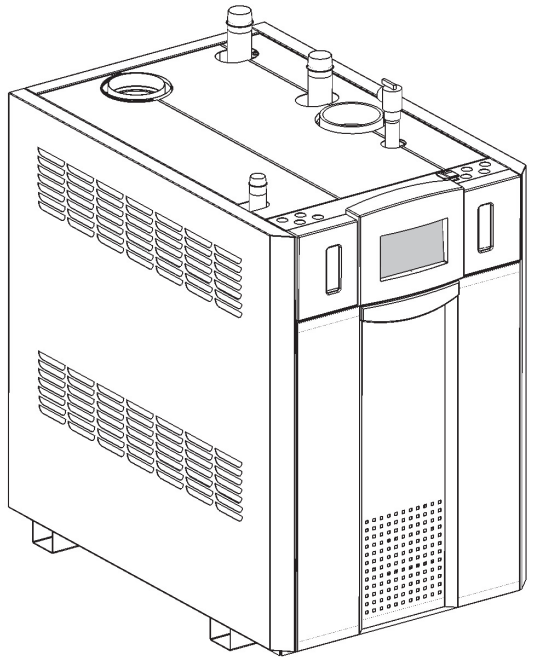


Installation and Operation Instructions for

Brute™

with Touchscreen Display

Modulating Boiler
Model BNTH
Sizes 285–850 MBTU/h

Water Heater
Model BNTV
Sizes 150–850 MBTU/h

FOR YOUR SAFETY: This product must be installed and serviced by a professional service technician, qualified in hot water boiler and heater installation and maintenance. Improper installation and/or operation could create carbon monoxide gas in flue gases which could cause serious injury, property damage, or death. Improper installation and/or operation will void the warranty.

⚠WARNING

If the information in this manual is not followed exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS

- **Do not try to light any appliance.**
- **Do not touch any electrical switch; do not use any phone in your building.**
- **Immediately call your gas supplier from a nearby phone. Follow the gas supplier's instructions.**
- **If you cannot reach your gas supplier, call the fire department.**

Installation and service must be performed by a qualified installer, service agency, or gas supplier.

⚠AVERTISSEMENT

Assurez-vous de bien suivres les instructions données dans cette notice pour réduire au minimum le risque d'incendie ou d'explosion ou pour éviter tout dommage matériel, toute blessure ou la mort.

Ne pas entreposer ni utiliser d'essence ni d'autres vapeurs ou liquides inflammables dans le voisinage de cet appareil ou de tout autre appareil.

QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ:

- **Ne pas tenter d'allumer d'appareils.**
- **Ne touchez à aucun interrupteur. Ne pas vous servir des téléphones dansle bâtiment où vous vous trouvez.**
- **Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.**
- **Si vous ne pouvez rejoindre le fournisseur de gaz, appelez le sservice des incendies.**

L'installation et l'entretien doivent être assurés par un installateur ou un service d'entretien qualifié ou par le fournisseur de gaz.

H2374700-

BRADFORD WHITE®

Table of Contents

Section 8 - Navigating the Touch Screen

Section 9 First Start Up and Adjustment

Section 10 Maintenance

Section 11 Troubleshooting

Section 12 Replacement Parts

Section 1 - GENERAL INFORMATION

⚠WARNING

Brute units **must** be installed in accordance with the procedures detailed in this manual, or the Bradford White warranty will be voided. The installation must conform to the requirements of the local jurisdiction having authority, and, in the United States, to the latest edition of the National Fuel Gas Code, ANSI Z223.1/ NFPA54. In Canada, the installation must conform to the latest edition of CSA B149.1 Natural Gas and Propane Gas Installation Code, and/or local codes. Where required by the authority having jurisdiction, the installation of Brute boilers must conform to the Standard for Controls and Safety Devices for Automatically Fired Boilers, ANSI/ASME CSD-1. Any modifications to the boiler, its gas controls, or wiring may void the warranty. If field conditions require modifications, consult the factory representative before initiating such modifications.

1.1 Introduction

This manual provides information necessary for the installation, operation, and maintenance of Bradford White Brute appliances. Read it carefully before starting the installation.

All application and installation procedures should be reviewed completely before proceeding with the installation. Consult the Bradford White factory, or local factory representative, with any problems or questions regarding this equipment. Experience has shown that most operating problems are caused by improper installation.

Brute is protected against over pressurization. A pressure relief valve is included with each Brute. Some Brutes may require that the PRV be installed prior to filling the system. Refer to Figures 1-7 for PRV locations.

⚠ DANGER

The inlet gas pressure to the appliance must not exceed 13" W.C. (3.2kPa).

All installations must be made in accordance with 1) American National Standard Z223.1/NFPA54-Latest Edition "National Fuel Gas Code" or 2) CSA B149.1 "Natural Gas and Propane Installation Code" and with the requirement of the local utility or other authorities having jurisdiction. Such applicable requirements take precedence over the general instructions contained herein.

All electrical wiring is to be done in accordance with the local codes, or in the absence of local codes, with: 1) The National Electrical Code ANSI/NFPA No. 70-latest Edition, or 2) CSA STD. C22.1 "Canadian Electrical Code - Part 1". This appliance must be electrically grounded in accordance with these codes.

1.2 Model Identification

Consult the rating plate on the unit. The following information describes the model number structure.

(1-3) **Model Series Designation**
B N T = Bradford White, Brute

(4) **Usage**
H = Hydronic
V = Volume Water

(5-7) **Size**
1 5 0 = 150,000 BTU/hr input, BNTV only
1 9 9 = 199,000 BTU/hr input, BNTV only
2 1 0 = 210,000 BTU/hr input, BNTV only
2 8 5 = 285,000 BTU/hr input
3 9 9 = 399,000 BTU/hr input
5 0 0 = 500,000 BTU/hr input
6 0 0 = 600,000 BTU/hr input
7 5 0 = 750,000 BTU/hr input
8 5 0 = 850,000 BTU/hr input

(8) **Fuel**
N = Natural Gas
P = LP Gas

(9) **Options Code**
X = Standard Unit
J = CSD-1, FM, GAP, IL Code (size 500-850 only)
C - STANDARD (Canada)
D - CSD-1 (Canada)
E - OUTDOOR
F - OUTDOOR (Canada)
G - CSD-1, OUTDOOR
H - CSD-1, OUTDOOR (Canada)

(10) **Pump Options**
N = Pump included (80-500 only)
X = No pump (configuration available for all sizes)

Model Nomenclature

1	2	3	4	5	6	7	8	9	10	11
B	**N**	**T**								**3**

SERIES	USAGE	SIZE MBTU/h	FUEL	OPTIONS CODE	PUMP OPTIONS	REVISION
Bradford White Brute	**H -** HYDRONIC **V -** VOLUME WATER	**1 5 0** **1 9 9** **2 1 0** **2 8 5** **3 9 9** **5 0 0** **6 0 0** **7 5 0** **8 5 0**	**N -** NATURAL **P -** PROPANE	**X -** STANDARD **J -** CSD-1, FM, GAP, IL (500-850 only) **C -** STANDARD (Canada) **D -** CSD-1 (Canada) **E -** OUTDOOR **F -** OUTDOOR (Canada) **G -** CSD-1, OUTDOOR **H -** CSD-1, OUTDOOR (Canada)	**N -** PUMP INCL. (80-500 only) **X -** NO PUMP	**3 -** THIRD

1.3 Appliance Overview - See Figures 1 through 6.

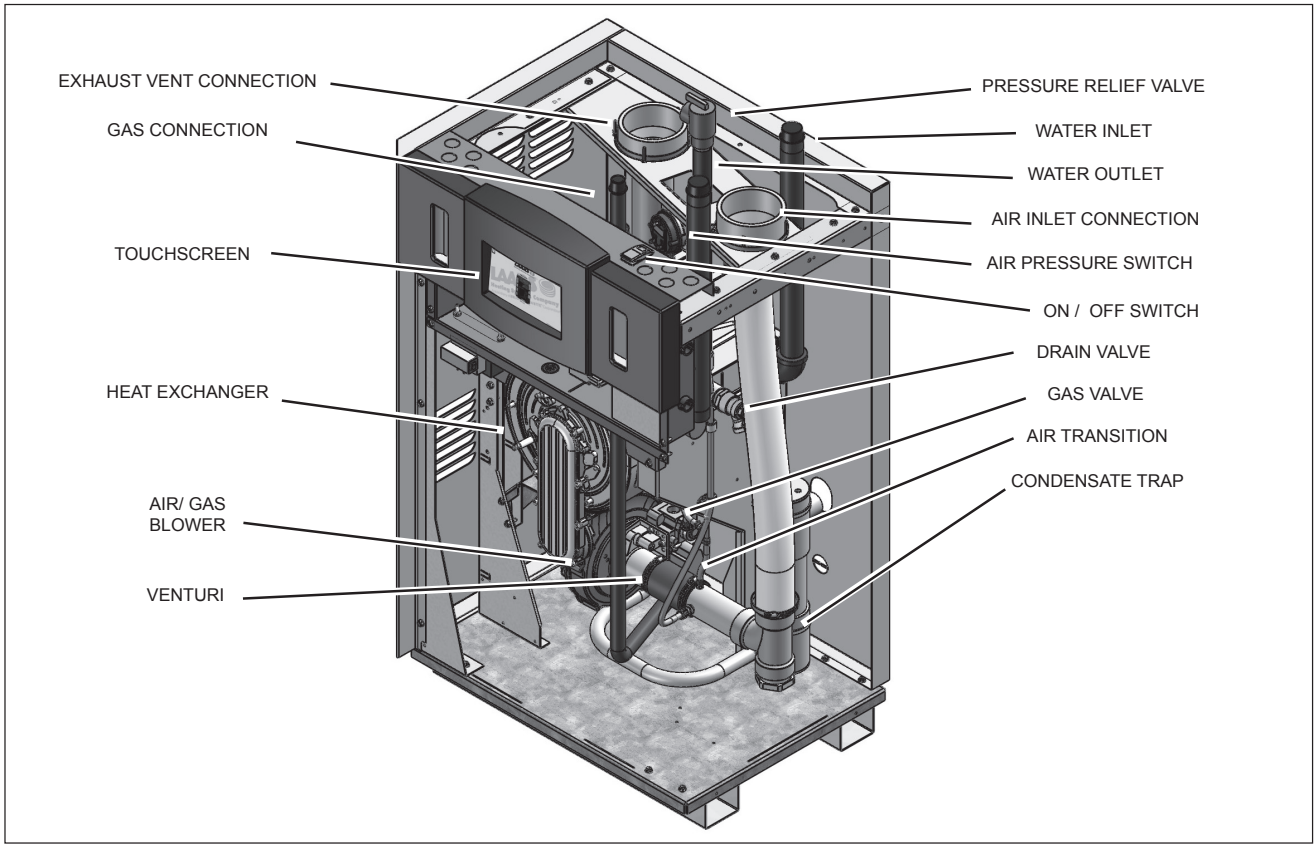


Figure 1. Location of Components, Sizes 150-210

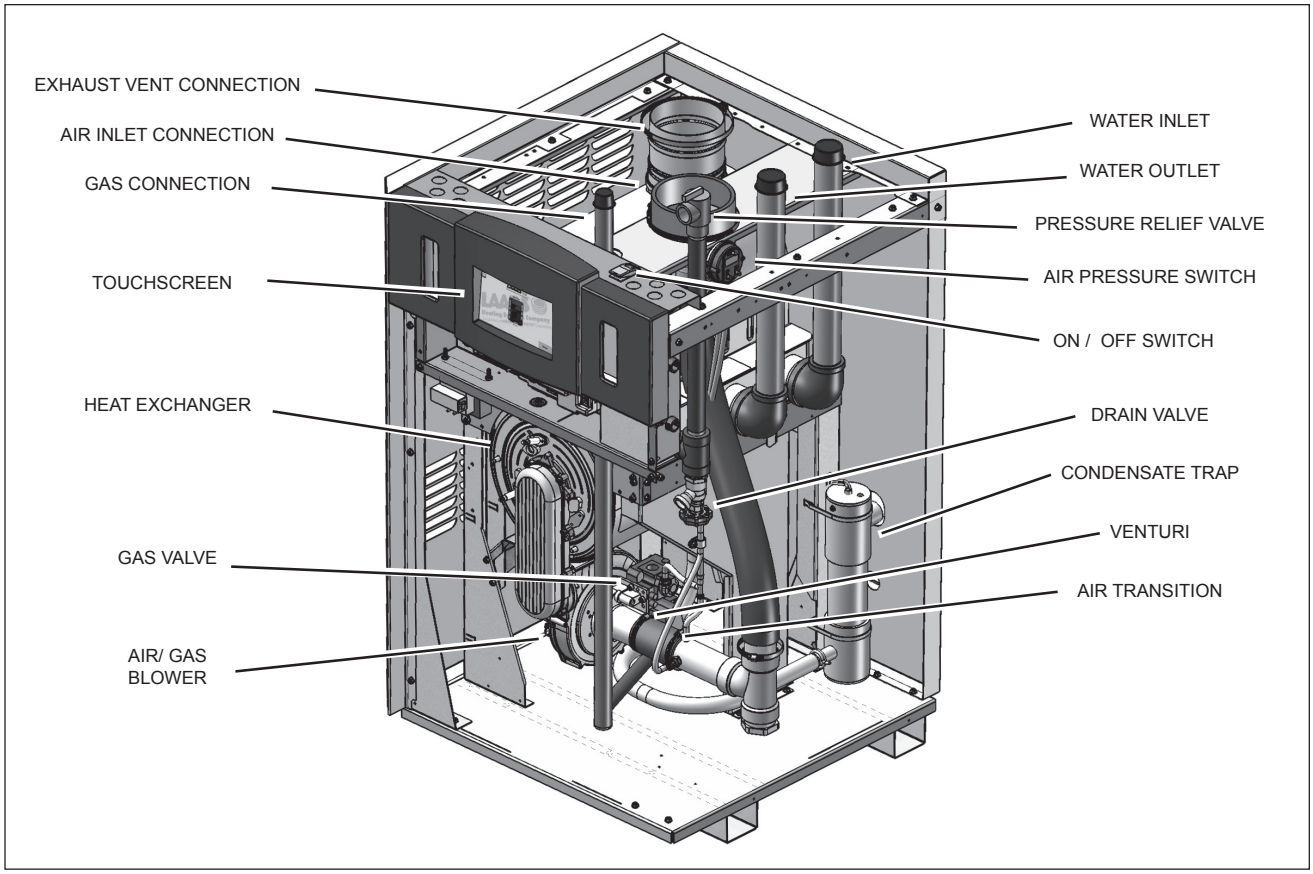


Figure 2. Location of Components, Size 285

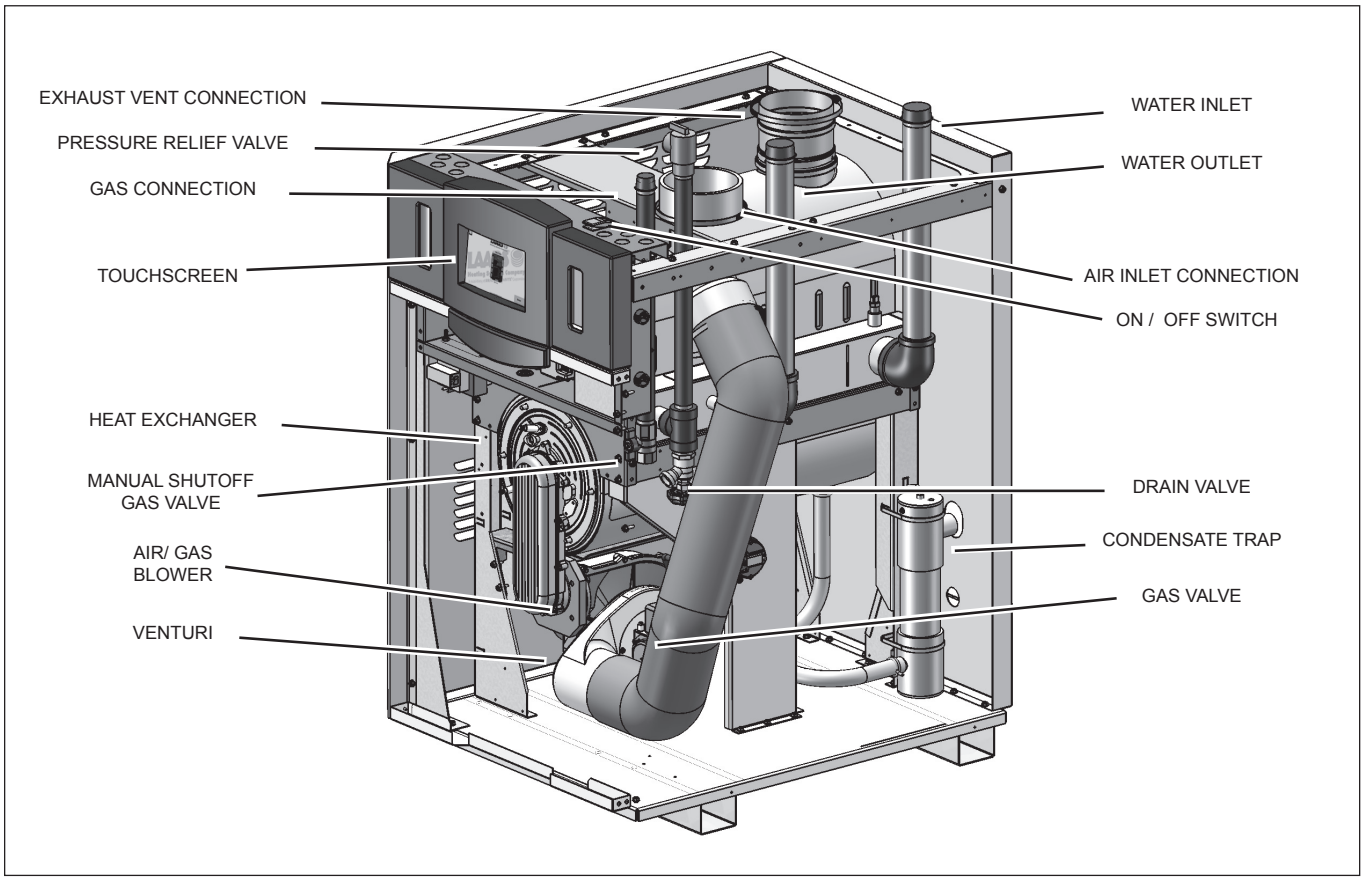


Figure 4. Location of Components, Size 399

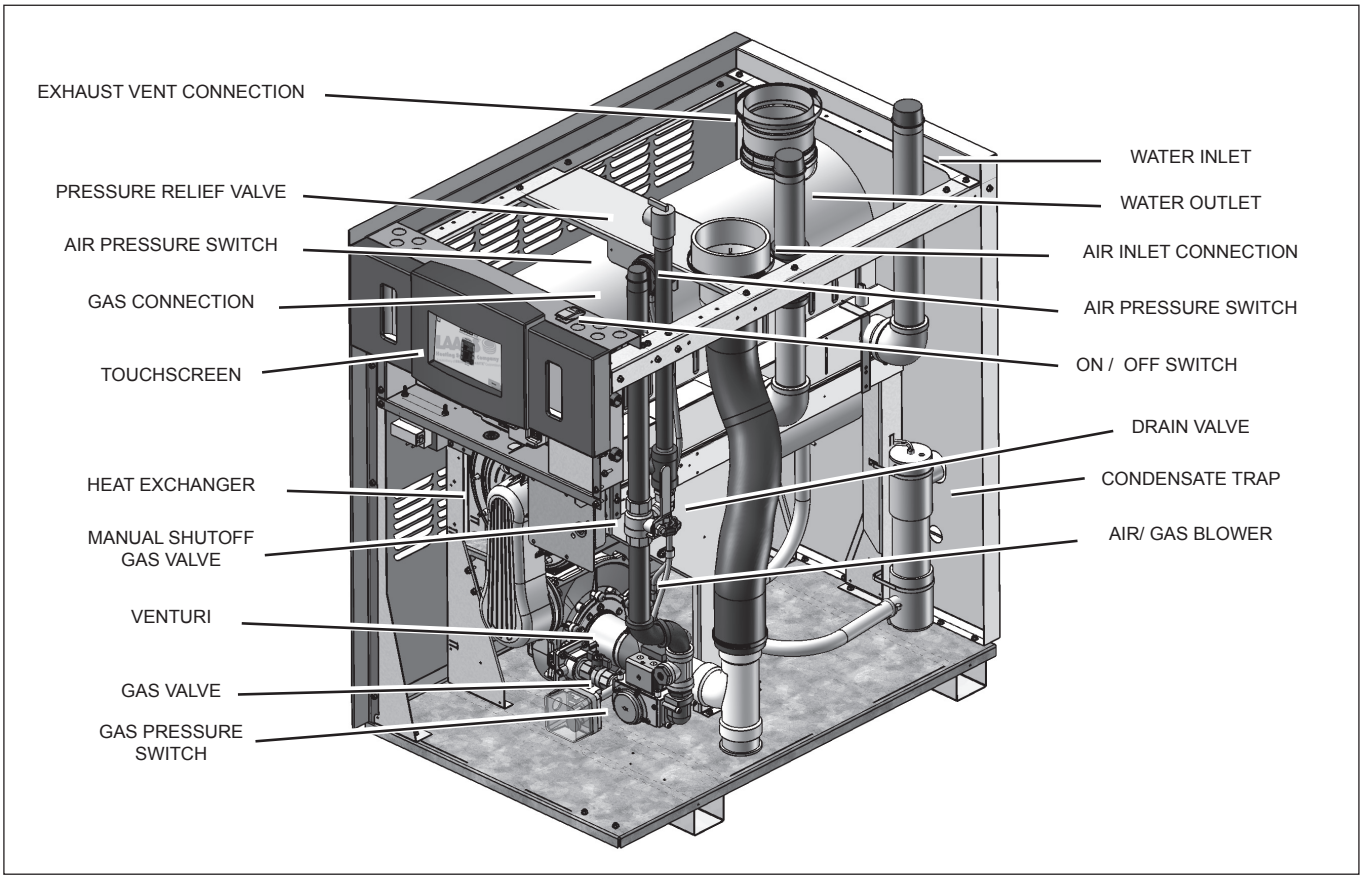


Figure 3. Location of Components, Size 500

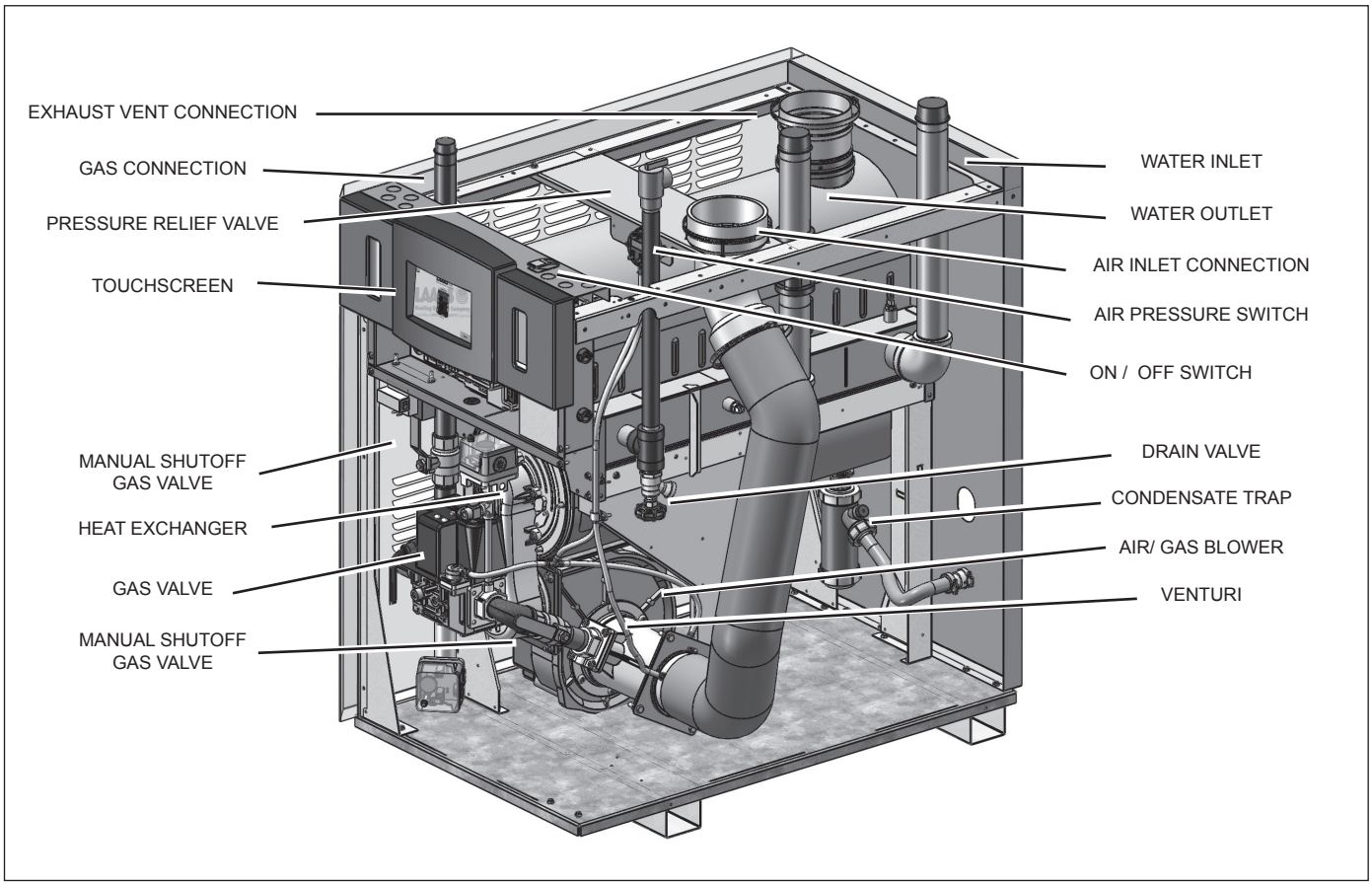


Figure 5. Location of Components, Size 600

1.4 Warranty

Bradford White Brute appliances are covered by a limited warranty. The owner should complete the warranty registration at **www.BradfordWhite.com**.

All warranty claims must be made at **www.BradfordWhite.com**. or to an authorized Bradford White representative. Claims must include the serial number and model (this information can be found on the rating plate), installation date, and name of the installer. Shipping costs are not included in the warranty coverage.

Some accessory items may be shipped in separate packages. Verify receipt of all packages listed on the packing slip. Inspect everything for damage immediately upon delivery, and advise the carrier of any shortages or damage. Any such claims should be filed with the carrier. **The carrier, not the shipper, is responsible for shortages and damage to the shipment whether visible or concealed.**

1.5 Unpacking

The Brute unit is shipped in a single crate with the following standard components packed with the appliance. (See Figure 7)

A. Exhaust vent terminal (US only)
B. Air intake terminal
C. Temperature/pressure gauge kit
D. Circulator pump/wire harness (units with pump)
E. CPVC exhaust pipe section (199-850) (US only)
F. Outdoor/system sensor kit
G. Flow switch kit (399-850)
H. Alternate size vent/terminal screens
J. Exhaust vent adapter CPVC/ST ST (750-850)
K. 4x6 PVC adapter with 4x7 PVC pipe section (750-850) (not to be used on exhaust in Canada)

1. Remove all packing and tie-down materials.
2. Check the contents of the carton against the items shown.

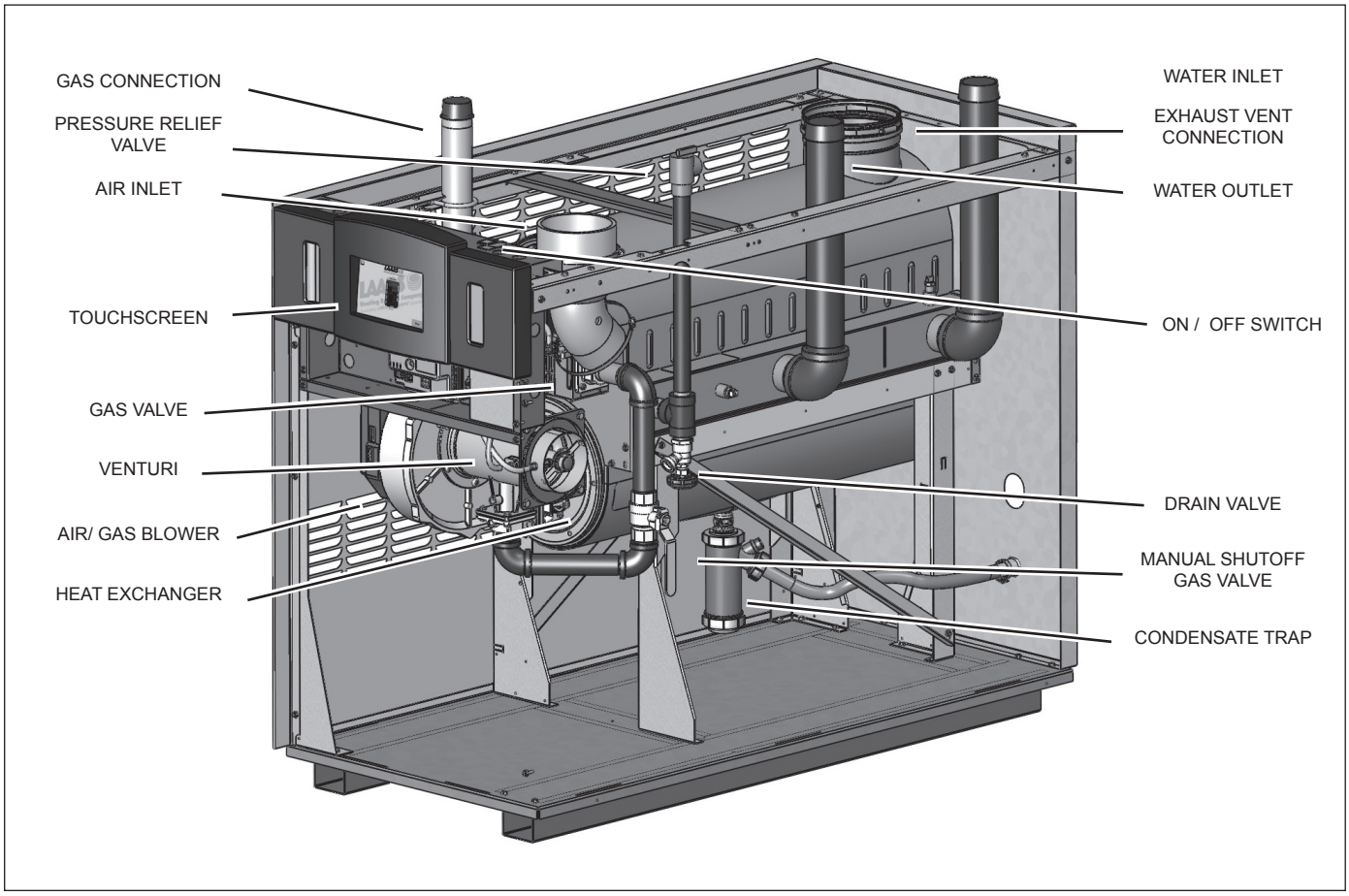


Figure 6. Location of Components, Sizes 750 and 850

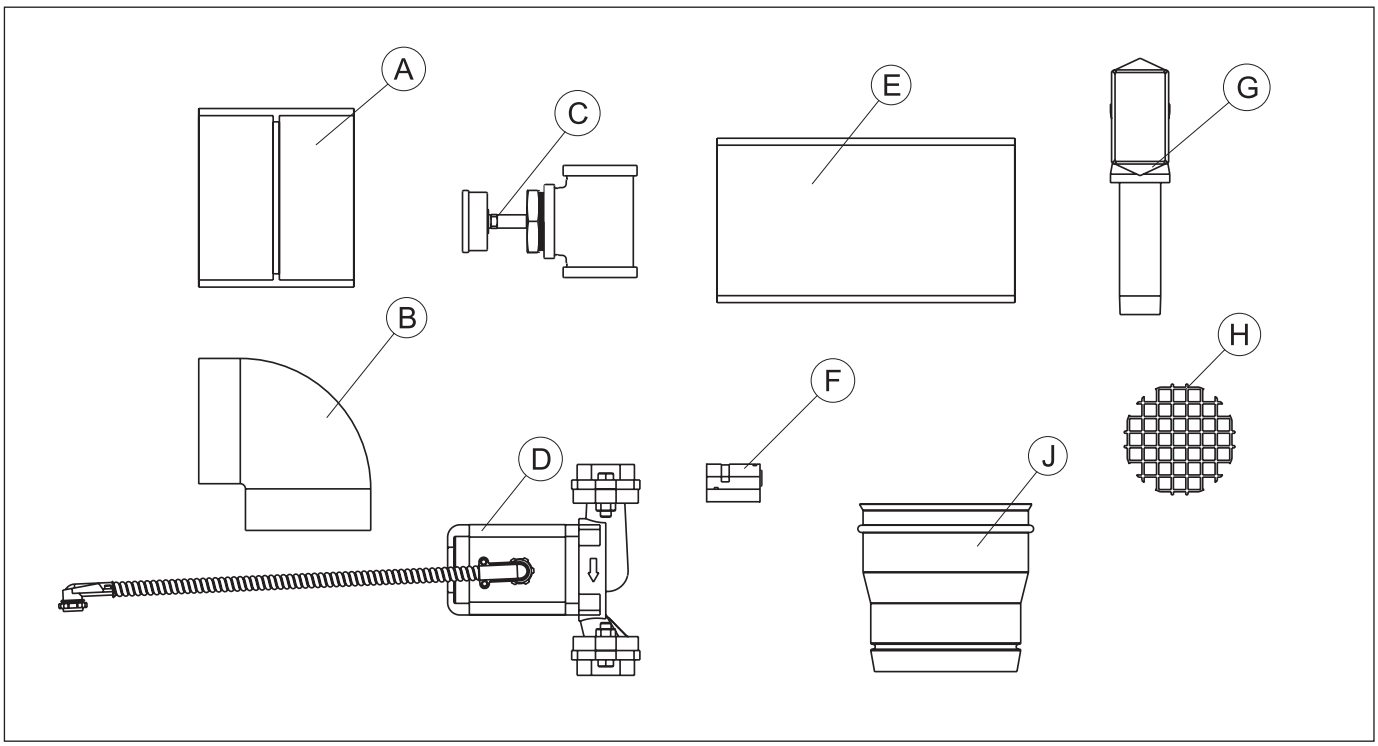


Figure 7. Contents of Shipping Package

1.6 Dimensions

All Brute model dimensions are shown in Table 1

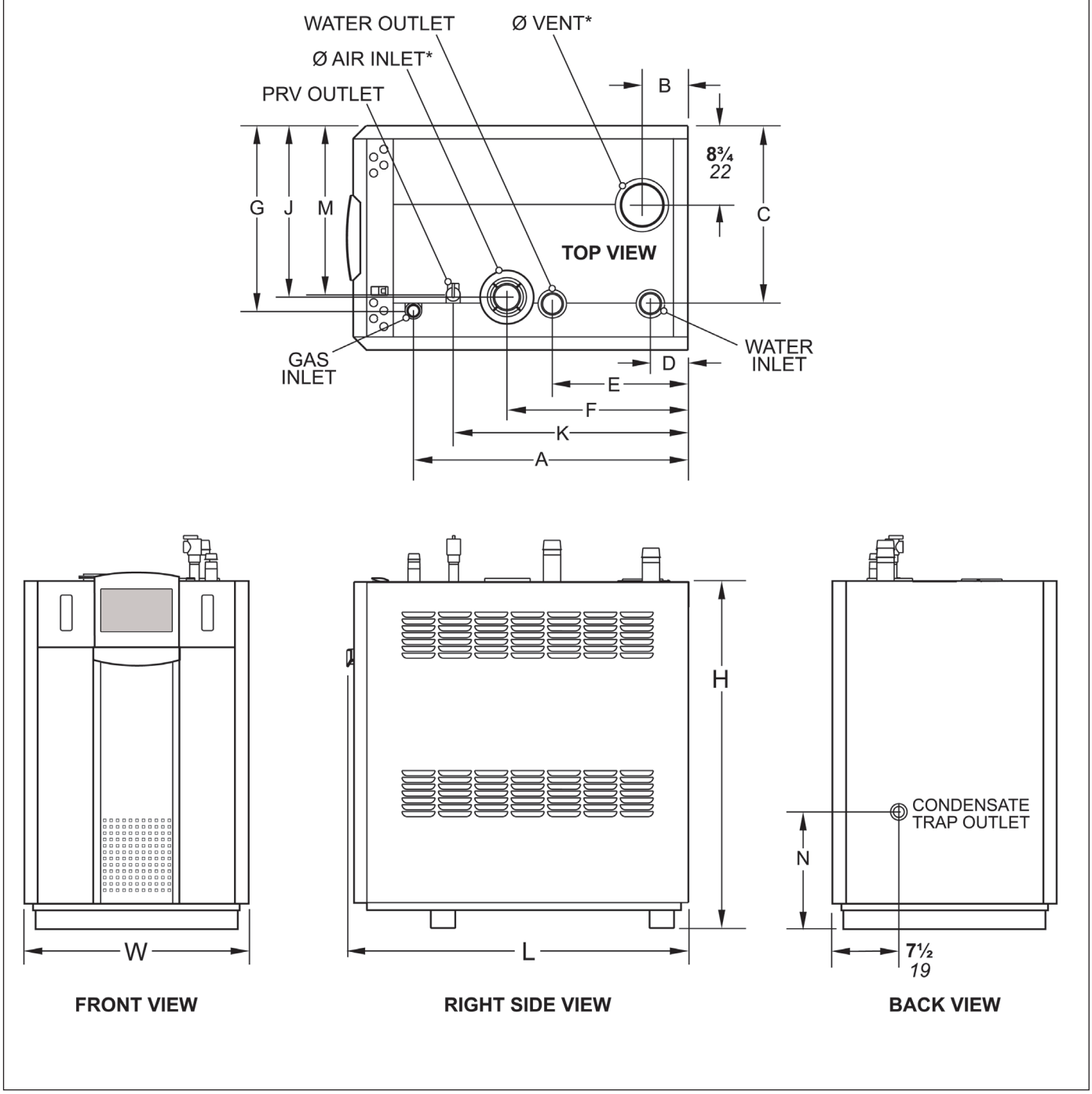
	A		B		C		D		E		F		G		J		K		M		N	
Size MODEL	**in**	*cm*	**in**	*cm*	**in**	*cm*	**in**	*cm*	**in**	*cm*	**in**	*cm*	**in**	*cm*	**in**	*cm*	**in**	*cm*	**in**	*cm*	**in**	*cm*
150 BNTV	**13** 1/4	*34*	**5** 1/4	*14*	**19**	*48*	**3** 1/4	*8*	**10** 3/4	*28*	**7** 1/2	*19*	**14** 1/4	*36*	**19** 1/2	*49*	**7** 1/2	*19*	**15** 1/4	*39*	**13**	*33*
199 BNTV	**20** 1/2	*52*	**5** 1/4	*14*	**19**	*48*	**3** 1/4	*8*	**17** 3/4	*45*	**7** 1/2	*19*	**14** 1/4	*36*	**19** 1/2	*49*	**11** 3/4	*30*	**15** 1/4	*39*	**13**	*33*
210 BNTV	**20** 1/2	*52*	**5** 1/4	*14*	**18** 1/4	*46*	**3** 1/4	*8*	**17** 3/4	*45*	**7** 1/2	*19*	**14** 1/4	*36*	**19** 1/2	*49*	**11** 3/4	*30*	**15** 1/4	*39*	**13**	*33*
285 BNTH	**20** 1/4	*52*	**7** 1/4	*19*	**19** 1/4	*49*	**6** 1/4	*16*	**11** 1/4	*29*	**13** 1/2	*34*	**14**	*36*	**15**	*38*	**17**	*43*	**18** 3/4	*48*	**13**	*33*
285 BNTV	**20** 1/4	*52*	**7** 1/4	*19*	**19** 3/4	*50*	**4** 1/4	*16*	**11** 1/4	*29*	**13** 1/2	*34*	**14**	*36*	**15**	*38*	**17**	*43*	**18** 3/4	*48*	**13**	*33*
399 BNTH	**25**	*64*	**5** 1/4	*13*	**19** 1/4	*49*	**4** 1/4	*11*	**14** 3/4	*37*	**18** 1/2	*47*	**19** 1/4	*49*	**16** 1/2	*42*	**21** 3/4	*55*	**18** 3/4	*48*	**13**	*33*
399 BNTV	**25**	*64*	**5** 1/4	*13*	**19** 3/4	*50*	**4** 1/4	*11*	**14** 3/4	*37*	**18** 1/2	*47*	**19** 1/4	*49*	**16** 1/2	*42*	**21** 3/4	*55*	**18** 3/4	*48*	**13**	*33*
500 BNTH	**30** 1/4	*77*	**5** 1/4	*13*	**19** 1/2	*50*	**4** 1/4	*11*	**15** 1/4	*38*	**20**	*51*	**20** 1/2	*52*	**19**	*48*	**26**	*66*	**18** 3/4	*48*	**13**	*33*
500 BNTV	**30** 1/4	*77*	**5** 1/4	*13*	**19** 3/4	*50*	**4** 1/4	*11*	**15** 1/4	*38*	**20**	*51*	**20** 1/2	*52*	**19**	*48*	**26**	*66*	**18** 3/4	*48*	**13**	*33*
600 (both)	**29** 3/4	*76*	**5**	*13*	**19** 1/2	*50*	**4** 1/4	*11*	**15**	*38*	**20**	*51*	**3**	*8*	**19**	*48*	**26**	*66*	**18** 3/4	*48*	**8** 1/4	*21*
750 (both)	**35** 1/2	*90*	**6**	*15*	**19** 1/2	*50*	**5** 1/4	*13*	**19**	*48*	**40** 1/2	*103*	**3** 1/4	*8*	**19**	*48*	**30** 3/4	*78*	**18** 3/4	*48*	**8** 1/4	*21*
850 (both)	**39** 3/4	*101*	**6**	*15*	**19** 1/2	*50*	**5** 1/4	*13*	**19**	*48*	**44** 3/4	*114*	**3** 1/2	*9*	**19**	*48*	**35**	*89*	**18** 3/4	*48*	**8** 1/4	*21*

	W (width)		L (length)		H (height)		AIR INLET		VENT	
SIZE	**IN**	***CM***	**IN**	***CM***	**IN**	***CM***	**IN**	***CM***	**IN**	***CM***
150	**25**	*64*	**19** 1/2	*68*	**38** 1/4	*97*	**3**	*7.6*	**3**	*7.6*
199/210	**25**	*64*	**26** 3/4	*68*	**38** 1/4	*97*	**3**	*7.6*	**3**	*7.6*
285	**25**	*64*	**26** 3/4	*68*	**38** 1/4	*97*	**4**	*11*	**4**	*11*
399	**25**	*64*	**31** 1/2	*80*	**38** 1/4	*97*	**4**	*11*	**4**	*11*
500	**25**	*64*	**37** 3/4	*96*	**38** 1/4	*97*	**4**	*11*	**4**	*11*
600	**25**	*64*	**37** 3/4	*96*	**38** 1/4	*97*	**4**	*11*	**4**	*11*
750	**25**	*64*	**51**	*130*	**38** 1/4	*97*	**4**	*11*	**6**	*17*
850	**25**	*64*	**55** 1/4	*130*	**38** 1/4	*97*	**4**	*11*	**6**	*17*

Dimensions are nominal and are shown in inches, *cm*.

