AERCO
A WATTS Brand

Operations and Service Manual

Benchmark® Boilers with Edge® [i] Controller

Natural Gas, Propane Gas and Dual Fuel Modulating & Condensing Boilers

Models 750 through 6000

Other documents for this product include:

OMM-0144, GF-217 Installation and Startup Manual
OMM-0146, GF-219 Reference Manual
TAG-0019, GF-2070 Boiler Application Design Guide
TAG-0022, GF-2050 Vent-Combustion Air Design Guide
TAG-0047, GF-2030 Benchmark Gas Guide
TAG-0048, GF-2060 Benchmark Power Design Guide

Applies to serial numbers:

G-21-0080 and above – BMK750 – 5000N
N-20-0200 and above – BMK5000 & 6000

ASME H
GAS-FIRED c UL us LISTED
AHRI CERTIFIED
Commercial Boilers
AHRI Standard BTS 2000

Heating and Hot Water Solutions

OMM-0145_E • GF-218 • 3/24/2021

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FOREWORD

The AERCO Benchmark (BMK) 750 through 6000 natural gas and propane fueled 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. These BMK models provide extremely high efficiency operation and are ideally suited for modern low temperature, as well as, conventional heating systems.

IMPORTANT!

Unless otherwise specified:

- All descriptions in this document apply to the Benchmark Series of boiler.
- All measurements apply to both natural gas and propane models.

The Benchmark models operate within the input and output ranges listed below.

Benchmark Boiler Intake and Output Ranges

MODEL	INPUT RANGE (BTU/HR.)		OUTPUT RANGE (BTU/HR.)	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
BMK750	50,000 (14.6 kW)	750,000 (220 kW)	47,750 (14 kW)	716,250 (210 kW)
BMK1000	50,000 (14.6 kW)	1,000,000 (293 kW)	48,300 (14.15 kW)	968,000 (284 kW)
BMK1500	75,000 (22 kW)	1,500,000 (440 kW)	64,500 (18.9 kW)	1,395,000 (409 kW)
BMK2000	100,000 (29.3 kW)	2,000,000 (586 kW)	86,000 (25.2 kW)	1,860,000 (545 kW)
BMK2500	167,000 (48.9 kW)	2,500,000 (732 kW)	144,000 (42.2 kW)	2,395,000 (702 kW)
BMK3000	200,000 (58.6 kW)	3,000,000 (879 kW)	174,000 (51.0 kW)	2,874,000 (842 kW)
BMK4000	267,000 (78.2 kW)	4,000,000 (1172 kW)	232,000 (68.0 kW)	3,800,000 (1113 kW)
BMK5000N	250,000 (73.3 kW)	4,990,000 (1462 kW)	218,000 (63.9 kW)	4,740,000 (1389 kW)
BMK5000	400,000 (117 kW)	5,000,000 (1465 kW)	348,000 (102 kW)	4,750,000 (1392 kW)
BMK6000	400,000 (117 kW)	6,000,000 (1758 kW)	348,000 (102 kW)	5,700,000 (1670 kW)

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, the BMK750 – 2000 and 5000 & 6000 comply with the NOx emission standards outlined in: **South Coast Air Quality Management District (SCAQMD), Rule 1146.2**. In addition, the BMK2500 – 6000 comply with the **Bay Area Air Quality Management District regulation 9, Rule 7**.

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

- **Room Combustion Air**:
  - Vertical Discharge
  - Horizontal Discharge
- **Ducted Combustion Air**:
  - Vertical Discharge
  - Horizontal Discharge

Please consult the *Benchmark Venting and Combustion Air Design Guide* (TAG-0022, GF-2050) for a list of allowable and preferred vent materials.

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

AERCO Technical Terminology Meanings	
TERMINOLOGY	**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 (0.45 kg) of water 1°F (0.55 °C)
BTU/HR	BTUs per Hour (1 BTU/hr = 0.29 W)
CCS	Combination Control System
CFH	Cubic Feet per Hour (1 CFH = 0.028 m^3/hr)
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_2 sensor)
Edge [i] Controller	A control system developed by AERCO and currently used in all Benchmark boilers.
EMS	Energy Management System; often used interchangeably with BAS

AERCO Technical Terminology Meanings	
TERMINOLOGY	**MEANING**
FM	Factory Mutual. Used to define boiler gas trains.
GF-xxxx	Gas Fired (an AERCO document numbering system)
GND	Ground
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 Edge [i] Controller
INTLK (INTL'K)	Interlock
I/O	Input/Output
I/O Box	Input/Output (I/O) Box currently used on Benchmark boilers
IP	Internet Protocol
ISO	International Organization for Standardization
Lbs.	Pounds (1 lb. = 0.45 kg)
LED	Light Emitting Diode
LN	Low Nitrogen Oxide
MA (mA)	Milliampere (0.001 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_2	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 Edge
P/N	Part Number
POC	Proof of Closure
PPM	Parts per Million

AERCO Technical Terminology Meanings	
TERMINOLOGY	**MEANING**
PSI	Pounds per Square Inch (1 PSI = 6.89 kPa)
PTP	Point-to-Point (usually over RS232 networks)
P&T	Pressure and Temperature
ProtoNode	Hardware interface between BAS and a boiler
PVC	Poly Vinyl Chloride, a common synthetic plastic
PWM	Pulse Width Modulation
REF (Ref)	Reference
RES.	Resistive
RS232 (or EIA-232)	A standard for serial, full-duplex (FDX) transmission of data based on the RS232 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	Variable Frequency Drive
VPS	Valve Proving System
W	Watt
W.C.	Water Column, a unit of pressure (1 W.C. = 249 Pa)
µA	Micro amp (1 millionth of an ampere)

SECTION 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 section 1.4 for important information regarding installation of units within the Commonwealth of Massachusetts.

IMPORTANT!

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

WARNING!

- Do not use matches, candles, flames, or other sources of ignition to check for gas leaks.
- 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 (BMK750 – 2000), 208 or 480 VAC (BMK2500 – BMK3000), 480 VAC (BMK4000 & 5000N), or 208**, **480 or 575 VAC (BMK5000 & 6000) and 24 volts AC** may be used in this equipment. On international units, the voltage can be **220V to 240V** single phase. 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 single-pole (120 VAC units) or three-pole (220 VAC and higher units) switch must be installed on the electrical supply line of the unit. The switch must be installed in an easily accessible position to quickly and safely disconnect electrical service. Do not affix switch to unit sheet metal enclosures.

CAUTION!

- Many soaps used for gas pipe leak testing are corrosive to metals. The piping must be rinsed thoroughly with clean water after leak checks have been completed.
- 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 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: External Manual Gas Shutoff Valve

In addition, to ensure safety an emergency shutdown procedure that addresses the following points should be designed and implement at the site:

- For automatically operated unattended boilers located in a boiler room, provide a manually operated remote shutdown switch or circuit breaker located just inside or outside each boiler room door. Design the system so activation of the emergency shutdown switch or circuit breaker will immediately shut off the fuel supply to the unit(s).
- For automatically operated unattended boilers in a location other than a boiler room, provide a manually operated remote shutdown switch or circuit breaker marked for easy identification at a location readily accessible in the event of boiler mis-operation.
- Design the system so activation of the emergency shutdown switch or circuit breaker will immediately shut off the fuel.
- For boilers monitored and/or operated from a continuously occupied control room, provide an emergency shutdown switch in the control room that is hard-wired to immediately shut off the fuel upon activation.

1.3 PROLONGED SHUTDOWN

If there is an emergency, turn off the electrical power supply to the boiler and close the manual gas valve located upstream from the unit. The installer must identify the emergency shut-off device.

If the unit is being shut down for an extended period of time, such as a year or more, complete the instructions in Section 8.10: *Shutting Boiler Down for Extended Period*.

When returning a unit to service after a prolonged shutdown, it is recommended that the instructions in Section 4: *Initial Startup Procedures* and Section 5: *Safety Device Testing* be performed to verify that all system-operating parameters are correct.

1.4 IMPORTANT – FOR MASSACHUSETTS INSTALLATIONS

Requirements 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 cannot 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)**

Requirements for Massachusetts Installations

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 Section 10 entitled "Equipment Not Required to Be Vented" in the most current edition of NFPA 54 as adopted by the Board; and

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

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

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

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

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

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

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

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

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

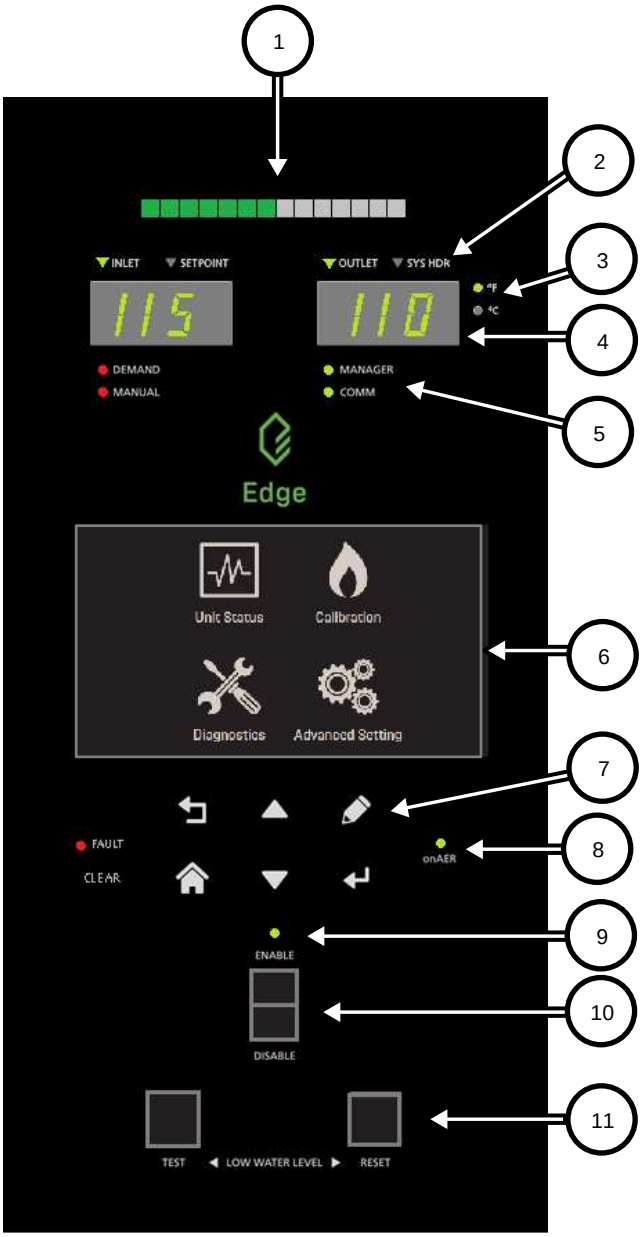
SECTION 2. EDGE [I] CONTROLLER OPERATION

2.1 INTRODUCTION

This section provides a brief outline of how to gain access to Benchmark Boiler's Edge [i] Controller functionality. Full instructions for using the Edge [i] Controller to setup, configure and operate a Benchmark Boiler are included in the *Edge [i] Controller Manual*, OMM-0141, GF-213-B

The Edge [i] Controller is shown below. This panel contains all of the controls, indicators and displays necessary to operate, adjust and troubleshoot the boiler.

The Edge [i] Controller's front panel consists of a touchscreen display along with a variety of indicators and buttons.



1	Multi-Function Bar, shows either: • Fire Rate • Valve Position
2	Parameter Indicator for both temperature read-outs: • LEFT: **Inlet** or **Setpoint temperature** • RIGHT: **Outlet** or **System Header temperature**
3	Temperature scale indicator: Fahrenheit or Celsius
4	Configurable temperature read-outs (2): • LEFT: **Inlet** or **Setpoint temperature** • RIGHT: **Outlet** or **System Header temperature**
5	Operation Mode Indicators (2): • LEFT: **Demand** or **Manual** • RIGHT: **Manager** or **Client** (BST only)
6	Edge [i] Controller Touchscreen
7	Soft Keys
8	onAER Indicator Light
9	Ready Light
10	Enable/Disable Switch
11	Low Water Level Buttons (2): • **TEST**: Initiates Low Water test • **RESET**: Resets unit after Low Water test

Figure 2-1 Edge [i] Controller Front Panel

2.2 LOGIN AND PASSWORD ENTRY

The Edge [i] Controller has multiple levels of password protection.

Level	Password	Description
1	No password	The default. Many parameters are visible but “Read Only.”
2	159	Allows routine maintenance to be performed. Appropriate for AERCO Trained Technicians (ATT).

A higher-level password is reserved AERCO Master Technicians (AMT). It is distributed on an individual basis.

To enter a password:

1. On the Edge [i] Controller, go to **Main Menu → Advanced Setup → Access**. The **Enter Password** screen appears.
2. Use the number keypad to enter the password (each number appears as a *), then press **Save**. You will have access to the functionality associated with the level of the password entered.

Figure 2.2: Enter Password Screen

3. Once you have successfully logged into the system, the **Main Menu** appears. All Edge functionality is accessed through one of the six **Main Menu** items.

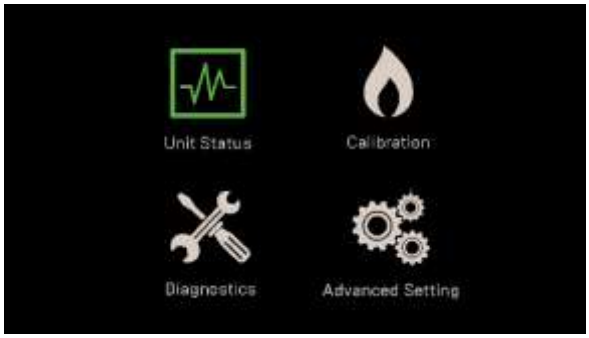


Figure 2-3: Edge [i] Controller Main Menu

NOTE:

Full instructions for using the Edge [i] Controller are in the *Edge [i] Controller Manual* (OMM-0141).

2.3 MENU STRUCTURE

The **Main Menu** give you access to all Edge [i] Controller user functionality. There are four major divisions within the menu structure.

Figure 3.3: The Edge [i] Controller Main Menu

2.3.1 Unit Status Menu

The **Unit Status** menu contains the following sections and parameters. Unlike other Edge menus, navigation starts at the **Unit Status** screen and proceeds from there by scrolling right.

Main Menu → Unit Status			
	Target Fire Rate	Read Only	The target Fire Rate (0% to 100%).
	Current Fire Rate	Read Only	The current Fire Rate (0% to 100%).
	Flame Strength	Read Only	The current Flame Strength (0% to 100%).
	Inlet Temp	Read Only	The current Inlet Water temperature
	Setpoint	Read Only	The unit's current Setpoint.
	Outlet	Read Only	The current Outlet temperature.
	Air Inlet	Read Only	The current Air Inlet temperature.
	O2	Read Only	The Current O_2 reading.
	Exhaust	Read Only	The current Exhaust temperature.
Main Menu → Plant Status – BST Manager Only			
	Outside Temp	Read Only	The reading of the outside temperature meter
	SH/Other Setpoint	Read Only	The BST cascade's current Setpoint.
	SH/Other Supply	Read Only	The supply temperature reading.
	Inlet Temp	Read Only	The inlet temperature reading.
	Units Available	Read Only	The number of units in the BST cascade.
	Units Firing	Read Only	The number of units in the BST cascade firing.
	Units Online	Read Only	The number of units in the BST cascade online.
	SH/Other Fire Rate	Read Only	The fire rate for the BST cascade.
Main Menu → BST Cascade Status – BST Manager Only			
	SH/Other Fire Rate	Read Only	The fire rate for the BST cascade.
	Units Online	Read Only	The number of units in the BST cascade online.
	SH/Other Setpoint	Read Only	The BST cascade's current Setpoint.
	Units Available	Read Only	The number of units in the BST cascade available.
	Sh/Other Supply	Read Only	The supply temperature reading.

	Units Firing	Read Only	The number of units firing in the BST cascade.
Main Menu → Isolation Valve Status – BST Manager Only			
	Min # Valves Open	Read Only	The number of isolation valves designated as "always open."
Main Menu → Runtime Statistics			
	Average Cycles Per Hour	Read Only	The unit's average number of cycles per hour.
	Run Hours	Read Only	The number of hours the unit has run since startup.
	Cycle Count	Read Only	The number of cycles during unit run hours.
Main Menu → Unit Event History			
	Event	Read Only	Lists the unit's warning and fault events.
Main Menu → Plant Event History			
	Event	Read Only	Lists the plant's warning and fault events.

2.3.2 Calibration Menu

The Calibration menu contains the following sections and parameters:

Main Menu → Calibration → Manual Combustion			
	NOx Requirement	Select	Select the unit's NOx requirement: **None**, **<= 20** or **<= 9 PPM**.
	Valve Position - Target	Read Only	The unit's target Valve Position.
	Valve Position - Reading	Read Only	The unit's actual Valve Position.
	Blower - Target	Read Only	Target blower voltage for current Valve Position.
	Blower - Reading	Read Only	The unit's actual blower voltage.
	O2% - Target	Read Only	The unit's target O_2% in the exhaust.
	O2% - Reading	Numeric Entry	The unit's actual O_2% in the exhaust.
	CO - Target	Read Only	The target CO amount in the exhaust, in ppm.
	CO - Reading	Numeric Entry	The actual CO amount in the exhaust, in ppm.
	NOx - Target	Read Only	The target NOx amount in the exhaust, in ppm
	NOx - Reading	Numeric Entry	The actual NOx amount in the exhaust, in ppm.
	Flame Strength - Reading	Numeric Entry	The unit's Flame Strength, from Multimeter
	Air Temperature - Reading	Read Only	The current air temperature.
	Downstream Gas pressure	Numeric Entry	Appears only when fire rate = 100%.
	Blower Voltage	Adjust	Adjust as needed to match targets to actual readings.

2.3.2.1 *Main Menu → Calibration → Input/Output*

Main Menu → Calibration → Input/Output → Temperature Sensors			
	Sensor	Select	Select: **Feed Forward**, **Exhaust**, **Outside Temp**, **Air Inlet**, **Lower Inlet**, **Outlet**.
	Offset	Numeric Entry	Optional offset applied to current Sensor
	Current Reading	Read Only	Current sensor's current reading. (Flow In Adj & Flow Rate removed).
Main Menu → Calibration → Input/Output → O2 Sensor			
	O2 Offset	Numeric Entry	A correction value to selected input, if needed.
	O2	Read Only	The Current O_2 reading.
	Auto Calibrate Now	Yes/No	Initiates Auto Calibration
	Auto Calibrate Status	Read Only	Displays current Auto Calibration status.
	Calibration Frequency	Select	Select: **Never**, **Monthly**, **Weekly**, **Daily**.

	Time	Numeric Entry	Specify Auto Calibrate time of day (**Calibration Frequency** = **Daily**).
Main Menu → Calibration → Input/Output → Analog Inputs			
	Analog Name	Select	Select: **Flow** or **Remote Analog In**.
	Offset	Numeric Entry	A correction value to selected input, if needed.
	Current Reading	Read Only	Current reading of selected input.
Main Menu → Calibration → Input/Output → Analog Outputs			
	Analog Name	Read Only	Displays the name **Analog Output**.
	Level	Numeric Entry	Set the output's level (0.00 to 20.00 mA)
	Offset	Numeric Entry	A correction value to the analog output, if needed (-2.00 to 2.00).
	Feedback	Read Only	Displays feedback from **Analog Output**.

2.3.2.2 *Main Menu → Calibration → Subsystems*

Main Menu → Calibration → Subsystems → Air Fuel Valve			
	Valve Position	Manual Adjust	Set to desired Valve Position.
	A/F Sensitivity	Numeric Entry	Set Air/Fuel Valve sensitivity (1% to 5%)
Main Menu → Calibration → Subsystems → Spark Monitor			
	Spark Monitor	Enabled/Disabled	Enables/Disables the Spark Monitor.
	Min Spark	Numeric Entry	Minimum spark. (0.00 to 0.29 amps)
	Max Spark	Numeric Entry	Maximum spark. (0.30 to 2.50 amps)

2.3.2.3 *Main Menu → Calibration → Combustion Summary*

Main Menu → Calibration → Combustion Summary			
	Valve Position	Read Only	Displays combustion calibration valve steps.
	O2	Read Only	Displays combustion calibration O2 results.
	NOx	Read Only	Displays combustion calibration NOx results.
	CO	Read Only	Displays combustion calibration CO results.
	Flame Strength	Read Only	Displays combustion calibration flame strength.

2.3.3 Diagnostics Menu

The Diagnostics menu contains the following sections:

2.3.3.1 *Main Menu → Diagnostics → Manual Run*

Main Menu → Diagnostics → Manual Run			
	Manual Mode	Enable/Disable	Enables/disables running in Manual Mode.
	Fire Rate	Adjust	Manual fire rate adjustment, 0 to 100%.
	O2	Read Only	The percentage of O_2 in the unit's exhaust.
	Flame Strength	Read Only	The flame strength sensed in the burner, 0 to 100%.

2.3.3.2 Main Menu → Diagnostics → Front Panel

Main Menu → Diagnostics → Front Panel			
	Touchscreen Display Test	On/Off	Starts the Touchscreen Display Test.
	Touchscreen Test	On/Off	Starts the Touchscreen Test.
	Status Light Test	On/Off	Starts the Status Light Test.
	Keypad and Switch Test	On/Off	Starts the Keypad and Switch Test.

2.3.3.3 Main Menu → Diagnostics → Analog Outputs and Relays

Main Menu → Diagnostics → Analog Outputs and Relays → Relays			
	Ignition Relay	Enable/Disable	Enables/Disables the Ignition Relay.
	Blower Relay	Enable/Disable	Enables/Disables the Blower Relay.
	Pump Relay	Enable/Disable	Enables/Disables the Pump Relay.
	Aux Relay	Enable/Disable	Enables/Disables the Aux Relay.
	Fault Relay	Enable/Disable	Enables/Disables the Fault Relay.
Main Menu → Diagnostics → Analog Outputs and Relays → Analog Outputs			
	Valve	Read/Adjust	Adjustable display of the A/F valve Position.
	Blower	Read/Adjust	Adjustable display of the Blower.

2.3.3.4 Main Menu → Diagnostics → Subsystems

Main Menu → Diagnostics → Subsystems → Air Fuel Valve Stepper Motor			
	Auto Stroke	Toggle	Initiates A/F cycle, 0 to 100 to 0%
	Valve Position In	Adjust	Manual adjustment of A/F Valve 0 to 100%.
Main Menu → Diagnostics → Subsystems → Blower			
	Profile	Select	Select the profile to run (default = **Profile 1**).
	Profile Run	Enable/Disable	Enables running the selected profile.
	Blower	Numeric Entry	Manually adjust the Blower's voltage.
Main Menu → Diagnostics → Subsystems → Ignition			
	Ignition Spark	Enable/Disable	Enables testing the unit's ignition spark.
	Spark Current	Read Only	The current Spark Current.

2.3.3.5 Main Menu → Diagnostics → System

Main Menu → Diagnostics → System → Pre-Start Up			
	Pre-Start Up Mode	Enable/Disable	Enables Pre-Start Up Mode, a test of various system components without firing the unit.
	Valve Position Out	Read Only	The current A/F valve position.
	Blower (voltage)	Read Only	The current Blower voltage.
	Blower (RPM)	Read Only	The current Blower RPM.
	Spark Current	Read Only	The current Spark Current.
	Flame Strength	Read Only	The current flame strength.
	Gas pressure	Read Only	The current gas pressure.
Main Menu → Diagnostics → System → Versions			
	Serial Number	Read Only	The unit's serial number.
	Software Version	Read Only	The Controller's software version.

	Engineering Version	Read Only	The Controller's Engineering software version.
	Graphic Data Version	Read Only	The Controller's graphic version.
	Display Version	Read Only	The Controller's display version.
	I/O Board Version	Read Only	The I/O board version.
	Touch Version	Read Only	The touch screen version.
	Bluetooth Version	Read Only	The Bluetooth version.
	Framework Version	Read Only	The Framework version.
	Bootloader version	Read Only	The Bootloader version.
	Display BL Version	Read Only	Display Bootloader version.
	I/O PCB BL Version	Read Only	I/O Board PCB Bootloader version.

2.3.3.6 *Main Menu → Diagnostics → Comm & Network*

Main Menu → Diagnostics → Comm & Network → IP Network			
	Unit IP Address	Read Only	The unit's IP address.
	Subnet Mask	Read Only	The unit's subnet mask address.
	Gateway IP Address	Read Only	The unit's gateway IP address.
	DSN 1	Read Only	The unit's DSN 1 address.
	DSN 2	Read Only	The unit's DSN 2 address.
	Unit MAC Address	Read Only	The unit's MAC address.
	Network Status	Read Only	The unit's current network status.
Main Menu → Diagnostics → Comm & Network → BAS			
	BAS	Read Only	The Building Automation System protocol.
	Communication Address	Read Only	The unit's BAS address.
	Device Instance	Read Only	The unit's Device Instance within BAS.
	Unit IP Address	Read Only	The unit's IP address on the network.
	Unit MAC Address	Read Only	The unit's MAC address within BAS.
	Last Command Received	Read Only	The last command received by the unit.
	BAS IP	Read Only	If Security is enabled, this is the IP of the BAS system that the unit can only communicate with.
	Network Status	Read Only	The unit's BAS network's current status.
Main Menu → Diagnostics → Comm & Network → onAER			
	Unit IP Address	Read Only	The unit's IP address.
	Upload Time	Read Only	Frequency at which the unit transmits data to onAER
	Test Setup	Enable	Initiates test o onAER functionality.
	Test Heartbeat	Enable	Initiates test of the onAER heartbeat.
Main Menu → Diagnostics → Comm & Network → USB Storage			
	Status	Read Only	Status of the USB device.
	Serial Number	Read Only	The serial number of the USB device.
	Size	Read Only	The size of the USB device.
	Available Space	Read Only	The amount of free space on the USB device.

2.3.3.7 Main Menu → Diagnostics → Input/Output Summary

Main Menu → Diagnostics → Input/Output Summary	
This screen is a read-only display of the following unit and/or BST cascade parameters:	
Air Inlet:	Supply Header:
Exhaust:	Return Header:
Outlet:	Outside Temp:
Lower Inlet:	Supply Loop 2:
Upper Inlet:	Return Loop 2:
DHW Temp :	RTD Spare 1:
Feed Forward:	RTD Spare 2:
O2:	Spare Aout2:
Spare Aout1:	Spare Aout3:
Cascade Valve:	Blower:
BLR V.S. Pump:	DHW V.S. Pump:
Flow:	CO/Analog In:
Air Pump:	Cas Vlv Fdbk:
Remote Ain:	Spare Ain1:
Spare Ain2:	Spare Ain3:
Blower Relay:	Swing Valve 1 Relay:
Ignition Relay:	Backup Relay:
Pump Relay:	DHW Relay:
Aux Relay:	V2/Spare 1 Relay:
Fault Relay:	Spare 2 Relay:
Blower	Blower
High Gas Pressure:	Low Gas Pressure:
Draft Pressure	Spare Pressure:

2.3.4 Advanced Setup Menu

The Advanced Setup menu contains the following sections:

Main Menu → Advanced Setup → Access		
Password	Numeric Entry	Enter **159** or your password, then press **Save**.

2.3.4.1 Main Menu → Advanced Setup → Unit

Main Menu → Advanced Setup → Unit → Unit Settings		
Unit Serial #	Entry	The unit's factory-set serial number. Do ***NOT*** change except when replacing the Controller.
Unit Type	Enter	Displays unit's product and model. Do ***NOT*** change except when replacing the Controller.
Unit Size	Select	Displays the unit's sizes. Do ***NOT*** change except when replacing the Edge Controller.
Date	Numeric Entry	Allows you to set the current date.
Time Format	Toggle	Choose the **12 Hour** or **24-Hour** time format.
Time	Numeric Entry	Allows you to set the current time.

	Vent Type	Select	Choose the vent material: PVC, cPVC, Polypro, Stainless Steel.
	Exhaust Safety	Enable/Disable	Depending on exhaust temperature and value of Vent Type, triggers an exhaust temperature warning, reduced fire rate or unit shutoff.
	Fuel Type	Toggle	Choose **Natural Gas**
	Control Type	Select	Displays the controller type: Edge [i].
	Control Use	Select	Choose either **Boiler** or **Water Heater**.
	Language	Select	Choose the language of the Controller's display: **English**, **Spanish**, **French**.
	Unit of Measurement	Toggle	Choose unit of measure: **Metric** or **English**.
	Temperature Sensor	Toggle	Choose the sensor type in use on the unit, either **Balco** or **PT 1000**. Do not change unless the sensor type is switched.
	Beeper	Toggle	Enables/disables the audible fault alarm.
	Run Cycles	Numeric Entry	Displays number of run cycles since last system reset. Can be reset to 0 or any number.
	Run Hours	Numeric Entry	Displays the number of run hours since the last system reset. Can be reset to 0 or any number.
	Reset Common Settings	Select Yes/No	Press **Yes** to restore *common* settings to default values.
	Clear Fault Log	Select Yes/No	Press **Yes** to clear the Unit Event History.
	Reset All Settings	Select Yes/No	Press **Yes** to restore *all* settings to default values.
Main Menu → Advanced Setup → Unit → Front Panel Configuration			
	Upper Left Display	Select	Choose **Setpoint** or **Water Inlet**.
	Upper Right Display	Select	Choose **Water Outlet** or **System Header**.
	Multi-Function Bar	Select	Choose the Multi-Function Bar display: **Fire Rate** or **Valve Position**.
	Brightness	Numeric Entry	Adjusts Touchscreen brightness.
	Screensaver Password	Enable/Disable	If set to **Enabled**, all access to the Controller requires a Password.
	Screen Timeout Minutes	Numeric Entry	Specifies touchscreen timeout in minutes (**Screensaver Password** = **Enabled**).
	Screen Timeout Now	Toggle	Choose **Yes** to put Controller into sleep mode. (**Screensaver Password** = **Enabled**).
Main Menu → Advanced Setup → Unit → Settings Transfer			
	Restore All Settings	Select	Restores all settings to the factory default.
	Restore Common Settings	Select	Restores common settings to the factory default.
	Save All Settings	Select	Saves all settings to USB or onboard memory.
Main Menu → Advanced Setup → Unit → Fault Management			
	Power Reset	Toggle	Choose if power fault reset mode, **Manual** or **Automatic**.
	Water Temp Reset	Toggle	Choose water temperature fault reset mode, **Manual** or **Automatic**.
	Gas Pressure Reset	Toggle	Choose if gas pressure fault reset mode, **Manual** or **Automatic**.
Main Menu → Advanced Setup → Unit → Freeze Protection			
	Freeze Protection	Enable/Disable	Enables/disables Freeze Protection functionality.
	Pump On Temperature	Numeric Entry	If enabled, ambient temperature below this value triggers the system pump to start (20 to 245°F **, Freeze Protection** = **Enabled**).
	Unit On Temperature	Numeric Entry	Ambient temperature below this value triggers the unit to fire (20 to 245°F , **Freeze Protection** = **Enabled**).
	Stop Temperature	Numeric Entry	Ambient temperature above this value returns system to normal operation (20 to 245°F, **Freeze Protection** = **Enabled**).
Main Menu → Advanced Setup → Unit → Unit Application Configuration			

	Unit Application	Select	Select unit's application: **SH**, **DHW** or **Other**.
	Unit SH Operating Mode Unit DHW Operating Mode Unit Other Operating Mode	Toggle	Choose either **Constant** or **Remote Setpoint**.
	Unit SH Setpoint Unit DHW Setpoint Unit Other Setpoint	Numeric Entry	Sets the unit's setpoint (**Unit Operating Mode = Constant Setpoint**).
	Analog Input Source	Select	Choose: **Spare Analog In 1**, **Spare Analog In 2**, **Spare Analog In 3** (**Unit Application** = **DHW** or **Other** *and* **Unit Operating Mode** = **Remote Setpt**).
	Name	Select	Choose: **Not Assigned**, **Remote Setpt 2**, **Swing V1 Fdbk**, **Swing V2 Fdbk**, **Blr VSP Fdbk**, **DHW VSP Fdbk**, **SmartPlate VP**, **NOx** (**Unit Application** = **DHW** or **Other** *and* **Unit Operating Mode** = **Remote Setpt**).
	Remote Signal	Select	Select the source of the remote signal: **4-20mA**, **0-20mA**, **BST (PWM) Input**, **Network**, **1-5V**, **0-5V**, **BAS** (**Unit SH Operating Mode** = **Remote Setpoint**, **Combination** or **Direct Drive**).
	Unit DHW Remote Signal Unit Other Remote Signal	Select	Select the source of the of the remote signal: (**Unit DHW Operating Mode** or **Unit Other Operating Mode** = **Remote Setpoint**.
	Unit Address	Toggle	Specifies the unit's Modbus address (**Remote Signal = Network**).
	Cascade Baud Rate	Numeric Entry	Specifies Modbus baud rate (**Remote Signal = Network**).
	Outdoor Air Temp Sens	Numeric Entry	Choose how to communicate with the outdoor temp sensor: **Off**, **BAS**, **Direct** or **Network** (**Unit Application** = **SH** and **Unit SH Operating Mode** = **Outdoor Reset**).
	OAR Min Outside Temp	Numeric Entry	The minimum outside air temperature the system will read (**Unit Application** = **SH** and **Unit SH Operating Mode** = **Outdoor Reset**).
	OAR Max Setpoint	Numeric Entry	The *maximum* allowable setpoint (**Unit Application** = **SH** and **Unit SH Operating Mode** = **Outdoor Reset**).
	OAR Max Outside Temp	Numeric Entry	The maximum Outside Temperature that the system will operate to (**Unit Application** = **SH** and **Unit SH Operating Mode** = **Outdoor Reset**).
	OAR Min Setpoint	Numeric Entry	The *minimum* allowable setpoint (**Unit Application** = **SH** and **Unit SH Operating Mode** = **Outdoor Reset**).
	Outdoor Rst Setpt	Numeric Entry	The current outdoor reset setpoint, based on the four OAR parameters (**Unit Application** = **SH** and **Unit SH Operating Mode** = **Outdoor Reset**).
Main Menu → Advanced Setup → Unit → Maintenance			
	12 Month Maintenance Complete?	Yes/No	Specifies 12 Month Maintenance completed.
	Fire Side Inspection	Yes/No	Specifies Fire Side Inspection completed.
	Optical Burner Inspection	Yes/No	Specifies Optical Burner Inspection completed
	Water Side Inspection	Yes/No	Specifies Water Side Inspection completed.
	CSD-1 Safety Device Inspection	Yes/No	Specifies CSD-1 Safety Device inspection completed.
	Combustion Calibration Check	Yes/No	Specifies Combustion Calibration Check completed.

2.3.4.2 *Main Menu → Advanced Setup → BST Cascade*

Main Menu → Advanced Setup → BST Cascade → Cascade Configuration				
	Parameter Name	**Type**	**BST Client BST Manager**	**Description**
	Unit Mode	Select	Client/Manager	Specify Unit Mode: **Off**, **BST Client** or **BST Manager**.
	BST Outdoor Temp	Read Only	Client/Manager	The current reading of the outdoor temperature sensor (**Outdoor Air Temp Sens** = **Network**, **Direct** or **BAS**).

Warm Weather Shtdwn	Numeric Entry	Client/Manager	The threshold outside temperature above which the unit shuts down (**Outdoor Air Temp Sens** = **Network**, **Direct** or **BAS**).
Auto-Manager Transfer	Toggle	Manager	Allows BST Manger functionality to be transferred to another unit if the BST Manger malfunctions.
Auto Failover Type	Toggle	Manager	Choose either C-More or Edge 2.
Auto-Manager Timer	Numeric Entry	Manager	Specifies duration of BST Manger malfunction that triggers **Auto-Manager Transfer** (10 to 120).
Auto-Manager Addr	Read Only	Manager	The address of the current BST Manger (0 to 16).
Backup Manager Addr	Numeric Entry	Manager	The address of the unit designated as the Backup BST Manger (0 to 16).
Hdr Temp Sensor	Select	Manager	Choose how the unit communicates with the Header Temp Sensor: **Off**, **Network**, **FFWD Temp** or **BAS**.
SH Sensor Comm Addr	Numeric Entry	Client/Manager	Specify the Modbus transmitter address (0 to 255, **Outdoor Air Temp Sens** , **Hdr Temp Sensor** or **DHW Temp Sensor** = **Network** or **BAS**).
SH Hdr Temp Point	Numeric Entry	Manager	The Modbus point within the Modbus address of the Header Temp Sensor (0 to 255, **Outdoor Air Temp Sens** , **Hdr Temp Sensor** or **DHW Temp Sensor** = **Network** or **BAS**).
DHW Temp Sensor	Select	Manager	Choose how to communicate with the DHW temperature sensor: **Off**, **Network**, **Direct** or **BAS** (in the Application Configuration screen, **Application** = **Other**).
DHW Hdr Sens Point	Numeric Entry	Manager	Specify the Modbus point within the Modbus address where the DHW temp sensor resides (**DHW Temp Sensor** = **Network** or **BAS**).
DHW Temp Unit Addr	Numeric Entry	Manager	Specify the unit to which the DHW Header Temp Sensor is connected (0 to 16, **DHW Temp Sensor** = **Direct**).
Rtn Hdr Temp Sensor	Select	Manager	Choose how the unit communicates with Header Temp Sensor: **Off**, **Network** or **BAS**.
Rtn Hdr Sens Point	Numeric Entry	Manager	The Modbus point within the Modbus address of the Header Temp Sensor (0 to 255, **Rtn Hdr Temp Sensor** = **Network**).
Outdoor Air Temp Sens	Select	Client/Manager	Once Enabled, specifies how the outdoor air temperature sensor communicates. Choose: **Off**, **BAS**, **Direct** or **Network**.
Outdoor Temp Addr	Numeric Entry	Manager	The Modbus transmitter address of the outdoor temp sensor (0 to 255, **Outdoor Air Temp Sens** = **Network**).
OAT Temp Point	Numeric Entry	Manager	The Modbus point within the Modbus address of the Outside Air Temp Sensor (0 to 255, **Outdoor Air Temp Sens** = **Network**).

Main Menu → Advanced Setup → BST Cascade → Cascade Communication

Parameter Name	Type	BST Client BST Manager	Description
Unit Address	Numeric Entry	Client/Manager	The unit's address in the BST cascade.
Min Address	Numeric Entry	Manager	The minimum address in the BST cascade (1 to 16).
Max Address	Numeric Entry	Manager	The maximum address in the BST cascade (1 to 16).
Cascade Baud Rate	Select	Client/Manager	The communication baud rate in the cascade.
Plant Failsafe Mode	Toggle	Client/Manager	The unit/plant's operating mode if communication is lost: **Shutdown** or **Constant Setpoint**.
Plant Failsafe Setpoint	Numeric Entry	Client/Manager	The unit/plant's setpoint if communication is lost (**Unit Failsafe Mode** = **Constant Setpoint**).
Network Timeout	Numeric Entry	Client/Manager	The timeout before a Modbus Fault is declared (5 to 999 sec.).

Error Threshold	Numeric Entry	Client/Manager	The number of Modbus Comm errors allowed before invoking a Modbus comm fault (1 to 9).
Comm Error 1-8	Read Only	Client/Manager	The number of comm errors on ports 1 - 8.
Comm Error 9-16	Read Only	Client/Manager	The number of comm errors on ports 9 – 16..
SSD Address	Numeric Entry	Client/Manager	The Client/Client Device address (0 to 250).
SSD Temp Format	Toggle	Manager	Choose either **Points** or **Degrees**.
Time & Date Sync Over BST	Enable/Disable	Client/Manager	If Enabled, the unit will synchronize time and date with the BST Manager.
BST Min Units	Numeric Entry	Manager	The minimum number of units in the BST cascade (1 to 16).
BST Max Units	Numeric Entry	Manager	The maximum number of units in the BST cascade (1 to 16).
BST On Timeout	Numeric Entry	Manager	Specifies the time the BST Manager must wait for a backup Client unit to turn on (15 – 300).

Main Menu → Advanced Setup → BST Cascade → BST Application Configuration

Application	Select	The BST Cascade's application, either **SH** or **Other**.
SH Operating Mode Other Operating Mode	Select	The BST Cascade's operating mode, **Constant Setpoint**.
SH Setpoint Other Setpoint	Numeric Entry	The BST Cascade's Setpoint (**Operating Mode** = **Constant Setpoint**).
BST Outdoor Temp	Read Only	The current reading of the outdoor temperature sensor.
Warm Weather Shtdwn	Numeric Entry	The threshold outside temperature above which the unit shuts down (30 to 120 °F).

Main Menu → Advanced Setup → BST Cascade → Operating Controls

Main Menu → Advanced Setup → BST Cascade → Operating Controls → *Sequencing Controls*

Low Flow Mode	Select	Choose **Off**, **On - Outlet Temp** or **On - Avg Temp**. If either "On" option is chosen, and BST detect a "low-flow" condition, it slowly shuts down one unit at a time in an attempt to raise the Fire Rate of the remaining units.
Low Flow Threshold	Numeric Entry	Specifies the valve position below which the plant enters this mode (10% to 35%).
SH Next On Valve Pos	Numeric Entry	The valve position that triggers the next unit to come on line (16% to 100%).
SH Next Off Valve Pos	Numeric Entry	The valve position that triggers the next unit to go off line (16% to 100%).
BST Max Units	Numeric Entry	The maximum number of units that will fire (1 to 16, **Unit Mode** in Cascade Configuration = **BST Manager**).
SH Valve Close Delay	Numeric Entry	The time an open Isolation Valve will remain open once a unit cycles off (0 to 15 min., **Unit Mode** = **BST Manager**).
SH BST Fire Rate Up	Numeric Entry	Controls the frequency of updates made to the Fire Rate sent to all units.
DHW High-Fire Fire Rate	Numeric Entry	Specifies the firing rate above which the swing boiler will be requested to support the DHW loop application (55 to 90).

Main Menu → Advanced Setup → BST Cascade → Operating Controls → *Anti-Cycling Control*

On Delay	Enter	Minimum length of time a unit must stay off after shutting down/going standby (30 to 300 sec.).
Slow Shutdown	Enable/Disable	Once enabled, if the unit runs at a fire rate above **Off Delay Threshold** and then shuts down, the fire rate will be reduced to the Stop Level for a period of time defined in **Off Delay**.
Off Delay	Numeric Entry	Specifies the amount of time full shut down will be delayed (0 to 9999 sec., **Slow Shutdown** = **Enabled**).
Off Delay Threshold	Numeric Entry	The threshold fire rate above which **Slow Shutdown** will take effect (40% to 100%, **Slow Shutdown** = **Enabled**).
Shutoff Delay Temp	Numeric Entry	The temperature above setpoint the unit may rise to during delay shutdown (0°F to 25°F).
Demand Offset	Numeric Entry	Offset temperature from setpoint before a unit may come online (0°F to 25°F).

Main Menu → Advanced Setup → BST Cascade → Operating Controls → *Temperature Control*		
SH Proportional Band DHW Proportional Band	Numeric Entry	Generates a fire rate based on the error that exists between the setpoint temperature and the actual outlet temperature. If the difference is less than the value of these parameters, the fire rate will be less than 100%.
SH Integral Band DHW Integral Band	Numeric Entry	Specifies the fraction of the output, due to setpoint error, to add or subtract from the output each minute to move towards the setpoint.
SH Derivative Band DHW Derivative Band	Numeric Entry	This value responds to the rate of change of the setpoint error. This is the time that this action advances the output.
Cascade Deadband Hi	Numeric Entry	These parameters define a temperature range within which the plant Outlet Temperature can drift above and below the Setpoint (0 to 25°F)
Cascade Deadband Lo	Numeric Entry	
Other Temp Hi Limit	Numeric Entry	The highest temperature for each Application the plant will meet (**Application** in Cascade Configuration = **Other**, 40 to 210°F)
Main Menu → Advanced Setup → BST Cascade → Operating Controls → *Valve Configuration*		
Output Signal Type	Toggle	Select the output signal type of the selected output: **Current** or **Voltage**.
Control Mode	Select	Select **On/Off**, **Linear Modulation** or **Delta T Modulation**.
Valve Feedback	Enable/Disable	Choose **Enabled** or **Disabled**.
Valve Feedback Status	Read Only	Displays the selected valve's current status (**Valve Feedback** = **Enabled**).
Valve Feedback Timer	Numeric Entry	The time to detect the **Valve Feedback Status** (30 to 240 sec, **Valve Feedback** = **Enabled**).
Open Vlv Control Signal	Select	Choose the signal that opens the valve: **0mA**, **4mA** or **20mA**.
Close Vlv Control Signal	Select	Choose the signal that closes the valve: **0mA**, **4mA** or **20mA**.
Min # Valves Open	Numeric Entry	Specify the minimum number of isolation valves that must stay open at all times, including during plant standby (1 to 16, **Unit Mode** in Cascade Configuration = **BST Manager**).
Main Menu → Advanced Setup → BST Cascade → Operating Controls → *Reserve Unit Control*		
Reserve Unit Control	Enable/Disable	Enables/disables the Reserve Unit Control feature.
Reserve Relay Unit Addr	Numeric Entry	The address of the unit designated as the Reserve Unit (0 to 16, **Reserve Unit Control** = **Enabled**).
Enable System Threshold	Numeric Entry	The plant fire rate that activates (closes) the Reserve Unit to fire (20% to 100%, **Reserve Unit Control** = **Enabled**).
Disable System Threshold	Numeric Entry	The plant fire rate that deactivates (opens) Reserve Unit (20% to 90%, **Reserve Unit Control** = **Enabled**).
Main Menu → Advanced Setup → BST Cascade → Operating Controls → *Setpoint Range*		
SH Setpt Low Limit Other Setpt Low Limit	Numeric Entry	The setpoint's *lower* limit (40 to 245°F, **Application** in Application Configuration = **SH** or **Other**).
SH Setpt Hi Limit Other Setpt Hi Limit	Numeric Entry	The setpoint's *upper* limit (20 to 220°F, **Application** in Application Configuration = **SH** or **Other**).
Setpoint Limiting	Enable/Disable	Enables/disables the Setpoint Limiting feature.
Setpoint Limit Band	Numeric Entry	The number of degrees *below* **Setpt Hi Limit** the unit's outlet temperature must fall before the unit restarts (0°F to 10°F, **Setpoint Limiting** = **Enabled**).
Setback Schedule	Enable/Disable	Enables/disables the Setback Schedule feature.
Setback Start Time	Numeric Entry	The Setback period's *start* time (**Setback Schedule** = **Enabled**).
Setback Stop Time	Numeric Entry	The Setback period's *end* time (**Setback Schedule** = **Enabled**).
Main Menu → Advanced Setup → BST Cascade → Operating Controls → *Lead/Lag*		
Lead/Lag Setting	Select	Select: **Run Hours**, **Unit Size** or **Select Lead Lag**.
Hours	Numeric Entry	The number of hours after which the Lead unit is rotated (25 to 225 hours, **Lead/Lag Setting** = **Run Hours**).
Lead Unit	Numeric Entry	Specify the address of the Lead unit (0 to 16, (**Lead/Lag Setting** = **Select Lead Lag**).

	Lag Unit	Numeric Entry	Specify the address of the Lag unit (0 to 16, **Lead/Lag Setting** = **Select Lead Lag**).

2.3.4.3 Main Menu → Advanced Setup → Com & Failsafe

Main Menu → Advanced Setup → Comm & Network → onAER			
	onAER Mode	Select	To enable onAER, select the communication method: **Ethernet**, **Wi-Fi** or **Wiznet** (for units where the Edge Controller replaced a C-More).
	Unit Upload Time	Numeric Entry	Determines how frequently unit data is uploaded to the server (30 to 9999 sec.).
	Cascade Upload Time	Numeric Entry	Determines how cascade data is uploaded to the server (60 to 9999 sec.).
	Status	Read Only	The communication interface status.
Main Menu → Advanced Setup → Comm & Network → Ethernet			
	DHCP	Enable/Disable	Enables/disables DHCP (Dynamic Host Configuration Protocol).
	IP Address	Numeric Entry	The static IP address of the unit (**DHCP** = **Disabled**).
	Subnet	Numeric Entry	The subnet address of the network (**DHCP** = **Disabled**).
	Gateway	Numeric Entry	The IP address of the Gateway (**DHCP** = **Disabled**).
	DNS1	Numeric Entry	The IP address of DNS Server 1 (**DHCP** = **Disabled**).
	DNS2	Numeric Entry	The IP address of DNS Server 2 **(DHCP** = **Disabled**).
	ICMP PING	Enable/Disable	Allows the unit to be pinged..
Main Menu → Advanced Setup → Comm & Network → Communication Failsafe			
	Unit Failsafe Mode	Toggle	Choose how the unit will operate when either the Manager communication or a Remote Signal is lost: **Constant Setpt** or **Shutdown**.
	Unit Failsafe Setpoint	Numeric Entry	The unit's default setpoint when communication fails (60 to 160°F, **Unit Failsafe Mode** = **Constant Setpt**).

2.3.4.4 Main Menu → Advanced Setup → Ancillary Devices

Main Menu → Advanced Setup → Ancillary Device → Interlocks			
	Remote Interlock Name	Select	Choose the Remote Interlock: **Flow**, **Damper**, **Louver**, **Other**.
	Remote Interlock Use	Toggle	Specify what will shut down if the selected Remote Interlock is open: **Unit Shutdown** or **Sys Shutdown**.
	Delayed Interlock Name	Select	Choose the Delayed Interlock: **Valve 1**, **Valve 2**, **Louver 1** or **Louver 2**.
	Auxiliary Delay	Numeric Entry	Select the Delayed Interlock's delay (0 to 240 sec.).

2.3.4.5 Main Menu → Advanced Setup → Performance

Main Menu → Advanced Setup → Performance → Temperature Control			
	Main Menu → Advanced Setup → Performance → Temperature Control → *PID Setting*		
	Proportional Band	Numeric Entry	Generates a fire rate based on the error that exists between the setpoint and the actual outlet temperature. If the error is less than Proportional Band, fire rate will be less than 100%. If the error is equal to or greater than proportional band, the fire rate will = 100% (1°F to 120°F).
	Integral Band	Numeric Entry	Specifies the fraction of the output, due to setpoint error, to add or subtract from the output each minute to move towards the setpoint. (0.00 to 5.00)

Derivative Band	Numeric Entry	Specifies the time that this action advances the output; it responds to the rate of change of the setpoint error (0.00 to 2.00 min.).
Warm-up Prop Band	Numeric Entry	These three parameters eliminate Temperature Overshoots during the "Warmup" period of a cold ignition cycle by temporarily modifying the PID Gain parameter during warmup.
Warm-up Integral Band	Numeric Entry	
Warm-up Derivative Band	Numeric Entry	
Restore Defaults	Yes/No	Choose **Yes** to reset all parameters to the factory default.
Main Menu → Advanced Setup → Performance → Temperature Control → *Temperature Conformance*		
Deadband High	Numeric Entry	These two settings create an "outlet temperature zone" (between Active Setpoint + Deadband High and Active Setpoint – Deadband Low) in which no Valve Position corrections are attempted. (0 to 25°F for both)
Deadband Low	Numeric Entry	
Temperature High Limit	Numeric Entry	The unit's maximum allowable working temperature. If the unit reaches this limit, it will fault and shut down (40 to 210 °F).
Main Menu → Advanced Setup → Performance → Temperature Control → *Setpoint Range*		
Setpoint Low Limit	Numeric Entry	Determines the upper and lower limit within which the setpoint can vary.
Setpoint High Limit	Numeric Entry	
Setpoint Limiting	Enable/Disable	Enables/disables Setpoint Limiting functionality.
Setpoint Limit Band	Numeric Entry	Sets the number of °F *below* **Setpoint High Limit** the unit's outlet temperature must fall before the unit restarts (0 to 10°F, **Setpoint Limiting** = **Enable**).
Setback Schedule	Enable/Disable	Enables/disables Setback Schedule functionality
Setback Setpoint	Numeric Entry	The Setpoint that will be in effect during the Setback period. (60°F to 245°F, **Setback Schedule** = **Enabled**).
Setback Start Time	Numeric Entry	The **Setback** period's ***start*** time (**Setback Schedule** = **Enable**).
Setback Stop Time	Numeric Entry	The **Setback** period's ***end*** time (**Setback Schedule** = **Enable**).
Main Menu → Advanced Setup → Performance → Temperature Control → *FFWD Settings*		
FFWD Temp	Read Only	Displays the current FFWD temperature.
PID Output	Read Only	Displays the calculated PID output.
FFWD Output	Read Only	Displays the current FFWD output.
Min Load Adj	Numeric Entry	Adjusts the output by adding an offset to the breakpoint chart at minimum flow. This is used to fine tune Feed-Forward (FFWD) output at low flow levels. (-50 - +50°F)
Max Load Adj	Numeric Entry	Adjusts the output by changing the scaling of the breakpoint chart at maximum flow. (-50 - +50°F)
Outlet Feedback	Yes/No	Enables Outlet Feedback functionality.
Feedback Gain	Numeric Entry	The percentage of feedback from the water outlet sensor the algorithm factors to determine fire rate (0.01 – 1.00).
Fdback Start Pos	Numeric Entry	The Feedback start position (0 – 100%).
Fdback End Pos	Numeric Entry	The Feedback end position (0 – 100%).
Max Feedback	Numeric Entry	Specifies the maximum Feedback position (0 – 100%).
Fdback Value	Read Only	Displays the current feedback value.
Breakpt at 100 to Breakpt at 0	Numeric Entry	Allows breakpoint temperature settings to be entered for 100% to 0% in 10% increments (60 – 260°F).
Temp Gov	Enable/Disable	Enables temperature governor limiting functionality, which aggressively reduces the effective Fire Rate as the Outlet Temperature approaches the High Temperature Limit.

GOV Limit-5 – GOV Limit-15	Numeric Entry	When the Outlet Temperature exceeds the **Temperature Hi Limit** by 5 to 15°F, the effective Fire Rate will be reduced by the value entered in GOV Limit-5 through GOV Limit-15 (0 – 100°F).
Above 70F Val	Numeric Entry	If the inlet water temp is above 70F, algorithm adds offset provided by this item to all the 11 breakpoints ("breakpoint at 100" – "breakpoint at 0"). (-10 - +10°F)
Below 70F Val	Numeric Entry	If the inlet water temp is below 70F, algorithm adds offset provided by this item to all the 11 breakpoints ("breakpoint at 100" – "breakpoint at 0"). (-10 - +10°F)
No FFWD Above FR	Read Only	No Feed Forward above this fire rate
No FFWD Feature	Read Only	No Feed Forward above fire rate feature status
Menu → Advanced Setup → Performance → Fire Control		
Main Menu → Advanced Setup → Performance → Fire Control → *Purge Control*		
Purge Blower Voltage	Numeric Entry	Sets the blower speed (blower output voltage) during the Purge cycle (2.0 to 10.0 V).
Purge Timer	Numeric Entry	Allows adjustment of the pre-ignition purge time (5 to 60 sec.).
Post Purge Timer	Numeric Entry	Allows adjustment of the post purge time before the unit shuts down (0 to 60 sec.).
Main Menu → Advanced Setup → Performance → Fire Control → *Ignition Control*		
Ignition Position	Numeric Entry	Sets the air fuel valve position at which the unit will operate during the ignition sequence (5% to 60%).
Ignition Blower Voltage	Read Only	Displays the actual blower voltage during ignition.
Ignition Voltage Offset	Numeric Entry	Allows an adjustment to the blower voltage during ignition (-5.00 to 5.00).
Low Fire Timer	Numeric Entry	Specifies how long to remain in the low fire position after ignition, before going to the desired output (2 to 600 sec.).
Ignition Hold Timer	Numeric Entry	Sets the length of time the unit stays in ignition position (0 to 60 sec.).
IGN Time Setting	Read Only	Displays the maximum time between confirmation of gas valve opening (POC) and a stable flame detected.
Main Menu → Advanced Setup → Performance → Fire Control → *Operating Control*		
Start Valve Position	Numeric Entry	Specifies the valve position at Start Level (0 to 40%).
Stop Valve Position	Numeric Entry	Specifies the valve position at Stop Level (0 to 40%).
Max Valve Position	Numeric Entry	The maximum valve position for unit (40 to 100%).
Standby Blower Voltage	Numeric Entry	Specifies the blower voltage in Standby Mode, during which the blower motor remains "ON" at low speed, to limit power cycles. AERCO recommends keeping the default, however, may set this between **2.00** and **0** volts on individually vented units in positive pressure mechanical rooms to compensate (0.0 to 10.0V).
Air Compensation	Enable/Disabled	**Innovation Only!**
Vlv Position Change Rate	Numeric Entry	Defines the rate at which the **valve position** will progress from one step to the next (0.5 to 60 sec.).
Skip Range Cntr	Numeric Entry	Together, these 3 parameters define an optional Fire Rate the Controller will skip-over (**Skip Range Cntr** = the center of the range)**.** These can be used to reduce objectionable noise at a certain Fire Rate, if there is no other remedy.
Skip Range Span	Numeric Entry	
Skip Speed	Numeric Entry	
Main Menu → Advanced Setup → Performance → Fire Control → *Anti-Cycling Control*		
On Delay	Numeric Entry	Sets the minimum time a unit must stay ***off*** after shutting down or going into standby (0 to 600 sec.).
Slow Shutdown	Enable/Disabled	Enable/disable the slow shut down feature once **Off Delay** threshold is achieved.

	Off Delay	Numeric Entry	Defines a Shutoff delay, during which time the unit remains at minimum fire rate after the unit has sequenced to shutoff. It is activated only when **Off Delay Threshold** is reached (0 to 9999 secs). (**Slow Shutdown** = **Enabled**).
	Off Delay Threshold	Numeric Entry	The Fire rate that activates the **Off Delay** function (40 to 100 %). (**Slow Shutdown** = **Enabled**).
	Shutoff Delay Temp	Numeric Entry	Specifies the number of degrees above setpoint that the outlet temperature can rise without triggering a unit shut down (0 to 25°F).
	Demand Offset	Numeric Entry	The temperature offset from setpoint before a unit may come online. (0°F to 25°F). This can reduce excessive cycling in **AUTO** mode. When above 0, the unit will not turn on again until **Valve Position In** reaches the **Start Level** value *AND* the outlet temperature goes below **Demand Offset**; the unit will fire at the ignition valve position or below for 1 minute. If this entry equals 0, the unit will turn on when the **Valve Position In** = **Start Level**.

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SECTION 3. START SEQUENCE

3.1 INTRODUCTION

The information in this section provides a guide to starting the Benchmark Boiler using the Edge [i] Controller. 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!

- All of the installation procedures in Section 2: *Installation* in the *Benchmark 750-6000 with Edge [i]: Install-Startup Manual* (OMM-0144, GF-217) must be completed before the initial start-up of the unit.
- Electrical voltages up to **120 VAC (BMK750 – 2000), 208 or 480 VAC (BMK2500 – 5000N), or 208**, **480** or **575 VAC (BMK5000 & 6000) and 24 volts AC** may be used in this equipment. 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.
- Initial startup of the unit ***must be*** performed by AERCO 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.

3.2 START SEQUENCE

When the Edge [i] Controller Enable/Disable switch is set to the ***Enable*** position, it checks all pre-purge safety switches to ensure they are closed. These switches include:

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

NOTE:

The **Blocked Inlet** and downstream **Blower Proof** switches are ***not*** checked prior to starting the pre-purge.

If all of the above switches are closed, the READY light (above the Enable/Disable switch) will light when the switch is in the **Enable** position and the unit will be in the STANDBY mode.

NOTE:

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

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

Start Sequence

1. The Controller's red **DEMAND** LED status indicator will light.
2. The unit checks all five pre-purge safety switches listed at the beginning of this section. The Edge [i] Controller's ignition sequence screen walks you through the ignition screens and demonstrates (or highlights) which switches are not met. SSOV locations are shown in Figure 3-1a through 3-1e.

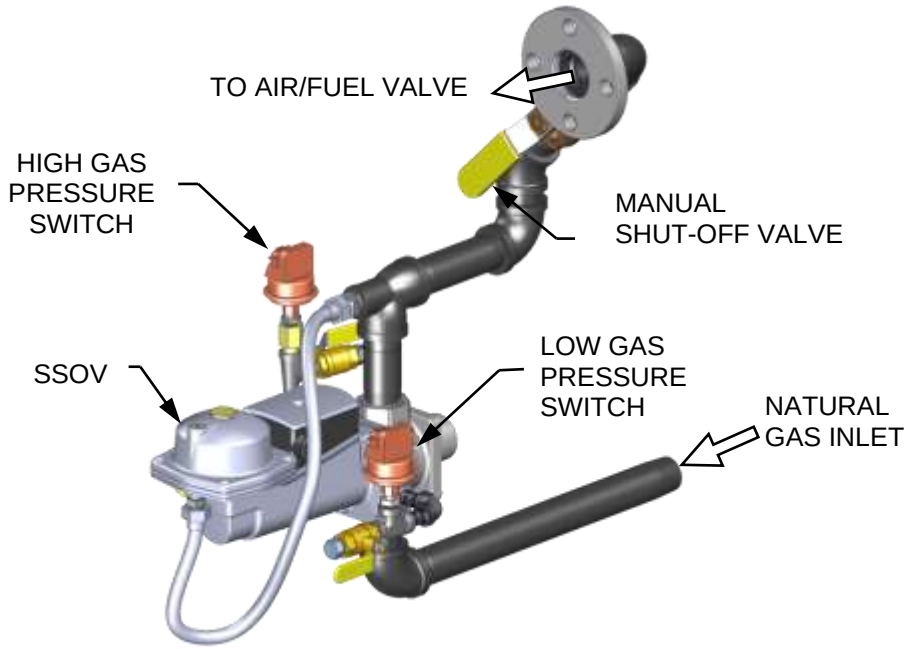

Figure 3-1a: BMK750 & 1000 SSOV Location (P/N 22140-1 shown)

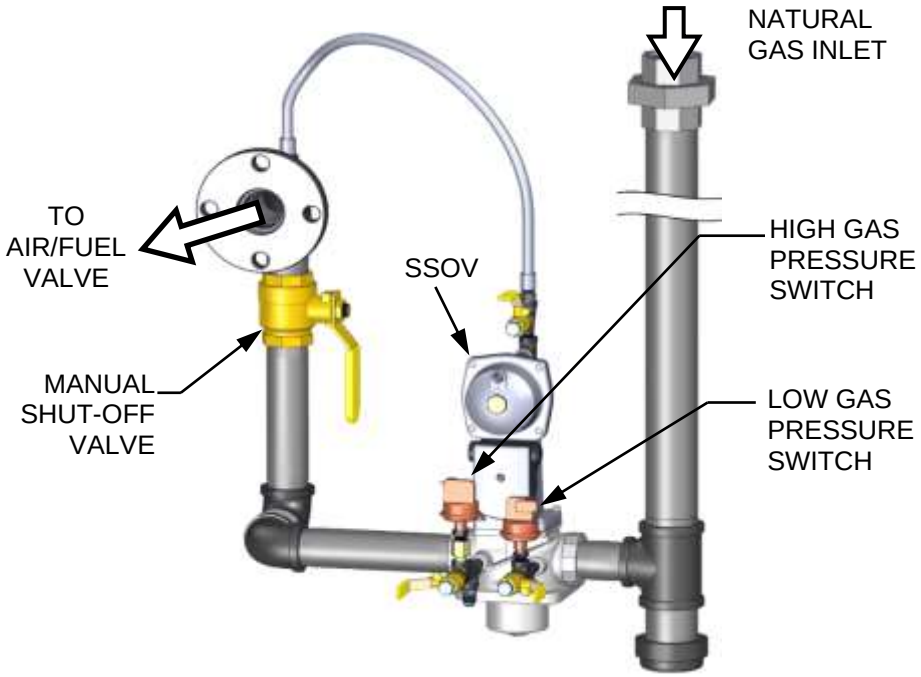

Figure 3-1b: BMK1500 & 2000 SSOV Location (P/N 22188 shown)

Start Sequence

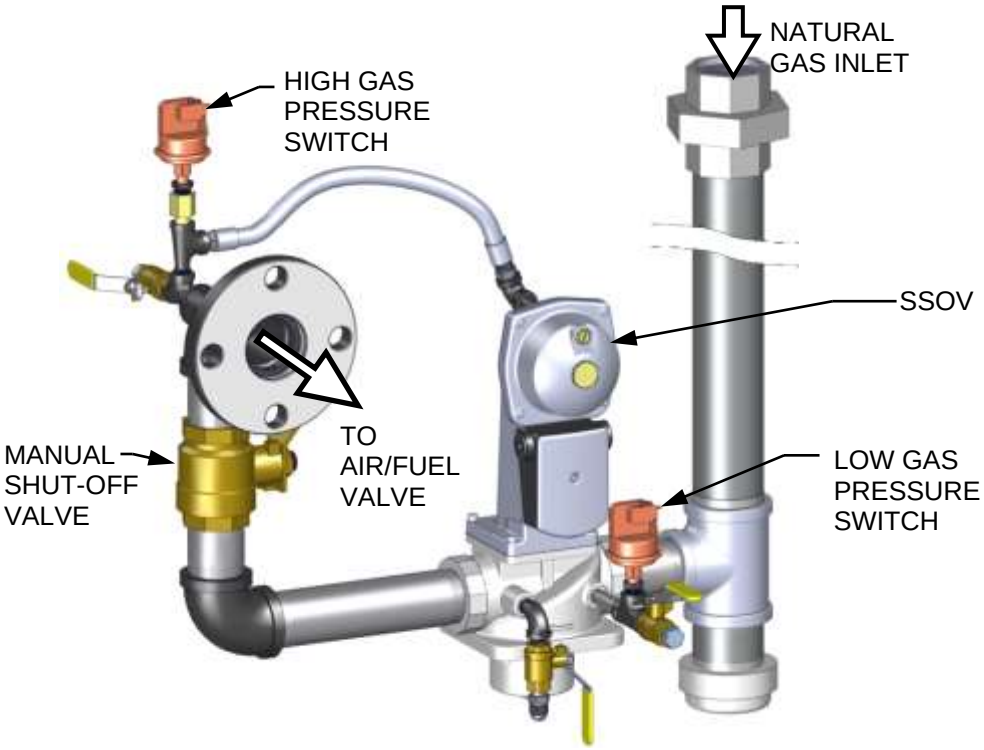

Figure 3-1c: BMK2500/3000: SSOV Location (P/N 22190 shown)

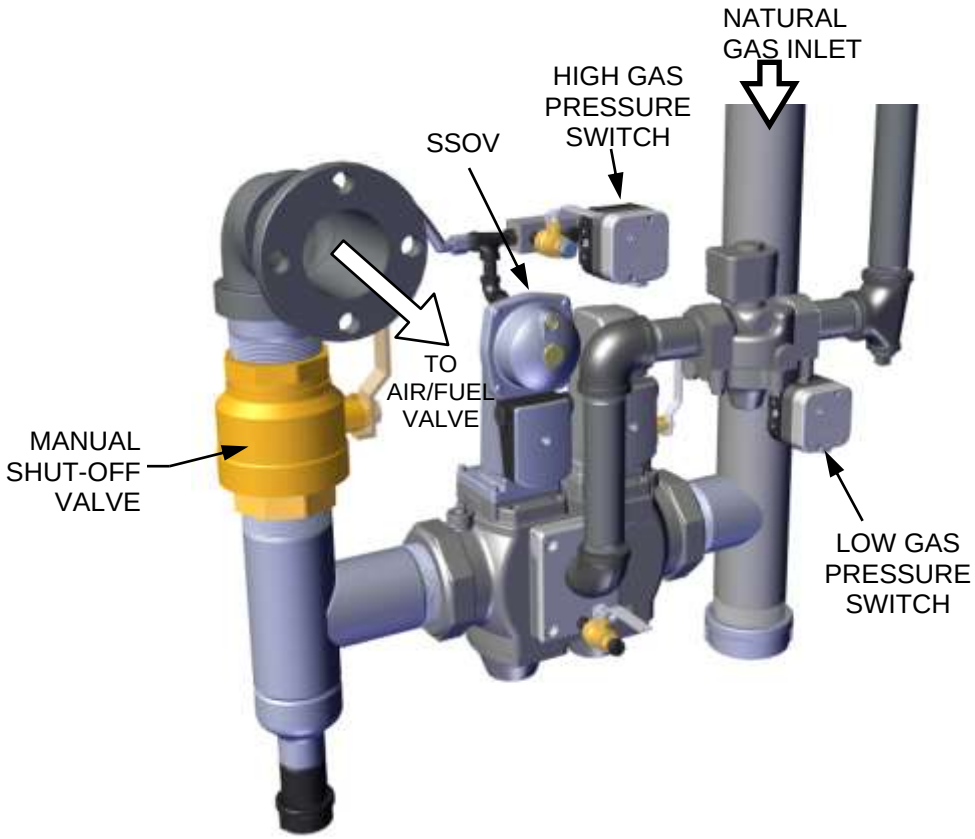

Figure 3-1d: BMK4000: SSOV Location (P/N 22373-3 shown)

Start Sequence

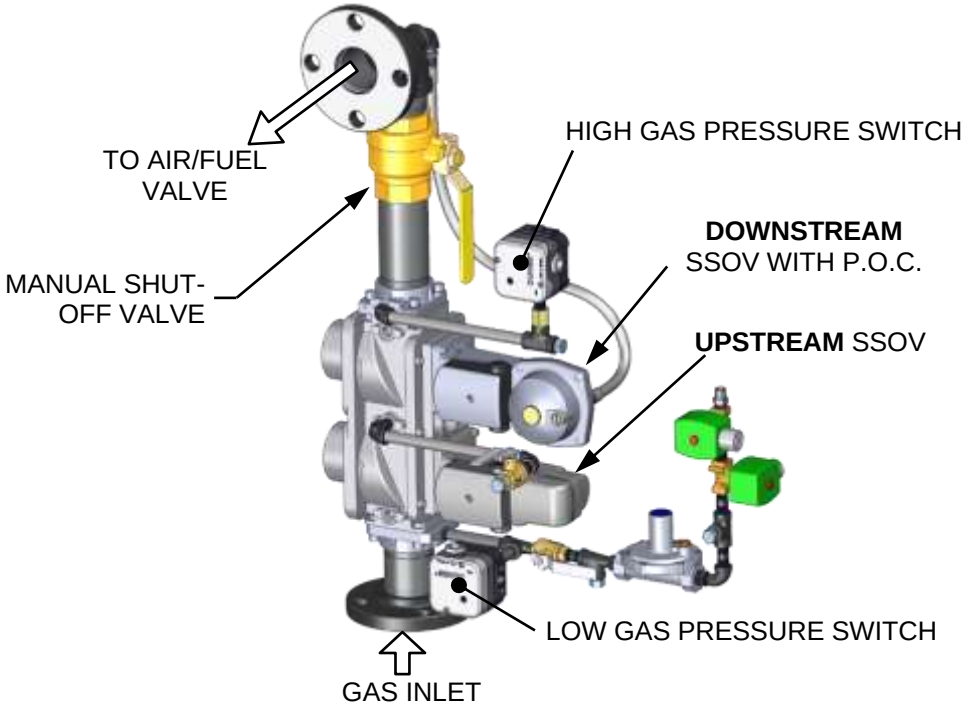

Figure 3-1e: BMK5000-6000: SSOV Location (P/N 22330-1 shown)

3. The Auxiliary Delay occurs for a configurable length of time and the Delayed Interlocks are closed.
4. Once all required safety device switches are closed, a purge cycle is initiated and the following events 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 3-2a and 3-2b) will read ***100*** to indicate that it is full-open (100%).
   c. The **Fire Rate** bargraph on the Controller's front face shows 100%.

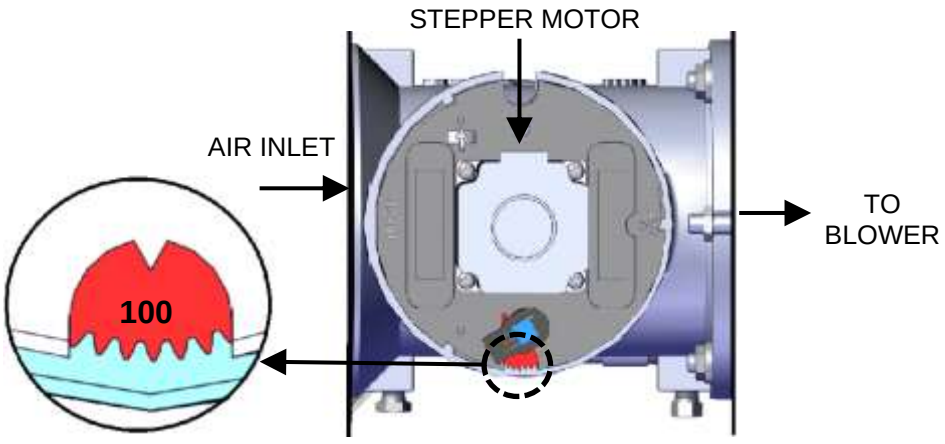

Figure 3-2a: BMK750 & 1000 Air/Fuel Valve in Purge Position

Start Sequence

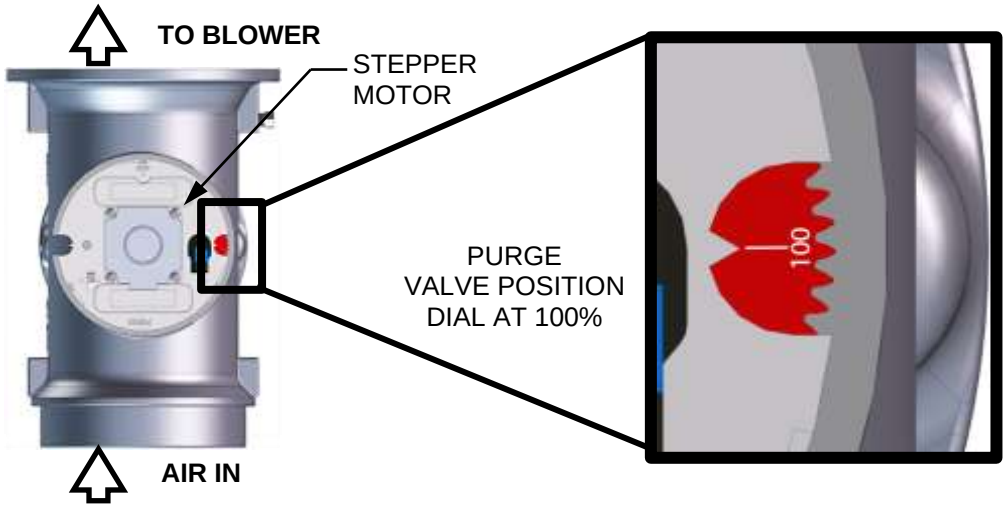

Figure 3-2b: BMK1500 – 6000 Air/Fuel Valve In Purge Position

5. Next, the Blower Proof and Blocked Inlet switches close (Figure 3-4a and 3-4b). On the Ignition Sequence screen the ***Purging*** indicator turns grey while purging is underway (Figure 3-3) and ***Purge Timer*** displays the purge cycle's elapsed time in seconds.

