AERCO
A WATTS Brand

Installation and Operation Manual

Benchmark® NX Boilers With Edge® X Controller

Natural Gas

Modulating & Condensing Boilers

Models 399 and 500



Other documents for this product include:

- OMM-0139, Edge Controller Manual
- OMM-0184, BMK NX Reference Manual
- TAG-0048, Benchmark Power Guide
- TAG-0119 Benchmark NX Gas Supply Guide
- TAG-0120, Benchmark NX Electrical Guide
- TAG-0121 BMK NX Piping Guide
- TAG-0122 Benchmark NX Venting and Combustion Guide
- TAG-0123, Boiler Application Guide

Disclaimer
The information contained in this document is subject to change without notice from AERCO International, Inc. AERCO makes no warranty of any kind with respect to this material, including, but not limited to, implied warranties of merchantability and fitness for a particular application. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation may not apply. AERCO International is not liable for errors appearing in this document, nor for incidental or consequential damages occurring in connection with the furnishing, performance, or use of these materials.

ASME H

GAS-FIRED c UL us LISTED

AERCO International, Inc. • 100 Oritani Drive • Blauvelt, NY 10913
USA: T: (845) 580-8000 • Toll Free: (800) 526-0288 • AERCO.com
Technical Support • (800) 526-0288 • Mon-Fri, 8 am - 5 pm EST
© 2026 AERCO

Contents

FOREWORD 5

SECTION 1: SAFETY PRECAUTIONS 8
1.1 WARNINGS & CAUTIONS 8
1.2 EMERGENCY SHUTDOWN 9
1.3 PROLONGED SHUTDOWN 9
1.4 IMPORTANT – FOR MASSACHUSETTS INSTALLATIONS 10

SECTION 2: INSTALLATION 12
2.1 RECEIVING THE UNIT 12
2.2 UNPACKING 12
2.3 SITE PREPARATION 12
2.3.1 Installation Clearances 13
2.3.2 Anchoring The Unit 14
2.3.3 Housekeeping Pad Requirements 14
2.4 LIFTING PROVISIONS/MOVING THE BOILER 15
2.5 SUPPLY AND RETURN PIPING 15
2.5.1 Flow Rate Specifications 15
2.5.2 BNX 399-500 Supply And Return Piping 15
2.6 WATER QUALITY – INITIAL SYSTEM FILL 16
2.7 PRESSURE RELIEF VALVE INSTALLATION 16
2.8 PRESSURE/TEMPERATURE GAUGE INSTALLATION 17
2.9 CONDENSATE DRAIN AND PIPING 17
2.10 GAS SUPPLY PIPING 18
2.10.1 Prior To Installation 18
2.10.2 Gas Supply Specifications 18
2.10.3 External Gas Supply Regulator 18
2.10.4 Manual Gas Shutoff Valve 19
2.11 AC ELECTRICAL POWER WIRING 20
2.11.1 Electrical Power Requirements 20
2.11.2 Power Panel 20
2.12 FIELD CONTROL WIRING – I/O BOARD 21
2.13 FLUE GAS VENT INSTALLATION 21
2.13.1 Massachusetts Installations 21
2.14 COMBUSTION AIR 22
2.14.1 Ducted Combustion Air 22
2.15 BST SEQUENCING ISOLATION VALVE INSTALLATION 22
2.15.1 Sequencing Isolation Valve Installation Instructions 23

SECTION 3: SEQUENCE OF OPERATION 24
3.1 START SEQUENCE 24
3.2 MINIMUM, START AND MAXIMUM BLOWER MODULATION RATE 25

SECTION 4: INITIAL STARTUP 26
4.1 INITIAL STARTUP REQUIREMENTS 26
4.2 TOOLS AND INSTRUMENTATION REQUIRED 26

4.3 RESOURCES 26
4.4 ON SITE CONSIDERATIONS 26
4.5 PRE-STARTUP CHECKLIST 27
4.6 STARTUP PROCEDURE 28
4.7 BURNER COMBUSTION ADJUSTMENT 29
SECTION 5: SAFETY DEVICE TESTING 32
5.1 TESTING OF SAFETY DEVICES....32
5.2 LOW GAS PRESSURE TEST 32
5.3 HIGH GAS PRESSURE TEST....33
5.4 LOW WATER LEVEL FAULT TEST....34
5.5 WATER TEMPERATURE FAULT TEST....34
5.6 INTERLOCK TESTS 35
5.6.1 Remote Interlock Test....35
5.6.2 Delayed Interlock Test 35
5.7 FLAME FAULT TEST....35
5.8 AIR PRESSURE ERROR TEST....36
5.9 BLOCKED CONDENSATE TEST....37
5.10 SAFETY PRESSURE RELIEF VALVE TEST 37
SECTION 6: STANDALONE MODES OF OPERATION 38
6.1 OUTDOOR RESET MODE....38
6.1.1 Outdoor Air Temperature Sensor Installation 38
6.1.2 Outdoor Reset Mode Startup 38
6.2 CONSTANT SETPOINT MODE 39
6.3 REMOTE SETPOINT MODE....40
SECTION 7: BOILER SEQUENCING TECHNOLOGY 41
7.1 INTRODUCTION 41
7.2 BST IMPLEMENTATION INSTRUCTION....42
7.2.1 BST Setup: Constant Setpoint....44
7.2.2 BST Setup: Remote Setpoint 44
7.2.3 BST Setup: Outdoor Air Temperature Reset 45
SECTION 8: RECOMMENDED MAINTENANCE SCHEDULE 47
8.1 MAINTENANCE SCHEDULE....47
8.2 IGNITER 48
8.3 FLAME DETECTOR....48
8.4 SAFETY DEVICE TESTING....48
8.5 BURNER INSPECTION 48
8.6 CONDENSATE DRAIN TRAP 49
8.7 SHUTTING BOILER DOWN FOR EXTENDED PERIOD 50
8.8 RETURNING BOILER TO SERVICE AFTER PROLONGED SHUTDOWN 50
8.9 RECOMMENDED PERIODIC TESTING....51
SECTION 9: TROUBLESHOOTING 52
9.1 INTRODUCTION 52
APPENDIX A: DIMENSIONAL AND CLEARANCE DRAWINGS....57

IMPORTANT SAFETY INFORMATION

This manual is intended for use by qualified installers, service technicians, and operators familiar with gas-fired boiler systems. Installation, startup, adjustment, alteration, service, or maintenance must be performed by qualified personnel in accordance with this manual, all applicable codes and regulations, and the instructions for associated equipment. Improper installation, startup, adjustment, alteration, service, or maintenance can result in property damage, fire, explosion, carbon monoxide exposure, serious personal injury, or death.

WARNING – FIRE, EXPLOSION AND CARBON MONOXIDE HAZARD

Improper installation, adjustment, service, combustion setup, or venting can result in fire, explosion, or release of carbon monoxide. Carbon monoxide is a colorless, odorless gas that can cause serious injury or death. Follow all instructions and applicable codes. Do not operate the boiler if the venting, combustion-air, gas-supply, safety-control, or condensate systems are damaged, disconnected, improperly installed, or not operating correctly.

FOREWORD

The AERCO Benchmark NX 399 and 500 natural gas 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 NX boiler's modulating capability relates energy input directly to fluctuating system loads. These BMK NX models provide extremely high efficiency operation and are ideally suited for modern low temperature, as well as, conventional heating systems.

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

Benchmark NX Boiler Intake and Output Ranges				
MODEL	INPUT RANGE (BTU/HR.)		OUTPUT RANGE (BTU/HR.)	
	MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
BNX 399	39,900 (11.7 kW)	399,000 (117 kW)	37,905 (11.1 kW)	379,050 (111 kW)
BNX 500	50,000 (14.6 kW)	500,000 (147 kW)	47,500 (13.9 kW)	475,000 (139 kW)

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

When installed and operated in accordance with this Instruction Manual, the BMKNX 399-500 comply with the NO_x emission standards outlined in: **South Coast Air Quality Management District (SCAQMD), Rule 1146.2**.

Whether used in singular or modular arrangements, the BMK NX 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 NX Venting and Combustion Air Design Guide* (TAG-0122) for a list of allowable and preferred vent materials.

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 NX	AERCO's Benchmark NX series boilers
BMS or BMS II	AERCO Boiler Management Systems
BLDG (Bldg)	Building

AERCO Technical Terminology Meanings	
TERMINOLOGY	**MEANING**
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
EMS	Energy Management System; often used interchangeably with BAS
FM	Factory Mutual. Used to define boiler gas trains.
GF-xxxx	Gas Fired (an AERCO document numbering system)
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
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 (1 thousandth of an ampere)
MAX (Max)	Maximum
MBH	1000 BTUs per Hour
MIN (Min)	Minimum
Modbus®	A serial, half-duplex data transmission protocol developed by AEG Modicon
NC (N.C.)	Normally Closed
NO (N.O.)	Normally Open
NO_x	Nitrogen Oxide
NPT	National Pipe Thread
O_2	Oxygen
O.D.	Outside Diameter
OMM, O&M	Operation and Maintenance Manual
PCB	Printed Circuit Board
P/N	Part Number
PPM	Parts per Million
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 or water heater
PVC	Poly Vinyl Chloride, a common synthetic plastic

AERCO Technical Terminology Meanings	
TERMINOLOGY	**MEANING**
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
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 in 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.
- Shut off all gas and electrical inputs to the unit before performing any maintenance.
- The exhaust vent pipe of the unit may operate 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 and 24 volts ac may be used in this equipment. Therefore, the cover on the unit's power panel (located behind the unit's front panel) must be installed at all times, except during maintenance and servicing.
- A single-pole (120 vac 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.
- Contact with energized components may cause electric shock, burns, serious injury, or death.
- Installation, wiring, startup, and service must be performed by qualified personnel in accordance with all applicable codes and the manufacturer's instructions.

WARNING!

This manual provides general installation, operation, and maintenance guidance. Site-specific conditions vary. The installer and operator remain responsible for compliance with all applicable codes, regulations, and project-specific engineering requirements.

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 gas shutoff valve (Figure 1-1) located external to the unit. **NOTE:** The Installer must identify and indicate the location of the emergency shutdown manual gas valve to operating personnel.



Figure 1-1: Manual Gas Shutoff Valve

In addition, to ensure safety an emergency shutdown procedure that addresses the following points should be designed and implemented 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 AERCO 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 a long time, such as a year or more, complete the instructions in Section 8.7: *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)**

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.

*******CONTINUED ON NEXT PAGE*******

Requirements for Massachusetts Installations

(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.
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: INSTALLATION

2.1 Receiving The Unit

Each Benchmark NX Boiler System is shipped as a single crated unit. The shipping weight for these BMK NX models is approximately as follows:

BNX 399: 476 lbs. (216 kg) **BNX 500:** 505 lbs. (229 kg)

The unit must be moved with proper rigging equipment for safety and to avoid damage. The unit should be completely inspected for evidence of shipping damage and shipment completeness at the time of receipt from the carrier and before the bill of lading is signed.

CAUTION!

While in shipping container, the unit must be moved by pallet jack or forklift from the ***front only***.

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

2.2 Unpacking

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

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

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

- Pressure/Temperature Gauge
- ASME Pressure Relief Valve
- Condensate Drain Trap (P/N 24819)
- A 1" Natural Gas Supply Shutoff Valve

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

2.3 Site Preparation

Ensure that the site selected for installation of the Benchmark NX Boiler includes:

- Access to a natural gas supply that conforms to the pressures specified in the *Benchmark NX Gas Supply Design Guide* (TAG-0121).
- AC input power as specified in *Benchmark NX Electrical Power Design Guide* (TAG-0120).
- To ensure proper condensate drainage, the unit must be installed on a level concrete "housekeeping" pad. See Section 2.3.3 for pad requirements.

2.3.1 Installation Clearances

All Benchmark NX models are the same height, but vary in depth by model. The unit must be installed with the prescribed clearances. The minimum required clearance dimensions are listed below. However, if Local Building Codes require additional clearances, these codes shall supersede AERCO's requirements.

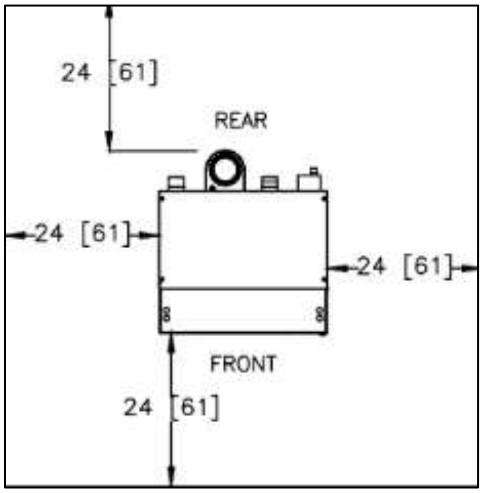
The ***minimum acceptable clearances*** required for **BNX 399-500** are as follows:

Front: 24 inches (61 cm) **Sides:** 24 inches (61 cm)
Rear: 24 inches (61 cm) **Top:** 18 inches (45.7 cm)

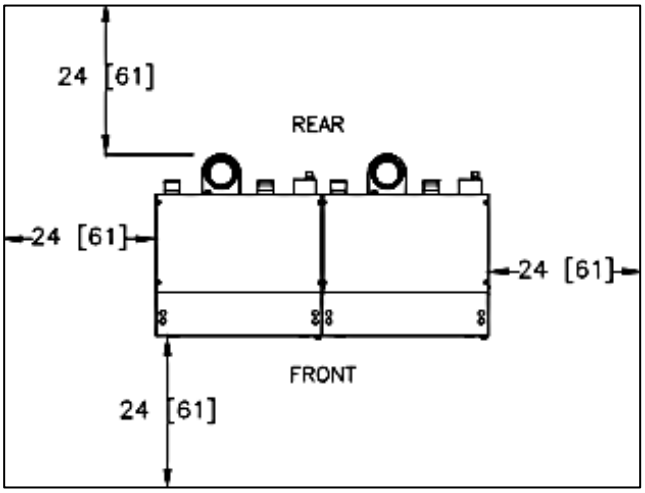
All gas piping, water piping and electrical conduit or cable must be arranged so that they do not interfere with the removal of any panels or inhibit service or maintenance of the unit.

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

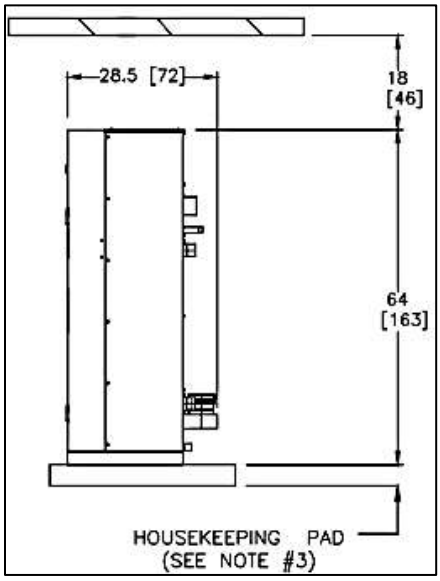
NOTE: BMK NX units may be installed with zero side clearances in pairs only. Perimeter clearances still apply.



Single Unit



Minimal Side Clearance Units



Side View

NOTES:
1. All dimensions shown are in inches (Centimeters)
2. The 24" (61) Front Clearance required per Nec. All other clearance dimensions are recommended minimums. Consult all local codes and authorities.
3. The Unit must be installed on a flat, level surface.

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

For Massachusetts installations: The unit must be installed by a plumber or gas-fitter licensed within the Commonwealth of Massachusetts. In addition, the installation must comply with all requirements specified in Section 1.4, above.

Figure 2-1: BMK NX 399/500 Clearances

2.3.2 Anchoring The Unit

If anchoring the unit, refer to Figure 2-2 for anchor locations.

