INSTALLATION, OPERATING AND SERVICE INSTRUCTIONS FOR

APEX™

CONDENSING HIGH EFFICIENCY DIRECT VENT

GAS - FIRED HOT WATER BOILER

ASME H

C ETL US LISTED
Intertek
9700609

AHRI CERTIFIED®
C www.ahridirectory.org

WARNING: Improper installation, adjustment, alteration, service or maintenance can cause property damage, injury, or loss of life. For assistance or additional information, consult a qualified installer, service agency or the gas supplier. This boiler requires a special venting system. Read these instructions carefully before installing.

103022-04 - 8/13

Price - $5.00

IMPORTANT INFORMATION - READ CAREFULLY

NOTE: The equipment shall be installed in accordance with those installation regulations enforced in the area where the installation is to be made. These regulations shall be carefully followed in all cases. Authorities having jurisdiction shall be consulted before installations are made.

All wiring on boilers installed in the USA shall be made in accordance with the National Electrical Code and/or local regulations.

All wiring on boilers installed in Canada shall be made in accordance with the Canadian Electrical Code and/or local regulations.

The City of New York requires a Licensed Master Plumber supervise the installation of this product.

The Massachusetts Board of Plumbers and Gas Fitters has approved the Apex™ Series boiler. See the Massachusetts Board of Plumbers and Gas Fitters website, **http://license.reg.state.ma.us/pubLic/pl_products/pb_pre_form.asp** for the latest Approval Code or ask your local Sales Representative.

The Commonwealth of Massachusetts requires this product to be installed by a Licensed Plumber or Gas Fitter.

The following terms are used throughout this manual to bring attention to the presence of hazards of various risk levels, or to important information concerning product life.

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death, serious injury or substantial property damage.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in moderate or minor injury or property damage.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death, serious injury or substantial property damage.

NOTICE

Indicates special instructions on installation, operation, or maintenance which are important but not related to personal injury hazards.

DANGER

DO NOT store or use gasoline or other flammable vapors or liquids in the vicinity of this or any other appliance.

If you smell gas vapors, NO NOT try to operate any appliance - DO NOT touch any electrical switch or use any phone in the building. Immediately, call the gas supplier from a remotely located phone. Follow the gas supplier's instructions or if the supplier is unavailable, contact the fire department.

Special Installation Requirements for Massachusetts

A. For all sidewall horizontally vented gas fueled equipment installed in every dwelling, building or structure used in whole or in part for residential purposes and where the sidewall exhaust vent termination is less than seven (7) feet above grade, the following requirements shall be satisfied:

1. If there is no carbon monoxide detector with an alarm already installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code in the residential unit served by the sidewall horizontally vented gas fueled equipment, a battery operated carbon monoxide detector with an alarm shall be installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code.
2. In addition to the above requirements, if there is not one already present, a carbon monoxide detector with an alarm and a battery back-up shall be installed and located in accordance with the installation requirements supplied with the detector on the floor level where the gas equipment is installed. The carbon monoxide detector with an alarm shall comply with 527 CMR, ANSI/UL 2034 Standards or CSA 6.19 and the most current edition of NFPA 720. In the event that the requirements of this subdivision can not be met at the time of the completion of the installation of the equipment, the installer shall have a period of thirty (30) days to comply with this requirement; provided, however, that during said thirty (30) day period, a battery operated carbon monoxide detector with an alarm shall be installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code. In the event that the sidewall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the carbon monoxide detector may be installed on the next adjacent habitable floor level. Such detector may be a battery operated carbon monoxide detector with an alarm and shall be installed in compliance with the most current edition of NFPA 720, NFPA 70 and the Massachusetts State Building Code.
3. A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating appliance or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, **"GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS"**.
4. A final inspection by the state or local gas inspector of the sidewall horizontally vented equipment shall not be performed until proof is provided that the state or local electrical inspector having jurisdiction has granted a permit for installation of carbon monoxide detectors and alarms as required above.

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

1. The equipment listed in Chapter 10 entitled "Equipment Not Required To Be Vented" in the most current edition of NFPA 54 as adopted by the Board; and
2. Product Approved sidewall horizontally vented gas fueled equipment installed in a room or structure separate from the dwelling, building or structure used in whole or in part for residential purposes.

C. When the manufacturer of Product Approved sidewall horizontally vented gas equipment provides a venting system design or venting system components with the equipment, the instructions for installation of the equipment and the venting system shall include:

1. A complete parts list for the venting system design or venting system; and
2. Detailed instructions for the installation of the venting system design or the venting system components.

D. When the manufacturer of a Product Approved sidewall horizontally vented gas fueled equipment does not provide the parts for venting flue gases, but identifies "special venting systems", the following shall be satisfied:

1. The referenced "special venting system" instructions shall be included with the appliance or equipment installation instructions; and
2. The "special venting systems" shall be Product Approved by the Board, and the instructions for that system shall include a parts list and detailed installation instructions.

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

WARNING

This boiler requires regular maintenance and service to operate safely. Follow the instructions contained in this manual.

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Read and understand the entire manual before attempting installation, start-up operation, or service. Installation and service must be performed only by an experienced, skilled, and knowledgeable installer or service agency

This boiler must be properly vented.

This boiler needs fresh air for safe operation and must be installed so there are provisions for adequate combustion and ventilation air.

The interior of the venting system must be inspected and cleaned before the start of the heating season and should be inspected periodically throughout the heating season for any obstructions. A clean and unobstructed venting system is necessary to allow noxious fumes that could cause injury or loss of life to vent safely and will contribute toward maintaining the boiler's efficiency.

Installation is not complete unless a pressure relief valve is installed into the tapping located on left side of appliance. - See the Water Piping and Trim Section of this manual for details.

This boiler is supplied with safety devices which may cause the boiler to shut down and not re-start without service. If damage due to frozen pipes is a possibility, the heating system should not be left unattended in cold weather; or appropriate safeguards and alarms should be installed on the heating system to prevent damage if the boiler is inoperative.

This boiler contains very hot water under high pressure. Do not unscrew any pipe fittings nor attempt to disconnect any components of this boiler without positively assuring the water is cool and has no pressure. Always wear protective clothing and equipment when installing, starting up or servicing this boiler to prevent scald injuries. Do not rely on the pressure and temperature gauges to determine the temperature and pressure of the boiler. This boiler contains components which become very hot when the boiler is operating. Do not touch any components unless they are cool.

Boiler materials of construction, products of combustion and the fuel contain alumina, silica, heavy metals, carbon monoxide, nitrogen oxides, aldehydes and/or other toxic or harmful substances which can cause death or serious injury and which are known to the state of California to cause cancer, birth defects and other reproductive harm. Always use proper safety clothing, respirators and equipment when servicing or working nearby the appliance.