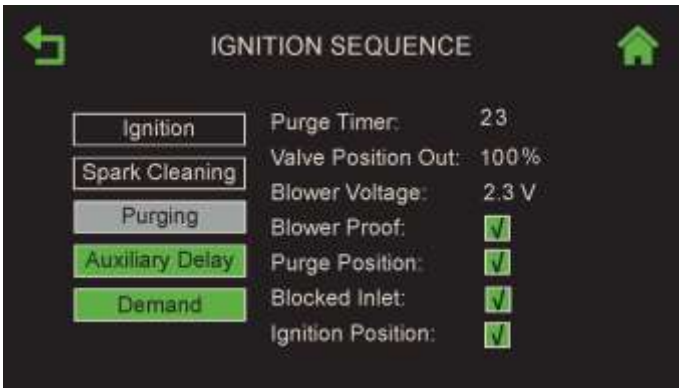

Figure 3-3: Ignition Sequence Screen – Purging

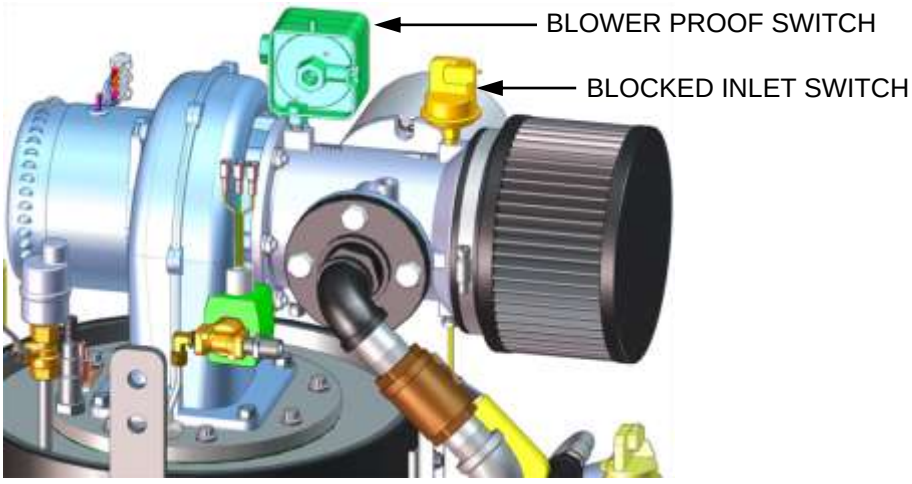

Figure 3-4a: BMK750 & 1000 Blower Proof Switch

Start Sequence

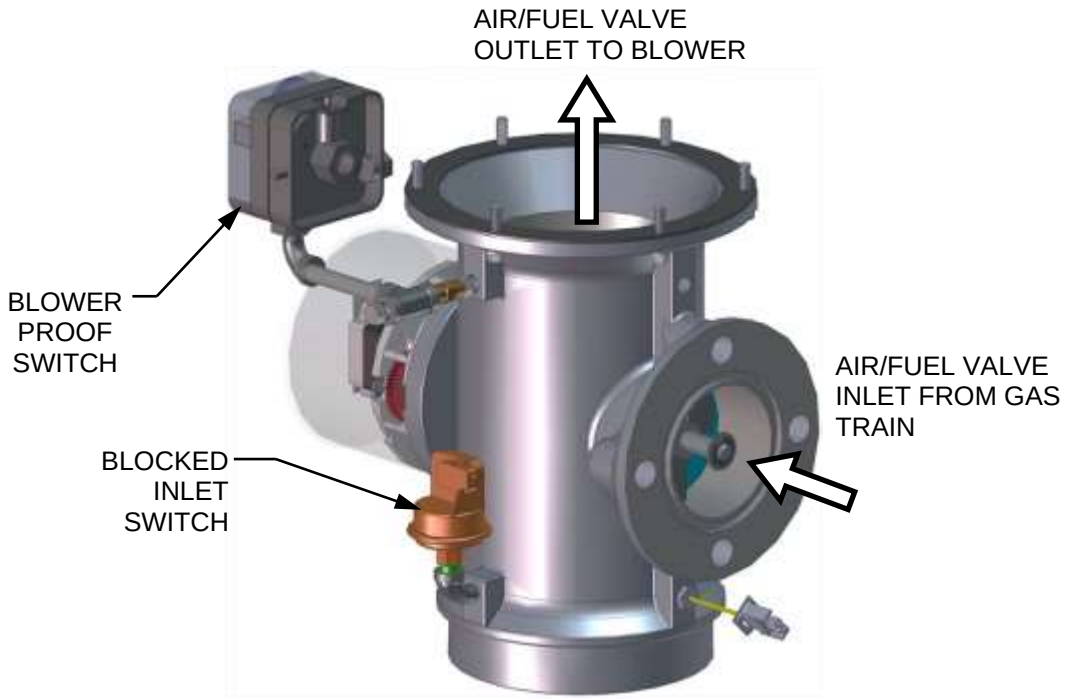

Figure 3-4b: BMK1500 – 6000 Blower Proof Switch

6. Upon completion of the purge cycle, the Controller initiates an ignition cycle and the following events occur:
   a) The Air/Fuel Valve rotates to the low-fire (Ignition) position and closes the ignition switch. The Dial on the Air/Fuel Valve (Figure 3-5) will read between ***25*** and ***35*** to indicate that the valve is in the low fire position.
   b) The Spark Cleaning cycle begins (default duration = 7 sec.) and the Ignition Sequence screen's ***Spark Cleaning*** indicator (Figure 3-3) turns grey. This cycle turns on the ignition transformer to produce a spark (with no gas flowing) to remove moisture and carbon buildup from the spark element. For the duration of this cycle, the Controller displays the ***Cleaning Igniter*** status message.
   c) Following the Spark Cleaning cycle, power is applied to the gas Safety Shut-off Valve (SSOV). When the SSOV indicates the Gas Valve is OPEN (POC) and the Ignition Sequence screen's ***Ignition*** indicator (Figure 3-3) turns grey.
   d) If no spark is present 3 seconds into the ignition trial, the Controller aborts the Ignition Cycle and shuts down the boiler. Refer to Section 9: *Troubleshooting* in this guide for guidance if this occurs.

Start Sequence

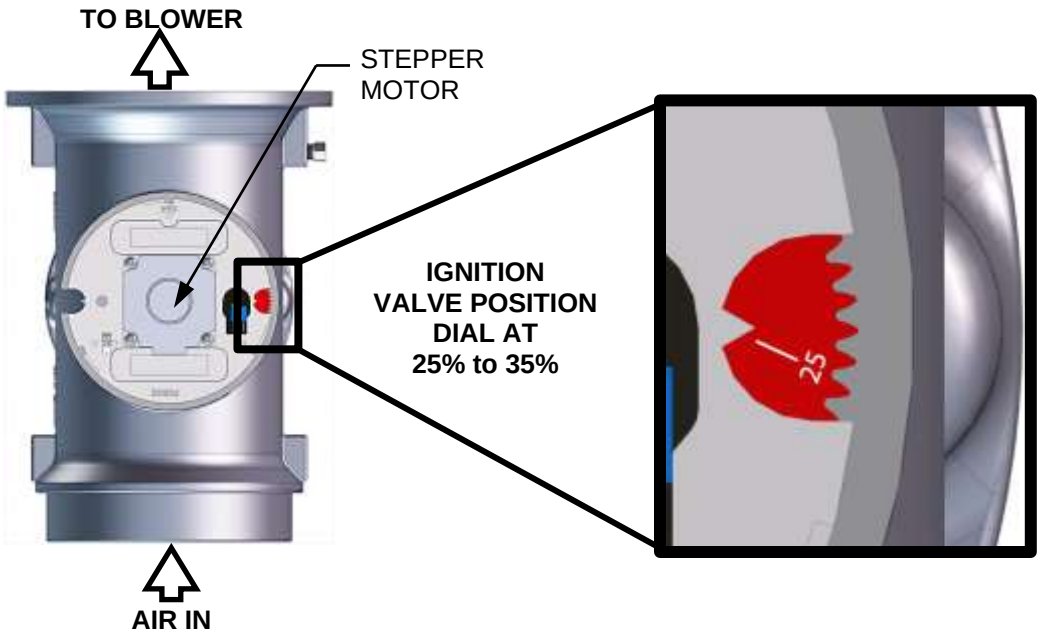

Figure 3-5: Air/Fuel Valve In Ignition Position

7. Up to 4 seconds are allowed for ignition to be detected. The ignition circuit is turned off one second after flame is detected.
8. After 2 seconds of continuous flame, the flame strength is indicated. After 5 seconds, the ***Unit Status*** screen appears.
9. With the unit firing properly, it will be controlled by the temperature control circuitry. The boiler's fire rate or valve position (depending on which was chosen in Section 4.2.2: *Front Panel Configuration* of the *Edge [i] Controller Manual*, OMM-0141, GF-213-B) will continuously display on the Controller's bargraph.
10. Once the demand for heat has been satisfied, the Edge [i] Controller will turn off the SSOV gas valve. The blower relay will be deactivated and the Air/Fuel Valve will be closed. ***Standby*** is displayed.

BMK5000 & 6000 Function Timing Chart For Proved Pilot Control System

	Operating State					
		Pre-purge		PFEP	MFEP	
	Standby	T = 0	T = 30	T = 37	T = 44	Run
Component				PFEP	MFEP	
Edge [i] Controller						
Scanner Power						
Ignition Power						
SSOV Power						
Pilot Valve Closed						
Pilot Valve Open						
Ignition Transformer Off						
Ignition Transformer On						
UV Scanner Powered						
UV Scanner "Ignored"						
UV Scanner In Use						
Relay 1 Coil						
Relay 1 C-NC						
Relay 1 C-NO						
Relay 2 Coil Power from R1						
Relay 2 Coil Power from SKP 15 POC						
Relay 2 C-NC						
Relay 2 C-NO						
SKP15 Power from R1 Contacts						
SKP15 Power from R2 contact and POC C-NO						
SKP15 Proof of Closure C-NC						
SKP15 Proof of Closure C-NO						
SKP25						
Power through R1						
Power through R2 and AUX						
Proof of Closure C-NC						
Proof of Closure C-NO						

3.3 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:

TABLE 3-1a: Start/Stop Levels – NATURAL GAS

	BMK 750/ 1000	BMK 750/1000 DF	BMK 1500	BMK 2000	BMK 2500	BMK 3000	BMK 4000	BMK 5000N	BMK 4000 & 5000N DF	BMK 5000	BMK 6000
Start Level:	22%	24%	20%	24%	24%	20%	27%	24%	24%	24%	24%
Stop Level:	18%	18%	16%	18%	16%	14%	23%	18%	18%	18%	18%
Ignition Position	35%	30%	29%	29%	29%	29%	45%	40%	35%	35%	50%

TABLE 3-1b: Start/Stop Levels – PROPANE GAS

	BMK 750/ 1000	BMK 750/1000 DF	BMK 1500	BMK 2000	BMK 2500	BMK 3000	BMK 4000	BMK 5000N	BMK 5000	BMK 6000
Start Level:	22%	24%	20%	24%	26%	22%	24%	24%	24%	24%
Stop Level:	18%	18%	16%	18%	18%	14%	18%	18%	18%	18%
Ignition Position	35%	30%	29%	29%	29%	29%	35%	35%	35%	50%

Normally, these settings do not require adjustment.

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

3.4 START/STOP LEVELS – AIR/FUEL & ENERGY INPUT

The Tables below show the relationship between the energy input and Air/Fuel Valve position for the BMK models covered in this document.

3.4.1 Benchmark 750/1000 Air/Fuel Valve Position and Energy Input

TABLE 3-2a: BMK750/1000 Air/Fuel Valve Position – NATURAL GAS

AIR/FUEL VALVE POSITION (% OPEN)	ENERGY INPUT (BTU/HR)		BOILER ENERGY INPUT (% OF FULL CAPACITY)	
	BMK750	BMK1000	BMK750	BMK1000
10%	0	0	0	0
18% (Stop Level)	50,000 (14.7 kW)	50,000 (14.7 kW)	6.7%	5%
20%	52,000 (15.2 kW)	54,000 (15.8 kW)	6.9%	5.4%
30%	108,000 (31.7 kW)	140,000 (41.0 kW)	14%	14%
40%	246,000 (72.1 kW)	297,000 (87.0 kW)	33%	30%
50%	369,000 (108.1 kW)	443,000 (126.9 kW)	49%	44%
60%	465,000 (136.3 kW)	564,000 (165.3 kW)	62%	56%
70%	554,000 (162.4 kW)	660,000 (193.4 kW)	74%	66%
80%	637,000 (186.7 kW)	789,000 (231.2 kW)	85%	79%
90%	733,000 (214.8 kW)	933,000 (273.4 kW)	98%	93%
100%	750,000 (219.8 kW)	1,000,000 (293.1 kW)	100%	100%

TABLE 3-2b: BMK750/1000 Air/Fuel Valve Position – PROPANE GAS

Air/Fuel Valve Position (% Open)	Energy Input (BTU/Hr)		Boiler Energy Input (% of Full Capacity)	
	BMK750	BMK1000	BMK750	BMK1000
10%	0	0	0	0
18% (Stop Level)	50,000 (14.7 kW	50,000 (14.7 kW	6.7%	5.0%
20%	71,000 (20.8 kW)	71,000 (20.8 kW)	9.5%	7.1%
30%	128,000 (37.5 kW)	181,000 (53.0 kW)	17%	18%
40%	373,000 (109.3 kW)	400,000 (117.2 kW)	50%	40%
50%	508,000 (148.9 kW)	562,000 (164.7 kW)	68%	56%
60%	565,000 (165.6 kW)	703,000 (206.0 kW)	75%	70%
70%	621,000 (182.0 kW)	791,000 (231.8 kW)	83%	79%
80%	660,000 (193.4 kW)	865,000 (253.5 kW)	88%	87%
90%	723,000 (211.9 kW)	963,000 (282.2 kW)	96%	96%
100%	750,000 (219.8 kW)	1,000,000 (293.1 kW)	100%	100%

TABLE 3-2c: BMK750/1000 DUAL FUEL Air/Fuel Valve Position – NATURAL GAS				
Air/Fuel Valve Position (% Open)	Energy Input (BTU/Hr)		Boiler Energy Input (% of Full Capacity)	
	BMK750 Dual Fuel	BMK 1000 Dual Fuel	BMK750 Dual Fuel	BMK 1000 Dual Fuel
18% (Stop Level)	48,850 (14.3 Kw)	48,850 (14.3 Kw)	6.5%	4.9%
20%	62,000 (18.2 Kw)	62,000 (18.2 Kw)	8.3%	6.2%
30%	132,000 (38.7 Kw)	132,000 (38.7 Kw)	17.6%	13.2%
40%	239,000 (70.0 Kw)	239,000 (70.0 Kw)	31.9%	23.9%
50%	358,000 (104.9 Kw)	358,000 (104.9 Kw)	47.7%	35.8%
60%	488,300 (143.1 Kw)	488,300 (143.1 Kw)	65.1%	48.8%
70%	571,000 (167.3 Kw)	633,500 (185.7 Kw)	76.1%	63.4%
80%	633,500 (185.7 Kw)	756,000 (221.6 Kw)	84.5%	75.6%
90%	693,200 (203.2 Kw)	894,000 (262.0 Kw)	92.4%	89.4%
100%	750,000 (219.8 Kw)	1,000,000 (293.1 Kw)	100.0%	100.0%

TABLE 3-2d: BMK750/1000 DUAL FUEL Air/Fuel Valve Position – PROPANE GAS						
Air/Fuel Valve Position (% Open)	Energy Input (BTU/Hr)				Boiler Energy Input (% of Full Capacity)	
	BMK750 Dual Fuel		BMK 1000 Dual Fuel		BMK750 Dual Fuel	BMK 1000 Dual Fuel
18% (Stop Level)	53,000	(15.5 Kw)	53,000	(15.5 Kw)	7.1%	5.3%
20%	65,000	(19.0 Kw)	65,000	(19.0 Kw)	8.7%	6.5%
30%	125,000	(36.6 Kw)	125,000	(36.6 Kw)	16.7%	12.5%
40%	231,000	(67.7 Kw)	231,000	(67.7 Kw)	30.8%	23.1%
50%	336,400	(98.6 Kw)	336,400	(98.6 Kw)	44.9%	33.6%
60%	477,000	(139.8 Kw)	477,000	(139.8 Kw)	63.6%	47.7%
70%	545,000	(159.7 Kw)	608,500	(178.3 Kw)	72.7%	60.9%
80%	608,500	(178.3 Kw)	710,000	(208.1 Kw)	81.1%	71.0%
90%	643,000	(188.4 Kw)	888,300	(260.3 Kw)	85.7%	88.8%
100%	750,000	(219.8 Kw)	1,000,000	(293.1 Kw)	100.0%	100.0%

3.4.2 Benchmark 1500 Air/Fuel Valve Position and Energy Input

TABLE 3-3a: BMK1500 Air/Fuel Valve Position – NATURAL GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
16% (Stop Level)	75,000 (22.3 kW)	5.0%
20%	127,000 (37.2 kW)	8.5%
30%	366,000 (107.2 kW)	24.4%
40%	629,000 (184.3 kW)	41.9%
50%	822,000 (240.9 kW)	54.7%
60%	977,000 (286.2 kW)	65.0%
70%	1,119,000 (327.9 kW)	74.5%
80%	1,255,000 (367.7 kW)	83.5%
90%	1,396,000 (409.0 kW)	92.9%
100%	1,502,000 (440.1 kW)	100%

TABLE 3-3b: BMK1500 Air/Fuel Valve Position – PROPANE GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
18% (Stop Level)	75,000	5.0%
20%	93,700	6.2%
30%	254,000	16.9%
40%	505,000	33.7%
50%	680,000	45.3%
60%	807,000	53.8%
70%	947,000	63.1%
80%	1,157,000	77.1%
90%	1,379,000	91.9%
100%	1,503,000	100%

3.4.3 Benchmark 2000 Air/Fuel Valve Position and Energy Input

TABLE 3-4a: BMK2000 Air/Fuel Valve Position – NATURAL GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
18% (Stop Level)	100,000 (29.3 kW)	5.7%
20%	143,000 (41.9 kW)	11%
30%	388,000 (113.7 kW)	23%
40%	759,000 (222.4 kW)	37%
50%	1,069,000 (313.2 kW)	51%
60%	1,283,000 (375.9 kW)	61%
70%	1,476,000 (432.5 kW)	74%
80%	1,675,000 (490.1 kW)	83%
90%	1,833,000 (537.1 kW)	93%
100%	2,000,000 (586.0 kW)	100%

TABLE 3-4b: BMK2000 Air/Fuel Valve Position – PROPANE GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
18% (Stop Level)	100,000	5.0%
20%	126,600	6.3%
30%	363,000	18.2%
40%	677,000	33.9%
50%	898,000	44.9%
60%	1,070,000	53.5%
70%	1,242,000	62.1%
80%	1,523,000	76.2%
90%	1,845,000	92.3%
100%	2,000,000	100%

3.4.4 Benchmark 2500 Air/Fuel Valve Position and Energy Input

TABLE 3-5a: BMK2500 Air/Fuel Valve Position – NATURAL GAS, Single Fuel		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
16% (Stop Level)	167,000 (48.9 kW)	6.7%
30%	430,000 (126.0 kW)	17%
40%	770,000 (225.7 kW)	31%
50%	1,070,000 (313.6 kW)	43%
60%	1,440,000 (422.0 kW)	58%
70%	1,815,000 (531.9 kW)	73%
80%	2,030,000 (594.9 kW)	81%
90%	2,300,000 (674.1 kW)	92%
100%	2,500,000 (732.7 kW)	100%

TABLE 3-5b: BMK2500 Air/Fuel Valve Position – PROPANE GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
18% (Stop Level)	155,000	6.2%
30%	400,000	16%
40%	808,000	32%
50%	1,055,000	42%
60%	1,330,000	53%
70%	1,671,000	67%
80%	1,998,000	80%
90%	2,280,000	91%
100%	2,500,000	100%

3.4.5 Benchmark 3000 Air/Fuel Valve Position and Energy Input

TABLE 3-6a: BMK3000 Air/Fuel Valve Position – NATURAL GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR.)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
14% (Stop Level)	200,000 (58.6 kW)	6.7%
30%	520,000 (152 kW)	17%
40%	880,000 (258 kW)	29%
50%	1,270,000 (372 kW)	42%
60%	1,680,000 (492 kW)	56%
70%	2,100,000 (615 kW)	70%
80%	2,390,000 (700 kW)	80%
90%	2,650,000 (777 kW)	88%
100%	3,000,000 (879 kW)	100%

TABLE 3-6b: BMK3000 Air/Fuel Valve Position – PROPANE GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
18% (Stop Level)	200,000	6.7%
30%	520,000	17%
40%	920,000	31%
50%	1,270,000	42%
60%	1,570,000	52%
70%	1,960,000	65%
80%	2,330,000	78%
90%	2,700,000	90%
100%	3,000,000	100%

3.4.6 Benchmark 4000 Air/Fuel Valve Position and Energy Input

TABLE 3-7a: BMK4000 Air/Fuel Valve Position – NATURAL GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR.)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
23% (Stop Level)	228,180	5.7%
30%	456,900	11.4%
40%	822,800	20.6%
50%	1,205,000	30.1%
60%	1,684,000	42.1%
70%	2,388,000	59.7%
80%	3,107,000	77.7%%
90%	3,582,000	89.6%
100%	4,000,000	100%

TABLE 3-7b: BMK4000 Air/Fuel Valve Position – NATURAL GAS - DUAL FUEL		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR.)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
18% (Stop Level)	246,000	6.2%
20%	346,000	8.7%
30%	846,000	21%
40%	1,384,000	35%
50%	1,883,000	47%
60%	2,442,000	61%
70%	2,783,000	70%
80%	3,151,000	79%
90%	3,541,000	89%
100%	4,000,000	100%

TABLE 3-7c: BMK4000 Air/Fuel Valve Position – PROPANE		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR.)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
18% (Stop Level)	241,000	6.0%
20%	338,000	8.5%
30%	825,000	21%
40%	1,388,000	35%
50%	1,922,000	48%
60%	2,418,000	60%
70%	2,801,000	70%
80%	3,158,000	79%
90%	3,545,000	89%
100%	4,000,000	100%

3.4.7 Benchmark 5000N Air/Fuel Valve Position and Energy Input

TABLE 3-8a: BMK5000N Air/Fuel Valve Position – NATURAL GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR.)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
18% (Stop Level)	256,000	6.5%
30%	776,300	15.6%
40%	1,563,000	31.5%
50%	2,198,000	44.3%
60%	2,601,000	52.4%
70%	3,111,000	62.6%
80%	3,755,000	75.6%
90%	4,391,000	88.4%
100%	4,966,000	100.0%

TABLE 3-8b: BMK 5000N Dual Fuel Air/Fuel Valve Position – NATURAL GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR.)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
18% (Stop Level)	246,000	4.9%
20%	346,000	6.9%
30%	846,000	17%
40%	1,384,000	28%
50%	1,883,000	38%
60%	2,442,000	49%
70%	3,019,000	60%
80%	3,669,000	73%
90%	4,350,000	87%
100%	4,999,000	100%
TABLE 3-8c: BMK 5000N Air/Fuel Valve Position – PROPANE GAS		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR.)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
18% (Stop Level)	241,000	4.8%
20%	338,000	6.8%
30%	825,000	17%
40%	1,388,000	28%
50%	1,922,000	38%
60%	2,418,000	48%
70%	3,028,000	61%
80%	3,672,000	73%
90%	4,316,000	86%
100%	4,999,000	100%

Table 3-8c applies to the BMK5000N Propane only model and the Dual Fuel-Propane model.

3.4.8 Benchmark 5000 Air/Fuel Valve Position and Energy Input

TABLE 3-9a: BMK5000 Air/Fuel Valve Position and Energy Input		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR.)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
10%	0	0%
18% (Stop Level)	400,000 (117 kW)	8%
30%	997,217 (292 kW)	20%
40%	1,667,848 (489 kW)	33%
50%	1,992,380 (584 kW)	40%
60%	2,486,881 (729 kW)	50%
70%	2,981,381 (874 kW)	60%
80%	3,780,230 (1108 kW)	76%
90%	4,375,500 (1282 kW)	88%
100%	5,000,000 (1465 kW)	100%

TABLE 3-9b: BMK5000 Gas Pressure De-Rating Chart
Applies to all models except Low Gas Pressure (LGP) models

Gas Pressure @ SSOV in inches W.C. (kPa)		Energy Input in BTU/hr	Oxygen (%O_2)	De-rating (% Full Fire)
Inlet	**Outlet**			
56” (13.9 kPa)	6.8” (1.70 kPa)	5,000,000 (1465 kW)	5.7	0%
14” (3.49 kPa)	6.8” (1.70 kPa)	5,000,000 (1465 kW)	5.7	0%
10” (3.23 kPa)	6.8” (1.70 kPa)	5,000,000 (1465 kW)	5.7	0%

3.4.9 Benchmark 6000 Air/Fuel Valve Position and Energy Input

TABLE 3-10a: BMK6000 Air/Fuel Valve Position and Energy Input		
AIR/FUEL VALVE POSITION (% OPEN)	**ENERGY INPUT (BTU/HR.)**	**BOILER ENERGY INPUT (% OF FULL CAPACITY)**
10%	0	0%
18% (Stop Level)	385,000 (113 kW)	6%
20%	400,000 (117 kW)	7%
30%	540,000 (158 kW)	9%
40%	770,000 (226 kW)	13%
50%	1,160,000 (340 kW)	19%
60%	1,650,000 (484 kW)	28%
70%	2,386,000 (699 kW)	40%
80%	3,515,000 (1030 kW)	59%
90%	4,650,000 (1362 kW)	78%

TABLE 3-10b: BMK6000 Gas Pressure De-Rating Chart Applies to all models except Low Gas Pressure (LGP) models				
Gas Pressure @ SSOV in inches W.C. (kPa)		**Energy Input in BTU/hr**	**Oxygen (%O_2)**	**De-rating (% Full Fire)**
Inlet	**Outlet**			
56” (13.9 kPa)	8” (1.99 kPa)	6,000,000 (1758 kW)	5.40	0%
14” (3.49 kPa)	8” (1.99 kPa)	6,000,000 (1758 kW)	5.40	0%
13” (3.23 kPa)	8” (1.99 kPa)	5,860,000 (1717 kW)	5.45	2%

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SECTION 4. INITIAL START-UP

4.1 INITIAL START-UP REQUIREMENTS

The following are the prerequisites for the initial start-up of the Benchmark boiler:

- Complete the installation per the *Benchmark 750-6000 with Edge [i]: Install-Startup Manual* (OMM-0144, GF-217), including gas supply piping, vent installation and condensate drain piping. Starting a unit without the proper piping, venting, or electrical systems can be dangerous and may void the product warranty.
- Set proper controls and limits (see Section 4: *Advanced Setup* in the *Edge [i] Controller Manual*, OMM-0141, GF-213-B).

Initial start-up consists of the following:

- Removing the protective bag from the air filter(s)
- Combustion calibration (Section 4.4: *Combustion Calibration*)
- Test safety devices (Section 5: *Safety Device Testing*)

Start-up must be successfully completed before putting the unit into service. The start-up instructions below should be followed precisely in order to operate the unit safely and at high thermal efficiency and low flue gas emissions.

Initial unit start-up ***must be*** performed by AERCO factory trained personnel, who are trained in the start-up and service of Benchmark boilers.

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***.

WARNINGS!

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 and/or property damage. This situation will void any warranty.

REMOVE THE AIR FILTER BAG BEFORE STARTING THE UNIT.

NOTE:

AERCO recommends that the **Standby Blower Voltage** parameter be kept at 2.00 volts (the default set at the factory) to prevent flue gas recirculation.

To check, go to the Controller's **Main Menu → Advanced Setup → Performance → Fire Control → Operating Control** and verify that the **Standby Blower Voltage** parameter is set to **2.00 V**.

However, individually vented units in positive pressure boiler rooms may set **Standby Blower Voltage** between **2.00** and **0** volts to compensate.

4.2 TOOLS & INSTRUMENTS 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:

- Digital Combustion Analyzer: Oxygen accuracy to ± 0.4%; Carbon Monoxide (CO) and Nitrogen Oxide (NOx) resolution to 1 PPM
- 0 to 16 inch W.C. (0 to 4.0 kPa) manometer or equivalent gauge and plastic tubing
- 1/4 inch NPT-to-barbed fittings for use with gas supply manometer
- Small and large flat blade screwdrivers
- Tube of silicone adhesive

4.2.2 Installing Gas Supply Manometer

A 16” W.C. (4.0 kPa) gas supply manometer (or gauge) is used in the following ways:

- Mounted on the ***upstream*** side of the SSOV to verify that the gas supply pressure is within the required range of 4” W.C. and 14” W.C.
- Mounted on the ***downstream*** side of the SSOV to monitor the gas pressure during the Combustion Calibration procedure, described in Sections 4.4.1 (Natural Gas) and 4.4.2 (Propane).

Figures 4-1a through 4-1e show where the gas supply manometer is installed on both the upstream and downstream locations.

Gas Supply Manometer Installation Instructions BMK750 – 5000N

1. Turn off the main gas supply upstream of the unit.
2. Remove the top panel and/or front panel from the boiler to access the gas train.
3. Remove the 1/4” NPT plug from the leak detection ball valve on the upstream or downstream side of the SSOV, as needed during testing, as shown in Figure 4-1a – 4-1d, below.
4. Install an 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. (4.0 kPa) manometer.

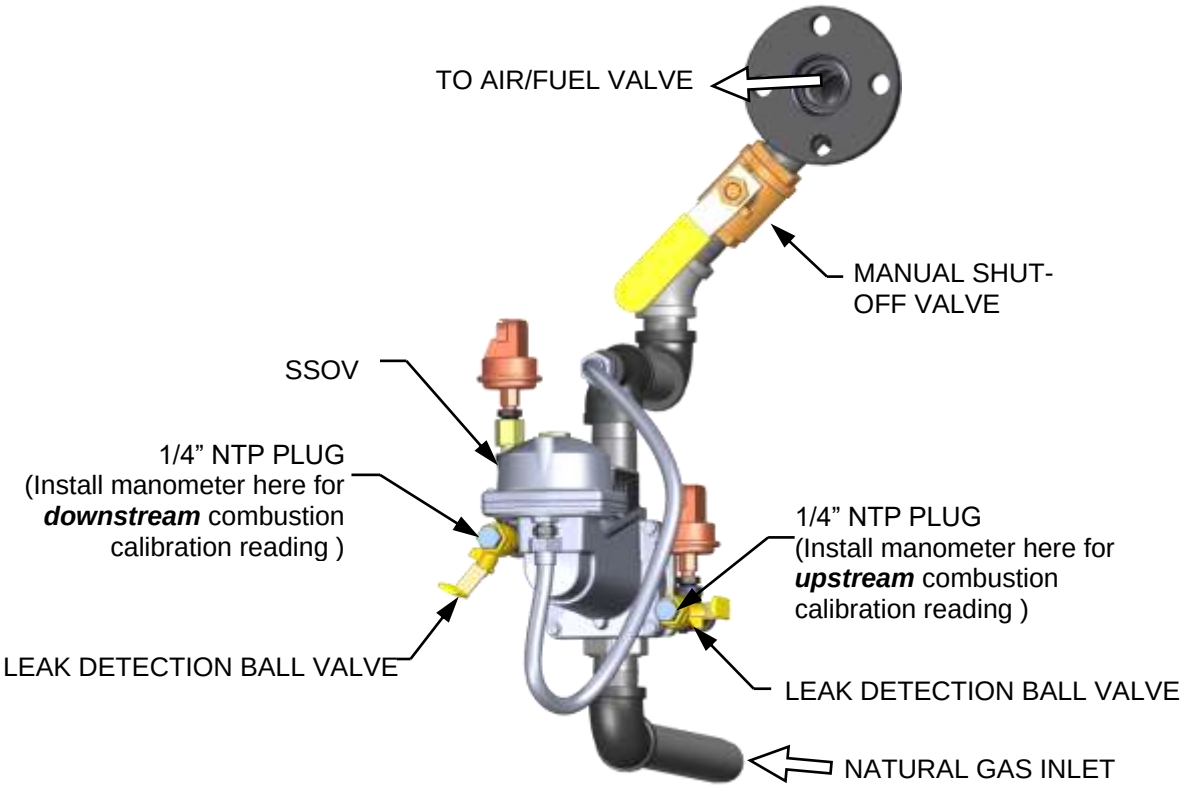

Figure 4-1a: 1/4 Inch Gas Plug Location – BMK750 & 1000 (P/N 22322 shown)

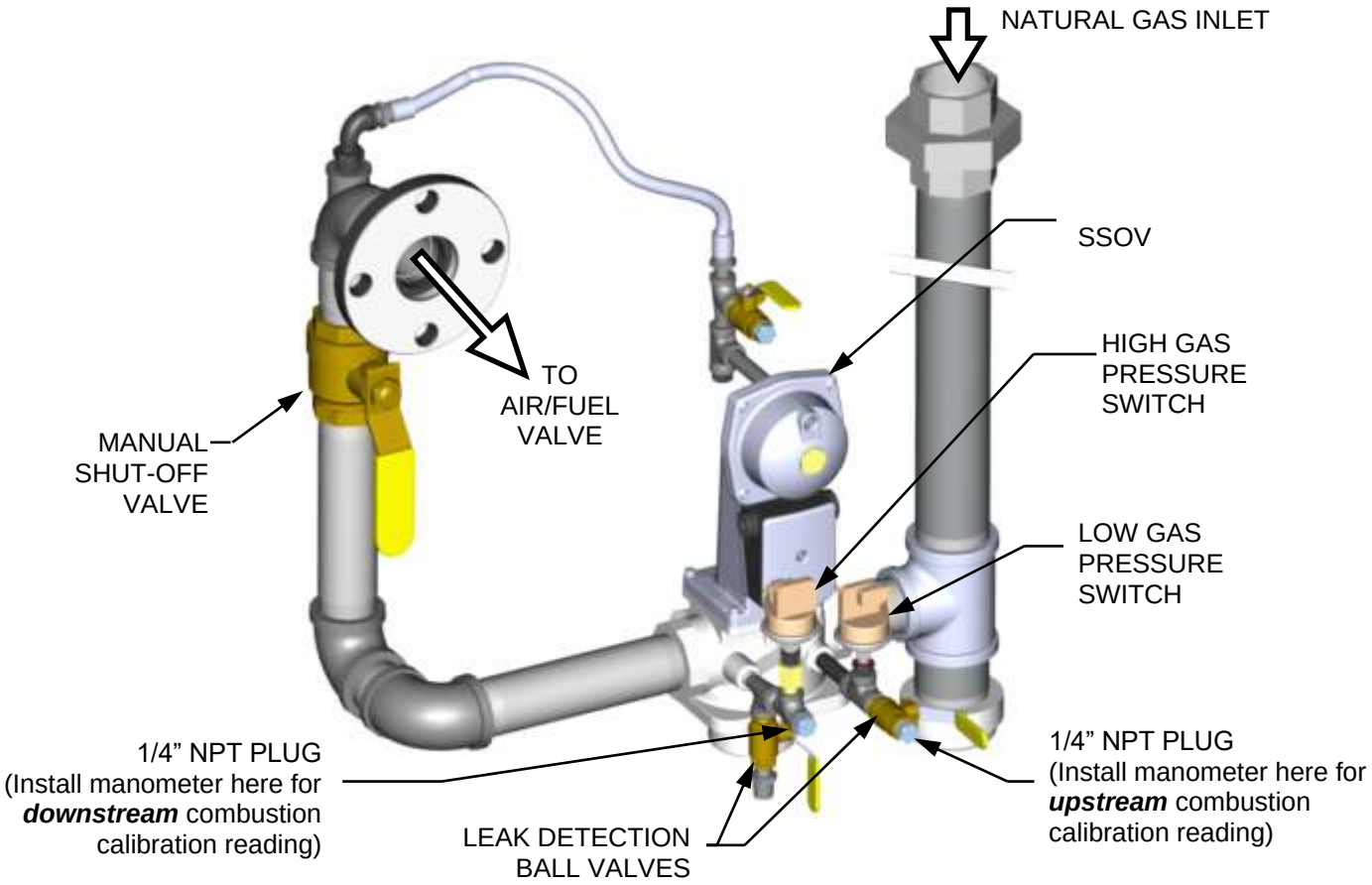

Figure 4-1b: 1/4 Inch Gas Plug Location – BMK1500 & 2000 (P/N 22314 shown)

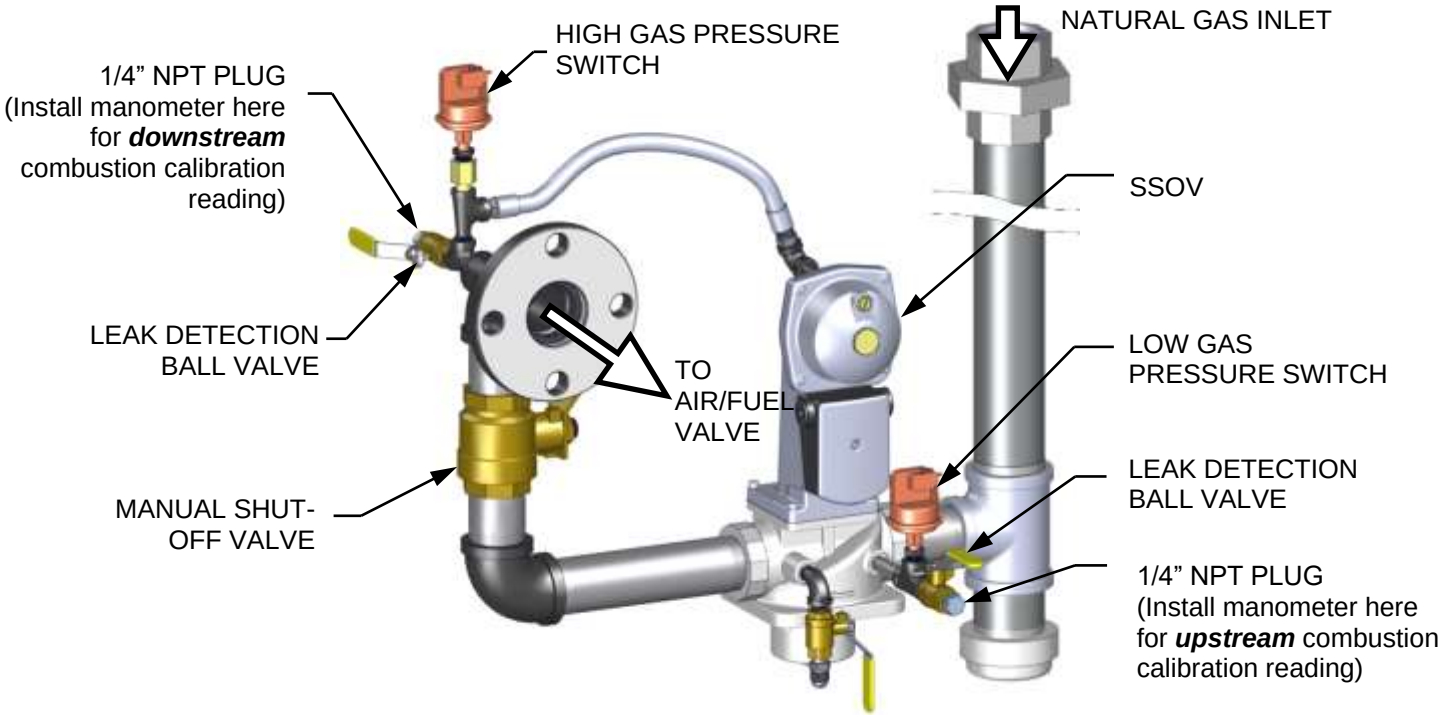

Figure 4-1c: BMK2500 1/4 Inch Gas Plug Location – BMK2500 (P/N 22318 shown)

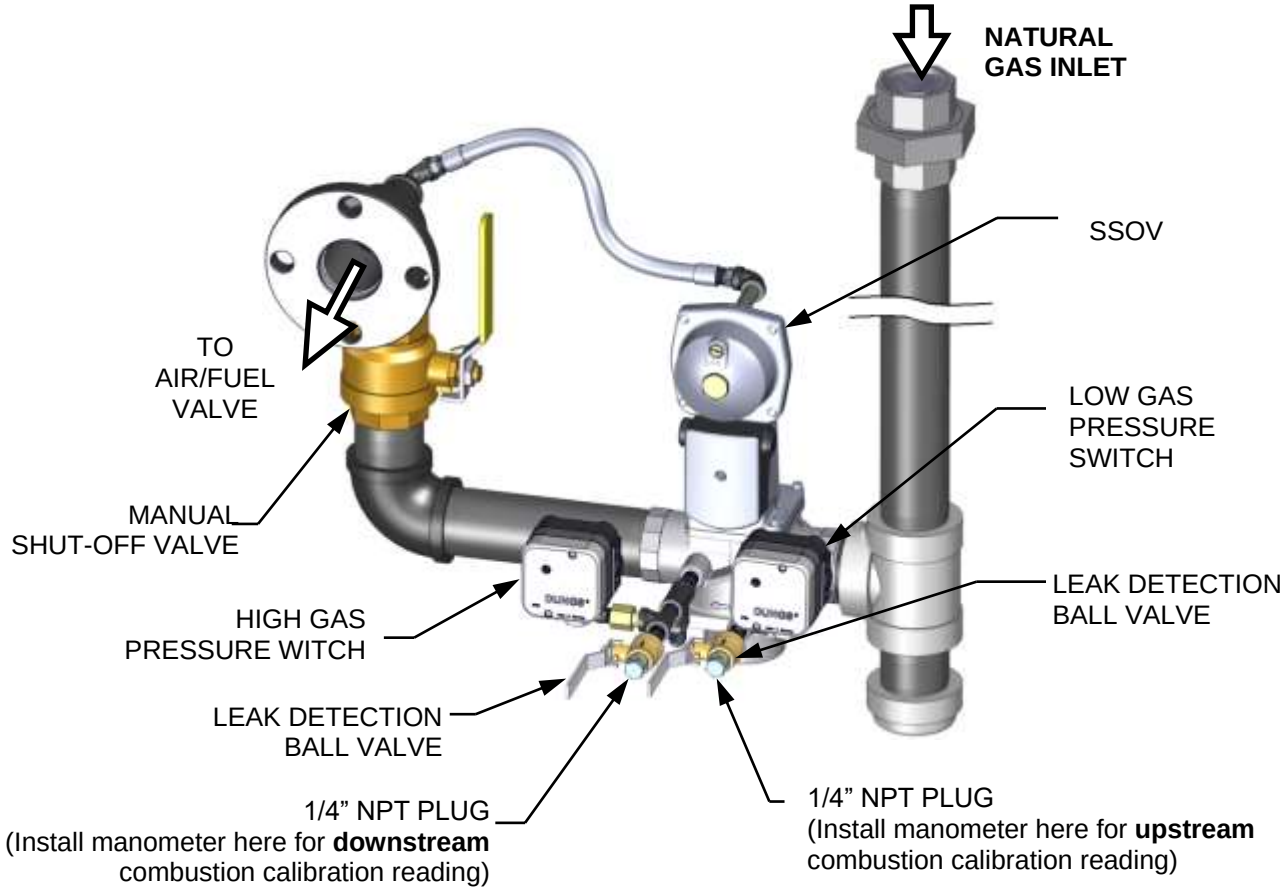

Figure 4-1d: 1/4 Inch Gas Plug Location – BMK3000 (P/N 22310 shown)

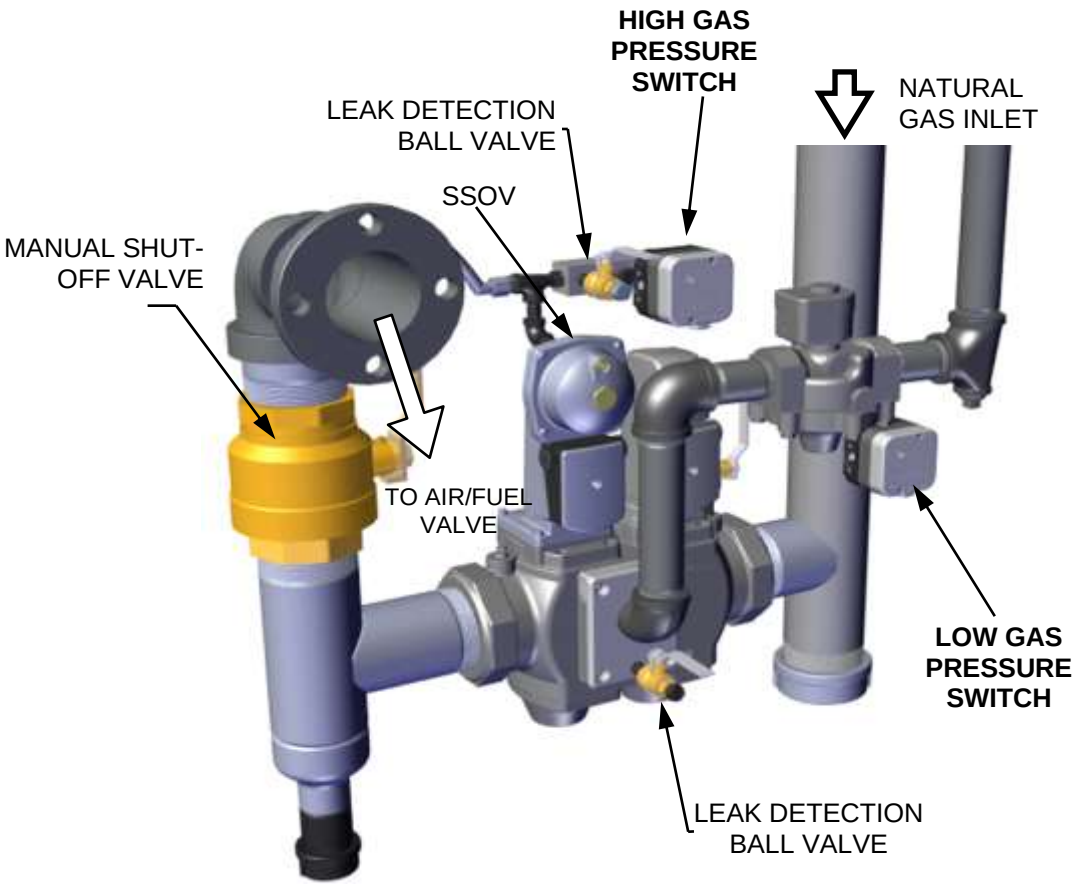

Figure 4-1e: Port Location for Combustion Calibration – BMK4000

Gas Supply Manometer Installation Instructions BMK5000 - 6000

1. Turn off the main gas supply upstream of the unit.
2. Remove the front panel from the boiler to access the gas train.
3. Connect the manometer directly to the Low and High Gas Pressure Switches, as shown in Figure 4-1f.

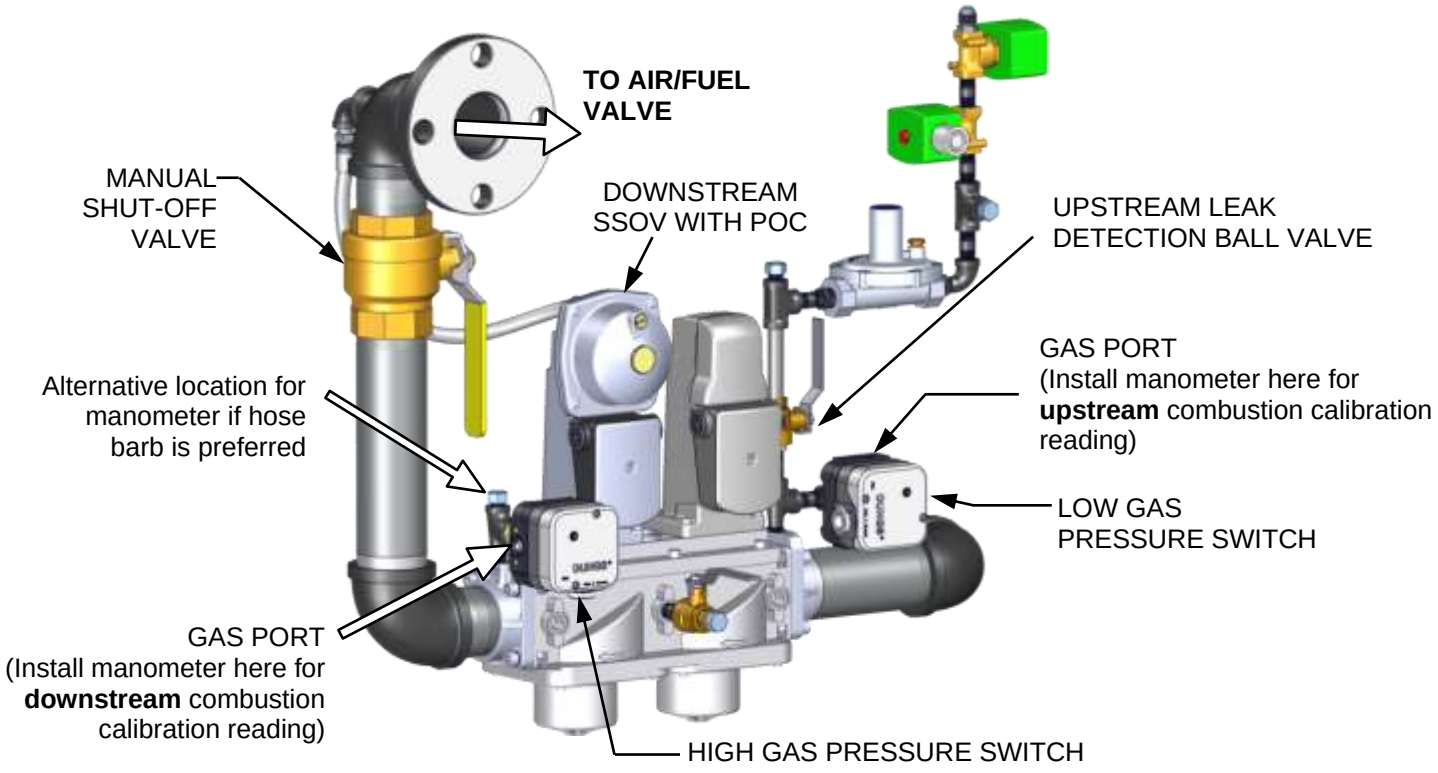

Figure 4-1f: Port Location for Combustion Calibration – BMK5000-6000

4.2.3 Accessing the Analyzer Probe Port

Benchmark units contain 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:

Analyzer Probe Port Access Instructions

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.**

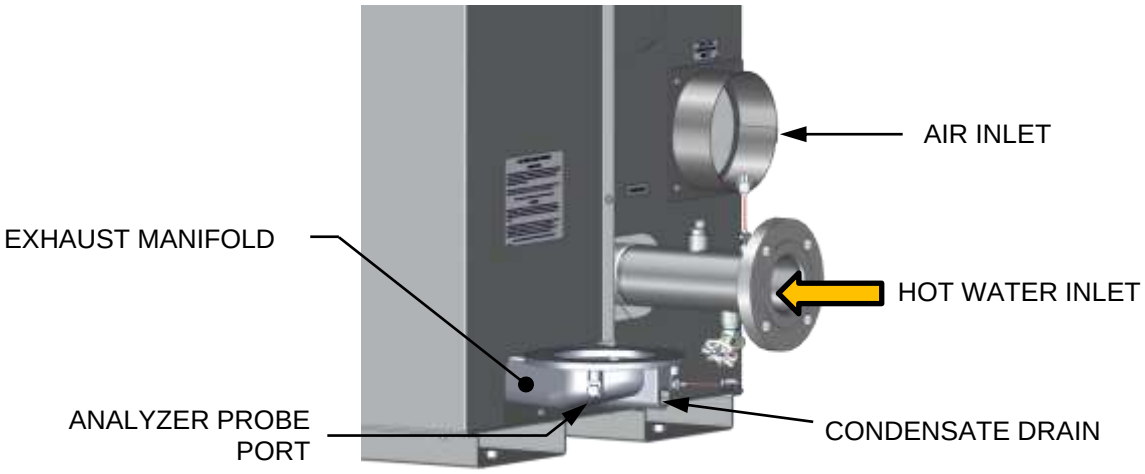

Figure 4-2: Analyzer Probe Port Location – BMK750 & 1000 Shown

4.3 BENCHMARK 5000 & 6000 PILOT FLAME IGNITION

Benchmark 5000 and 6000 boilers are equipped with an interrupted pilot ignition system. The pilot is ignited by a spark discharge within the Pilot Burner inside the combustion chamber. The input. of the Pilot flame is approximately **18,000 BTU/hr. (5.3 kW)**. The Pilot Burner flame will stay ignited until the main Burner flame has stabilized and **FLAME PROVEN** appears on the Controller's display.

The Pilot gas supply regulator ***reduces*** the supply pressure as follows:

- On standard pressure models, it reduces line pressure to **4.9" W.C. (1.2 kPa)**.
- On Low Gas Pressure models, it reduces line pressure to **2.0" W.C. (0.5 kPa)**.

The Pilot Burner should be inspected at the beginning of each heating season, or every 6 months of continuous operation. It is constructed of high quality, heat resistant stainless steel, however some darkening of the metal is expected. No adjustment of the Pilot should be required, however the gas pressure downstream of the regulator should be checked if an ignition issue is encountered. Refer to Figure 4-1 for test port location.

The Pilot Burner flame is proven by two Pilot Flame Detectors, located above and below the Pilot Burner. These are optical sensors inserted into tubes with quartz windows; they observe the Pilot through holes in the refractory insulation. They have a red LED which changes from flashing to steady-ON when they encounter the flicker of a flame that meets or exceeds the internal sensing threshold. (Only one of the two detectors need to sense the pilot flame throughout the ignition period). The holes in the refractory should be checked annually to ensure that the path to the Injector-Ignitor is clear.

NOTE:
The pilot flame detectors switch the signal to neutral when the flame is proven.

4.4 FUEL TYPES AND COMBUSTION CALIBRATION

All BMK models are preconfigured at the factory to use either natural gas or propane gas, and BMK models 1500 to 6000 are available in dual fuel versions (natural gas and propane).

Both fuel types require different combustion calibration values, and so care must be taken to ensure to follow the instructions for the fuel being used.

- **Natural Gas** combustion calibration: Section 4.4.1
- **Propane** combustion calibration: Section 4.4.2

Instructions for switching between fuel types in dual fuel models are presented in Section 4.6.

4.5 COMBUSTION CALIBRATION

The Benchmark boiler is combustion calibrated for Standard NOx emissions (<20 ppm). For jurisdictions that require Ultra-Low NOx operation (<9 ppm), see Table 4-2 for details. The gas pressure must be within the ranges shown in Table 4-2 for each model of boiler **at full fire**.

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 COMBUSTION CALIBRATION PROCEDURE BELOW TO PROVIDE OPTIMUM PERFORMANCE AND KEEP READJUSTMENTS TO A MINIMUM.

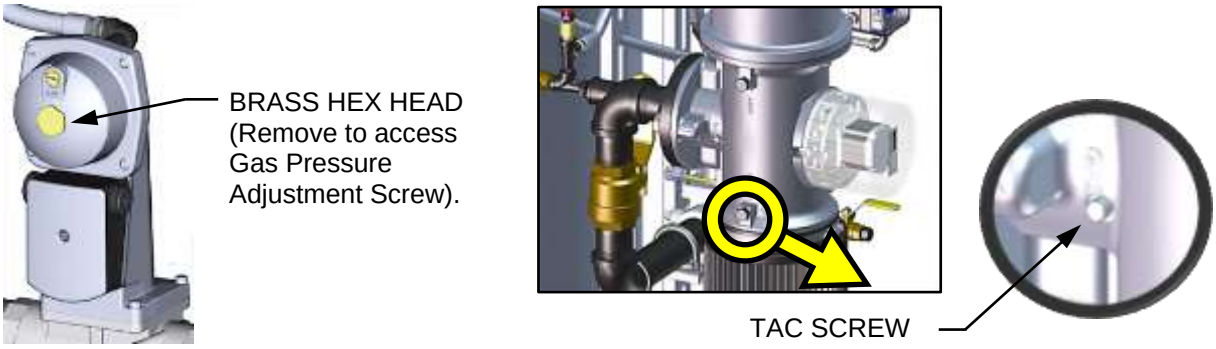

Figure 4-3: Gas Pressure Adjustment Screw and TAC Screw Location

WARNING:

Combustion calibration and AERtrim can both alter the voltage sent to the blower, and can thus interfere with each other. If AERtrim is enabled, and a change is made to any calibration point during combustion calibration, you must make a corresponding change to the same calibration point in AERtrim (see Section 9.4: *AERtrim O_2 Sensor Auto Calibration*). If you fail to make the change in AERtrim, AERtrim may ignore the combustion calibration value and adjust the O_2 to the AERtrim value instead.

4.5.1 NATURAL GAS Manual Combustion Calibration

These instructions apply only to units running **NATURAL GAS**.

NATURAL GAS Manual Combustion Calibration Instructions

1. Ensure the Edge [i] Controller's Enable/Disable switch is set to **Disable**.
2. Open the water supply and return valves to the unit and ensure that the system pumps are running.
3. Open the **NATURAL GAS** supply valve to the unit.
4. Turn external AC power to the unit **ON**.
5. On the Controller, go to: **Main Menu → Calibration → Manual Combustion**. If necessary, enter a technician level password.
6. The first **Manual Combustion Calibration** screen appears lists the three steps that must be completed before continuing.

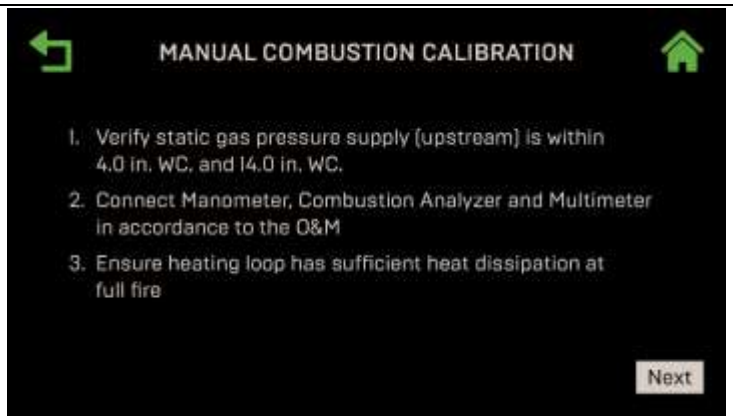

Figure 4-4: First Manual Combustion Calibration Screen

7. Connect the gas pressure manometer to the ***upstream*** side of the gas train's SSOV (see Section 4.2.2) and connect the Combustion Analyzer and Multimeter (per Section 4.2.3) and ensure that the heating loop is capable of dissipating sufficient heat at full fire.
8. Verify that the incoming (upstream) gas pressure to the unit is within the allowable range (see the *Benchmark Gas Supply Design Guide* (TAG-0047, GF-2030).
9. Once you have completed the previous step, move the manometer (or use a secondary one) to the ***downstream*** side of the SSOV and press **Next** to continue.
10. Choose the NOx requirement for this installation: **None**, **<= 20 PPM** or **<=9 PPM**.

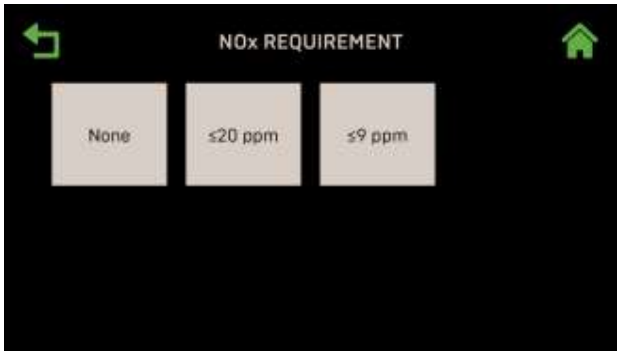

Figure 4-5: Choose NOx Requirement

11. The main **Manual Combustion Calibration** screen appears. It provides two methods to ramp the unit's valve position up or down:
    - **Method 1**: Toggle through the pre-set calibration points till you reach the desired valve position, then press **Go** to go to that point (left image below).
    - **Method 2**: Enable **Fine VP Step**, then manually press the **+** or **–** buttons once per 1% to bring the unit to the desired valve position (right image below).

NATURAL GAS Manual Combustion Calibration Instructions

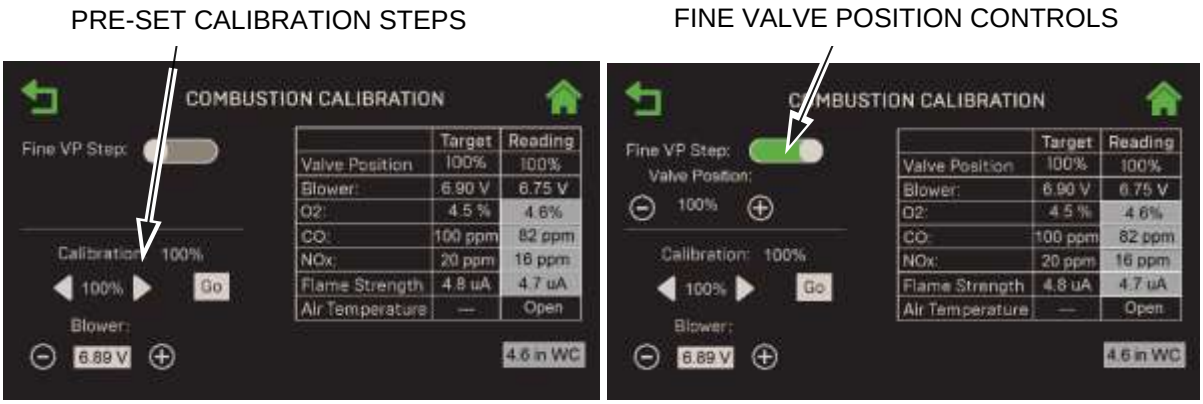

Figure 4-6: Manual Combustion Calibration Screens

12. Set the Controller's Enable/Disable switch to **Enable**.
13. Change the valve position to 30%, press the **Go** button, then verify that the unit has ignited and is operating as expected.
14. Use the ▶ (Right) arrow key to change the valve position to **100%**, then press **Go**.
15. Verify that the manifold gas pressure on the ***downstream*** side of the SSOV is within the range shown in Table 4-1. If it isn't, remove the brass hex nut on the SSOV actuator to access the gas pressure adjustment screw (Figure 4-3). Make adjustments using a flat-tip screwdriver, slowly rotating the gas pressure adjustment (in 1/4-turn increments) ***clockwise*** to ***increase*** gas pressure or ***counterclockwise*** to ***reduce*** it. The resulting gas pressure reading on the ***downstream*** manometer should fall in the range listed below.

TABLE 4-1: REFERENCE Natural Gas Manifold Gas Pressure Range @ 100% Fire Rate

Model	Single Fuel	Dual Fuel *
BMK750	2.0" ± 0.2" W.C. (0.50 ± 0.05 kPa)	See NOTE 1
BMK1000	2.4" ± 0.4" W.C. (0.60 ± 0.10 kPa)	4.9" +/-0.2" W.C. (1.22 ± 0.02 kPa)
BMK1500	3.6" ± 0.1" W.C. (0.90 ± 0.02 kPa)	3.6" ± 0.1" W.C. (0.90 ± 0.02 kPa)
BMK2000	3.4" ± 0.2" W.C. (0.85 ± 0.05 kPa)	6.3" ± 0.1" W.C. (1.57 ± 0.02 kPa)
BMK2500	2.0" ± 0.1" W.C. (0.50 ± 0.02 kPa)	5.8" ± 0.1" W.C. (1.44 ± 0.02 kPa)
BMK3000	2.1" ± 0.2" W.C. (0.52 ± 0.05 kPa)	6.0" ± 0.2" W.C. (1.49 ± 0.05 kPa)
BMK4000	3.0" ± 0.2" W.C. (0.75 ± 0.05 kPa)	4.9" ± 0.2" W.C. (1.22 ± 0.05 kPa
BMK5000N	1.8" ± 0.2" W.C. (0.45 ± 0.05 kPa)	4.9" ± 0.2" W.C. (1.22 ± 0.05 kPa
BMK5000	6.3" ± 0.2" W.C. (1.56 ± 0.05 kPa)	6.3" ± 0.2" W.C. (1.56 ± 0.05 kPa)
BMK5000 (Low Gas Pressure)	2.6" ± 0.1" W.C. (0.65 ± 0.02 kPa)	-
BMK6000	7.9" ± 0.2" W.C. (1.97 ± 0.05 kPa)	7.9" ± 0.2" W.C. (1.97 ± 0.05 kPa)
BMK6000 (Low Gas Pressure)	1.9" ± 0.2" W.C. (0.50 ± 0.05 kPa)	-

* This column lists natural gas pressures on dual fuel units. For propane values, see Section 4.5.2.

NOTE 1: For BMK750 Dual Fuel, measure Natural Gas Manifold Pressure at 80% Fire Rate. Range shall be 5.0" +/- 0.2" W.C. (1.24 +/- 0.2 kPa)

NATURAL GAS Manual Combustion Calibration Instructions

16. With the valve position still at 100%, insert the combustion analyzer probe into the exhaust manifold probe opening (see Figure 4-2a – 4-2c in Section 4.2.3) and allow enough time for the combustion analyzer reading to stabilize.
17. Compare the combustion analyzer's oxygen (O_2) reading to the **O_2** value in the **Reading** column (Figure 4-6). If they differ, go to the **Main Menu → Calibration → Input/Output → Oxygen Sensor** screen and adjust the **O2 Offset** parameter, up to **±3%**, to make the on-board O_2 sensor match the value from the combustion analyzer. If your combustion analyzer is correctly calibrated, and the on-board O_2 sensor cannot be made to match the analyzer, the sensor may be defective and need to be replaced.
18. Compare the **O_2** value in the **Target** and **Reading** columns. If they don't match, adjust the **Blower Voltage** until the **O_2** value in both columns match; use either the **+** or **–** controls, or press on the field and type the value directly.
19. If adjusting the blower voltage is not sufficient to get the **O_2 Reading** column to match the **Target** column, then repeat Step 15 to adjust the gas pressure up or down within the range shown in the table, then repeat Step 18. Continue repeating Steps 15 and 18 until the gas pressure is within the range in Table 4-1 and the **O_2 Reading** column to matches the **Target** column.
20. Enter the downstream manometer's gas pressure reading in the **Downstream Gas Pressure** field. Note, this field appears only when **Valve Position %** = **100%**.
21. Compare the measured nitrogen oxide (NOx) and carbon monoxide (CO) readings to the **Target** values in Table 4-2 (shown as a reference only). If you chose the NOx <=9 ppm in step 9, use the values in the **Ultra-Low NOx** columns. If you are not in a "NOx-limited" area and/or do not have a NOx measurement in your analyzer, set the O_2 to the value in the **Standard NOx** column in the table below.

TABLE 4-2: NATURAL GAS Calibration Target Values @ 100% Valve Position

Model	Standard NOx		Ultra-Low NOx		CO
	O_2 %	NOx	O_2 %	NOx	
750	5.5% ± 0.2%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<100 ppm
1000	5.5% ± 0.2%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<100 ppm
1500	5.2% ± 0.2%	≤20 ppm	5.7% ± 1.0%	≤9 ppm	<100 ppm
2000	6.0% ± 0.2%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<100 ppm
2500	5.6% ± 0.2%	≤20 ppm	-	-	<100 ppm
3000	5.1% ± 0.2%	≤20 ppm	-	-	<100 ppm
3000 DF	5.3% ± 0.2%	≤20 ppm	-	-	<100 ppm
4000/5000N *	5.5% ± 0.2%	≤20 ppm	6.0% ± 0.2%	≤9 ppm	<100 ppm
5000/6000	5.5% ± 0.5%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<100 ppm

* The 4000, 4000DF, 5000N and 5000NDF can operate at 4.5% O_2 at full fire in jurisdictions that do not have NOx restrictions.

NOTE:
These instructions assume that the **inlet air temperature is between 50°F and 100°F (10°C – 37.8°C)**. If NOx readings exceed the target values in Table 4-1, above, or Table 4-3, below, increase the O_2 level up to 1% higher than the Target value. You must then record the increased O_2 value on the Combustion Calibration sheet.

NATURAL GAS Manual Combustion Calibration Instructions

22. On Benchmark 3000 - 6000 units *only*, record the manifold (downstream) gas pressure at 100%. This value will be used in Section 5.2.2: *Low Pressure Gas Test*, and Section 5.3.2: *High Pressure Gas Test*.

23. Once the O_2 level is within the specified range at 100%:
    - Enter the **Flame Strength**, **NOx** and **CO** readings from the Combustion Analyzer and multi-meter in the Manual Combustion Calibration screen's **Reading** column.
    - Enter the same values, plus the **O_2** value, on the Combustion Calibration Data Sheet provided with the unit.

24. Lower the Valve Position to the next calibration point using the ◄ (Left) arrow key (if using Method 1 in step 11) or the Fine Valve Position **–** (Minus) key (if using Method 2).
    - BMK750 & 1000: **80%**
    - BMK1500 – 6000: **70%**

25. Repeat step 17, 18 and 21 at that valve position and the rest of the valve positions in Table below corresponding to your model. The O_2, NOx and CO should stay within the ranges shown in these tables.

TABLE 4-3a: NATURAL GAS BMK Final Valve Positions: BMK750/1000

Valve Position		Standard NOx		Ultra-Low NOx		CO
Single Fuel	Dual Fuel	O_2 %	NOx	O_2 %	NOx	
80%	70%	5.5% ± 0.2%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<100 ppm
60%	50%	5.5% ± 0.2%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<100 ppm
45%	40%	5.5% ± 0.2%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<50 ppm
30%	30%	5.5% ± 0.2%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<50 ppm
18%	18%	5.5% ± 0.2%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<50 ppm

TABLE 4-3b: NATURAL GAS Final Valve Positions: BMK1500/2000

Valve Position		Standard NOx		Ultra-Low NOx		CO
1500	2000	O_2 %	NOx	O_2 %	NOx	
70%		6.0% ± 0.2%	≤20 ppm	5.5% ± 1.0%	≤9 ppm	<100 ppm
50%		6.3% ± 0.2%	≤20 ppm	5.8% ± 1.0%	≤9 ppm	<100 ppm
40%		7.0% ± 0.2%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<50 ppm
30%		7.0% ± 0.2%	≤20 ppm	6.0% ± 1.0%	≤9 ppm	<50 ppm
16%	18%	7.0% ± 0.2%	≤20 ppm	8.0% ± 1.0%	≤9 ppm	<50 ppm

NATURAL GAS Manual Combustion Calibration Instructions

TABLE 4-3c: NATURAL GAS Final Valve Positions: BMK1500/2000 Duel Fuel

Valve %	BMK1500 DF	BMK2000 DF	NOx	CO
	O_2 %			
70%	6.0% ± 0.2%	6.5% ± 0.2%	≤20 ppm	<100 ppm
50%	6.3% ± 0.2%	6.5% ± 0.2%	≤20 ppm	<100 ppm
40%	7.0% ± 0.2%	6.5% ± 0.2%	≤20 ppm	<50 ppm
30%	7.0% ± 0.2%	6.5% ± 0.2%	≤20 ppm	<50 ppm
16%	8.0% ± 0.2%	5.5% ± 0.2%	≤20 ppm	<50 ppm

TABLE 4-3d: NATURAL GAS Final Valve Positions: BMK2500/3000

BMK2500 Single and Duel Fuel					
Single Fuel		Dual Fuel		NOx	CO
Valve %	O_2 %	Valve %	O_2 %		
70%	5.9% ± 0.2%	70%	5.9% ± 0.2%	≤20 ppm	<100 ppm
50%	6.0% ± 0.2%	45%	6.2% ± 0.2%	≤20 ppm	<100 ppm
40%	6.3% ± 0.2%	30%	6.0% ± 0.2%	≤20 ppm	<50 ppm
30%	6.3% ± 0.2%	20%	5.8% ± 0.2%	≤20 ppm	<50 ppm
16%	6.0% ± 0.2%	16%	6.0% ± 0.2%	≤20 ppm	<50 ppm
BMK3000 Single and Duel Fuel					
70%	5.1% ± 0.2%	85%	5.4% ± 0.2%	≤20 ppm	<100 ppm
50%	6.1% ± 0.2%	65%	5.5% ± 0.2%	≤20 ppm	<100 ppm
40%	5.0% ± 0.2%	45%	5.7% ± 0.2%	≤20 ppm	<50 ppm
30%	6.4% ± 0.2%	30%	5.6% ± 0.2%	≤20 ppm	<50 ppm
14%	6.4% ± 0.2%	14%	6.2% ± 0.2%	≤20 ppm	<50 ppm

TABLE 4-3e: NATURAL GAS Final Valve Positions: BMK4000

Valve Position	Standard NOx		Ultra-Low NOx		CO
Single Fuel	O_2 %	NOx	O_2 %	NOx	
70%	5.5% ± 0.2%	≤20 ppm	6.0% ± 0.2%	≤9 ppm	<100 ppm
50%	5.5% ± 0.2%	≤20 ppm	6.0% ± 0.2%	≤9 ppm	<100 ppm
40%	5.5% ± 0.2%	≤20 ppm	6.0% ± 0.2%	≤9 ppm	<50 ppm
30%	5.5% ± 0.2%	≤20 ppm	6.0% ± 0.2%	≤9 ppm	<50 ppm
23%	6.0% ± 0.2%	≤20 ppm	6.5% ± 0.2%	≤9 ppm	<50 ppm

TABLE 4-3f: NATURAL GAS Final Valve Positions: 5000N

Valve Position	Standard NO_x		Ultra-Low NO_x		CO
	O_2 %	NO_x	O_2 %	NO_x	
70%	5.5% ± 0.2%	≤20 ppm	7.5% ± 0.2%	≤9 ppm	<100 ppm
50%	5.5% ± 0.2%	≤20 ppm	7.5% ± 0.2%	≤9 ppm	<100 ppm
40%	5.5% ± 0.2%	≤20 ppm	7.5% ± 0.2%	≤9 ppm	<50 ppm
30%	5.5% ± 0.2%	≤20 ppm	7.5% ± 0.2%	≤9 ppm	<50 ppm
18%	6.0% ± 0.2%	≤20 ppm	7.5% ± 0.2%	≤9 ppm	<50 ppm

NATURAL GAS Manual Combustion Calibration Instructions

TABLE 4-3g: NATURAL GAS Final Valve Positions: BMK4000/5000N Dual Fuel

Valve Position	Standard NO_x		Ultra-Low NO_x		CO
	O_2 %	NO_x	O_2 %	NO_x	
70%	5.5% ± 0.2%	≤20 ppm	6.0% ± 0.2%	≤9 ppm	<100 ppm
50%	5.5% ± 0.2%	≤20 ppm	6.5% ± 0.2%	≤9 ppm	<100 ppm
40%	5.5% ± 0.2%	≤20 ppm	6.5% ± 0.2%	≤9 ppm	<50 ppm
30%	5.5% ± 0.2%	≤20 ppm	6.5% ± 0.2%	≤9 ppm	<50 ppm
18%	5.5% ± 0.2%	≤20 ppm	5.5% ± 0.2%	≤9 ppm	<50 ppm

TABLE 4-3h: NATURAL GAS Final Valve Positions: BMK5000, Single & DF

Valve Position		Standard NOx		Ultra-Low NOx		CO
Single Fuel	Dual Fuel	O_2 %	NOx	O_2 %	NOx	
70%		5.5% ± 0.5%	<20 ppm	6.0% ± 1.0%	≤9 ppm	<100 ppm
50%		5.5% ± 0.5%	<20 ppm	6.0% ± 1.0%	≤9 ppm	<100 ppm
40%		5.5% ± 0.5%	<20 ppm	6.0% ± 1.0%	≤9 ppm	<50 ppm
30%		5.5% ± 0.5%	<20 ppm	6.0% ± 1.0%	≤9 ppm	<50 ppm
18%		6.0% ± 1. 0%	<20 ppm	6.5% ± 1.5%	≤9 ppm	<50 ppm

NOTE: BMK5000 Low Gas Pressure (LGP) Model does not offer Ultra Low NOx settings.

TABLE 4-3i: NATURAL GAS Final Valve Positions: BMK6000, Single & DF

Valve Position		Standard NOx		Ultra-Low NO_x		CO
Single Fuel	Dual Fuel	O_2 %	NOx	O_2 %	NOx	
70%	85%	5.5% ± 0.5%	<20 ppm	6.0% ± 1.0%	≤9 ppm	<100 ppm
50%	65%	5.5% ± 0.5%	<20 ppm	6.0% ± 1.0%	≤9 ppm	<100 ppm
40%	45%	5.5% ± 0.5%	<20 ppm	6.0% ± 1.0%	≤9 ppm	<50 ppm
30%	30%	5.5% ± 0.5%	<20 ppm	6.0% ± 1.0%	≤9 ppm	<50 ppm
18%	18%	6.0% ± 1.0%	<20 ppm	6.5% ± 1.5%	≤9 ppm	<50 ppm

Note: BMK6000 Low Gas Pressure (LGP) Model does not offer Ultra Low NOx settings.

26. If the oxygen level at the lowest valve position is too high, and the Blower voltage is at the minimum value, you can adjust the TAC screw, which is recessed in the top of the Air/Fuel Valve (see Figure 4-3). Rotate the screw 1/2 turn **clockwise** (CW) **to add fuel and reduce the O_2** to the specified level. Recalibration MUST be performed again from 60% or 50% down to the lowest valve position after making a change to the TAC screw.

This completes the NATURAL GAS combustion calibration procedure.

4.5.2 PROPANE GAS Combustion Calibration

These instructions apply only to units running **PROPANE** gas.

PROPANE Combustion Calibration Instructions

1. Set the Edge [i] Controller's **Enable/Disable** switch to **Disable**.
2. Open the water supply and return valves to the unit and ensure that the system pumps are running.
3. Open the **PROPANE** supply valve to the unit.
4. Turn external AC power to the unit **ON**.
5. On the Controller, go to: **Main Menu → Calibration → Manual Combustion**. If necessary, enter a technician level password.
6. The first **Manual Combustion Calibration** screen appears. Complete the three steps listed before continuing with the instructions. ***In addition***, if your unit is running AERtrim, you must turn that feature off before continuing, as AERtrim will interfere with combustion calibration.

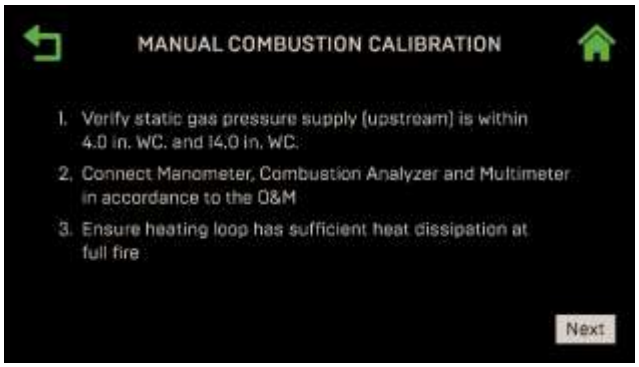

Figure 4-7: First Manual Combustion Calibration Screen

7. Connect the gas pressure manometer to the ***upstream*** side of the gas train's SSOV, as shown in Section 4.2.2 and connect the Combustion Analyzer and Multimeter, as shown in Section 4.2.3, and ensure that the heating loop is capable of dissipating sufficient heat at full fire.
8. Verify that the incoming gas pressure to the unit is within the allowable range (see the *Benchmark Gas Supply Design Guide* (TAG-0047, GF-2030).
9. Once you have completed the previous step, move the manometer (or use a secondary one) to the ***downstream*** side of the SSOV and press **Next** to continue.
10. For the NOx requirement choose **None**.

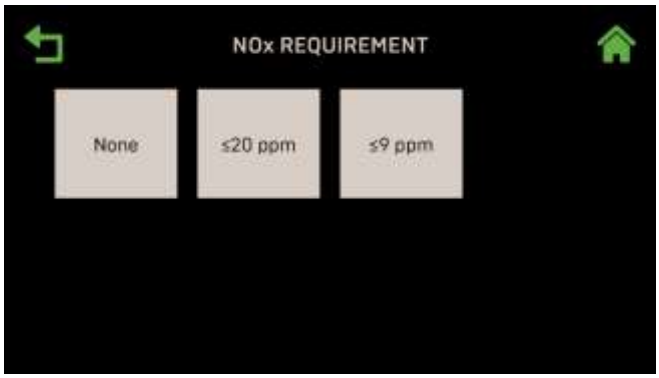

Figure 4-8: Choose NOx Requirement

11. The main **Manual Combustion Calibration** screen appears. It provides two methods to ramp the unit's valve position up or down:
    - **Method 1**: Toggle through the pre-set calibration points till you reach the desired valve position, then press **Go** to go to that point (left image below).
    - **Method 2**: Enable **Fine VP Step**, then manually press the **+** or **–** buttons once per 1% to bring the unit to the desired valve position (right image below).

