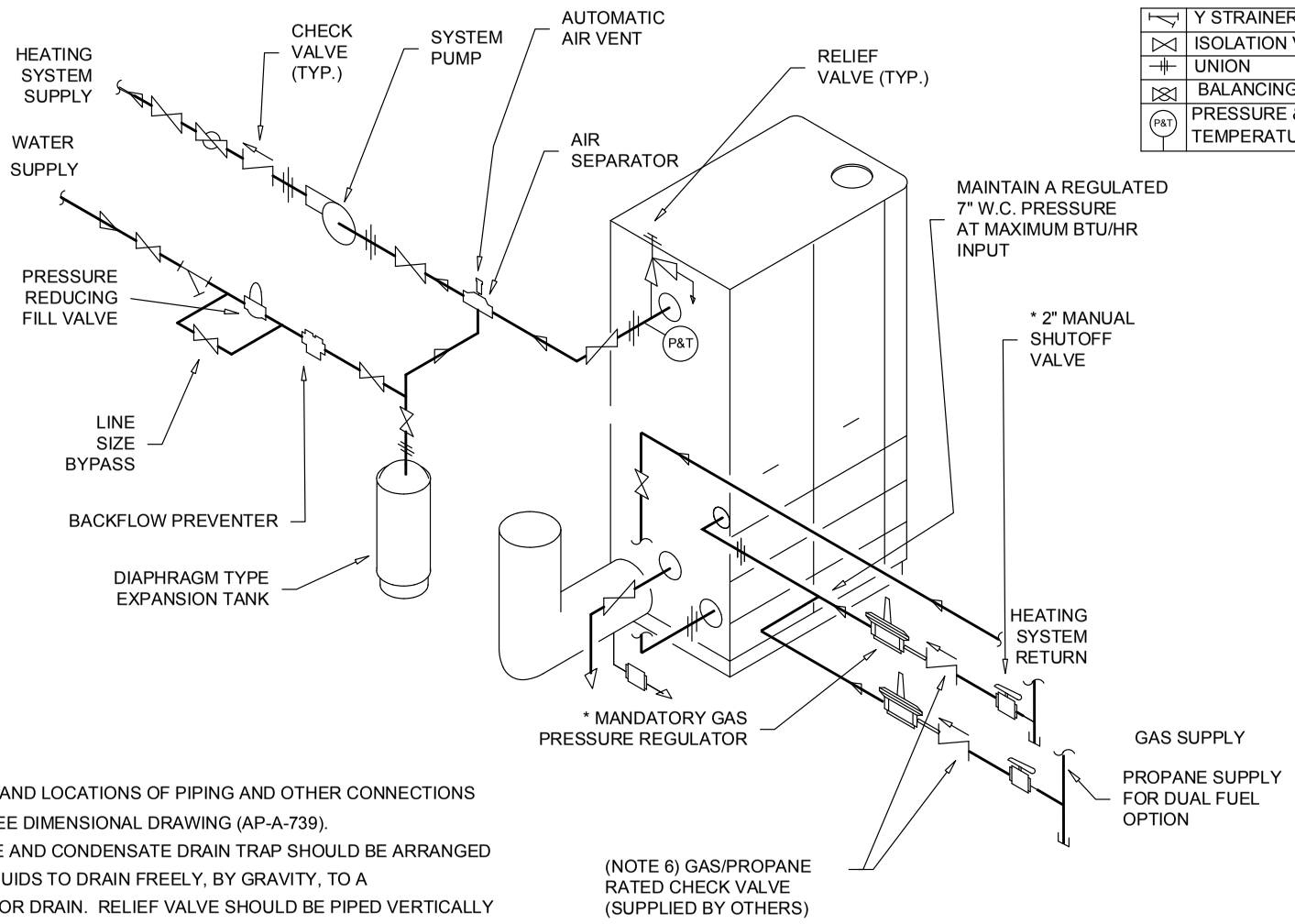
1) THIS APPLIANCE MAY BE INSTALLED ON COMBUSTIBLE FLOORING
2) MINIMUM CLEARANCES TO ADJACENT CONSTRUCTION ARE AS FOLLOWS:

LEFT AND RIGHT SIDES: 24''
FRONT: 24"
REAR: 42" *
CEILING HEIGHT: 101"

NOTES:
1) REAR CLEARANCE MAY BE REDUCED TO 30" DEPENDENT UPON PIPING AND VENTING COMPONENT SELECTION, ARRANGEMENT, AND LOCAL CODE REQUIREMENTS.

AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647		
BENCHMARK 2 MIL. BTU GAS FIRED BOILER INSTALLATION CLEARANCES		
DWN.BY SCD DATE 052698 SCALE NTS APPD. MPC DATE 052698	SD-A-549	REV. D

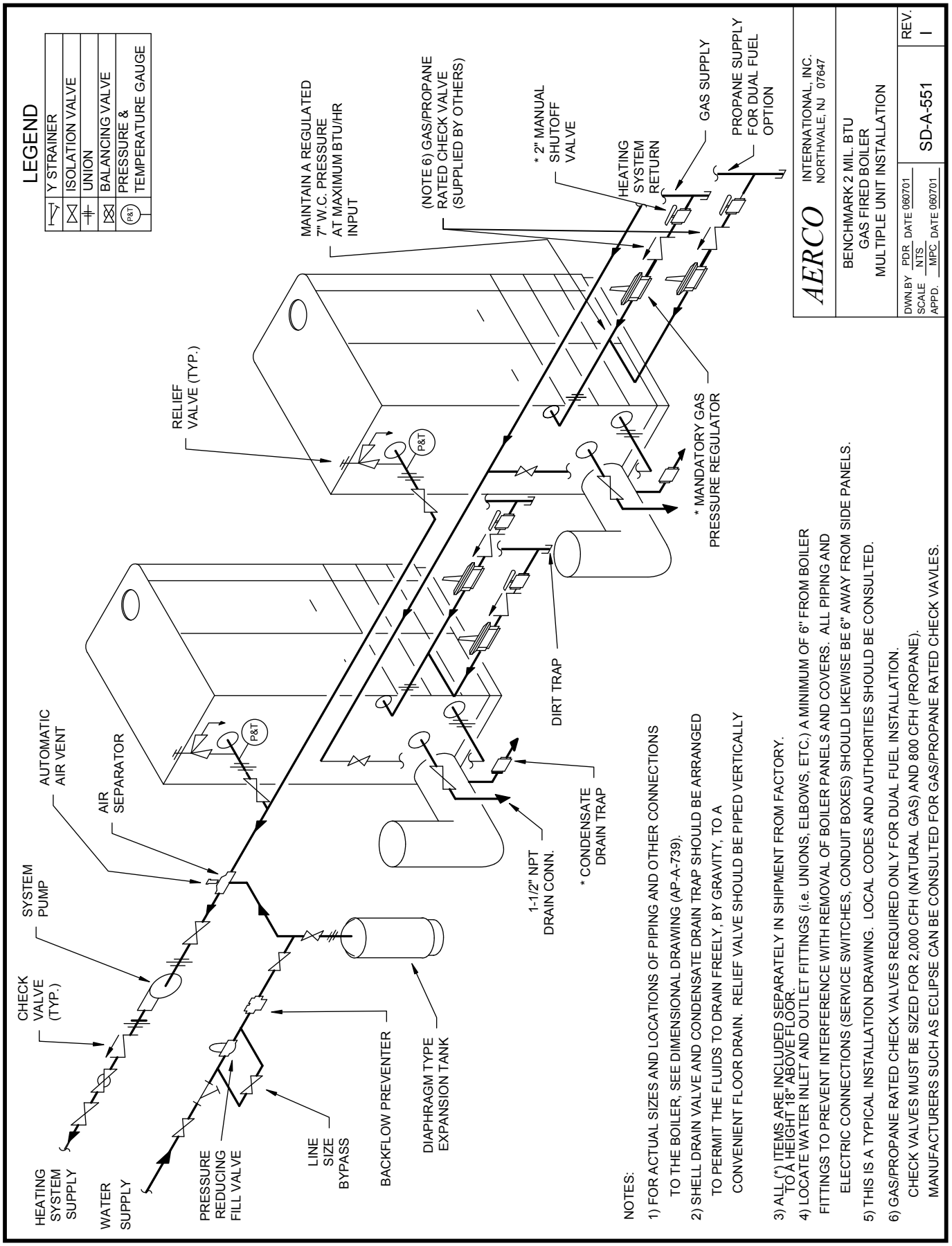

TOP VIEW
FRONT
REAR
24"
24"
24"
56"
42"*
SIDE VIEW
101"
18"
79"
64"
4" HIGH PAD
INSTALLATION CLEARANCES
1) THIS APPLIANCE MAY BE INSTALLED ON COMBUSTIBLE FLOORING
2) MINIMUM CLEARANCES TO ADJACENT CONSTRUCTION ARE AS FOLLOWS:
LEFT AND RIGHT SIDES: 24"
FRONT: 24"
REAR: 42" *
CEILING HEIGHT: 101"
3) THE 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
NOTES:
1) REAR CLEARANCE MAY BE REDUCED TO 30" DEPENDENT UPON PIPING AND VENTING COMPONENT SELECTION, ARRANGEMENT, AND LOCAL CODE REQUIREMENTS.
AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647
BENCHMARK 2 MIL. BTU
GAS FIRED BOILER TWO UNIT
ZERO SIDE CLEARANCE INSTALLATION
DWN. BY SCD DATE 052698
SCALE NTS
APPD. WEC DATE 052798
SD-A-555
REV. C



NOTES:

1) FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE BOILER, SEE DIMENSIONAL DRAWING (AP-A-739).
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) GAS/PROPANE RATED CHECK VALVES REQUIRED ONLY FOR DUAL FUEL INSTALLATION. CHECK VALVES MUST BE SIZED FOR 2,000 CFH (NATURAL GAS) AND 800 CFH (PROPANE). MANUFACTURERS SUCH AS ECLIPSE CAN BE CONSULTED FOR GAS/PROPANE RATED CHECK VAVLES.

AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647		
BENCHMARK 2 MIL. BTU GAS FIRED BOILER SINGLE UNIT INSTALLATION		
DWN.BY PDR DATE 060701 SCALE NTS APPD. MPC DATE	SD-A-543	REV. I


LEGEND
Y STRAINER
ISOLATION VALVE
UNION
BALANCING VALVE
PRESSURE & TEMPERATURE GAUGE
P&T
HEATING SYSTEM SUPPLY
WATER SUPPLY
PRESSURE REDUCING FILL VALVE
LINE SIZE BYPASS
BACKFLOW PREVENTER
DIAPHRAGM TYPE EXPANSION TANK
CHECK VALVE (TYP.)
SYSTEM PUMP
AUTOMATIC AIR VENT
AIR SEPARATOR
1-1/2" NPT DRAIN CONN.
* CONDENSATE DRAIN TRAP
DIRT TRAP
RELIEF VALVE (TYP.)
MAINTAIN A REGULATED 7" W.C. PRESSURE AT MAXIMUM BTU/HR INPUT
(NOTE 6) GAS/PROPANE RATED CHECK VALVE (SUPPLIED BY OTHERS)
* 2" MANUAL SHUTOFF VALVE
HEATING SYSTEM RETURN
* MANDATORY GAS PRESSURE REGULATOR
GAS SUPPLY
PROPANE SUPPLY FOR DUAL FUEL OPTION
NOTES:
1) FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE BOILER, SEE DIMENSIONAL DRAWING (AP-A-739).
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.
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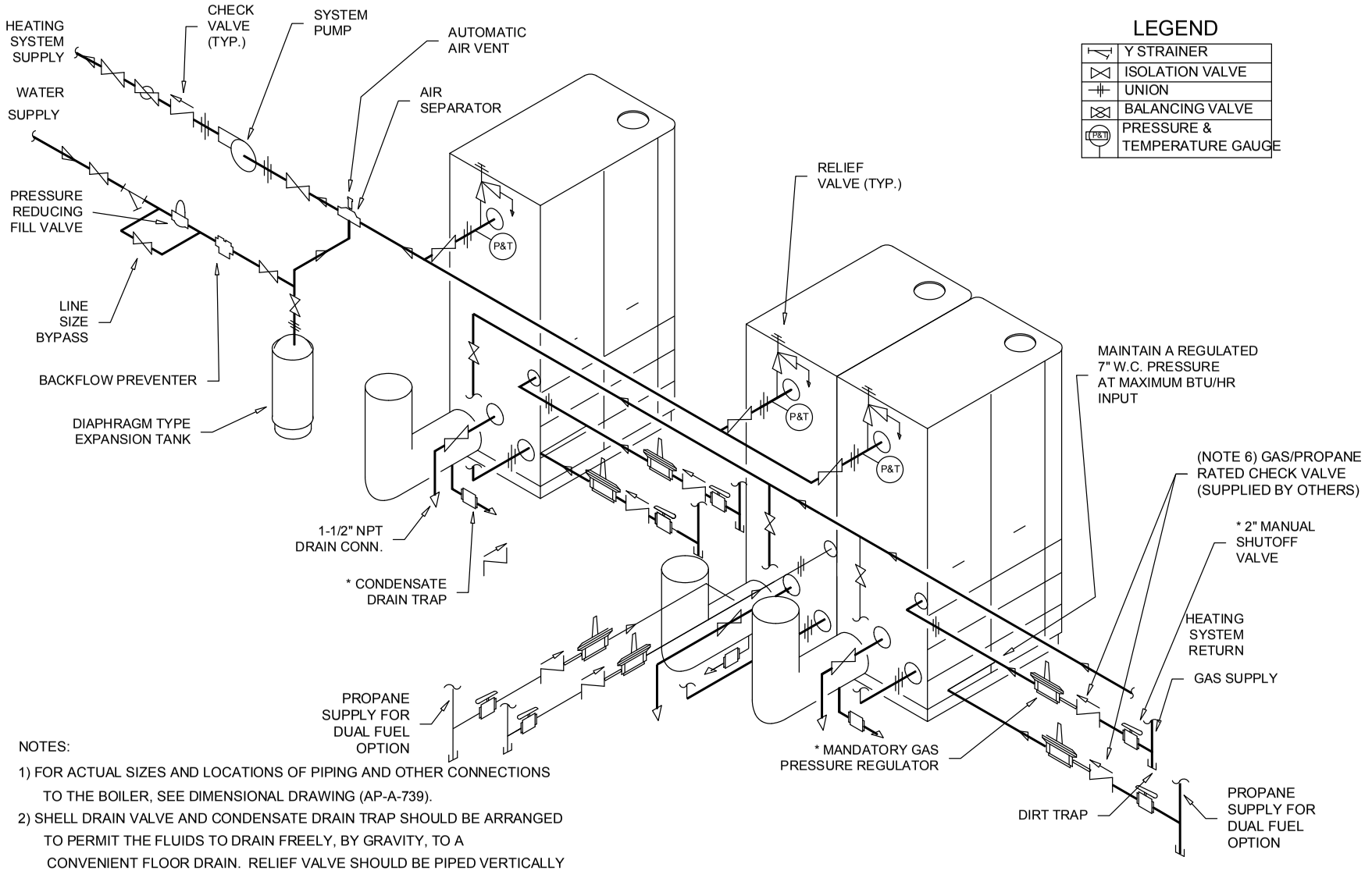
6) GAS/PROPANE RATED CHECK VALVES REQUIRED ONLY FOR DUAL FUEL INSTALLATION. CHECK VALVES MUST BE SIZED FOR 2,000 CFH (NATURAL GAS) AND 800 CFH (PROPANE). MANUFACTURERS SUCH AS ECLIPSE CAN BE CONSULTED FOR GAS/PROPANE RATED CHECK VAVLES.
AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647
BENCHMARK 2 MIL. BTU GAS FIRED BOILER MULTIPLE UNIT INSTALLATION
DWN.BY PDR DATE 060701
SCALE NTS
APPD. MPC DATE 060701
SD-A-551
REV. I



NOTES:

1) FOR ACTUAL SIZES AND LOCATIONS OF PIPING AND OTHER CONNECTIONS TO THE BOILER, SEE DIMENSIONAL DRAWING (AP-A-739).
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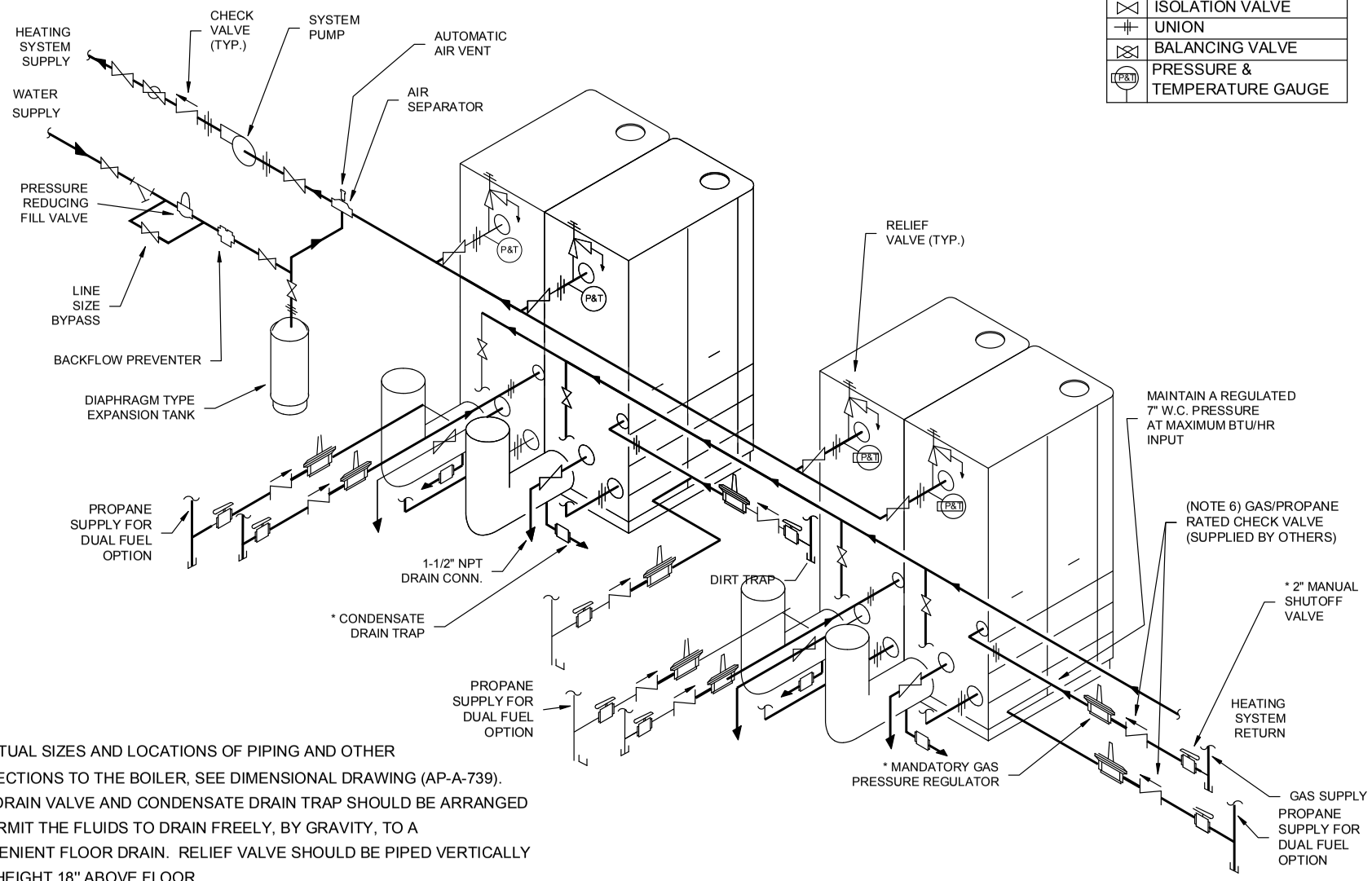
AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647