*Brute is shipped with adapters for the air and vent that accept standard pipe of the proper size and type.

Table 1. Dimension Drawing, Sizes 199-850


WATER OUTLET
Ø VENT*
Ø AIR INLET*
PRV OUTLET
B
8¾
22
G
J
M
C
TOP VIEW
GAS
INLET
WATER
INLET
D
E
F
K
A
H
W
L
CONDENSATE
TRAP OUTLET
N
7½
19
FRONT VIEW
RIGHT SIDE VIEW
BACK VIEW

Section 2 - LOCATING THE APPLIANCE

2.1 General Information

The Brute unit is designed for indoor installations only.

The appliance should be located to provide clearances on all sides for maintenance and inspection. It should not be located in an area where leakage of any connections will result in damage to the area adjacent to the appliance or to lower floors of the structure.

When such a location is not available, it is recommended that a suitable drain pan, adequately drained, be installed under the appliance.

The appliance is design certified by CSA-International for installation on combustible flooring; in basements; in closets, utility rooms or alcoves**. Brutes must never be installed on carpeting.** The location for the appliance should be chosen with regard to the vent pipe lengths and external plumbing and on a level surface. The unit shall be installed such that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during operation and service (circulator replacement, control replacement, etc.). When vented vertically, the Brute must be located as close as practical to the vertical section of the vent. If the vent terminal and/or combustion air terminal terminate through a wall, and there is potential for snow accumulation in the local area, both terminals should be installed at an appropriate level above grade or the maximum expected snow line.

The dimensions and requirements that are shown in Table 1 should be met when choosing the locations for the appliance.

2.2 Locating Appliance for Correct Vent Distance from Outside Wall or Roof Termination

The forced draft combustion air blower in the appliance has sufficient power to vent properly when the guidelines in Table 2 are followed.

NOTE: When located on the same wall, the Brute combustion air intake terminal must be installed a minimum of 12” below the exhaust terminal.Models 399-850 also require a minimum horizontal distance from intake to exhaust terminal of 36”.

APPLIANCE SURFACE	SUGGESTED SERVICE ACCESS CLEARANCE **INCHES**	*CM*
Left Side	**1**	*2.5*
Right Side	**12**	*31*
Top	**24**	*61*
Back	**6**	*15*
Closet, Front (285-500)	**6**	*15*
Alcove, Front (285-500)	**24**	*61*
Front (600-850)	**24**	*61*
Vent	–	–
Certified by CSA for zero clearance to combustible materials on all sides.		

Table 2. Clearances

INTAKE / EXHAUST						
	STANDARD	MAX EQUIV.		OPTIONAL	MAX EQUIV.	
SIZE	VENT	**FT.**	*M*	VENT	**FT.**	*M*
150	3”	**100**	*30.5*	n/a	—	—
199/210	3”	**100**	*30.5*	n/a	—	—
285	4”	**100**	*30*	n/a	—	—
399	4”	**100**	*30*	n/a	—	—
500	4”	**100**	*30*	n/a	—	—
600*	4”	**40**	*6.1*	6”	**100**	*30*
750	4”	**40**	*6.1*	6”	**100**	*30*
850	4”	**40**	*6.1*	6”	**100**	*30*
Installations in the U.S. require exhaust vent pipe that is a combination of PVC & CPVC complying with ANSI/ASTM D1785 F441 or stainless steel complying with UL1738. Installations in Canada require exhaust vent pipe that is certified to ULC S636.						
Intake (air) pipe must be PVC or CPVC that complies with ANSI/ASTM D1785 F441, ABS that complies with ANSI/ASTM D1527 or galvanized material.						
The installer must comply fully with the manufacturer’s installation instructions, including use of minimum exhaust length CPVC, to maintain ANSI Z21.13 safety certification.						
Closet and alcove installations do not allow the use of PVC under any circumstances						
To calculate max equivalent length, measure the linear feet of the pipe, and add 5 feet *(1.5m)* for each 90°***** elbow used.						
* For any combination of vent and intake lengths up to 40 equivalent feet, any even or uneven combination of length is allowed. For overall lengths greater than 40 equivalent feet, the exhaust may be up to 20 feet greater than the intake length.						

Table 3. Vent / Air Pipe Sizes

*****Add 2 $^{1}/_{2}$ feet (.76 meters) for each 45 elbow used.

Section 3 - VENTING AND COMBUSTION AIR

3.1 Combustion Air

Brute boilers and water heaters must have provisions for combustion and ventilation air in accordance with the applicable requirements for Combustion Air Supply and Ventilation in the National Fuel Gas Code, ANSI Z223 1; or in Canada, the Natural Gas and Propane Installation Code, CSA B149.1. All applicable provisions of local building codes must also be adhered to.

A Brute unit can take combustion air from the space in which it is installed, or the combustion air can be ducted directly to the unit. Ventilation air must be provided in either case.

Combustion Air From Room

In the United States, the most common requirements specify that the space shall communicate with the outdoors in accordance with method 1 or 2, which follow. Where ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect.

Method 1: Two permanent openings, one commencing within 12” (300mm) of the top and one commencing within 12” (300mm) of the bottom, of the enclosure shall be provided. The openings shall communicate directly, or by ducts, with the outdoors or spaces that freely communicate with the outdoors. When directly communicating with the outdoors, or when communicating to the outdoors through vertical ducts, each opening shall have a minimum free area of 1 square inch per 4000 Btu/hr (550 square mm/kW) of total input rating of all equipment in the enclosure. When communicating to the outdoors through horizontal ducts, each opening shall have a minimum free area of not less than 1 square inch per 2000 Btu/hr (1100 square mm/kW) of total input rating of all equipment in the enclosure.

Method 2: One permanent opening, commencing within

	HORIZONTAL INTAKE AND EXHAUST PVC VENT TERMINAL KITS								
	2” PVC			3” PVC			4” PVC		6” PVC
Size	Standard	Concentric CA006000	Flush Mount CA010100	Standard CA005900	Concentric 239-44069-01	Flush Mount CA010101	Standard	Flush Mount CA010102	Standard
150	n/a	n/a	n/a	incl.	opt.	opt.	n/a	n/a	n/a
199/210	n/a	n/a	n/a	incl.	opt.	opt.	n/a	n/a	n/a
285	n/a	n/a	n/a	opt.	opt.	opt.	incl.	opt.	n/a
399	n/a	n/a	n/a	n/a	n/a	n/a	incl.	opt.	n/a
500	n/a	n/a	n/a	n/a	n/a	n/a	incl.	opt.	n/a
600	n/a	n/a	n/a	n/a	n/a	n/a	incl.	opt.	opt.
750	n/a	n/a	n/a	n/a	n/a	n/a	incl.	n/a	opt.
850	n/a	n/a	n/a	n/a	n/a	n/a	incl.	n/a	opt.

Concentric vent terminal = 10 ft. pipe length

Table 4. PVC Vent Terminal Kits

SIZE	PRO TECH (FasNSeal)			HEAT FAB (Saf-T-Vent)				Z FLEX (Z-Vent)		
	Boiler Adapter	Flue Termination	Intake Air Termination	Boiler Adapter	Intermediate Adapter	Flue Termination	Intake Air Termination	Boiler Adapter	Flue Termination	Intake Air Termination
399-600	F303759	FSBS4 FSRC4(R.C)	FSAIH04 303888	KB285600	9454BUREZ-1*	9492 5400CI	9414TERM	2SVSLA04	2SVSTP04 2SVSRCX04	2SVSTEX0490
750-850	F303759	FSBS6	FSAIH04 303888							

Figure 8. Approved Stainless Terminations and Adapters

	INSTALLATION STANDARDS	
MATERIAL	UNITED STATES	CANADA
ABS	ANSI/ASTM D1527	Air pipe material must be chosen based upon the intended application of the boiler.
PVC, sch 40	ANSI/ASTM D1785 or D2665	
CPVC, sch 40	ANSI/ASTM F441	
Single wall galv. steel	26 gauge	

Figure 9. Required Combustion Air Pipe Material

12” (300mm) of the top of the enclosure, shall be permitted. The opening shall directly communicate with the outdoors or shall communicate through a vertical or horizontal duct to the outdoors or spaces that directly communicate with the outdoors and shall have a minimum free area of 1 square inch per 3000 Btu/hr (734 square mm/kW) of the total input rating of all equipment located in the enclosure. This opening must not be less than the sum of the areas of all vent connectors in the confined space.

Other methods of introducing combustion and ventilation air are acceptable, providing they conform to the requirements in the applicable codes listed above.

In Canada, consult local building and safety codes or, in absence of such requirements, follow CAN/CSA B149.

Ducted Combustion Air

The combustion air can be taken through the wall, or through the roof. When taken from the wall, it must be taken from out-of-doors by means of the Bradford White horizontal wall terminal, shown in Table 3a and 3b. See Table 2 to select the appropriate diameter air pipe. When taken from the roof, a field-supplied rain cap or an elbow arrangement must be used to prevent entry of rain water. (See Figure10.)

Use ABS, PVC, CPVC or galvanized pipe for the combustion air intake. (See Table 4.) The pipe should be sized per Table 2. Route the intake to the boiler as directly as possible. Seal all joints. Provide adequate hangers. The unit must not support the weight of the combustion air intake pipe. Maximum linear pipe length allowed is shown in Table 2. Subtract 5 allowable linear ft. (1.5m) for every elbow used.

The connection for the intake air pipe is at the top of the unit. (See Figure 9.)

In addition to air needed for combustion, air shall also be supplied for ventilation, including air required for comfort and proper working conditions for personnel. Refer to the applicable codes.

3.2 Venting

⚠ WARNING

Failure to use polypropylene CPVC or stainless steel venting for the first 20” (285-600) / 30” (199 / 210) of vent material or for any part of the venting that is installed inside a closet may lead to property damage, personal injury or death. The proper length of this material is supplied with boiler. Boilers in the U.S. may use pipe included with the boiler.

Failure to use the appropriate vent material, installation techniques, glues/sealants could lead to vent failure causing property damage, personal injury or death.

All venting must be installed according to this manual and any other applicable local codes, including but not limited to, ANSI Z223.1/NFPA 54, CSA B149.1, CSAB149.2 and ULC-S636. Failure to follow this manual and applicable codes may lead to property damage, severe injury, or death.

The flue temperature of the Brute changes dramatically with changes in operating water temperature. Therefore, it is necessary to assess the application of the boiler to determine the required certified vent class. If the Brute is installed in an application where the ambient temperature is elevated, and/or installed in a closet/alcove, polypropylene, CPVC or stainless steel material is required. If the system temperatures are unknown at the time of installation, Class IIB or higher venting material is recommended.

The Brute is a Category IV appliance and may be installed with PVC and CPVC that complies with ANSI/ASTM D1785 F441, polypropylene that complies with ULC-S636 Class

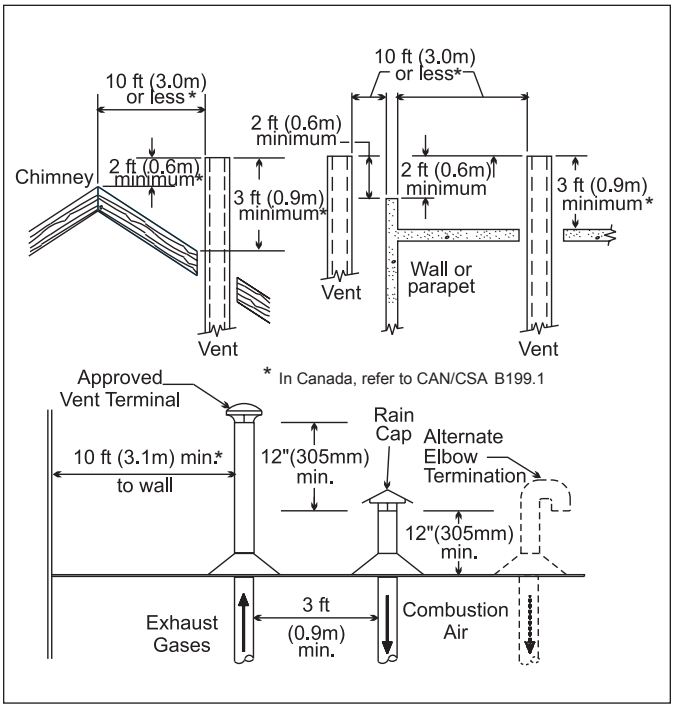


Figure 10. Combustion Air and Vent Through Roof

	INSTALLATION STANDARDS	
MATERIAL	UNITED STATES	CANADA
Stainless Steel	UL 1738	Venting must be ULC-S636 certified for use as venting material. The venting material class must be chosen based upon the maximum flue gas temperature and the intended application of the boiler.
PVC, sch 40	ANSI/ASTM D1785	
CPVC, sch 40	ANSI/ASTM F441	
Polypropylene	ULC-S636	

Figure 11. Required Exhaust Vent Material

IIb, or a stainless steel venting system that complies with UL 1738 Standard. (See Table 5.)

The unit's vent can terminate through the roof, or through an outside wall.

When using PVC/CPVC for vent material, venting must be connected to the CPVC section included with Brute sizes 80-850. The CPVC vent section included with the Brute may be broken by CPVC fittings if necessary, but never reduced in total length. See Table 2 to select the appropriate vent pipe diameter. When using polypropylene, all vent material must be produced by the same manufacturer, and have a ULC-S636 rating.

All installations should be done following the vent supplier's recommended installation techniques. If manufacturer's instructions are not available for the material used, follow the Bradford White recommendations.

The vent pipe must pitch upward, toward the vent terminal, not less than 1/4" per foot, so that condensate will run back to the Brute to drain. Route vent pipe to the heater as directly as possible. Seal all joints and provide adequate hangers as required in the venting system manufacturer's Installation Instructions. Horizontal portions of the venting system must be supported to prevent sagging and may not have any low sections that could trap condensate. The unit must not support the weight of the vent pipe. Please see Table 2 for proper diameter vs. length allowed.

IMPORTANT NOTE ABOUT COMMON VENTING: A single vent that is shared by multiple Brute units MUST be engineered by a competent venting specialist, and involves the selection of draft inducing equipment, hardware and controls to properly balance flue gas pressures. **Do not common vent Brute units unless the vent system meets this requirement. Brute units are never permitted to share a vent with Category I appliances.**

Venting Requirements Unique to Canada

Brute boilers and water heaters are Vent Category IV appliances. Per the requirements of CAN/CSA-B149.1, only BH vent systems can be connected to these units and such vent systems, either ULC S636 certified stainless steel or other ULC S636 certified BH vent (eg. plastics) must be installed per the vent manufacturer's certified installation instructions.

As a result, two items listed in the Unpacking section (Figure 8) are **not included** with Brute units for Canada (underlined):

A **exhaust vent terminal** *(not included)*

B. air intake terminal

C. temperature/pressure gauge kit

D. circulator pump/wire harness (units with pump)

E. **CPVC exhaust pipe section (80-500)** *(not incl.)*

F. outdoor/system sensor kit

G. flow switch kit (399-850)

H. alternate size vent/terminal screens

J. exhaust vent adapter CPVC/ST ST (750-850)

It is the responsibility of the appropriately licensed technician installing this Brute unit to use ULC S636 certified vent material consistent with the requirements as described in the Venting and Combustion Air section.

Class I venting systems are suitable for gas-fired appliances producing flue gas temperature of more than 135°C, but not more than 245°C.

Class II venting systems are suitable for gas-fired appliances producing flue gas temperatures of 135°C or less.

Class II venting systems are further classified into four temperature ratings as follows:

A Up to and including 65°C

B Up to and including 90°C

C Up to and including 110°C, and

D Up to and including 135°C

IMPORTANT! It is also the responsibility of the installer to ensure that a flue gas sampling port is installed in the vent system. This flue gas sampling port must be installed near the flue connection of the Brute unit: within 2 feet of the flue connection. There is no flue gas sampling port internal to the Brute, so one must be installed in the vent system external to the Brute unit. A flue gas sampling port available as a component of the ULC S636 certified vent system is preferred. However, if one is not available with the certified vent system, Bradford White suggests using a tee with the

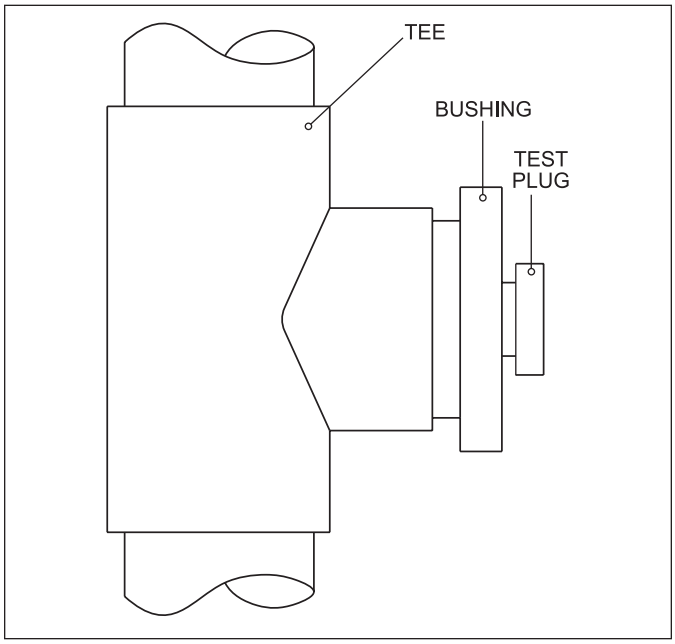


Figure 12. Test Port - ULC-S636 system

branch connection sized to allow for insertion of a flue gas analyzer probe. The branch connection must be resealable with a cap or other by other means to ensure the vent system remains sealed. (See Figure 11.)

Consideration must be given to the placement and orientation of the flue gas sampling port to ensure that condensate is free to flow back into the Brute unit and not collect anywhere in the vent system - including in the flue gas sampling port.

An exhaust vent terminal must be installed. If an exhaust vent terminal is not available with the certified vent system, Bradford White suggests the use of a coupler fitting from the certified vent system into which the vent terminal screen, included with the Brute and shown in the Unpacking section, be installed. Be sure to install and terminate both vent and combustion air pipes per the Venting and Combustion Air section of the Brute instructions.

3.3 Locating Vent and Combustion Air Terminals

Side Wall Vent Terminal

The appropriate Bradford White side wall vent terminal must be used. The terminal must be located in accordance with ANSI Z223.1/NFPA 54 and applicable local codes. In Canada, the installation must be in accordance with CSA B149.1 or .2 and local applicable codes. Consider the points listed on the following page when installing the terminal.

1. Figure 12 shows the requirements for mechanical vent terminal clearances for the U.S. and Canada.
2. Vent terminals for condensing appliances or appliances with condensing vents are **not** permitted to terminate above a public walkway, or over an area where condensate or vapor could create a nuisance or hazard.
3. Locate the vent terminal so that vent gases cannot be drawn into air conditioning system inlets.
4. Locate the vent terminal so that vent gases cannot enter the building through doors, windows, gravity inlets or other openings. Whenever possible, avoid locations under windows or near doors.
5. **Locate the vent terminal so that it cannot be blocked by snow. The installer may determine that a vent terminal must be higher than the minimum shown in codes, depending upon local conditions.**
6. Locate the terminal so the vent exhaust does not settle on building surfaces or other nearby objects. Vent products may damage surfaces or objects.
7. If the boiler or water heater uses ducted combustion air from an intake terminal located on the same wall.

If the vent termination is located in an area exposed to high winds, an optional PVC tee (the same diameter as the vent pipe) may be used. The tee'd vent termination offers greater protection from wind related operating issues.

Side Wall Combustion Air Terminal

The Bradford White side wall combustion air terminal, or concentric terminal must be used when the heater takes air from a side wall. (See Table 3.) Contact Bradford White for AL29-4C termination fittings. Consider the following when installing the terminal. (See Figures 13-15.)

1. Do not locate the air inlet terminal near a source of corrosive chemical fumes (e.g., cleaning fluid, chlorine compounds, etc.)
2. Locate the terminal so that it will not be subject to damage by accident or vandalism. It must be at least 7 feet (2.1m) above a public walkway.
3. Locate the combustion air terminal so that it cannot be blocked by snow. The National Fuel Gas Code requires that it be at least 12 inches (30cm) above grade, but the installer may determine it should be higher, depending upon local conditions.
4. If the Brute is side-wall vented to the same wall, locate the vent terminal at least 1 foot (0.3m) above the combustion air terminal.
5. **For concentric vent, follow instructions included with vent kit.**
6. Multiple vent kits should be installed such that the horizontal distance between the outlet group and the inlet group is 36" (90cm). (Figure 14.)
7. The vent outlet for models 199-285 must be no lower than the center of the air inlet, and must be at least 12" (30cm) away from the air inlet. Vent outlets for models 399-850 must be at least 12" above the top of the air inlet, and must be at least 36" (90cm) horizontally from the air inlet. (Figure 14.)

Vertical Vent Terminal

When the unit is vented through the roof, the vent must extend at least 3 feet (0.9m) above the point at which it penetrates the roof. It must extend at least 2 feet (0.6m) higher than any portion of a building within a horizontal distance of 10 feet (3.0m), and high enough above the roof line to prevent blockage from snow. The vent terminal included with the Brute can be used in both vertical and horizontal applications. When the combustion air is taken from the roof, the combustion air must terminate at least 12" (30cm) below the vent terminal. (See Figure 10.)

Vertical Combustion Air Terminal

When combustion air is taken from the roof, a field-supplied rain cap or an elbow arrangement must be used to prevent entry of rain water. (Figure 10.) The opening on

		U.S. Installations (see note 1)	Canadian Installations (see note 2)
A=	Clearance above grade, veranda, porch, deck, or balcony	12 inches (30 cm) See note 6	12 inches (30 cm) See note 6
B=	Clearance to window or door that may be opened	Direct vent only: 12 inches (30cm); Other than Direct vent: 4 ft (1.2m) below or to side of opening; 1 ft (30cm) above opening	36 inches (91 cm) NT 80 only - 12 inches (30 cm)
C=	Clearance to permanently closed window	See note 4	See note 5
D=	Vertical clearance to ventilated soffit located above the terminal within a horizontal distance of 2 feet (61cm) from the center line of the terminal	See note 4	See note 5
E=	Clearance to unventilated soffit	See note 4	See note 5
F=	Clearance to outside corner	See note 4	See note 5
G=	Clearance to inside corner	See note 4	See note 5
H=	Clearance to each side of center line extended above meter/regulator assembly	See note 4	3 feet (91 cm) within a height 15 feet above the meter/regulator assembly
I=	Clearance to service regulator vent outlet	See note 4	3 feet (91 cm)
J=	Clearance to nonmechanical air supply inlet to building or the combustion air inlet to any other appliance	Direct vent only: 12” (30cm) 80-285; 36” (91cm) 399-850. Other than Direct vent: 4 ft (1.2m) below or to side of opening; 1 ft (30cm) above opening	36 inches (91 cm) NT 80 only - 12 inches (30 cm)
K=	Clearance to a mechanical air supply inlet	3 feet (91 cm) above if within 10 feet (3 m) horizontally	6 feet (1.83 m)
L=	Clearance above paved sidewalk or paved driveway located on public property	Vent termination not allowed in this location for category IV appliances.	7 ft (2.1 m) See note 5
M=	Clearance under veranda, porch, deck, or balcony	See note 4	12 inches (30 cm) (see note 3)

Notes:

1. In accordance with the current ANSI Z223.1 / NFPA 54 National Fuel Gas Code.
2. In accordance with the current CAN/CSA-B149.1 Installation Codes.
3. Permitted only if veranda, porch, deck, or balcony is fully open on a minimum of two sides beneath the floor.
4. For clearances not specified in ANSI Z223.1 / NFPA 54, clearance is in accordance with local installation codes and the requirements of the gas supplier.
5. For clearances not specified in CAN/CSA-B149, clearance is in accordance with local installation codes and the requirements of the gas supplier.
6. IMPORTANT: Terminal must be placed such that it remains a minimum 12” above expected snow line. Local codes may have more specific requirements, and must be consulted.

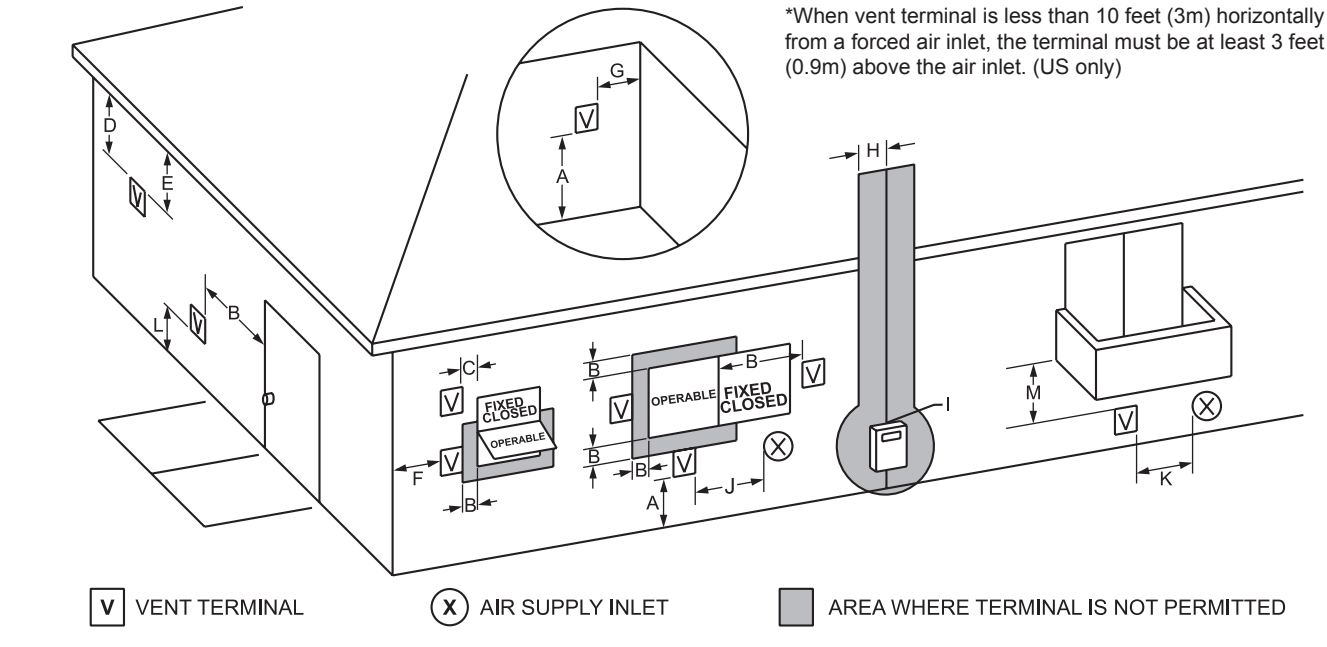
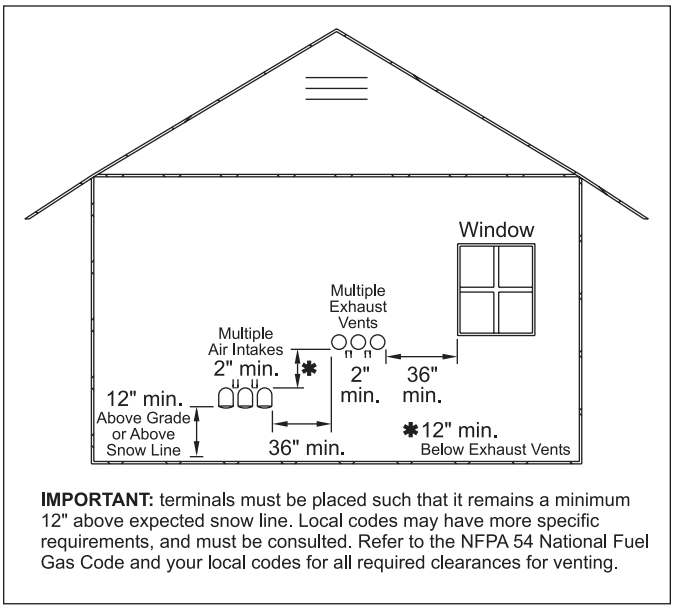


Figure 13. Combustion Air and Vent Through Side Wall



IMPORTANT: terminals must be placed such that it remains a minimum 12" above expected snow line. Local codes may have more specific requirements, and must be consulted. Refer to the NFPA 54 National Fuel Gas Code and your local codes for all required clearances for venting.

Figure 15. Multiple Side-Wall Terminals,

the end of the terminal must be at least 12” (30cm) above the point at which it penetrates the roof, and high enough above the roof line to prevent blockage from snow. When the vent terminates on the roof, the combustion air must terminate at least 12” (30cm) below the vent terminal.

Installations in the Commonwealth of Massachusetts

In Massachusetts the following items are required if 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. From Massachusetts Rules and regulations 248 CMR 5.08 (begininning on 2nd page following):

1. **Installation of Carbon Monoxide Detectors**

   At the time of installation of the side wall vented gas fueled appliance, the installing plumber or gas-fitter shall observe that a hard-wired carbon monoxide detector with an alarm battery back-up is installed on the floor level where the gas appliance 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 horizontally vented gas fueled equipment. It shall be the responsibility of the property owner to secure the services of qualified licensed professionals for 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 with alarm and battery back-up may be installed on the next adjacent floor level.

   b. In the event that the requirements of the 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 be installed.

2. **Approved Carbon Monoxide Detectors**

   Each carbon monoxide detector 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 horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print no less than one-half (1/2) inch in size: “GAS VENT DIRECTLY BELOW, KEEP CLEAR OF ALL OBSTRUCTIONS.”

4. **Inspection**

   The state or local gas inspector of the side-wall horizontally vented gas fueled appliance 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) 1-4.

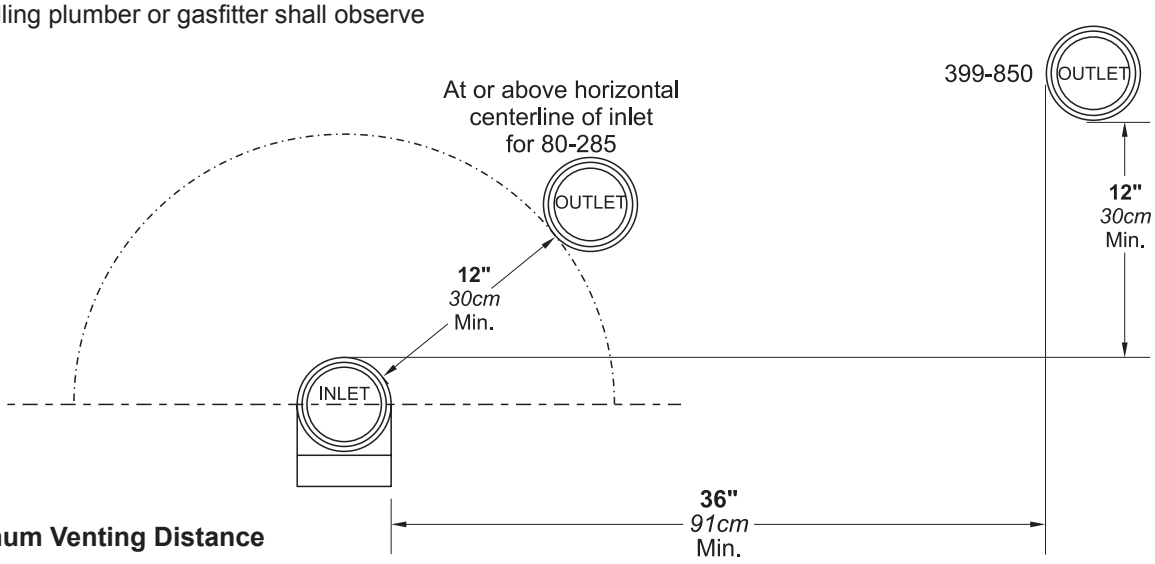


Figure 14. Minimum Venting Distance

3.4 Common Vent Test

NOTE: This section does not describe a method for common venting Brute units. It describes what must be done when a unit is removed from a common vent system. Brute units require special vent systems and fans for common vent. Contact the factory if you have questions about common venting Brute units.

When an existing boiler is removed from a common venting system, the common venting system is likely to be too large for proper venting of the appliances remaining connected to it.

At the time of removal of an existing boiler, the following steps shall be followed with each appliance remaining connected to the common venting system placed in operation, while the other appliances remaining connected to the common venting system are not in operation.

1. Seal any unused openings in the common venting system.
2. Visually inspect the venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion and other deficiencies which could cause an unsafe condition.
3. Insofar as it is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.
4. Place in operation the appliance being inspected. Follow the lighting instructions. Adjust the thermostat so the appliance will operate continuously.
5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
6. After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous conditions of use.
7. Any improper operation of the common venting system should be corrected so that the installation conforms to the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CSA B149.1, Installation Codes. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables and guidelines in the National Fuel Gas Code, ANSI Z223.1 NFPA 54 and/or CSA B149.1, Installation Codes.

Section 4 - GAS SUPPLY AND PIPING

Gas piping should be supported by suitable hangers or floor stands, not the appliance.

Review the following instructions before proceeding with the installation.

1. Verify that the appliance is fitted for the proper type of gas by checking the rating plate. Brute will function properly without the use of high altitude modification at elevations up to 10,000 feet (3050 m).
2. The maximum inlet gas pressure must not exceed 13” W.C. (3.2kPa). The minimum inlet gas pressure is 4” W.C. (1.0kPa).
3. Refer to Tables 6a, 6b, 6c and 6d to size the piping.
4. Run gas supply line in accordance with all applicable codes.
5. Locate and install manual shutoff valves in accordance with state and local requirements.
6. A sediment trap must be provided upstream of the gas controls.
7. All threaded joints should be coated with piping compound resistant to action of liquefied petroleum gas.
8. The appliance and its individual shutoff valve must be disconnected from the gas supply piping during any pressure testing of that system at test pressures in excess of 1/2 PSIG (3.45kPa).
9. The unit must be isolated from the gas supply system by closing its individual manual shutoff valve during any pressure testing of the gas supply piping system at test pressures equal to or less than 1/2 PSIG (3.45kPa).
10. The appliance and its gas connection must be leak tested before placing it in operation.
11. Purge all air from gas lines.

⚠ WARNING:

Open flame can cause gas to ignite and result in property damage, severe injury, or loss of life.

NOTE: The Brute appliance and all other gas appliances sharing the gas supply line must be firing at maximum capacity to properly measure the inlet supply pressure. The pressure can be measured at the supply pressure port on the gas valve. Low gas pressure could be an indication of an undersized gas meter, undersized gas supply lines and/or an obstructed gas supply line. Some Brute units are equipped with low and high gas pressure switches that are integrally vent limited. These types of devices do not require venting to atmosphere.

Brute NATURAL GAS REQUIRED SIZE	CU FT / HR.
150	150
199/210	199/210
285	285
399	399
500	500
600	600
750	750
850	850

TO SIZE PIPING:
Measure linear distance from meter outlet to last boiler. Add total input of all boilers and divide by 1000 to obtain cu ft / hr required. Add total equivalent length of fittings used according to Table 6B. Align total length (pipe and fittings) on left side column of Table 6C with highest cubic feet of gas required.

Notes:
Consult and confirm with Applicable Fuel Gas Code before beginning work. Verify gas inlet pressure is between 4 and 13 in W.C. before starting boiler.

Table 5.

EQUIVALENT LENGTHS OF STRAIGHT PIPE FOR TYPICAL SCH 40 FITTINGS						
	NOMINAL PIPE SIZE					
FITTING	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
	LINEAR FEET					
90° ELBOW	3.6	4.4	5.2	6.6	7.4	8.5
TEE	4.2	5.3	6.6	8.7	9.9	12

Table 6. Equivalent Lengths of Straight Pipe, SCH 40

SCH 40 METAL PIPE CAPACITY FOR 0.60 SPECIFIC GRAVITY NATURAL GAS						
	NOMINAL PIPE SIZE @ 0.30" W.C. PRESSURE DROP					
LENGTH	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
FT	CUBIC FEET OF GAS PER HOUR					
20	92	190	350	730	1100	2100
40		130	245	500	760	1450
60		105	195	400	610	1150
80		90	170	350	530	990
100			150	305	460	870

Table 7. Nominal Pipe Size @ 0.30" W.C. Press Drop

SCHED 40 METAL PIPE CAPACITY FOR 1.50 SPECIFIC GRAVITY UNDILUTED PROPANE						
	NOMINAL PIPE SIZE @ 11" W.C. INLET AND 0.5" W.C. PRESSURE DROP					
SIZE	1/2"	3/4"	1"	1-1/4"	1-1/2"	2"
LENGTH	MAXIMUM CAPACITY IN THOUSANDS OF BTU PER HOUR					
20	200	418	787	1616	2422	4664
40	137	287	541	1111	1664	3205
60	110	231	434	892	1337	2574
80	94	197	372	763	1144	2203
100	84	175	330	677	1014	1952

NOTES:

1. Follow all local and national LP gas codes for line sizing and equipment requirements.
2. Verify that inlet gas pressure remains between 4 and 13 inches of water column before and during operation.

Source: ANSI Z223.1-80 National Fuel Gas Code.