Failure to follow all instructions in the proper order can cause personal injury or death. Read all instructions, including all those contained in component manufacturers manuals which are provided with the boiler before installing, starting up, operating, maintaining or servicing.

All cover plates, enclosures and guards must be in place at all times.

NOTICE

This boiler has a limited warranty, a copy of which is printed on the back of this manual. It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when the installation is complete.

TABLE OF CONTENTS

I. Product Description, Specifications and Dimensional Data

Apex™ Series boilers are condensing high efficiency gas-fired direct vent hot water boilers designed for use in forced hot water space or space heating with indirect domestic hot water heating systems, where supply water temperature does not exceed 210°F. These boilers have special coil type stainless steel heat exchangers, constructed, tested and stamped per Section IV 'Heating Boilers' of ASME Boiler and Pressure Vessel Code, which provide a maximum heat transfer and simultaneous protection against flue gas product corrosion. These boilers are not designed for use in gravity hot water space heating systems or systems containing significant amount of dissolved oxygen (swimming pool water heating, direct domestic hot water heating, etc.).

Table 1: Dimensional Data (See Figures 1A, 1B and 1C)

Dimension	Boiler Model		
	APX399	**APX500**	**APX800**
A - Inch (mm)	28-7/8 (734)	44-7/8 (1140)	54-9/16 (1384)
B - Inch (mm)	6-3/16 (157)	22-1/8 (562)	28-3/8 (724)
C - Inch (mm)	13-1/16 (332)	29 (737)	34-1/4 (876)
D - Inch (mm)	23-3/4 (602)	39-11/16 (1008)	48-1/16 (1226)
E - Inch (mm)	15-13/16 (402)	29-3/8 (752)	33-13/16 (864)
Gas Inlet F (FPT)	3/4"	3/4"	1
Return G	1-1/2" (FPT)		2" (MPT)
Supply H	1-1/2" (FPT)		2" (MPT)
Condensate Drain J	Factory Provided Socket End Compression Pipe Joining Clamp for 3/4" Schedule 40 PVC Pipe		
Boiler Two-Pipe CPVC/PVC Vent Connector (Figures 1A, 1B and 1C) - Inch	4 x 4		6 x 6
Approx. Shipping Weight (LBS)	304	350	430