BENCHMARK 2 MIL. BTU GAS FIRED
BOILER THREE UNIT INSTALLATION
(2 ZERO-SIDE & 1 SEPARATE)

DWN.BY CZ DATE 072701	SD-A-594	REV. D
SCALE NTS		
APPD. _____ DATE _____		



NOTES:

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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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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.
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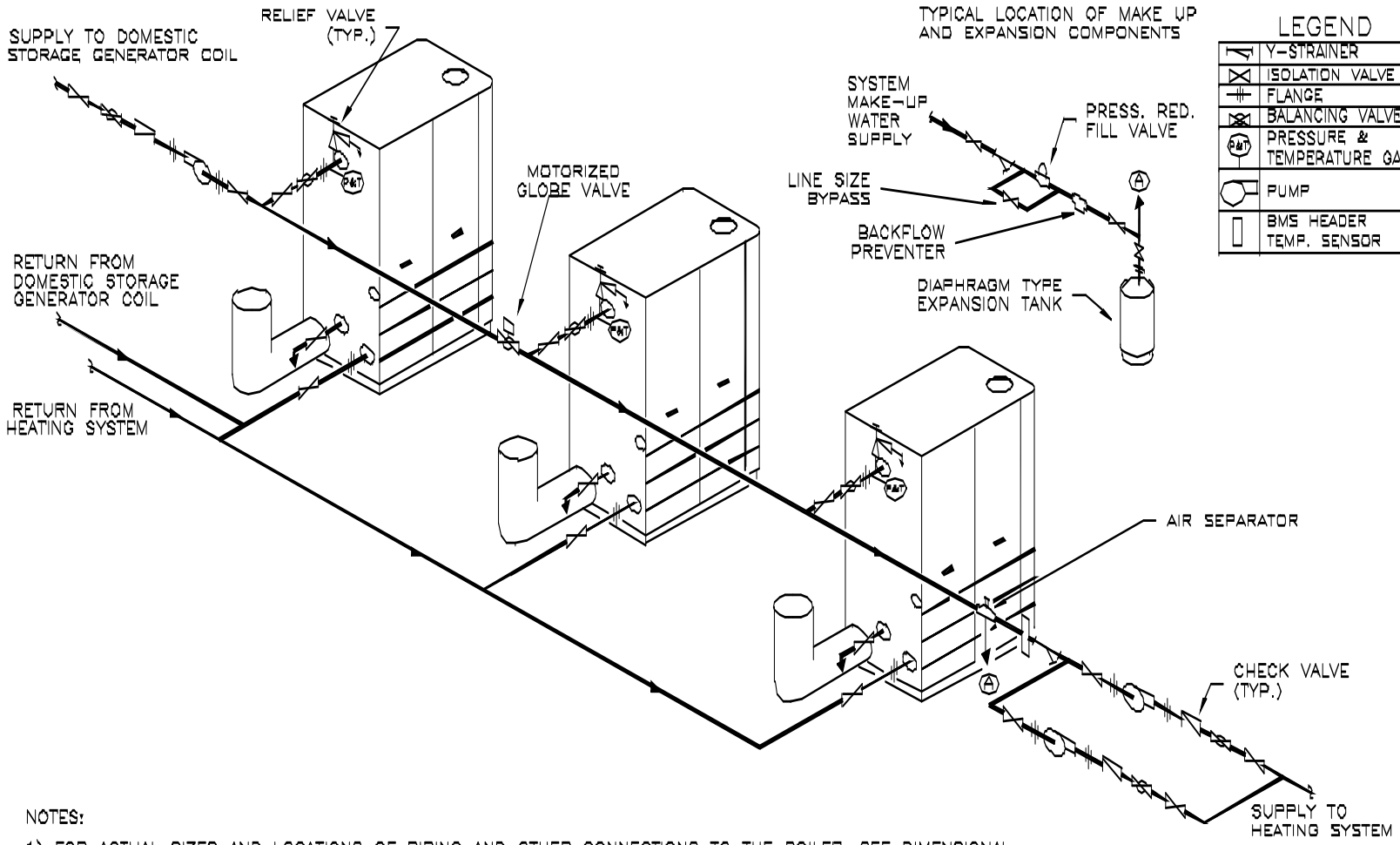
AERCO INTERNATIONAL, INC.
NORTHVALE, NJ 07647

BENCHMARK 2 MIL. BTU GAS FIRED MULTIPLE BOILERS WITH ZERO SIDE CLEARANCE INSTALLATION

DWN.BY PDR DATE 072701
SCALE NTS
APPD. _____ DATE _____

SD-A-593

REV. D



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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 VALVES SHOULD BE PIPED VERTICALLY TO A A HEIGHT 18" ABOVE FLOOR.
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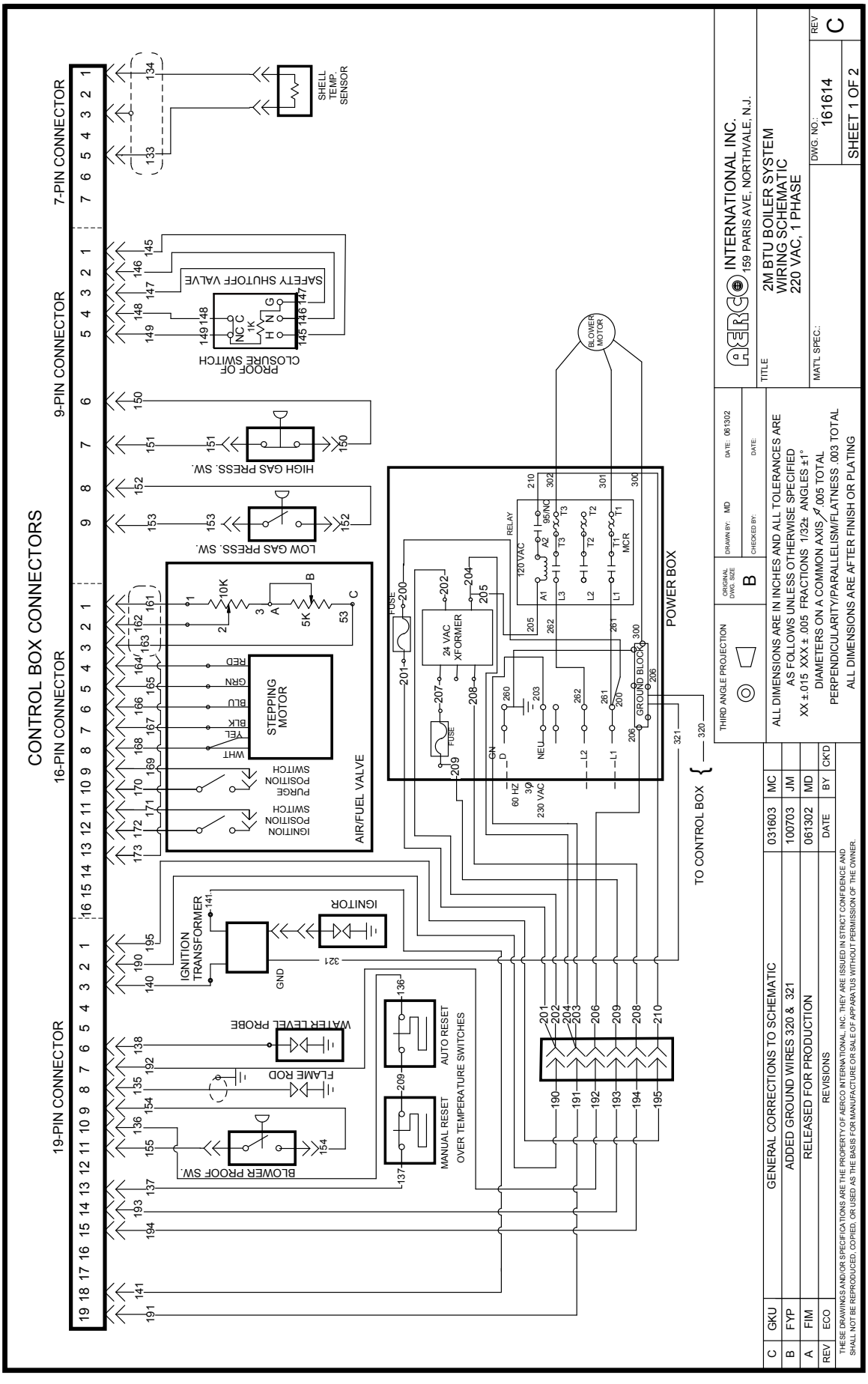
5) THIS IS A TYPICAL INSTALLATION DRAWING, LOCAL CODES AND AUTHORITIES SHOULD BE CONSULTED.