- All holes are flush with the bottom surface of the frame.
- All dimensions shown are in inches [centimeters]

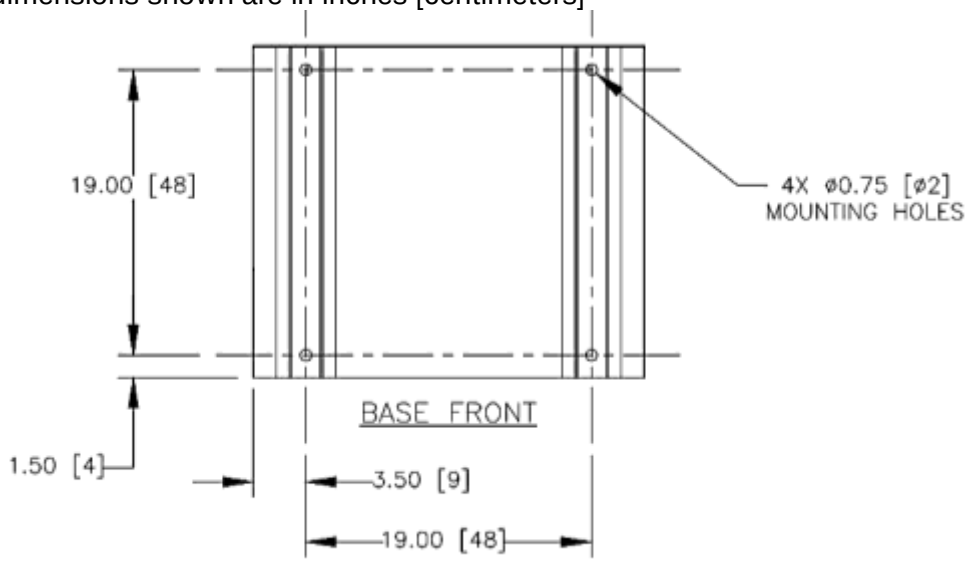


Figure 2-2: BMK NX 399/500 Anchor Bolt Locations

2.3.3 Housekeeping Pad Requirements

To ensure proper condensate drainage, the unit must be installed on a level concrete "housekeeping" pad. The unit must be positioned so the condensate assembly is *not* located over the pad.

The minimum thickness of the concrete housekeeping pad depends on whether the unit will connect to a Condensate Neutralizer tank. The minimum pad thickness for installations *without* a Condensate Neutralizer tank is **4 to 6 inches** (10.2 to 15.2 cm).

If using AERCO Condensate Neutralizer Tank (P/N 89030), you must ensure enough height for the condensate to drain into the condensate trap, neutralizer tank, and drain. For more information, see Technical Instructions TID-0074.

The BMK NX 399/500 must be installed on a 4" pad.

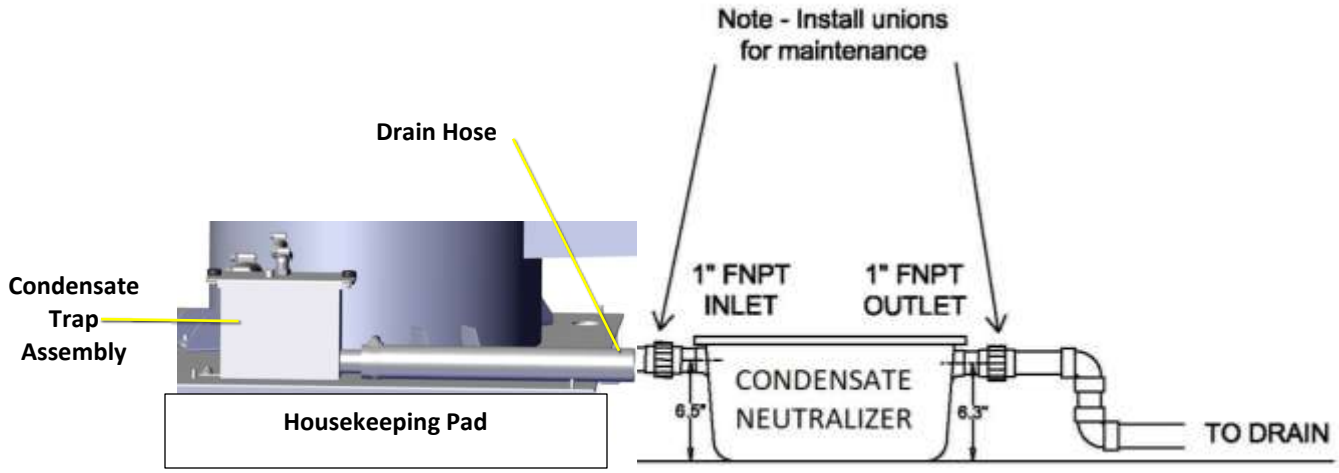


Figure 2-3: Condensate Neutralizer Tank Installation

2.4 Lifting Provisions/Moving the Boiler

Unpack and inspect the unit, then remove the four (4) lag screws securing the boiler to the shipping pallet. The boiler can be moved with a forklift by inserting forklift tines into the front slots in the base of the unit.

2.5 Supply and Return Piping

When connecting the hot water outlet and cold-water inlet to building piping, thoroughly clean the mating surfaces. Gaskets of appropriate size for the pipe flange must be provided in the field. Operating unit above the maximum flow requirements of the boiler will void the warranty.

2.5.1 Flow Rate Specifications

AERCO BMK NX boilers require the following minimum flow rate per boiler for proper and stable boiler temperature control operation. To prevent erosion of construction materials, maximum flow per boiler are limited as shown below.

BNX Model	Minimum Flow Rate	Maximum Flow Rate
BNX 399	19 gpm (72 lpm)	75 gpm (284 lpm)
BNX 500	23 gpm (87 lpm)	91 gpm (344 lpm)

2.5.2 BNX 399-500 Supply And Return Piping

Benchmark NX 399 and 500 boilers utilizes 2" (5.08cm) NPT for water supply and return connections. The location of the supply and return piping connections are on the rear of the unit as shown below.

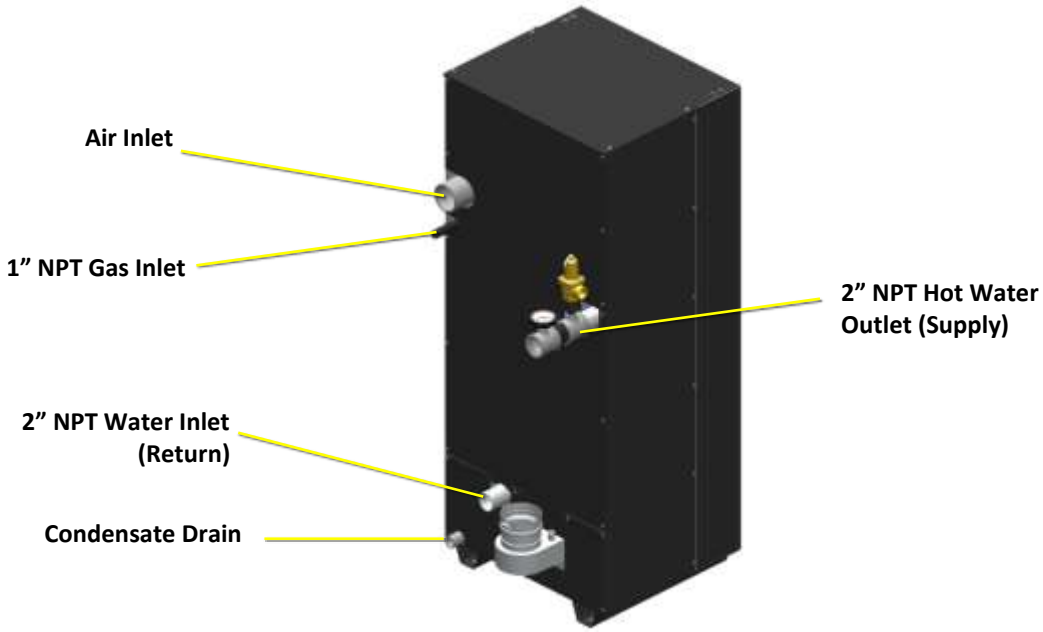


Figure 2-4: BNX 399/500 Supply and Return Locations

2.6 Water Quality – Initial System Fill

Water quality guidelines should be strictly adhered to prevent corrosion of the heat exchanger and other components. It is important to understand the chemical composition of incoming water to the boiler.

Heat exchanger failures due to water quality are not covered under warranty.

To prevent corrosion, fouling, and harmful effects on the boiler:

- Chloride limits are set to 250 ppm to prevent corrosion of the heat exchanger. In the table below, your Chloride test result dictates which row you must be in.
- Sulfates are limited to lower ppm limits as the tested chloride levels increase and are acceptable at any ppm when chlorides are less than 100 ppm
- Allowable hardness depends on the concentration of sulfates and chlorides and should not exceed 50 ppm

EXAMPLE: If the chloride is between 175 and 250, sulfate must be 25 ppm or below, and hardness must be 10 ppm or below for the boiler to operate smoothly with minimal risk.

MAINTENANCE: Water quality should be analyzed 3 months after startup. If found in compliance with guidelines described below, water quality should be analyzed as part of annual maintenance.

NOTE: Systems with leaks can cause significant amounts of make-up water, creating a loop that is no longer considered "closed" and allowing contaminants in with the replenished make-up water. AERCO recommends the installation of a positive displacement flow meter on the make-up water line to sense any freshwater make-up introduction. Water quality should be verified in the event of freshwater being introduced into the boiler loop and treated as necessary to meet guidelines below. Contact your local AERCO Sales Representative or AERCO Technical Services if you have any questions.

Chloride (ppm)	Sulfate (ppm)	Hardness (ppm)	pH	Conductivity (umho/cm)
< 250	≤ 25	≤ 10	7-10.5	≤ 3500
< 175	≤ 50	≤ 25	7-10.5	≤ 3500
< 100	No Limit	≤ 50	7-10.5	≤ 3500

Definitions:

- Chlorides - Causes stainless steel to corrode
- Sulfates – Accelerates corrosion of stainless steel in the presence of chlorides
- Hardness - Keeping hardness values low will help to prevent scale buildup
- pH – The first step towards boiler treatment, maintain between 7-10.5
- Conductivity - The increase of total solids promotes deposition of scales

2.7 Pressure Relief Valve Installation

An ASME rated Pressure Relief Valve is supplied with each Benchmark NX Boiler The pressure rating for the relief valve must be specified on the sales order. Available pressure ratings range from **30 to 160 psi (207 to 1103 kPa)**. The relief valve is installed on the hot water outlet of the boiler as shown below. A suitable pipe joint compound should be used on the threaded connections. Any excess should be wiped off to avoid getting any joint compound into the valve body. The relief valve must be piped to **within 12 inches (30.5 cm)** of the floor to prevent injury in the event of a discharge. No valves, restrictions, or other blockages are allowed in the full port discharge line. In multiple unit installations, the discharge lines must ***NOT*** be manifolded together. Each must be individually run to a suitable discharge location.

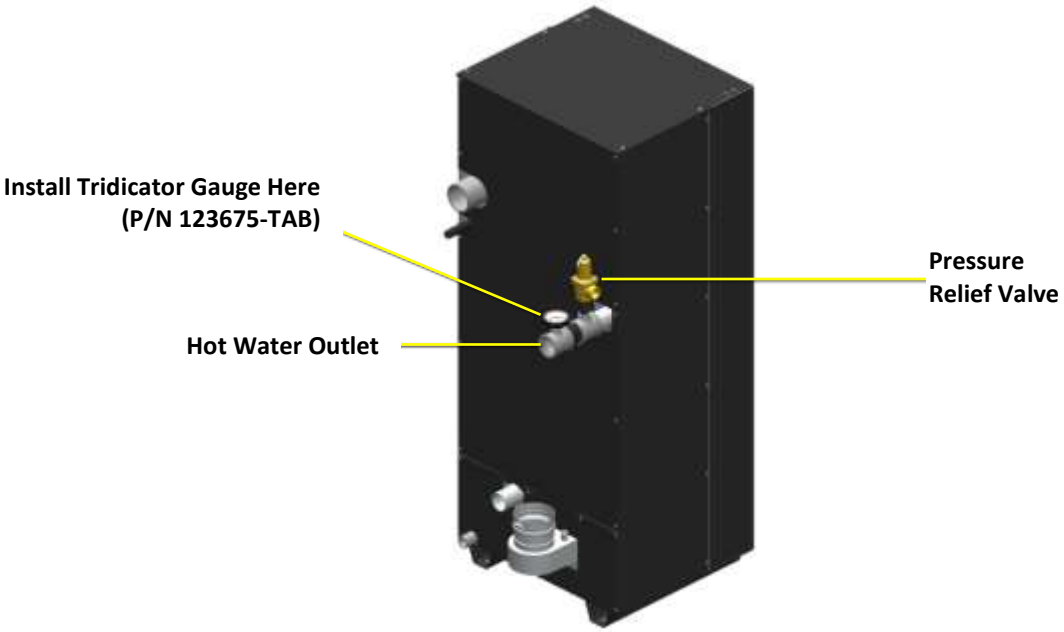


Figure 2-5: BNX 399/500 P&T Relief Valve Location

WARNING: HOT WATER AND PRESSURE HAZARD
The pressure relief valve may discharge hot water or steam capable of causing severe burns. Pipe the discharge to a safe location in accordance with applicable codes. Do not cap, plug, restrict, reduce, valve, or otherwise obstruct the relief-valve discharge.

2.8 Pressure/Temperature Gauge Installation

The Pressure/Temperature Gauge must be installed in the outlet piping as shown in figure 2-5. The gauge must be inserted so that the sensing bulb is in the hot water outlet flow.

2.9 Condensate Drain and Piping

The Benchmark NX Boiler is designed to condense water vapor from the flue products. Therefore, the installation must have provisions for suitable condensate drainage or collection. See below for information on the condensate drain and piping.

The condensate trap inlet is pre-piped inside the unit. At the condensate trap outlet, a 1-1/4" EPDM rubber hose is preinstalled from the factory. A field-sourced polypropylene hose must be used to route the condensate from the trap to a condensate neutralizer tank or nearby floor drain (see Figure 2-3). Additional field-sourced fittings may be necessary to connect the polypropylene hose to a condensate neutralizer.

NOTE: The following guidelines ***must*** be observed to ensure proper condensate drainage:

- Condensate trap inlet must be level with or lower than the exhaust manifold drain port.
- The base of the condensate trap must be supported to ensure that it is level (horizontal).
- The trap must be removable for routine maintenance. AERCO recommends that a union be utilized between the exhaust manifold condensate drain port and the trap inlet port.
- If the condensate trap does not connect directly to the exhaust manifold condensate drain port, the pipe between the drain and the trap ***must*** be **stainless steel** or **aluminum**.
- The concrete housekeeping pad must not extend under the condensate assembly.

If a floor drain is not available, a condensate pump can be used to remove condensate to an appropriate drain. Maximum condensate flow rate is: BNX 399 = 3.8 gph; BNX 500 = 4.9 gph.

2.10 Gas Supply Piping

AERCO's *Benchmark NX Gas Supply Design Guide*, TAG-0121 must be consulted prior to designing or installing any gas supply piping.

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

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

NOTE: Arrange all gas piping so it does not interfere with removal of any covers, inhibit service/maintenance, or restrict access between the unit and walls, or another unit.

BNK Model	Natural Gas Piping
399 and 500	1 inch (2.54 cm) in back of unit

2.10.1 Prior To Installation

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

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

To avoid unit damage when pressure testing gas piping, the unit must be isolated from the gas supply piping. A thorough leak test of all external piping must be performed using a soap and water solution or suitable equivalent. The gas piping used must meet all applicable codes. **NOTE: Piping must NOT be welded directly to the gas train.**

2.10.2 Gas Supply Specifications

Benchmark NX boilers require a stable natural gas input that complies with the allowable gas inlet pressure range specified in the *Benchmark NX Gas Supply Design Guide* (TAG-0119).

2.10.3 External Gas Supply Regulator

An external gas pressure regulator is recommended on the gas inlet piping under most conditions (see, below). Regulators must conform to the specifications in the *Benchmark NX Gas Supply Design Guide* (TAG-0119).