I. Product Description, Specifications and Dimensional Data (continued)

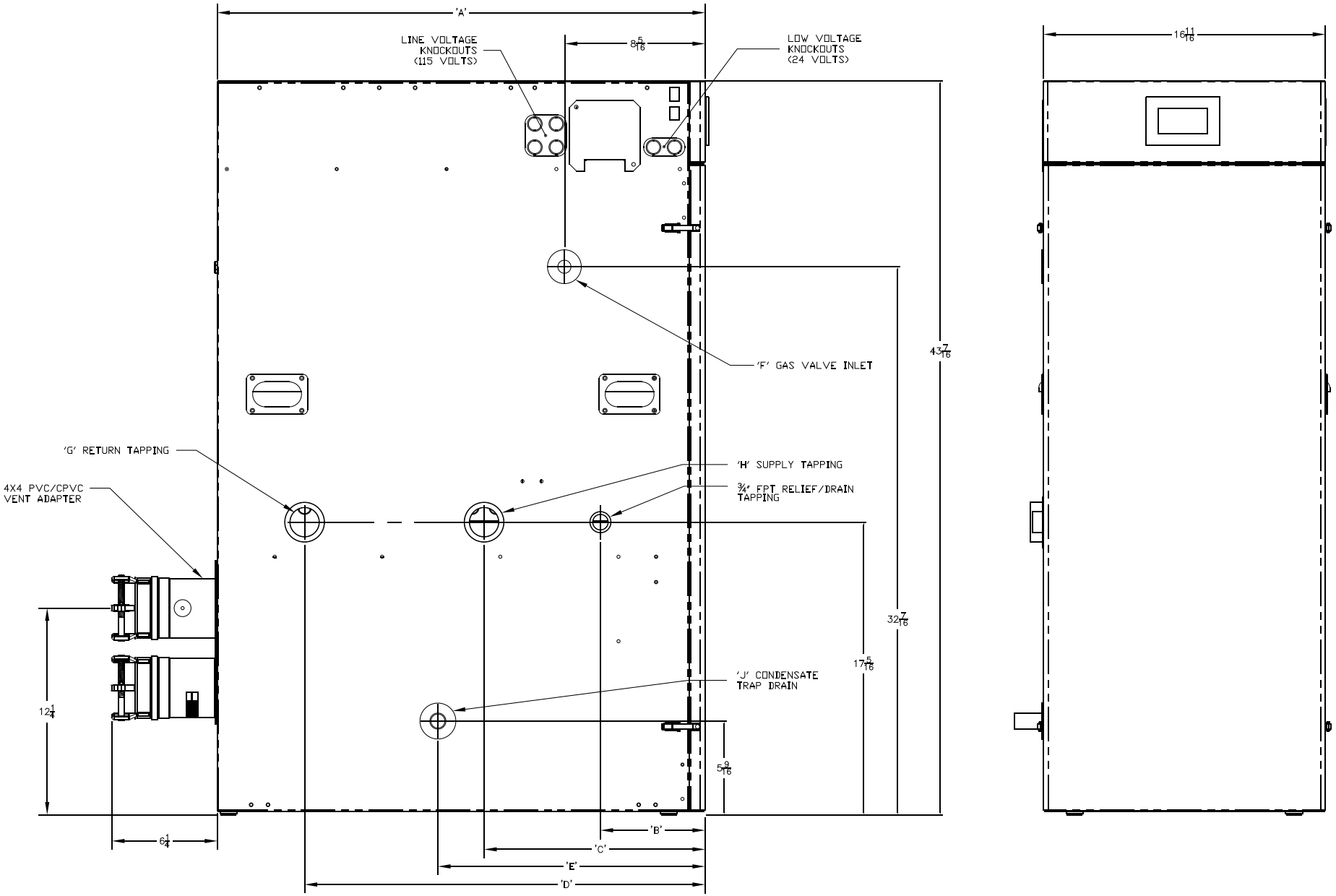


Figure 1A: Apex™ - Model APX399

I. Product Description, Specifications and Dimensional Data (continued)

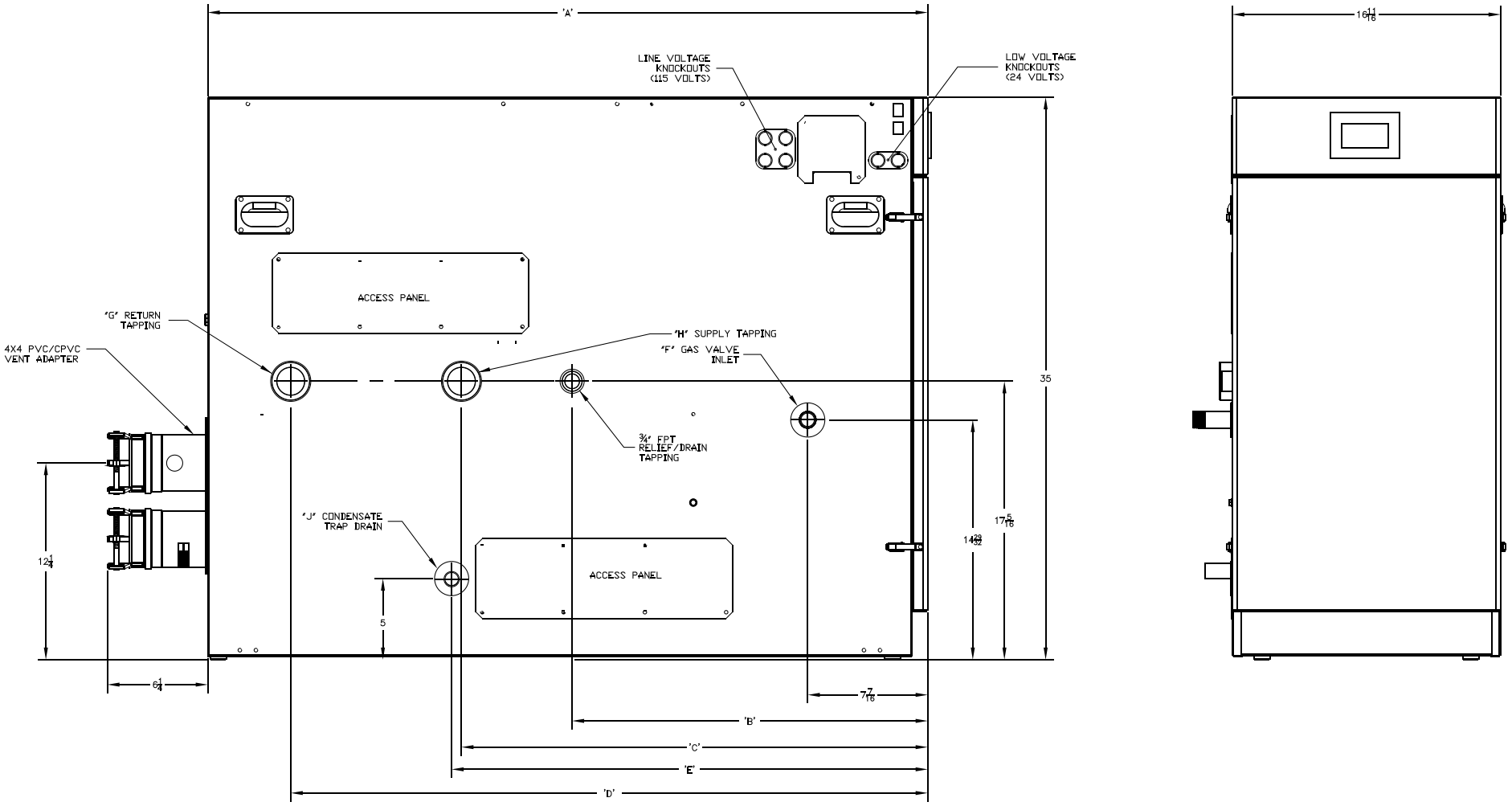


Figure 1B: Apex™ - Model APX500

I. Product Description, Specifications and Dimensional Data (continued)

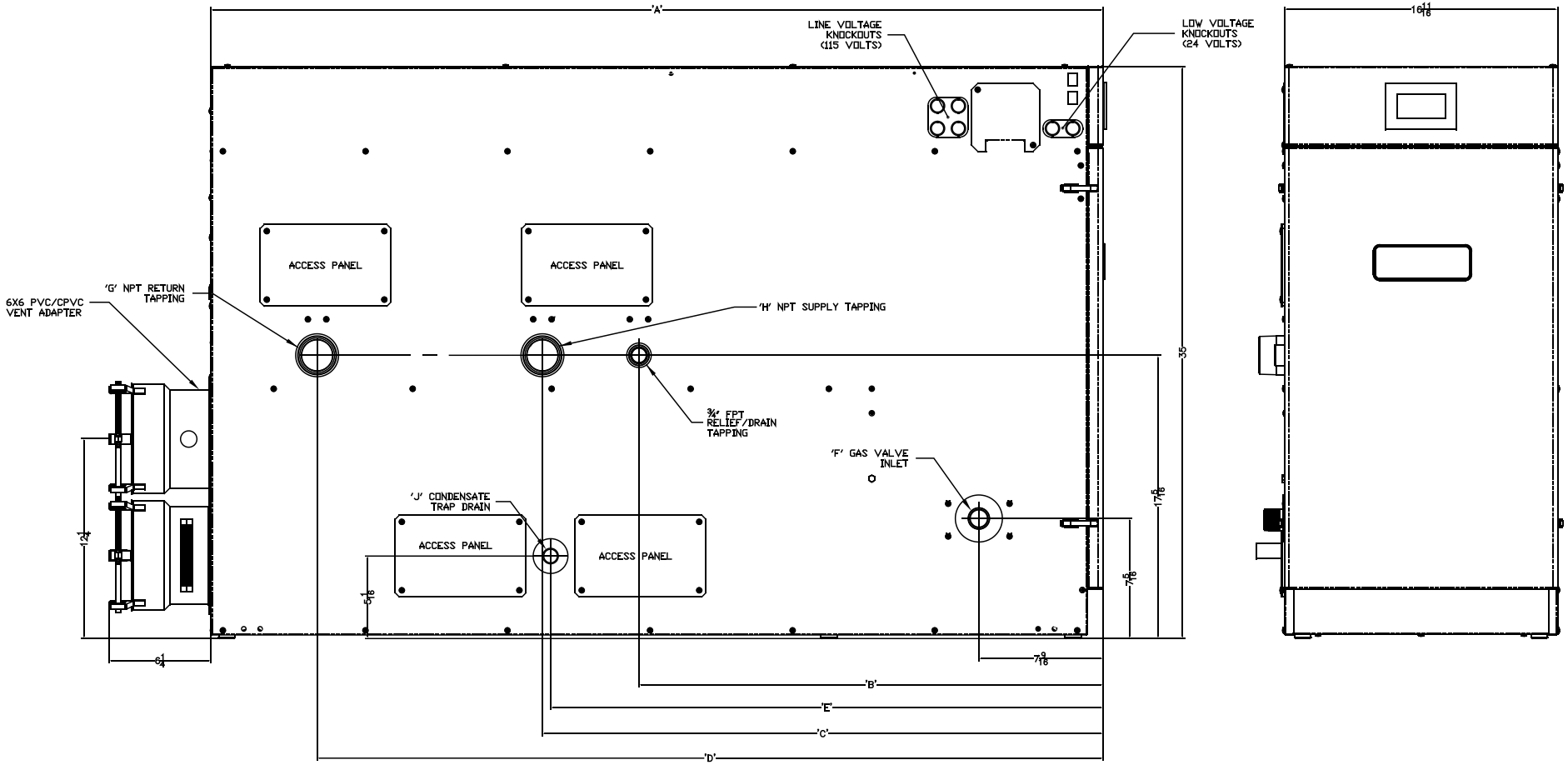


Figure 1C: Apex™ - Model APX800

I. Product Description, Specifications and Dimensional Data (continued)

Table 2A: Rating Data - Models APX399, APX500 and APX800 (0 to 5000 Feet Elevation Above Sea Level)