PRE-SET CALIBRATION CONTROLS VALVE POSITION CONTROLS

Figure 4-9: Manual Combustion Calibration Screens

12. Set the Controller's Enable/Disable switch to **Enable**.
13. Change the valve position to 30%, press the **Go** button, then verify that the unit has ignited successfully and is operating as expected.
14. Use the ▶ (Right) arrow key to change the valve position to **100%**, then press **Go**.
15. Verify that the gas pressure on the ***downstream*** side of the SSOV is within the required range shown in Table 4-4. If it isn't, remove the brass hex nut on the SSOV actuator to access the gas pressure adjustment screw (Figure 4-3). Adjust using a flat-tip screwdriver, slowly rotating the gas pressure adjustment (in 1/4-turn increments) ***clockwise*** to ***increase*** gas pressure or ***counterclockwise*** to ***reduce*** it. The resulting gas pressure reading on the ***downstream*** manometer should fall in the range listed below.

TABLE 4-4: PROPANE Gas Pressure Range @ 100% Fire Rate

Model	Nominal Gas Pressure
BMK750P	3.9" W.C. ± 0.2" W.C. (0.97 kPa ± 0.05 kPa)
BMK1000P	7.6" W.C. ± 0.2" W.C. (1.89 kPa ± 0.05 kPa)
BMK750DF	See NOTE 2
BMK1000DF	1.8" W.C. ± 0.1" W.C. (0.45 kPa ± 0.02 kPa)
1500DF & 1500P	1.4" W.C. ± 0.1" W.C. (0.35 kPa ± 0.02 kPa)
2000DF & 2000P	2.5" W.C. ± 0.1" W.C. (0.62 kPa ± 0.02 kPa)
2500DF & 2500P	2.0" W.C. ± 0.1" W.C. (0.50 kPa ± 0.02 kPa)
3000DF & 3000P	1.6" W.C. ± 0.1" W.C. (0.40 kPa ± 0.02 kPa)
4000DF & 4000P	1.5" W.C. ± 0.1" W.C. (1.12 kPa ± 0.02 kPa)
5000NDF & 5000NP	1.5" W.C. ± 0.1" W.C. (1.12 kPa ± 0.02 kPa)
5000DF & 5000P	2.0" ± 0.2" W.C. (0.50 to 0.05 kPa)
6000DF & 6000P	4.2" ± 0.2" W.C. (1.05 to 0.05 kPa)

NOTE 2: For BMK750 Dual Fuel, measure Propane Gas Manifold Pressure at 85% Fire Rate. Range shall be 1.8" +/- 0.1" W.C. (0.45 kPa ± 0.02 kPa)

PROPANE Combustion Calibration Instructions

16. With the valve position still at 100%, insert the combustion analyzer probe into the exhaust manifold probe opening (see Figure 4-2a – 4-2c in Section 4.2.3) and allow enough time for the combustion analyzer reading to stabilize.
17. Compare the combustion analyzer's oxygen (O_2) reading to the **O_2** value in the **Reading** column (Figure 4-9). If they differ, go to the **Main Menu → Calibration → Input/Output → Oxygen Sensor** screen and adjust the **O2 Offset** parameter, up to **±3%**, to make the on-board O_2 sensor match the value from the combustion analyzer. If your combustion analyzer is correctly calibrated, and the on-board O_2 sensor cannot be made to match the analyzer, the sensor may be defective and need to be replaced.
18. Compare the **O_2** value in the **Target** and **Reading** columns. If they don't match, adjust the **Blower Voltage** until the **O_2** value in both columns match; use either the **+** or **–** controls, or press on the field and type the value directly.
19. If adjusting the blower voltage is not sufficient to get the **O_2 Reading** column to match the **Target** column, then repeat Step 15 to adjust the gas pressure up or down within the range shown in the table, then repeat Step 18. Continue repeating Steps 15 and 18 until the gas pressure is within the range in Table 4-4 and the **O_2 Reading** column to matches the **Target** column.
20. Enter the downstream manometer's gas pressure reading in the **Downstream Gas Pressure** field. Note, this field appears only when **Valve Position %** = **100%**.
21. Compare the measured nitrogen oxide (NOx) and carbon monoxide (CO) readings to the **Target** values in the Table 4-5 (shown as a reference only). If you are not in a "NOx-limited" area and/or do not have a NOx measurement in your analyzer, set the O_2 to the value in the **Oxygen (O_2) %** column in the table below.

TABLE 4-5: PROPANE Calibration Readings at 100% Valve Position

Model	Oxygen (O_2) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
750 & 1000	5.5% ± 0.2%	≤100 ppm	<150 ppm
1500	5.2% ± 0.2%	≤100 ppm	<150 ppm
2000	6.0% ± 0.2%	≤100 ppm	<150 ppm
2500	5.0% ± 0.2%	≤100 ppm	<150 ppm
3000	5.2% ± 0.2%	≤100 ppm	<150 ppm
4000	4.5% ± 0.2%	≤100 ppm	<150 ppm
5000N	4.5% ± 0.2%	≤100 ppm	<150 ppm
5000	5.5% ± 0.5%	≤100 ppm	<150 ppm
6000	5.0% ± 0.5%	≤100 ppm	<150 ppm

NOTE:
These instructions assume that the **inlet air temperature is between 50°F and 100°F (10°C – 37.8°C)**. If NOx readings exceed the target values in Table 4-4, above, or Table 4-6, below, increase the O_2 level up to 1% higher than the Target value. You must then record the increased O_2 value on the Combustion Calibration sheet.

22. On Benchmark 3000 - 6000 units *only*, record the manifold (downstream) gas pressure at 100%. This value will be used in Section 5.2.2: *Low Pressure Gas Test*, and Section 5.3.2: *High Pressure Gas Test*.

23. Once the O_2 level is within the specified range at 100%:
    - Enter the **Flame Strength**, **NOx** and **CO** readings from the Combustion Analyzer and multi-meter in the Manual Combustion Calibration screen's **Reading** column.
    - Enter the same values, plus the **O_2** value, on the Combustion Calibration Data Sheet provided with the unit.
24. Lower the Valve Position to the next calibration point using the ◄ (Left) arrow key (if using Method 1 in step 11) or the Fine Valve Position – (Minus) key (if using Method 2).

BMK750P & 1000P	**80%**
BMK750P & 1000P (Dual Fuel Models)	**70%**
BMK1500/2000/2500 DF & P	**70%**
BMK3000 DF & P	**85%**
BMK4000 DF & P	**70%**
BMK5000N DF & P	**70%**
BMK5000P & 6000P	**70%**
BMK5000DF & 6000DF	**85%**

25. Repeat step 17, 18 and 21 at that valve position and the rest of the valve positions in Table Table 4-6a and 4-6b, depending on model. The O_2, NOx and CO should stay within the ranges shown in these tables.

TABLE 4-6a: PROPANE Final Valve Positions: BMK750 – 5000N

Valve Position	Oxygen (O_2) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
BMK750/1000			
80%	5.5% ± 0.2%	<100 ppm	<150 ppm
60%	5.5% ± 0.2%	<100 ppm	<150 ppm
45%	5.5% ± 0.2%	<100 ppm	<150 ppm
30%	6.3% ± 0.2%	<100 ppm	<100 ppm
18%	5.5% ± 0.2%	<100 ppm	<100 ppm
BMK750/1000 DUEL Fuel			
70%	5.5% ± 0.2%	<100 ppm	<150 ppm
50%	5.5% ± 0.2%	<100 ppm	<150 ppm
40%	5.5% ± 0.2%	<100 ppm	<150 ppm
30%	5.5% ± 0.2%	<100 ppm	<100 ppm
18%	5.5% ± 0.2%	<100 ppm	<100 ppm
BMK1500			
70%	5.2% ± 0.2%	<100 ppm	<150 ppm
50%	5.3% ± 0.2%	<100 ppm	<150 ppm
40%	6.2% ± 0.2%	<100 ppm	<150 ppm
30%	7.0% ± 0.2%	<100 ppm	<100 ppm
18%	8.5% ± 0.2%	<100 ppm	<100 ppm

PROPANE Combustion Calibration Instructions

Valve Position	Oxygen (O_2) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
BMK2000			
70%	6.5% ± 0.2%	<100 ppm	<150 ppm
50%	6.5% ± 0.2%	<100 ppm	<150 ppm
40%	6.5% ± 0.2%	<100 ppm	<150 ppm
30%	6.5% ± 0.2%	<100 ppm	<100 ppm
18%	5.5% ± 0.2%	<100 ppm	<100 ppm
BMK2500			
70%	5.4% ± 0.2%	<100 ppm	<150 ppm
45%	5.6% ± 0.2%	<100 ppm	<150 ppm
30%	6.0% ± 0.2%	<100 ppm	<100 ppm
22%	5.8% ± 0.2%	<100 ppm	<100 ppm
18%	6.0% ± 0.2%	<100 ppm	<100 ppm
BMK3000			
85%	5.2% ± 0.2%	<100 ppm	<150 ppm
65%	5.4% ± 0.2%	<100 ppm	<150 ppm
45%	6.0% ± 0.2%	<100 ppm	<150 ppm
30%	6.4% ± 0.2%	<100 ppm	<100 ppm
18%	6.4% ± 0.2%	<100 ppm	<100 ppm
BMK4000			
70%	4.5% ± 0.2%	<100 ppm	<150 ppm
50%	5.5% ± 0.2%	<100 ppm	<150 ppm
40%	5.5% ± 0.2%	<100 ppm	<150 ppm
30%	5.5% ± 0.2%	<100 ppm	<100 ppm
18%	5.5% ± 0.2%	<100 ppm	<100 ppm
BMK5000N			
70%	4.5% ± 0.2%	<100 ppm	<150 ppm
50%	5.5% ± 0.2%	<100 ppm	<150 ppm
40%	5.5% ± 0.2%	<100 ppm	<150 ppm
30%	5.5% ± 0.2%	<100 ppm	<100 ppm
18%	5.5% ± 0.2%	<100 ppm	<100 ppm

PROPANE Combustion Calibration Instructions

TABLE 4-6b: PROPANE Final Valve Positions: BMK5000 & 6000

Valve Position		Oxygen (O_2) %	Nitrogen Oxide (NOx)	Carbon Monoxide (CO)
Single-Fuel	Dual-Fuel			
BMK5000				
70%	70%	5.5% ± 0.5%	<100 ppm	<150 ppm
50%	50%	5.5% ± 0.5%	<100 ppm	<150 ppm
40%	40%	5.5% ± 0.5%	<100 ppm	<150 ppm
30%	30%	5.5% ± 0.5%	<100 ppm	<150 ppm
18%	18%	6.0% ± 1.0%	<100 ppm	<150 ppm
BMK6000				
70%	85%	5.5% ± 0.5%	<100 ppm	<150 ppm
50%	65%	5.5% ± 0.5%	<100 ppm	<150 ppm
40%	45%	5.5% ± 0.5%	<100 ppm	<150 ppm
30%	30%	5.5% ± 0.5%	<100 ppm	<150 ppm
18%	18%	6.0% ± 1.0%	<100 ppm	<150 ppm

NOTE:
If NOx readings exceed the target values in Table 4-6a and 4-6b, increase the O_2 level up to 1% higher than the listed calibration range shown in the table. Record the increased O_2 value on the Combustion Calibration sheet.

26. If the oxygen level at the lowest valve position is too high, and the Blower voltage is at the minimum value, you can adjust the TAC screw, which is recessed in the top of the Air/Fuel Valve (see Figure 4-3). Rotate the screw 1/2 turn **clockwise** (CW) **to add fuel and reduce the O_2** to the specified level. Recalibration MUST be performed again from 60% or 50% down to the lowest valve position after making a change to the TAC screw.

This completes the PROPANE gas combustion calibration procedure.

4.6 REASSEMBLY

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

Reassembly Instructions

1. Set the Enable/Disable switch to the **Disable** position.
2. Disconnect AC power from the unit.
3. Shut off the gas supply to the unit.
4. Remove the manometer and barbed fittings and reinstall the NPT plug using a suitable pipe thread compound.

Reassembly Instructions

5. Remove the combustion analyzer probe from the 1/4” vent hole in the exhaust manifold and then replace the 1/4” NPT plug in the vent hole.
6. Replace all previously removed sheet metal enclosures on the unit.

4.7 DUAL FUEL SWITCHOVER

All Benchmark Dual Fuel models contain a fuel selector switch, located to the right of the I/O board, behind the front panel.

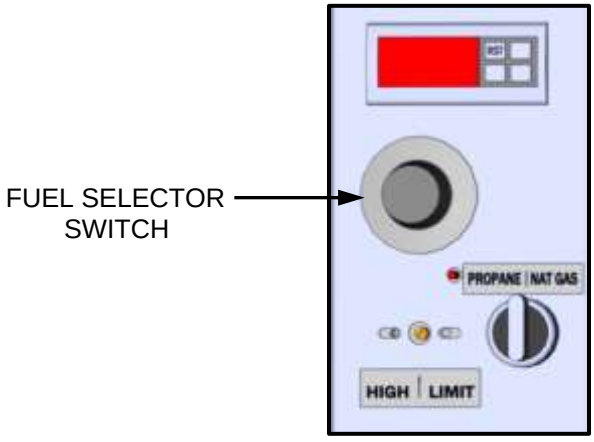

Figure 4-10: Dual Fuel Switch

Switchover from NATURAL GAS to PROPANE Instructions

1. Set the Edge [i] Controller's **Enable/Disable** switch to **Disable**.
2. Close the external Natural Gas supply valve.
3. Open the external Propane gas supply valve.
4. Locate the Fuel Selector Switch (see Figure 4-10), behind the front door.
5. Set the Fuel Selector Switch from **NAT GAS** to **PROPANE**.
6. Replace the front door panel previously removed from the boiler.

Switchover from PROPANE to NATURAL GAS Instructions

1. Set the Edge [i] Controller's **Enable/Disable** switch to **Disable**.
2. Close the external Propane Gas supply valve.
3. Open the external Natural Gas supply valve.
4. Locate the Fuel Selector Switch (see Figure 4-10), behind the front door.
5. Set the Fuel Selector Switch from **PROPANE** to **NAT GAS**.
6. Replace the front door panel previously removed from the boiler.

4.8 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** button. These controls are mounted on a plate as shown in Figure 4-11a – 4-11c. 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 4-11a – 4-11c before the boiler can be restarted.

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

The digital **Over-Temperature Alarm** switch shown in Figure 4-11a – 4-11c and Figure 4-12 is preset at the factory to 210ºF (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 4.7.1.

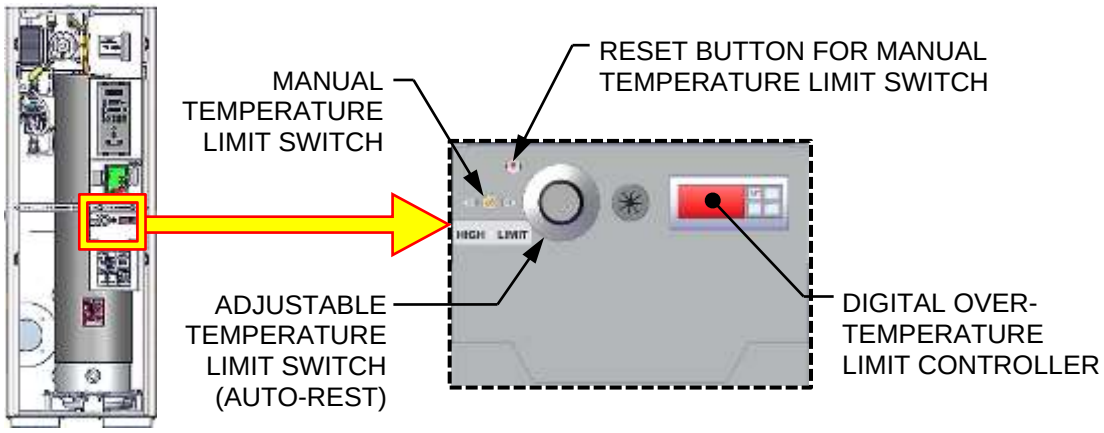

Figure 4-11a: BMK750 & 1000 Over-Temperature Limit Switch Location

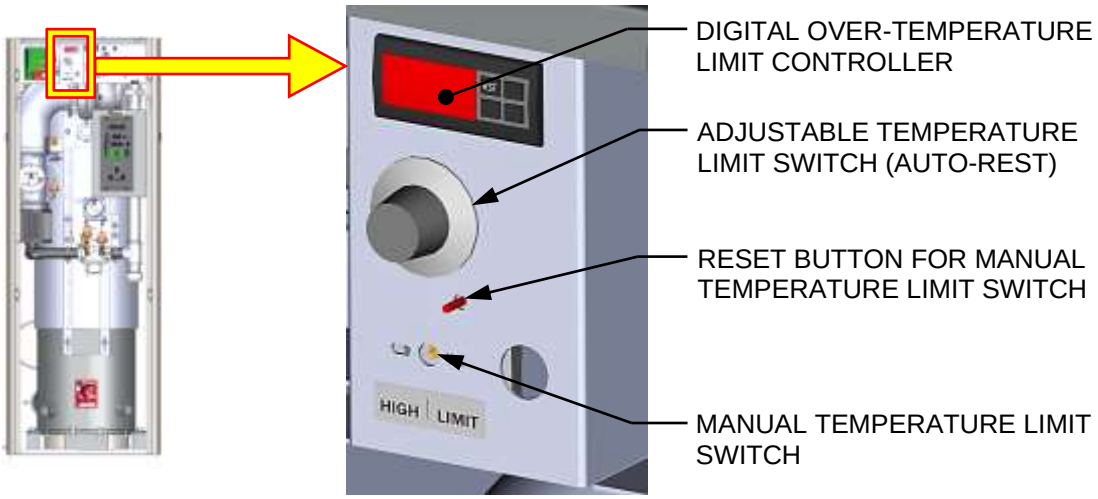

Figure 4-11b: BMK1500 – 5000N Over-Temperature Limit Switch Location

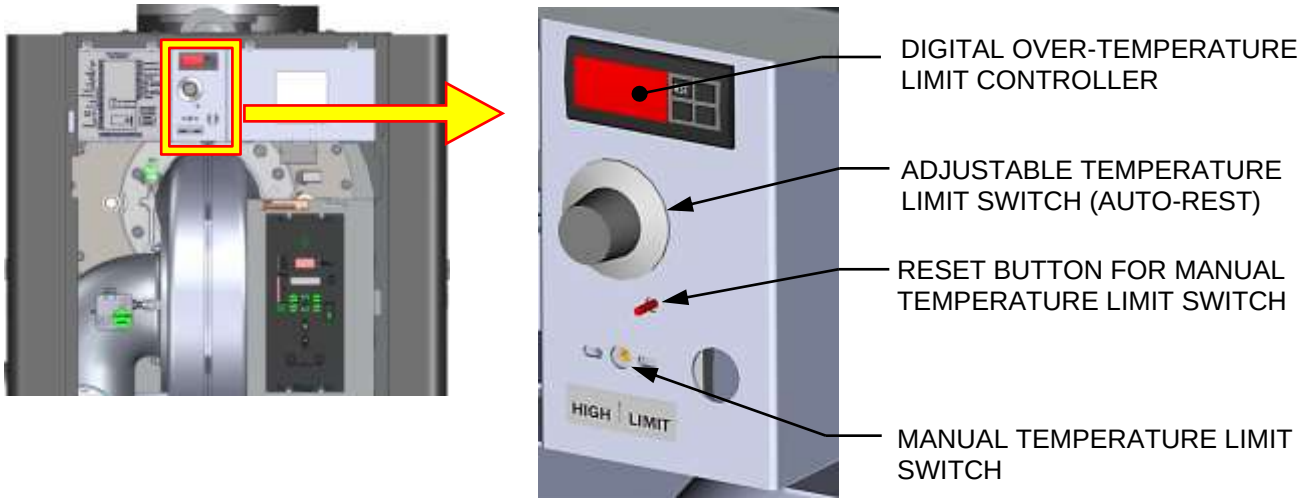

Figure 4-11c: BMK5000-6000 Over-Temperature Limit Switch Location

4.8.1 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 4-12 and Table 4-9.

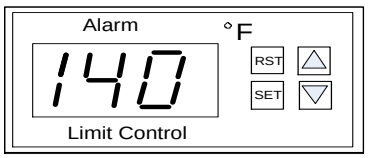

Figure 4-12: Digital Over-Temperature Alarm Switch Front Panel

TABLE 4-9: Over-Temperature Alarm Switch Controls and Display

CONTROL/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 **Over-Temperature Alarm** switch settings:

Over-Temp Alarm Switch Check and Adjustment Instructions

1. Set the **Enable/Disable** switch to the **Enable** position.
2. Press the **SET** button on the **Over-Temperature 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, 98.9°C).
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.

Over-Temp Alarm Switch Check and Adjustment Instructions

5. Once the desired over-temperature alarm setting (210ºF) is displayed, press the **SET** button to store the setting in memory.
6. To calibrate the offset (P1), press and hold the **SET** button on the Over-Temperature Alarm switch for 8 seconds. Access code value **0** should appear in the display. The switch comes from the factory with the code set at **0**. AERCO recommends that you do not change this code.
7. Press the **SET** button again to enter the code. The first parameter label, *SP*, will appear in the display.
8. Using the ▲ and ▼ arrow keys, select parameter **P1**.
9. Press **SET** to view the value stored in memory.
10. If the desired value is not displayed, modify the setting using the ▲ and ▼ arrow keys. The value can be changed from -10° to +10° (-5.5°C to + 5.5°C) offset. Press **SET** to enter the value and exit to the text parameter.
11. To exit the programming mode, press the SET and ▼ buttons simultaneously or simply wait one minute and the display will automatically exit the programming mode.
12. Once the programming mode has been exited, the display will show the current outlet water temperature of the boiler.

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SECTION 5. SAFETY DEVICE TESTING

5.1 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.

NOTES:

- **Manual** and **Auto** modes of operation are required to perform the following tests. For a full explanation, see Section 3.1: *Manual Mode* in the *Edge [i] Controller Manual* (OMM-0141, GF-213-B).
- It is necessary to remove the front door and side panels from the unit to perform the tests described below.

WARNING!

Electrical voltages up to **120 VAC (BMK750 – 2000), 208 or 480 VAC (BMK2500 – BMK3000), 480 VAC (BMK4000 & 5000N), or 208**, **480 or 575 VAC (BMK5000 & 6000) and 24 volts AC** may be used in this equipment. Power must be removed prior to performing wire removal or other test procedures that can result in electrical shock.

5.2 LOW GAS PRESSURE TEST

Complete the instructions in Section 5.2.1 for BMK750 – 2500 units, or in Section 5.2.2 for BMK3000 – 6000 units, which have different Low and High Gas Pressure switches.

5.2.1 Low Gas Pressure Test: BMK750 – 2500

To simulate a low gas pressure fault, refer to Figure 5-1a to 5-1c and perform the following steps:

LOW Gas Pressure Test Instructions: BMK750 – 2500

1. Remove the front panel from the boiler to access the gas train components.
2. Close the leak detection ball valve located at the Low Gas Pressure switch.
3. Remove the 1/4" NPT plug from the ball valve at the Low Gas Pressure switch.
4. Install a **0 - 16" W.C. (0 – 4.0 kPa)** manometer or gauge where the 1/4" plug was removed.
5. Slowly open the 1/4" ball valve near the Low Gas Pressure switch.
6. On the Controller, go to **Main Menu → Diagnostics → Manual Mode.**
7. Enable the **Manual Mode** parameter. The **Comm** LED will go off and the **MANUAL** LED will light.
8. Adjust the Air/Fuel Valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
9. While the unit is firing, slowly close the external manual gas shut-off valve upstream of the unit (not shown).
10. The unit should shut down and display a ***Fault Lockout - Gas Pressure Fault*** message at approximately the pressure shown in Table 5-1 (the pressure setting of the Low Gas Pressure switch):

TABLE 5-1: LOW Gas Pressure, ± 0.2" W.C. (± 50 Pa)

Benchmark Model	Natural Gas	Propane
BMK750/1000 FM & DBB Single-Fuel	2.6" W.C. (648 Pa)	7.5" W.C. (1,868 Pa)
BMK750/1000 DUAL-Fuel	5.2" W.C. (1294 Pa)	5.2" W.C. (1294 Pa)
BMK1500/2000 FM & DBB Single-Fuel	3.6" W.C. (897 Pa)	–
BMK1500/2000 Dual-Fuel	4.4" W.C. (1,096 Pa)	2.6" W.C. (648 Pa)
BMK1500/2000 DBB Dual-Fuel	2.6" W.C. (648 Pa)	2.6" W.C. (648 Pa)
BMK2500 FM & DBB Single-Fuel	3.6" W.C. (897 Pa)	–
BMK2500 Dual-Fuel	7.5" W.C. (1,868 Pa)	3.6" W.C. (897 Pa)
BMK2500 DBB Dual-Fuel	7.5" W.C. (1,868 Pa)	3.6" W.C. (897 Pa)

11. Close the ball valve near the Low Gas Pressure switch (opened in Step 5).
12. Fully open the external manual gas shut-off valve (not shown) and press the Controller's **CLEAR** button.
13. The fault message should clear, the **FAULT** indicator should go off, and the unit should restart.
14. Upon test completion, close the ball valve, remove the manometer and replace the 1/4" NPT plug removed in step 3.

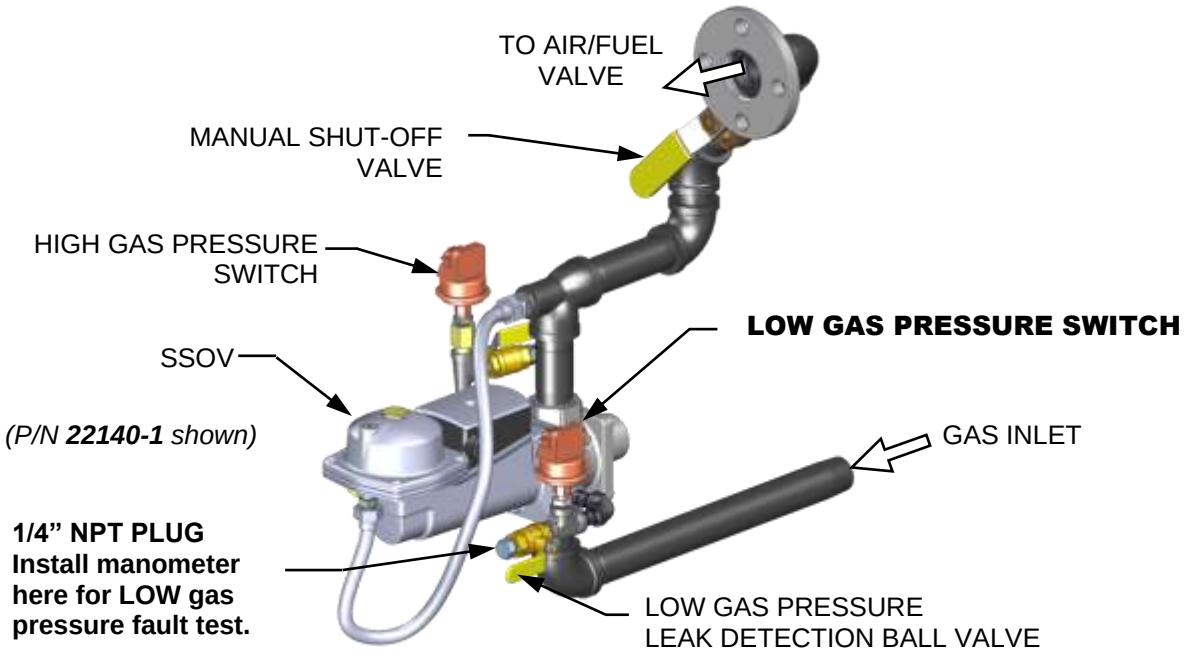


Figure 5-1a: BMK750/1000 LOW Gas Pressure Test Components

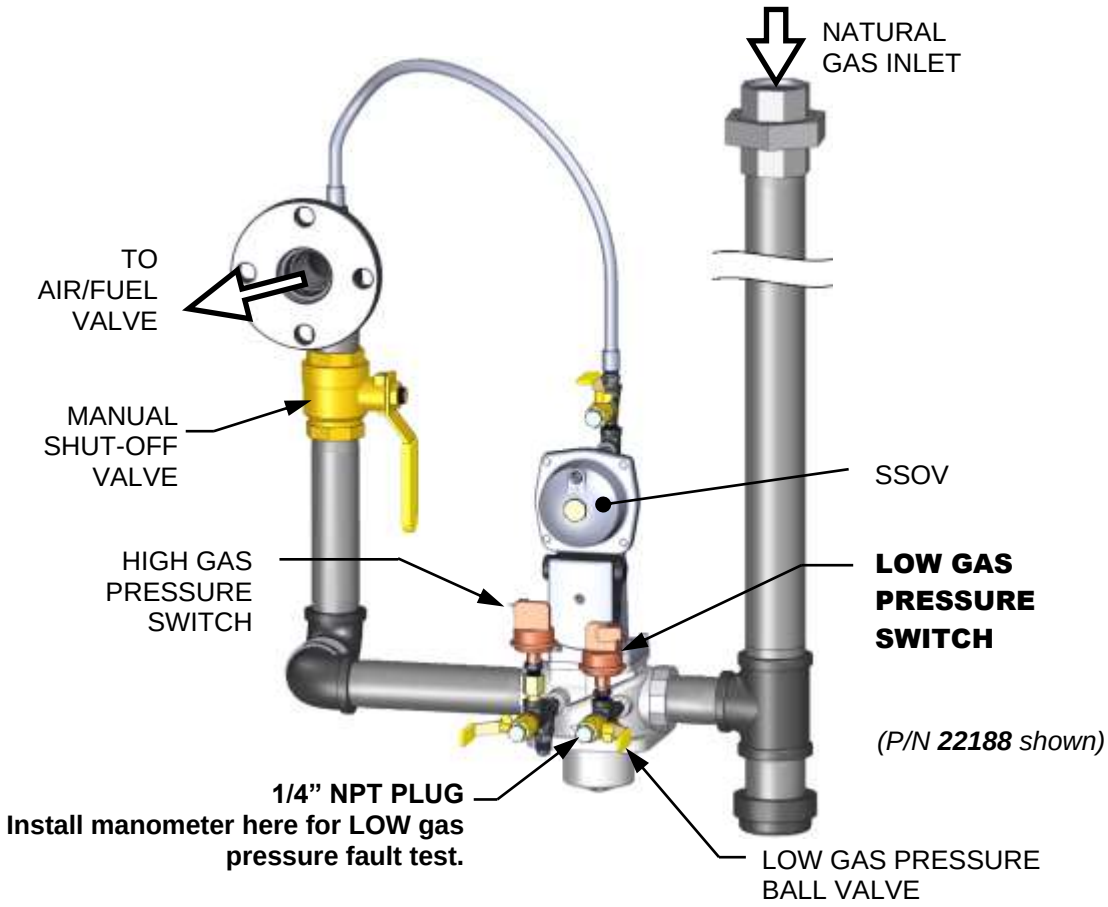


Figure 5-1b: BMK1500/2000 LOW Gas Pressure Test Components

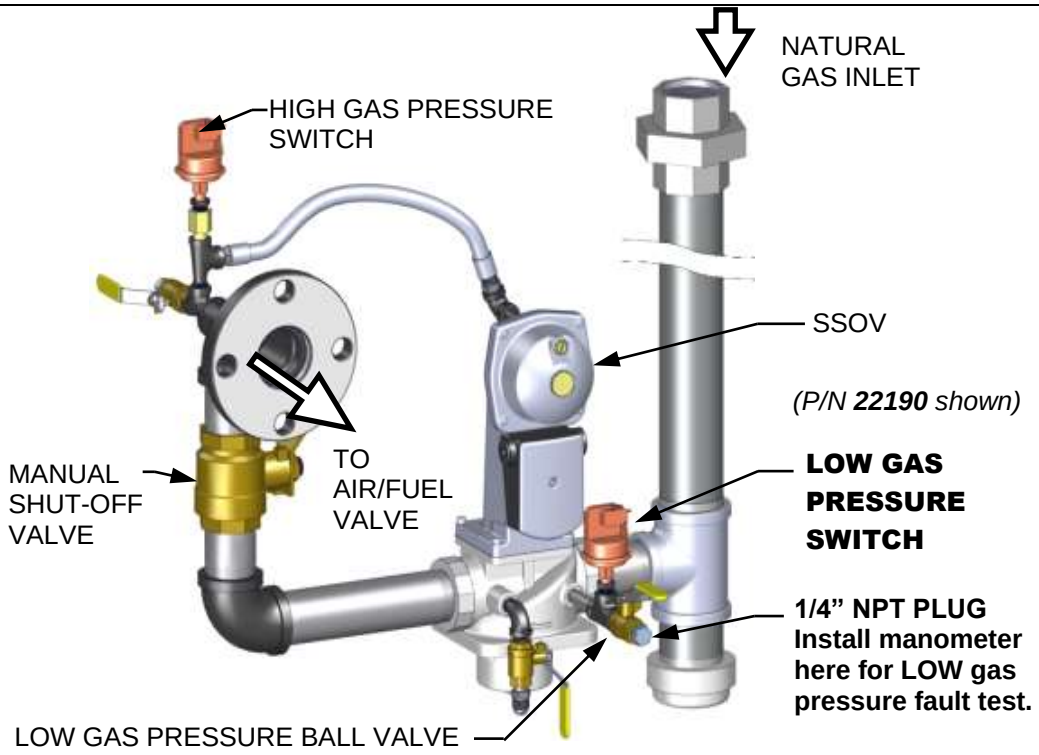


Figure 5-1c: BMK2500 LOW Gas Pressure Test Components

5.2.2 Low Gas Pressure Test: BMK3000 – 6000 Only

To simulate a low gas pressure fault on BMK3000 – 6000 units, refer to Figure 5-2a, 5-2b, and 5-2c below, and perform the following steps:

LOW Gas Pressure Test Instructions: BMK3000 – 6000 Only

1. Close the **external** gas supply ball valve upstream of the unit (not shown).
2. Remove the front panel from the boiler to access the gas train components.
3. Locate the port on the top of the Low Gas Pressure switch and loosen the screw inside a few turns to open it. **Do not remove this screw completely.** Alternatively, you can remove the 1/4-inch plug shown in Figure 5-2a and 5-2b and install a hose barb fitting in that location.
4. Attach one end of the plastic tubing to the port or barb fitting and the other end to a **0 –** 16**" W.C. (0 – 4.0 kPa)** manometer.
5. Apply the reading of the manifold pressure taken in Step 22 of Section 4.4.1 (Natural Gas units) or Step 22 of Section 4.4.2 (Propane units) and plug it into the following formula, which calculates the minimum allowable gas pressure:

BMK3000	FM Natural Gas pressure →____ x 0.5 + 0.7 = _____ min gas pressure DBB Natural Gas pressure →____ x 0.5 + 1.6 = _____ min gas pressure Propane Gas pressure →_____ x 0.5 + 0.6 = _____ min gas pressure
BMK4000	FM Natural Gas pressure →____ x 0.5 + 0.6 = _____ min gas pressure DBB Natural Gas pressure →____ x 0.5 + 0.6 = _____ min gas pressure Propane Gas pressure → ____ x 0.5 + 1.1 = _____ min gas pressure
BMK5000N	FM Natural Gas pressure →____ x 0.5 + 0.9 = _____ min gas pressure DBB Natural Gas pressure →____ x 0.5 + 0.9 = _____ min gas pressure Propane Gas pressure → ____ x 0.5 + 1.6 = _____ min gas pressure

LOW Gas Pressure Test Instructions: BMK3000 – 6000 Only

BMK5000	FM Natural Gas pressure →____ x 0.5 + 6.0 = _____ min gas pressure LGP * Natural Gas pressure →____ x 0.5 + 0.9 = _____ min gas pressure Propane Gas pressure →____ x 0.5 + 3.7 = _____ min gas pressure
BMK6000	FM Natural Gas pressure →____ x 0.5 + 6.0 = _____ min gas pressure LGP * Natural Gas pressure →____ x 0.5 + 1.3 = _____ min gas pressure Propane Gas pressure →____ x 0.5 + 3.7 = _____ min gas pressure

* Applies to all models except Low Gas Pressure (LGP) models

6. Remove the cover from the Low Gas Pressure switch and set the dial indicator to **2** (the minimum).
7. Open the external gas supply ball valve upstream of the unit.
8. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode** and then enable the **Manual Mode** control.
9. Adjust the Air/Fuel Valve position to **100%** using the **+** (Plus) and **–** (Minus) controls.
10. While the unit is firing, read the CO value on the combustion analyzer and slowly decrease the incoming gas supply pressure until the CO reading is **approximately 300 ppm**.
11. Take a reading of the inlet gas pressure. If the inlet pressure is below the minimum calculated in step 5, above, then increase the pressure to match the calculated minimum.
12. Slowly turn the indicator dial on the **Low Gas Pressure** switch until the unit shuts down due to a gas pressure fault.
13. Readjust the inlet gas pressure to what it was prior to the test.
14. Press the Edge [i] Controller's **CLEAR** button to clear the fault.
15. The fault message should clear, the red **FAULT** LED go off, and the unit should restart.
16. For Dual Fuel units, repeat the previous procedure on the **Propane** gas train, starting with the **Propane** Low Gas Pressure Switch.

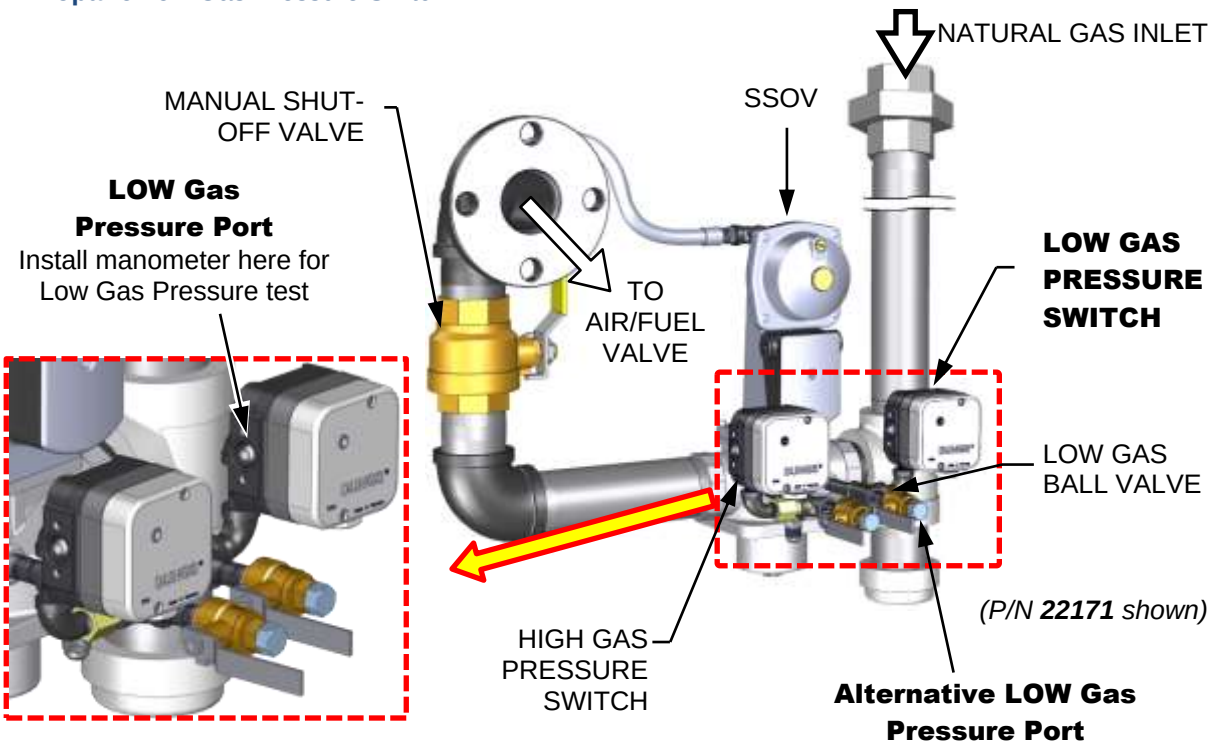


Figure 5-2a: BMK3000 LOW and HIGH Gas Pressure Test Components

LOW Gas Pressure Test Instructions: BMK3000 – 6000 Only

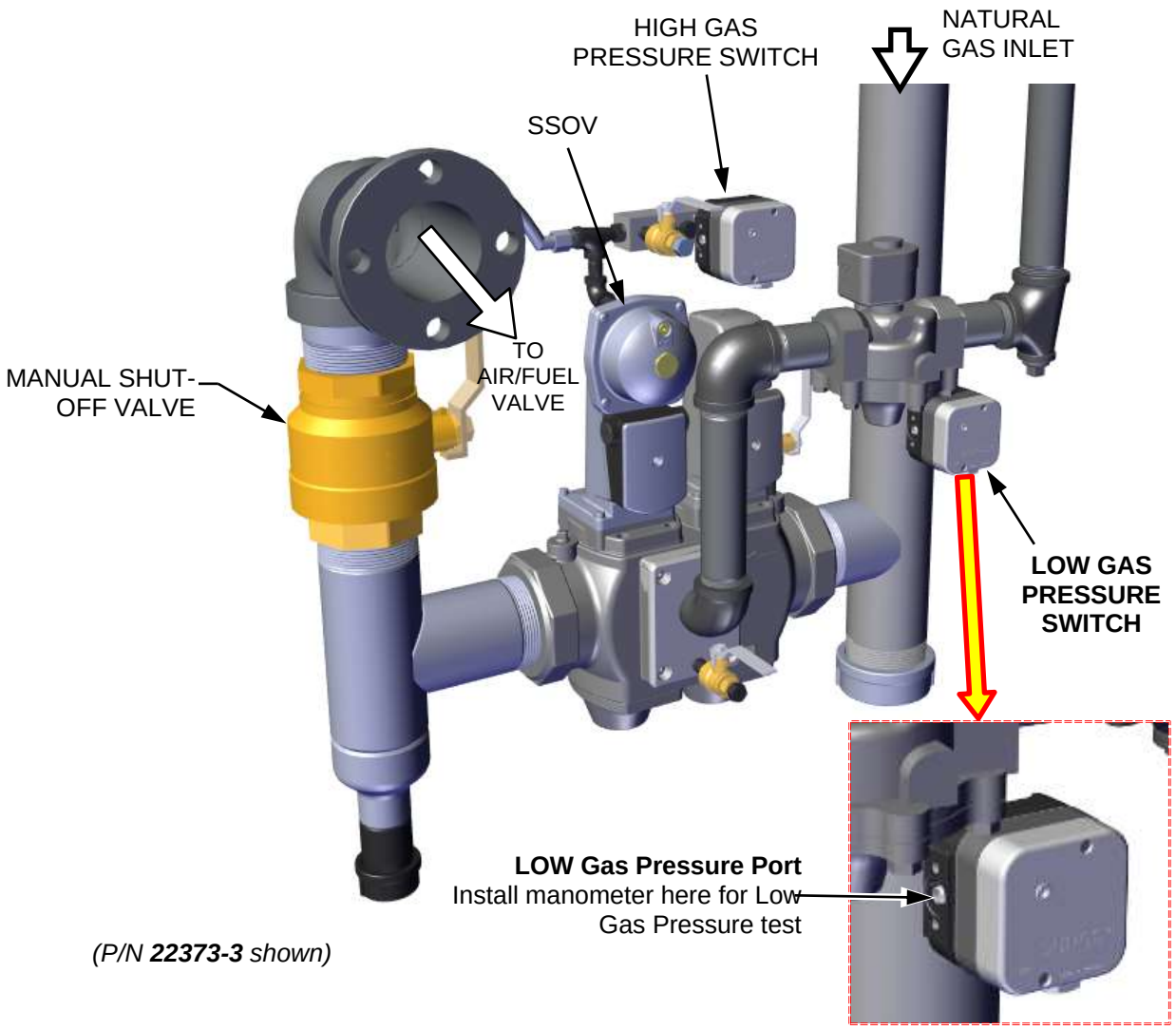


Figure 5-2b: BMK4000-5000N LOW and HIGH Gas Pressure Test Components

LOW Gas Pressure Test Instructions: BMK3000 – 6000 Only

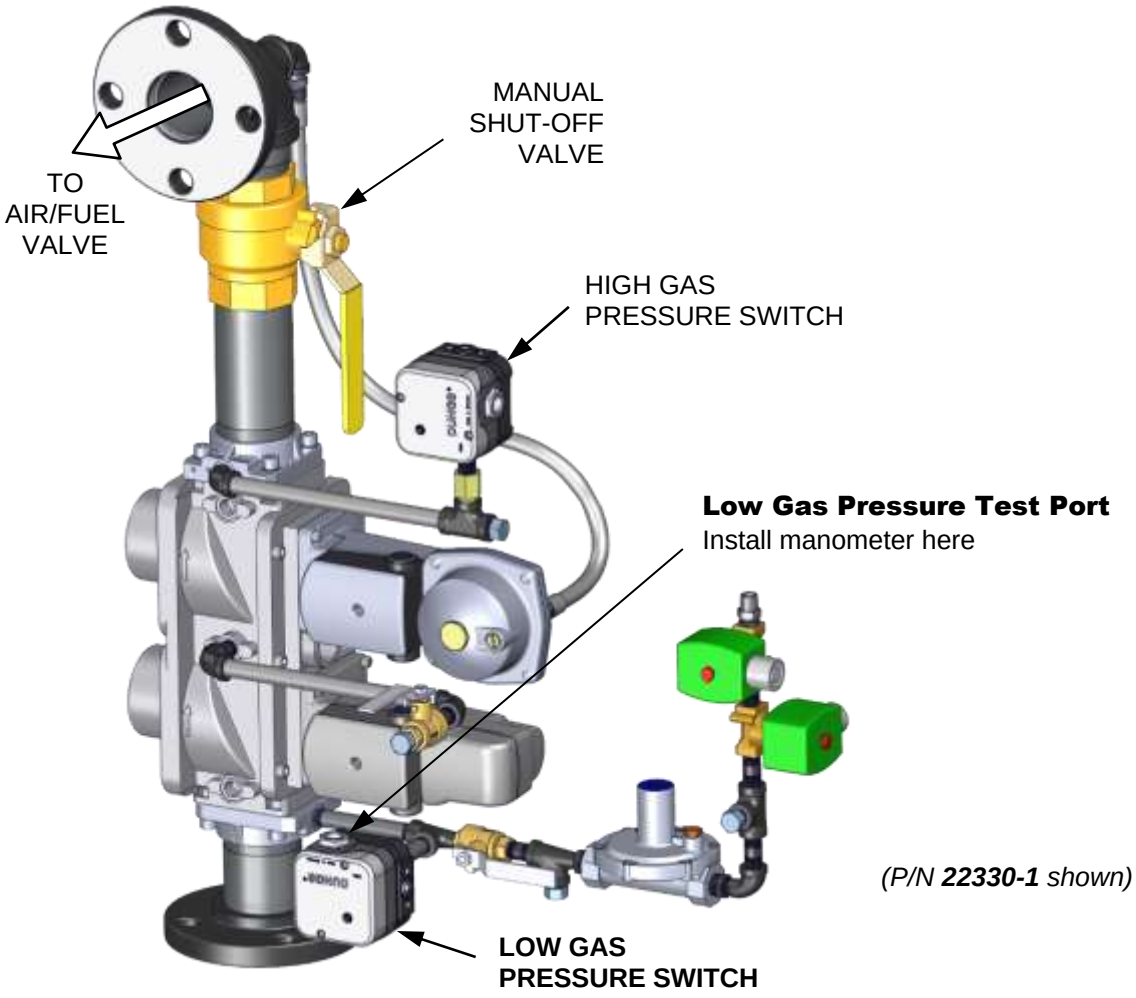


Figure 5-2c: BMK6000 LOW and HIGH Gas Pressure Test Components

5.3 HIGH GAS PRESSURE TEST

Complete the instructions in Section 5.3.1 for BMK750 – 2500 units, or in Section 5.3.2 for BMK3000 – 6000 units, which have different High Gas Pressure switches.

5.3.1 High Gas Pressure Test: BMK750 – 2500

To simulate a high gas pressure fault, refer to Figure 5-3a through Figure 5-3c and perform the following steps:

HIGH Gas Pressure Test Instructions: BMK750 – 2500

1. Close the leak detection ball valve located at the High Gas Pressure switch.
2. Remove the 1/4" NPT plug from the High Gas pressure leak detection ball valve shown in Figures 5-3a through 5-3c.
3. Install a **0 - 16" W.C. (0 – 4.0 kPa)** manometer or gauge where the 1/4" plug was removed.
4. Slowly open the leak detection ball valve.
5. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode**.
6. Enable the **Manual Run** control.
7. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
8. With the unit running, monitor the gas pressure on the manometer installed in step 2 and record the gas pressure reading.
9. Slowly increase the gas pressure using the adjustment screw on the SSOV ***while counting the number of turns you make***.
10. The **FAULT** indicator should start flashing and the unit should shut down and display a ***Fault Lockout - Gas Pressure Fault*** message at approximately the value shown in Table 5-2 (the pressure setting of the High Gas Pressure switch). If the unit does not trip off within 0.2" W.C. of the pressure shown, the switch needs to be replaced.

TABLE 5-2: HIGH Gas Pressure, ± 0.2" W.C. (± 50 Pa)

Benchmark Model	Natural Gas	Propane
BMK750/1000 FM & DBB Single-Fuel	4.7" W.C. (1.17 KPa)	4.7" W.C. (1.17 KPa)
BMK750/1000 DUAL-Fuel	7.0" W.C. (1.74 kPa)	2.6" W.C. (0.65 kPa)
BMK1500/2000 Single-Fuel	4.7" W.C. (1.17 KPa)	–
BMK1500/2000 DBB Single-Fuel	4.7" W.C. (1.17 KPa)	–
BMK1500/2000 Dual-Fuel	4.7" W.C. (1.17 KPa)	4.7" W.C. (1.17 KPa)
BMK1500/2000 DBB Dual-Fuel	3.5" W.C. (0.87 kPa)	3.5" W.C. (0.87 kPa)
BMK2500 FM & DBB Single-Fuel	3.0" W.C. (0.75 kPa)	–
BMK2500 Dual-Fuel	7.0" W.C. (1,74 kPa)	2.6" W.C. (0.65 kPa)
BMK2500 DBB Dual-Fuel	7.0" W.C. (1,74 kPa)	2.6" W.C. (0.65 kPa)

11. Reduce the gas pressure by returning the SSOV adjustment screw back to its original position before starting step 9 (the value recorded in step 8). This pressure should be within the range used during combustion calibration, shown in Table 4-1 (Natural Gas) and Table 4-4 (Propane gas).
12. Press the **CLEAR** button on the Edge [i] Controller to clear the fault.
13. The fault message should clear, the **FAULT** indicator should go off and the unit should restart (if in **Manual** mode).
14. Upon test completion, close the ball valve and remove the manometer. Replace the 1/4" NPT plug removed in step 2.

HIGH Gas Pressure Test Instructions: BMK750 – 2500

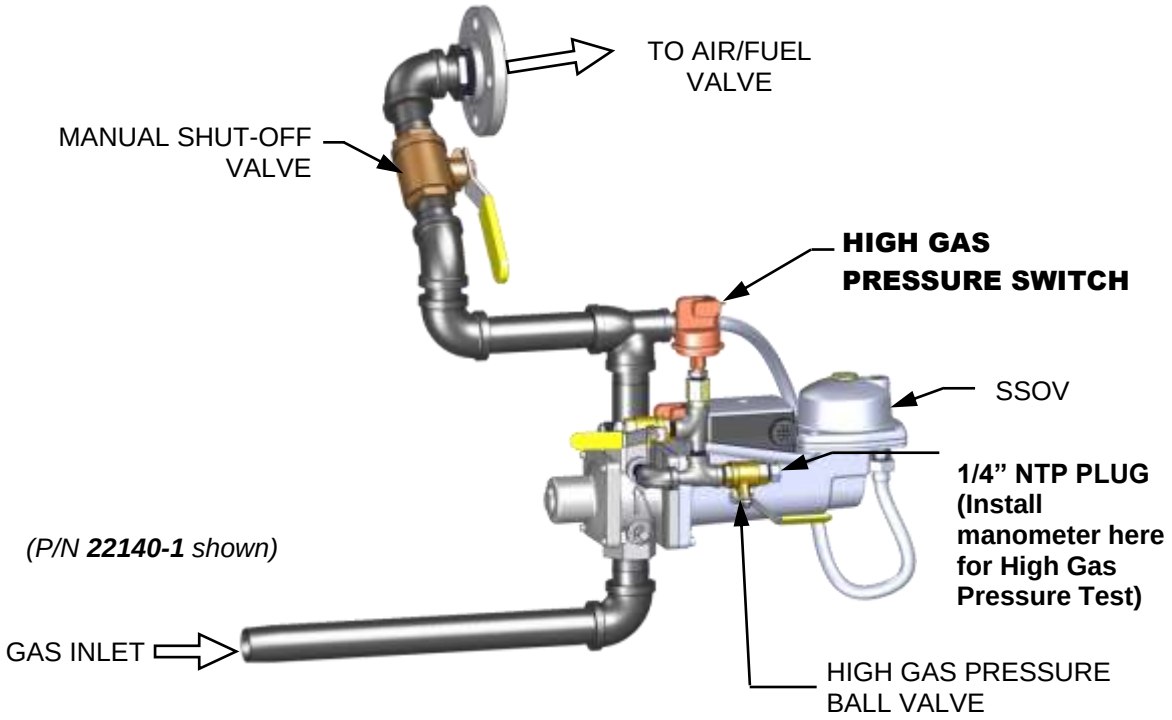


Figure 5-3a: BMK750/1000 HIGH Gas Pressure Test Components

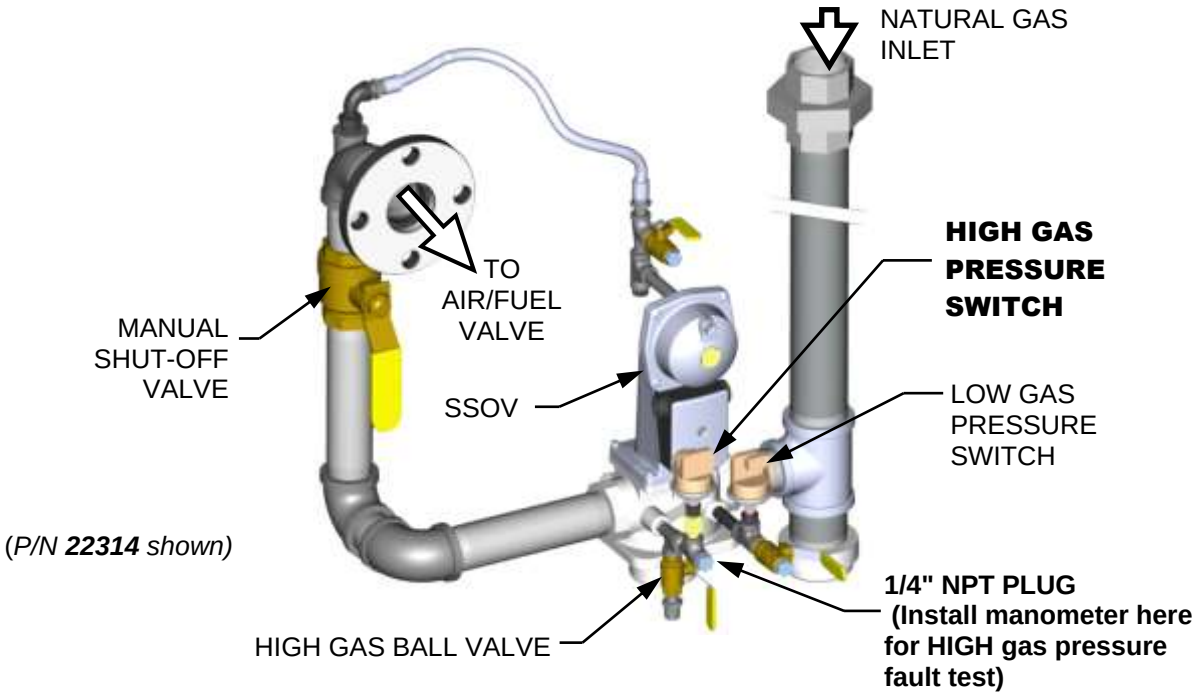


Figure 5-3b: BMK1500/2000 HIGH Gas Pressure Fault Test

HIGH Gas Pressure Test Instructions: BMK750 – 2500

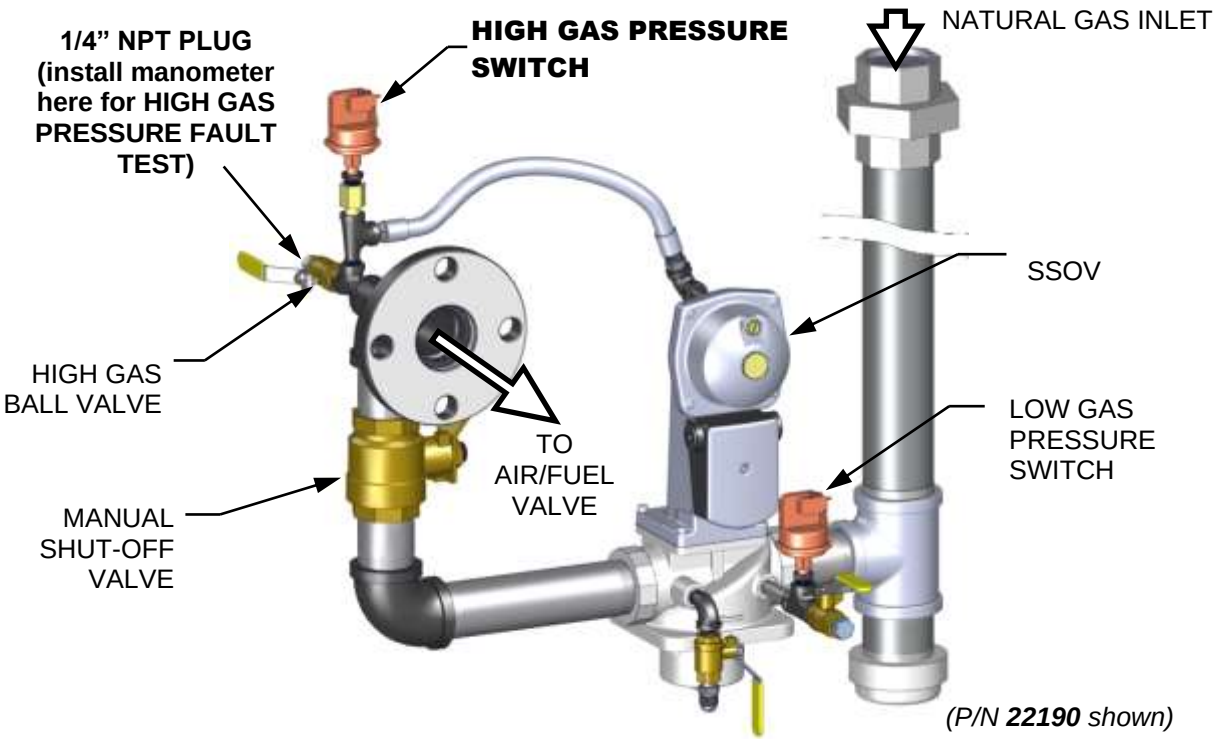


Figure 5-3c: BMK2500 HIGH Gas Pressure Fault Test

5.3.2 High Gas Pressure Test: BMK3000 – 6000 Only

To simulate a high gas pressure fault, refer to Figure 5-4a and 5-4b and perform the following steps:

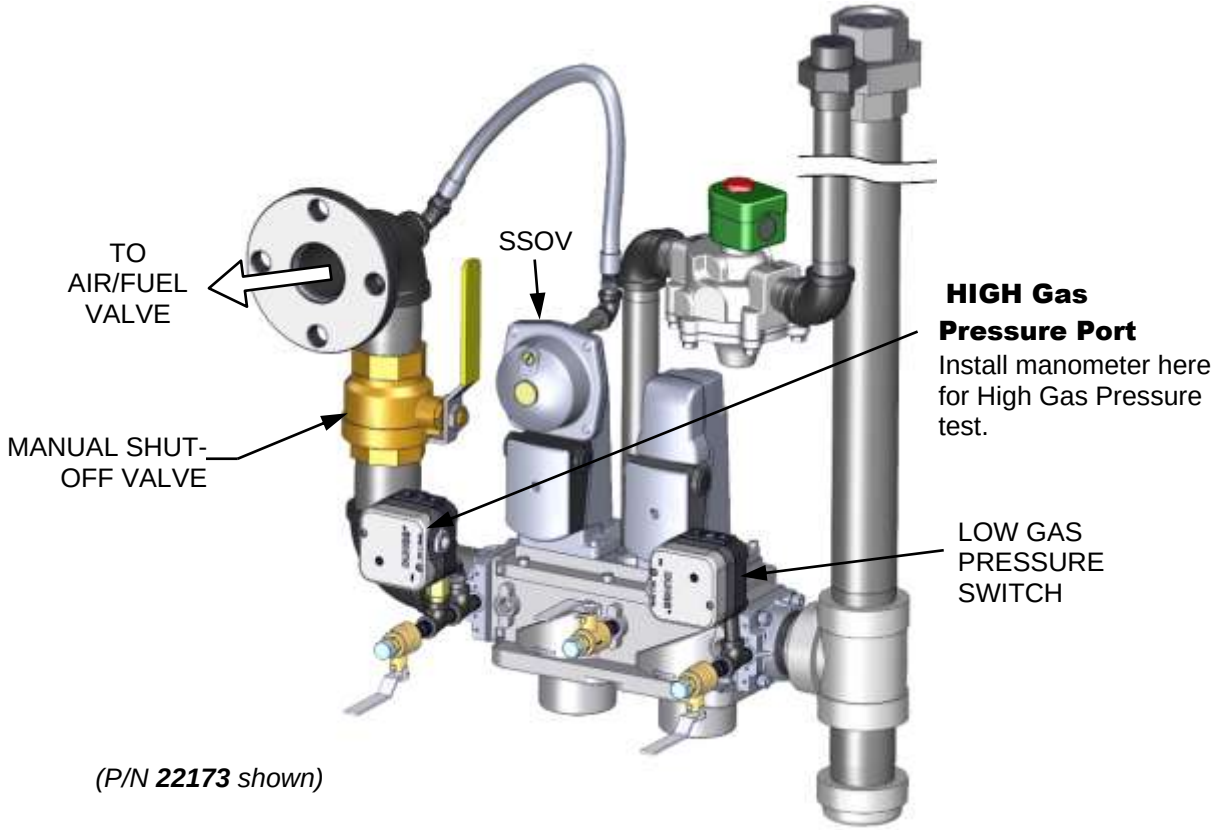
HIGH Gas Pressure Test Instructions: BMK3000 – 6000 ONLY

1. Shut off the **external** gas supply by closing the external gas supply ball valve.
2. Locate the port on the side of the **High Gas Pressure** switch and loosen the screw in the port a few turns to open it. **Do not completely remove the screw.** Alternatively, you can remove the 1/4-inch plug shown in Figure 5-4a and 5-4b and install a hose barb fitting in that location.
3. Attach one end of the plastic tubing to the port or barb fitting and the other end to **a 0 – 16" W.C. (0 – 4.0 kPa)** manometer.
4. Apply the reading of the manifold pressure taken in Step 21 of Section 4.4.1 (natural gas units) or Step 21 of Section 4.4.2 (propane units) and plug it into the following formula, which calculates the ***maximum*** allowable gas pressure:

BMK3000	Natural Gas Pressure → _____ x 1.5 = _____ max gas pressure
BMK4000 & 5000N	Natural Gas Pressure → _____ x 1.5 = _____ max gas pressure
BMK5000 & 6000	Natural Gas Pressure → _____ x 1.5 = _____ max gas pressure Propane Gas Pressure → _____ x 1.5 = _____ max gas pressure

HIGH Gas Pressure Test Instructions: BMK3000 – 6000 ONLY

5. Remove the cover from the High Gas Pressure switch and **set the dial indicator to 20** (the maximum).
6. Open the **external** gas supply ball valve upstream of the unit.
7. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode** and then enable the **Manual Mode** control.
8. Use the **+** (Plus) and **–** (Minus) controls to bring the unit up to 100%.
9. Slowly increase the manifold gas supply pressure by turning the Gas Pressure Adjustment Screw in the Downstream SSOV (see Section 4.4, Figure 4-3) while reading the CO level on the combustion analyzer. Adjust the manifold pressure until the CO reading is **approximately 300 ppm**. Note the number of turns you make, as you will turn it back to its original position in step 13, below.
10. Take a reading of the manifold gas pressure. If the manifold pressure is ***greater*** than the maximum calculated in step 3, then use the Gas Pressure Adjustment Screw to decrease the manifold pressure until it is at the maximum allowed.
11. Slowly turn the indicator dial on the High Gas Pressure switch until the unit shuts down due to a gas pressure fault. This is the setpoint.
12. Press the **RESET** button on the High Gas Pressure switch (in the center of the dial).
13. Readjust the manifold gas supply pressure to what it was before it was increased in step 9.
14. Press the **CLEAR** button on the Edge [i] Controller to clear the fault.
15. Fire the unit back up to insure gas pressure out of the SSOV is set as it was originally.
16. Upon test completion, close the ball valve and remove the manometer fitting from the port, and then turn the port screw clockwise till the port is closed.
17. For Dual Fuel gas trains, repeat this procedure on the **Propane** gas train, starting with opening the port on the **Propane** High Gas Pressure Switch.



*(P/N **22173** shown)*

HIGH Gas Pressure Test Instructions: BMK3000 – 6000 ONLY

Figure 5-4a: BMK3000 HIGH Gas Pressure Test Components

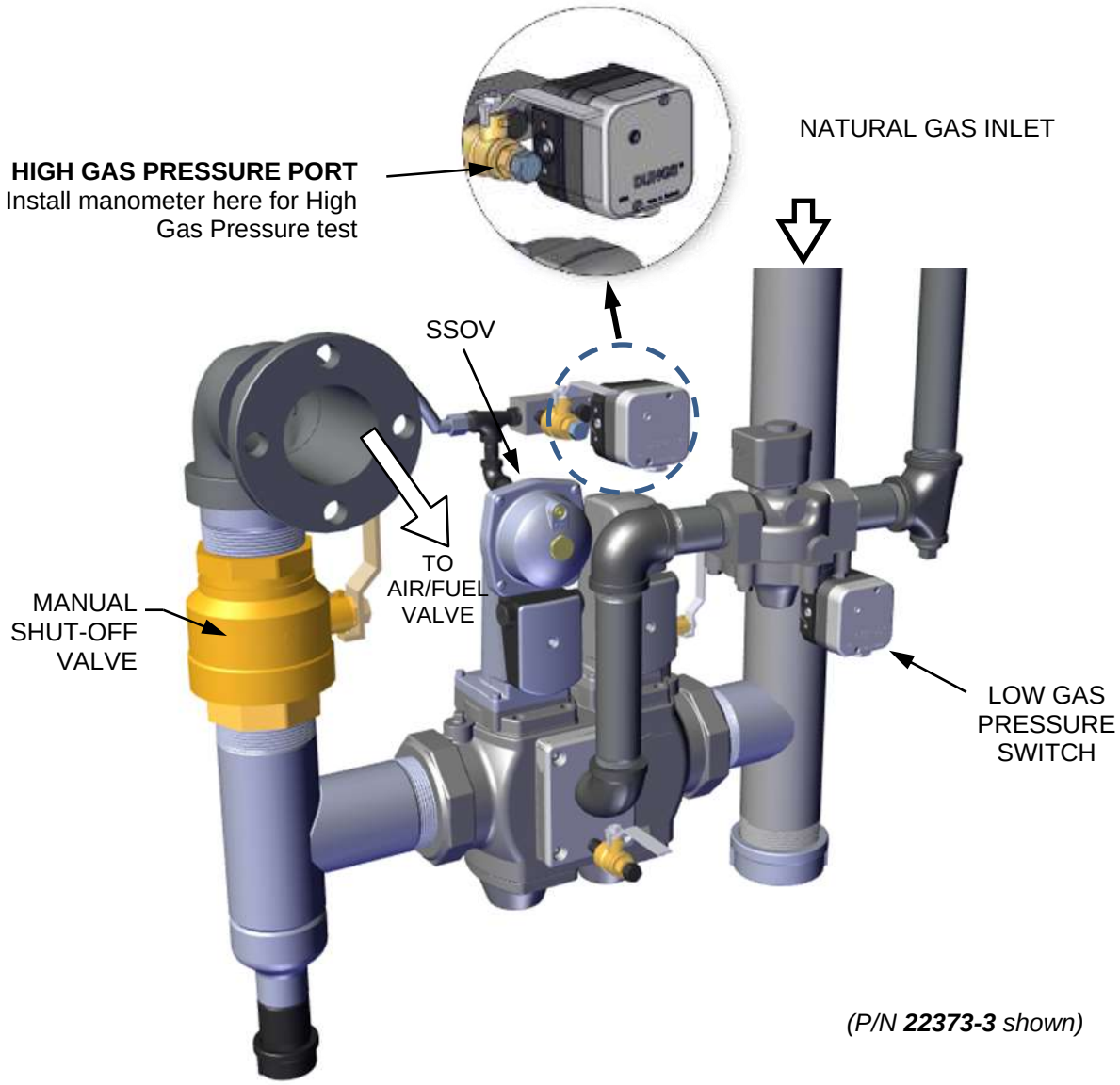
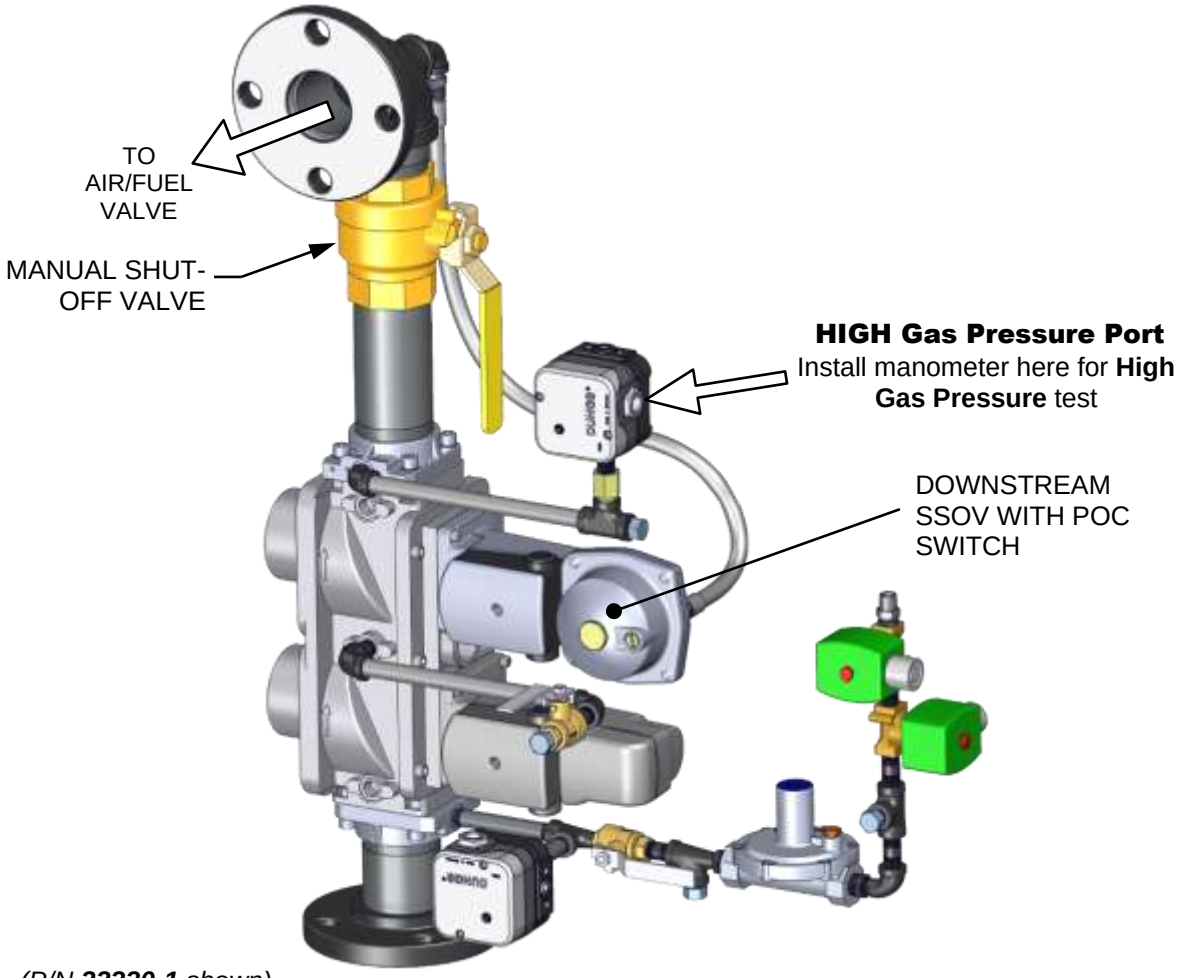


Figure 5-4b: BMK4000/5000N LOW and HIGH Gas Pressure Test Components

HIGH Gas Pressure Test Instructions: BMK3000 – 6000 ONLY



*(P/N **22330-1** shown)*

Figure 5-4c: BMK5000/6000 High Gas Pressure Switch Locations & Test Ports

5.4 LOW WATER LEVEL FAULT TEST

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

LOW Water Fault Test Instructions

1. Set the Controller's **Enable/Disable** switch to **Disable**.
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. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode**.
6. Enable the **Manual Run** control.
7. Raise the valve position **above 30%** using the **+** (Plus) and **–** (Minus) controls.
8. Set the Controller's **Enable/Disable** switch to **Enable**. 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.
9. Close the drain and pressure relief valve used in draining the unit.
10. Open the water shut-off valve in the return piping to the unit.
11. Open the water supply shut-off valve to the unit to refill.
12. After the shell is full, press the **LOW WATER LEVEL – RESET** button to reset the low water cutoff.
13. Press the **CLEAR** button to reset the **FAULT** LED and clear the displayed error message.
14. Set the **Enable/Disable** switch to **Enable**. The unit is now ready for operation.

5.5 WATER TEMPERATURE FAULT TEST

A high-water temperature fault is simulated by adjusting the **Automatic Reset Over-Temperature** switch.

Water Temperature Fault Test Instructions

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***.

NOTE:

If the Controller's is not configured to display outlet temperature, go to the **Main Menu → Advanced Setup → Unit → Front Panel Configuration** screen and set the **Upper-Right Display** parameter to **Water Outlet**.

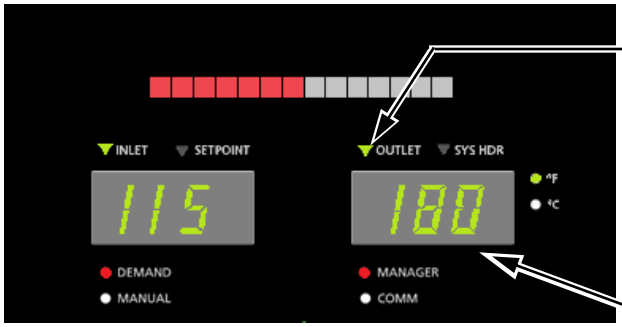


Figure 5-5a: Edge [i] Controller Front Face

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.

Water Temperature Fault Test Instructions

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

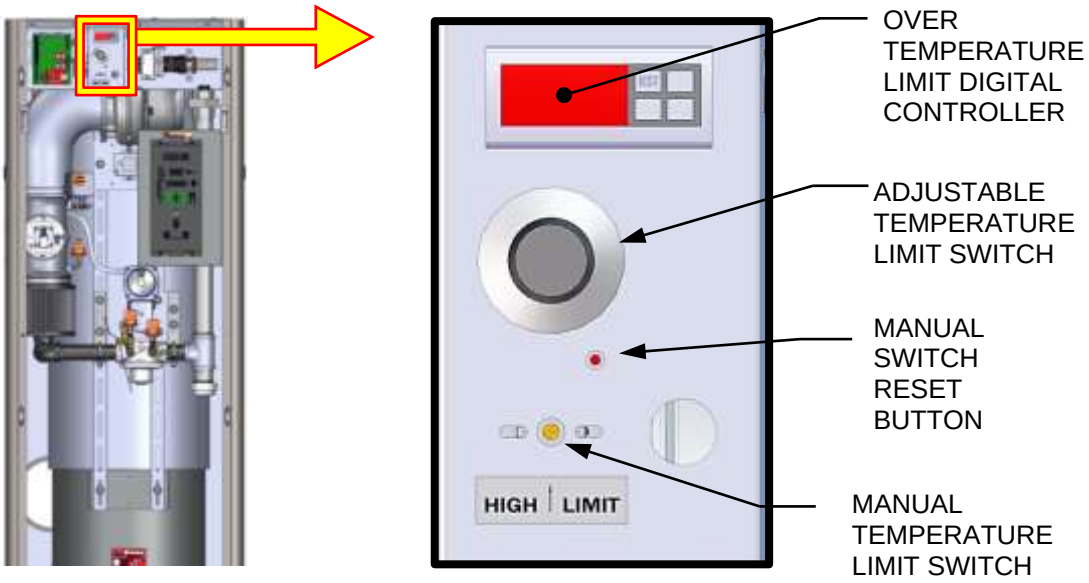


Figure 5-5b: Temperature Limit Switch Location – BMK1500-3000 Shown

5.6 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 (see Section 2.11.1: *I/O Board Connections* in the *Benchmark 750-6000 with Edge [i]: Install-Startup Manual* (OMM-0144, GF-217) and are labeled *REMOTE INTL'K IN* and *DELAYED INTL'K IN*.