Table 9. Nominal Pipe Size @ 0.11" W.C. and 0.5" Press Drop

Section 5 - PUMP REQUIREMENTS

5.1 Brute Boiler Flow and Head Requirements

	TEMPERATURE RISE IN °F									
	20°F		25°F		30°F		35°F		40°F	
SIZE	FLOW GPM	H/L FT	FLOW GPM	H/L FT	FLOW GPM	H/L FT	FLOW GPM	H/L FT	FLOW GPM	H/L FT
150	14.3	28.5	11.4	19	9.5	13.6	8.1	11.2	7.1	8.8
199/210	20	24.1	16	16.7	13.4	11.6	11.3	9	9.9	6.9
285	27	25.5	22	17.5	18	14	15	10.5	13	8
399	39	28	31	20	25	14.5	22	11	19	9
500	48	24	38	16	32	12	27	9	24	8
600	58	44	46	31	38	22	33	18	29	15
750	72	37	58	23	48	17	41	13	36	10
850	81	33	65	22	54	15	46	10	41	8

TEMPERATURE RISE IN °C										
	11°C		***14°C***		***17°C***		***19°C***		***22°C***	
SIZE	*FLOW lpm*	*H/L m*	*FLOW lpm*	*H/L m*	*FLOW lpm*	*H/L m*	*FLOW lpm*	*H/L m*	*FLOW lpm*	*H/L m*
150	*54*	*8.7*	*43*	*5.8*	*36*	*4.1*	*31*	*3.4*	*27*	*2.7*
199/210	*76*	*7.3*	*61*	*5.1*	*51*	*3.5*	*43*	*2.7*	*37*	*2.1*
285	*102*	*7.8*	*83*	*5.3*	*68*	*4.3*	*57*	*3.2*	*49*	*2.4*
399	*148*	*8.5*	*117*	*6.1*	*95*	*4.4*	*83*	*3.4*	*72*	*2.7*
500	*182*	*7.3*	*144*	*4.9*	*121*	*3.7*	*102*	*2.7*	*91*	*2.4*
600	*220*	*13.4*	*174*	*9.4*	*144*	*6.7*	*125*	*5.5*	*110*	*4.6*
750	*273*	*11.3*	*220*	*7.0*	*182*	*5.2*	*155*	*4.0*	*136*	*3.0*
850	*307*	*10.1*	*246*	*6.7*	*204*	*4.6*	*174*	*3.0*	*155*	*2.4*

Table 8. Water Flow Requirements

5.2 Brute Water Heater Flow and Head Requirements

	NORMAL WATER*					
Size	**Flow gpm**	**H/L feet**	**Temp Rise °F**	***Flow lpm***	***H/L m***	***Temp Rise °C***
150	**19**	**49**	**15**	*72*	*14.9*	*8*
199	**25**	**28**	**15**	*95*	*8.5*	*8*
285	**36**	**33**	**15**	*98*	*10.1*	*8*
399	**50**	**35**	**15**	*189*	*10.7*	*8*
500	**63**	**28**	**15**	*239*	*8.5*	*8*
600**	**60**	**24**	**19**	*227*	*7.3*	*11*
750**	**68**	**35**	**21**	*257*	*10.7*	*12*
850**	**68**	**26**	**24**	*257*	*7.9*	*13*

* Maximum water hardness of 10 grains per gallon allowed.
** See section 6B.7 on page 27 for pump information.

Table 10. Water Heater Flow Data

Section 6A - WATER CONNECTIONS - BNTH BOILER

Section 6 is divided into two parts. Section 6A covers BNTH units designed for hydronic heating. Section 6B covers BNTV models, which are designed exclusively for "volume water" domestic hot water applications. Refer to the proper section for instructions on installing and piping your product. Refer to Table 9 for the connection pipe sizes required.

6A.1 BNTH System Piping - Hot Supply Connections

NOTE: This appliance must be installed in a closed pressure system with a minimum of 12 psi (82.7kPa) static pressure at the boiler.

Hot water piping should be supported by suitable hangers or floor stands. Do not support piping with this appliance. Due to expansion and contraction of copper pipe, consideration should be given to the type of hangers used. Rigid hangers may transmit noise through the system resulting from the piping sliding in the hangers. It is recommended that padding be used when rigid hangers are installed. Maintain 1" (2.5cm) clearance to combustibles for hot water pipes.

Pipe the discharge of the relief valve (full size) to a drain or in a manner to prevent injury in the event of pressure relief. Install an air purger, an air vent, a diaphragm-type expansion tank, and a hydronic flow check in the system supply loop. Minimum fill pressure must be 12psig (82.7kPa). Install shutoff valves where required by code.

BNTH SIZE	PIPE SIZE, INCHES	BNTV SIZE	PIPE SIZE, INCHES
150	1	150	1¼
210	1¼	199	1¼
285	1¼	285	2
399	1¼	399	2
500	1½	500	2
600	1½	600	2
750	2	750	2
850	2	850	2

Table 11. Water Connection Pipe Sizes

Brute's efficiency is higher with lower return water temperatures. Therefore, to get the most of low return temperature with multiple boilers, pipe as shown in Figures 17-19.

Brute BNTV models 150-500 can be ordered with or without a pump included.

Brute BNTH models 80-500 can also be ordered with or without a pump included.

Brute with a pump MUST be piped in a primary-secondary fashion (using either piping or a hydraulic separator) such that the pump that is mounted on the boiler ONLY serves the boiler.

When the pump is supplied by Bradford White, the Brute boiler must be located within 15 feet (4.6m) of the supply and return header (or the hydraulic separator). Pumps supplied by Bradford White are sized for a maximum of 30 feet (9.1m) of connection size piping and the headloss of the boiler only. (See Table 7.)

If longer pipe lengths are required, the pump should be sized for the boiler per Table 7 and for the piping it will serve, and should be supplied to job separately. Even with pumps supplied by others, Bradford White strongly recommends primary-secondary piping.

6A.2 BNTH Cold Water Make-Up

1. Connect the cold water supply to the inlet connection of an automatic fill valve.
2. Install a suitable back flow preventer between the automatic fill valve and the cold water supply.
3. Install shut off valves where required.

The boiler piping system of a hot water heating boiler connected to heating coils located in air handling appliances where they may be exposed to refrigerated air circulation must be equipped with flow control valves or other automatic means to prevent gravity circulation of the boiler water during the cooling cycle.

A boiler installed above radiation level, or as required by

the authority having jurisdiction, must be provided with a low water cutoff device either as a part of the boiler or at the time of boiler installation.

6A.3 Condensate Drain

A condensate drain trap is built into the Brute unit.

Connect a 3/4" PVC pipe between the drain connection and a floor drain (or a condensate pump if a floor drain is not accessible).

The condensate drain must be installed so as to prevent accumulation of condensate. When a condensate pump is not used, the tubing must continuously slope downward toward the drain with no spiraling.

Consult local codes for the proper disposal method for the condensate.

⚠ Caution

Condensate is mildly acidic (pH = 5), and may harm some floor drains and/or pipes, particularly those that are metal. Ensure that the drain, drainpipe, and anything that will come in contact with the condensate can withstand the acidity, or neutralize the condensate before disposal. **Damage caused by failure to install a neutralizer kit or to adequately treat condensate will not be the manufacturer's responsibility.**

6A.4 Freeze Protection

⚠ WARNING

Glycol must not be used in domestic hot water applications. Refer to Section 6B.4 for instructions on BNTV, domestic hot water freeze protection.

Brute units are certified for indoor use only, and are not design-certified for placement outdoors.

Proper precautions for freeze protection are recommended for boiler installations in areas where the danger of freezing exists.

Power outage, interruption of gas supply, failure of system components, activation of safety devices, etc., may prevent a boiler from firing. **Any time a boiler is subjected to freezing conditions, and the boiler is not able to fire, and/or the water is not able to circulate, there is a risk of freezing in the boiler or in the pipes in the system.** When water freezes, it expands which may result in bursting of pipes, or damage to the boiler, which could result in leaking or flooding conditions.

Do not use automotive antifreeze. To help prevent freezing, Bradford White recommends the use of inhibited glycol concentrations between 20% and 35% glycol. Typically, this concentration will serve as burst protection for temperatures down to approximately -5°F (-20°C). If temperatures are expected to be lower than -5°F (-20°C), glycol concentrations up to 50% can be used. *When concentrations greater than 35% are used, water flow rates must be increased to maintain a 20°F to 25°F temperature rise through the boiler.*

NOTE: Bradford White supplied pumps are not all capable of maintaining the reduced temperature rise required with glycol concentrations greater than 35%. If glycol concentrations required are greater than 35% a field supplied pump should be used.

⚠ Caution

Different glycol products may provide varying degrees of protection. Glycol products must be maintained properly in a heating system, or they may become ineffective. Consult the glycol specifications, or the glycol manufacturer, for information about specific products, maintenance of solutions, and set up according to your particular conditions.

6A.5 BNTH Suggested Piping Schematics

Figures 15 through 21 show suggested piping configurations for BNTH boilers. These diagrams are only meant as a guide. All components or piping required by local code must be installed.

6A.6 Recognized Chemicals

The following manufacturers offer glycols, inhibitors, and anti foamants that are suitable for use in the Brute. Please refer to the manufacturers instructions for proper selection and application.

1. Sentinel Performance Solutions Group
2. Hercules Chemical Company
3. Dow Chemical Company

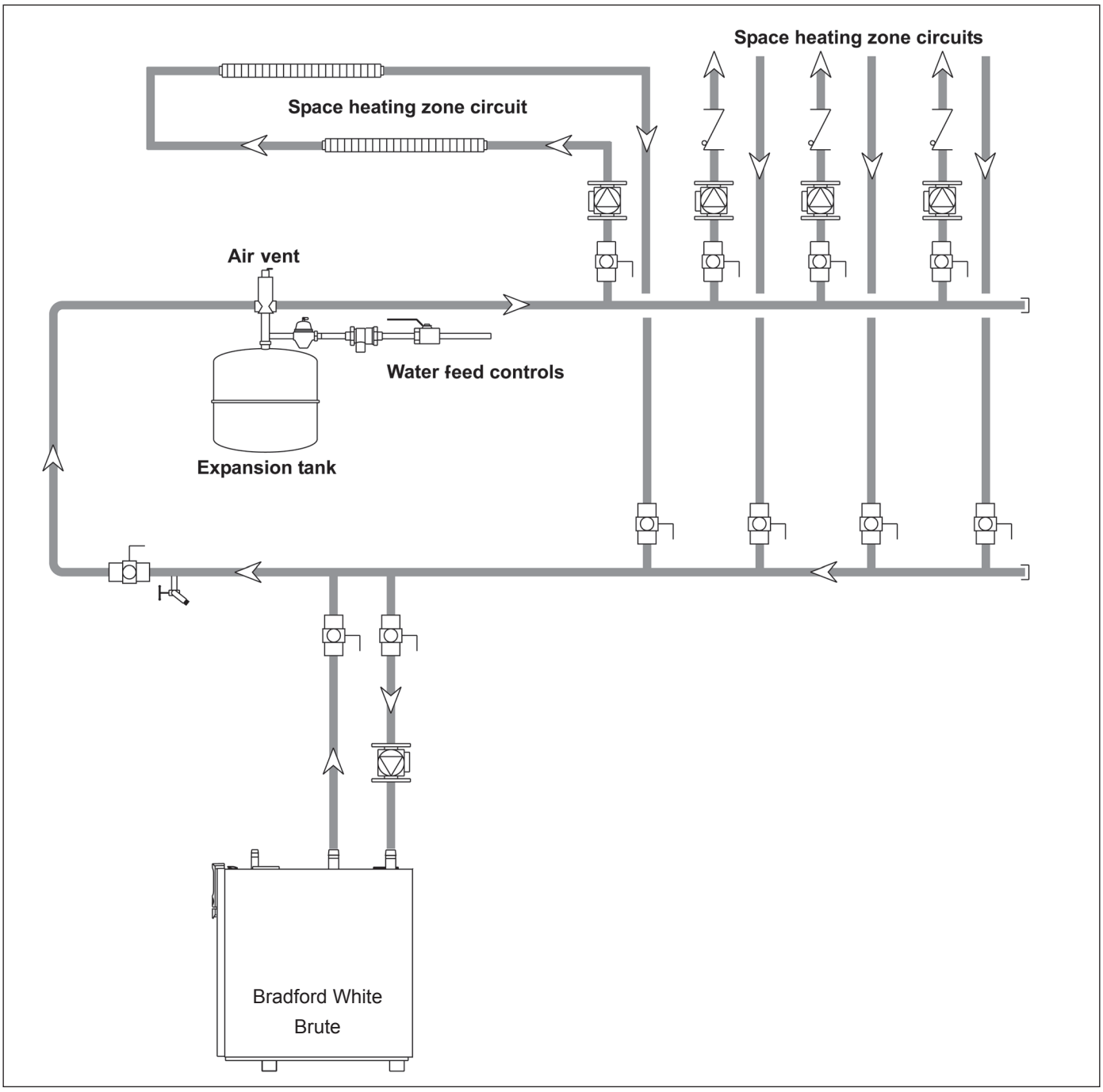


Figure 16. Hydronic Piping — Single Boiler, Zoning with Circulators

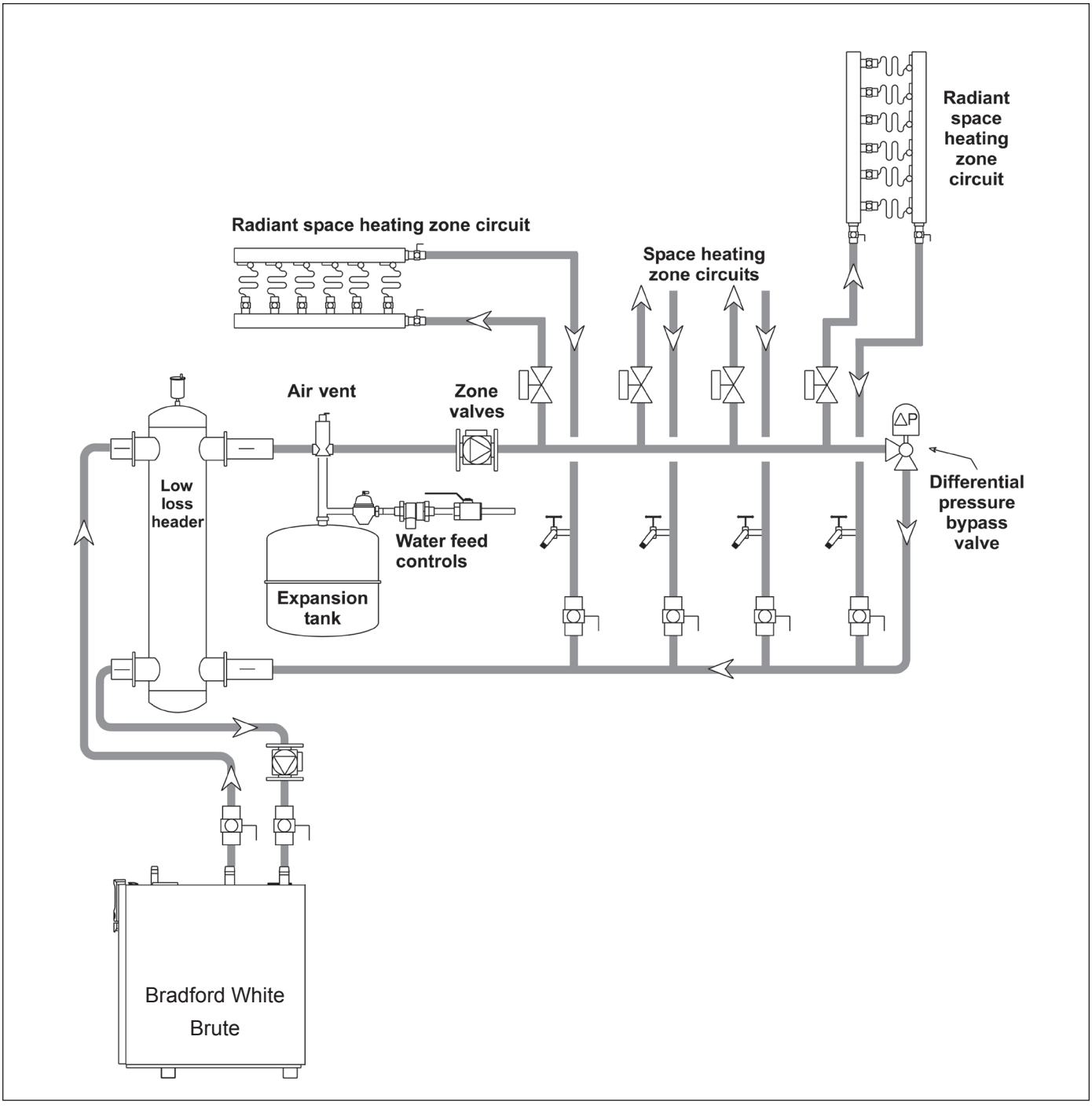


Figure 17. Hydronic Piping — Single Boiler, Low Temp Radiant Space Heating Using Low Loss Header and Zone Valves

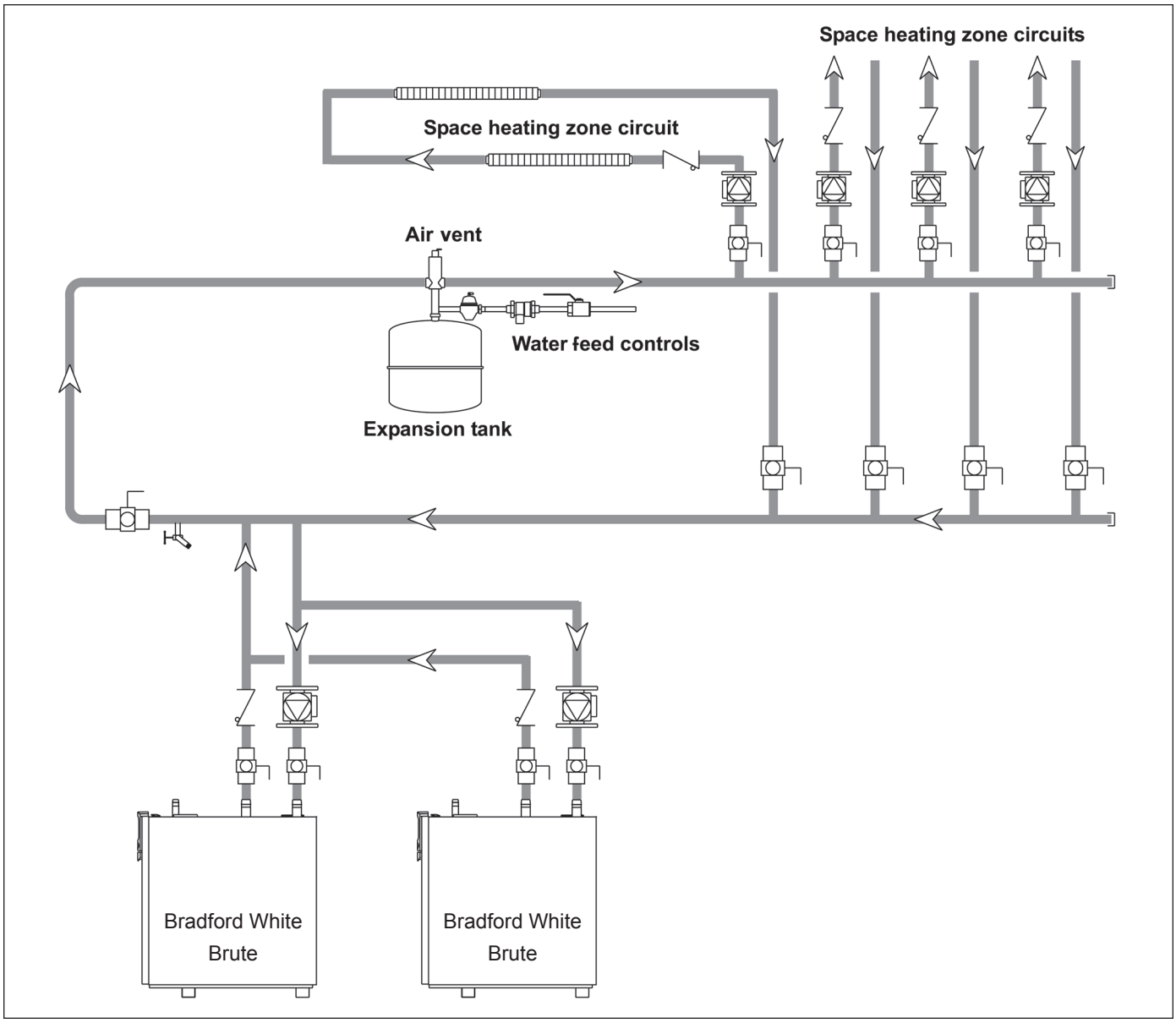


Figure 18. Hydronic Piping — Multiple Boilers, Zoning with Circulators

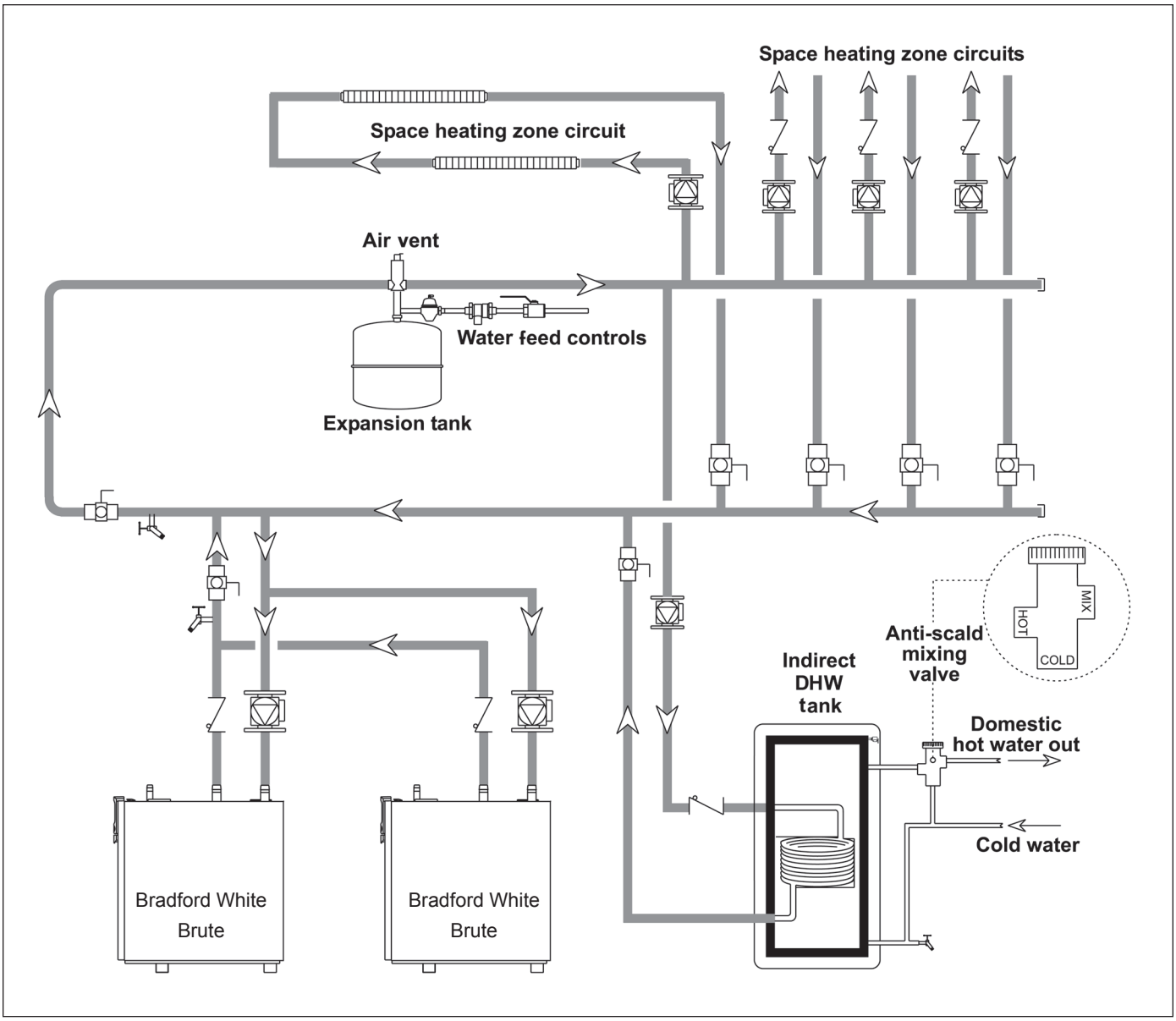


Figure 19. Hydronic Piping — Multiple Boilers with Indirect DHW Tank Piped from System Loop

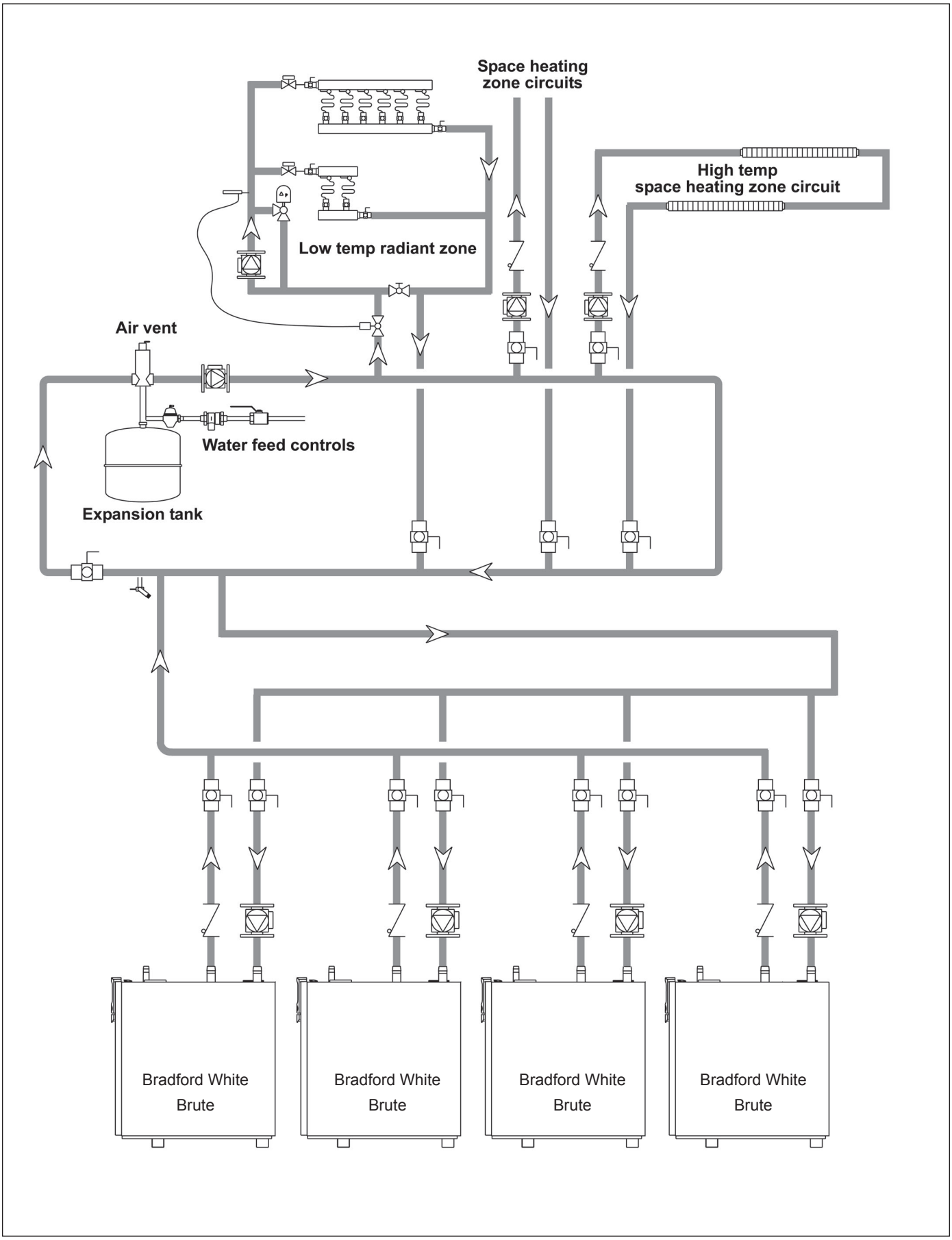


Figure 20. Hydronic Piping — Multiple Boilers, Reverse Return, Multi-Temp Zones, Zoning with Circulators

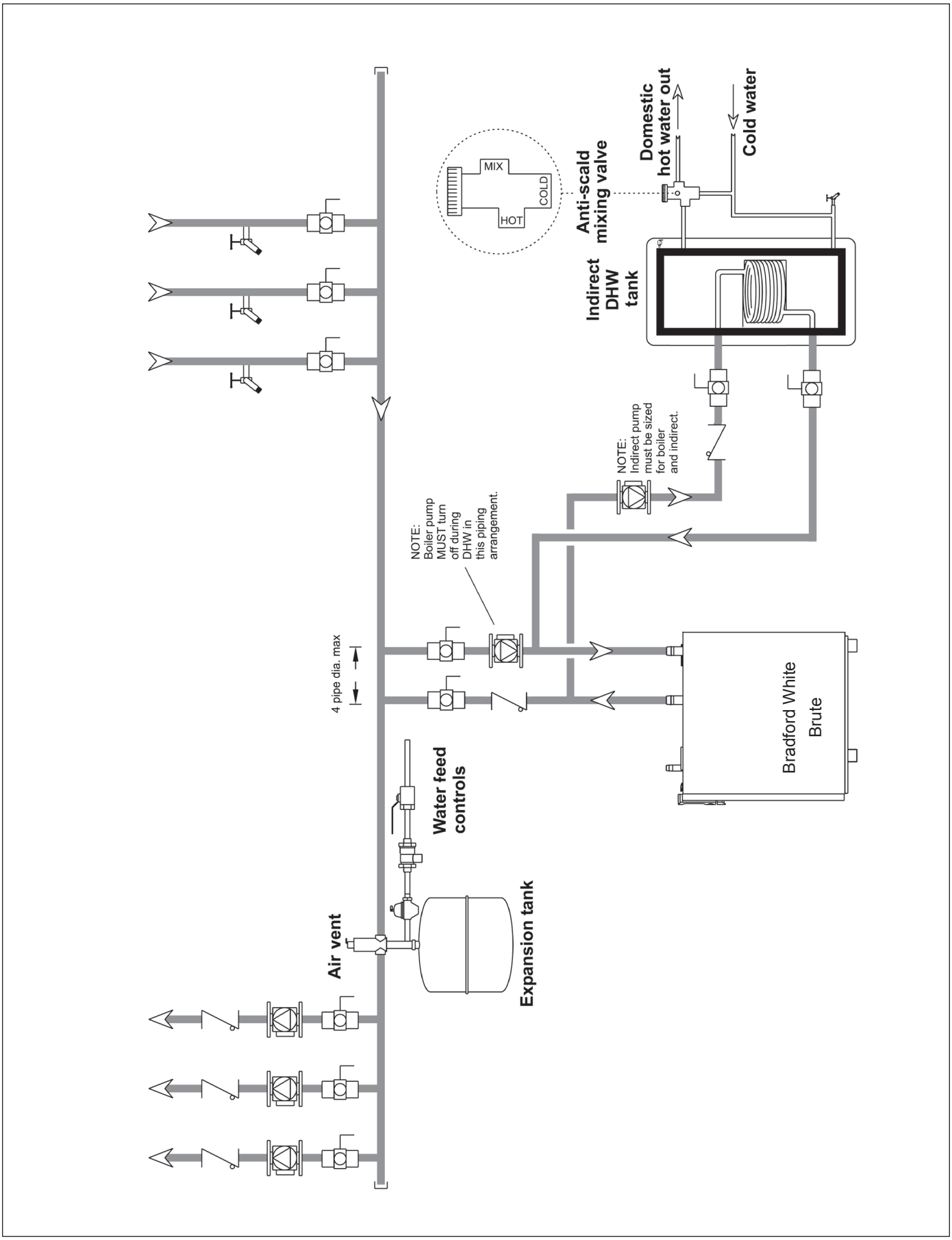


Figure 21. Hydronic Piping — Heating Zones with Indirect DHW Tank Piped with Zone Pumps

The indirect DHW tank is piped directly off of the boiler. The boiler pump must shut down during DHW operation.

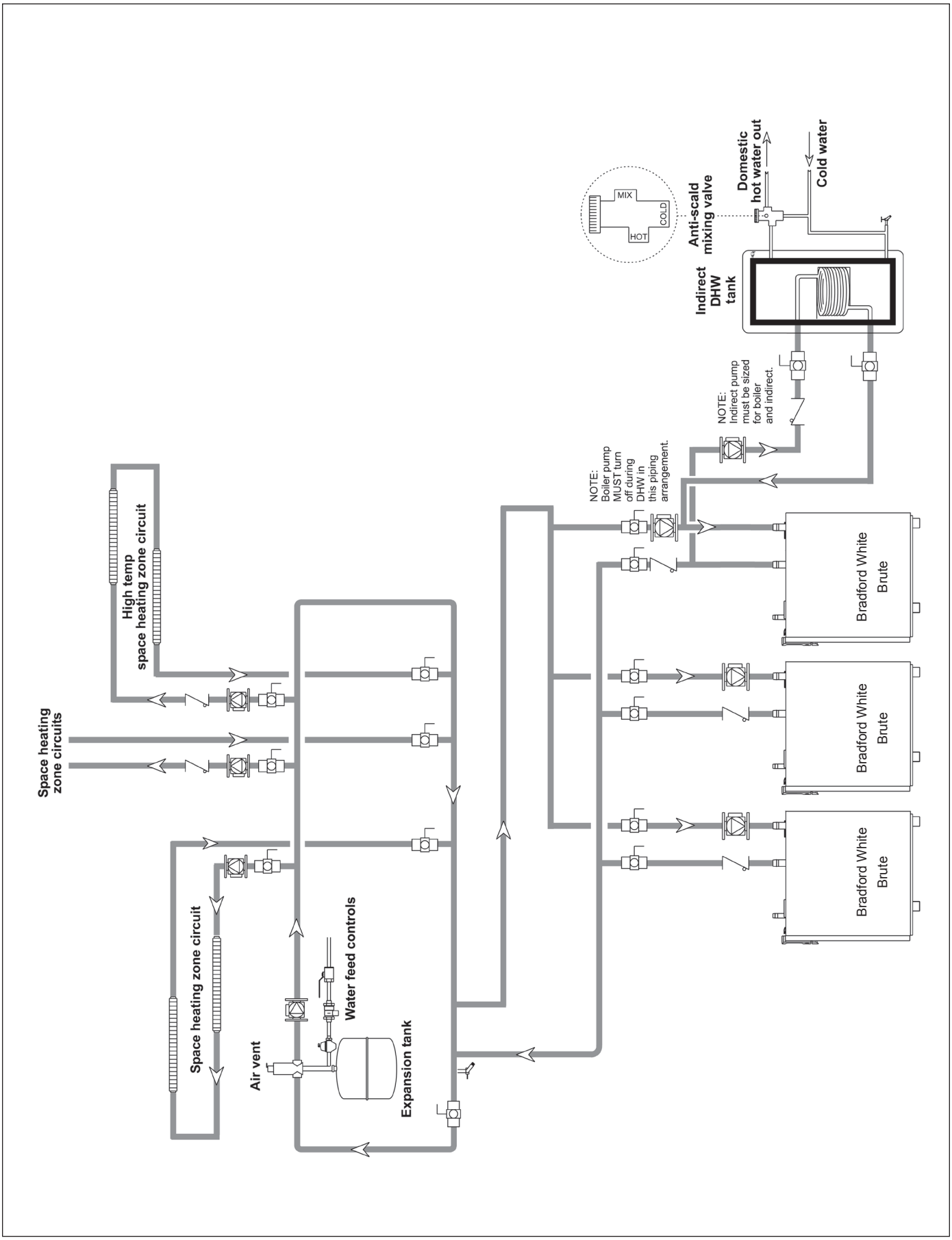


Figure 22. Hydronic Piping, Multiple Boilers with Indirect DHW Off of One Boiler

The boiler pump must shut down during DHW operation.

Section 6B - WATER CONNECTIONS - BNTV WATER HEATER

Section 6 is divided into two parts. Section 6A covers BNTH units designed for hydronic heating. Section 6B covers BNTV models, which are designed exclusively for "volume water" domestic hot water applications. Refer to the proper section for instructions on installing and piping your product. Refer to Table 11 on page 17 for the connection pipe sizes required.

6B.1 BNTV Water Quality

BNTV water heaters must be installed in water conditions of 10gpg hardness or less with a pH range of 8.2 to 9.5. Operating the BNTV in water with higher hardness levels will cause heat exchanger fouling, erosion, or corrosion leading to premature component failure, reduced efficiency, heat exchanger failure or system failure. Failure of this type will not be warranted. If the water in use exceeds the conditions recommended, a water softener or other device should be installed to improve water quality.

6B.2 Piping Requirements

Water piping should be supported by suitable hangers and floor stands. Do not support piping with the appliance. Due to expansion and contraction of copper pipe, consideration should be given to the type of hangers and supports used. Rigid hangers may transmit noise through the system resulting from piping sliding in the hangers. It is recommended that padding be used when rigid hangers are installed. Maintain 1" (2.5cm) clearance to combustibles for hot water pipes.

Pipe the discharge of the relief valve (full size) to the drain or in a manner to prevent injury in the event of pressure relief. Install a diaphragm-type expansion

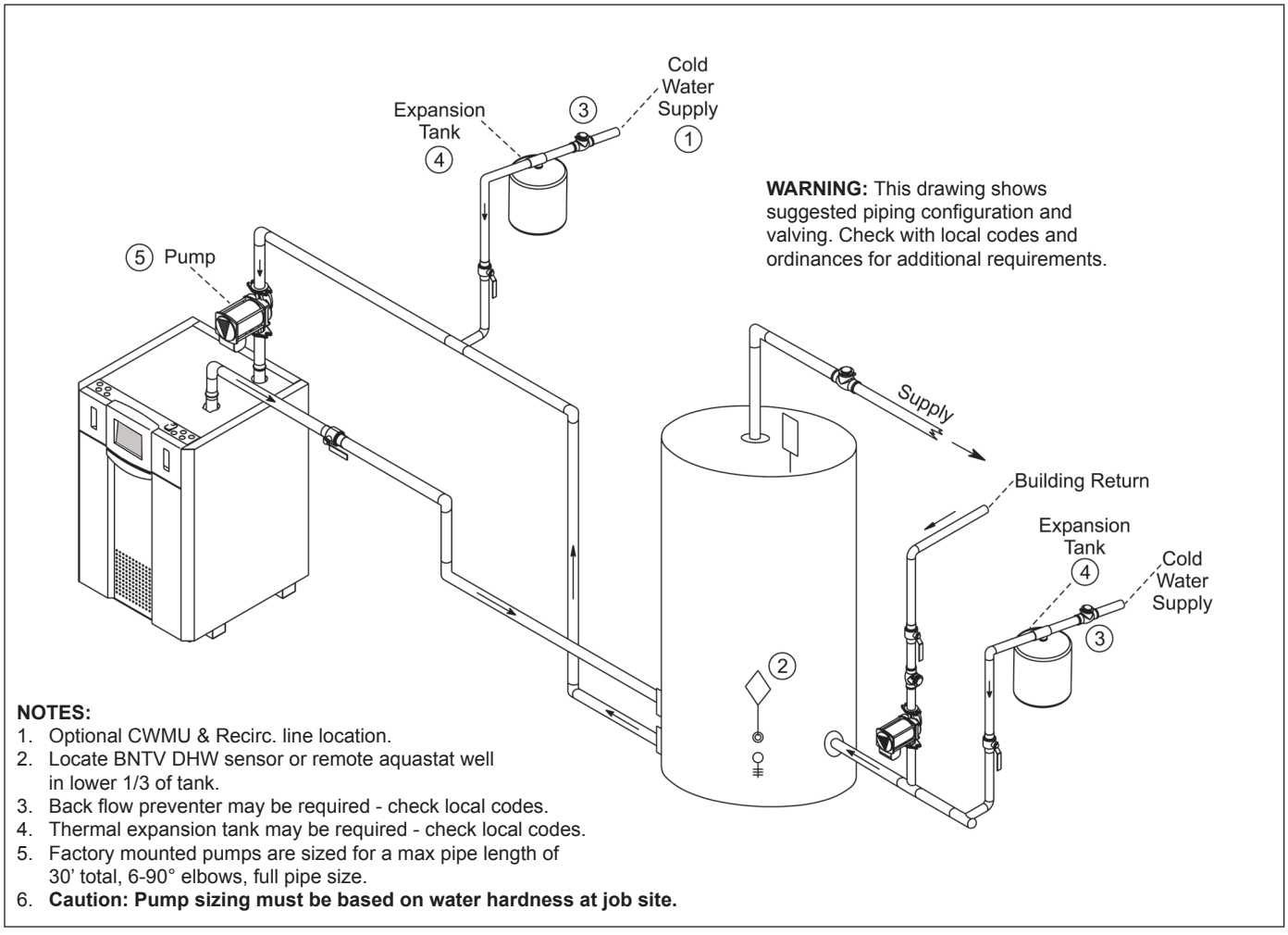


Figure 23. DHW Piping, One Heater, One Vertical Tank

tank, flow check, and shutoff valves where needed or as required by code.