Model Number	Input (MBH)		* Output (MBH)	Net AHRI Ratings Water (MBH)	Thermal Efficiency (%)	Apex Series Gas-Fired Boilers		
	Min.	Max.				Combustion Efficiency (%)	Boiler Water Volume (Gal.)	Heat Transfer Area (Sq. Ft.)
APX399	80	399	375	326	94.1	94.5	3.4	41.8
APX500	100	500	475	413	95.0	95.0	4.2	50.8
APX800	160	800	760	661	95.0	93.0	5.0	65.3

Notes: * Gross Output
Maximum Allowable Working Pressure, Water - 160 PSI
Safety Relief Valve Pressure, Water - 50 PSI Shipped from Factory (std.) (APX399 and APX500); 60 PSI Shipped from Factory (std.) (APX800); 80 PSI and 100 PSI - optional (APX399, APX500 and APX800)
Maximum Allowable Temperature, Water - 210°F
APX399 and APX500 Boiler models are factory shipped as Natural Gas builds and have to be field adjusted for LP gas application. Refer to 'System Start- Up Section of this manual for detailed procedure.
APX800 Boiler Model is factory shipped as either Natural Gas build or LP gas build.
Ratings shown are for installations at sea level and elevations up to 2000 Feet. For elevations above 2000 Feet, ratings should be reduced at the rate of two and half percent (2.5%) for each 1000 Feet above sea level.

Table 2B: Rating Data - Models APX399, APX500 and APX800 (5001 to 10000 Feet Elevation Above Sea Level)

Model Number	Input (MBH)		* Output (MBH)	Net AHRI Ratings Water (MBH)	Thermal Efficiency (%)	Apex Series Gas-Fired Boilers		
	Min.	Max.				Combustion Efficiency (%)	Boiler Water Volume (Gal.)	Heat Transfer Area (Sq. Ft.)
APX399	80	399	375	328	94.1	94.5	3.4	41.8
APX500	167	500	475	413	95.0	95.0	4.2	50.8
APX800	267	800	760	661	95.0	93.0	5.0	65.3

Notes: * Gross Output
Maximum Allowable Working Pressure, Water - 160 PSI
Safety Relief Valve Pressure, Water - 50 PSI Shipped from Factory (std.) (APX399 and APX500); 60 PSI Shipped from Factory (std.) (APX800); 80 PSI and 100 PSI - optional (APX399, APX500 and APX800)
Maximum Allowable Temperature, Water - 210°F
APX399 and APX500 Boiler models are factory shipped as Natural Gas builds and have to be field adjusted for LP gas application. Refer to 'System Start- Up Section of this manual for detailed procedure.
APX800 Boiler Model is factory shipped as either Natural Gas build or LP gas build.
Ratings shown are for installations at sea level and elevations up to 2000 Feet. For elevations above 2000 Feet, ratings should be reduced at the rate of two and half percent (2.5%) for each 1000 Feet above sea level.

II. Unpacking Boiler

CAUTION

Do not drop boiler.

A. Move boiler to approximate installed position.

B. Remove all crate fasteners.

C. Lift and remove outside container.

D. Remove boiler from cardboard positioning sleeve on shipping skid.

WARNING

Installation of this boiler should be undertaken only by trained and skilled personnel from a qualified service agency.

E. Move boiler to its permanent location.

III. Pre-Installation and Boiler Mounting

WARNING

If you do not follow these instructions exactly, a fire or explosion may result causing property damage or personal injury.

NOTICE

Due to the low water content of the boiler, mis-sizing of the boiler with regard to the heating system load will result in excessive boiler cycling and accelerated component failure. Burnham Commercial DOES NOT warrant failures caused by mis-sized boiler applications. DO NOT oversize the boiler to the system. Multiple boiler installations greatly reduce the likelihood of boiler oversizing.

A. **Installation must conform** to the requirements of the authority having jurisdiction. In the absence of such requirements, installation must conform to the *National Fuel Gas Code*, NFPA 54/ANSI Z223.1, and/or CAN/CSA B149.1 Installation Codes.

B. **Boiler is certified** for installation on combustible flooring. Do not install boiler on carpeting.

C. **Provide clearance** between boiler jacket and combustible material in accordance with local fire ordinance. Refer to Figure 2 for minimum listed clearances from combustible material. Recommended service clearance is 24 inches from left side, front, top and rear of the boiler. Recommended front clearance may be reduced to the combustible material clearance providing:

1. Access to boiler front is provided through a door or removable front access panel.
2. Access is provided to the condensate trap located underneath the heat exchanger.

D. **Protect gas ignition system components** from water (dripping, spraying, rain, etc.) during boiler operation and service (circulator replacement, condensate trap, control replacement, etc.).

E. **Provide combustion and ventilation air** in accordance with applicable provisions of local building codes, or: USA - *National Fuel Gas Code*, NFPA 54/ANSI Z223.1, Air for Combustion and Ventilation; Canada - *Natural Gas and Propane Installation Code*, CAN/CSA-B149.1, Venting Systems and Air Supply for Appliances.

WARNING

Adequate combustion and ventilation air must be provided to assure proper combustion.

F. **The boiler should be located** so as to minimize the length of the vent system. The PVC combustion air piping, or the optional concentric vent piping, containing integral combustion air inlet piping, must terminate where outdoor air is available for combustion and away from areas that may contaminate combustion air. In particular, avoid areas near chemical products containing chlorines, chlorofluorocarbons, paint removers, cleaning solvents and detergents. Avoid areas containing saw dust, loose insulation fibers, dry wall dust etc.

CAUTION

Avoid operating this boiler in an environment where sawdust, loose insulation fibers, dry wall dust, etc. are present. If boiler is operated under these conditions, the burner interior and ports must be cleaned and inspected daily to insure proper operation.

G. **General.**

1. Apex boilers are intended for installations in an area with a floor drain, or, in a suitable drain pan to prevent any leaks or relief valve discharge to cause property damage
2. Apex boilers are not intended to support external piping and venting. All external piping and venting must be supported independently of the boiler.
3. Apex boilers must be installed level to prevent condensate from backing up inside the boiler.
4. Boiler Installation:
   a. For basement installation provide a solid level base such as concrete, where floor is not level, or, water may be encountered on the floor around boiler. Floor must be able to support weight of boiler, water and all additional system components.
   b. Boiler must be level to prevent condensate from backing up inside the boiler.
   c. Provide adequate space for condensate piping or a condensate pump if required.

