

**Benchmark 1500/2000 Dual Fuel & Propane Boilers**  
Installation, Operation & Maintenance Manual



**Propane and Natural Gas  
Modulating & Condensing  
Hot Water Boilers**

**Propane-Only Models:**

- BMK 1500P
- BMK 2000P

**Natural Gas/Propane  
Dual Fuel Models:**

- BMK 1500DF
- BMK 2000DF

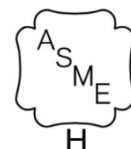
Applicable to Serial Numbers:  
**G-16-0450** and above

**USER MANUAL**  
Installation, Operation and Maintenance

**BENCHMARK  
1500 & 2000  
(PROPANE & DUAL FUEL)  
Gas-Fired Boilers**



**Latest Update: 03/11/2016**



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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## Installation, Operation & Maintenance Manual

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### TABLE OF CONTENTS

FOREWORD .....	7
<b>CHAPTER 1. SAFETY PRECAUTIONS.....</b>	<b>11</b>
1.1 WARNINGS & CAUTIONS .....	11
1.2 EMERGENCY SHUTDOWN.....	12
1.3 PROLONGED SHUTDOWN.....	12
<b>CHAPTER 2. INSTALLATION.....</b>	<b>15</b>
2.1 INTRODUCTION .....	15
2.2 RECEIVING THE UNIT.....	15
2.3 UNPACKING .....	15
2.4 SITE PREPARATION .....	16
2.4.1 Installation Clearances .....	16
2.4.2 Setting the Unit.....	17
2.5 SUPPLY AND RETURN PIPING.....	18
2.6 PRESSURE RELIEF VALVE INSTALLATION.....	19
2.7 CONDENSATE DRAIN & PIPING.....	20
2.8 GAS SUPPLY PIPING .....	21
2.8.1 Gas Supply Specifications.....	22
2.8.2 Manual Gas Shutoff Valve .....	22
2.8.3 External Gas Supply Regulator.....	22
2.9 AC ELECTRICAL POWER WIRING.....	24
2.9.1 Electrical Power Requirements.....	25
2.10 FIELD CONTROL WIRING .....	26
2.10.1 Outdoor Air In (OUT) & Air Sensor Common (COM) .....	27
2.10.2 AIR TEMP SENSOR Terminals.....	27
2.10.3 O <sub>2</sub> SENSOR (O <sub>2</sub> + & O <sub>2</sub> -).....	28
2.10.4 SPARK SIGNAL Terminals.....	28
2.10.5 ANALOG IN Terminals .....	28
2.10.6 VALVE FEEDBACK Terminals .....	28
2.10.7 SHIELD Terminals .....	29
2.10.8 ANALOG OUT Terminals.....	29
2.10.9 RS485 Comm (+, GND, & -).....	29
2.10.10 RS232 Comm (TxD & RxD) .....	29
2.10.11 VFD/Blower (0-10 & AGND).....	29
2.10.12 Interlocks.....	29
2.10.13 Fault Relay (NC, COM, & NO).....	30
2.10.14 Auxiliary Relay Contacts (NC, COM, & NO).....	30
2.11 FLUE GAS VENT INSTALLATION.....	30
2.12 COMBUSTION AIR.....	31
2.13 DUCTED COMBUSTION AIR.....	31
2.14 SEQUENCING ISOLATION VALVE INSTALLATION .....	32
<b>CHAPTER 3. OPERATION.....</b>	<b>35</b>
3.1 INTRODUCTION .....	35
3.2 CONTROL PANEL DESCRIPTION.....	35
3.3 CONTROL PANEL MENUS.....	39
3.3.1 Menu Processing Procedure.....	39
3.4 OPERATING MENU .....	41
3.5 SETUP MENU .....	42

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## Installation, Operation & Maintenance Manual

3.6 CONFIGURATION MENU .....	42
3.7 TUNING MENU .....	45
3.8 COMBUSTION CAL MENU .....	45
3.9 BST (BOILER SEQUENCING TECHNOLOGY) MENU .....	46
3.10 START SEQUENCE .....	48
3.11 START/STOP LEVELS .....	52
<b>CHAPTER 4. INITIAL START-UP .....</b>	<b>53</b>
4.1 INITIAL START-UP REQUIREMENTS .....	53
4.2 TOOLS AND INSTRUMENTATION FOR COMBUSTION CALIBRATION .....	53
4.2.1 Required Tools & Instrumentation .....	53
4.2.2 Installing Gas Supply Manometer .....	54
4.2.3 Accessing the Analyzer Probe Port .....	55
4.3 NATURAL GAS COMBUSTION CALIBRATION .....	56
4.4 PROPANE COMBUSTION CALIBRATION .....	60
4.5 REASSEMBLY AFTER COMBUSTION CALIBRATION .....	63
4.6 DUAL-FUEL SWITCHOVER INSTRUCTIONS .....	64
4.6.1 Switchover from NATURAL GAS to PROPANE .....	64
4.6.2 Switchover from PROPANE to NATURAL GAS .....	65
4.7 OVER-TEMPERATURE LIMIT SWITCHES .....	66
4.7.1 Digital Alarm Switch Checks and Adjustments .....	67
<b>CHAPTER 5. MODE OF OPERATION .....</b>	<b>69</b>
5.1 INTRODUCTION .....	69
5.2 INDOOR/OUTDOOR RESET MODE .....	69
5.2.1 Reset Ratio .....	69
5.2.2 Building Reference Temperature .....	69
5.2.3 Outdoor Air Temperature Sensor Installation .....	69
5.2.4 Indoor/Outdoor Startup .....	69
5.3 CONSTANT SETPOINT MODE .....	70
5.3.1 Setting the Setpoint .....	70
5.4 REMOTE SETPOINT MODES .....	71
5.4.1 Remote Setpoint Field Wiring .....	71
5.4.2 Remote Setpoint Startup .....	72
5.5 DIRECT DRIVE MODES .....	72
5.5.1 Direct Drive Field Wiring .....	73
5.5.2 Direct Drive Startup .....	73
5.6 AERCO CONTROL SYSTEM (ACS) .....	73
5.6.1 ACS External Field Wiring .....	74
5.6.2 ACS Setup and Startup .....	74
5.7 COMBINATION CONTROL SYSTEM (CCS) .....	74
5.7.1 Combination Control System Field Wiring .....	75
5.7.2 Combination Control System Setup and Startup .....	75
<b>CHAPTER 6. SAFETY DEVICE TESTING .....</b>	<b>77</b>
6.1 TESTING OF SAFETY DEVICES .....	77
6.2 LOW GAS PRESSURE FAULT TEST .....	78
6.3 HIGH GAS PRESSURE TEST .....	79
6.4 LOW WATER LEVEL FAULT TEST .....	80
6.5 WATER TEMPERATURE FAULT TEST .....	81
6.6 INTERLOCK TESTS .....	82
6.6.1 Remote Interlock Test .....	82
6.6.2 Delayed Interlock Test .....	83

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## Installation, Operation & Maintenance Manual

6.7 FLAME FAULT TESTS .....	83
6.8 AIR FLOW FAULT TESTS .....	85
6.8.1 Blower Proof Switch Test .....	85
6.8.2 Blocked Inlet Switch Test.....	85
6.9 SSOV PROOF OF CLOSURE SWITCH.....	87
6.10 PURGE SWITCH OPEN DURING PURGE .....	88
6.11 IGNITION SWITCH OPEN DURING IGNITION.....	89
6.12 SAFETY PRESSURE RELIEF VALVE TEST .....	90
<b>CHAPTER 7. MAINTENANCE .....</b>	<b>91</b>
7.1 MAINTENANCE SCHEDULE.....	91
7.2 IGNITER-INJECTOR .....	92
7.3 FLAME DETECTOR.....	94
7.4 O <sub>2</sub> SENSOR .....	95
7.5 SAFETY DEVICE TESTING .....	95
7.6 BURNER ASSEMBLY INSPECTION .....	96
7.7 CONDENSATE DRAIN TRAP.....	100
7.8 AIR FILTER CLEANING & REPLACEMENT .....	101
7.9 WATER CUTOFF (LWCO) CAPACITOR INTEGRITY TEST.....	102
7.9.1 Low Water Cutoff (LWCO) - Capacitor Electrical Short Test .....	102
7.9.2 Low Water Cutoff (LWCO) - Standard C-More Test .....	104
7.10 SHUTTING THE BOILER DOWN FOR AN EXTENDED PERIOD OF TIME .....	104
7.11 PLACING THE BOILER BACK IN SERVICE AFTER A PROLONGED SHUTDOWN.....	105
7.12 SPARK MONITOR (AC CURRENT TRANSDUCER).....	105
<b>CHAPTER 8. TROUBLESHOOTING GUIDE.....</b>	<b>107</b>
8.1 INTRODUCTION .....	107
8.2 ADDITIONAL FAULTS WITHOUT SPECIFIC FAULT MESSAGES .....	119
<b>CHAPTER 9. BOILER SEQUENCING TECHNOLOGY .....</b>	<b>121</b>
9.1 INTRODUCTION .....	121
9.1.1 Installation Notes.....	122
9.2 AERCO BST QUICK START CHART .....	123
9.3 BST IMPLEMENTATION INSTRUCTION .....	124
9.3.1 Option 1 - Constant Setpoint with DIRECT Wired Header Sensor.....	124
9.3.2 Option 2 - Constant Setpoint with MODBUS Wired Header Sensor .....	125
9.3.3 Option 3 - Outdoor Reset with DIRECT WIRED Header Sensor AND DIRECT WIRED Outdoor Sensor .....	126
9.3.4 Option 4 - Outdoor Reset with MODBUS Header Sensor AND MODBUS Outdoor Sensor.....	128
9.3.5 Option 5 - Remote Setpoint with DIRECT WIRED Header Sensor AND 4-20ma Setpoint Drive .....	130
9.3.6 Option 6 - Remote Setpoint with DIRECT WIRED Header Sensor AND MODBUS Setpoint Drive.....	131
9.3.7 Option 7 - Remote Setpoint with MODBUS Header Sensor AND 4-20ma Setpoint Drive .....	132
9.3.8 Option 8 - Remote Setpoint with MODBUS Header Sensor AND MODBUS Setpoint Drive.....	134
<b>APPENDIX A: BOILER MENU ITEM DESCRIPTIONS .....</b>	<b>135</b>
TABLE A-1: OPERATING MENU ITEM DESCRIPTIONS .....	135
TABLE A-2: SETUP MENU ITEM DESCRIPTIONS .....	136
TABLE A-3: CONFIGURATION MENU ITEM DESCRIPTIONS.....	137
TABLE A-4: TUNING MENU ITEM DESCRIPTIONS .....	140
TABLE A-5: COMBUSTION CALIBRATION MENU ITEM DESCRIPTIONS .....	141
<b>APPENDIX B: STARTUP, STATUS &amp; DISPLAY MESSAGES .....</b>	<b>143</b>
<b>APPENDIX C: SENSOR RESISTANCE/VOLTAGE CHART .....</b>	<b>147</b>
<b>APPENDIX D: RECOMMENDED PERIODIC TESTING .....</b>	<b>149</b>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## Installation, Operation & Maintenance Manual

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<b>APPENDIX E: INDOOR/OUTDOOR RESET RATIO CHARTS.....</b>	<b>151</b>
<b>APPENDIX F: DIMENSIONAL AND CLEARANCE DRAWINGS.....</b>	<b>155</b>
<b>APPENDIX G: PART DRAWINGS.....</b>	<b>157</b>
<b>APPENDIX H: WIRING DIAGRAMS.....</b>	<b>171</b>
<b>APPENDIX I: PIPING DRAWINGS.....</b>	<b>179</b>
<b>APPENDIX J: C-MORE CONTROL PANEL VIEWS.....</b>	<b>185</b>
<b>APPENDIX K: RECOMMENDED SPARES .....</b>	<b>187</b>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## FORWARD

### FOREWORD

The AERCO Benchmark (BMK) 1500 and 2000 MBH boilers are modulating and condensing units. They represent a true industry advance that meets the needs of today's energy and environmental concerns. Designed for application in any closed loop hydronic system, the Benchmark's modulating capability relates energy input directly to fluctuating system loads. The turn down ratios for these boilers is 20:1. These BMK models provide extremely high efficiency operation and are ideally suited for modern low temperature, as well as, conventional heating systems.

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

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

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

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

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

Whether used in singular or modular arrangements, the BMK 2500DF and 3000DF Dual Fuel boilers offer the maximum venting flexibility with minimum installation space requirements. These Boilers are Category II, III and IV, positive pressure appliances. Single and/or multiple breeched units are capable of operation in the following vent configurations:

- Conventional, Vertical
- Conventional, Sidewall
- Conventional, Direct Vent, Vertical
- Sealed, Direct Vent, Horizontal

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

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

### IMPORTANT

Unless otherwise specified, all descriptions and procedures provided in this Installation, Operation & Maintenance Manual apply to the Benchmark series of boilers in Dual Fuel (natural gas and propane) or propane-only configurations.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

FORWARD

## *Phrases, Abbreviations and Acronyms*

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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## FORWARD

Phrase, Abbreviation or Acronym	Meaning
HDR	Header
Hex	Hexadecimal Number (0 – 9, A – F)
HP	Horse Power
HX	Heat Exchanger
Hz	Hertz (Cycles Per Second)
I.D.	Inside Diameter
IGN	Ignition
IGST Board	Ignition/Stepper Board, contained in C-More Control Box
INTLK (INTL'K)	Interlock
I/O	Input/Output
I/O Box	Input/Output (I/O) Box currently used on Benchmark, Innovation and KC1000 Series products
IP	Internet Protocol
ISO	International Organization for Standardization
Lbs.	Pounds
LED	Light Emitting Diode
LN	Low Nitrogen Oxide
MA (mA)	Milliampere (1 thousand <sup>th</sup> of an ampere)
MAX (Max)	Maximum
MBH	1000 BTUs per Hour
MIN (Min)	Minimum
Modbus®	A serial, half-duplex data transmission protocol developed by AEG Modicon
NC (N.C.)	Normally Closed
NO (N.O.)	Normally Open
NOx	Nitrogen Oxide
NPT	National Pipe Thread
O <sub>2</sub>	Oxygen
O.D.	Outside Diameter
OMM & O&M	Operation and Maintenance Manual
OnAER	AERCO's on-line remote monitoring system
PCB	Printed Circuit Board
PMC Board	Primary Micro-Controller (PMC) board, contained in the C-More
P/N	Part Number
PPM	Parts per Million
PSI	Pounds per Square Inch
PTP	Point-to-Point (usually over RS232 networks)
P&T	Pressure and Temperature
ProtoNode	Hardware interface between BAS and a boiler or water heater
PVC	Poly Vinyl Chloride, a common synthetic plastic
PWM	Pulse Width Modulation
REF (Ref)	Reference

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## FORWARD

Phrase, Abbreviation or Acronym	Meaning
RES.	Resistive
RS232 (or EIA-232)	A standard for serial, full-duplex (FDX) transmission of data based on the RS232 Standard
RS422 (or EIA-422)	A standard for serial, full-duplex (FDX) transmission of data based on the RS422 Standard
RS485 (or EIA-485)	A standard for serial, half-duplex (HDX) transmission of data based on the RS485 Standard
RTN (Rtn)	Return
SETPT (Setpt)	Setpoint Temperature
SHLD (Shld)	Shield
SPDT	Single Pole Double Throw, a type of switch
SSOV	Safety Shut Off Valve
TEMP (Temp)	Temperature
Terminating Resistor	A resistor placed at each end of a daisy-chain or multi-drop network in order to prevent reflections that may cause invalid data in the communication
Tip-N-Tell	A device that indicates if a package was tipped during shipping
UL	A business that tests and validates products
VAC	Volts, Alternating Current
VDC	Volts, Direct Current
VFD	Vacuum Fluorescent Display, also Variable Frequency Drive
W	Watt
W.C.	Water Column, a unit of pressure
μA	Micro amp (1 million <sup>th</sup> of an ampere)

### CHAPTER 1. SAFETY PRECAUTIONS

#### 1.1 WARNINGS & CAUTIONS

Installers and operating personnel MUST, at all times, observe all safety regulations. The following warnings and cautions are general and must be given the same attention as specific precautions included in these instructions. In addition to all the requirements included in this AERCO Instruction Manual, the installation of units MUST conform with local building codes, or, in the absence of local codes, ANSI Z223.1 (National Fuel Gas Code Publication No. NFPA-54) for gas-fired boilers and ANSI/NFPASB for LP gas-fired boilers. Where applicable, the equipment shall be installed in accordance with the current Installation Code for Gas Burning Appliances and Equipment, CSA B149.1, and applicable Provincial regulations for the class; which should be carefully followed in all cases. Authorities having jurisdiction should be consulted before installations are made.

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

#### IMPORTANT

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

#### **WARNINGS!**

- Do not use matches, candles, flames, or other sources of ignition to check for gas leaks.
- Fluids under pressure may cause injury to personnel or damage to equipment when released. Be sure to shut off all incoming and outgoing water shutoff valves. Carefully decrease all trapped pressures to zero before performing maintenance.
- Before attempting to perform any maintenance on the unit, shut off all gas and electrical inputs to the unit.
- The exhaust vent pipe of the unit operates under a positive pressure and therefore must be completely sealed to prevent leakage of combustion products into living spaces.
- Electrical voltages up to 120 VAC may be used in this equipment. Therefore the cover on the unit's power box (located behind the front panel door) must be installed at all times, except during maintenance and servicing.
- A three-pole switch must be installed on the electrical supply line of the unit. The switch must be installed in an easily accessible position to quickly and safely disconnect electrical service. Do not affix switch to unit sheet metal enclosures.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 1 – SAFETY PRECAUTIONS

### CAUTION

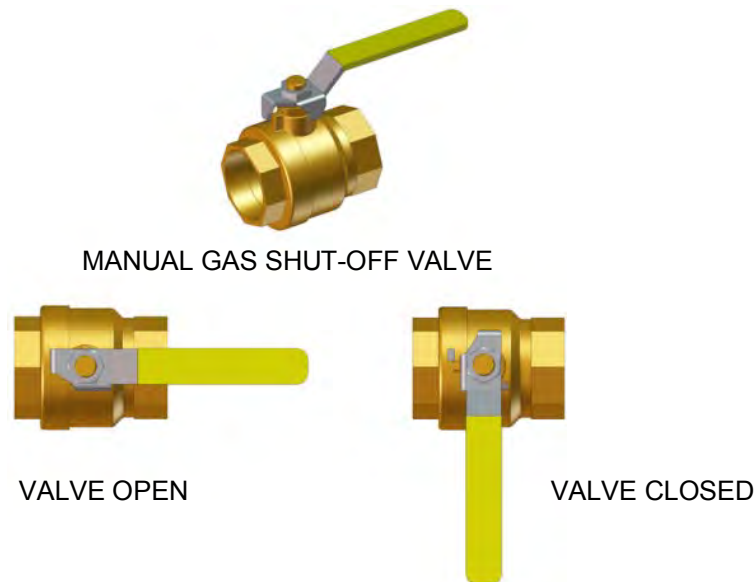
- Many kinds of soap used for gas pipe leak testing are corrosive to metals. The piping must be rinsed thoroughly with clean water after leak checks have been completed.
- DO NOT use this boiler if any part has been under water. Call a qualified service technician to inspect and replace any part that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

## 1.2 EMERGENCY SHUTDOWN

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

### NOTE

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



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

## 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.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 1 – SAFETY PRECAUTIONS

### IMPORTANT – FOR MASSACHUSETTS INSTALLATIONS

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

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

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

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

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

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

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

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

(Continued)

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 1 – SAFETY PRECAUTIONS

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(Continued)

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.

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

## CHAPTER 2. INSTALLATION

### 2.1 INTRODUCTION

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

### 2.2 RECEIVING THE UNIT

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

#### NOTE

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

### 2.3 UNPACKING

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

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

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

- Pressure/Temperature Gauge
- ASME Pressure Relief Valve
- Condensate Drain Trap (P/N **24060**)
- 2" Natural Gas and/or 1" Propane Gas Supply Shutoff Valve

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### 2.4 SITE PREPARATION

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

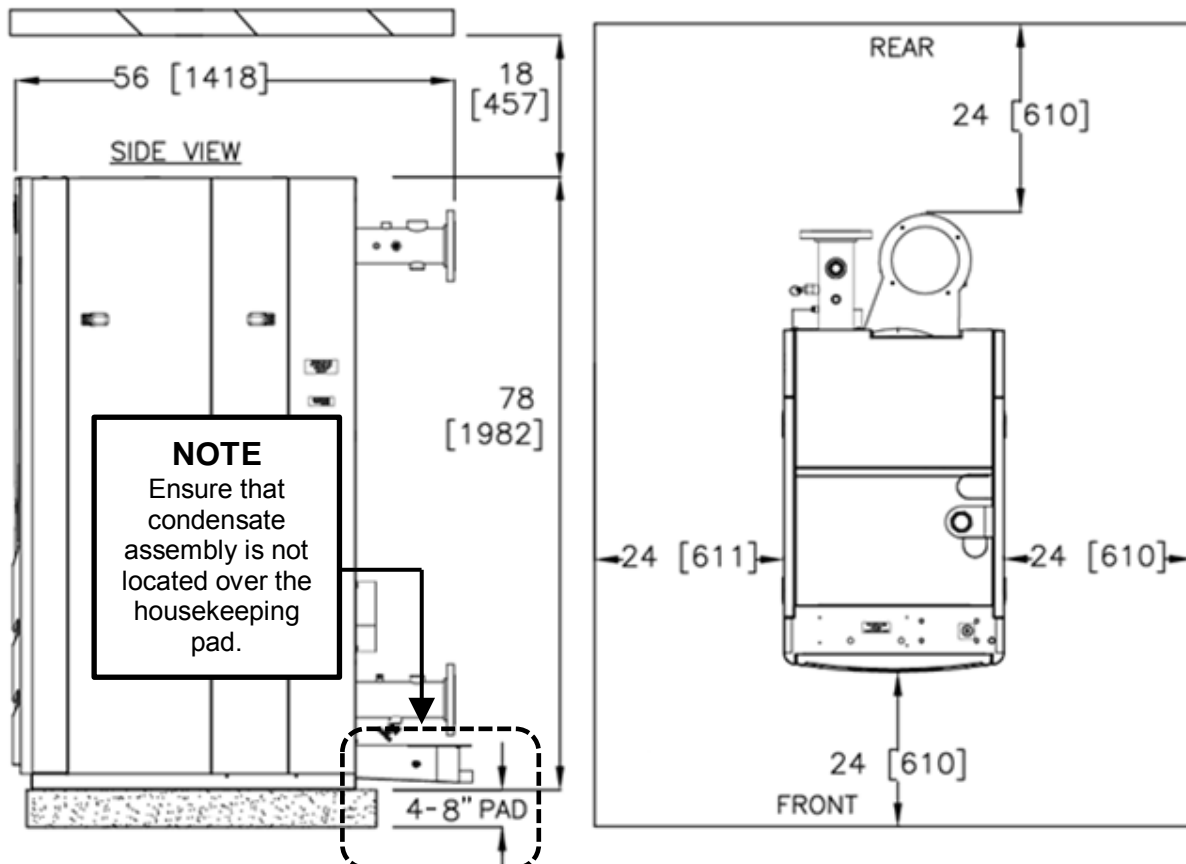
- Access to AC Input Power at 120 VAC, Single-Phase, 60 Hz @ 20 Amps
- Access to a Natural Gas gas line at a **minimum pressure of:**
  - **6.0" W.C. at gas flow of 1,500,000 BTU/hr.** energy input for the **BMK 1500**
  - **8.5" W.C. at gas flow of 2,000,000 BTU/hr.** energy input for the **BMK 2000.**
- Access to a Propane gas line at a **minimum pressure of 4.0" W.C.** for both BMK 1500 & BMK 2000.

#### 2.4.1 Installation Clearances

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

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

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



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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### WARNING!

Keep the unit area clear and free from all combustible materials and flammable vapors or liquids.

### CAUTION

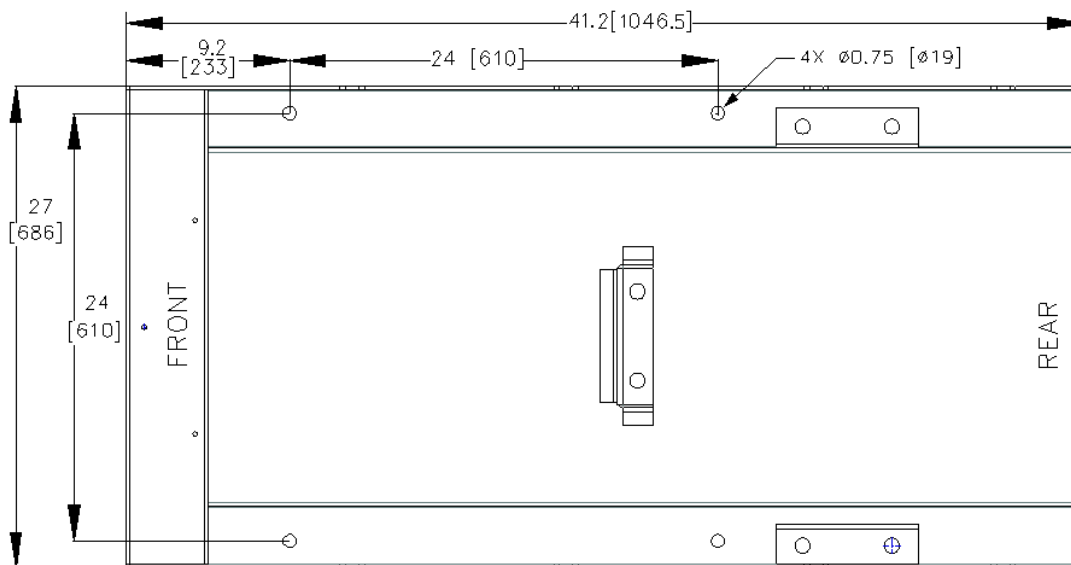
While packaged in the shipping container, the unit must be moved by pallet jack or forklift from the FRONT ONLY.

### FOR MASSACHUSETTS ONLY:

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

## 2.4.2 Setting the Unit

The unit must be installed on a 4 inch to 8 inch concrete housekeeping pad to ensure proper condensate drainage. Ensure that the condensate assembly at the rear of the unit is not positioned above the housekeeping pad during installation so as not to interference with condensate piping. If anchoring the unit, refer to Figure 2-1b for anchor locations.



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

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

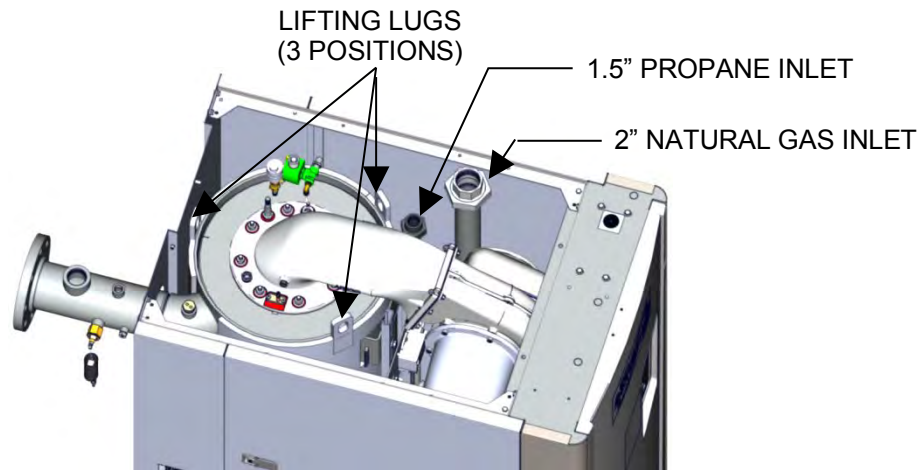
Remove the four (4) lag screws securing the unit to the shipping skid. Lift the unit off the shipping skid and position it on the 4 to 6 inch concrete housekeeping pad (required) in the desired location.

### WARNING!

When lifting or moving the boiler, **do not** attempt to manipulate the boiler using the gas train or blower.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION



**Figure 2-2: Boiler Lifting Provisions**

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

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

## 2.5 SUPPLY AND RETURN PIPING

Benchmark 1500 and 2000 Boilers have 4" 150# flanges for the water system supply and return piping connections. The physical location of the supply and return piping connections are on the rear of the unit as shown in Figure 2-3. Refer to Appendix F for dimensional data.

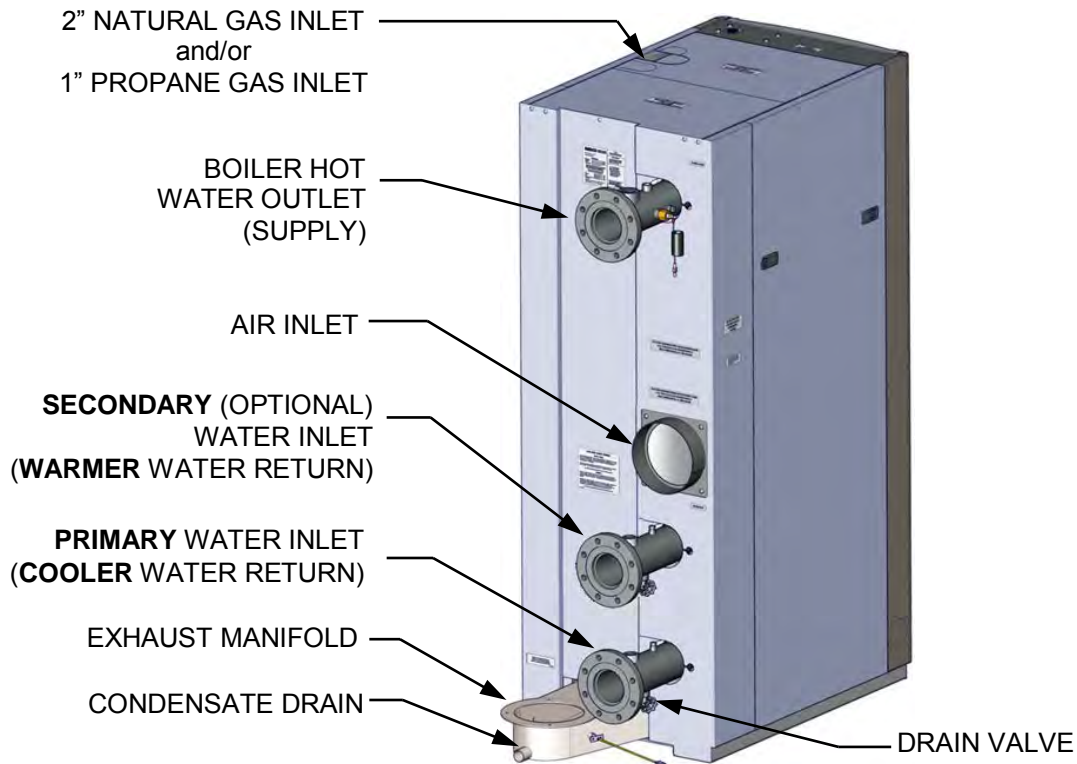
When connecting the hot water outlet and cold water inlet to building piping, first make sure the mating surfaces are thoroughly clean. AERCO recommends using Loctite® 7649 to prime the mating surfaces and then Loctite 567 as pipe dope. Do *NOT* use Teflon tape.

The optional dual inlet connections (available by Summer 2016) allow these units to be configured with a separate cooler return temperature zone, rather than blending high and low return temperature zones. Utilizing the dual return capability, these boilers can take further advantage of the condensing capabilities. When configured with a lower return temperature zone or AERCO SmartPlates, thermal efficiency can improve by up to 6% (Based on an 80°F minimum return water temperature at full fire. Lower return temperatures are possible which would yield even greater efficiency gains. The maximum temperature differential across the boiler heat exchanger is 100°F.)

To use the secondary inlet, pipe the **warmer** return water to the **secondary** (upper) inlet and the **cooler** return water to the **primary** (lower) inlet. If the flow through both the primary and the secondary return is constant, then the combined minimum flows must equal the specified minimum flow of the boiler. If the flow through either of the inlet returns is intermittent, then the minimum flow through one of the return connections must always equal the specified minimum flow of the boiler. Contact your AERCO representative for additional information.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

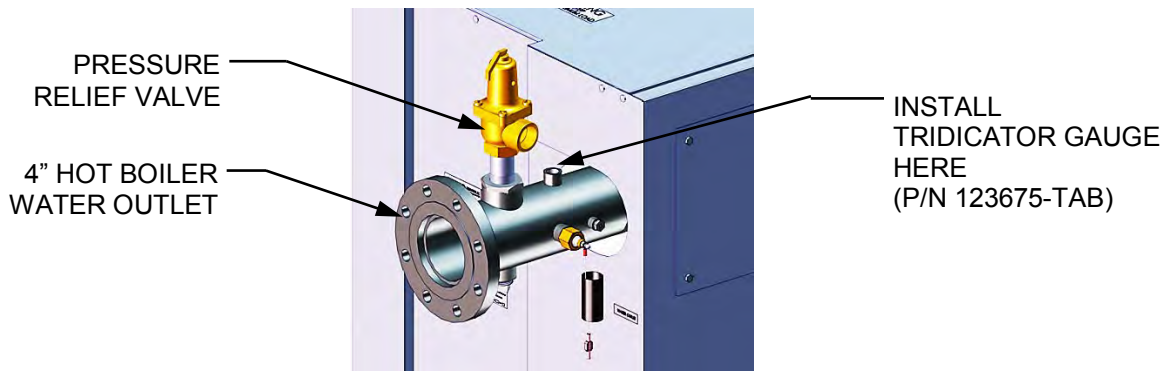
## CHAPTER 3 – OPERATION



**Figure 2-3: Supply and Return Locations**

## 2.6 PRESSURE RELIEF VALVE INSTALLATION

An ASME rated Pressure Relief Valve is supplied with each Benchmark Boiler. The pressure rating for the relief valve must be specified on the sales order. Available pressure ratings range from 30 psi to 160 psi. The relief valve is installed on the hot water outlet of the boiler as shown in Figure 2-4. A suitable pipe joint compound should be used on the threaded connections. Any excess should be wiped off to avoid getting any joint compound into the valve body. The relief valve must be piped to within 12 inches of the floor to prevent injury in the event of a discharge. No valves, restrictions, or other blockages are allowed in the discharge line. In multiple unit installations the discharge lines must ***NOT*** be manifolded together. Each must be individually run to a suitable discharge location.



**Figure 2-4: P&T Relief Valve Location**

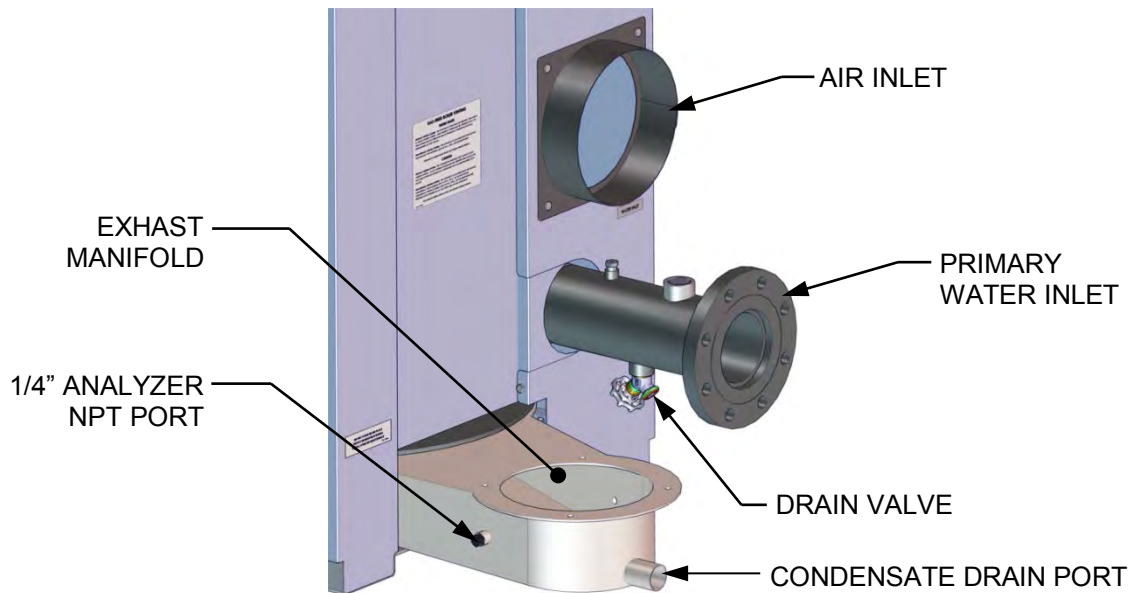
# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### 2.7 CONDENSATE DRAIN & PIPING

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

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



**Figure 2-5: Condensate Drain Connection Location**

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

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

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

#### Condensate Trap Installation

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

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### WARNING!

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

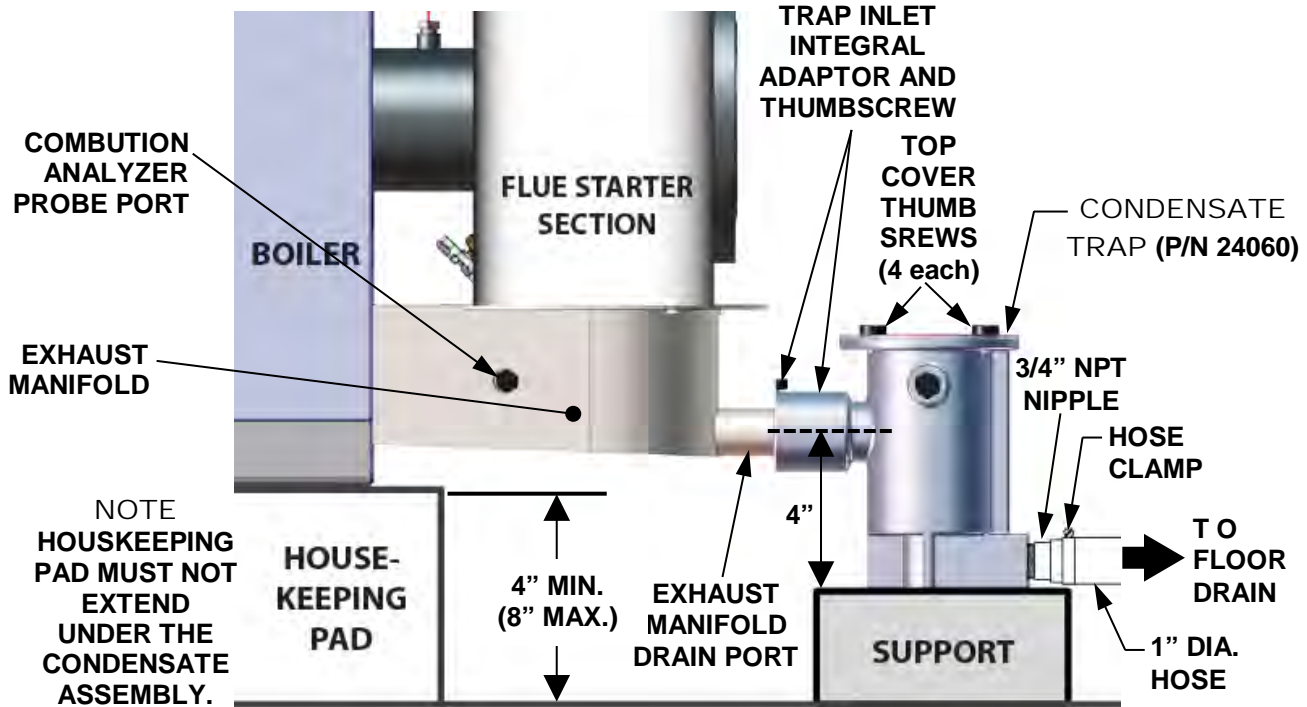


Figure 2-6: Sample Condensate Trap Installation (Right Side View)

## 2.8 GAS SUPPLY PIPING

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

### WARNING!

Never use matches, candles, flames or other sources of ignition to check for gas leaks.

### CAUTION

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

### NOTE

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

Benchmark 1500 and 2000 units contain a 2 inch NATURAL GAS inlet connection, and a 1 inch PROPANE gas connection on the top of the unit, as shown in Figures 2-2 and 2-3.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

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

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

To avoid unit damage when pressure testing gas piping, the unit must be isolated from the gas supply piping. **The gas pressure applied to the unit must never exceed 14" W.C.** A thorough leak test of all external piping must be performed using a soap and water solution or suitable equivalent. The gas piping used must meet all applicable codes.

### 2.8.1 Gas Supply Specifications

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

- The maximum static pressure to the unit **must not exceed 14" W.C.**
- Supply piping and pressure to the unit must be sufficient to provide 2000 CFH volume of gas while maintaining the following gas pressures **while operating at maximum capacity**:
  - **6" W.C. NATURAL GAS** – BMK 1500
  - **8.5" W.C. NATURAL GAS** – BMK 2000
  - **4.0" W.C. PROPANE** – BMK 1500 & BMK 2000

### 2.8.2 Manual Gas Shutoff Valve

A manual shut-off valve must be installed on both natural gas and propane gas supply lines upstream of the boiler as shown in Figure 2-7. **Maximum allowable gas pressure to the boiler is 14" W.C.**

### 2.8.3 External Gas Supply Regulator

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

- **NATURAL GAS:** The external natural gas regulator must be capable of regulating 100,000 – 2,120,000 BTU/HR of natural gas while maintaining a minimum gas pressure of **6.0" W.C.** (BMK 1500) or **8.5" W.C.** (BMK 2000).
- **PROPANE GAS:** The external propane gas regulator must be capable of regulating **100,000 – 2,120,000** BTU/HR of propane gas while maintaining a gas pressure of **4.0" W.C.** (both BMK 1500 BMK 2000) minimum to the unit
- A lock-up style regulator **MUST** be used when gas supply pressure will **exceed 14" W.C.**

#### 2.8.3.1 Massachusetts Installations Only

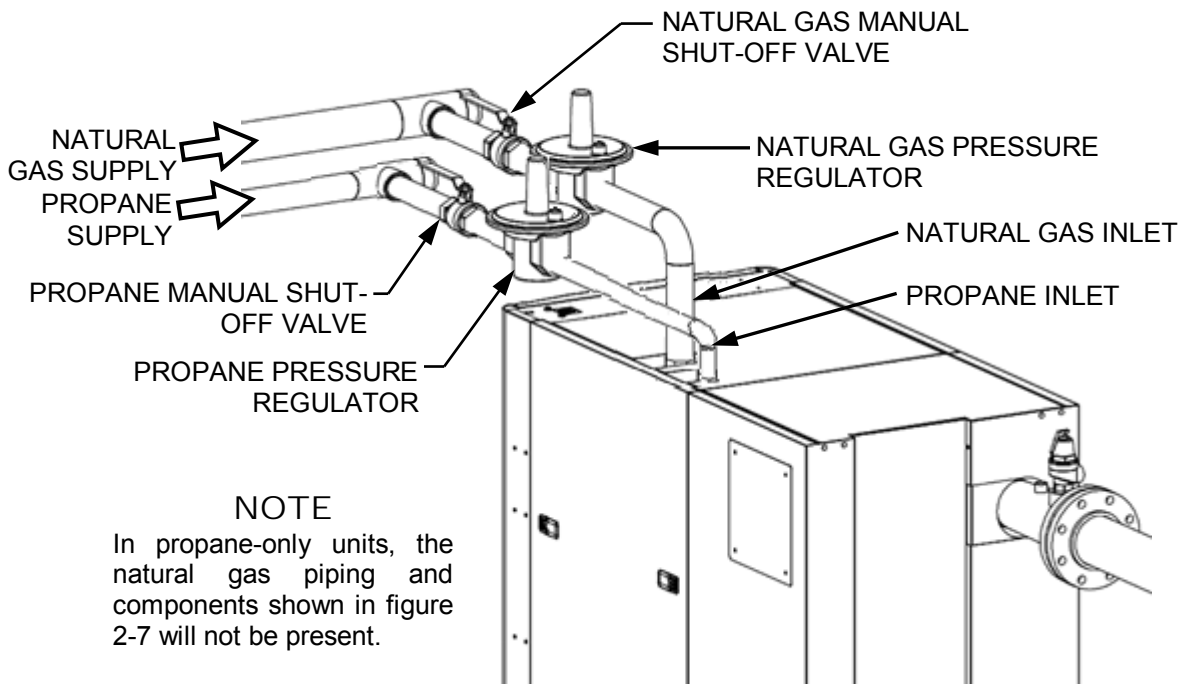
For Massachusetts installations, a mandatory external gas supply regulator must be positioned as shown in Figure 2-7. The gas supply regulator must be properly vented to outdoors. Consult the local gas utility for detailed requirements concerning venting of the supply gas regulator.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### 2.8.3.2 All Installations (Except Massachusetts)

For installations with 3 or more units (other than Massachusetts) that **EXCEED 7" W.C.** gas pressure, a separate external gas supply regulator, as shown in Figure 2-7, is highly recommended. No regulator is required for gas pressures **below 7" W.C.** of pressure. Consult the local gas utility for detailed requirements concerning venting of the supply gas regulator.



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

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

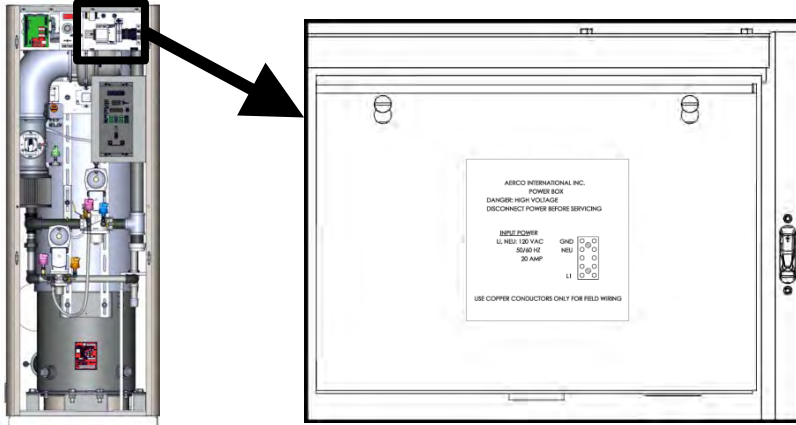


# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### 2.9 AC ELECTRICAL POWER WIRING

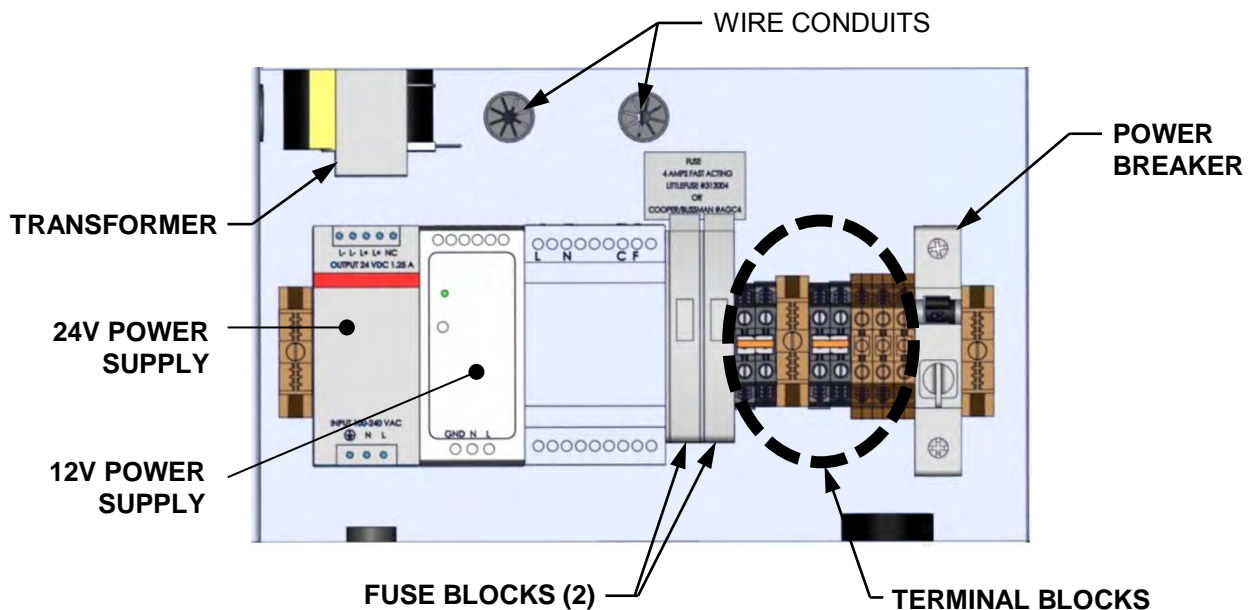
The AERCO Benchmark Electrical Power Wiring Guide, GF-2060, must be consulted prior to connecting any AC power wiring to the unit. External AC power connections are made to the unit inside the Power Box on the front of the unit. Remove the front panel to access the Power Box, which is mounted in the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



**Figure 2-8: Power Box Location with Cover Closed**

**WARNING!**

The power breaker shown in figure 2-9 does **NOT** remove power from the terminal blocks.



**Figure 2-9: Power Box Internal Components**

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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### NOTE

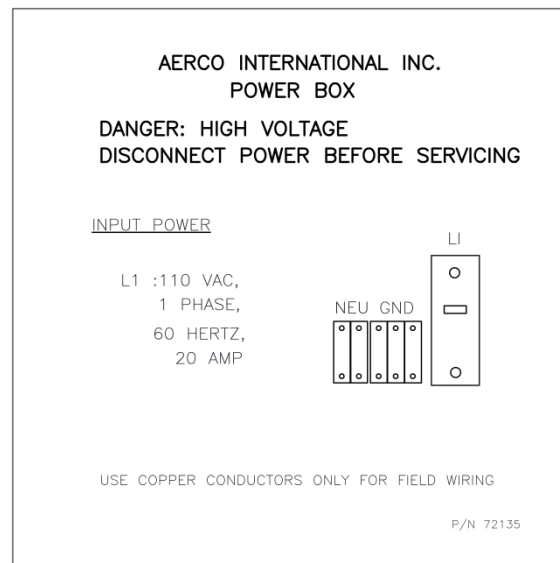
All electrical conduit and hardware must be installed so that it does not interfere with the removal of any unit covers, inhibit service/maintenance, or prevent access between the unit and walls or another unit.