NOTE: It is the customer's responsibility to source and purchase the appropriate gas regulator. AERCO offers for sale an appropriate regulator, which may be ordered at the time of unit purchase or separately. Contact your AERCO sales representative for more information.

On all Benchmark NX models it is strongly recommended that the pressure regulator be installed a minimum distance of **10 pipe diameters** between the pressure regulator and the nearest *downstream* fittings (an elbow or the unit itself), and a minimum of **5 pipe diameters** between the pressure regulator and any *upstream* fitting, such as elbow or shutoff valve, as shown below.



Figure 2-6: BNX 399/500 Gas Regulator and Manual Shut-Off Valve

NOTE: **Massachusetts Installations Only:** For Massachusetts installations, an external gas supply regulator must be positioned as shown. The gas supply regulator must be properly vented to outdoors. Consult your local gas utility for requirements concerning venting of the supply gas regulator.

2.10.4 Manual Gas Shutoff Valve

A manual shut-off valve must be installed in the gas line upstream of the boiler as shown above.

2.11 AC Electrical Power Wiring

All power requirements are in AERCO's *Benchmark NX Electrical Power Design Guide*, TAG-0120. This must be consulted prior to connecting any AC power wiring to the unit.

⚡⚡ ELECTRICAL HAZARD WARNING ⚡⚡
Disconnect and verify removal of external electrical power before servicing electrical components.

2.11.1 Electrical Power Requirements

BNX Model	Voltage	Phase	FLA[1]	MOP[2]
BNX 399-500	120V	1ph/60Hz	4.5A	10.1A

[1] Full-Load Amps

[2] Maximum Over Circuit Protection (MOCP)

2.11.2 Power Panel

External AC power connection is made inside the Power Panel, located on the front of the unit.

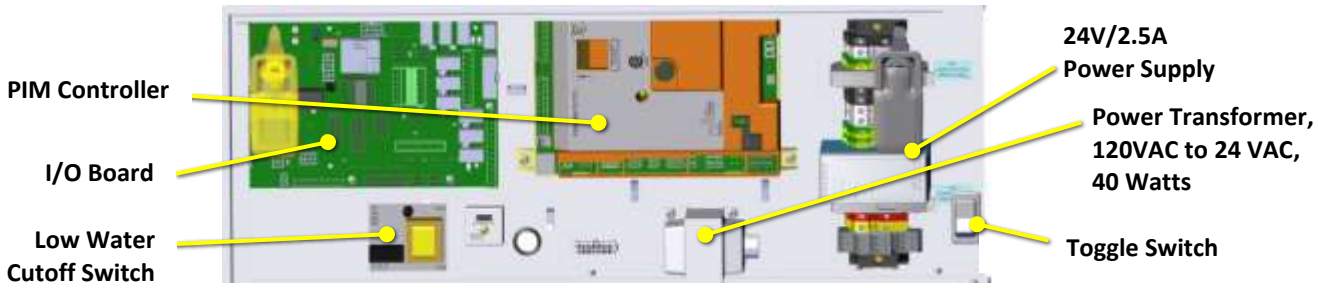


Figure 2-7: Power Panel

The required AC power connection has a label on the corresponding terminal blocks. Run the electrical service through the opening above the Power Panel and make the connections in accordance with the terminal block label.

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

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

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

WARNING!
The toggle switch shown does NOT remove power from the terminal blocks.

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

2.12 Field Control Wiring – I/O Board

For field wiring instructions, refer to:

- OMM - 0173: Edge X Communication Guide for Systems Integrators
- OMM - 0170: Edge X Operation Manual

2.13 Flue Gas Vent Installation

AERCO's *Benchmark NX Venting and Combustion Air Design Guide (TAG-0122),* must be consulted before any flue or combustion air venting is designed or installed. Suitable, UL approved, positive pressure, watertight vent materials MUST be used for safety and UL certification.

Once you have selected the vent material, enter that material in the Edge Controller:

1. Go to: **Settings > Advanced Setup> Unit Settings > Vent**
2. Find the **Vent Type** parameter.
3. Set the value of this parameter to match your vent material: PVC, Polypro or Stainless Steel. This sets the exhaust temperature limits. Note, PVC is not allowed in the state of Massachusetts.

Because the unit is capable of discharging low temperature exhaust gases, **the flue must be pitched back towards the unit a minimum of 1/4" per foot (0.64 cm per 0.3 m)** to avoid any condensate pooling and to allow for proper drainage.

While there is a positive flue pressure during operation, the combined pressure drop of vent and combustion air systems **must not exceed 120 equivalent feet (36.6m) or 0.6" W.C. (149 Pa)**. Fittings as well as pipe lengths must be calculated as part of the equivalent length. For a natural draft installation, **the draft must not exceed -0.25" W.C. (-62 Pa)**. These factors must be planned into the vent installation. If the maximum allowable equivalent lengths of piping are exceeded, the unit will not operate properly or reliably.

2.13.1 Massachusetts Installations

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

Selkirk Corporation - Heatfab Division 130 Industrial Blvd. Turners Falls, MA 01376 Phone: 1-800-772-0739 www.heatfab.com	**Watertown Supply** 33 Grove St. Watertown, MA 02472 Phone: (617) 924-2840 www.watertownsupply.com
Glover Sheet Metal, Inc. 44 Riverdale Ave. Newton, MA 02485 Phone: (617) 527-8178 www.gloversheetmetal.com	**Emerson Swan Co** 300 Pond St. Randolph, MA 02368 Phone 781-986-2555 www.emersonswan.com

2.14 Combustion Air

The *Benchmark NX Venting and Combustion Air Design Guide (TAG-0122)* MUST be consulted before any inlet air venting is designed or installed. Air supply is a direct requirement of ANSI 223.1, NFPA-54, CSA B149.1 and local codes. These codes should be consulted before a permanent design is determined.

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

If combustion air is supplied directly to the unit(s) though air duct(s), see instructions below.

If combustion air is not supplied through air ducts, it must be supplied to the unit(s) through two permanent openings. These two openings must have a free area of **not less than one square inch (6.5 cm²) for each 4000 BTUs (1.17 kW) input for each unit**. The free area must take into account restrictions such as louvers and bird screens.

For installations within Canada, refer to CSA B149.1-10, sections 8.4.1 and 8.4.3.

WARNING: CARBON MONOXIDE HAZARD

An improperly designed, installed, sealed, or obstructed vent system can permit combustion products, including carbon monoxide, to enter occupied spaces. Follow this manual, TAG-0122, the vent manufacturer's instructions, and all applicable codes.

2.14.1 Ducted Combustion Air

For ducted combustion air installations, the air ductwork must be attached directly to the air inlet connection on the sheet metal enclosure. Consult the *Benchmark Venting and Combustion Air Design Guide (TAG-0122)* when designing combustion air ducting.

In a ducted combustion air application, the combustion air ducting pressure losses must be taken into account when calculating the total maximum allowable venting run. When using the unit in a ducted combustion air configuration, the minimum diameter connection at the unit is:

TABLE 2-4: Air Duct Minimum Diameter

Benchmark Model	Duct Diameter
BNX 399 – BNX 500	4-inch (10.2 cm) diameter connection

2.15 BST Sequencing Isolation Valve Installation

All Benchmark NX units are pre-wired with a connection for an optional motorized external sequencing isolation valve (P/N **92176**This valve is an integral component of AERCO's on-board Boiler Sequencing Technology (BST) solution. BST allows sites with multiple boilers to have one boiler, designated the "Manager," manage the other boilers at the site, designated as "Clients" in such a way that the efficiency of the entire boiler array is maximized.

When operated with the BST system, the BST Manager controls its own isolation valve and sends signals to BST Clients to open or close their isolation valves. After boiler load is satisfied, its isolation valve remains opens for a time interval defined in the controller settings. Once system load is satisfied and all Client units have stopped firing, the BST Manager opens the isolation valves of all Client units.

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

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

NOTE: The Sequencing Isolation Valve control is a pre-programmed valve, available only from AERCO. It is installed only on boilers that are part of a Boiler Sequencing Technology cascade.

2.15.1 Sequencing Isolation Valve Installation Instructions

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

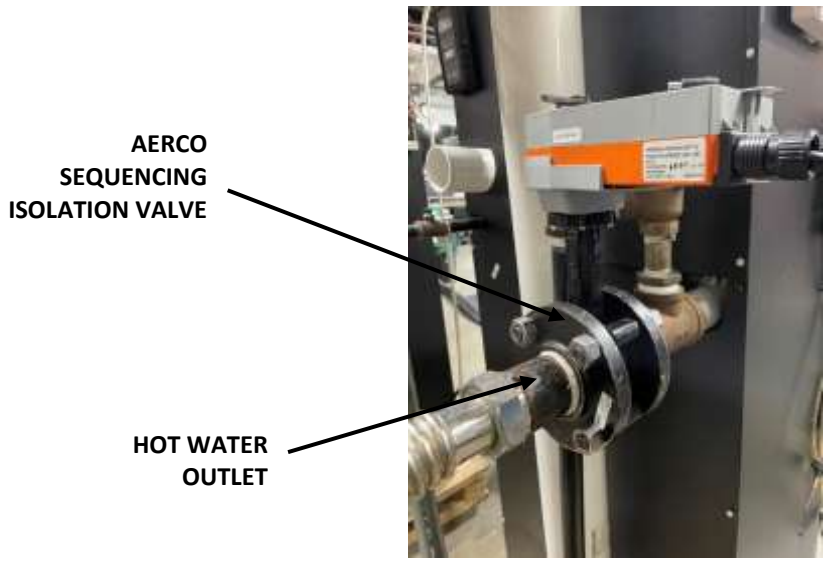


Figure 2-8: Sequencing Isolation Valve Installed

2. Find the cable inside the unit's enclosure with the unused Molex connector with a cap containing a jumper wire inserted in it (the jumper wire allows units that do not have a sequencing isolation valve to operate normally). The other end is connected to the I/O board, the delayed interlock terminal block, and to a power supply.

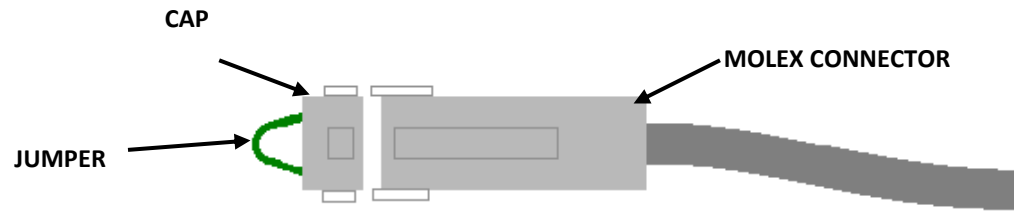


Figure 2-9: Sequencing Isolation Valve Molex Connector and Jumper Wire

3. Remove and dispose of the cap with jumper wire attached.
4. Plug the Molex connector into the sequencing isolation valve's connector.
5. When the Sequencing Isolation Valve is used, the **Auxiliary Delay** setting must be set to 120 seconds.

SECTION 3: SEQUENCE OF OPERATION

3.1 Start Sequence

1. **Incoming 120VAC**
   a. Power to fuse when Main Control Switch is ON.

2. **Power On** - When the Enable/Disable switch on the Edge X Controller is turned on:
   a. 120V to PIM J13 for blower circuit
   b. 120V is applied to fuse, if fuse is good, lamp in control switch is lit.
   c. Fused 120V is applied to the step-down transformer (24V)
   d. Fused 120V is applied to the L.W.C.O.
   e. 24V and Fused 120V is applied to the Platform Ignition Module (PIM). The circulator and spark igniter circuits are 120V.
   f. The PIM performs a processor and memory self-test to insure proper operation. The PIM confirms the presence of a valid ID card which matches the configuration previously stored in memory. If the valid ID card is not present, the PIM generates a diagnostic fault. The non-volatile memory is checked for an active hard lockout condition. A lockout indicates the previous attempt to light was unsuccessful, such as a hi-limit or other system fault occurred. The PIM stays in hard lockout until a manual reset is performed.

3. **Control Device Pre-check** – The following control circuits are checked for closure before the control system will initiate a Call for Heat.
   a. The PIM continuously monitors the flame status to verify no flame is present during Standby. If an erroneous flame is detected, the PIM generates a false flame fault.
   b. The Electronic Low Water Cut-Off control is a self-contained electronic device which senses the presence of water at the top of the storage tank. When the presence of water is confirmed, the contacts close on the LWCO and is sensed by PIM control. A solid red LED on the LWCO PCB indicates presence of water.
   c. The High Temperature Limit is combined in a common probe body with the upper tank sensor. The PIM will compare the high limit thermistor temperature with the upper tank thermistor temperature. If the two temperatures are not the same, a sensor failure will result.
   d. When the High Temperature Limit operation has been verified by comparison, the limit temperature will then be confirmed to be under the maximum allowable temperature.
   e. The enable circuits on Connector Strip J9, Remote and Delayed Interlocks must be closed to start operation. If no external enable, the terminals should be jumped. (Factory default)

4. **Call For Heat -** If the operating control senses the temperature at the outlet is below the boiler set point less boiler differential and the previous control interlocks and safeties are satisfied:
   a. Aux Relay is closed to activate any connected remote devices
   b. Delayed Interlock is closed by any connected remote proving switches, enabling the boiler to continue the sequence of operation.
   c. When the blower is energized blower speed is verified as within operational range for ignition.
   d. The ignition pre-purge delay takes place. Approximately 15 seconds.
   e. The voltage level of the 24 VAC supply input is confirmed to be above 18.0 VAC.
   f. The Ignition cycle begins.

5. **Ignition** – When the prepurge is completed a 4-second Trial for Ignition (TFI) period is initiated:
   a. The spark ignition transformer is energized.
   b. The Gas Safety Valve is energized. (Opened) allowing gas to flow.
   c. The flame safeguard control monitors the flame through the flame sensing electrode.
   d. If the flame control senses the presence of flame before the end of the TFI period, the spark transformer will be de-energized and the flame control will continue to monitor the flame until the operating thermostat ends the call for heat condition.

6. **Heating**
   a. The flame status, LWCO switch, blower motor speed and other safety switches are continually monitored for proper state.
   b. The High Limit sensor is confirmed to read below the High Limit setpoint.
   c. The temperature of water in the tank is compared to the temperature control set point to determine when to begin firing in heating mode.
   d. The boiler remains in heating mode and, with extended operation, condensation begins to fill the condensation trap and drain line; (a normally operating booster heater does not create condensation). The boiler stops firing when the tank water temperature matches the temperature control set point.
   e. The gas valve(s) are immediately disabled.
   f. A Blower Post-purge is completed and the control proceeds to Standby mode.

7. **Flame Failure / Flame Loss**
   a. If the flame rod fails to sense flame during an attempt to light the burner (Ignition Trial Fail), the ignition control will end the ignition sequence, and the gas valve will be closed. Immediately following the end of the first failed ignition cycle, a new ignition sequence will be initiated to attempt to relight the burner. The standard configuration of the Benchmark NX boiler allows for three ignition failures before lockout.
   b. If the burner successfully lights and operates but the flame is lost, the gas valve will be closed, and the blower will continue to operate in order to purge any remaining combustion products from the boiler. The standard configuration of the Benchmark NX boiler allows for three (Main Flame Loss) occurrences before lockout. Following each (Main Flame Loss) the PIM will purge and initiate the ignition sequence. If the Benchmark NX boiler fails to light in the following 2 attempts, the error will be logged as a Main Flame Loss.

3.2 Minimum, Start and Maximum Blower Modulation Rate

Below are the Minimum (MIN MOD), Start (START MOD) and Maximum (MAX MOD) Blower Modulation Rate, along with the corresponding Energy Input at MIN MOD and MAX MOD. These are Factory preset parameters in the BTC II controller. Note: The Blower Modulation rate is not equal to the boiler Energy Input percentage/firing rate.