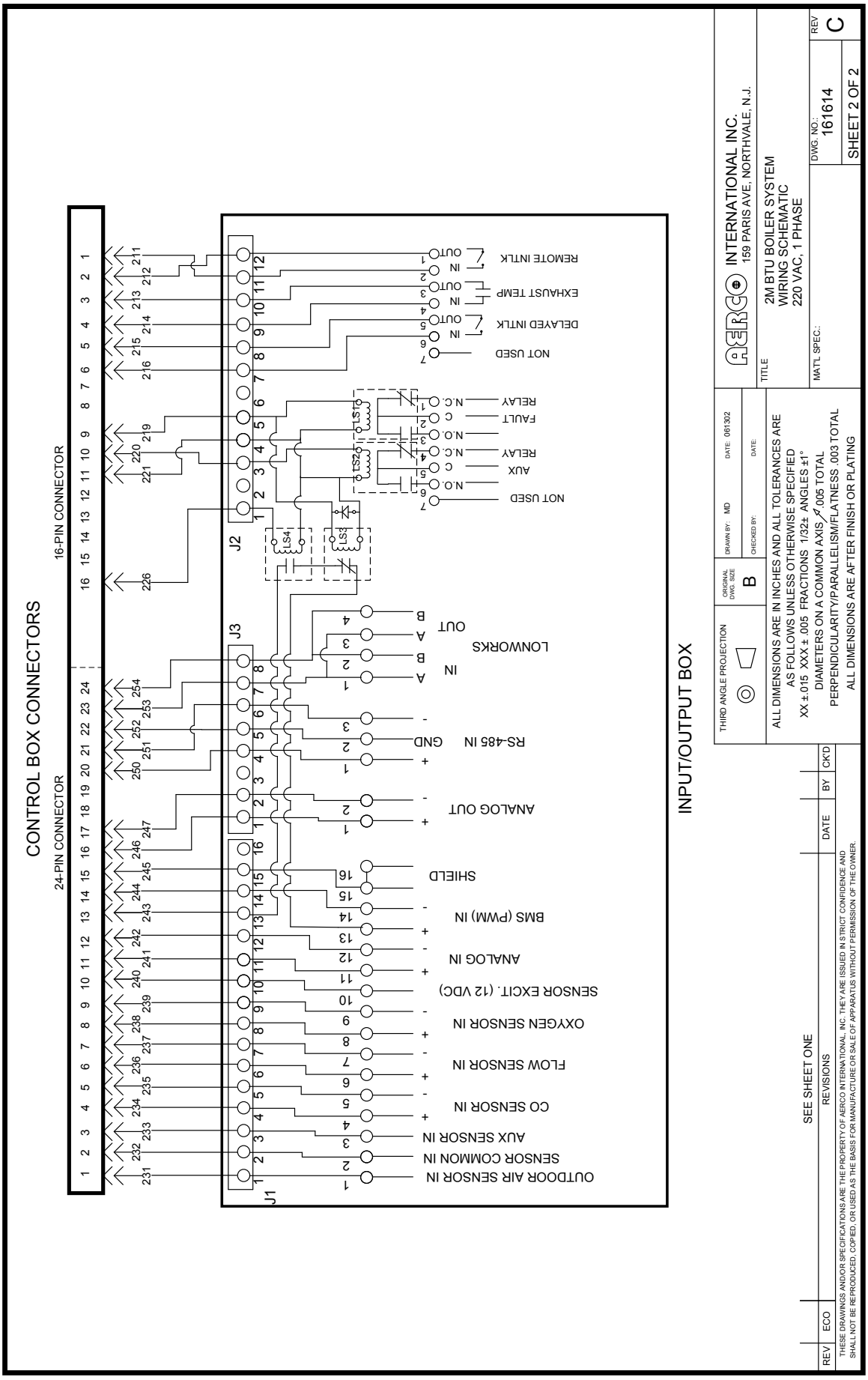
AERCO INTERNATIONAL, INC. NORTHVALE, NJ 07647

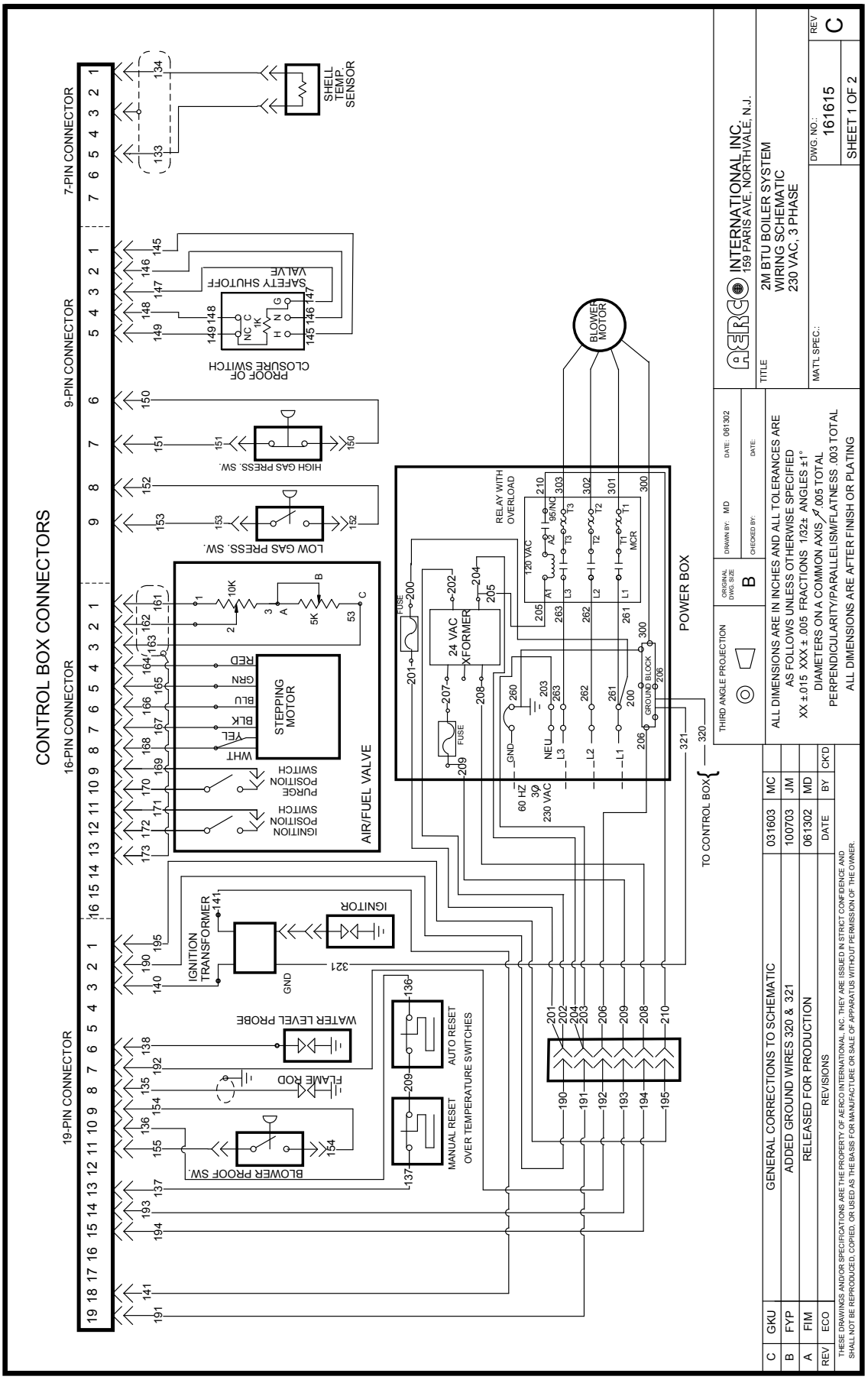
BENCHMARK 2 MIL. BTU GAS FIRED BOILER LAYOUT FOR COMBINATION HEATING & DOMESTIC WATER PLANT