### 2.9.1 Electrical Power Requirements

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

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

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



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

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

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

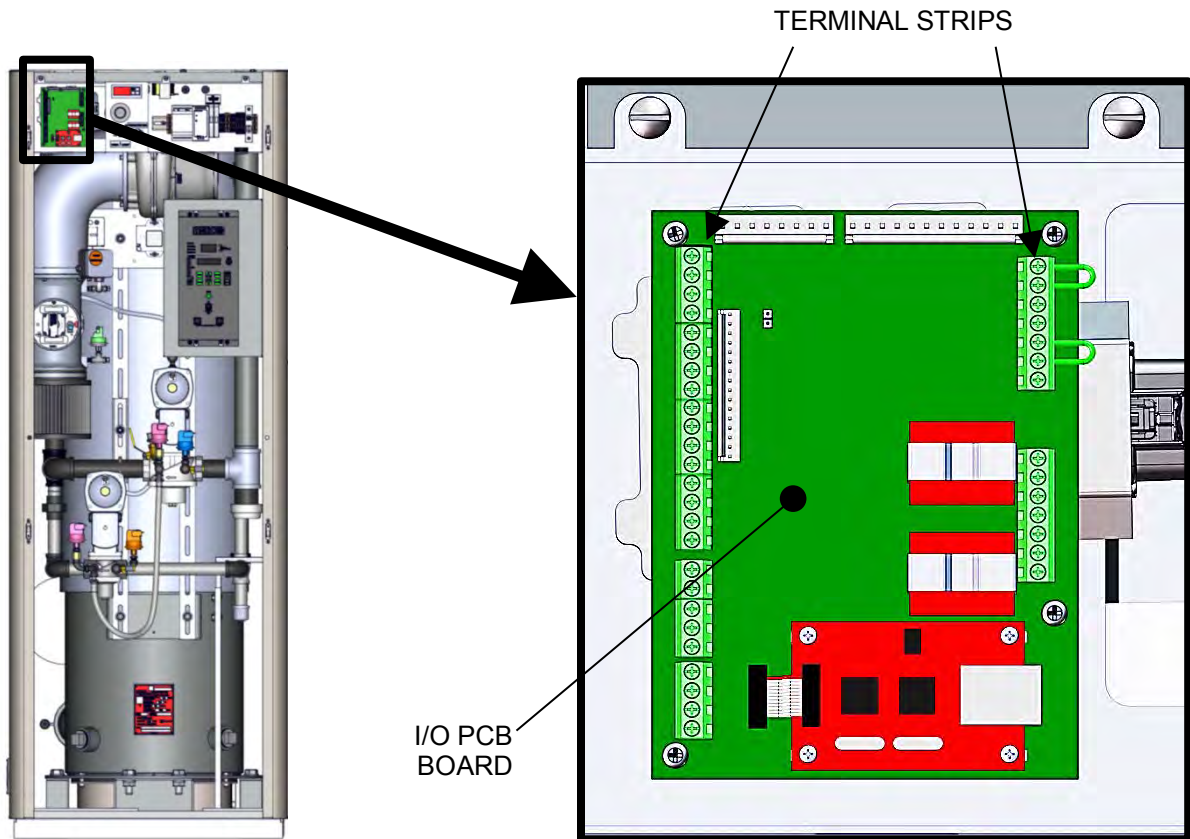
After placing the unit in service, the ignition safety shutoff device must be tested. If an external electrical power source is used, the installed boiler must be electrically bonded to ground in accordance with the requirements of the authority having jurisdiction. In the absence of such requirements,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

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

### 2.10 FIELD CONTROL WIRING

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

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



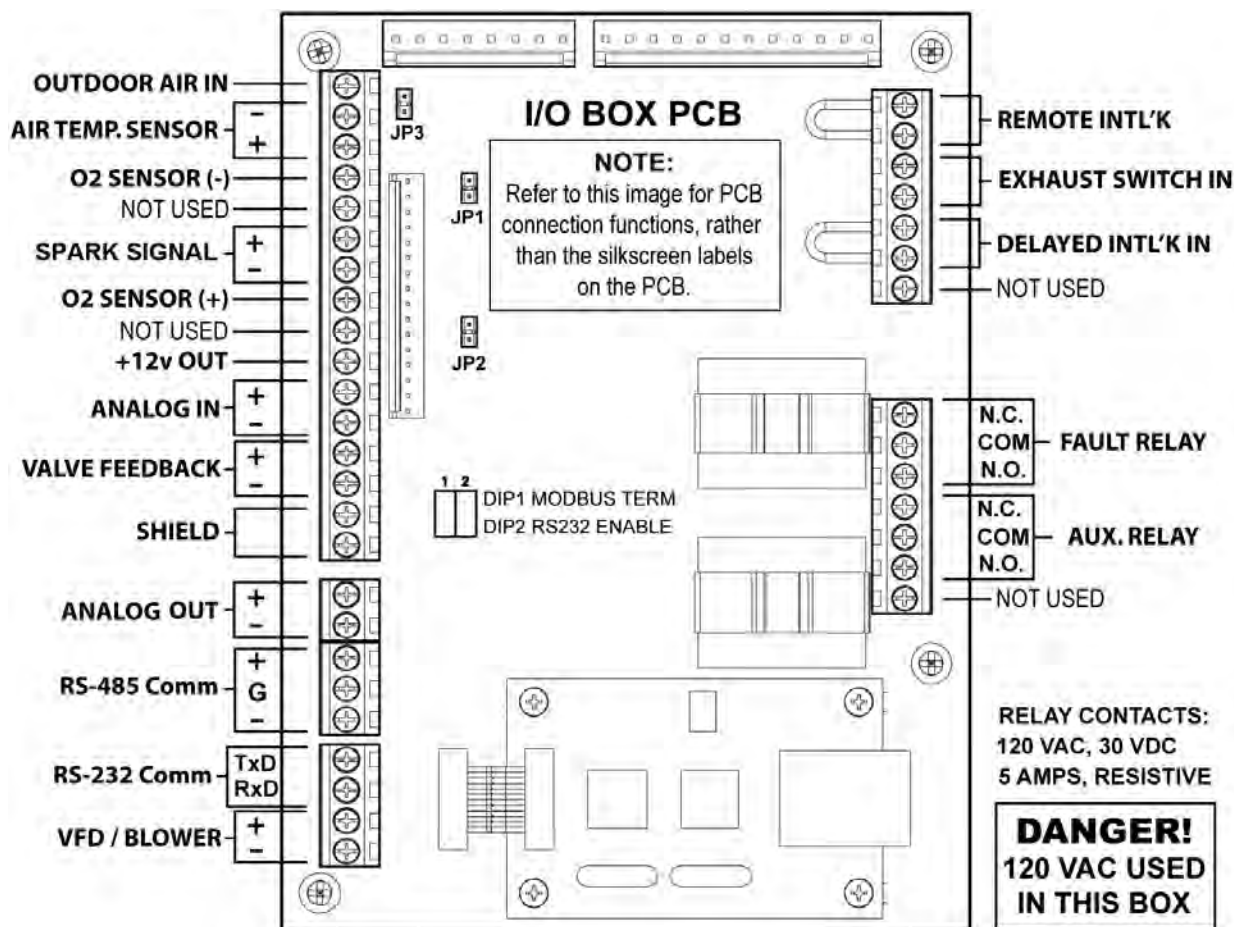
**Figure 2-11: Input/Output (I/O) Box Location**

#### NOTE

Use Figure 2-12 to determine the functions of the I/O PCB connections. Do not use the silkscreened labels on the PCB itself, as these may not match the function names. There is a diagram of the connection functions on the cover of the I/O Box as well.

#### **WARNING!**

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



**Figure 2-12: I/O Box Terminal Strips**

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

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

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

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

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

### 2.10.2 AIR TEMP SENSOR Terminals

The AIR TEMP SENSOR terminals are used to monitor the air inlet temperature sensor (P/N **61024**). This input is always enabled and is a “to view only” input that can be seen in the *Operating* menu. A resistance chart for this sensor is provided in APPENDIX C. This sensor is

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

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an active part of the combustion control system and must be operational for accurate air/fuel mixing control.

### 2.10.3 O<sub>2</sub> SENSOR (O<sub>2</sub>+ & O<sub>2</sub>-)

The O<sub>2</sub> SENSOR (+) and O<sub>2</sub> SENSOR (-) terminals are used to connect an integrated oxygen sensor to the I/O Box PCB. The O<sub>2</sub> concentration is displayed in the *Operating* menu of the C-More Control system after a 60 second warm-up period.

### 2.10.4 SPARK SIGNAL Terminals

The SPARK SIGNAL terminals (+ & -) connect to the spark monitor (P/N **61034**, also called "AC Current transducer"), which monitors the current going to the ignition transformer (P/N **65085**, see Section 7-12). If the current is insufficient (too high or low) during the ignition sequence, the controller will abort the ignition cycle. The controller will attempt up to three ignition cycles. If the current is insufficient by the third try, the controller will shut down and display a fault message.

### 2.10.5 ANALOG IN Terminals

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

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

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

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

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

### 2.10.6 VALVE FEEDBACK Terminals

The Valve Feedback terminals are used when the Sequencing Isolation Valve Feedback option is selected. The Valve Feedback signal is connected to the "Valve Fdbk" terminals and is used to confirm that the valve has properly opened or closed. If the Valve Feedback signal does not match the Valve-Open or Valve-Close command for the time defined in the "Valve Fdbk timer" entry, the controller will proceed as follows:

- (a) If the valve fails with the Valve Stuck Open fault, the "Valve Stuck Open" message will be displayed and the unit will remain active.
- (b) If the valve fails with the Valve Stuck Closed fault, the "Valve Stuck Closed" message will be displayed and the unit will shut down.

#### NOTE

If the Valve Feedback option is used, Shorting Jumper #JP2 on the I/O Board MUST be inserted.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

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### 2.10.7 SHIELD Terminals

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

### 2.10.8 ANALOG OUT Terminals

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

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

#### NOTE

When driving an isolation valve, shorting jumper #JP2 on the I/O Board *MUST* be installed.

- When the 4-20mA is selected for the Analog Output, the 0-10VDC is disabled at the VFD/Blower terminals, and the selected output is available at the terminals labeled *Analog Output +/-*.

### 2.10.9 RS485 Comm (+, GND, & -)

The RS485 communication terminals are used when the boiler plant is being controlled by an Energy Management System (EMS) or an AERCO Control System (ACS) using Modbus (RS485) communication.

### 2.10.10 RS232 Comm (TxD & RxD)

As of Firmware version 4.0 and above, these terminals are used only by factory-trained personnel to monitor OnAER communications via a portable computer.

### 2.10.11 VFD/Blower (0-10 & AGND)

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

### 2.10.12 Interlocks

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

#### NOTE

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

#### 2.10.12.1 Remote Interlock In (OUT & IN)

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

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### 2.10.12.2 Delayed Interlock In (OUT & IN)

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

- In conjunction with the optional external sequencing valve (see section 2.14 and Chapter 9 – BST), a component of AERCO's on-board Boiler Sequencing Technology (BST) solution. By default a cable of the boiler's wiring harness is connected to these terminals. If BST is implemented, the other end of that cable is connected to the sequencing valve.
- If BST is *NOT* implemented, the second use is typically in conjunction with the AUXILIARY RELAY CONTACTS described in section 2.10.14. This interlock circuit is located in the purge section of the start string. It can be connected to the proving device (end switch, flow switch etc.) of an auxiliary piece of equipment started by the unit's auxiliary relay. If the delayed interlock is connected to a proving device that requires time to close (make), a time delay (AUX START ON DLY) that holds the start sequence of the unit long enough for a proving switch to make (close) can be programmed.

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

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

### 2.10.13 Fault Relay (NC, COM, & NO)

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

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

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

## 2.11 FLUE GAS VENT INSTALLATION

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

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

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

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### **Selkirk Corporation - Heatfab Division**

130 Industrial Blvd.  
Turners Falls, MA 01376  
Phone: 1-800-772-0739  
[www.heat-fab.com](http://www.heat-fab.com)

### **Watertown Supply**

33Grove St.  
Watertown, MA 02472  
Phone: (617) 924-2840  
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44 Riverdale Ave.  
Newton, MA 02485  
Phone: (617) 527-8178  
[www.gloversheetmetal.com](http://www.gloversheetmetal.com)

## **2.12 COMBUSTION AIR**

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

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

For combustion air supply from ducting, see section 2.13 below and consult the AERCO GF-2050, Gas Fired Venting and Combustion Air Guide.

Air must be supplied to the unit(s) through two permanent openings. These two openings must have a free area of **not less than one square inch for each 4000 BTUs input for each unit.** The free area must take into account restrictions such as louvers and bird screens. For Canada installations, refer to the requirements specified in CSA B149.1-10, sections 8.4.1 and 8.4.3.

## **2.13 DUCTED COMBUSTION AIR**

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

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

- BMK 1500 – 6 inch diameter connection
- BMK 2000 – 8 inch diameter connection



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### 2.14 SEQUENCING ISOLATION VALVE INSTALLATION

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

When operated with the BST system, the Master controls its own isolation valve and sends signals to the slave units to open or close their isolation valves. After the boiler load is satisfied, the isolation valve opens for a programmed interval (default = 1 minute) before closing. When the system load is satisfied, the BST system will open the isolation valves for all of the boilers.

The implementation of BST, and the installation and use of this valve is optional. However, **when BST is implemented, use of this valve is strongly recommended.**

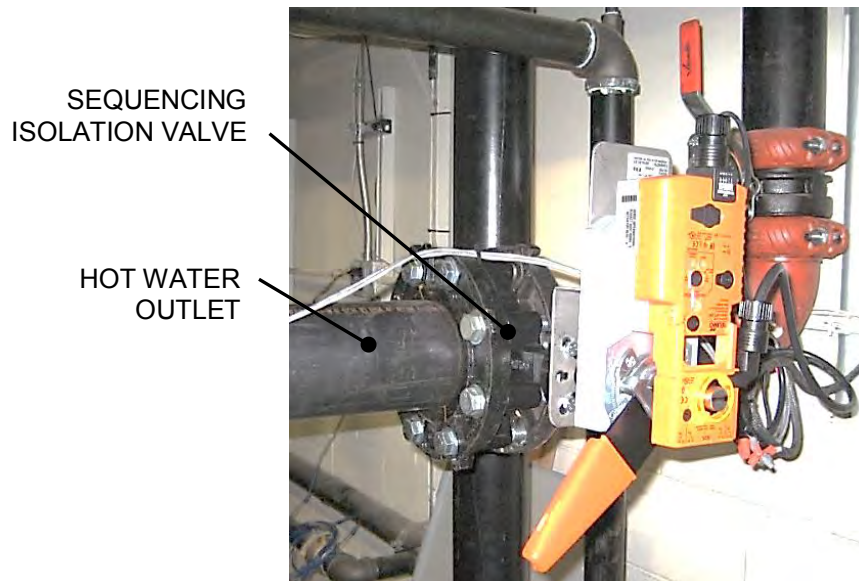
The boiler is pre-wired to accept the sequencing isolation valve. Installation consists of installing the sequencing isolation valve in the hot water outlet pipe, and then connecting it into the shell harness, as described below.

#### NOTE

When the Sequencing Isolation Valve is used, the AUX START ON DLY in the *Configuration* menu must be set to at least 120 seconds. The Sequencing Isolation Valve control is only available when BST is enabled. Refer to section 2.10.12.2 and Table 3-4 in section 3-6 and Chapter 9.

#### Installing the Sequencing Isolation Valve

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



**Figure 2-13: Sequencing Isolation Valve Installed**

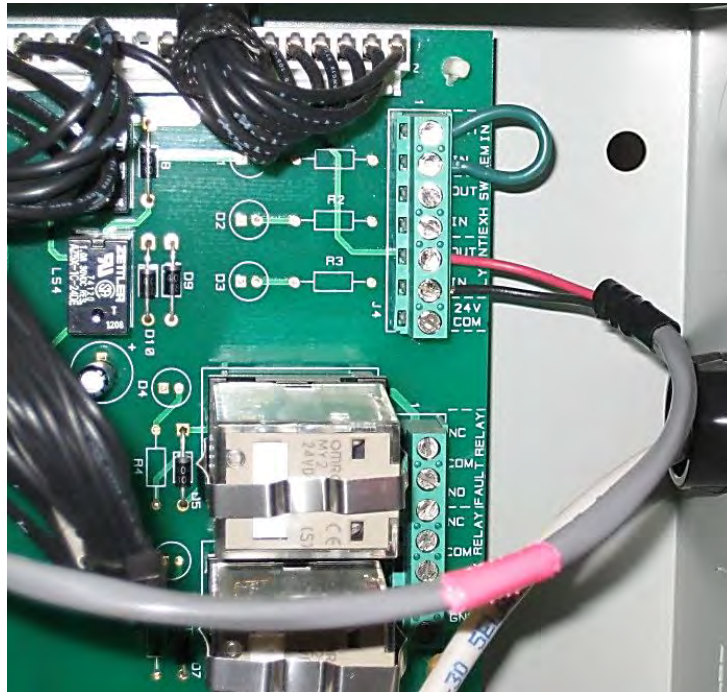


# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### Installing Sequencing Isolation Valve – *Continued*

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



**Figure 2-14: Sequencing Isolation Valve Installed**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

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### CHAPTER 3. OPERATION

#### 3.1 INTRODUCTION

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

#### WARNING!

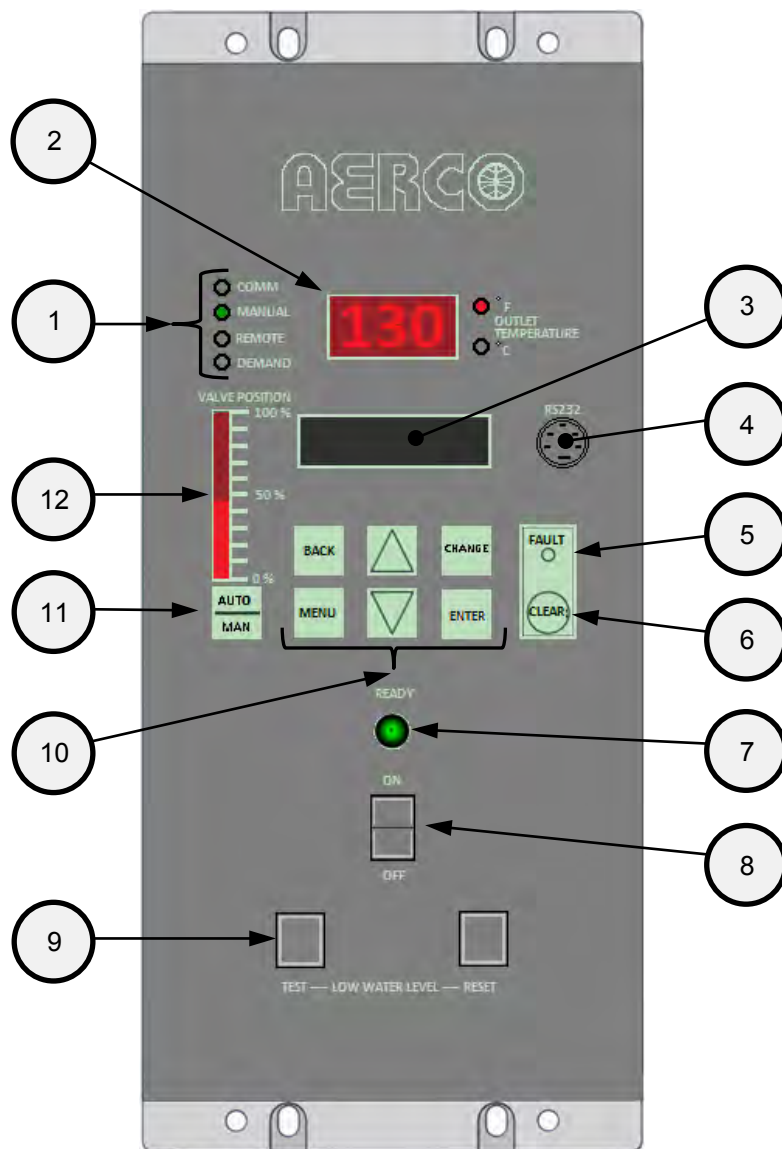
- Electrical voltages in this system include 120 and 24 volts AC. It must be serviced only by factory certified service technicians.
- **DO NOT ATTEMPT TO DRY FIRE THE UNIT.** Starting the unit without a full water level can seriously damage the unit and may result in injury to personnel or property damage. This situation will void any warranty.

#### CAUTION

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

#### 3.2 CONTROL PANEL DESCRIPTION

All Benchmark boilers utilize the C-More Control Panel shown in Figure 3-1. This panel contains all of the controls, indicators and displays necessary to operate, adjust and troubleshoot the boiler. These operating controls, indicators and displays are listed and described in Table 3-1. Additional information on these items is provided in the individual operating procedures and menu descriptions provided in this Chapter.



**Figure 3-1: Control Panel Front View**

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

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

Item	Feature	Function
1	<u>LED Status Indicators</u> Four Status LEDs indicate the current operating status as follows:	
	<b>COMM</b>	Lights when RS232 communication is occurring – see Item 4
	<b>MANUAL</b>	Lights when the valve position (fire rate) is being controlled using the front panel keypad. This mode of operation is for service technician use only.
	<b>REMOTE</b>	Lights when the unit is being controlled by an external signal from an Energy Management System
	<b>DEMAND</b>	Lights when there is a demand for heat.
2	<b>OUTLET TEMPERATURE</b> Display	3–Digit, 7–Segment LED display continuously displays the outlet water temperature. The °F or °C LED next to the display lights to indicate whether the displayed temperature is in degrees Fahrenheit or degrees Celsius. The °F or °C blinks when operating in the Deadband Mode. On a BST Master, display flashes & shows header temperature.
3	<b>VFD Display</b>	Vacuum Fluorescent Display (VFD) consists of 2 lines each capable of displaying up to 16 alphanumeric characters. The information displayed includes: <ul style="list-style-type: none"> <li>• Startup Messages</li> <li>• Fault Messages</li> <li>• Operating Status Messages</li> <li>• Menu Selection</li> <li>• BST Messages</li> </ul>
4	<b>RS232 Port</b>	This port is used only by factory-trained personnel to monitor OnAER communications, in combination with the RS232 Adaptor Cable (P/N <b>124675</b> ).
5	<b>FAULT</b> Indicator	Red <b>FAULT</b> LED indicator lights when a boiler alarm condition occurs. An alarm message will appear in the VFD.
6	<b>CLEAR</b> Key	Turns off the <b>FAULT</b> 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	<b>READY</b> Indicator	Lights ON/OFF switch is set to <b>ON</b> and all Pre-Purge conditions have been satisfied.
8	<b>ON/OFF</b> Switch	Enables and disables boiler operation.
9	<b>LOW WATER LEVEL TEST/RESET</b> Switches	Allows operator to test operation of the water level monitor. Pressing <b>TEST</b> opens the water level probe circuit and simulates a Low Water Level alarm. Pressing <b>RESET</b> resets the water level monitor circuit. Pressing the <b>CLEAR</b> key (item 6) resets the display.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

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

Item No.	Control, Indicator Or Display	Function
<b>10</b>	<u>MENU Keypad</u> Six (6) keys which provide the following functions for the Control Panel Menus:	
	<b>MENU</b>	Steps through the main menu categories shown in Figure 3-2. The Menu categories wrap around in the order shown.
	<b>BACK</b>	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 <b>CHANGE</b> 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 <b>CHANGE</b> key was pressed and the menu item is flashing, pressing the ▼ arrow key will decrement the selected setting.
	<b>CHANGE</b>	Permits a setting to be changed (edited). When the <b>CHANGE</b> 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.
	<b>ENTER</b>	Saves the modified menu settings in memory. The display will stop flashing.
<b>11</b>	<b>AUTO/MAN</b> Switch	This switch toggles the boiler between the AUTOMATIC and MANUAL modes of operation. When in the MANUAL ( <b>MAN</b> ) mode, the front panel controls are enabled and the <b>MANUAL</b> status LED lights. Manual operation is for service only.  When in the AUTOMATIC ( <b>AUTO</b> ) mode, the <b>MANUAL</b> status LED will be off and the front panel controls disabled.
<b>12</b>	<b>VALVE POSITION</b> Bargraph	20 segment red LED bargraph continuously shows the Air/Fuel Valve position in 5% increments from 0 to 100%

### 3.3 CONTROL PANEL MENUS

The Control Panel incorporates an extensive menu structure which permits the operator to set up, and configure the unit. The menu structure consists of five major menu categories which are applicable to this manual. These categories are shown in Figure 3-2. Each of the menus shown, contain options which permit operating parameters to be viewed or changed. The menus are protected by a password levels to prevent unauthorized use.

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

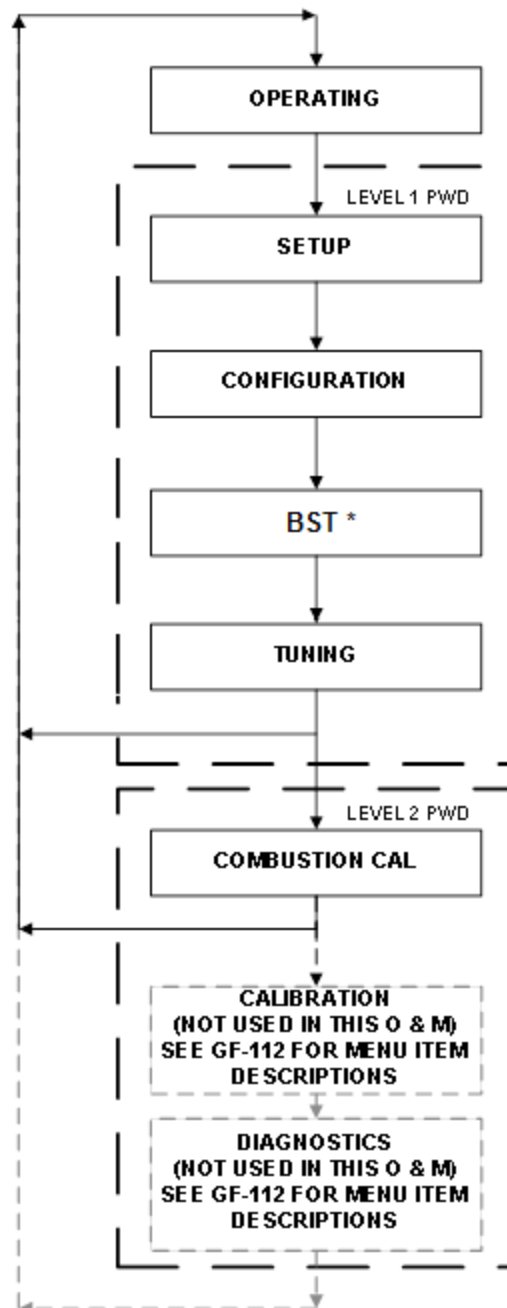
Once the valid **level 1 password (159)** is entered, the options listed in the *Setup*, *Configuration* and *Tuning* menus can be viewed and changed, if desired. The *Combustion Cal* menu is protected by the **level 2 password (6817)** which is used in Chapter 4 to perform combustion calibration prior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

#### 3.3.1 Menu Processing Procedure

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

#### Menu Processing Procedure

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



\* Only if BST is enabled (see Chapter 9)

**Figure 3-2: Menu Structure**

### NOTE

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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### 3.4 OPERATING MENU

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

**Table 3-2: Operating Menu**

	Menu Item Display	Available Choices or Limits	
		Minimum	Maximum
1	Active Setpoint	40°F	240°F
2	Inlet Temp	40°F	140°F
3	Air Temp	-70°F	245°F
4	* Outdoor Temp	-70°F	130°F
5	Valve Position In	0%	100%
6	* Valve Position Out	0%	100%
7	Exhaust Temp	°F	°F
8	Flame Strength	0%	100%
9	Oxygen Level	0%	21%
10	Ignition Time	0.00	10.00
11	SSOV Time to OPN	0.00	10.00
12	Spark Current	0	2.5 A
13	Run Cycles	0	999,999,999
14	Run Hours	0	999,999,999
15	Fault Log	0	19

**\*NOTE**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### 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, and units of temperature measurements. A view-only software version display is also provided to indicate the current Control Box software version.

**Table 3-3: Setup Menu**

	Menu Item Display	Available Choices or Limits		Default
		Minimum	Maximum	
1	Password	0	9999	0
2	Language	English		English
3	Time	12:00 am	11:59 pm	
4	Date	01/01/00	12/31/99	
5	Unit of Temp	Fahrenheit or Celsius		Fahrenheit
6	Comm Address	0	127	0
7	Baud Rate	2400, 4800, 9600, 19.2K		9600
8	OnAER Mode	Ethernet or SD Card		Ethernet
9	Min Upload Timer	0	9,999 Sec	0
10	Unit Alpha	E, G, H, R, N or A		A
11	Unit Year	0	99	0
12	Unit Serial #	0	9999	0
13	Software	Ver 0.00	Ver 9.99	Current software version

### 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.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

**Table 3-4: Configuration Menu**

	Menu Item Display	Available Choices or Limits		Default
		Minimum	Maximum	
1	Internal Setpt	Lo Temp Limit	Hi Temp Limit	130°F
2	Unit Type	KC Boiler, KC Boiler LN, BMK Blr Std, BMK Blr Std Dual, BMK Blr LN, BMK Blr LN Dual KC Water Heater, KC Water Heater LN, RECON Wtr Heater, Innovation WH		BMK Boiler LN
3	Unit Size (Only the unit sizes available for the Unit Type will be isplayed)	750 MBH, 1000 MBH, 1500 MBH, 2000 MBH, 2500 MBH, 3000 MBH, 6000 MBH		1500 MBH or 2000 MBH
4	Fuel Type	Natural Gas or Propane		Natural Gas for DF or Propane for P
5	Boiler Mode	Constant Setpoint, Remote Setpoint, Direct Drive, Combination, Outdoor Reset		Constant Setpoint
6	Remote Signal (If Mode = Remote Setpoint, Direct Drive or Combination)	4 – 20 mA/1 – 5V 0 -20 mA/0 – 5V PWM Input (Legacy BMS), Network		4 – 20 mA, 1-5V
7	Outdoor Sensor	Enabled or Disabled		Disabled
8	* Bldg Ref Temp (If Mode = Outdoor Reset)	40°F	230°F	70°F
9	* Reset Ratio (If Mode = Outdoor Reset)	0.1	9.9	1.2
10	* System Start Tmp (If Outdoor Sensor = Enabled)	30°F	100°F	60°F
11	Setpt Lo Limit	40°F	Setpt Hi Limit	60°F
12	Setpt Hi Limit	Setpt Lo Limit	210°F	195°F
13	Temp Hi Limit	40°F	210°F	195°F
14	Max Valve Position	40%	100%	100%
15	Pump Delay Timer	0 min.	30 min.	0 min.
16	Aux Start On Dly	0 sec.	120 sec.	0 sec.
17	Failsafe Mode	Shutdown or Constant Setpt		Shutdown

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

**Table 3-4: Configuration Menu**

	Menu Item Display	Available Choices or Limits		Default
		Minimum	Maximum	
18	Analog Output	Off, Setpoint, Outlet Temp, Valve Pos 4-20mA, valve Pos 0-10v		Valve Pos 0-10v
19	Low Fire Timer	2 sec.	600 sec.	2 sec.
20	Setpt Limiting	Enabled or Disabled		Disabled
21	Setpt Limit Band	0°F	10°F	5°F
22	Network Timeout	5 sec.	999 sec.	30 sec.
23	Shutoff Dly Temp	0°F	25°F	10°F
24	Demand Offset	0°F	25°F	0°F
25	Deadband High	0°F	25°F	5°F
26	Deadband Low	0°F	25°F	5°F
27	IGST Version	V2.00 or Lower		V2.02
28	IGN Time Setting	4 sec.	7 sec.	
29	Slow Shutdown	Enabled or Disabled		Disabled
30	Slow Sht Duration	0 sec.	9,999 sec.	60 sec.
31	Slow Sht Threshold	40%	100%	60%
32	BST Menu	Enabled or Disabled		Disabled

**\*NOTE**

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

**CAUTION**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### 3.7 TUNING MENU

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

**Table 3-5: Tuning Menu**

	Menu Item Display	Available Choices or Limits		Default
		Minimum	Maximum	
1	Prop Band	1°F	120°F	70°F
2	Integral Gain	0.00	2.00	1.00
3	Derivative Time	0.0 min	2.00 min	0.0min
4	Warmup Prop Band	1 °F	120 °F	95 °F
5	Warmup Int Gain	0.00	2.00	0.50
6	Warmup PID timer	0 sec.	240 sec.	20 sec.
7	Reset Defaults?	Yes, No, Are You Sure?		No

### 3.8 COMBUSTION CAL MENU

The *Combustion Cal* (Calibration) menu is protected by the level 2 password (**6817**) which must be entered to view or change the menu items shown in Table 3-6. These menu items are used to vary the speed of the unit's blower motor based on air temperature and air density at prescribed Air/Fuel Valve positions (% open). This is accomplished by providing a DC drive voltage to the motor which then adjusts the rotational speed of the blower to maximize combustion efficiency and ensure the unit conforms to the Nitrogen Oxide (NOx) and Carbon Monoxide (CO) emissions specified in Chapter 4. The valve positions (%) and default drive voltages are listed in Table 3-6.

**Table 3-6: Combustion Cal Menu**

	Menu Item Display	
	BMK 1500DF	BMK 2000DF
1	CAL Voltage 16% for Natural Gas CAL Voltage 18% for Propane	CAL Voltage 18%
2	CAL Voltage 30%	CAL Voltage 30%
3	CAL Voltage 40%	CAL Voltage 40%
4	CAL Voltage 50%	CAL Voltage 50%
5	CAL Voltage 70%	CAL Voltage 70%
6	CAL Voltage 100%	CAL Voltage 100%
7	SET Valve Position	SET Valve Position
8	Blower Output	Blower Output
9	Set Stdby Volt	Set Stdby Volt
10	Oxygen Level	Oxygen Level

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### 3.9 BST (Boiler Sequencing Technology) Menu

The BST Menu must be enabled in order to be displayed and accessed. This is done by setting the BST Menu item, the last item in the *Configuration* menu (item 33 in Table 3-4) to **Enabled**.

The Boiler Sequencing Technology (BST) Menu contains all of the items required to Configure, Operate and Monitor the functionality of the BST System. There are over 50 items in this menu, and selecting any particular item from the list, for inspection or modification, could be time consuming. As a result, the BST Menu has been segmented into FIVE logical groups based on functionality.

The five Item groups are:

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

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

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

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

**Table 3-7: BST Menu**

Menu Item Display		Available Choices or Limits			Default
		Minimum		Maximum	
1	<b>BST Mode</b>	Off	BST Slave	BST Master	Off
2	BST Setpoint	BST Setpt Lo Limit		BST Setpt Hi Limit	130°F
3	Header Temp	NA			Header Temp (°F)
4	BST Fire Rate	0		100%	Fire rate %
5	BST Ave Fire Rate	0		100%	Avg Fire Rate %
6	BST Outdoor Temp	NA			Outdoor Temp (°F)
7	Units Available	0		8	Units Present
8	Units Ignited	0		8	Units firing
9	BST Valve State	0 (CLOSED)		1 (OPEN)	0
10	1 Comm Errors 8	0		9	0
11	1 BST Units 8	0 (see table)		0 (see table)	0
12	<b>*BST SETUP MENU*</b>	Disabled		Enabled	Disabled
13	BST Setpoint Mode	Constant Setpoint	Remote Setpoint	Outdoor Reset	Constant Setpt
14	Head Temp Source	Network		FFWD Temp	FFWD Temp
15	Header Temp Addr	0		255	240
16	Header Temp Point	0		255	14

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

**Table 3-7: BST Menu**

Menu Item Display		Available Choices or Limits			Default
		Minimum		Maximum	
17	BST Outdoor Sens	Disabled		Enabled	Disabled
18	Outdr Tmp Source	Outdoor Temp		Network	Outdoor Temp
19	Outdoor Tmp Addr	0		255	240
20	Outdoor Tmp Pnt	0		255	215
21	BST Remote Signal	4-20 mA/1-5 Vdc;	0-20 mA/0-5 Vdc;	Network	Network
22	BST Auto Mstr	No		Yes NOTE! A Modbus temperature transmitter must be installed in conjunction with this feature.	No
23	BST Auto Timer	10 sec		120 sec	30 sec
24	Remote Intlk Use	Boiler Shutdown		System Shutdown	System Shutdown
25	One Boiler Mode	Off	On-Outlet Temp	On-Avg Temp	Off
26	1 Blr Threshold	10		35	25
27	Setpoint Setback	Disable		Enable	Disable
28	Setback Setpoint	BST Setpt Lo Limit		BST Setpt HI Limit	130°F
29	Setback Start	12:00am		11:59pm	12.00am
30	Setback End	12:00am		11:59pm	12.00am
31	Rate Threshold	1°F		30°F	15°F
<b>32 *BST OPERATE MENU*</b>					
		Disabled		Enabled	Disabled
33	BST Next On VP	16%		100%	50%
34	BST Max Boilers	1		8	8
35	BST On Delay	30 sec		300 sec	60 sec
36	BST On Timeout	15 sec		300 sec	60 Sec
37	Valve Override	Off	Closed	Open	Off
38	Valve Off Delay	0		15 min	1 min
39	BST Sequencing	Run Hours	Unit Size	Select Lead	Run Hours
40	Select Lead Unit	0		127	0
41	Select Lag Unit	0		127	0
42	Lead/Lag Hours	25 hours		225 hours	72 hours
<b>43 *BST TEMP CTRL MENU*</b>					
		Disabled		Enabled	Disabled
44	BST Temp Hi Limit	40°F		210°F	210°F
45	BST Setpt Lo Limit	40°F		BST Setpt HI Limit	60°F
46	BST Setpt HI Limit	BST Setpt Lo Limit		220°F	195°F
47	BST Prop Band	1°F		120°F	100°F
48	BST Intgral Gain	0.00		2.00	0.50
49	BST Deriv Time	0.00 Min		2.00 Min	0.10 Min
50	BST Deadband Hi	0		25	1

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

**Table 3-7: BST Menu**

Menu Item Display		Available Choices or Limits		Default
		Minimum	Maximum	
51	BST Deadband Lo	0	25	1
52	Deadband En Time	0	120 Sec	30 Sec
53	BST FR Up Rate	1	120	20
54	BST Bldg Ref Tmp	40°F	230°F	70°F
55	BST Reset Ratio	0.1	9.9	1.2
56	System Start Tmp	30°F	120°F	60°F
<b>57</b>	<b>*BST COMM MENU*</b>	Disabled	Enabled	Disabled
58	Comm Address	0	127	0
59	BST Min Addr	1	128	1
60	BST Max Addr	1	128	8
61	SSD Address	0	250	247
62	SSD Poll Control	0	1000	0
63	Err Threshold	1	9	5
64	SSD Temp Format	Degrees	Points	Degrees
65	BST Upd Timer	0	9999 sec	0

### 3.10 START SEQUENCE

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

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

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

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

#### NOTE

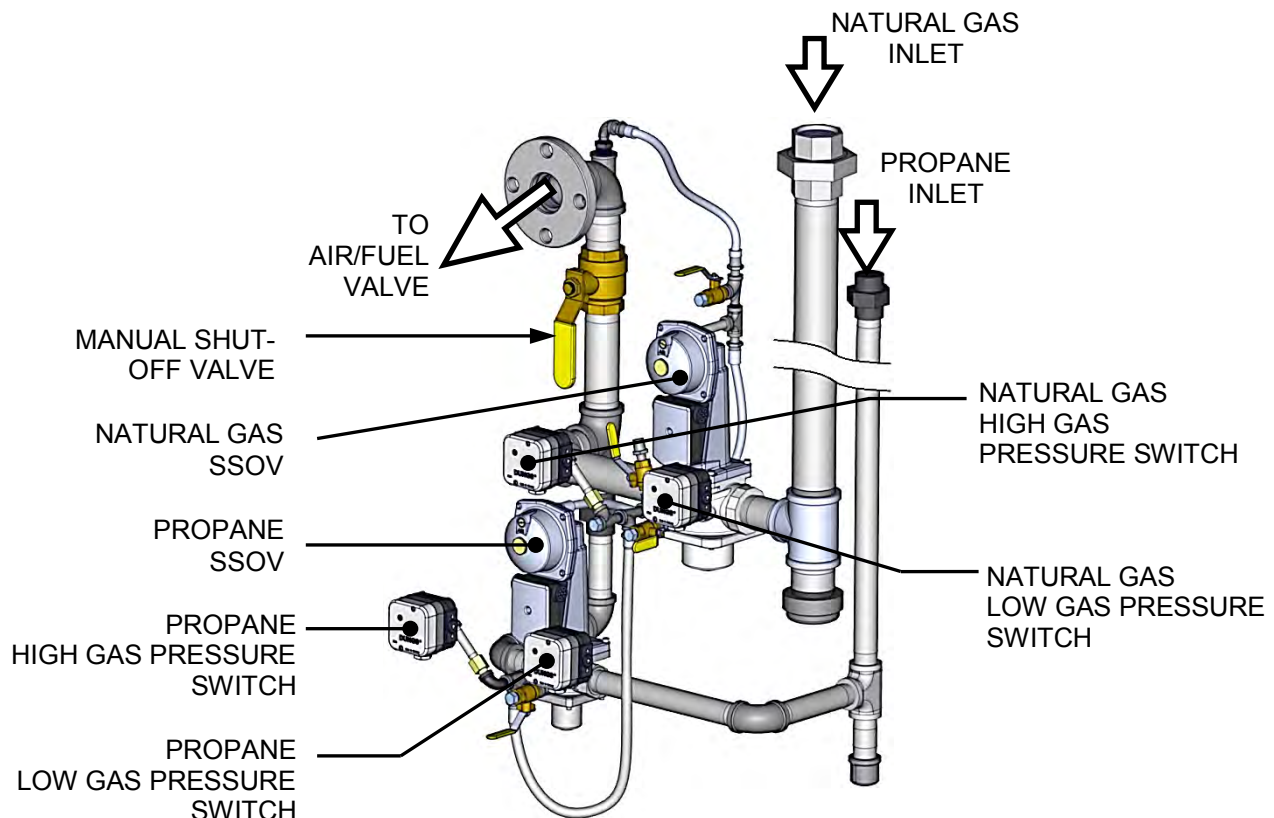
If any of the Pre-Purge safety device switches are open, the appropriate fault message will be displayed. Also, the appropriate messages will be displayed throughout the start sequence, if the required conditions are not observed.



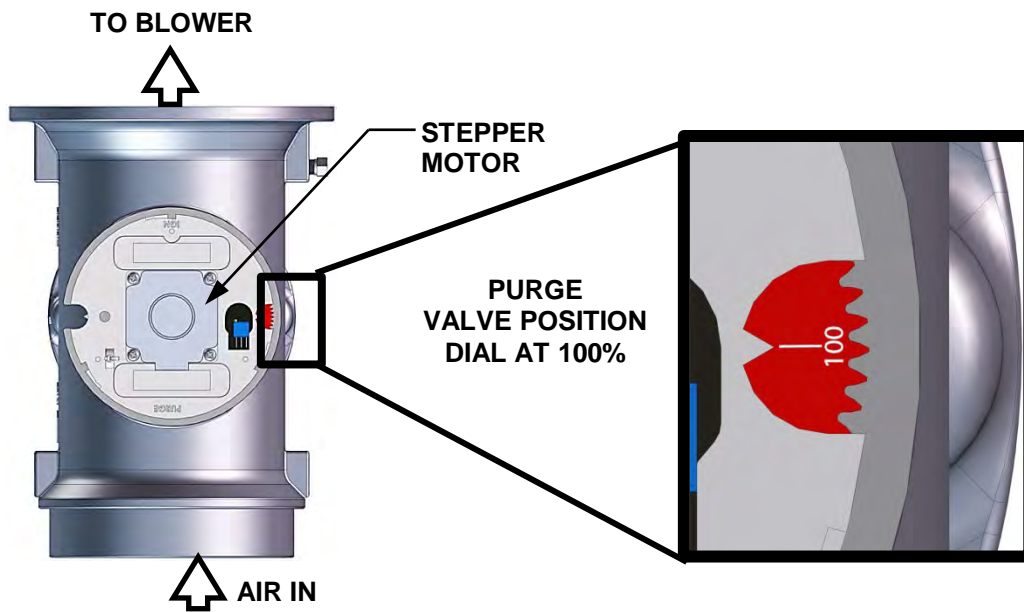
# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

1. The **DEMAND** LED status indicator will light.
2. The unit checks to ensure that the Proof of Closure (POC) switches in the downstream Safety Shut-Off Valve (SSOV) are closed. See Figure 3-3 for SSOV locations.
3. With all required safety device switches closed, a purge cycle will be initiated and the following events will occur:
  - a. The Blower relay energizes and turns on the blower.
  - b. The Air/Fuel Valve rotates to the full-open purge position and closes purge position switch. The dial on the Air/Fuel Valve (Figure 3-4) will read **100** to indicate that it is full-open (100%).
  - c. The **VALVE POSITION** bargraph will show 100%.

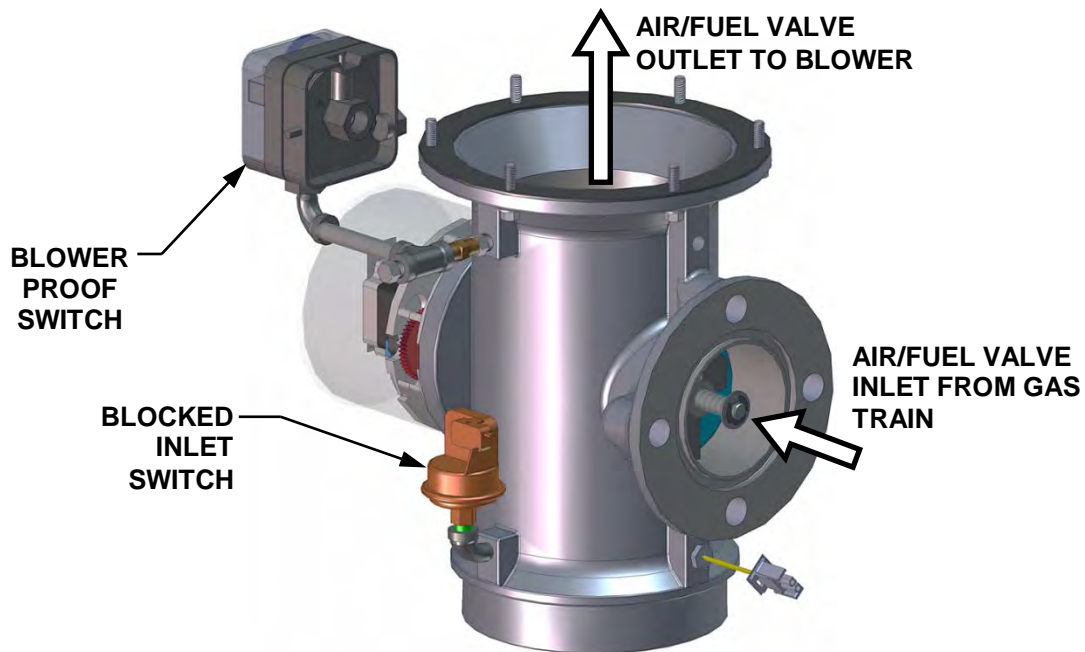


**Figure 3-3: SSOV Location**



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

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



**Figure 3-5: Blower Proof Switch**

5. Upon completion of the purge cycle, the Control Box initiates an ignition cycle and the following events occur:
  - a) The Air/Fuel Valve rotates to the low-fire (Ignition Position) position and closes the ignition switch. The Dial on the Air/Fuel Valve (Figure 3-6) will read between **25** and **35** to indicate that the valve is in the low fire position.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

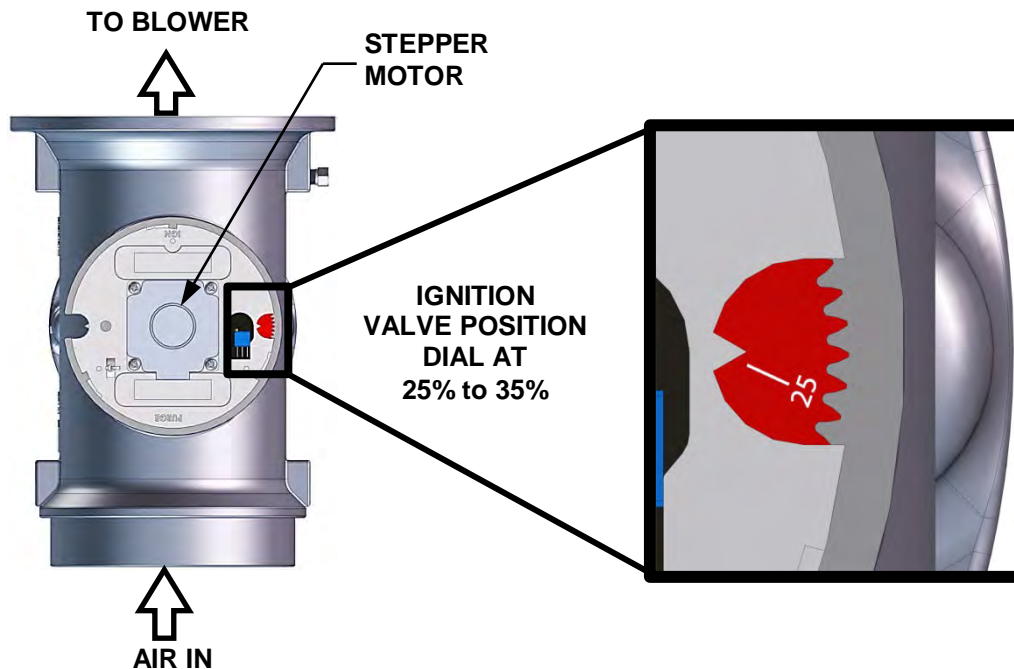
## CHAPTER 3 – OPERATION

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

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

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

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



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

- Up to 4 seconds will be allowed for ignition to be detected. The igniter relay will be turned off one second after flame is detected.
- 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.
- With the unit firing properly, it will be controlled by the temperature controller circuitry. The boiler's VALVE POSITION will be continuously displayed on the front panel bargraph.

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 3 – OPERATION

### 3.11 START/STOP LEVELS

The start and stop levels are the Air/Fuel Valve positions (% open) that start and stop the unit, based on load. These levels are Factory preset as follows and should not require adjustment:

	Natural Gas		Propane Gas	
	BMK 1500	BMK 2000	BMK 1500	BMK 2000
<b>Start Level:</b>	24%	24%	24%	24%
<b>Stop Level:</b>	16%	18%	18%	18%

Note that the energy input of the boiler is not linearly related to the Air/Fuel Valve position.

The Tables below show the relationship between the energy input and Air/Fuel Valve position.