These circuits can shut down the unit in the event an interlock is opened. Both interlocks are shipped from the factory jumpered (closed). However, they 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.

5.6.1 Remote Interlock Test

Remote Interlock Test Instructions

1. Remove the cover from the I/O Box and locate the REMOTE INTL'K IN terminals.
2. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode**, then enable the **Manual Run** control.
3. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
4. 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.
5. The unit should shut down and the Controller should display ***Interlock Open***.
6. Once the interlock connection is reconnected, the ***Interlock Open*** message should automatically clear and the unit should restart.

5.6.2 Delayed Interlock Test

Delayed Interlock Test Instructions
1. Remove the cover from the I/O Box and locate the DELAYED INTL'K IN terminals. 2. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode**, then enable the **Manual Run** control. 3. Set the valve position between 25% and 30% using the **+** (Plus) and **–** (Minus) controls. 4. 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. 5. The unit should shut down and display a ***Delayed Interlock Open*** fault message. The **FAULT** LED should be flashing. 6. Reconnect the wire or jumper removed in step 5 to restore the interlock. 7. Press the **CLEAR** button to reset the fault 8. The unit should start.

5.7 FLAME FAULT TEST

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 Test Instructions

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode**.
3. Enable the **Manual Run** control.
4. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
5. Close the gas train's Manual Shutoff valve located between the Safety Shut-Off Valve (SSOV) and the Air/Fuel Valve, as shown on Figure 5-3a to 5-3c, above.
6. It may be necessary to jump out the High Gas Pressure switch.
7. Set the Controller's **Enable/Disable** switch to **Enable** to start the unit.
8. The unit should purge and light the Pilot flame and then shut down after reaching the main Burner Ignition cycle and display ***Flame Loss During Ign***.
9. Open the Manual Shutoff valve closed in step 5 and press the **CLEAR** soft key.
10. Restart the unit and allow it to prove flame.
11. Once flame is proven, close the Manual Shutoff valve located between the SSOV and the Air/Fuel Valve (see Figure 5-3a to 5-3c, above).
12. The unit should shut down and do one of the following:
    a. **BMK750 – 2000 units**: the unit will execute an *IGNITION RETRY* cycle by performing the following steps:
        - The unit will execute a shutdown purge cycle for a period of 15 seconds and display ***Wait Fault Purge***.
        - The unit will execute a 30 second re-ignition delay and display Wait Retry Pause.
        - The unit will then execute a standard ignition sequence and display Wait Ignition Retry.
        - Since the Manual Shutoff valve is still closed, the unit will fail the ignition retry sequence. Therefore, it will shut down and display **Flame Loss During Ign** following the IGNITION RETRY cycle.
    b. **BMK2500 – 3000 units**: the unit will Lockout and ***Flame Loss During Run*** will flash in the display.
13. Open the manual gas valve closed in step 11.
14. Press the **CLEAR** button. The unit should restart and fire.

5.8 AIR FLOW FAULT TESTS - BLOWER PROOF & BLOCKED INLET SWITCHES

These tests check the operation of the **Blower Proof** switch **and Blocked Inlet** switch shown in Figure 5-6a, 5-6b and 5-6c.

5.8.1 Blower Proof Switch Test

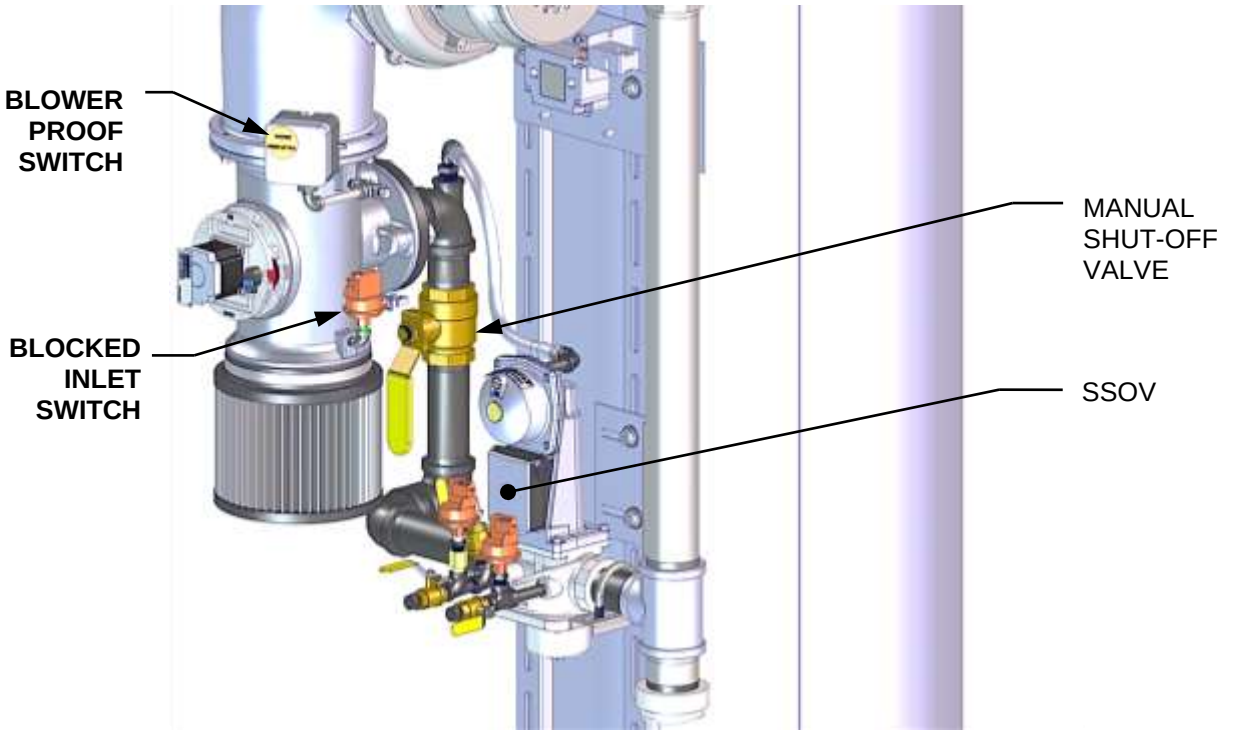


Figure 5-6a: Blower Proof & Blocked Inlet Switch Locations – BMK1500 – 5000N

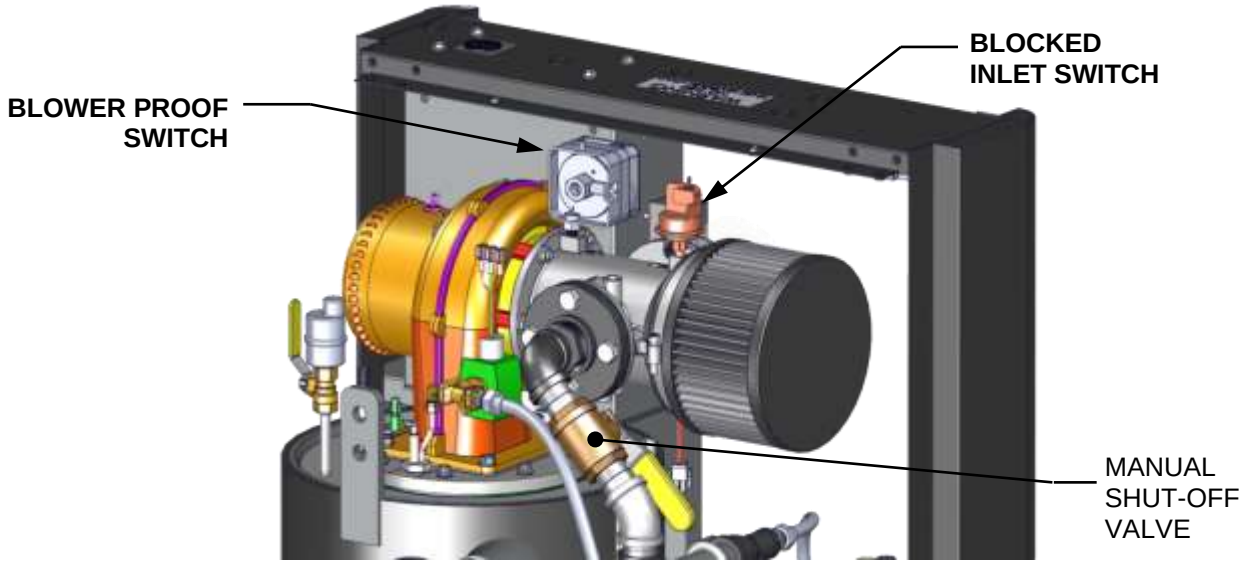


Figure 5-6b: Blower Proof & Blocked Inlet Switch Locations – BMK750 &1000

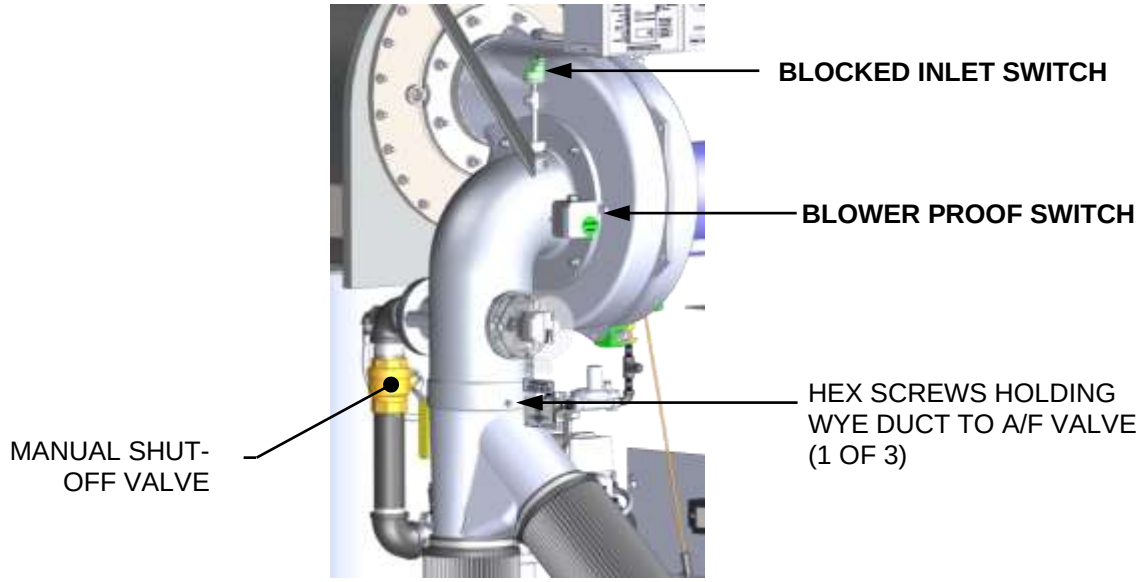


Figure 5-6c: Blower Proof & Blocked Inlet Switch Locations – BMK5000 & 6000

Blower Proof Switch Test Instructions

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. Depending on the model, remove the side and/or front panels to gain access to the Blower Proof Switch (see Figures above for location).
3. Use a Phillips head screw drive to remove the front cover from the switch to reveal the switch setting indicator dial (0.3 in the Figure below).

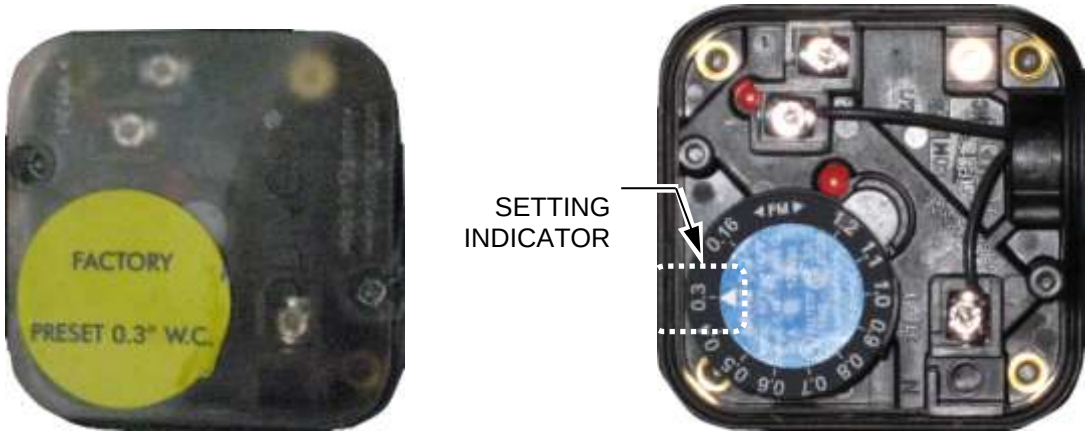


Figure 5-7: Blower Proof Switch

4. Set the Controller's **Enable/Disable** switch to **Enable** and wait for the boiler to go into the Purge sequence.
5. After about 5 seconds, with air flowing into the combustion chamber, slowly turn the dial clock-wise (to higher value) until the unit trips off with an **Air Flow Fault During Purge** message. Optionally, you could attach a manometer and measure the setting at the trip point.
6. After the boiler shuts down, reset the dial indicator to its original position, shown on the switch cover label, then replace the switch cover.
7. Reset the boiler.

5.8.2 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 Instructions

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. Remove the air filter(s) (see Figure 5-6a, 5-6b or 5-6c, above).

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) Create a connector similar to the one shown below and connect it to the Flame Detector's black connector boot. Keep the alligator clip away from bare metal parts until step 4b.

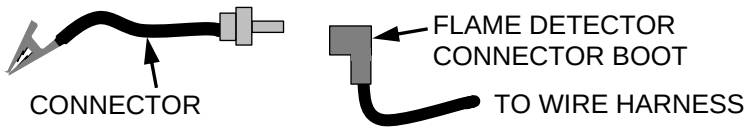


Figure 5-8: Connecting the Flame Signal Generator

4. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode** and then put the unit in **Manual Mode**, then complete the following:
   a) Ramp the boiler up to 100% fire rate and then set the Controller's **Enable/Disable** switch to **Enable**.
   b) When the Controller gets into the ignition phase, it will show ***Ignition Trial***. At that point attach the alligator clip (see Figure 5-8) to any bare metal surface or ground. The Controller displays ***Flame Proven*** and begins to ramp up to 100% fire rate. Note that no gas or flame is present in the boiler at this time.
5. Wait for the boiler to ramp up to at least 90% before continuing.
6. Cover the combustion air inlet opening with a solid, flat object, such as a piece of thick plywood or a thick metal plate.
7. The unit should shut down and display ***Airflow Fault During Run***. This step confirms proper operation of the Blocked Inlet switch.
8. Remove the cover from the air inlet opening and reinstall the Combustion Air Duct or air filter.
9. Remove the jumper wires installed in step 3 and replace the black connector boot on the Flame Detector.
10. Press the **CLEAR** button. The unit should restart.

5.9 SSOV PROOF OF CLOSURE SWITCH CHECK

The SSOV, shown in Figure 5-9, contains the **Proof of Closure** switch. The **Proof of Closure** switch circuit is checked as follows:

SSOV Proof Of Closure Switch Check Instructions

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode**, and then put the unit in **Manual Mode**.
3. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
4. Remove the cover from the SSOV by loosening the screw shown in Figure 5-9. 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 Controller's **Enable/Disable** switch to **Enable** 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 5-9: SSOV Actuator Cover Location

5.10 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 Check Instructions

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. On the Controller, go to: **Main Menu → Diagnostics → Manual Mode**, and then put the unit in **Manual Mode**.
3. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
4. Remove the Air/Fuel Valve cover by rotating the cover counterclockwise to unlock it (see Figure 5-10).
5. Remove one of the two wires (#171 or #172) from the Purge switch (Figure 5-11a – 5-11c).
6. Set the Controller's **Enable/Disable** switch to **Enable** to start the unit.
7. The unit should begin its start sequence, then shut down and display ***Prg Switch Open During Purge***.
8. Replace the wire on the Purge switch and depress the **CLEAR** button. The unit should restart.

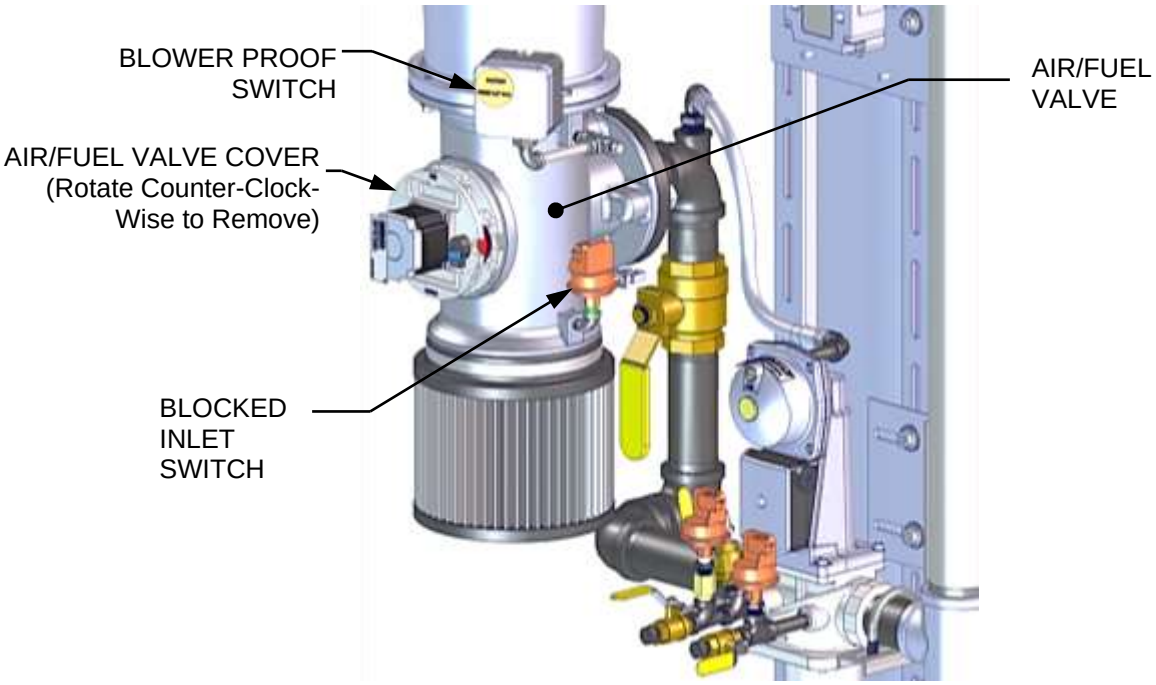


Figure 5-10: Air/Fuel Valve Cover Location – BMK1500 Shown

Purge Switch Open During Purge Check Instructions

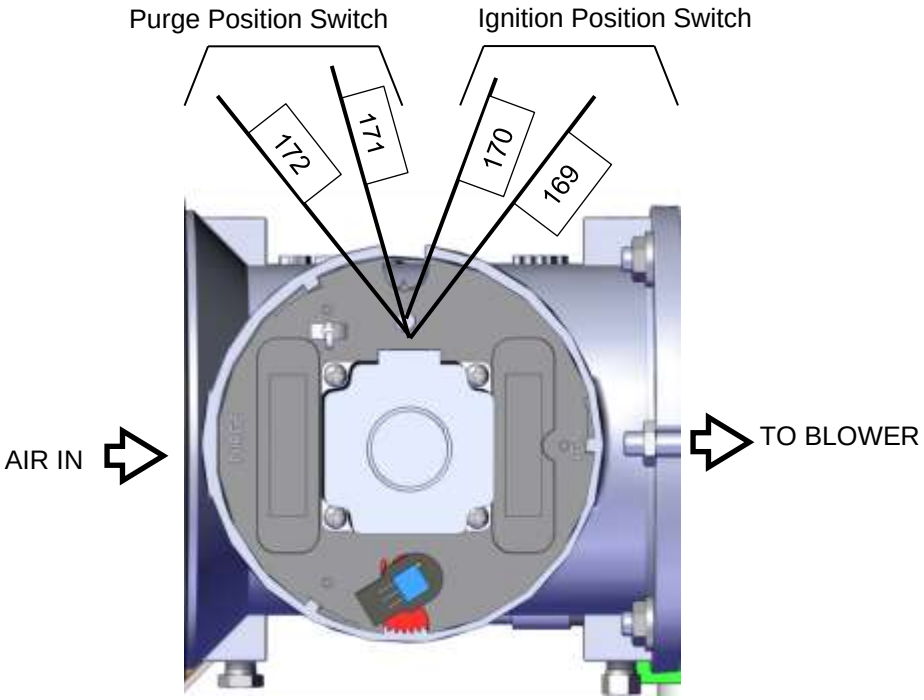


Figure 5-11a: Air/Fuel Purge and Ignition Locations – BMK750/1000

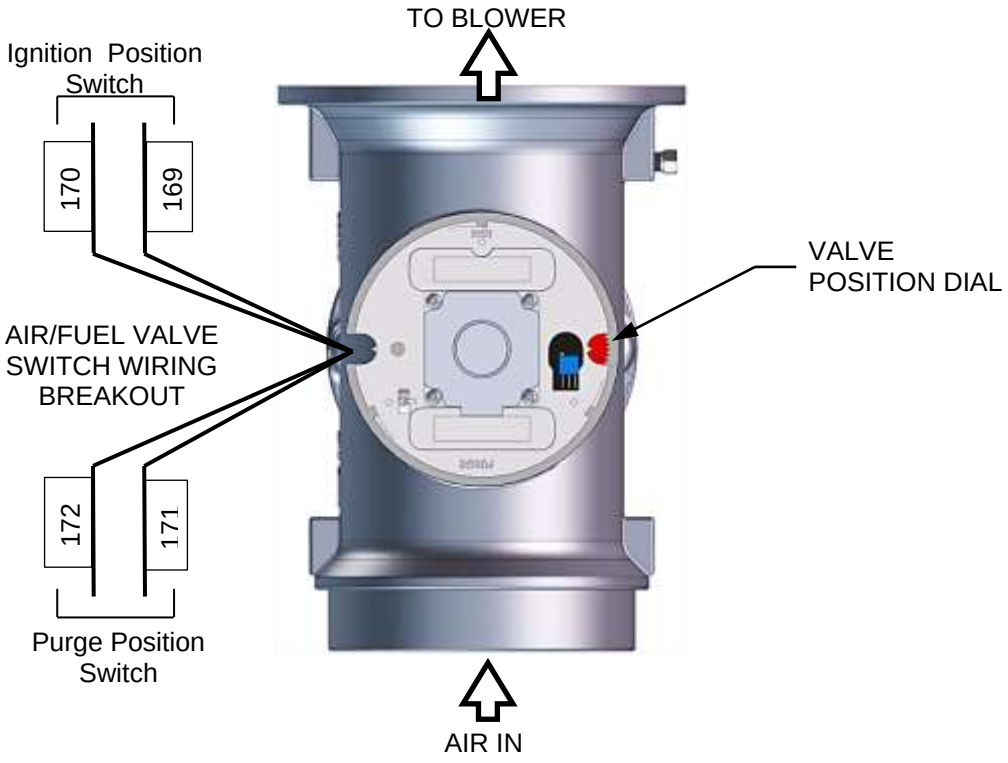


Figure 5-11b: Air/Fuel Purge and Ignition Locations – BMK1500 – 5000N

Purge Switch Open During Purge Check Instructions

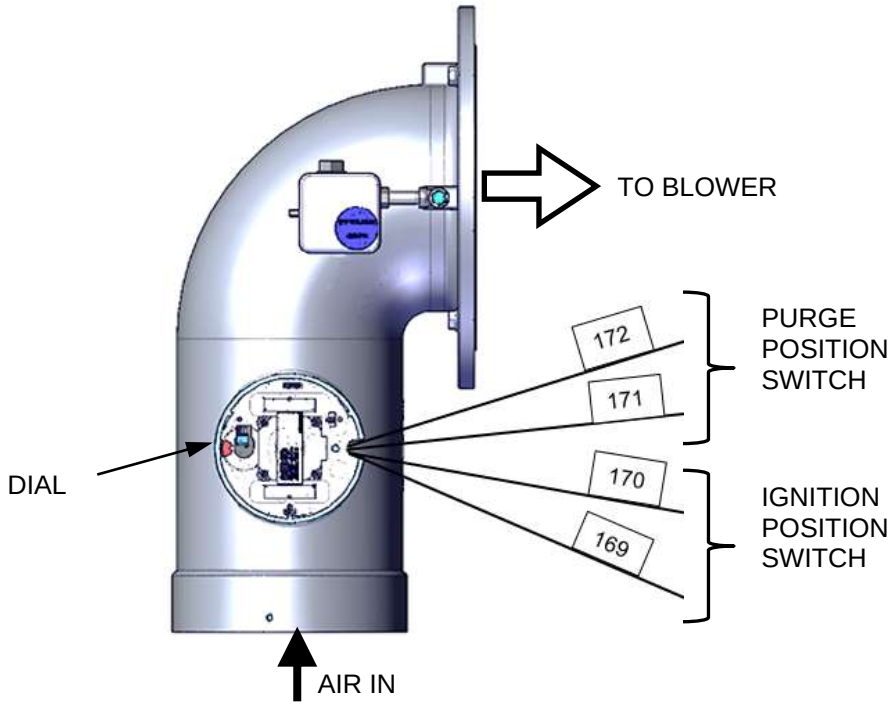


Figure 5-11c: Air/Fuel Purge and Ignition Locations – BMK5000 & 6000

5.11 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 Check Instructions

1. Set the Controller's **Enable/Disable** switch to **Disable**.
2. Go to **Main Menu→Diagnostics→Manual Run** and then put the unit in **Manual Mode**.
3. Set the valve position **between 25% and 30%** using the **+** (Plus) and **–** (Minus) controls.
4. Remove the Air/Fuel Valve cover (Figure 5-10, above) by rotating the cover counterclockwise.
5. Remove one of the two wires (#169 or #170) from the Ignition switch (see Figure 5-11a – 5-11c, above).
6. Set the Controller's **Enable/Disable** switch to **Enable** to start the unit.
7. The unit should begin its start sequence and then shut down and display ***Ign Switch Open During Ignition***.
8. Replace the wire on the Ignition switch and press the **CLEAR** button. The unit should restart.

5.12 SAFETY PRESSURE RELIEF VALVE TEST

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

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SECTION 6. STANDALONE MODES OF OPERATION

The descriptions and instructions in this chapter apply to **Standalone** units **only**; the unit cannot be a BST Client or BST Manager.

To verify that the unit is ***not*** a BST Client or Manager, go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration**, then verify that **Unit Mode** = **Off**.

For instructions on configuring BST modes of operation, see Chapter 7: *Boiler Sequencing Technology*, below

Benchmark standalone boilers are capable of being operated in any one of six different modes. The following sections 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. After reading this section, parameters can be customized to suit the needs of the specific application.

6.1 OUTDOOR AIR RESET MODE

The **Outdoor Air Reset** operating mode 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.

To enable this operating mode:

1. Go to **Main Menu → Advanced Setup → Unit → Unit Application Configuration**.
2. Set the **Unit Application** parameter to **SH**.
3. Set the **Unit SH Operating Mode** parameter to **Outdoor Reset**.
4. Set the **Outdoor Air Temp Sens** parameter to **Network**, **Direct** or **BAS**.

6.1.1 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 (61m)** from the unit. connections are made at the Input/Output (I/O) Box on the front of the boiler.

The Outdoor Air Temp Sensor must be connected to the **OUTDOOR AIR** and **AIR SENSOR COMMON** terminals on the I/O board. Use shielded 18 to 22 AWG wire for connections.

For additional information on wiring see to Section 2.11.1: *Outdoor Air & Air Sensor Common* in the *Benchmark 750-6000 with Edge [i]: Install-Startup Manual* (OMM-0144, GF-217).

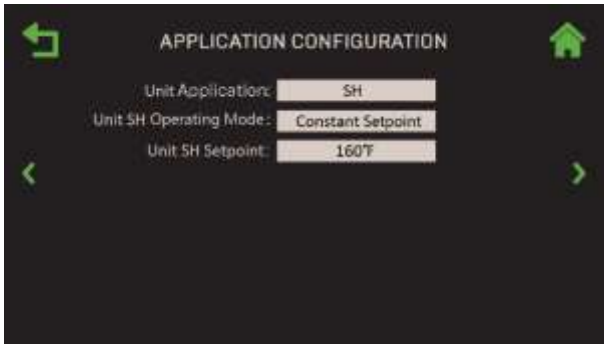
6.1.2 Outdoor Reset Mode Startup

Startup in the **Outdoor Reset** mode is accomplished as follows:

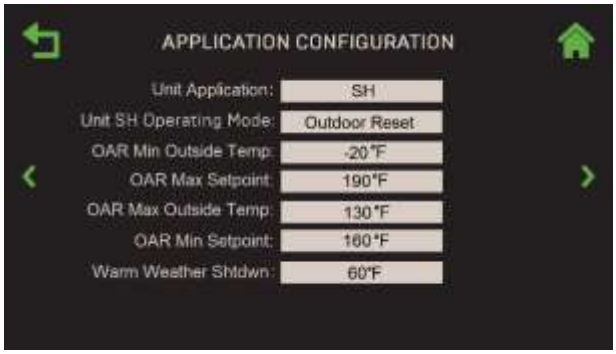
NOTE:
It is required to have an outdoor sensor for the Outdoor reset. A header sensor or boiler supply sensor can be used depending on the plant configuration.

Outdoor Reset Mode Setup Instructions

1. Go to: **Main Menu → Advanced Setup → Unit → Application Configuration**.
2. Press the **Unit Application** parameter and choose **SH**.
3. In the **Unit SH Operating Mode** parameter, choose **Outdoor Reset**. The parameters that appear will be used to create a temperature curve to vary the unit's active setpoint depending on the Outside Air Temperature (OAT).



Unit Application = SH



Unit Application = Outdoor Reset

Figure 6-1: Application Configuration Screen

4. Set the following parameters to define the total outside air temperature span which will be used for Setpoint control.
   - **OAR Min Outside Temp**: The minimum outside temperature the system can read; it is tied to the OAR Max Setpoint. For example, if OAR Min Outside Temp is -5°F and OAR Max Setpoint is 180°F, when the outside temperature is -5°F or below, the system will supply 180°F.
   - **OAR Max Outside Temp**: Outdoor Air Reset Maximum Outside Temperature that the system will operate to. For example: if set to 60°F, the boiler will operate between 60°F outside temperature and OAR Min Outside Temp setting.
5. Set the following parameters to define the Setpoint curve, which will be used to yield a desired setpoint for a given outside temperature:
   - **OAR Max Setpoint**: The maximum allowable setpoint (range = Min Setpoint up to 210°F (98.9°C)).
   - **OAR Min Setpoint**: The minimum allowable setpoint (range = 40°F (4.4°C) up to the Max Setpoint).
6. Set the **Warm Weather Shutdown** parameter to the threshold outside temperature above which the unit shuts down. For example, if set to 65°F, when the outside temperature goes above 65°F, the unit goes into standby. The unit will then restart when temperature falls below 60°F.

6.2 CONSTANT SETPOINT MODE

The **Constant Setpoint** mode (the default) 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.

The setpoint temperature of the unit is adjustable from 40°F to 245°F (4.4°C to 118.3°C).

To set the unit to **Constant Setpoint** mode:

Constant Setpoint Mode Setup Instructions

1. Go to: **Main Menu → Advanced Setup → Unit →Application Configuration**.
2. Press **SH Operating Mode** and choose **Constant Setpt**.
3. Press **SH Setpoint** and choose the desired setpoint.

6.3 REMOTE SETPOINT MODE

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.

NOTE:

See Section 2.11.5: *Analog In* in the *Benchmark 750-6000 with Edge [i]: Install-Startup Manual* (OMM-0144, GF-217) for field wiring instructions.

When using the **Remote Setpoint** mode default setting, **4 - 20 mA/1 - 5 VDC**, 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 Setpoint Low Limit, while a **20 mA /5V** signal is equal to a Setpoint High Limit setpoint. When a 0 to **20 mA/0 to 5 VDC** signal is used, **0 mA** is equal to Setpoint Low Limit.

In addition to the current and voltage signals described above, the **Remote Setpoint** mode can also be driven by a RS-485 Modbus Network signal from an EMS or BAS.

The **Remote Setpoint** mode 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 Edge [i] Controller. Contact your local AERCO representative for details.

To set the unit to **Remote Setpoint** mode:

Remote Setpoint Mode Setup Instructions

1. Go to **Main Menu →Advanced Setup → Unit →Application Configuration.**
2. Press **SH Operating Mode** and choose **Remote Setpt**.
3. Set the **Remote Setpoint** parameter to one of the following:
   - 4-20mA/1-5V
   - BST (PWM) Input
   - BAS
   - 0-20mA/0-5V
   - Network

If the **Network** setting is selected for RS-485 Modbus operation, a valid Comm Address must be entered in the *Setup* menu. Refer to the *Modbus Communication Manual* (OMM-0035, GF-114) for additional information.

While it is possible to change the values of temperature related functions, the unit is factory preset with values that work well in most applications. It is suggested that an AERCO representative be contacted, prior to changing any temperature related function values.

6.4 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.

The 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 be driven by a RS-485 Modbus Network signal from an EMS or BAS. When in **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 Edge [i] Controller. Contact your local AERCO representative for details.

To enable the **Direct Drive** mode:

Direct Drive Mode Setup Instructions

1. Go to: **Main Menu → Advanced Setup → Unit →Application Configuration**.
2. Press **SH Operating Mode** parameter and choose **Direct Drive**.
3. The **Remote Signal** parameter now appears. It can be set to one of the options below.
   - 4-20mA
   - BST (PWM) Input
   - 1-5V
   - BAS
   - 0-20mA/
   - Network
   - 0-5V

Direct Drive Mode Setup Instructions

4. If **Network** was selected in the previous step, the **Unit Address** parameter appears. Enter a valid Comm address in this parameter.

Refer to *Modbus Communication Manual* (OMM-0035, GF-114) for additional information.

6.5 AERCO CONTROL SYSTEM (ACS)

NOTE:

ACS is for installations with between 17 and 32 boilers. It utilizes only RS-485 signaling to the boiler. For installations with 1 to 16 boilers Boiler Sequencing Technology (BST) is recommended. See Section 7: *Boiler Sequencing Technology*.

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 (0.61 and 3m)** downstream of the ***last*** boiler in the boiler plant's supply water header.

ACS can control up to 32 boilers via Modbus (RS-485) network communication.

For ACS programming, operation, and Header Sensor installation details, see the *ACS Operations Guide* (OMM-081, GF-131). For operation via an RS-485 Modbus network, refer to *Modbus Communication Manual* (OMM-0035, GF-114).

To enable the **ACS** mode:

ACS Mode Setup Instructions

1. As a prerequisite, verify that the unit is ***not*** a BST Client or Manager. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration, Unit Mode** = **Off**.
2. On the Controller, go to: **Main Menu → Advanced Setup → Unit →Application Configuration**.
3. Press **Unit SH Operating Mode** parameter and choose **Direct Drive**.
4. Press the **Remote Signal** parameter and choose **Network**.
5. Press the **Baud Rate** parameter and choose **9600**.

NOTE:

See Section 2.11.1 in the *Benchmark 750-6000 with Edge [i]: Install-Startup Manual* (OMM-0144, GF-217) for field wiring instructions.

6.6 COMBINATION CONTROL SYSTEM (CCS)

NOTE:

The ACS can be utilized for a Combination Control System.

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

between constant setpoint and ACS control.

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

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

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

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

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

When the combo units are satisfying the domestic load, they are in the **Constant Setpoint** mode of operation. When the combo units switch over to space heating, their mode of operation changes to follow the ACS command. For more information concerning the operation of the ACS, consult the *AERCO Control System Manual* (OMM-0081, GF-131); for information on mounting and wiring the ACS Relay Box, see section 2.14 in that manual.

6.6.1 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.

6.6.2 Combination Control System Setup and Startup

To setup a boiler for **Combination** mode:

Combination Control System Setup Instructions

1. As a prerequisite, verify that the unit is ***not*** a BST Client or Manager. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration, Unit Mode** = **Off**.
2. On the Controller, go to: **Main Menu → Advanced Setup → Unit →Application Configuration**.
3. Press **SH Operating Mode** and choose **Combination**.
4. Press the **Remote Signal** parameter and choose **Network**.

While it is possible to change other temperature-related functions for **Combination** mode, these functions are preset at the factory. 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.

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SECTION 7. BOILER SEQUENCING TECHNOLOGY

7.1 INTRODUCTION

The Boiler Sequencing Technology system (BST) is an integrated 16 boiler control system. It is built into the Edge [i] Controller. It has its own sophisticated PID control system designed to simultaneously control the light off and modulation of **up to 16 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 when 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 unit the BST network is defined as the "Manager" and all other units on the network are defined as "Client" units. The Manager monitors the system Header Temperature, and also monitors all Client unit's status information, efficiently controlling all units in order to achieve and maintain the required BST Setpoint Temperature.

When there is a demand, the BST Manager will light off the lead boiler based on the BST Sequencing selection in the *BST Cascade Status* screen. As system load increases and the valve position of the ignited unit(s) reach the Next On VP (% valve position), the Manager will light off the next available unit. A simplified block diagram of multiple Boilers connected to a BST is shown in Figure 7-1 below.

NOTE: Use either FFWD Header Temp Sensor or Modbus Header Temp Sensor

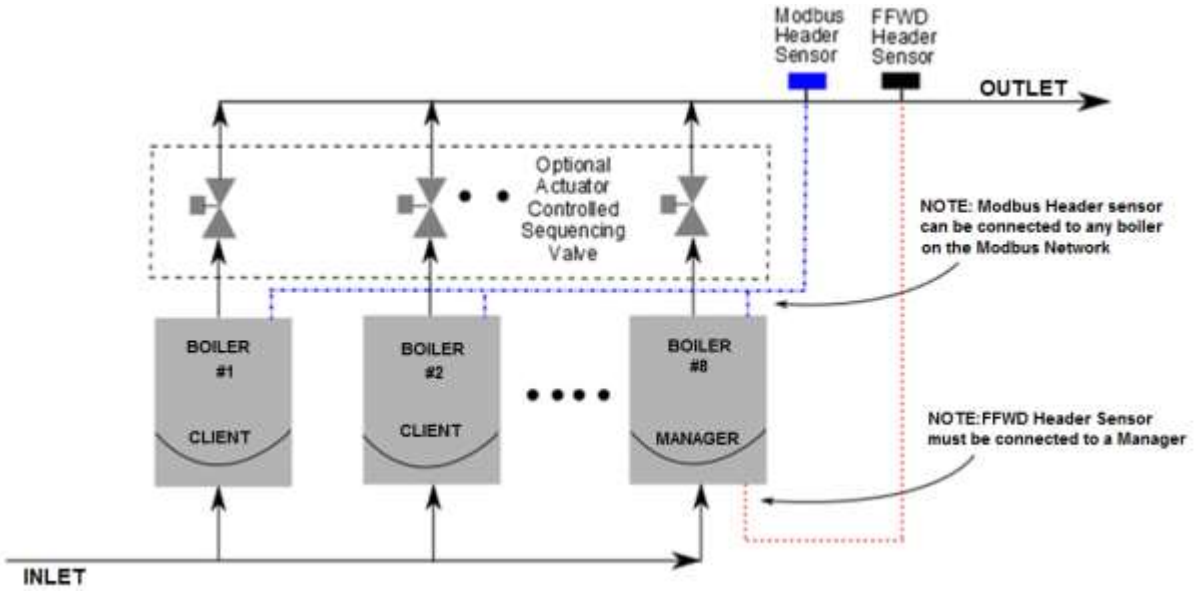


Figure 7-1: Simplified BST Block Diagram

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 Edge [i] Controller will open the isolation valves for all of the boilers. The BST controls the valves via a 0-20 mA signal (see Section 2.11.1: *I/O Board Connections* in the *Benchmark 750-6000 with Edge [i]: Install-Startup Manual* (OMM-0144, GF-217).

7.1.1 Installation Notes

A ProtoNode is needed for all Protocols on BMK with EDGE[i] Controllers, including BACnet, Modbus. If your installation includes a ProtoNode SSD (Client-Client 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 on the 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.

7.2 BST QUICK START CHART

Select the single option that suites your installation and then complete the instructions in the corresponding sub-sections of section 7.3 *BST Implementation Instructions*.

Constant Setpoint (choose option 1 or 2)	
Option 1 – Direct Wired Header (Header Temp)	Complete section 7.3.1
Option 2 – Modbus Header (Network)	Complete section 7.3.2
Outdoor Reset (choose option 3 or 4)	
Option 3 – Direct Wired Header AND Direct Wired Outdoor Air	Complete section 7.3.3
Option 4 – Modbus Header AND Modbus Outdoor Air	Complete section 7.3.4
Remote Setpoint (choose option 5 through 8)	
Option 5 – 4-20ma Drive AND Direct Wired Header	Complete section 7.3.5
Option 6 – Modbus Drive via ProtoNode AND Direct Wired Header	Complete section 7.3.6
Option 7 – 4-20ma Drive AND Modbus Header	Complete section 7.3.7
Option 8 – Modbus Drive via ProtoNode AND Modbus Header	Complete section 7.3.8

7.3 BST IMPLEMENTATION INSTRUCTION

There are 8 BST implementation options, described below. The instructions for each refer to I/O board connections described in Section 2.11 in the *Benchmark 750-6000 with Edge [i]: Install-Startup Manual* (OMM-0144, GF-217).

All instructions in the sections below refer to one or more of the following components:

- Modbus Transmitter:
  - P/N **24444-1** includes PT1000 Header Temp Sensor P/N **61058**, box and power supply.
  - P/N **24444-3** includes PT1000 Header Temp Sensor P/N **61058**.
- Header Temp Sensor, either:
  - P/N **61040 (BALCO)** if connecting directly to I/O board.
  - P/N **61058 (PT1000)** dual bead, if connecting to Modbus Transmitter
- Outdoor Sensor, either:
  - P/N **61047 (BALCO)** if connecting directly to I/O board.
  - P/N **61060 (PT1000)** if connecting to Modbus Transmitter.

7.3.1 Option 1 Constant Setpoint: Direct Wired Header Temp Sensor

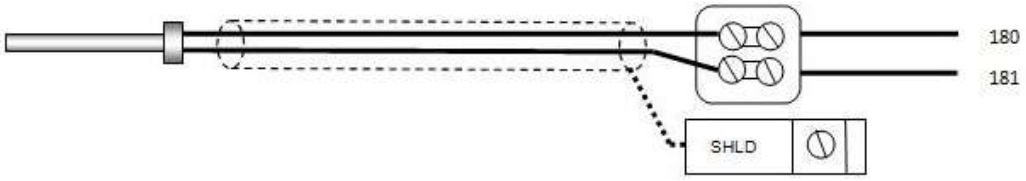
OPTION 1 Instructions: Constant Setpoint with Direct Wired Header Temp Sensor

OPTION 1 Step 1: HEADER TEMP SENSOR WIRING – BST MANAGER Unit

1. On the **BST Manager** unit, connect the **Header Temp Sensor** 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 Temp Sensor** must be installed between 2 and 10 feet (0.61 and 3.1m) downstream of the ***last*** boiler in the plant's supply water header.
- Shielded pair 18 - 22 AWG cable is recommended for **Header Temp 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.



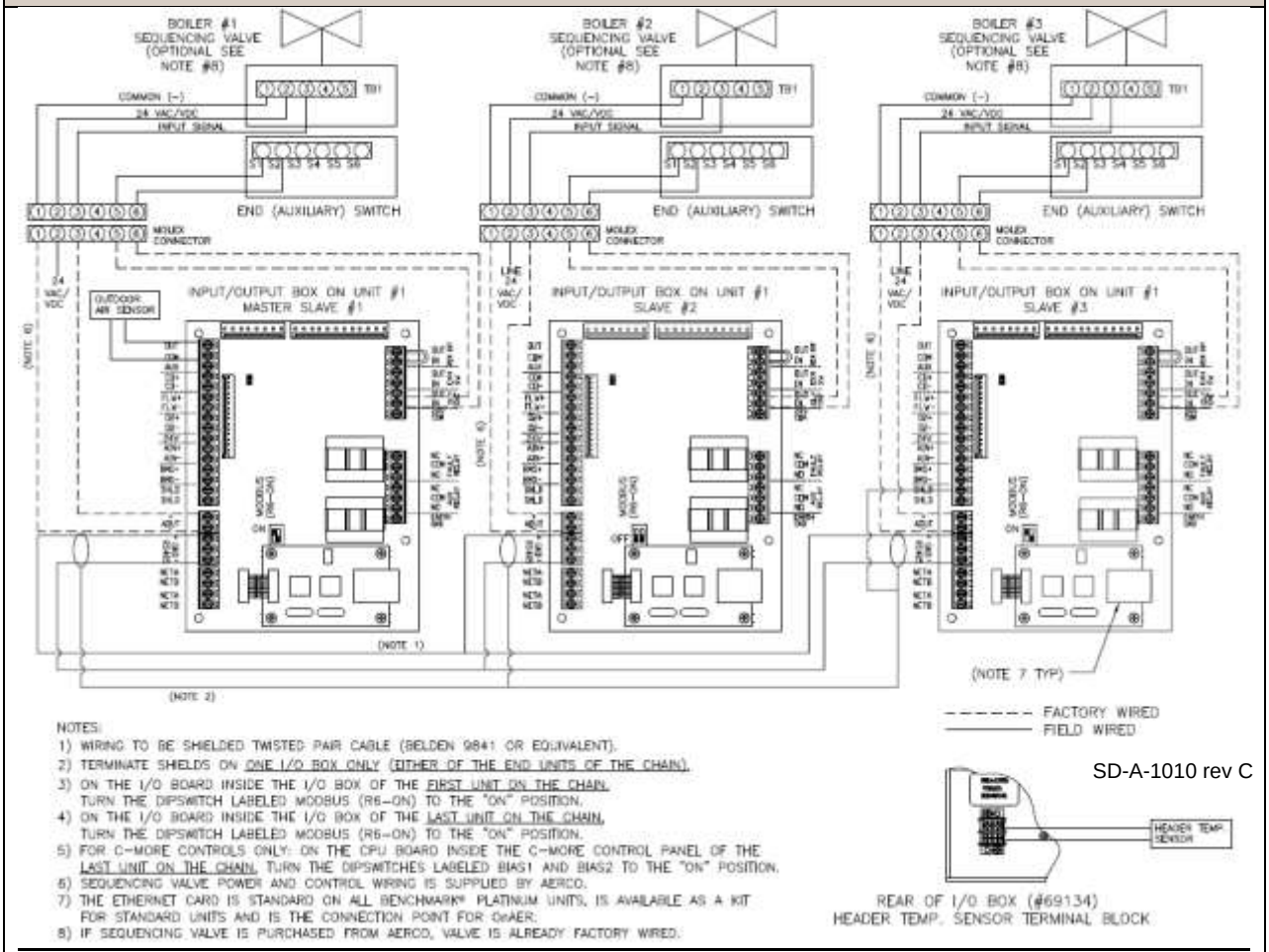
HEADER TEMP SENSOR I/O BOX

OPTION 1 Step 2: CONNECT BOILERS IN DAISY CHAIN

1. Connect the boilers in a daisy chain, as shown below.

Continued on next page

OPTION 1 Instructions: Constant Setpoint with Direct Wired Header Temp Sensor



NOTES:
1) WIRING TO BE SHIELDED TWISTED PAIR CABLE (BELDEN 9841 OR EQUIVALENT).
2) TERMINATE SHIELDS ON ONE I/O BOX ONLY (EITHER OF THE END UNITS OF THE CHAIN).
3) ON THE I/O BOARD INSIDE THE I/O BOX OF THE FIRST UNIT ON THE CHAIN, TURN THE DIPSWITCH LABELED MODBUS (R6-ON) TO THE "ON" POSITION.
4) ON THE I/O BOARD INSIDE THE I/O BOX OF THE LAST UNIT ON THE CHAIN, TURN THE DIPSWITCH LABELED MODBUS (R6-ON) TO THE "ON" POSITION.
5) FOR C-MORE CONTROLS ONLY: ON THE CPU BOARD INSIDE THE C-MORE CONTROL PANEL OF THE LAST UNIT ON THE CHAIN, TURN THE DIPSWITCHES LABELED BIAS1 AND BIAS2 TO THE "ON" POSITION.
6) SEQUENCING VALVE POWER AND CONTROL WIRING IS SUPPLIED BY AERCO.
7) THE ETHERNET CARD IS STANDARD ON ALL BENCHMARK® PLATINUM UNITS. IS AVAILABLE AS A KIT FOR STANDARD UNITS AND IS THE CONNECTION POINT FOR OnAER.
8) IF SEQUENCING VALVE IS PURCHASED FROM AERCO, VALVE IS ALREADY FACTORY WIRED.

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OPTION 1 Step 3: CONFIGURATION

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration** and set the **Unit Mode** parameter to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication** and set the **Unit Address** parameter to the communication address of the unit.

On the <u>BST Manager</u> only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu listed in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Auto Manager Transfer	Disabled (Available on the Manger unit only)
	Unit Mode	BST Manager
	Hdr Temp Sensor	FFWD Temp
Application Configuration	Application	Space Heating
	SH Operating Mode	Constant Setpoint
	SH Setpoint	Header temperature required for the cascade
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

7.3.2 Option 2 Constant Setpoint: Modbus Wired Header Temp Sensor

OPTION 2 Instructions: Constant Setpoint with Modbus Wired Header Temp Sensor

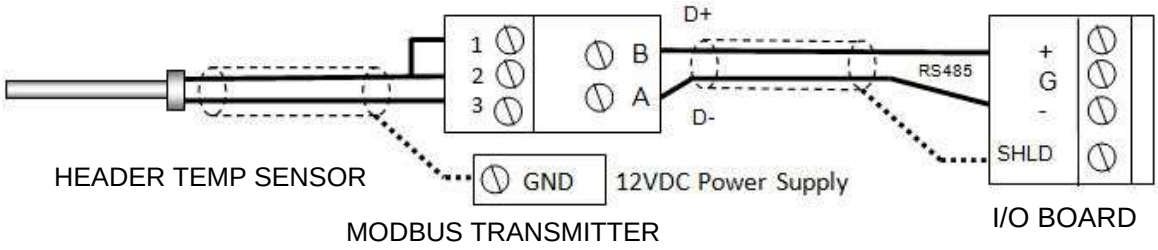
OPTION 2 Step 1: MODBUS HEADER TEMP SENSOR WIRING – ANY BOILER

Using the Modbus Transmitter gives the plant the ability to use the Backup manager feature. This allows any of the client units to become a Backup manager if the manager unit is not communicating.

1. Connect the **Modbus Transmitter** terminal **Pin B** to the **RS485+** terminal, and **Pin A** to the **RS485-** terminal on the I/O Board of any Boiler unit, using shielded pair 18 - 22 AWG cable.
2. Connect the **Header Temp Sensor** to pins **2** and **3** of the **Modbus Transmitter** using shielded pair 18 - 22 AWG cable.
3. Install a jumper wire between pins **1** and **2** of the **Modbus Transmitter**.

NOTES:

- Polarity must be observed for the RS485 connections.
- Ground the shield to any **SHLD** terminal on the I/O Board.
- The **Header Temp Sensor** must be installed between 2 and 10 feet (0.61 and 3.1m) 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.



OPTION 2 Step 2: CONNECT BOILERS IN DAISY CHAIN

2. Connect the boilers in a daisy chain, as shown below.

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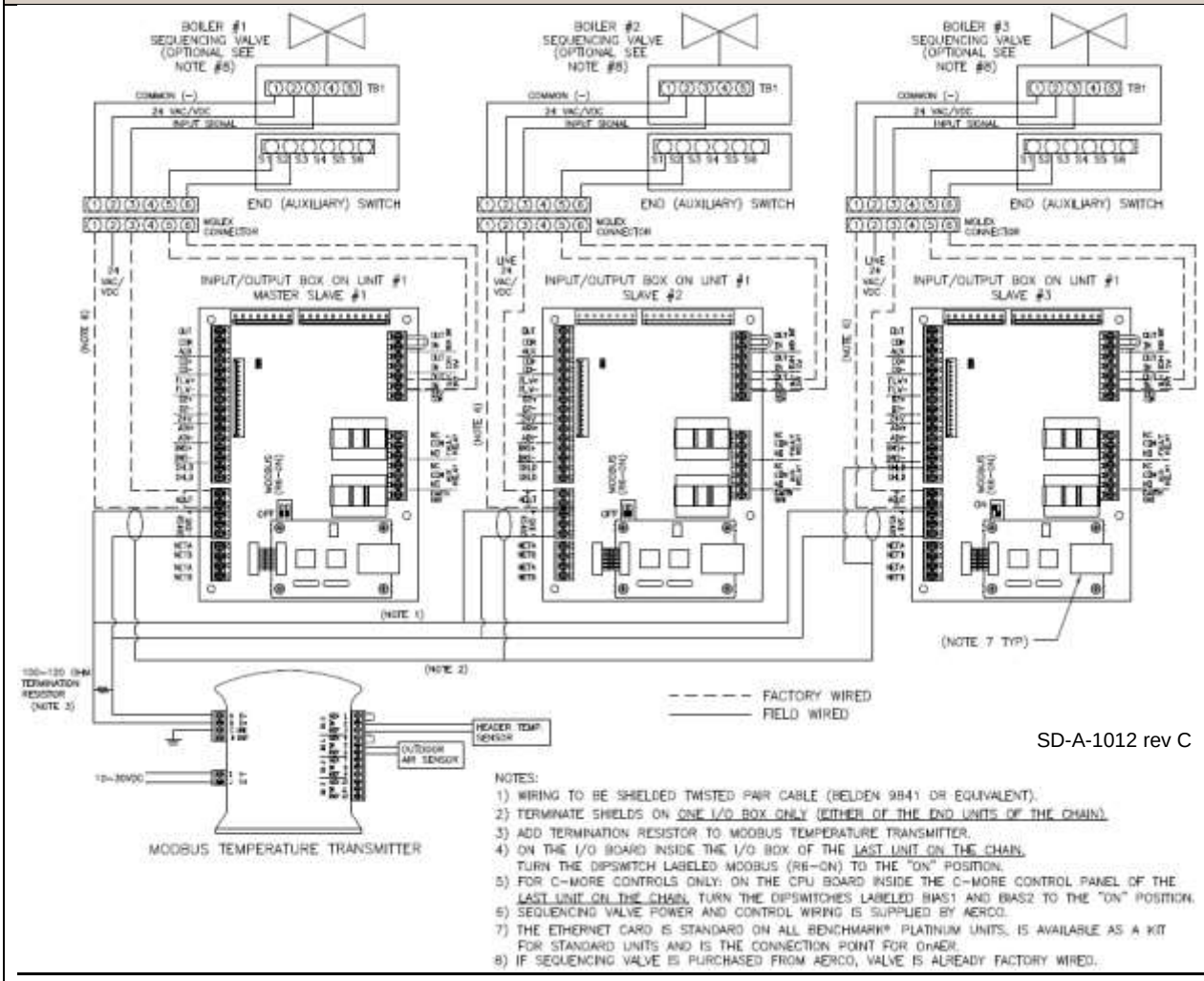
OPTION 2 Instructions: Constant Setpoint with Modbus Wired Header Temp Sensor



Step 3: CONFIGURATION

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration** and set the **Unit Mode** parameter to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication** and set the **Unit Address** parameter to the communication address of the unit.

Continued on next page

OPTION 2 Instructions: Constant Setpoint with Modbus Wired Header Temp Sensor

On the BST Manager only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Auto Manager Transfer	Enabled (This is available on the Manager unit only)
	Auto failover Type	C-More
	Backup Manager Address	Enter the designated backup unit address
	Unit Mode	BST Manager
	Hdr Temp Sensor	Network
	Sensor Comm Address	240
	Hdr Temp Point	14
Application Configuration	Application	Space Heating
	SH Operating Mode	Constant Setpoint
	Plant Setpoint	Header temperature required for the cascade
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

7.3.3 Option 3 Outdoor Reset: Direct Wired Header Temp Sensor & Direct Wired Outdoor Sensor

OPTION 3 Instructions: Outdoor Reset, Direct Wired Header Temp Sensor & Outdoor Sensor

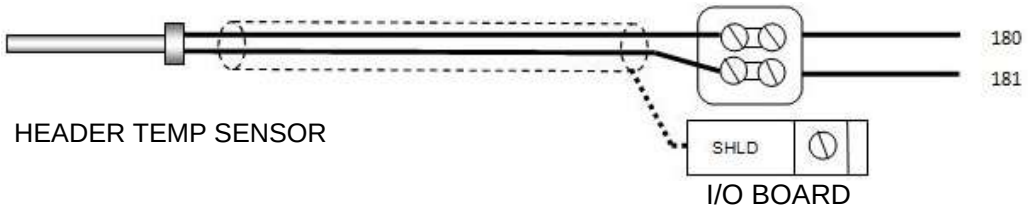
NOTE:
Both **Header Temp Sensor** *and* **Outdoor Sensor** must be wired. See the *Edge [i] Controller Manual* (OMM-0141, GF-213-B) for more information.

OPTION 3 Step 1: DIRECT WIRED HEADER TEMP SENSOR WIRING – BST MANAGER Unit

1. On the **BST Manager** unit, connect the **Header Temp Sensor** to the Feed Forward (FFWD) terminals on the P-1 Harness via the terminal block labeled ***Header Temp sensor*** on the I/O Board.
2. Ground the shield to any **SHLD** terminal on the I/O Board.

NOTES:

- The **Header Temp Sensor** must be installed between 2 and 10 feet (0.61 and 3.1m) downstream of the ***last*** boiler in the plant's supply water header.
- Shielded pair 18 - 22 AWG cable is recommended for **Header Temp Sensor** wiring. There is no polarity to be observed. Ground the shield to the *Shield* terminal on the I/O Board. The sensor end of the shield must be left free and ungrounded.

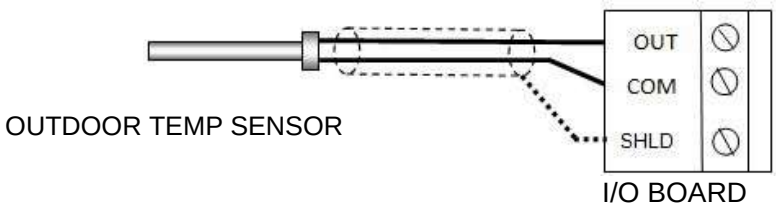


OPTION 3 Step 2: DIRECT WIRED OUTDOOR SENSOR WIRING – BST MANAGER Unit

1. On the **BST Manager** Unit, connect the **Outdoor Temp Sensor** to the **OUT** and **COM** terminals on the I/O Board.
2. Connect the shield to any **SHLD** terminal on the I/O Board.

NOTES:

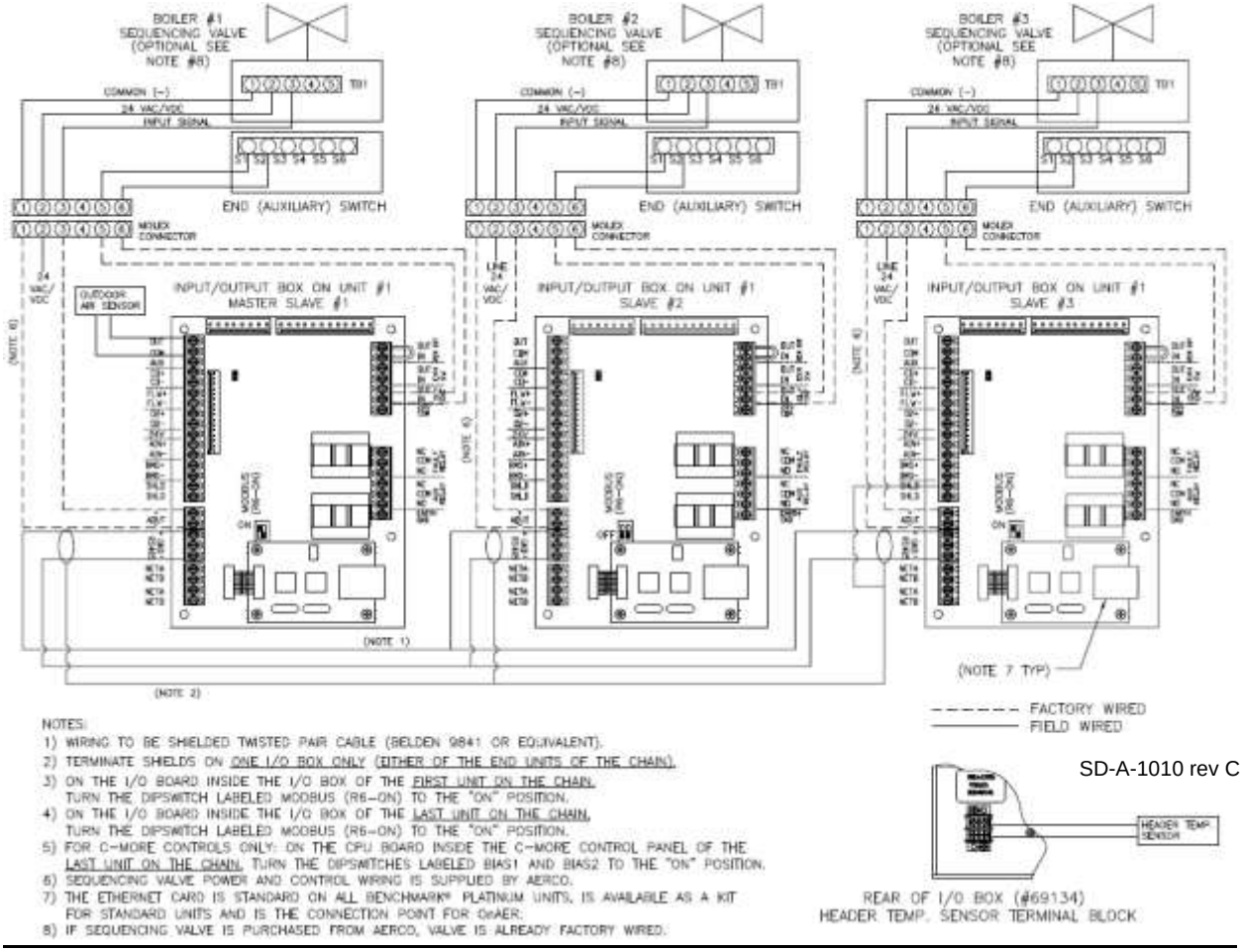
- Twisted shielded pair 18 - 22 AWG cable is recommended for **Header Temp Sensor** wiring. There is no polarity to be observed. The sensor end of the shield must be left free and ungrounded.
- When mounting the Outdoor sensor, it **must be located on the North side of the building** where an average 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 (61m) from the boiler.



OPTION 3 Instructions: Outdoor Reset, Direct Wired Header Temp Sensor & Outdoor Sensor

OPTION 3 Step 3 –DAISY CHAIN WIRING BETWEEN BOILERS

1. Connect the boilers in a daisy chain, as shown below.



NOTES:
1) WIRING TO BE SHIELDED TWISTED PAIR CABLE (BELDEN 9841 OR EQUIVALENT).
2) TERMINATE SHIELDS ON ONE I/O BOX ONLY (EITHER OF THE END UNITS OF THE CHAIN).
3) ON THE I/O BOARD INSIDE THE I/O BOX OF THE FIRST UNIT ON THE CHAIN, TURN THE DIPSWITCH LABELED MODBUS (R6-ON) TO THE "ON" POSITION.
4) ON THE I/O BOARD INSIDE THE I/O BOX OF THE LAST UNIT ON THE CHAIN, TURN THE DIPSWITCH LABELED MODBUS (R6-ON) TO THE "ON" POSITION.
5) FOR C-MORE CONTROLS ONLY: ON THE CPU BOARD INSIDE THE C-MORE CONTROL PANEL OF THE LAST UNIT ON THE CHAIN, TURN THE DIPSWITCHES LABELED BIAS1 AND BIAS2 TO THE "ON" POSITION.
6) SEQUENCING VALVE POWER AND CONTROL WIRING IS SUPPLIED BY AERCO.
7) THE ETHERNET CARD IS STANDARD ON ALL BENCHMARK® PLATINUM UNITS, IS AVAILABLE AS A KIT FOR STANDARD UNITS AND IS THE CONNECTION POINT FOR OnAER.
8) IF SEQUENCING VALVE IS PURCHASED FROM AERCO, VALVE IS ALREADY FACTORY WIRED.

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REAR OF I/O BOX (#69134)
HEADER TEMP. SENSOR TERMINAL BLOCK

OPTION 3 Step 4 –CONFIGURATION

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration** and set the **Unit Mode** parameter to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication** and set the **Unit Address** parameter to the communication address of the unit.

Continued on next page

OPTION 3 Instructions: Outdoor Reset, Direct Wired Header Temp Sensor & Outdoor Sensor

On the <u>BST Manager</u> only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Auto Manager Transfer	Disabled (This option is available on the Manager unit only)
	Unit Mode	BST Manager
	Hdr Temp Sensor	FFWD Temp
Application Configuration	Application	Space Heating
	SH Operating Mode	Outdoor Reset
	Outdoor Temp Sensor	Direct
	Plant Setpoint	Header temperature required for the cascade
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

7.3.4 Option 4 Outdoor Reset: Modbus Header Temp Sensor & Modbus Outdoor Temp Sensor

OPTION 4 Instructions: Outdoor Reset, Modbus Header Temp Sensor & Modbus Outdoor Temp Sensor

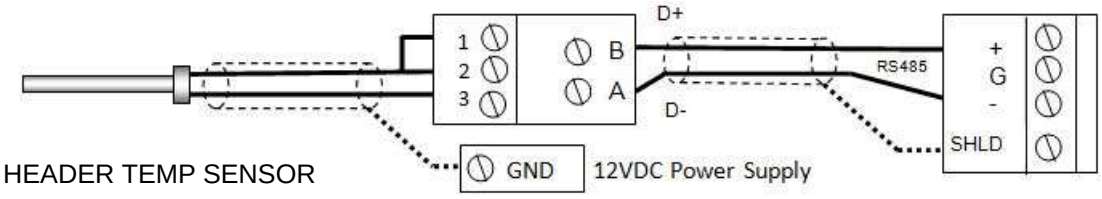
NOTE:
Both Header Temp Sensor ***and*** Outdoor Sensor must be wired. See the *Edge [i] Controller Manual* (OMM-0141, GF-213-B) for more information.

OPTION 4 Step 1: HEADER TEMP SENSOR WIRING – ANY BOILER

Using the Modbus Transmitter gives the plant the ability to use the Backup manager feature. This allows any of the client units to become a Backup manager if the manager unit is not communicating.

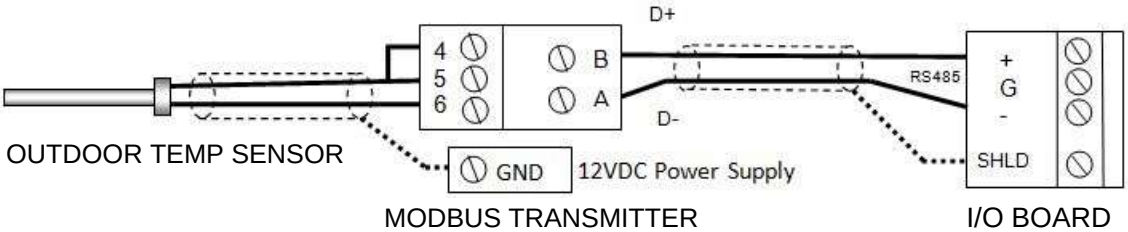
1. Connect the **Modbus Transmitter** terminal **Pin B** to the **RS485+** terminal, and **Pin A** to the **RS485-** terminal on the I/O Board of any Boiler unit, using shielded pair 18 - 22 AWG cable.
2. Connect the **Header Temp Sensor** (P/N **61040**) to pins **2** and **3** of the **Modbus Transmitter**, using shielded pair 18 - 22 AWG cable.
3. Install a jumper wire between pins **1** and 2 of the **Modbus Transmitter**.

NOTES:
- Polarity must be observed for the RS485 connections.
- Ground the shield to any **SHLD** terminal on the I/O Board.
- The **Header Temp Sensor** must be installed between 2 and 10 feet (0.61 and 3.1m) 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.



OPTION 4 Step 2: OUTDOOR SENSOR WIRING

1. If you have not already done so, complete step 1 of the instructions above to connect the **Modbus Transmitter** to the I/O Board.
2. Connect the **Outdoor Temp Sensor** to **Pins 5** and **6** of the **Modbus Transmitter** using a shielded pair 18 - 22 AWG cable.
3. On the **Modbus Transmitter**, install a jumper wire between **Pins 4** and **5**.



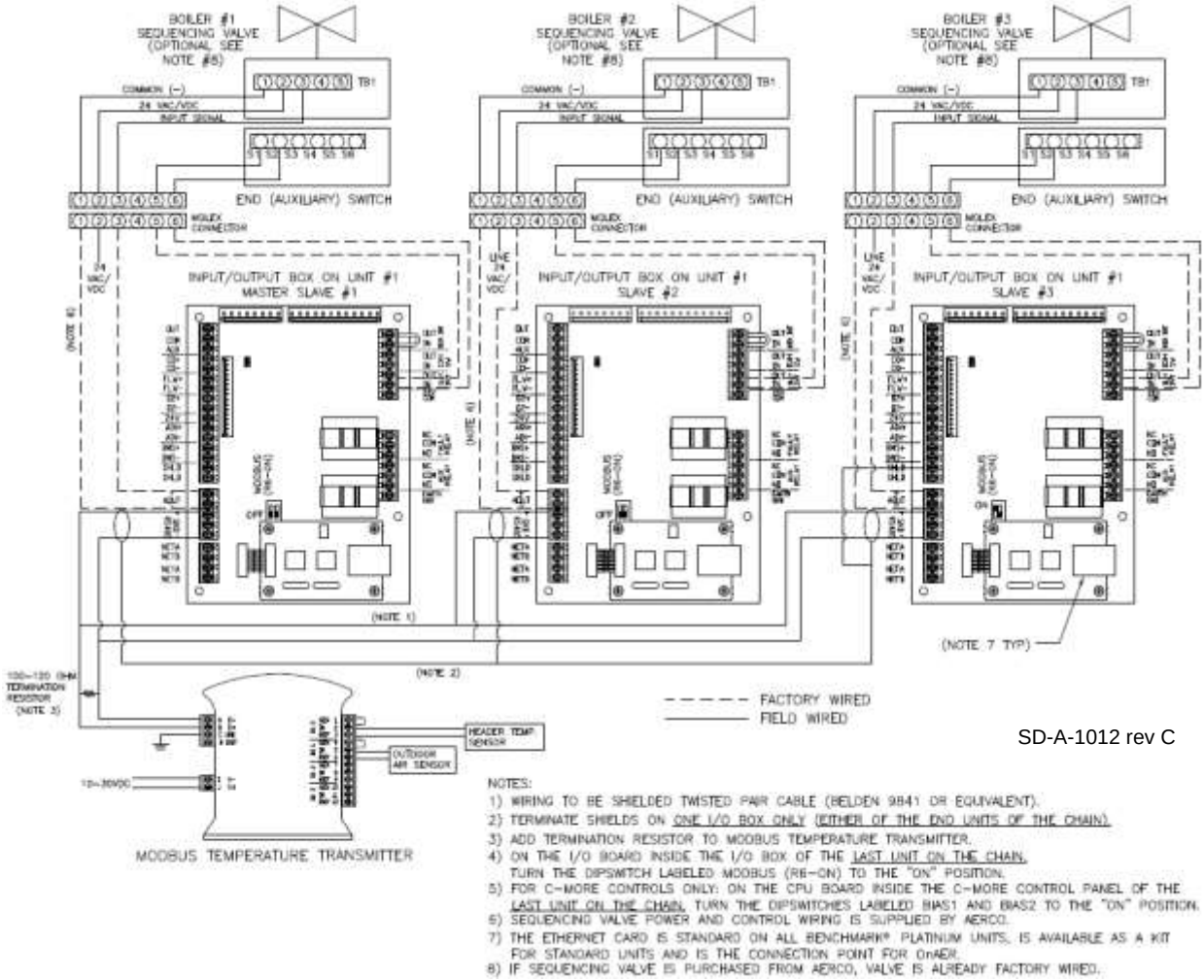
OPTION 4 Instructions: Outdoor Reset, Modbus Header Temp Sensor & Modbus Outdoor Temp Sensor

NOTES:

- Polarity must be observed for the RS485 connections.
- Ground the shield at any **SHLD** terminal in the I/O the Board.
- 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 (61m) from the boiler.
- 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.

OPTION 4 Step 3 –DAISY CHAIN WIRING BETWEEN BOILERS

1. Connect the boilers in a daisy chain, as shown below.



Continued on next page

OPTION 4 Instructions: Outdoor Reset, Modbus Header Temp Sensor & Modbus Outdoor Temp Sensor

OPTION 4 Step 4 –CONFIGURATION

Using the Modbus Transmitter gives the plant the ability to use the Backup manager feature. This allows any of the client units to become a Backup manager if the manager unit is not communicating.

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration**:
   - Set the **Unit Mode** parameter to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication**:
   - Set the **Unit Address** parameter to the communication address of the unit.

On the <u>BST Manager</u> only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Auto Manager Transfer	Enabled (This is available on the Manger unit only)
	Auto failover Type	C-More
	Backup Manager Address	Enter the designated backup unit address
	Unit Mode	BST Manager
	Hdr Temp Sensor	Network
	Sensor Comm Address	240
	Hdr Temp Point	14
Application Configuration	Application	Space Heating
	SH Operating Mode	Outdoor Reset
	Outdoor Temp Sensor	Network
	Sensor Comm Address	240
	Outdoor Temp Point	15
	Plant Setpoint	Header temperature required for the cascade
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

7.3.5 Option 5 Remote Setpoint: Direct Wired Header Temp Sensor & 4-20ma Setpoint Drive

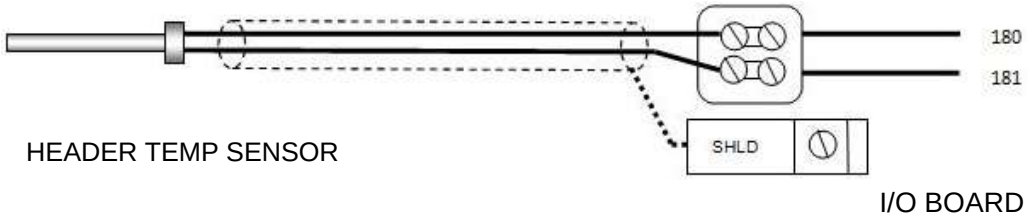
OPTION 5 Instructions: Remote Setpoint, Direct Wired Header Temp Sensor, 4-20ma Setpoint Drive

NOTE:
Both **Header Temp Sensor** *and* **4-20ma Direct Drive** must be wired. See the *Edge [i] Controller Manual* (OMM-0141, GF-213-B) for more information.

OPTION 5 Step 1: HEADER TEMP SENSOR WIRING – BST MANAGER Unit

1. On the **BST Manager** unit, connect the **Header Temp Sensor** to the **Feed Forward (FFWD)** terminals on the P-1 Harness via the terminal block labeled ***Header Temp sensor*** on the I/O Board.
2. Ground the shield to any **SHLD** terminal on the I/O Board.

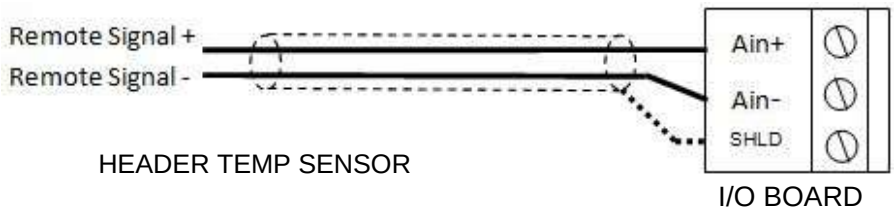
NOTES:
- The **Header Temp Sensor** must be installed between 2 and 10 feet (0.61 and 3.1m) downstream of the ***last*** boiler in the plant's supply water header.
- Shielded pair 18 - 22 AWG cable is recommended for **Header Temp Sensor** wiring. There is no polarity to be observed. The ground for the shield is at the **SHLD** terminal on the I/O Board. The sensor end of the shield must be left free and ungrounded.



OPTION 5 Step 2: DIRECT WIRED 0-20mA or 4-20mA WIRING – BST MANAGER Unit

1. Connect the **4-20mA** or **0-20mA** terminals from the Direct Drive source to the **Ain+** and **Ain-** terminals on the BST Manager's I/O Board.
2. Connect the shield to any **SHLD** terminal on the I/O Board.