DWN. BY SCD DATE 052698	SD-A-554	REV. B
SCALE NTS		
APPD. MPC DATE 052896		

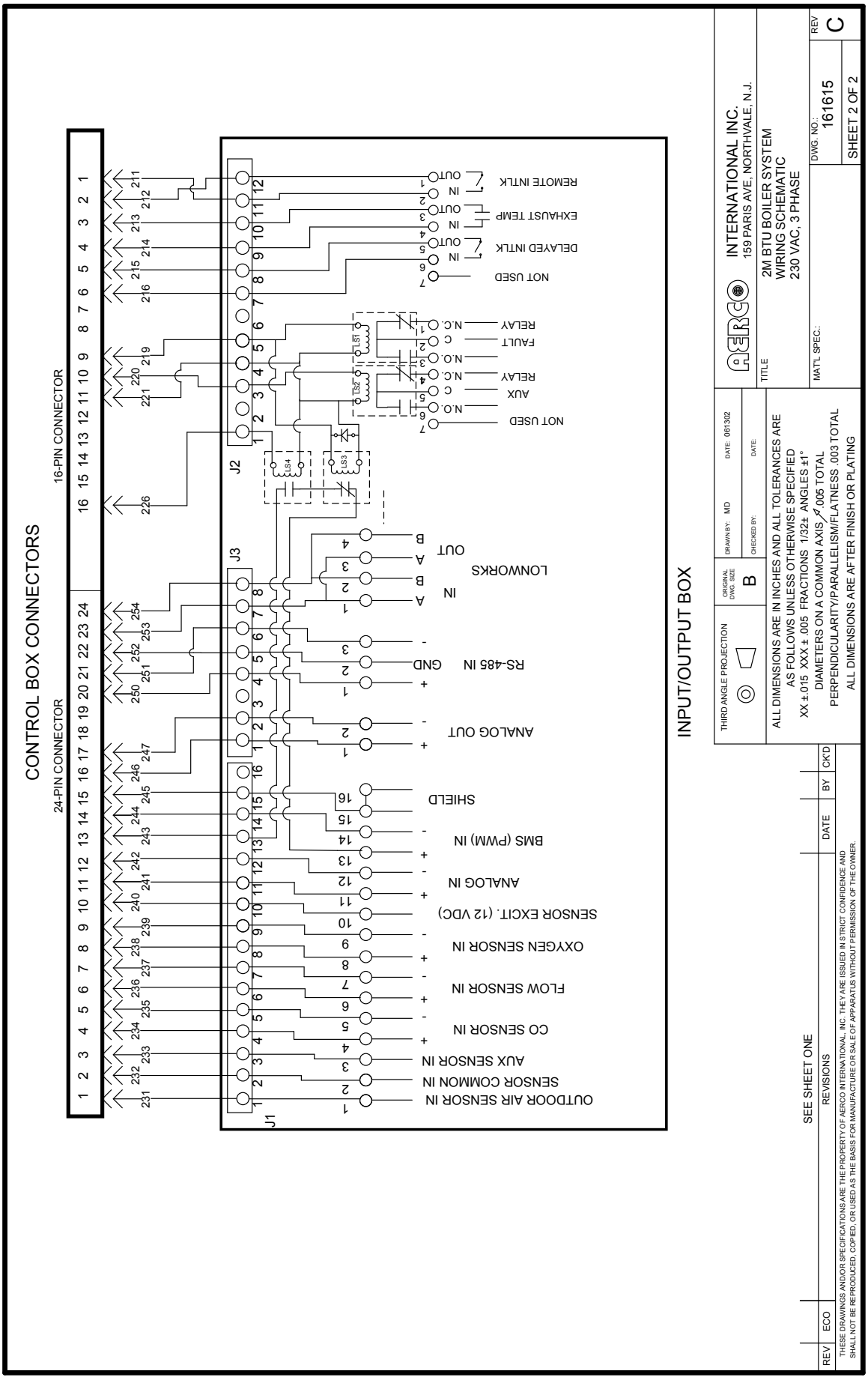

CONTROL BOX CONNECTORS
19-PIN CONNECTOR
16-PIN CONNECTOR
9-PIN CONNECTOR
7-PIN CONNECTOR
SHELL TEMP. SENSOR
PROOF OF CLOSURE SWITCH
SAFETY SHUTOFF VALVE
HIGH GAS PRESS. SW.
LOW GAS PRESS. SW.
AIR/FUEL VALVE
STEPPING MOTOR
IGNITION POSITION SWITCH
PURGE POSITION SWITCH
BLOWER PROOF SW.
IGNITION TRANSFORMER
IGNITOR
WATER LEVEL PROBE
FLAME ROD
AUTO RESET
MANUAL RESET
OVER TEMPERATURE SWITCHES
POWER BOX
24 VAC XFORMER
RELAY
MCR
GROUND BLOCK
BLOWER MOTOR
60 HZ 3Ø 230 VAC
TO CONTROL BOX
AERCO INTERNATIONAL INC.
159 PARIS AVE, NORTHVALE, N.J.
2M BTU BOILER SYSTEM
WIRING SCHEMATIC
220 VAC, 1 PHASE
DWG. NO.: 161614
REV C
SHEET 1 OF 2
THIRD ANGLE PROJECTION
ORIGINAL DWG. SIZE B
DRAWN BY: MD DATE: 061302
CHECKED BY: DATE:
ALL DIMENSIONS ARE IN INCHES AND ALL TOLERANCES ARE AS FOLLOWS UNLESS OTHERWISE SPECIFIED
XX ± .015 XXX ± .005 FRACTIONS 1/32± ANGLES ±1°
DIAMETERS ON A COMMON AXIS ⌀.005 TOTAL
PERPENDICULARITY/PARALLELISM/FLATNESS .003 TOTAL
ALL DIMENSIONS ARE AFTER FINISH OR PLATING
C GKU GENERAL CORRECTIONS TO SCHEMATIC 031603 MC
B FYP ADDED GROUND WIRES 320 & 321 100703 JM
A FIM RELEASED FOR PRODUCTION 061302 MD
REV ECO REVISIONS DATE BY CK'D
THESE DRAWINGS AND/OR SPECIFICATIONS ARE THE PROPERTY OF AERCO INTERNATIONAL, INC. THEY ARE ISSUED IN STRICT CONFIDENCE AND SHALL NOT BE REPRODUCED, COPIED, OR USED AS THE BASIS FOR MANUFACTURE OR SALE OF APPARATUS WITHOUT PERMISSION OF THE OWNER.