Brute 150-500 can be ordered with pumps. Whether the factory pumps or other pumps are installed the piping should be installed such that the pump supplies flow to the heater it is attached to only. The factory pumps are sized for 30 feet and 6 elbows of total pipe length, so the heater should be placed within 15 feet of the tank. If longer runs are required, a properly-sized field-supplied pump should be used.

6B.3 Cold Water Make-Up

The cold water make-up may be connected to the tank or to the inlet of the boiler as shown in Figures 22-25. Install back flow preventers and shut offs where needed or required by code. Pipe sizes may have to be increased to accomodate cold water make-up flow.

6A.4 Condensate Drain

A condensate drain trap is built into the Brute unit.

Connect a 3/4” PVC pipe between the drain connection and a floor drain (or a condensate pump if a floor drain is not accessible).

The condensate drain must be installed so as to prevent accumulation of condensate. When a condensate pump is not used, the tubing must continuously slope downward toward the drain with no spiraling.

Consult local codes for the proper disposal method for the condensate.

⚠ Caution

Condensate is mildly acidic (pH = 5), and may harm some floor drains and/or pipes, particularly those that are metal. Ensure that the drain, drainpipe, and anything that will come in contact with the condensate can withstand the acidity, or neutralize the condensate before disposal. **Damage caused by failure to install a neutralizer kit or to adequately treat condensate will not be the manufacturer’s responsibility.**

6B.5 Freeze Protection

Brute heaters are not certified for outdoor installation, so the chance of freezing is minimized. In an event such as power outage, component failure or other issue when freezing is likely, the heater and system must be drained to avoid the risk of damage due to freezing. Glycol must ***not*** be used in volume water heating applications.

6B.6 BNTV Suggested Piping Schematics

Figures 23-25 show suggested piping configurations for BNTV boilers. These diagrams are only meant as guides. All components or piping required by local code must be installed.

6B.7 BNTV Suggested Pumps

Possible pumps for BNTV sizes 600-850 are Grundfos model TP 40-160/2B, or for size 600 (only) is Armstrong model E22B. See Table 8 on page 16 for heater water flow and head requirements.

Note - The head loss for the piping, fittings, and accessories must be calculated and added to the heater

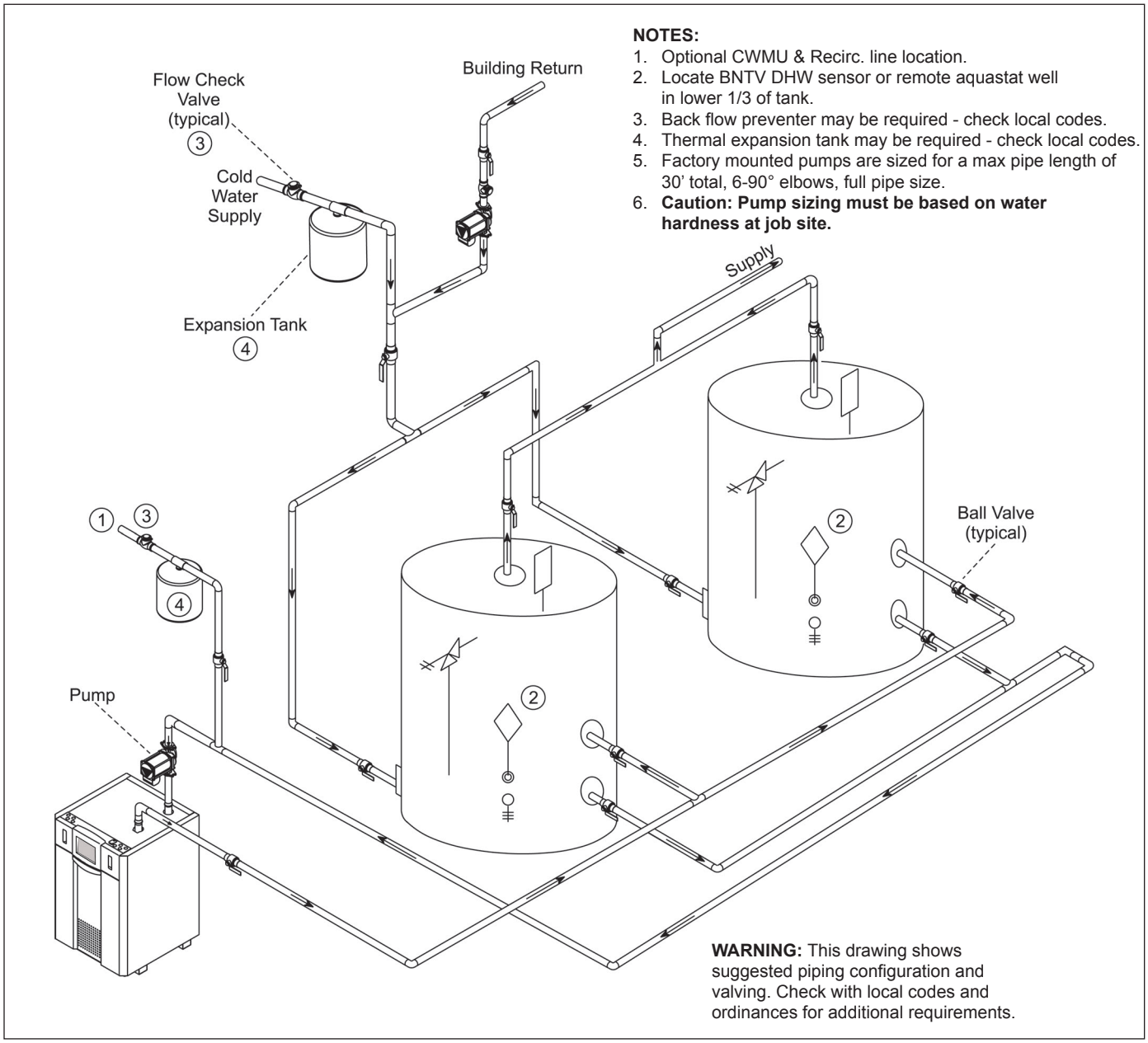


Figure 24. DHW Piping, One Heater, Two Vertical Tanks

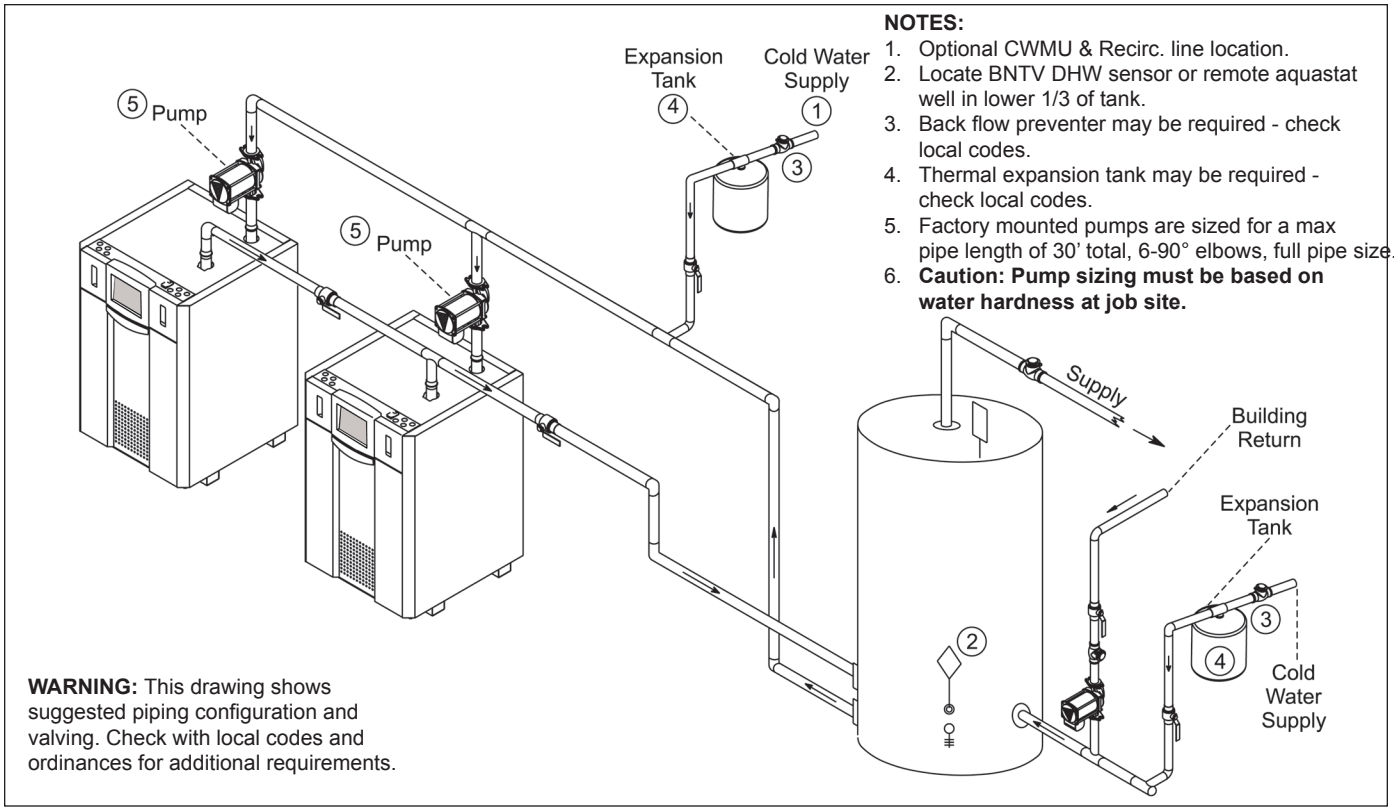


Figure 25. DHW Piping, Two Heaters, One Vertical Tank

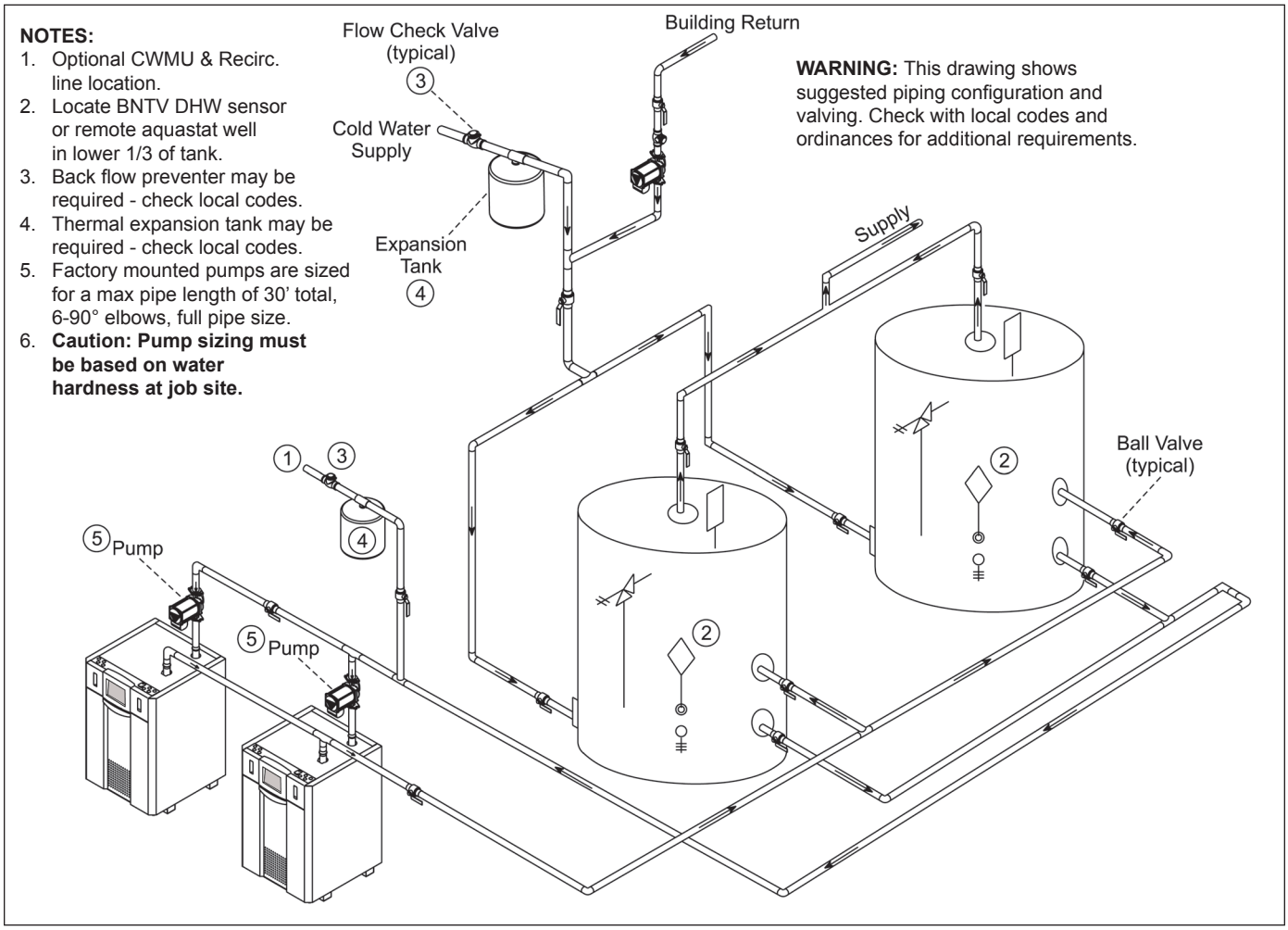


Figure 26. DHW Piping, Two Heaters, Two Vertical Tanks

Section 7 - INSTALLATION AND WIRING

7.1 Installation Warnings

⚠WARNING

The appliance must be electrically grounded in accordance with the requirements of the authority having jurisdiction or, in the absence of such requirements, with the latest edition of the National Electrical Code, ANSI/NFPA 70, in the U.S. and with the latest edition of CSA C22.1 Canadian Electrical Code, Part 1, in Canada. Do not rely on the gas or water piping to ground the metal parts of the boiler. Plastic pipe or dielectric unions may isolate the boiler electrically. Service and maintenance personnel, who work on or around the boiler, may be standing on wet floors and could be electrocuted by an ungrounded boiler. Electrocution can result in severe injury or death.

Single pole switches, including those of safety controls and protective devices, must not be wired in a grounded line.

All electrical connections are made on the terminal blocks that are located inside the control panel. Wiring connections are shown in Figure 34.

All internal electrical components have been prewired. No attempt should be made to connect electrical wires to any other location except the terminal blocks.

⚠ Caution

The supply voltage to the Brute unit must not be disconnected, except for service or isolation, or unless otherwise instructed by procedures outlined in this manual. To signal a call for heat, use the 24V field interlock, as shown in the wiring diagram.

DO NOT MAKE AND BREAK THE LINE VOLTAGE TO THE Brute UNIT TO SIGNAL A CALL FOR HEAT. A call for heat/ end call for heat MUST be connected to the field interlock terminals. Some Brute components are designed to have constant voltage during normal operation. If the Brute's supply voltage is toggled as a call for heat signal, premature failure of these components may result.

The Brute unit does not recognize 4mA as a signal to shut off. If the call for heat is not connected between the field interlock terminals, the Brute will remain in low fire when it sees 4mA as a modulating signal.

7.2 Main Power Connections

Connect a 15A fused, 120-volt supply to the main power switch. (The hot leg is connected directly to the switch.) The neutral leg is connected directly to the white wire. The ground wire can be connected to the grounding lug on the control panel. (See Fig. 34.)

7.3 Pump Connections and Operation

The controller in the Brute energizes the pump contacts when it receives a call for heat. Once the call for heat is satisfied, the pump will remain on for the defined pump overrun time.

The Boiler Pump terminals (TB5 - max 7.4 FLA) are fed by 120V (violet wire) internally from the main power feed. The System and DHW contacts are dry contacts. Appropriate voltage must be supplied to the System and DHW pumps for proper operation.

The System pump connections are located on terminal block 5 (TB5) in the control panel. (See Figure 34.) The System pump contacts are rated for 120Vac, 7.4 Amps. To use the contacts, power must be supplied on one terminal with the other terminal wired to the pump or a relay controlling the pump.

The DHW pump connections are located on terminal block 5 (TB5) in the control panel and are rated for 120Vac, 7.4 Amps. To use the contacts, power must be supplied on one terminal, and the other terminal wired to the pump or a relay controlling the pump.

Additional 120VAC circuits may be required for the pumps.

7.4 Hydronic Heating Using External Modulation Control -

About External Control -

When the Brute is used for hydronic heating with external modulation control, a call for heat must be supplied to the "T-T or Interlock" terminal. Once the call is supplied the control starts the Boiler and System pumps and begins the ignition process. Once in Run, the Brute monitors the flame signal, call for heat, safeties, and water temperatures. The boiler setpoint is used to limit the maximum water temperature leaving the boiler only. The modulation rate is controlled by a 4-20mA signal supplied by an external control. (This can also be 0-10Vdc using a converter - Bradford White part number CA006100.) When setting up a system using an external control, take care to set Anti-Short Cycle feature to prevent "hunting " and possible

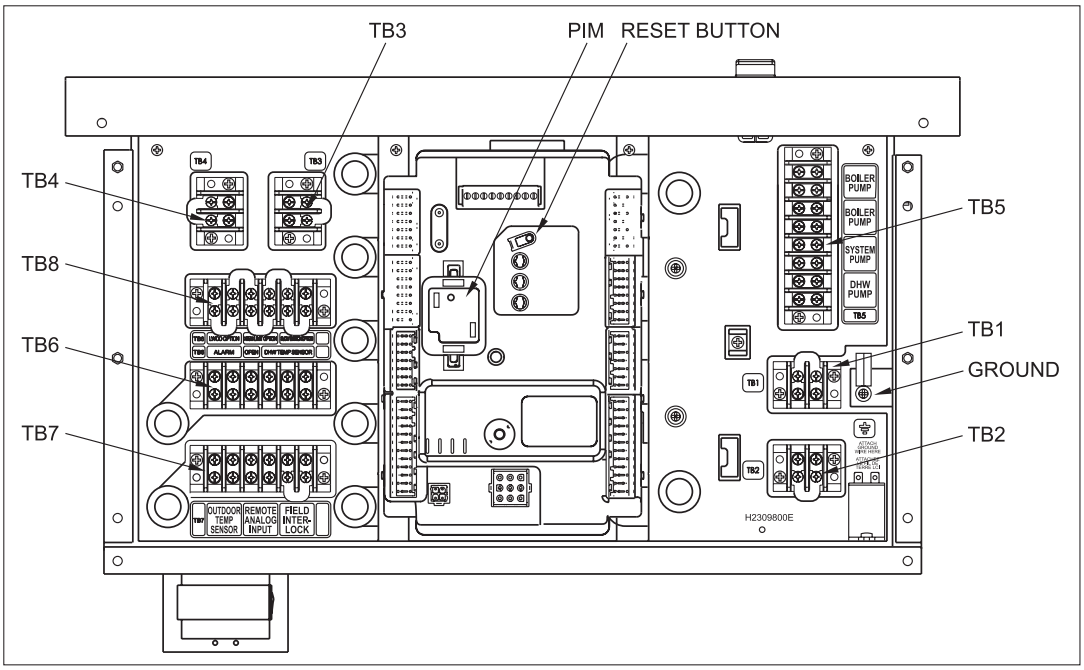


Figure 27. Control Panel Layout

SIZES	BOILER			PUMP CONNECTIONS RATINGS (Boiler, System Pump and DHW Pump Connections)
	VOLTS	PHASE	AMPS	
199–850 No Pump	120	Single	2*	115V – Maximum 1HP or 7.4A max
199-500 With Pump	120	Single	Less than 6*	115V – Maximum 1HP or 7.4A max

*Minimum 15A circuit required

Table 12. BNTH Electrical Data

SIZES	WATER HEATER VOLTS	PHASE	AMPS
199-500 No pump	120	Single	2*
199 With pump	120	Single	7*
285-500 With pump	120	Single	8*
600-850 No pump	See Pump Rating Plate FLA (must be less than 7.4 FLA)		

*Minimum 15A circuit required

Table 13. BNTV Electrical Data

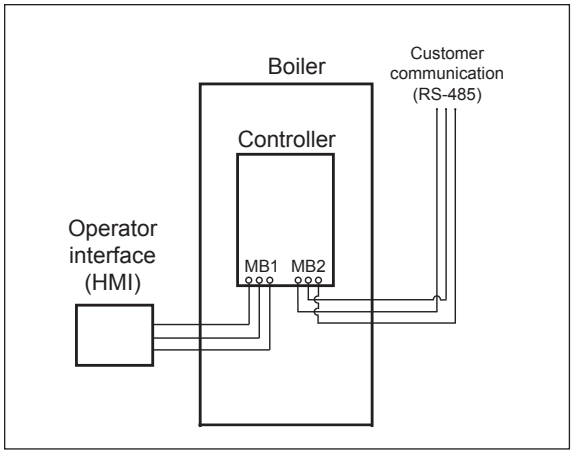


Figure 28. BAS Connections to a Single Boiler

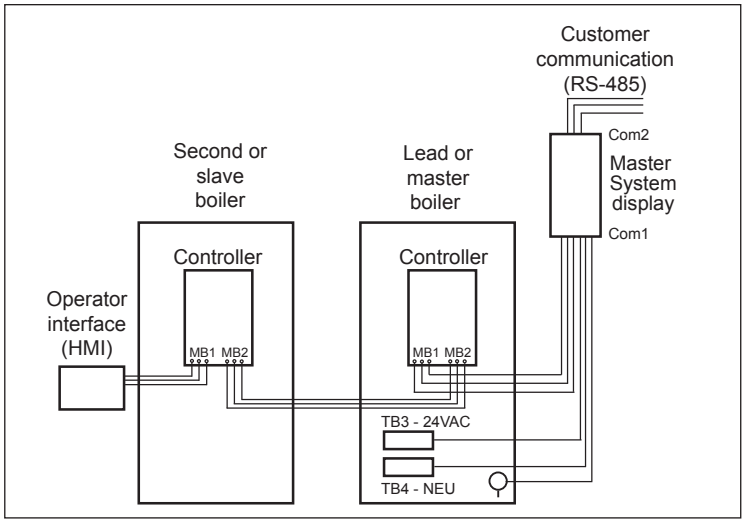


Figure 29. BAS Connections to a Lead/ Lag System

premature component failure.

Connections for External Control -

Connect the 4-20mA signal from an external control or building automation system to terminal block 7 (TB7) in the control panel. The connections are labeled Remote Analog Input. When making the connections, follow the polarity designations shown on the label.

Terminal block 8 (TB8) in the control panel can be used for connecting optional components, such as low water cutoffs, flow switches, additional high limits and other field-supplied devices that must be interlocked with the boiler. These are non-powered dry contacts only. All safeties or end switches must be wired in series by removing the supplied jumpers.

7.6 Connections to a Building Automation System

Brute boilers can be controlled and monitored through the included Modbus ports. The Modbus wiring should be completed according to the diagrams shown below. If alternate communication protocols are desired, Bradford White offers “gateways” to allow BACnet, LON, and other communications protocols. For additional information on setting up Modbus and other communication protocols, contact the factory.

Signals from a Building Automation System can be connected to the MB2 Modbus connections on the controller. See Fig. 41. (MB1 is used to connect to the Operator Interface (UI).

If multiple boilers are connecting in a cascading Lead/ Lag arrangement, the signals from the Building Automation System must be brought in through a System Display.
See Fig. 42.

7.7 Ladder and Wire Diagrams

See Figure 30 and Figure 31

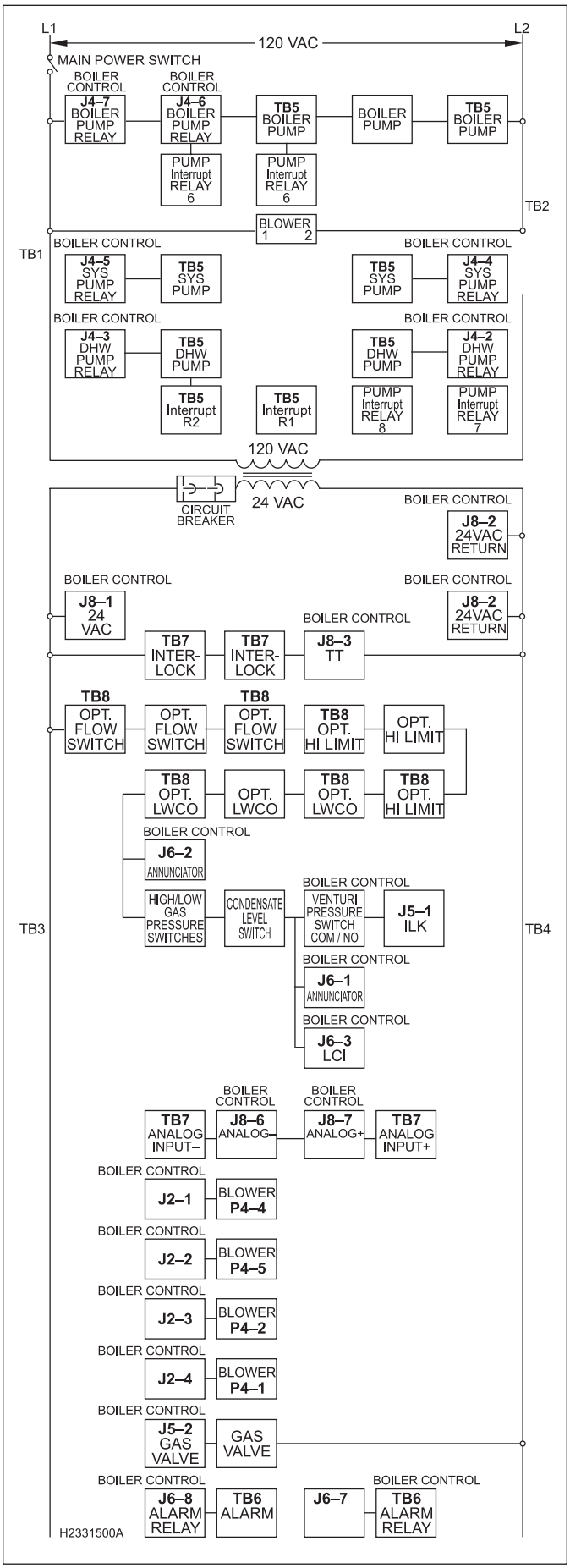


Figure 30. Ladder Diagram

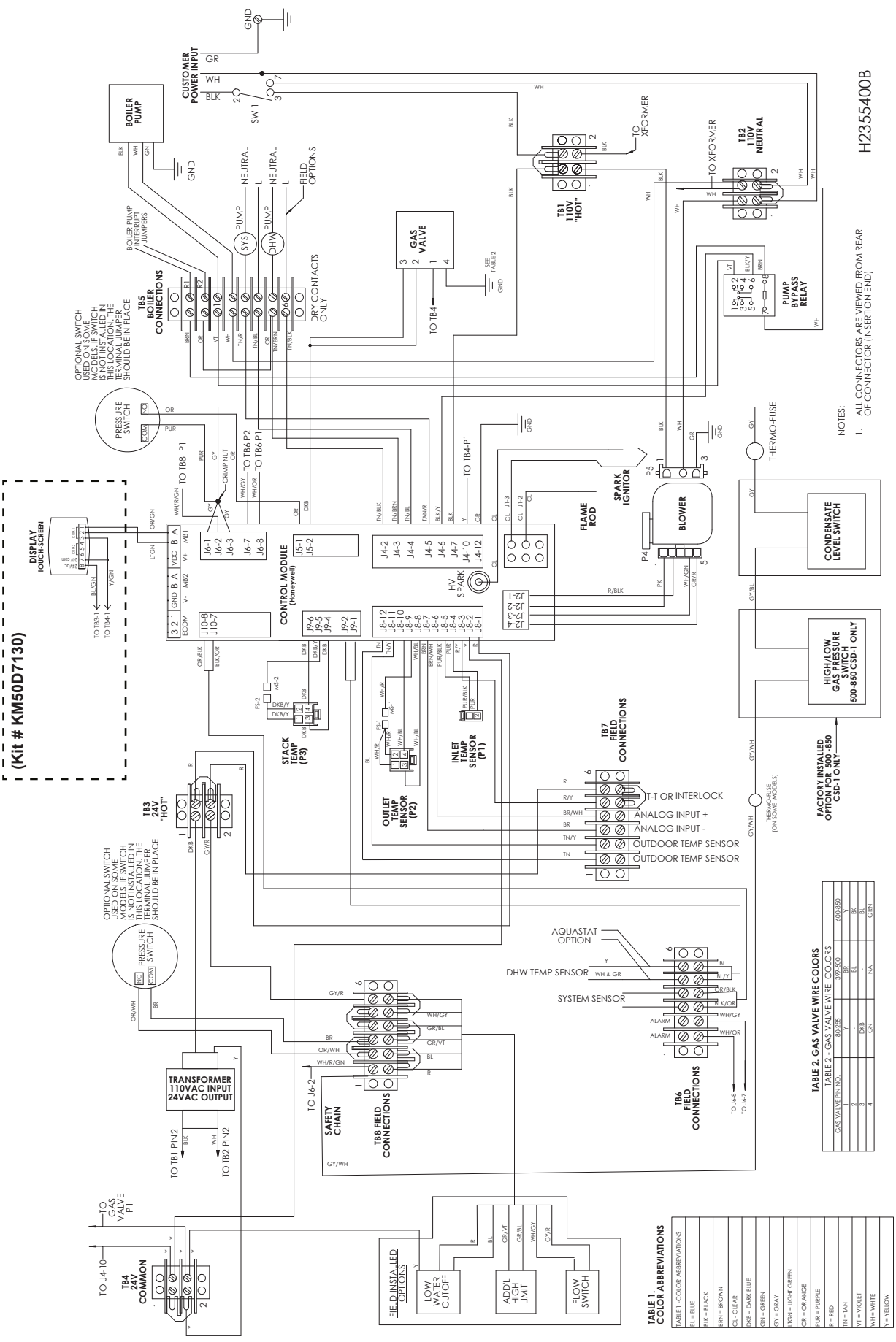


Figure 31. Wiring Diagram, All Sizes

Section 8
Navigating the Touch Screen

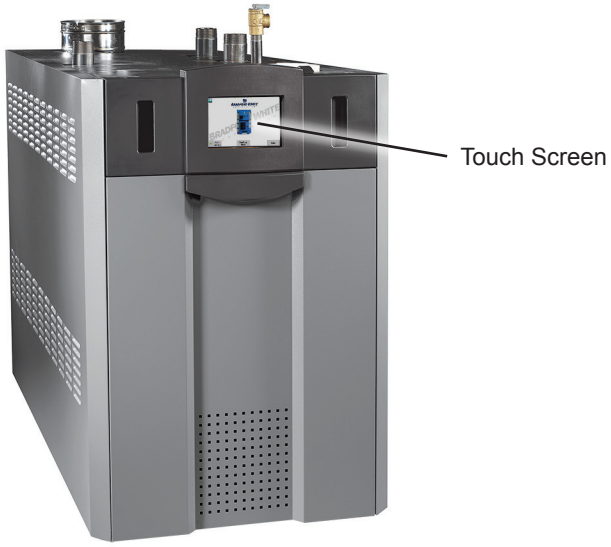


Figure 32. Brute with Touch Screen

8.1 The Touch Screen

The Touch Screen is located front and center on the Brute and allows you to navigate into all of the functionality and control that is available to setup and customize your heating and/or hotwater system.

8.2 Using the Touch Screen

A screen saver is programmed into the display. Simply touch the screen to wake it up.

While under normal operation, the Touch Screen will automatically present this Home screen. See Menu 1

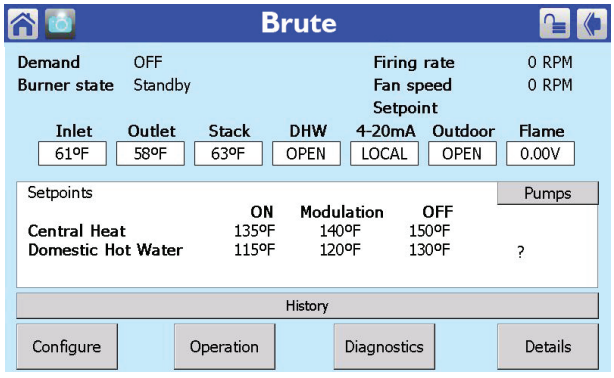
Menu 1. Home Screen

The home screen shows a picture of the Brute controller. The color of the controller depends on the status of the Brute, as shown below.

Color	Status	Control Icon
Blue	Normal operation	
Red	Lockout	
Gray	Standby mode (Burner switch off)	
Gray and crossed out	Communication problem	
Yellow	Hold state. This could be Anti short cycle, fan speed transitions, etc.	

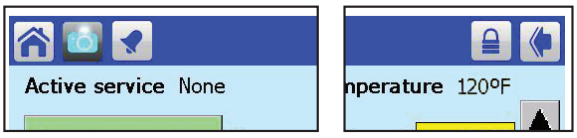
Figure 33. Boiler Status Colors

To check the operation of the appliance, press the large Control Icon on the Home screen. The system will present a Status Summary screen for the appliance:



Menu 2. Status Summary

Screen Menu Icons



There are several icons at the top of the Touch Screen Menus (and most of the other screens) that will help you move around the system:

Home	Upper left-hand corner	Return to Home page
Camera	Upper left-hand corner	Screen-shot of current menu as a JPG file
Bell	Upper left-hand corner	System in Lockout, Reset required
Padlock	Upper right-hand corner	Shows whether a password has been entered so parameters can be changed
Back	Upper right-hand corner	Return to previous screen

Sometimes a screen is used to present a list, and often the list is too long to present on a single screen view. To see the rest of the list, pull down on the bar on the right side of the screen, or use the up- and down-arrows.

To make a change, or to get more information about one of the items on the list, press on the line for that item.

To change some parameters, a password is required. The control system includes three levels of password protection:

OEM Password — Setup and parameter changes available only to the factory.

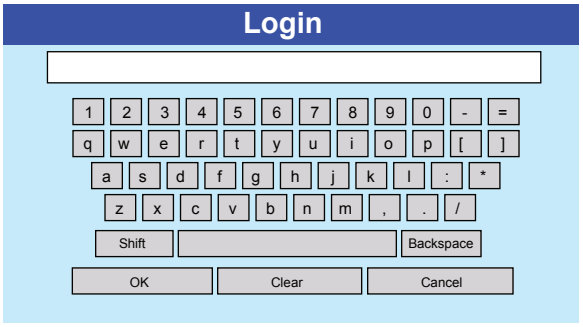
Installer Password — Setup and parameter changes made when the system is installed, and some diagnostic and troubleshooting functions.

The installer level password is "lnt" (lower case "LNT.")

User Level (no password required) — Non-critical adjustments and functions, including adjusting the Central Heat and Domestic Hot Water setpoints, monitoring the input and output variables, reading parameters from the controller, and reading the error log

(For some special safety-related functions, besides entering the correct password, the system will ask you to go through an additional "verification" process. For more information, see the section on "Configuration.")

When a password is necessary, the system will present the keyboard screen. See Menu 3.



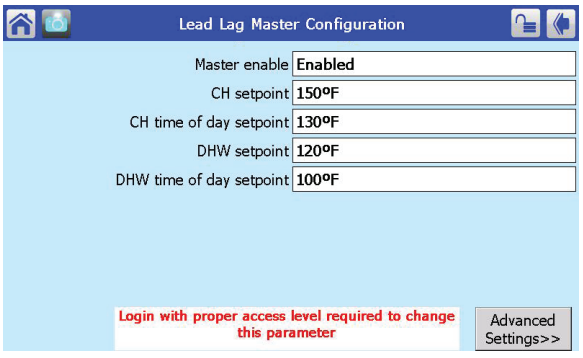
Menu 3. Keyboard Screen

The passwords used by this system are "case sensitive" – it matters whether a letter in the password is capitalized or not. Pressing the Shift key toggles between capital and lower case letters.

"BS" stands for "Back Space," and also works as a Delete key.

Anyone can *view* all of the parameters. However, to *change* most of the parameters, you will need a password.

At the bottom of the screen, the system indicates that you need to enter a password.



Menu 4. Login Required

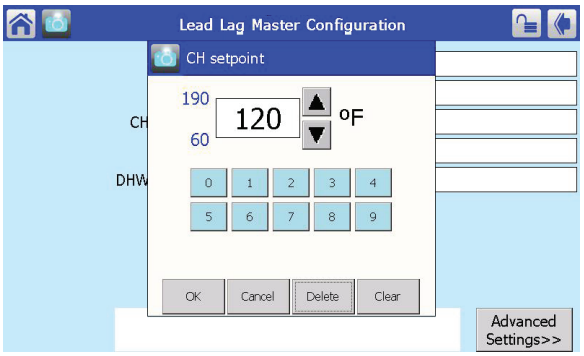
The screen used to Login is similar to the Keyboard screen.

It may be difficult for some operators to press the keys on this screen. In this case, use the back of a plastic pen, or a stylus, or a pencil eraser. (Do not use sharp metal tools – these may damage the plastic

surface of the screen.)

Each time you press a key, the system will respond with a beep. If you are entering a password, an asterisk (*) will appear for each character you enter. The beeps and asterisks will help you enter the correct number of characters for your password.

When changing a numerical value, the system presents a numerical entry screen, as shown below.

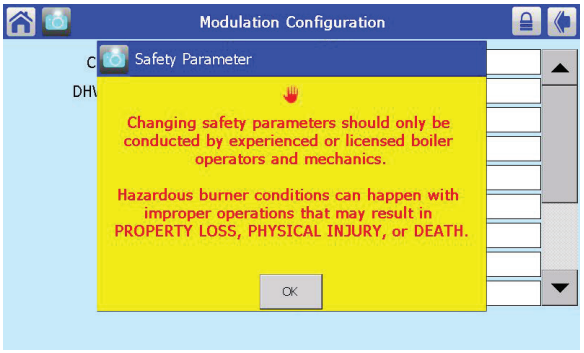


Menu 5. Numeric Entry Screen

8.3 Verification Process for Safety-Related Parameters

The verification process allows the user to confirm that all the changes made are correct and that there have not been any inadvertent changes made.

1. When you start to change a parameter that is related to safety, the system will present a warning which looks like this:



Menu 6. Parameter Safety Warning

⚠WARNING

Changing safety parameters should only be conducted by experienced, licensed boiler operators and mechanics. Hazardous burner conditions can happen with improper operations that may result in PROPERTY LOSS, PHYSICAL INJURY, or DEATH.

Press OK to continue. The system will ask you to login before you make a change. (For more information on logging in, see Section 8.2.)

2. If you make a change in any group that could affect the safe operation of the unit, the control system will ask you to "verify" the change before it is accepted.

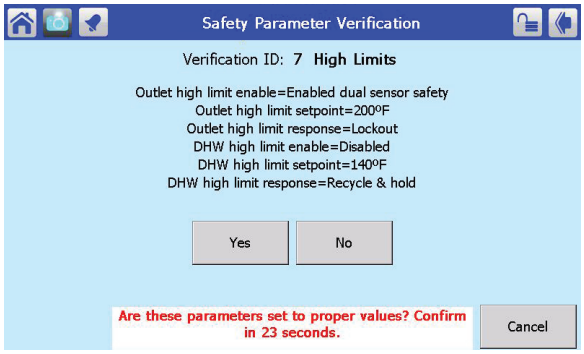
3. Once all parameters have been changed, return to the configure menu. In the lower right hand corner of the screen you will see 'VERIFY' Press VERIFY, then press BEGIN to start verification.

Notes –

- Once you change one of these safety-related parameters, you ***must*** finish the verification process for the group that includes the parameter, ***or the control system will not let the boiler operate***. You can wait to do the verification until you have changed parameters in other groups, but before you return the boiler to service, you must complete the verification process for all groups that have been changed.
- At the end of the verification process, you must press the Reset button on the front of the controller. See Figure 34. You have to do this within 30 seconds, or the verification will be cancelled. To make it easy to reach the Reset button, open the door on the front of the boiler and slide out the control panel ***before*** beginning the verification.

Figure 34. Reset Button on Controller

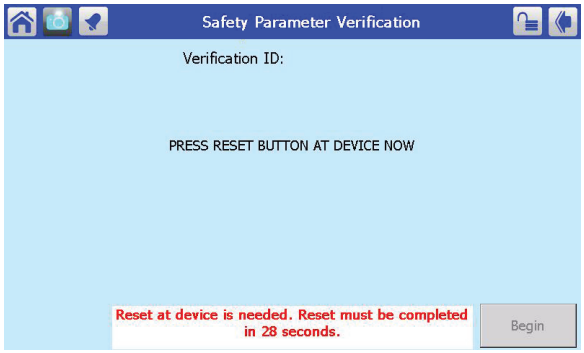
4. The system will present a listing for each group of parameters that need verification
   See Menu 7.