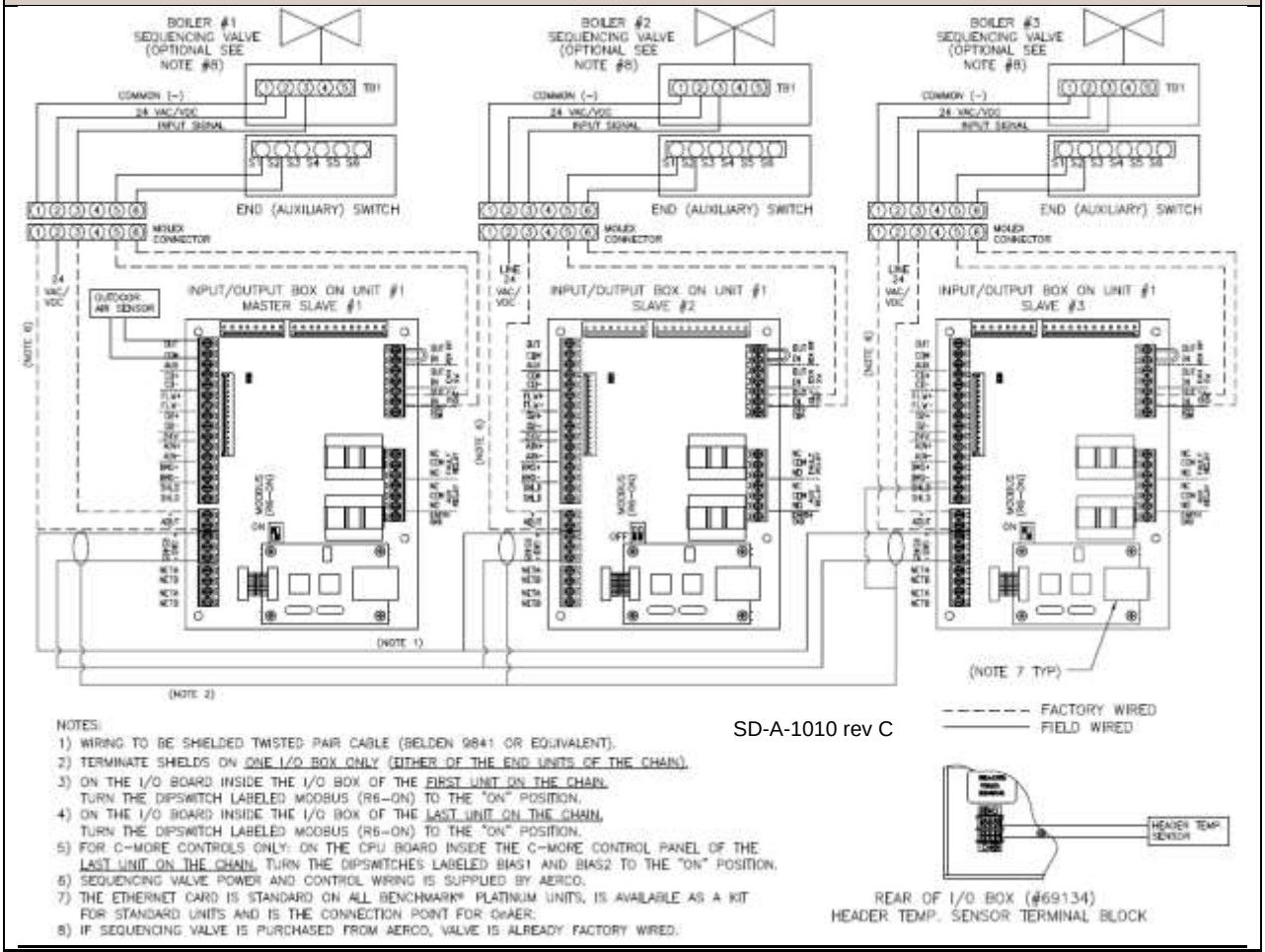
NOTES:
- Shielded pair 18 - 22 AWG cable is recommended for this connection. Polarity must be observed.
- The ground for the shield is at the driver signal source.



OPTION 5 Step 3 – DAISY CHAIN WIRING BETWEEN BOILERS

1. Connect the boilers in a daisy chain, as shown below.

OPTION 5 Instructions: Remote Setpoint, Direct Wired Header Temp Sensor, 4-20ma Setpoint Drive



OPTION 5 Step 4: OPTION 5 CONFIGURATION

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration** and set the **Unit Mode** parameter to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication** and set the **Unit Address** parameter to the communication address of the unit

On the <u>BST Manager</u> only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Unit Mode	BST Manager
	Hdr Temp Sensor	Header Temp
Application Configuration	Application	Space Heating
	SH Operating Mode	Rmt Setpt Analog
	BST Remote Signal	4-20mA/1-5V *
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

* Be sure that the SW1-4 DIP switch on Controller's Interface Board is set appropriately (On = Current, Off = Voltage.)

7.3.6 Option 6 Remote Setpoint: Direct Wired Header Temp Sensor & Modbus Setpoint Drive (via ProtoNode)

OPTION 6 Instructions: Remote Setpoint, Direct Wired Header Temp Sensor, Modbus Setpoint Drive via ProtoNode

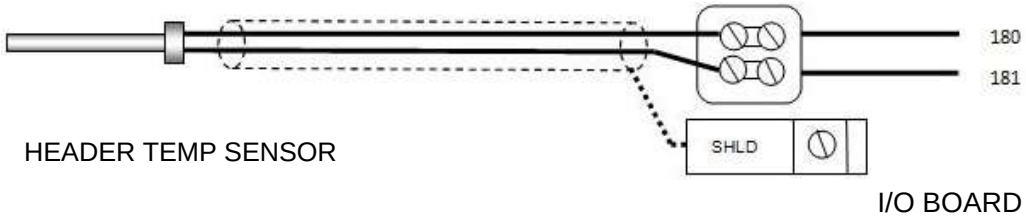
NOTE:
Both **Header Temp Sensor** *and* **Outdoor Sensor** must be wired. See the *Edge [i] Controller Manual* (OMM-0141, GF-213-B) for more information.

OPTION 6 Step 1: HEADER TEMP SENSOR WIRING – BST MANAGER Unit

1. On the **BST Manager** unit, connect the **Header Temp Sensor** to the **Feed Forward (FFWD)** terminals on the P-1 Harness via the terminal block labeled ***Header Temp sensor*** on the I/O Board.
2. Ground the shield to any **SHLD** terminal on the I/O Board.

NOTES:

- The **Header Temp Sensor** must be installed between 2 and 10 feet (0.61 and 3.1m) downstream of the ***last*** boiler in the plant's supply water header.
- Shielded pair 18 - 22 AWG cable is recommended for **Header Temp Sensor** wiring. There is no polarity to be observed. The ground for the shield is at the **SHLD** terminal on the I/O Board. The sensor end of the shield must be left free and ungrounded.



OPTION 6 Step 2: CONFIGURE AND CONNECT SSD DEVICE (PROTONODE)

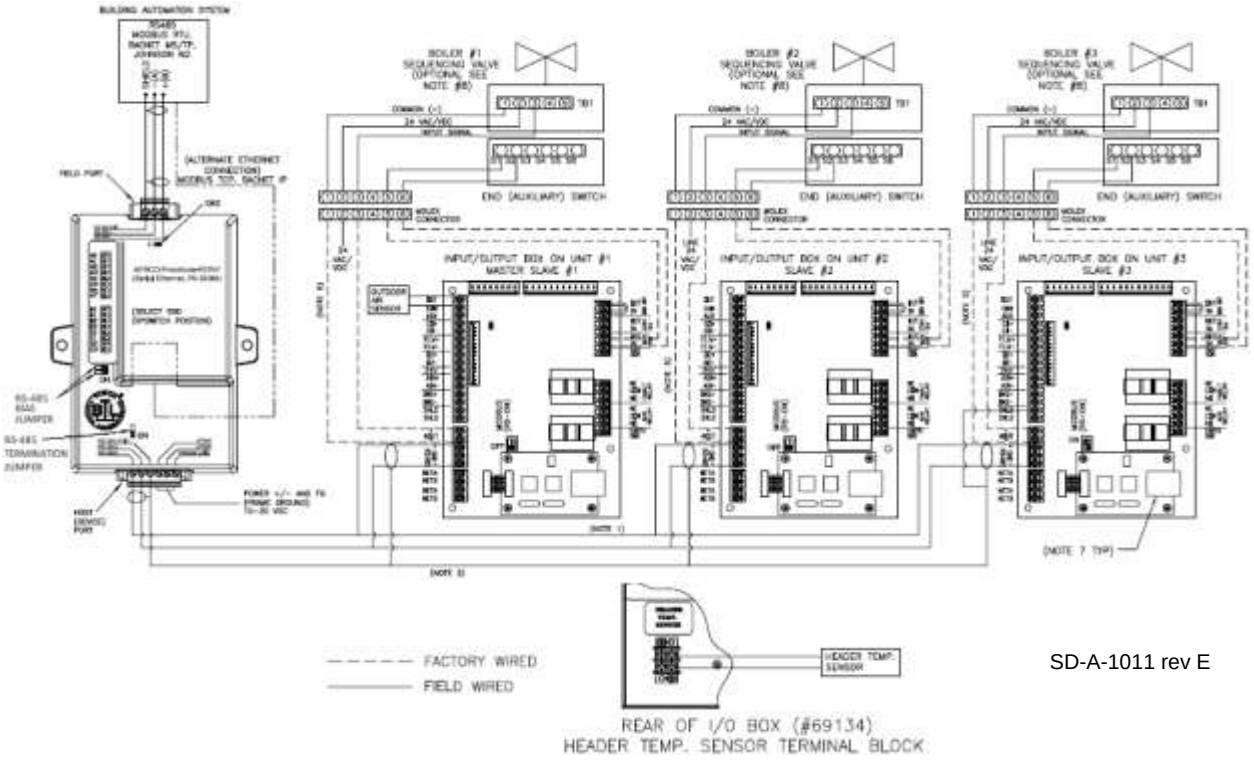
1. Connect the ProtoNode per the instructions in one of the *ProtoNode FPC N34, FPC-N35 Manuals*:
   - For FPC-N34 (P/N 64129) or FPC-N35 (P/N 64130), see OMM-0107 (GF-150).
   - For FPC-N34 (P/N 64168) or FPC-N35 (P/N 64169), see OMM-0150 (GF-150_B).

Continued on next page

OPTION 6 Instructions: Remote Setpoint, Direct Wired Header Temp Sensor, Modbus Setpoint Drive via ProtoNode

OPTION 6 Step 3 – DAISY CHAIN WIRING BETWEEN BOILERS

1. Connect the boilers in a daisy chain, as shown below.



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NOTES:
1) WIRING TO BE SHIELDED TWISTED PAIR CABLE (BELDEN 9841 OR EQUIVALENT).
2) TERMINATE SHIELDS ON ONE I/O BOX ONLY (EITHER OF THE END UNITS OF THE CHAIN).
3) REMOVE COVER FROM PROTONODE AND PLACE RED "BIAS" JUMPERS IN THE "ON" POSITION AND THE BLUE "TERMINATION" JUMPER IN THE "ON" POSITION.
4) ON THE I/O BOARD INSIDE THE I/O BOX OF THE LAST UNIT ON THE CHAIN, TURN THE DIPSWITCH LABELED MODBUS (R6–ON) TO THE "ON" POSITION.
5) SEQUENCING VALVE POWER AND CONTROL WIRING IS SUPPLIED BY AERCO.
6) IF TERMINATION IS NEEDED AT FIELD PORT CONNECTION TO THE BUILDING AUTOMATION SYSTEM (BAS), ACTIVATE THE "END OF LINE" TERMINATION SWITCH (SW2) JUST BELOW THE FIELD PORT UNDER THE COVER. SEE GF–129 MANUAL FOR MORE DETAILED INFORMATION ON THE PROTONODE.
7) THE ETHERNET CARD IS STANDARD ON ALL BENCHMARK® PLATINUM UNITS, IS AVAILABLE AS A KIT FOR STANDARD UNITS AND IS THE CONNECTION POINT FOR OnAER.
8) IF SEQUENCING VALVE IS PURCHASED FROM AERCO, VALVE IS ALREADY FACTORY WIRED.

NOTES:

- Polarity must be observed for the RS485 connections.
- Connect the shield to any **SHLD** terminal on the I/O Board.
- When mounting the **Outdoor Temp 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 (61m) from the boiler.
- 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.

OPTION 6 Instructions: Remote Setpoint, Direct Wired Header Temp Sensor, Modbus Setpoint Drive via ProtoNode

OPTION 6 Step 4 – CONFIGURATION

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration** and set the **Unit Mode** parameter to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication** and set the **Unit Address** parameter to the communication address of the unit.

On the <u>BST Manager</u> only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Unit Mode	BST Manager
	Hdr Temp Sensor	Header Temp
Application Configuration	Application	Space Heating
	SH Operating Mode	Rmt Setpt Netwrk
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

7.3.7 Option 7 Remote Setpoint: Modbus Header Temp Sensor & 4-20ma Setpoint Drive

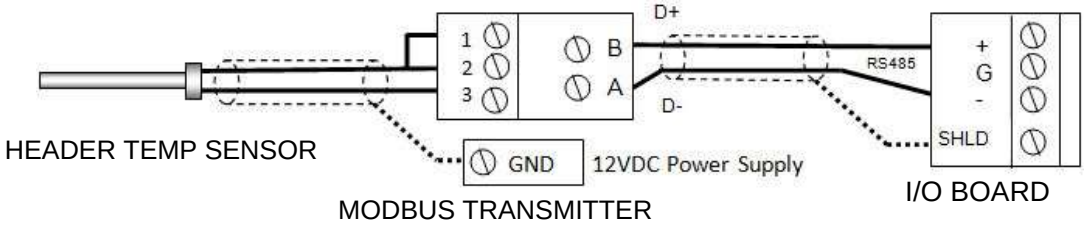
OPTION 7 Instructions: Remote Setpoint, Modbus Header Temp Sensor & 4-20ma Setpoint Drive

NOTE:
Both **Header Temp Sensor** *and* **4-20ma Direct Drive** must be wired. See the *Edge [i] Controller Manual* (OMM-0141, GF-213-B) for more information.

OPTION 7 Step 1: MODBUS HEADER TEMP SENSOR WIRING – ANY BOILER

1. Connect the **Modbus Transmitter** terminal **Pin B** to the **RS485+** terminal, and **Pin A** to the **RS485-** terminal on the I/O Board of any Boiler unit, using shielded pair 18 - 22 AWG cable.
2. Connect the shield to any **SHLD** terminal on the I/O Board.
3. Connect the **Header Temp Sensor** to pins **2** and **3** of the **Modbus Transmitter** units using Shielded pair 18 - 22 AWG cable.
4. On the **Modbus Transmitter**, install a jumper wire between pins 1 and 2.

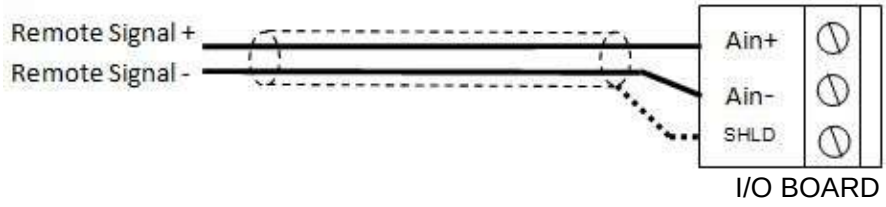
NOTES:
- Polarity must be observed for the RS485 connections.
- Connect the shield to any **SHLD** terminal on the I/O Board.
- The **Header Temp Sensor** must be installed between 2 and 10 feet (0.61 and 3.1m) downstream of the ***last*** boiler in the plant's supply water header.
- There is no polarity 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.



OPTION 7 Step 2: DIRECT WIRED 0-20mA or 4-20mA WIRING – BST MANAGER

1. Connect the **4-20mA** or **0-20mA** terminals from the Direct Drive source to the **Ain+** and **Ain-** terminals on the BST Manager.
2. Connect the shield to any **SHLD** terminal on the I/O Board.

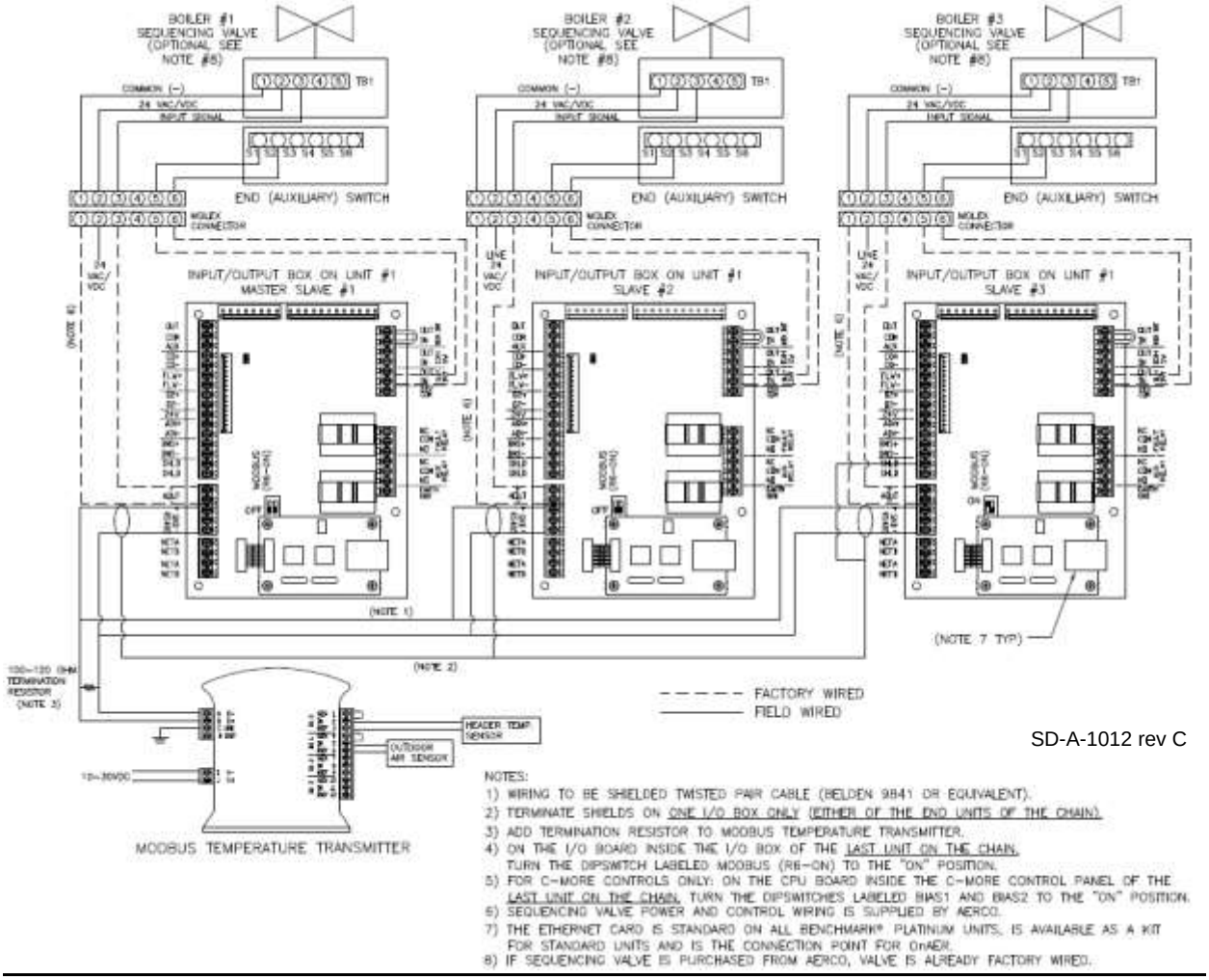
NOTES:
- Shielded pair 18 - 22 AWG cable is recommended for this connection. Polarity must be observed.
- The ground for the shield is at the driver signal source.



OPTION 7 Instructions: Remote Setpoint, Modbus Header Temp Sensor & 4-20ma Setpoint Drive

OPTION 7 Step 3: CONNECT BOILERS IN DAISY CHAIN

1. Connect the boilers in a daisy chain, as shown below.



OPTION 7 Step 4: OPTION 7 CONFIGURATION

Using the Modbus Transmitter gives the plant the ability to use the Backup manager feature. This allows any of the client units to become a Backup manager if the manager unit is not communicating.

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration**:
   - Set the **Unit Mode** parameter to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication**:
   - Set the **Unit Address** parameter to the communication address of the unit.

Continued on next page

OPTION 7 Instructions: Remote Setpoint, Modbus Header Temp Sensor & 4-20ma Setpoint Drive

On the BST Manager only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Auto Manager Transfer	Enabled (This is available on the Manager unit only)
	Auto Failover Type	C-More
	Backup Manager Address	Enter the designated backup unit address
	Unit Mode	BST Manager
	Hdr Temp Sensor	Network
	Sensor Comm Address	240
	Hdr Temp Point	14
Application Configuration	Application	Space Heating
	SH Operating Mode	Rmt Setpt Analog
	BST Remote Signal	4-20mA/1-5V *
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

* Be sure that the SW1-4 DIP switch on Controller's Interface Board is set appropriately (On = Current, Off = Voltage.)

7.3.8 Option 8 Remote Setpoint: Modbus Header Temp Sensor & MODBUS Setpoint Drive via ProtoNode

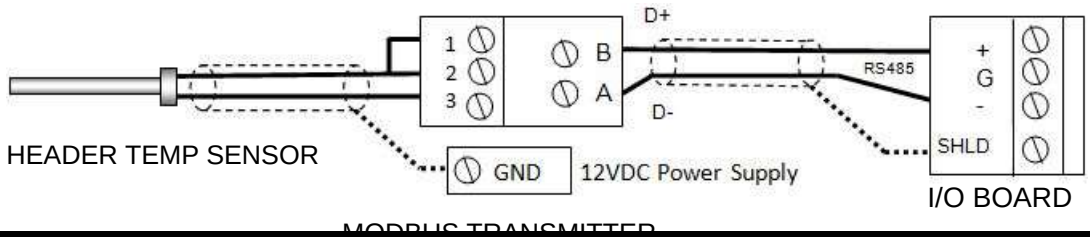
OPTION 8 Instructions: Remote Setpoint, Modbus Header Temp Sensor & Modbus Setpoint Drive

OPTION 8 Step 1: MODBUS HEADER TEMP SENSOR WIRING – ANY BOILER

1. Connect the **Modbus Transmitter** terminal **Pin B** to the **RS485+** terminal, and **Pin A** to the **RS485-** terminal on the I/O Board of any Boiler unit, using shielded pair 18 - 22 AWG cable.
2. Connect the shield to any **SHLD** terminal on the I/O Board.
3. Connect the **Header Temp Sensor** to pins **2** and **3** of the **Modbus Transmitter** using shielded pair 18 - 22 AWG cable.
4. Install a jumper wire between pins 1 and 2 of the **Modbus Transmitter**.

NOTES:

- Polarity must be observed for the RS485 connections.
- Connect the shield to any **SHLD** terminal on the I/O Board.
- The **Header Temp Sensor** must be installed between 2 and 10 feet (0.61 and 3.1m) 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.



OPTION 8 Step 2: CONFIGURE AND CONNECT SSD DEVICE (PROTONODE)

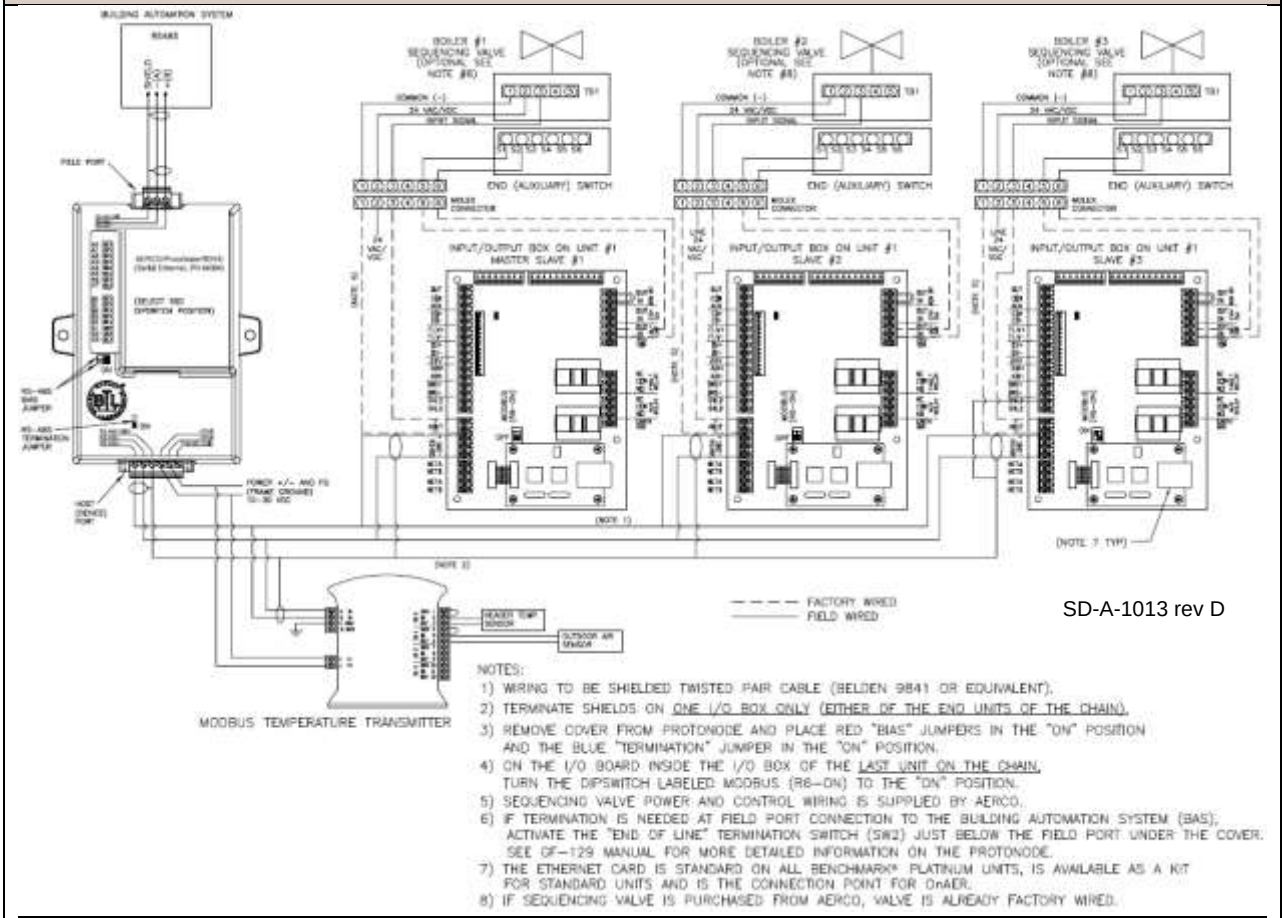
1. Connect the ProtoNode per the instructions in one of the *ProtoNode FPC N34, FPC-N35 Manuals*:
   - For FPC-N34 (P/N 64129) or FPC-N35 (P/N 64130), see OMM-0107 (GF-150).
   - For FPC-N34 (P/N 64168) or FPC-N35 (P/N 64169), see OMM-0150 (GF-150_B).

OPTION 8 Step 3: CONNECT BOILERS IN DAISY CHAIN

1. Connect the boilers in a daisy chain, as shown below.

Continued on next page

OPTION 8 Instructions: Remote Setpoint, Modbus Header Temp Sensor & Modbus Setpoint Drive



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NOTES:
1) WIRING TO BE SHIELDED TWISTED PAIR CABLE (BELDEN 9841 OR EQUIVALENT).
2) TERMINATE SHIELDS ON ONE I/O BOX ONLY (EITHER OF THE END UNITS OF THE CHAIN).
3) REMOVE COVER FROM PROTONODE AND PLACE RED "BIAS" JUMPERS IN THE "ON" POSITION AND THE BLUE "TERMINATION" JUMPER IN THE "ON" POSITION.
4) ON THE I/O BOARD INSIDE THE I/O BOX OF THE LAST UNIT ON THE CHAIN, TURN THE DIPSWITCH LABELED MODBUS (R6–ON) TO THE "ON" POSITION.
5) SEQUENCING VALVE POWER AND CONTROL WIRING IS SUPPLIED BY AERCO.
6) IF TERMINATION IS NEEDED AT FIELD PORT CONNECTION TO THE BUILDING AUTOMATION SYSTEM (BAS), ACTIVATE THE "END OF LINE" TERMINATION SWITCH (SW2) JUST BELOW THE FIELD PORT UNDER THE COVER. SEE GF–129 MANUAL FOR MORE DETAILED INFORMATION ON THE PROTONODE.
7) THE ETHERNET CARD IS STANDARD ON ALL BENCHMARK® PLATINUM UNITS, IS AVAILABLE AS A KIT FOR STANDARD UNITS AND IS THE CONNECTION POINT FOR OnAER.
8) IF SEQUENCING VALVE IS PURCHASED FROM AERCO, VALVE IS ALREADY FACTORY WIRED.

OPTION 8 Step 4: CONFIGURATION

On <u>All</u> Boilers:

1. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Configuration**:
   - Set the **Unit Mode** parameter to **BST Client**.
2. Go to: **Main Menu → Advanced Setup → BST Cascade → Cascade Communication**:
   - Set the **Unit Address** parameter to the communication address of the unit.

Continued on next page

OPTION 8 Instructions: Remote Setpoint, Modbus Header Temp Sensor & Modbus Setpoint Drive

Using the Modbus Transmitter gives the plant the ability to use the Backup manager feature. This allows any of the client units to become a Backup manager if the manager unit is not communicating.

On the BST Manager only:

1. Go to **Main Menu → Advanced Setup → BST Cascade**, set the Parameters to the Values in each menu in the table below.

Menu/Screen Name	Parameters	Values
Cascade Configuration	Unit Mode	BST Manager
	Hdr Temp Sensor	Network
	Sensor Comm Address	240
	Hdr Temp Point	14
Application Configuration	Application	Space Heating
	SH Operating Mode	Rmt Setpt Netwrk
Cascade Comm	Min address	The *minimum* unit address in the cascade
	Max address	The *maximum* unit address in the cascade
	Cascade Baud Rate	The baud rate for the cascade.

SECTION 8. MAINTENANCE

8.1 MAINTENANCE SCHEDULE

All Benchmark boilers require 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 8-1. For a complete inspection check list see ASME CSD-1 chart.

WARNING!

Prior to servicing, ensure that the following guidelines are strictly observed:

- Follow all Lockout/Tagout protocols in effect at the site.
- Disconnect the AC power 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 8-1: Maintenance Schedule

SEC	ITEM	6 MOS. *	12 MOS.	24 MOS.	LABOR TIME
8.2	Igniter-Injector (BMK750 – 5000N only)	Inspect	Inspect, replace if necessary	Replace	15 mins.
8.3	Pilot Burner (BMK5000 & 6000 only)	Inspect	Inspect, replace if necessary	Replace	15 mins.
8.4	Flame Detector	Inspect	Inspect, replace if necessary	Replace	15 mins.
8.5	O_2 Sensor	Inspect	Inspect/Clean		15 mins.
4.4	Combustion Calibration	Check	Check		1 hr.
8.6	Testing of Safety Devices		See ASME CSD-1 Chart		45 mins.
8.7	Burner			Inspect	2 hrs.
8.8	Condensate Drain Trap	Inspect	Inspect, Clean & Replace Gaskets	Inspect, Clean & Replace Gaskets	30 mins.
8.9	Air Filter		Clean	Replace	15 mins.
8.10	Refractory Replacement (BMK5000-6000 only)	Repair if needed			
8.13	Periodic Testing	Routine verification of functionality, various schedule			

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

In order to perform the maintenance tasks specified in Table 8-1, the following maintenance kits are available from AERCO. All kits included a Technical Instruction Document (TID) with instructions for performing the maintenance.

TABLE 8-2a: 12 Month Maintenance Kits

Model	Kit#	Parts Serviced/Replaced	Doc Name
750 - 3000	58025-01	Ignitor, Flame Rod, Condensate trap O rings	TID-0131
5000/6000	58025-11	Pilot Burner, Flame Rod & Condensate trap	TID-0095

TABLE 8-2b: 24 Month Maintenance Kits			
Model	**Kit#**	**Parts Serviced/Replaced – Includes all 12 Month Parts**	**Doc Name**
750/1000	58025-08	Burner & Blower gaskets, LWCO, air filter replacement	TID-0100
	58025-17	Burner & Blower gaskets, LWCO, air filter *cleaner*	
1500/2000	58025-13	Burner & Blower gaskets, LWCO, air filter replacement	TID-0113
	58025-19	Burner & Blower gaskets, LWCO, air filter *cleaner*	
2500/3000	58025-10	Burner & Blower gaskets, LWCO, air filter replacement	TID-0102
	58025-18	Burner gaskets, LWCO, air filter *cleaner*	
4000/5000N	58025-20	Burner & Blower gaskets, LWCO, air filter replacement	TID-0215
	58025-21	Burner gaskets, LWCO, air filter *cleaner*	
5000/6000	58025-12	LWCO, air pump filter, Burner & Blower gaskets, air filter	TID-0096
	58025-14	LWCO, air pump filter, air filter	
	58025-15	LWCO, air pump filter, Burner & Blower gaskets, air filter *cleaning kit*	
	58025-16	LWCO, air pump filter, air filter *cleaning kit*	

8.2 IGNITER-INJECTOR – BMK750 – 5000N

The ignitor-injector should be ***inspected*** annually and ***replaced*** at least every 24 months of operation, sooner if there is evidence of substantial erosion or carbon build-up. Parts and instructions are included in 12 Month Maintenance Kit P/N **58025-01** and all BMK750 – 5000N 24 Month Maintenance Kits.

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:

Note that during installation, use the number of indexing (clocking) washers necessary that, when tight, the gas injection tube is positioned as shown in Figure 8-1d.

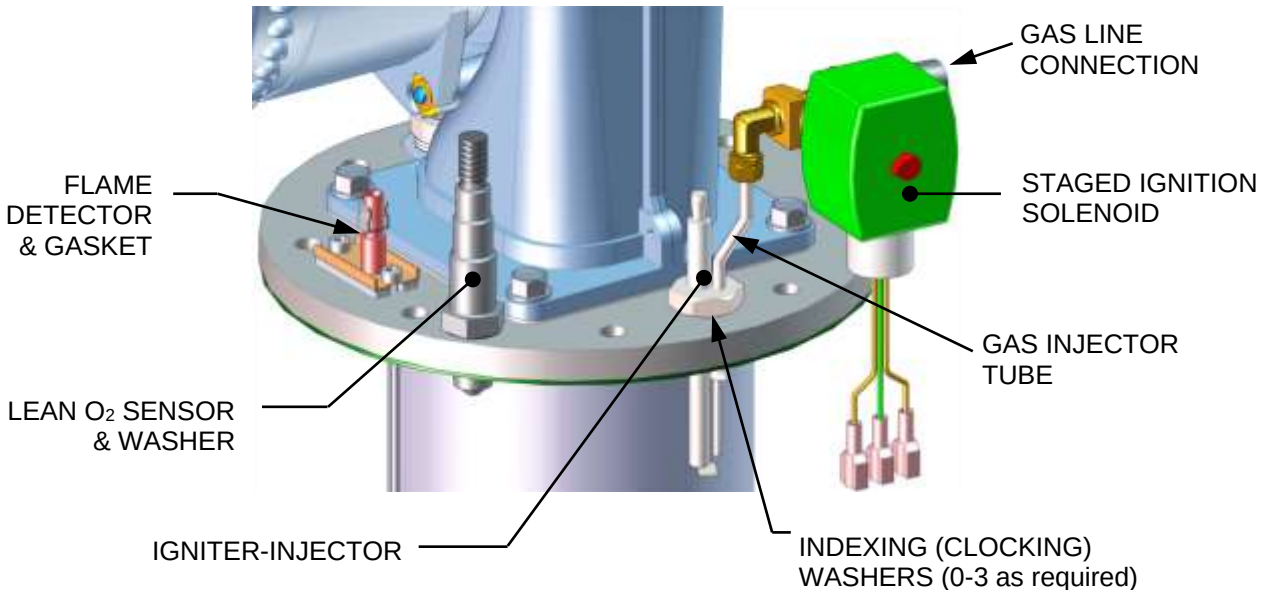


Figure 8-1a: Igniter-Injector & Flame Detector (BMK750/1000)

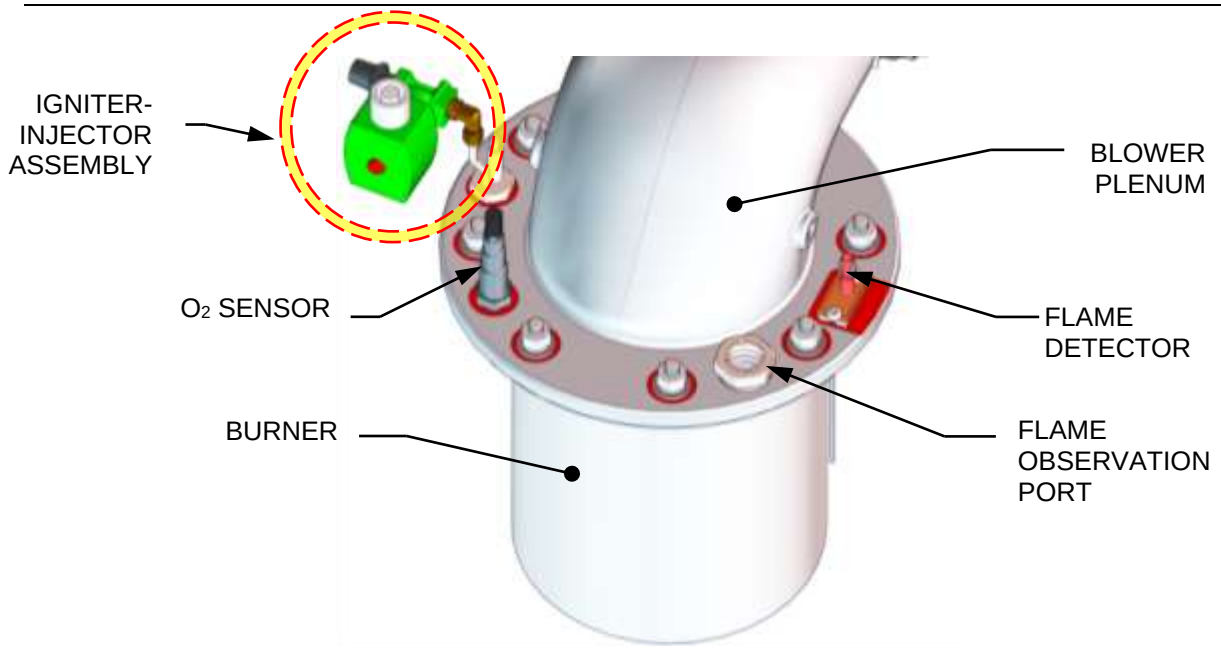


Figure 8-1b: Igniter-Injector & Flame Detector (BMK1500/2000)

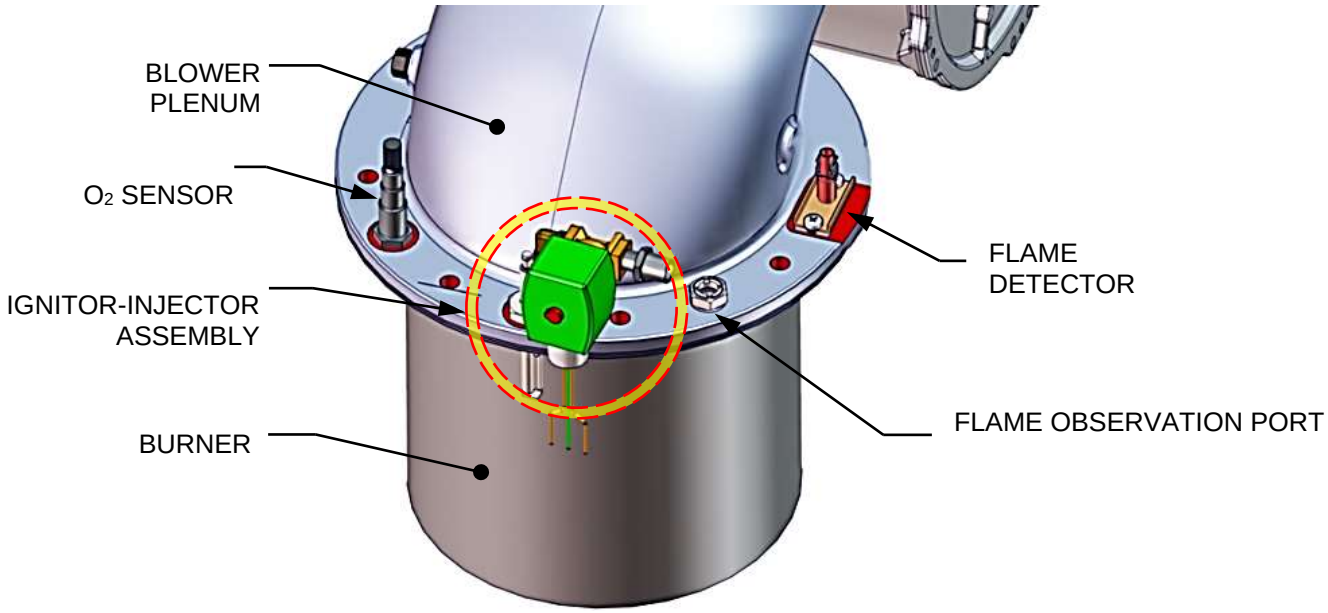


Figure 8-1c: Igniter-Injector & Flame Detector (BMK2500-5000N)

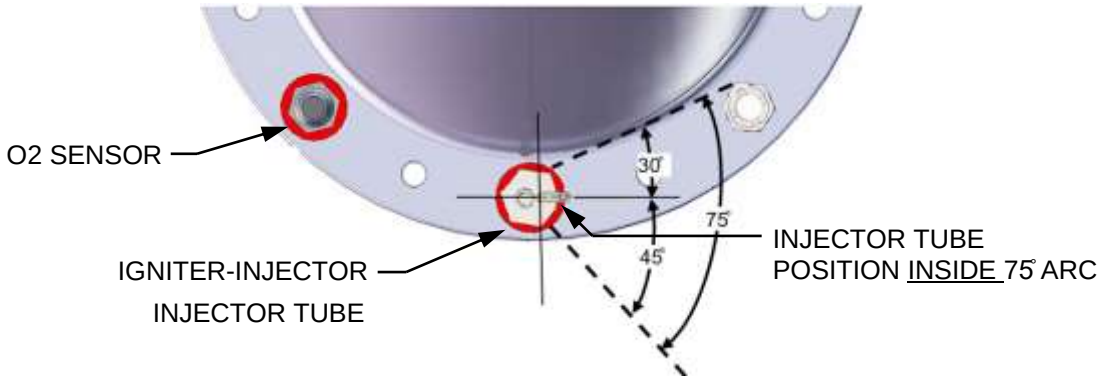


Figure 8-1d. Igniter-Injector Orientation (BMK2500/3000 Shown)

8.2.1 Pilot Ignition Rod – BMK5000 & 6000

The Benchmark 5000 and 6000 Pilot Burner (P/N **66026**) is mounted to the Burner's front plate. It should be ***inspected*** every 12 months and ***replaced*** every 24 months, or if damaged or warped.

Parts and instructions are included in 12 Month Maintenance Kit P/N **58025-11** and all BMK5000 – 6000 24 Month Maintenance Kits.

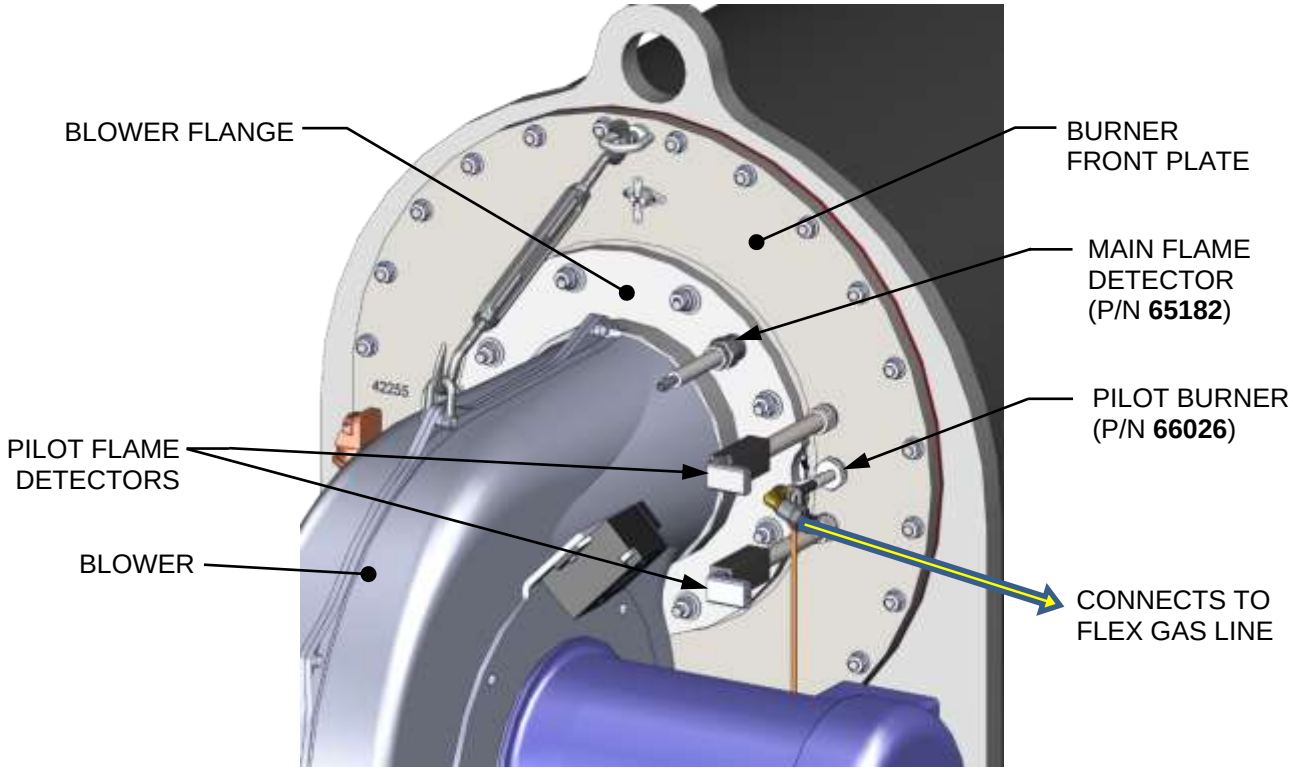


Figure 8-2: Pilot Burner and Pilot Flame Detectors (BMK5000/6000)

8.3 FLAME DETECTOR

The BMK750 – 5000N Flame Detector (kit P/N **24356-1**) is located on the burner plate at the top of the unit (see Figure 8-1a through 8-1c, above).

The BMK5000 & 6000 Main Flame Detector (P/N **65182**) is located on the Blower Flange near the top of the unit (see Figure 8-2a, above).

The flame detector should be ***inspected*** every 12 months and ***replaced*** every 24 months, or sooner if damaged or warped. Note, it may be hot; allow the unit to cool sufficiently before removing the flame detector.

Be sure to use the current model flame detector, included in the maintenance kit; some older flame detectors are shaped differently and may not function properly.

This part and instructions are included in both 12 Month Maintenance Kit P/N **58025-01** (BMK750 –3000) and P/N **58025-11** (BMK5000 & 6000) and all BMK750 – 6000 24 Month Maintenance Kits.

8.4 O_2 SENSOR

The Lean Oxygen Sensor (P/N **61026**) should be ***cleaned*** and ***inspected*** every 12 months. It is not included in any of the 12- or 24-month maintenance kits.

On BMK750 – 3000 units, it is located on the burner plate at the top of the unit. It may be hot, so allow the unit to cool sufficiently before removing or replacing the it.

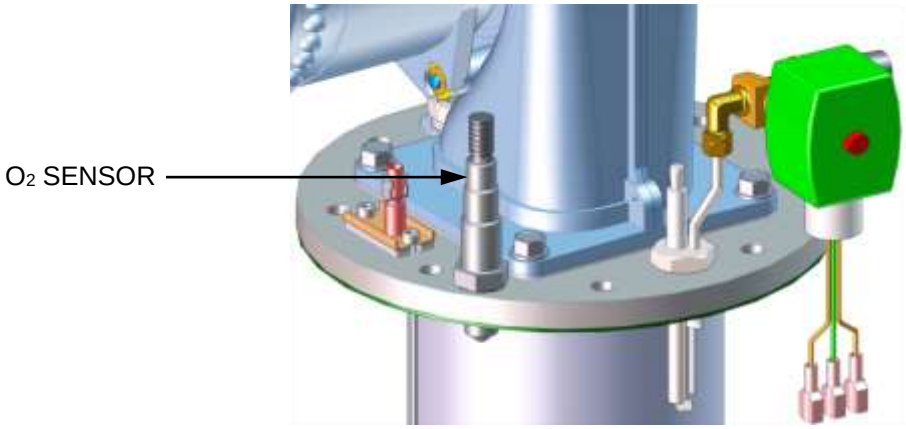
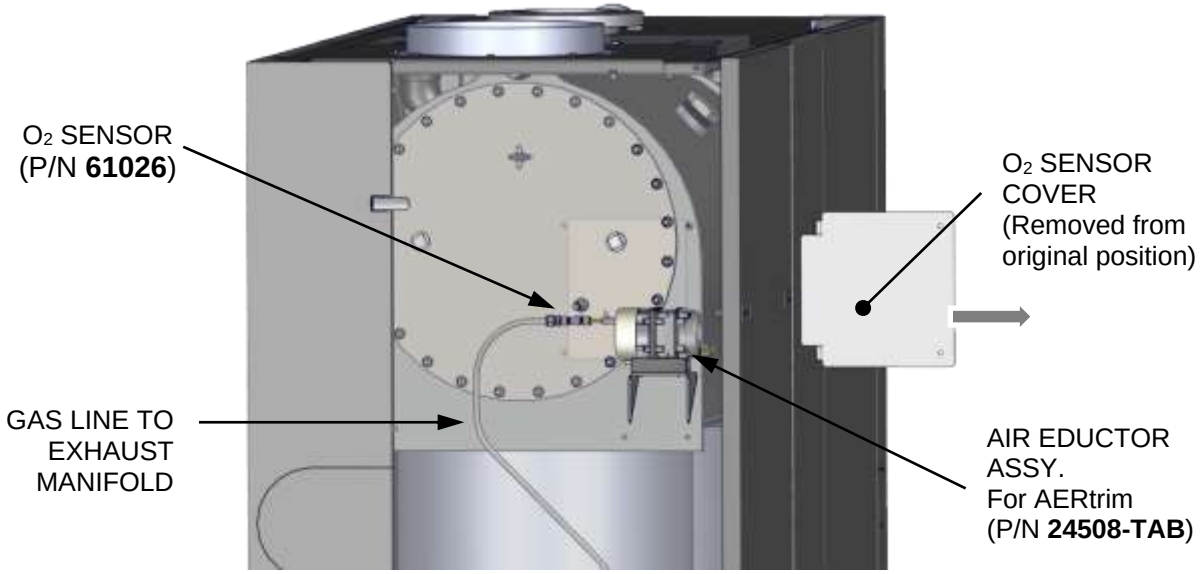


Figure 8-3a: O_2 Sensor Mounting Location – BMK750 & 1000

On the BMK5000 & 6000, it is located on the burner's rear plate, on the rear of the unit.



REAR OF UNIT

Figure 8-3b: O_2 Sensor Mounting Location – BMK5000 & 6000

Lean O_2 Sensor Maintenance Instructions

1. Set the Edge [i] Controller's **Enable/Disable** switch to the **OFF** position.
2. Remove the top shroud from the unit by grasping the top handle and lifting straight up. This will disengage the shroud from the four (4) pins in the side panels.
3. Disconnect the O_2 sensor lead wire by pushing in on the release tab and pulling apart the connector.

Lean O_2 Sensor Maintenance Instructions

4. Next, loosen and remove the O_2 sensor and crush washer from the burner plate using a 15/16" open-end wrench.
5. Thoroughly inspect the O_2 sensor. If eroded, the sensor should be replaced. Otherwise clean the sensor with a fine emery cloth.
6. Reinstall the O_2 sensor and crush washer on the burner plate.
7. Reconnect the sensor lead wire.
8. Reinstall the shroud on the unit.

8.4.1 Air Eductor Air Pump Maintenance – BMK5000 & 6000

Benchmark 5000 and 6000 units contain an Air Eductor assembly, mounted just inside the O_2 Sensor Cover on the unit's back panel, (see Figure 8-3b, above). It includes an air pump, which draws an air sample from the combustion chamber past the O_2 Sensor, ensuring its accuracy.

The air pump contains an air pump filter (P/N **87008**), which should be ***inspected-cleaned*** every 12 months and ***replaced*** every 24 months. It is included in the BMK5000 & 6000 24 Month Maintenance Kits.

Air Pump Maintenance and Troubleshooting Instructions

1. Remove the Air Pump's plastic air filter cover and clean or replace the air filter (see Figure 8-4, below).
2. If the Air Eductor or the Air Pump is not operating properly, try the following troubleshooting steps:
   a) Check the connector to the Air Pump for corrosion or contamination, clean as needed.
   b) If the Air Pump is not running, check 120 VAC power to the Air Pump. If 120 VAC power is OK, replace the Air Pump.
   c) If the Air Pump is running, check current drawn in series with one power wire. If the current is within the range of 0.1 to 0.6 amps, the Air Pump is operating properly.
   d) Check the signal from current sensor. If it is within the range of 0.20 to 1.20 VDC, there may be a connector problem or IGST board issue. Check all connectors and wires first. Try swapping IGST board with known good board before ordering a new one.
3. Reattach the O_2 Sensor Cover to the unit's back panel.

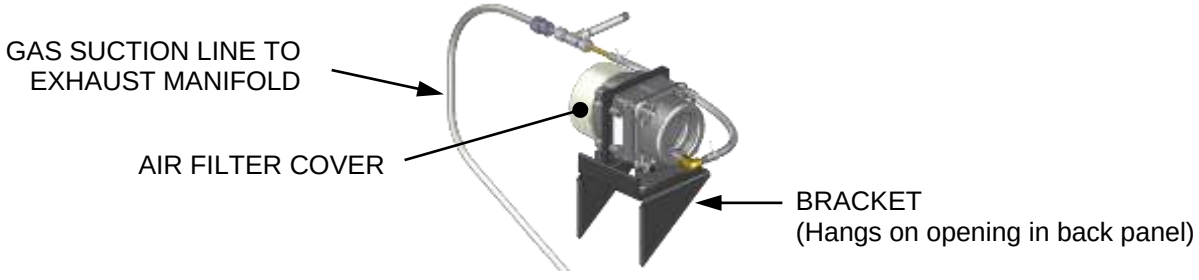


Figure 8-4: Air Eductor Assembly – BMK5000 & 6000

8.5 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 Section 5: *Safety Device Testing* in this guide for a description and instructions for performing these tests.

8.6 BURNER INSPECTION

The burner assembly should be ***inspected*** every 24 months to ensure that all components are intact and functioning as designed. This requires the replacement of one or two burner gaskets (depending on BMK model), and blower and gas train O-Rings, which are included in all 24 Month Maintenance Kits. If the burner is not fully intact, it must be ***replaced*** as soon as possible.

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.

Burner inspection parts are included all 24 Month Maintenance Kits. Instructions are in the Technical Instruction Documents (TIDs) included with the kits:

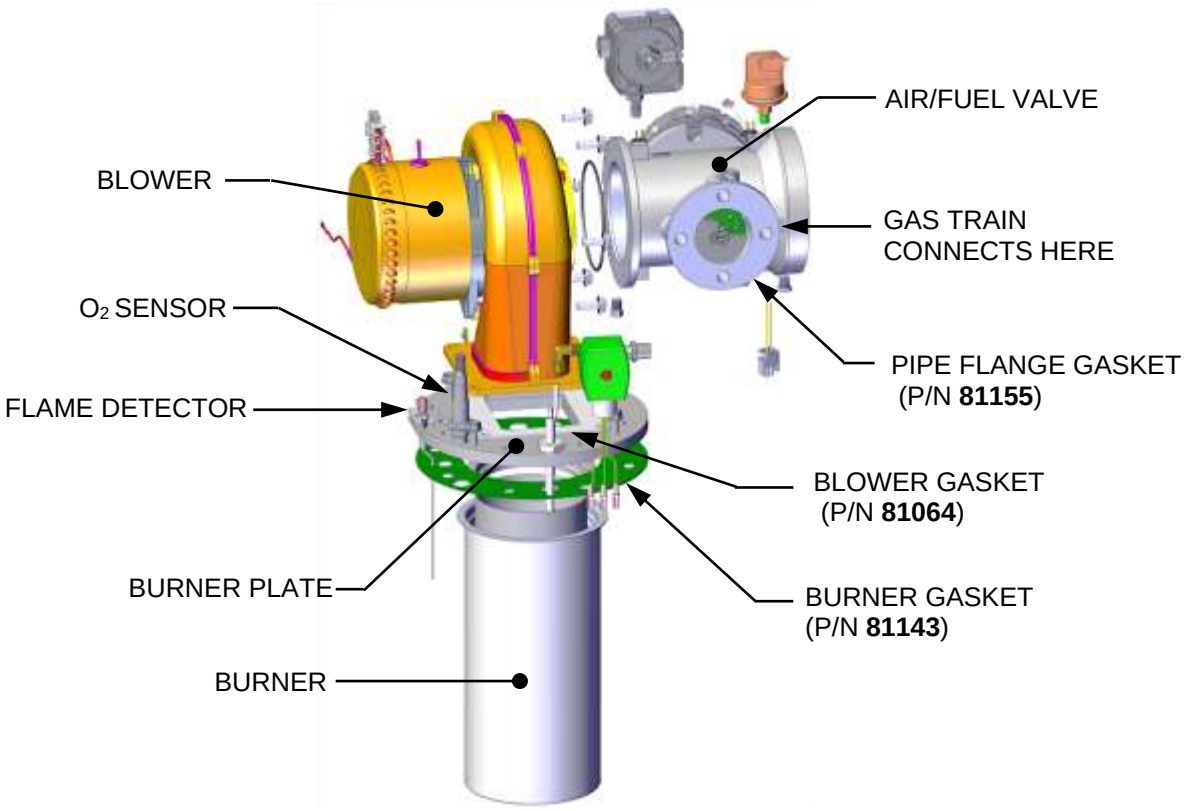


Figure 8-5a: Burner Assembly Exploded View – BMK750/1000

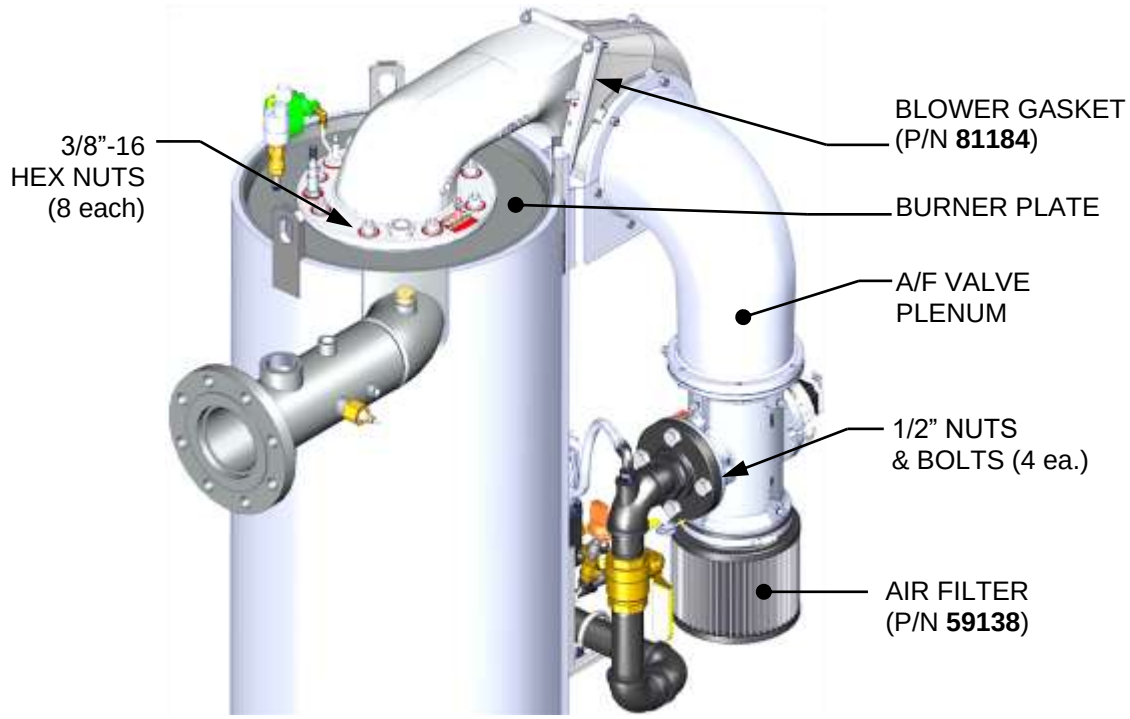


Figure 8-5b: BMK1500/2000 Burner Assembly Mounting Details

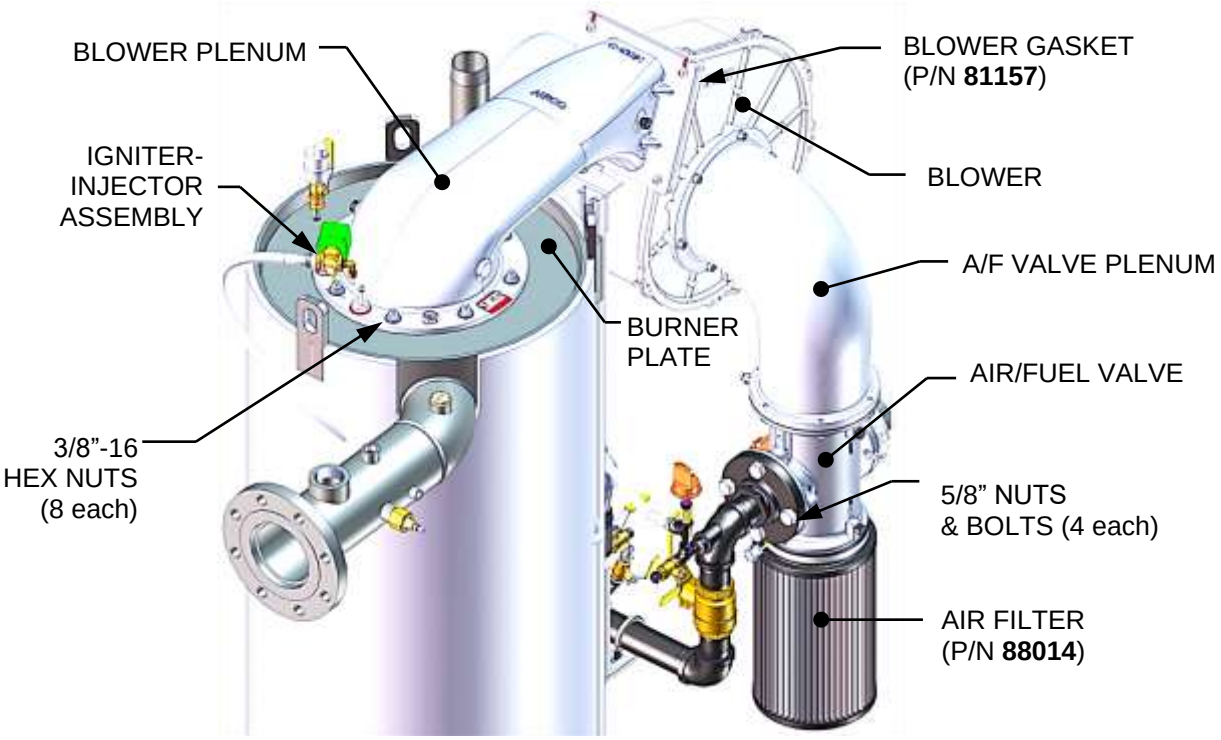


Figure 8-5c: Burner Assembly Mounting Details – BMK2500 – 5000N

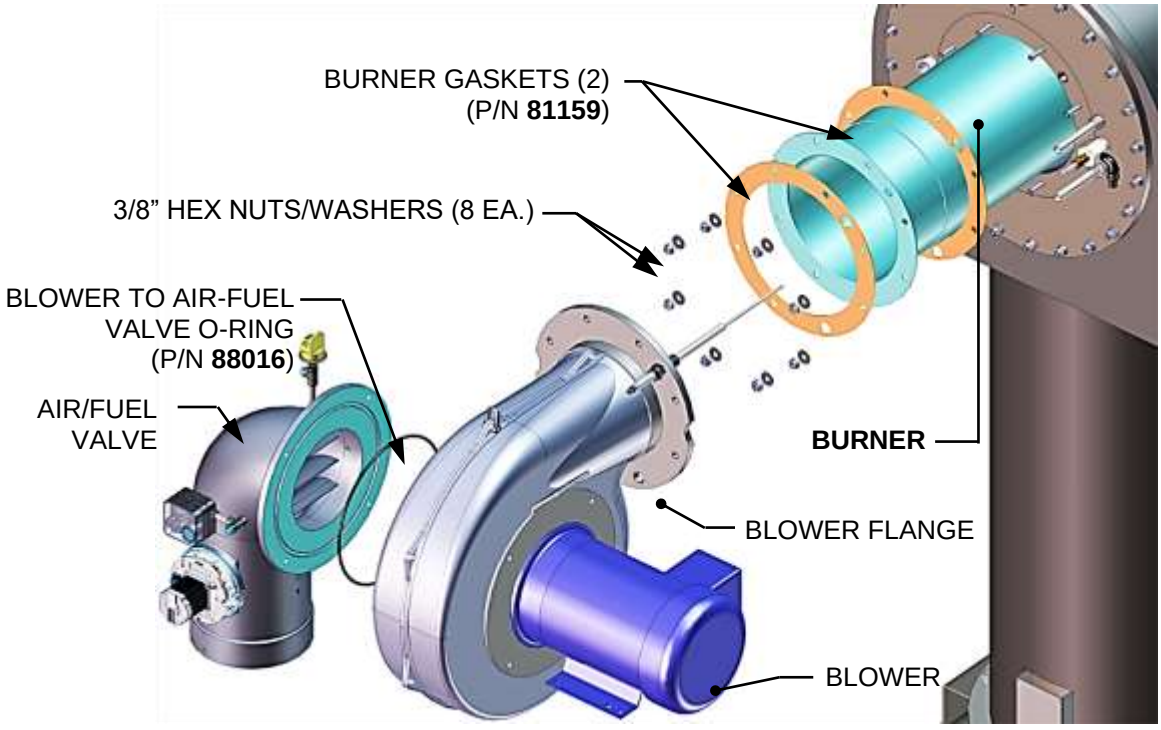


Figure 8-5d: Burner Assembly Exploded View – BMK5000 & 6000

8.7 CONDENSATE DRAIN TRAP

All Benchmark boilers contain a condensate trap (P/N **24441**), located external to the unit, attached to the exhaust manifold's drain at the rear of the unit.

This trap must be ***inspected*** for leaks and blockages, ***cleaned*** to ensure that the float is free to move, and condensate flows normally, and the O-Ring (P/N **84017** included in all 24 Month Maintenance Kits) replaced if it is worn or damaged. In addition, you must ensure the vent (under the removable cover) is free and clear of obstructions.

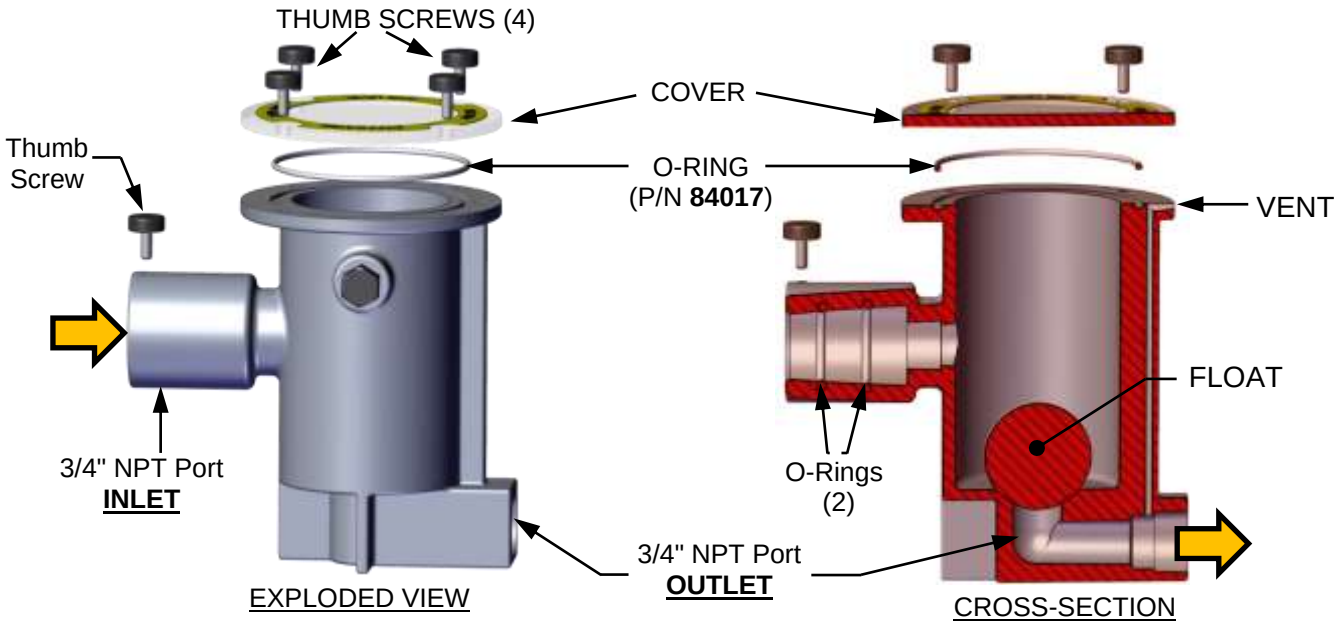


Figure 8-6: External Condensate Trap – Cross-Section & Exploded View

If your system includes a condensate neutralizer, the active ingredient must be replaced periodically.

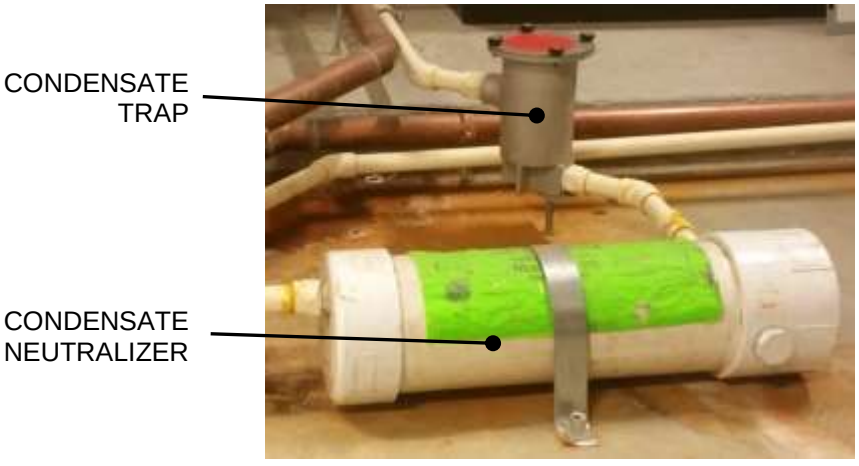


Figure 8-7: Condensate Trap and Neutralizer

8.8 Air Filter Cleaning and Replacement

The boiler's air filter should be maintained as follows:

Cleaned every 12 months.

Replaced after 24 months if it shows any signs of deterioration. However, if it is still in good condition, you can order a 24 Month Maintenance kit that includes an air filter cleaning kit in place of a new filter.

NOTE:

Failure to clean or replace the air filter may affect stable combustion, result in less efficient operation, and may result in combustion reliability issues.

All 24 Month Maintenance Kits include one of two parts:

- **An Air Filter Cleaning Kit** – Appropriate if the filter is intact
- **New Air Filter** – Necessary if the filter is deteriorated or damaged

Check Table 8-2b, above, to find the part number of the kit appropriate for your site. Instructions are included in the TID that accompanies the kit.

8.9 Refractory Replacement – BMK5000 & 6000 ONLY

A low mass, fiber-based material insulates the front and rear end plates of the combustion chamber. This material has very low thermal conductivity and is not susceptible to thermal shock conditions that cause failures of hard-faced refractory materials.

WARNING!

The heat exchanger insulation utilizes ceramic fiber material. Wear a fitted NIOSH-approved particulate respirator (3m n95 or equivalent) When servicing the heat exchanger and burner assemblies. At high temperatures, ceramic fibers can be converted to crystalline silica fibers, which have been identified as carcinogenic when inhaled.

In the event that access to the unit's combustion chamber is required, the preferred method is to remove the rear refractory first, since it is a much less complicated procedure; removing the front refractory requires first removing the blower, burner and air/fuel valve assemblies before reaching the refractory material.

If either the front or rear refractory needs to be replaced, obtain one of the Benchmark 5000/6000 Refractory Replacement kits from AERCO. There are three kits available:

- P/N **58197-1** – Front Refractory for units with Front Burner Plate 42255
- P/N **58197-2** – Front Refractory for units with Front Burner Plate 43071
- P/N **58197-3** – Rear Refractory

Instructions for replacing both are included in technical Instruction Document TID-0221, included with the kit.

8.10 SHUTTING BOILER DOWN FOR EXTENDED PERIOD

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 An Extended Period Instructions

1. Set Enable/Disable switch on the front panel to the **Disable** 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.
6. Open the drain valve and drain all water from the unit.
7. If the temperature in the storage location will ever get below freezing, **for even a short time**, you must drain ***all*** water from the unit ***before*** the temperature falls below freezing. Step 6 is not sufficient, as it leaves some water in the bottom of the heat exchanger chamber. You must then use a suction pump inserted through the inspection ports to remove ***all*** water from the bottoms of the heat exchanger chamber and base assembly.

WARNING!

If the temperature will ever fall below freezing, failure to drain ***all*** water can cause heat exchanger tubes to crack and fail.

8.10.1 Benchmark 5000/6000 Long Term Blower Storage

Benchmark 5000 and 6000 blowers can be damaged if they are left in long term storage (exceeding 30 days after receipt of equipment). If a Benchmark 5000 and 6000 blower is kept in storage for more than 30 days, you must complete the instructions below.

Benchmark 5000/6000 Long Term Blower Storage Instructions

1. Select a suitable storage site:
   - Level, well-drained, firm surface, in clean, dry and warm location. Minimum temperature of 50°F (10°C).
   - Isolated from possibility of physical damage from construction vehicles, erection equipment, etc.
   - Accessible for periodical inspection and maintenance.
2. The blower should be supported under each corner of its base to allow it to "breath". Supports (2 x 4's, timbers, or railroad ties) should be placed diagonally under each corner.
3. If the equipment is to be stored for more than three (3) months, the entire blower assembly must be loosely covered with plastic, but not tightly wrapped.
4. Storage Maintenance:

NOTE:

A periodic inspection and maintenance log, by date and action taken, must be developed and maintained for each blower. See example below. Each item must be checked monthly.

Benchmark 5000/6000 Long Term Blower Storage Instructions

Example Storage / Maintenance Schedule Log

Item	Action	Dates Checked
1	Re-inspect units to insure any protective devices used are functioning properly. Check for scratches in the finish which will allow corrosion or rust to form	
2	Rotate wheel a minimum of 10 full revolutions to keep the motor bearing grease from separating and drying out. **(THIS STEP IS CRITICAL!)**	

5. General Motor Procedure:

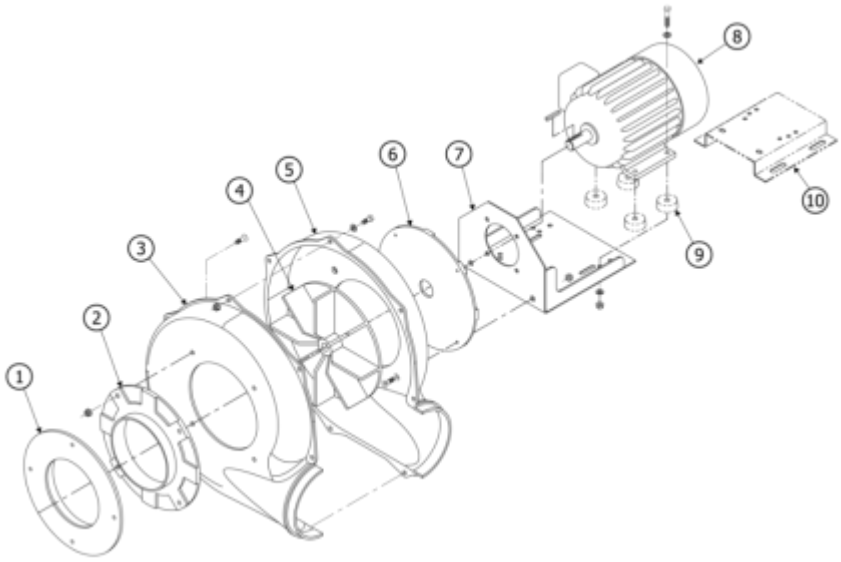
If the motor is not put into service immediately, the motor must be stored in a clean, dry, warm location. Minimum temperature of 50°F. (10°C,). Several precautionary steps must be performed to avoid motor damage during storage.

a) Use a "Megger" each month to ensure that integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.

b) DO NOT lubricate the motor bearings during storage. Motor bearings are packed with grease at the factory.

c) If the storage location is damp or humid, the motor windings must be protected from moisture. This can be done by applying power to the motor's space heaters, (IF AVAILABLE) while the motor is in storage. If the motor does not have space heaters, storing it in a damp or humid location will, very quickly, cause internal corrosion and motor failure which is not warranted.

NOTE: For specific storage instructions, for the actual motor and any accessory parts that were supplied, refer to the manufacturer's instructions.



1. INLET FLANGE
2. INLET-SIDE PLATE
3. INLET-SIDE HOUSING
4. BLOWER WHEEL
5. DRIVE-SIDE HOUSING
6. DRIVE-SIDE PLATE
7. BASE, FAN
8. MOTOR
9. RISER BLOCKS *
10. RISER BASE *

* IF REQUIRED

Figure 8-11: Benchmark 5000-6000 Blower Exploded View

8.11 RETURNING THE BOILER TO SERVICE AFTER SHUTDOWN

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

Placing the Boiler Back in Service After A Prolonged Shutdown Instructions

1. Review installation requirements included in Section 2 of the *Benchmark 750-6000 with Edge [i]: Install-Startup Manual* (OMM-0144, GF-217).
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 Section 4 of this guide.
5. Perform the instructions in Section 5: *Safety Device Testing*, above, and all scheduled procedures described Section 8: *Maintenance*.

8.12 RECOMMENDED PERIODIC TESTING

WARNING!