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

Air/Fuel Valve Position (% Open)	Natural Gas		Propane Gas	
	Energy Input (BTU/Hr)	Boiler Energy Input (% of Full Capacity)	Energy Input (BTU/Hr)	Boiler Energy Input (% of Full Capacity)
16% (Stop Level)	75,000	5.0%	(18% Stop Level) 75,000	5.0%
20%	107,000	7.1%	93,700	6.2%
30%	281,000	18.7%	254,000	16.9%
40%	536,000	35.7%	505,000	33.7%
50%	717,000	47.8%	680,000	45.3%
60%	848,000	56.5%	807,000	53.8%
70%	992,000	66.1%	947,000	63.1%
80%	1,184,000	78.9%	1,157,000	77.1%
90%	1,393,000	92.9%	1,379,000	91.9%
100%	1,507,000	100%	1,503,000	100%

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

Air/Fuel Valve Position (% Open)	Natural Gas		Propane Gas	
	Energy Input (BTU/Hr)	Boiler Energy Input (% of Full Capacity)	Energy Input (BTU/Hr)	Boiler Energy Input (% of Full Capacity)
18% (Stop Level)	100,000	5.0%	100,000	5.0%
20%	132,000	6.6%	126,600	6.3%
30%	410,000	20.5%	363,000	18.2%
40%	786,000	39.3%	677,000	33.9%
50%	1,045,000	52.3%	898,000	44.9%
60%	1,280,000	64.0%	1,070,000	53.5%
70%	1,546,000	77.3%	1,242,000	62.1%
80%	1,686,000	84.3%	1,523,000	76.2%
90%	1,866,000	93.3%	1,845,000	92.3%
100%	2,000,000	100%	2,000,000	100%

## CHAPTER 4. INITIAL START-UP

### 4.1 INITIAL START-UP REQUIREMENTS

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

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

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

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

An AERCO Gas Fired Startup Sheet, included with each Benchmark unit, must be completed for each unit for warranty validation and a copy must be returned promptly to AERCO via e-mail at: **STARTUP@AERCO.COM**.

#### WARNING!

**DO NOT ATTEMPT TO DRY FIRE THE UNIT.** Starting the unit without a full water level can seriously damage the unit and may result in injury to personnel or property damage. This situation will void any warranty.

#### NOTE

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

### 4.2 TOOLS AND INSTRUMENTATION FOR COMBUSTION CALIBRATION

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

#### 4.2.1 Required Tools & Instrumentation

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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

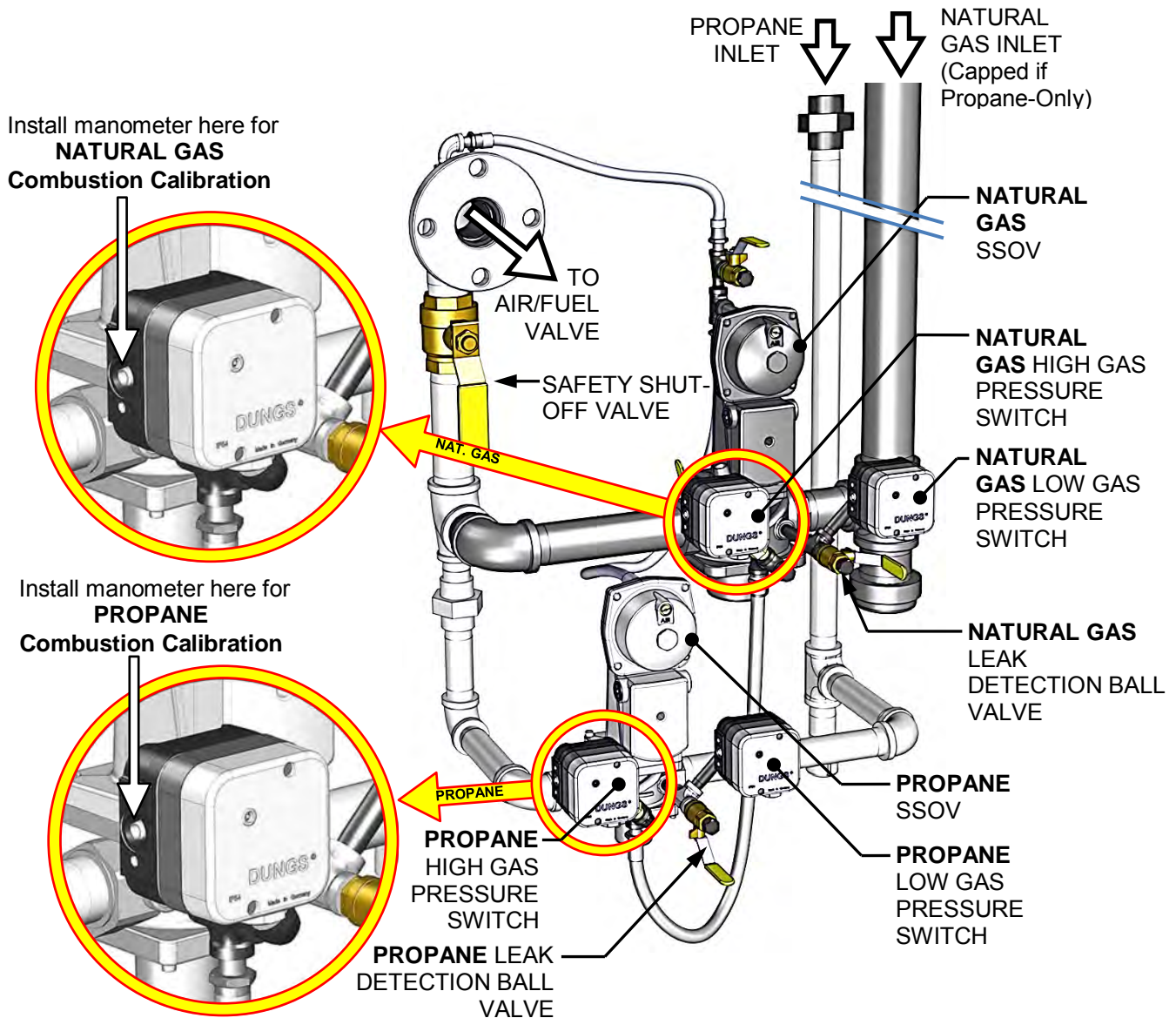
## CHAPTER 5 – MODE OF OPERATION

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

### 4.2.2 Installing Gas Supply Manometer

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

The gas supply manometer is installed at the downstream location at the ports in the sides of the High Gas Pressure Switches, as shown in Figure 4-1.



**Figure 4-1: BMK 1500DF/2000DF: Port Locations for Combustion Calibration**

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

To monitor the gas pressure on the downstream side of the SSOV during Combustion Calibration (section 4.3 and 4.4), install the 16" W.C. manometer(s) as described in the following steps:

### Installing Gas Supply Manometer

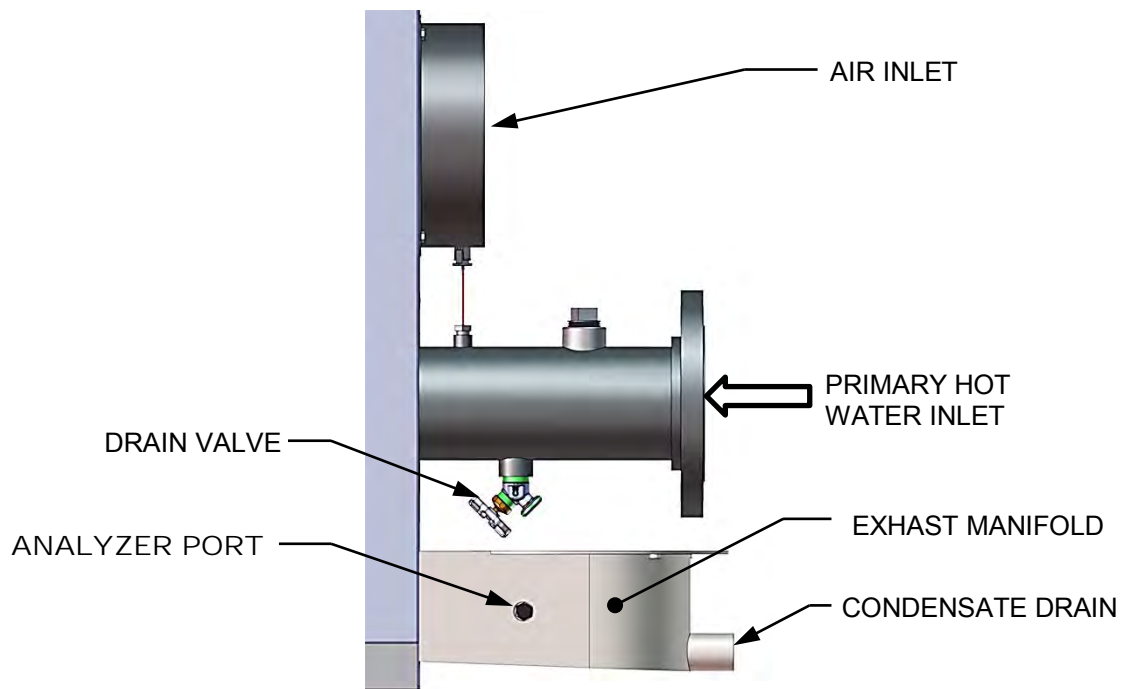
1. Turn off the main gas supply upstream of the unit.
2. Remove the top panel and front panel from the boiler to access the gas train components.
3. Locate the appropriate port (Natural Gas or Propane) on the side of the High Gas Pressure Switch, as shown in Figure 4-1, and turn the screw inside the port a few turns counter-clockwise to open. Do not remove the screw.
4. Install a NPT-to-barbed fitting into the tapped plug port.
5. Attach one end of the plastic tubing to the barbed fitting and the other end to the 16" W.C. manometer.

### 4.2.3 Accessing the Analyzer Probe Port

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

### Accessing the Analyzer Probe Port

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



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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

### 4.3 NATURAL GAS COMBUSTION CALIBRATION

The instructions below for NATURAL GAS combustion calibration apply to both BMK 1500DF and BMK 2000DF model units.

#### NOTE

The Natural Gas combustion calibration procedures in this section are only applicable to dual fuel models.

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

**Table 4-1: Nominal Gas Pressure – NATURAL GAS**

BMK Boiler Model	Nominal Natural Gas Pressure
BMK 1500DF	3.5" W.C. ± 0.2" W.C.
BMK 2000DF	6.3" W.C. ± 0.2" W.C.

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

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

#### NATURAL GAS Combustion Calibration

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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

### NATURAL GAS Combustion Calibration – Continued

13. Compare the oxygen readings on the combustion analyzer to the on-board O<sub>2</sub> sensor value displayed in the Operating Menu of the C-More Control Panel. If the values differ by more than  $\pm 1.5\%$  and your combustion analyzer is correctly calibrated, the on-board O<sub>2</sub> sensor may be defective and need to be replaced.
14. Compare the measured oxygen level to the oxygen range shown below. Also, ensure that the nitrogen oxide (NOx) and carbon monoxide (CO) readings do not exceed the values shown. If you are not in a “NOx-limited” area and/or do not have a NOx measurement in your analyzer, set the oxygen (O<sub>2</sub>) at **5.5%  $\pm$  0.5%**.

**Table 4-2: Combustion Calibration Readings – 100% Valve Position**

Valve Position	Oxygen (O <sub>2</sub> ) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
100%	5.0% - 6.0%	$\leq 20$ ppm	<100 ppm

15. If the oxygen level is not within the required tolerance, the gas pressure on the downstream side of the SSOV must be adjusted using the gas pressure adjustment screw on the SSOV (Figure 4-3). Slowly rotate the gas pressure adjustment (approximately 1/4-turn increments). Allow the combustion analyzer to stabilize following each adjustment. Clockwise rotation reduces the oxygen level, while counterclockwise rotation increases the oxygen level.
16. Once the oxygen level is within the specified range at 100%, record the O<sub>2</sub>, NOx and CO readings on the Combustion Calibration Data Sheets provided with the unit.
17. Lower the valve position to **70%** using the **▼** arrow key.

#### NOTE

The remaining combustion calibration steps are performed using the *Combustion Cal* menu included in the C-More Control System. The combustion calibration control functions will be used to adjust the oxygen level (%) at valve positions of **70%**, **50%**, **40%**, **30%** and **16%** (BMK 1500DF) or **18%** (BMK 2000DF), as described below. These steps assume that the **inlet air temperature is within the range of 50°F to 100°F**. If NOx readings exceed the target values shown, increase the O<sub>2</sub> level up to 1% higher than the listed calibration range. Record the increased O<sub>2</sub> value on the Combustion Calibration sheet.

18. Press the **MENU** key on the front panel of the C-MORE and access the *Setup* menu. Enter password **6817** and then press the **ENTER** key.
19. Press the **MENU** key on the front panel of the C-MORE until **Combustion Cal Menu** appears on the display.
20. Press the **▲** arrow key until **SET Valve Position** appears on the display.
21. Press the **CHANGE** key. **SET Valve Position** will begin to flash.
22. Press the **▲** arrow key until the **SET Valve Position** reads **70%**. Press the **ENTER** key.
23. Next, press the down (**▼**) arrow key until **CAL Voltage 70%** is displayed.
24. Press the **CHANGE** key and observe that **CAL Voltage 70%** is flashing.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

### NATURAL GAS Combustion Calibration – *Continued*

25. The oxygen level at the **70%** valve position should be as shown below. Also, ensure that the nitrogen oxide (NOx) and carbon monoxide (CO) readings do not exceed the following values:

**Table 4-3: Combustion Calibration Readings – 70% valve Position**

Valve Position	Oxygen (O <sub>2</sub> ) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
70%	5.4% ± 0.5%	≤50 ppm	<150 ppm

26. If the oxygen level is not within the specified range, adjust the level using the ▲ and ▼ arrow keys. This will adjust the output voltage to the blower motor as indicated on the display. Pressing the ▲ arrow key increases the oxygen level and pressing the down ▼ arrow key decreases the oxygen level.
27. Once the oxygen level is within the specified range at **70%**, press the **ENTER** key to store the selected blower output voltage for the **70%** valve position. Record all readings on the Combustion Calibration Sheets provided.
28. Repeat steps 20 through 27 for valve positions of **50%**, **40%**, **30%** and **16%** (on the BMK 1500DF only) or **18%** (on the BMK 2000DF only). The oxygen (O<sub>2</sub>), nitrogen oxide (NOx) and carbon monoxide (CO) should remain within the same limits for all valve positions as shown in the following table.

#### NOTE

If NOx readings exceed the target values shown (<20 ppm), increase the O<sub>2</sub> level up to 1% higher than the listed calibration range shown in the table. Record the increased O<sub>2</sub> value on the Combustion Calibration sheet.

**Table 4-4: Combustion Calibration Readings**

Valve Position	Oxygen (O <sub>2</sub> ) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
50%	6.0% ± 0.5	<20 ppm	<100 ppm
40%	6.3% ± 0.5	<20 ppm	<100 ppm
30%	6.3% ± 0.5	<20 ppm	<100 ppm
16% BMK 1500DF	6.0% ± 0.5	<20 ppm	<100 ppm
18% BMK 2000DF			

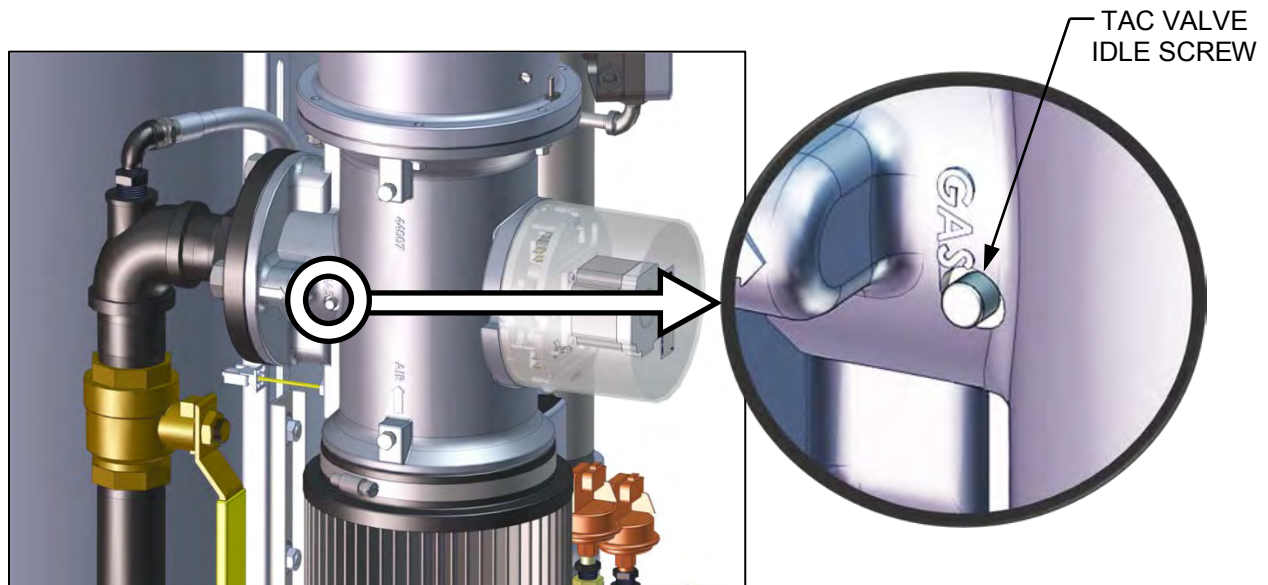
29. If the oxygen level at the **16%** (BMK1500DF) or **18%** (BMK2000DF) valve position is too high and the Blower voltage is at the minimum value, you can adjust the idle screw (TAC valve) which is recessed in the top of the Air/Fuel Valve (see Figure 4-4). Rotate the screw 1/2 turn clockwise (CW) to add fuel and reduce the O<sub>2</sub> to the specified level. Recalibration **MUST** be performed again from **50%** down to **16%** (BMK1500DF) or **18%** (BMK2000DF) after making a change to the idle screw (TAC valve).
30. **This completes the NATURAL GAS combustion calibration procedures.**

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION



**Figure 4-3: Gas Pressure Adjustment Screw Location**



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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

### 4.4 PROPANE COMBUSTION CALIBRATION

If the boiler is a dual fuel model currently running Natural Gas, complete the instructions in section 4.6.1 to switch the boiler fuel source from NATURAL GAS to PROPANE gas.

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

**Table 4-5: Nominal Gas Pressure – PROPANE**

BMK Boiler Model	Nominal PROPANE Gas Pressure
BMK 1500DF & 1500P	1.4" W.C. ±0.2" W.C.
BMK 2000DF & 2000P	2.5" W.C. ±0.2" W.C.

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

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

The following Instructions for PROPANE combustion calibration apply to both BMK 1500DF and BMK 2000DF dual fuel units, and to BMK 1500P and BMK 2000P single fuel Propane units.

#### PROPANE Combustion Calibration

1. Open the water supply and return valves to the unit and ensure that the system pumps are running.
2. Open the PROPANE supply valve to the unit.
3. Set the control panel ON/OFF switch to the **OFF** position
4. Turn on external ac power to the unit. The display will show loss of power and the time and date.
5. Set the unit to the Manual mode by pressing the **AUTO/MAN** key. A flashing manual valve position message will display the present position in % and the **MANUAL** LED will light.
6. Adjust the air/fuel valve position to 0% by pressing the ▼ arrow key.
7. Ensure that the leak detection ball valve downstream of the SSOV is open.
8. Set the ON/OFF switch to the **ON** position.
9. Change the valve position to **30%** using the ▲ arrow key. The unit should begin its start sequence and fire.
10. Next, verify that the gas pressure downstream of the SSOV is set to the proper value, listed in Table 4-5, above. If gas pressure adjustment is required, remove the brass hex nut on the SSOV actuator to access the gas pressure adjustment screw (Figure 4-3, above). Make gas pressure adjustments using a flat-tip screwdriver to obtain the proper gas pressure.
11. Using the ▲ arrow key, increase the valve open position to 100%. Verify that the gas pressure on the downstream side of the SSOV settles within the range listed in Table 4-5. Readjust the gas pressure if necessary.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

### PROPANE Combustion Calibration – Continued

12. With the valve position at 100%, insert the combustion analyzer probe into the flue probe opening and allow enough time for the combustion analyzer reading to stabilize.
13. Compare the oxygen readings on the combustion analyzer to the on-board O<sub>2</sub> sensor value displayed in the *Operating* Menu of the C-More Control Panel. If the values differ by more than  $\pm 1.5\%$  and your combustion analyzer is correctly calibrated, the on-board O<sub>2</sub> sensor may be defective and need to be replaced.
14. Compare the measured oxygen level to the oxygen range shown below. Also, ensure that the nitrogen oxide (NO<sub>x</sub>) and carbon monoxide (CO) readings do not exceed the values shown. If you are not in a “NO<sub>x</sub>-limited” area and/or do not have a NO<sub>x</sub> measurement in your analyzer, set the oxygen (O<sub>2</sub>) at **4.5%  $\pm$  0.5%**.

**Table 4-6: Combustion Calibration Readings – 100% Valve Position**

Valve Position	Oxygen (O <sub>2</sub> ) %	Nitrogen Oxide (NO <sub>x</sub> )	Carbon Monoxide (CO)
100%	4.0% - 5.0%	$\leq 50$ ppm	$< 150$ ppm

15. If the oxygen level is not within the required tolerance, the gas pressure on the downstream side of the SSOV must be adjusted using the gas pressure adjustment screw on the SSOV (Figure 4-3). Slowly rotate the gas pressure adjustment (approximately 1/4-turn increments). Allow the combustion analyzer to stabilize following each adjustment. Clockwise rotation reduces the oxygen level, while counterclockwise rotation increases the oxygen level.
16. Once the oxygen level is within the specified range at 100%, record the O<sub>2</sub>, NO<sub>x</sub> and CO readings on the Combustion Calibration Data Sheets provided with the unit.
17. Lower the valve position to **70%** using the ▼ arrow key.

#### NOTE

The remaining combustion calibration steps are performed using the *Combustion Cal* menu included in the C-More Control System. The combustion calibration control functions will be used to adjust the oxygen level (%) at valve positions of **70%**, **50%**, **40%**, **30%** and **18%**, as described below. These steps assume that the **inlet air temperature is within the range of 50°F to 100°F**. If NO<sub>x</sub> readings exceed the target values shown, increase the O<sub>2</sub> level up to 1% higher than the listed calibration range. Record the increased O<sub>2</sub> value on the Combustion Calibration sheet.

18. Press the **MENU** key on the front panel of the C-MORE and access the *Setup* menu. Enter password **6817** and then press the **ENTER** key.
19. Press the **MENU** key on the front panel of the C-MORE until **COMBUSTION CAL MENU** appears on the display.
20. Press the ▲ arrow key until **SET VALVE POSITION** appears on the display.
21. Press the **CHANGE** key. **SET VALVE POSITION** will begin to flash.
22. Press the ▲ arrow key until the *SET Valve Position* reads **70%**. Press the **ENTER** key.



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

### PROPANE Combustion Calibration – Continued

23. Next, press the down (▼) arrow key until **CAL Voltage 70%** is displayed.
24. Press the **CHANGE** key and observe that **CAL Voltage 70%** is flashing.
25. The oxygen level at the **70%** valve position should be as shown below. Also, ensure that the nitrogen oxide (NOx) and carbon monoxide (CO) readings do not exceed the following values:

**Table 4-7: Combustion Calibration Readings – 70% Valve Position**

Valve Position	Oxygen (O <sub>2</sub> ) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
70%	5.4% ± 0.5%	≤50 ppm	<150 ppm

26. If the oxygen level is not within the specified range, adjust the level using the ▲ and ▼ arrow keys. This will adjust the output voltage to the blower motor as indicated on the display. Pressing the ▲ arrow key increases the oxygen level and pressing the down ▼ arrow key decreases the oxygen level.
27. Once the oxygen level is within the specified range at **70%**, press the **ENTER** key to store the selected blower output voltage for the **70%** valve position. Record all readings on the Combustion Calibration Sheets provided.
28. Repeat steps 20 through 27 for valve positions of **50%**, **40%**, **30%** and **18%**. The oxygen (O<sub>2</sub>), nitrogen oxide (NOx) and carbon monoxide (CO) should remain within the same limits for all valve positions as shown in the following table.

#### NOTE

If NOx readings exceed the target values shown (<50 ppm), increase the O<sub>2</sub> level up to 1% higher than the listed calibration range shown in the table. Record the increased O<sub>2</sub> value on the Combustion Calibration sheet.

**Table 4-8: Combustion Calibration Readings**

Valve Position	Oxygen (O <sub>2</sub> ) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
50%	5.5% ± 0.5	<50 ppm	<150 ppm
40%	5.5% ± 0.5	<50 ppm	<150 ppm
30%	6.3% ± 0.5	<50 ppm	<150 ppm
18%	6.0% ± 0.5	<50 ppm	<150 ppm

29. If the oxygen level at the **18%** valve position is too high and the Blower voltage is at the minimum value, you can adjust the idle screw (TAC valve) which is recessed in the top of the Air/Fuel Valve (see Figure 4-4). Rotate the screw 1/2 turn clockwise (CW) to add fuel and reduce the O<sub>2</sub> to the specified level. Recalibration **MUST** be performed again from **50%** down to **18%** after making a change to the idle screw (TAC valve).
30. **This completes the PROPANE combustion calibration procedure.**

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

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### 4.5 REASSEMBLY AFTER COMBUSTION CALIBRATION

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

#### Reassembly After Combustion Calibration

1. Set the ON/OFF switch in the **OFF** position.
2. Disconnect AC power from the unit.
3. Shut off the gas supply to the unit.
4. Remove the manometer tubing and fitting from the port in the side of the high gas pressure switch and turn the integral port screw clock-wise until port is closed.
5. Remove the combustion analyzer probe from the 1/4" vent hole in the exhaust manifold. Replace the 1/4" NPT plug in the manifold.
6. Replace all previously removed sheet metal enclosures on the unit.
7. **This concludes reassembly of the unit after combustion calibration.**

### 4.6 DUAL-FUEL SWITCHOVER INSTRUCTIONS

#### NOTE

The switchover instructions in this section are only applicable to dual fuel models.

#### 4.6.1 Switchover from NATURAL GAS to PROPANE

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

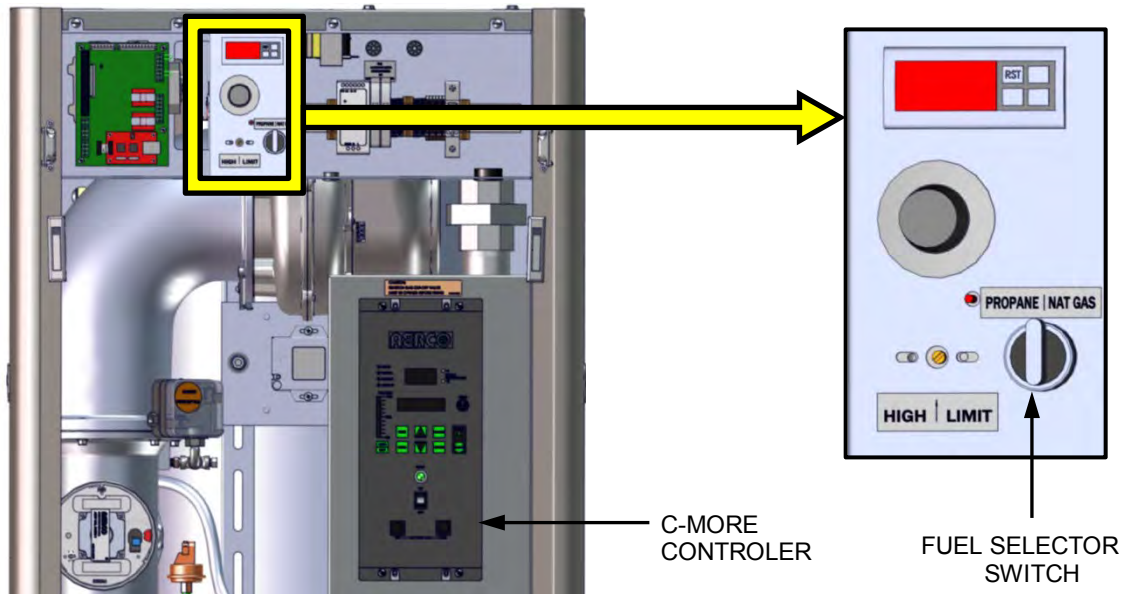
#### Switchover from NATURAL GAS to PROPANE

1. Set the ON/OFF switch on the C-More Controller to the **OFF** position.
2. Close the external Natural Gas supply valves.
3. Open the external Propane Gas supply valves.
4. Refer to Figure 4-6 and locate the Fuel Selector Switch on the unit, behind the front door.
5. Set the Fuel Selector Switch to the **PROPANE** position. A **GAS PRESSURE FAULT** message will be displayed on the Control Box.
6. Clear the Gas Pressure Fault by pressing the **CLEAR** key.
7. Set the ON/OFF switch on the C-More /control Box to the **ON** position.
8. Press the **MENU** key once. **SETUP MENU** will be displayed.
9. Press the **▲** arrow key once. **PASSWORD** will be displayed.
10. Press the **CHANGE** key. **PASSWORD** will begin to flash.
11. Using the **▲** arrow key, increment the display and stop at **159**.
12. Press the **ENTER** key to store the displayed password.
13. **PASSWORD 1** will be displayed, indicating that the valid Level 1 password has been stored.
14. Next, access the *Configuration* menu by pressing the **MENU** key once.
15. Using the **▲** and **▼** arrow keys, scroll through the *Configuration* menu and stop at **Fuel Type**.
16. Press the **CHANGE** key. **FUEL TYPE** will begin to flash.
17. Press the **▲** arrow key. **PROPANE** will be displayed.
18. Press the **ENTER** key to store the *Propane Fuel type*.
19. Replace the front door panel previously removed from the boiler.
20. **This completes the switchover from NATURAL GAS to PROPANE.**



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION



PARTIAL FRONT VIEW WITH FRONT COVER REMOVED

**Figure 4-6: Dual Fuel Switch Location**

### 4.6.2 Switchover from PROPANE to NATURAL GAS

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

#### Switchover from PROPANE to NATURAL GAS

1. Set the ON/OFF switch on the C-More Controller to the **OFF** position.
2. Close the external Propane Gas supply valves.
3. Open the external Natural Gas supply valves.
4. Refer to Figure 4-6 and locate the Fuel Selector Switch on the front of the unit.
5. Set the Fuel Selector Switch to the **NATURAL GAS** position. A **GAS PRESSURE FAULT** message will be displayed on the Control Box.
6. Clear the Gas Pressure Fault by pressing the **CLEAR** key.
7. Apply AC power to the boiler.
8. Press the **MENU** key once. **SETUP MENU** will be displayed.
9. Press the **▲** arrow key once. **PASSWORD** will be displayed.
10. Press the **CHANGE** key. **PASSWORD** will begin to flash.
11. Using the **▲** arrow key, increment the display and stop at **159**.
12. Press the **ENTER** key to store the displayed password.
13. **PASSWORD 1** will be displayed, indicating that the valid Level 1 password has been stored.
14. Next, access the *Configuration* menu by pressing the **MENU** key once.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

### Switchover from PROPANE to NATURAL GAS – Continued

15. Using the ▲ and ▼ arrow keys, scroll through the *Configuration* menu and stop at **FUEL TYPE**.
16. Press the **CHANGE** key. **FUEL TYPE** will begin to flash.
17. Press the ▼ arrow key. **NATURAL GAS** will be displayed.
18. Press the **ENTER** key to store the *Natural Gas Fuel* type.
19. Replace the front door panel previously removed from the boiler.
20. **This completes the steps necessary to switch from PROPANE Gas to NATURAL GAS.**

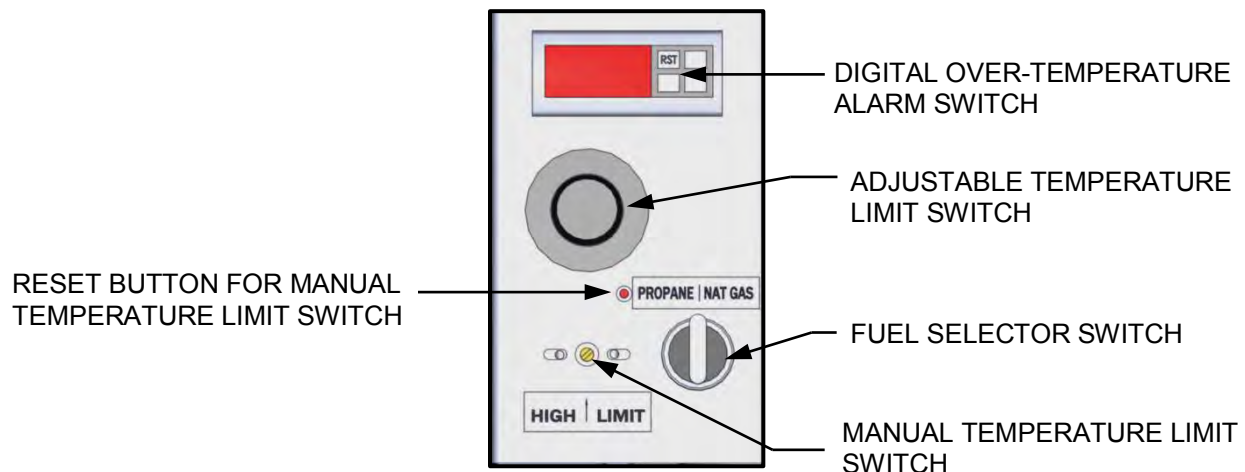
## 4.7 OVER-TEMPERATURE LIMIT SWITCHES

The unit contains three (3) types of over-temperature limit controls. These controls consist of a Manual Reset button, a rotary adjustable Temperature Limit switch and a digital Over-Temperature Alarm switch. These controls are mounted on a plate as shown in Figure 4-5. They can be accessed by opening the front panel door of the unit.

The Manual Reset button is not adjustable and is permanently fixed at 210°F (98.9°C). This button will shut down and lock out the boiler if the water temperature exceeds 210°F (98.9°C). Following an over-temperature condition, it must be manually reset by pressing the manual reset button shown in Figure 4-4 before the boiler can be restarted.

The rotary adjustable Over-Temperature Limit switch is manually adjustable from 32°F - 212°F (0°C – 100°C). This switch allows the boiler to restart, once the temperature drops below the selected temperature setting on the dial. Set the dial on this switch to the desired setting.

The digital Over-Temperature Alarm switch shown in Figures 4-5 and 4-6 is preset at the factory to 210°F (98.9°C) and should not be changed. If an over-temperature condition is detected, this switch automatically shuts down the boiler and sounds an audible alarm. If desired, the Over-Temperature Alarm can be checked or adjusted using the procedure in section 4.5.1.



**Figure 4-5: Over-Temperature Limit Switch Locations**

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

### 4.7.1 Digital Alarm Switch Checks and Adjustments

The Over-Temperature Alarm switch settings can be checked or adjusted using the controls and display on the front panel of the switch illustrated and described in Figure 4-6 and Table 4-9.

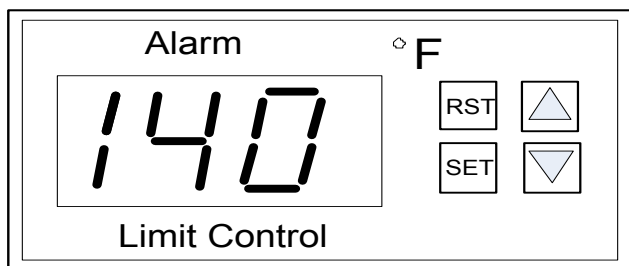


Figure 4-8: Digital Alarm Switch Front Panel

Table 4-9: Digital Alarm Switch Controls and Display

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

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

#### Check or Adjust Digital Alarm Switch Settings

1. Set the ON/OFF to the **ON** position.
2. Press the **SET** button on the Digital Alarm Switch. **SP** will appear in the display.
3. Press the **SET** button again. The current over-temperature limit value stored in memory will be displayed. (default = 210°F).
4. If the display does not show the required over-temperature alarm setting, press the ▲ or ▼ arrow button to change the display to the desired temperature setting.
5. Once the desired over-temperature alarm setting (210°F) is displayed, press the **SET** button to store the setting in memory.
6. To calibrate the offset (P1), press and hold the **SET** button for 8 seconds on the Digital Alarm Switch. Access code value **0** should appear in the display. The switch comes from the factory with the code set at 0. AERCO recommends that you do not change this code.
7. Press the **SET** button again to enter the code. The first parameter label, **SP**, will appear in the display.
8. Using the ▲ and ▼ arrow keys, select parameter P1.
9. Press **SET** to view the value stored in memory.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

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### Check or Adjust Digital Alarm Switch Settings – Continued

10. If the desired value is not displayed, modify the setting using the ▲ and ▼ arrow keys. The value can be changed from -10° to +10° offset. Press **SET** to enter the value and exit to the text parameter.
11. To exit the programming mode, press the **SET** and ▼ buttons simultaneously, or simply wait one minute and the display will automatically exit the programming mode.
12. Once the programming mode has been exited, the display will show the current outlet water temperature of the boiler.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

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### CHAPTER 5. MODE OF OPERATION

#### 5.1 INTRODUCTION

The boiler is capable of being operated in any one of six different modes. The following sections in this Chapter provide descriptions of each of these operating modes. Each boiler is shipped from the factory tested and configured for the ordered mode of operation. All temperature related parameters are at their factory default values which work well in most applications. However, it may be necessary to change certain parameters to customize the unit to the system environment. A complete listing and descriptions of the temperature related parameters are included in Appendix A. Factory defaults are listed in Chapter 3. 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 200 feet** from the unit. Sensor connections are made at the Input/Output (I/O) Box on the front of the boiler. Connections are made at the terminals labeled OUTDOOR AIR IN and AIR SENSOR COM inside the I/O Box. Use shielded 18 to 22 AWG wire for connections. A wiring diagram is provided on the cover of the I/O Box. Refer to Chapter 2, section 2.9.1 for additional wiring information.

##### 5.2.4 Indoor/Outdoor Startup

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

#### NOTE

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

### Indoor/Outdoor Startup

1. Refer to the Indoor/Outdoor reset ratio charts in Appendix E.
2. Choose the chart corresponding to the desired Building Reference Temperature.
3. Go down the left column of the chart to the coldest design outdoor air temperature expected in your area.
4. Once the design outdoor air temperature is chosen, go across the chart to the desired supply header temperature for the design temperature chosen in step 3.
5. Next, go up that column to the Reset Ratio row to find the corresponding reset ratio.
6. Access the *Configuration* menu and scroll through it until the display shows **BLDG REF TEMP** (Building Reference Temperature). If necessary, refer to section 3.3 for detailed instructions on menu changing.
7. Press the **CHANGE** key. The display will begin to flash.
8. Use the ▲ and ▼ arrow keys to select the desired Building Reference Temperature.
9. Press **ENTER** to save any changes.
10. Next, scroll through the *Configuration* menu until the display shows **RESET RATIO**.
11. Press the **CHANGE** key. The display will begin to flash.
12. Use the ▲ and ▼ arrow keys to select the Reset Ratio determined in step 5.
13. Press **ENTER** to save the change.

### 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:

**Table 5-1: Constant Setpoint Mode Settings**

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

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

### 5.4 REMOTE SETPOINT MODES

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

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

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

In addition to the current and voltage signals described above, the REMOTE SETPOINT mode can also driven by a RS485 Modbus Network signal from an EMS or BAS.

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

#### NOTE

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

In order to enable the REMOTE SETPOINT mode, the following menu setting must be made in the *Configuration* menu:

**Table 5-2: Remote Setpoint Mode Settings**

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

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

If the Network setting is selected for RS485 Modbus operation, a valid Comm Address must be entered in the *Setup* menu. Refer to Modbus Communication Manual GF-114 for additional information.

While it is possible to change the settings of temperature related functions, the unit is factory preset with settings that work well in most applications. It is suggested that an AERCO representative be contacted, prior to changing any temperature related function settings. For descriptions of temperature-related functions and their factory defaults, refer to Appendices A and E.

#### 5.4.1 Remote Setpoint Field Wiring

The only wiring connections necessary for the REMOTE SETPOINT mode are connection of the remote signal leads from the source to the unit's I/O Box. The I/O Box is located on the front panel of the boiler. For either a 4-20mA/0-5V or a 0-20mA/0-5V setting, the connections are made at the ANALOG IN terminals in the I/O Box. For a Network setting, the connections are made at the RS485 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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

must be observed. The source end of the shield must be connected at the source. When driving multiple units, each unit's wiring must conform to the above.

### 5.4.2 Remote Setpoint Startup

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

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

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

## 5.5 DIRECT DRIVE MODES

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

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

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

In addition to the current and voltage signals described above, the DIRECT DRIVE mode can also driven by a RS485 Modbus Network signal from an EMS or BAS.

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

### NOTE

If a voltage, rather than current signal is used to control the remote setpoint, a DIP switch adjustment must be made on the 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:

**Table 5-3: Direct Drive Mode Settings**

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

Refer to section 3.3 for instructions on changing menu options.



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

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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 RS485 COMM terminals in the I/O Box. The signal must be floating, (ungrounded) at the I/O Box and the wire used must be a two wire shielded pair from 18 to 22 AWG. Polarity must be observed. The source end of the shield must be connected at the source. When driving multiple units, each unit's wiring must conform to the above.

### 5.5.2 Direct Drive Startup

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

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

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

## 5.6 AERCO CONTROL SYSTEM (ACS)

### NOTE

ACS can utilize only RS485 signaling to the boiler.

The ACS mode of operation is used in conjunction with an AERCO Control System. The ACS mode is used when it is desired to operate multiple units in the most efficient manner possible. For this mode of operation, an ACS Header Sensor must be installed between 2 and 10 feet downstream of the LAST boiler in the boiler plant's supply water header. The ACS can control up to 40 boilers; Up to 32 via Modbus (RS485) network communication. For ACS programming, operation, and Header Sensor installation details, see ACS Operations Guide, GF-131. For operation via an RS485 Modbus network, refer to Modbus Communication Manual GF-114.

To enable the ACS Mode, the following menu settings must be made in the *Configuration* menu:

Menu Option	Setting
Boiler Mode	Direct Drive
Remote Signal	Network (RS485)

Refer to section 3.3 for instructions on changing menu options.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

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### 5.6.1 ACS External Field Wiring

Wiring connections for RS485 Modbus control are made between the 485 A- and 485 B+ terminals on the ACS (boilers 9 through 40) and the RS485 COMM terminals in the I/O Box on the front of the boilers.

Wire the units using shielded twisted pair wire between 18 and 22 AWG. Observe the proper polarity for the ACS RS485 COMM wiring connections. Shields should be terminated only at the ACS and the boiler end must be left floating. Each unit's wiring must conform to the above.

### 5.6.2 ACS Setup and Startup

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

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

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

## 5.7 COMBINATION CONTROL SYSTEM (CCS)

### NOTE

Only ACS can be utilized for the Combination Control System.

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

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

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

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

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

between the BLDG HEAT and BLDG PRIORITY boilers, and the other between the BLDG PRIORITY and the DHW PRIORITY boilers.

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

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

### 5.7.1 Combination Control System Field Wiring

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

### 5.7.2 Combination Control System Setup and Startup

Setup for the COMBINATION mode requires entries to be made in the *Configuration* menu for boiler mode, remote signal type and setpoint. The setpoint is adjustable from 40°F to 190°F.

Enter the following settings in the *Configuration* menu:

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

Refer to section 3.3 for instructions on changing menu options.

While it is possible to change other temperature-related functions for COMBINATION mode, these functions are preset to their factory default values. These default settings work well in most applications. It is suggested that AERCO be contacted prior to changing settings other than the unit's setpoint. For a complete listing of temperature related function defaults, see Chapter 3.

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

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

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 5 – MODE OF OPERATION

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### CHAPTER 6. SAFETY DEVICE TESTING

#### 6.1 TESTING OF SAFETY DEVICES

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

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

#### NOTE

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

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

#### **WARNING!**

Electrical voltages in this system may include 120 and 24 volts AC. Power must be removed prior to performing wire removal or other test procedures that can result in electrical shock.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 6 – SAFETY DEVICE TESTING

### 6.2 LOW GAS PRESSURE FAULT TEST

The instructions below apply to both the BMK 1500DF and BMK 2000DF and to both the NATURAL GAS and PROPANE gas trains.

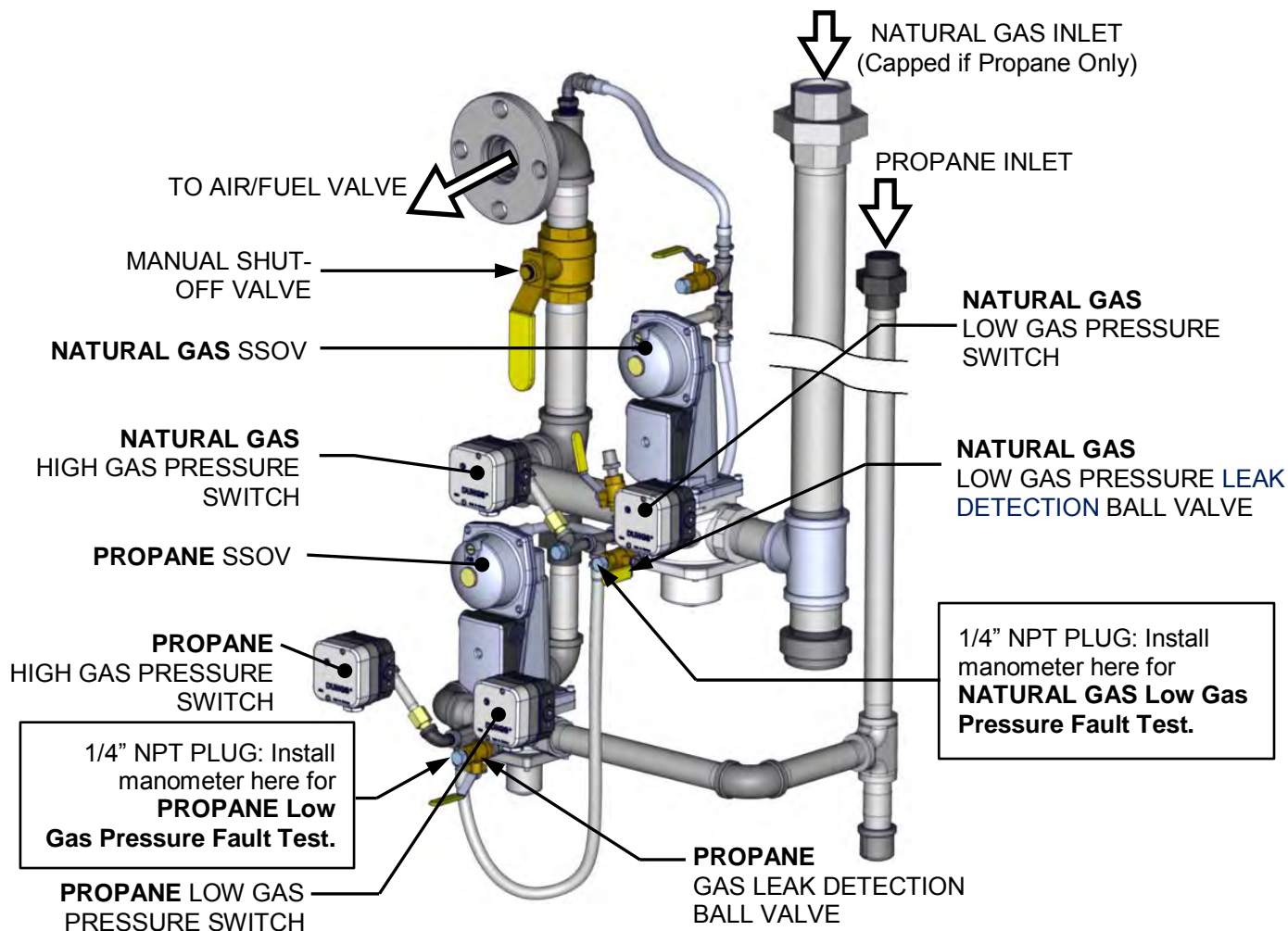


Figure 6-1a: Low Gas Pressure Test

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

#### Low Gas Pressure Fault Test

1. Ensure that the appropriate low gas pressure leak detection ball valve (Natural Gas or Propane) is closed (see Figure 6-1a). Note that there are two Natural Gas leak detection ball valves (for high and low pressure) but only one on the Propane gas train.
2. Remove the 1/4" plug from the appropriate (Natural Gas or Propane) ball valve at the associated low gas pressure switch as shown in Figure 6-1a.
3. Install a 0 – 16" W.C. manometer or a W.C. gauge where the 1/4" plug was removed.
4. Slowly open the ball valve near the low gas pressure switch.
5. Place the unit in **MANUAL** mode and adjust the Air/Fuel Valve position (% open) **between 25 and 30%**.
6. While the unit is firing, slowly close the external manual gas shut-off valve.