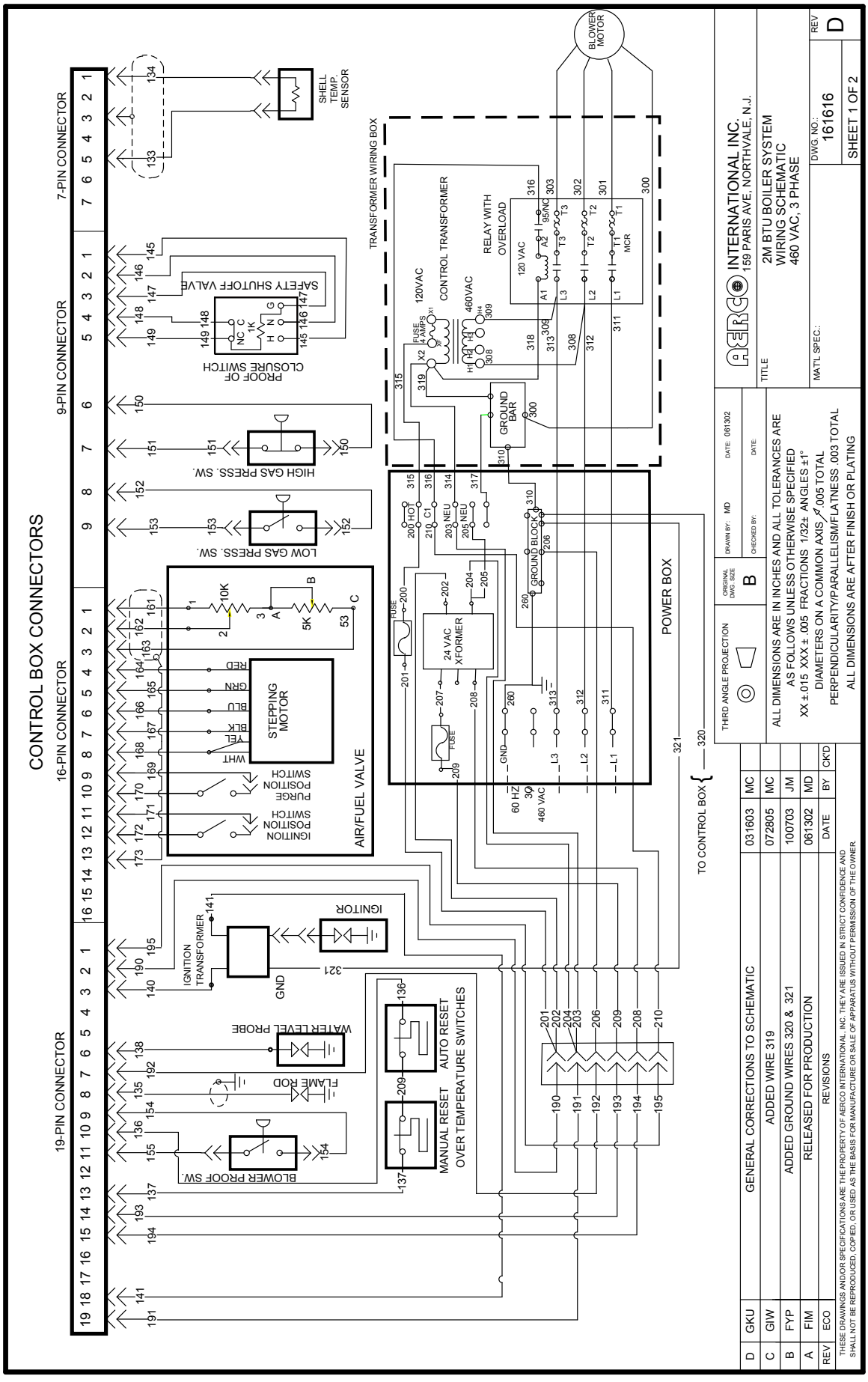
APPENDIX H


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
RS-485 IN GND
LONWORKS IN
LONWORKS OUT
NOT USED
AUX
RELAY
FAULT
RELAY
NOT USED
DELAYED INTLK
EXHAUST TEMP
REMOTE INTLK
LS1
LS2
LS3
LS4
SEE SHEET ONE
REV ECO REVISIONS DATE BY CK'D
THESE DRAWINGS AND/OR SPECIFICATIONS ARE THE PROPERTY OF AERCO INTERNATIONAL, INC. THEY ARE ISSUED IN STRICT CONFIDENCE AND SHALL NOT BE REPRODUCED, COPIED, OR USED AS THE BASIS FOR MANUFACTURE OR SALE OF APPARATUS WITHOUT PERMISSION OF THE OWNER.
THIRD ANGLE PROJECTION
ORIGINAL DWG. SIZE B
DRAWN BY: MD DATE: 061302
CHECKED BY: DATE:
ALL DIMENSIONS ARE IN INCHES AND ALL TOLERANCES ARE AS FOLLOWS UNLESS OTHERWISE SPECIFIED
XX ±.015 XXX ± .005 FRACTIONS 1/32± ANGLES ±1°
DIAMETERS ON A COMMON AXIS ⌀.005 TOTAL
PERPENDICULARITY/PARALLELISM/FLATNESS .003 TOTAL
ALL DIMENSIONS ARE AFTER FINISH OR PLATING
AERCO INTERNATIONAL INC.
159 PARIS AVE, NORTHVALE, N.J.
TITLE
2M BTU BOILER SYSTEM
WIRING SCHEMATIC
220 VAC, 1 PHASE
MAT'L SPEC.:
DWG. NO.: 161614
REV C
SHEET 2 OF 2


CONTROL BOX CONNECTORS
19-PIN CONNECTOR
16-PIN CONNECTOR
9-PIN CONNECTOR
7-PIN CONNECTOR
SHELL TEMP. SENSOR
PROOF OF CLOSURE SWITCH
SAFETY SHUTOFF VALVE
HIGH GAS PRESS. SW.
LOW GAS PRESS. SW.
AIR/FUEL VALVE
STEPPING MOTOR
IGNITION POSITION SWITCH
PURGE POSITION SWITCH
RED
GRN
BLU
BLK
YEL
WHT
10K
5K
IGNITION TRANSFORMER
IGNITOR
WATER LEVEL PROBE
FLAME ROD
BLOWER PROOF SW.
MANUAL RESET
AUTO RESET
OVER TEMPERATURE SWITCHES
GND
24 VAC XFORMER
FUSE
RELAY WITH OVERLOAD
120 VAC
MCR
GROUND BLOCK
POWER BOX
BLOWER MOTOR
60 HZ 30 230 VAC
NEU
L1
L2
L3
TO CONTROL BOX
THIRD ANGLE PROJECTION
ORIGINAL DWG. SIZE
B
DRAWN BY: MD
DATE: 061302
CHECKED BY:
DATE:
AERCO INTERNATIONAL INC.
159 PARIS AVE, NORTHVALE, N.J.
TITLE
2M BTU BOILER SYSTEM
WIRING SCHEMATIC
230 VAC, 3 PHASE
MAT'L SPEC.:
DWG. NO.:
161615
REV
C
SHEET 1 OF 2
ALL DIMENSIONS ARE IN INCHES AND ALL TOLERANCES ARE AS FOLLOWS UNLESS OTHERWISE SPECIFIED
XX ±.015 XXX ± .005 FRACTIONS 1/32± ANGLES ±1°
DIAMETERS ON A COMMON AXIS .005 TOTAL
PERPENDICULARITY/PARALLELISM/FLATNESS .003 TOTAL
ALL DIMENSIONS ARE AFTER FINISH OR PLATING
C GKU GENERAL CORRECTIONS TO SCHEMATIC 031603 MC
B FYP ADDED GROUND WIRES 320 & 321 100703 JM
A FIM RELEASED FOR PRODUCTION 061302 MD
REV ECO REVISIONS DATE BY CK'D
THESE DRAWINGS AND/OR SPECIFICATIONS ARE THE PROPERTY OF AERCO INTERNATIONAL, INC. THEY ARE ISSUED IN STRICT CONFIDENCE AND SHALL NOT BE REPRODUCED, COPIED, OR USED AS THE BASIS FOR MANUFACTURE OR SALE OF APPARATUS WITHOUT PERMISSION OF THE OWNER.

APPENDIX H


CONTROL BOX CONNECTORS
24-PIN CONNECTOR
16-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
RS-485 IN
GND
LONWORKS
IN
OUT
NOT USED
RELAY
AUX
RELAY
FAULT
NOT USED
DELAYED INTLK
EXHAUST TEMP
REMOTE INTLK
SEE SHEET ONE
REVISIONS
REV
ECO
DATE
BY
CK'D
THIRD ANGLE PROJECTION
ORIGINAL DWG. SIZE
B
DRAWN BY: MD
DATE: 061302
CHECKED BY:
DATE:
ALL DIMENSIONS ARE IN INCHES AND ALL TOLERANCES ARE AS FOLLOWS UNLESS OTHERWISE SPECIFIED
XX ±.015 XXX ± .005 FRACTIONS 1/32± ANGLES ±1°
DIAMETERS ON A COMMON AXIS ⌀.005 TOTAL
PERPENDICULARITY/PARALLELISM/FLATNESS .003 TOTAL
ALL DIMENSIONS ARE AFTER FINISH OR PLATING
AERCO INTERNATIONAL INC.
159 PARIS AVE, NORTHVALE, N.J.
TITLE
2M BTU BOILER SYSTEM
WIRING SCHEMATIC
230 VAC, 3 PHASE
MAT'L SPEC.:
DWG. NO.:
161615
REV
C
SHEET 2 OF 2
THESE DRAWINGS AND/OR SPECIFICATIONS ARE THE PROPERTY OF AERCO INTERNATIONAL, INC. THEY ARE ISSUED IN STRICT CONFIDENCE AND SHALL NOT BE REPRODUCED, COPIED, OR USED AS THE BASIS FOR MANUFACTURE OR SALE OF APPARATUS WITHOUT PERMISSION OF THE OWNER.


CONTROL BOX CONNECTORS
19-PIN CONNECTOR
16-PIN CONNECTOR
9-PIN CONNECTOR
7-PIN CONNECTOR
SHELL TEMP. SENSOR
PROOF OF CLOSURE SWITCH
SAFETY SHUTOFF VALVE
HIGH GAS PRESS. SW.
LOW GAS PRESS. SW.
BLOWER PROOF SW.
MANUAL RESET OVER TEMPERATURE SWITCHES
AUTO RESET
WATER LEVEL PROBE
FLAME ROD
IGNITOR
IGNITION TRANSFORMER
GND
STEPPING MOTOR
RED
GRN
BLU
BLK
YEL
WHT
IGNITION POSITION SWITCH
PURGE POSITION SWITCH
AIR/FUEL VALVE
10K
5K
1K
TRANSFORMER WIRING BOX
CONTROL TRANSFORMER
120VAC
460VAC
FUSE 4 AMPS
RELAY WITH OVERLOAD
120 VAC
MCR
GROUND BAR
POWER BOX
FUSE
24 VAC XFORMER
GROUND BLOCK
60 HZ 3Φ 460 VAC
TO CONTROL BOX
BLOWER MOTOR
THIRD ANGLE PROJECTION
ORIGINAL DWG. SIZE B
DRAWN BY: MD
DATE: 061302
CHECKED BY:
DATE:
AERCO INTERNATIONAL INC.
159 PARIS AVE, NORTHVALE, N.J.
TITLE
2M BTU BOILER SYSTEM
WIRING SCHEMATIC
460 VAC, 3 PHASE
MAT'L SPEC.:
DWG. NO.: 161616
REV D
SHEET 1 OF 2
ALL DIMENSIONS ARE IN INCHES AND ALL TOLERANCES ARE AS FOLLOWS UNLESS OTHERWISE SPECIFIED
XX ± .015 XXX ± .005 FRACTIONS 1/32± ANGLES ±1°
DIAMETERS ON A COMMON AXIS ⌀.005 TOTAL
PERPENDICULARITY/PARALLELISM/FLATNESS .003 TOTAL
ALL DIMENSIONS ARE AFTER FINISH OR PLATING
D GKU GENERAL CORRECTIONS TO SCHEMATIC 031603 MC
C GIW ADDED WIRE 319 072805 MC
B FYP ADDED GROUND WIRES 320 & 321 100703 JM
A FIM RELEASED FOR PRODUCTION 061302 MD
REV ECO REVISIONS DATE BY CK'D
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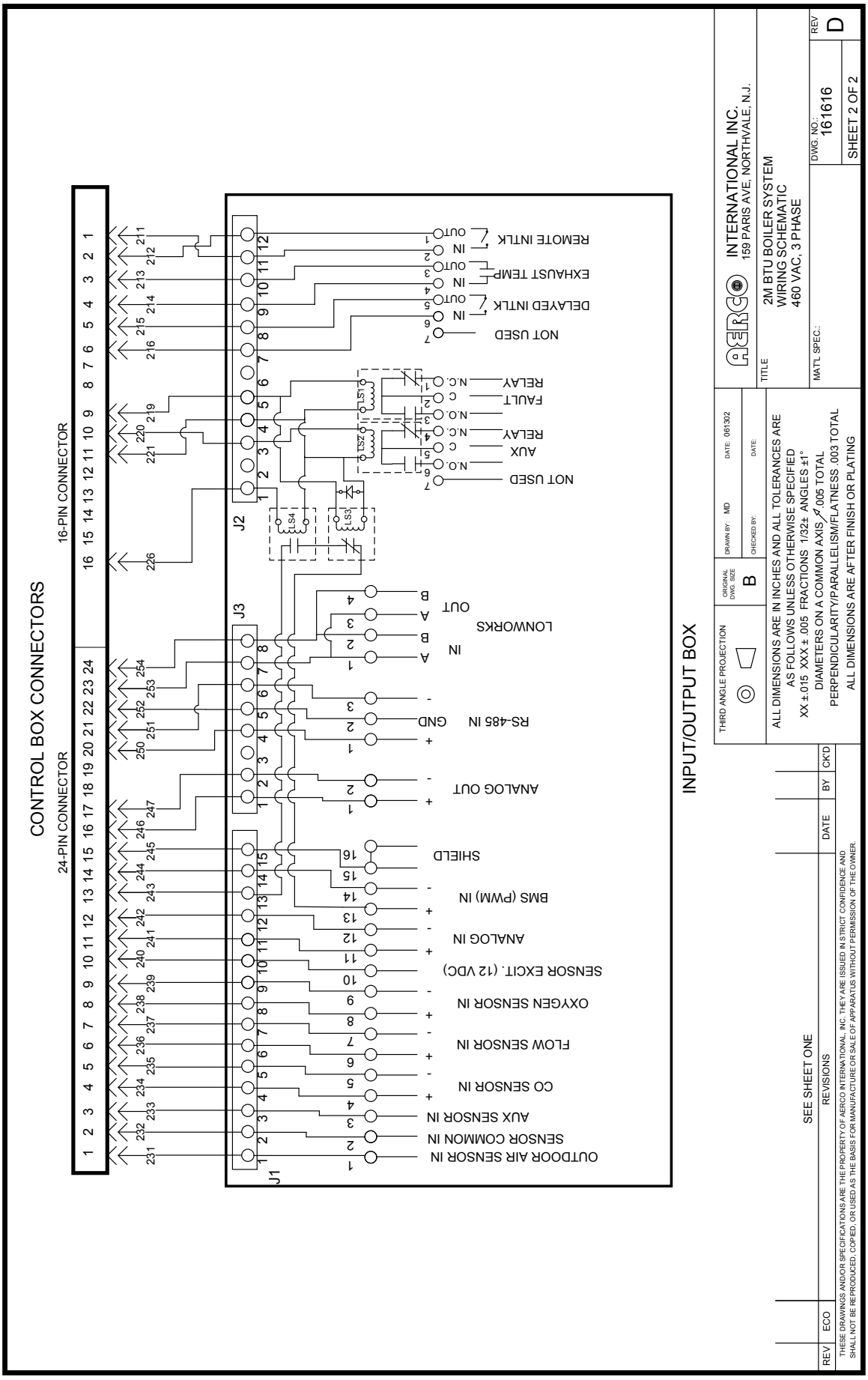
APPENDIX H