Menu 7. Safety Parameter Confirmation

5. For each group, check the list carefully. Press Yes if all of the parameters in the group have been entered correctly. For each group, you are given 30 seconds to select Yes/No.
   A count-down timer is shown at the bottom of the screen.

   If you made changes in other safety-related groups, verify the entries in those groups in the same way. Do this until the following screen shows



Menu 8. Safety Parameter Reset

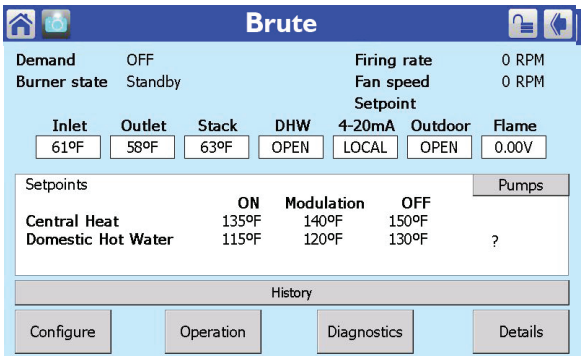
6. When the process is complete, the system will tell you to reset the control system. The Reset button is located on the front of the controller. You must press the Reset button within 30 seconds, or the verification will be cancelled. A count-down timer is shown at the bottom of the screen.

8.4 Checking Individual Parameters

1. From the 'Home' screen (Menu 9), press the icon for the controller.

Menu 9. 'Home' screen

2. The Status Summary page for the controller will appear. This shows the current operating condition of the controller, and also shows some of the configuration settings.
   See Menu 10



Menu 10. Status Summary Screen

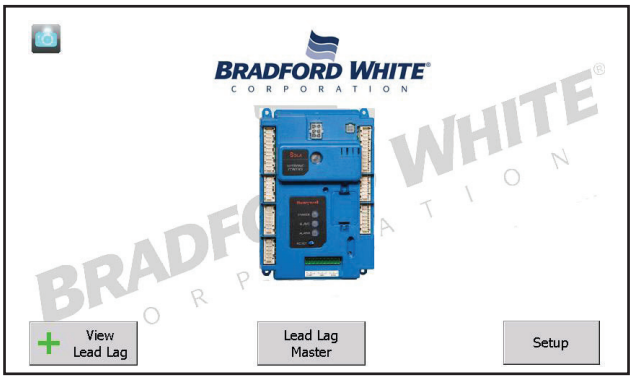
Notice the four buttons at the bottom of each Status Summary screen:

- Configure – Allows an installer to change some of the setup parameters used by the system. A password may be required.
- Operation – Used to adjust the setpoints, change the fan speed, turn a burner on or off, or turn the pumps on or off.
- Diagnostics – Allows you to run diagnostic tests, or check the inputs and outputs used by the system.
- Details – Allows you to check the status of all of the setup parameters on the control system.

8.5 Configuring Parameters

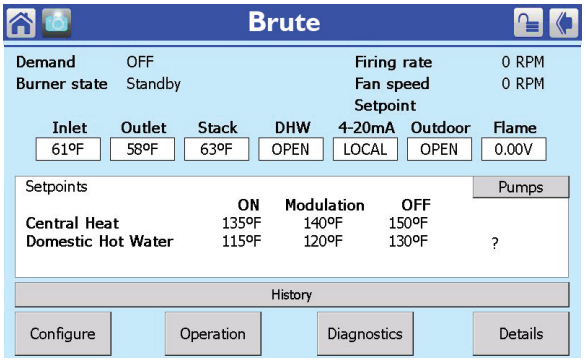
In this section, we will give you a quick explanation of how to change parameters on the controller.

1. From the Home Page screen (Menu 11), press the icon for the controller.



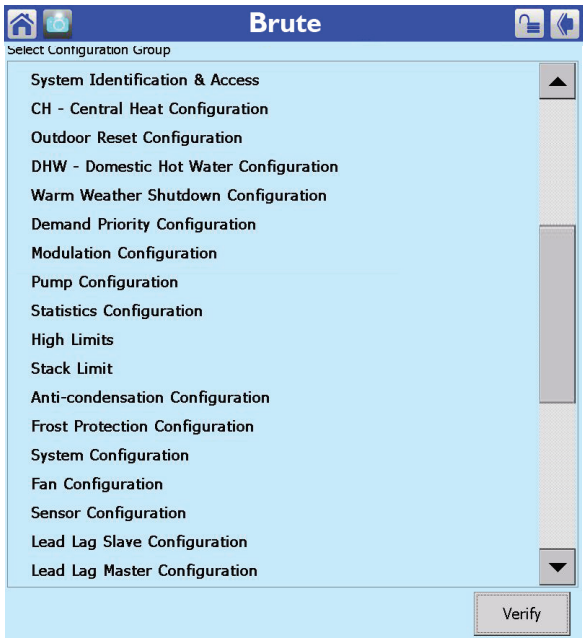
Menu 11. Home Page Screen

2. The Status Summary page for that controller will appear. See Menu 12



Menu 12. Status Summary Screen

3. Press the Configure button to start a configuration session for the controller.



Menu 13. Configuration Screen

This screen lists all of the configuration groups that will be outlined in Section 9.

8.6 Setting the Date and Time on the System Display

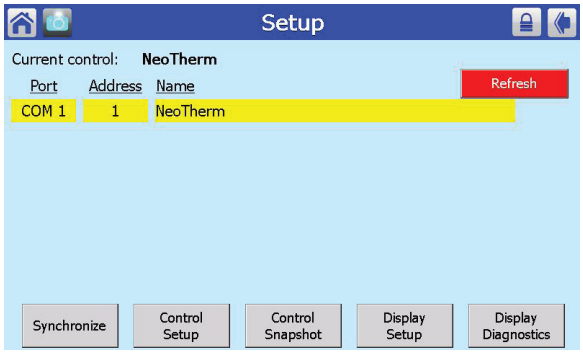
The display includes an internal clock, which keeps track of the date and time. This setting is important, because log entries for Lockouts and Alerts include time listings. If the Date and Time setting for the boiler is not correct, the listings in the Lockout and Alert logs will be incorrect.

To set the clock:

1. Start at the 'Home' screen.

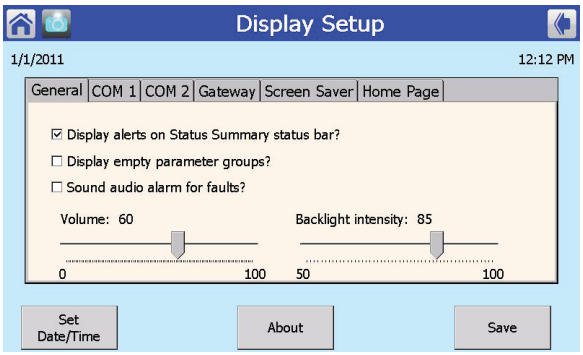
Menu 14. 'Home' screen

2. Press the Setup button on the lower right corner of the screen. The system will present the Setup screen.



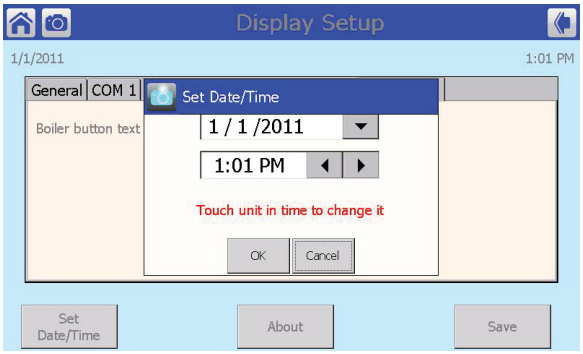
Menu 15. Setup Screen

3. Press the Display Setup button at the bottom of the screen.



Menu 16. Display Setup Screen

4. Press 'Set Date/Time' button.

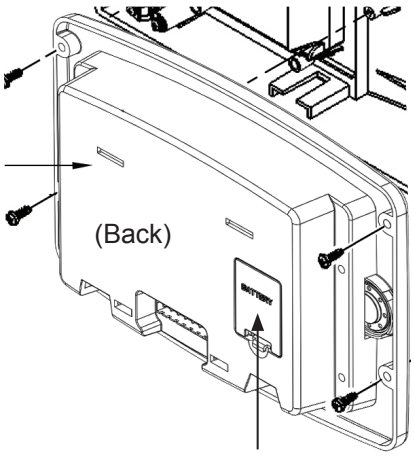


Menu 17. Date and Time

5. Use the arrows to change the date and time, and then press the OK button.

Battery

The display has a removable battery (CR2032) to store time, date, lockout, and alerts in the event of a power failure. It has an expected lifetime of 10 years. The battery can be accessed from the back of the Touchscreen display.

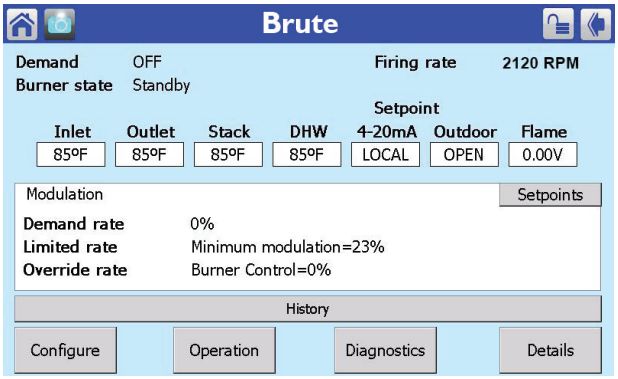


Battery (CR2032)

8.7 Configuration Sub-Menus (ALL)

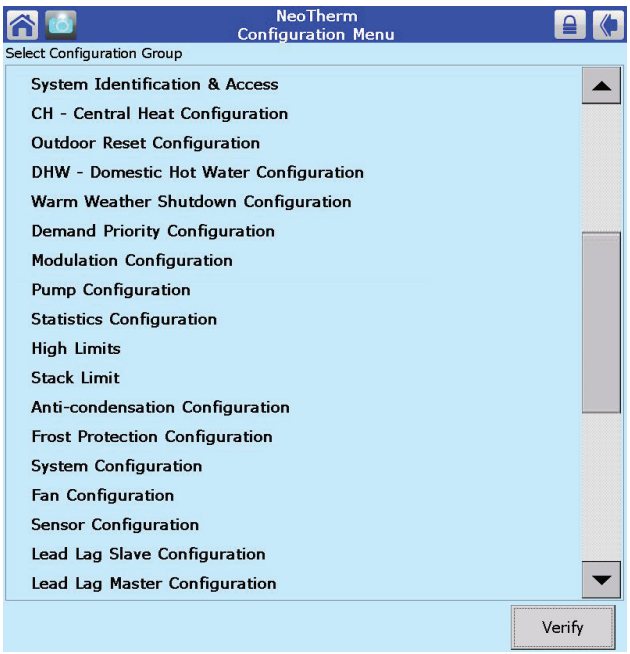
Menu 18. Home Screen

To navigate to the Configuration Menu Screen, first touch the controller icon on the home screen to access the Status Summary screen,



Menu 19. Status Summary Screen

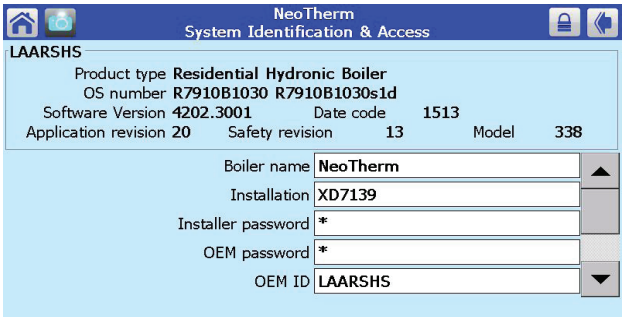
From the Status Summary Screen, touch the 'Configure' button on the bottom left, to access the Configuration Menu.



Menu 20. Configuration Menu

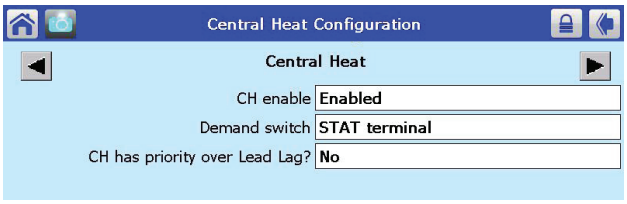
8.7.1 thru 8.7.15 are the Configuration Sub-Menus.

8.7.1 System Identification & Access



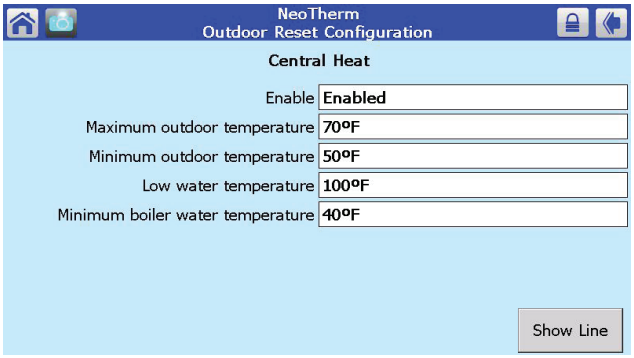
This sub-menu will display information regarding software, date codes, model numbers and program name, as well as giving the installer access to re-name the boiler and to change the modbus addresses for lead lag operation.

8.7.2 CH - Central Heat Configuration



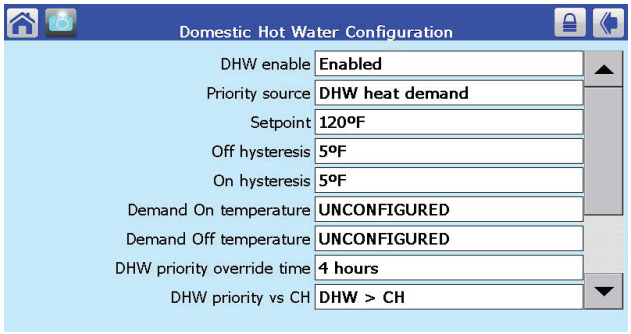
When using the Brute for hydronic heating, a call for heat must be supplied to the "T-T" terminals found on TB7 labeled "T-T or Interlock". Once a call for heat is established, the control will start the appropriate (selected) pumps, and begin the ignition process. From the "Home" screen touch the Sola icon, then press "Configure". Choose 'CH-Central Heat Configuration to make adjustments to setpoint, and modulation for a single boiler CH demand.

8.7.3 Outdoor Reset Configuration



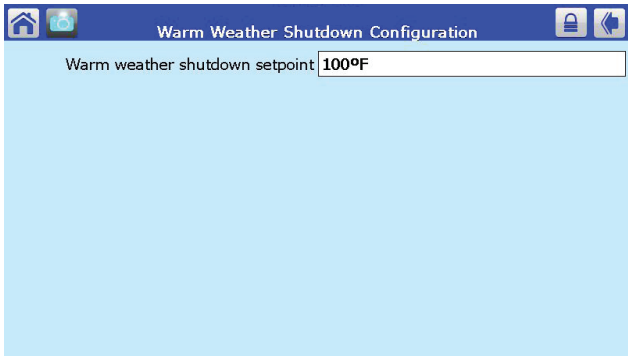
Description of Outdoor Sensor

8.7.4 DHW - Domestic Hot Water Configuration



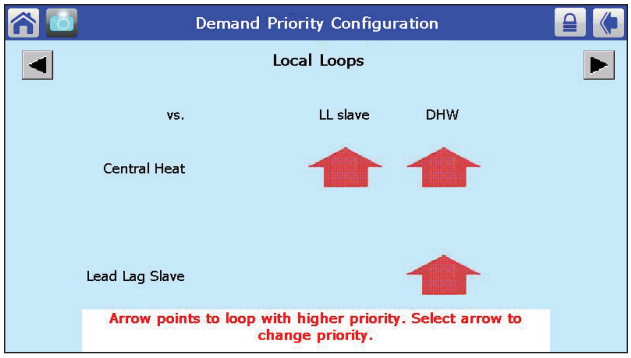
DHW - Domestic Hot Water is used to configure the DHW temperature parameters for water heaters (BNTV) and for indirect water heaters that are used with boiler (BNTH) systems.

8.7.5 Warm Weather Shutdown Configuration



From this sub-menu you will be able to enable/disable the Warm Weather Shutdown feature and adjust the set point.

8.7.6 Demand Priority Configuration

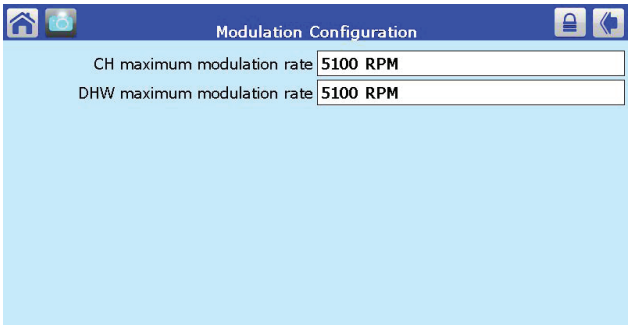


From the Demand Priority Configuration, the installer can adjust the priority of the different demand types.

-Central Heat
-Domestic Hot Water
-Lead Lag

The control uses arrows as indicators to point to the loop with higher priority.

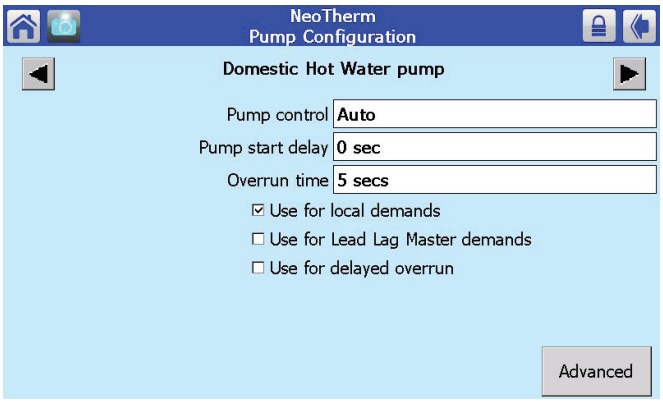
8.7.7 Modulation Configuration



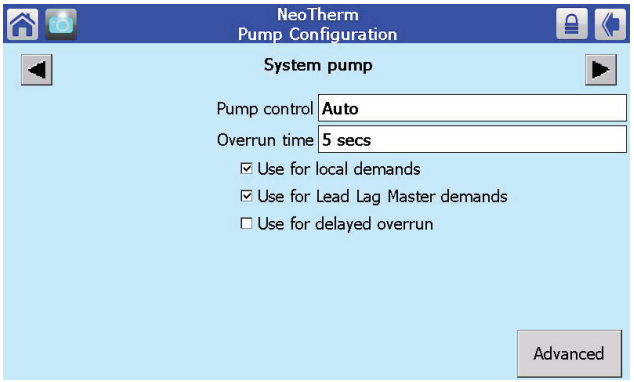
From this sub-menu the installer has the ability to adjust the range of modulation for the CH, and DHW demands. Brute is designed with a 5:1 turn down ratio. Any change to the minimum and maximum modulation rates will affect the overall ratio of the boiler. The installer level password will allow changes to these parameters. Consult the factory if an adjustment is needed to any of these parameters.

8.7.8 Pump Connections

The controller in the Brute energizes the pump contacts when it receives a call for heat. Once the call for heat is satisfied, the pump will remain on for the defined pump overrun time.\

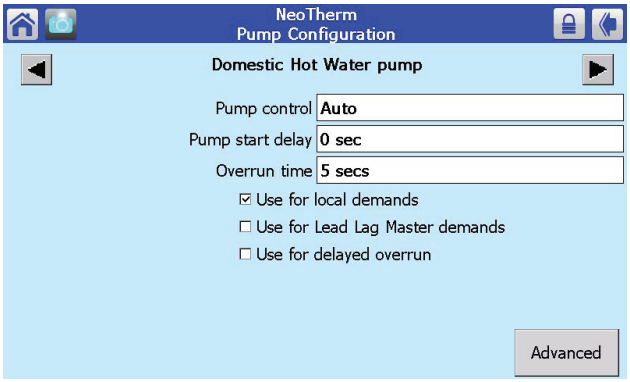


The Boiler Pump terminals (TB5 - max 7.4 FLA) are fed by 120V (violet wire) internally from the main power feed. The System and DHW contacts are dry contacts. Appropriate voltage must be supplied to the System and DHW pumps for p[redacted]ion.



8.7.8 Pump Connections (cont)

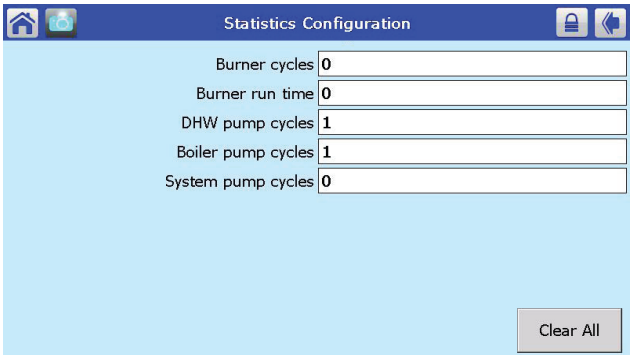
The System pump connections are located on terminal block 5 (TB5) in the control panel. The System pump contacts are rated for 120Vac, 7.4 Amps. To use the contacts, power must be supplied on one terminal with the other terminal wired to the pump or a relay controlling the pump.



The DHW pump connections are located on terminal block 5 (TB5) in the control panel and are rated for 120Vac, 7.4 Amps. To use the contacts, power must be supplied on one terminal, and the other terminal wired to the pump or a relay controlling the pump.

Additional 120VAC circuits may be required for the pumps.

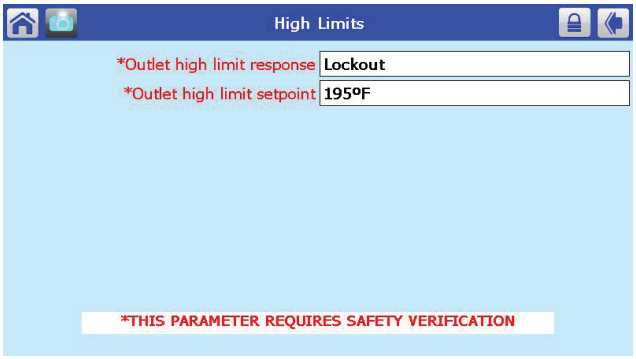
8.7.9 Statistics Configuration



The statistics configuration sub-menu allows the installer to view Burner Cycles, Burner Run Time, DHW Pump Cycles, Boiler Pump Cycles, and System Pump Cycles.

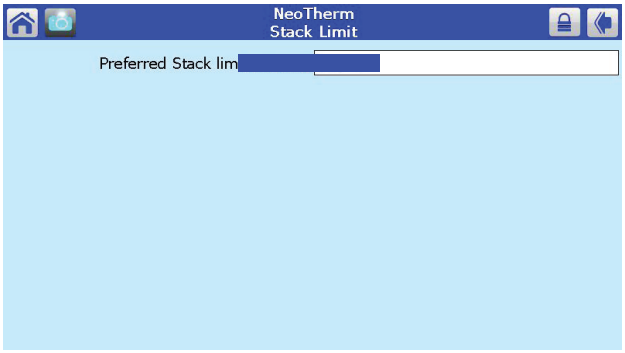
This sub-menu is ‘Read-Only’

8.7.10 High Limits



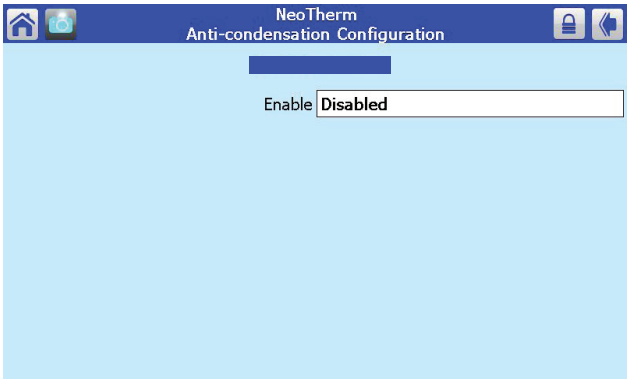
The outlet High limit can be adjusted using the installer password. After a change is made, the control will lockout and require a Safety Verification (see Section 9.3 for more details on Safety Verification).

8.7.11 Stack Limits

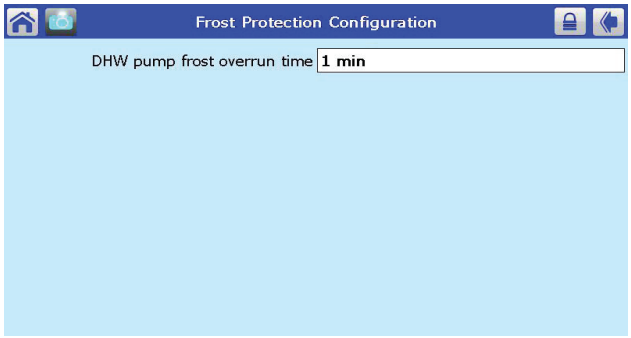


8.7.12 Anti-Condensation Configuration

Anti-condensation (frost protection) is enabled/disabled on this screen

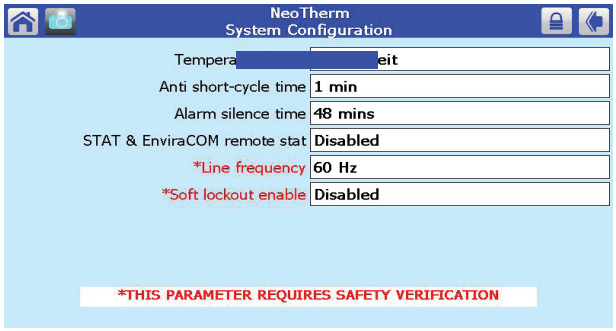


8.7.13 Frost Protection



Frost protection will assist in keeping the Brute from freezing when the unit is not able to fire, but is still able to run the pumps. The frost overrun time can be changed on this screen.

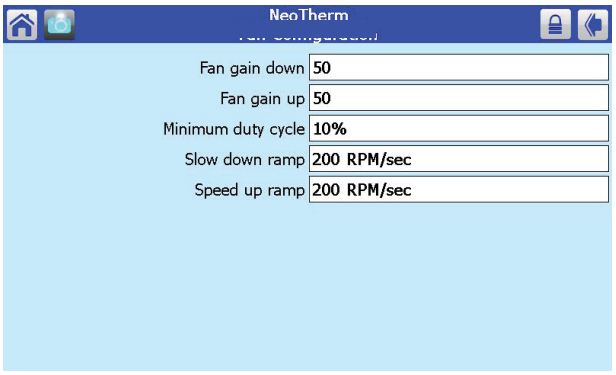
8.7.14 System Configuration



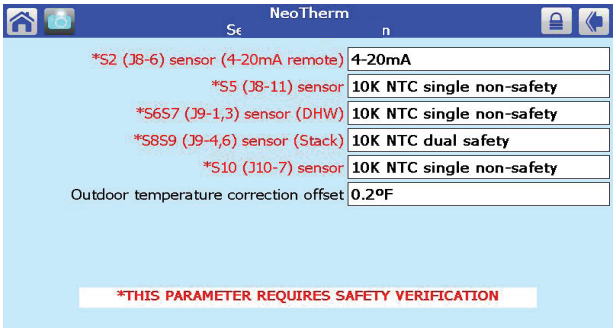
The installer can set the control to display temperature units in °F or °C, can adjust the anti short -cycle time, the low fire cutoff time, burner off inhibit time, and can set the time allowed for an alarm to sound before being silenced.

8.7.15 Fan Configuration

To increase/decrease the speed at which the fan control loop reacts to a decrease in fan speed, adjust the Fan gain down parameter. Similarly, to increase/ decrease the speed at which the fan control loop reacts to an increase in fan speed, adjust the Fan gain up parameter. The minimum duty cycle is a view only parameter. To set a fixed RPM at which the fan should ramp up or down, adjust the Speed up ramp or Speed down ramp respectively.



8.7.16 Sensor Configuration



The outdoor temperature can be read from the outdoor sensor that is shipped with the Brute.

About Lead/Lag Operation

About Lead/Lag Operation -

If an installation includes two or more boilers, they may be set up for “Lead/Lag” operation. One boiler will be set up as the “Master”, and the others will operate as “Slaves.” Figure 35 shows an installation with eight boilers. (A Lead/Lag system can include up to eight boilers.) The boiler controllers are connected in a “daisy chain” using a Modbus connection.

A single System sensor is used to monitor the demand for heat. The input from this sensor is used by the Master controller to control the modulation rates of all of the operating boilers.

Lead/Lag Modulation Cycle -

Note - We will explain the modulation cycle here, in case you need to understand how the Lead/Lag system actually operates. If you are installing the unit(s) and want to skip this section, just remember that, as the heating demand increases, the Lead/Lag system puts more boilers on-line. As the heating demand is reduced, the Lead/Lag system shuts off some of the boilers.

The signal from the System sensor is sent to the unit operating as the Lead/Lag Master. A Run sequence is initiated when the system temperature falls to the Lead/Lag Central Heat setpoint. (Actually this is the LL CH setpoint less the On Hysteresis value. The default setting for On Hysteresis is 5°F, but this is adjustable.)

Notice that, when a boiler is operating as part of a Lead/Lag system, it does not use the normal CH setpoint – it uses the special LL CH setpoint on the Lead/Lag Master.

The unit acting as the Lead/Lag Master decides which boiler is assigned to start first. This assignment is rotated across all of the available boilers so that any one boiler does not run significantly longer than the others. The Lead/Lag controller tracks the run times for all of the boilers, and uses this to calculate the starting order for the boilers. This means that each time the system starts up, a different boiler may start first.

> ⚠ Caution
>
> You should set the Modbus addresses before you connect the Modbus wiring. If the wiring is attached before the Modbus addresses on the controls are changed, there will be multiple controls with the same address, and the system will not work.

> ⚠ WARNING
>
> If the Modbus addresses are not assigned properly, the system could fail to operate correctly, or it might operate in an unsafe manner. This could lead to property damage, personal injury or death.

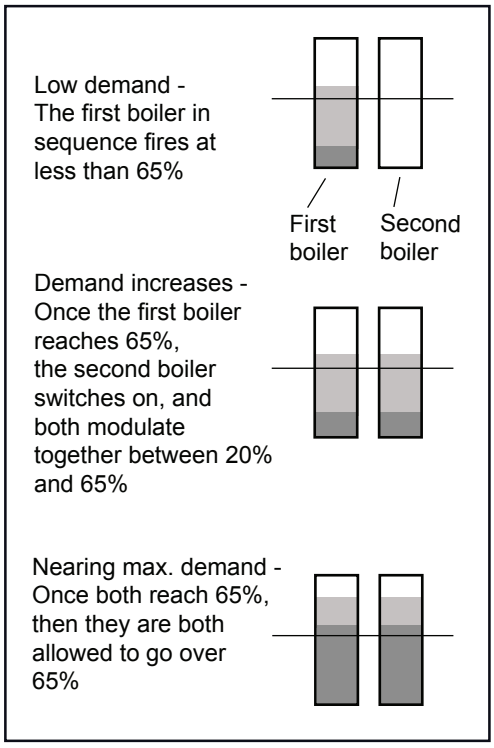


Figure 35. Lead / Lag Operation, 2 boilers.

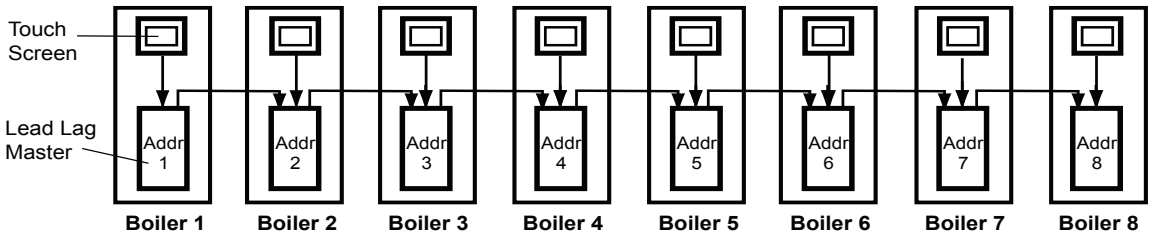


Figure 36. “Lead/Lag” Operation in a System with Eight Boilers. Note: The Displays on Boilers 2 thru 8 will display information pertaining only to that specific boiler.

Number of boilers installed	Base load value
1	NA
2	65%
3	50%
4	35%
5	35%
6	35%
7	35%
8	35%

Figure 38. Base Load Settings

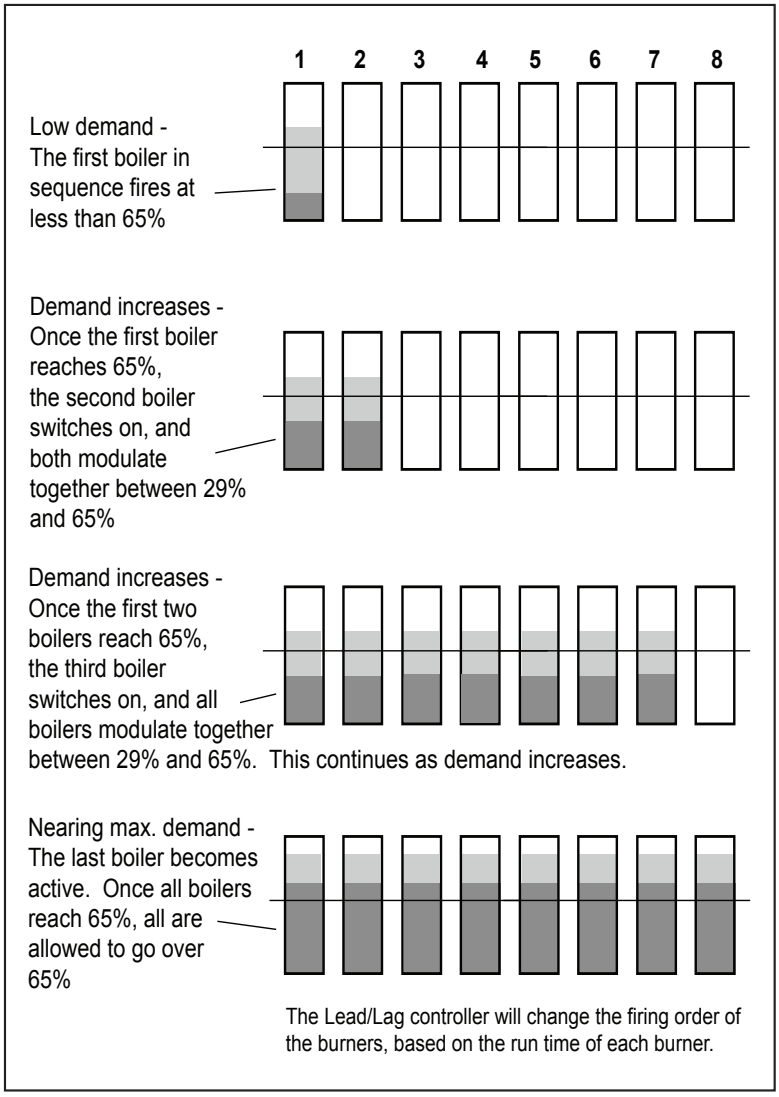


Figure 37. Lead / Lag Operation, 3 or more boilers

- When the Run sequence is initiated, the boiler with the least amount of runtime will fire.
- If the heating demand increases so that the firing rate of that first boiler rises to your boiler configurations Base Load Value **(see Figure 37)**, the next boiler in the sequence will start up and begin firing at 20 to 35% fan speed (depending on your configuration). After this, the entire configuration of boilers will modulate up or down together, in reaction to the changes in demand.

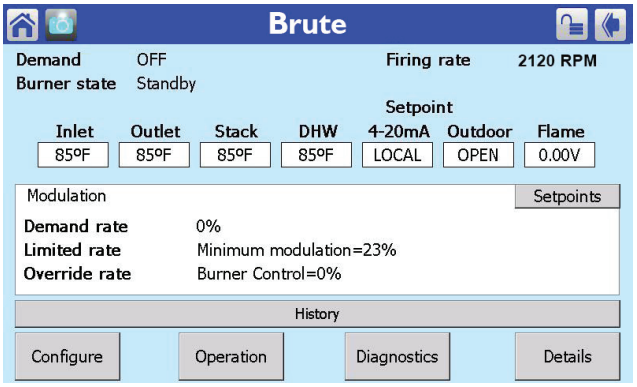
Control Settings for Lead/Lag System - Part 1

1. Power up all of the boilers in the system.
2. In an installation with several boilers, you must give each boiler a different name, sot that the controller of the Lead/Lag Master can communicate with the other units. All of the units come from the factory with a Modbus address of “1,” so you will need to change some of these addresses. On each unit, go to the screen for “System ID and Access,” and enter a unique name.
3. The unit operating as the Lead/Lag Master must be ‘Master Enabled’ first and then set up address “1,” and the other boilers should each be ‘Slave Enabled’ and have unique Modbus address numbers typically 2 thru X (total number of boilers)

8.7.17 Lead/Lag Slave Configuration

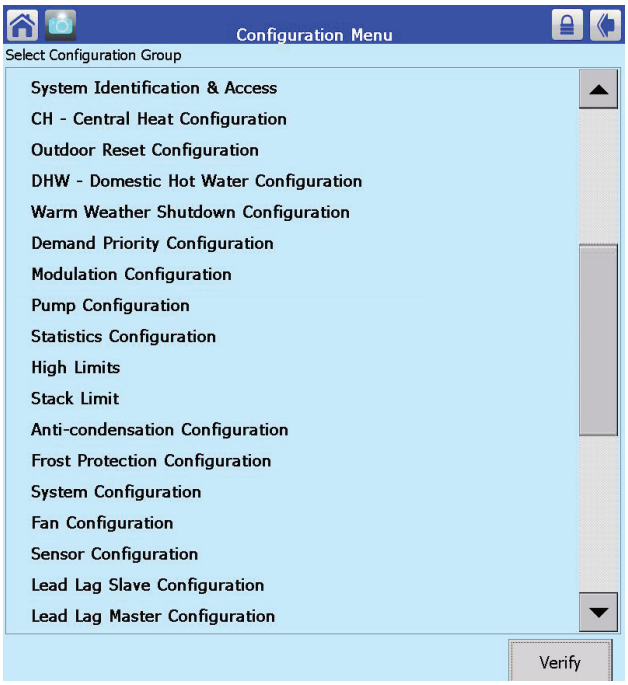
Menu 21. Home Screen

On the boilers, touch the controller Icon on the Home Screen.



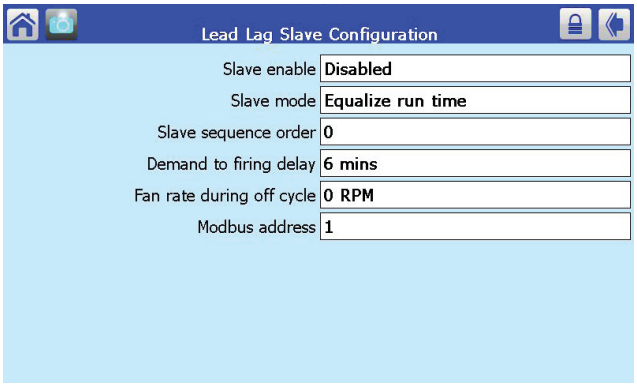
Menu 22. Status Summary Screen

Select 'Configure'.



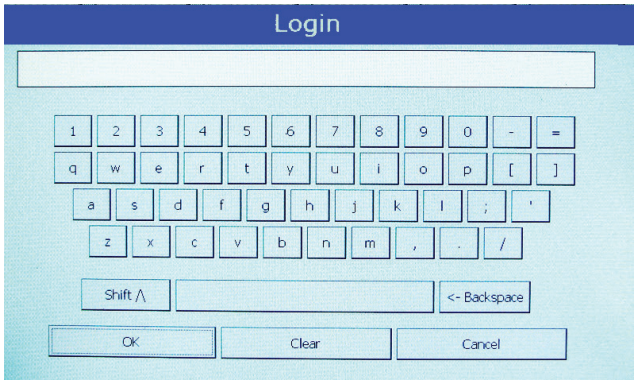
Menu 23. Configuration Menu,

Scroll down and select 'Lead Lag Slave Configuration'.



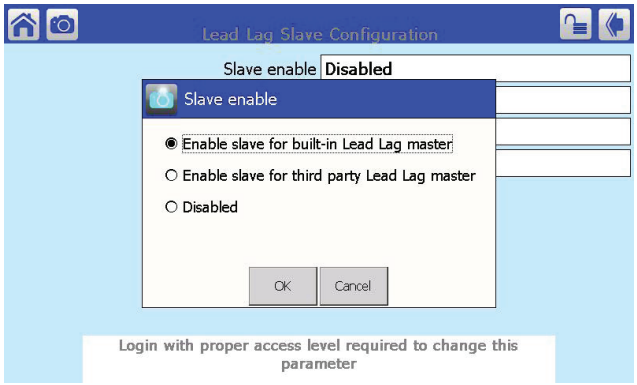
In the Lead Lage Slave Sub-Menu, Identify each unit (including the Lead/Lag Master) as a slave by turning on "Slave Enable."