Boiler Clearances to Combustible (and Non-Combustible) Material:

APX399 and APX500 Boiler Models:

These boilers are approved for closet installation with the following clearances – Top = 1”, Front = 1”, Left Side = 10”, Right Side = 2”, Rear = *6”

APX800 Boiler Model:

This boiler is approved for alcove installation with the following clearances – Top = 1”, Front = Open, Left Side = 10”, Right Side = 2”, Rear = *6”

*** Note:**

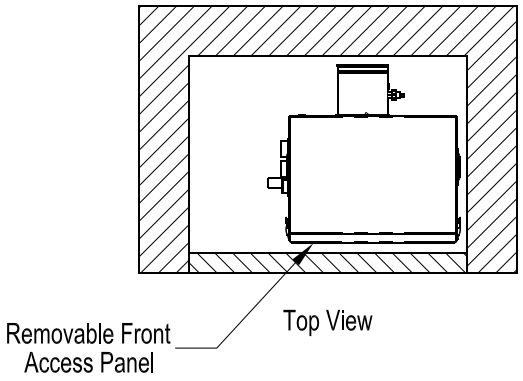
When boiler is vented vertically, the minimum clearance from the rear of the jacket is increased to 18” with a short radius 90° elbow provided in order to provide adequate space at boiler rear for installation of vent and air intake piping and service access

Boiler Service Clearances – Applicable to all Boiler Models:

Top = 24”, Front = 24”, Left Side = 24”, Right Side = 24”, Rear = 24”

The above Clearances are recommended for Service Access but may be reduced to the Combustible Material Clearances provided:

1. The boiler front is accessible thru a door
2. Access is provided to the condensate trap located on the left side of boiler
3. Access is provided to thermal link located at the boiler rear



Approved Direct Vent System	Vent Pipe Material	Vent Pipe Direction	Enclosure	Vent Pipe Nominal Diameter	Minimum Clearance to Combustible Material
Factory Standard Two-Pipe CPVC/PVC Vent and PVC Air Intake	* CPVC/PVC	Vertical or Horizontal	Unenclosed at all Sides	4” or 6”	1”
Available Optional Two-Pipe Rigid Polypropylene Vent (or, Flexible Polypropylene Liner for Vertical Venting only) and Rigid Polypropylene_or PVC Combustion Air Intake	Pipe Rigid Polypropylene Vent (or, Flexible Polypropylene Liner for Vertical Venting only)			80 mm 10 mm (110 mm) 150 mm (160 mm)	1”
Available Optional Two-Pipe Stainless Steel Vent and Galvanized Steel or Air Intake	Stainless Steel			4” or 6”	1”
Available Optional Concentric Inner Polypropylene Vent and Outer Steel Air Intake	Polypropylene			100/150 mm (110/160 mm)	0”
* Do not enclose PVC venting - use CPVC vent pipe in enclosed spaces, or to penetrate through combustible or non-combustible walls					

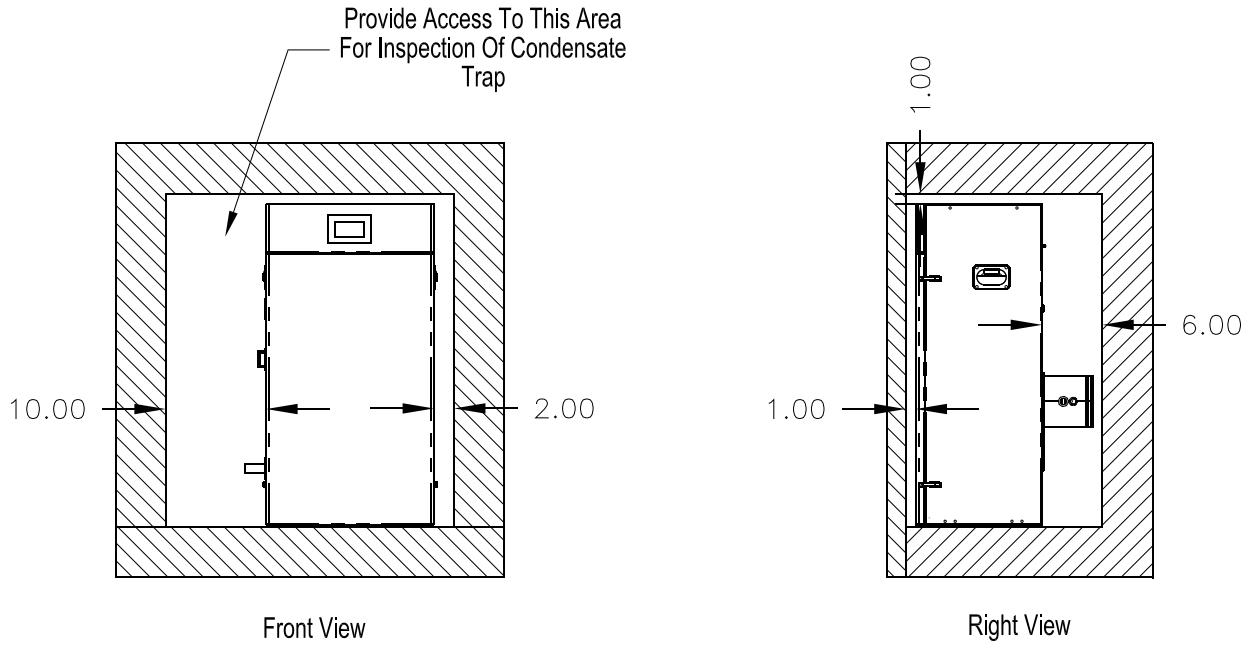


Figure 2: Clearances To Combustible and Non-combustible Material

H. Boiler Stacking

1. For installations with unusually high space heating and/or domestic hot water heating loads, where employing two (2) Apex (APX) boilers will offer the benefits of greater operational efficiency, floor space savings and boiler redundancy, the Apex (APX) boilers may be installed stacked one on the top of the other. Refer to Table 3 "Apex (APX) Boiler Model Stacking Combinations" for details.