TABLE 3-1a: MIN, START, MAX MOD – NATURAL GAS

	BMK NX 399	BMK NX 500
MIN MOD:	10% (45 MBH)	10% (50 MBH)
START MOD:	25%	30%
MAX MOD:	50% (399 MBH)	90% (500 MBH)

SECTION 4:INITIAL STARTUP

4.1 Initial Startup Requirements

Installation must be complete prior to performing initial startup; and the startup must be complete prior to placing the boiler into service. Starting the boiler without proper piping, combustion air, venting or electrical connections or control settings can be dangerous and may void the product warranty. The following startup instructions must be followed precisely in order to achieve proper and efficient operation to assure trouble-free service life.

WARNING!

Proper startup must be made by a qualified installer or service agency, who must read and follow the supplied instructions and appliance markings. Failure to complete proper startup before use, tampering with controls or not following all instructions and markings may damage this equipment, void the warranty and may result in property damage, personal injury or death.

4.2 Tools and Instrumentation Required

- Electronic Combustion Analyzer with stack temperature and draft gauge
- Two digital or U-tube Manometer or pressure gauge
- Multi Meter VAC, VDC, Ohms, Continuity
- Amp Meter Clamp on recommended (0-10 Amp Range)
- Normal Hand Tools

4.3 Resources

- Product Installation & Maintenance Manuals
- Start-up Report with instructions
- Local, State, & Federal Codes
- Website: www.aerco.com
- Technical Support: 1-800-526-0288

4.4 On Site Considerations

- Electrical Supply in accordance with the Nameplate Rating
- Adequate uncontaminated indoor or outdoor combustion air
- Adequate Fuel Supply
- Adequate Water Supply
- Exhaust Vent that complies with the installation instructions and local code requirements
- Condensate drainage that complies with installation instructions and local code requirements
- Enough heat rejection (usage) to allow heater to complete combustion analysis

4.5 Pre-Startup Checklist

IMPORTANT: Before starting the boiler, ensure that the unit is properly and completely installed. If your unit is not installed properly, DO NOT attempt startup. Contact your installer immediately.

WARNING: SAFETY CONTROLS
Do not bypass, jumper, disable, or alter any safety device or interlock except temporarily as expressly directed by an authorized test procedure in this manual and only by qualified service personnel. Restore all safety devices and interlocks to normal operating condition immediately after testing. Never leave the boiler unattended while a safety device or interlock is bypassed.

Before starting the unit, check for adequate electrical service, confirm if any external control wiring connections exist, confirm the tank is filled with water, check all tank connections for leaks, and ensure the condensate trap is installed properly and that the gas supply meets the product rating decal requirements as follows:

CHECK ELECTRICAL SERVICE

1. Start by checking the electrical service. Confirm that the voltage supplied to the boiler is a 120 volt, single phase, 60 Hertz power supply that is also electrically grounded. See the appliance rating decal on the front of the unit for the electrical service requirements for your specific product. **NOTE: If connecting via pigtail, must be grounded and non-GFCI plug.**
2. Shut off electrical service to the unit and turn the boiler power switch to the OFF position.
3. Unscrew and remove the two top cover plates to access the control enclosure. Locate the document packet containing the wiring diagram.
4. Check that a fuse is installed in the fuse terminals of the power panel assembly.
5. Visually check that all components are intact and no damage has occurred during transit and installation. Check all wire connections within the control cabinet. A loose connection could cause damage or intermittent shutdowns.

CHECK FOR EXTERNAL CONTROL WIRING CONNECTIONS

Before initial startup, the boiler must be isolated from any remote controlling device. On the field access terminal strip, check to see if Connector Strip J9, Remote and Delayed Interlocks are jumped. If they are, nothing more needs to be done. If the terminals are not jumped but have wires connected to them, this indicates that a remote on/off relay is controlling the boiler from the Building Automation System. These wires must be removed prior to startup and the terminals must be jumped. Before bypassing the Remote and Delayed Interlocks, ensure it is safe to operate the equipment. Ensure it is safe to operate the boiler with this enable/disable bypassed. Remember to remove the jumper and reconnect the remote wires after startup is complete.

CONFIRM THE SUPPLY GAS TYPE

Confirm the gas type supplied matches the rating label requirement on the front of the boiler. The Benchmark NX boiler requires **Natural** gas. If Natural Gas is not correct your unit will require a conversion. Contact the factory for instructions for converting to or from Natural Gas.

CONFIRM THE SUPPLY GAS PRESSURE

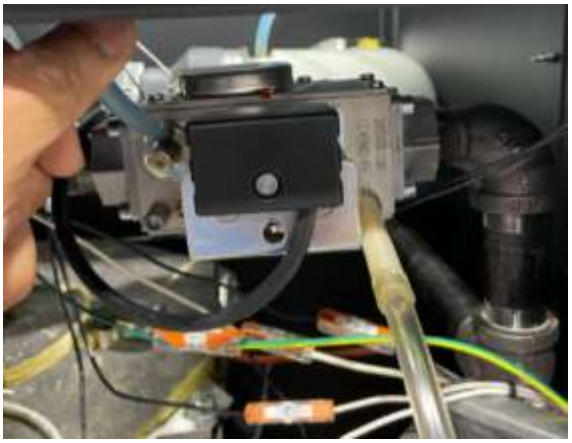
WARNING!
Never operate the boiler in normal service with a required safety interlock bypassed.

WARNING!
If you smell gas: Do not try to light any appliance. Do not try to touch any electrical switch or use a phone in your building. Immediately call your gas supplier and follow their instructions.

For **Natural Gas**, the maximum inlet static gas pressure must not exceed **14.0** inches water column and must not drop below **4.0** inches water column during operation.

To check the supply gas pressure:

1. Shut off the main gas supply to the boiler.
2. Open Port P1 of the gas valve, two turns counter-clockwise using an allen screw.
3. Connect manometer to Port P1 of the gas valve.



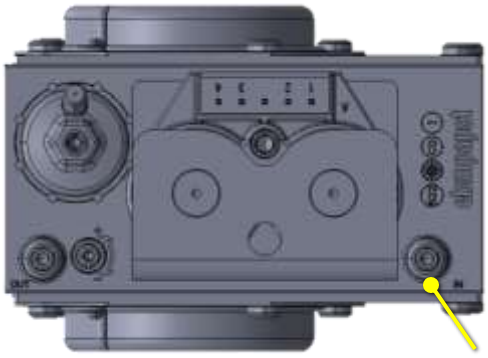


Figure 4-1: Manometer location for Supply Gas Pressure

4. Open main gas supply and check for gas leaks on all joints upstream of the gas valve using a soap solution. If any bubbles are detected, close the manual gas valve and tighten the leaking connection.
5. Measure the supply gas pressure.

IMPORTANT: If the supply gas pressure is outside of the allowable range, notify the building maintenance personnel or installer to reduce the gas pressure to the boiler!

4.6 Startup Procedure

1. Begin by turning the Enable/Disable switch on the Edge Controller to the OFF position. Some venting systems have a test port section where the combustion analyzer probe can be inserted. If the vent system does not have a combustion testing port, use the analyzer probe port on the exhaust manifold (see Diagram 4-2). Alternatively, a small test hole in the flue vent above the appliance vent connection can be drilled.

IMPORTANT: Before restarting the unit, ensure there is a way for the system to dissipate heat..



Figure 4-2: Analyzer Probe Port Location

2. Remove the front panel from the boiler to access the gas train components.
3. Close gas train ball valve located between the Gas Valve and the Venturi (Figure 4-3).

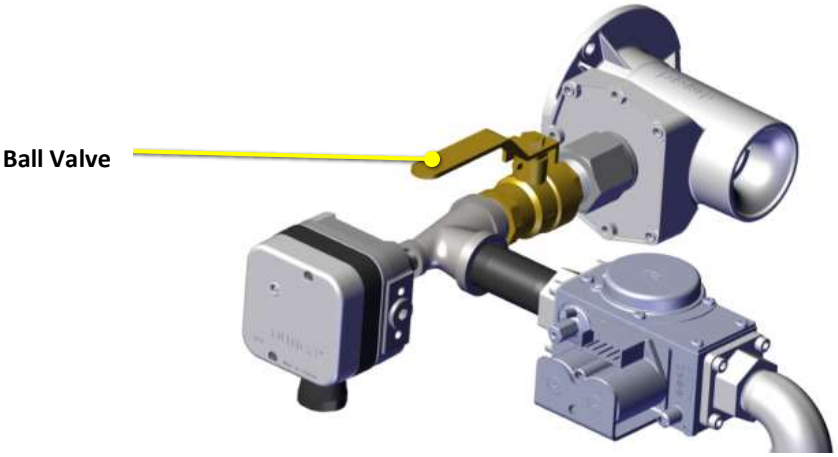


Figure 4-3: Ball Valve Location

4. Jump out the High Gas Pressure switch.
5. On the Controller, Follow the path Service > Manual Run.
6. Press "Enable Manual Run" button. Press "Yes" to acknowledge "Enable Manual Run".
7. Use the Fire Rate slider or use the '+' or '–' icons to set the firing rate between 30-35%.
8. The unit should purge and when it reaches the ignition cycle, it will shut down and display *Flame Loss During Ignition*.
9. Fully open the ball valve that was closed in step 3.
10. Press the reset button on the High Gas Pressure switch and remove the jumper installed previously.
11. Press the **CLEAR** button. The fault message should clear, and the **FAULT** indicator should go off.
12. Restart the unit and allow it to prove flame.
13. Follow the directions below to adjust the burner combustion.

4.7 Burner Combustion Adjustment

WARNING!

DO NOT OPERATE THE APPLIANCE WITH CARBON MONOXIDE LEVELS ABOVE 200 PPM.

Carbon monoxide is a colorless, odorless and poisonous gas that commonly results from gas combustion. High concentrations of Carbon Monoxide are extremely dangerous to humans and animals. Operation of an appliance at carbon monoxide levels above 200ppm can cause unsafe operation and the potential for poisonous carbon monoxide to enter occupied areas. Such improper installation can cause property damage, personal injury, exposure to hazardous materials or death. If at any point carbon monoxide is in excess of 200 ppm, contact AERCO for assistance.

1. With the burner firing, measure the gas pressure at the beginning of the gas train. If the inlet flow gas pressure for Natural Gas is equal to or greater than 4.0 inches water column, continue with the startup. If the inlet flow gas pressure drops below these minimum requirements, a supply gas volume or piping problem may exist and must be corrected before the startup can continue.
2. With the burner firing, monitor the combustion analyzer readings. The desired Oxygen (O2) must be in accordance to Table 5-1.

TABLE 5-1: O2 Range

	BNX 399	BNX 500
O_2 For Natural gas at High Fire	4.5% to 6.0%	4.5% to 6.0%
O_2 For Natural gas at Low Fire	5.0% to 6.5%	4.5% to 6.0%

If the level is in this range, no adjustment is required or recommended. If the level must be adjusted, use the following adjustment screws on the gas valve:

High Fire: High Fire Adjustment screw – clockwise to decrease gas flow and increase O2, or counter-clockwise to increase gas flow and decrease O2.

Low Fire: Low Fire Adjustment screw – counter-clockwise to decrease gas flow and increase O2, or clockwise to increase gas flow and decrease O2.

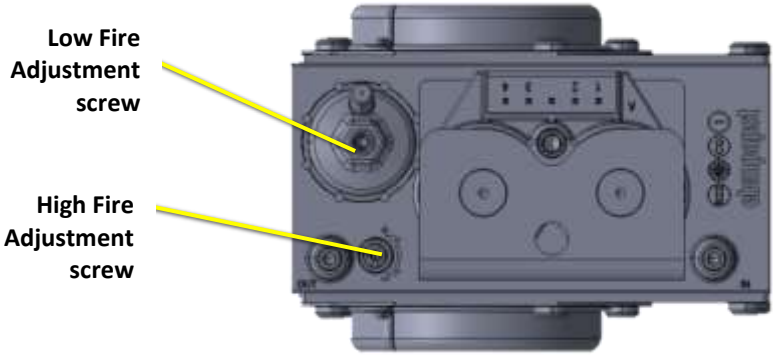


Figure 4-4: Gas Valve Adjustment Screws

NOTE: Do not attempt to adjust combustion based on manifold pressure (downstream of gas valve). Manifold pressure should only be used as a reference point.

3. The Benchmark NX uses a modulating burner control system. The O2 level must be checked at both High Fire and Low Fire. The firing rate adjustment is done in the **Manual Run** screen on the Edge controller. When adjusting combustion in Manual Run, you will be bypassing the setpoint. Ensure you do not create a scalding situation and ensure you have enough hot water usage to compete combustion adjustments.

WARNING: SCALDING HAZARD

Manual Run operation may cause water temperatures to rise above normal operating conditions because the normal setpoint is bypassed. Always ensure sufficient heat dissipation and monitor water temperature throughout combustion adjustment.

To access the Manual Run Menu:

a. Follow the path Service > Manual Run.

b. Press “Enable Manual Run” button.

c. Press “Yes” to acknowledge “Enable Manual Run”.

d. Use the Fire Rate slider or use the '+' or '–' icons to set the firing rate

e. Set the firing rate to 30% and wait for unit to prove flame.

f. Once flame is proven, set the Firing to 100% (**High Fire**). With the burner firing rate stabilized at **High Fire**, adjust the High Fire Adjustment screw clockwise to decrease gas flow and increase O2, or counter-clockwise to increase gas flow and decrease O2.

Only make combustion adjustments if O2 falls outside range shown in Table 5-1.

g. Once the desired **High Fire** levels are achieved, decrease firing rate to 10% (**Low Fire**). With the burner firing rate stabilized at **Low Fire**, adjust the Low Fire Adjustment screw counter-clockwise to decrease gas flow and increase O2, or clockwise to increase gas flow and decrease O2.

Only make combustion adjustments if O2 falls outside range shown in Table 5-1.

h. Once desired **Low Fire** combustion is reached, return to **High Fire** to confirm settings.

i. When all combustion are complete, the Manual Run is disabled by touching the "Manual Run" yellow banner on top of the screen, then click the "Disable Manual Run" button.

j. Remove the manometer from Port P1 of the gas valve.

k. Close Port P1 of the gas valve, turning clockwise using an allen screw.

4. Check Vent Pressure: With the combustion properly adjusted, now use the same vent opening that was used for the combustion analyzer probe to measure the vent pressure. With the burner firing, confirm the vent pressure does not exceed .60" W.C. Pressure in excess of .60" W.C. indicates high vent restriction, possibly a venting sizing issue that must be addressed by the installer before operating the boiler.

SECTION 5: SAFETY DEVICE TESTING

5.1 Testing Of Safety Devices

Periodic safety device testing is required to ensure controls and safety devices are operating properly. The boiler control system 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.

⚡⚡ ELECTRICAL HAZARD WARNING ⚡⚡

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

5.2 Low Gas Pressure Test

WARNING: QUALIFIED SERVICE PERSONNEL ONLY

The procedures in this section intentionally simulate fault conditions and may require temporary bypass or disconnection of safety controls. These procedures must be performed only by qualified service personnel who understand the boiler, its controls, and the hazards of fuel gas, electricity, hot water, and combustion products. Never leave the boiler unattended with a safety device bypassed. Immediately restore all wiring, valves, switches, interlocks, and safety devices to normal configuration after testing. Do not return the boiler to service unless every safety device functions as specified.