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

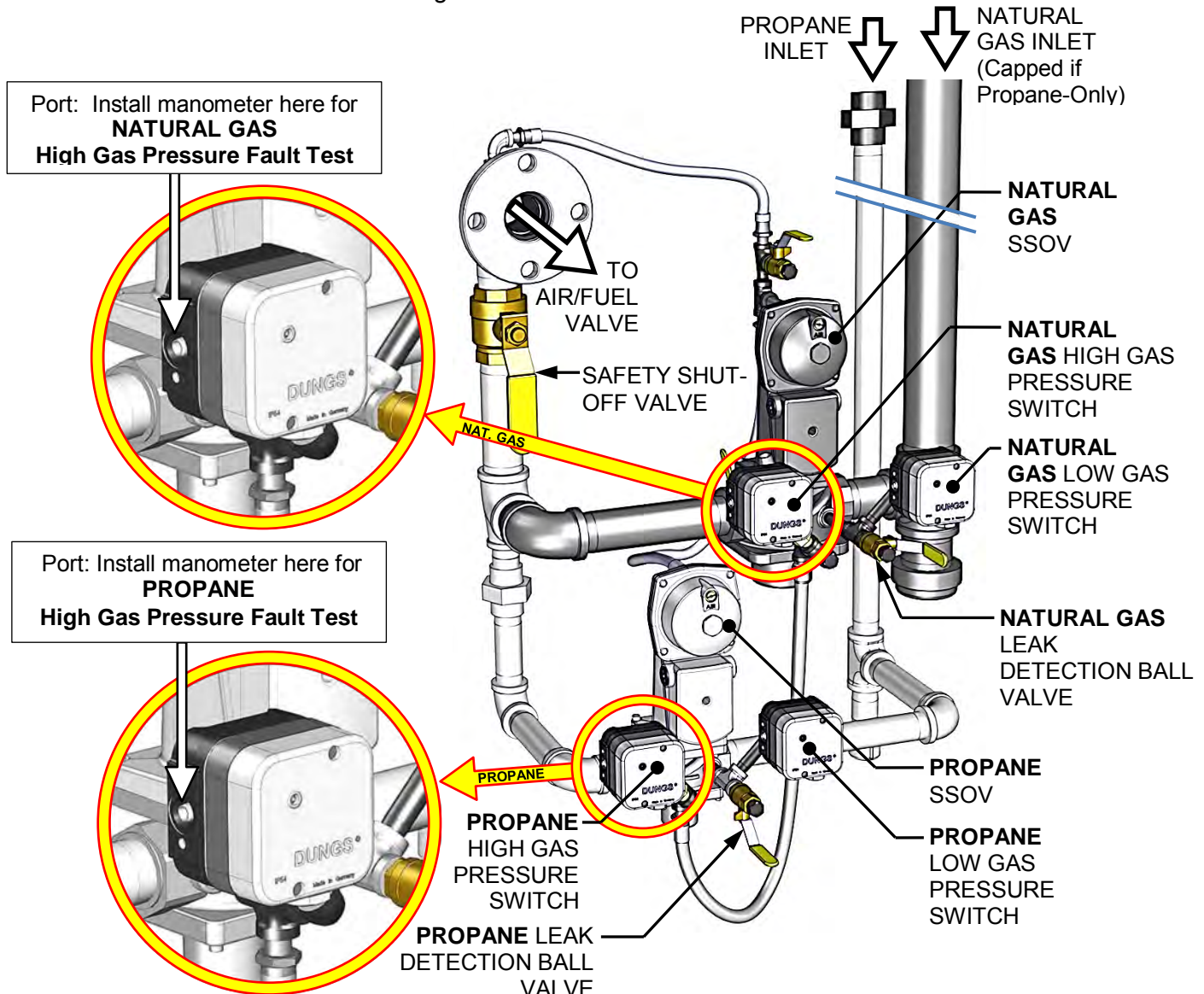
## CHAPTER 6 – SAFETY DEVICE TESTING

### Low Gas Pressure Fault Test – Continued

7. The unit should shut down and display a **GAS PRESSURE** fault message at approximately **2.6" W.C.**
8. Fully open the external manual gas shut-off valve and press the **CLEAR** button on the Control Box.
9. The fault message should clear and the **FAULT** indicator should go off. The unit should restart.
10. Upon test completion, close the ball valve and remove the manometer. Replace the 1/4" plug removed in step 1.

### 6.3 HIGH GAS PRESSURE TEST

The instructions below apply to both the BMK 1500DF and BMK 2000DF and to both the NATURAL GAS and PROPANE gas trains.



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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 6 – SAFETY DEVICE TESTING

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

### High Gas Pressure Test

1. Ensure that the appropriate high gas pressure leak detection ball valve (Natural Gas or Propane) is closed (see Figure 6-1b). Note that there are two Natural Gas leak detection ball valves (for high and low pressure) but only one on the Propane gas train.
2. Locate the appropriate port (Natural Gas or Propane) on the side of the High Gas Pressure Switch, as shown in Figure 6-1b, and turn the screw inside the port a few turns counter-clockwise to open. Do not remove the screw. Install a NPT-to-barbed fitting into the port.
3. Slowly open the leak detection ball valve.
4. Start the unit in MANUAL mode at a valve position (firing rate) between 25 and 30%.
5. With the unit running, monitor the gas pressure on the manometer installed in step 2 and record the gas pressure reading.
6. Slowly increase the gas pressure using the adjustment screw on the SSOV (see Figure 4-3).
7. The unit should shut down and display a **GAS PRESSURE** fault message when the gas pressure exceeds the value in the Gas Pressure column in Table 6-1, below.

**Table 6-1: High Gas Pressure Switch Test**

Unit	Fuel	Switch Setting	Gas Pressure
BMK 1500DF	Natural Gas	4.7" W.C.	3.5" W.C.
BMK 1500DF	Propane	3.5" W.C.	1.4" W.C.
BMK 2000DF	Natural Gas	7.5" W.C.	6.3" W.C.
BMK 2000DF	Propane	3.5" W.C.	2.5" W.C.

8. Reduce the gas pressure back to the value recorded in step 6. This pressure should be within the range of the value in Table 6-1, above.
9. Press the **CLEAR** button on the Control Box to clear the fault.
10. The fault message should clear and the **FAULT** indicator should go off. The unit should restart.
11. Upon test completion, close the ball valve and remove the manometer. Replace the 1/4" plug removed in step 1.

## 6.4 LOW WATER LEVEL FAULT TEST

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

### Low Water Level Fault

1. Set the ON/OFF switch to the **OFF** position
2. Close the water shut-off valves in the supply and return piping to the unit.
3. Slowly open the drain valve on the rear of the unit. If necessary the unit's relief valve may be opened to aid in draining.
4. Continue draining the unit until a **LOW WATER LEVEL** fault message is displayed and the **FAULT** indicator flashes.
5. Place the unit in the MANUAL mode and raise the valve position above 30%.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 6 – SAFETY DEVICE TESTING

### Low Water Level Fault – *Continued*

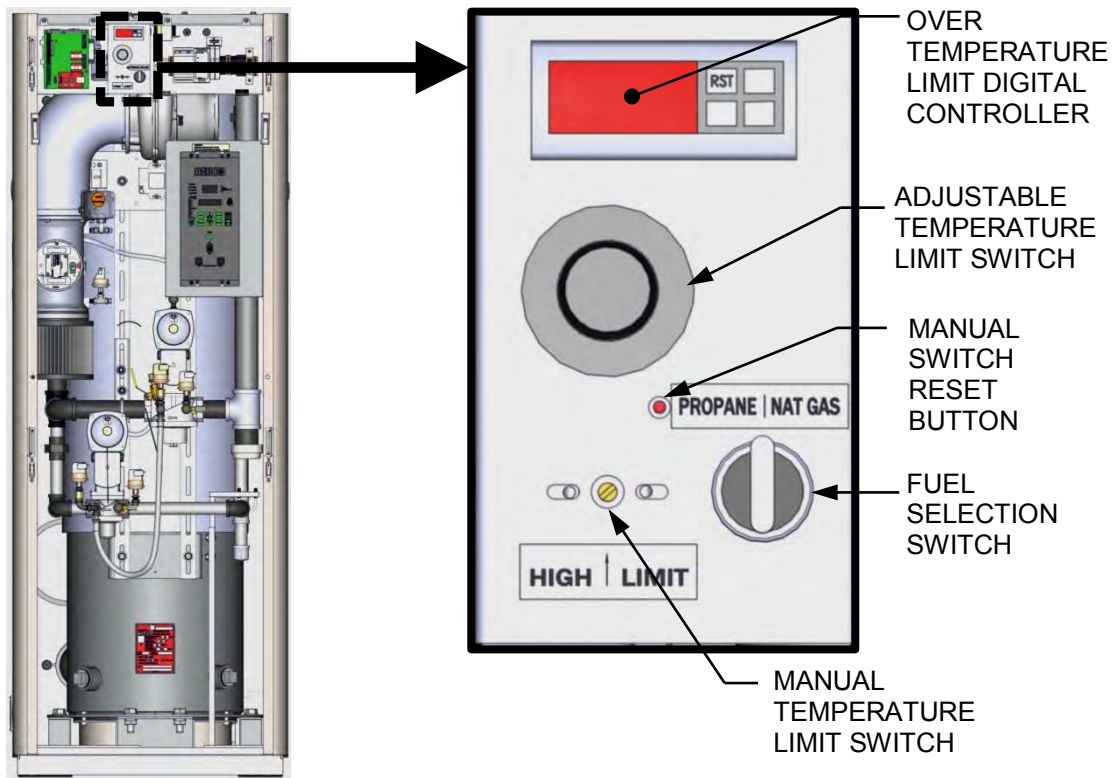
6. Set the ON/OFF switch to the **ON** position. The READY light should remain off and the unit should not start. If the unit does start, shut the unit off immediately and refer fault to qualified service personnel.
7. Close the drain and pressure relief valve used in draining the unit.
8. Open the water shut-off valve in the return piping to the unit.
9. Open the water supply shut-off valve to the unit to refill.
10. After the shell is full, press the **LOW WATER LEVEL RESET** button to reset the low water cutoff.
11. Press the **CLEAR** button to reset the FAULT LED and clear the displayed error message.
12. Set the ON/OFF switch to the **ON** position. The unit is now ready for operation.

## 6.5 WATER TEMPERATURE FAULT TEST

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

### Water Temperature Fault Test

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



**Figure 6-2: Temperature Limit Switch Location**

## 6.6 INTERLOCK TESTS

The unit is equipped with two interlock circuits called the Remote Interlock and Delayed Interlock. Terminal connections for these circuits are located in the I/O Box (Figure 2-12) and are labeled REMOTE INTL’K IN and DELAYED INTL’K IN. These circuits can shut down the unit in the event that an interlock is opened. These interlocks are shipped from the factory jumpered (closed). However, each of these interlocks may be utilized in the field as a remote stop and start, an emergency cut-off, or to prove that a device such as a pump, gas booster, or louver is operational.

### 6.6.1 Remote Interlock Test

#### Remote Interlock Test

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

### 6.6.2 Delayed Interlock Test

#### Delayed Interlock Test

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

### 6.7 FLAME FAULT TESTS

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

#### Flame Fault Tests

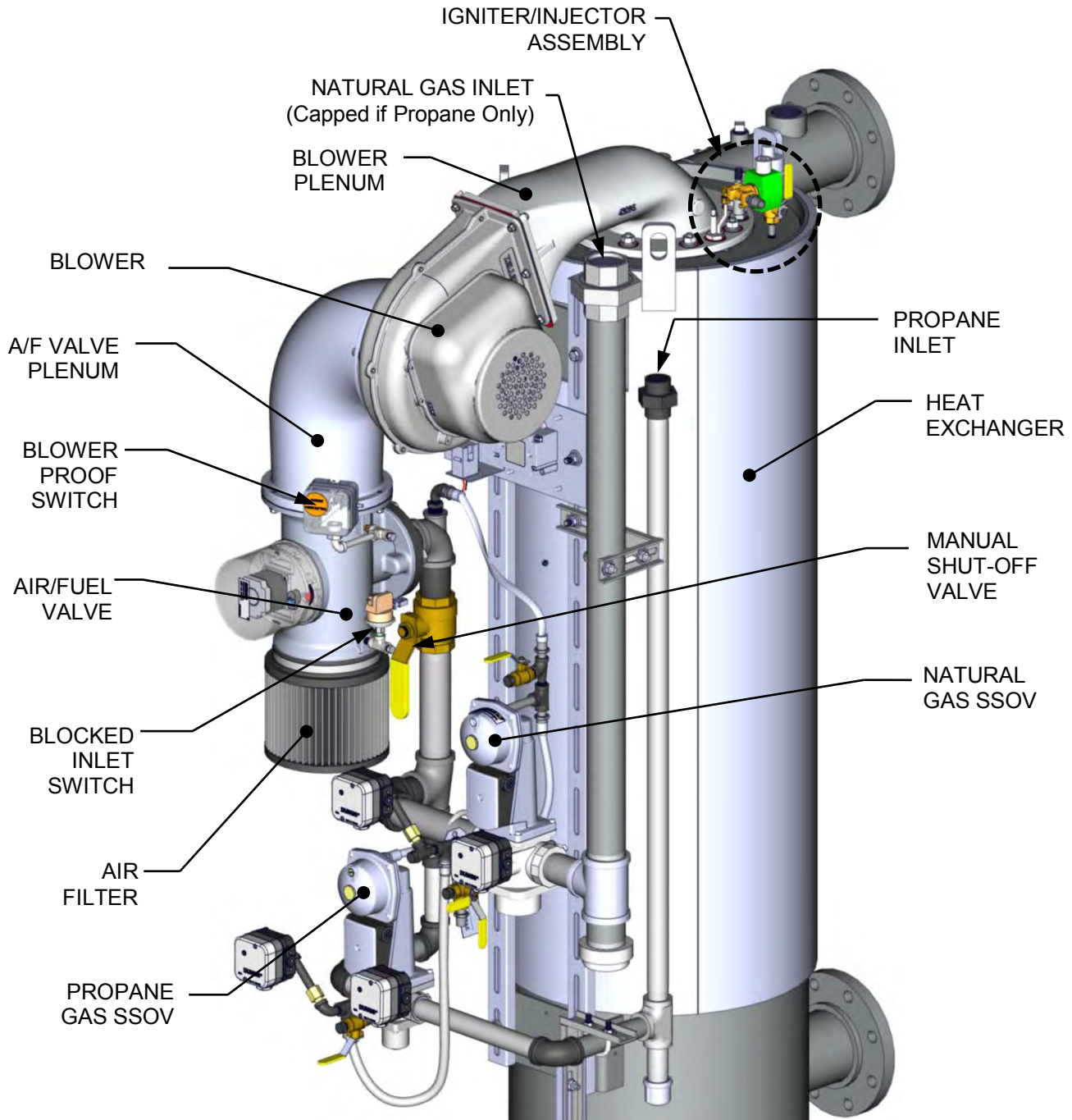
1. Set the ON/OFF switch to the **OFF** position.
2. Place the unit in the MANUAL mode and set the valve position **between 25% and 30%**.
3. Close the manual gas shutoff valve located between the Safety Shut-Off Valve (SSOV) and the Air/Fuel Valve (see Figure 6-3).
4. Set the ON/OFF switch to the **ON** position to start the unit.
5. The unit should purge and light the Pilot Flame, then it should shut down after reaching the main burner ignition cycle and display **FLAME LOSS DURING IGN.**
6. Open the valve previously closed in step 3 and press the **CLEAR** button.
7. Restart the unit and allow it to prove flame.
8. Once flame is proven, close the manual gas valve located between the SSOV (Figure 6-3) and the Air/Fuel Valve.
9. The unit should shut down and execute an *IGNITION RETRY* cycle by performing the following steps:
  - a) The unit will execute a shutdown purge cycle for a period of 15 seconds and display **WAIT FAULT PURGE.**
  - b) The unit will execute a 30 second re-ignition delay and display **WAIT RETRY PAUSE.**
  - c) The unit will then execute a standard ignition sequence and display **WAIT IGNITION RETRY.**

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 6 – SAFETY DEVICE TESTING

### Flame Fault Tests – *Continued*

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



**Figure 6-3: Bare Boiler – Partial View**



### 6.8 AIR FLOW FAULT TESTS

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

#### 6.8.1 Blower Proof Switch Test

##### Blower Proof Switch Test

1. Disable the blower output drive voltage as follows:
  - a) Press the **MENU** key until **CONFIGURATION MENU** is displayed.
  - b) Press the **▲** arrow key until the **ANALOG OUTPUT** function is displayed, then press the **CHANGE** key.
  - c) Press the **▼** arrow key until **OFF** is displayed, then press the **ENTER** key.
2. Start the unit and put the unit in MANUAL mode at a valve position **between 25% and 30%**.
3. The unit should shut down and lockout, showing **AIRFLOW FAULT DURING PURGE** in the display.
4. The unit should perform one IGNITION RETRY cycle and then shut down, since the blower is disabled. The unit will then display **AIRFLOW FAULT DURING PURGE**.
5. Re-enable the blower output drive voltage by performing the following steps:
  - a) Press the **MENU** key until **CONFIGURATION MENU** is displayed.
  - b) Press the **▲** arrow key until the **ANALOG OUTPUT** function is displayed, then press the **CHANGE** key.
  - c) Press the **▲** arrow key until **VALVE POSITION 0-10V** is displayed, then press the **ENTER** key. (Note, some units will instead display **VALVE POSITION 4-20V**.)
  - d) Press the **CLEAR** button to clear the airflow fault.
6. Once the unit has proved flame, turn off the blower again by going to the *Configuration* menu, *Analog Output* menu item and select **OFF**.
7. The Blower Proof Switch will open and the blower should stop. The unit should shut down and display **AIRFLOW FAULT DURING RUN**.
8. Go to the *Configuration* menu, *Analog Output* item and select **VALVE POSITION 0-10v**.

#### 6.8.2 Blocked Inlet Switch Test

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

##### Blocked Inlet Switch Test

1. Turn the main ON/OFF switch on the front of the Control Panel to the **OFF** position.
2. For units that get combustion air from a Combustion Air Duct, remove that duct, located directly above the boiler (see Figure 6.3, above). For units that have an air filter in place of a Combustion Air Duct (not shown), remove the air filter.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 6 – SAFETY DEVICE TESTING

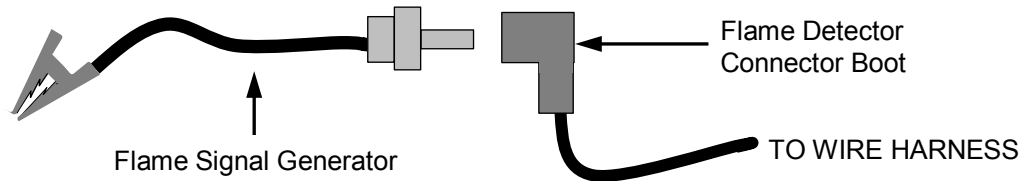
### Blocked Inlet Switch Test – Continued

#### **WARNING!**

The blower suction is very strong and can pull nearby objects into the blower's fan blades. Do not allow anything to be pulled into the blower. Do not wear anything that could get caught and pull you into the blower.

3. Turn off the gas supply ball valve to the boiler and then complete the following steps:

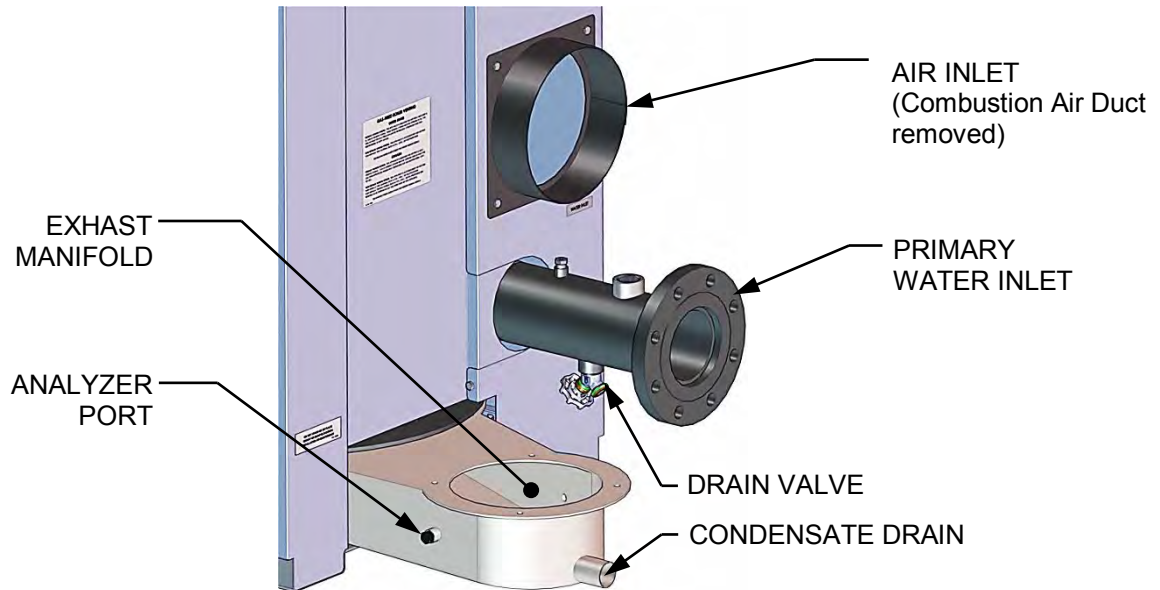
- a) Use jumper wires to jump out the Low Gas Pressure Switch and the Blower Proof Switch.
- b) Remove the black connector boot from the Flame Detector.
- c) Connect the Flame Signal Generator to the black connector boot.



**Figure 6.3a: Connecting the Flame Signal Generator**

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





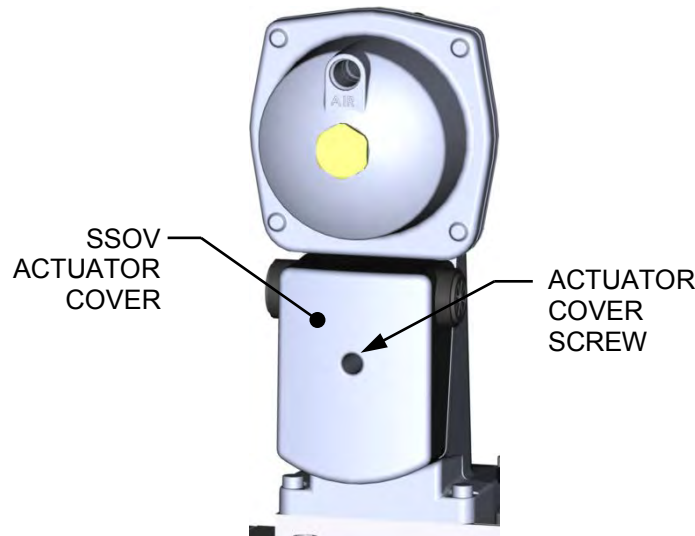
**Figure 6-4: Boiler Rear View Showing Air Inlet Location**

### 6.9 SSOV PROOF OF CLOSURE SWITCH

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

#### SSOV Proof of Closure Switch

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



**Figure 6-5: SSOV Actuator Cover Location**

### 6.10 PURGE SWITCH OPEN DURING PURGE

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

#### Purge Switch Open During Purge

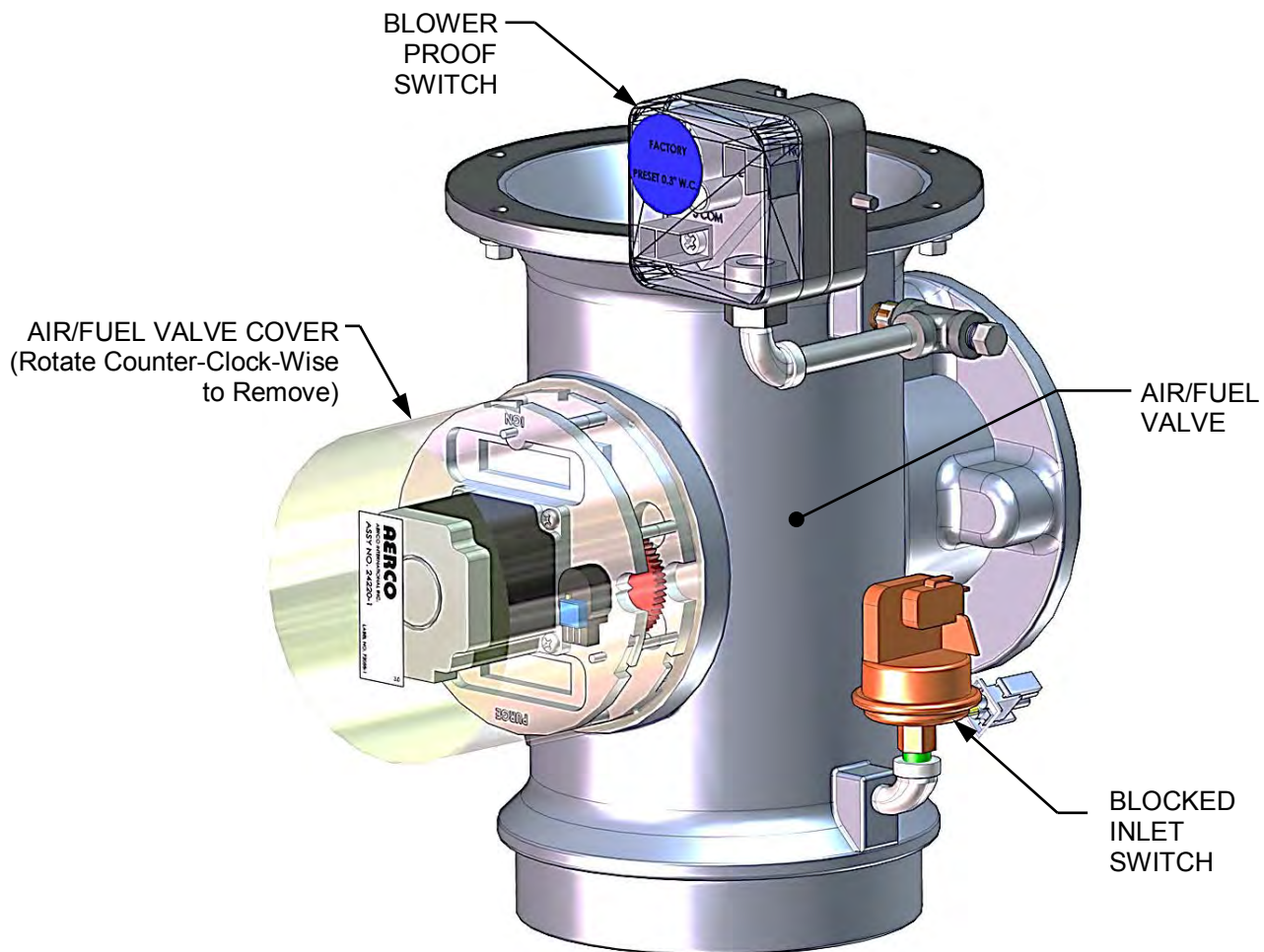
1. Set the unit's ON/OFF switch to the **OFF** position.
2. Place the unit in MANUAL mode and set the valve position **between 25% and 30%**.
3. Remove the Air/Fuel Valve cover by rotating the cover counterclockwise to unlock it (see Figure 6-6).
4. Remove one of the two wires (#171 or #172) from the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

### 6.11 IGNITION SWITCH OPEN DURING IGNITION

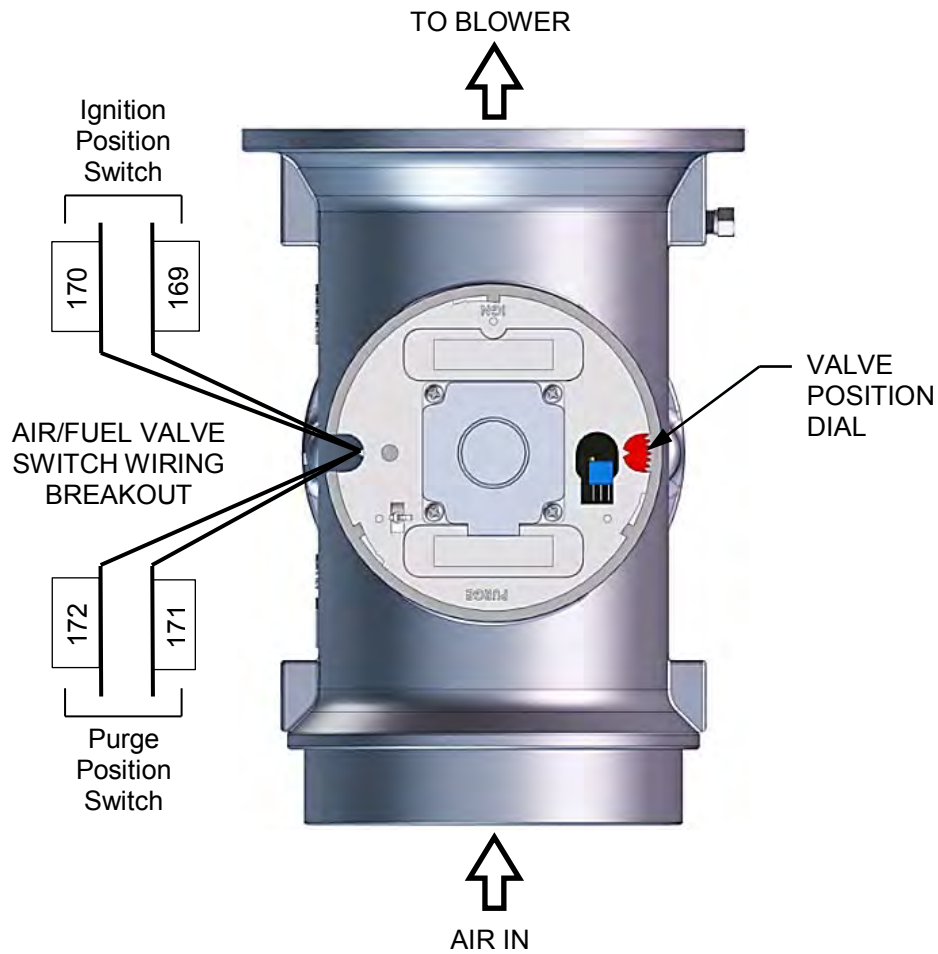
The Ignition Switch (and the Purge Switch) is located on the Air/Fuel Valve. To check the switch, proceed as follows:

#### Ignition Switch Open During Ignition

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



**Figure 6-6: Air/Fuel Valve Cover Location**



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

### 6.12 SAFETY PRESSURE RELIEF VALVE TEST

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

### CHAPTER 7. MAINTENANCE

#### 7.1 MAINTENANCE SCHEDULE

The unit requires regular routine maintenance to keep up efficiency and reliability. For best operation and life of the unit, the following routine maintenance procedures should be performed in the time periods specified in Table 7-1. For a complete inspection check list see ASME CSD-1 chart.

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

- 12 Month Maintenance Kit, P/N **58025-01**
- 24-Month Waterside/Fireside Inspection Kit, P/N **58025-13** (See NOTE below)

#### NOTE

The 24-Month Waterside/Fireside Inspection Kit also includes the items contained in the Annual Maintenance Kit (P/N **58025-01**). Therefore, only Kit P/N **58025-13** is required when performing the waterside/fireside inspections. Refer to Appendix K for recommended spares.

#### WARNING!

To avoid personal injury, prior to servicing ensure that the following guidelines are strictly observed:

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

**Table 7-1: Maintenance Schedule**

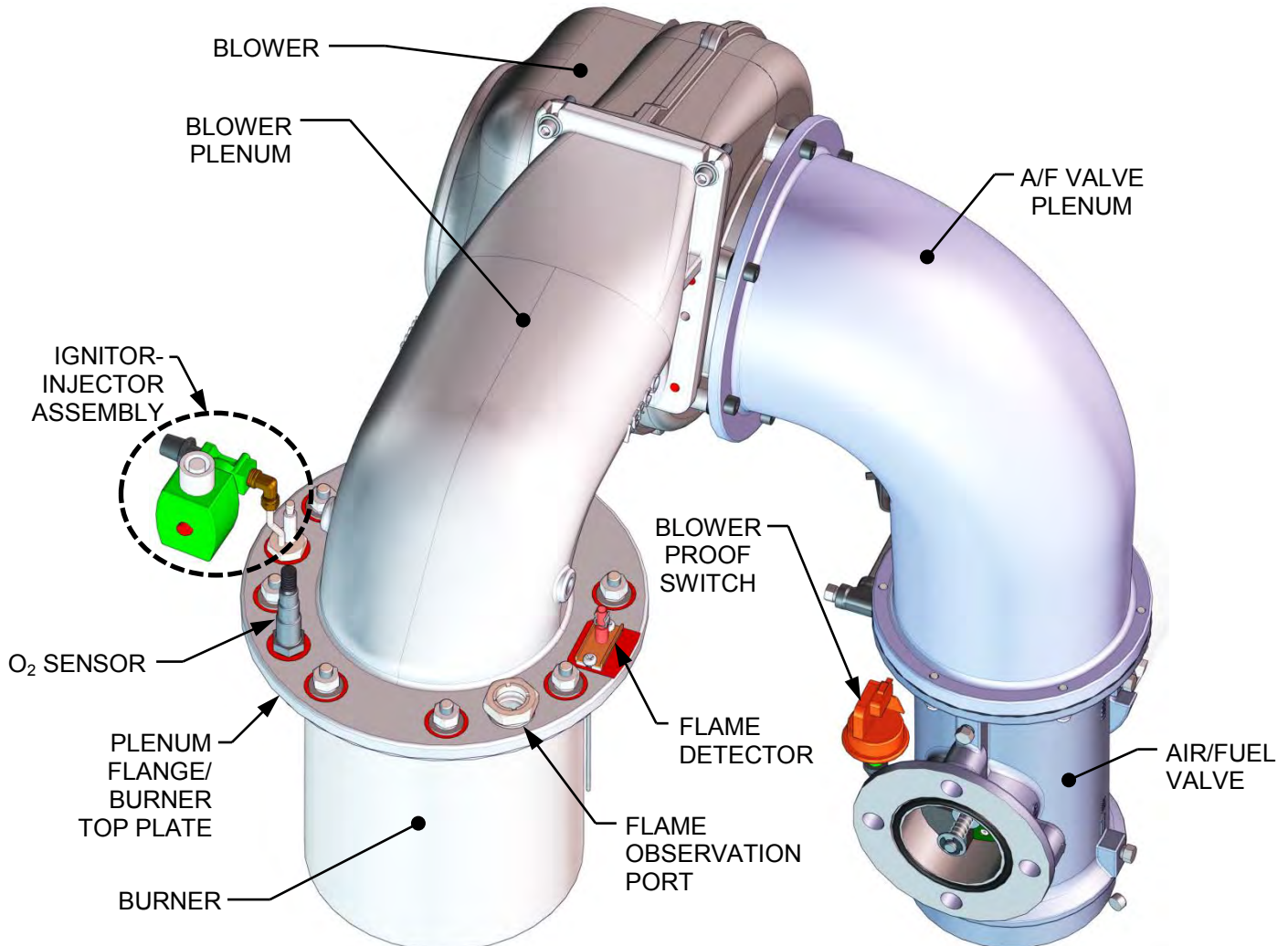
Section	Item	6 Mos.	12 Mos.	24 Mos.	Labor Time
<b>7.2</b>	Igniter-Injector Kit (P/N <b>58023</b> )	*Inspect	Inspect	Replace	15 mins.
<b>7.3</b>	Flame Detector Kit (P/N <b>24356-1</b> )	*Inspect	Inspect	Replace	15 mins.
<b>7.4</b>	Lean O <sub>2</sub> Sensor (P/N <b>61026</b> )	*Inspect	Inspect	-	15 mins.
<b>4.3 &amp; 4.4</b>	Combustion Calibration	*Check	Check	-	1 hr.
<b>7.5</b>	Testing of Safety Devices	-	See ASME CSD-1 Chart	-	45 mins.
<b>7.6</b>	Burner	-	-	Inspect	2 hrs.
<b>7.7</b>	Condensate Drain Trap	*Inspect	Inspect, Clean & Replace Gaskets	Inspect, Clean & Replace Gaskets	30 mins.
<b>7.8</b>	Air Filter (P/N <b>59138</b> )	-	Clean	Replace	15 mins.
<b>7.9</b>	Low Water Cutoff (LWCO) Probe Capacitor	-	Test	Replace & Test	15 mins.

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



### 7.2 IGNITER-INJECTOR

The igniter-injector (Kit P/N 58023) is located on the burner plate at the top of the boiler. In addition to providing the ignition spark required to light the burner, the igniter-injector also contains a gas injector tube which connects to the staged ignition assembly. Figure 7-1 shows the complete burner assembly removed from the boiler and indicates the location of the igniter-injector flame detector and other related components.



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

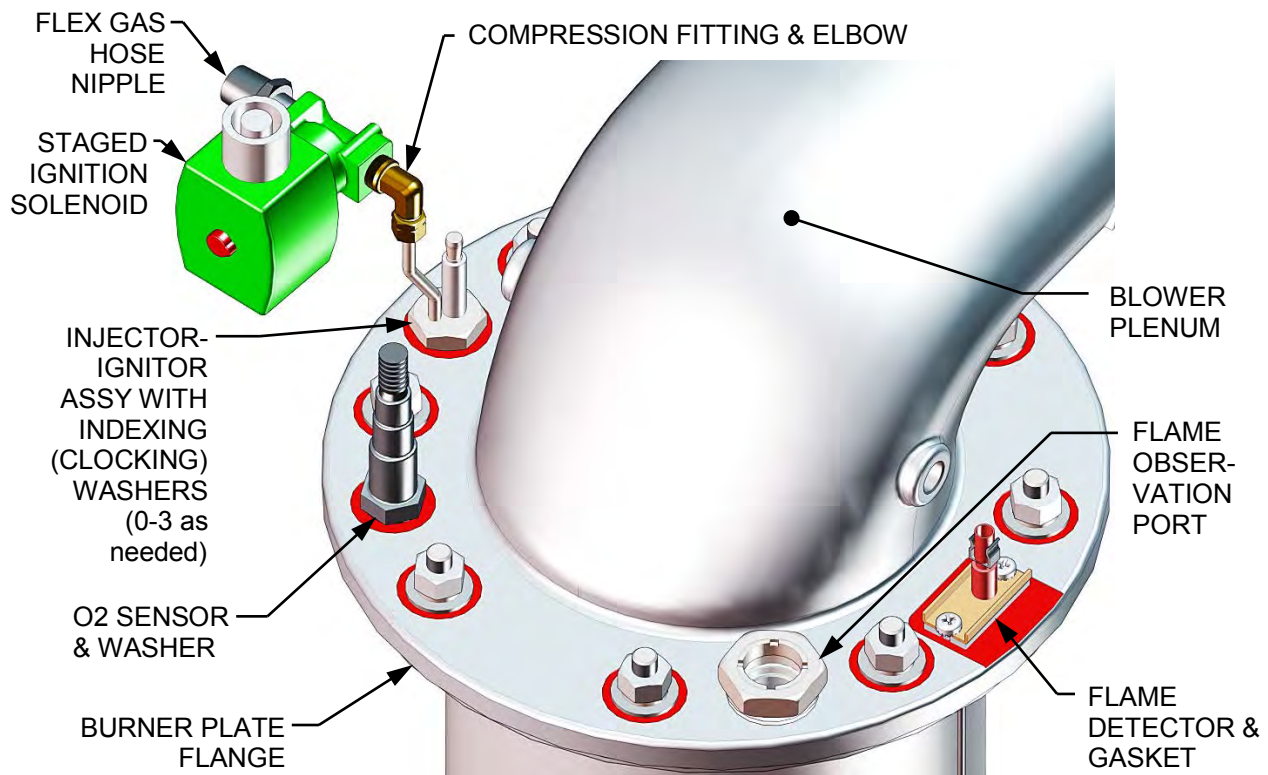
The igniter-injector may be hot, therefore, care should be exercised to avoid burns. It is easier to remove the igniter-injector from the unit after the unit has cooled to room temperature. To inspect/replace the Igniter:

#### Igniter-Injector Maintenance Procedures

1. Set the ON/OFF switch on the control panel, to the **OFF** position. Disconnect AC power from the unit
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.
3. Disconnect the cable from the igniter-injector (Figure 7-1).

### Igniter-Injector Maintenance Procedures – Continued

4. Refer to the partial exploded view in Figure 7-2. Using a 7/16" open-end wrench, disconnect the compression nut securing the gas injector tube of the igniter-injector to the elbow of the staged ignition assembly. Disconnect the staged ignition assembly from the igniter-injector.
5. Next, loosen and remove the igniter-injector from the burner plate using a 1" open-end wrench.
6. Check the igniter-injector for evidence of erosion or carbon build-up. If there is evidence of substantial erosion or carbon build-up, the igniter-injector should be replaced. If carbon build-up is present, clean the component using fine emery cloth. Repeated carbon build-up is an indication that the combustion settings of the unit should be checked. Refer to Chapter 4 for combustion calibration procedures.



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

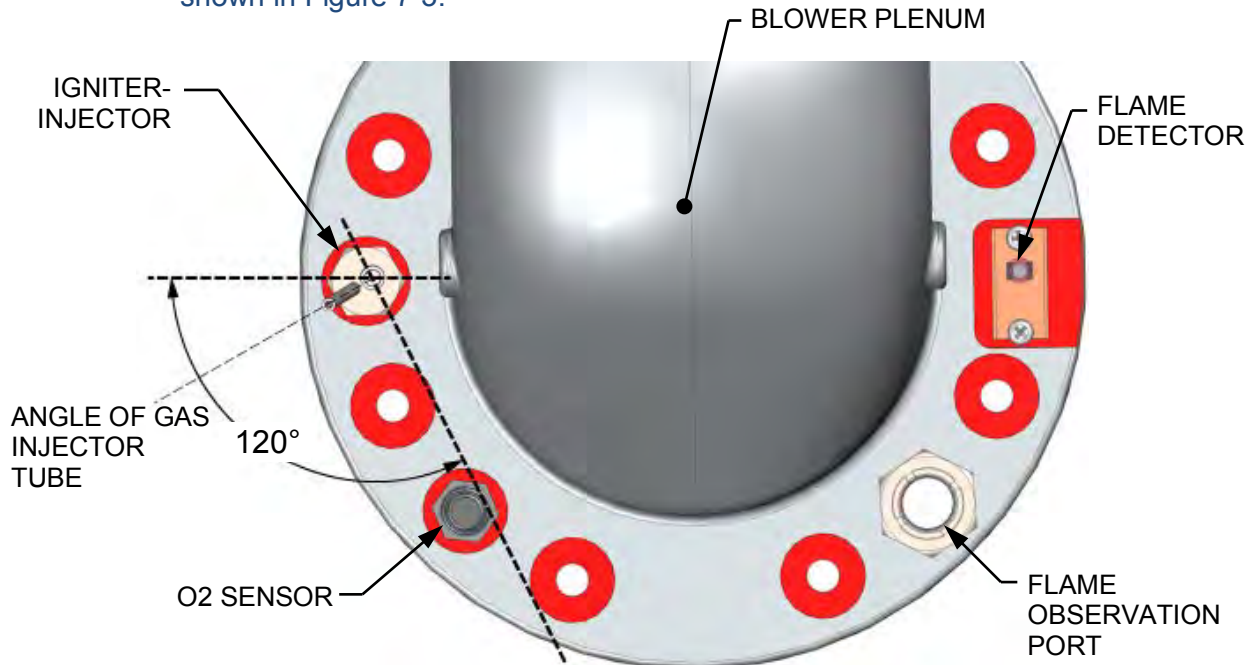
7. Next, loosen and remove the igniter-injector from the burner plate using a 1" open-end wrench.
8. Check the igniter-injector for evidence of erosion or carbon build-up. If there is evidence of substantial erosion or carbon build-up, the igniter-injector should be replaced. If carbon build-up is present, clean the component using fine emery cloth. Repeated carbon build-up is an indication that the combustion settings of the unit should be checked. Refer to Chapter 4 for combustion calibration procedures.
9. Prior to reinstalling the igniter-injector, a high temperature, conductive, anti-seize compound must be applied to the threads.



### Igniter-Injector Maintenance Procedures – Continued

#### NOTE

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



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

10. Reinstall the igniter-injector in the burner plate. **Torque to 170 - 180 in-lbs. DO NOT over tighten.**
11. Connect the staged ignition assembly to the gas injector tube of the igniter-injector by securing the compression nut to the elbow of the staged ignition assembly.
12. Reconnect the igniter-injector cable.
13. Reinstall the shroud on the unit.

## 7.3 FLAME DETECTOR

The flame detector (Kit P/N **24356-1**) is located on the burner plate at the top of the unit (see Figures 7-1 and 7-2). The flame detector may be hot. Allow the unit to cool sufficiently before removing the flame detector. Inspect or replace the flame detector as follows:

### Flame Detector Maintenance

1. Set the control panel ON/OFF switch to the **OFF** position. Disconnect AC power from the unit.
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 7 – MAINTENANCE

### Flame Detector Maintenance – Continued

3. Disconnect the flame detector lead wire.
4. Remove the two (2) screws securing the flame detector to the plate (Figure 7-2). The flame detector is secured to the burner plate with one #10-32 screw and one #8-32 screw.
5. Remove the flame detector and gasket from the burner plate.
6. Thoroughly inspect the flame detector. If eroded, the detector should be replaced. Otherwise clean the detector with a fine emery cloth.
7. Reinstall the flame detector and flame detector gasket.
8. Reconnect the flame detector lead wire.
9. Reinstall the shroud on the unit.

## 7.4 O<sub>2</sub> SENSOR

The Lean Oxygen Sensor (P/N **61026**) is located on the burner plate at the top of the unit (see Figures 7-1 and 7-2). The sensor may be hot. Allow the unit to cool sufficiently before removing or replacing the O<sub>2</sub> sensor.

### O<sub>2</sub> Sensor Maintenance Procedures

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

## 7.5 SAFETY DEVICE TESTING

Systematic and thorough tests of the operating and safety devices should be performed to ensure that they are operating as designed. Certain code requirements, such as ASME CSD-1, require that these tests be performed on a scheduled basis. Test schedules must conform to local jurisdictions. The results of the tests should be recorded in a log book. See Chapter 6-Safety Device Testing Procedures.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 7 – MAINTENANCE

### 7.6 BURNER ASSEMBLY INSPECTION

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

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

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

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

#### Burner Assembly Inspection and Maintenance Procedures

1. Set the ON/OFF switch on the control panel, to the **OFF** position. Disconnect AC power from the unit and turn off the gas supply.
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.
3. Disconnect the lead wire from the flame detector installed on the burner plate. See Figure 7-2.
4. Remove the two (2) screws securing the flame detector to the plate. The flame detector is secured to the burner plate with one (1) #10-32 screw and one (1) #8-32 screw.
5. Remove the flame detector and gasket from the burner plate.
6. Disconnect the cable from the igniter-injector.
7. Using a 7/16" open-end wrench, disconnect the compression nut securing the gas injector tube of the igniter-injector to the elbow of the staged ignition assembly (see Figure 7-2). Disconnect the staged ignition assembly from the igniter-injector.
8. Next, loosen and remove the igniter-injector from the burner plate using a 1" open-end wrench.
9. Retrieve the blower support rig and attach it to the blower and unit as described in the instructions provided with the rig.
10. Loosen and remove the four 5/16x1-3/4" bolts, washers, and nuts from the burner plenum where it is attached to the blower (see Figure 7-4a & 7-4b).
11. Remove the eight (8) 3/8-16 nuts, using a 9/16" wrench, attaching the blower plenum to the burner beneath (see Figure 7-4a & 7-4b).
12. Remove the blower plenum from between the blower and the burner and set aside for later reassembly. O2 sensor and flame observation port remain assembled to the plenum flange.
13. Remove the burner by pulling straight up.
14. Remove and replace the burner gasket(s) (see Figure 7-5).

#### NOTE

The burner assembly is heavy, weighing approximately 65 lbs.

### Burner Assembly Inspection and Maintenance Procedures – Continued

#### IMPORTANT!

ALL THREE gaskets provided for maintenance **MUST** be installed during this procedure, as shown in Figure 7-5, even if there is only one existing gasket being replaced. Note that the **LOWER RELEASE GASKET** has tabs, which the others do not.