Table 3: Apex (APX) Boiler Model Stacking Combinations

Bottom Boiler Model	Top Boiler Model
APX399	APX399
APX500	APX399 or APX500
APX800	APX399, APX500 or APX800

2. **To field assemble individual Apex (APX) boilers into a stackable configuration**, use the steps below:
   a. Position the bottom boiler first. Refer to Sections II "Unpacking Boiler" and III "Pre-Installation & Boiler Mounting" of the manual for details. **Always position higher input boiler model as bottom boiler**.
   b. Each Apex (APX) boiler is factory packaged with two (2) Stacking Boiler Attachment Brackets (P/N 101679-01) and the bracket mounting hardware [six (6) self-drilling hex washer head plated #8 x ½" long screws, P/N 80860743]. Locate and remove the brackets and the hardware. The Stacking Boiler Attachments Bracket has three 7/32" diameter holes punched in a triangular pattern. See Figure 3 "Stacking Boiler Attachment Bracket Placement".
   c. Apex (APX) boiler left and right side panels have a series of dimples at panel top and bottom. These dimples are positioning dimples for Stacking Boiler Attachment Bracket mounting screws. Side panel bottom positioning dimples are evenly spaced from boiler front and back, while side panel top positioning dimples follow specific pattern to compensate for Apex (APX) boiler model variable depth.
   d. Position the upper boiler on the top of the bottom boiler and align boiler front doors and sides flush with each other.
      - Place first Stacking Boiler Attachment Bracket onto the upper boiler left side panel, at the panel lower left corner and align bracket two upper holes with corresponding side panel lower dimples.
      - The remaining lower bracket hole must align with a matching bottom boiler left side panel top positioning dimple.
      - Once bracket holes and side panel dimple alignment is verified, attach the bracket to top and bottom boiler left side panels with the mounting screws.
   e. Repeat above procedure to install second Stacking Boiler Attachment Bracket and secure the stacked boiler right side panels together at the front right corner.
   f. Install the third Stacking Boiler Attachment Bracket to secure top and bottom boiler left side panels at the rear left corner. Align the bracket holes with corresponding positioning dimples in the top boiler and bottom boiler left side panels, then secure bracket with the screws.
   g. Repeat above procedure to install the forth Stacking Boiler Attachment Bracket to secure stacked boiler right side panels at the rear right corner.
3. **When installing stackable boiler combinations** observe the following guidelines:
   a. Venting - Top and bottom boilers must have their individual vent piping and vent terminals.

WARNING

No common manifolded venting is permitted.

For side-wall venting individual model vent terminals must terminate not closer than 12 inches horizontally and three (3) feet vertically from each other in order to prevent combustion air contamination. For vertical through the roof venting, individual vertical vent terminals, if level with each other, must be spaced no closer than 12 inches horizontally. If vertical terminals cannot end in one plane, they must be spaced no closer than three (3) feet horizontally.

Chimney chase concentric venting is permitted for modules, when stackable, providing concentric vertical (roof) vent terminals, if level with each other, are spaced no closer then 12 inches horizontally.

If vertical vent terminals cannot end in one plane, they must be spaced no closer then three (3) feet horizontally.

Follow instructions in Section IV "Venting" of the manual for specifics of individual boiler vent termination. Follow instructions in Section V "Condensate Disposal" for each individual boiler flue gas condensate line construction and condensate disposal. Terminating individual boiler condensate lines into common pipe prior to drain disposal is permissible, providing common pipe has sufficient flow capacity to handle combined condensate volume of stackable combination.

b. Gas Piping - Follow instructions in Section VII "Gas Piping" of the manual for sizing and installation of an individual boiler. When common gas piping is sized, insure it will have **adequate capacity for combined input (CFH gas flow) of the selected stackable boiler combination.**

c. Water Piping and Trim - Follow instructions in Section VI "Water Piping and Trim" of the manual for system piping and boiler secondary piping selection/sizing based on **combined heating capacity and/or gross output of the selected stackable boiler combination**. Follow instructions of Section VI "Water Piping and Trim" for each individual boiler trim installation.

d. Electrical - Follow instructions in Section VIII "Electrical" of the manual to wire individual boilers.

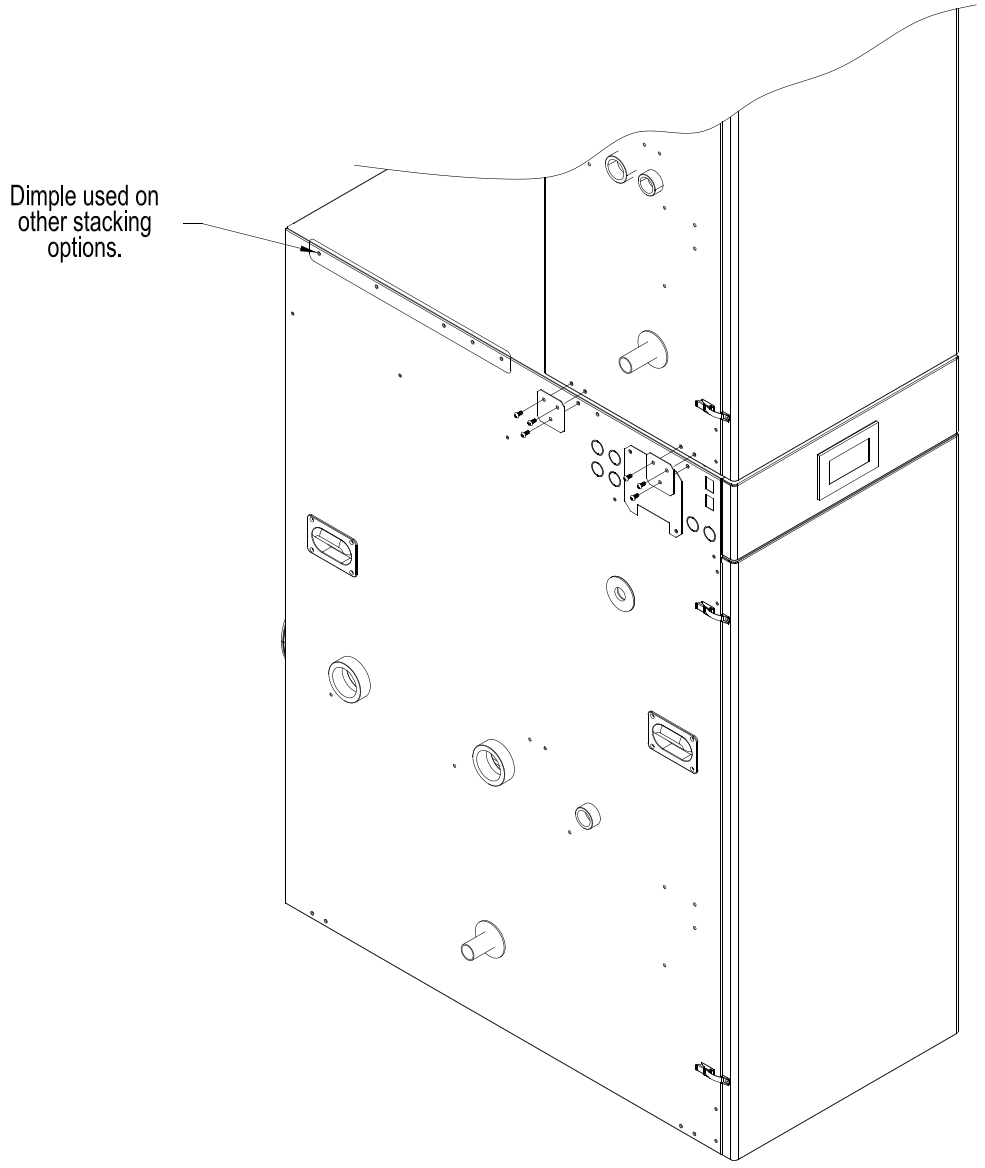


Figure 3: Stacking Boiler Attachment Bracket Placement

IV. Venting

WARNING

Failure to vent this boiler in accordance with these instructions could cause products of combustion to enter the building resulting in severe property damage, personal injury or death.