You will be prompted to sign in. This can be done by pressing the 'LOCK' symbol at the top right



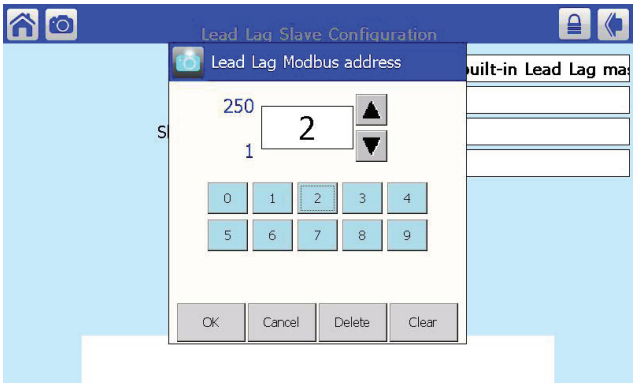
type in 'LNT' and press OK.

Then you can select Slave Enable.



Select 'Enable slave for built-in Lead Lag master' .
Then select OK

Then select a Modbus address (number) for that boiler.

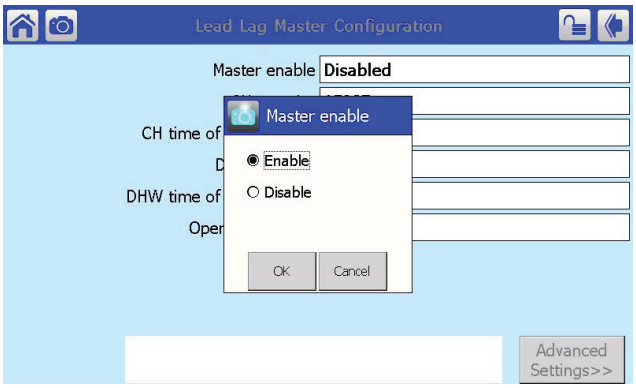


Then select OK

Repeat on all boilers, keeping them in a sensible sequencial order. ' .

8.7.18 Lead Lag Master Configuration

Then set up the Master controller by going to the Lead Lag Master boiler and opening up the Lead Lag Master Configuration in that boilers Configuration Menu. Select Master Enable



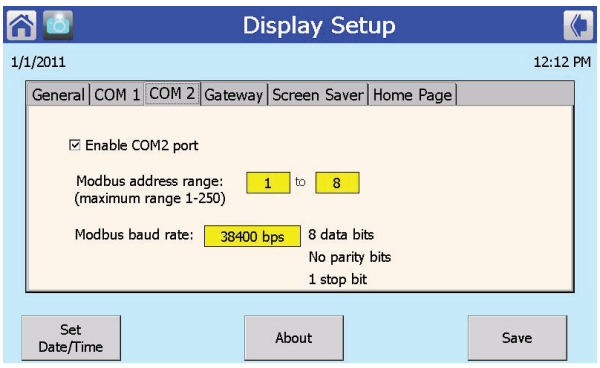
Select OK and then Back out to the Main Menu.

Wiring Connections for Lead/Lag -

Now you can make the Modbus wiring connections between the units. The controller in each boiler includes two wiring terminals for the Modbus system, labeled “MB1” and “MB2.” MB1 has the wiring connections to the User Interface display on each unit, and MB2 is used to communicate with the other boilers in the Lead/Lag system.

To reach the controller, open the cabinet of the boiler by turning the door lock and then opening the doors.

The wiring from the controller on the first boiler runs to the controller on the next boiler. Use 22 AWG or thicker shielded twisted-pair wire with drain. Two twisted pairs or three conductors are needed. Wire A on MB2 of Boiler 1 must be connected to A on MB2 of Boiler 2, wire B on Boiler 1 goes to B on Boiler 2, and wire C on Boiler 1 goes to C on Boiler 2. Repeat this wiring for any other boilers in the system. Connect all of the drain wires and ground the drain wire on one end of the assembly only.



Menu 24. Enabling COM2 Menu

8.8 Connections to a Building Automation System

Brute boilers can be controlled and monitored through the included Modbus ports. The Modbus wiring must be completed according to the diagrams shown below. If alternate communication protocols are desired, Bradford White offers “gateways” to allow BACnet, LON, and other communications protocols. For additional information on setting up Modbus and other communication protocols, contact the factory.

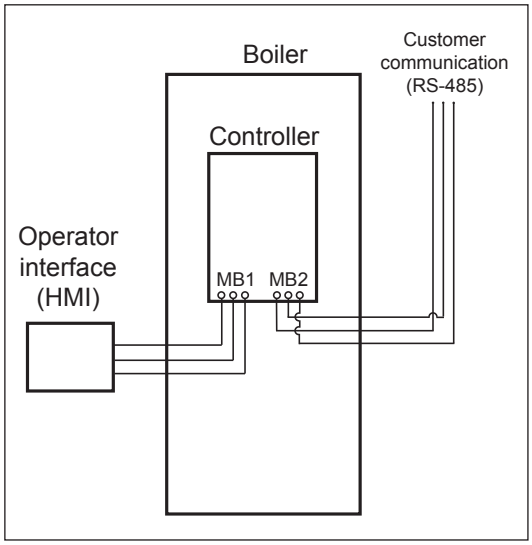


Figure 39. BAS connnections to a Single Boiler

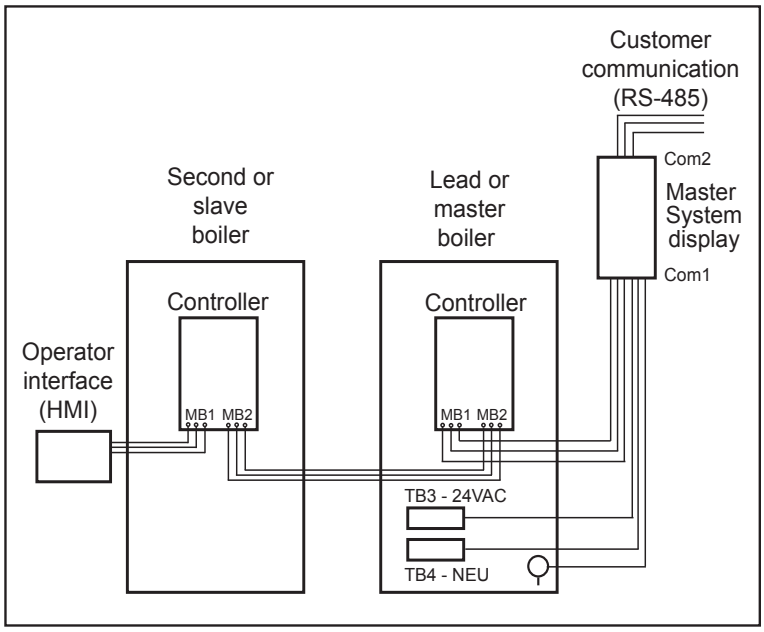
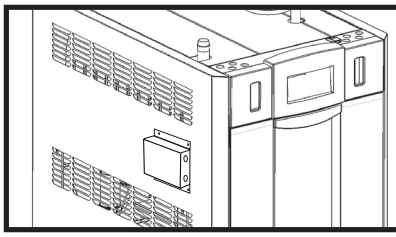


Figure 40. BAS connnections to a Lead Lag System

8.9 Optional Variable Speed Pump Control (V.S.P.C.)

Variable Speed Pump Control is optional equipment on all commerical Brute boilers (sizes 285 up to 850 MBH). Pump speed is controlled to maintain a user-chosen temperature rise between the inlet and outlet of the Brute.

For the entire kit and the complete 4 page instruction sheet, Reference Kit # CA013600



Variable speed pump control kit for **Brute**

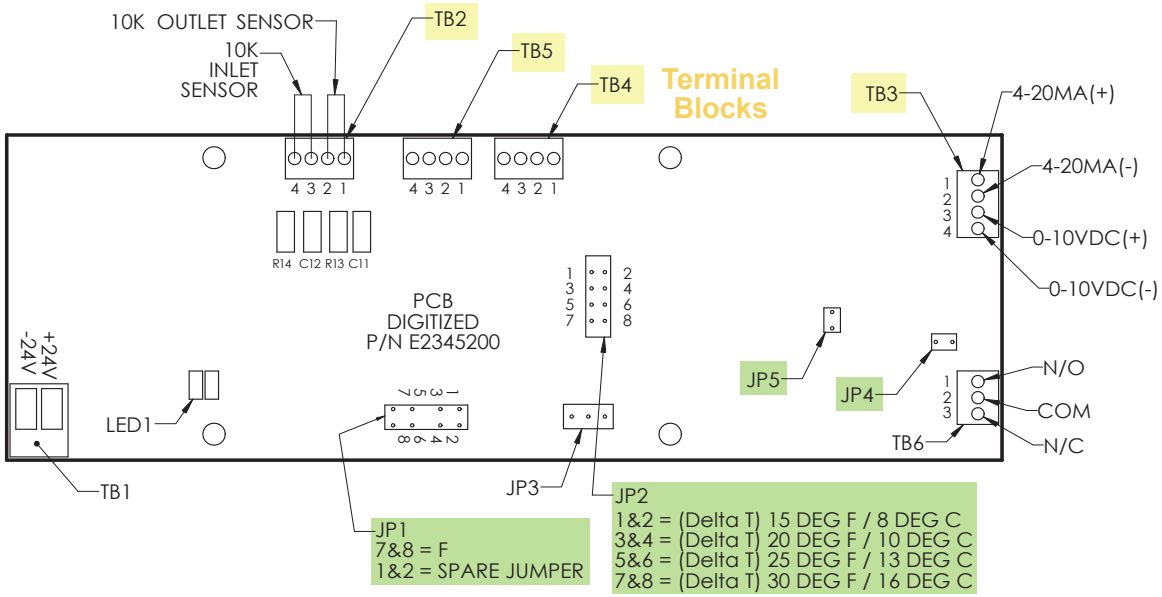
Modulating Boilers
Model NTH. Sizes 285–850 MBTU/h

FOR YOUR SAFETY: This procedure must be performed by a professional service technician, qualified in hot water boiler installation. Improper connections could create an electrical hazard, which could cause serious injury, property damage, or death.

OUTDOOR WATER-TIGHT ENCLOSURE AND GROMMETS, NOT INCLUDED.

GENERAL PCB OPERATION:

1. The desired Delta T can be set to any of the following values by moving or adding jumpers to the **(JP2)** terminal on the control: **See Figure 2.**
   15 deg F/8 deg C 20 deg F/10 deg C 25 deg F/13 deg C 30 deg F/ 16 deg C
   By adding a second jumper, one on "15 deg F" and one on "20 deg F", it is possible to achieve 35 deg F /19 deg C.
   By adding a second jumper, one on "15 deg F" and one on "25 deg F", it is possible to achieve 40 deg F/22 deg C.
2. As shipped, the V.S.P.C. has a jumper on the **(JP4)** terminal, to operate a 0-10 VDC output. If a 4-20 mA output is needed, move the jumper to the **(JP5)** terminal.
3. V.S.P.C. can operate in °F or °C. A jumper on the **(JP1)** terminal has set the default to °F. Remove that jumper for °C.
4. If Main Gas valve is "OFF" AND a call for heat is "TRUE" then the PCB overrides the PID control and runs the pump output at 100% (10 VDC, or 20 mA).
5. Once the Main Gas valve is energized the PCB will maintain pump output at 100% for 60 seconds to allow the system to stabilize Once the 60 second timer has expired, the PCB will then run the pump output speed based on the jumper setpoint.
6. When "T-T" is satisfied, the PCB will run pump at 100% output for the duration of the pump overrun time.
7. The V.S.P.C. PCB has a low end cap to prevent nuisance low flow trips. The cap is factory programmed to 2 VDC.
8. Factory settings are: **Degrees** - Fahrenheit **Output Signal** - 0 -10VDC



8.10.1 – Combustion Setup Procedure

In this section, we will explain how to set up the gas valve so the boiler will run efficiently at both the High Fire and Low Fire conditions.

Required tools: Screwdrivers, Torx bits, Allen Wrench Set, Combustion Analyzer

> **⚠ WARNING**
> Improper adjustment may lead to poor combustion quality, increasing the amount of carbon monoxide produced. Excess carbon monoxide levels may lead to personal injury or death.

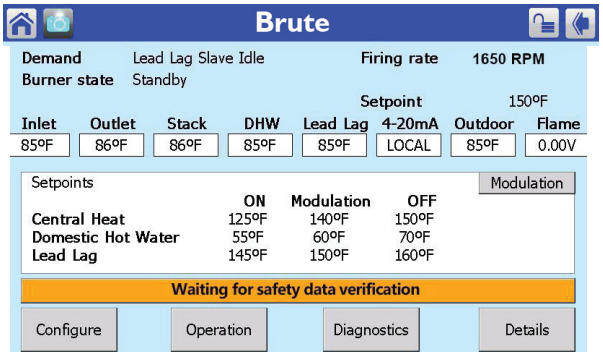
1. On the Main Gas Valve, locate the adjustments for high fire throttle, and low fire offset.

   Refer to Table 1 for appropriate CO2 ranges.

2. Press the Control Icon at the center of the Home Screen.

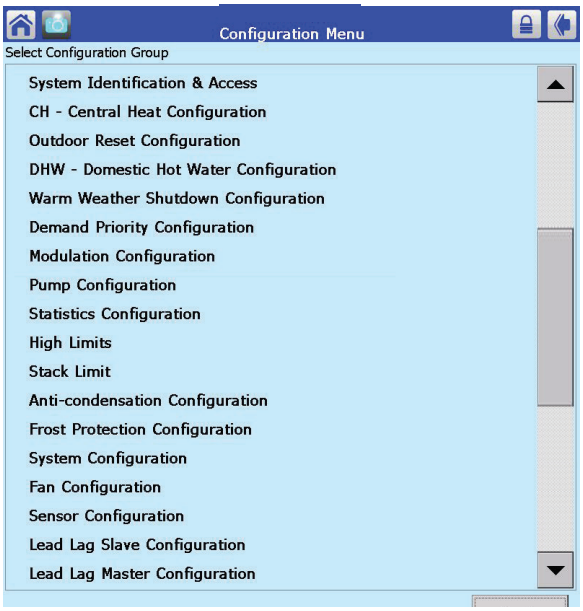
Menu 25. 'Home' screen

3. The system will present the Status Summary screen.



Menu 26. Status Summary Screen

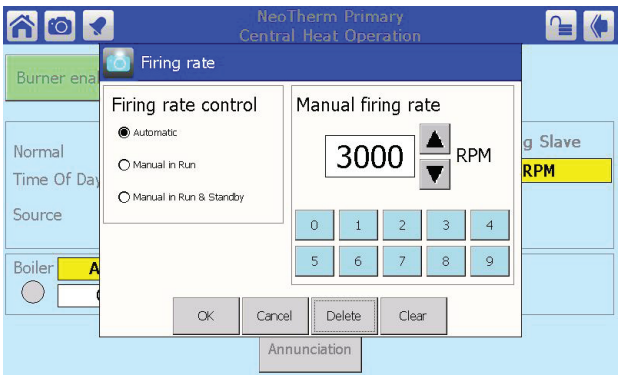
4. Press the 'Configure' button in the lower left corner.



Menu 27. Configuration Menu

5. Brute is equipped with a zero governing, negative regulator valve. The valve throttle should be adjusted only at high fire, and the offset adjustment is only to be done at low fire. From the "Home" screen, touch the control icon, then press the 'Operation' button.
   From the 'Operation' Menu, you can select 'Firing Rate' which will prompt you for a password. Once installer level password has been entered, press the 'Firing Rate' box again.

6. Press the box for Firing Rate again. The controller will present the Manual Firing Rate screen shown in Figure 41



Menu 28. Manual Firing Rate

7. Notice the three options on the left side of the screen:

   Auto -

   The firing rate will be set automatically by the controller, based on the heat load. Set this item to

Auto at the end of the test.

Manual in Run -

The Manual in Run control will only set the fan speed when the control has proven flame and the unit has entered the Run mode.

Manual in Run and Standby -

Using this setting, the manual control will set the fan speed whether the boiler is operating or not.

For this test, select Manual in Run.

8. Type in a value for high fire RPM, which can be found on the 'Modulation Configuration' screen (see Section 8.7.7). (The actual RPM will not go this high – the control will limit the fan speed to the maximum set at the factory.)

   By using the manual control, and entering a high RPM value, this forces the burner to run at full combustion so you can adjust the gas valve for the correct CO_2 output.

   Figure 41 shows the adjusting points on the gas valve. Adjust the High Fire screw to get the proper CO_2 level for high fire. See Table 14 and Table 15. To raise the high fire CO_2 level, turn the High Fire adjustment screw counter-clockwise. To lower the high fire CO_2 level, turn the screw clockwise.

9. Repeat step 8, except this time set the fan speed RPM to 1200rpm. (Again, the actual RPM will not go this low – the control will limit the fan speed to the minimum set at the factory.) This will force the boiler to operate in low fire. Adjust the Low Fire screw so the CO_2 matches Table 14 and Table 15.
   To raise the low fire CO_2, turn the Low Fire adjustment screw clockwise. To lower the low fire CO_2, turn the screw counter-clockwise.

10. The adjustment you made for the Low Fire setting could affect the High Fire setting, so you need to re-check the High Fire setting. Go back to the Operations screen and set the Firing Rate back to high fire. The CO_2 should still be about at the level listed in Table 14 and Table 15. If the CO_2 is not correct, repeat the steps listed above.

11. Set the Firing Rate back to 1200 RPM, and re-check the CO_2 during Low Fire.

12. Once the CO_2 values are correct for both High Fire and Low Fire, go back to the Operation screen and select Automatic operation. At this point, you have set up the burner for this boiler.

8.10.2 – Adjusting CO_2

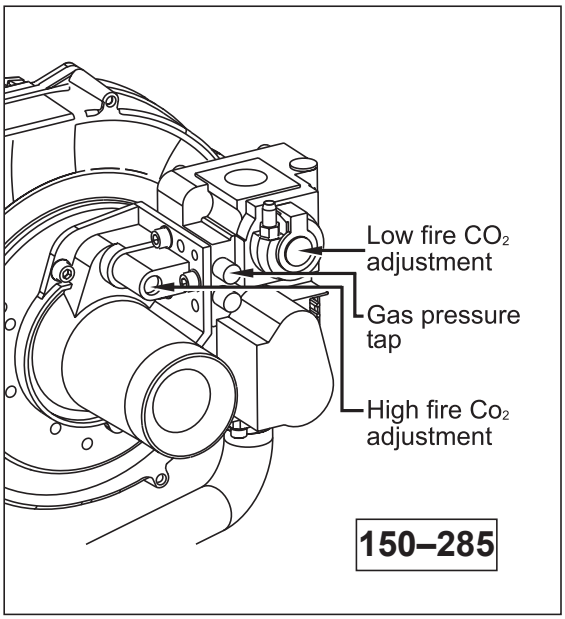
See Section 8.10

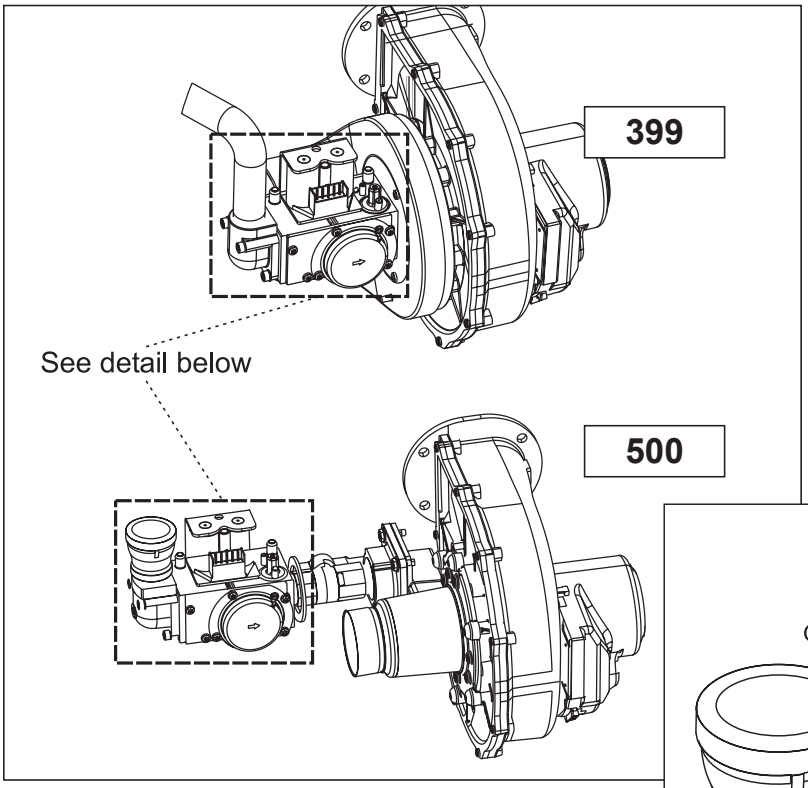
GAS TYPE	HIGH FIRE, CO_2	LOW FIRE, CO_2	DIFFRNTL PRESSURE (**inches wc**)
Natural	8.8 to 9.8%	0.5% lower than high fire setting	3.6” to 3.9”
Propane	9.8 to 10.2%		

Table 14. (Residential, sizes 150 - 285 Mbtu) CO_2 Range and Differential Pressure

GAS TYPE	HIGH FIRE, CO_2	LOW FIRE, CO_2	MANIFOLD PRESSURE
Natural	8.8 to 9.0%	0.5% lower than high fire setting	-.005” to -.015” wc
Propane	9.8 to 10.0%		

Table 15. (Commercial, sizes 399 - 850 Mbtu) CO_2 Range and Manifold Pressure





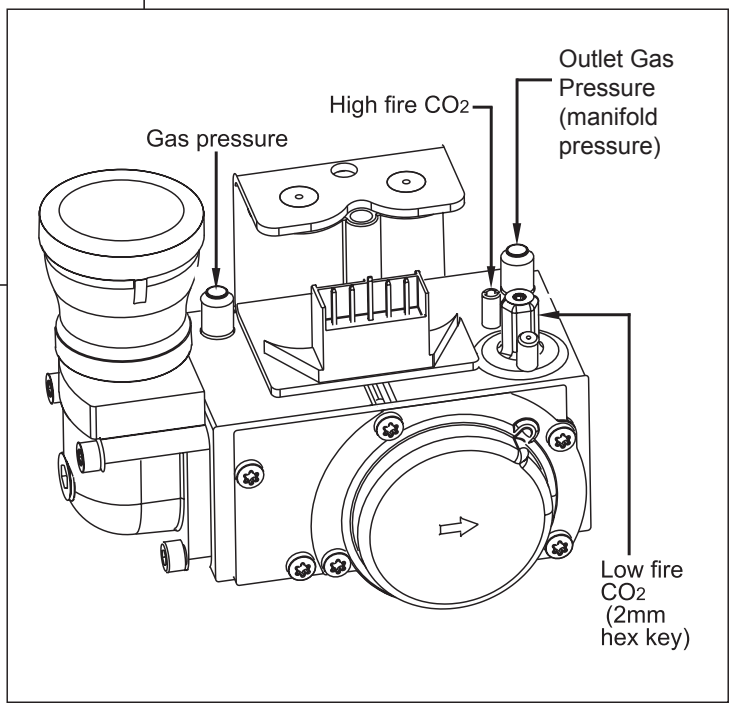
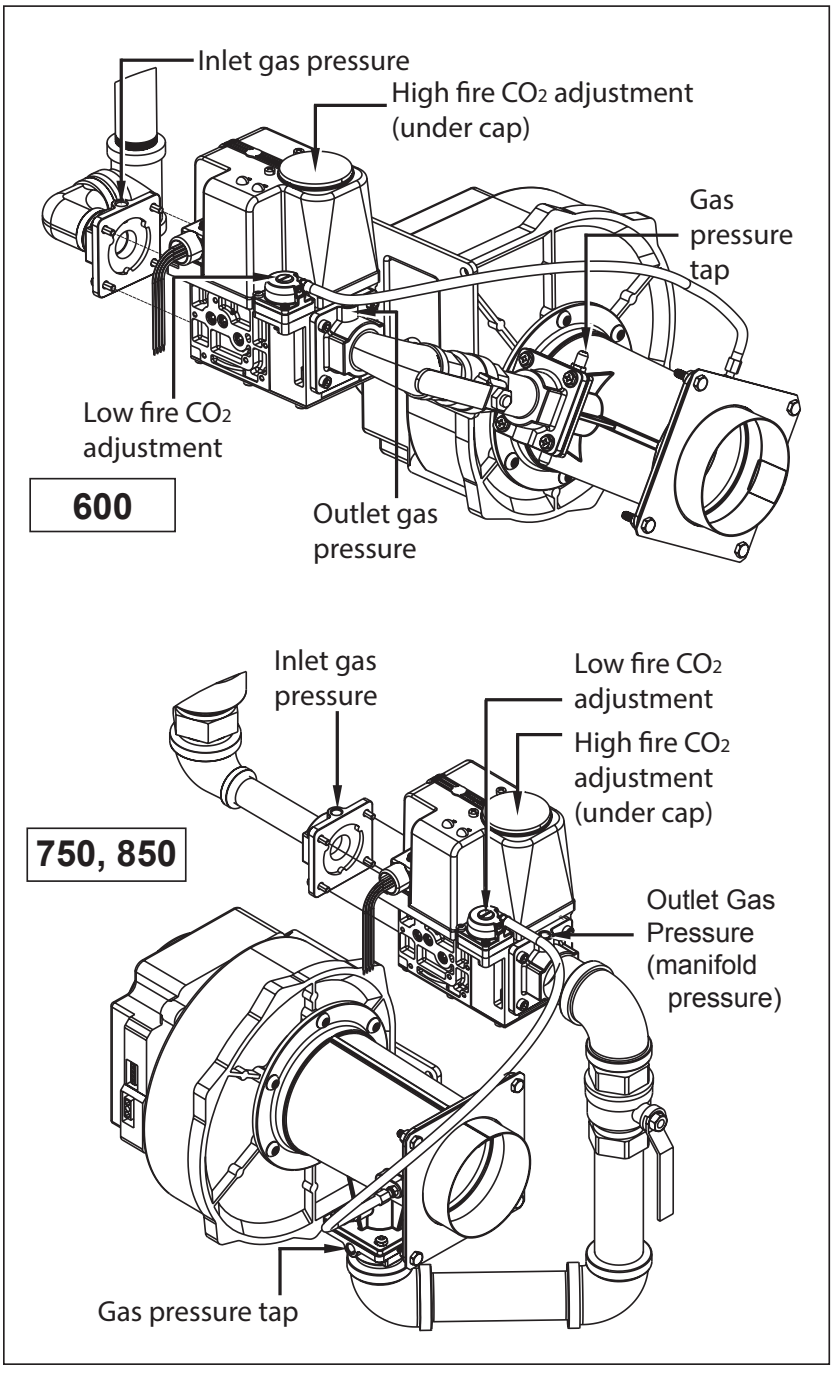


Figure 41. Brute Gas Valves (ALL)

NeoTherm Series Boiler							
Model Number	Input, MBH		Heating Capacity, MBH	Net AHRI Rating Water, MBH	AFUE, %	Thermal Efficiency, %	Combustion Efficiency, %
	Min	Max					
BNTH 150	30	150	138	120	95.0		
BNTH 210	42	210	194	171	95.0		
BNTH 285	57	285	264	229	95.0		
BNTH 399	79.8	399	386	336		96.5	96.5
BNTH 500	100	500	475	413		95.0	95.0
BNTH 600	120	600	572	497		95.3	96.0
BNTH 750	150	750	724	630		96.6	96.6
BNTH 850	170	850	813	707		95.7	95.7

Table 16. Brute Boiler Efficiencies



Section 9 - First Start Up and Adjustment

9.1 Filling the Boiler System

1. Ensure the system is fully connected. Close all bleeding devices and open the make-up water valve. Allow the system to fill slowly.
2. If a make-up water pump is employed, adjust the pressure switch on the pumping system to provide a minimum of 12 psi (81.8 kPa) at the highest point in the heating loop.
3. If a water pressure regulator is provided on the make-up water line, adjust the pressure regulator to provide at least 12 psi (81.8 kPa) at the highest point in the heating loop.
4. Open all of the bleeding devices on all radiation units at the high points in the piping throughout the system, unless automatic air bleeders are provided at these points.

   Note - There is an air bleed located on the left side of Brute unit, on top of the water manifold.
5. Cycle the boiler pump on and off 10 times, 10 seconds on and 10 seconds off, to remove all air from the heat exchanger. Then run the system and appliance pumps for a minimum of 30 minutes with the gas shut off.

⚠ WARNING

Failure to remove all air from the heat exchanger could lead to property damage, severe injury or death.

6. Open all strainers in the circulating system, check the operation of the flow switch (if equipped), and check for debris. If any debris is present, clean it out to ensure proper circulation.
7. Recheck all air bleeders as described in Step 4.
9. Start up the boiler according to the procedure listed in this manual. Operate the entire system, including the pump, boiler, and radiation units for one hour.
11. Shut down the entire system and vent all radiation units and high points in the system piping, as described in Step 4.
12. Close the make-up water valve and check the strainer in the pressure reducing valve for sediment or debris from the make-up water line. Reopen the make-up water valve.
13. Check the gauge for correct water pressure and also check the water level in the system. If the height indicated above the boiler insures that water is at the highest point in the circulating loop, then the system is ready for operation.
14. Prime the condensate trap with water. (This is not required for BNTH 600, 750, and 850 units.)
15. Refer to local codes and the make-up water valve manufacturer's instructions as to whether the make-up water valve should be left open or closed.
16. After placing the unit in operation, the ignition system safety shutoff device must be tested.

    First, shut off the manual gas valve, and call the unit for heat. The main gas terminals will be energized, and attempt to light, for four seconds, and then will de-energize. The unit will go into lockout after the required number of trial for ignition periods.

    Next, turn the power Off, and then On again. Press the manual reset button on the boiler control, open the manual gas valve, and allow the unit to light. While the unit is operating, close the manual gas valve and ensure that power to the main gas valve has been cut.
17. Within three days of start-up, recheck all air bleeders and the expansion tank as described in Steps 4 and 8 above.

Important Note: The installer is responsible for identifying to the owner/operator the location of all emergency shutoff devices.

⚠ WARNING

Do not use this appliance if any part has been under water. Bradford White requires boilers and water heaters to be replaced, not repaired, if they have been partially or completely submerged.

9.2 First Operation

⚠ Caution

The initial setup must be checked before the unit is put in operation. Problems such as failure to start, rough ignition, strong exhaust odors, etc. can be due to improper setup. Damage to the boiler resulting from improper setup is not covered by the limited warranty.

REQUIRED TOOLS: differential pressure gauge capable of reading negative 0.01 inches W.C. (0.002kPa), screw drivers, Torx bits, combustion analyzer.

1. Using this manual, make sure the installation is complete and in full compliance with the

instructions and all local codes.

2. Determine that the appliance and system are filled with water and all air has been bled from both. Open all valves.
3. Observe all warnings on the Operating Instructions label and turn on the gas and electrical power to the appliance.
4. The Brute unit will begin the start sequence. The blower and pump will energize for the pre-purge period, then the ignition sequence will start. After all safety devices have been verified, the gas valve will open. If ignition doesn't occur, turn off the Brute, and check that there is proper gas supply. Wait 5 minutes before restarting.
5. Turn the Brute on.
6. **After placing the appliance in operation, the Burner Safety Shutoff Device must be tested**:
   - Close the gas shutoff valve with the burner operating.
   - The flame will go out and the blower will continue to run for the post purge cycle. One or three additional attempts to light will follow. Each cycle will include pre-purge, ignitor on, valve/flame on, and post purge. Ignition will not occur because the gas is off. The ignition control will lockout.
   - Open the gas shutoff valve. Reset the boiler control by pressing the Reset button on the control or on the display. Restart the appliance. The ignition sequence will start again and the burner will start. The appliance will return to its previous mode of operation.

⚠ DANGER

If you detect any odor of gas, or if the gas burner does not appear to be functioning in a normal manner, CLOSE THE MAIN SHUTOFF VALVE. Do not shut off the switch. Contact your heating contractor, gas company, or factory representative.

9.3 Shutting Down the Brute Unit

1. Turn off the main electrical disconnect switch.
2. Close all manual gas valves.
3. If you think the Brute unit might freeze, drain it. All water must be removed from the heat exchanger, or damage from freezing may occur. Also be sure to protect the piping in the building from freezing.

⚠ Caution

This step must be performed by a qualified service person.

9.4 Restarting the Brute Unit

If the unit has been drained, see Section 9.1 in this manual for instructions on filling and purging the unit properly.

1. Turn off the main electrical disconnect switch.
2. Close all manual gas valves.
3. **WAIT FIVE (5) MINUTES.**
4. Set the aquastat or thermostat to its lowest setting.
5. Open all manual gas valves.
6. Reset all safety switches (pressure switch, manual reset high limit, etc.).
7. Set the temperature controller to the desired temperature setting, and switch on electrical power.
8. The burner will go through a prepurge period and ignitor warm-up period, followed by ignition.

Section 10
MAINTENANCE

⚠ WARNING

Disconnect all power to the appliance before attempting any service. Contact with electricity can result in severe injury or death.

10.1 System Maintenance

Do this once a year, unless otherwise noted.

1. Lubricate the system water-circulating pump, if required, per the instructions on the pump.
2. If a strainer is employed in a pressure reducing valve or the piping, clean it every six months.
3. Inspect the venting system for obstruction or leakage at least once a year. Periodically clean the screens in the vent terminal and combustion air terminal (when used).
4. Keep the area around the appliance clear and free of combustible materials, gasoline, and other flammable vapors and liquids.
5. If the appliance is not going to be used for extended periods in locations where freezing normally occurs, it should be isolated from the system and completely drained of all water.
6. Low water cutoffs, if installed, should be checked every year. Float-type low water cutoffs should be flushed periodically.
7. Inspect and clean the condensate collection, float switch and disposal system yearly.
8. When a means is provided to neutralize the condensate, ensure that the condensate is being neutralized properly.
9. Inspect the flue passages, and clean with a brush or vacuum if necessary. Sooting in flue passages indicates improper combustion. Determine the cause for this and correct it.
10. Inspect the vent system and air intake system, and ensure that all joints are sealed properly. If any joints need to be resealed, completely remove any existing sealing material, and clean the joint(s) with alcohol. Apply new sealing material, and reassemble.

10.2 Appliance Maintenance and Component Description

Use only genuine Bradford White replacement parts.

⚠ Caution

Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

The gas and electric controls in the unit are engineered for long life and dependable operation, but the safety of equipment depends on their proper functioning. Only a qualified service technician should inspect the basic items listed below every year:

a. Appliance control
b. Automatic gas valve
c. Pressure switches
d. Blower
e. Pump
f. Flow switch
g. Low water cutoff
h. Burner
i. Heat exchanger

Burner

Check the burner for debris. Remove the blower arm assembly to access the burner. Remove the four bolts connecting the blower to the arm. (See Figure 47.) Remove the five bolts which hold the burner arm in place. Pull the burner up and out. Clean the burner, if necessary, by blowing compressed air from the outside of the burner into the center, and wipe the inside clean with glass cleaner. A dirty burner may be an indication of improper combustion or dirty combustion air. Determine the cause of this, and correct it. If the burner gasket is damaged, replace it when replacing the burner.

NOTE: When installing the burner, make sure the flange is aligned with the mating surface, as each is keyed to control the fit.

Modulating Gas Valve / Venturi

The modulating gas valve consists of a valve body that incorporates the On/Off gas flow control and a negative pressure regulator. It provides the air/gas ratio control in combination with the Venturi to the unit. It is designed to operate with a gas supply pressure between 4 and 13 inches w.c. To remove the gas valve and/or Venturi, shut off the 120 Volt power supply to the boiler. Turn off all manual gas valves connecting the boiler to the main gas supply line. Remove the front door of the boiler to gain access to the gas valve and Venturi. Disconnect the four flange bolts connecting the gas manifold pipe to the gas valve. Remove the electrical connections to the gas valve. Remove the bolts connecting the Venturi flange to the blower. This allows the entire gas valve and Venturi assembly to be removed to facilitate inspection and cleaning.

Reassemble the valve/Venturi assembly in reverse order, making sure to include all gaskets and O-rings. Turn on the manual gas valves and check for gas leaks. Turn on the 120 Volt power. Place the unit in operation following the instructions in Section 9. Once the boiler is operating. check for leaks again and confirm that all fasteners are tight.

Check the appliance setup according to Section 9.

Appliance Control

The Brute unit has an integrated control that incorporates manual reset high limit control, operating temperature control, modulating control, ignition control, outdoor reset control, pump control and many other features. If any of these features are thought to be defective, please consult the factory for proper trouble shooting practices prior to replacing the control. If control replacement is required, turn off all power to the appliance and shut off all manual gas valves to the appliance. Remove the front door to the appliance and the plastic bezel and the control panel. Remove all wire connections from the control board. The control board connections are keyed to only allow connection in the proper location, but proper handling techniques should be used to avoid damage to the wiring or connectors. To remove the control, push in on the two tabs on the left side of the board to unlatch the clips from the control panel. Rotate the control around the fastening points on the right side of the control to remove the hooks from the control panel. To replace the control, repeat the steps listed above in the reverse orders making sure to connect all wires in the proper locations. Place the appliance in operation following the steps outlined in Section 9.

Ignitor Assembly

The ignitor assembly is a two rod system that consists of a ground rod and a spark rod (See Figure 47). To remove the ignitor assembly, shut off the 120 Volt power supply to the appliance. Turn off all manual gas valves connecting the appliance to the main gas supply line. Remove the front door of the boiler to gain access to the ignitor assembly. Remove the two wires connected to the assembly. Then remove the two bolts connecting the ignitor assembly to the burner door. If the old ignitor assembly is determined to be defective, install a new ignitor assembly (check that the spark gap is 3/16”). Replace the gasket if necessary.

Flame Sensor

The flame sensor is a single rod system. To replace the flame sensor electrode, shut off the 120 Volt power supply to the boiler. Turn off all manual gas valves connecting the boiler to the main gas supply line. Remove the front door of the boiler to gain access to the flame sensor electrode. Remove the flame sensor

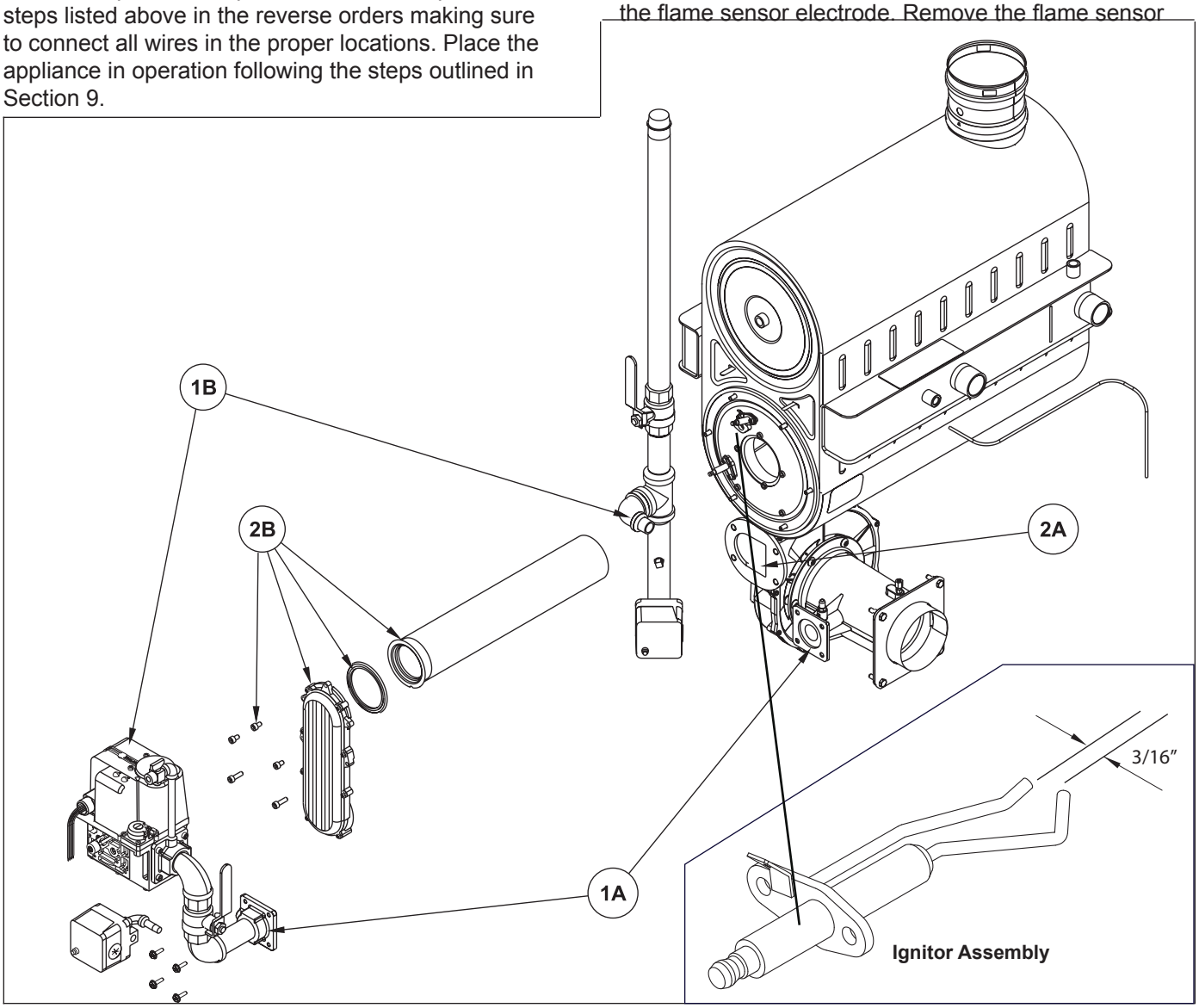


Figure 47 - Burner Service

wire from the electrode. Remove the two bolts fastening the electrode to the burner doors. Remove and replace the old flame sensor gasket. If the old electrode is determined to be defective, install a new flame sensor electrode in the reverse order.