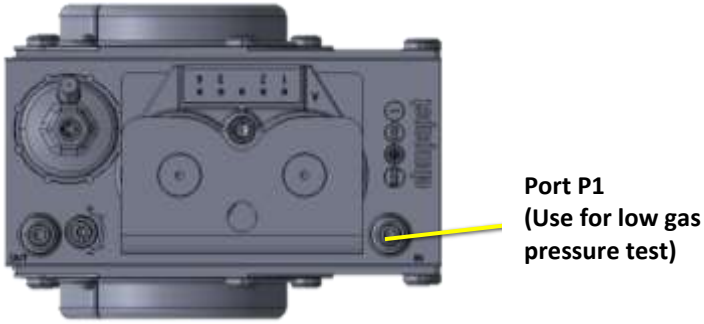


Figure 5-1: Manometer location for Low Gas Pressure Test

1. Shut off the main gas supply to the boiler.
2. Remove the front panel from the boiler to access the gas train components.
3. Open Port P1 of the gas valve, two turns counter-clockwise using an allen screw.
4. Connect manometer to Port P1 of the gas valve. See Figure 5-1.
5. On the Controller, Follow the path **Service > Manual Run**.
6. Press “Enable Manual Run” button. Press “Yes” to acknowledge “Enable Manual Run”.
7. Use the Fire Rate slider or use the ‘+’ or ‘–’ icons to set the firing rate between 30-35%.
8. While unit is firing, slowly close the external manual gas shut-off valve upstream of the unit.
9. The unit should shut down and display ***LGP/HGP/HIGH TEMP*** at approximately 3.5” W.C. (872 Pa)(the pressure setting of the Low Gas Pressure switch).
10. Fully open the external manual gas shut-off valve, press the manual reset button on the Low Gas Pressure switch and press the Controller’s **CLEAR** button.
11. The fault message should clear, the **FAULT** indicator should go off, and unit should restart.
12. Upon test completion, remove the manometer from Port P1 of the gas valve.
13. Close Port P1 of the gas valve, turning clockwise using an allen screw.

5.3 High Gas Pressure Test

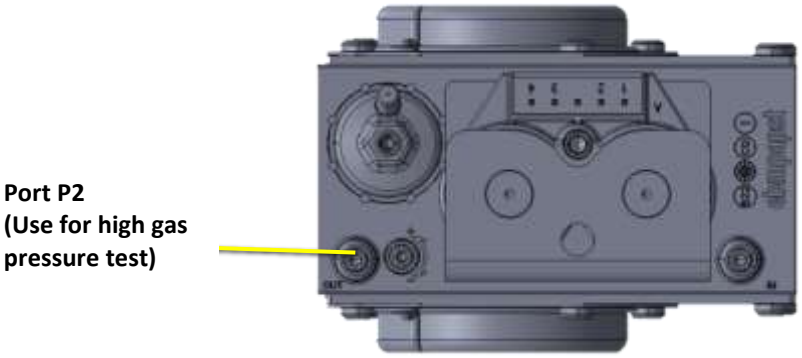


Figure 5-2: Manometer location for High Gas Pressure Test

1. Set the Controller's Enable/Disable switch to Disable.
2. Remove the front panel from the boiler to access the gas train components.
3. Open Port P2 of the gas valve, two turns counter-clockwise using an allen screw.
4. Connect manometer to Port P2 of the gas valve. See figure 5-1.
5. Close the gas train ball valve located between the Gas Valve and the Venturi (Figure 4-3).
6. Set the Controller's Enable/Disable switch to Enable.
7. On the Controller, Follow the path **Service > Manual Run**.
8. Press "Enable Manual Run" button. Press "Yes" to acknowledge "Enable Manual Run".
9. Use the Fire Rate slider or use the '+' or '–' icons to set the firing rate between 30-35%.
10. With the ball valve in step 5 still closed, when the gas valve opens, the unit should shut down and display ***LGP/HGP/HIGH TEMP*** at approximately the pressure shown in Table 5-3 (the pressure setting of the High Gas Pressure switch):

TABLE 5-3: HIGH Gas Pressure, ± 0.2" W.C. (± 50 Pa)		
Benchmark NX Model	**Natural Gas**	
BNX 399/500	2.0" W.C. (872 Pa)	

11. Fully open the ball valve that was closed in step 5, press the manual reset button on the High Gas Pressure switch and press the Controller's **CLEAR** button.
12. The fault message should clear, the **FAULT** indicator should go off, and unit should restart.
13. Upon test completion, remove the manometer from Port P2 of the gas valve.
14. Close Port P2 of the gas valve, turning clockwise using an allen screw.

5.4 Low Water Level Fault Test

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 unit. If necessary, open the relief valve to aid in draining.
4. Continue draining until ***Primary LWCO Level*** is displayed and the FAULT indicator flashes.
5. On the Controller, Follow the path **Service > Manual Run**.
6. Press "Enable Manual Run" button. Press "Yes" to acknowledge "Enable Manual Run".
7. Use the Fire Rate slider or use the '+' or '–' icons to set the firing rate between 30-35%.
8. Set **Enable/Disable** switch to **Enable**. The **READY** light should remain off and the unit should not start. If the unit starts, shut the unit off 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 shell is full, press **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 using the **Manual Reset Over-Temperature** switch.

1. Start the unit in the normal operating mode and allow the unit to stabilize at its setpoint.
2. On the Manual Reset Over-Temperature switch, note the current setting, then:
   a. Press the **Set** button two times, to activate a setting change.
   b. Use the **Down** arrow to lower the setting to a temperature ***below*** the Outlet temperature displayed on the Controller's front face (see Figure 5-3).
   c. Press the **Set** and **Down** arrow at the same time to save that temperature setting.



Figure 5-3: Over Temperature Limit Switch

3. Once the Manual Reset switch setting is just below the outlet water temperature, the unit should shut down, the **FAULT** indicator should flash, and a ***LGP/HGP/HIGH TEMP*** fault message should be displayed. It should not be possible to restart the unit.
4. On the Manual Reset Over-Temperature switch:
   a. Press the **Set** button two times, to activate a setting change.
   b. Use the **Up** arrow to return the switch to its original setting.
   c. Press the **Set** and **Down** arrow at the same time to save that temperature setting.
5. Press RST (Reset) button on Manual Reset switch and press Controller's CLEAR button.
6. The fault message should clear, the FAULT indicator should go off, and the unit should restart once the setting is above the actual outlet water temperature

5.6 Interlock Tests

The unit is equipped with two interlock circuits, the **Remote Interlock**, and **Delayed Interlock**. These circuits are connected to the I/O board's connector strip J9, labeled **Remote Interlock and Delayed Interlock** (see Section 2.12). These circuits can shut down the unit if an interlock is opened. These interlocks are shipped from jumpered (closed). However, they may be utilized in the field as a remote stop and start, emergency cut-off, or to prove that a pump, gas booster, or louver is operational.

5.6.1 Remote Interlock Test

1. Remove I/O Box cover and locate the **Remote Interlock** terminals on connector strip J9.
2. On the Controller, Follow the path Service > Manual Run.
3. Press "Enable Manual Run" button. Press "Yes" to acknowledge "Enable Manual Run".
4. Use the Fire Rate slider or use the '+' or '–' icons to set the firing rate between 30-35%.
5. If there is a jumper across the **Remote Interlock** 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.
6. The unit should shut down and the Controller should display ***Interlock Open***.
7. Once the interlock connection is reconnected, the ***Interlock Open*** message should automatically clear, and the unit should restart.

5.6.2 Delayed Interlock Test

1. Remove I/O Box cover and locate the **Delayed Interlock** terminals on connector strip J9.
2. On the Controller, Follow the path Service > Manual Run.
3. Press "Enable Manual Run" button. Press "Yes" to acknowledge "Enable Manual Run".
4. Use the Fire Rate slider or use the '+' or '–' icons to set the firing rate between 30-35%.
5. If there is a jumper across the **Delayed Interlock 1** terminals, remove one side. If the interlock is connected to an external device, disconnect one of the wires leading to the proving switch.
6. The unit should shut down and display a ***Delayed Interlock Open*** fault message.
7. Reconnect the wire or jumper removed in step 5 to restore the interlock.
8. Press the **CLEAR** button to reset the fault.
9. The unit should start.

5.7 Flame Fault Test

Flame faults can occur during ignition or while unit is running. To simulate fault conditions:

1. Set the Controller's Enable/Disable switch to Disable.
2. Remove the front panel from the boiler to access the gas train components.
3. Close the gas train's ball valve between the Gas Valve and the Venturi (Figure 4-3).
4. Jump out the High Gas Pressure switch.
5. Set the Controller's Enable/Disable switch to Enable.
6. On the Controller, Follow the path Service > Manual Run.
7. Press "Enable Manual Run" button. Press "Yes" to acknowledge "Enable Manual Run".
8. Use the Fire Rate slider or use the '+' or '–' icons to set the firing rate between 30-35%.
9. The unit should purge and when it reaches the ignition cycle, it will shut down and display ***Flame Loss During Ignition***.

10. Fully open the ball valve that was closed in step 3.
11. Press the manual reset button on the High Gas Pressure switch.
12. Press **CLEAR** button. The fault message should clear and **FAULT** indicator should go off.
13. Restart the unit and allow it to prove flame.
14. Once flame is proven, close the ball valve that was opened in step 10 *(Tip: close the valve relatively quickly – within 2 seconds, to avoid combustion oscillations)*.
15. The unit should shut down and display **Flame Loss During Run**.
16. Fully open the ball valve that was closed in step 14.
17. Press manual reset on the High Gas Pressure switch and remove jumper installed in step 4.
18. Press the Controller's **CLEAR** button. The fault message should clear, the **FAULT** indicator should go off. The unit should restart and fire.

5.8 Air Pressure Error Test

This test checks the operation of the **Blower**. This is accomplished by temporarily disconnecting the PWM signal to the Blower until **Air Pressure fault** occurs.

1. Start the unit in the normal operating mode and allow the unit to stabilize at its setpoint.
2. Remove the top panel from the boiler to access the blower.
3. Remove the Molex connector for the PWM signal – see Figure 5-4.

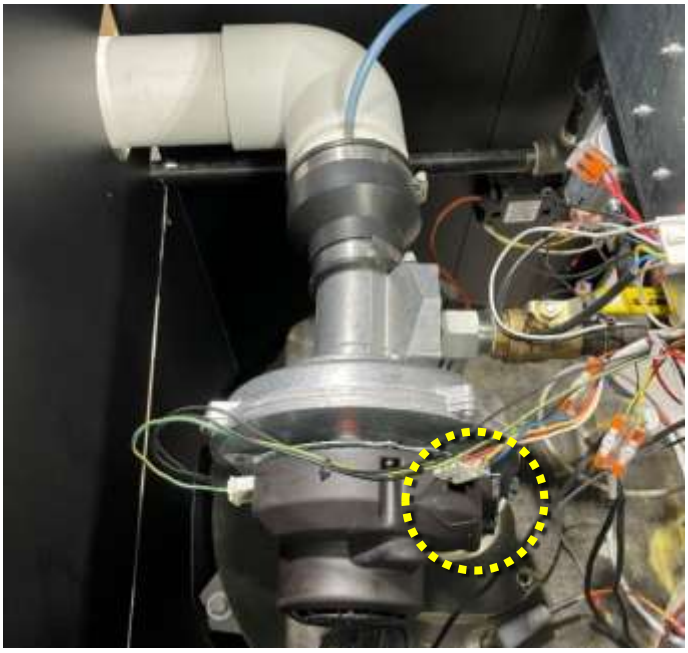


Figure 5-4: Molex Connector Location of PWM signal to Blower

4. The unit should shut down and display **Air Pressure Error**.
5. Reinstall the molex connector that was removed from step 3.
6. Press the Controller's **CLEAR** button. The fault message should clear, the **FAULT** indicator should go off. The unit should restart and fire.

5.9 Blocked Condensate Test

This test checks the operation of the **Blocked Condensate Level Switch**. This is accomplished by temporarily lifting the float switch until **Blocked Condensate** occurs.

1. Start the unit in the normal operating mode and allow the unit to stabilize at its setpoint.
1. Remove the front panel from the boiler to access the condensate trap.
2. Lift the cover of the condensate trap by removing the two thumbscrews – see Figure 5-5.

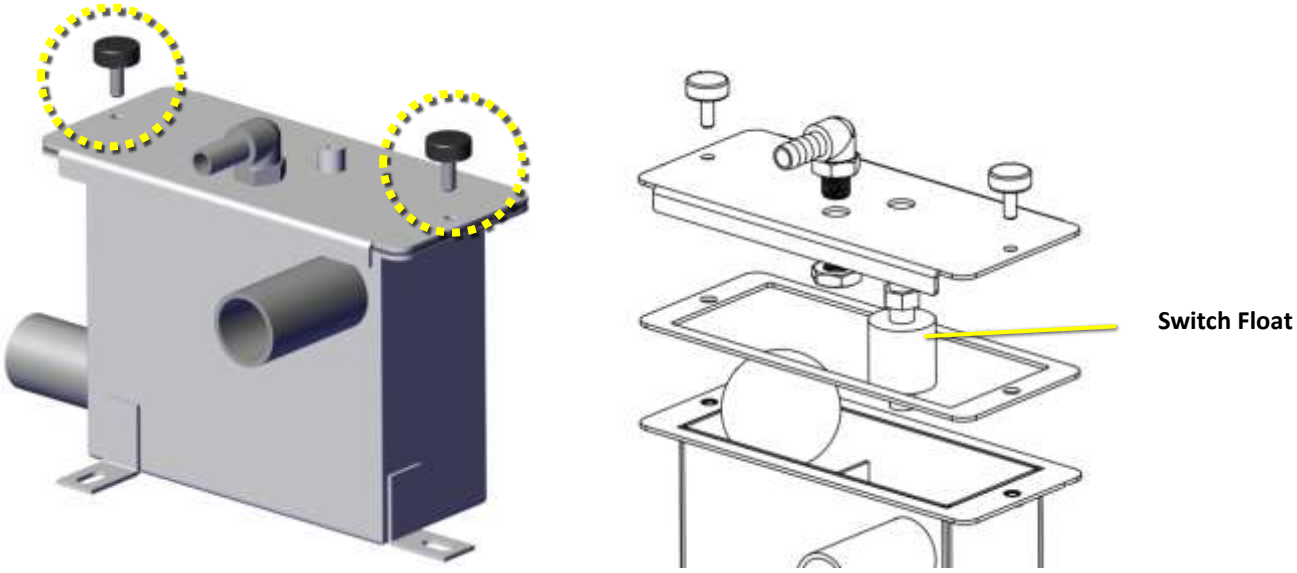


Figure 5-5: Remove Thumbscrews

3. While holding the cover over the body, lift switch float.
4. The unit should shut down and display **Blocked Condensate**.
5. Release the switch float.
6. The fault message should clear automatically and the **FAULT** indicator should go off. The unit should restart and fire.

5.10 Safety Pressure Relief Valve Test

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

SECTION 6: STANDALONE MODES OF OPERATION

Benchmark NX boilers are capable of operating in six different modes. The following sections provide descriptions of each of these operating modes. 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 specific application.

6.1 Outdoor Reset Mode

The **Outdoor Reset** mode of operation is based on outside air temperatures. As the outside air temperature decreases, the supply header temperature will increase and vice versa. For this mode, it is necessary to install an outside air sensor.

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 I/O board strip J19, terminals 15 (labeled *Outside Temp +)* and 5 (*Outside Temp –*). Use shielded 18 to 22 AWG wire for connections.

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.

1. As a prerequisite, verify that the unit is ***not*** a BST Client or Manager. Go to: **Settings>Advanced Setup>Cascade Mode>Cascade Settings>Cascade Configuration.** Toggle **Cascade Mode** off.
2. On the Controller, go to: **Settings>Advanced Setup>Standalone Mode>Application Settings (Application Configuration tab)**
3. Set Operating Mode = **Outdoor Air Reset**. The parameters that appear will be used to create a temperature curve to vary the active setpoint depending on the Outside Air Temperature (OAT).