#### NOTE

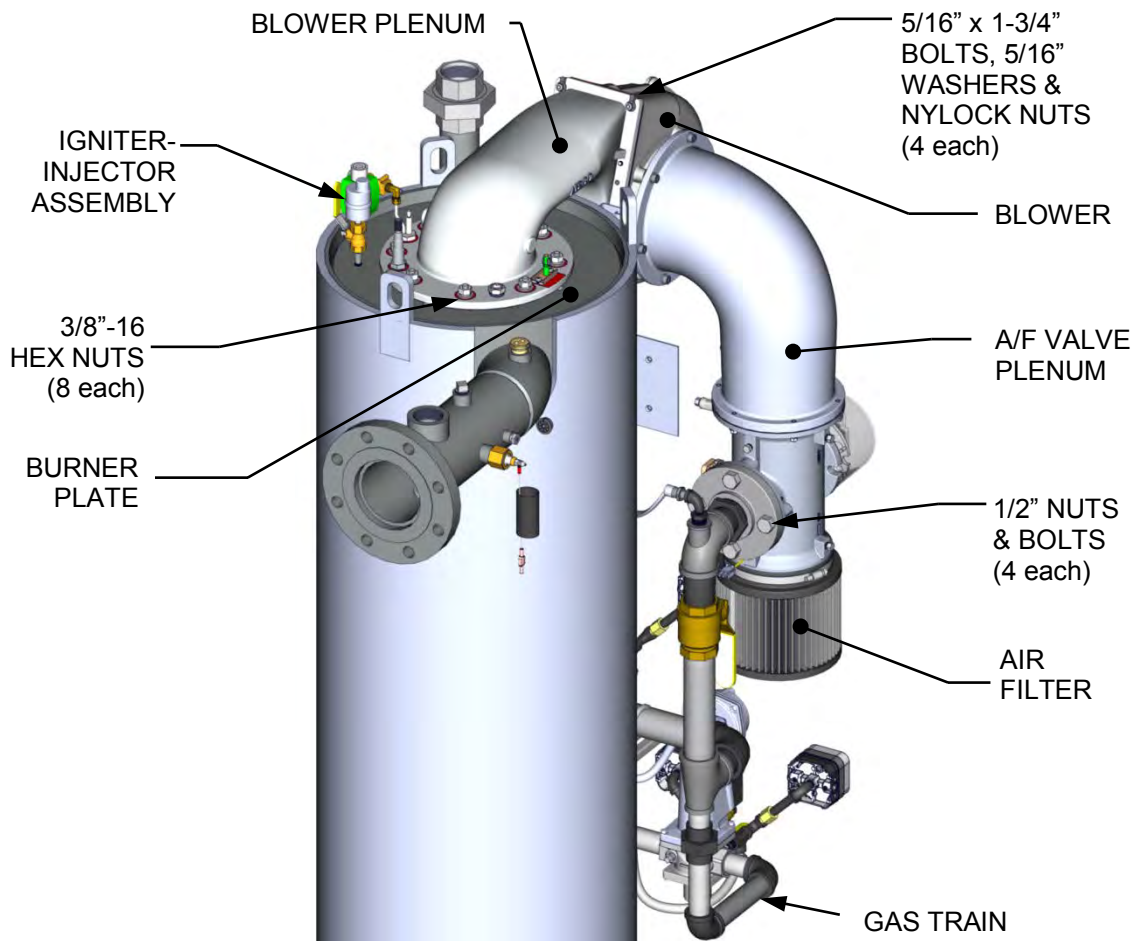
During reassembly, apply a light coating of high-temperature, anti-seize lubricant to the threads of the igniter-injector and grounding screw. Also, ensure that the igniter-injector is properly positioned as indicated in Figure 7-3. **Torque the igniter-injector to 170 - 180 in-lbs.**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 7 – MAINTENANCE

### Burner Assembly Inspection and Maintenance Procedures – *Continued*



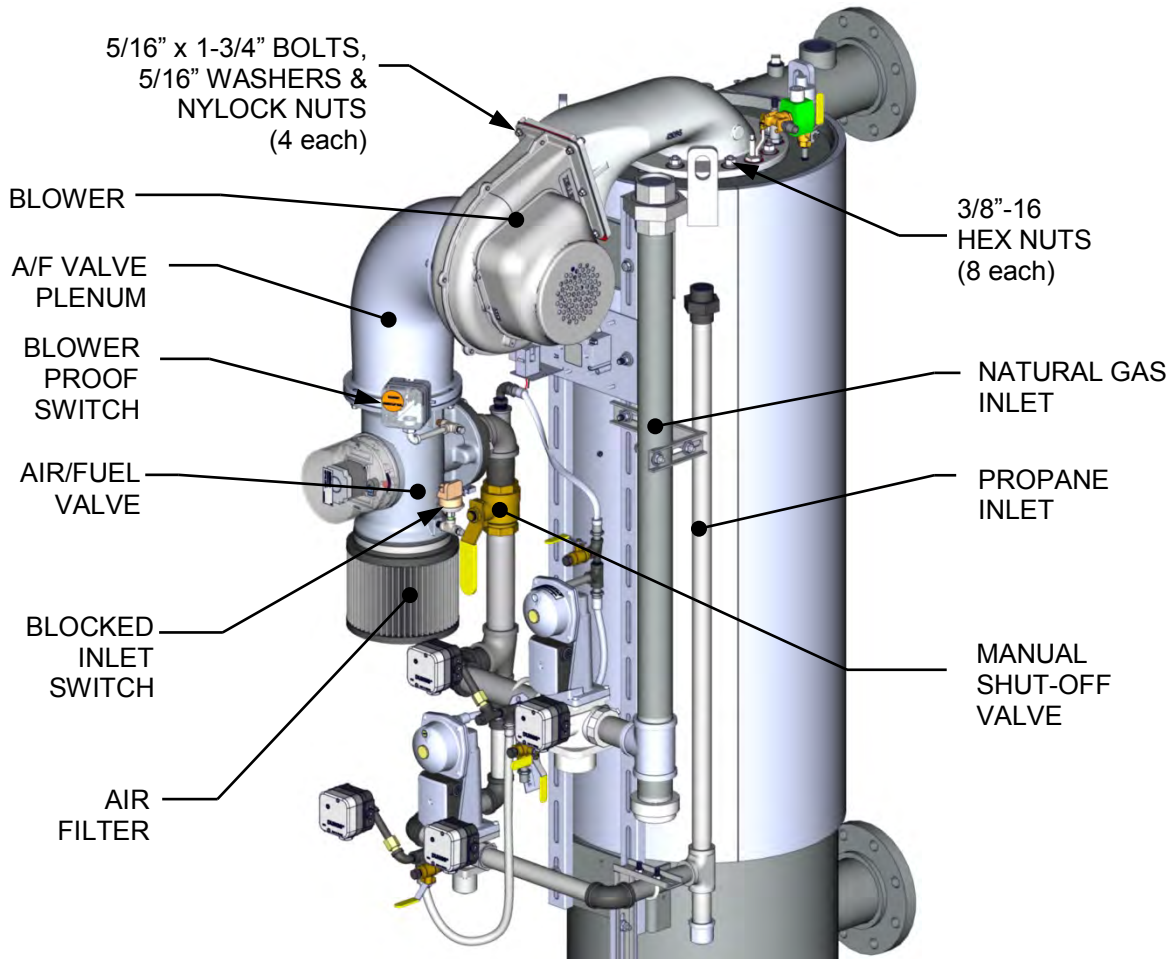
**Figure 7-4a: Burner Assembly Mounting Details**



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 7 – MAINTENANCE

### Burner Assembly Inspection and Maintenance Procedure – *Continued*



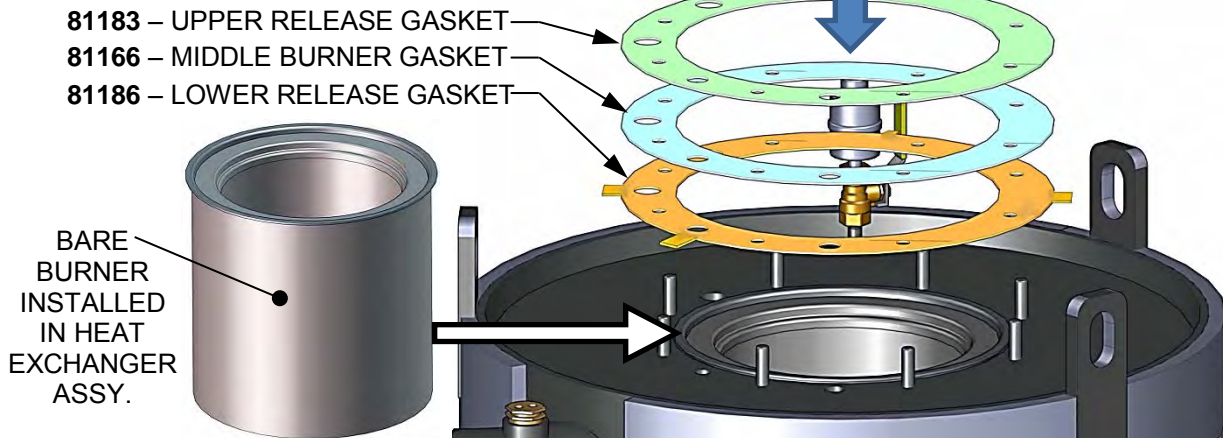
**Figure 7-4b: Burner Assembly Mounting Details**

**NOTE**

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

**IMPORTANT!**

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



**Figure 7-5: Bare Burner and Replacement Gaskets Location**

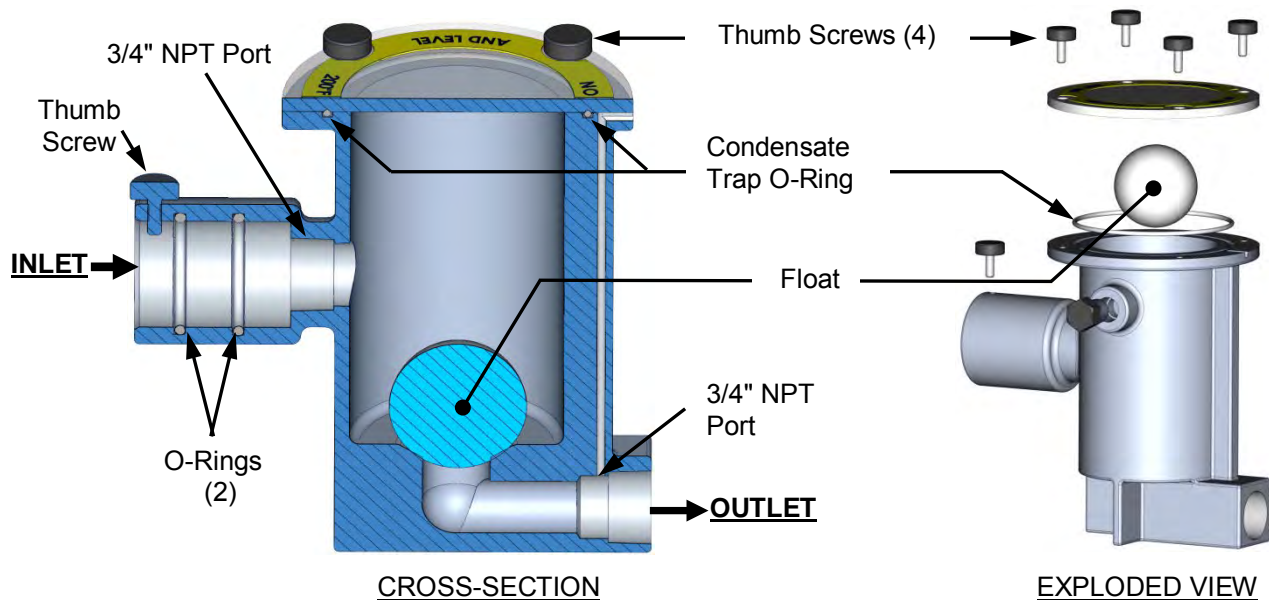
### 7.7 CONDENSATE DRAIN TRAP

Benchmark boilers contain a condensate trap (P/N **59138**), located external to the unit and attached to the drain connection from the exhaust manifold. The location on the unit is shown in Chapter 2, Figure 2-6. This trap should be inspected and cleaned in accordance with the maintenance schedule shown in Table 7-1 to ensure proper operation.

To inspect and clean the trap, proceed as follows:

#### Condensate Trap Inspection and Cleaning

1. Disconnect the external condensate trap by loosening and then removing connections on the inlet and outlet sides of the condensate trap (see Figure 7-6).
2. Loosen the four (4) thumbscrews securing the trap's cover and then remove the cover and the O-ring from under the cover.
3. Remove the float and then thoroughly clean the trap and float. Also inspect the drain piping for blockage. If the trap cannot be thoroughly cleaned, replace the entire trap (P/N **59138**).
4. Replace the float, install the O-ring (P/N **84017**), and then replace the trap cover.
5. Reassemble all piping and hose connections to the condensate trap inlet and outlet.



**Figure 7-6: External Condensate Trap – Cross-Section & Exploded View**



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 7 – MAINTENANCE

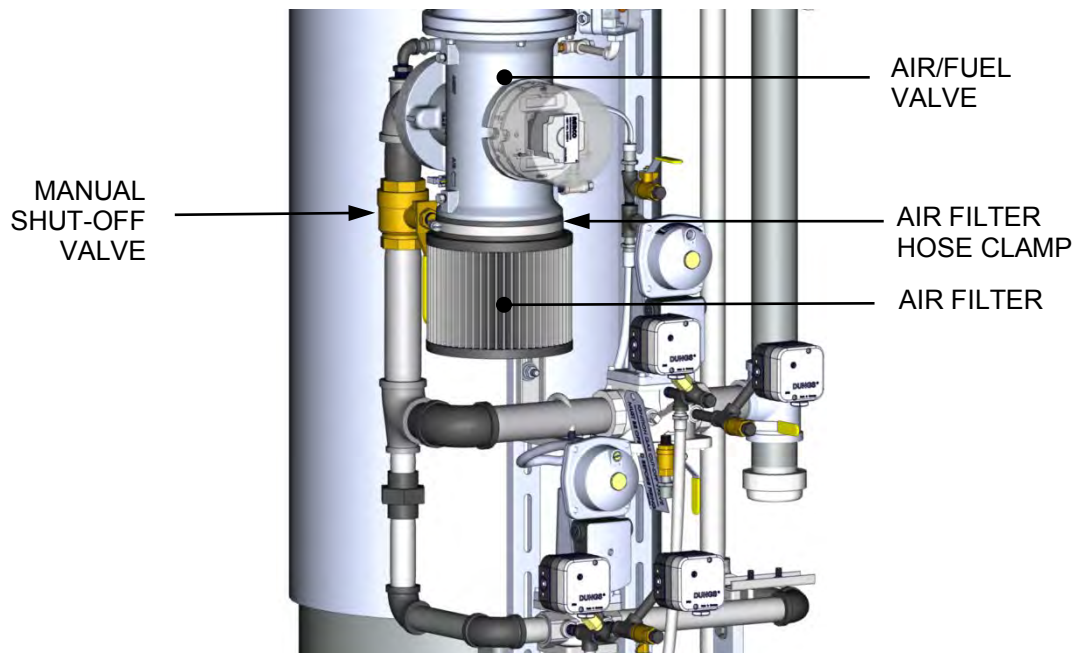
### 7.8 AIR FILTER CLEANING & REPLACEMENT

The Benchmark boiler is equipped with an air filter (P/N **88014**) which should be cleaned and re-oiled every 12 months and replaced every 24 months. The air filter is located at the inlet of the air fuel valve at the top of the boiler as shown in Figure 7-7.

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

#### Air Filter Cleaning & Replacement Procedures

1. Set the ON/OFF switch on the control panel, to the **OFF** position. Disconnect AC power from the unit.
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.
3. Refer to Figure 7-7 and locate the air filter attached to the air/fuel valve inlet.
4. Using a flat-tip screwdriver or 5/16" nut driver, loosen the clamp securing the filter to the inlet flange of the air/fuel valve. Remove the filter and clamp.
5. The filter may be cleaned in hot soapy water to remove oil and dirt. It should then be thoroughly dried and then sprayed with a light coating of K&N® Air Filter Oil (or equivalent specifically formulated for air filters) prior to reinstallation. Do NOT use WD-40.
6. Each replacement air filter is equipped with its own clamp. Therefore, simply install the replacement air filter on inlet flange of the air fuel valve and tighten the clamp with a flat-tip screwdriver or 5/16" nut driver.
7. Replace the top shroud on the unit and return boiler to service use.

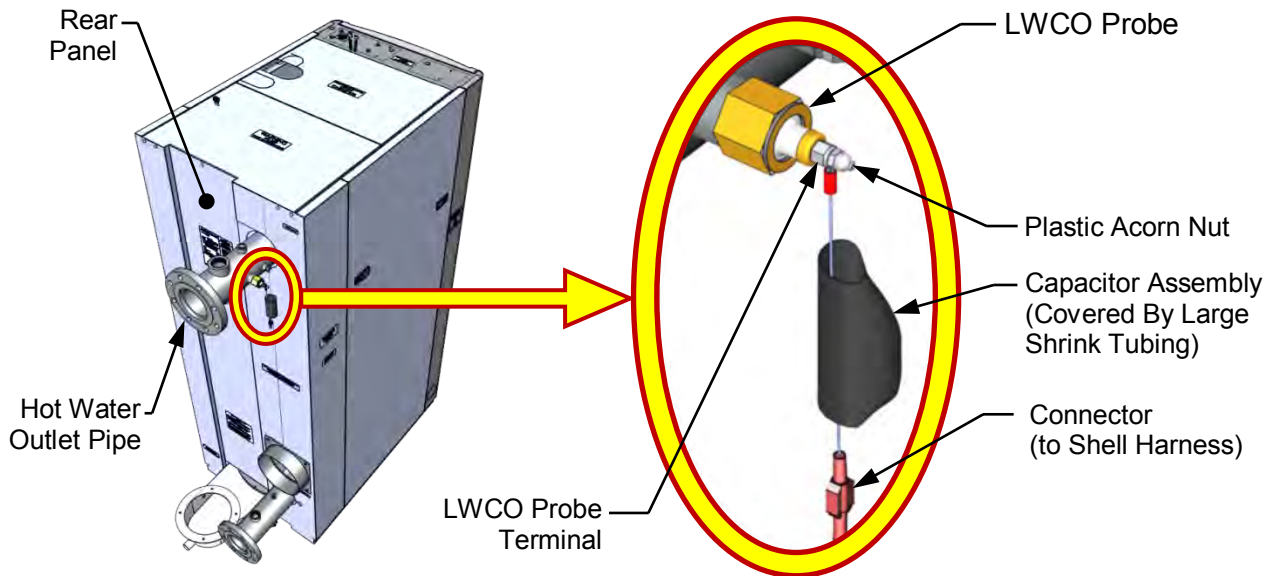


**Figure 7-7: Air Filter Location**

### 7.9 WATER CUTOFF (LWCO) CAPACITOR INTEGRITY TEST

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

Refer to Figure 7-8 for an illustration of the LWCO probe assembly and its typical installation.



**Figure 7-8: LWCO Probe Location (BMK1500 Shown)**

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

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

#### LWCO Capacitor Electrical Short Test

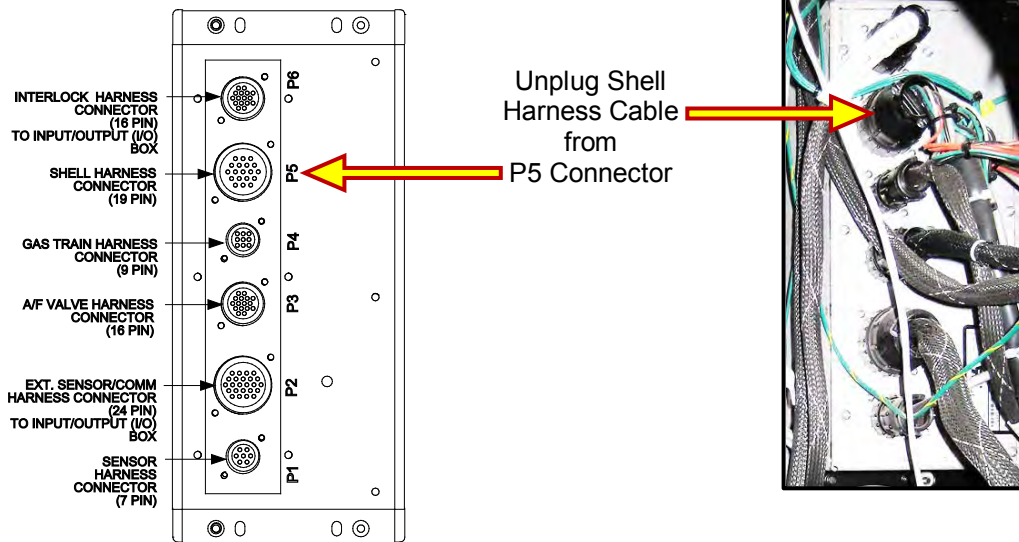
1. Turn the AC power to the unit to **OFF**.

#### **WARNING!**

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

### LWCO Capacitor Electrical Short Test – Continued

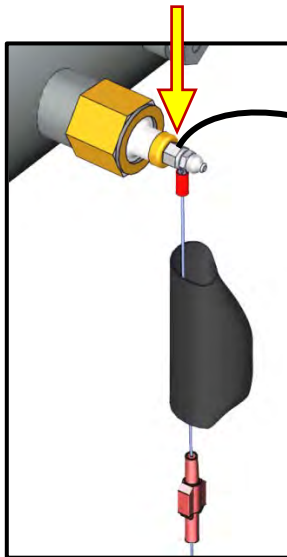
2. Remove the Shell Harness Cable (male) connector from the P-5 (female) connector on the rear panel of the C-More controller (see Figure 7-9).



**Figure 7-9: Removing Shell Harness Cable from P5 Conn. on C-More Rear Panel**

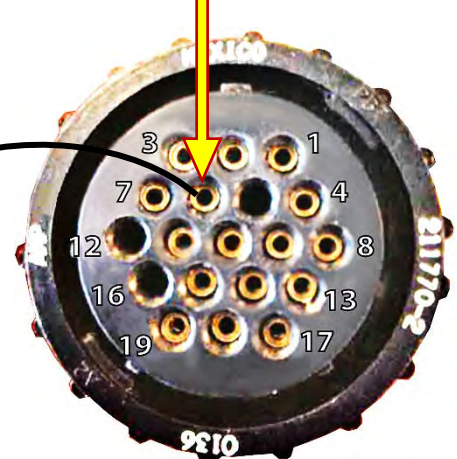
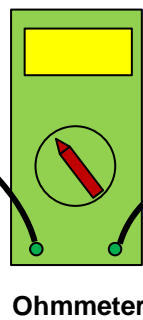
3. Using an ohmmeter, connect one ohmmeter probe to the LWCO capacitor terminal on the unit shell as shown on left in Figure 7-10.
4. Connect the second ohmmeter probe to Pin #6 of Shell Harness Connector (removed from the C-More controller) as shown on right in Figure 7-10.

Connect 1<sup>st</sup> Lead to LWCO Terminal



**LWCO Probe Assembly Connector**

Connect 2<sup>nd</sup> Lead to PIN #6



**19-Pin Shell Harness Cable Connector**

**Figure 7-10: Connecting Ohmmeter between LWCO Probe & Shell Harness Cable**

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 7 – MAINTENANCE

### LWCO Capacitor Integrity Test – Continued

5. Confirm that the ohmmeter does NOT read a short.

#### NOTE

If the ohmmeter reads a short, the capacitor assembly needs to be replaced. Refer to document TID-0113, provided with the 24-month maintenance kit, for LWCO replacement instructions.

6. Remove both ohmmeter probes and reconnect the Shell Harness connector to the P5 connector on the rear of the C-More controller.

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

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

#### Standard Low Water Cutoff C-More Test

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

### 7.10 SHUTTING THE BOILER DOWN FOR AN EXTENDED PERIOD OF TIME

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

#### Shutting Boiler Down for Extended Period

1. Set ON/OFF switch on the front panel to the **OFF** position to shut down the boiler's operating controls.
2. Disconnect AC power from the unit.
3. Close the water supply and return valves to isolate boiler.
4. Close external gas supply valve.
5. Open relief valve to vent water pressure.

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

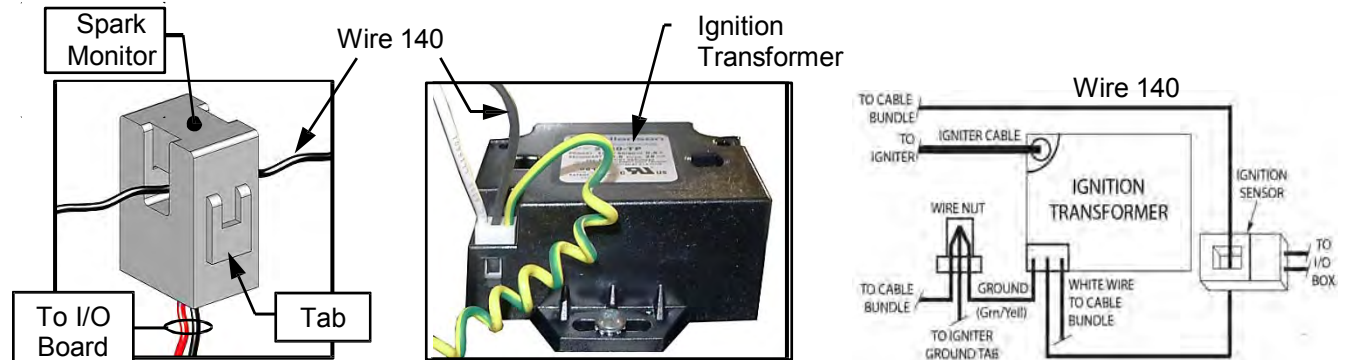
After a prolonged shutdown (one year or more), the following procedures must be followed:

#### Placing Boiler in Service After Long Shutdown

1. Review installation requirements included in Chapter 2.
2. Inspect all piping and connections to the unit.
3. Inspect exhaust vent and air inlet duct work (if applicable).
4. Perform initial startup per Chapter 4.
5. Perform safety device testing and scheduled maintenance procedures per Chapters 6 and 7 of this manual.

### 7.12 SPARK MONITOR (AC CURRENT TRANSDUCER)

The spark monitor (P/N 61034) evaluates the strength of the current between the ignition transformer and igniter-injector. Wire# 140, connected to the ignition transformer (see Figure 7-11), passes through the monitor's orifice. If an adequate AC current is not detected in the wire during ignition, the unit automatically shuts down. The monitor's wires are connected to the I/O board's Spark Signal terminals (see section 2.10.4).



**Figure 7-11: Spark Detector Sensor (AC Current Transducer) P/N 61034**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 7 – MAINTENANCE

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### CHAPTER 8. TROUBLESHOOTING GUIDE

#### 8.1 INTRODUCTION

This troubleshooting guide is intended to aid service/maintenance personnel in isolating the cause of a fault in a Benchmark 1500 MBH and 2000 MBH boilers. The troubleshooting procedures contained herein are presented in tabular form on the following pages. These tables are comprised of three columns labeled: Fault Indication, Probable Cause and Corrective Action. The numbered items in the Probable Cause and Corrective Action columns correspond to each other. For example, Probable Cause No. 1 corresponds to Corrective Action No. 1, etc.

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

#### Fault Correction

1. Observe the fault messages displayed in the Control Box display.
2. Refer to the Fault Indication column in Troubleshooting Table 8-1 which follows and locate the Fault that best describes the existing conditions.
3. Proceed to the Probable Cause column and start with the first item (1) listed for the Fault Indication.
4. Perform the checks and procedures listed in the Corrective Action column for the first Probable Cause candidate.
5. Continue checking each additional Probable Cause for the existing fault until the fault is corrected.
6. Section 8.2 and Table 8-2 contain additional troubleshooting information which may apply when a no fault message is displayed.

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

#### NOTE

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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

**TABLE 8-1: BOILER TROUBLESHOOTING**

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
AIRFLOW FAULT DURING IGNITION	<ol style="list-style-type: none"> <li>1. Blower stopped running due to thermal or current overload.</li> <li>2. Blocked Blower inlet or inlet air filter.</li> <li>3. Blockage in Blower Proof switch.</li> <li>4. Blockage in Blocked Inlet switch.</li> <li>5. Defective Blower Proof switch.</li> <li>6. Defective Blocked Inlet switch.</li> <li>7. Loose temperature to AUX connection in I/O Box.</li> <li>8. Defective temperature sensor.</li> <li>9. Loose wire connection between the 0-10V signal from I/O box to the Blower input.</li> <li>10. Defective I/O Box.</li> <li>11. Wrong 0-10V output selection on the control box.</li> <li>12. Defective Air-Fuel Valve potentiometer.</li> <li>13. Hard light.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check combustion blower for signs of excessive heat or high current drain that may trip thermal or current overload devices.</li> <li>2. Inspect the inlet to the combustion blower including the air filter at the air/fuel valve for signs of blockage.</li> <li>3. Remove the Blower Proof switch and inspect for signs of blockage, clean or replace as necessary.</li> <li>4. Remove the Blocked Inlet switch and inspect for signs of blockage, clean or replace as necessary.</li> <li>5. Check the continuity of the Blower Proof switch with the combustion blower running. If there is an erratic resistance reading or the resistance reading is greater than zero ohms, replace the switch.</li> <li>6. Turn off unit and check the continuity of the Blocked Inlet switch. If there is an erratic resistance reading or the resistance reading is greater than zero ohms, replace the switch.</li> <li>7. Check the actual inlet air temperature and measure voltage at AUX input in the I/O Box. Verify that the voltage conforms to the values shown in the tabular listing provided in Appendix C.</li> <li>8. Refer to CORRECTIVE ACTION 7 and verify that the voltage conforms to the values shown in Appendix C.</li> <li>9. Check wire connection from I/O Box 0-10V signal to the Blower Motor.</li> <li>10. Measure voltage at the I/O box 0-10V output. A voltage of 10V equates to a 100% open valve position.</li> <li>11. Check the <i>Analog Out</i> option on the <i>C-More Configuration</i> menu. <b>Valve Position 0-10V</b> should be selected.</li> <li>12. Check Air/Fuel Valve position at 0%, 50% and 100% open positions. The positions on the VALVE POSITION bargraph should match the readings on the Air/Fuel Valve dial.</li> <li>13. Check igniter-injector for soot or erosion of electrode. Check injector solenoid valve to insure proper open/close operation.</li> </ol>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

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

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
AIRFLOW FAULT DURING PURGE	<ol style="list-style-type: none"> <li>1. Blower not running or running too slow.</li> <li>2. Defective Blocked Inlet switch.</li> <li>3. Blockage in air filter or Blocked Inlet switch.</li> <li>4. Blocked blower inlet or inlet ductwork.</li> <li>5. No voltage to Blocked Inlet switch from C-More Control Box.</li> <li>6. PROBABLE CAUSES from 3 to 12 for AIRFLOW FAULT DURING IGNITION apply for this fault.</li> </ol>	<ol style="list-style-type: none"> <li>1. Start the unit. If the blower does not run check the blower solid state relay for input and output voltage. If the relay is OK, check the blower.</li> <li>2. Start the unit. If the blower runs, turn off unit and check the Blocked Inlet switch for continuity. Replace the switch if continuity does not exist.</li> <li>3. Remove the air filter and Blocked Inlet switch and inspect for signs of blockage. Clean or replace as necessary.</li> <li>4. Inspect the inlet to the combustion blower including any ductwork leading up to the combustion blower for signs of blockage.</li> <li>5. During the start sequence, verify that 24 VAC is present between each side of the switch and ground. If 24 VAC is not present, refer fault to qualified service personnel.</li> <li>6. See CORRECTIVE ACTIONS from 3 to 12 for AIRFLOW FAULT DURING IGNITION.</li> </ol>
AIRFLOW FAULT DURING RUN	<ol style="list-style-type: none"> <li>1. Blower stopped running due to thermal or current overload.</li> <li>2. Blocked Blower inlet or inlet ductwork.</li> <li>3. Blockage in air filter or Blocked Inlet switch.</li> <li>4. Defective Blocked Inlet switch.</li> <li>5. Combustion oscillations.</li> <li>6. Probable causes from 3 to 16 for AIRFLOW FAULT DURING IGNITION applies for this fault.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check combustion blower for signs of excessive heat or high current draw that may trip thermal or current overload devices.</li> <li>2. Inspect the inlet to the combustion blower, including any ductwork leading up to the combustion blower, for signs of blockage.</li> <li>3. Remove the air filter and Blocked Inlet switch and inspect for signs of blockage, clean or replace as necessary.</li> <li>4. Verify that 24 VAC is present between each side of the switch and ground. If 24 VAC is not present at both sides, replace switch.</li> <li>5. Run unit to full fire. If the unit rumbles or runs rough, perform combustion calibration.</li> <li>6. See CORRECTIVE ACTIONS from 3 to 12 for AIRFLOW FAULT DURING IGNITION.</li> </ol>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

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

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
<p>DELAYED INTERLOCK OPEN</p>	<ol style="list-style-type: none"> <li>1. Delayed Interlock Jumper not properly installed or missing.</li> <li>2. Device proving switch hooked to interlocks is not closed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check to insure jumper is properly installed across the delayed interlock terminals in the I/O Box.</li> <li>2. If there are 2 external wires on these terminals, check to see if an end switch for a proving device (such as a pump, louver, etc.) is tied these interlocks. Ensure that the device and/or its end switch is functional. A jumper may be temporarily installed to test the interlock.</li> </ol>
<p>DIRECT DRIVE SIGNAL FAULT</p>	<ol style="list-style-type: none"> <li>1. Direct drive signal is not present:               <ul style="list-style-type: none"> <li>--Not yet installed.</li> <li>--Wrong polarity.</li> <li>--Signal defective at source.</li> <li>--Broken or loose wiring.</li> </ul> </li> <li>2. Signal is not isolated (floating).</li> <li>3. Control Box signal type selection switches not set for correct signal type (voltage or current).</li> </ol>	<ol style="list-style-type: none"> <li>1. Check I/O Box to ensure signal is hooked up.               <ul style="list-style-type: none"> <li>--Hook up if not installed.</li> <li>--If installed, check polarity.</li> <li>--Measure signal level.</li> <li>--Check wiring continuity between source and unit.</li> </ul> </li> <li>2. Check signal at source to ensure it is isolated.</li> <li>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 <i>Configuration</i> menu.</li> </ol>
<p>FLAME LOSS DURING IGN</p>	<ol style="list-style-type: none"> <li>1. Worn Flame Detector.</li> <li>2. No spark from Spark Igniter.</li> <li>3. Defective Ignition Transformer.</li> <li>4. Defective Ignition/Stepper (IGST) Board.</li> <li>5. Defective SSOV.</li> </ol>	<ol style="list-style-type: none"> <li>1. Remove and inspect the Flame Detector for signs of wear. Replace if necessary.</li> <li>2. Close the internal gas valve in the unit. Install and arc a spark igniter outside the unit.</li> <li>3. If there is no spark, check for 120VAC at the primary side to the ignition transformer during the ignition cycle.</li> <li>4. If 120VAC is not present, the IGST Board in the Control Box may be defective. Refer fault to qualified service personnel.</li> <li>5. While externally arcing the spark igniter, observe the open/close indicator in the Safety Shut-Off Valve to ensure it is opening. If the valve does not open, check for 120VAC at the valve input terminals. If 120VAC is not present, the IGST board in the Control Box may be defective. Refer fault to qualified service personnel.</li> </ol>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

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

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
FLAME LOSS DURING IGN (continued)	<ul style="list-style-type: none"> <li>6. Carbon or other debris on Burner.</li> <li>7. Staged ignition solenoid valve doesn't open.</li> <li>8. Clogged staged ignition piece.</li> </ul>	<ul style="list-style-type: none"> <li>6. Remove View-Port and inspect Burner with Boroscope. If it is fouled or black with soot, remove the Burner and inspect for any carbon build-up or debris. Clean and reinstall.</li> <li>7. When unit goes to ignition, listen for a clicking sound at the staged ignition solenoid valve to ensure it is opening.</li> <li>8. Remove and inspect staged ignition piece for blockage.</li> </ul>
FLAME LOSS DURING RUN	<ul style="list-style-type: none"> <li>1. Worn Flame Detector or cracked ceramic.</li> <li>2. Defective Regulator.</li> <li>3. Poor combustion calibration.</li> <li>4. Debris on burner.</li> <li>5. Blocked condensate drain.</li> </ul>	<ul style="list-style-type: none"> <li>1. Remove and inspect the Flame Detector for signs of wear or cracked ceramic. Replace if necessary.</li> <li>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.</li> <li>3. Check combustion calibration using procedures in Chapter 4.</li> <li>4. Remove the burner and inspect for any carbon build-up or debris. Clean and reinstall.</li> <li>5. Remove blockage in condensate drain.</li> </ul>
HEAT DEMAND FAILURE	<ul style="list-style-type: none"> <li>1. The Heat Demand Relays on the Ignition/Stepper (IGST) board failed to activate when commanded.</li> <li>2. Relay is activated when not in Demand.</li> </ul>	<ul style="list-style-type: none"> <li>1. Press <b>CLEAR</b> button and restart the unit. If the fault persists, replace Ignition/Stepper (IGST) Board.</li> <li>2. Defective relay. Replace IGST Board.</li> </ul>
HIGH EXHAUST TEMPERATURE	<ul style="list-style-type: none"> <li>1. Poor combustion calibration.</li> <li>2. Carboned heat exchanger due to incorrect combustion calibration.</li> </ul>	<ul style="list-style-type: none"> <li>1. Check combustion calibration using procedures in Chapter 4.</li> <li>2. If exhaust temperature is greater than 200° F, check combustion calibration. Calibrate or repair as necessary.</li> </ul>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

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

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
HIGH GAS PRESSURE	<ol style="list-style-type: none"> <li>1. Incorrect supply gas pressure.</li> <li>2. Defective SSOV Actuator.</li> <li>3. Defective High Gas Pressure Switch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check to ensure gas pressure at inlet of SSOV does not exceed 14" W.C.</li> <li>2. If gas supply pressure downstream of SSOV Actuator cannot be lowered to the range of <b>3.5" ± 0.2" W.C. for BMK1500</b> or <b>6.3" ± 0.2" W.C. for BMK2000</b> using the gas pressure adjustment screw (see section 4.3.1 or 4.3.2, step 10), the SSOV Actuator may be defective.</li> <li>3. Remove the leads from the high gas pressure switch. Measure continuity across the common (C) and normally closed (NC) terminals with the unit not firing. Replace the switch if continuity does not exist.</li> </ol>
HIGH WATER TEMP SWITCH OPEN	<ol style="list-style-type: none"> <li>1. Faulty Water temperature switch.</li> <li>2. Incorrect PID settings.</li> <li>3. Faulty shell temperature sensor.</li> <li>4. Unit in MANUAL mode.</li> <li>5. Unit setpoint is greater than Over Temperature Switch setpoint.</li> <li>6. System flow rate changes are occurring faster than units can respond.</li> </ol>	<ol style="list-style-type: none"> <li>1. Test the temperature switch to insure it trips at its actual water temperature setting.</li> <li>2. Check PID settings against Menu Default settings in Chapter 3. If the settings have been changed, record the current readings then reset them to the default values.</li> <li>3. Using the resistance charts in the Appendix C, Measure the resistance of Shell sensor and BTU sensor at a known water temperature.</li> <li>4. If unit is in MANUAL mode switch to AUTO mode.</li> <li>5. Check setpoint of unit and setpoint of Temperature Switch; Ensure that the temperature switch is set higher than the unit's setpoint.</li> <li>6. If the system is a variable flow system, monitor system flow changes to ensure that the rate of flow change is not faster than what the units can respond to.</li> </ol>
HIGH WATER TEMPERATURE	<ol style="list-style-type: none"> <li>1. See HIGH WATER TEMPERATURE SWITCH OPEN.</li> <li>2. Temp HI Limit setting is too low.</li> </ol>	<ol style="list-style-type: none"> <li>1. See HIGH WATER TEMPERATURE SWITCH OPEN.</li> <li>2. Check Temp HI Limit setting.</li> </ol>
IGN BOARD COMM FAULT	<ol style="list-style-type: none"> <li>1. Communication fault has occurred between the PMC board and Ignition/Stepper (IGST) board.</li> </ol>	<ol style="list-style-type: none"> <li>1. Press <b>CLEAR</b> button and restart unit. If fault persists, contact qualified Service Personnel.</li> </ol>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

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

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
IGN SWTCH CLOSED DURING PURGE	<ol style="list-style-type: none"> <li>1. Air/Fuel Valve not rotating.</li> <li>2. Defective or shorted switch.</li> <li>3. Switch wired incorrectly.</li> <li>4. Defective Power Supply Board or fuse.</li> <li>5. Defective IGST Board.</li> </ol>	<ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> <li>4. Check DS1 &amp; DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.</li> <li>5. Check “Heartbeat” LED DS1 and verify it is blinking ON &amp; OFF every second. If not, replace IGST Board.</li> </ol>
IGN SWTCH OPEN DURING IGNITION	<ol style="list-style-type: none"> <li>1. Air/Fuel Valve not rotating to ignition position.</li> <li>2. Defective ignition switch.</li> <li>3. Defective Power Supply Board or fuse.</li> <li>4. Defective IGST Board.</li> </ol>	<ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>3. Check DS1 &amp; DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.</li> <li>4. Check “Heartbeat” LED DS1 and verify it is blinking ON &amp; OFF every second. If not, replace IGST Board.</li> </ol>



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

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

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
INTERLOCK OPEN	<ol style="list-style-type: none"> <li>1. Interlock jumper not installed or removed.</li> <li>2. Energy Management System does not have unit enabled.</li> <li>3. Device proving switch hooked to interlocks is not closed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check for a jumper properly installed across the interlock terminals in the I/O box.</li> <li>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).</li> <li>3. Check that proving switch for any device hooked to the interlock circuit is closing and that the device is operational.</li> </ol>
LINE VOLTAGE OUT OF PHASE	<ol style="list-style-type: none"> <li>1. Line and Neutral switched in AC Power Box.</li> <li>2. Incorrect power supply transformer wiring.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check hot and neutral in AC Power Box to ensure they are not reversed.</li> <li>2. Check transformer wiring, in AC Power Box, against the power box transformer wiring diagram to ensure it is wired correctly.</li> </ol>
LOW GAS PRESSURE	<ol style="list-style-type: none"> <li>1. Incorrect supply gas pressure.</li> <li>2. Defective Low Pressure Gas Switch.</li> </ol>	<ol style="list-style-type: none"> <li>1. Measure gas pressure upstream of the SSOV Actuator(s) with the unit firing. For FM gas trains, ensure it is between <b>6.0" W.C. and 14" W.C.</b> For DBB gas trains, ensure it is between <b>6.5" W.C. and 14" W.C.</b> (see section. 4.3).</li> <li>2. Measure gas pressure at the low gas pressure switch. If it is greater than <b>4.7" W.C.</b> (for both BMK 1500 and BMK 2000), measure continuity across the switch and replace if necessary.</li> </ol>
LOW WATER LEVEL	<ol style="list-style-type: none"> <li>1. Insufficient water level in system.</li> <li>2. Defective water level circuitry.</li> <li>3. Defective water level probe.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check system for sufficient water level.</li> <li>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.</li> <li>3. Check continuity of probe end to the shell, change probe if there is no continuity.</li> </ol>
MODBUS COMMFAULT	Unit not seeing information from Modbus network.	Check network connections. If fault persists, contact qualified Service Personnel.
PRG SWTCH CLOSED DURING IGNITION	<ol style="list-style-type: none"> <li>1. A/F Valve rotated open to purge and did not rotate to ignition position.</li> </ol>	<ol style="list-style-type: none"> <li>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.</li> </ol>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

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

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
(continued)	<ol style="list-style-type: none"> <li>2. Defective or shorted switch.</li> <li>3. Switch wired incorrectly.</li> <li>4. Defective Power Supply Board or fuse.</li> <li>5. Defective IGST Board.</li> </ol>	<ol style="list-style-type: none"> <li>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).</li> <li>3. If the switch is wired correctly, replace the switch.</li> <li>4. Check DS1 &amp; DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.</li> <li>5. Check “Heartbeat” LED DS1 and verify it is blinking ON &amp; OFF every second. If not, replace IGST Board.</li> </ol>
PRG SWTCH OPEN DURING PURGE	<ol style="list-style-type: none"> <li>1. Defective purge switch.</li> <li>2. No voltage present at switch.</li> <li>3. Switch wired incorrectly.</li> <li>4. Defective Power Supply Board or fuse</li> <li>5. Defective IGST Board.</li> </ol>	<ol style="list-style-type: none"> <li>1. If the air-fuel valve does rotate, check purge switch for continuity when closing. Replace switch if continuity does not exist.</li> <li>2. Measure for 24 VAC from each side of the switch to ground. If 24VAC is not present, refer fault to qualified service personnel.</li> <li>3. Check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals).</li> <li>4. Check DS1 &amp; DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.</li> <li>5. Check “Heartbeat” LED DS1 and verify it is blinking ON &amp; OFF every second. If not, replace IGST Board.</li> </ol>
OUTDOOR TEMP SENSOR FAULT	<ol style="list-style-type: none"> <li>1. Loose or broken wiring.</li> <li>2. Defective Sensor.</li> <li>3. Incorrect Sensor.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inspect Outdoor Temperature sensor for loose or broken wiring.</li> <li>2. Check resistance of sensor to determine if it is within specification.</li> <li>3. Ensure that the correct sensor is installed.</li> </ol>
O2 % OUT OF RANGE	<ol style="list-style-type: none"> <li>1. Combustion Calibration incorrect.</li> <li>2. Blocked inlet air duct or louver.</li> </ol>	<ol style="list-style-type: none"> <li>1. Check Combustion Analyzer and recalibrate the boiler.</li> <li>2. Unblock air inlet and measure open area for combustion air to the room.</li> </ol>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

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

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
RECIRC PUMP FAILURE	1. Internal recirculation pump failed.	1. Replace recirculation pump.
REMOTE SETPT SIGNAL FAULT	<ol style="list-style-type: none"> <li>1. Remote setpoint signal not present: Not yet installed. Wrong polarity. Signal defective at source. Broken or loose wiring.</li> <li>2. Signal is not isolated (floating) if 4 to 20 mA.</li> <li>3. Control Box signal type selection switches not set for correct signal type (voltage or current).</li> </ol>	<ol style="list-style-type: none"> <li>1. Check I/O Box to ensure signal is hooked up. Hook up if not installed. If installed, check polarity. Measure signal level. Check continuity of wiring between source and unit.</li> <li>2. Check signal at source to ensure it is isolated.</li> <li>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 <i>Configuration</i> menu.</li> </ol>
RESIDUAL FLAME	<ol style="list-style-type: none"> <li>1. Defective Flame Detector.</li> <li>2. SSOV not fully closed.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace Flame Detector.</li> <li>2. Check open/close indicator window of Safety Shut-Off Valve (SSOV) and ensure that the SSOV is fully closed. If not fully closed, replace the valve and or actuator.  Close the 2" Gas Shut-Off Valve downstream of SSOV (Figure 2-7). Install a manometer or gauge at the leak detection port between the SSOV and Gas Shut Off Valve. If a gas pressure reading is observed replace the SSOV Valve and/or Actuator.</li> </ol>
SSOV FAULT DURING PURGE	See SSOV SWITCH OPEN	
SSOV FAULT DURING RUN	SSOV switch closed for 15 seconds during run.	1. Replace or adjust micro-switch in SSOV actuator. If fault persists, replace actuator.
SSOV RELAY FAILURE	<ol style="list-style-type: none"> <li>1. SSOV relay failed on IGST board.</li> <li>2. Floating Neutral.</li> <li>3. Hot and Neutral reversed at SSOV.</li> </ol>	<ol style="list-style-type: none"> <li>1. Press <b>CLEAR</b> button and restart unit. If fault persists, replace Ignition/Stepper (IGST) Board.</li> <li>2. The Neutral and Earth Ground are not connected at the source and therefore there is a voltage measured between the two. Normally this measurement should be near zero or no more than a few millivolts.</li> <li>3. Check SSOV power wiring.</li> </ol>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

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

FAULT INDICATION	PROBABLE CAUSES	CORRECTIVE ACTION
SSOV SWITCH OPEN	<ol style="list-style-type: none"> <li>1. Actuator not allowing for full closure of gas valve.</li> <li>2. SSOV powered when it should not be.</li> <li>3. Defective Switch or Actuator.</li> <li>4. Incorrectly wired switch.</li> </ol>	<ol style="list-style-type: none"> <li>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.</li> <li>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.</li> <li>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.</li> <li>4. Ensure that the SSOV Proof of Closure switch is correctly wired.</li> </ol>
STEPPER MOTOR FAILURE	<ol style="list-style-type: none"> <li>1. Air/Fuel Valve out of calibration.</li> <li>2. Air/Fuel Valve unplugged.</li> <li>3. Loose wiring connection to the stepper motor.</li> <li>4. Defective Air/Fuel Valve stepper motor.</li> <li>5. Defective Power Supply Board or fuse.</li> <li>6. Defective IGST Board.</li> </ol>	<ol style="list-style-type: none"> <li>1. Refer to GF-112 (C-More O &amp; M) and perform the Stepper Feedback Calibration procedure in Section 6, section 6.2.1.</li> <li>2. Check that the Air/Fuel Valve is connected to the Control Box.</li> <li>3. .Inspect for loose connections between the Air/Fuel Valve motor and the wiring harness.</li> <li>4. Replace stepper motor.</li> <li>5. Check DS1 &amp; DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.</li> <li>6. Check “Heartbeat” LED DS1 and verify it is blinking ON &amp; OFF every second. If not, replace IGST Board.</li> </ol>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE

### 8.2 ADDITIONAL FAULTS WITHOUT SPECIFIC FAULT MESSAGES

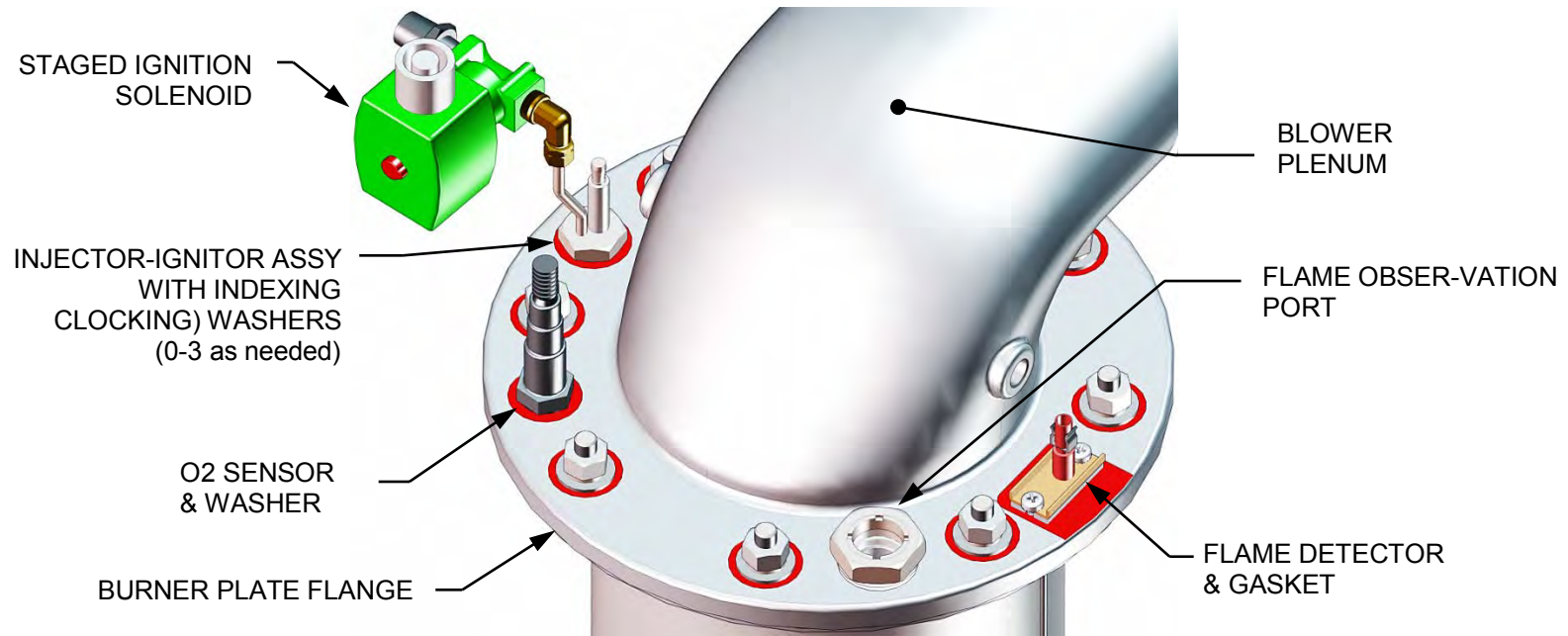
Refer to Table 8-2 to troubleshoot faults which may occur without a specific fault message being displayed.