Periodic testing of all boiler controls and safety devices is required to ensure they continue to operate as designed. Precautions must 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.

TABLE 8-3: Recommended Periodic Testing

ITEM	FREQUENCY	ACTION BY	REMARKS
NOTE: Refer to indicated sections of this manual and the *Benchmark 750-6000 with Edge [i]: Install-Startup Manual* (OMM-0144, GF-217) for detailed procedures.			
Gauges, monitors and indicators	Daily	Operator	Visual inspection and record readings in operator log
Instrument and equipment settings	Daily	Operator	Visual check against factory recommended specifications
	Weekly	Operator	Verify factory settings
Firing Rate Control	Semi-Annually	Service Tech	Verify factory settings
	Annually	Service Tech	Check with combustion calibration test equipment (see Section 4.2: *Tools & Instruments for Combustion Calibration* in this guide), and the O_2 sensor (see Section 8.4: *O_2 Sensor* in this guide).
Flue, vent, stack and intake air duct	Monthly	Operator	Visually inspection condition and check for obstructions
Spark Igniter-Injector	Weekly	Operator	See Section 8.2: *Ignitor-Injector* of this guide.
Air/Fuel Valve position	Weekly	Operator	Check position indicator dial. See Section 3.2: *Start Sequence* in this guide.

TABLE 8-3: Recommended Periodic Testing

ITEM	FREQUENCY	ACTION BY	REMARKS
SSOV Leakage test	Annually	Service Tech	Check for leakage in accordance with the SSOV manufacturer's (Siemens) recommendations.
Flame failure	Weekly	Operator	Close manual gas shutoff valve and check safety shutdown. See Section 5.7: *Flame Fault Test* of this guide.
Flame signal strength	Weekly	Operator	Check flame strength in the Edge [i] Controller's *Unit Status* screen.
Low water level cut off and alarm	Weekly	Operator	See Section 5.4: *Low Water Level Fault Test in* this Guide.
Slow drain test	Semi-Annually	Operator	Perform a slow drain test in accordance with ASME Boiler and Pressure Vessel Code, Section IV.
High water temp. safety control test	Annually	Service Tech	See Section 5.5: *Water Temperature Fault Test* in this guide.
Operating controls	Annually	Operator	See Section 2: *Edge [i] Controller Operation* in this guide.
Low air flow	Monthly	Operator	See Section 5.8: *Air Flow Fault Tests* and Section 8.8: *Air Filter Cleaning and Replacement* in this guide.
High and low gas pressure interlocks	Monthly	Operator	See Sections 5.2: *Low Gas Pressure Test* and 5.3: *High Gas Pressure Test* in this guide.
Air/Fuel Valve purge position switch	Annually	Service Tech	See Section 5.10 *Purge Switch Open During Purge* in this guide.
Air/Fuel Valve ignition position switch	Annually	Service Tech	See Section 5.11: *Ignition Switch Open During Ignition* in this guide.
Safety valves	As required	Operator	Check per A.S.M.E. Boiler and Pressure Vessel Code, Section IV.
Inspect burner components	Semi-Annually	Service Tech	See Section 8.6: *Burner Inspection* in this guide.
Condensate Trap	Semi-Annually	Operator	See Section 8.7: *Condensate Drain Trap* in this guide.
Oxygen (O_2) Level	Monthly	Operator	Verify oxygen level is between 3% and 8% during boiler operation.

8.13 RECOMMENDED SPARES

NOTE: Refer to the parts list illustrations in the *Benchmark 750-6000 With Edge [I]: Install-Startup Manual* (OMM-0144, GF-217) for the locations of the parts listed below.

For a list of 12- and 24-Month Maintenance Kits, see Section 8.1: *Maintenance Schedule*.

TABLE 8-4: Recommended Emergency Spare Parts

DESCRIPTION	BMK 750/1000	BMK 1500/2000	BMK 2500 – 3000
Blower Replacement Kit	58061	58038	58063-1 – 460V 58063-2 – 208V
SSOV Actuator/Regulator Combo - Used on: • ALL FM gas trains • ***Downstream*** SSOV on DBB gas trains	64048	64048	64048
SSOV Actuator Without Proof of Closure Switch - Used on: • ***Upstream*** SSOV on DBB gas trains	27086-1	27086-1	27086-1

TABLE 8-5: Recommended Emergency Spare Parts – BMK5000 & 6000

DESCRIPTION	PART NUMBER
Actuator Replacement Kit: SSOV with P.O.C. Switch Kit	27086-2
Actuator Replacement Kit: SSOV with Regulator, POC Switch & Damping Orifice	64106
Pilot Regulator w/ 2-6" Spring	24384
Pilot Solenoid Valve, 1/4" NPT **FRU Kit**	58089
Temperature Switch - Manual Reset	123552
Ignitor Rod **FRU Kit** (component of Flame Rod Assy. 65150)	65182

TABLE 8-6: Optional Spare Parts

DESCRIPTION		PART NUMBER
Edge [i] Controller		64134
Burner	BMK750 & 1000	46026
	BMK1500	46042
	BMK2000	46044
	BMK2500	46039
	BMK3000	46038
	BMK4000 & 5000N	46060
	BMK5000 & 6000	46025
Oxygen Sensor		61026

SECTION 9. TROUBLESHOOTING

9.1 INTRODUCTION

This section is intended to aid service/maintenance personnel in isolating the cause of a fault in your Benchmark boiler. The troubleshooting procedures below 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 Instructions
1. Observe the fault messages displayed on the Edge [i] Controller.
2. Refer to the Fault Indication column in Troubleshooting Table 10-1, below, 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 9-2 contains additional troubleshooting information that may apply to situations in which no fault message is displayed.

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

TABLE 9-1: Boiler Troubleshooting Procedures

Fault	Probable Causes	Corrective Action
AIRFLOW FAULT DURING IGNITION	1. Blower stopped running due to thermal or current overload.	1. Check combustion blower for signs of excessive heat or high current drain that may trip thermal or current overload devices.
	2. Blocked Blower inlet or inlet air filter.	2. Inspect the inlet to the combustion blower including the air filter at the air/fuel valve for signs of blockage.
	3. Blockage in Blower Proof switch.	3. Remove the Blower Proof switch and inspect for signs of blockage, clean or replace as necessary.
	4. Blockage in Blocked Inlet switch.	4. Remove the Blocked Inlet switch and inspect for signs of blockage, clean or replace as necessary.
	5. Defective Blower Proof switch.	5. Check the continuity of the Blower Proof switch with the combustion blower running. If there is an erratic resistance reading or the resistance reading is greater than zero ohms, replace the switch.
	6. Defective Blocked Inlet switch.	6. Turn off unit and check the continuity of the Blocked Inlet switch. If there is an erratic resistance reading or the resistance reading is greater than zero ohms, replace the switch.
	7. Bad inlet air temperature sensor.	7. Check the actual inlet air temperature reading and measure resistance at the Sensor Harness connection P1. Verify that the reading conforms to the values shown in Section 2 of the *Benchmark 750-6000 with Edge [i]: Reference Manual (OMM-0146, GF-219).*
	8. Defective temperature sensor.	8. Refer to CORRECTIVE ACTION 7 and verify that the voltage conforms to the values shown in Section 2 of the *Benchmark 750-6000 with Edge [i]: Reference Manual (OMM-0146, GF-219).*
	9. Loose wire connection between the Blower and the Controller.	9. Check wire connection from the Blower motor to the Secondary Power Panel.
	10. Defective Air-Fuel Valve potentiometer.	10. 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.
	11. Hard light.	11. Check igniter-injector for soot or erosion of electrode. Check injector solenoid valve to insure proper open/close operation.

TABLE 9-1: Boiler Troubleshooting Procedures

Fault	Probable Causes	Corrective Action
AIRFLOW FAULT DURING PURGE	1. Blower not running or running too slow.	1. Start the unit. If the blower does not run check the blower solid state relay for input and output voltage. If the relay is OK, check the blower.
	2. Defective Blocked Inlet switch.	2. Start the unit. If the blower runs, turn off unit and check the Blocked Inlet switch for continuity. Replace the switch if continuity does not exist.
	3. Blockage in air filter or Blocked Inlet switch.	3. Remove the air filter and Blocked Inlet switch and inspect for signs of blockage. Clean or replace as necessary.
	4. Blocked blower inlet or inlet ductwork.	4. Inspect the inlet to the combustion blower including any ductwork leading up to the combustion blower for signs of blockage.
	5. No voltage to Blocked Inlet switch from Edge [i] Controller.	5. During the start sequence, verify that 24 VAC is present between each side of the switch and ground. If 24 VAC is not present, refer fault to qualified service personnel.
	6. PROBABLE CAUSES from 3 to 12 for AIRFLOW FAULT DURING IGNITION apply for this fault.	6. See CORRECTIVE ACTIONS for AIRFLOW FAULT DURING IGNITION, items 3 to 12.
	7. Missing or improperly connected Blocked Flue jumper.	7. Check auxiliary box to be sure Blocked Flue input is jumpered and properly connected.
AIRFLOW FAULT DURING RUN	1. Blower stopped running due to thermal or current overload.	1. Check blower for signs of excessive heat or high current draw that may trip thermal or current overload devices.
	2. Blocked Blower inlet or inlet ductwork.	2. Inspect the inlet to the blower, including any ductwork leading up to the combustion blower, for signs of blockage.
	3. Blockage in air filter or Blocked Inlet switch.	3. Remove the air filter and Blocked Inlet switch and inspect for signs of blockage, clean or replace as necessary.
	4. Defective Blocked Inlet switch.	4. Verify that 24 VAC is present between each side of the switch and ground. If 24 VAC is not present at both sides, replace switch.
	5. Combustion oscillations.	5. Run unit to full fire. If the unit rumbles or runs rough, perform combustion calibration.
	6. Probable causes from 3 to 16 for AIRFLOW FAULT DURING IGNITION applies for this fault.	6. See CORRECTIVE ACTIONS from 3 to 12 for AIRFLOW FAULT DURING IGNITION.

TABLE 9-1: Boiler Troubleshooting Procedures

Fault	Probable Causes	Corrective Action
DELAYED INTERLOCK OPEN	1. Delayed Interlock Jumper not properly installed or missing.	1. Check to insure jumper is properly installed across the Delayed Interlock terminals in the I/O Box.
	2. Device proving switch hooked to interlocks is not closed.	2. If there are 2 external wires on these terminals, check to see if an end switch for a proving device (such as a pump, louver, etc.) is tied these interlocks. Ensure that the device and/or its end switch is functional. A jumper may be temporarily installed to test the interlock.
DIRECT DRIVE SIGNAL FAULT	1. Direct drive signal is not present: • Not yet installed. • Wrong polarity. • Signal defective at source. • Broken or loose wiring.	1. Check I/O Box to ensure signal is hooked up. • Hook up if not installed. • If installed, check polarity. • Measure signal level. • Check wiring continuity between source and unit.
	2. Signal is not isolated (floating).	2. Check signal at source to ensure it is isolated.
	3. Edge [i] Controller signal type selection switches not set for correct signal type (voltage or current).	3. Check DIP switch on the Controller's Interface board to ensure it is set correctly for the type of signal being sent. Check control signal type set in **Advanced Setup → BST Cascade → Application Configuration** screen.
FLAME LOSS DURING IGN	1. Worn Flame Detector.	1. Remove and inspect the Flame Detector for signs of wear. Replace if necessary.
	2. No spark from Spark Igniter.	2. Close the internal gas valve in the unit. Install and arc a spark igniter outside the unit.
	3. Defective Ignition Transformer.	3. If there is no spark, check for 120VAC at the primary side to the ignition transformer during the ignition cycle.
	4. Defective Ignition/Stepper (IGST) Board.	4. If 120VAC is not present, the IGST Board in the Edge [i] Controller may be defective. Refer fault to qualified service personnel.
	5. Defective SSOV.	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 Edge [i] Controller may be defective. Refer fault to qualified service personnel.

TABLE 9-1: Boiler Troubleshooting Procedures

Fault	Probable Causes	Corrective Action
FLAME LOSS DURING RUN	1. Worn Flame Detector or cracked ceramic.	1. Remove and inspect the Flame Detector for signs of wear or cracked ceramic. Replace if necessary.
	2. Defective Regulator.	2. Check gas pressure readings using a gauge or manometer into and out of the Air/Fuel Valve to ensure that the gas pressure into and out of the valve is correct.
	3. Poor combustion calibration.	3. Check combustion calibration using the procedures in Section 4.4: *Combustion Calibration* of this guide.
	4. Debris on burner.	4. Remove the burner and inspect for any carbon build-up or debris. Clean and reinstall.
	5. Blocked condensate drain.	5. Remove blockage in condensate drain.
HEAT DEMAND FAILURE	1. The Heat Demand Relays on the Ignition/Stepper (IGST) board failed to activate when commanded.	1. Press **CLEAR** button and restart the unit. If the fault persists, replace Ignition/Stepper (IGST) Board.
	2. Relay is activated when not in Demand.	2. Defective relay. Replace IGST Board.
HIGH EXHAUST TEMPERATURE	1. Poor combustion calibration.	1. Check combustion calibration using procedures in Section 4.4: *Combustion Calibration* of this guide.
	2. Carboned heat exchanger due to incorrect combustion calibration.	2. If exhaust temperature is greater than 200° F (93.3°C), check combustion calibration. Calibrate or repair as necessary.
HIGH GAS PRESSURE	1. Incorrect supply gas pressure.	1. Check to ensure gas pressure at inlet of SSOV does not **exceed 14" W.C. (3.49 kPa)**.
	2. Defective SSOV Actuator.	2. If gas supply pressure downstream of SSOV Actuator cannot be lowered to the range specified in Table 4-1 (Natural Gas) or Table 4-4 (Propane) in Section 4.4: *Combustion Calibration* of this guide; the SSOV Actuator may be defective.
	3. Defective **High Gas Pressure** switch.	3. Remove the leads from the High Gas Pressure switch. Measure continuity across the common (C) and normally closed (NC) terminals with the unit not firing. Replace the switch if continuity does not exist.
HIGH WATER	1. Faulty Water temperature switch.	1. Test the temperature switch to insure it trips at its actual water temperature setting.

TABLE 9-1: Boiler Troubleshooting Procedures		
Fault	**Probable Causes**	**Corrective Action**
TEMP SWITCH OPEN	2. Incorrect PID settings.	2. Check PID settings (**Advanced Setup → Performance → Temperature Control**, first 3 items). If the settings have been changed, record the current readings then reset to default values.
	3. Faulty shell temperature sensor.	3. Using the resistance charts in Section 2 of the *Benchmark 750-6000 with Edge [i]: Reference Manual (OMM-0146, GF-219)* measure the resistance of Shell sensor and BTU sensor at a known water temperature.
	4. Unit in **Manual** mode.	4. If unit is in **Manual** mode, switch to **Auto** mode (**Diagnostic → Manual Mode**).
	5. Unit setpoint is greater than Over Temperature switch setpoint.	5. Check setpoint of unit and setpoint of Temperature switch; Ensure that the temperature switch is set higher than the unit's setpoint.
	6. System flow rate changes are occurring faster than units can respond.	6. If the system is a variable flow system, monitor system flow changes to ensure that the rate of flow change is not faster than what the units can respond to.
HIGH WATER TEMPERATURE	1. See HIGH WATER TEMPERATURE SWITCH OPEN.	1. See HIGH WATER TEMPERATURE SWITCH OPEN.
	2. Temp HI Limit setting is too low.	2. Check Temp HI Limit setting.
IGN BOARD COMM FAULT	1. Communication fault has occurred between the PMC board and Ignition/Stepper (IGST) board.	1. Press **CLEAR** button and restart unit. If fault persists, contact qualified Service Personnel.
	2. 32 Pin Ribbon cable defective.	2. Replace 32 Pin Ribbon cable.
IGN SWITCH CLOSED DURING PURGE	1. Air/Fuel Valve not rotating.	1. Start the unit. The Air/Fuel Valve should rotate to the purge (open) position. If the valve does not rotate at all or does not rotate fully open, check the Air/Fuel Valve calibration. If calibration is okay, the problem may be in the Air-Fuel Valve or the Edge [i] Controller. Refer to qualified service personnel.
	2. Defective or shorted switch.	2. If the Air/Fuel Valve does rotate to purge, check the ignition switch for continuity between the N.O. and COM terminals. If the switch shows continuity when not in contact with the cam replace the switch.

TABLE 9-1: Boiler Troubleshooting Procedures

Fault	Probable Causes	Corrective Action
	3. Switch wired incorrectly.	3. Check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals). If the switch is wired correctly, replace the switch.
	4. Defective Power Supply Board or fuse.	4. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady **ON**, replace Power Supply Board.
	5. Defective IGST Board.	5. Check "Heartbeat" LED DS1 and verify it is blinking **ON** & **OFF** every second. If not, replace IGST Board.
IGN SWTCH OPEN DURING IGNITION	1. Air/Fuel Valve not rotating to ignition position.	1. Start the unit. The Air/Fuel Valve should rotate to the purge (open) position, then back to ignition position (towards closed) during the ignition cycle. If the valve does not rotate back to the ignition position, check the Air/Fuel Valve calibration. If calibration is okay, the problem may be in the Air/Fuel Valve or the Controller. Refer fault to qualified service personnel.
	2. Defective Ignition switch.	2. If the Air/Fuel Valve does rotate to the ignition position, check the ignition position switch for continuity between the N.O. and COM terminals when in contact with the cam.
	3. Defective Power Supply Board or fuse.	3. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.
	4. Defective IGST Board.	4. Check "Heartbeat" LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.
INTERLOCK OPEN	1. Interlock jumper not installed or removed.	1. Check for a jumper properly installed across the interlock terminals in the I/O box.
	2. Energy Management System does not have unit enabled.	2. If there are two external wires on these terminals check any Energy Management system to see if they have the units disabled (a jumper may be temporarily installed to see if the interlock circuit is functioning).
	3. Device proving switch hooked to interlocks is not closed.	3. Check that proving switch for any device hooked to the interlock circuit is closing and that the device is operational.
LINE VOLTAGE	1. Line and Neutral switched in AC Power Box.	1. Check hot and neutral in AC Power Box to ensure they are not reversed.

TABLE 9-1: Boiler Troubleshooting Procedures

Fault	Probable Causes	Corrective Action
OUT OF PHASE	2. Incorrect power supply transformer wiring.	2. Check transformer wiring, in AC Power Box, against the power box transformer wiring diagram to ensure it is wired correctly.
LOW GAS PRESSURE	1. Incorrect supply gas pressure.	1. Measure gas pressure upstream of the SSOV Actuator(s) with the unit firing. Ensure it is above the value in Table 4-2 (Natural Gas) or Table 4-5 (Propane).
	2. Defective Low Gas Pressure switch.	2. Measure gas pressure at the Low Gas Pressure switch. If it is **greater than 1 inch above the Low Gas Pressure switch setting** in Table 4-2 (Natural Gas) or Table 4-5 (Propane), measure continuity across the switch and replace if necessary.
LOW WATER LEVEL	1. Insufficient water level in system.	1. Check system for sufficient water level.
	2. Defective water level circuitry.	2. Test water level circuitry using the Low Water **TEST** and **RESET** buttons on the Controller's front panel. Replace water level circuitry if it does not respond.
	3. Defective water level probe.	3. Check continuity of probe end to the shell, change probe if there is no continuity.
MODBUS COMMFAULT	Unit not seeing information from Modbus network.	Check network connections. If fault persists, contact qualified Service Personnel.
PRG SWTCH CLOSED DURING IGNITION	1. A/F Valve rotated open to purge and did not rotate to ignition position.	1. Start the unit. The Air/Fuel Valve should rotate to the purge (open) position, then back to ignition position (towards closed) during the ignition cycle. If the valve does not rotate back to the ignition position, check the Air/Fuel Valve calibration. If calibration is okay, the problem may be in the Air/Fuel Valve or the Edge [i] Controller. Refer fault to qualified service personnel.
	2. Defective or shorted switch.	2. If the Air/Fuel Valve does rotate to the ignition position, check the purge switch for continuity between the N.O. and COM terminals. If the switch shows continuity when not in contact with the cam, check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals).
	3. Switch wired incorrectly.	3. If the switch is wired correctly, replace the switch.
	4. Defective Power Supply Board or fuse.	4. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.

TABLE 9-1: Boiler Troubleshooting Procedures

Fault	Probable Causes	Corrective Action
	5. Defective IGST Board.	5. Check "Heartbeat" LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.
PRG SWTCH OPEN DURING PURGE	1. Defective Purge switch.	1. If the air-fuel valve does rotate, check Purge switch for continuity when closing. Replace switch if continuity does not exist.
	2. No voltage present at switch.	2. Measure for 24 VAC from each side of the switch to ground. If 24VAC is not present, refer fault to qualified service personnel.
	3. Switch wired incorrectly.	3. Check to ensure that the switch is wired correctly (correct wire numbers on the normally open terminals).
	4. Defective Power Supply Board or fuse.	4. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.
	5. Defective IGST Board.	5. Check "Heartbeat" LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.
OUTDOOR TEMP SENSOR FAULT	1. Loose or broken wiring.	1. Inspect Outdoor Temperature sensor for loose or broken wiring.
	2. Defective Sensor.	2. Check resistance of sensor to determine if it is within specification.
	3. Incorrect Sensor.	3. Ensure that the correct sensor is installed.
RECIRC PUMP FAILURE	1. Internal recirculation pump failed.	1. Replace recirculation pump.
REMOTE SETPT SIGNAL FAULT	1. Remote setpoint signal not present: • Not yet installed. • Wrong polarity. • Signal defective at source. • Broken or loose wiring.	1. Check I/O Box to ensure signal is hooked up. • Hook up if not installed. • If installed, check polarity. • Measure signal level. • Check continuity of wiring between source and unit.
	2. Signal is not isolated (floating) if 4 to 20 mA.	2. Check signal at source to ensure it is isolated.
	3. Edge [i] Controller signal type selection switches not set for correct signal type (voltage or current).	3. Check DIP switch on PMC board to ensure it is set correctly for the type of signal being sent. Check control signal type set in the **Remote Signal** parameter (**Advanced Setup→ Unit → Application Configuration**).
RESIDUAL	1. Defective Flame Detector.	1. Replace Flame Detector.

TABLE 9-1: Boiler Troubleshooting Procedures		
Fault	**Probable Causes**	**Corrective Action**
FLAME	2. SSOV not fully closed.	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 Gas Shut-Off Valve downstream of SSOV. 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.
	3. Wire strand from burner head in contact with Flame Detector	3. Ensure Flame Detector is in good condition and is not tilted inward toward burner head.
SSOV FAULT DURING PURGE	See SSOV SWITCH OPEN	
SSOV FAULT DURING RUN	SSOV switch closed for 15 seconds during run.	1. Replace actuator.
SSOV RELAY FAILURE	1. SSOV relay failed on IGST board.	1. Press **CLEAR** button and restart unit. If fault persists, replace Ignition/Stepper (IGST) Board.
	2. Floating Neutral.	2. The Neutral and Earth Ground are not connected at the source and therefore there is a voltage measured between the two. Normally this measurement should be near zero or no more than a few millivolts.
	3. Hot and Neutral reversed at SSOV.	3. Check SSOV power wiring.
SSOV SWITCH OPEN	1. Actuator not allowing for full closure of gas valve.	1. Observe operation of the Safety Shut-Off Valve (SSOV) through indicator on the Valve actuator and ensure that the valve is fully and not partially closing.
	2. SSOV powered when it should not be	2. If the SSOV never closes, it may be powered continuously. Close the gas supply and remove power from the unit. Refer fault to qualified service personnel.
	3. Defective switch or Actuator.	3. Remove the electrical cover from the SSOV and check switch continuity. If the switch does not show continuity with the gas valve closed, either adjust or replace the switch or actuator.
	4. Incorrectly wired switch.	4. Ensure that the SSOV Proof of Closure switch is correctly wired.
STEPPER MOTOR FAILURE	1. Air/Fuel Valve unplugged.	1. Check that the Air/Fuel Valve is connected to the Edge [i] Controller.
	2. Loose wiring connection to the stepper motor.	2. Inspect for loose connections between the Air/Fuel Valve motor and the wiring harness.

TABLE 9-1: Boiler Troubleshooting Procedures		
Fault	**Probable Causes**	**Corrective Action**
	3. Defective Air/Fuel Valve stepper motor.	3. Replace stepper motor.
	4. Defective Power Supply Board or fuse.	4. Check DS1 & DS2 LEDs on Power Supply Board. If they are not steady ON, replace Power Supply Board.
	5. Defective IGST Board.	5. Check "Heartbeat" LED DS1 and verify it is blinking ON & OFF every second. If not, replace IGST Board.
	6. Air/Fuel Valve out of calibration	6. Perform the stepper motor calibration procedure (**Main Menu → Diagnostics → Subsystems → Air Fuel Valve Stepper Motor**).

9.2 ADDITIONAL FAULTS WITHOUT SPECIFIC FAULT MESSAGES

Refer to Table 9-2 to troubleshoot faults which may occur without a specific fault message being displayed.

TABLE 9-2: Boiler Troubleshooting with No Fault Message Displayed

Observed Incident	Probable Causes	Corrective Action
Hard Light-Off	1. Clogged/damaged Gas Injector on Igniter-Injector (Figure 8-1a through Figure 8-1c).	1. Disconnect the Staged Ignition Assembly solenoid from the Gas injector Tube of the Igniter-Injector (Figure 8-1a through Figure 8-1c) and inspect Gas Injector to ensure it is not clogged or damaged.
	2. Defective Staged Ignition Solenoid (Figure 8-1a through Figure 8-1c).	2. Close the Manual Shutoff Valve. Attempt to start the unit and listen for a “clicking” sound that the Staged Ignition Solenoid makes during Ignition Trial. If “clicking” sound is not heard after 2 or 3 attempts, replace the Staged Ignition Solenoid.
Fluctuating Gas Pressure	1. Gas pressure going into unit is fluctuating.	1. Stabilize gas pressure going into unit. If necessary, troubleshoot Building Supply Regulator.
	2. Damping Orifice not installed.	2. Check if the gas train is supposed to have a Damping Orifice, and if so, ensure that it is installed in the SSOV Actuator, as shown in Figure 10-1, below. For DBB Gas Trains, the Damping Orifice is installed in the downstream SSOV Actuator).

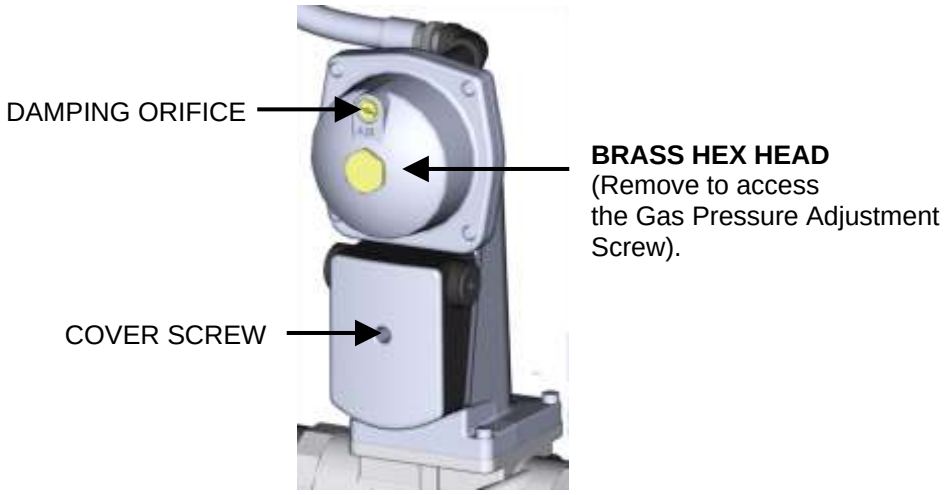
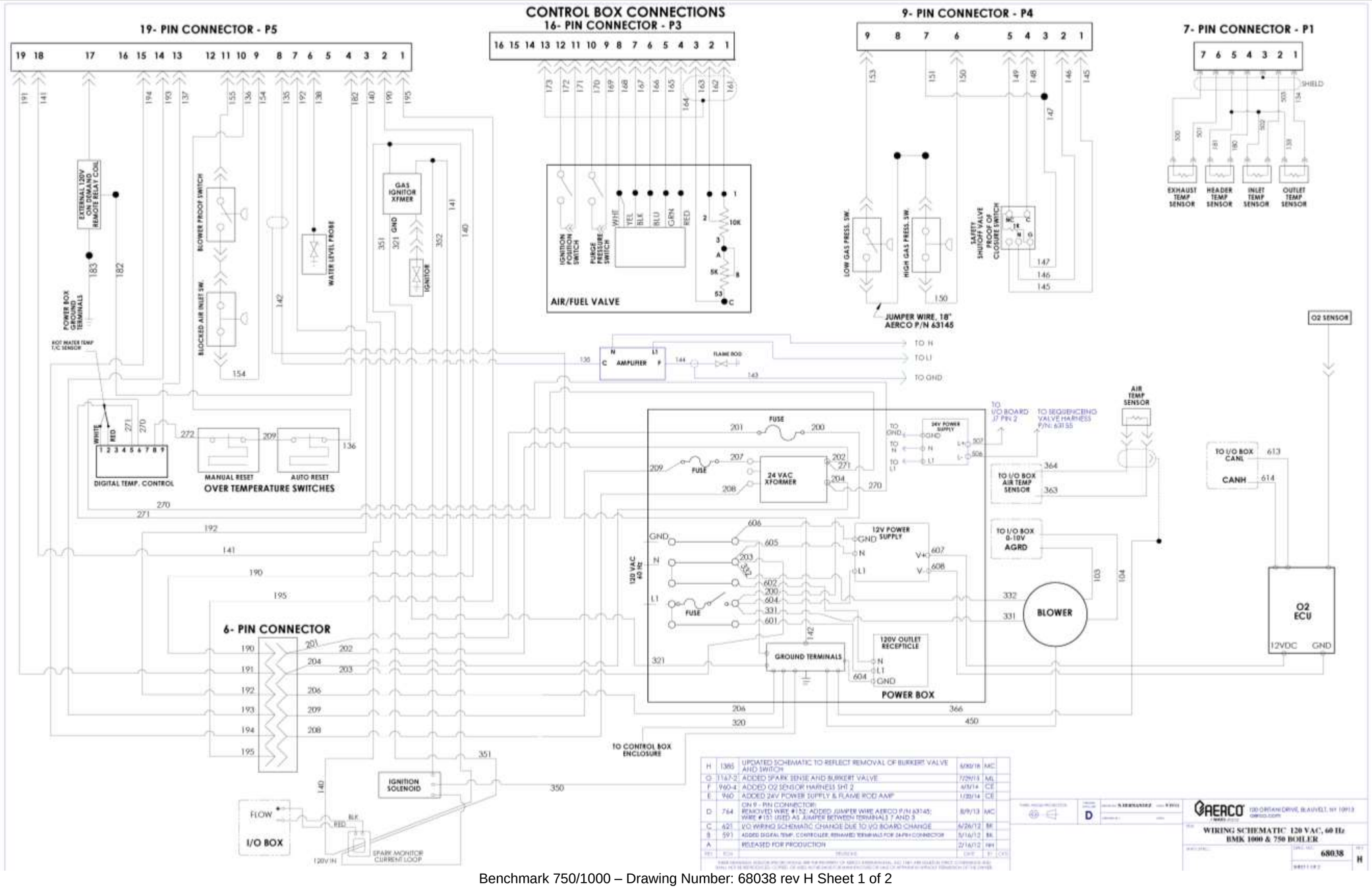


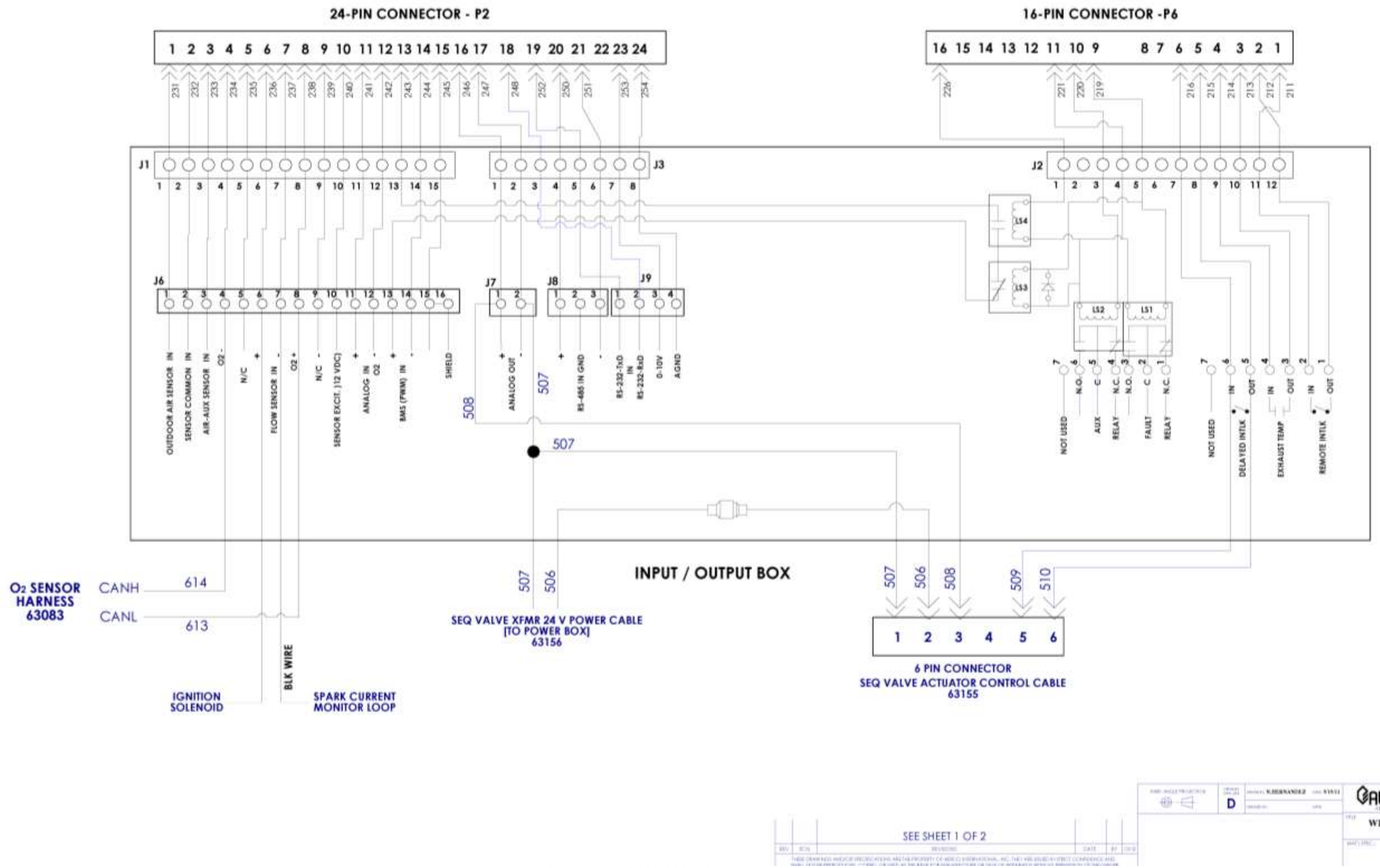
Figure 9-1: SSOV Actuator with Gas Pressure Adjustment (SKP25)

APPENDIX A: WIRING SCHEMATICS

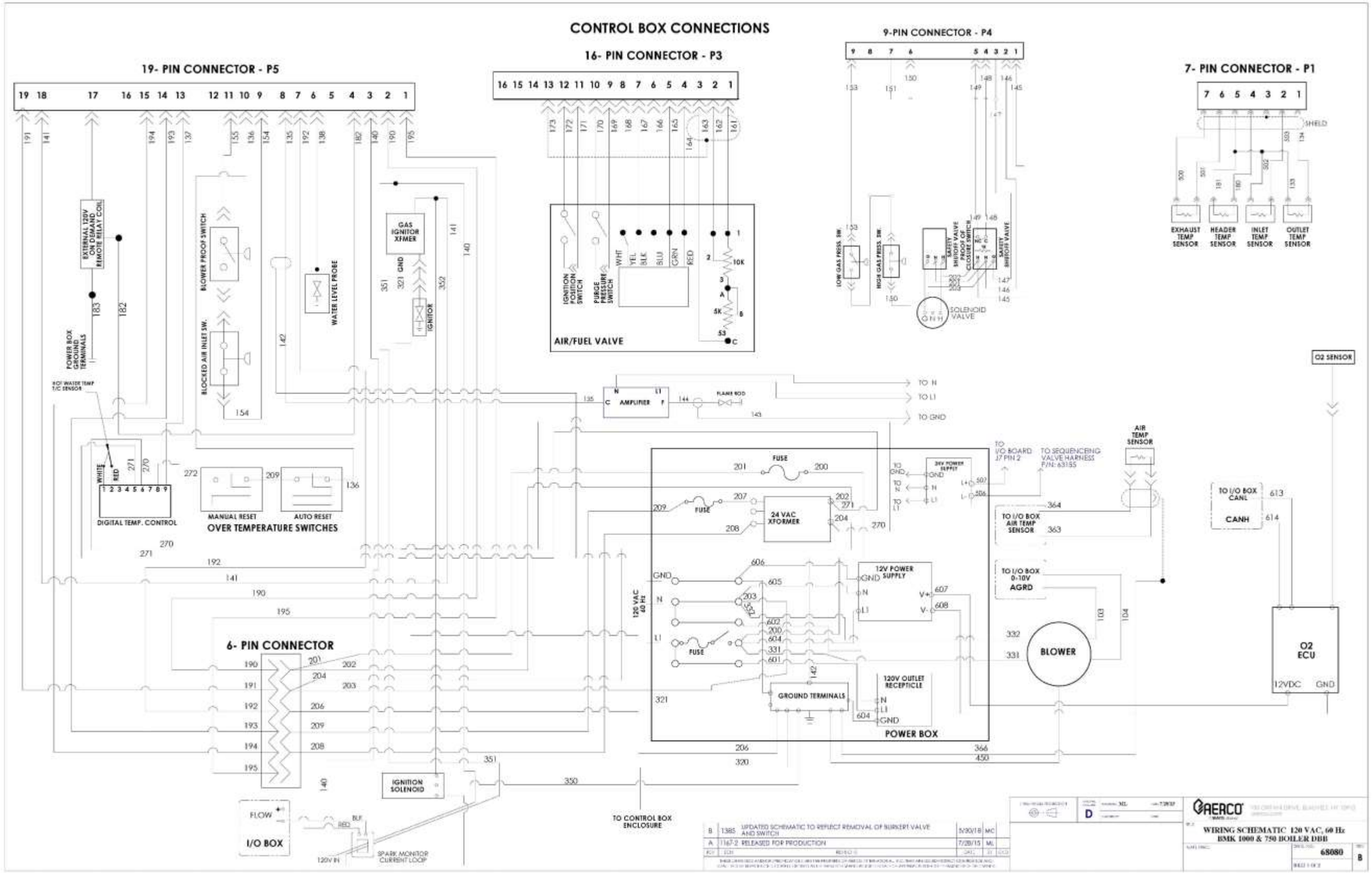


Benchmark 750/1000 – Drawing Number: 68038 rev H Sheet 1 of 2

CONTROL BOX CONNECTORS



Benchmark 750/1000 – Drawing Number: 68038 rev H Sheet 2 of 2



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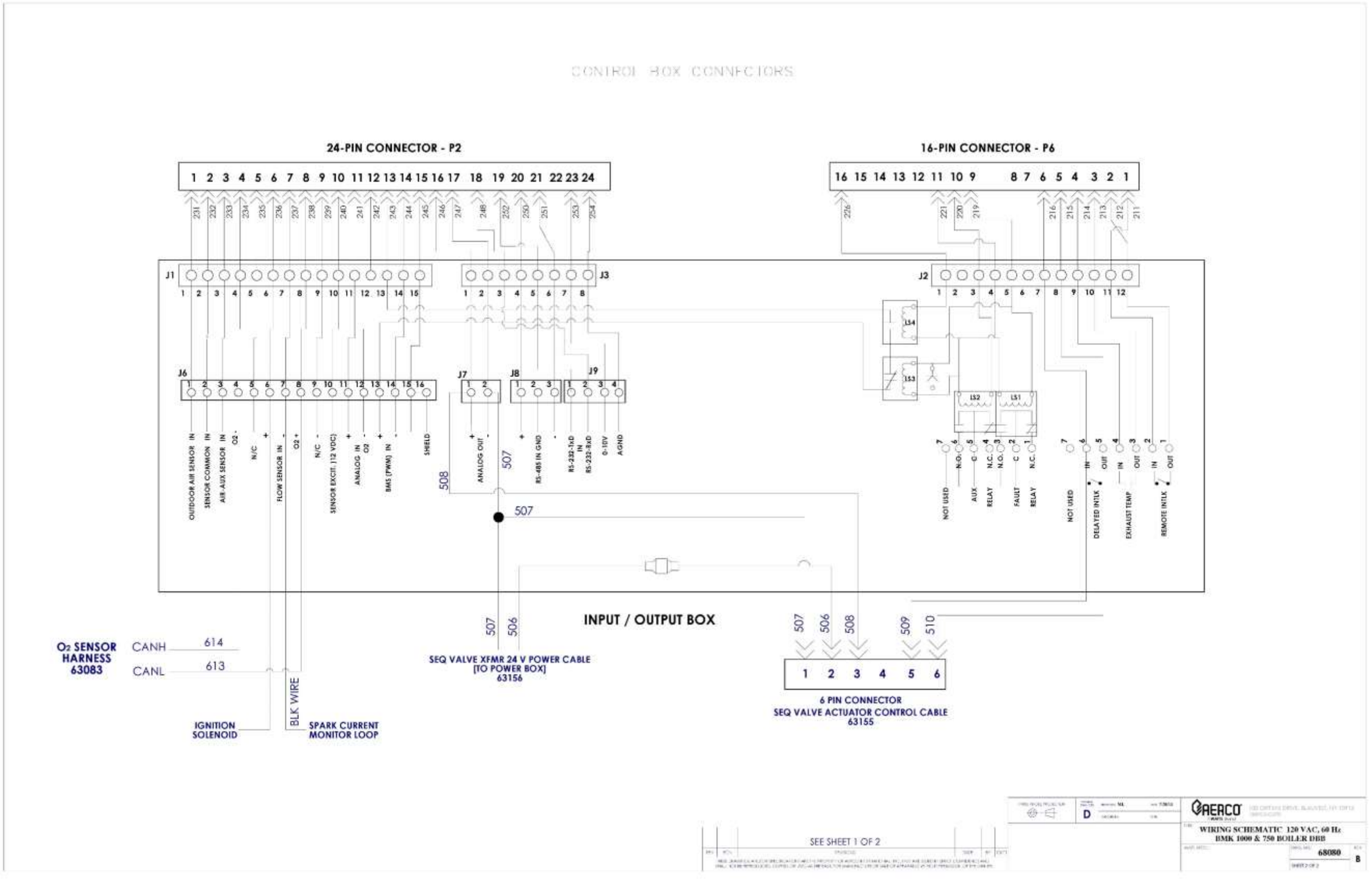
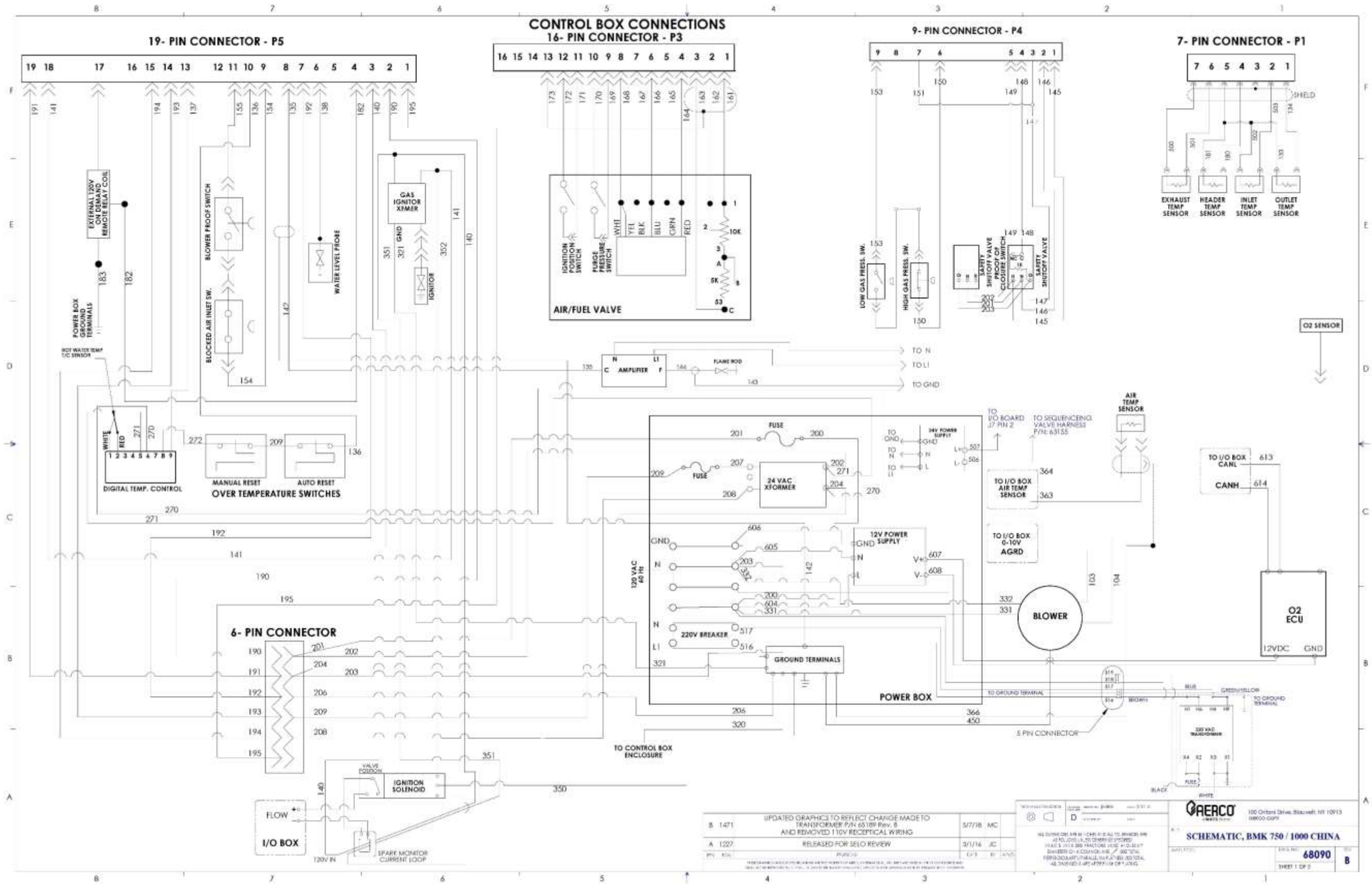


Benchmark 750/1000 – Drawing Number: 68080 rev B Sheet 2 of 2



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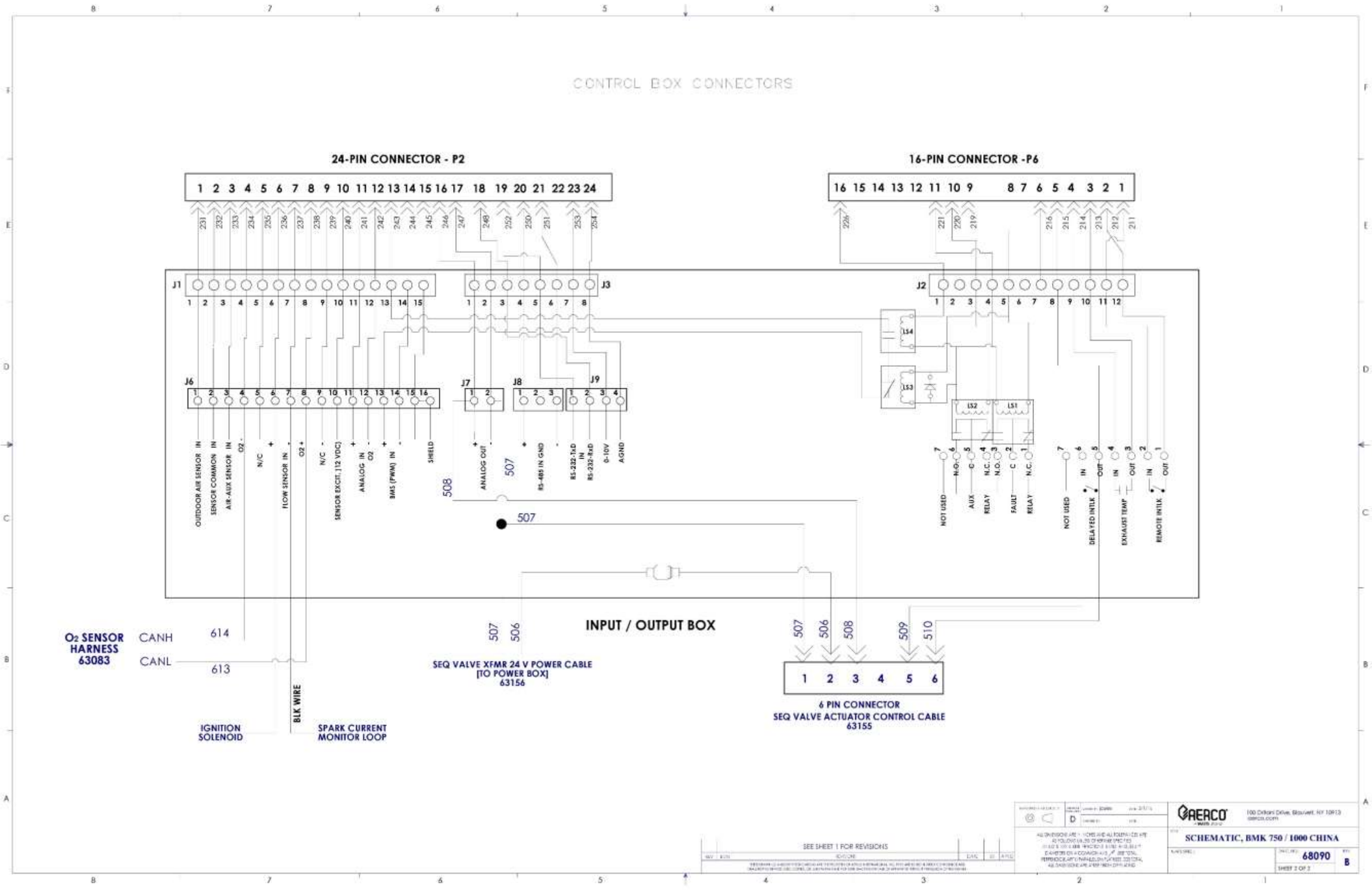

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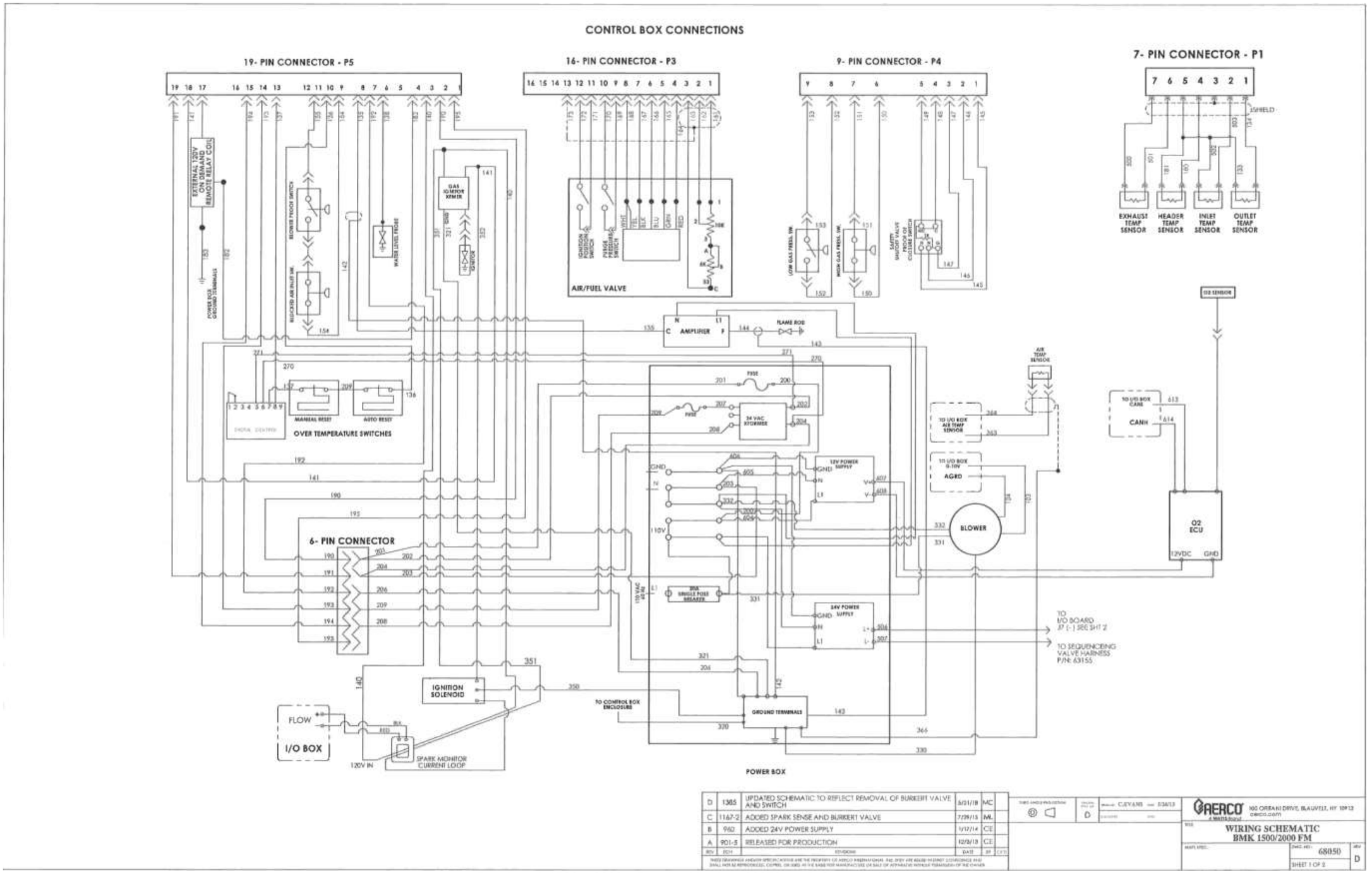

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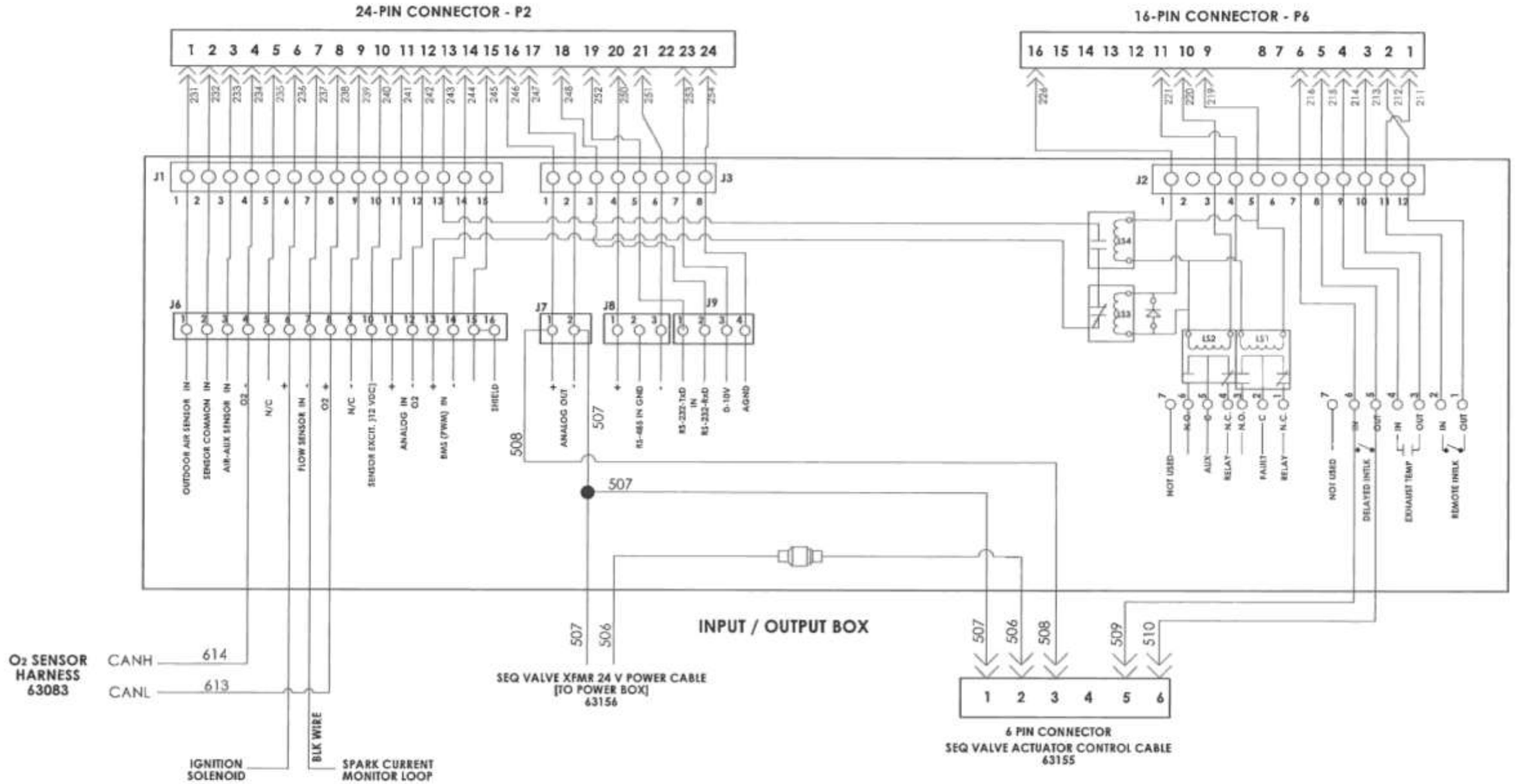
CONTROL BOX CONNECTORS



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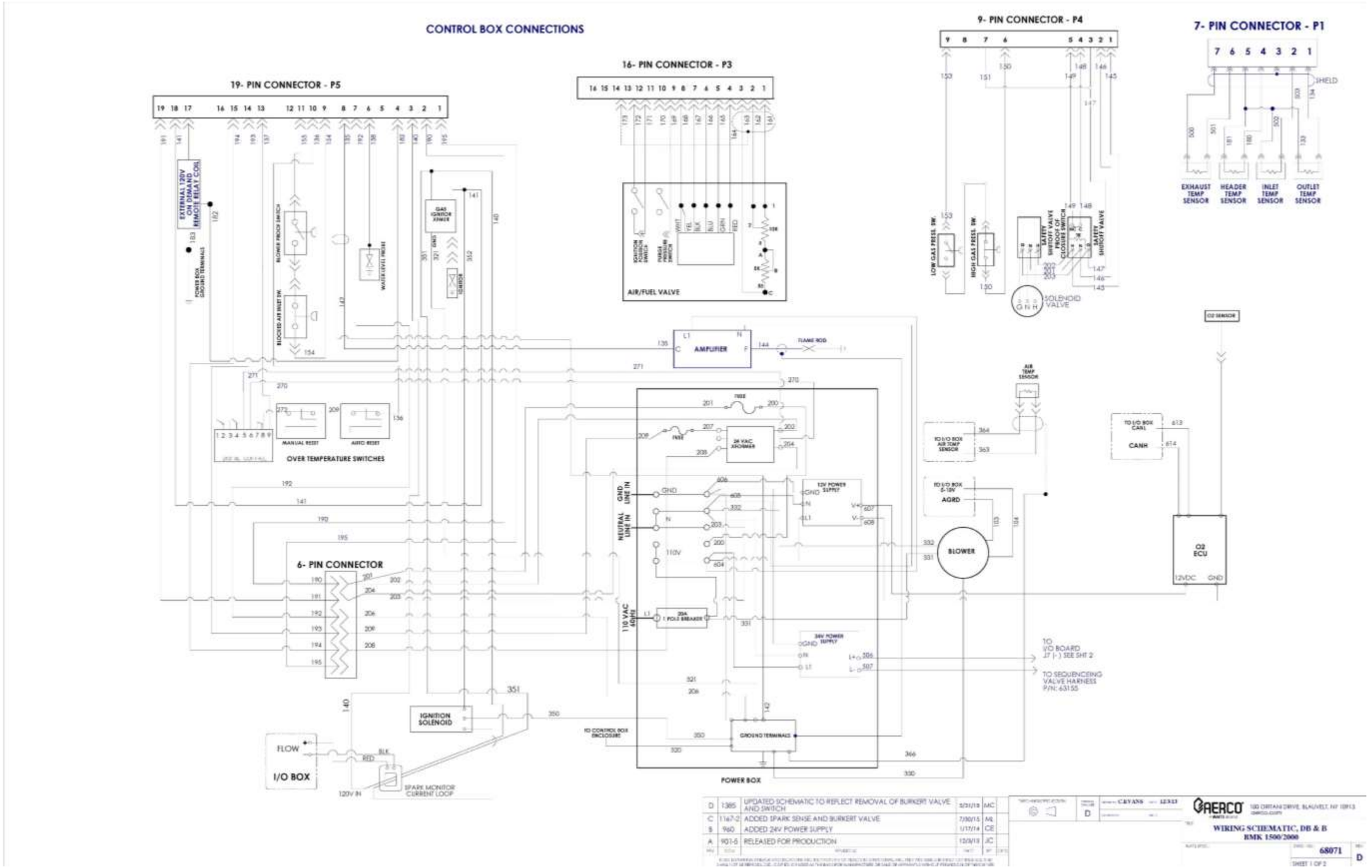

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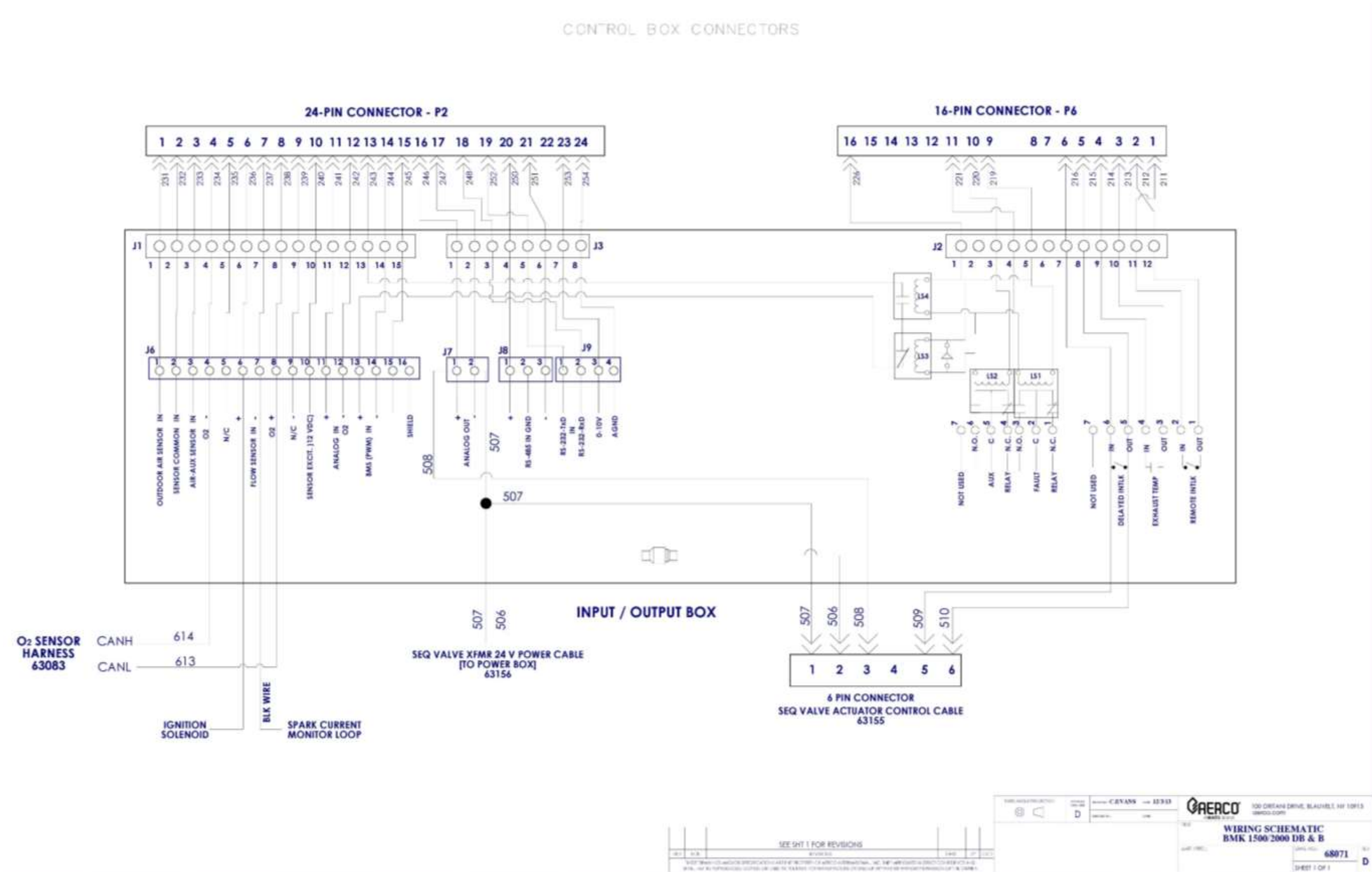

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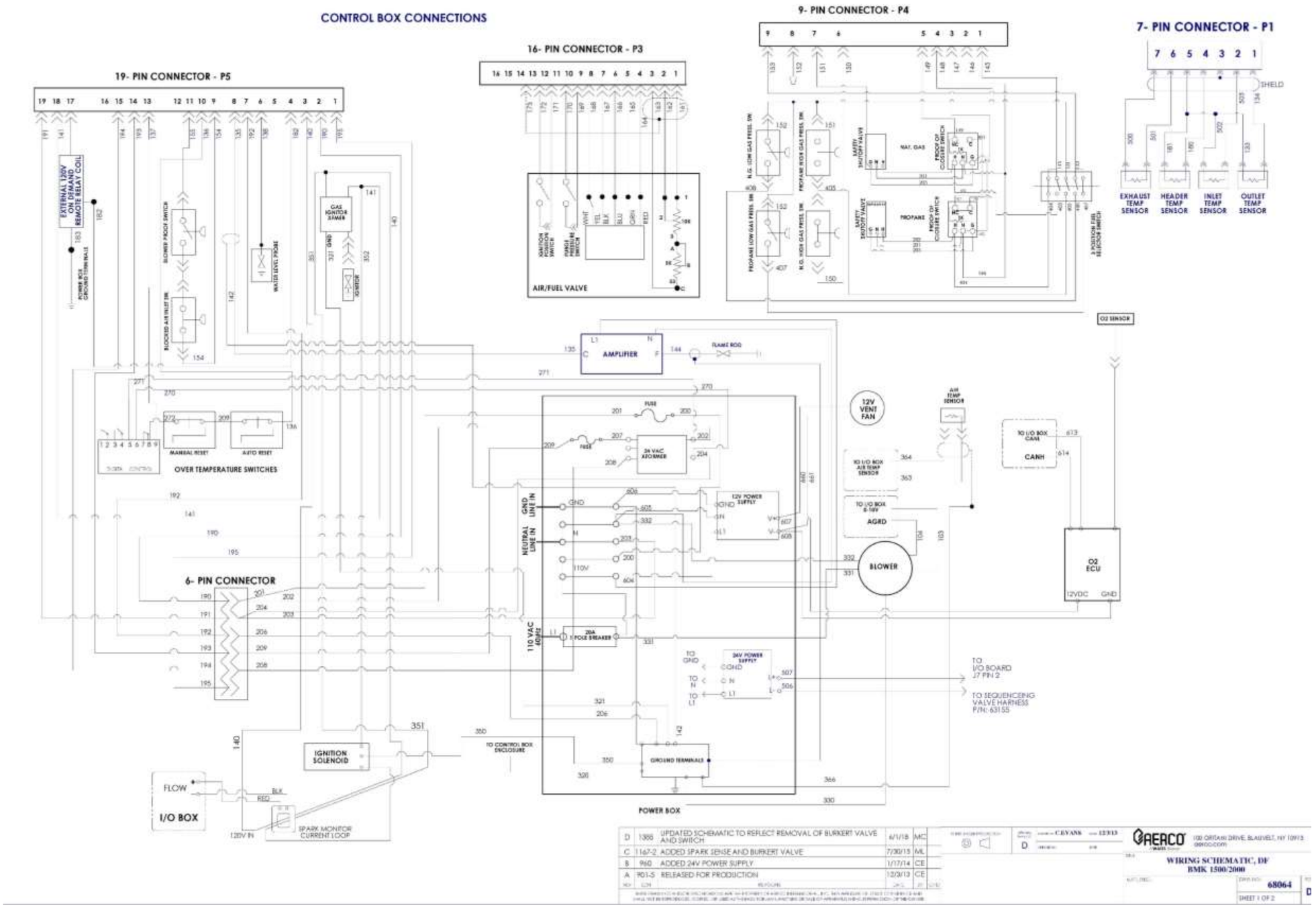

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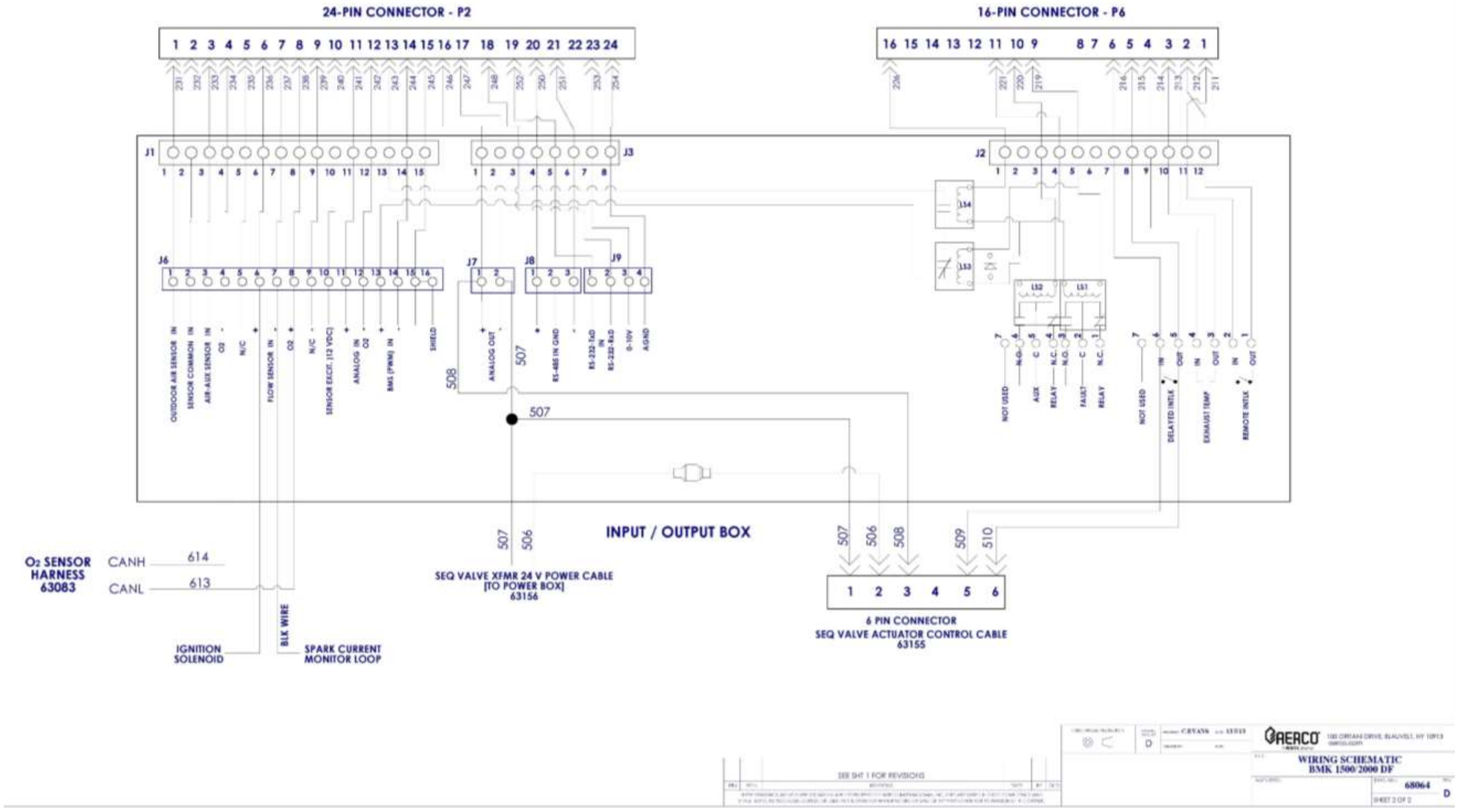

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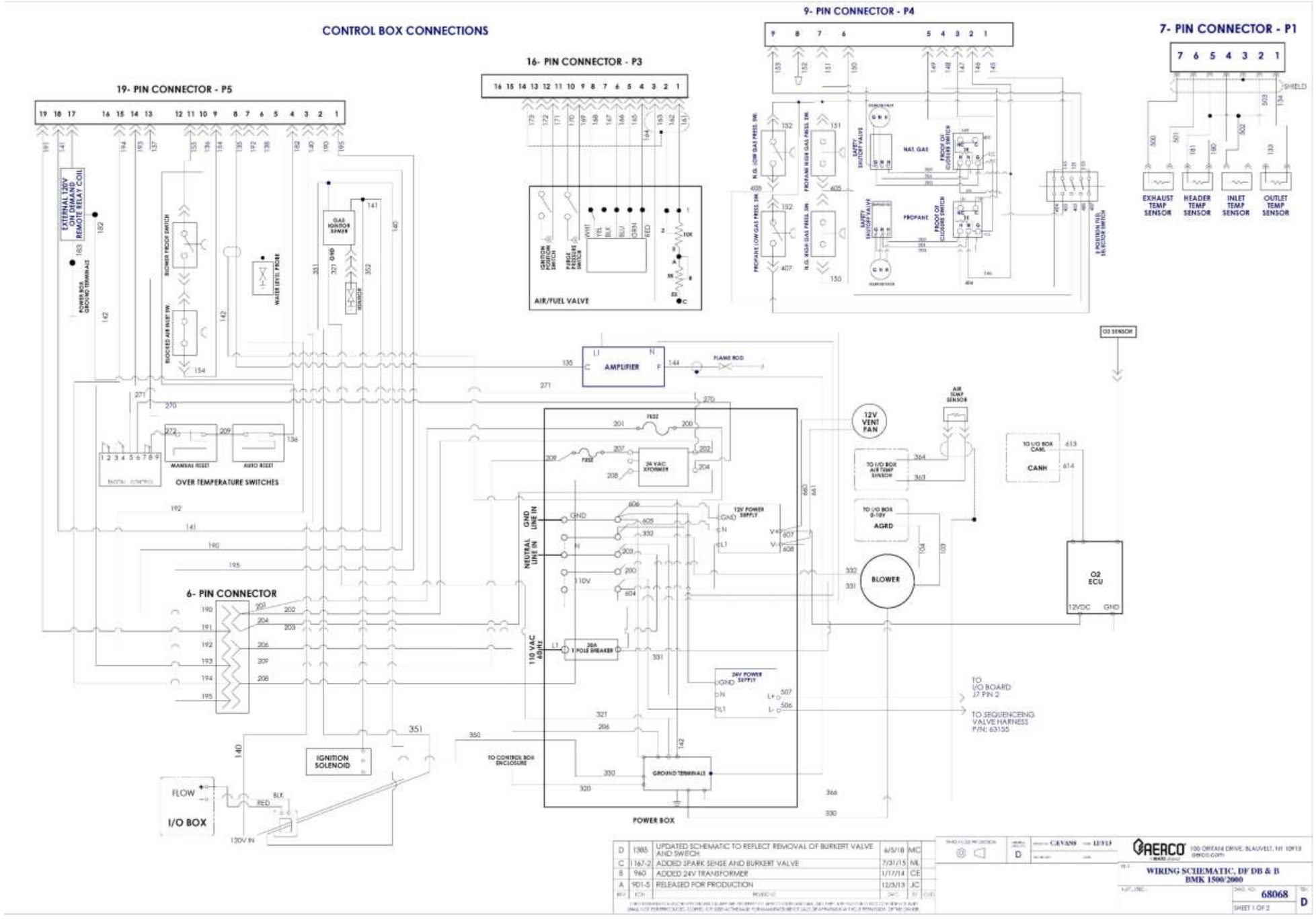