CONTROL BOX CONNECTORS
24-PIN CONNECTOR
16-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
RS-485 IN
GND
LONWORKS
IN
OUT
NOT USED
RELAY
AUX
RELAY
FAULT
RELAY
NOT USED
EXHAUST TEMP
DELAYED INTLK
REMOTE INTLK
SEE SHEET ONE
THIRD ANGLE PROJECTION
ORIGINAL DWG. SIZE
B
DRAWN BY: MD
DATE: 061302
CHECKED BY:
DATE:
ALL DIMENSIONS ARE IN INCHES AND ALL TOLERANCES ARE AS FOLLOWS UNLESS OTHERWISE SPECIFIED
XX ±.015 XXX ± .005 FRACTIONS 1/32± ANGLES ±1°
DIAMETERS ON A COMMON AXIS ⌀.005 TOTAL
PERPENDICULARITY/PARALLELISM/FLATNESS .003 TOTAL
ALL DIMENSIONS ARE AFTER FINISH OR PLATING
AERCO INTERNATIONAL INC.
159 PARIS AVE, NORTHVALE, N.J.
TITLE
2M BTU BOILER SYSTEM
WIRING SCHEMATIC
460 VAC, 3 PHASE
MAT'L SPEC.:
DWG. NO.: 161616
REV D
SHEET 2 OF 2
REV
ECO
REVISIONS
DATE
BY
CK'D
THESE DRAWINGS AND/OR SPECIFICATIONS ARE THE PROPERTY OF AERCO INTERNATIONAL, INC. THEY ARE ISSUED IN STRICT CONFIDENCE AND SHALL NOT BE REPRODUCED, COPIED, OR USED AS THE BASIS FOR MANUFACTURE OR SALE OF APPARATUS WITHOUT PERMISSION OF THE OWNER.