**TABLE 8-2: BOILER TROUBLESHOOTING WITH NO FAULT MESSAGE DISPLAYED**

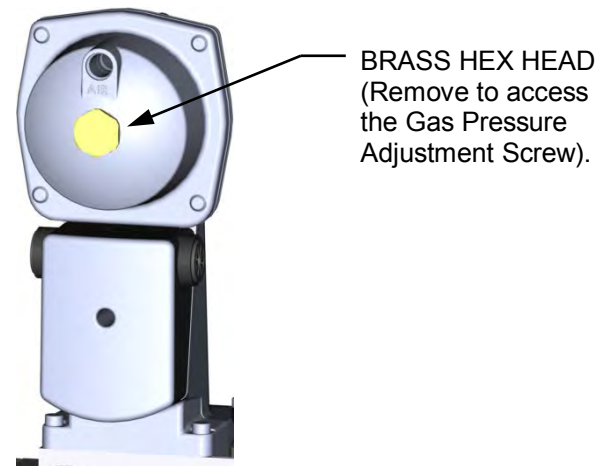
OBSERVED INCIDENT	PROBABLE CAUSES	CORRECTIVE ACTION
Hard Light-Off	<ol style="list-style-type: none"><li>1. Clogged/damaged Gas Injector on Igniter-Injector (Figure 8-1).</li><li>2. Defective Staged Ignition Solenoid (Figure 8-1).</li></ol>	<ol style="list-style-type: none"><li>1. Disconnect the Staged Ignition Assembly solenoid from the Gas injector Tube of the Igniter-Injector (Figure 8-1) and inspect Gas Injector to ensure it is not clogged or damaged.</li><li>2. Close the 2" Manual Shutoff Valve. Attempt to start the unit and listen for a "clicking" sound that the Staged Ignition Solenoid makes during Ignition Trial. If "clicking" sound is not heard after 2 or 3 attempts, replace the Staged Ignition Solenoid.</li></ol>
Fluctuating Gas Pressure	<ol style="list-style-type: none"><li>1. Gas pressure going into unit is fluctuating.</li></ol>	<ol style="list-style-type: none"><li>1. Stabilize gas pressure going into unit. If necessary, troubleshoot Building Supply Regulator.</li></ol>
Air/Fuel Valve "hunting" at the 80% Valve Position	<ol style="list-style-type: none"><li>1. IGST and Power Supply Boards in Control Box are outdated.</li></ol>	<ol style="list-style-type: none"><li>1. Check to ensure that the IGST and Power Supply Boards are Rev. E or higher.</li></ol>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 8 – TROUBLESHOOTING GUIDE



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



**Figure 8-2: SSOV Actuator Gas Pressure Adjustment Screw Location**



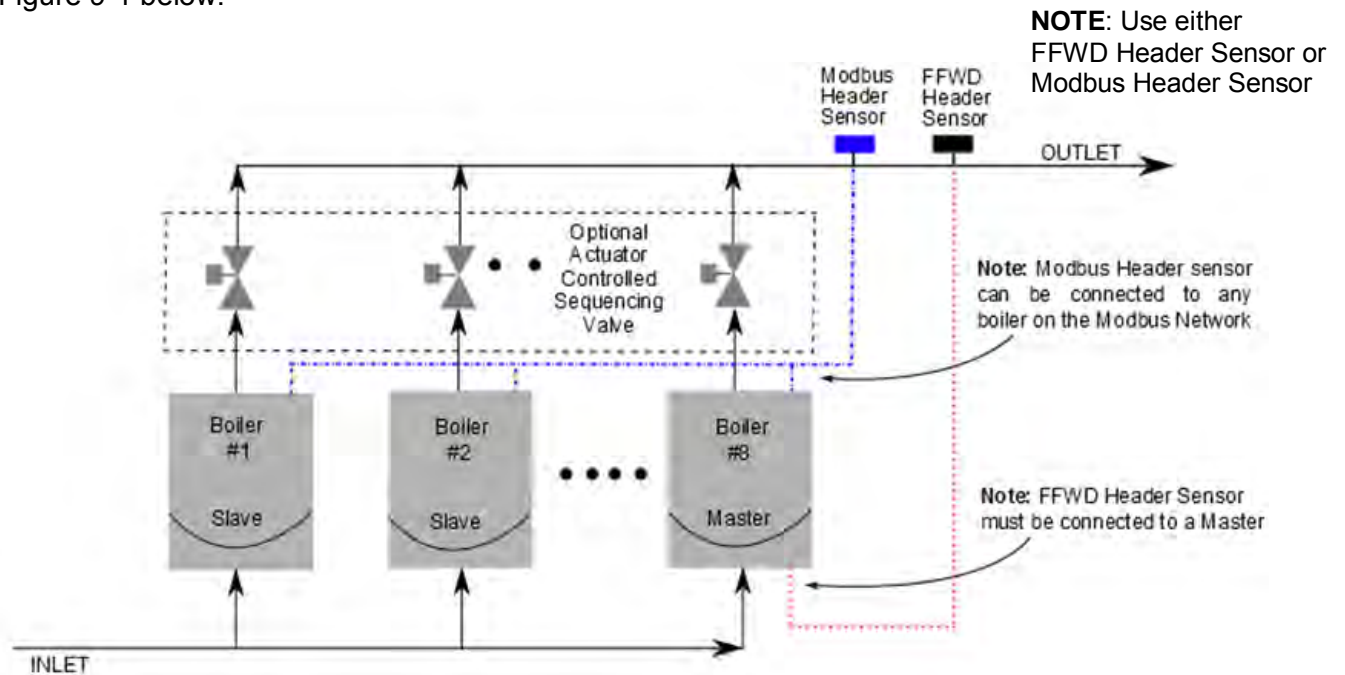
## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

### 9.1 INTRODUCTION

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

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

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



**Figure 9-1. Simplified BST Block Diagram**

**NOTE**

After the boiler load is satisfied, the isolation valve remains open for a programmed interval (default = 2 minutes) before closing. When the *system load* is satisfied, the panel will open the isolation valves for all of the boilers. The BST controls the valves via a 0-20 mA signal (See section 2.10.5)



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

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### 9.1.1 Installation Notes

If you are installing a BST system that also includes a ProtoNode SSD (Slave-Slave Device), you **must** adhere to the procedure listed below. Failure to complete these steps can result in the failure of the BST system.

- a) Do *NOT* install the ProtoNode Device at the outset of the installation. If the ProtoNode Device is already installed, you must physically disconnect it from the Modbus network in I/O board.
- b) Make sure that the Modbus load and bias resistors are properly configured for the system to operate without the ProtoNode installed.
- c) Temporarily set the BST system for CONSTANT SETPOINT mode of operation (see below).
- d) Turn on and completely test the installation to verify that it is operating proper.
- e) Once the installation is working properly as a BST system, install the ProtoNode Device.
- f) Make sure that the Modbus load and bias resistors are properly configured for the system to operate with the ProtoNode installed.
- g) Set the BST system for desired mode of operation (SETPOINT mode).
- h) Test the system completely with the ProtoNode installed.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

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### 9.2 AERCO BST Quick Start Chart

Select the single option that suites your installation and then complete the instructions in the corresponding sub-sections of section 9.3 BST Implementation Instructions.

#### Constant Setpoint (choose option 1 or 2)

**Option 1** – Direct Wired Header                      Complete section 9.3.1

**OR**

**Option 2** – Modbus Header                              Complete section 9.3.2

#### Outdoor Reset (choose option 3 or 4)

**Option 3** – Direct Wired Header AND Direct Wired Outdoor Air      Complete section 9.3.3

**OR**

**Option 4** – Modbus Header AND Modbus Outdoor Air                      Complete section 9.3.4

#### Remote Setpoint (choose option 5 through 8)

**Option 5** – 4-20ma Drive AND Direct Wired Header                      Complete section 9.3.5

**OR**

**Option 6** – Modbus Drive AND Direct Wired Header                      Complete section 9.3.6

**OR**

**Option 7** – 4-20ma Drive AND Modbus Header                              Complete section 9.3.7

**OR**

**Option 8** – Modbus Drive AND Modbus Header                              Complete section 9.3.8

### 9.3 BST Implementation Instruction

#### 9.3.1 Option 1 - Constant Setpoint with DIRECT Wired Header Sensor

##### Step 1: Direct Wired Header Sensor Wiring

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

##### NOTES:

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



##### Step 2: Configure ALL C-More Units

###### On ALL Boilers:

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

###### On MASTER only:

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

###### When ALL C-More units have been configured:

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

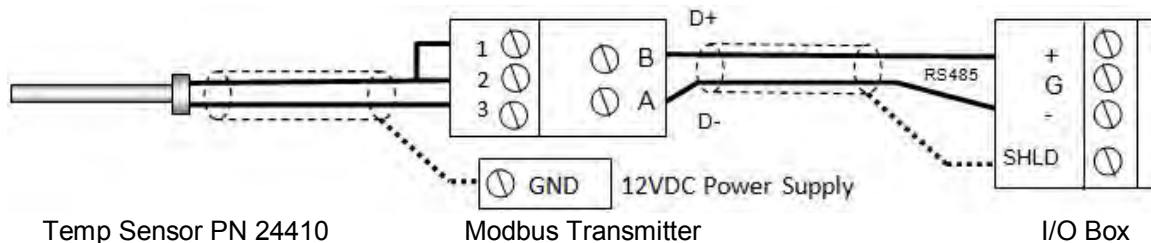
### 9.3.2 Option 2 - Constant Setpoint with MODBUS Wired Header Sensor

#### Step 1: MODbus Header Sensor Wiring

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

#### NOTES:

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



#### Step 2: Configure ALL C-More Units

##### On ALL Boilers:

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

##### On MASTER only:

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

##### When ALL C-More units have been configured:

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

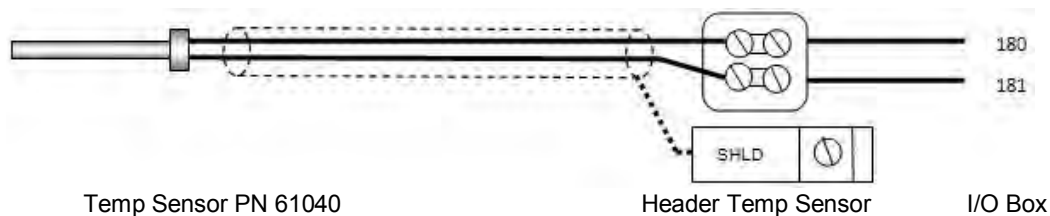
### 9.3.3 Option 3 - Outdoor Reset with DIRECT WIRED Header Sensor AND DIRECT WIRED Outdoor Sensor

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

#### **Step 1 - Direct Wired Header Sensor Wiring**

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

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

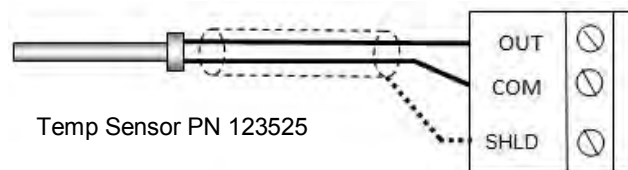


#### **Step 2 - Direct Wired Outdoor Sensor**

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

**NOTES:**

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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

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### Option 3 – Continued

#### Step 3 - Configure ALL C-More Units

##### **On ALL Boilers:**

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

##### **On MASTER only:**

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

##### **When ALL C-More units have been configured:**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

### 9.3.4 Option 4 - Outdoor Reset with MODBUS Header Sensor AND MODBUS Outdoor Sensor

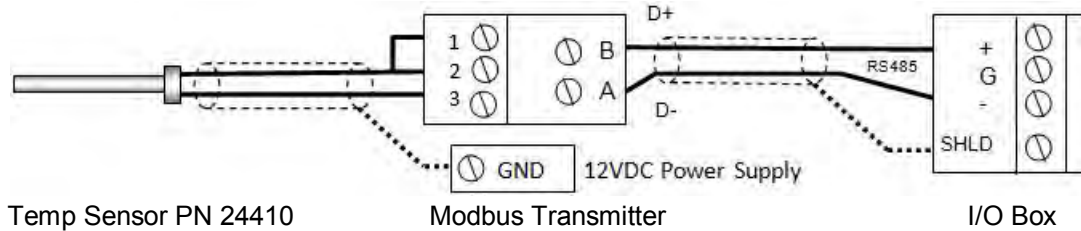
**NOTE:** Both Header Sensor AND Outdoor Sensor must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

#### **Step 1 - Modbus Header Sensor Wiring**

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

#### **NOTES:**

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



#### **Step 2 - Modbus Outdoor Sensor Wiring**

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

#### **NOTES:**

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

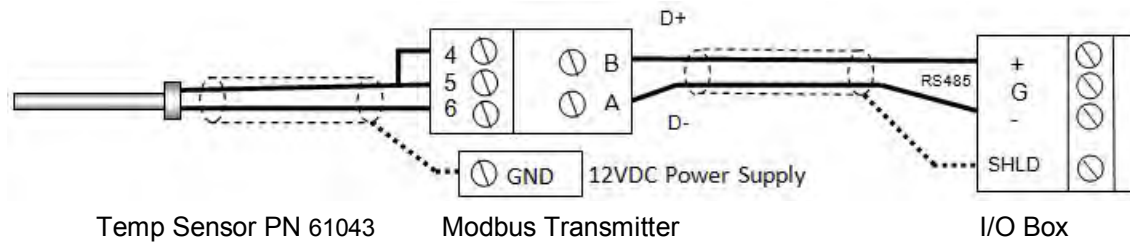


# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

### Option 4 – Continued

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



### Step 3 - Configure ALL C-More Units

#### **On ALL Boilers:**

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

#### **On MASTER only:**

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

#### **When ALL C-More units have been configured:**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

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

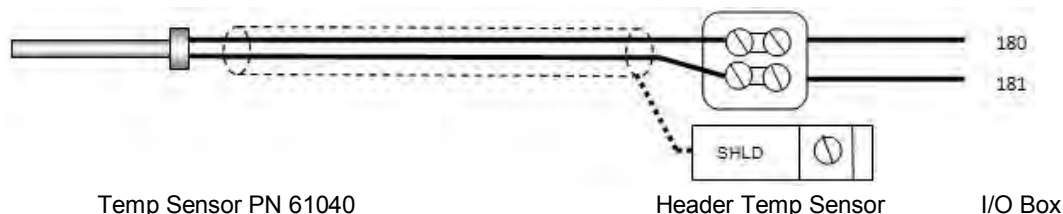
**NOTE:** Both Header Sensor AND 4-20ma Direct Drive must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

#### Step 1: Direct Wired Header Sensor Wiring

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

#### **NOTES:**

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

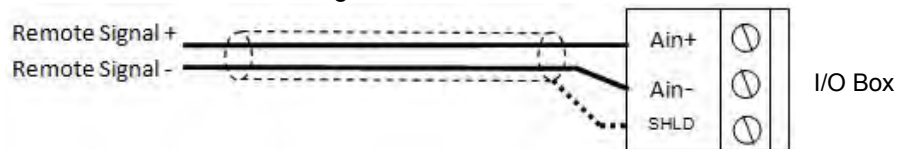


#### Step 2: Direct Wired 0-20ma or 4-20ma Wiring

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

#### **NOTE:**

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



#### Step 3: Configure ALL C-More Units

##### **On ALL Boilers:**

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

##### **On MASTER only:**

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

##### **When ALL C-More units have been configured:**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

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

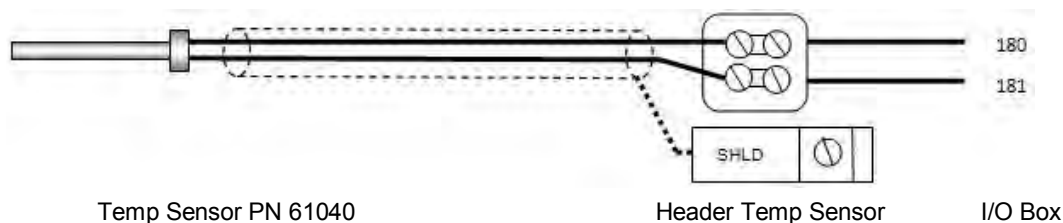
**NOTE:** Both Header Sensor AND the ProtoNode SSD Device must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

#### **Step 1: Direct Wired Header Sensor Wiring**

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

#### **NOTES:**

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



#### **Step 2: Remote Setpoint with Network**

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

#### **Step 3: Configure ALL C-More Units**

##### **On ALL Boilers:**

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

##### **On Master only:**

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

##### **When ALL C-More units have been configured:**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

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

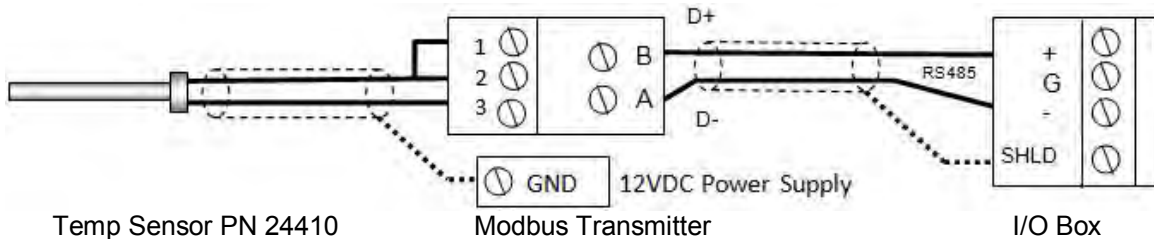
**NOTE:** Both Header Sensor AND 4-20ma Direct Drive must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

#### Step 1: MODbus Header Sensor

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

#### **NOTES:**

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

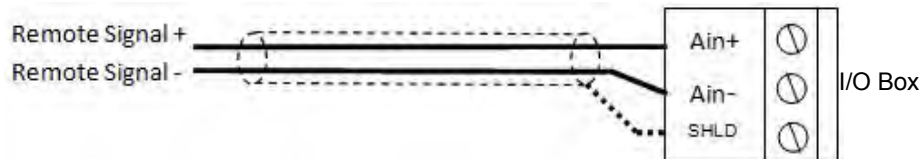


#### Step 2: Direct Wired 0-20ma or 4-20ma Wiring

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

#### **NOTES:**

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



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

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### Option 7 – Continued

#### **Step 3: Configure ALL C-More Units**

##### **On ALL Boilers:**

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

##### **On MASTER only:**

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

##### **When ALL C-More units have been configured:**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## CHAPTER 9. BOILER SEQUENCING TECHNOLOGY

### 9.3.8 Option 8 - Remote Setpoint with MODBUS Header Sensor AND MODBUS Setpoint Drive

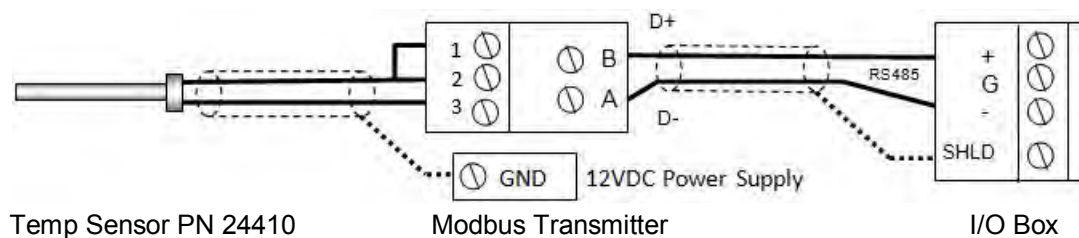
**NOTE!** Both Header Sensor AND ProtoNode SSD Device must be wired. See the C-More Controller User Manual, OMM-0032, GF-112 and ProtoNode User Manual, OMM-0080, GF-129 for more information.

#### **Step 1: MODbus Header Sensor**

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

#### **NOTES:**

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



#### **Step 2: Remote Setpoint with Network**

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

#### **Step 3: Configure ALL C-More Units**

##### **On ALL Boilers:**

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

##### **On MASTER only:**

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

When ALL C-More units have been configured:

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX A – BOILER MENU DESCRIPTIONS

### Appendix A: BOILER MENU ITEM DESCRIPTIONS

#### TABLE A-1: OPERATING MENU ITEM DESCRIPTIONS

See section 3-4 for a range of choices and the default values.

Table A-1: OPERATING MENU ITEM DESCRIPTIONS		
MENU OPTIONS		DESCRIPTION
1	Active Setpoint	This is the setpoint temperature to which the control is set when operating in the Constant Setpoint, REMOTE SETPOINT or OUTDOOR RESET mode. When in the CONSTANT SETPOINT mode, this value is equal to the Internal Setpoint setting in the Configuration Menu. When in the REMOTE SETPOINT Mode, this value is the setpoint equivalent to the remote analog signal supplied to the unit. When in the OUTDOOR RESET Mode, this is the derived value from the charts in Appendix E.
2	Inlet Temp	Displays the inlet water temperature.
3	Air Temp	Air Temp is the air temperature at the input to the Air/Fuel Valve. This reading is one of the parameters used to control the Blower Motor speed.
4	Outdoor Temp	Outdoor temperature is displayed in °F or °C, only if outdoor temperature sensor is installed and enabled.
5	Valve Position In	Desired input valve position. This would normally be the same as the fire valve position shown on the bar graph (valve position out) when the boiler is operating.
6	Valve Position Out	Displays actual real time Valve Position.
7	Exhaust Temp	Displays the exhaust temperature in °F (default) or °C.
8	Flame Strength	Displays flame strength from 0% to 100%.
9	Oxygen Level	Displays the real-time combustion oxygen (O <sub>2</sub> ) level (%) measured by the O <sub>2</sub> sensor.
10	Ignition Time	Displays the elapsed time between confirmation of gas valve opening (POC) until a stable flame is detected.
11	SSOV Time to OPN	Displays the elapsed time between 120VAC being applied to the Gas Valve and confirmation of gas valve opening (POC).
12	Spark Current	Displays the current going to the ignition transformer.
13	Run Cycles	Displays the total number of run cycles.
14	Run Hours	Displays total run time of unit in hours.
15	Fault Log	Displays information on the last 20 faults.



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX A – BOILER MENU DESCRIPTIONS

**TABLE A-2: SETUP MENU ITEM DESCRIPTIONS**

See section 3-5 for a range of choices and the default values.

SETUP MENU		
MENU OPTIONS		DESCRIPTION
1	Password	Allows Level 1 or Level 2 password to be entered. Entering the Level 1 Password (159) allows options in the Setup, Configuration and Tuning Menus to be modified. Entering the Level 2 Password (6817) allows options in the Calibration and Diagnostics Menus to be changed or activated, in addition to all Level 1 Menu options.
2	Language	Permits selection of English, Spanish or French for displayed messages.
3	Time	Displays time from 12:00 am to 11:59 pm.
4	Date	Displays dates from 01/01/00 to 12/31/99
5	Unit of Temp	Permits selection of temperature displays in degrees Fahrenheit (°F) or degrees Celsius (°C).
6	Comm Address	For RS-485 communications (0 to 127). RS232 should have its own (programmable) password.
7	Baud Rate	Allows communications Baud Rate to be set (2400 to 19.2K). Default is 9600.
8	OnAER Mode	Allows selection of either Ethernet or SD Card
9	Min Upload Timer	Mandatory for AERCO OnAER Remote Data Collection (ORDC). This parameter enables ORDC and defines the minimum amount of time between heartbeat data uploads in seconds. The COMM LED will light during the upload.
10	Unit Alpha	Mandatory for AERCO OnAER Remote Data Collection. This value must match the first alpha digit on the Code Plate, e.g., <b>G</b> -12-1234.
11	Unit Year	Mandatory for AERCO OnAER Remote Data Collection. This value must match the 2-digit year on the Code Plate, e.g., G- <b>12</b> -1234.
12	Unit Serial #	Mandatory for AERCO OnAER. Remote Data Collection. This value must match the 4-digit serial # on the Code Plate, e.g., G-12- <b>1234</b> .
13	Software Version	Identifies the current software version of the control box.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX A – BOILER MENU DESCRIPTIONS

**TABLE A-3: CONFIGURATION MENU ITEM DESCRIPTIONS**

See section 3-6 for a range of choices and the default values.

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

CONFIGURATION MENU		
MENU OPTIONS		DESCRIPTION
1	Internal Setpoint	Allows internal setpoint to be set from 40°F to 240°F.
2	Unit Type	Can be one of the following: BMK Blr Std, BMK Blr Std Dual, BMK Blr LN, BMK Blr LN Dual.
3	Unit Size	Sets unit size, depending on the Unit Type. 1500 MBH for Benchmark 1500, 2000 MBH MBH for Benchmark 2000
4	Fuel Type	Allows selection of Natural Gas or Propane.
5	Boiler Mode	Only if Unit Type = Boiler. Allows selection of: Constant Setpoint, Remote Setpoint, Direct Drive, Combination, or OUTDOOR RESET Mode.
6	Remote Signal	Only available if Mode = REMOTE SETPOINT, DIRECT DRIVE or COMBINATION. Used to set the type of external signal which will be used when operating in the REMOTE SETPOINT, DIRECT DRIVE or COMBINATION mode.
7	Outdoor Sensor	Allows outdoor sensor function to be set to Enabled or Disabled.
8	Bldg Ref Temp	Only available if Boiler Mode = <b>Outdoor Reset</b> . Allows the building reference temperature to be set when operating a boiler in the Outdoor Reset Mode.
9	Reset Ratio	Only available if Boiler Mode = <b>Outdoor Reset</b> . Permits setting of Reset Ratio when operating boiler in the Outdoor Reset Mode.
10	System Start Tmp	Only if Outdoor Sensor = <b>Enabled</b> . This menu item allows the system start temperature to be set.
11	Setpt Lo Limit	Used to set the <i>minimum</i> allowable setpoint, from 40°F up to the Setpt Hi Limit.
12	Setpt Hi Limit	Used to set the <i>maximum</i> allowable setpoint, from the Setpt Lo Limit up to 210°F.
13	Temp Hi Limit	This is the maximum allowable outlet temperature, up to 210°F. Any temperature above this setting will turn off the unit. The temperature must then drop 5° below this setting to allow the unit to run.
14	Max Valve Position	Sets the maximum allowable valve position for the unit.
15	Pump Delay Timer	Specifies the amount of time, up to 30 minutes, to keep the pump running after the unit turns off.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX A – BOILER MENU DESCRIPTIONS

CONFIGURATION MENU		
MENU OPTIONS		DESCRIPTION
16	Aux Start On Dly	Specifies the amount of time to wait, up to 120 seconds, between activating the Aux Relay (due to a demand) and checking the pre-purge string to start the boiler.
17	Failsafe Mode	Allows the FAILSAFE mode to be set to either Constant Setpoint or Shutdown.
18	Analog Output	Must be set to <b>Valve Pos 0-10V</b> for BMK 1500 and BMK 2000. <b>DO NOT CHANGE</b> from its default value.
19	Lo Fire Timer	Specifies how long, from 2 to 600 seconds, to remain in the low fire position after ignition, before going to the desired output.
20	Setpt Limiting	Setpoint Limiting can be Enabled or Disabled.
21	Setpt Limit Band	The Setpoint Limit Band can be set from <b>0°F</b> to <b>10°F</b> .
22	Network Timeout	Specifies the timeout value in seconds before a Modbus fault is declared, up to 999 seconds
23	Shutoff Dly Temp	This feature delays the shutdown of a boiler in order to reduce excessive cycling. This specifies the temperature value the Outlet Temperature is permitted to rise above setpoint before being shut down.
24	Demand Offset	<p>This entry will reduce excessive ON/OFF cycling in AUTO mode. When this entry is a non-zero value, the unit will not turn on again until <i>Valve Position In</i> reaches the Start Level value AND the Outlet Temperature goes below the <i>Active Setpoint – Demand Offset</i>. In addition, the boiler will fire at the 29% Valve Position level or below for a period of one minute.</p> <p>When this entry is set to zero, the unit will turn on again as soon as the <i>Valve Position in</i> reaches the <i>Start Level</i> value. There will not be a one minute delay when firing at the 29% Valve Position level.</p>

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX A – BOILER MENU DESCRIPTIONS

CONFIGURATION MENU		
MENU OPTIONS		DESCRIPTION
25	Deadband High	<p>Deadband High and Deadband Low settings create an “Outlet Temperature” Zone in which no Valve Position corrections will be attempted.</p> <p>The Deadband ZONE is defined as operating with an Outlet Temperature between Active Setpoint + Deadband High and Active Setpoint – Deadband Low.</p> <p>When the Outlet Temperature reaches Active Setpoint and remains there for a period of 15 seconds, the unit will go into a DEADBAND MODE at which point no Valve Position corrections will be attempted while the Outlet Temperature remains anywhere within the Deadband ZONE. When the unit is in the DEADBAND MODE, the °F or °C LED will flash on and off. When the Outlet Temperature drifts out of the Deadband ZONE, the DEADBAND MODE will be terminated and the PID LOOP will again attempt Valve Position corrections.</p> <p>Setting range is 0 to 25. (Default is 5 for both Deadband High and Deadband Low)</p>
26	Deadband Low	
27	IGST Version	Displays the version of the IGST Board installed.
28	IGN Time Setting	Displays the MAX Ignition time of 4 Seconds or 7 Seconds as set in the Safety String Harness.
29	Slow Shutdown	Set the Slow Shutdown feature to Enabled or Disabled.
30	Slow Sht Duration	If Slow Shutdown = <b>Enabled</b> , sets the time a boiler will continue to run at the Stop Level after running above the Slow Sht Threshold level, up to 9,999 seconds.
31	Slow Sht Threshold	Sets the Fire Rate above which a boiler will trigger the Slow Shutdown feature.
32	BST Menu	When set to Enabled, the BST menu options appear.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX A – BOILER MENU DESCRIPTIONS

**TABLE A-4: TUNING MENU ITEM DESCRIPTIONS**

See section 3-7 for a range of choices and the default values.

TUNING MENU			
MENU OPTIONS		DESCRIPTION	
1	Prop Band	Generates a fire rate based on the error that exists between the setpoint temperature and the actual outlet temperature. If the actual error is less than the proportional band setting (1 to 120°F), the fire rate will be less than 100%. If the error is equal to or greater than the proportional band setting, the fire rate will be 100%.	
2	Integral Gain	This sets the fraction of the output, due to setpoint error, to add or subtract from the output each minute to move towards the setpoint. Gain is adjustable from 0.00 to 1.00 (Default is 1.0).	
3	Derivative Time	This value (0.0 to 2.0 min.) responds to the rate of change of the setpoint error. This is the time that this action advances the output.	
Warmup		The feature embodied in the next three menu items eliminates Temperature Overshoots during the “Warmup” period of a cold ignition cycle on all boilers by temporarily modifying the PID Gain parameter during warmup and for a period defined in the Tuning Menu.	
4	Warmup Prop Band	Range = 1 - 120	Default = 95
5	Warmup Int Gain	Range = .00 – 2.00	Default = .50
6	Warmup PID Timer	Range = 0 - 240 seconds	Default = 20 seconds
5	Reset Defaults?	Allows Tuning Menu options to be reset to their Factory Default values.	

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX A – BOILER MENU DESCRIPTIONS

### TABLE A-5: COMBUSTION CALIBRATION MENU ITEM DESCRIPTIONS

See section 3-8 for a range of choices and the default values.

#### NOTE

The Level 2 Password must be entered to view the options in the Combustion Cal Menu. This Menu is used during the Combustion Calibration procedures described in Chapter 4 of this Manual.

COMBUSTION CAL MENU			
	MENU OPTION		DESCRIPTION
	<b>NATURAL GAS</b>	<b>PROPANE GAS</b>	Displays the default DC drive voltage provided to the blower at each of the Air/Fuel Valve positions show in the left-hand column. This drive voltage adjusts the rotational speed of the blower to maximize combustion efficiency.
1	CAL Voltage: BMK 1500 = 16% BMK 2000 = 18%	CAL Voltage 16%	
2	CAL Voltage 30%	CAL Voltage 30%	
3	CAL Voltage 40%	CAL Voltage 40%	
4	CAL Voltage 50%	CAL Voltage 50%	
5	CAL Voltage 70%	CAL Voltage 70%	
6	CAL Voltage 100%	CAL Voltage 100%	
7	Set Valve Position		Permits selection of the Air/Fuel Valve position (% open) to be set from 0 to 100%.
8	Blower Output		Permits the DC drive voltage to the blower to be monitored.
9	Set Stby V out		Permits the Standby Voltage to be set from 0 to 4.00 Volts.
10	Oxygen Level		Permits the combustion oxygen level to be displayed (0% to 25%)

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX A – BOILER MENU DESCRIPTIONS

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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX B – STARTUP, STATUS & DISPLAY MESSAGES

### Appendix B: STARTUP, STATUS & DISPLAY MESSAGES

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

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX B – STARTUP, STATUS & DISPLAY MESSAGES

**Table B-2: Fault Messages**

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX B – STARTUP, STATUS & DISPLAY MESSAGES

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

FAULT MESSAGE	FAULT DESCRIPTION
LOW WATER LEVEL	The Low Water Cutoff board is indicating low water level.
NETWORK COMM FAULT	The RS485 network information is not present or is corrupted.
O <sub>2</sub> % OUT OF RANGE	The O <sub>2</sub> % has gone below 3% or above 8%.
OUTDOOR TEMP SENSOR FAULT	The temperature measured by the Outdoor Air Sensor is out of range.
OUTLET TEMP SENSOR FAULT	<p>The temperature measured by the Outlet Sensor is out of range:</p> <ul style="list-style-type: none"> <li>• OUTLET TEMPERATURE display = SHt Indicates sensor is shorted</li> <li>• OUTLET TEMPERATURE display = Opn indicates sensor is open-circuited</li> </ul>
PRG SWTCH CLOSED DURING IGNITION	The Purge Position Limit Switch on the Air/Fuel Valve closed during ignition.
PRG SWTCH OPEN DURING PURGE	The Purge Position Limit Switch on the Air/Fuel Valve opened during purge.
REMOTE SETPT SIGNAL FAULT	The Remote Setpoint signal is not present or is out of range.
RESIDUAL FLAME	The Flame signal was seen for more than 60 seconds during standby.
SSOV SWITCH OPEN	The SSOV switch opened during standby.
SSOV FAULT DURING PURGE	The SSOV switch opened during purge.
SSOV FAULT DURING IGN	The SSOV switch closed or failed to open during ignition.
SSOV FAULT DURING RUN	The SSOV switch closed for more than 15 seconds during run.
SSOV RELAY FAILURE	A failure has been detected in one of the relays that control the SSOV.
STEPPER MOTOR FAILURE	The Stepper Motor failed to move the Air/Fuel Valve to the desired position.

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX B – STARTUP, STATUS & DISPLAY MESSAGES

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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX C – SENSOR RESISTANCE/VOLTAGE CHART

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### Appendix C: SENSOR RESISTANCE/VOLTAGE CHART

#### *Temperature Sensor Resistance Voltage Chart (Balco)*

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

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX C – SENSOR RESISTTANCE/VOLTAGE CHART

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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX D – RECOMMENDED PERIODIC TESTING

### Appendix D: RECOMMENDED PERIODIC TESTING

#### WARNING!

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

Item	Frequency	Performed By	Remarks
<b>Refer to indicated sections of this manual for detailed procedures</b>			
Gauges, monitors and indicators	Daily	Operator	Visual inspection and record readings in operator log
Instrument and equipment settings	Daily	Operator	Visual check against factory recommended specifications
	Weekly	Operator	Verify factory settings
Firing Rate Control	Semi-Annually	Service Technician	Verify factory settings
	Annually	Service Technician	Check with combustion calibration test equipment. See sections 4.3 and 7.4.
Flue, vent, stack or intake air duct	Monthly	Operator	Visually inspection condition and check for obstructions
Spark Igniter-Injector	Weekly	Operator	See section 7.2
Air/Fuel Valve position	Weekly	Operator	Check position indicator dial (section 3.10)
SSOV Leakage test	Annually	Service Technician	Check for leakage in accordance with the SSOV manufacturer's (Siemens) recommendations.
Flame failure	Weekly	Operator	Close manual gas shutoff valve and check safety shutdown. See section 6.7
Flame signal strength	Weekly	Operator	Check flame strength using the Control Panel Operating Menu. See section 3.4.
Low water level cut off and alarm	Weekly	Operator	See section 6.4
Slow drain test	Semi-Annually	Operator	Perform a slow drain test in accordance with ASME Boiler and Pressure Vessel Code, Section IV.
High water temperature safety control test	Annually	Service Technician	See section 6.5
Operating controls	Annually	Operator	See section 3.2
Low air flow	Monthly	Operator	See section 6.8
High and low gas pressure interlocks	Monthly	Operator	See sections 6.2 and 6.3
Air/Fuel Valve purge position switch	Annually	Service Technician	See section 6.10
Air/Fuel Valve ignition position switch	Annually	Service Technician	See section 6.11
Safety valves	As required	Operator	Check per A.S.M.E. Boiler and Pressure Vessel Code, Section IV
Inspect burner components	Semi-Annually	Service Technician	See section 7.6
Condensate Trap	Semi-Annually	Operator	See section 7.7
Oxygen (O <sub>2</sub> ) Level	Monthly	Operator	Verify oxygen level is between 3% and 8% during boiler operation



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX D – RECOMMENDED PERIODIC TESTING

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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX E – INDOOR/OUTDOOR RESET RATIO CHARTS

### Appendix E: INDOOR/OUTDOOR RESET RATIO CHARTS

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

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

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

Air Temp	RESET RATIO									
	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			

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX E – INDOOR/OUTDOOR RESET RATIO CHARTS

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

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

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

Air Temp	RESET RATIO									
	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				

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX E – INDOOR/OUTDOOR RESET RATIO CHARTS

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

Air Temp	RESET RATIO									
	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	147
40F	96	103	110	117	124	131	138	145	152	159
35F	99	107	115	123	131	139	147	155	163	171
30F	102	111	120	129	138	147	156	165	174	183
25F	105	115	125	135	145	155	165	175	185	195
20F	108	119	130	141	152	163	174	185	196	207
15F	111	123	135	147	159	171	183	195	207	219
10F	114	127	140	153	166	179	192	205	218	
5F	117	131	145	159	173	187	201	215		
0F	120	135	150	165	180	195	210			
-5F	123	139	155	171	187	203	219			
-10F	126	143	160	177	194	211				
-15F	129	147	165	183	201	219				

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

Air Temp	RESET RATIO									
	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					

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX E – INDOOR/OUTDOOR RESET RATIO CHARTS

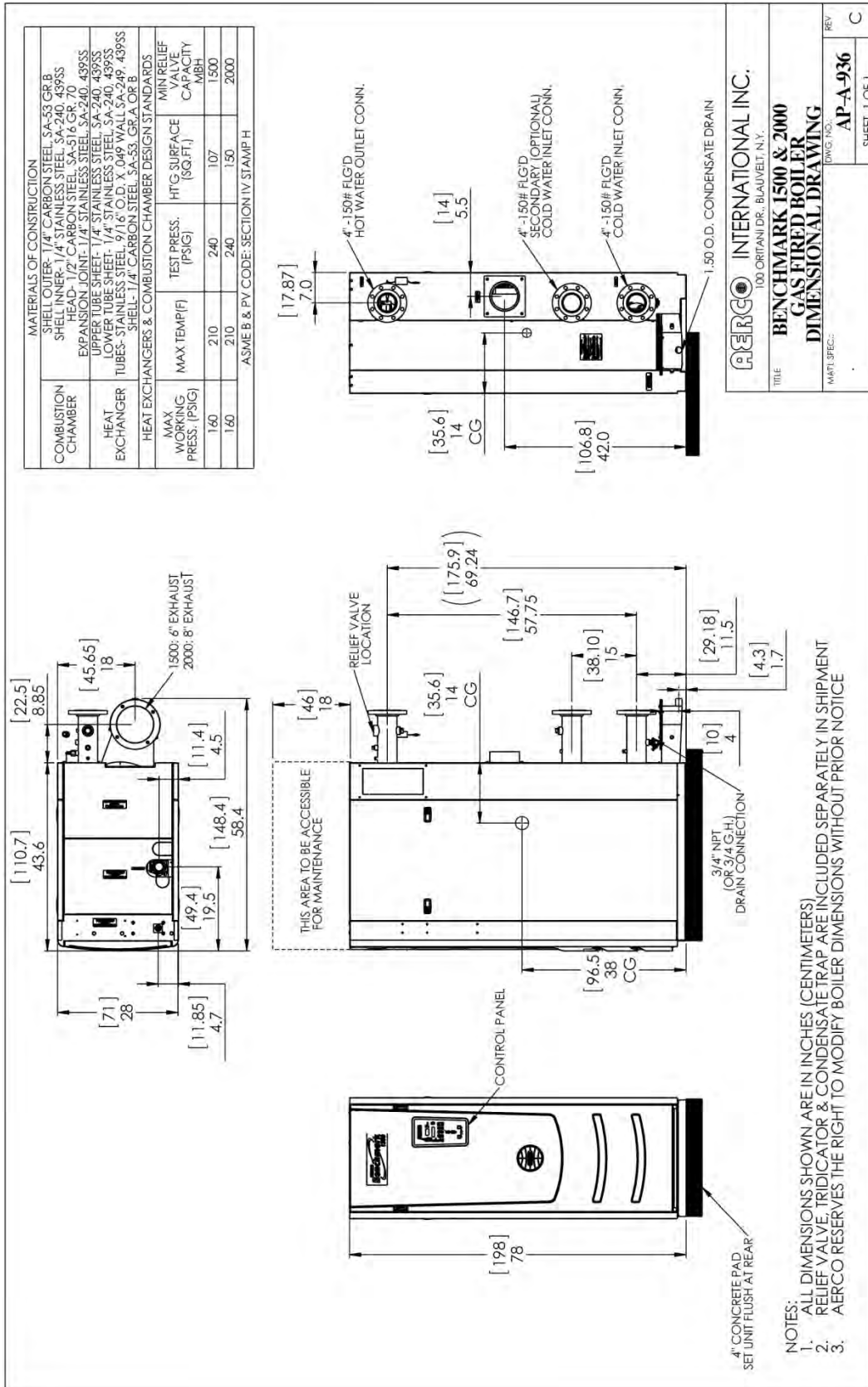
**Table E-7: Header Temperature for a Building Reference Temperature of 90F**

Air Temp	RESET RATIO									
	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					

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX F – DIMENSIONAL AND CLEARANCE DRAWINGS

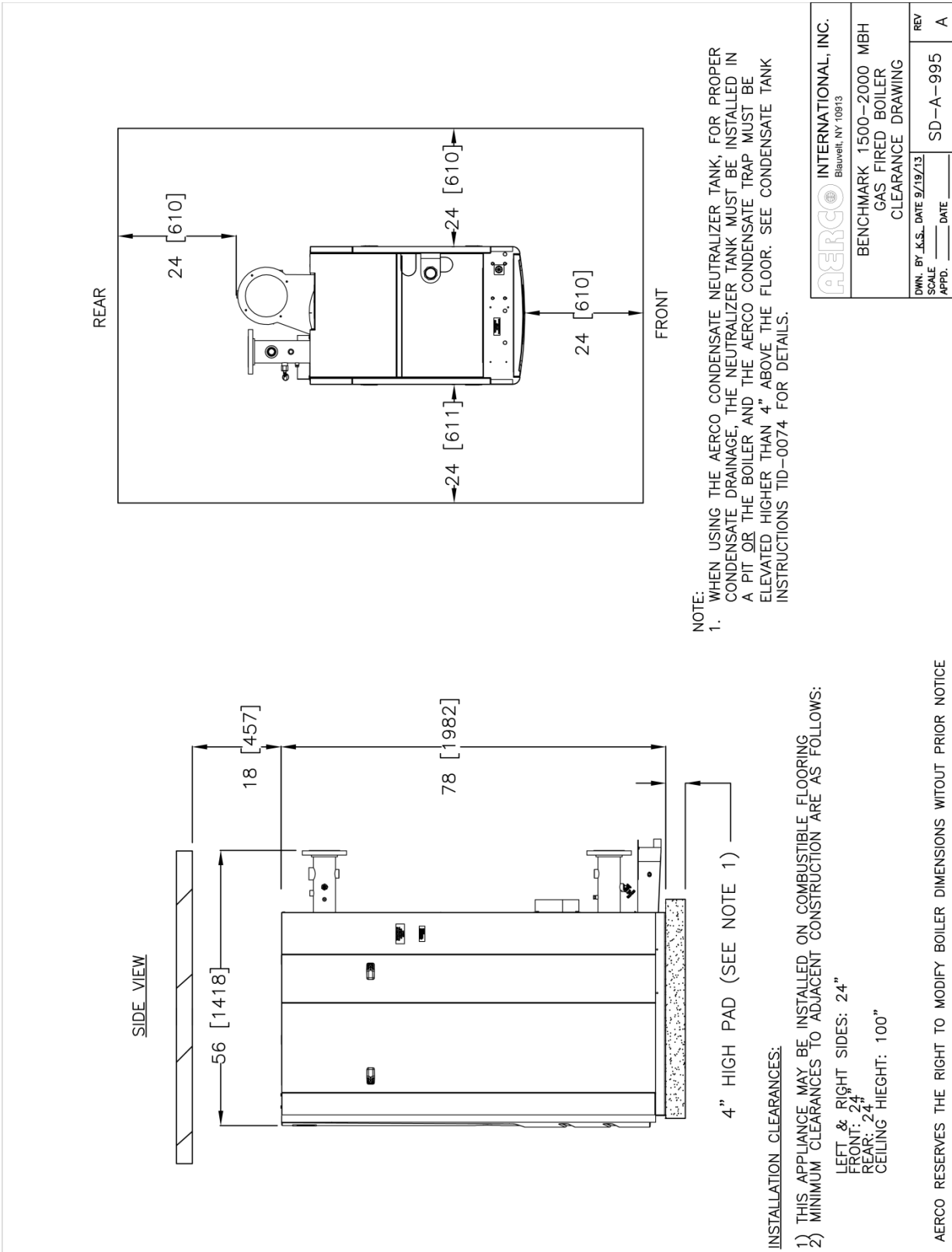
### Appendix F: DIMENSIONAL AND CLEARANCE DRAWINGS



Drawing Number: AP-A-936 rev C

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX F – DIMENSIONAL AND CLEARANCE DRAWINGS



Drawing Number: AP-A-995 rev A



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS

### Appendix G: PART DRAWINGS

#### Benchmark 1500DF – 2000DF Part List

Item#	Qty	Part #	Description	Item#	Qty	Part #	Description
<b>EXHAUST MANIFOLD</b>				<b>CONTROLS (Continued)</b>			
1	1	39187	MANIFOLD: EXHAUST	30	1	61002-5	BLOCKED INLET SWITCH -4.5" W.C.
2	1	81165	MANIFOLD: SEAL	31	1	69186-1	CONTROL BOX: C-MORE
3	6	9-22	PIPE PLUG: 1/4" NPT: STEEL	32a	1	65085	IGNITION TRANSFORMER
<b>GAS TRAIN</b>				32b	1	61034	SPARK MONITOR
				33	1	63108	SSOV/RELAY JUMPER
				34	1	93230	SNUBBER
				35	1	64081	ECU, O <sub>2</sub> SENSOR
4	1	22198	BMK 1500DF/2000DF GAS TRAIN ASSY	36	1	65011	TRANSFORMER 115V/24V 100VA
		22201	BMK 1500DF/2000DF DBB GAS TRAIN ASSY	37	1	65109	12V POWER SUPPLY
5	1	63019	GAS TRAIN HARNESS	38	3	69141	DIN RAIL MOUNT END STOP
6	1	97087-26	FLEX HOSE, 26" on Gas Train 22198				
		97087-20	FLEX HOSE, 20" on Gas Train 22201				
7	2	97087-20	FLEXIBLE HOSE, 20"	39	2	65120	TERMINAL BLOCK: DIN MOUNTED: BLK
<b>BURNER, AIR/FUEL VALVE</b>				40	2	65121	TERMINAL BLOCK: DIN MOUNTED: WHT
				41	3	65122	TERMINAL GROUND BLOCK: DIN MOUNTED
				42	2	65118	FUSE TERMINAL: DIN MOUNTED
9	1	81186	LOWER RELEASE GASKET	43	1	64088	LIMIT CONTROL TEMPERATURE, DIGITAL CONTROLLER
10				44	1	60019	DISCONNECT, FUSIBLE
				45	1	65156	FLAME DETECTOR SIGNAL AMPLIFIER
11	1	24277	STAGED IGNITION ASSY	46	1	65162	24V POWER SUPPLY (Sequencing Isolation Valve)
12	1	81166	BURNER GASKET	47	2	124512	FUSE: 4 AMP
13	1	81183	BURNER RELEASE GASKET	48	1	123449	SENSOR: TEMPERATURE
14	1	43090	AIR FUEL VALVE PLENUM	49	1	58132	THERMOWELL
15	1	24311-3	AIR FUEL VALVE ASSY, BMK 1500	50	1	63105	I/O SENSOR/COMM HARNESS
11				51	1	63104	I/O INTERLOCK HARNESS
				52	1	63090	HARNESS ASSY: TEMP LIM CONT PWR
<b>HOSES &amp; INSULATION</b>				53	1	63150	HARNESS: FLAME DETECTOR
				54	1	33170	MOUNTING PANEL
				55	1	124324	GROUND BAR
16	1	97005-9	FLEX GAS TUBE 48"	56	1	63156	POWER CABLE, 24V SEQUENCE VALVE
17	1	80089	SHELL INSULATION	57	1	63103	SHELL HARNESS
<b>BLOWER</b>				58	1	63109	HARNESS: GAS TRAIN
				59	1	61024	AIR INLET TEMPERATURE SENSOR
18	1	58038	BLOWER ASSEMBLY REPLACEMENT KIT	60	1	123449	SENSOR: TEMPERATURE
19	1	81184	BLOWER OUTLET GASKET	61	1	61030	SENSOR: OUTLET TEMPERATURE
20	1	81100	GASKET, BLOWER MOTOR	62	1	69151	PCB ASSY
21	1	24356-1	FLAME DETECTOR KIT (with gasket)	63	1	63109	GAS TRAIN HARNESS
22	1	61026	LEAN OXYGEN SENSOR	64	1	65104	CABLE, H.V. IGNITION
23	1	59104	OBSERVATION PORT	65	1	63058	HARNESS: BLOWER SIGNAL
24	1	58023	IGNITOR-INJECTOR REPLACEMENT KIT	66	1	63083	HARNESS: O <sub>2</sub> SENSOR
25	1	59138	AIR FILTER	67	1	63111	HARNESS: CONTROL
26	1	43095	BLOWER PLENUM	68	1	38036	POWER PANEL COVER
<b>CONTROLS</b>				69	1	69151	PCB ASSY
				70	1	38035	I/O PANEL COVER
27	1	123966	SWITCH: OVER TEMP-AUTO RESET	71	1	38036	POWER PANEL COVER
28	1	123552	SWITCH: OVER TEMP-MANUAL RESET				
29				60011-4			
				60011-2			

❶ Not shown on drawing

AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF – 2000DF Part List</b>	01/15/2015
	<b>Whole Boiler 29313-3 – 29337-3</b>	Sheet 1 of 8

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS

### Benchmark 1500DF – 2000DF Part List – Continued

Item#	Qty	Part #	Description	Item#	Qty	Part #	Description
<b>SHEET METAL/PANEL ASSEMBLY</b>				<b>OTHER ACCESSORIES &amp; PARTS</b>			
72	1	37117	BACK PANEL: RIGHT	87 ❶	1	SEE TABLE A	PRESSURE/TEMP GAUGE
73 ❶	1	37118	BACK PANEL: LEFT	88 ❶	1	SEE TABLE A	PRESSURE RELIEF VALVE
74	2	35029	TOP RAIL	89 ❶	1	123540	EXT. MANUAL SHUT-OFF VALVE
75	1	25068	FRONT FRAME ASSEMBLY	90	1	69126	LOW WATER CUTOFF/CAPACITOR ASSY
76	1	25078	FRONT PANEL	91	1	123863	1/8" NTP BALL VALVE
77	1	72068	DOME LABEL	92	1	92094	3/4" DRAIN VALVE
78	2	59179	HANDLE, CONCEALED	93 ❶	1	59043	CONDENSATE FLOAT
79	4	59133	LATCH	94 ❶	1	24060	COND. TRAP ASSY
80	1	37119	FRONT TOP PANEL	95	1	59178	1/8" AIR VENT
81	1	37120	BACK TOP PANEL	96	1	90052	NIPPLE 1/8" X 1.50 LG
82	2	30117	SIDE PANEL	97	1	63035-1	FUEL SELECTOR SWITCH
83	1	74031	BMK 1500 LOGO	98	1	65147	AXIAL FAN, 12V DC
	1	74033	BMK 2000 LOGO				
84	1	39164	AIR INLET ADAPTER	100 ❶	1	92084-6	MOTORIZED SEQUENCING ISOLATION VALVE (OPTIONAL)