⚠ Caution

The ignitor and sensor may be hot, and can cause burns or injury.

Transformer with Integral Circuit Breaker

The appliance has a 24Vac transformer with integral 4 amp circuit breaker installed to supply the control voltage required for the appliance. The transformer is sized to provide power for the Brute unit only, and should not be used to supply power to additional field devices. If additional loads are added, or a short occurs during installation, the integral circuit breaker may trip. If this happens, be sure to reset the circuit breaker before replacing the transformer.

The transformer is mounted underneath the control panel. If the transformer must be replaced, turn off the 120Vac power to the appliance. Remove the transformer wires from the terminal blocks. Remove the fasteners holding the transformer, then remove the transformer. Replace with a new transformer in the reverse order.

If the transformer is replaced with a part other than the OEM transformer, be sure to add circuit protection if it is not integral to the new transformer.

⚠ WARNING

Failure to include proper circuit protection may lead to premature component failure, fire, injury or death.

Blower

The combustion air blower is a high-pressure centrifugal blower with a variable speed motor. The speed of the motor is determined by the control logic. 120 Volt power remains on to the blower at all times. If the blower must be changed, turn off the 120 Volt power and gas supply to the unit. Take the front panel off. Disconnect the 120 Volt and control signal connections from the blower. Disconnect the bolts connecting the Venturi to the blower housing. Disconnect the fan outlet bolts from the burner door blower arm. If the fan is determined to be defective, replace the existing fan with a new one, reversing the steps listed above. Be sure to install all of the required O-rings and gaskets between the blower arm and the blower and blower face and venturi flange.

Heat Exchanger Coils

Black carbon soot buildup on the heat exchanger is caused by one or more of the following; incomplete combustion, combustion air problems, venting problems, or heater short cycling. Soot buildup or other debris on the heat exchanger may restrict the flue passages.

If black carbon soot buildup on the heat exchanger is suspected, disconnect the electrical supply to the unit, and turn off the gas supply by closing the manual gas valve on the unit. Access the heat exchanger through the burner door at the front of the boiler, and inspect the tubing using a flashlight. If there is a buildup of black carbon soot or other debris on the heat exchanger, clean using this procedure:

⚠ WARNING

Black carbon soot buildup on a dirty heat exchanger can be ignited by a random spark or flame. To prevent this from happening, dampen the soot deposits with a wet brush or fine water spray before servicing the heat exchanger.

1. Shut off the 120 Volt power supply to the boiler
2. Turn off all manual gas valves connecting the boiler to the main gas supply line.
3. For BNT 600 models only:
   (All other sizes please skip to step four)

   BNT 600 models will require the gas valve to be removed in order to remove the burner door. To do this, remove the wiring connections from the gas valve. Remove the flange bolts from the gas supply pipe connected to the gas valve (1B). Remove the flange bolts connecting the gas train to the Venturi (1A). Remove the gas train assembly, and keep the gaskets and O-rings.
4. Remove the four bolts connecting the blower flange to the burner door arm.
5. Remove the nuts located on the outside diameter of the burner door to the heat exchanger.
6. Remove the burner door and burner assembly from the heat exchanger.
7. Disconnect the condensate drain line.
8. Attach a longer hose to the drain and run it to a bucket.
9. Clean the heat exchanger by brushing away any light accumulations of soot and debris. Use a brush with soft bristles (non metallic) to avoid damaging the surfaces of the heat exchanger tubes.
10. Once the tubes have been brushed clean, rinse the tubes and combustion chamber with a small amount of water to rinse all of the debris out of the bottom of the flue collector and into the longer condensate trap line. This will be diverted into the separate container.

NOTE: The Warranty does not cover damage caused by lack of required maintenance, lack of water flow, or improper operating practices.

⚠ WARNING

Failure to rinse the debris from the heat exchanger and temporary drain line may lead to clogged condensate lines, traps and neutralizers. Condensate pumps (if used) may also be damaged by the debris left behind, possibly causing property damage.

11. Install all components removed in the reverse order to place the appliance back in operation. Be sure all gaskets are in place as the components are installed. Replace any damaged gaskets. Do ***not*** reuse damaged gaskets.
12. Place the appliance in operation according to the instructions in Section 10. Check all gas connections for leaks. Confirm that all fasteners are tight.

Optional Gas Pressure Switches

The high and low gas pressure switches are 24V manual reset switches that act to cut power to the gas valves if the gas pressure is too low or too high for proper operation. The gas pressure switches used are integrally vent limited, and do not require venting to atmosphere. To remove a switch, remove the screw on the plastic housing and pull the clear cover off. Disconnect the two wires from the screw terminals. Twist the switch off the pipe nipple. Reassemble in reverse order. For natural gas, set the low gas pressure switch to 3” w.c. For propane, set the low gas pressure

BNT size (mbtu)	Kit number
150	CA006203
199	CA006204
210	CA006204
285	CA006205
399	CA008600
500	CA008600
600	CA008600
750	CA008600
850	CA008600

Table 16a - Propane Gas Conversion Kits

BNT size (mbtu)	Kit number
150	CA006206
199	CA006206
210	CA006206
285	CA006206
399	CA008600
500	CA008600
600	CA008600
750	CA008600
850	CA008600

Table 16b - Natural Gas Conversion Kits

Section 11
TROUBLESHOOTING

11.1 Lockouts, Holds, and Alerts

The control system on the Brute BNT responds to three kinds of trouble indications:

- **LOCKOUT:** A "lockout" is caused by a serious problem that might involve a safety issue. Once the controller enters a lockout, the burners will shut down, and will not be allowed to run again until the cause of the problem is corrected, and the control is manually reset. The controller will also lockout if you change a safety-related parameter, and the unit will require 'Safety Verification' before the control will be allowed to operate. (For more information on verification, see Section 9) During a lockout condition, the image of the affected controller on the 'home' screen will appear in red. A bell symbol will appear in the upper left-hand corner of the control screen. The system maintains a "history" of the 15 most recent lockouts.
- **HOLD:** The system may enter a "hold" for a period of time before locking out. This allows the controller to see if the error becomes resolved prior to the hard lockout. Holds may also show during ignition sequence and normal operation, as the control moves from one task to another.
- **ALERT:** An "alert" indicates that some feature of the control system's operation was not correct, delayed or waiting for a response. This indicates a change in state of the control system and doesn't necessarily mean there is a problem. For example, Alerts occur as the fan speed transitions from the pre-purge to the startup. This indicates that the control system is waiting for a condition to be satisfied. No Reset is required to recover from an alert. The system maintains a "history" of the 15 most recent alerts. Sometimes it can be helpful to check this list as a troubleshooting aid.

11.1.1 Responding to a Lockout, Hold, or Alert

1. If a problem occurs while the system is starting up, the system will declare a Hold. A brief explanation of the cause of the Hold will appear in an orange bar across the bottom of the screen. If you tap the orange bar, the system will present more information about the Hold.

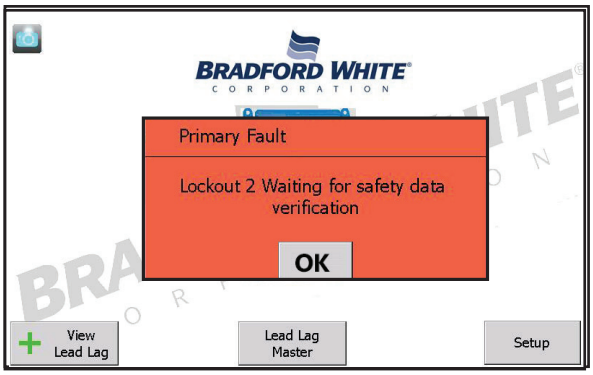
   Correct the cause of the problem, and press the button on the screen to clear the Hold.
2. If a serious problem continues, the system will Lockout. A brief explanation of the cause of the Lockout will appear in an orange bar across the bottom of the screen. If you tap the orange bar, the system will present more information about the Lockout.

   Correct the cause of the problem, and press the Reset button.
3. If an Alert occurs while the system is running, the system will present a note across the bottom of the screen. If you tap the orange bar, the system will present more information about the Alert. Press the OK button to indicate that you have seen the Alert.
4. If an audible alarm on the display is active, you can use the Silence button to stop it.

12.1.2 Viewing the Lockout and Alert Histories

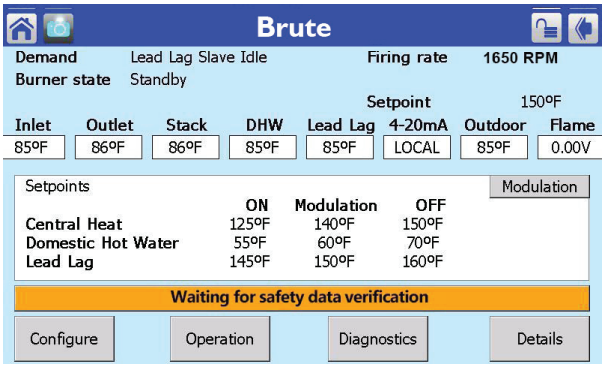
If your boiler is in a Lockout status, the Home Screen will be look like Menu 1

1. To view the Lockout/Alert history, start at the 'home' screen Menu 1.



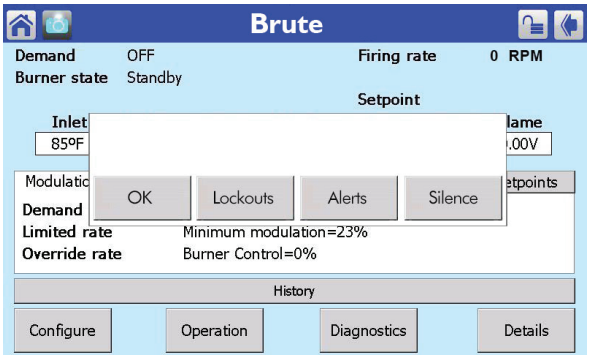
Menu 1. 'Home' screen (shown in Lockout)

2. Touch the Control Icon in the center of the screen and the Status Summary Screen will appear.



Menu 2. Status Summary Menu

3. Press the long Yellow Alert or Yellow Lockout Bar (the long bar will be a long Grey '**History**' Bar if not currently in Alert or Lockout).



Menu 3. OK, Lockouts, Alerts, or Silence.

Choose which history list you would like to see.

OK: brings you back to the status summary screen.

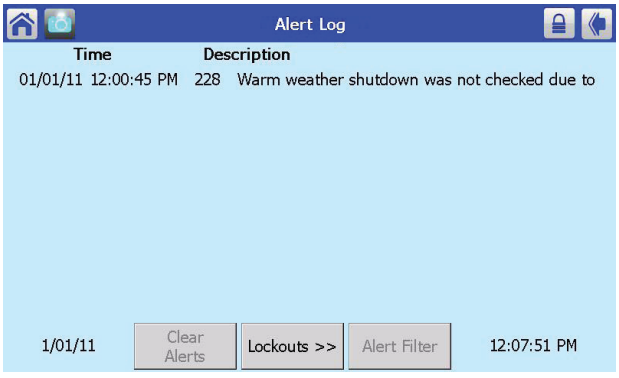
LOCKOUTS brings you to a list of the last 15 lockout events.

ALERTS brings you to a list of the last 15 alerts.

SILENCE allows you to silence an alarm.

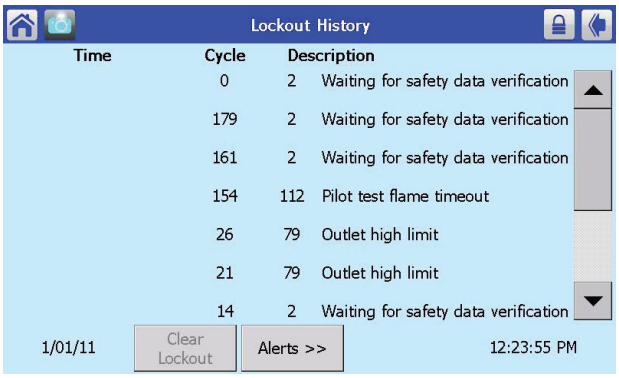
From here you can select 'OK' to back out of current screen or 'Lockouts' to bring up a list of the last 15 Lockout occurances. Press 'Alerts' to bring up a list of the last 15 Alerts, and 'Silence Alarm' in the event of a lockout condition. By silencing the alarm, the audible alert has been disabled. However, the Lockout is still active. Reset of the control is needed once the condition has been repaired.

If you choose 'ALERTS', this menu will appear.



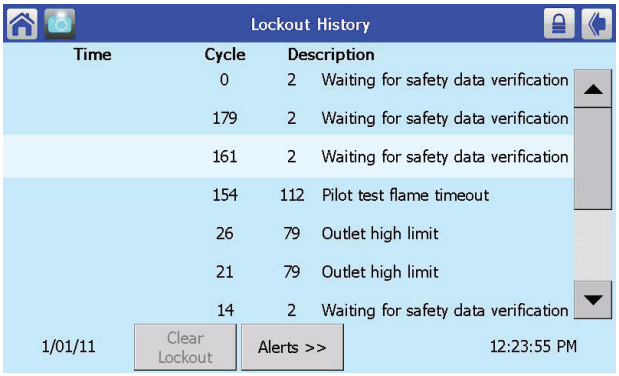
Menu 4. Alert History

If you choose 'LOCKOUTS', this menu will appear.



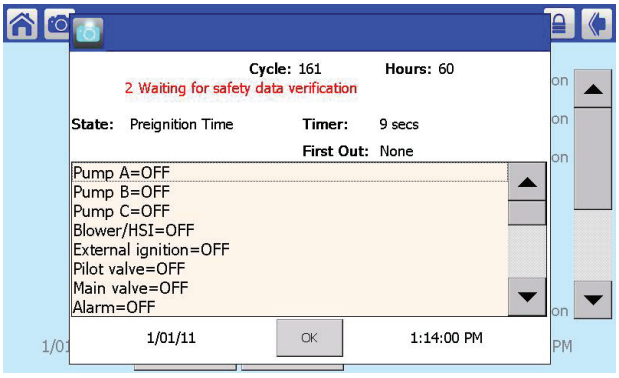
Menu 5. Lockout History

4. You can see more detailed information of an alert or lockout by touching the special entry on the screen.



Menu 6. Lockout History (showing selected)

Note: The most recent Lockout or Alert will be at the top of the menu list.



Menu 7. Lockout Detail

Return back to the Status Summary Menu by pressing the 'Back' arrow.

11.2 Troubleshooting Table

This table includes a listing of the fault codes that may be displayed. Some of these can be corrected by changing a parameter, while other conditions are more complicated, and will require a service technician.

The first column lists the code number that will appear at the beginning of the Lockout or Hold message in the orange bar at the bottom of the screen. The second column lists the text as it will appear on the Touch Screen. The third column shows whether the condition will cause a Hold, or Lockout, or both. The fourth column lists some suggestions for corrective action.

Code	Description	Lockout or Hold	Procedure
1	Unconfigured safety data	L	1. New device, complete device configuration and safety verification. 2. If fault repeats, replace module
2	Waiting for safety data verification	L	1. Device in Configuration mode and safety parameters need verification and a device needs reset to complete verification. 2. Configuration ended without verification, re enter configuration, verify safety parameters and reset device to complete verification. 3. If fault repeats, replace module.
3	Internal fault: Hardware fault	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
4	Internal fault: Safety Relay key feedback error	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
5	Internal fault: Unstable power (DC DC) output	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
6	Internal fault: Invalid processor clock	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
7	Internal fault: Safety relay drive error	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
8	Internal fault: Zero crossing not detected	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
9	Internal fault: Flame bias out of range	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
10	Internal fault: Invalid burner control state	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
11	Internal fault: Invalid burner control state flag	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
12	Internal fault: Safety relay drive cap short	H	Internal fault 1. Reset module 2. If fault repeats, replace module.

13	Internal fault: PII (Pre-Ignition Interlock) shorted to ILK (Interlock)	H or L	Internal fault 1. Reset module 2. If fault repeats, replace module.
15	Internal fault: Safety relay test failed due to feedback ON	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
16	Internal fault: Safety relay test failed due to safety relay OFF	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
17	Internal fault: Safety relay test failed due to safety relay not OFF	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
18	Internal fault: Safety relay test failed due to feedback not ON	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
19	Internal fault: Safety RAM write	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
20	Internal fault: Internal fault: Flame ripple and overflow	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
21	Internal fault: Flame number of sample mismatch	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
22	Internal fault: Flame bias out of range	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
23	Internal fault: Bias changed since heating cycle starts	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
24	Internal fault: Spark voltage stuck low or high	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
25	Internal fault: Spark voltage changed too much during flame sensing time	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
26	Internal fault: Static flame ripple	H	Internal fault 1. Reset module 2. If fault repeats, replace module.

27	Internal fault: Flame rod shorted to ground detected	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
28	Internal fault: A/D linearity test fails	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
29	Internal fault: Flame bias cannot be set in range	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
30	Internal fault: Flame bias shorted to adjacent pin	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
31	Internal fault: SLO electronics unknown error	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
32-46	Internal fault: Safety Key 0 through 14	L	Internal fault 1. Reset module 2. If fault repeats, replace module.
47	Flame Rod to ground leakage	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
48	Static flame (not flickering)	H	Internal fault 1. Reset module 2. If fault repeats, replace module.
49	24 VAC voltage low/high	H	1. Check the module and display connections. 2. Check the module power supply and make sure that frequency, voltage and VA meet the specifications.
50	Modulation fault	H	Internal sub-system fault. 1. Review alert messages for possible trends. 2. Correct possible problems.
51	Pump fault	H	Internal sub-system fault. 1. Review alert messages for possible trends. 2. Correct possible problems.
52	Motor tachometer fault	H	Internal sub-system fault. 1. Review alert messages for possible trends. 2. Correct possible problems.
53	AC input phases reversed	L	1. Check the module and display connections. 2. Check the module power supply and make sure that both frequency and voltage meet the specifications. 3. On 24 VAC applications, assure that J4 terminal 10 and J8 terminal 2 are connected together.
59	Internal Fault: Mux pin shorted	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
61	Anti short cycle	H	Will not be a lockout fault. Hold Only.

62	Fan speed not proved	H	Will not be a lockout fault. Hold Only.
63	LCI (Limit Control Input) OFF	H	1. Check wiring and correct any faults. 2. Check Interlocks connected to the LCI to assure proper function. 3. Reset and sequence the module; monitor the LCI status. 4. If code persists, replace the module
64	PII (Pre-Ignition Interlock) OFF	H or L	1. Check wiring and correct any faults. 2. Check Preignition Interlock switches to assure proper functioning. 3. Check the valve operation. 4. Reset and sequence the module; monitor the PII status. 5. If code persists, replace the module.
67	ILK (Interlock) OFF	H or L	1. Check wiring and correct any possible shorts. 2. Check Interlock (ILK) switches to assure proper function. 3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.
68	ILK (Interlock) ON	H or L	1. Check wiring and correct any possible shorts. 2. Check Interlock (ILK) switches to assure proper function. 3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.
70	Wait for leakage test completion	H	1. Internal Fault. Reset module. 2. If fault repeats, replace module.
78	Demand Lost in Run	H	1. Check wiring and correct any possible errors. 2. If previous steps are correct and fault persists, replace the module.
79	Outlet high limit	H or L	1. Check wiring and correct any possible errors. 2. Replace the outlet high limit. 3. If previous steps are correct and fault persists, replace the module.
80	DHW (Domestic Hot Water) high limit	H or L	1. Check wiring and correct any possible errors. 2. Replace the DHW high limit. 3. If previous steps are correct and fault persists, replace the module.
81	Delta T limit	H or L	1. Check inlet and outlet sensors and pump circuits for proper operation. 2. Recheck the Delta T Limit to confirm proper setting. 3. If previous steps are correct and fault persists, replace the module.
82	Stack limit	H or L	1. Check wiring and correct any possible errors. 2. Replace the Stack high limit. 3. If previous steps are correct and fault persists, replace the module.
91	Inlet sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the Inlet sensor. 3. If previous steps are correct and fault persists, replace the module.
92	Outlet sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the Outlet sensor. 3. If previous steps are correct and fault persists, replace the module.
93	DHW (Domestic Hot Water) sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the DHW sensor. 3. If previous steps are correct and fault persists, replace the module.

94	Header sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the header sensor. 3. If previous steps are correct and fault persists, replace the module.
95	Stack sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the stack sensor. 3. If previous steps are correct and fault persists, replace the module.
96	Outdoor sensor fault	H	1. Check wiring and correct any possible errors. 2. Replace the outdoor sensor. 3. If previous steps are correct and fault persists, replace the module.
97	Internal Fault: A2D mismatch.	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
98	Internal Fault: Exceeded VSNSR voltage tolerance	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
99	Internal Fault: Exceeded 28V voltage tolerance	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
100	Pressure Sensor Fault	H	1. Verify the Pressure Sensor is a 4-20 ma source. 2. Check wiring and correct any possible errors. 3. Test Pressure Sensor for correct operation. 4. Replace the Pressure sensor. 5. If previous steps are correct and fault persists, replace the module.
105	Flame detected out of sequence	H or L	1. Check that flame is not present in the combustion chamber. Correct any errors. 2. Make sure that the flame detector is wired to the correct terminal. 3. Make sure the F & G wires are protected from stray noise pickup. 4. Reset and sequence the module, if code reappears, replace the flame detector. 5. Reset and sequence the module, if code reappears, replace the module.
106	Flame lost in MFEP	L	1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.
107	Flame lost early in run	L	1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.
108	Flame lost in run	L	1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.

109	Ignition failed	L	1. Check main valve wiring and operation - correct any errors. 2. Check the fuel supply. 3. Check fuel pressure and repeat turndown tests. 4. Check ignition transformer electrode, flame detector, flame detector siting or flame rod position. 5. If steps 1 through 4 are correct and the fault persists, replace the module.
110	Ignition failure occurred	H	Hold time of recycle and hold option. Will not be a lockout fault. Hold Only. Internal hardware test. Not a lockout.
111	Flame current lower than weak threshold	H	Hold time of recycle and hold option. Will not be a lockout fault. Hold Only. Internal hardware test. Not a lockout.
113	Flame circuit timeout	L	Flame sensed during Initiate or off cycle, hold 240 seconds, if present after 240 seconds, system will lockout.
119	Control Interaction Fault	H	Flap valve identifications configured incorrectly.
122	Lightoff rate proving failed	L	1. Check wiring and correct any potential wiring errors. 2. Check VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
123	Purge rate proving failed	L	1. Check wiring and correct any potential wiring errors. 2. Check VFD's (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
128	Fan speed failed during prepurge	H or L	1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
129	Fan speed failed during preignition	H or L	1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
130	Fan speed failed during ignition	H or L	1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
131	Fan movement detected during standby	H	1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
132	Fan speed failed during run	H	1. Check wiring and correct any potential wiring errors. 2. Check the VFDs (Variable-speed Fan Drive) ability to change speeds. 3. Change the VFD 4. If the fault persists, replace the module.
137	ILK (Interlock) failed to close	H	1. Check wiring and correct any possible shorts. 2. Check Interlock (ILK) switches to assure proper function. 3. Verify voltage through the interlock string to the interlock input with a voltmeter. 4. If steps 1-3 are correct and the fault persists, replace the module.

149	Flame detected	H or L	Holds if flame detected during Safe Start check up to Flame Establishing period.
150	Flame not detected	H	Sequence returns to standby and restarts sequence at the beginning of Purge after the HF switch opens if flame detected during Safe Start check up to Flame Establishing period.
154	Purge Fan switch On	H or L	1. Purge fan switch is on when it should be off. 2. Check wiring and correct any errors. 3. Inspect the Purge Fan switch J6 terminal 3 and its connections. Make sure the switch is working correctly and is not jumpered or welded. 4. Reset and sequence the relay module. 5. If the fault persists, replace the relay module.
155	Purge fan switch OFF	H or L	1. Purge fan switch is off when it should be on. 2. Check wiring and correct any errors. 3. Inspect the Purge Fan switch J6 terminal 3 and its connections. Make sure the switch is working correctly and is not jumpered or welded. 4. Reset and sequence the relay module. 5. If the fault persists, replace the relay module.
156	Combustion pressure and flame ON	H or L	1. Check that flame is not present in the combustion chamber. Correct any errors. 2. Make sure that the flame detector is wired to the correct terminal. 3. Make sure the F & G wires are protected from stray noise pickup. 4. Reset and sequence the module, if code reappears, replace the flame detector. 5. Reset and sequence the module, if code reappears, replace the module.
157	Combustion pressure and flame OFF	L	1. Check that flame is not present in the combustion chamber. Correct any errors. 2. Make sure that the flame detector is wired to the correct terminal. 3. Make sure the F & G wires are protected from stray noise pickup. 4. Reset and sequence the module, if code reappears, replace the flame detector. 5. Reset and sequence the module, if code reappears, replace the module.
158	Main valve ON	L	1. Check Main Valve terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persists, replace the module.
159	Main valve OFF	L	1. Check Main Valve terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persists, replace the module.
160	Ignition ON	L	1. Check Ignition terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persists, replace the module.
161	Ignition OFF	L	1. Check Ignition terminal wiring and correct any errors. 2. Reset and sequence the module. If fault persists, replace the module.
164	Block intake ON	L	1. Check wiring and correct any errors. 2. Inspect the Block Intake Switch to make sure it is working correctly. 3. Reset and sequence the module. 4. During Standby and Purge, measure the voltage across the switch. Supply voltage should be present. If not, the Block Intake Switch is defective and needs replacing. 5. If the fault persists, replace the relay module.

165	Block intake OFF	L	1. Check wiring and correct any errors. 2. Inspect the Block Intake Switch to make sure it is working correctly. 3. Reset and sequence the module. 4. During Standby and Purge, measure the voltage across the switch. Supply voltage should be present. If not, the Block Intake Switch is defective and needs replacing. 5. If the fault persists, replace the relay module.
172	Main relay feedback incorrect	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
174	Safety relay feedback incorrect	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
175	Safety relay open	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
176	Main relay ON at safe start check	L	Internal Fault. 1. Reset Module. 2. If fault repeats, replace module.
178	Safety relay ON at safe start check	L	Internal Fault. 1. Reset module. 2. If fault repeats, replace module.
184	Invalid BLOWER/ HSI output setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
185	Invalid Delta T limit enable setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
186	Invalid Delta T limit response setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
187	Invalid DHW (Domestic Hot Water) high limit enable setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
188	Invalid DHW (Domestic Hot Water) high limit response setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
189	Invalid flame sensor type setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

192	Invalid igniter on during setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
193	Invalid ignite failure delay setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
194	Invalid ignite failure response setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.\
195	Invalid ignite failure retries setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
196	Invalid ignition source setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
197	Invalid interlock open response setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
198	Invalid interlock start check setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
199	Invalid LCI (Limit Control Input) enable setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
200	Invalid lightoff rate setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
201	Invalid lightoff rate proving setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
202	Invalid MFEP (Main Flame Establishing Period) time setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

203	Invalid MFEP (Main Flame Establishing Period) flame failure response setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
204	Invalid NTC sensor type setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
205	Invalid Outlet high limit response setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
207	Invalid PII (Pre-Ignition Interlock) enable setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
210	Invalid Postpurge time setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
211	Invalid Power up with lockout setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
212	Invalid Preignition time setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
213	Invalid Prepurge rate setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
214	Invalid Prepurge time setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
215	Invalid Purge rate proving setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
216	Invalid Run flame failure response setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

217	Invalid Run stabilization time setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
218	Invalid Stack limit enable setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
219	Invalid Stack limit response setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
220	Unconfigured Delta T limit setpoint setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
221	Unconfigured DHW (Domestic Hot Water) high limit setpoint setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
222	Unconfigured Outlet high limit setpoint setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
223	Unconfigured Stack limit setpoint setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
224	Invalid DHW (Domestic Hot Water) demand source setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
225	Invalid Flame threshold setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
226	Invalid Outlet high limit setpoint setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
227	Invalid DHW (Domestic Hot Water) high limit setpoint setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
228	Invalid Stack limit setpoint setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

229	Invalid Modulation output setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
230	Invalid CH (Central Heat) demand source setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
231	Invalid Delta T limit delay setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
232	Invalid Pressure sensor type setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
234	Invalid Outlet high limit enable setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
235	Invalid Outlet connector type setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
236	Invalid Inlet connector type setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
237	Invalid DHW (Domestic Hot Water) connector type setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
238	Invalid Stack connector type setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
239	Invalid Header connector type setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.
240	Invalid Outdoor connector type setting	L	1. Return to Configuration mode and recheck selected parameters, reverify and reset module. 2. If fault repeats, verify electrical grounding. 3. If fault repeats, replace module.

11.3 Diagnostic Tests and Input/ Output Indicators

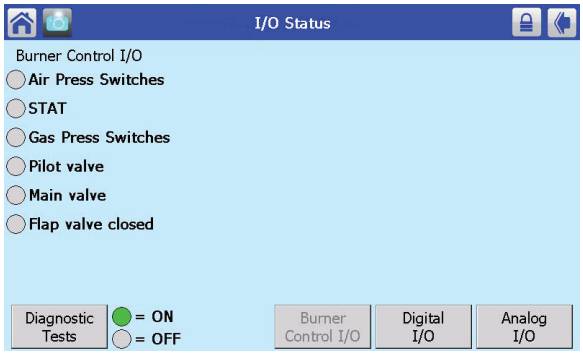
Two kinds of screens are grouped together in this section:

- Detailed indications of the input and output signals
- Diagnostic tests of the pumps and burner modulation

Note that these functions apply to just one selected controller.

To access the diagnostic functions, from the home screen, touch the control icon, then touch the 'Diagnostics' button.

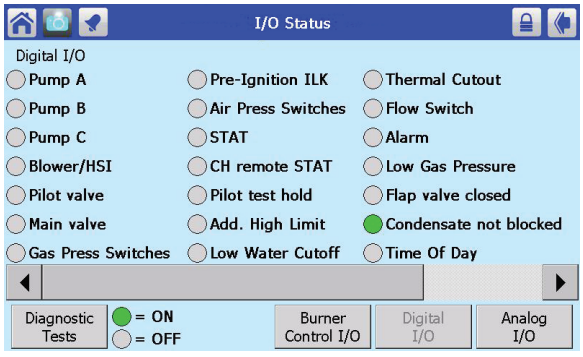
1. The buttons at the bottom of the screen select the types of inputs and outputs displayed. The Burner Control I/O button leads to Menu 8



Menu 8. Burner Control I/O Screen

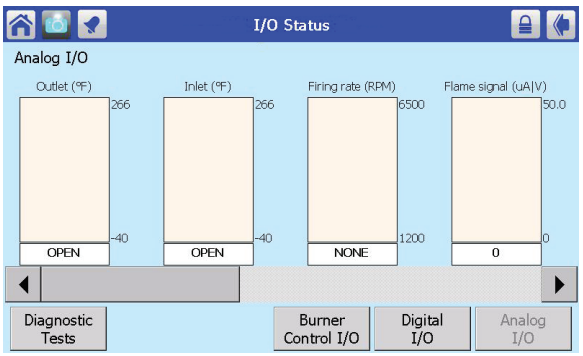
A green dot indicates a function that is "on."

2. Press the Digital I/O button to see parameters with the functions that are either "on" or "off." See Menu 9.



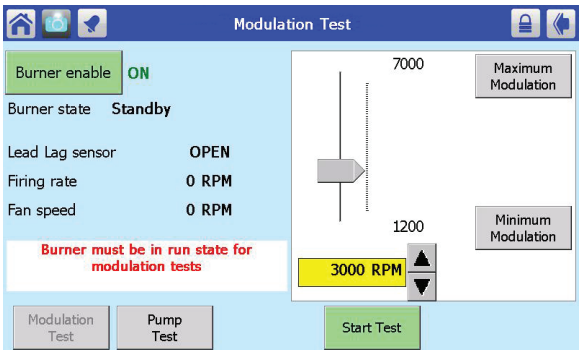
Menu 9. Digital I/O Screen

3. The button for Analog I/O displays items that change continuously between two limits. See Menu 10



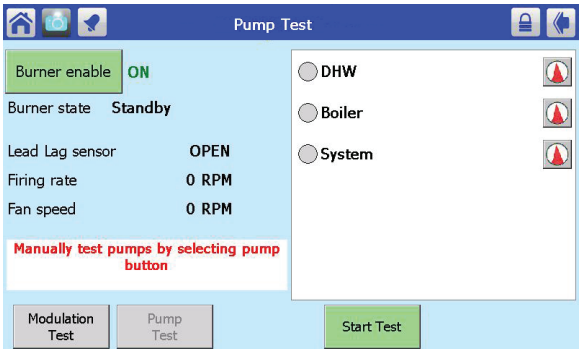
Menu 10. Analog I/O Screen

4. Press the button for Diagnostic Tests. The Modulation test allows you to change the rate at which the burner fires, and watch the results. See Menu 11



Menu 11. Modulation Test

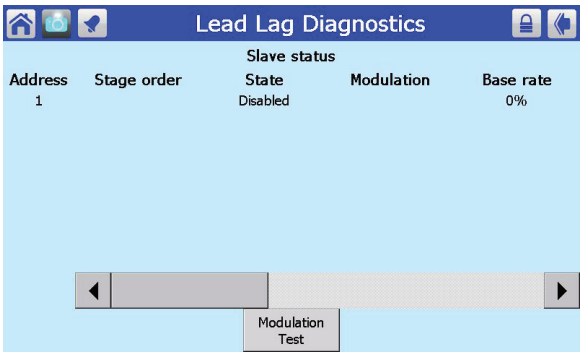
5. Press the Pump Test button. The Pump test shows detailed information about the three pumps that may be used by the system.



Menu 12. Pump Test

11.4 Lead/Lag Slave Diagnostics

The control system includes a diagnostic screen that lists some information on the Lead/Lag slaves in the system. See Menu 13

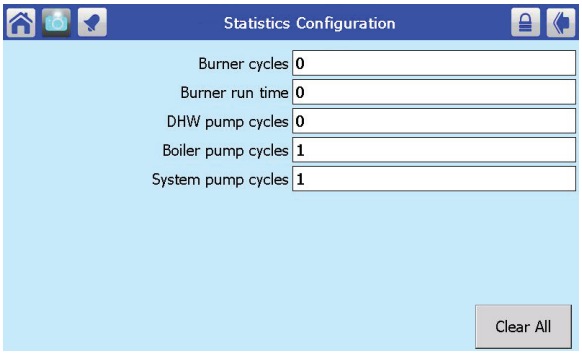


Menu 13. Lead/Lag Diagnostics

Use the left- and right-arrows to see all of the columns in the display.

11.5 Statistics

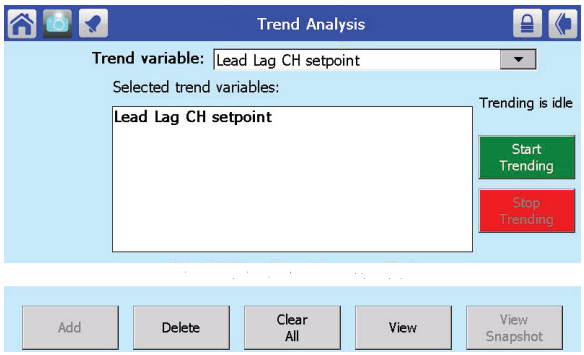
The controller can present some summary information about the operation of the system – number of pump cycles, number of burner cycles, etc.



Menu 14. Statistics Configuration Screen

11.6 Analysis

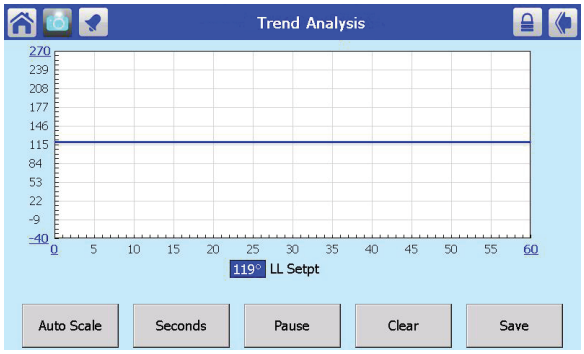
The control system includes an Analysis branch that can display the behavior over a period of time for several different parameters: fan speed, outlet temperature, inlet temperature, etc.



Menu 15. Analysis Setup Screen

To use this function, select the parameter you want to track from the pull-down list. The system will present a graph that tracks that variable.

To see the graph for the currently-selected function, press the View button.



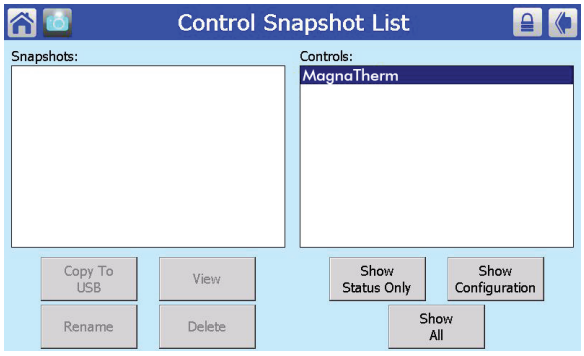
Menu 16. Trend Analysis Graph

The time scale can be adjusted by pressing the Seconds button in the lower left-hand corner.

11.7 Control Snapshot

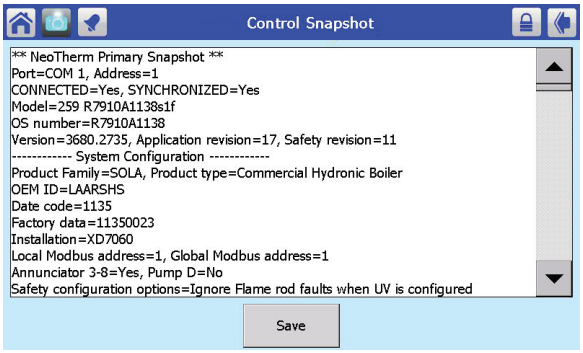
The software allows you to take a "snapshot" of the current state of the controller, including setup information and operating information. This information can be helpful during troubleshooting.

Menu 17 shows the Control Snapshot screen.



Menu 17. Control Snapshot List Screen

Select one of the controllers listed on the right side of the screen. Press one of the buttons below the right column to see the snapshot. See Menu 18.



Menu 18. Typical Control Snapshot

The Show Status button captures the current status of the I/O of the control only. Show Configuration captures the current parameter settings and the control setup. You can save the snapshot, give it a name, or send a copy to the USB port.

11.8 Operating Sequence

When there is a call for heat, the unit will close pump contacts to energize the customer supplied relay/contactor to start water flow. Once the LCI circuit (flow switch, gas pressure switches, LWCO, and High Limit aquastats) are completed the unit will start the blower and begin the ignition sequence.