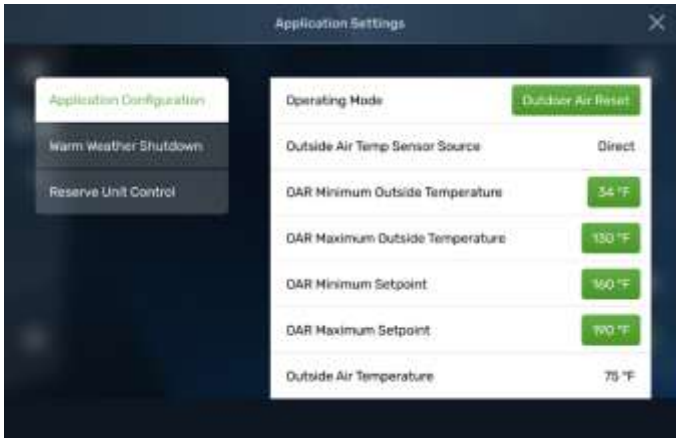


Figure 6-1: Application Configuration Screen

4. Set the following parameters to define the total outside air temperature span which will be used for Setpoint control.
   - **OAR Minimum 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 Maximum 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 Maximum Setpoint:** The maximum allowable setpoint (range = Min Setpoint up to 210°F (98.9°C)).
   - **OAR Minimum Setpoint:** The minimum allowable setpoint (range = 40°F (4.4°C) up to the Max Setpoint).
6. Set the **Warm Weather Standby** (WWS) 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 200°F (4.4°C to 93.3°C).

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

1. As a prerequisite, verify that the unit is ***not*** a BST Client or Manager. Go to: **Settings>Advanced Setup>Cascade Mode>Cascade Settings>Cascade Configuration**. Toggle **Cascade Mode** off.
2. On the Controller, go to: **Settings>Advanced Setup>Standalone Mode>Application Settings (Application Configuration tab)**
3. Set Operating Mode = **Constant Setpoint**.
4. Enter the desired **Setpoint**.

6.3 Remote Setpoint Mode

The 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:** For field wiring instructions, refer to:
> OMM - 0173: Edge X Communication Guide for Systems Integrators
> OMM - 0170: Edge X Operation Manual

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.

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

1. As a prerequisite, verify that the unit is ***not*** a BST Client or Manager. Go to: **Settings>Advanced Setup>Cascade Mode>Cascade Settings>Cascade Configuration**. Toggle **Cascade Mode** off.
2. On the Controller, go to: **Settings>Advanced Setup>Standalone Mode>Application Settings** (**Application Configuration tab**).
3. Set Operating Mode = **Remote Setpoint**
4. Select Setpoint Source: **BAS** or **Analog Input**.

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.

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 Controller. It has its own sophisticated PID control system designed to simultaneously control the light off and modulation of **up to 16 Benchmark NX 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 Boiler Modulation Rate (Fire Rate). Operating all boilers below the defined Next On Modulation Rate ensures that they are firing at their most efficient Fire Rate. One unit in 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 Manager will light off the lead boiler. The Controller shall have a lead-lag priority by run hours. Lowest run hour unit becomes the lead and runs first. When the Run Hours of the Lead unit exceeds the Run Hours of the Lag Unit by the Lead/Lag Hours item entry, the BST will cycle down the Lead unit to send it into standby and search for a new Lead unit to fire up in its place. A piping diagram of multiple Boilers connected to a BST is shown in Figure 7-1 below.

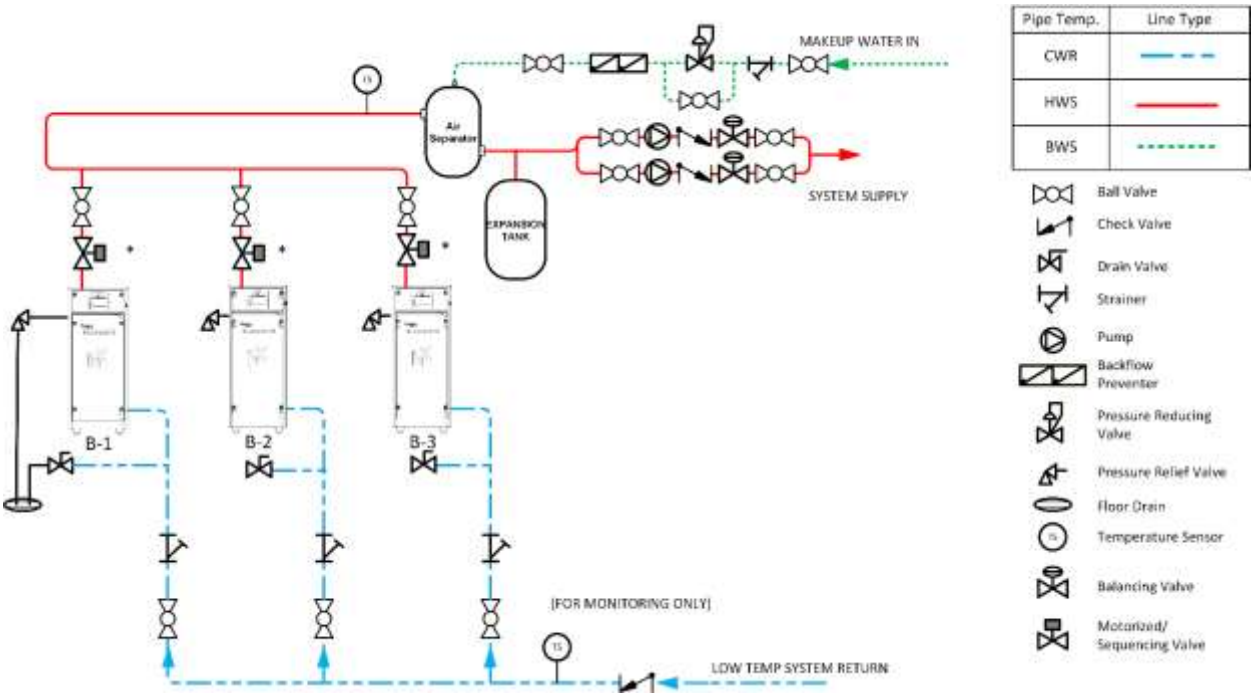


Figure 7-1: Piping Diagram – Multiple Boilers

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 Controller will open the isolation valves for all the boilers.

The BST setup options are:

1. Constant Setpoint
2. Remote Setpoint, which includes two options:
   - Analog Input (4-20mA, 0-20mA, 1-5V, or 0-5V)
   - BAS Mode
3. Outdoor Air Temperature Reset

7.2 BST Implementation Instruction

The instructions below refer to I/O board connections on the Benchmark boilers, as described in Figure 7-2.

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

- Header Temp Sensor P/N **61058 (PT1000)** dual bead
- Outdoor Sensor P/N **61060 (PT1000)**

The wiring diagram below applies to the setup instructions in the next three sections.

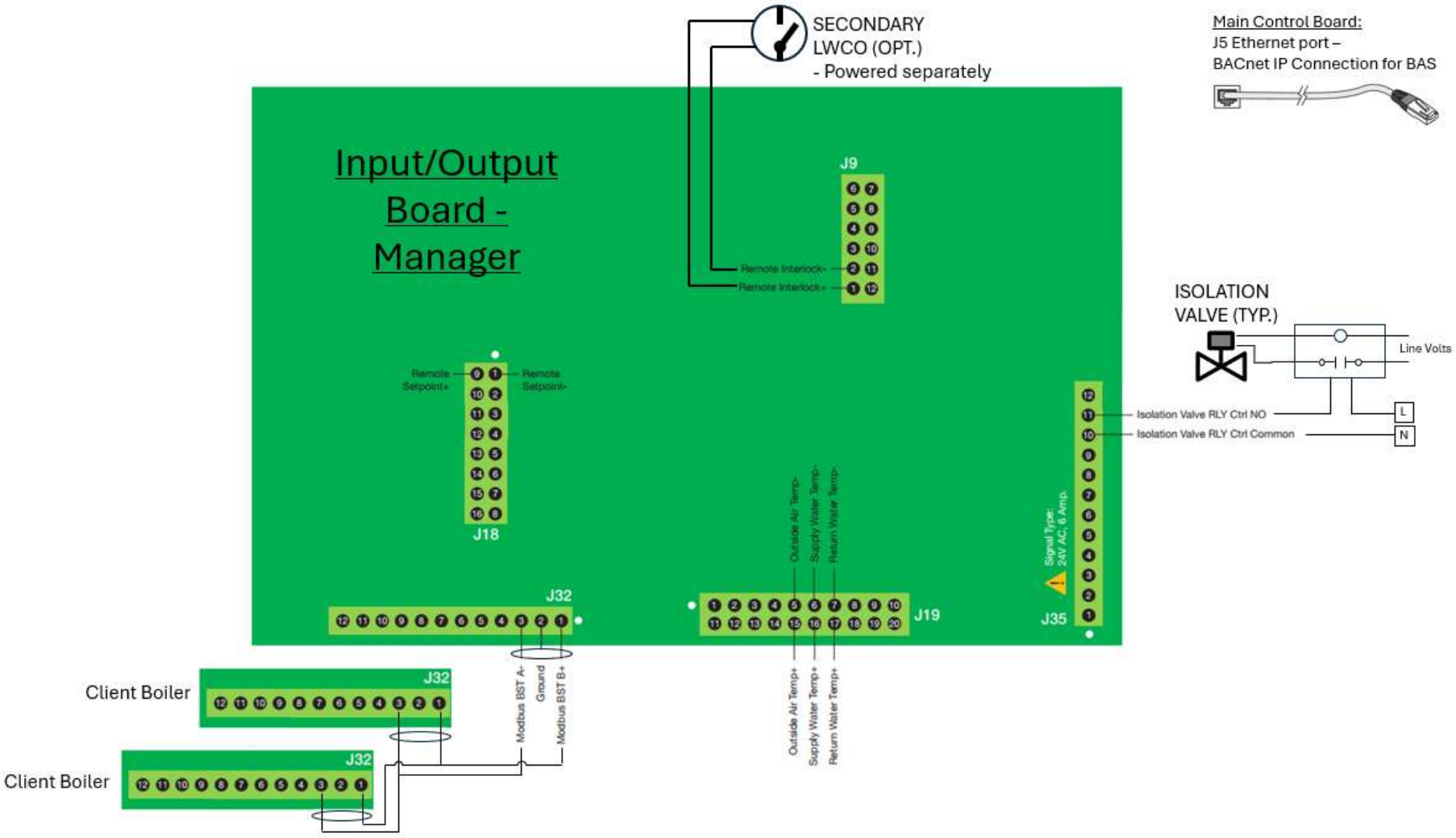


Figure 7-2: BST, BAS and Field Wiring

7.2.1 BST Setup: Constant Setpoint

Complete the instructions below to configure the Controller for **Constant Setpoint**.

1. Go to: **Main Menu > Advanced Setup > Cascade Mode > Cascade Settings > Cascade Configuration** menu:
   - Toggle **Cascade Mode** to On
   - **Unit Role:** select **Manager**
   - **Max Cascade Units:** Enter the number of units in cascade
   - **Unit Start Address:** Enter the unit start address for the cascade, **1** up to the total number of units in the cascade; for example, **1**.
   - **Unit End Address:** Enter the unit end address for the cascade, up to the total number of units in the cascade; for example, **3.**
   - **Manager Address:** Enter the manager address.

   Note: Set up all Client units and enter the **Client Address** for each.
2. Go to: **Main Menu > Advanced Setup > Cascade Mode > Cascade Settings > Cascade Failsafe** menu:
   - **Cascade Failsafe Mode**: The Manager's operating mode if there is a loss of communication between the Manager and Client units, or to the BAS or external signal/sensor, such as an outdoor sensor (default = **Constant Setpoint**).
   - **Cascade Failsafe Setpoint** (only if **Cascade Failsafe Mode** = **Constant Setpoint)**: Specify the Setpoint for all units in the cascade.
3. Go to: **Main Menu > Advanced Setup > Cascade Mode > Cascade Settings > Lead-Lag** menu:
   - **Hours:** When the Run Hours of the Lead unit exceeds the Run Hours of the Lag Unit by this number, the BST will cycle down the Lead unit to send it into standby and search for a new Lead unit to fire up in its place.
4. Go to: **Main Menu > Advanced Setup > Cascade Mode > Application Settings > Application Configuration** menu:
   - **Operating Mode:** Choose **Constant Setpoint**
   - **Setpoint:** Enter the desired setpoint value

7.2.2 BST Setup: Remote Setpoint

Complete the instructions below to configure the Controller for **Remote Setpoint**.

1. Go to: **Main Menu > Advanced Setup > Cascade Mode > Cascade Settings > Cascade Configuration** menu:
   - Toggle **Cascade Mode** to On
   - **Unit Role:** select **Manager**
   - **Max Cascade Units:** Enter the number of units in cascade
   - **Unit Start Address:** Enter the unit start address for the cascade, **1** up to the total number of units in the cascade; for example, **1**.
   - **Unit End Address:** Enter the unit end address for the cascade, up to the total number of units in the cascade; for example, **3.**
   - **Manager Address:** Enter the manager address.

   NOTE: Set up all Client units and enter the **Client Address** for each.

2. Go to: Main Menu > Advanced Setup > Cascade Mode > Cascade Settings > Cascade Failsafe menu:
   - **Cascade Failsafe Mode**: The Manager's operating mode if there is a loss of communication between the Manager and Client units, or to the BAS or external signal/sensor, such as an outdoor sensor (default = **Constant Setpoint**).
   - **Cascade Failsafe Setpoint** (only if **Cascade Failsafe Mode** = **Constant Setpoint)**: Specify the Setpoint for all units in the cascade.
3. Go to: Main Menu > Advanced Setup > Cascade Mode > Cascade Settings > Lead-Lag menu:
   - **Hours:** When the Run Hours of the Lead unit exceeds the Run Hours of the Lag Unit by this number, the BST will cycle down the Lead unit to send it into standby and search for a new Lead unit to fire up in its place.
4. Go to: Main Menu > Advanced Setup > Cascade Mode > Application Settings > Application Configuration menu:
   - **Operating Mode:** Choose **Remote Setpoint**
   - **Setpoint Source:** Choose the source of the setpoint – **BAS** or **Analog Input.** If **Analog Input** is selected, The following additional parameters will appear:
     - **Signal Type**: Choose **Voltage** or **Current**
     - **Setpoint Minimum Signal**: Enter the minimum value of the chosen signal type (voltage or current)
     - **Setpoint Maximum Signal**: Enter the maximum value of the chosen signal type (voltage or current)
     - **Setpoint Signal Timeout**: If analog signal is lost, after the programmed value of this signal timeout, the screen will display alert of lost setpoint signal. If the Communication failsafe is enabled and set to Constant Setpoint the boiler will operate in failsafe Constant Setpoint until connection with the setpoint source is reestablished.
     - **Setpoint Minimum Limit**: Enter the temperature corresponding to the Setpoint Minimum Signal
     - **Setpoint Maximum Limit**: Enter the temperature corresponding to the Setpoint Maximum Signal

7.2.3 BST Setup: Outdoor Air Temperature Reset

Complete the instructions below to configure the Controller for **Outdoor Air Temp Reset**.

1. Go to: Main Menu > Advanced Setup > Cascade Mode > Cascade Settings > Cascade Configuration menu:
   - Toggle **Cascade Mode** to On
   - **Unit Role:** select **Manager**
   - **Max Cascade Units:** Enter the number of units in cascade
   - **Unit Start Address:** Enter the unit start address for the cascade, **1** up to the total number of units in the cascade; for example, **1**.
   - **Unit End Address:** Enter the unit end address for the cascade, up to the total number of units in the cascade; for example, **3.**
   - **Manager Address:** Enter the manager address.

     NOTE: Set up all Client units and enter the **Client Address** for each.

2. Go to: **Main Menu > Advanced Setup > Cascade Mode > Cascade Settings > Cascade Failsafe** menu:
   - **Cascade Failsafe Mode**: The Manager's operating mode if there is a loss of communication between the Manager and Client units, or to the BAS or external signal/sensor, such as an outdoor sensor (default = **Constant Setpoint**).
   - **Cascade Failsafe Setpoint** (only if **Cascade Failsafe Mode** = **Constant Setpoint)**: Specify the Setpoint for all units in the cascade.
3. Go to: **Main Menu > Advanced Setup > Cascade Mode > Cascade Settings > Lead-Lag** menu:
   - **Hours:** When the Run Hours of the Lead unit exceeds the Run Hours of the Lag Unit by this number, the BST will cycle down the Lead unit to send it into standby and search for a new Lead unit to fire up in its place.
4. Go to: **Main Menu > Advanced Setup > Cascade Mode > Application Settings > Application Configuration** menu:
   - **Operating Mode:** Choose **Outdoor Air Reset**
   - **OAR Minimum Outside Temperature:** Specifies the minimum outside air temperature the system will read; it interacts with the OAR Maximum Setpoint. For example, if OAR Minimum Outside Temperature is set to -5°F and OAR Maximum Setpoint is 180°F, when the outside temperature is -5°F or below, the system will supply 180°F.
   - **OAR Maximum Outside Temperature:** 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 Minimum Outside Temperature setting.
   - **OAR Minimum Setpoint:** The minimum allowable setpoint.
   - **OAR Maximum Setpoint:** The maximum allowable setpoint

SECTION 8:RECOMMENDED MAINTENANCE SCHEDULE

8.1 Maintenance Schedule

For maximum efficiency and reliability, the following routine maintenance should be performed in the time periods specified. For a complete inspection check list see ASME CSD-1 chart.