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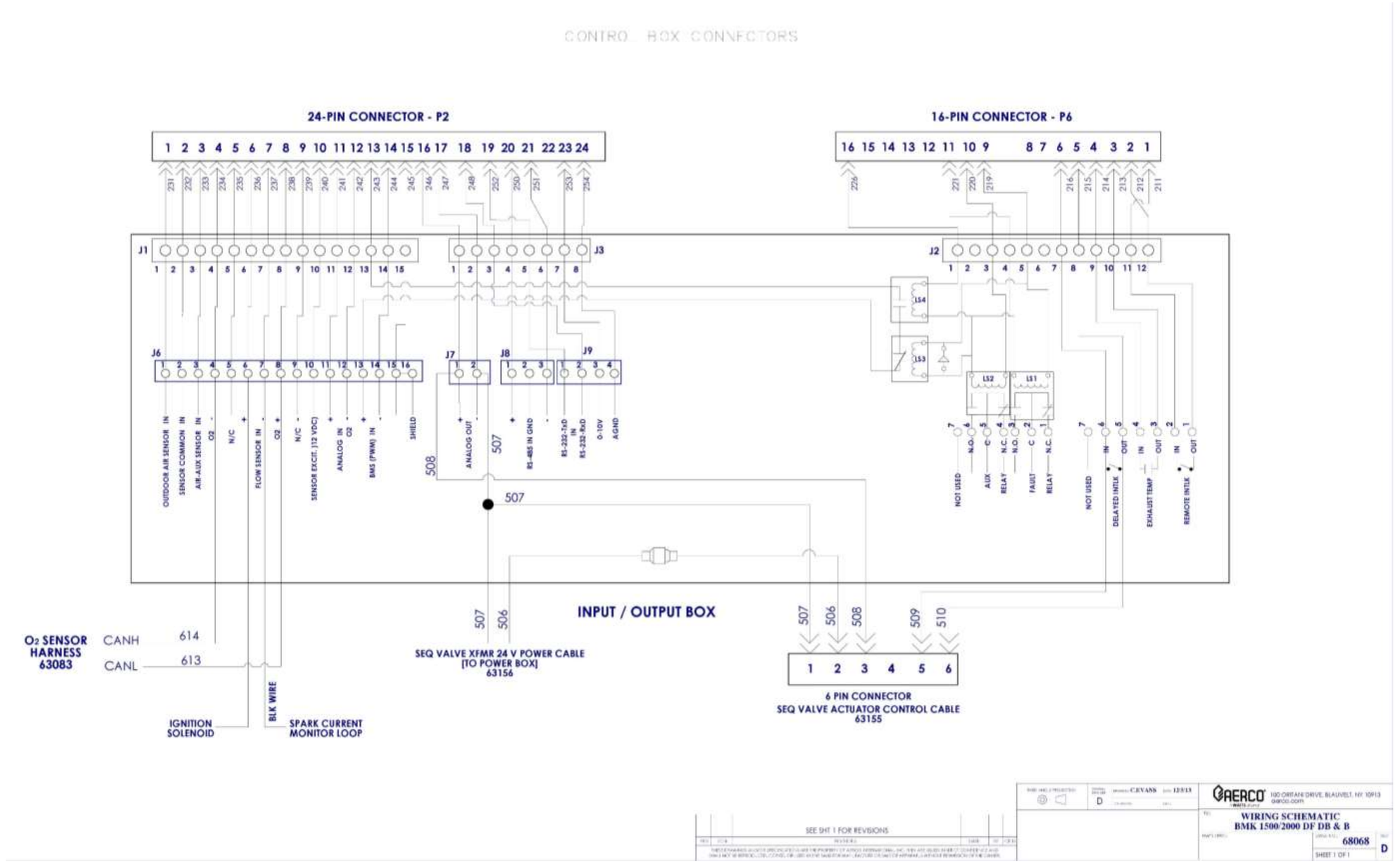

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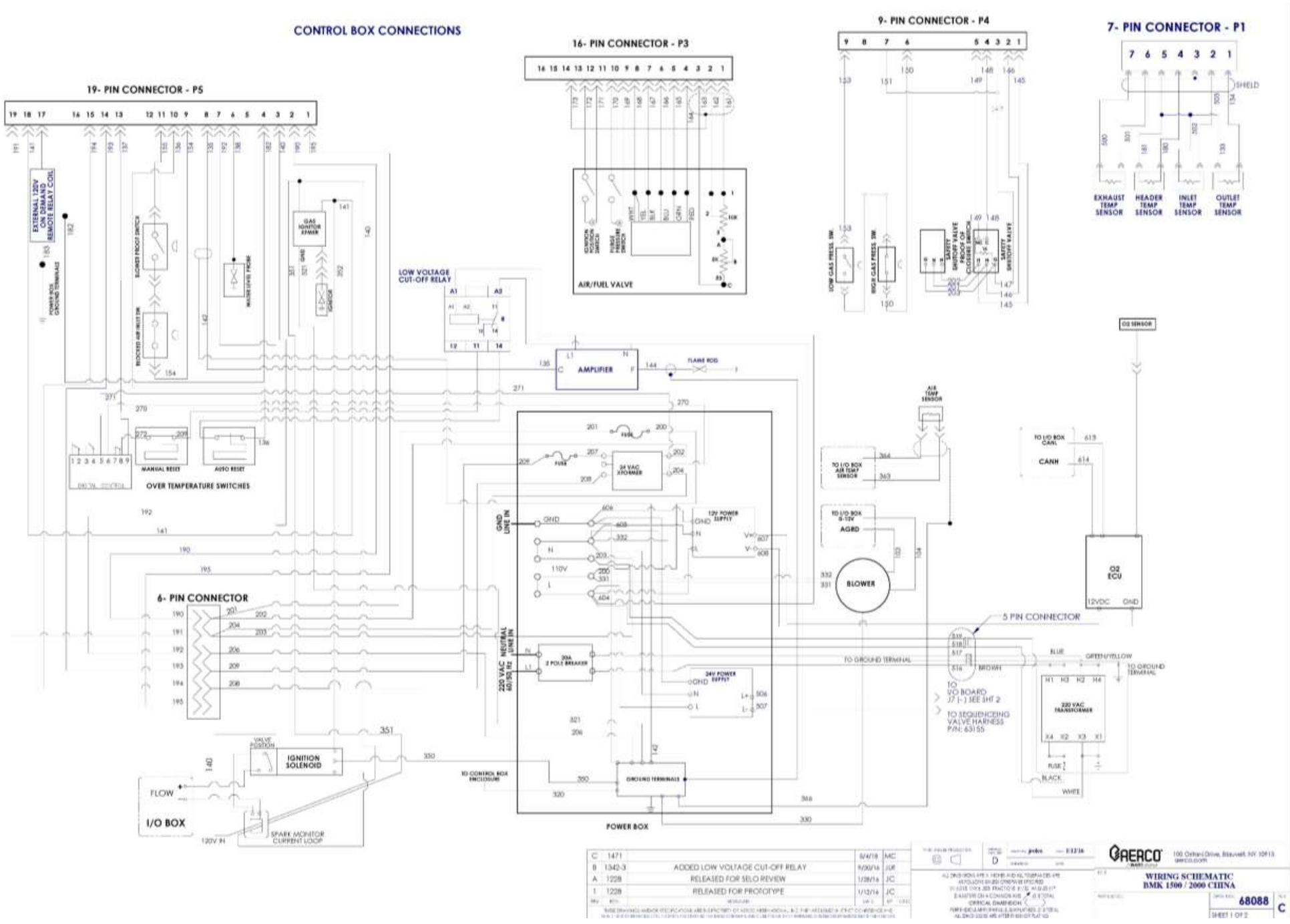

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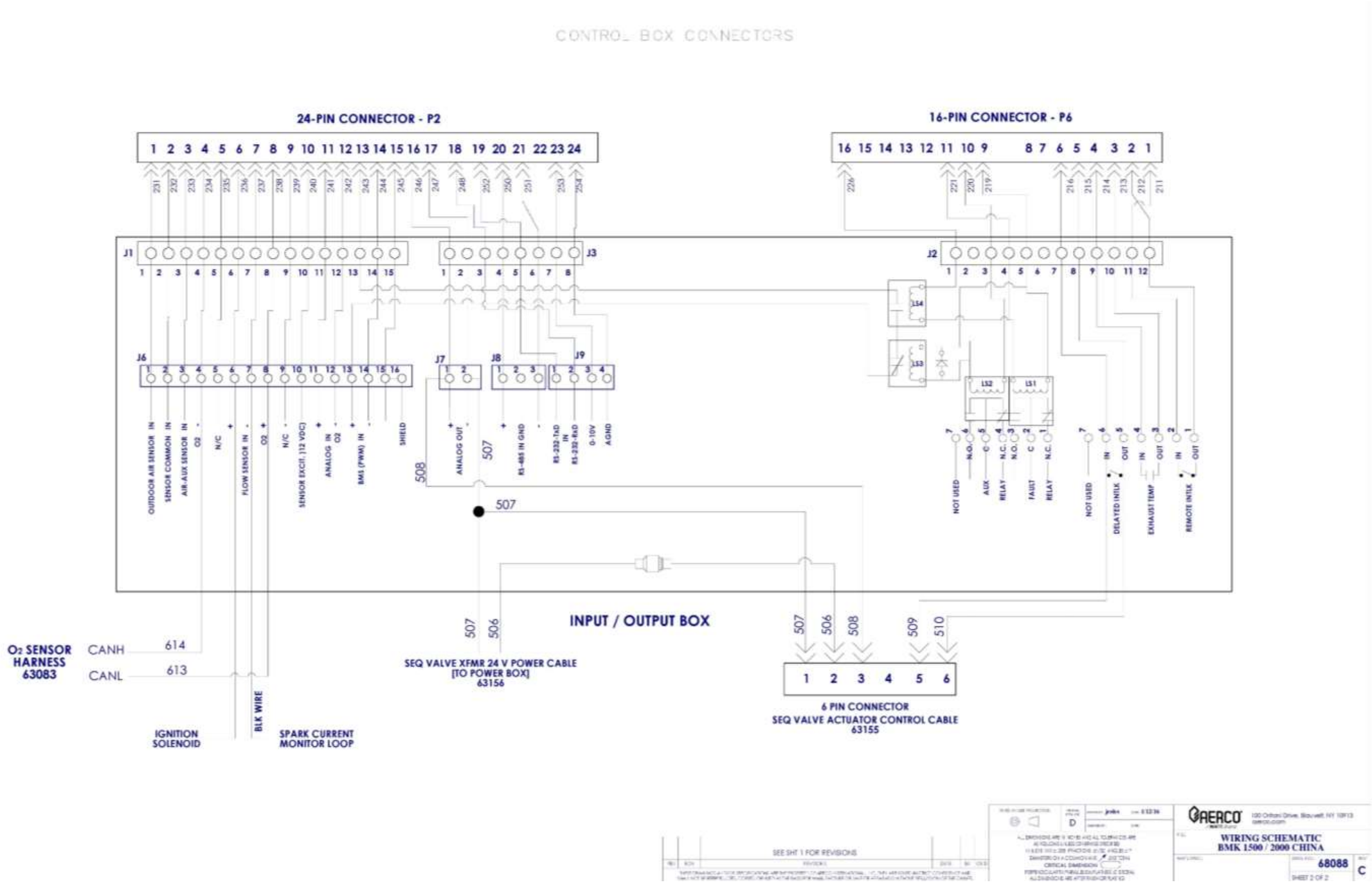

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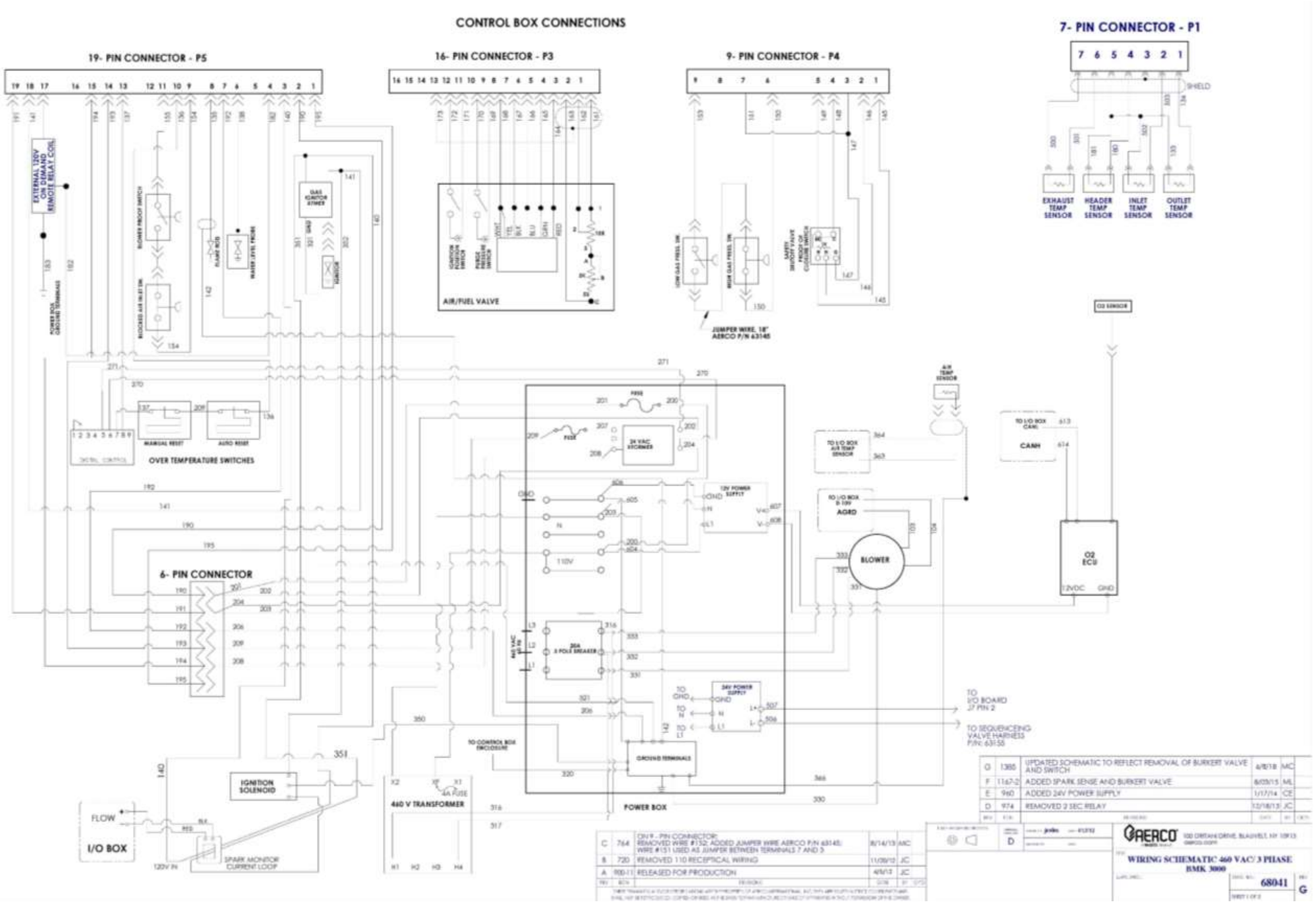
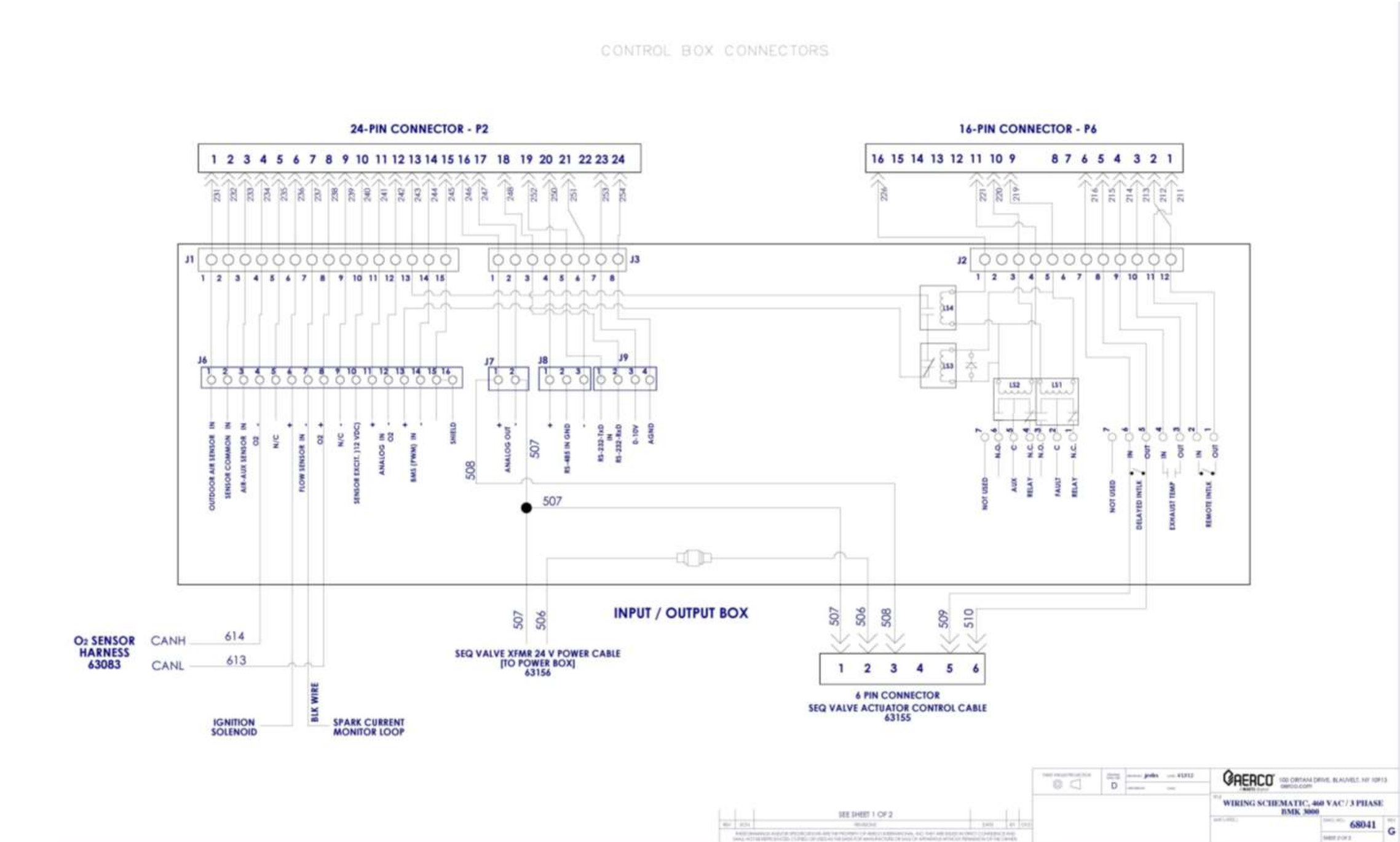


Benchmark 2500 – 3000 – Drawing Number: 68041 rev G Sheet 1 of 2



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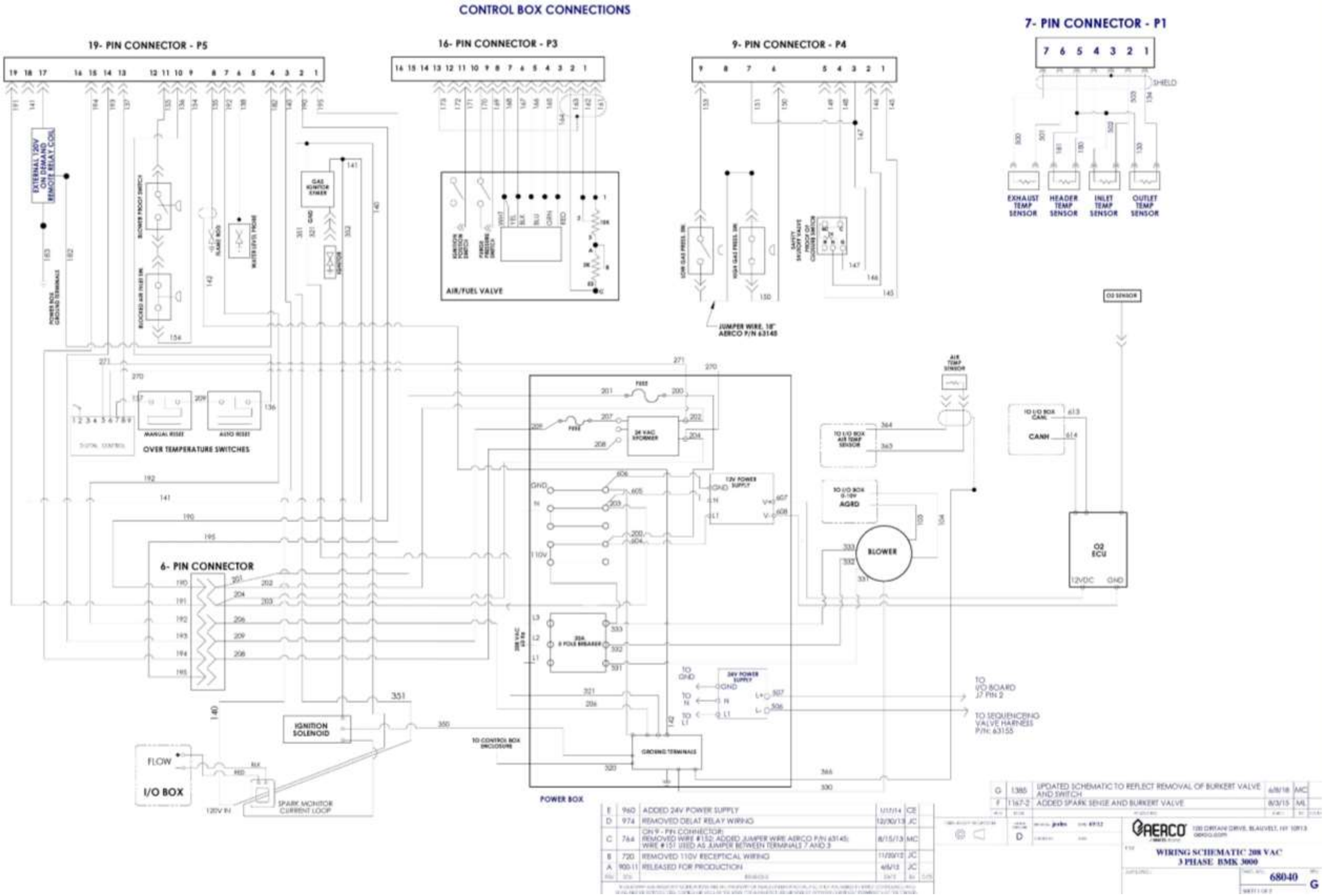
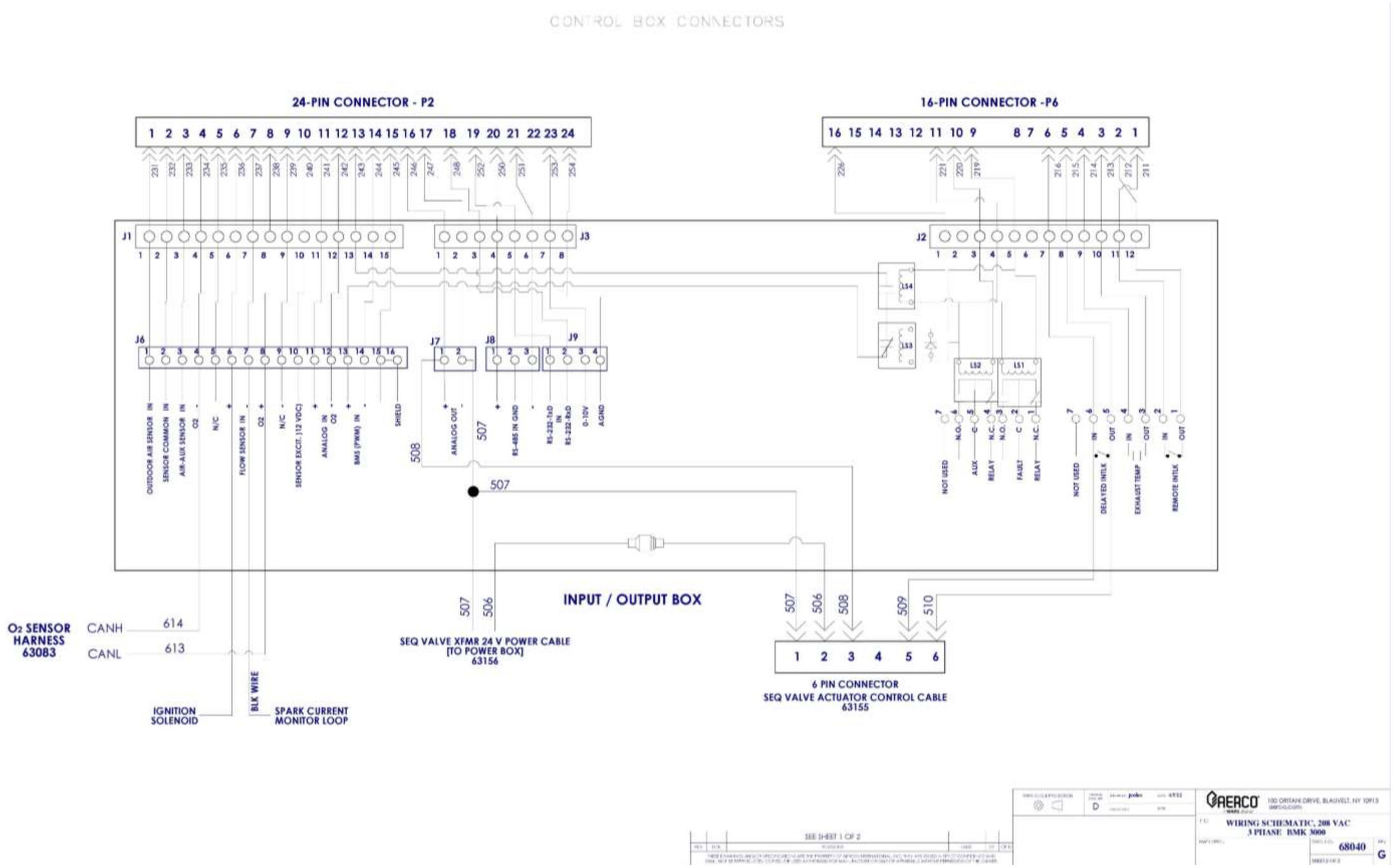


Benchmark 2500 – 3000 – Drawing Number: 68040 rev G Sheet 1 of 2



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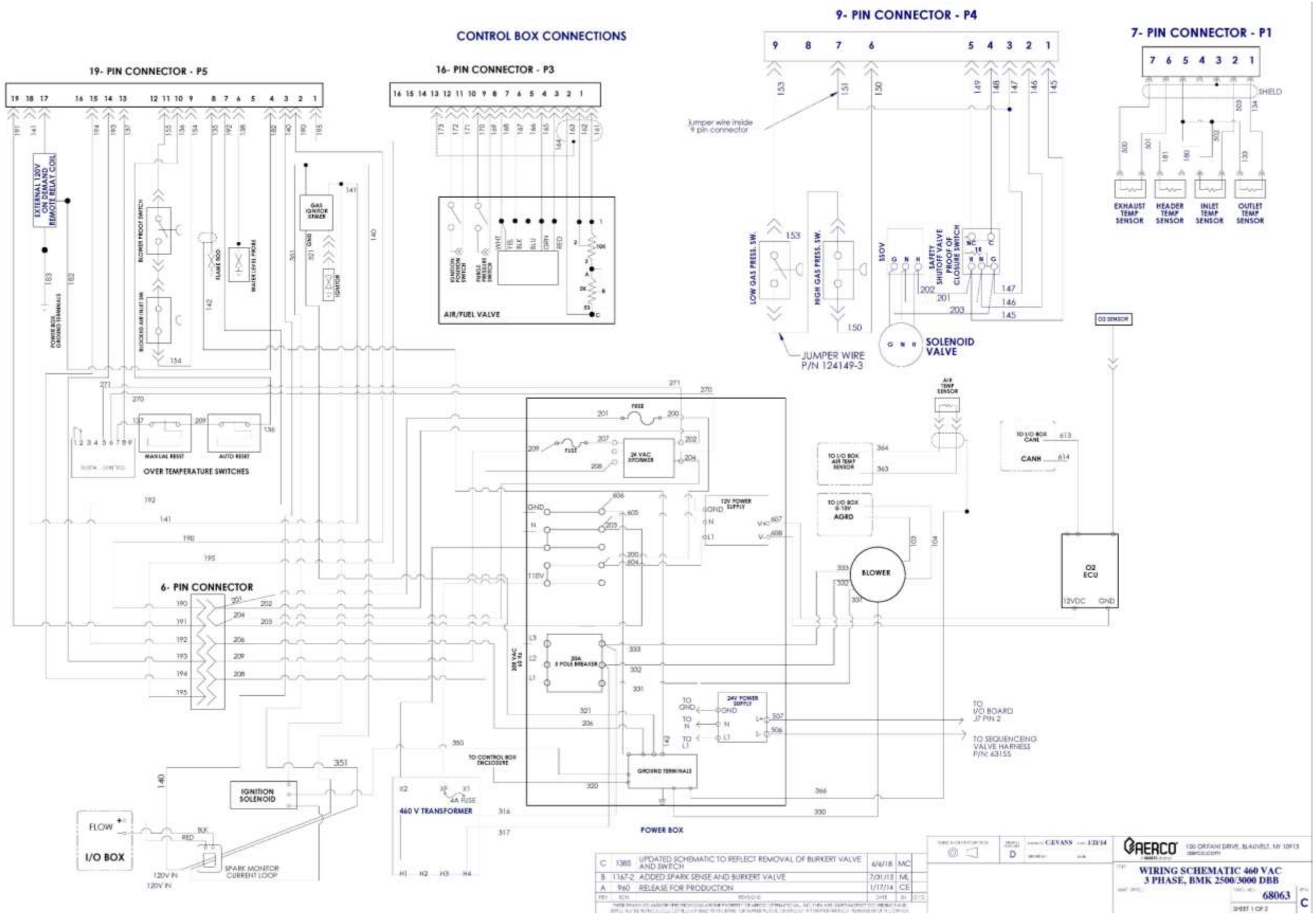

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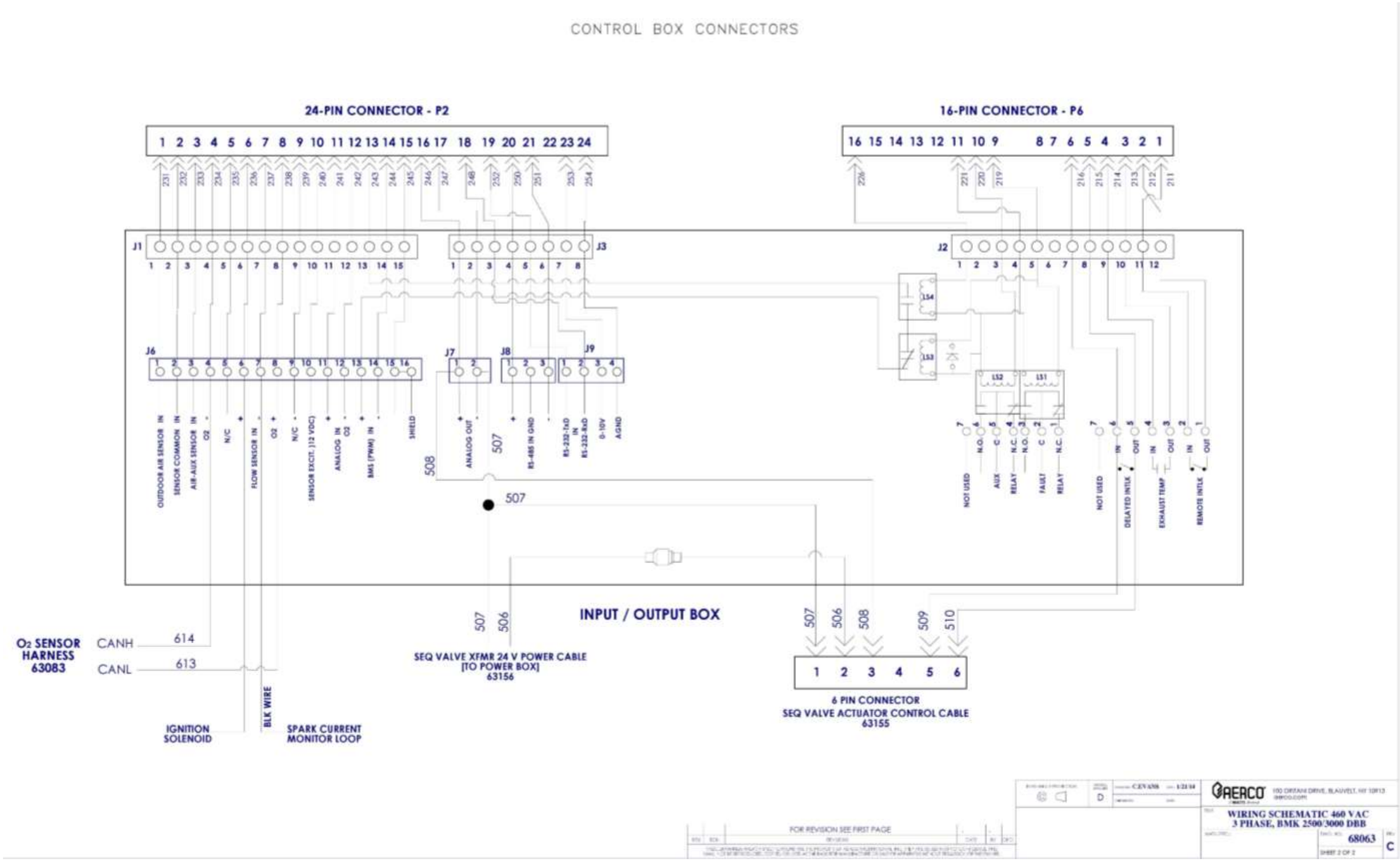

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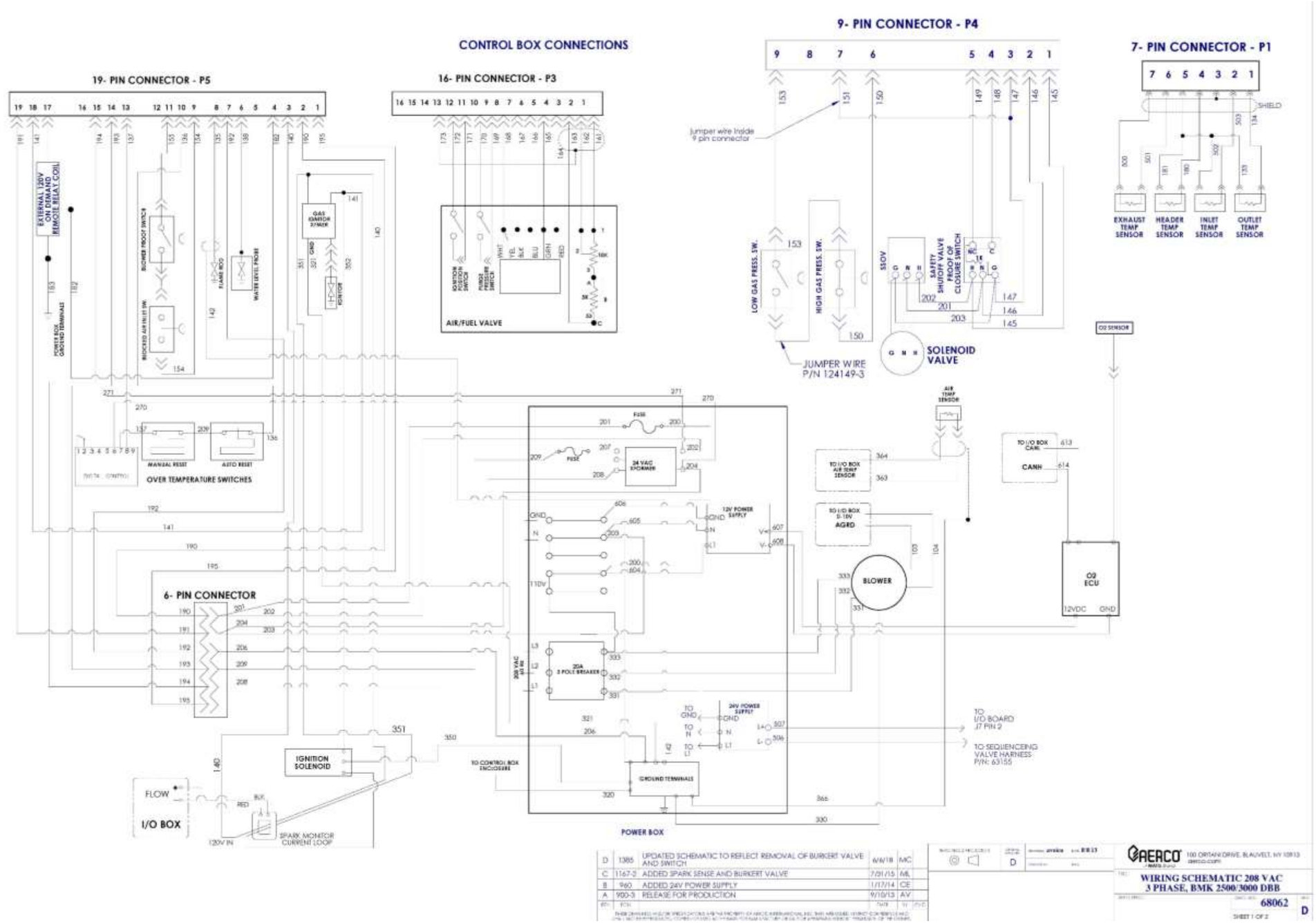

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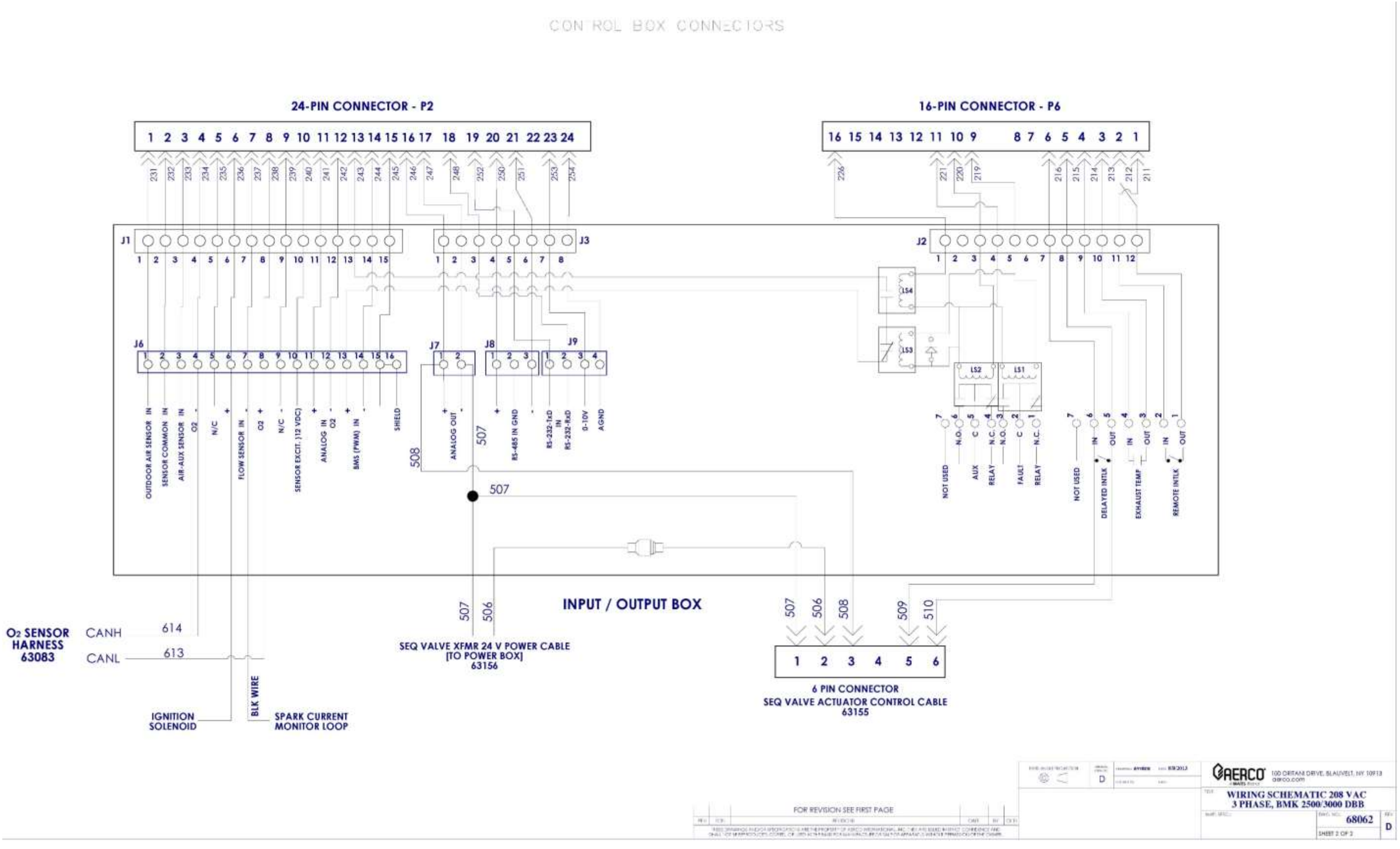

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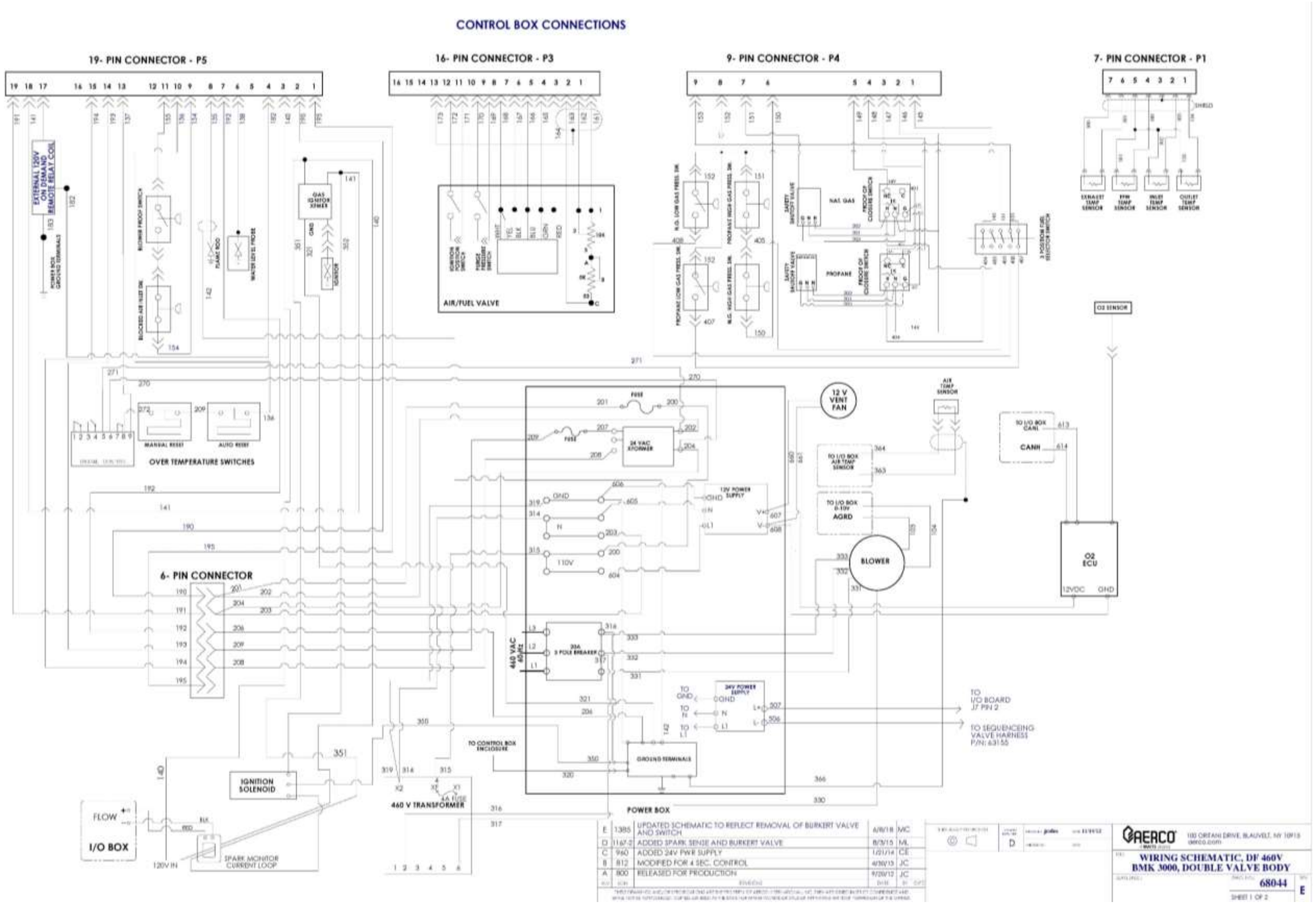

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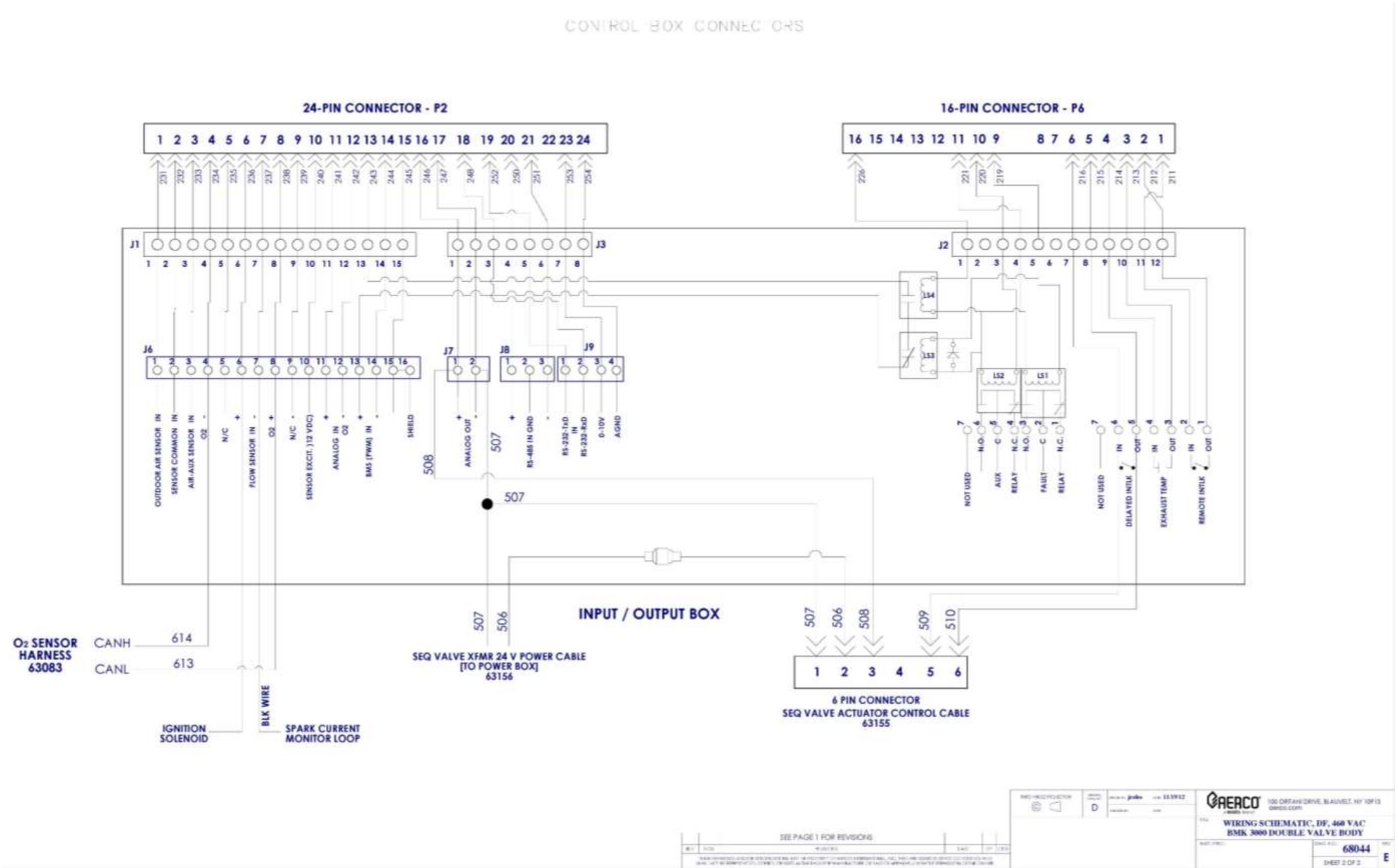
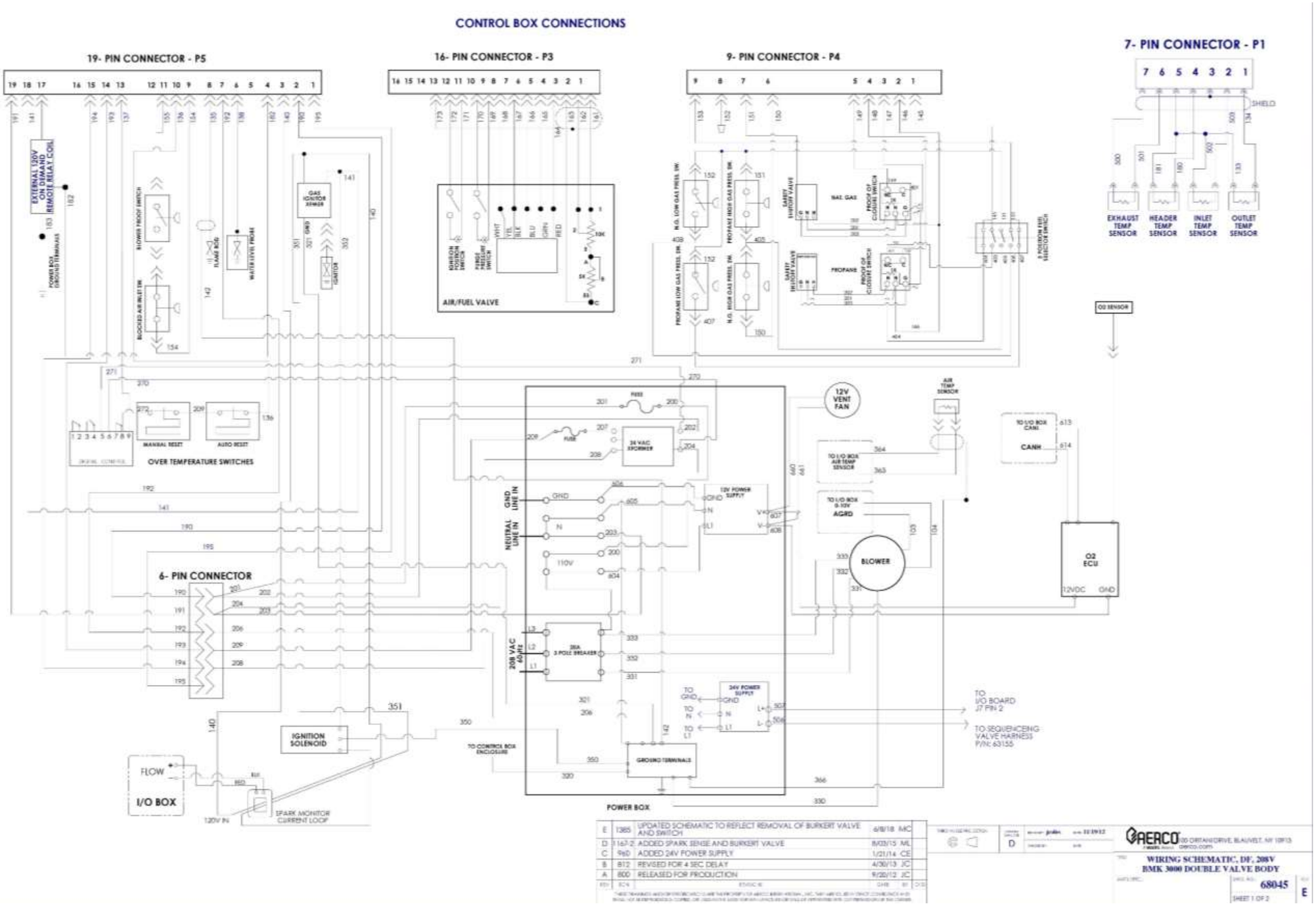
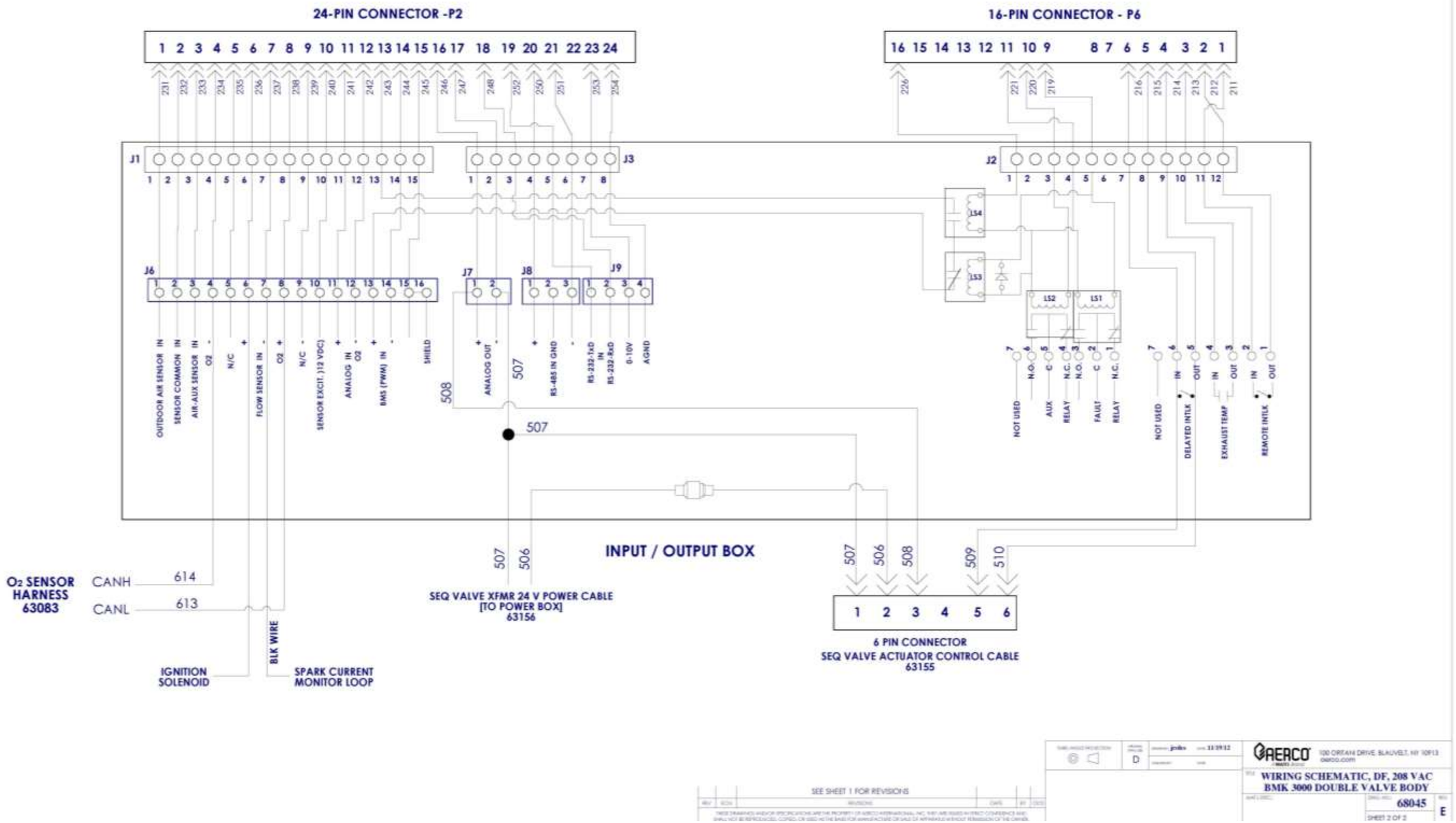


Benchmark 2500 – 3000 – Drawing Number: 68044 rev E Sheet 2 of 2

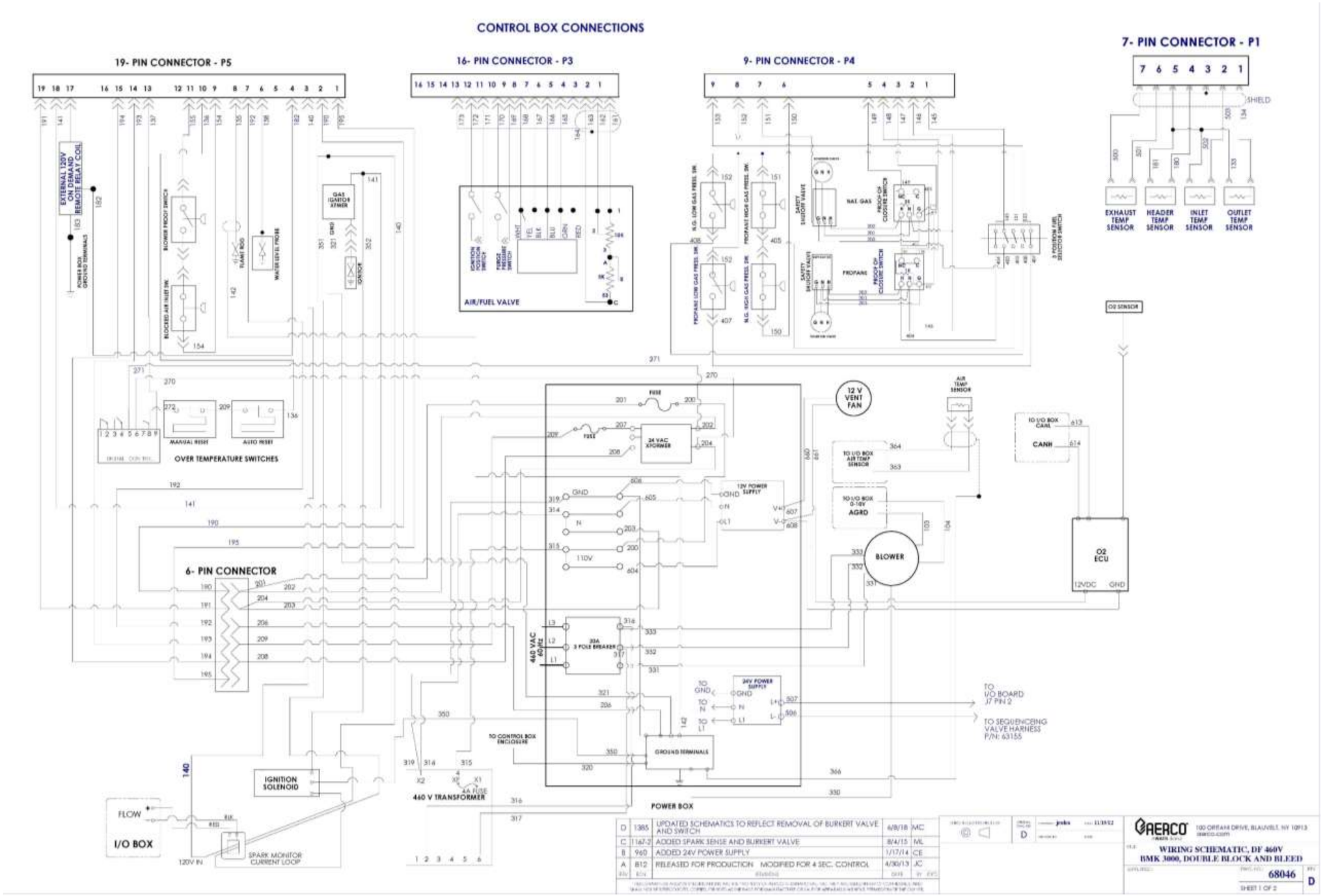


Benchmark 2500 – 3000 – Drawing Number: 68045 rev E Sheet 1 of 2

CONTROL BOX CONNECTORS



Benchmark 2500 – 3000 – Drawing Number: 68045 rev E Sheet 2 of 2



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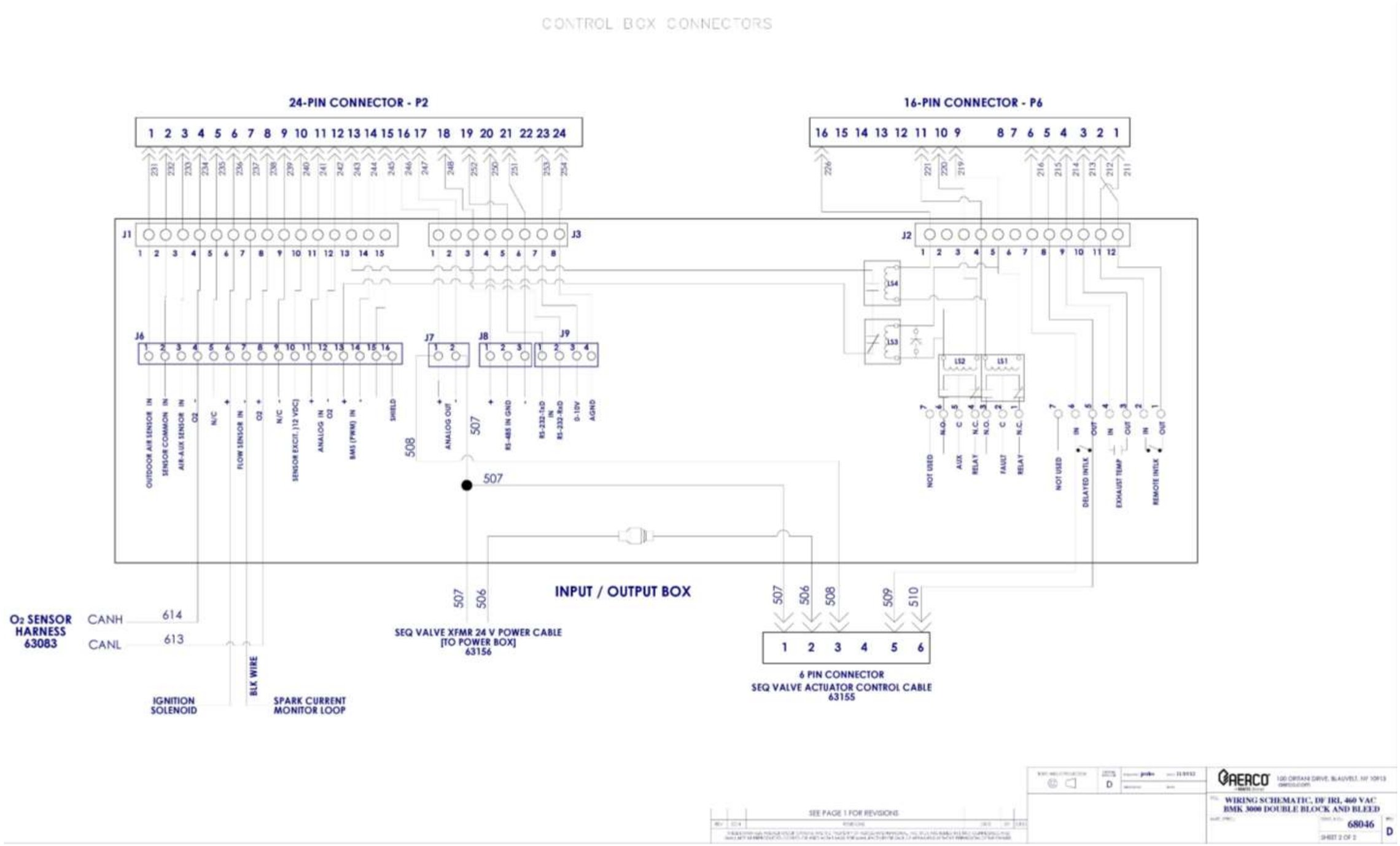
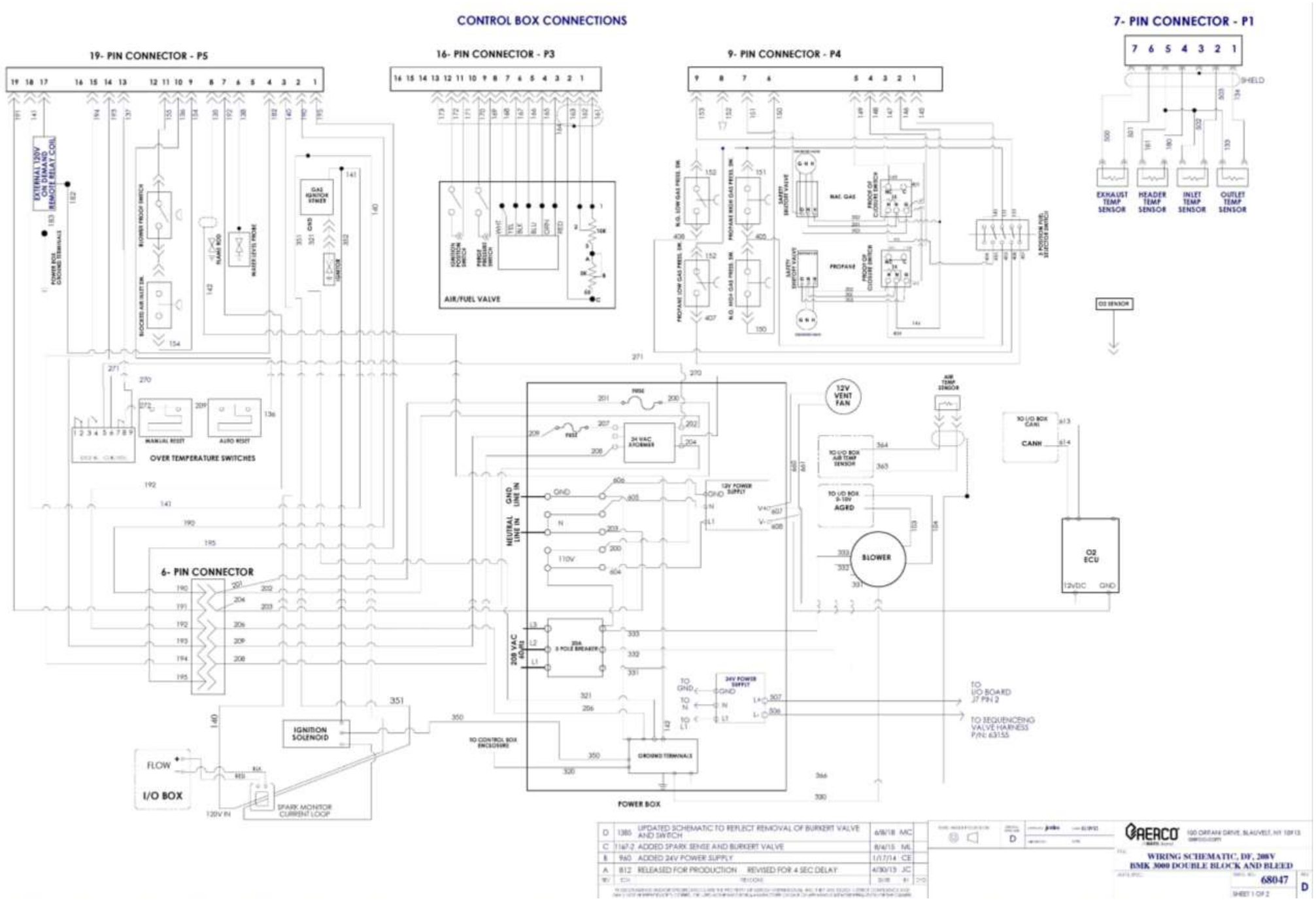


Benchmark 2500 – 3000 – Drawing Number: 68046 rev E Sheet 2 of 2



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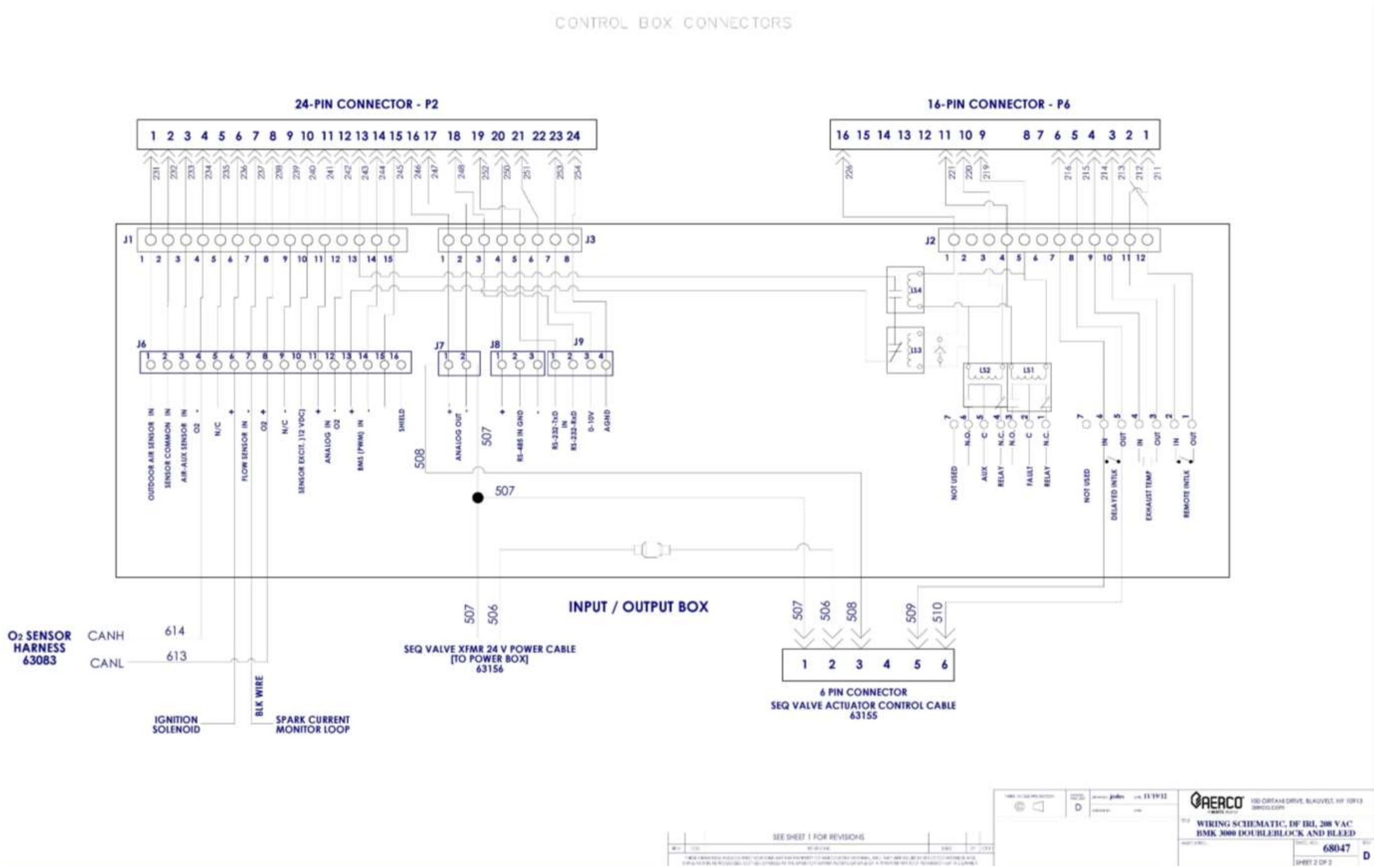
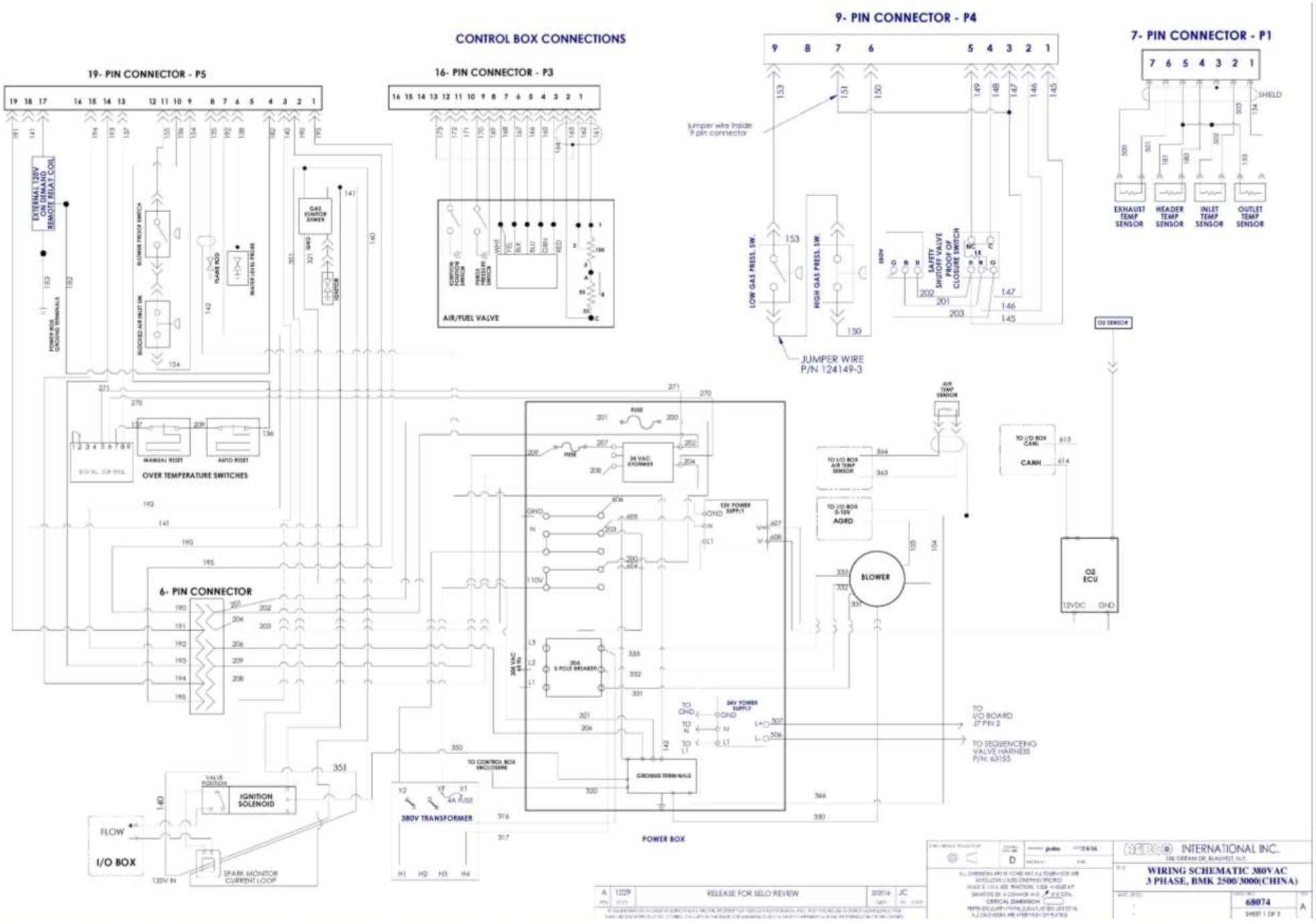
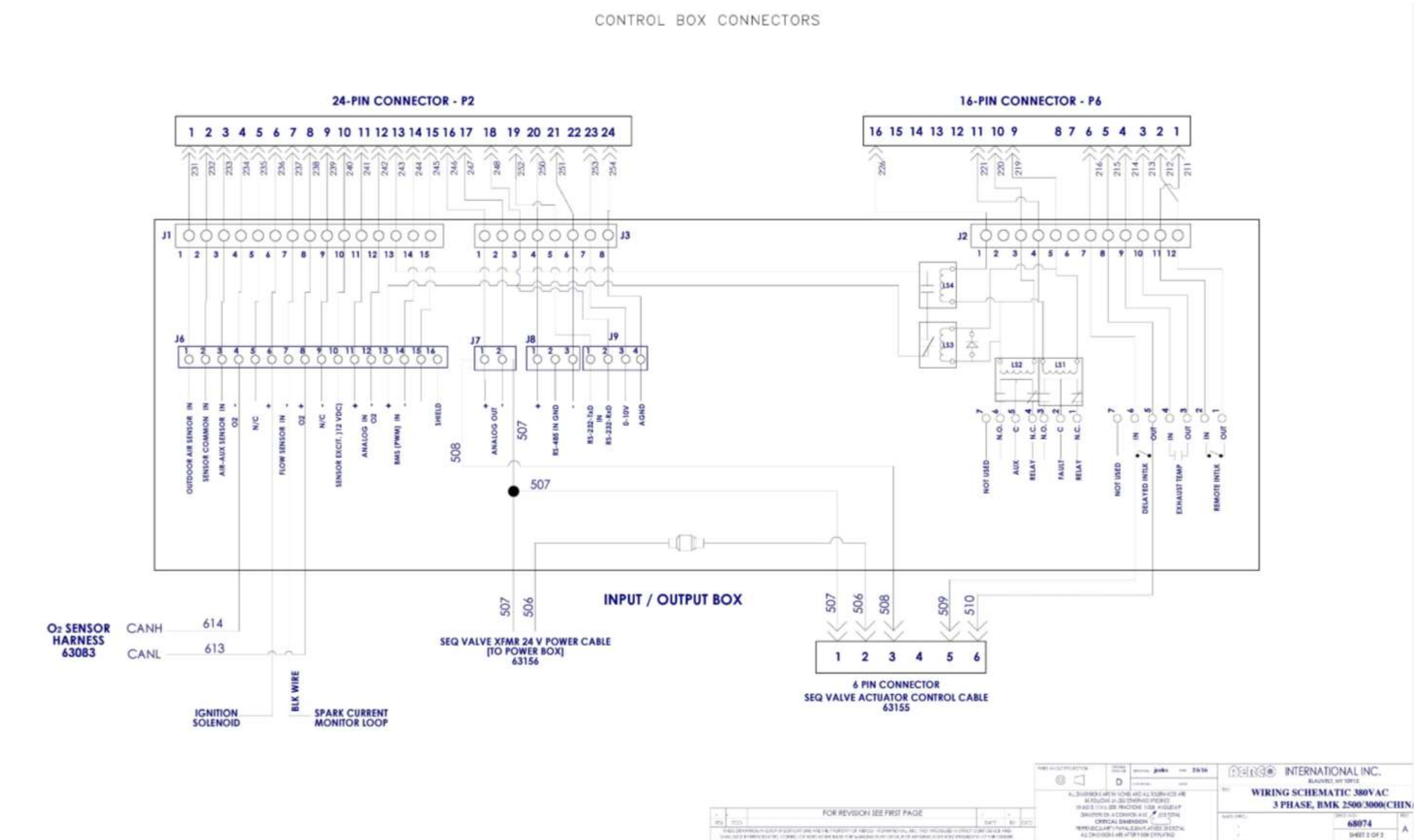