❶ Not shown on drawings below

**TABLE A – Benchmark 1500**

Part No.	Description	Item 88	Item 87
58088-C30	30 PSI KIT (CONBRACO)	92015-17	123675-5
58088-C50	50 PSI KIT (CONBRACO)	92015-18	123675-5
58088-C60	60 PSI KIT (CONBRACO)	92015-19	123675-6
58088-C75	75 PSI KIT (CONBRACO)	92015-20	123675-6
58088-C100	100 PSI KIT (CONBRACO)	92015-21	123675-6
58088-C125	125 PSI KIT (CONBRACO)	92015-22	123675-6
58088-C150	150 PSI KIT (CONBRACO)	92015-6	123675-7
58088-W30	30 PSI KIT (WATTS)	92015-11	123675-5
58088-W50	50 PSI KIT (WATTS)	92015-12	123675-5
58088-W60	60 PSI KIT (WATTS)	92015-13	123675-6
58088-W75	75 PSI KIT (WATTS)	92015-14	123675-6
58088-W100	100 PSI KIT (WATTS)	92015-15	123675-6
58088-W125	125 PSI KIT (WATTS)	92015-16	123675-6
58088-W150	150 PSI KIT (WATTS)	5130-150	123675-7
58088-W160	160 PSI KIT (KUNKLE)	92015-23	123675-7

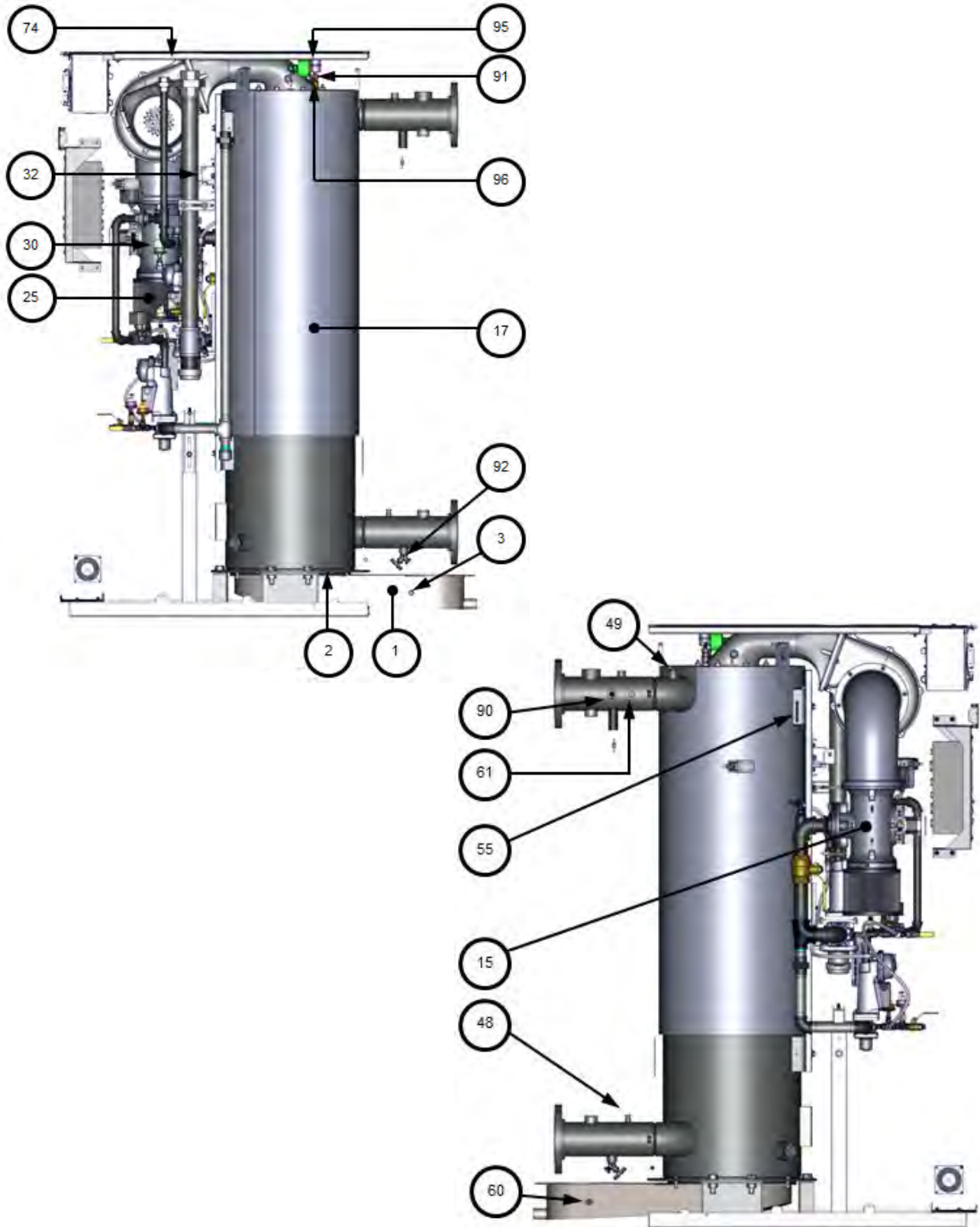
**TABLE A – Benchmark 2000**

Part No.	Description	Item 88	Item 87
58087-1	30 PSI	123661	123675-5
58087-2	50 PSI	124283	123675-5
58087-3	75 PSI	5130-75	123675-6
58087-4	100 PSI	5130-100	123675-6
58087-5	150 PSI	123659	123675-7
58087-6	60 PSI	92022	123675-6
58087-7	125 PSI	5130-125	123675-6
58087-8	160 PSI	92015-23	123675-7

AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF – 2000DF Part List</b>	01/15/2015
	<b>Whole Boiler 29313-3 – 29337-3</b>	Sheet 2 of 8

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

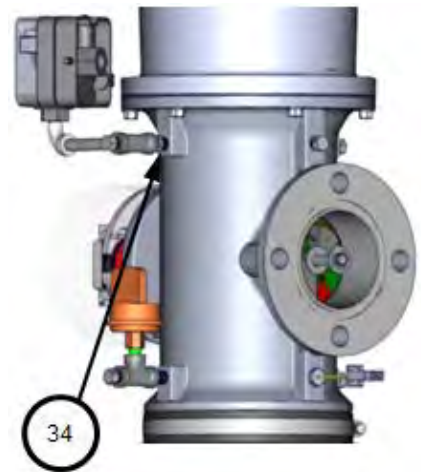
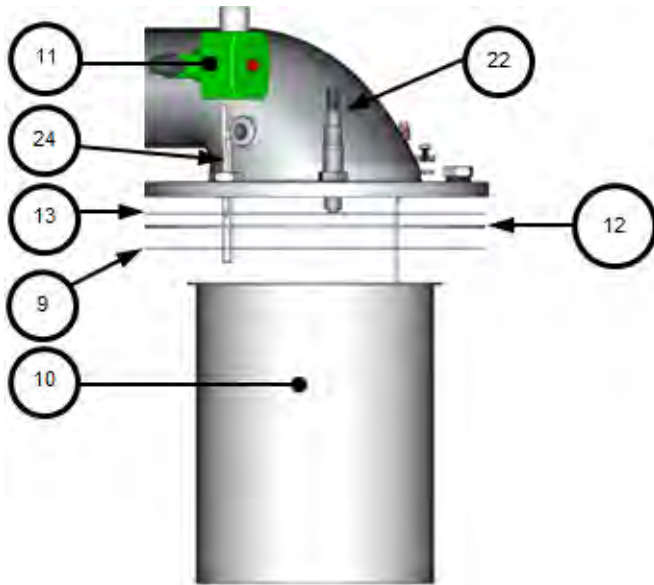
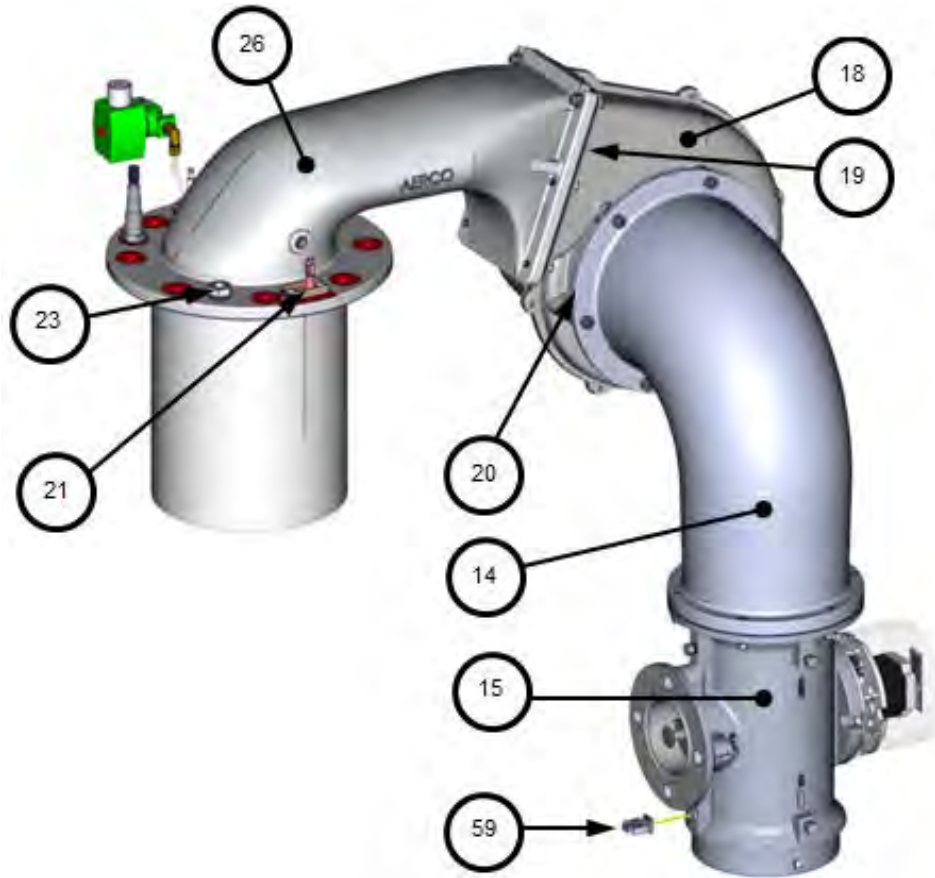
## APPENDIX G – PART DRAWINGS



AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF – 2000DF Part List</b>	01/15/2015
	<b>Whole Boiler 29313-3 – 29337-3</b>	Sheet 3 of 8

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS



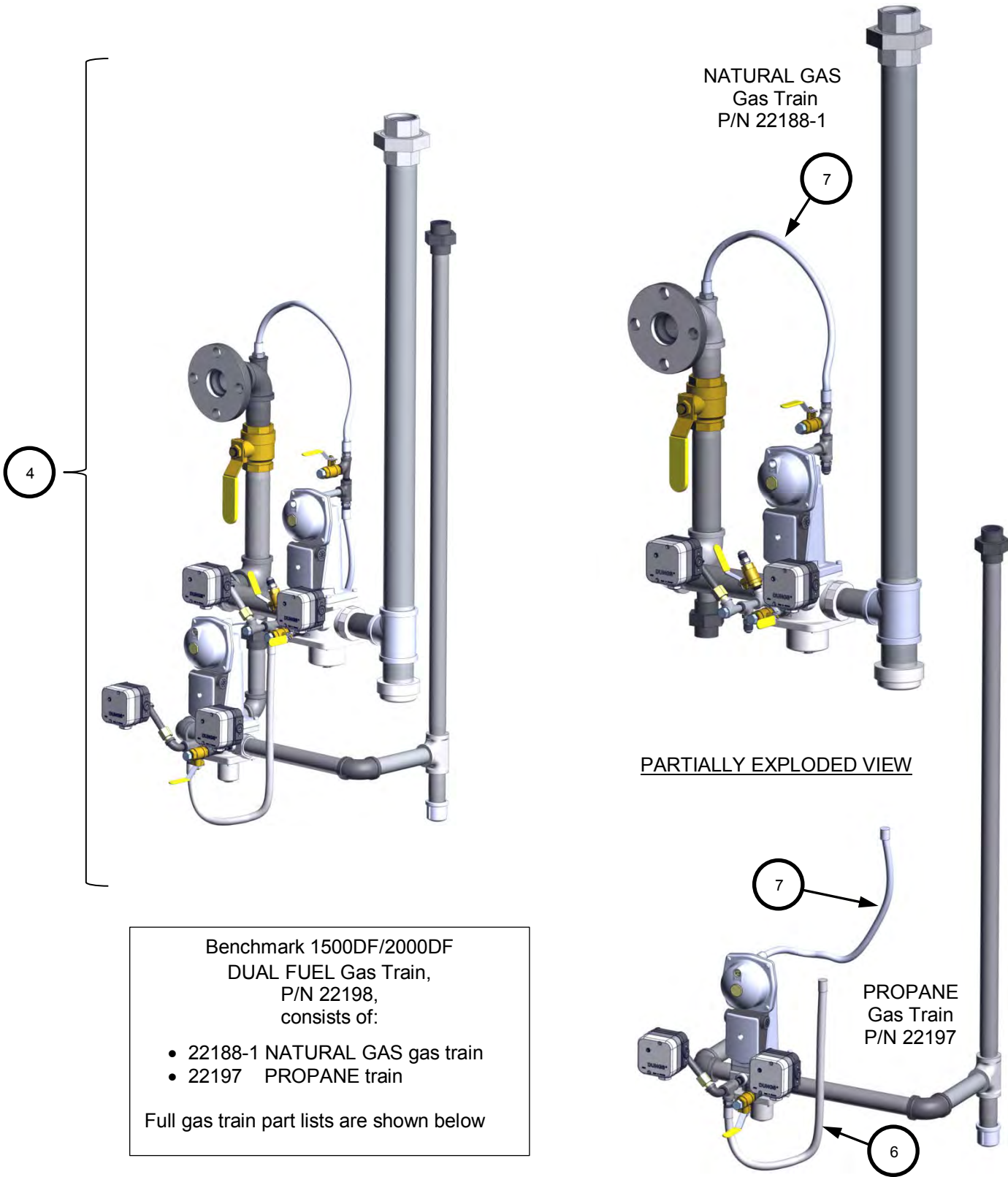
Benchmark 1500 Burner-Air/Fuel Valve Assembly P/N 24378  
 Benchmark 2000 Burner-Air/Fuel Valve Assembly P/N 24378-1

See full part lists below

AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF – 2000DF Part List</b>	01/15/2015
	<b>Whole Boiler 29313-3 – 29337-3</b>	Sheet 4 of 8

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS

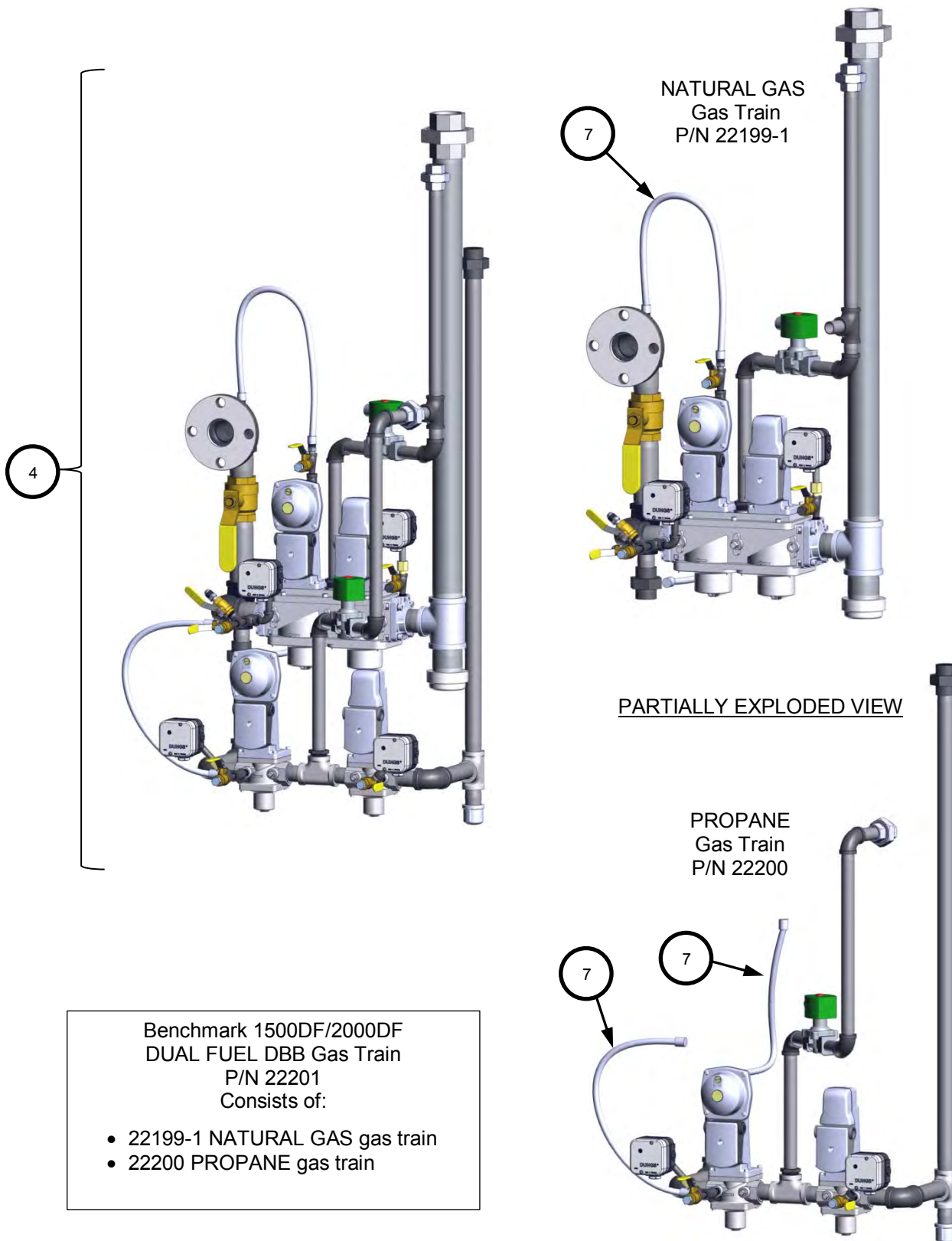


AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF – 2000DF Part List</b>	01/15/2015
	<b>Whole Boiler 29313-3 – 29337-3</b>	Sheet 5 of 7



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

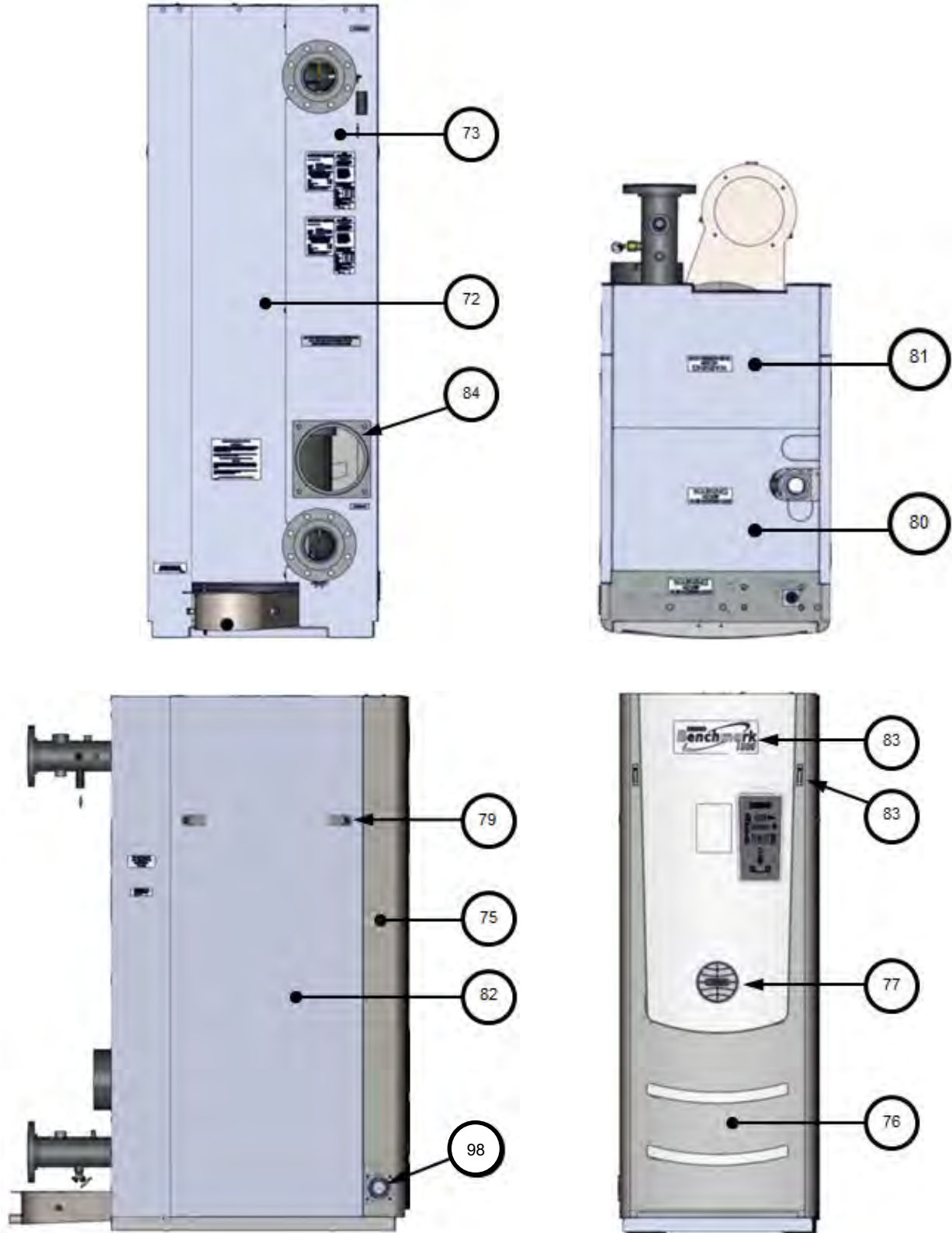
## APPENDIX G – PART DRAWINGS



AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF – 2000DF Part List</b>	01/15/2015
	<b>Whole Boiler 29313-3 – 29337-3</b>	Sheet 6 of 8

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS

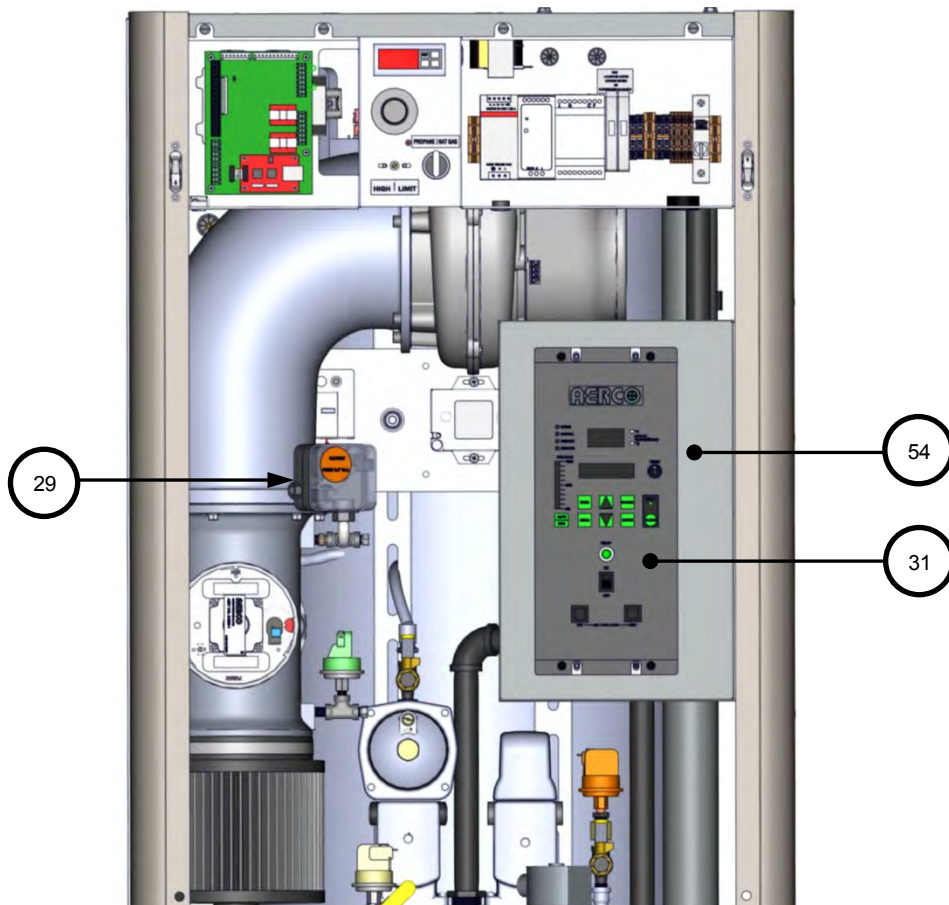
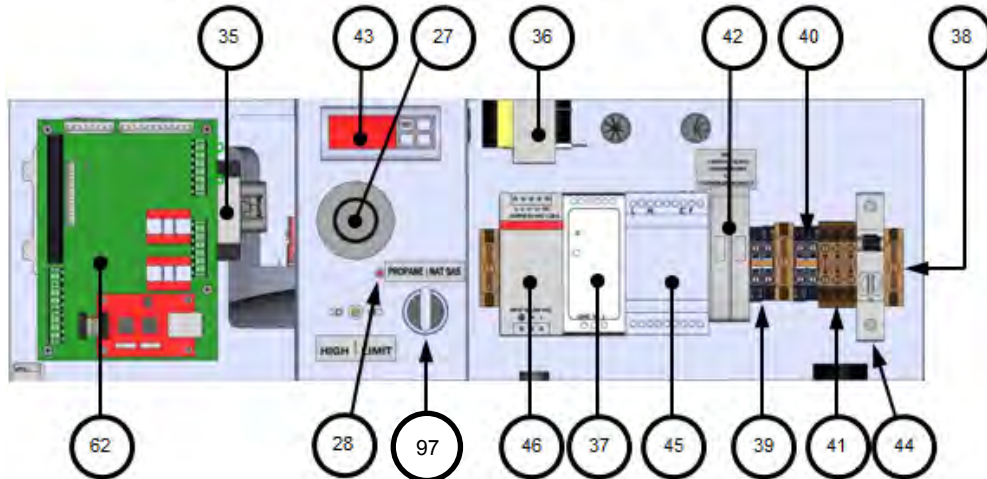


AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF – 2000DF Part List</b>	01/15/2015
	<b>Whole Boiler 29313-3 – 29337-3</b>	Sheet 7 of 8



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS



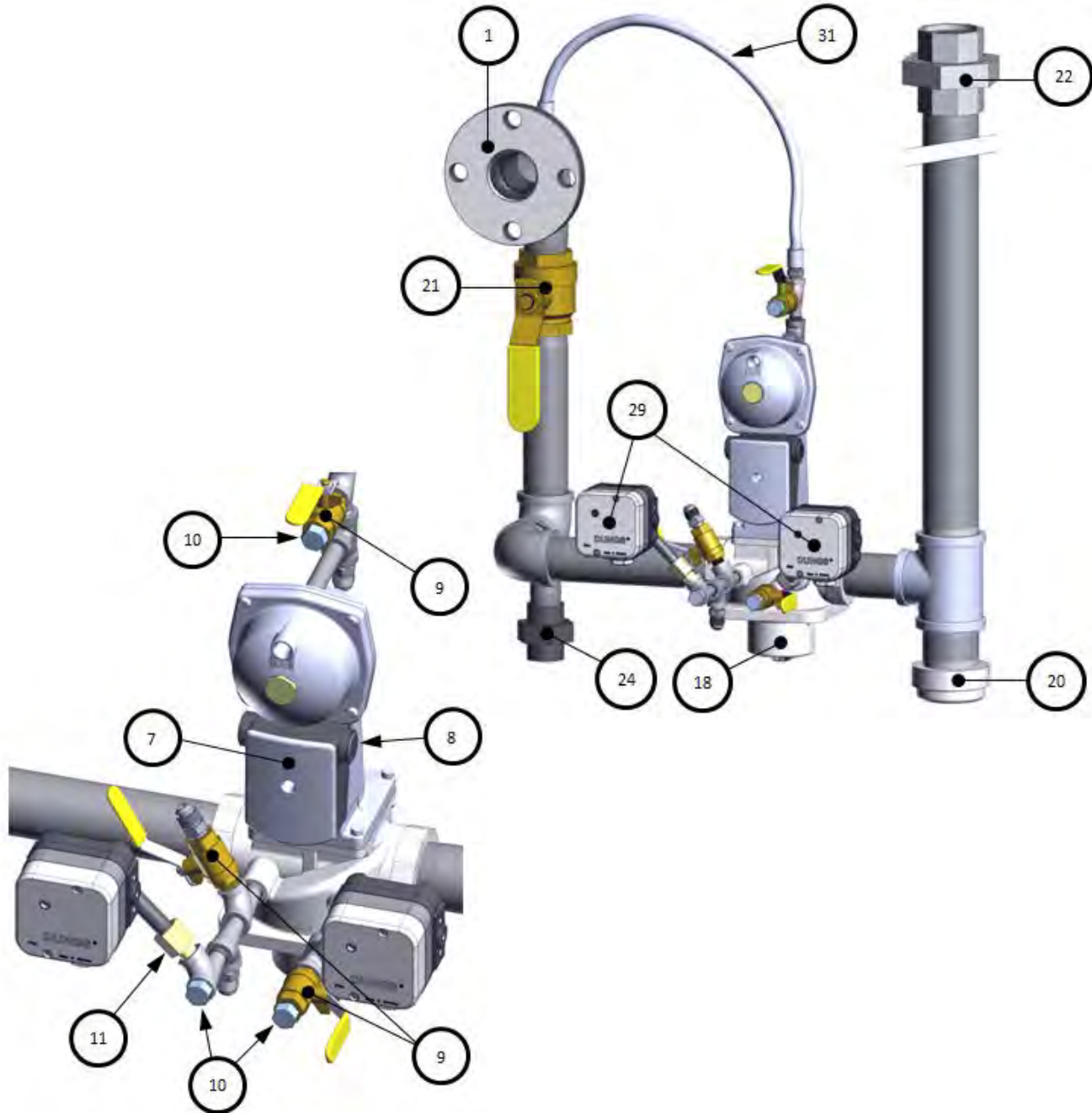
AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF – 2000DF Part List</b>	01/15/2015
	<b>Whole Boiler 29313-3 – 29337-3</b>	Sheet 8 of 8

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS

### Benchmark 1500DF – 2000DF Natural Gas Gas Train – P/N 22188-1 rev C

Item	Qty.	Part No.	Description	Item	Qty.	Part No.	Description
1	1	123542	FLANGE 2" 125# 2"NPT	20	1	93382	2" NPT CAP
7	1	69005	ACTUATOR, SSOV W/ REGULATOR	21	1	92006-7	VALVE, BALL BRASS 1-1/2" NPT
8	2	12951-2	BUSHING, CONTROL BOX	22	1	9-294	UNION, 2" NPT 300#
9	3	92077	1/4" NPT MXF BRASS BALL VALVE	24	1	9-291	UNION, 1" NPT 300# BI
10	3	9-22	PIPE PLUG, 1/4" NPT, STEEL	29	2	60020	SWITCH, DUNGS GAS PRESSURE 2-20" W.C.
11	1	99017	SNUBBER, PRESSURE, 1/4"	31	1	97087-20	FLEX HOSE, 20"
18	1	124150	VALVE, SSOV 1-1/2" NPT				



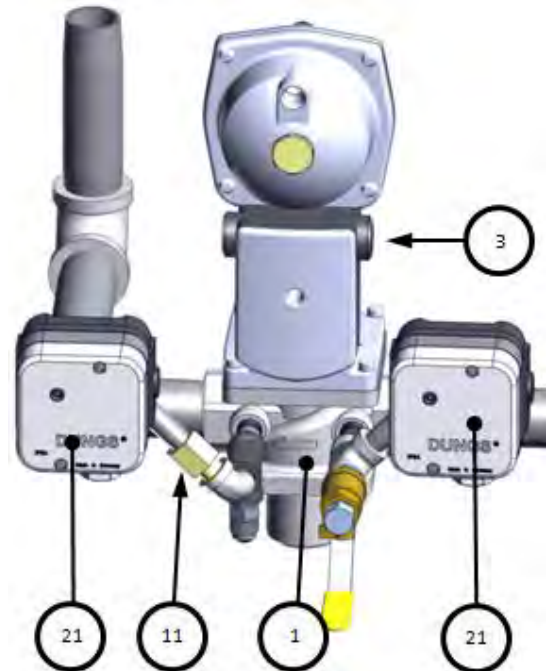
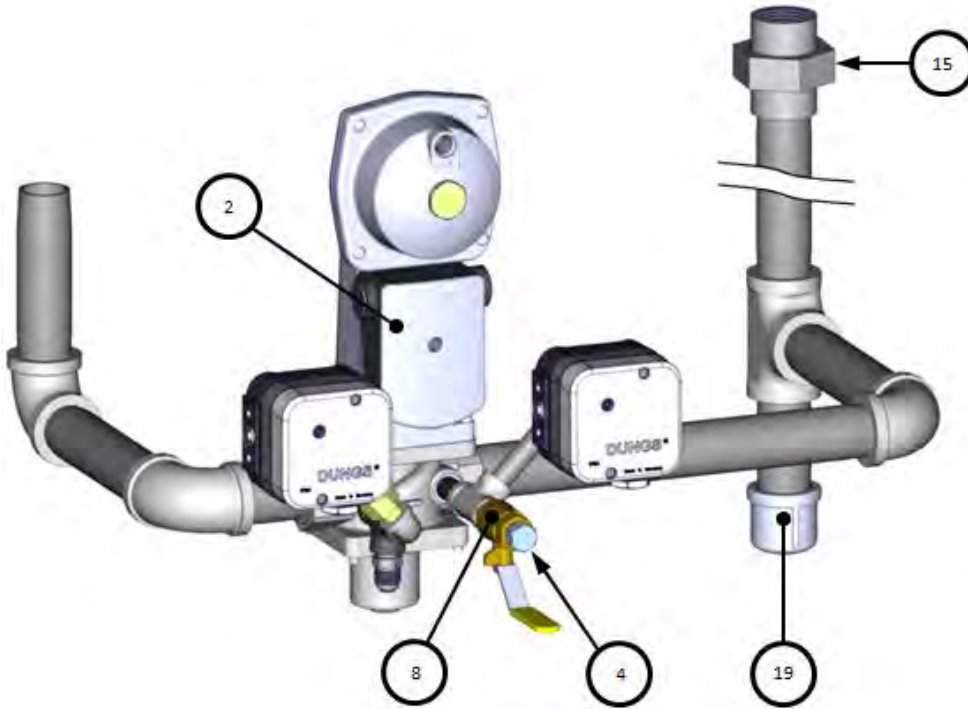
AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF-2000DF Gas Train NATURAL GAS</b>	05/28/2015
	<b>22188-1 rev C</b>	Sheet 1 of 1

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS

### Benchmark 1500DF – 2000DF PROPANE Gas Train – 22197 rev D

Item	Qty.	Part No.	Description	Item	Qty.	Part No.	Description
1	1	92036	VALVE, SSOV 1" NPT	11	1	99017	SNUBBER, PRESSURE, 1/4"
2	1	69005	ACTUATOR, SSOV W/ REGULATOR	15	1	9-291	UNION, 1" NPT 300# BI
3	2	12951-2	BUSHING, CONTROL BOX	19	1	93466	CAP, 1" NPT M/I
4	1	9-22	PIPE PLUG, 1/4" NPT, STEEL	21	2	60020	SWITCH, DUNGS GAS PRESSURE 2-20" W.C.
8	1	92077	1/4" NPT MXF BRASS BALL VALVE				



AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF-2000DF PROPANE Gas Train</b>	05/28/2015
	<b>22197 rev C</b>	Sheet 1 of 1

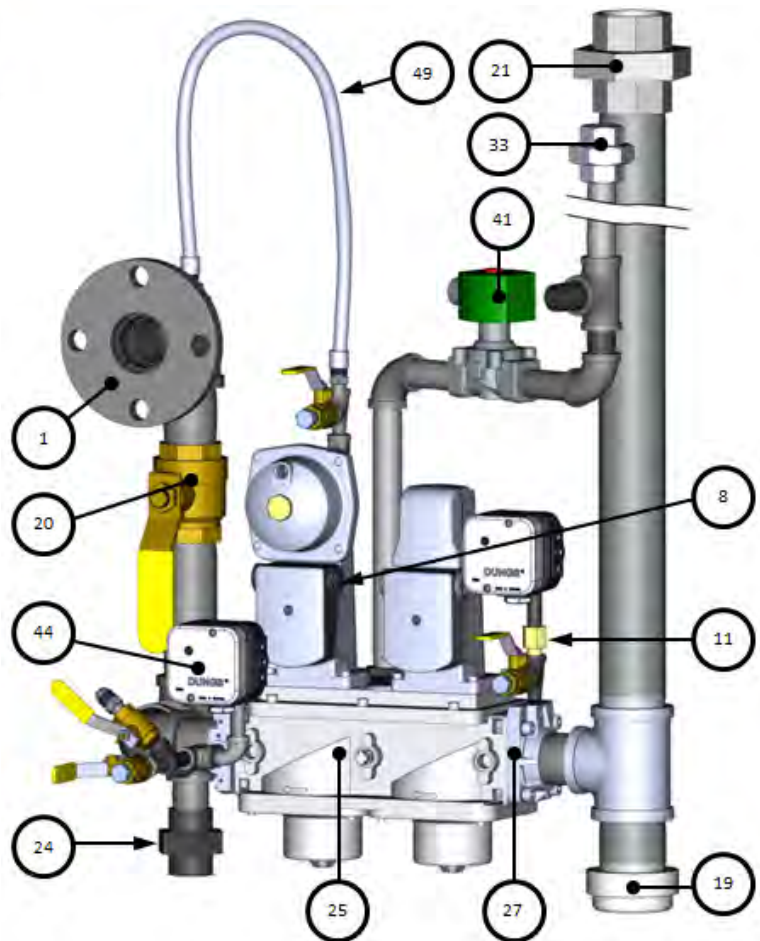
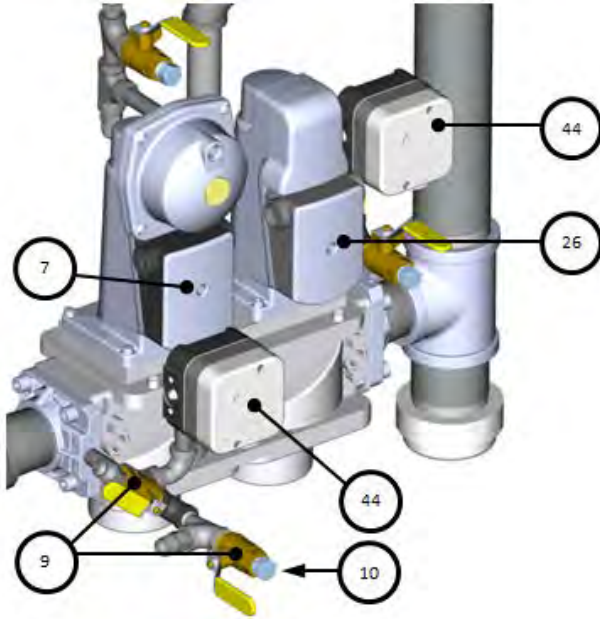


# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS

### Benchmark 1500DF – 2000DF DBB NATURAL GAS Gas Train – P/N 22199-1 rev D

Item	Qty	Part No.	Description	Item	Qty	Part No.	Description
1	1	123542	FLANGE 2" 125# 2"NPT	24	1	9-291	UNION, 1" NPT 300# BI
7	1	69005	ACTUATOR, SSOV W/ REGULATOR	25	1	124142	VALVE, SSOV, DOUBLE BODY, 2" NPT
8	2	12951-2	BUSHING, CONTROL BOX	26	1	69038	ACTUATOR, SSOV W/O P.O.C. SWITCH
9	4	92077	1/4" NPT MXF BRASS BALL VALVE	27	2	95029	FLANGE, SSOV 1 1/2" NPT
10	3	9-22	PIPE PLUG, 1/4" NPT, STEEL	33	1	124094	UNION, 3/4" NPT #150
11	1	99017	SNUBBER, PRESSURE, 1/4"	41	1	122774	VALVE, VENT 3/4" NPT
19	1	93382	2" NPT CAP	44	2	60020	SWITCH, DUNGS GAS PRESSURE 2-20" W.C.
20	1	92006-7	VALVE, BALL BRASS 1-1/2" NPT	49	1	97087-20	TUBING, FLEXIBLE 20"
21	1	9-294	UNION, 2" NPT 300#				



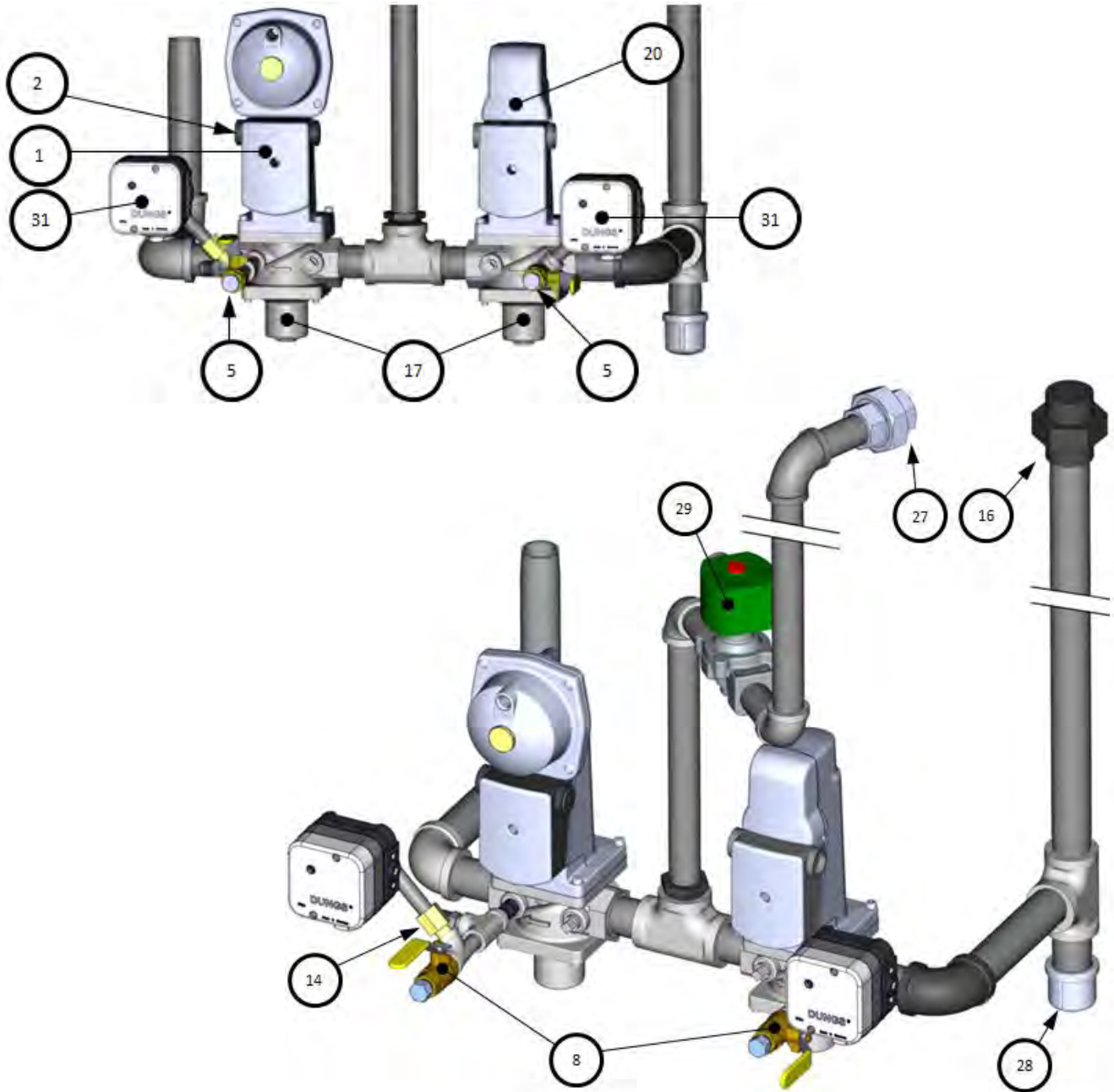
AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF-2000DF DBB NATURAL GAS Gas Train</b>	10/16/2015
	<b>22199-1 rev D</b>	Sheet 1 of 1

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS

### Benchmark 1500DF – 2000DF DBB PROPANE Gas Train – P/N 22200 rev E

Item	Qty	Part #	Description	Item	Qty	Part #	Description
1	1	69005	ACTUATOR, SSOV W/ REGULATOR	17	2	92036	VALVE, SSOV 1" NPT1
2	2	12951-2	BUSHING, CONTROL BOX	20	1	69038	ACTUATOR, SSOV W/O P.O.C. SWITCH
5	2	9-22	PIPE PLUG, 1/4" NPT, STEEL	27	1	124094	UNION, 3/4" NPT #150
8	2	92077	1/4" NPT MXF BRASS BALL VALVE	28	1	93466	CAP, 1" NPT M/I
14	1	99017	SNUBBER, PRESSURE, 1/4"	29	1	122774	VALVE, VENT 3/4" NPT
16	1	9-291	UNION, 1" NPT 300# BI	31	2	60020	SWITCH, DUNGS GAS PRESSURE 2-20" W.C.