⚠ WARNING!

- Follow all Lockout/Tagout protocols in effect at the site.
- Disconnect AC power 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 MONS.	12 MOS.	24 MOS.	LABOR TIME
8.2	Igniter	Inspect	Inspect/replace	Replace	15 mins.
8.3	Flame Detector	Inspect	Inspect/replace	Replace	15 mins.
4.7	Combustion Calibration	Check	Check		1 hr.
8.4	Test Safety Devices		See ASME CSD-1 Chart		45 mins.
8.5	Burner			Inspect	2 hrs.
8.6	Condensate Drain Trap	Check	Inspect/clean/ replace gaskets	Inspect/clean/ replace gaskets	30 mins.
2.6	Water Quality		Verify		
8.9	Periodic Testing	Routine verification of functionality, various schedule			

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

To perform maintenance tasks in Table 8-1, the following kits are available from AERCO. All kits include 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
399/500	58245-1	Igniter, Flame Rod, Condensate trap gasket	TID-0294

TABLE 8-2b: 24 Month Maintenance Kits

Model	Kit#	Parts Serviced/Replaced – Includes all 12 Month Parts	Doc Name
399/500	58245-2	Burner & Blower gaskets,	TID-0295

8.2 Igniter

The igniter 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 58245-1 and 24 Month Maintenance Kit 58245-2.

The igniter may be hot; therefore, care should be exercised to avoid burns. It is easier to remove the igniter from the unit after the unit has cooled to room temperature. See Figure 8-1.

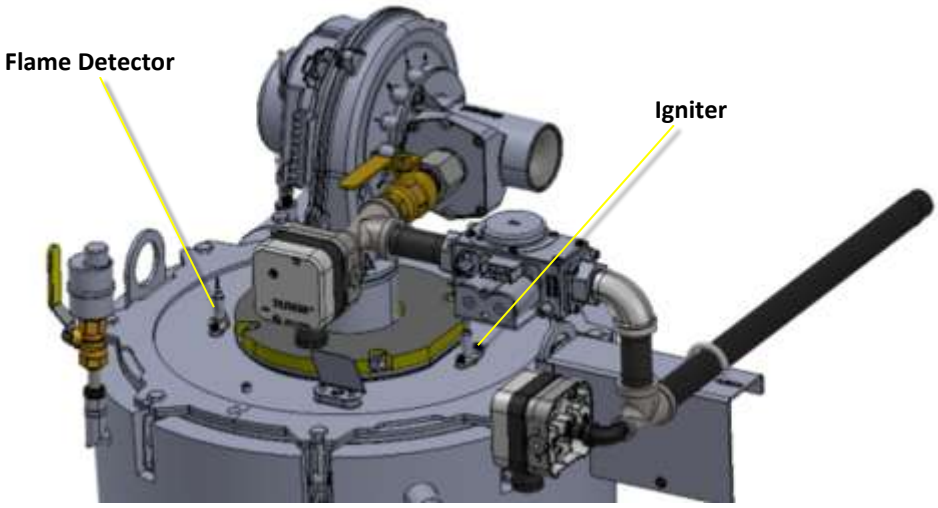


Figure 8-1: Flame Detector and Igniter Locations

8.3 Flame Detector

The flame detector is located on the burner plate at the top of the unit (see Figure 8-1, above). Parts and instructions are included in 12 Month Maintenance Kit P/N 58245-1 and 24 Month Maintenance Kit 58245-2. 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.

8.4 Safety Device Testing

Systematic and thorough tests of the operating and safety devices should be performed to ensure that they are operating as designed. Certain code requirements, such as ASME CSD-1, require that these tests be performed on a scheduled basis. Test schedules must conform to local jurisdictions. The results of the tests should be recorded in a logbook. See Section 5: Safety Device Testing in this guide for a description and instructions for performing these tests.

8.5 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 two burner plate gaskets and blower gaskets and 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.

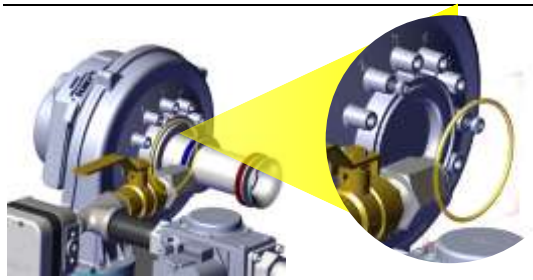


Figure 8-2: Blower O-Ring P/N 59379

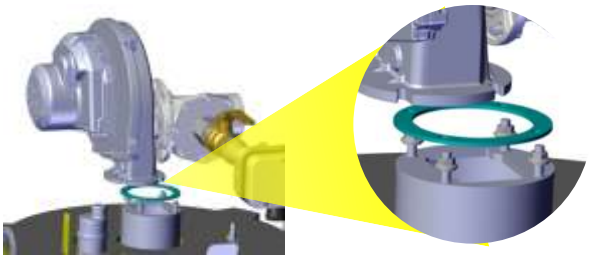


Figure 8-3: Blower Gasket P/N 81269

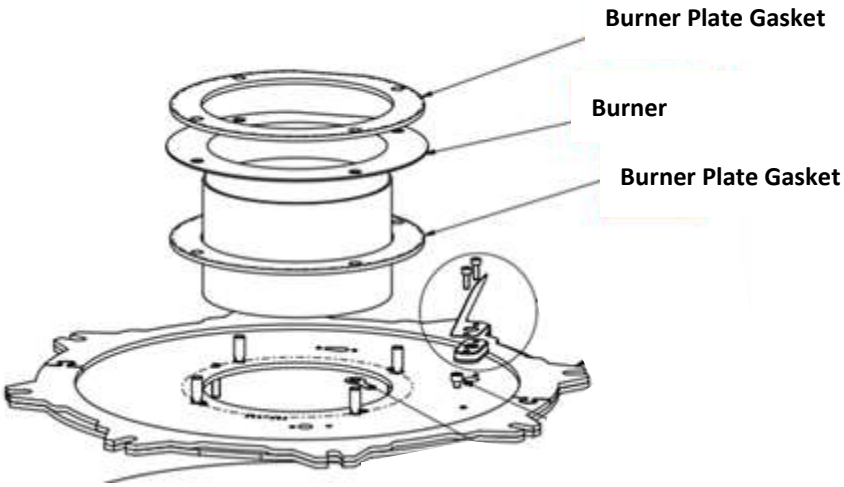


Figure 8-4: Burner Assembly

8.6 Condensate Drain Trap

All Benchmark NX boilers contain an internal condensate trap (P/N 24819) attached to the exhaust manifold's drain. This trap must be inspected and cleaned to ensure the float is free to move and condensate flows normally. The gasket (P/N 81268 included in the 24-Month Maintenance Kit) should be replaced if it is worn or damaged.

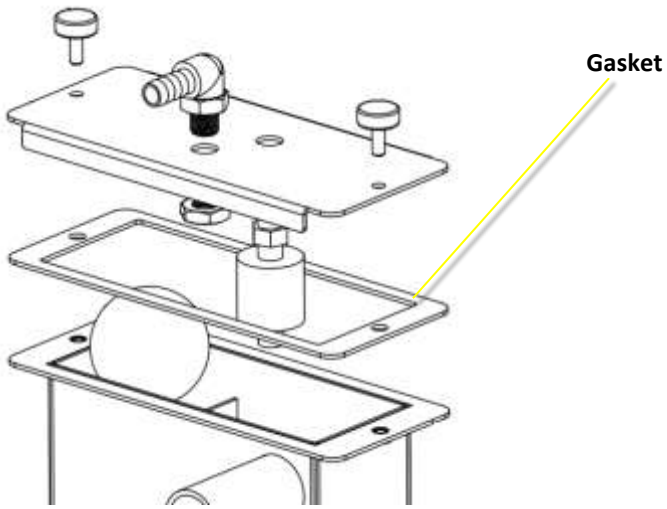


Figure 8-5: Condensate Drain Tap (Exploded View)

8.7 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.

1. Set Enable/Disable switch on front panel to **Disable** to shut down 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 may get below freezing **for even a short time** you must drain ***all*** water from the unit. Step 6 is not sufficient, as it leaves some water in the bottom of the heat exchanger chamber. You must 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 temperature falls below freezing, failure to drain all water can cause heat exchanger tubes to fail. Freeze damage can rupture or damage boiler components. Do not return a boiler that has been exposed to freezing conditions to service unless it has been inspected and tested for damage by qualified personnel in accordance to National Board Inspection Code (NBIC) and local jurisdiction.

8.8 Returning Boiler to Service After Prolonged Shutdown

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

1. Review installation requirements in the Benchmark Edge Installation Manual (OMM-0136).
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 and all scheduled procedures described in Section 8.

8.9 Recommended Periodic Testing

WARNING!

The owner or user of 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 logbook.

TABLE 8-3: Recommended Periodic Testing

ITEM	FREQUENCY	ACTION BY	REMARKS
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)
Flue, vent, stack and intake air duct	Monthly	Operator	Visually inspection condition and check for obstructions
Spark Igniter	Weekly	Operator	See Section 8.2: *Igniter* of this guide.
Gas valve check	Annually	Service Tech	Check gas safety shut-off valves for proper operation and tightness.
Flame failure	Weekly	Operator	See Section 5.7: *Flame Fault Test* of this guide.
Flame signal strength	Weekly	Operator	Check flame strength in the Edge 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.
Low air flow	Monthly	Operator	See Section 5.8: *Air Pressure Error Test.*
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.
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 8.5: *Burner Inspection* in this guide.
Condensate Trap	Semi-Annually	Operator	See Section 8.6: *Condensate Drain Trap* in this guide.

SECTION 9: TROUBLESHOOTING

9.1 Introduction

This section is to aid service/maintenance personnel in isolating the cause of a fault in your Benchmark boiler. The procedures below are presented in tabular form on the following pages.

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

1. Observe the fault messages displayed on the Edge Controller.
2. Refer to the Fault Indication column in Troubleshooting Table 8-1, 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.

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
AIR PRESSURE	Blocked blower inlet or inlet ductwork.	Inspect inlet to combustion blower including any ductwork leading to blower for blockage.
	Defective Blower	During blower purge periods blower operation is not sensed. Check incoming power to blower for voltage.
BLOCKED CONDENSATE	Condensate path is blocked.	Check condensate drain is piped correctly and free of obstruction.
	Condensate float has malfunctioned.	Inspect the condensate trap float mechanism to make sure it moves freely.
BLOWER SPEED BELOW MINIMUM	Blower feedback to PIM is not being read	Verify tachometer signal and connection on **J10 of the PIM Controller**.
BTC-PIM ID CARD ERROR	Original card is replaced with an incorrect card or has been disconnected from the PIM control board	Check that the proper ID card is securely connected. Perform a power and system reset.
DELAYED INTERLOCK OPEN	Delayed Interlock Jumper not installed or missing.	Ensure jumper is properly installed across the Delayed Interlock terminals in the I/O Box.
	Device proving switch hooked to interlocks is not closed.	If there are 2 external wires on these terminals, check if an end switch for a proving device (such as a pump, louver, etc.) is tied to the interlocks. Ensure the device and/or its end switch is functional. A jumper may be temporarily installed to test the interlock.
EXHAUST TEMP HIGH	The Exhaust Temperature has exceeded 200°F (93.3°C).	Check for a blocked flue
	Poor combustion calibration.	Check combustion calibration using procedures in Section 4.4: *Combustion Calibration* of this guide.
	Carboned heat exchanger due to incorrect combustion calibration.	If exhaust temperature is greater than 200° F (93.3°C), check combustion calibration. Calibrate or repair as necessary.
EXHAUST TEMP SENSOR FAULT	Exhaust Temp Sensor is not connected or malfunctioned.	Check the vent sensor and connections.
FLAME LOSS DURING IGNITION	Worn Flame Detector.	Remove and inspect the Flame Detector for signs of wear. Replace if necessary.
	No spark from Spark Igniter.	Close the internal gas valve in the unit. Install and arc a spark igniter outside the unit.
	Defective Ignition Transformer.	If there is no spark, check for 120VAC at the primary side to the ignition transformer during the ignition cycle.

TABLE 9-1: Boiler Troubleshooting Procedures

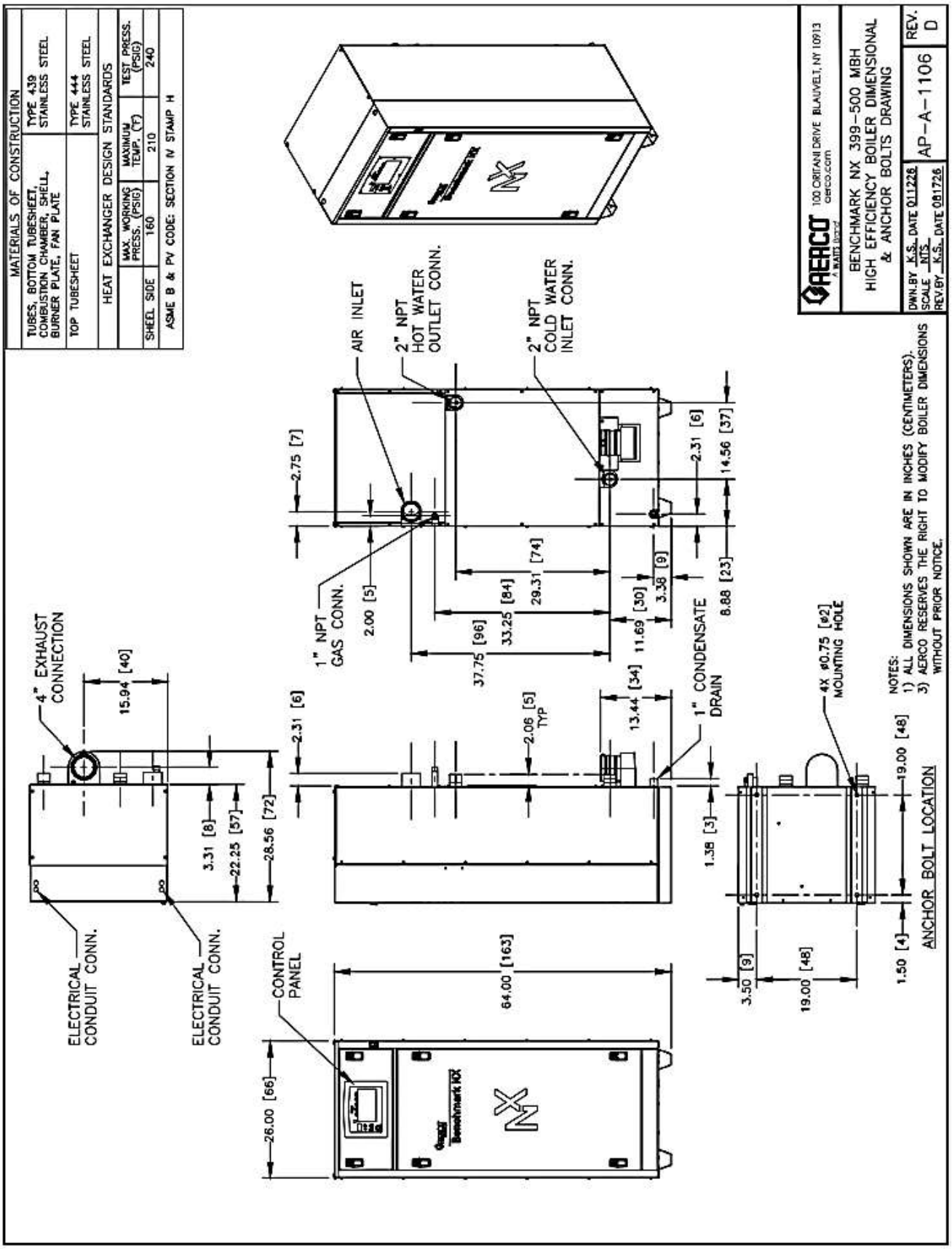
Fault	Probable Causes	Corrective Action
FLAME LOSS DURING RUN	Worn Flame Detector or cracked ceramic.	Remove and inspect the Flame Detector for signs of wear or cracked ceramic. Replace if necessary.
	Poor combustion calibration.	Check combustion calibration using procedures in Section **4.5 of this guide.**
FTBUS COMMUNICATION	Communication error on FTBus	Verify the BTC II is connected and operating. Check the cable between the BTC II and **J4 of the PIM Controller.**
HIGH TEMP LIMIT CONTROL OPEN	High Limit Temp Sensor is not connected or malfunctioned.	Check the high limit and outlet sensor and connections
HIGH WATER TEMP FAULT	Temp measured by High Limit Sensor exceeded Temp Hi Limit.	Check for proper water flow. Check high limit and outlet sensors.
INLET TEMP SENSOR FAULT	Inlet Water Temp Sensor is not connected or malfunctioned.	Check the inlet sensor and connections
LGP/HGP/HIGH TEMP	Insufficient supply gas pressure.	Measure gas pressure at **(need to know from Engr where gas pressure is measured)** with the unit firing, making sure it is greater than the Low Gas Pressure Switch setting in Table 5-1.
	Defective Low Gas Pressure switch.	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 5-1, measure continuity across the switch and replace if necessary.
	Gas pressure to Burner is too high	Check to ensure gas pressure at **(need to know from Engr where gas pressure is measured) is less than the High Gas Pressure switch setting in Trable 5-2**
	Defective **High Gas Pressure** switch.	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.
	Faulty Water temperature switch.	Test the temperature switch to ensure it trips at its actual water temperature setting.
	System flow rate changes are occurring faster than units can respond.	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.
OAT SENSOR OPEN	Loose or broken wiring.	Inspect Outdoor Temperature sensor for loose or broken wiring.