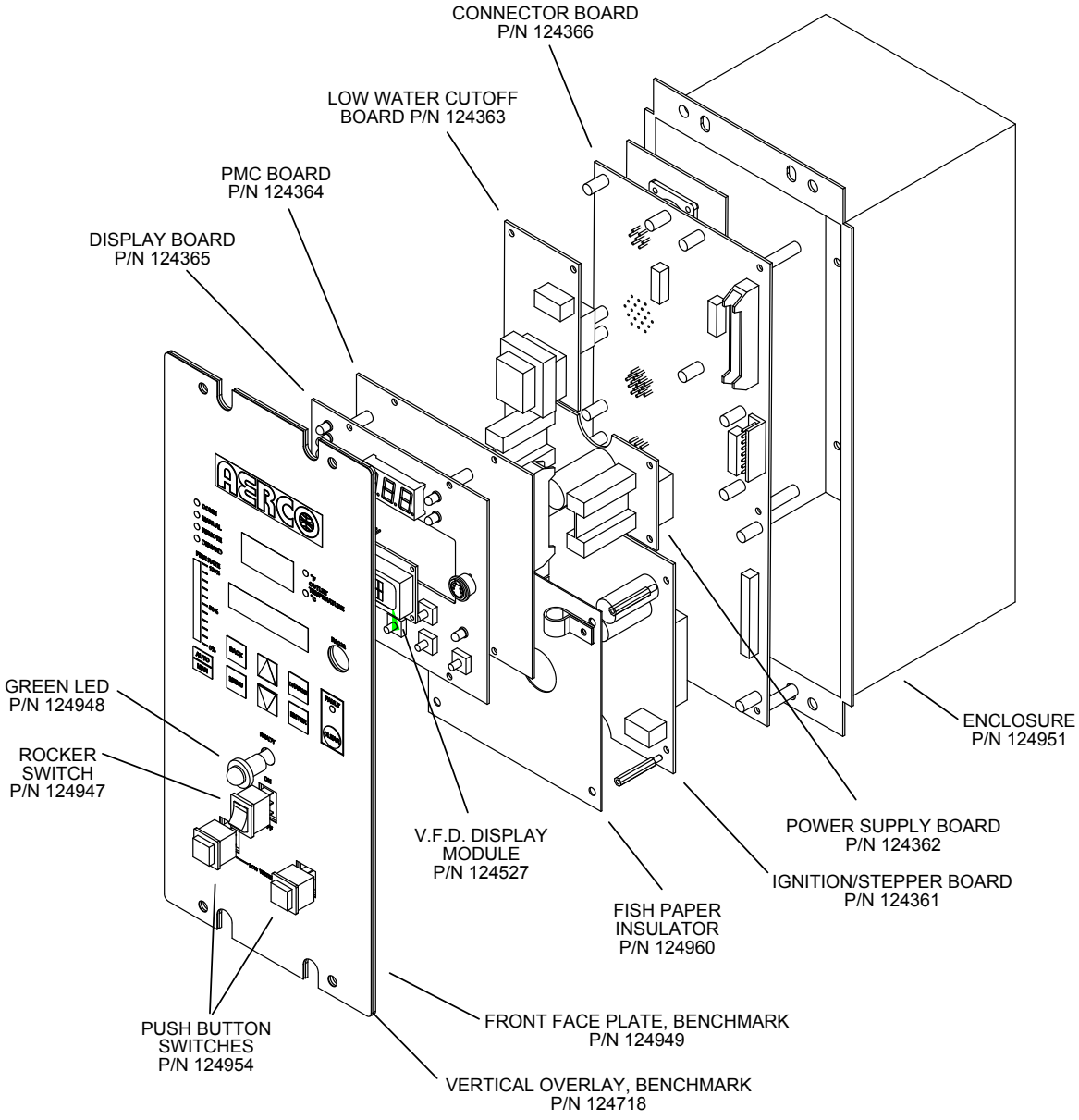
APPENDIX I

RECOMMENDED PERIODIC TESTING CHECK LIST

WARNING

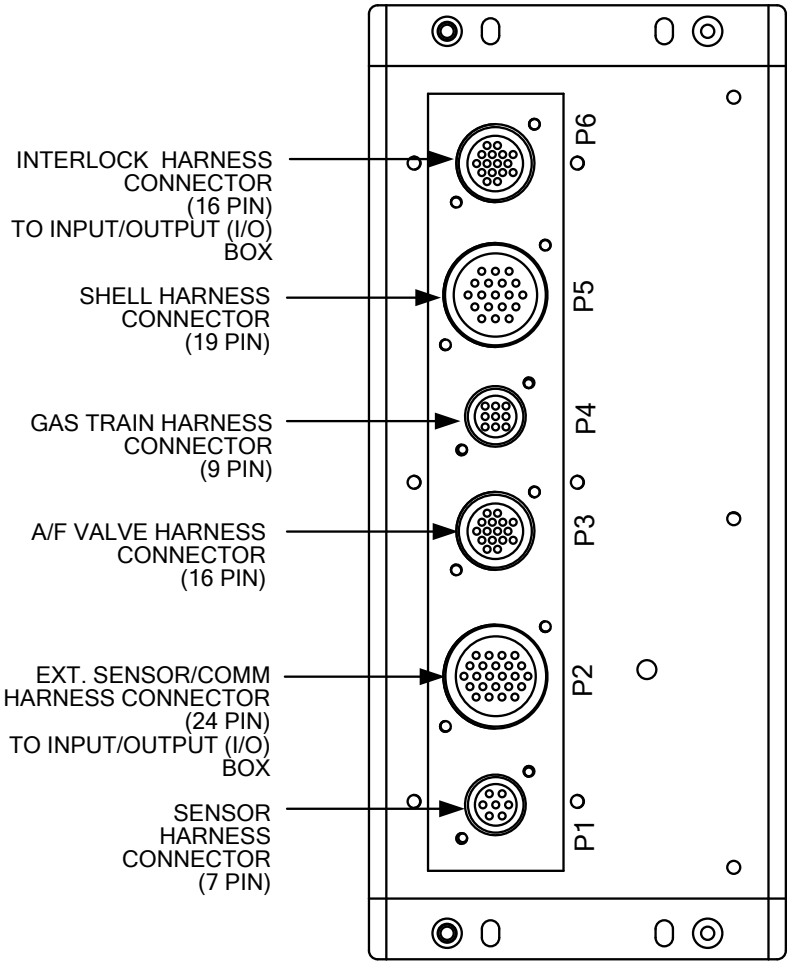
NOTE: Periodic testing of all boiler controls and safety devices is required to determine that they are operating as designed. Precautions shall be taken while tests are being performed to protect against bodily injury and property damage. The owner or user of an automatic boiler system should set up 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
See indicated sections of this manual for detailed procedures			
Gages, monitors and indicators	Daily	Operator	Make visual inspection and record readings in operator log
Instrument and equipment settings	Daily		Make visual check against factory recommended specifications
	Weekly	Operator	Verify factory settings
Firing rate control	Semiannually	Service technician	Verify factory settings
	Annually	Service technician	Check with combustion test equipment- see section 7.4
flue, vent, stack or intake air duct	monthly	Operator	Visual inspection for condition or obstructions
Igniter	Weekly	Operator	see section 7.2
main fuel valve			
valve position	Weekly	Operator	Check position indicator
leakage test	annually	Service technician	Close manual fuel supply valve and test for pressure on down stream valve port
Combustion safety			
flame failure	weekly	Operator	Close manual fuel supply valve check safety shutdown timing
flame signal strength	weekly	Operator	Read signal with meter and log see section 7.3
low water fuel cut off and alarm	weekly	operator	See section 6.3
slow drain test	Semiannually	operator	Perform a slow drain test in accordance with ASME Boiler and Pressure
			Vessel Code section IV
high limit safety control test	annually	Service technician	See section 6.4
operating control	annually	Operator	See section 3.2
low air pressure	monthly	Operator	See section 6.6
high and low gas pressure interlocks	monthly	Operator	See section 6.2
air valve purge position switch	annually	Service technician	See section 6.6
low fire position switch	Annually	Service technician	See section 6.7
safety valves	as required	Operator	As per A.S.M.E. Boiler and Pressure Vessel Code section IV
inspect burner components	Semiannually	Service technician	See section 7.6



BENCHMARK CONTROL PANEL EXPLODED VIEW

APPENDIX J



BENCHMARK CONTROL PANEL REAR VIEW

BENCHMARK DUAL-FUEL
PROPANE SWITCH-OVER INSTRUCTIONS

Prior to operating a Benchmark Dual-Fuel Unit using propane, the Start and Stop levels must be changed to 28% and 24%. In addition, the following valves must be set to the following positions:

- The Diverter Valve handle shown in Figure 1 must be set to the PROPANE (UP) position.
- The Air Injection Valve handle shown in Figure 2 must be set to the Open position.

START/STOP LEVEL CHANGES

The Start and Stop levels are changed using the front panel controls on the C-More Control Box. Proceed as follows:

1. Press the **MENU** key once. *Setup Menu* will be displayed.
2. Press the ▲ arrow key once. *Password* will be displayed.
3. Press the **CHANGE** key. *Password* will begin to flash.
4. Using the ▲ arrow key, increment the display and stop at *6817.*
5. Press the **ENTER** key to store the displayed password.
6. *Password 2* will be displayed, indicating that the valid Level 2 password has been stored.
7. Next, access the *Calibration Menu* by pressing the **MENU** key four times.
8. Press the ▼ arrow key one time. *Start Level 20%* should be displayed indicating that it is currently set for Natural Gas operation.
9. Press the **CHANGE** key. The *Start Level* will begin to flash.
10. Press the ▲ arrow key and increase the *Start Level* to *28%.*
11. Press the **ENTER** key to store the *28% Start Level.*
12. Press the ▼ arrow key again. *Stop Level 16%* should be displayed indicating that it is currently set for Natural Gas operation.
13. Press the **CHANGE** key. The *Stop Level* will begin to flash.
14. Press the ▲ arrow key and increase the *Stop Level* to *24%.*
15. Press the **ENTER** key to store the *24% Stop Level.*
16. Return to the *Operating Menu* by pressing the **BACK** key twice.
17. Refer to Figure 1 and verify that the Diverter Valve handle is set to the PROPANE (UP) position.
18. Refer to Figure 2 and verify that the Air Injection Valve is Open

IMPORTANT

Remember to change the Start/Stop Levels back to 20% and 16% prior to switching back to Natural Gas operation. Also, ensure that the Diverter Valve handle is properly positioned as shown in Figure 1 and the Air Injection Valve shown in Figure 2 is Closed.

APPENDIX K

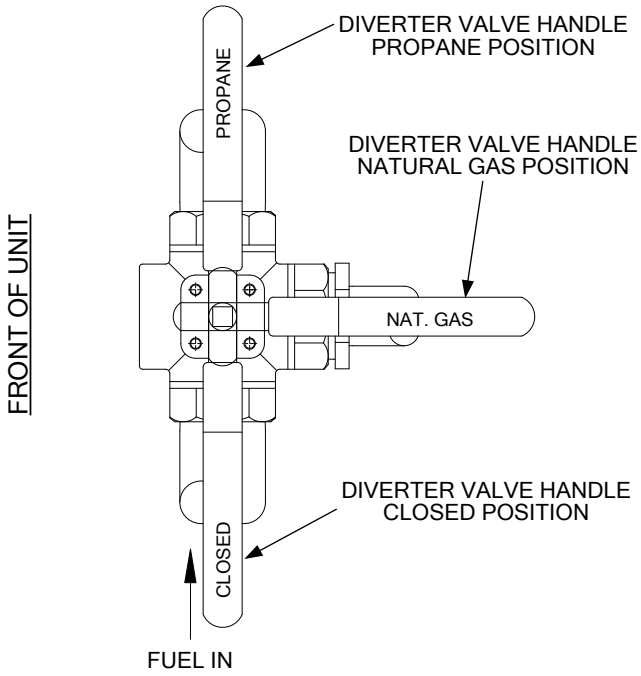
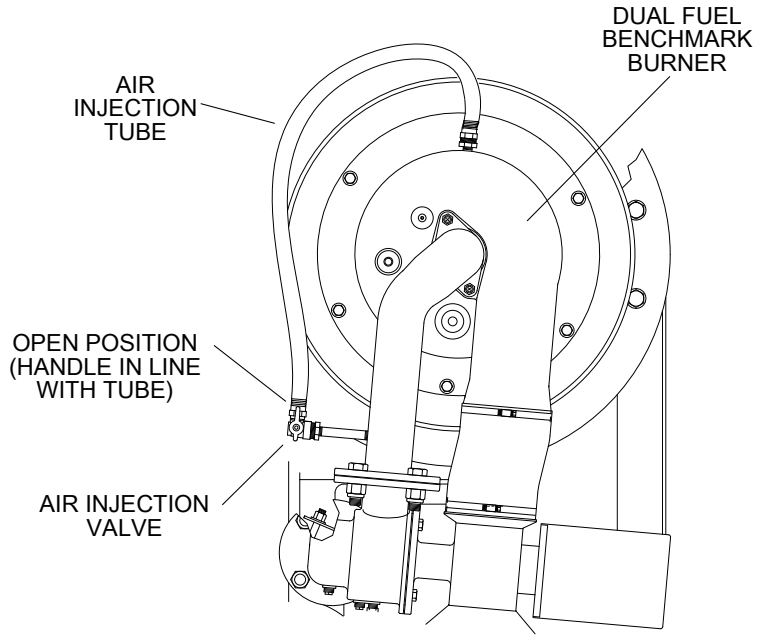


FIGURE 1. DUAL-FUEL DIVERTER VALVE



PARTIAL TOP VIEW SHOWING DUAL FUEL BURNER

FIGURE 2. DUAL-FUEL AIR INJECTION VALVE