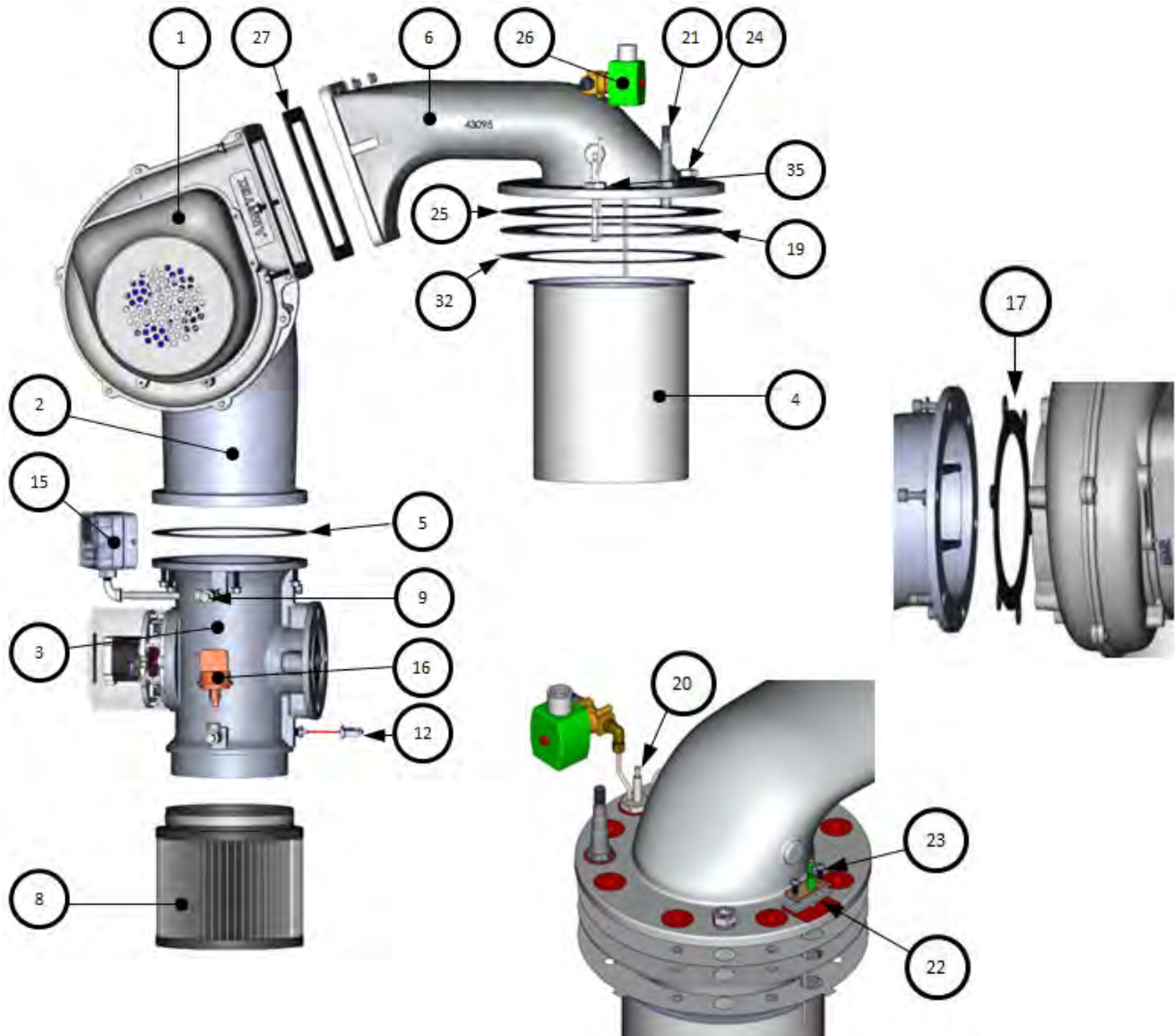
AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500DF-2000DF DBB PROPANE                  Gas Train</b>	10/16/2015
	<b>22200 rev E</b>	Sheet 1 of 1

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS

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

Item	Qty	Part #	Description	Item	Qty	Part #	Description
1	1	69078	BLOWER: AMETEK 12.3"	16	1	61002-5	BLOCKED INLET SWITCH -8.0" W.C.
2	1	43090	AIR FUEL VALVE PLENUM	17	1	81100	GASKET: BLOWER 12.3"
3	1	24220-3	A/F VALVE ASSY: BMK 1500	19	1	81166	GASKET: BURNER
		24220-10	A/F VALVE ASSY: BMK 2000	20	1	66026	IGNITOR-INJECTOR
4	1	46042	BURNER: BMK 1500	21	1	61026	O <sub>2</sub> SENSOR
		46044	BURNER: BMK 2000	22	1	81048	GASKET: FLAME ROD LOW NOX
5	1	81057	GASKET: BLOWER	23	1	66034	FLAME ROD
6	1	43095	BLOWER PLENUM	24	1	59104	OBSERVATION PORT
8	1	59138	FILTER: AIR 6"	25	1	81183	GASKET: RELEASE
9	5	9-21	PLUG: HEX HD 1/8 NPT	26	1	24277	STAGED IGNITION ASSY
12	1	61024	AIR INLET TEMPERATURE SENSOR	27	1	81184	GASKET: BLOWER
15	1	60011-4	SWITCH ASSY: BLOWER PROOF: BMK 1500	32	1	81186	GASKET: RELEASE: LOWER
		60011-2	SWITCH ASSY: BLOWER PROOF: BMK 2000	35	1	53033	WASHER: CLOCKING



AERCO International, Inc. Blauvelt, NY 10913	<b>Benchmark 1500 - 2000 Burner Assembly</b>	10/28/2015
	<b>24378-TAB rev F</b>	Sheet 1 of 1

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX G – PART DRAWINGS

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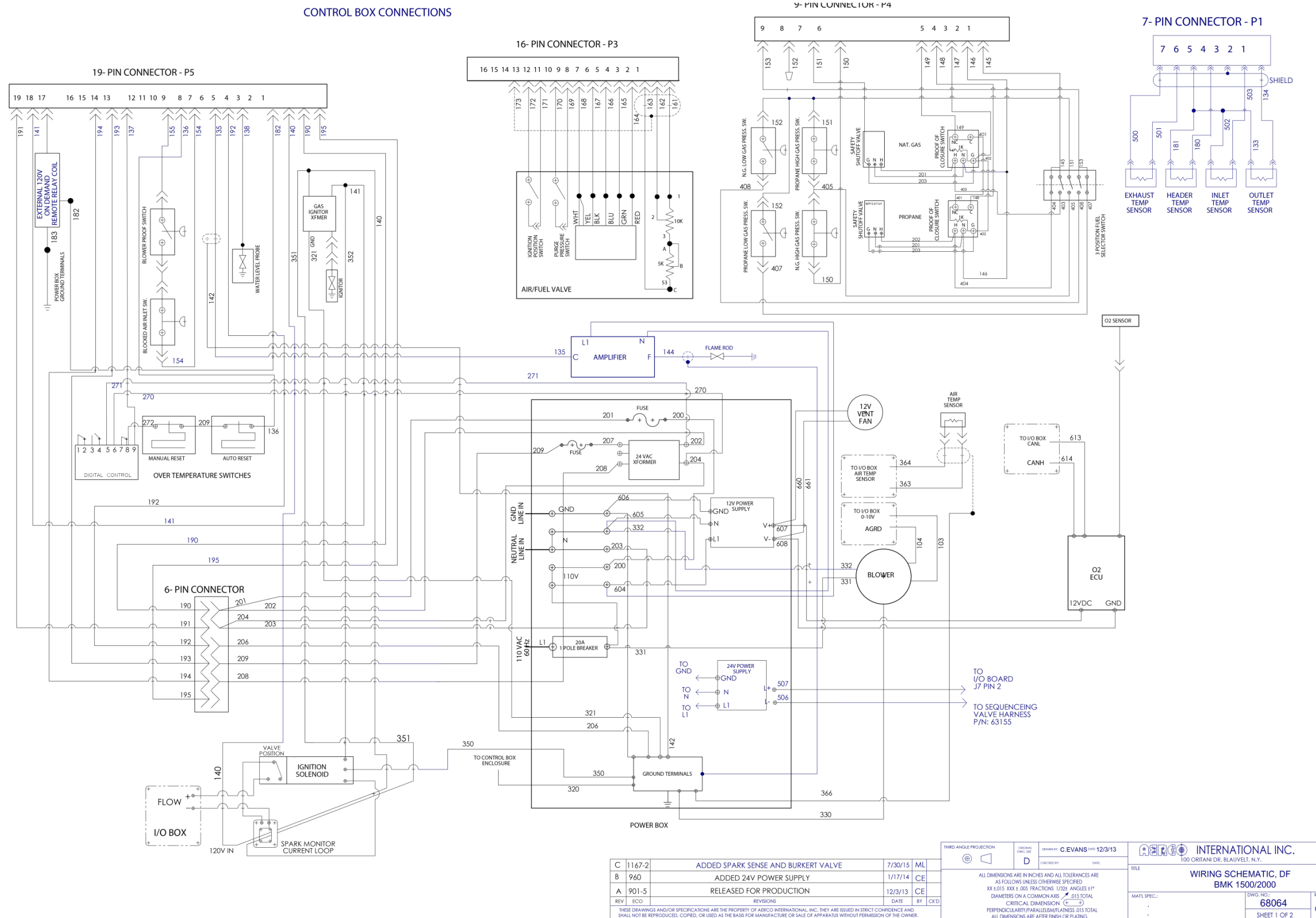
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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX H – WIRING DIAGRAMS

### Appendix H: WIRING DIAGRAMS



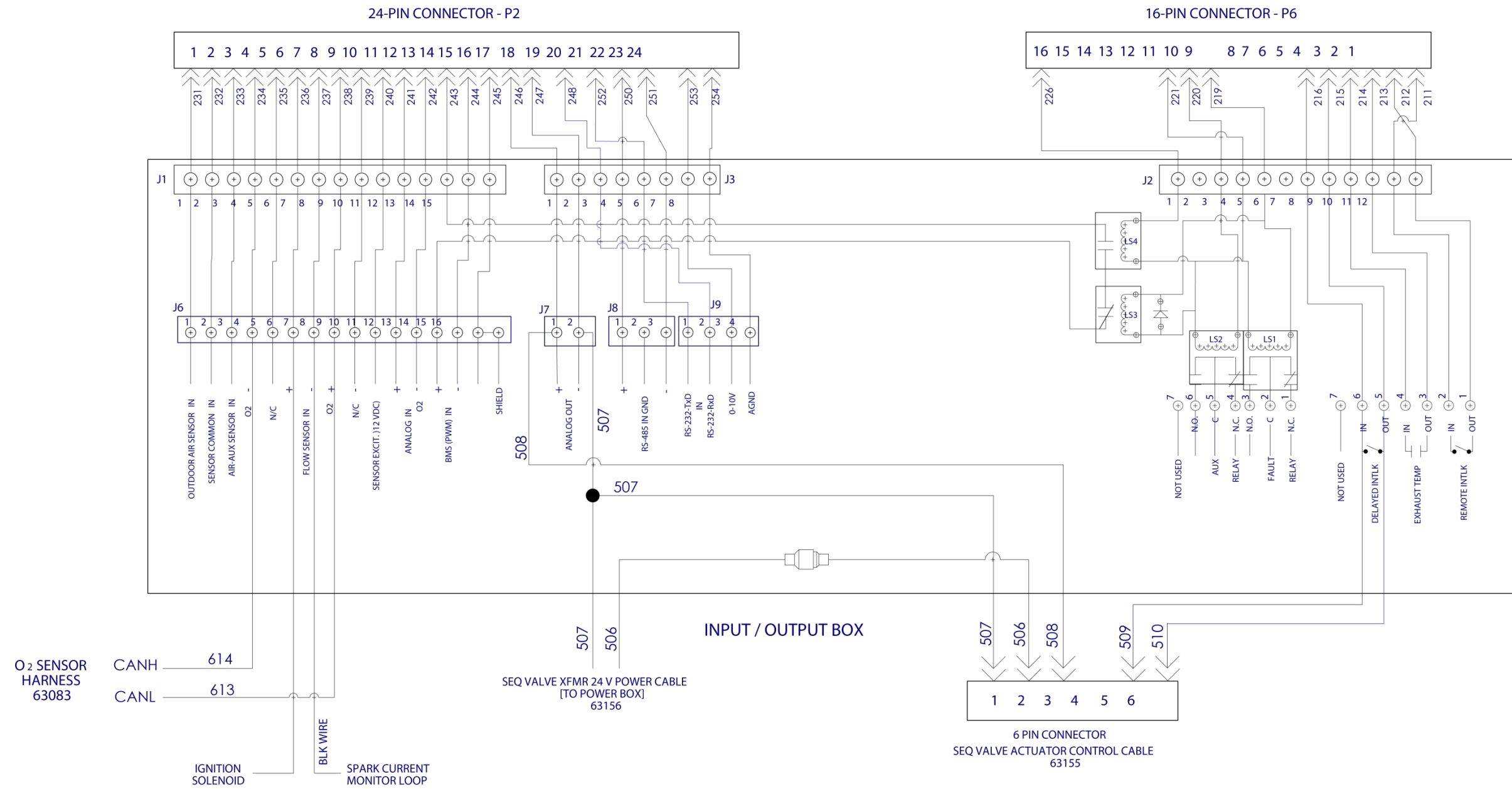
Drawing Number 68064 rev C page 1 of 2

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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX H – WIRING DIAGRAMS

### CONTROL BOX CONNECTORS



REV	ECO	REVISIONS	DATE	BY	CKD

SEE SHT 1 FOR REVISIONS

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THIRD ANGLE PROJECTION	ORIGINAL DATE: D	DRAWN BY: C. EVANS DATE: 12/5/13	AERCO INTERNATIONAL, INC. 100 ORITANI DR., BLAUVELT, N.Y.
ALL DIMENSIONS ARE IN INCHES AND ALL TOLERANCES ARE AS FOLLOWS UNLESS OTHERWISE SPECIFIED: XX ± 0.15 XXX ± 0.05 FRACTIONS 1/32± ANGLES ± 1° DIAMETERS ON A COMMON AXIS ± 0.15 TOTAL CRITICAL DIMENSION (C) ± 0.05 PERPENDICULARITY/PARALLELISM/FLATNESS .015 TOTAL ALL DIMENSIONS ARE AFTER FINISH OR PLATING			TITLE: <b>WIRING SCHEMATIC</b> <b>BMK 1500/2000 DF</b> MATL. SPEC.: DWS. NO.: <b>68064</b> SHEET 2 OF 2
REV: C			SHEET 2 OF 2

Drawing Number 68064 rev C page 2 of 2

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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX H – WIRING DIAGRAMS

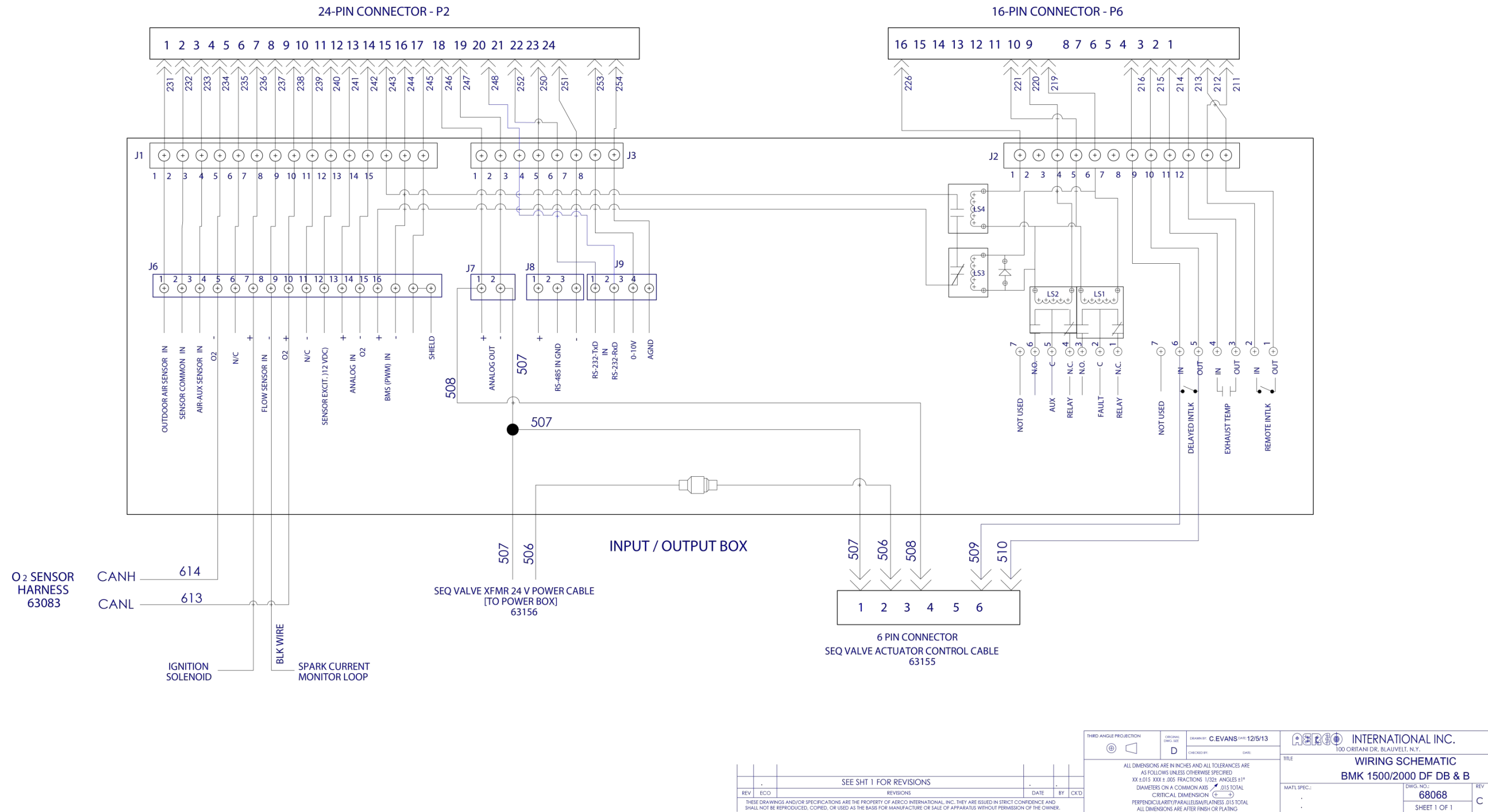
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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX H – WIRING DIAGRAMS

### CONTROL BOX CONNECTORS



Drawing Number 68068 rev C page 2 of 2

REV	ECO	REVISIONS	DATE	BY	CKD
1		SEE SHT 1 FOR REVISIONS			

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THIRD ANGLE PROJECTION	DESIGNED BY: C. EVANS DATE: 12/5/13	INTERNATIONAL INC. 100 ORITANI DR., BLAUVELT, N.Y.
ALL DIMENSIONS ARE IN INCHES AND ALL TOLERANCES ARE AS FOLLOWS UNLESS OTHERWISE SPECIFIED: XX ± 0.15 XXX ± .005 FRACTIONS 1/32± ANGLES ± 1° DIAMETERS ON A COMMON AXIS .015 TOTAL CRITICAL DIMENSION (F) PERPENDICULARITY PARALLELISM FINISH .015 TOTAL ALL DIMENSIONS ARE AFTER FINISH OR PLATING	TITLE: WIRING SCHEMATIC BMK 1500/2000 DF DB & B	DWG. NO.: 68068 SHEET 1 OF 1



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX H – WIRING DIAGRAMS

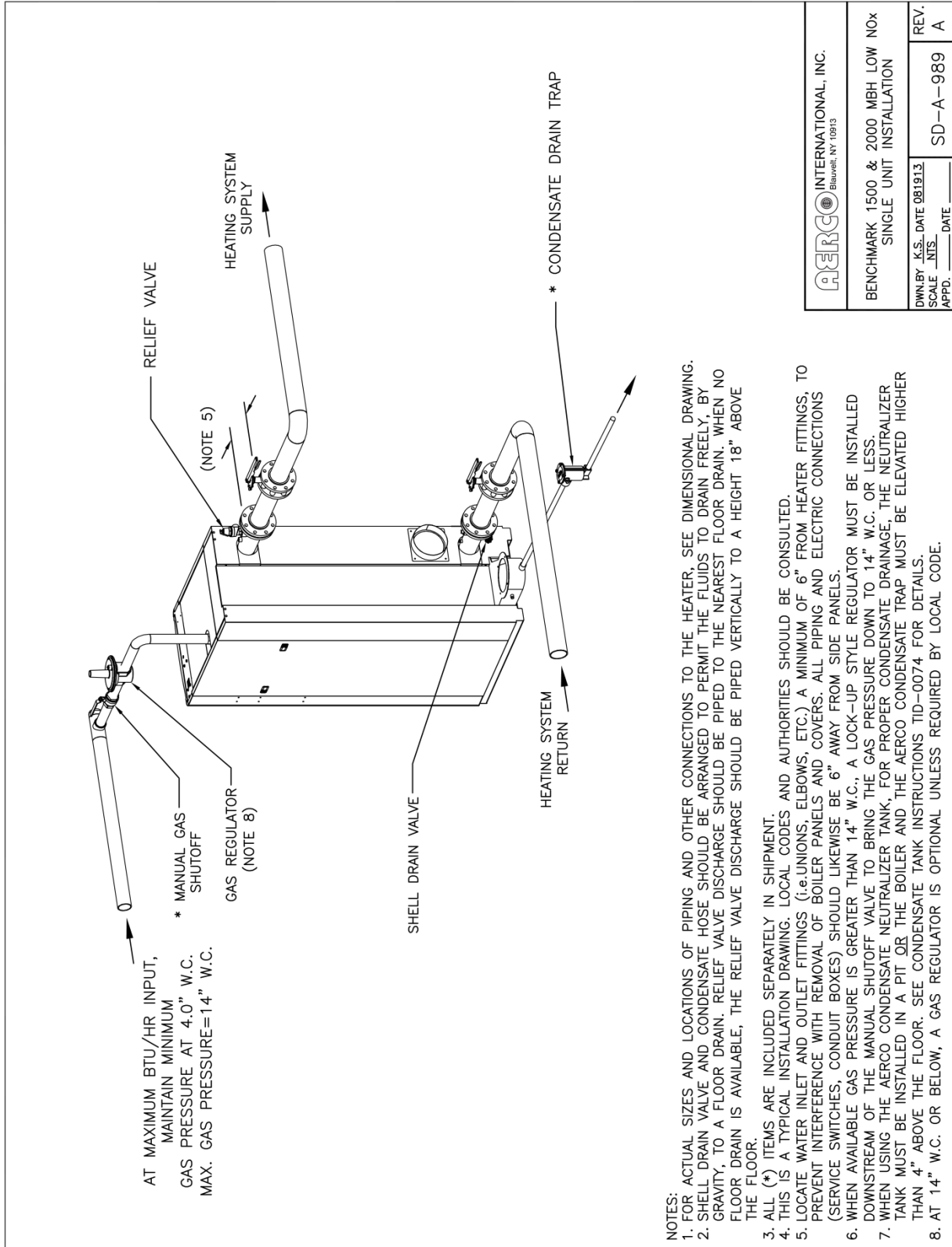
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# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX I – PIPING DRAWINGS

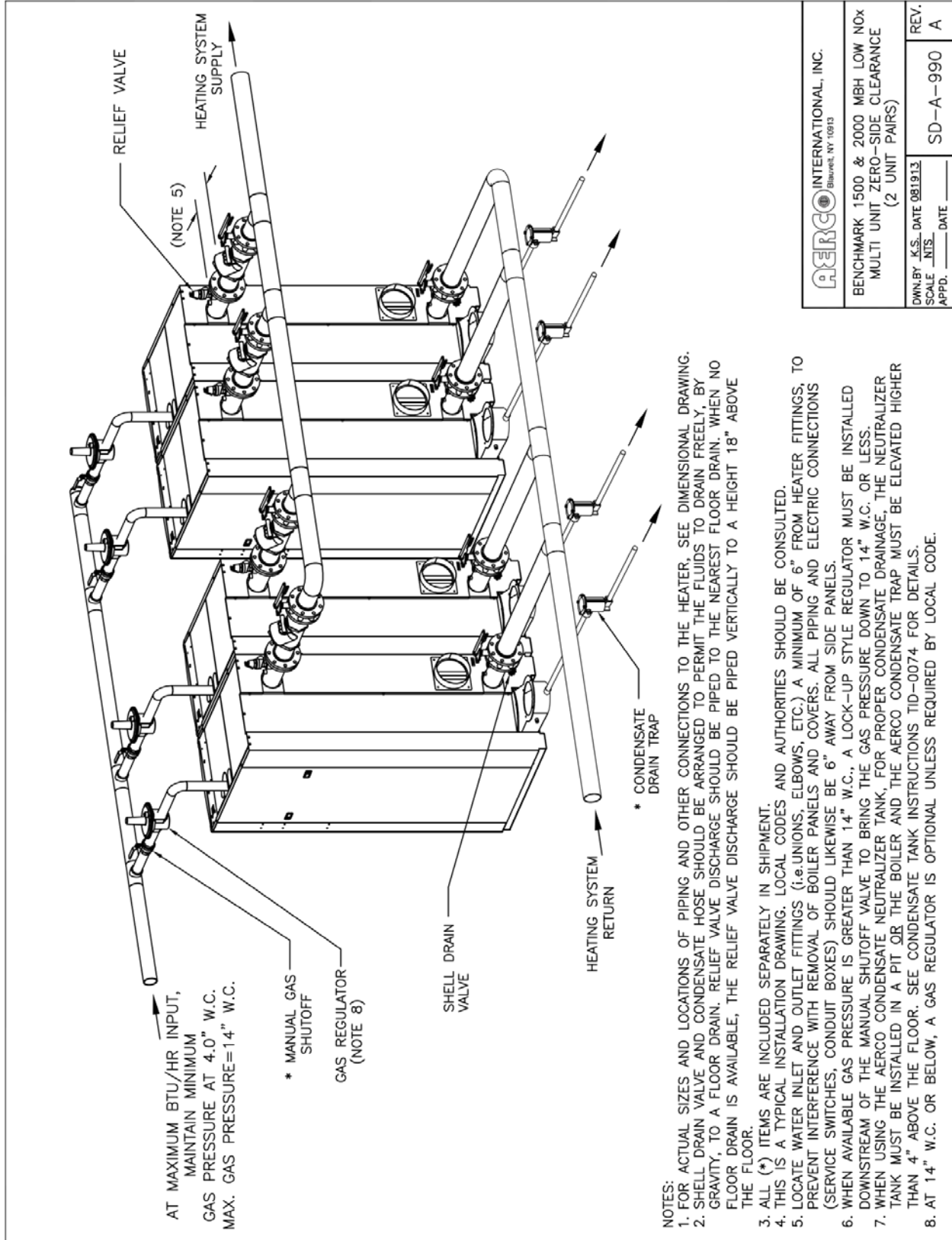
### Appendix I: PIPING DRAWINGS



Drawing Number: SD-A-989 rev A

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX I – PIPING DRAWINGS



Drawing Number: SD-A-990 rev A

AERCO INTERNATIONAL, INC.  
Blauvelt, NY 10913

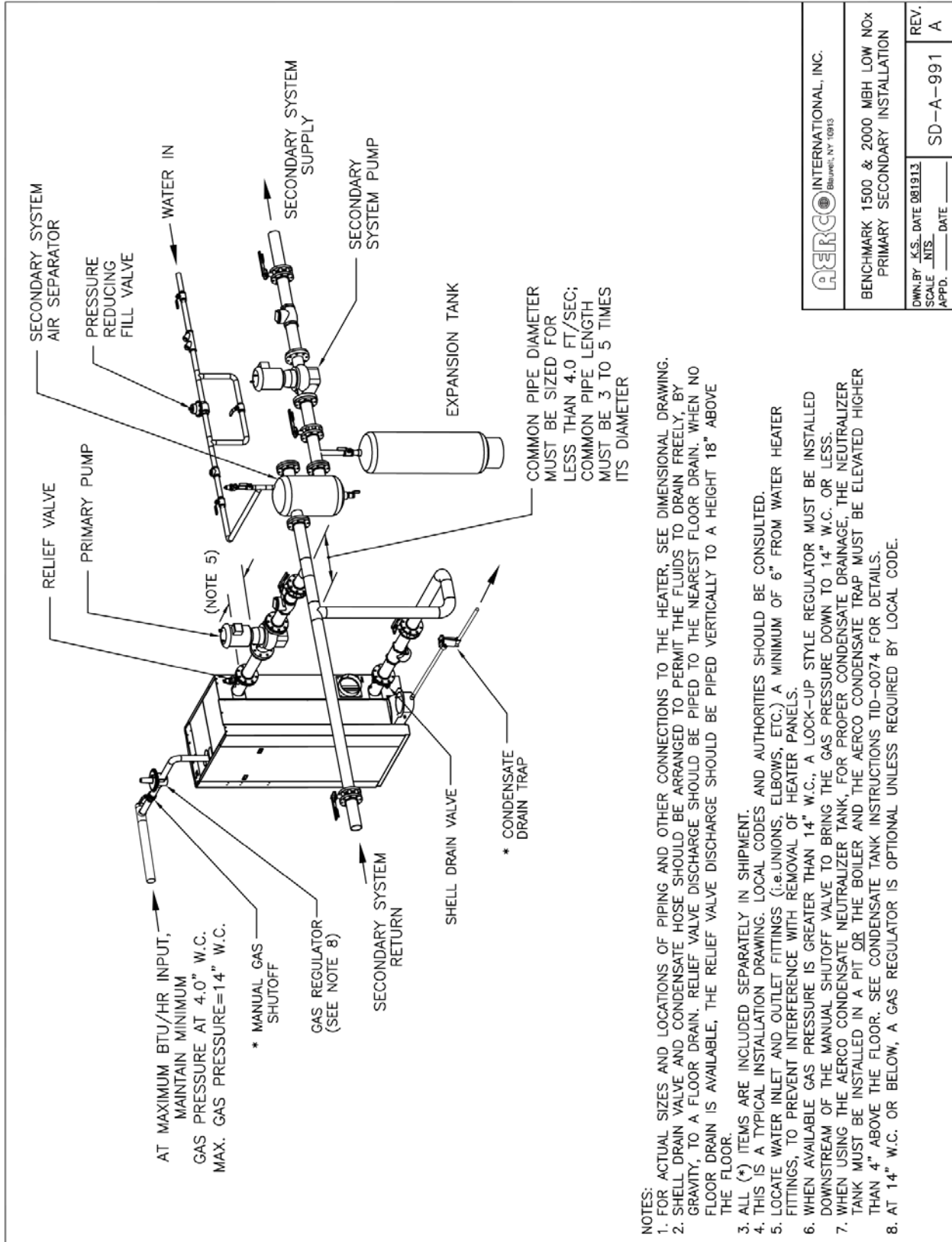
BENCHMARK 1500 & 2000 MBH LOW NOx  
MULTI UNIT ZERO-SIDE CLEARANCE  
(2 UNIT PAIRS)

DOWN BY K.S. DATE 08/19/13  
SCALE NTS. DATE \_\_\_\_\_ DATE \_\_\_\_\_  
APPD. \_\_\_\_\_ DATE \_\_\_\_\_

REV. SD-A-990  
A

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX I – PIPING DRAWINGS

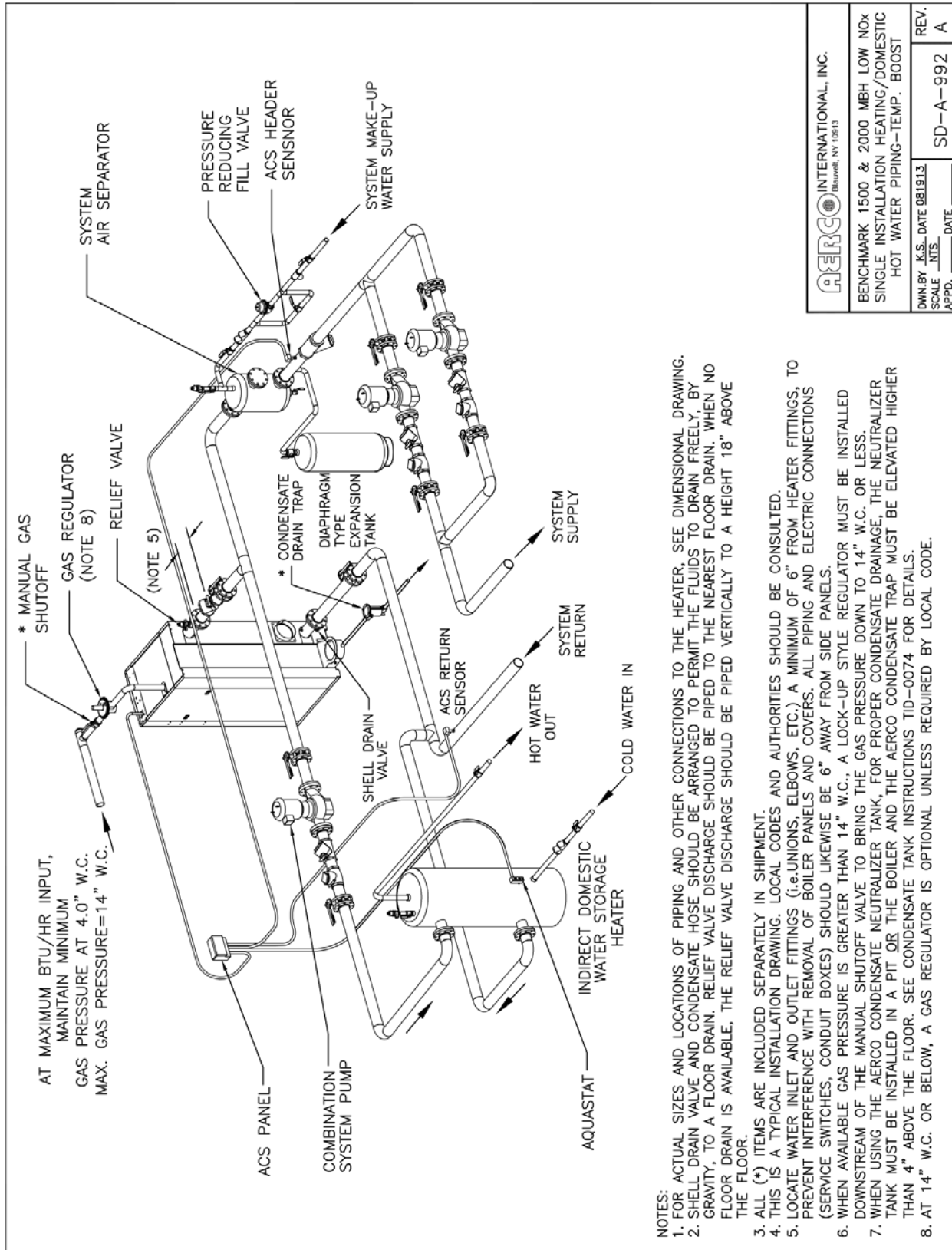


 <small>BIRMINGHAM, NY 10913</small>	
<b>BENCHMARK 1500 &amp; 2000 MBH LOW NOx</b> PRIMARY SECONDARY INSTALLATION	
DWN BY: K.S. DATE 08/19/13 SCALE: NTS. DATE _____ APPD: _____ DATE _____	REV. SD-A-991 A

Drawing Number: SD-A-991 rev A

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX I – PIPING DRAWINGS



Drawing Number: SD-A-992 rev A

AERCO INTERNATIONAL, INC.  
Blauevelt, NY 10913

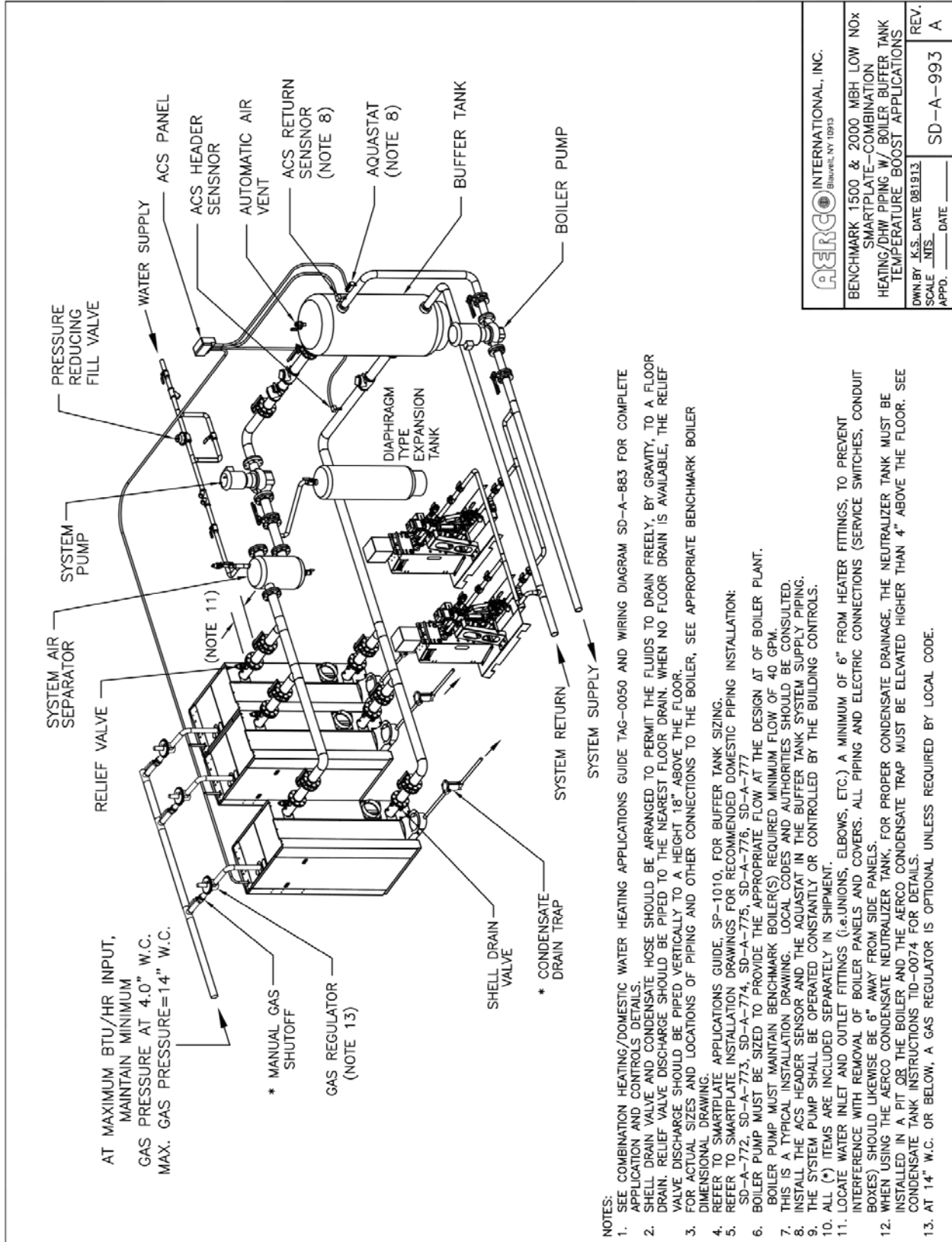
BENCHMARK 1500 & 2000 MBH LOW NOx SINGLE INSTALLATION HEATING/DOMESTIC HOT WATER PIPING-TEMP. BOOST

DOWN BY K.S. DATE 08/19/13	SCALE NTS	DATE	REV.
APPD.	SD-A-992		A



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

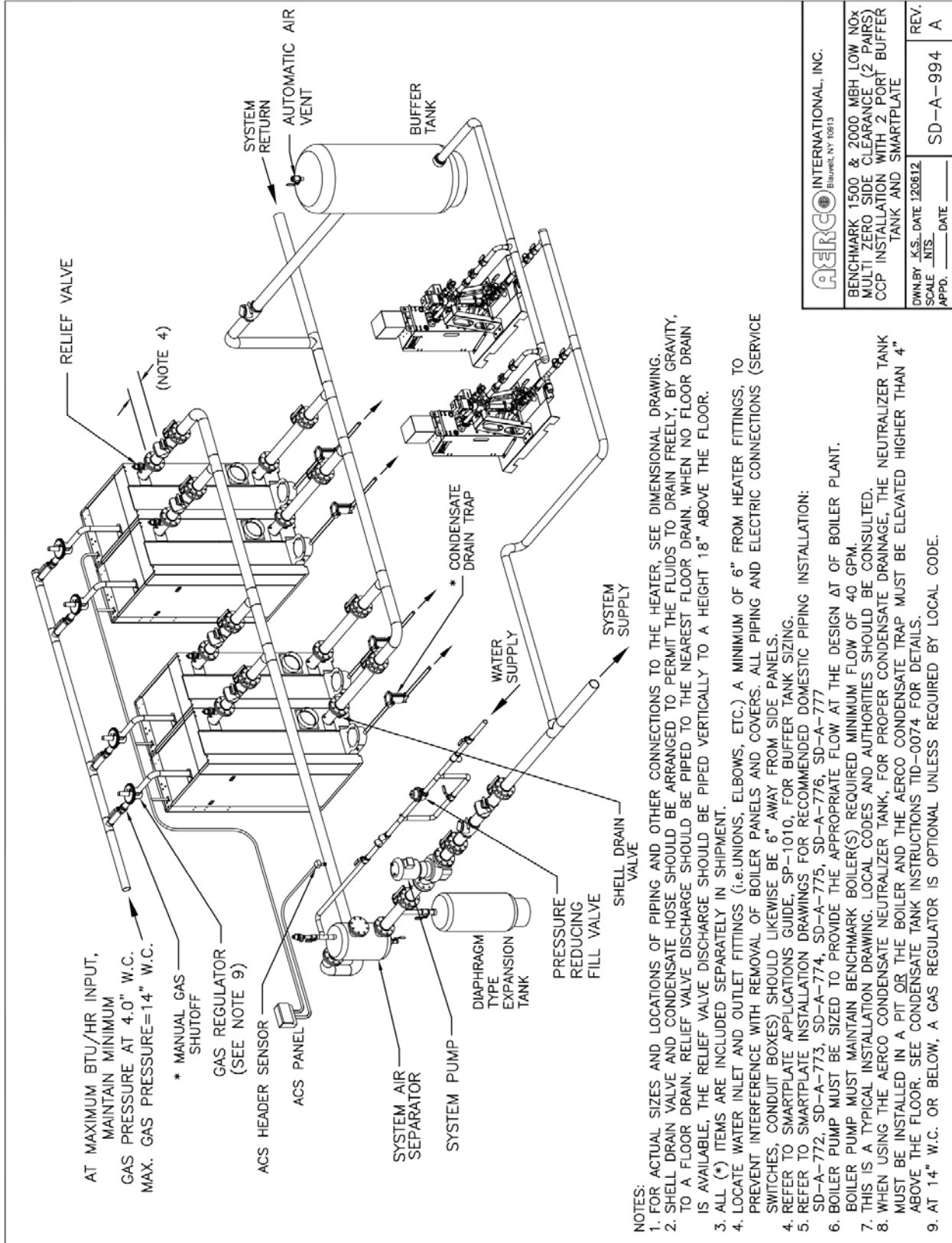
## APPENDIX I – PIPING DRAWINGS



Drawing Number: SD-A-993 rev A

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX I – PIPING DRAWINGS



 <small>Blauvelt, NY 10913</small>	
BENCHMARK 1500 & 2000 MBH LOW NOX MULTI ZERO SIDE CLEARANCE (2 PAIRS) CCP INSTALLATION WITH 2 PORT BUFFER TANK AND SMARTPLATE	
DWN BY: K.S. DATE 12/06/12 SCALE: NTS APPD: _____ DATE _____	SD-A-994 REV. A

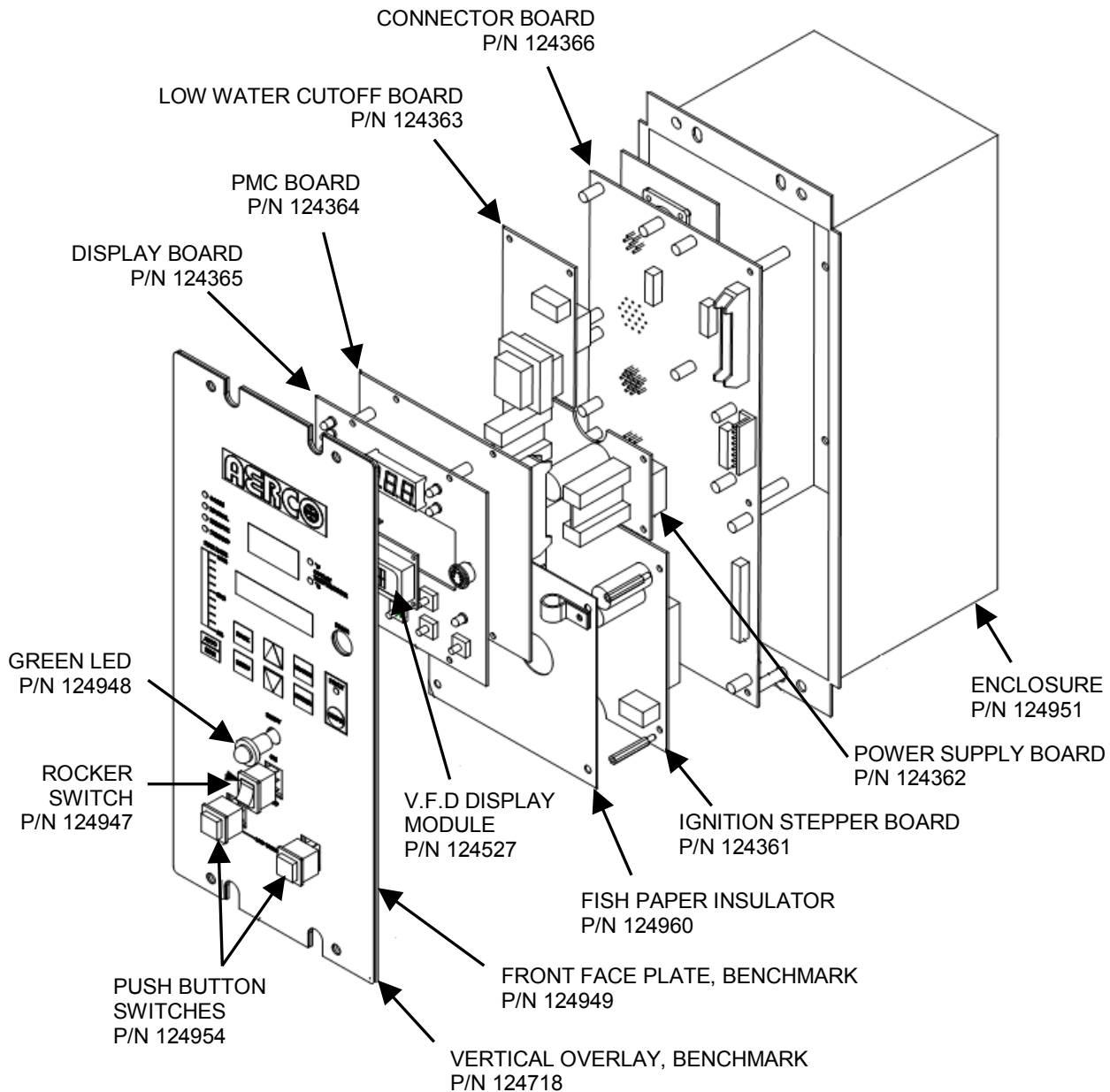
Drawing Number: SD-A-994 rev A



# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX J – C-MORE CONTROL PANEL VIEWS

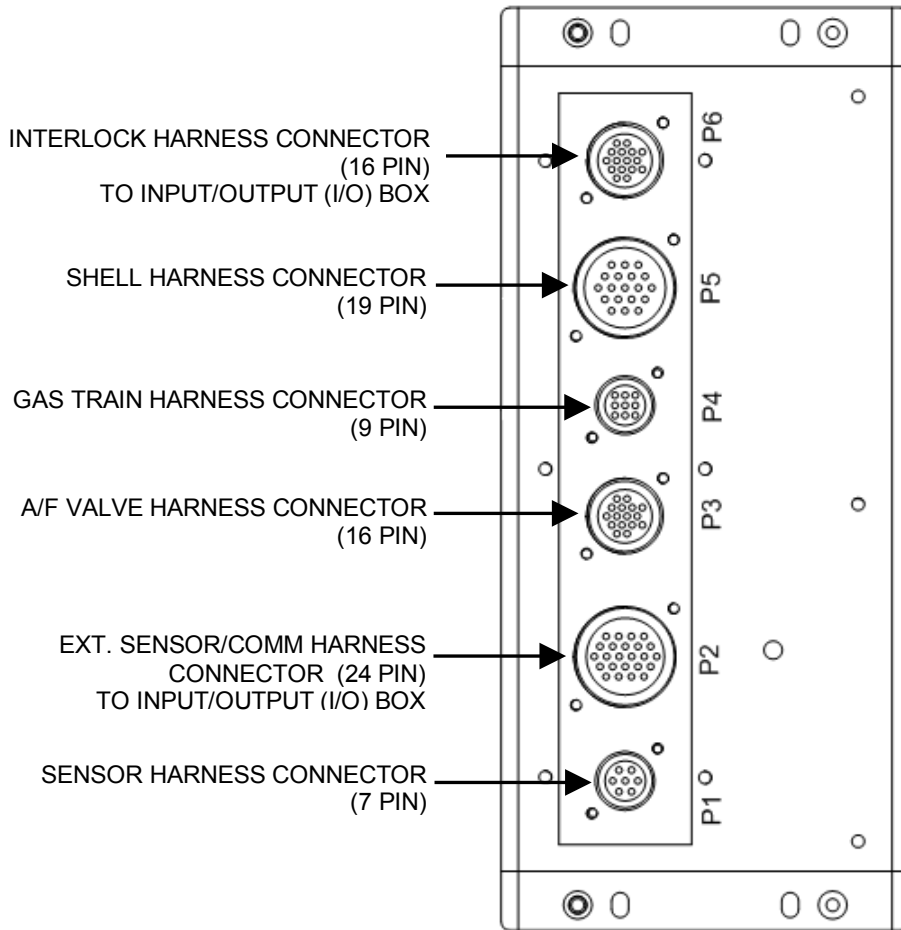
### Appendix J: C-MORE CONTROL PANEL VIEWS



**Figure J-1 – Benchmark Control Panel - Exploded View**

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX J – C-MORE CONTROL PANEL VIEWS



**Figure J-2: Benchmark Control Panel Rear View**

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## APPENDIX K – RECOMMENDED SPARES

### Appendix K: RECOMMENDED SPARES

#### NOTE

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

**Table K-1: Recommended Emergency Spare Parts**

DESCRIPTION	PART NUMBER
120 VAC Blower	69078
SSOV Actuator/Regulator Combo - Used on: <ul style="list-style-type: none"> <li>• ALL FM gas train models</li> <li>• <b>Downstream</b> SSOV of IRI gas train models</li> </ul>	69005
SSOV Actuator <u>Without</u> Proof of Closure Switch - Used on: <ul style="list-style-type: none"> <li>• <b>Upstream</b> SSOV of IRI gas train models</li> </ul>	69038
Temperature Switch - Manual Reset	123552

**Table K-2: Spare Parts Recommended for Maintenance**

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

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

**Table K-3: Optional Spare Parts**

DESCRIPTION	PART NUMBER
C-More Control Box	181197
Burner	<b>BMK 1500:</b> 46042
	<b>BMK 2000:</b> 46044
Lean Oxygen Sensor	61026

# Benchmark 1500/2000 Dual Fuel & Propane Boilers

## Change Log:

Date	Description	Changed By
10/01/2015	<p>Rev B PIRs:</p> <p><b>901-6:</b> Add support for single-fuel Propane gas train.</p> <p><b>992-1:</b> Replaced old style Condensate trap 20460 with new style, 24441 in section 7.7</p> <p><b>1000:</b> P/N 61026 now labeled "Lean Oxygen Sensor," 64081 now named "ECU"</p> <p><b>1011:</b> Changed Blocked Inlet Switch pressure from -8.0 to -4.5 in Appendix A.</p> <p><b>1023:</b> Added drawings for gas trains 22199-1 &amp; 22200; removed Gas Pressure Switch 61002-16, added 610020 on gas train 22199-1; replaced Gas Pressure Switch 61002-12 with 61002-16 on gas train 22200, in Appendix H.</p> <p><b>934-65:</b> Added explanatory paragraph to section 2.15 – Sequencing Isolation Valve Installation</p> <p><b>1028:</b> Replaced fuel rod 66020 with 66034</p> <p><b>1044:</b> Modify Table A (Spare Parts Kit) in Appendix H</p> <p><b>1052:</b> Replace existing gas switches with standard "adjustable" switches on gas train 22201 &amp; 22198, in Appendix H.</p> <p><b>934-79:</b> Warranty revision, dated 6/11/14, replaced "water heater" with "boiler."</p> <p><b>934-87:</b> Updated graphic &amp; instructions in section 2-10, updated tables 3-2, 3-3 and 3-4.</p> <p><b>934-88:</b> Removed SD-A-898 from Appendix G.</p> <p><b>934-99:</b> Added new section 7.9 - LWCO Cap Test Instructions.</p> <p><b>934-104:</b> Changed calibration settings, section 3.8, 4.3 &amp; 4.4.</p> <p><b>1083:</b> Added propane-only unit info, new gas train graphic, added new maintenance table, misc. format changes and corrections.</p> <p><b>1092:</b> Removed Chapter 9 – RS232 Communication, per Firmware version 4.0 and above.</p> <p><b>1094:</b> Replaced Tridicator P/N 69087-TAB with 123675-TAB.</p> <p><b>934-150:</b> Clarified references to &amp; function of spark monitor (p/n 61034) (or AC current transducer) in section 2.10.4, added new section 7.12 Spark Monitor</p> <p><b>934-155:</b> Added Installation Notes regarding BST with ProtoNode SSD to new section 9.1.</p> <p><b>934-184:</b> Changed gas pressure for BMK 2000 from 3.9 to 6.3 in Table 8.1</p> <p><b>1152:</b> Replace Thermowell 93359 with 58132</p> <p><b>1174:</b> Updated gas trains in Appendix G</p> <p><b>1235:</b> Replace Blower Proof switch 60011-2 with 60011-4 in Appendix G.</p> <p><b>DIR 225:</b> Section 7.8, replaced "use WD_40" with "use K&amp;N® Air Filter Oil (or equivalent). Do NOT use WD-40."</p> <p><b>1167-2:</b> Modified schematics in Appendix H.</p> <p><b>DIR: 242:</b> Revise combustion calibration instructions (section 4.3) and Combustion Cal menu options (Section 3.8, 3.11, Appendix A table A-5).</p>	Curtis Harvey & Chris Blair
03/11/2016	<p>Rev C PIRs:</p> <p><b>1115-1:</b> Updated gas trains, removed air damper orifice</p> <p><b>1240:</b> Replace Blower Proof switch 60011-1 with 60011-4, updated gas train and burner part lists and drawings in Appendix G</p> <p><b>DIR 301:</b> Clarified 2nd bullet in section 2.10.8, added recommendation to use Sequencing Valve at site that implement BST in section 2.14, added new Note to Figure 9.1.</p> <p><b>DIR 311:</b> Corrected Front Frame part number (item 75) in Appendix G</p> <p><b>DIR 319:</b> Change torque value in section 7.6 BURNER ASSEMBLY INSPECTION, step 15, from 22 ft. lbs. to 35 ft. lbs.</p> <p><b>DIR 320:</b> Added new steps 9 &amp; 10 to section 6.7 Flame Fault test.</p> <p><b>DIR 324:</b> Updated Section 2.5 2.5 SUPPLY AND RETURN PIPING, clarified dual water inlet</p>	