TABLE 9-1: Boiler Troubleshooting Procedures

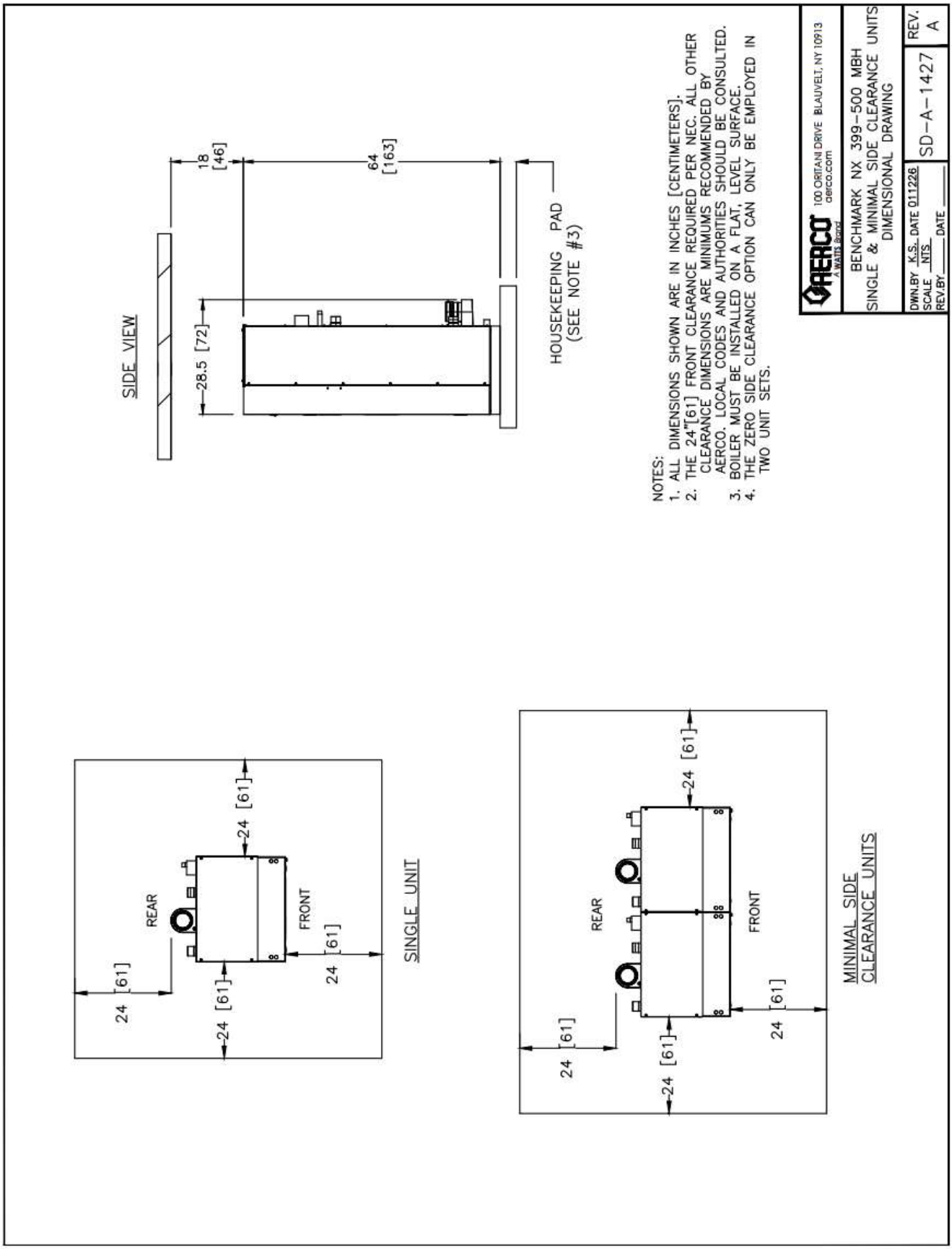
Fault	Probable Causes	Corrective Action
OAT SENSOR SHORT	Defective Sensor.	Check resistance of sensor to determine if it is within specification.
	Incorrect Sensor.	Ensure that the correct sensor is installed.
OUTLET TEMP SENSOR FAULT	Outlet Water Temp Sensor is not connected or malfunctioned.	Check the outlet sensor and connections
PIM INTERNAL FAILURE	The PIM control board may have failed.	Replace the control board if manually resetting the control does not correct the fault.
PRIMARY LOW WATER LEVEL	Insufficient water level in system.	Check system for sufficient water level.
	Defective water level circuitry.	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.
	Defective water level probe.	Check continuity of probe end to the shell, change probe if there is no continuity.
REMOTE INTERLOCK OPEN	Interlock jumper not installed or removed.	Check for a jumper properly installed across the interlock terminals in the I/O box.
	Energy Management System does not have unit enabled.	If there are two external wires on terminals, check any Energy Management system to see if units are disabled (a jumper may be temporarily installed to see if the interlock circuit is functioning).
	Device proving switch hooked to interlocks is not closed.	Check that proving switch for any device hooked to the interlock circuit is closing and that the device is operational.
REMOTE PROOF	Proving switch of ancillary equipment not closing.	The remote proving circuit, when used, is designed to check for the operation of ancillary mechanical room equipment such as a fresh air damper or flow switch. Check for the proper function and correct wiring of such equipment
REMOTE SETPT SIGNAL FAULT	Remote setpoint signal not present:	Check I/O Box to ensure signal is hooked up.
	Not yet installed.	Hook up if not installed.
	Wrong polarity.	If installed, check polarity.
	Signal defective at source.	Measure signal level.
	Broken or loose wiring.	Check continuity of wiring between source and unit.
	Signal is not isolated (floating) if 4 to 20 mA.	Check signal at source to ensure it is isolated.

TABLE 9-1: Boiler Troubleshooting Procedures		
Fault	**Probable Causes**	**Corrective Action**
	Edge Controller signal type selection switches not set for correct signal type (voltage or current).	Check DIP switch on PMC board to ensure it is set correctly for signal being sent. Check control signal type set in the **Remote Signal** parameter (**Advanced Setup→ Unit → Application Configuration**).
RESIDUAL FLAME	Gas valve not fully closed, which propagates a flame after the call for heat cycle has ended.	Check for leakage through the gas valve. If no mechanical cause can be found, replace flame control.

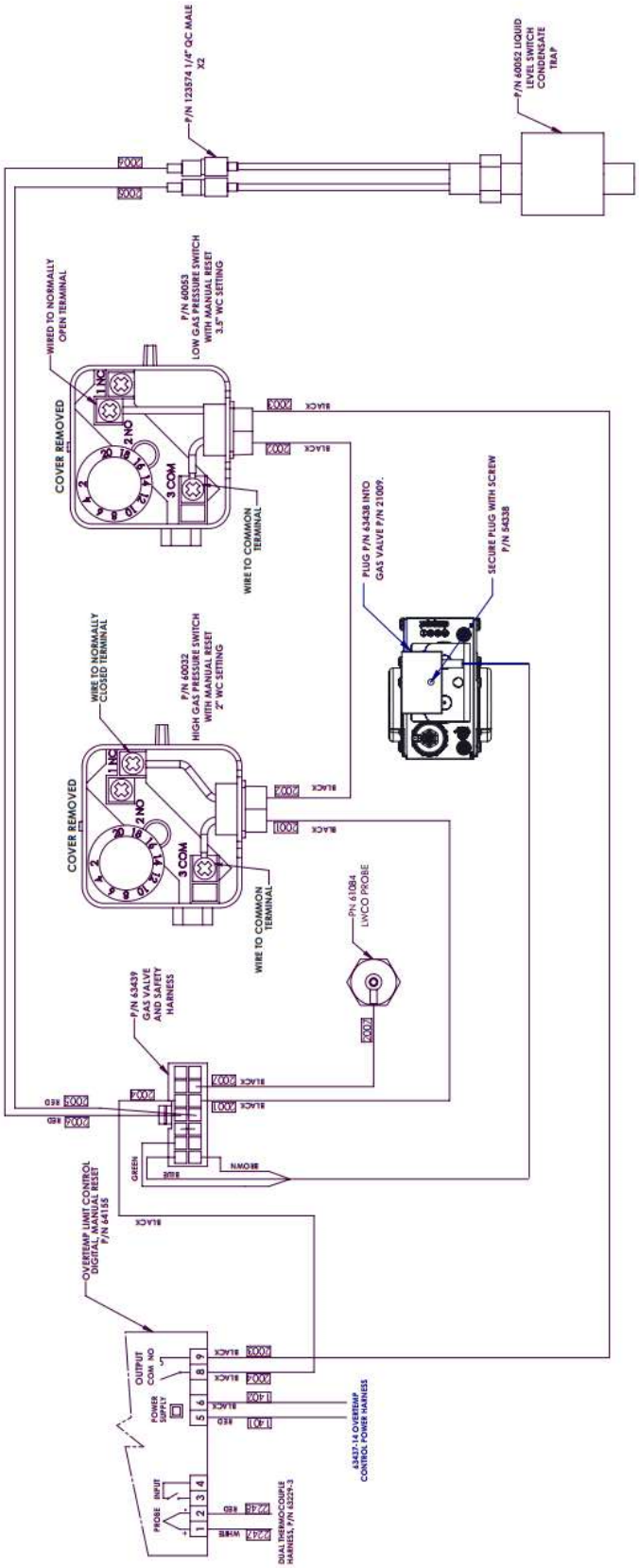
Appendix A: Dimensional and Clearance Drawings



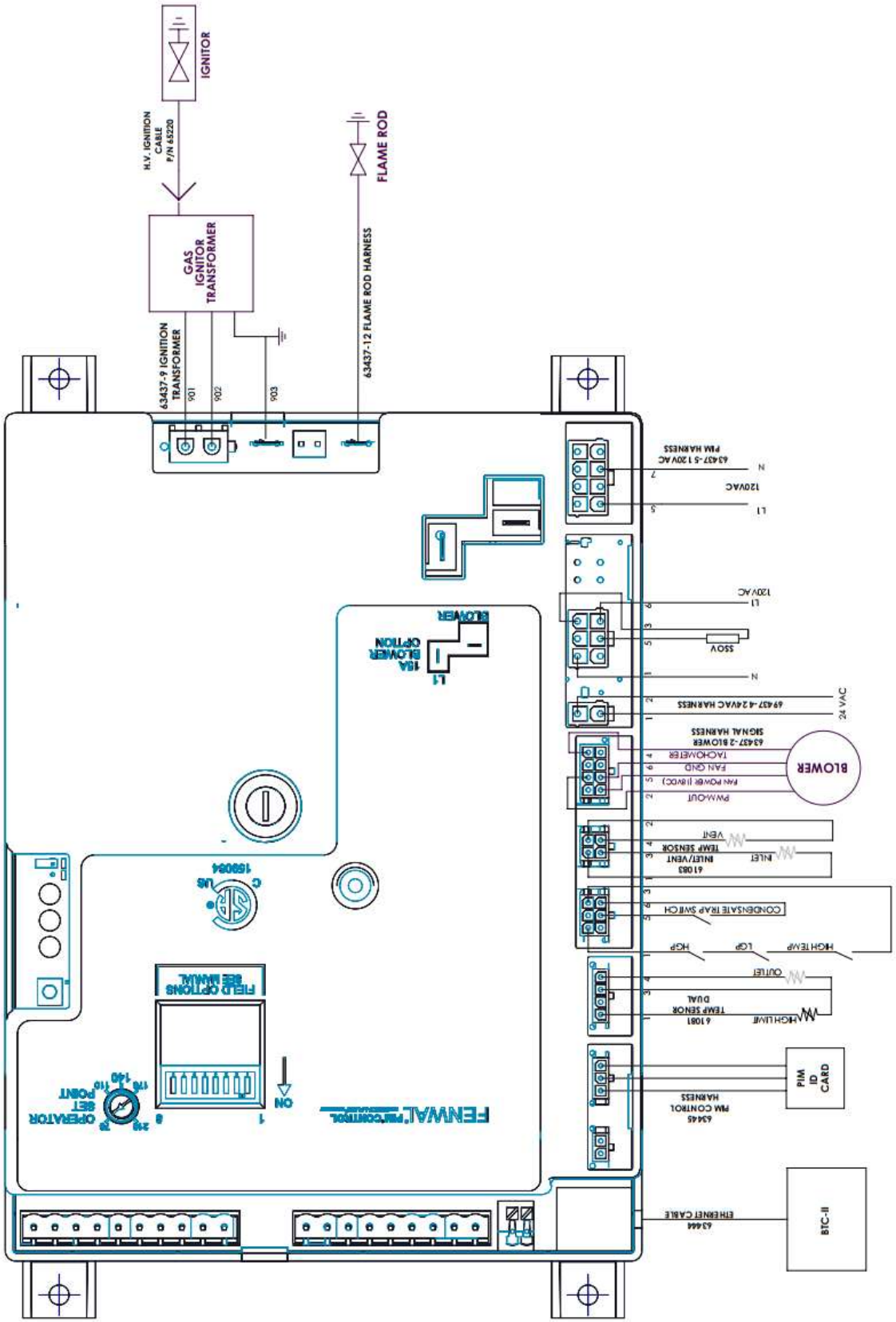
Benchmark NX 399/500 Dimension Drawing AP-A-1106



Benchmark NX 399/500 Clearances Drawing SD-A-1427



Wiring Diagram: Safety and Gas Valve Wiring



Wiring Diagram: PIM Control

© AERCO International, Inc., 2026