Do not interchange vent systems or materials unless otherwise specified.

The use of thermal insulation covering vent pipe and fittings is prohibited.

Do not use a barometric damper, draft hood or vent damper with this boiler.

When using the CPVC/PVC vent option, the use of CPVC is required when venting in vertical or horizontal chase ways, closets and through wall penetrations.

The CPVC vent materials supplied with this boiler do not comply with B149.1.S1-07 and are not approved for use in Canadian jurisdictions that require vent systems be listed to ULC S636-2008. In these jurisdictions, vent this boiler using either stainless steel Special Gas vent or a listed ULC S636 Class IIB venting system.

Do not locate vent termination where exposed to prevailing winds. Moisture and ice may form on surface around vent termination. To prevent deterioration, surface must be in good repair (sealed, painted, etc.).

Do not locate air intake vent termination where chlorines, chlorofluorocarbons (CFC's), petroleum distillates, detergents, volatile vapors or other chemicals are present. Severe boiler corrosion and failure will result.

The use of cellular core PVC (ASTM F891), cellular core CPVC or Radel (polyphenolsulfone) is prohibited.

Do not locate vent termination under a deck.

Do not reduce specified diameters of vent and combustion air piping.

When installing vent pipe through chimney, as a chase, no other appliance can be vented into the chimney.

Do not allow low spots in the vent where condensate may pool.

A. General Guidelines

1. Vent system installation must be in accordance with *National Fuel Gas Code*, NFPA 54/ANSI Z221.3 or CAN/CSA B149.1 *Installation Code for Canada*, or, applicable provisions of local building codes. Contact local building or fire officials about restrictions and installation inspection in your area.
2. The Apex™ is designed to be installed as a Direct Vent (sealed combustion) boiler. The air for combustion is supplied directly to the burner enclosure from outdoors and flue gases are vented directly outdoors (through wall or roof).
3. The following combustion air/vent system options are approved for use with the Apex™ boilers (refer to Table 4):
   a. **Two-Pipe CPVC/PVC Vent/Combustion Air System** - separate CPVC/PVC pipe serves to expel products of combustion and separate PVC pipe delivers fresh outdoor combustion air. Refer to Part B for specific details.
   b. **Two-Pipe Polypropylene Vent/Combustion Air System** - separate rigid or flexible polypropylene pipe serves to expel products of combustion and separate rigid polypropylene pipe or PVC pipe delivers fresh outdoor combustion air. Refer to part C for specific details.
   c. **Two-Pipe Stainless Steel Vent/Combustion Air System** - separate stainless steel pipe serves to expel products of combustion. Separate PVC or galvanized pipe delivers fresh outdoor air. Refer to Part D for specific details.
   d. **Concentric Inner Polypropylene Vent and Outer Steel Combustion Air System** - the assembly consists of inner fire resistant polypropylene vent pipe and outer steel pipe casing. The inner pipe serves as conduit to expel products of combustion, while outdoor fresh combustion air is drawn through the space between the inner and outer pipes. Refer to Part E for specific details.
4. Horizontal vent pipe must maintain a 1/4" per foot slope down towards the boiler.
5. Horizontal combustion air pipe must maintain a minimum ¼" per foot slope down towards terminal, when possible. If not, slope toward boiler.
6. Do not install venting system components on the exterior of the building except as specifically required by these instructions (refer to Figure 4):
   a. Vent terminals must be at least 1 foot from door, window, or gravity inlet into the building.
   b. Maintain the correct clearance and orientation between the vent and air intake terminals.

Table 4: Vent/Combustion Air System Options

Approved Direct Vent System	Vent Material	Orientation	Termination	Description	Figures	Component Table	Part
Factory Standard Two-Pipe, CPVC/PVC Vent and PVC Air Intake	CPVC/PVC	Horizontal	Standard (thru sidewall)	The system includes separate CPVC vent pipe and PVC air intake pipe terminating thru sidewall with individual penetrations for the vent and air intake piping and separate terminals (tees).	4 thru 9A, 9B, 10	5A	B.
			Optional Snorkel (thru sidewall)	Same as above but separate snorkel type terminals.	4 thru 7, 10, 11	5B	
		Optional Vertical	Vertical (thru roof)	The system includes separate CPVC vent pipe and PVC air intake pipe terminating thru roof with individual penetrations for the vent and air intake piping and separate vertical terminals.	4 thru 6, 10, 12, 13	5C	
Available Optional Two-Pipe, Rigid Polypropylene Vent **(or Flexible Polypropylene Liner for Vertical venting only)** and Rigid Polypropylene or PVC Pipe Air Intake	Rigid Polypropylene **(or Flexible Polypropylene Liner for vertical Venting only)**	Horizontal	Standard (thru sidewall)	The system includes separate Rigid Polypropylene vent pipe and Rigid Polypropylene or PVC air intake pipe terminating thru sidewall with individual penetrations for the vent and air intake piping and separate terminals (tees).	4 thru 9A, 9B, 10	9, 10	C.
			Optional Snorkel (thru sidewall)	Same as above but separate snorkel type terminals.	4 thru 7, 10, 11	9, 10	
		Optional Vertical	Vertical (thru roof or chimney/chase)	The system includes separate Flexible Polypropylene vent liner and Rigid Polypropylene vent pipe combination for venting and Rigid Polypropylene or PVC air intake pipe terminating thru roof with individual penetrations for the vent and air intake and individual vent /air terminals.	12 thru 16	9, 10	
Available Optional Two-Pipe, Stainless Steel Vent and PVC/Galvanized Steel Air Intake	Stainless Steel	Horizontal	Standard (thru sidewall)	The system includes separate stainless steel vent pipe and PVC/galvanized steel air intake pipe terminating thru sidewall with individual penetrations for the vent and air intake piping and separate terminals	9A, 9B, 16, 17	11A, 11B	D.
			Optional Snorkel (thru sidewall)	Same as above but separate snorkel type terminals.	11, 16, 17		
		Vertical	Vertical (thru roof)	The system includes separate stainless steel vent pipe and PVC/galvanized steel air intake pipe terminating thru roof with individual penetrations for the vent and air intake piping and separate terminals.	12, 13, 17		
Available Optional Concentric, Inner Polypropylene Vent and Outer Steel Air Intake	Polypropylene	Horizontal	Horizontal (Wall) Terminal	Concentric vent/air pipe terminates thru sidewall.	18 thru 25	12, 13	E.
		Vertical	Vertical (Roof) Terminal	Concentric vent/air pipe terminates thru roof.	18 thru 21, 26 thru 31		

i. The centerlines between the vent and air intake terminals must be spaced a minimum of 12” apart. More than 12” spacing is recommended.