Brute is equipped with a low and high fire air pressure switch. The unit will pre-purge at 65% fan for 30 seconds and prove fan through the blocked intake switch. Once fan is proven, the blower will proceed to 24% and the 10 second Pre-ignition timer will start to allow the HSI to heat up. Once the Pre-ignition timer has expired the control will open the Pilot solenoid and the Pilot Flame Establishing Period (PFEP) will start for 10 seconds to establish flame. Once flame has been established and the 10 second timer has expired the control will open the main valve and the Main Flame Establishing Period will begin for a period of 5 seconds. If flame is established within those 5 seconds then unit will proceed to Run, if flame does not establish the unit will post-purge to 100% for 30 seconds and the sequence for ignition will begin again. For Non CSD-1 units retry for ignition is 3 times before Lockout 109 (Ignition Failure) occurs. For CSD-1 units there is a single retry before Lockout 109 occurs.

Section 12 - REPLACEMENT PARTS

Use only genuine Bradford White replacement parts.

12.1 General Information

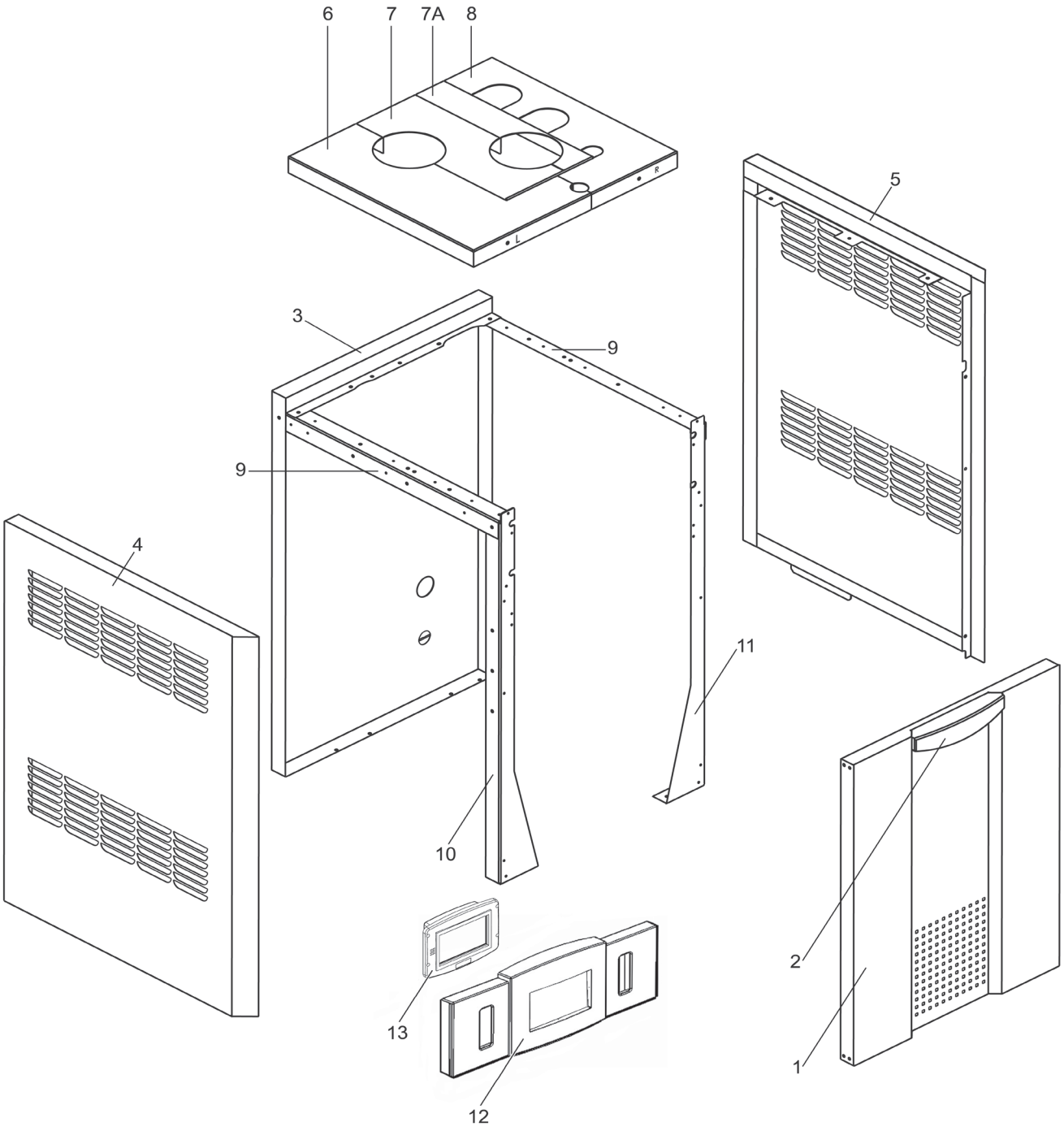
To order or purchase parts for the Bradford White Brute, contact your nearest Bradford White dealer or distributor. If they cannot supply you with what you need, contact Customer Service. (See the back cover for the address, telephone and fax numbers.)

12.2 Parts List

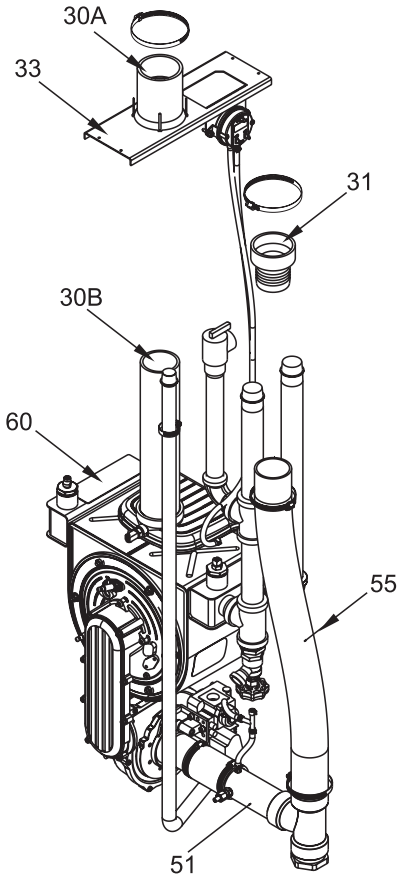
ITEM	DESCRIPTION	SIZE BNTH 210 BNTV 199	SIZE BNTH 285 BNTV 285	SIZE BNTH 399 BNTV 399	SIZE BNTH 500 BNTV 500	SIZE BNTH 600 BNTV 600	SIZE BNTH 750 BNTV 750	SIZE BNTH 850 BNTV 850
Jacket Components – *See Figure 63*								
1	Front Panel Assembly	R60D3200	R60D3200	R60D3201	R60D3202	R60D3202	R60D3202	R60D3202
2	Front Panel Handle	R50D3204	R50D3204	R50D3204	R50D3204	R50D3204	R50D3204	R50D3204
3	Rear Panel	R50D3101	R50D3101	R50D3101	R50D3101	R50D3101	R50D3101	R50D3101
4	Left Side Panel	R19D3002/	R30D3002	R40D3002	R50D3002 R20D3002	R50D3002	75D3002	85D3002
5	Right Side Panel	R30D3001	R30D3001	R40D3001	R50D3001	R50D3001	75D3001	85D3001
6	Left Top Panel	R20D3303	30D3312	R40D3303	50D3308	60D3303	75D3303	85D3303
7	Middle Left Top Panel	20D3403	30D3311	40D3401	50D3401	60D3302	75D3302	85D3302
7A	Middle Right Top Panel	20D3402	30D3313	—	—	—	—	—
8	Right Top Panel	R20D3301	30D3314	40D3402	50D3402	60D3301	75D3301	85D3301
9	Jacket Angle Support	R30D3102 (2)	R30D3102 (2)	R40D3102 (2)	R50D3102 (2) BNTH R51D3102 (2) BNTV	R50D3102 (2)	75D3102 (2)	85D3102 (2)
10	Jacket Support, Left Stanchion	R50D3003	R50D3003	R50D3003	R50D3003	R50D3003	R50D3003	R50D3003
11	Jacket Support, Right Stanchion	R50D3004	R50D3004	R50D3004	R50D3004	R50D3004	R50D3004	R50D3004
12	Front Bezel	R50D7121	R50D7121	R50D7121	R50D7121	R50D7121	R50D7121	R50D7121
13	Touchscreen Display	E2339800	E2339800	E2339800	E2339800	E2339800	E2339800	E2339800
Internal Components – *See Figure 64*								
20	Base Assembly	R15D1100	R30D1100	R40D1100	R50D1100	60D1100	75D1100	85D1100
21	Left Rear Support Stanchion	R50D1001	R50D1001	R50D1001	R50D1001	R50D1001	R50D1001	R50D1001
22	Left Front/Right Rear Support Stanchion	—	R50D1002 (2)	R50D1002 (2)	R50D1002 (2)	R50D1002 (2)	R50D1002 (2)	R50D1002 (2)
23	Cantilevered Base Stanchion	R40D1001	R40D1001	R40D1001	R40D1001	R50D1003	75D1002	75D1002
24	Brace, Front, HX Stanchion	20D1005	85D1005	85D1005	85D1005	60D1005	85D1005	85D1005
24A	Brace, Rear, HX Stanchion	20D1007	R50D1005	85D1005	85D1005	85D1005	85D1005	85D1005
25	Mounting Rail	R30D1004 (2)	R30D1004 (2)	40D1004 (2)	R50D1004 (2)	R50D1004 (2)	75D1004 (2)	85D1004 (2)
26A	Diagonal Brace	—	—	—	—	—	75D1006 (2)	75D1006 (2)
27	Condensate Trap Assy	R20D4020	R50D4020	R50D4020	R50D4020	R2075701	R2075701	R2075701

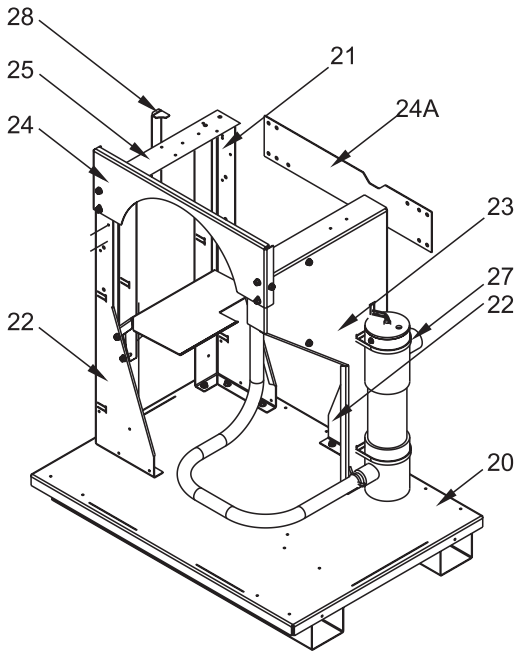
ITEM	DESCRIPTION	SIZE BNTH 210 BNTV 199	SIZE BNTH 285 BNTV 285	SIZE BNTH 399 BNTV 399	SIZE BNTH 500 BNTV 500	SIZE BNTH 600 BNTV 600	SIZE BNTH 750 BNTV 750	SIZE BNTH 850 BNTV 850
28	Heat Exch. Rail Clip	— (2)	R50D1006 (2)	—	—	— (2)	—	—
30	PVC Reducer	RP2053000	RP2052900	RP2052800	50D4027	RP2052800	RP2052800	RP2052800
30a	CPVC Reducer or Coupling	RP2065600	—	—	—	—	R75D4020	R75D4020
30b	2” Dia. Pipe, CPVC	RD2010213 BNTV RD2010213 BNTH	—	—	—	—	—	—
31	Hose Barbed Adapter	RP2056100	RP2056100	—	—	—	—	—
33	Air Inlet/Exhaust Bracket	R20D3120	30D3505	40D3005	85D3005	85D3005	85D3005	85D3005
Gas Train Components – *See Figure 65*								
40	Combustion Air Blower	RA2114200	RA2114200	RA2113100	RA2113100	R2012101	R2012101	R2012101
41	Gas Valve/Venturi	RV2017903	RV2017904	—	—	—	—	—
42	Gas Valve	—	—	RV2019200	V2019600	V2018500	V2018500	V2018500
43	Gas/Air Venturi	—	—	—	RA2116700	A2115000	A2115000	A2115000
44	Manual Gas Valve	—	—	RV2000200	V2003000	V2003000 (2)	V2003200	V2003200
44A	Manual Gas Valve	—	—	—	RV2000200	—	V2003000	V2003000
45	Gas Valve Flange Kit	—	—	—	RP2050100	RP2050100	RP2050100	RP2050100
46	Gas Valve/Venturi Cork Gasket	—	—	—	RS2104900	RS2104900	RS2104900	RS2104900
47	Gas Valve O-Ring	R30-227	R30-227	—	—	—	—	—
48	Venturi O-Ring	—	—	RS2105200	RS2105200	RS2105200	RS2105200	RS2105200
49	High Gas Pressure Switch	—	—	—	R50D5014	R50D5013	R75D5014	R75D5014
50	Low Gas Pressure Switch	—	—	—	R50D5015	R50D5012	R75D5015	R75D5015
51	Duct/Venturi Transition	R10D5013	R30D5013	—	R50D5017	R60D5052	R60D5052	R85D5052
52	Gas Supply Pipe	RP2051400	RP2051500	P2054300	P2054300	P2054300	P2064200	P2064200
53	Gas Pipe, 3/4” NPT Formed Nipple	—	—	RP2056500	—	—	—	—
55	Air Inlet Flex Hose	D0091401	D0091401	RD0091202	D0091301	RD0091201	RD0091203	RD0091203
56	Air Inlet Collector	—	—	RV2019400	—	—	—	—
57	Electrical Connector w/Cable	—	—	RE2331700	RE2331700	—	—	—
58	Elbow Adapter	—	—	RV2019300	RV2019300	—		
59	Blower Gasket W/Fasteners	—	—	—	—	RS2107500	RS2107500	RS2107500
Heat Exchanger Components – *See Figure 66*								
60	Heat Exchanger	RS2105700 BNTH S2111000 BNTV	RS2111100	RS2111200	RS2111300	RS2111300	RS2111400	RS2111500
61	Pump Assembly	R20D4140 BNTH 15D4040 BNTV	R30D4110 BNTH 50D4040 BNTV	R40D4110 BNTH 50D4040 BNTV	R50D4110 BNTH 50D4040 BNTV	—	—	—
62	Low Water Cutoff Switch	—	—	—	RE2076500	RE2076500	RE2076500	RE2076500

ITEM	DESCRIPTION	SIZE BNTH 210 BNTV 199	SIZE BNTH 285 BNTV 285	SIZE BNTH 399 BNTV 399	SIZE BNTH 500 BNTV 500	SIZE BNTH 600 BNTV 600	SIZE BNTH 750 BNTV 750	SIZE BNTH 850 BNTV 850
63	Inlet Water Temp Sensor	RE2320600	RE2320600	RE2320600	RE2320600	RE2320600	RE2320600	RE2320600
64	Duplex Outlet Water Temperature Sensor	RE2319900	RE2319900	RE2319900	RE2319900	RE2319900	RE2319900	RE2319900
65	Duplex Stack Temperature Sensor	RE2319700	RE2319800	RE2319800	RE2319800	RE2319800	RE2319800	RE2319800
66	Pressure Relief Valve, BNTH	R51-182 (30 PSI)	RA2113602 (75 PSI)	RA2113602 (75 PSI)	RA2113602 (75 PSI)	RA2113602 (75 PSI)	RA2113602 (75 PSI)	RA2113602 (75 PSI)
	Pressure Relief Valve, BNTV	A2114802 (125 PSI)	A2114802 (125 PSI)	A2114802 (125 PSI)	A2114802 (125 PSI)	A2114802 (125 PSI)	A2114802 (125 PSI)	A2114802 (125 PSI)
67	Air Vent	R1-592	R1-592	R1-592	R1-592	R1-592	R1-592	R1-592
68	Burner Door w/gaskets	RS2108300	RS2108300	RS2108300	RS2108300	RS2108300	RS2108300	RS2108300
68A	Gaskets-only (burner door)	R2069400	R2069400	R2069400	R2069400	R2069400	R2069400	R2069400
69	Burner Gasket	RS2108500	RS2108500	RS2108500	RS2108500	RS2108500	RS2108500	RS2108500
69A	Gasket Set (burner, ignitor, sensor & door gaskets)	RS2109100	RS2109100	RS2109100	RS2109100	RS2109100	RS2109100	RS2109100
70	Front Refractory Tile	RT2109000	RT2109000	RT2109000	RT2109000	RT2109000	RT2109000	RT2109000
71	Rear Refractory Tile	R50D2021	R50D2021	R50D2021	R50D2021	R50D2021	R50D2021	R50D2021
72	Main Burner w/gasket	R2069104	R2069105	R2069106	R2069106	R2069107	R2069108	R2069109
73	Flame Sensor w/gasket	R2069200	R2069200	R2069200	R2069200	R2069200	R2069200	R2069200
74	Ignitor w/gasket	R2069300	R2069300	R2069300	R2069300	R2069300	R2069300	R2069300
74A	Ignitor Gasket	RW2013300	RW2013300	RW2013300	RW2013300	RW2013300	RW2013300	RW2013300
74B	Screw, Ignitor/ Flame Sensor	m4-.7X8mm S2112700	m4-.7X8mm S2112700	m4-.7X8mm S2112700	m4-.7X8mm S2112700	m4-.7X8mm S2112700	m4-.7X8mm S2112700	m4-.7X8mm S2112700
74C	Flame/Sensor Gasket	RW2013400	RW2013400	RW2013400	RW2013400	RW2013400	RW2013400	RW2013400
75	Air/Gas Channel (80-600) Air Adapter (750-850)	RS2108700	RS2108700	RS2108700	RS2108801	RS2108801	RS2115400	RS2115400
75A	Screw, Air/Gas Channel	RS2109400 (5)	RS2109400 (5)	RS2109400 (5)	RS2109400 (5)	RS2109400 (5)	RF2029200 (5)	RF2029200 (5)
76	Drain	R10-143	R10-143	R10-143	R10-143	R10-143	R10-143	R10-143
77	Sight Glass	R50D2020	R50D2020	R50D2020	R50D2020	R50D2020	R50D2020	R50D2020
Electrical Components – *See Figure 67*								
80	Control Panel Enclosure	R50D7001	R50D7001	R50D7001	R50D7001	R50D7001	R50D7001	R50D7001
R50D7001								
81	Transformer	RE2108700	RE2108700	RE2108700	RE2108700	RE2108700	RE2108700	RE2108700
82	High Voltage Shield	R50D7002	R50D7002	R50D7002	R50D7002	R50D7002	R50D7002	R50D7002
83	Top Panel Bracket	R50D7003	R50D7003	R50D7003	R50D7003	R50D7003	R50D7003	R50D7003
84	Electronic Control Module, Standard	*Contact Customer Service at 800 900-9276 x11*						
84	Electronic Control Module, CSD-1	*Contact Customer Service at 800 900-9276 x11*						
85	Rocker Switch	RE2322700	RE2322700	RE2322700	RE2322700	RE2322700	RE2322700	RE2322700
87	Wire Harness	R50D7414	R50D7408	R50D7406	R50D7402	R50D7410	R50D7409	R50D7409
89	Air Pressure Switch	RE2334701	RE2334700	—	RE2334700	RE2334700	RE2334701	RE2334700
90	Water Flow Switch	—	—	R2008400	R2008400	R2008400	R2008400	R2008400

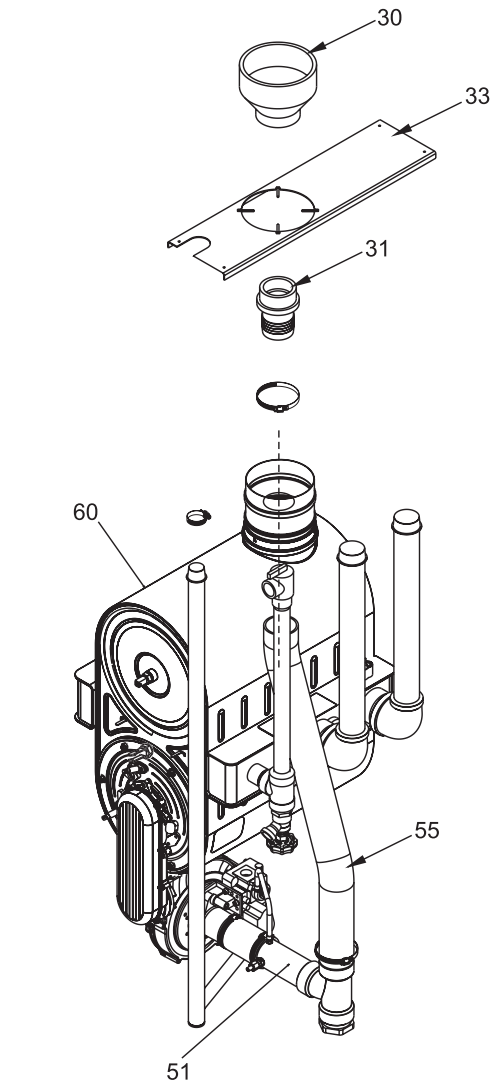


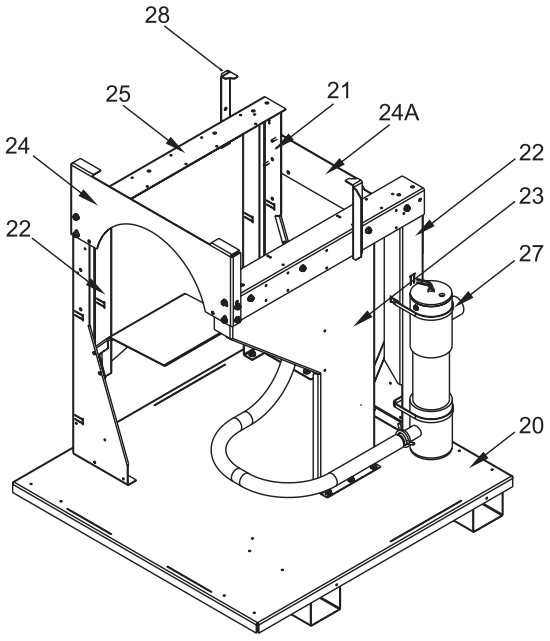
Parts Illustration 1. Jacket Components



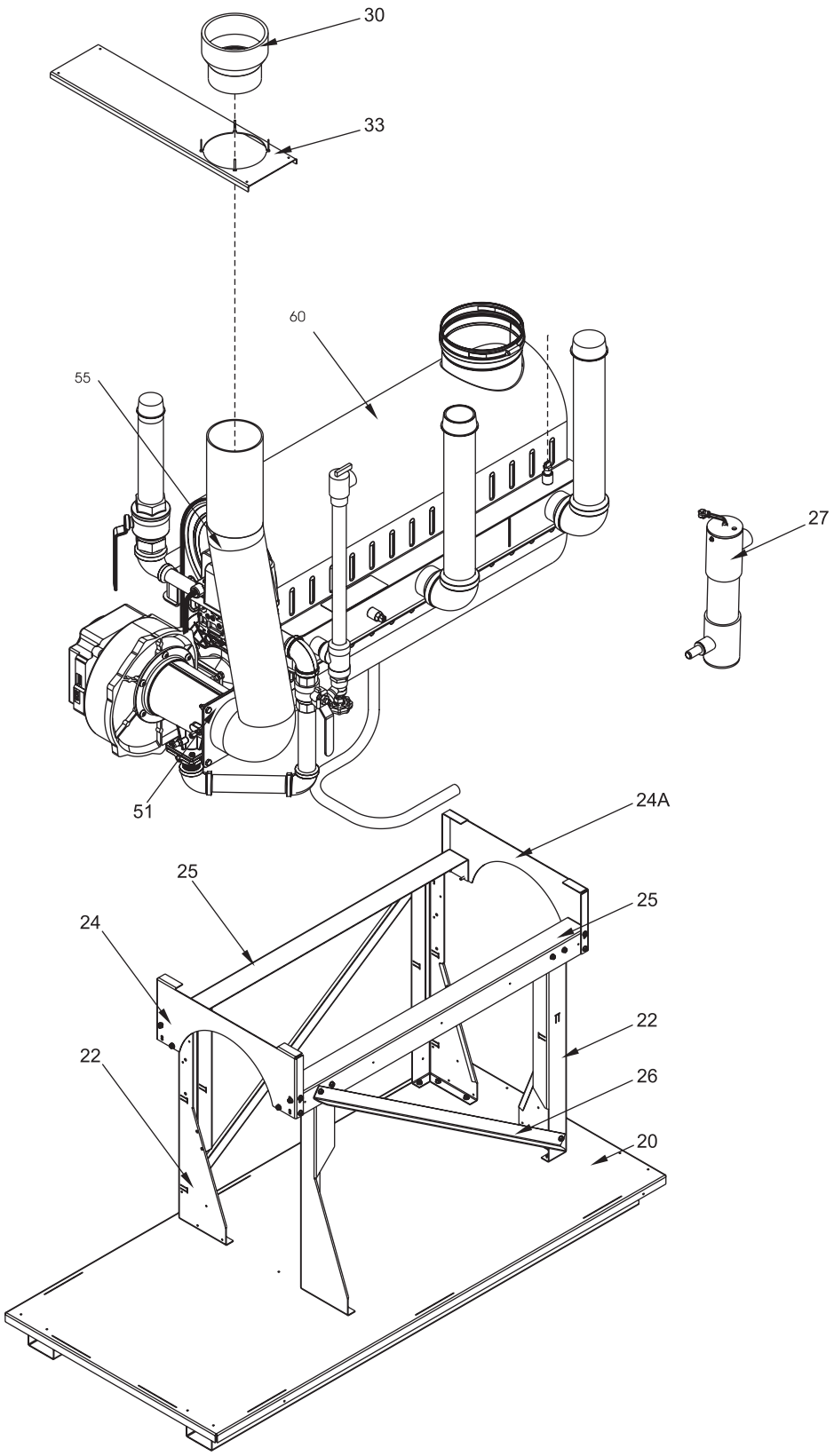


Parts Illustration 2. Internal Components, Sizes 150–210

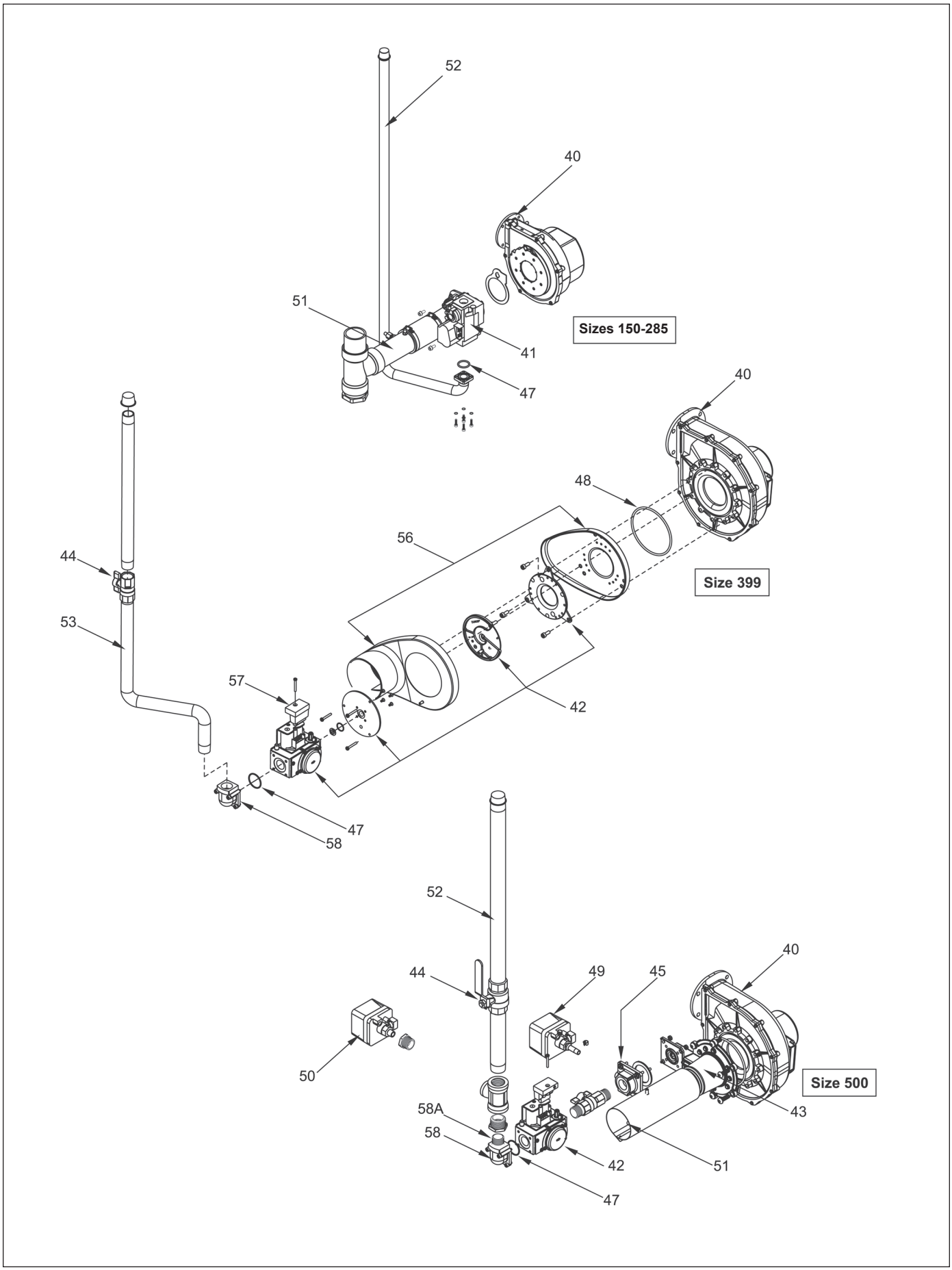




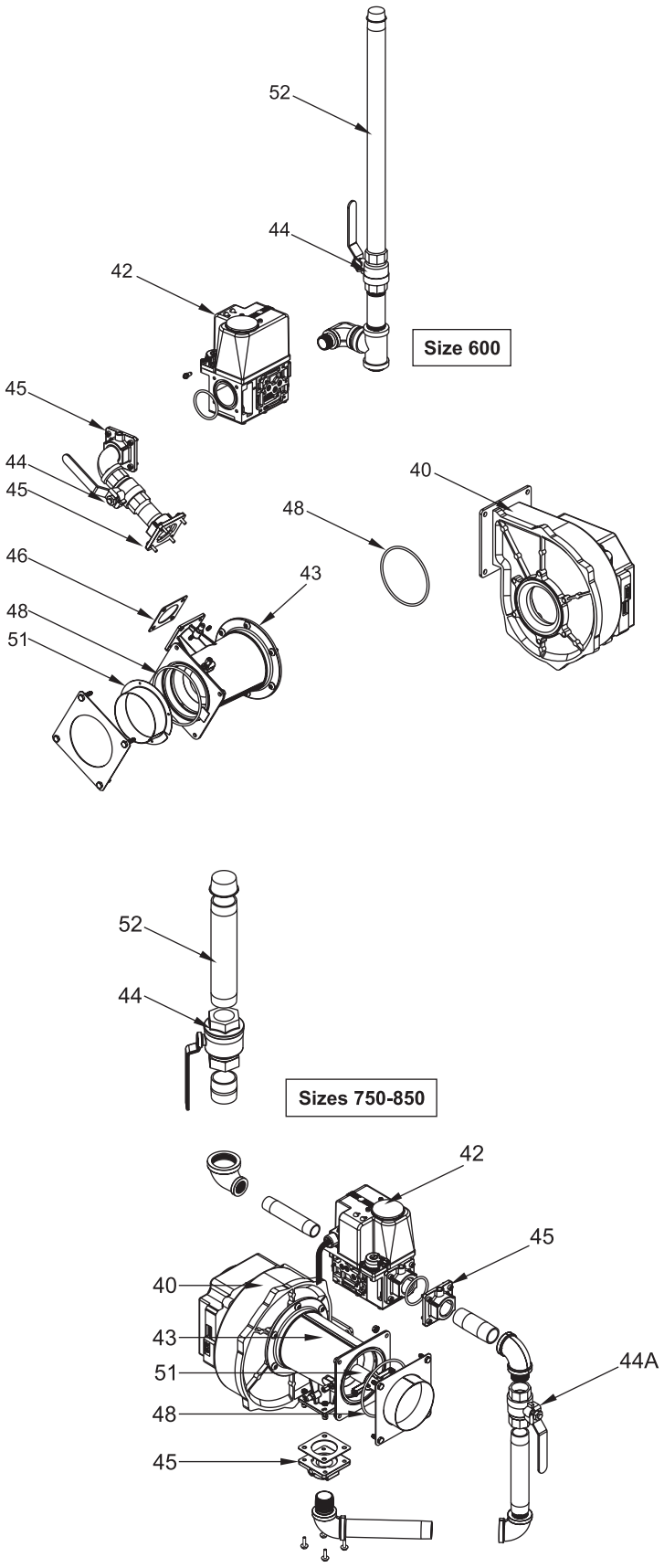
Parts Illustration 3. Internal Components, Sizes 285–600



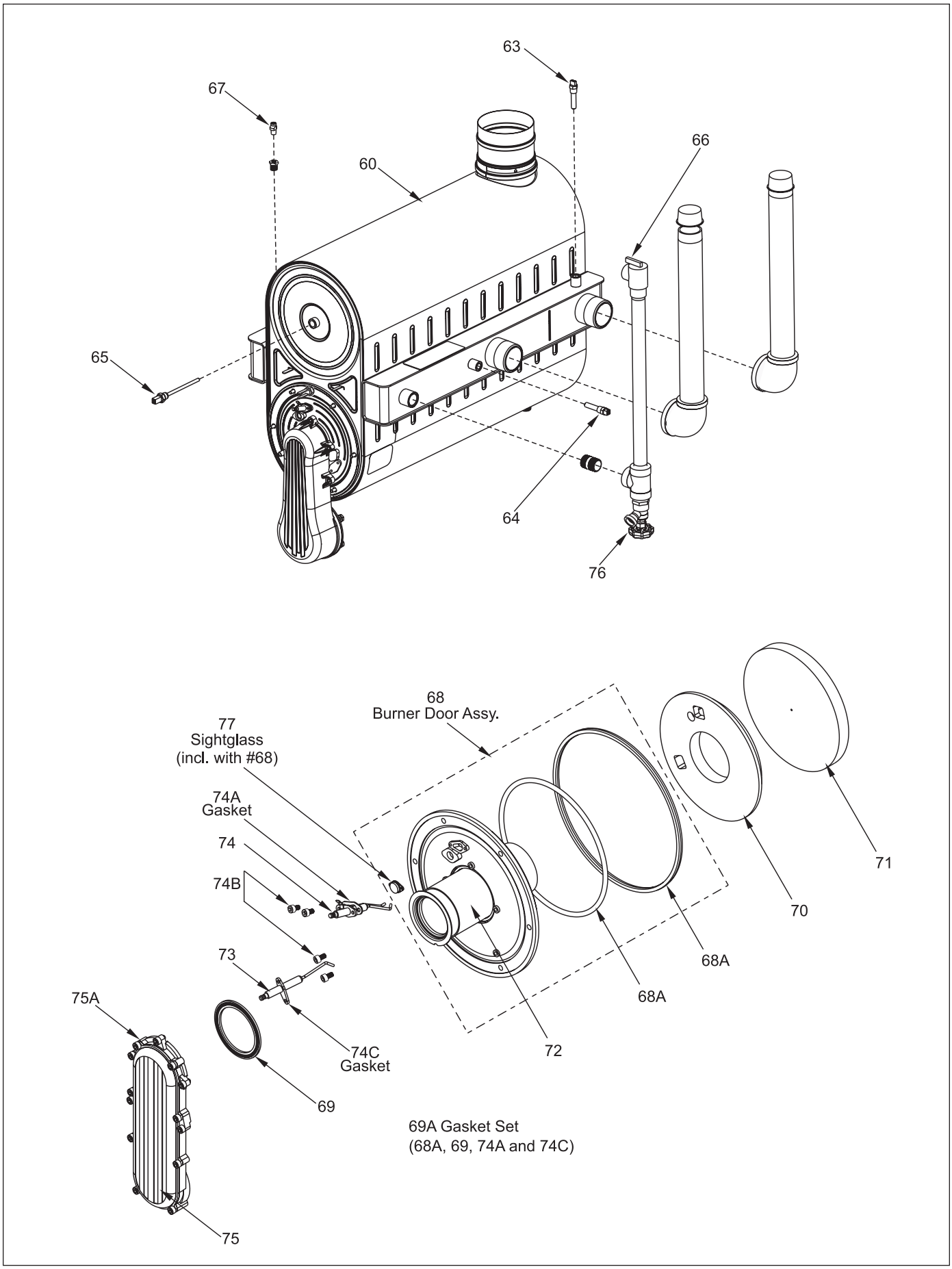
Parts Illustration 4. Internal Components, Sizes 750-850



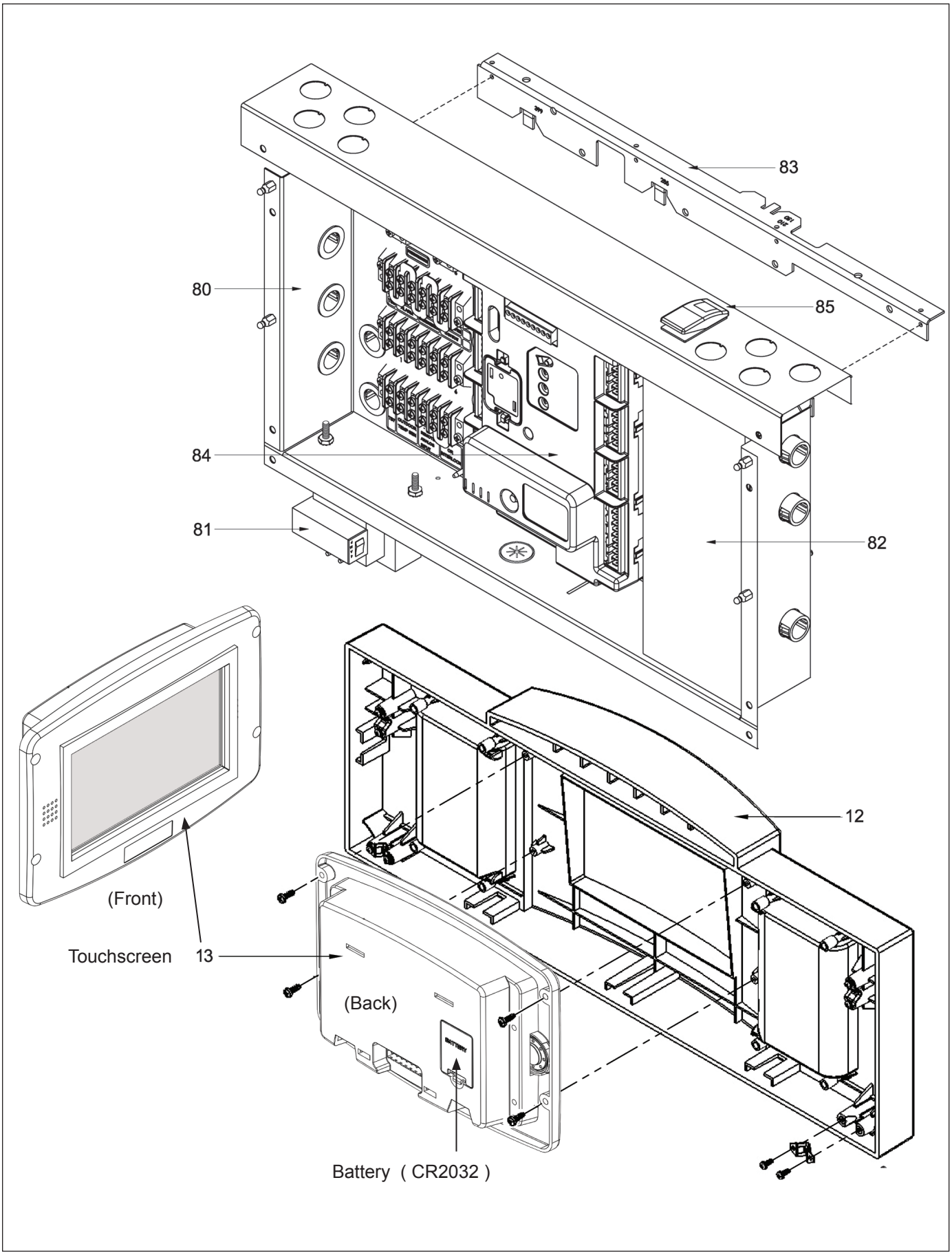
Parts Illustration 5. Gas Train Components, Sizes 150-500



Parts Illustration 6. Gas Train Components, Sizes 600-850



Parts Illustration 7. Heat Exchanger Components



Parts Illustration 8. Electrical Components

Notes:

Notes:

Dimensions and specifications subject to change without notice in accordance with our policy of continuous product improvement.

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