Benchmark 2500 – 3000 – Drawing Number: 68047 rev D Sheet 2 of 2

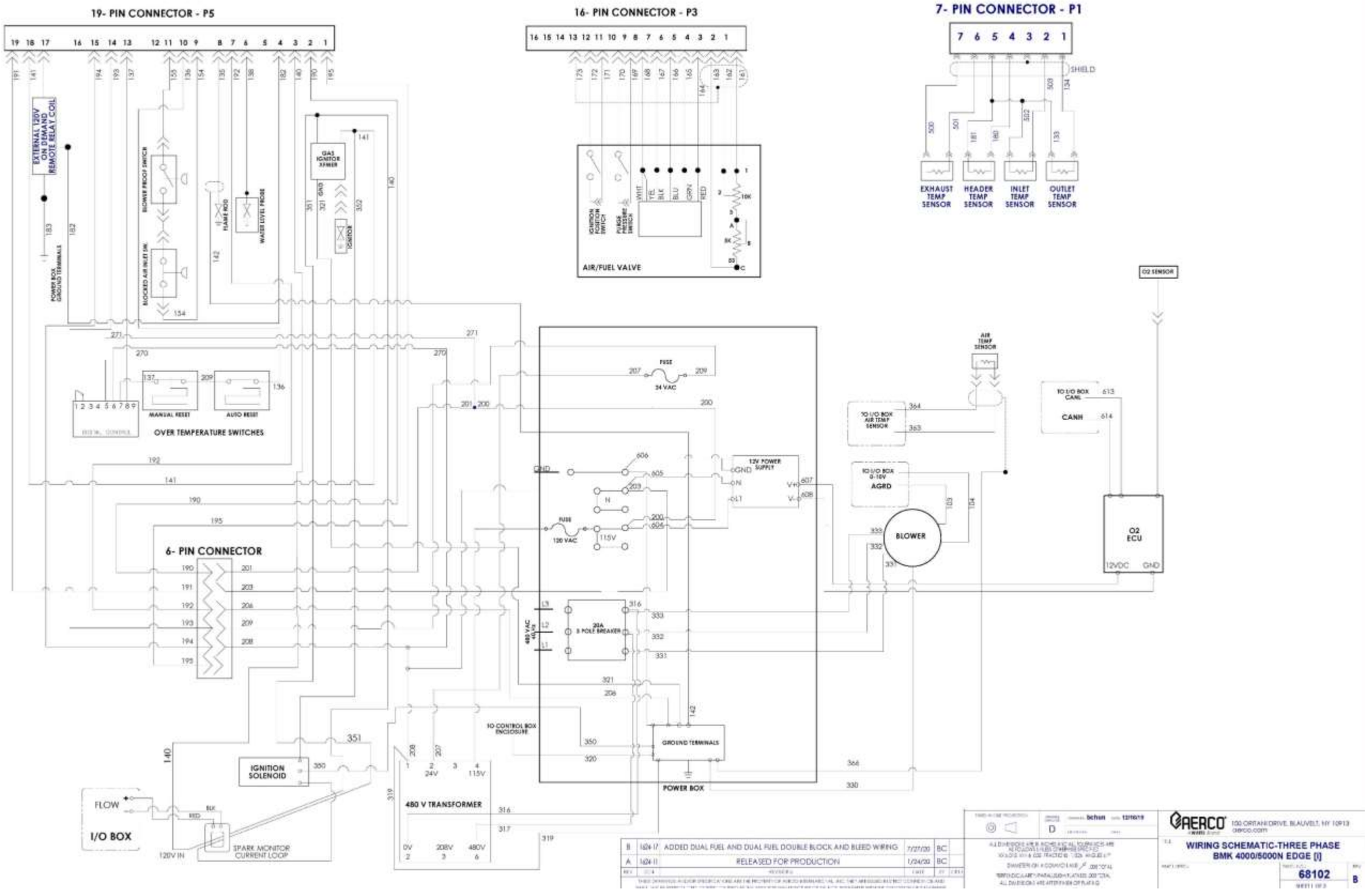


Benchmark 2500 – 3000 – Drawing Number: 68074 rev A Sheet 1 of 2

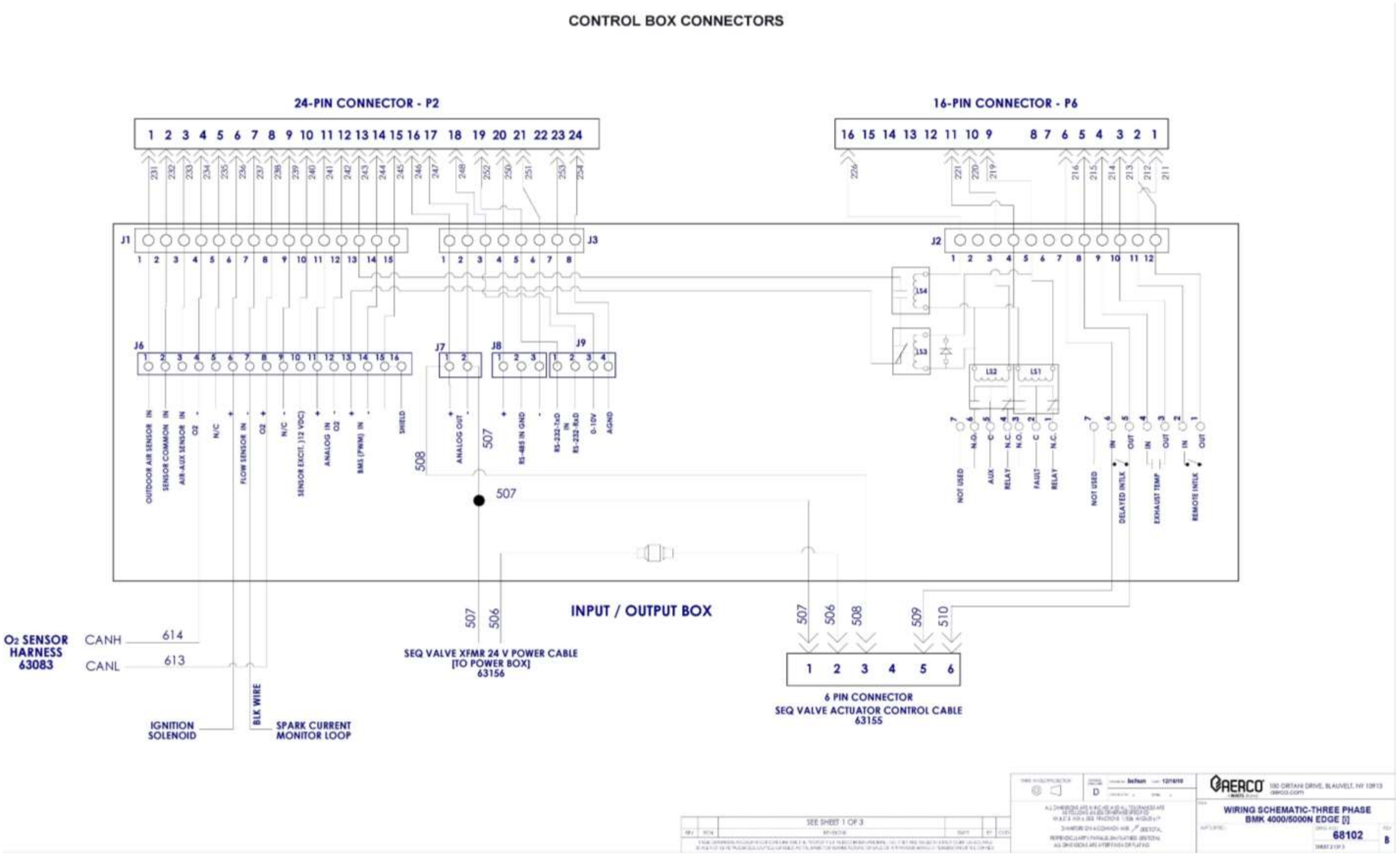


Benchmark 2500 – 3000 – Drawing Number: 68074 rev A Sheet 2 of 2

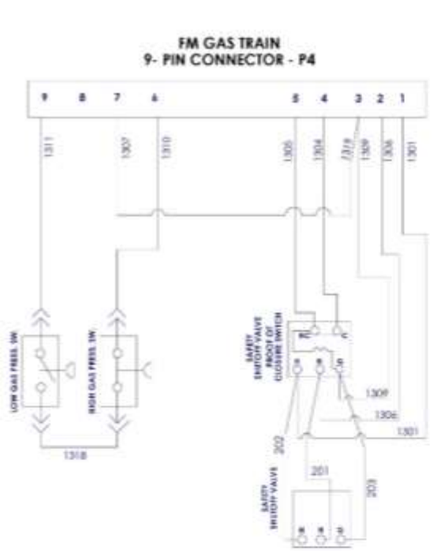
CONTROL BOX CONNECTIONS

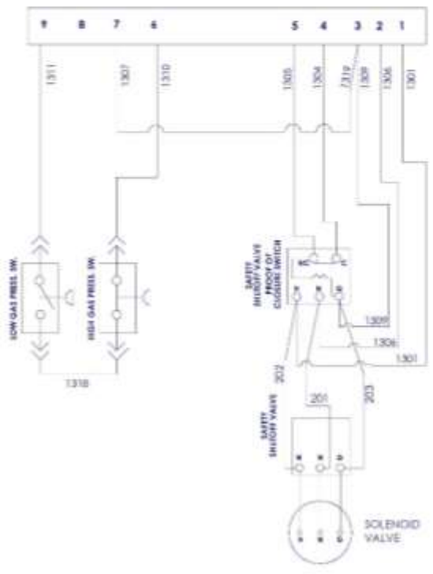


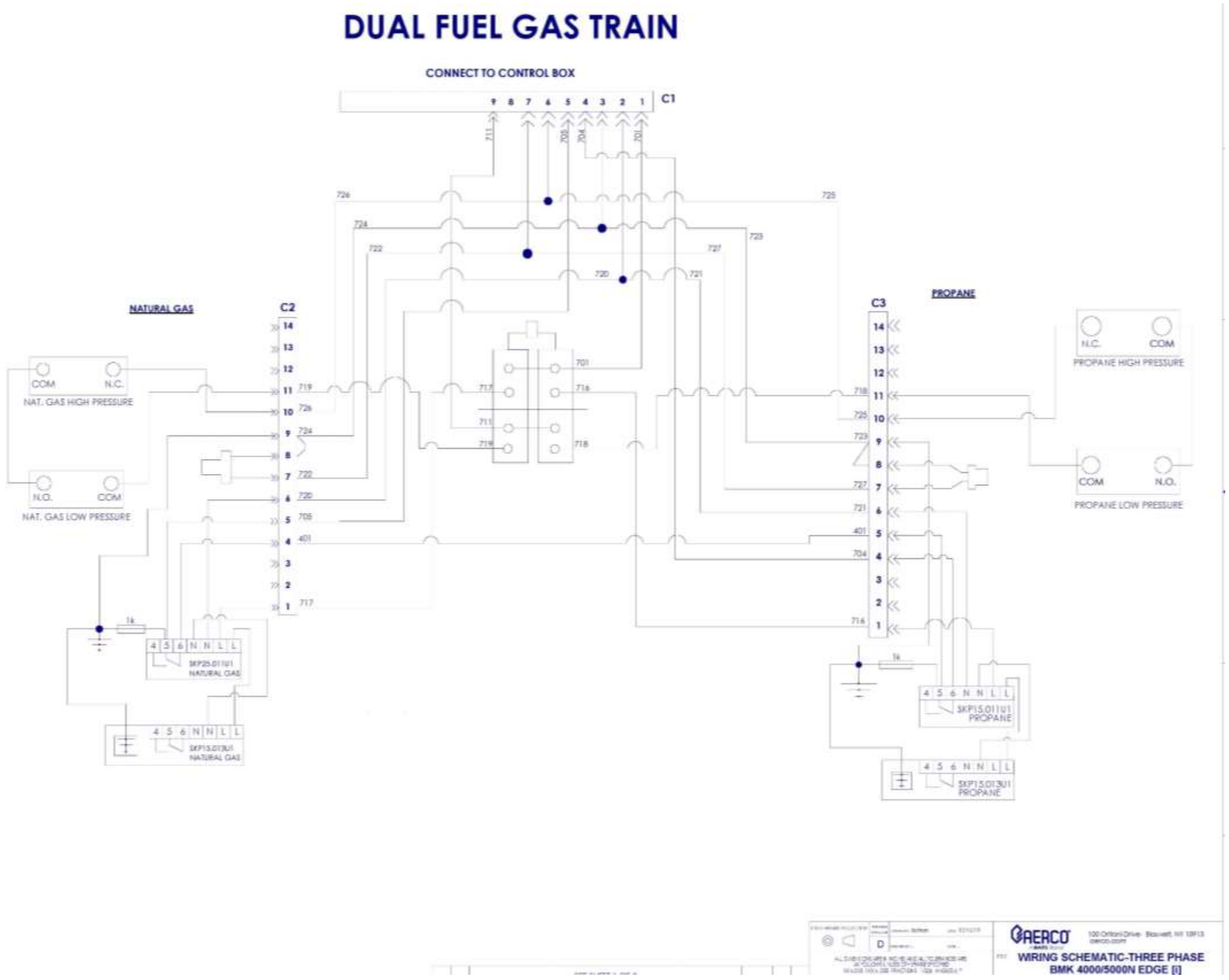
Benchmark 4000/5000N Drawing Number: 68102 rev B Sheet 1 of 4



Benchmark 4000/5000N Drawing Number: 68102 rev B Sheet 2 of 4







Benchmark 4000/5000N Drawing Number: 68102 rev B Sheet 3 of 4

DUAL FUEL DOUBLE BLOCK AND BLEED GAS TRAIN

CONNECT TO CONTROL BOX

C1 9 8 7 6 5 4 3 2 1

NATURAL GAS

C2

COM N.C. NAT. GAS HIGH PRESSURE

N.O. COM NAT. GAS LOW PRESSURE

SKP25.011U1 NATURAL GAS

SKP15.013U1 NATURAL GAS

DBB SOLENOID VALVE H N G

PROPANE

C3

N.C. COM PROPANE HIGH PRESSURE

COM N.O. PROPANE LOW PRESSURE

SKP15.011U1 PROPANE

SKP15.013U1 PROPANE

DBB SOLENOID VALVE H N G

RELEASED FOR PRODUCTION

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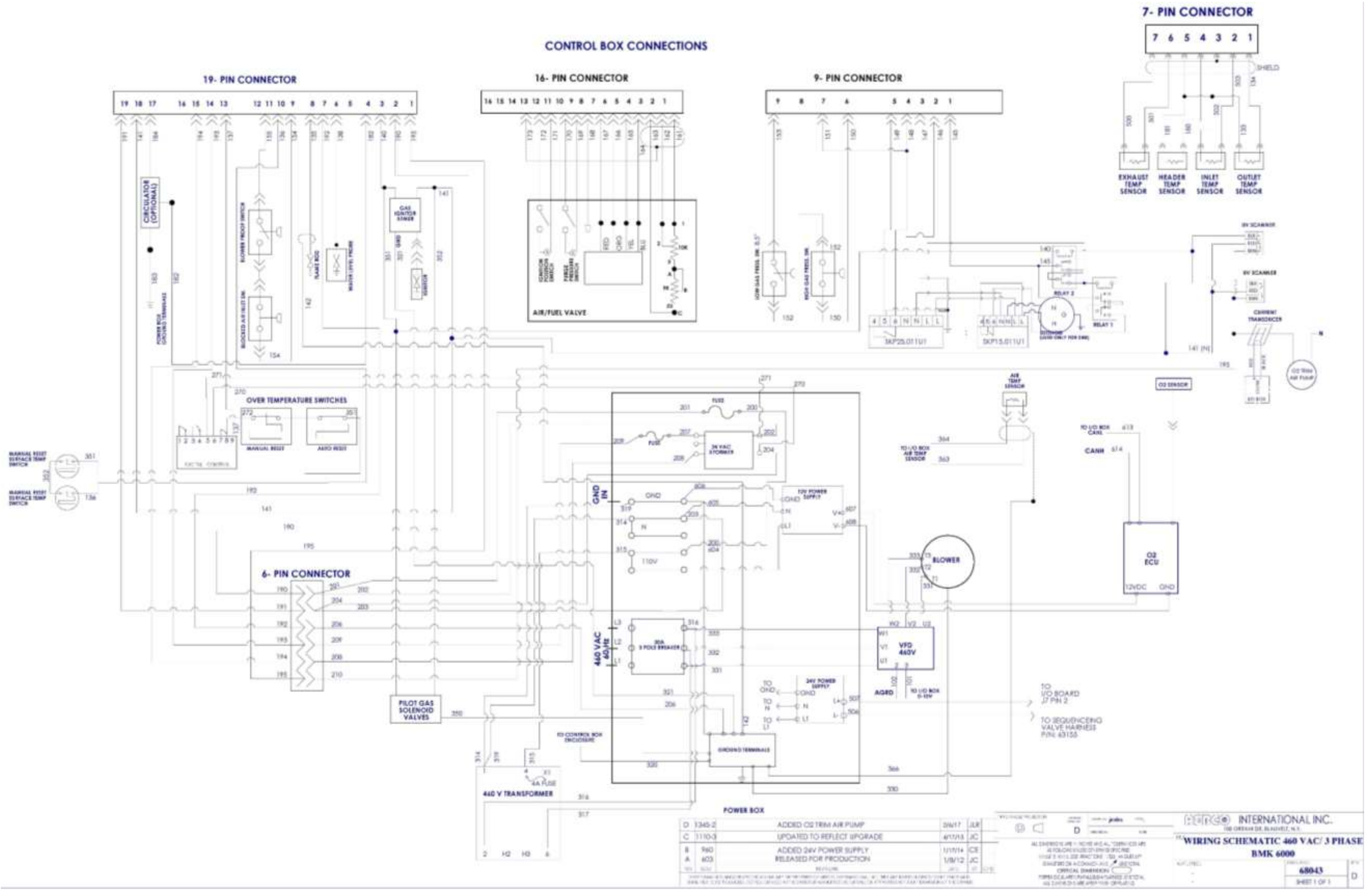
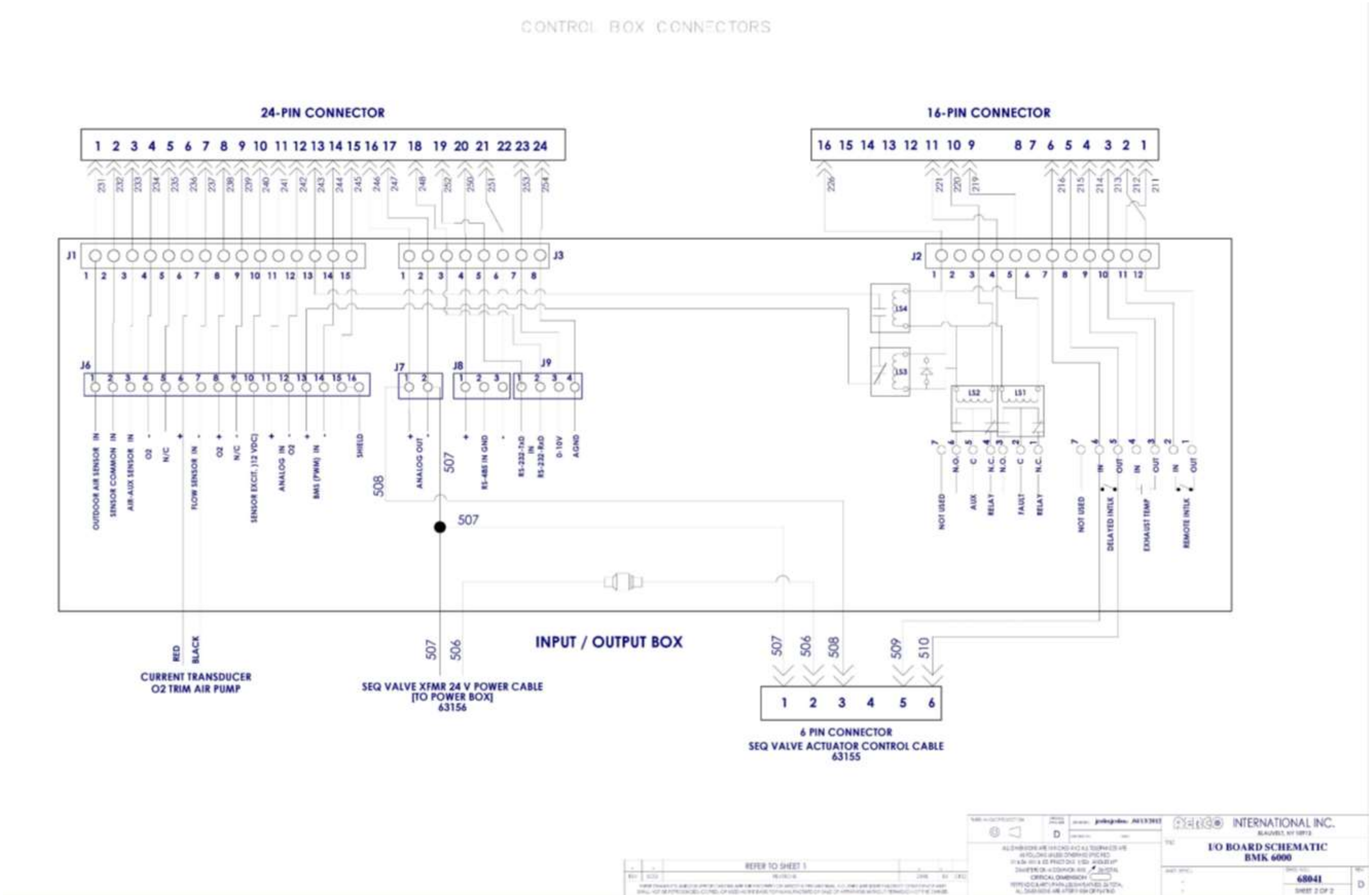
WIRING SCHEMATIC-THREE PHASE BMK 4000/5000N EDGE [i]

DWG. NO. 68102 REV B SHEET 4 OF 4

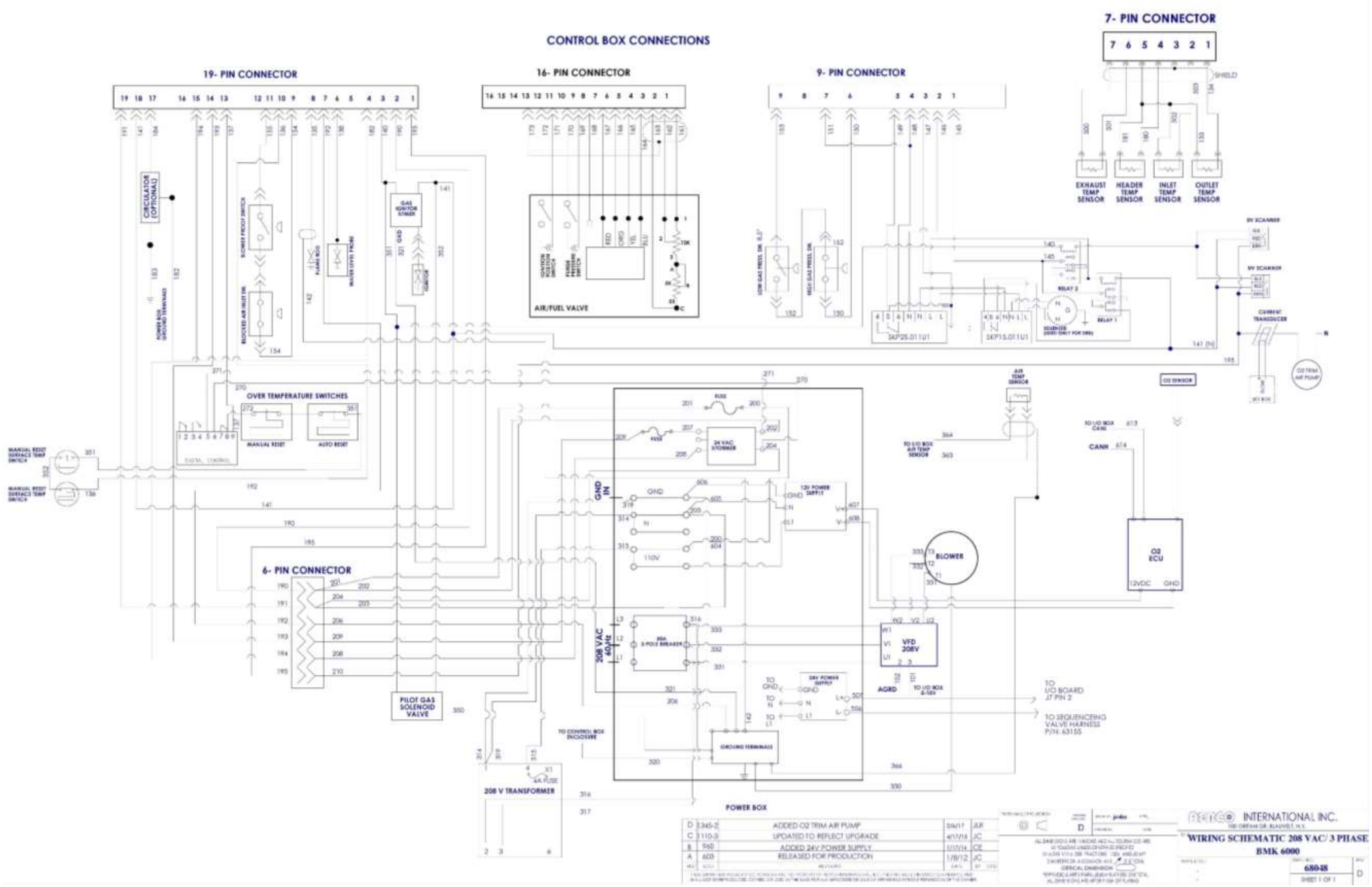
Benchmark 4000/5000N Drawing Number: 68102 rev B Sheet 4 of 4



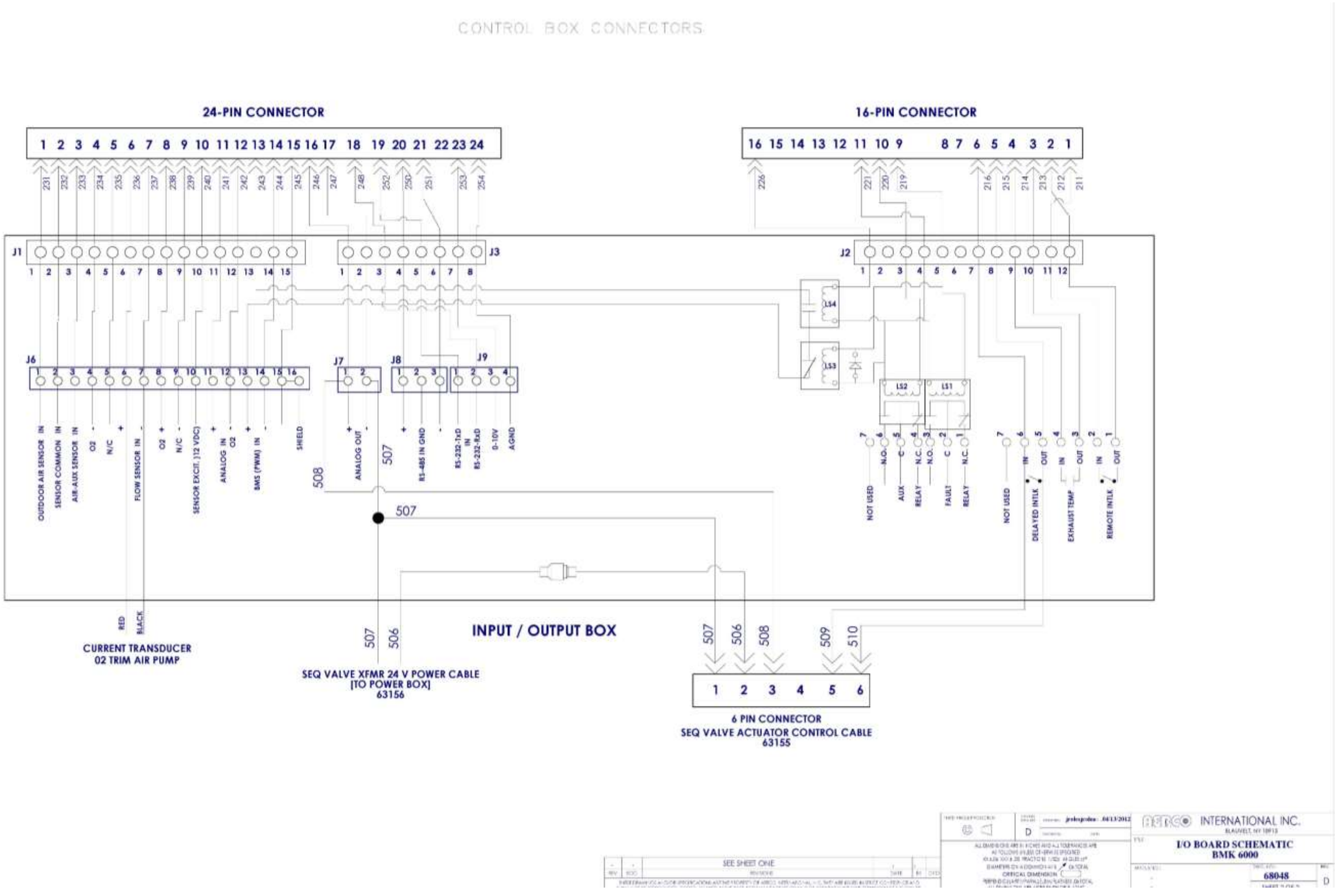
Benchmark 5000/6000 Drawing Number: 68043 rev D Sheet 1 of 2



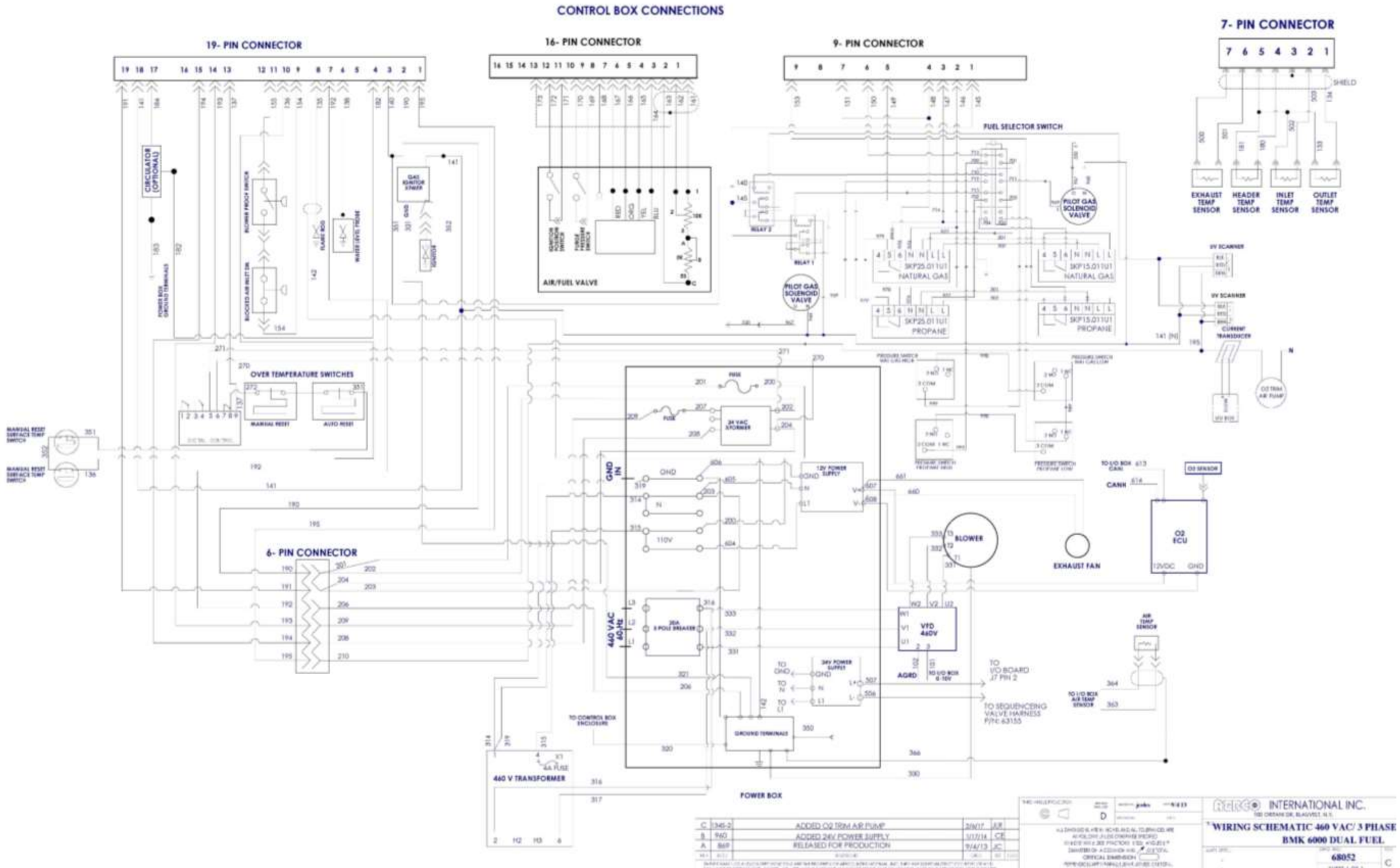
Benchmark 5000/6000 Drawing Number: 68043 rev D Sheet 2 of 2



Benchmark 5000/6000 Drawing Number: 68048 rev D Sheet 1 of 2



Benchmark 5000/6000 Drawing Number: 68048 rev D Sheet 2 of 2



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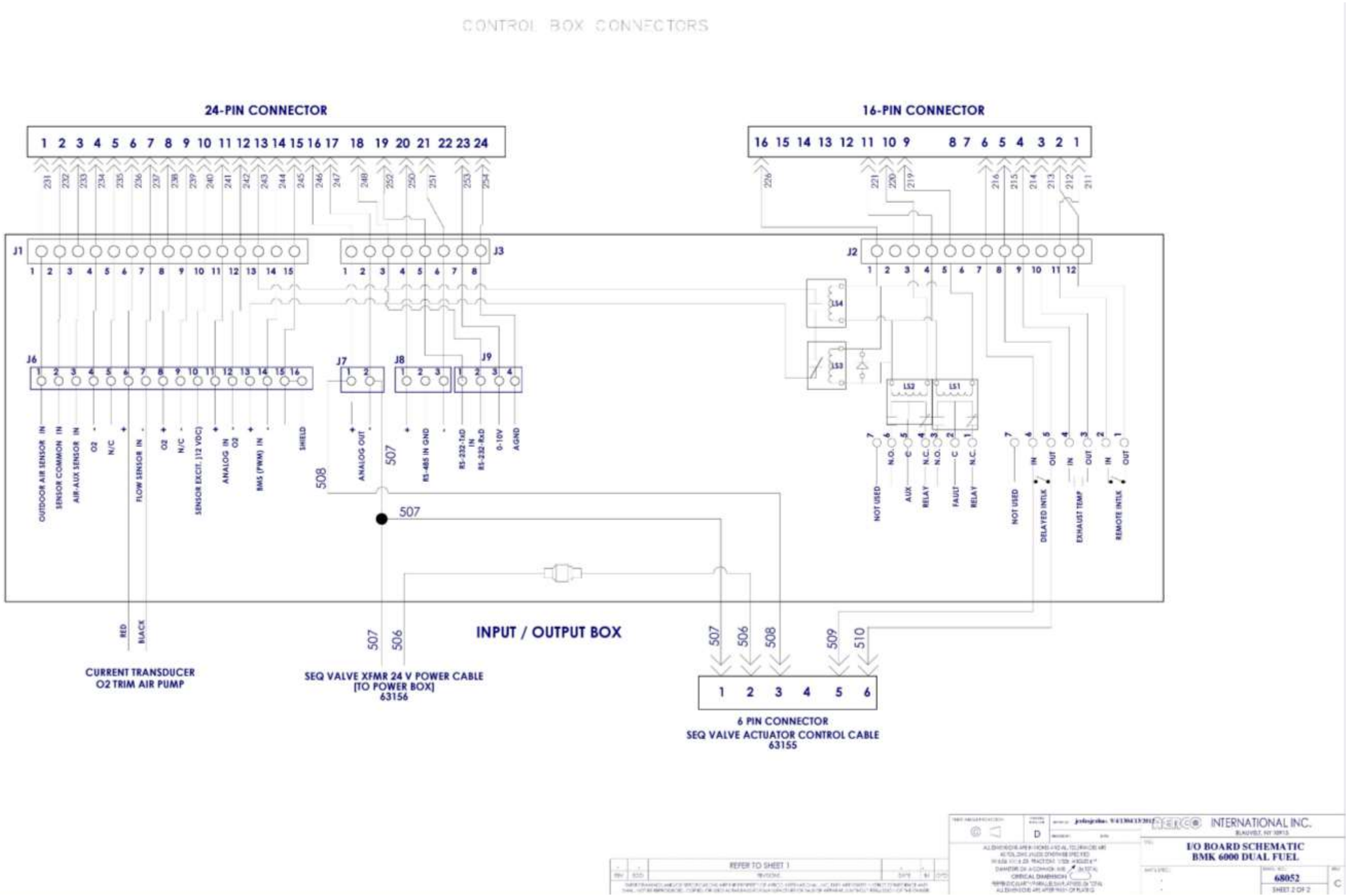
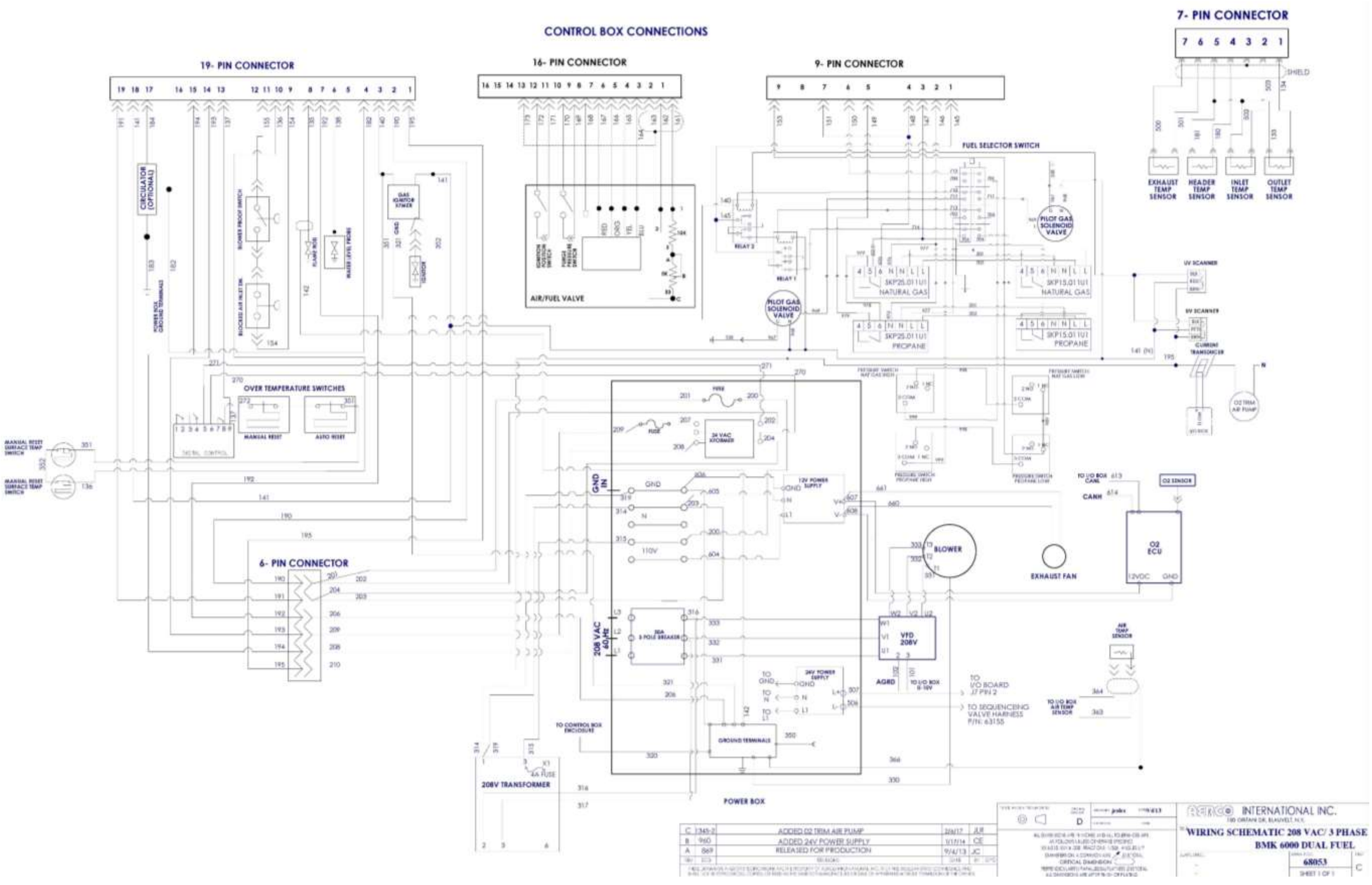


Benchmark 5000/6000 Drawing Number: 68052 rev C Sheet 2 of 2



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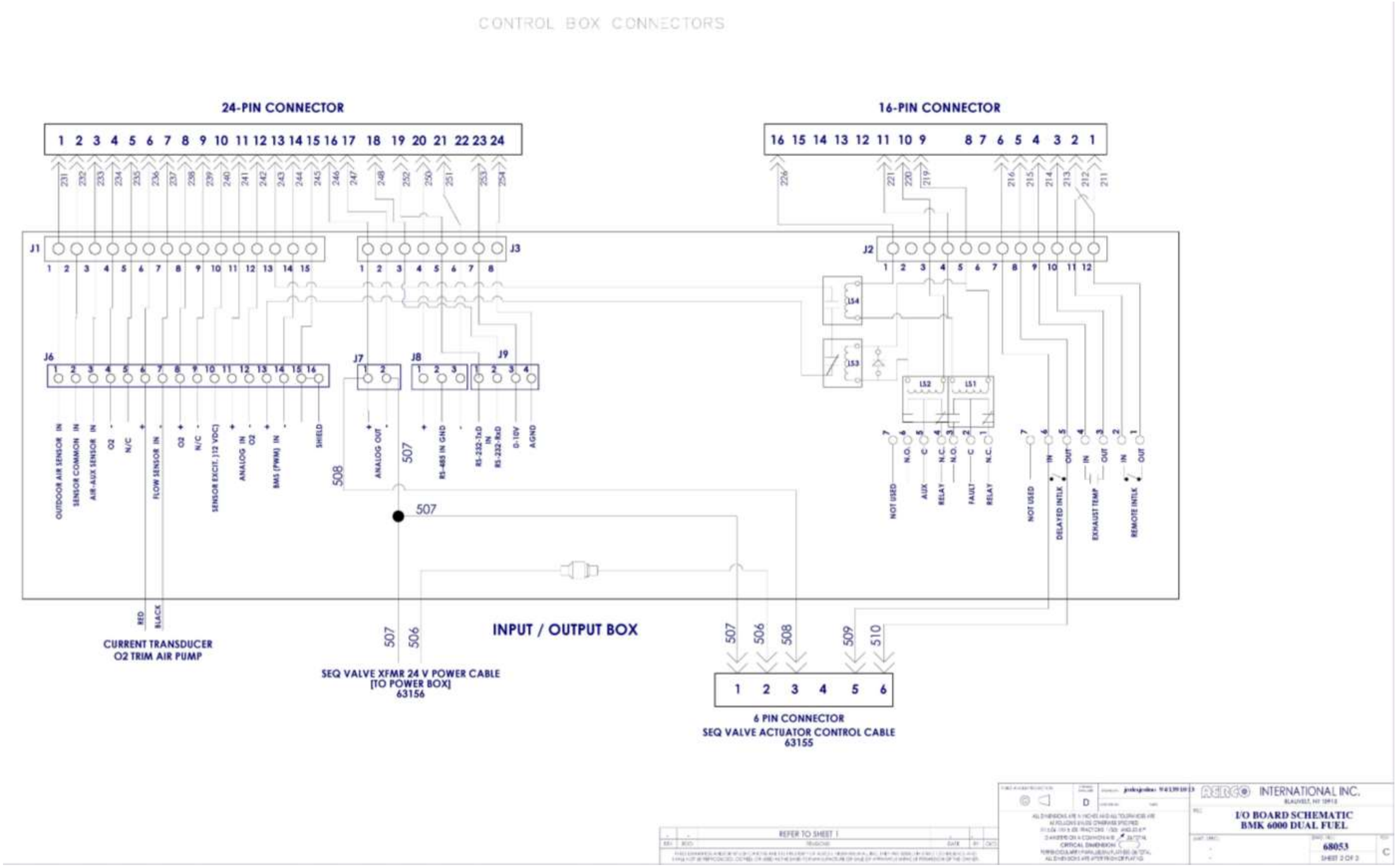
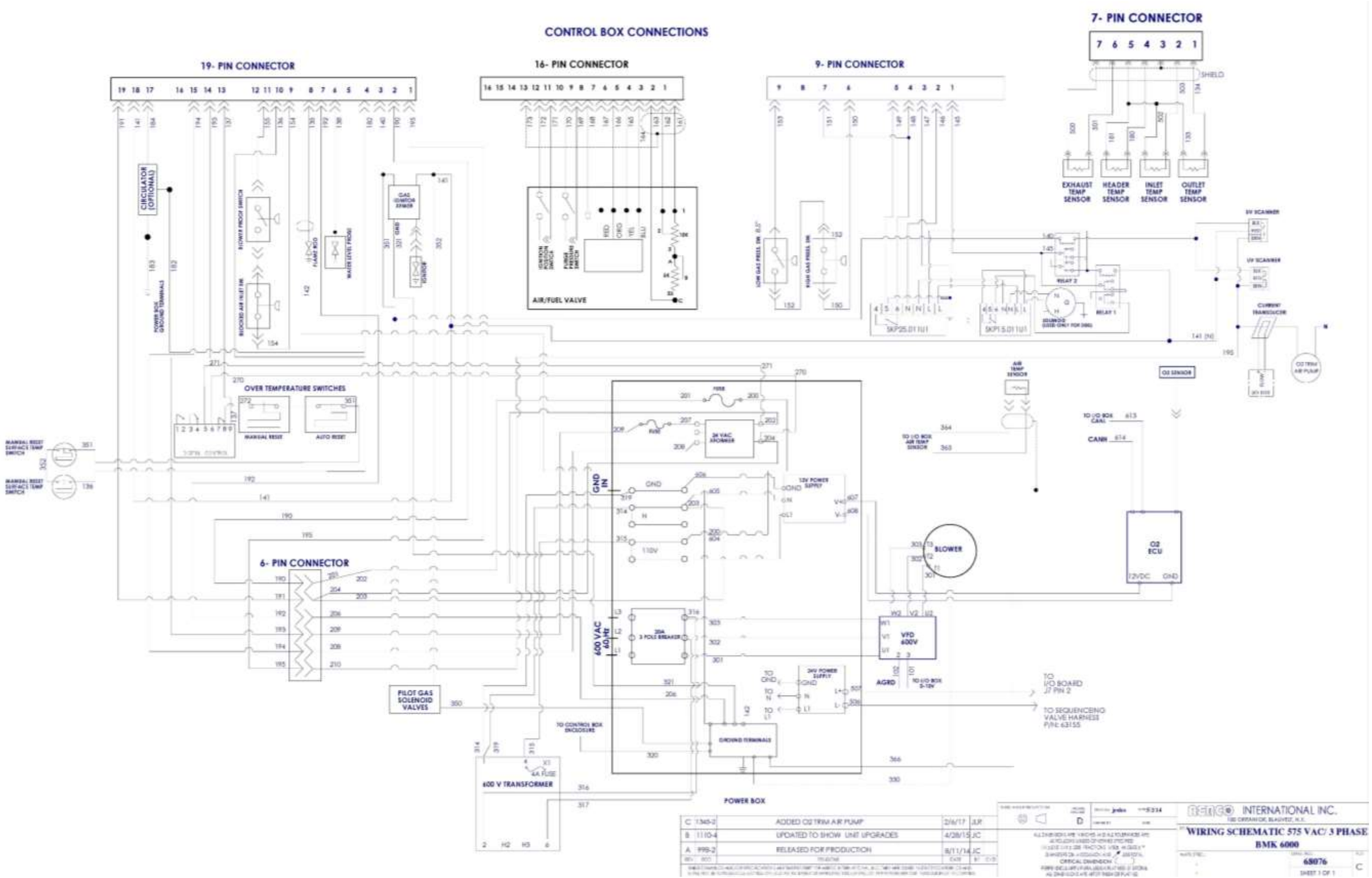
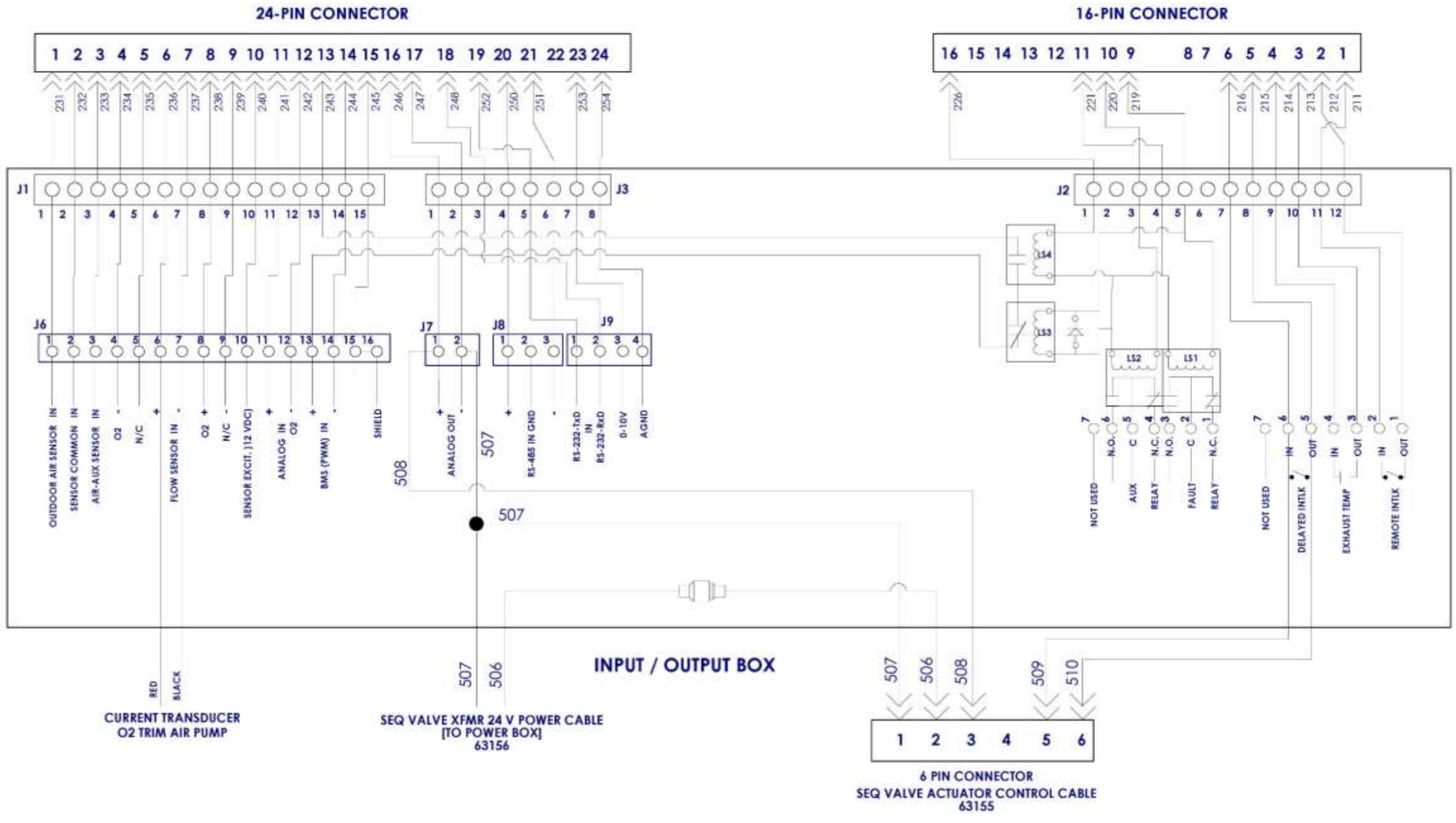


Benchmark 5000/6000 Drawing Number: 68053 rev C Sheet 2 of 2

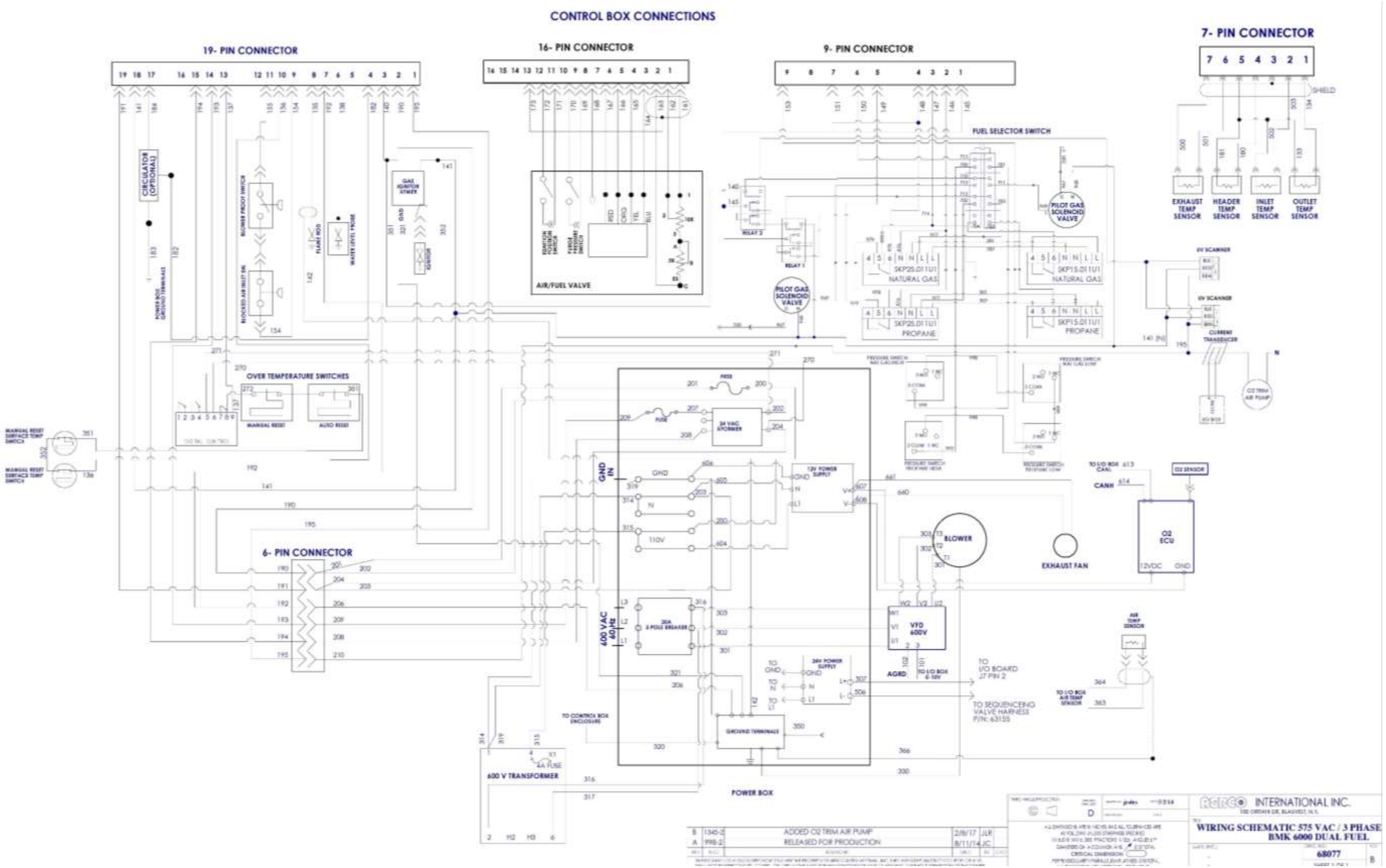


Benchmark 5000/6000 Drawing Number: 68076 rev C Sheet 1 of 2

CONTROL BOX CONNECTORS

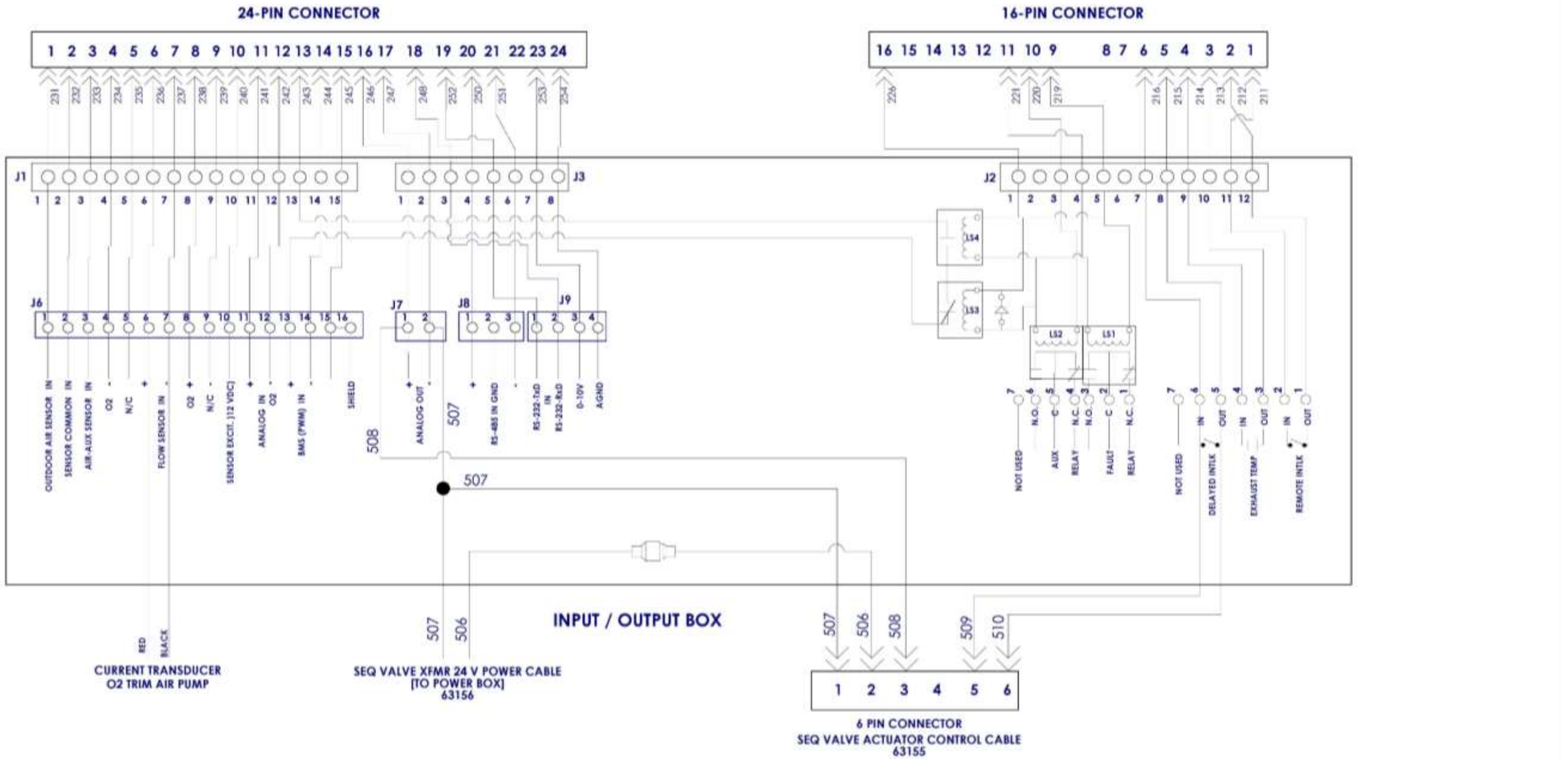


Benchmark 5000/6000 Drawing Number: 68076 rev C Sheet 2 of 2

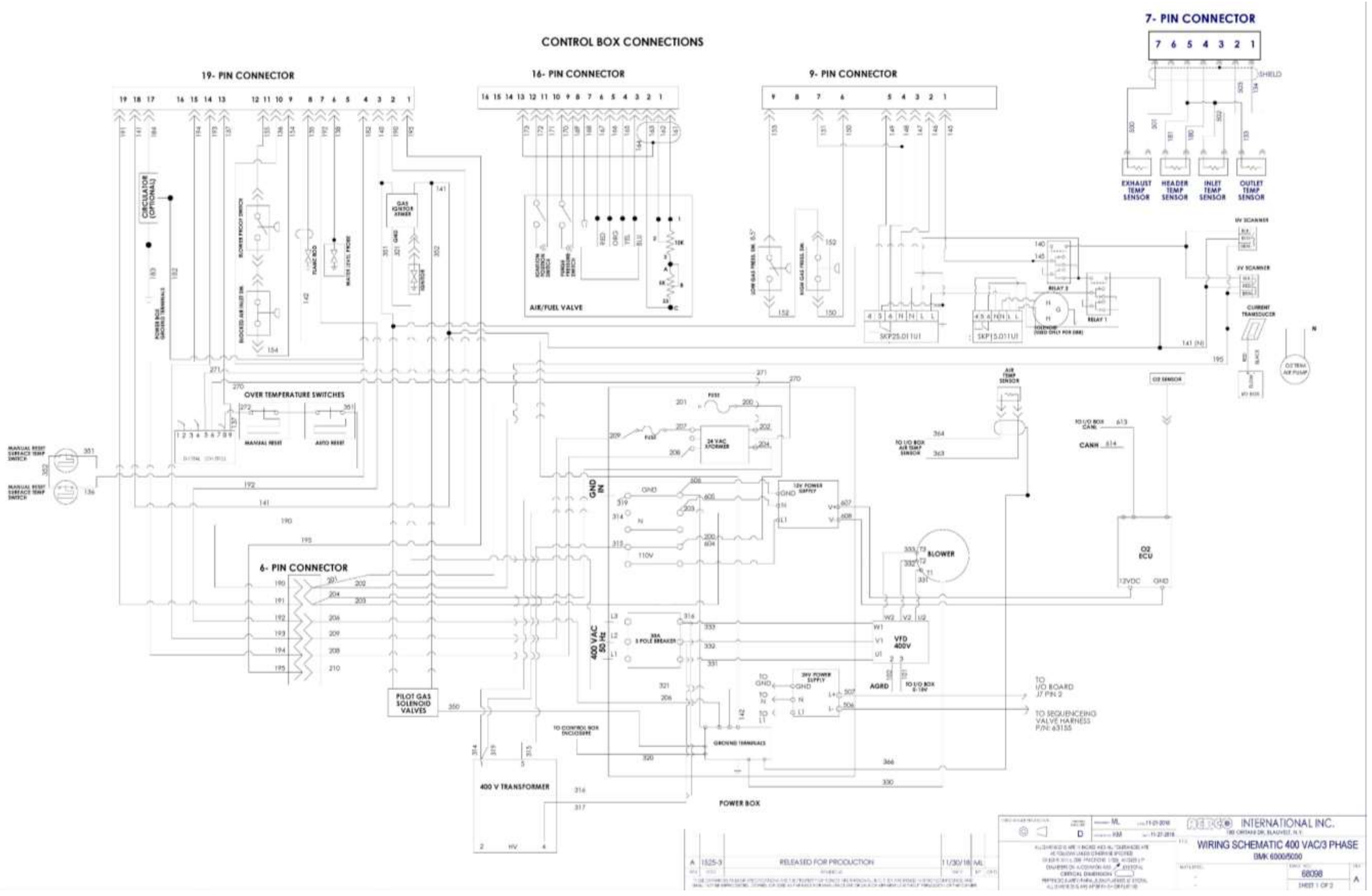


Benchmark 5000/6000 Drawing Number: 68077 rev B Sheet 1 of 2

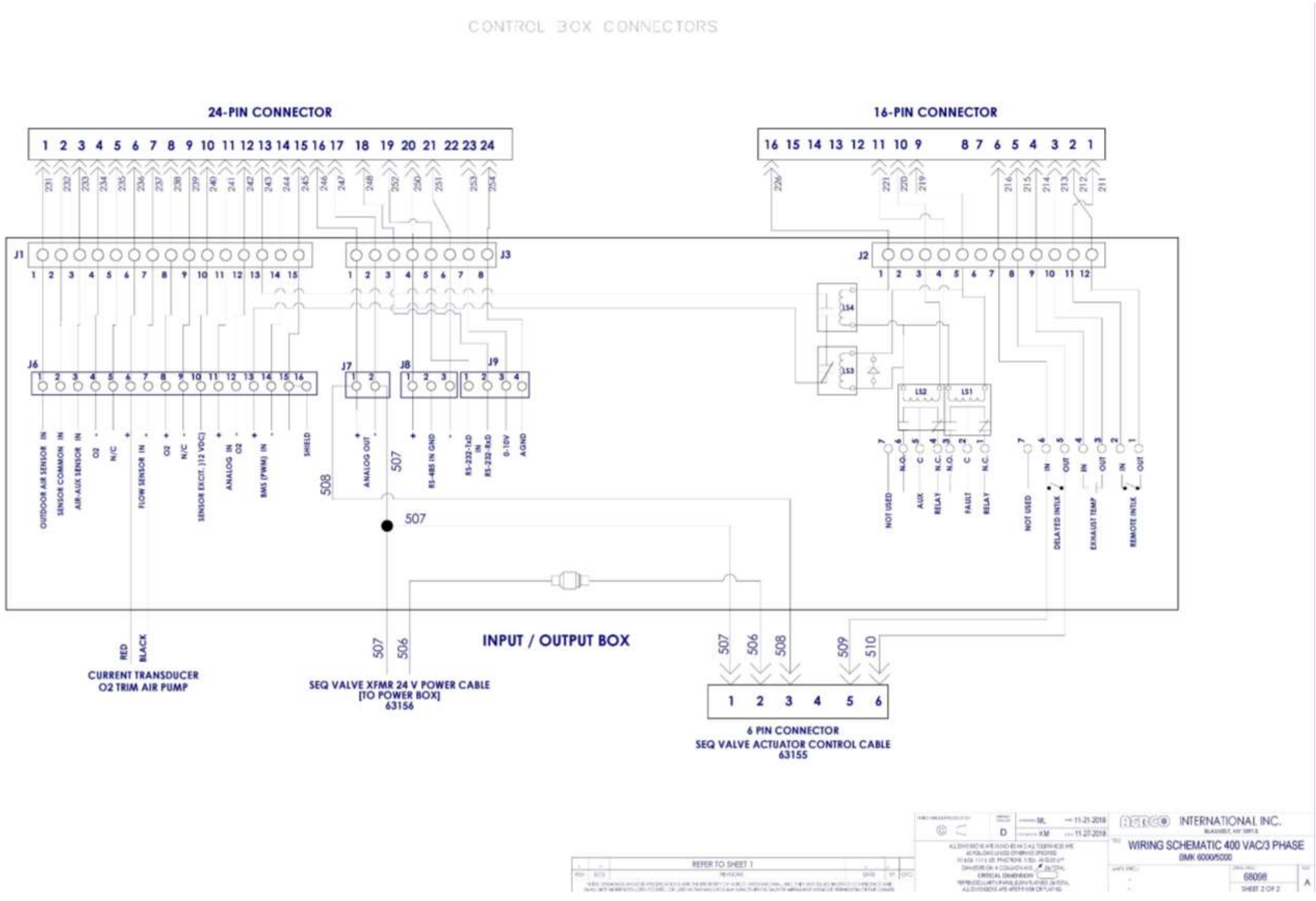
CONTROL BOX CONNECTORS



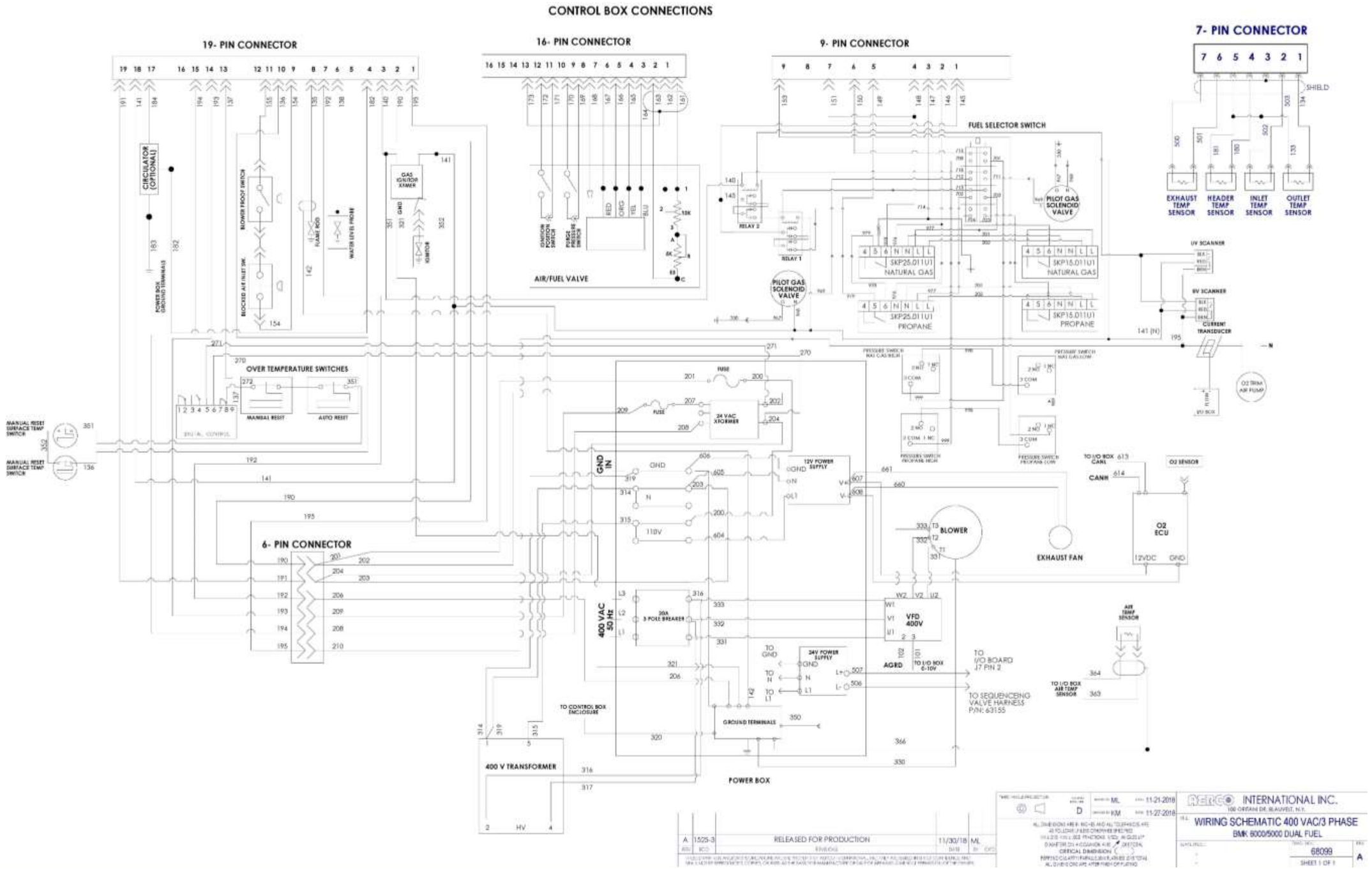
Benchmark 5000/6000 Drawing Number: 68077 rev B Sheet 2 of 2



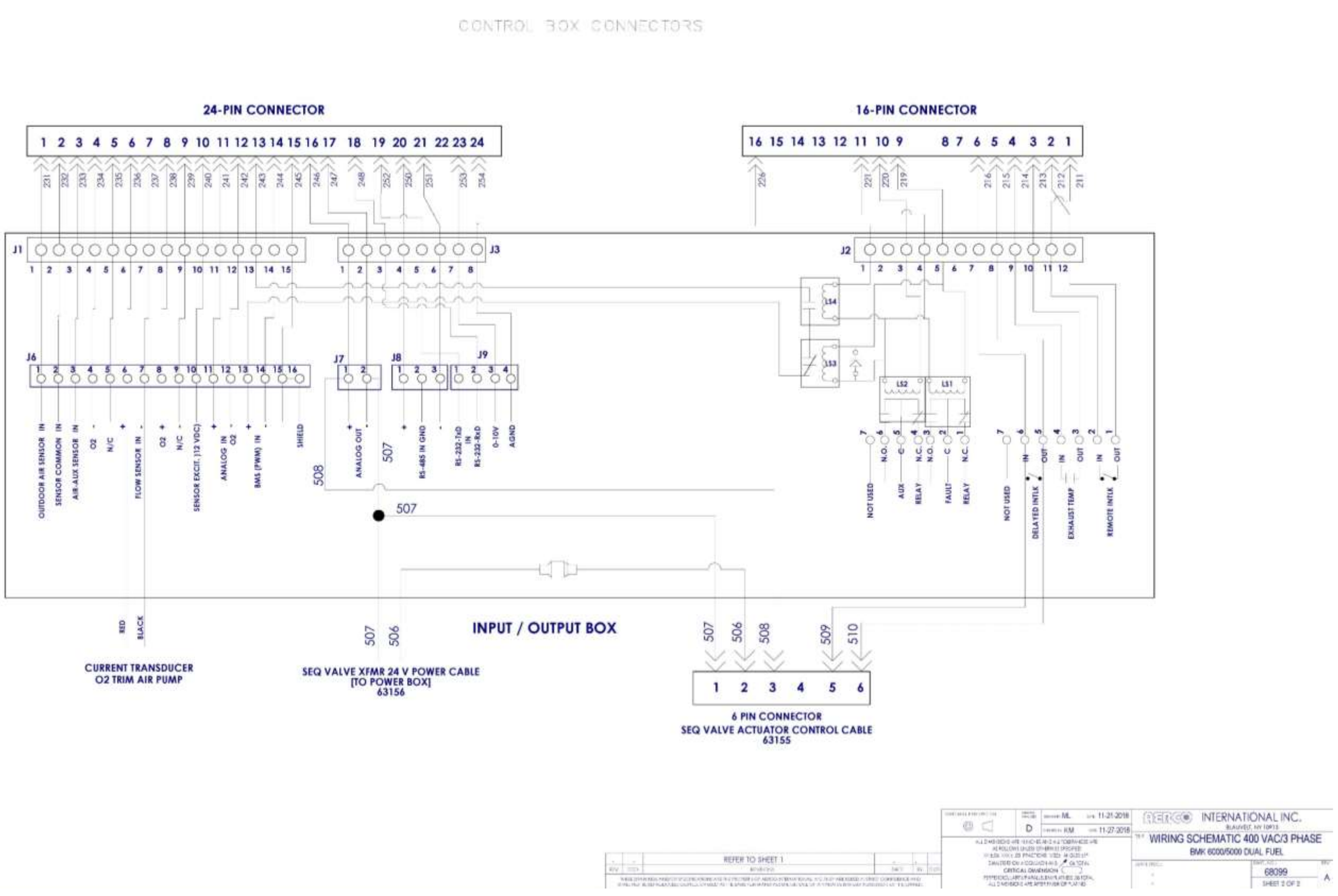
Benchmark 5000/6000 Drawing Number: 68098 rev A Sheet 1 of 2



Benchmark 5000/6000 Drawing Number: 68098 rev A Sheet 2 of 2



Benchmark 5000/6000 Drawing Number: 68099 rev A Sheet 1 of 2



Benchmark 5000/6000 Drawing Number: 68099 rev A Sheet 2 of 2

Change Log:

Date	Description	Changed By
5/25/2020	**Rev B:** Added Appendix A: Wiring Schematics Replaced gas train graphics in Section 3.2, 5.2 and 5.3. Corrected location of Outdoor Air and Air Temp Sensor terminal in Section 6.1.1. Clarified reason for "Dual Fuel" column in Table 4.1 Modified BST configuration instructions, Sections 7.3.1 – 7.3.8 Additions to cover Low Gas Pressure (LGP) models, in Sections 3.4.8, 3.4.9, 4.3 and 5.2.2.	Linley Thobourne & Chris Blair
8/20/2020	**Ref C:** Revised intro to Combustion Calibration regarding Low NOx, Section 4.5. **DIR 20-05**: Replace BMK 5000/6000 Pilot Burner (29700) with P/N **66026**, Sections 4.4 and 8.2.1 ang 8.3. Revised front and rear refractory instructions, Section 8.9. (ref PIR 1608-3). **DIR 20-23**: Revised Combustion Calibration values for BMK 4000 & 5000N for both Natural gas (Section 4.5.1) and Propane (Section 4.5.2). Added BMK 4000 & 5000N tables to Section 3.4: Start/Stop Levels. Added removal of air filter bag to startup procedure, Section 4.1 (ref ECN 1687). Updated BMK 4000/5000N Schematic drawings, Appendix A-3. Revised Figure 8-1d, Ignitor-Injector orientation, Section 8.2.	Chris Blair
1/6/2021	**Rev D:** Updated Wiring Schematics in Appendix A for increased clarity Added values for BMK 750/1000 Dual Fuel models, Sections 3.3, 3.4.1, 4.5.1, 4.5.2, 5.2.1, 5.3.1.	Linley Thobourne and Chris Blair
3/24/2021	**Rev E:** Updated Table of Contents	Linley Thobourne