ii. If possible, locate air intake and vent terminations on the same wall to prevent nuisance shutdowns. However, boiler may be installed with vertical venting and sidewall combustion air inlet or vice versa where installation conditions do not allow for alternate arrangement.

iii. The vent and air intake terminations may be at varying heights when installed on the same wall, but the height of the vent termination should always be higher than the air intake termination and within the specified limit as shown in Figure 9B.

c. The bottom of the vent and air intake terminal must be at least 12" (18" in Canada) above the normal snow line. In no case should they be less than 12" above grade level.

d. The bottom of the vent terminal must be at least 7 feet above a public walkway.

e. Do not install the vent terminal directly over windows or doors.

f. The bottom of the vent terminal must be at least 3 feet above any forced air inlet located within 10 feet.

g. A clearance of at least 4 feet horizontally must be maintained between the vent terminal and gas meters, electric meters, regulators, and relief equipment. Do not install vent terminal over this equipment.

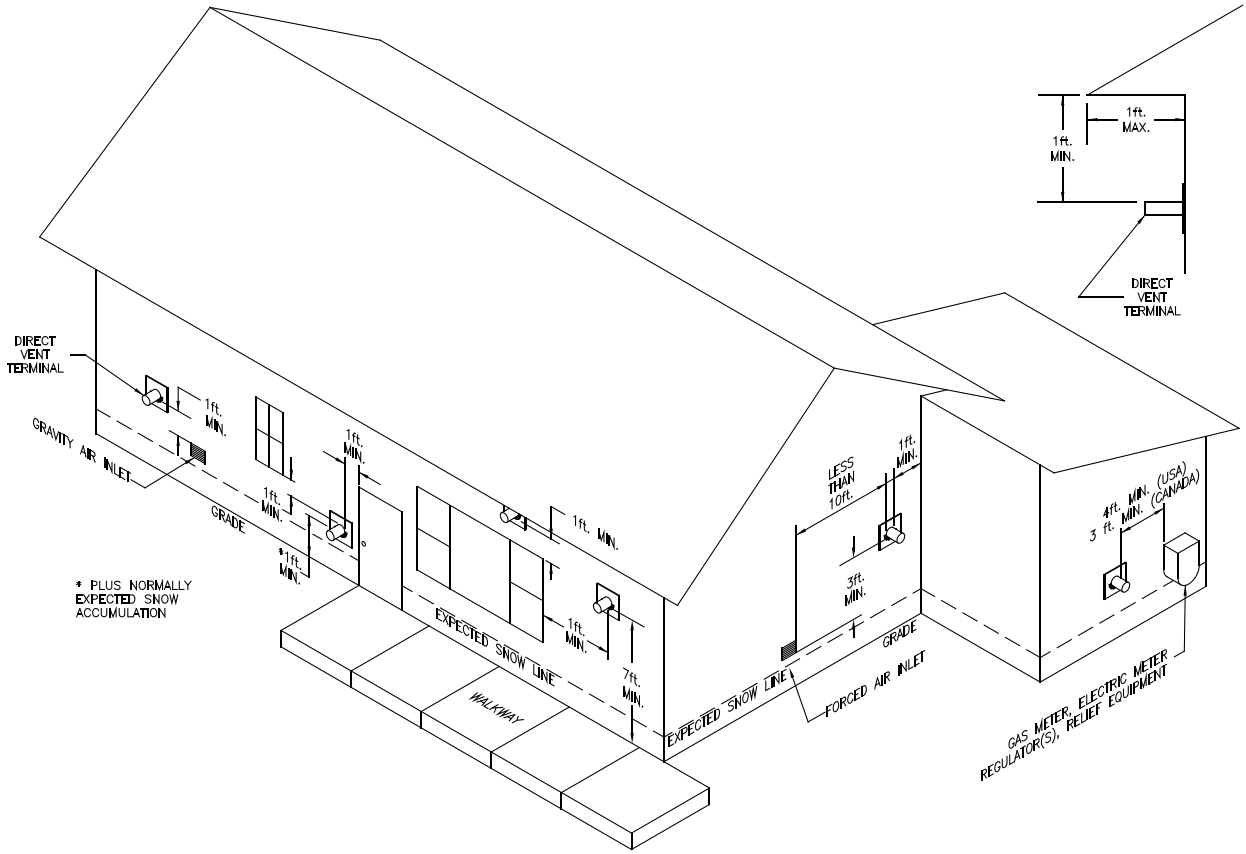


Figure 4: Location of Vent Terminal Relative to Windows, Doors, Grades, Overhangs, Meters and Forced Air Inlets
(Concentric Terminal Shown - Two-Pipe System Vent Terminal to be installed in same location - Two-Pipe System Air Intake Terminal Not Shown)

h. Do not locate the vent terminal under decks or similar structures.

i. Minimum twelve (12) inches vertically from any roof overhang twelve (12) inches or less wide.

   If a roof overhang width exceeds twelve (12) inches the terminal vertical clearance must be increased to avoid flue vapor condensation.

j. Top of vent terminal must be at least 5 feet below eaves, soffits, or overhangs. Maximum depth of overhang is 3 ft.

k. If window and/or air inlet is within four (4) feet of an inside corner, then terminal must be at least six (6) feet from adjoining wall of inside corner.

l. Concentric - Minimum twelve (12) inches horizontally from a building corner.

m. Under certain conditions, water in the flue gas may condense, and possibly freeze, on objects around the terminal including on the structure itself. If these objects are subject to damage by flue gas condensate, they should be moved or protected.

n. If possible, install the vent and air intake terminals on a wall away from the prevailing wind. Reliable operation of this boiler cannot be guaranteed if the terminal is subjected to winds in excess of 40 mph.

o. Air intake terminal must not terminate in areas that might contain combustion air contaminates, such as near swimming pools.

p. For sidewall venting the minimum horizontal distance between any adjacent individual module (boiler) vent terminations is twelve (12) inches.

   Increasing this distance is recommended to avoid frost damage to building surfaces where vent terminations are placed.

CAUTION

Installing multiple individual module (boiler) vent terminations too close together may result in cross contamination and combustion product water vapor condensation on building surfaces, where vent termination are placed, and subsequent frost damage. To avoid/minimize frost damage, extend the distance from building surfaces to vent termination end and increase the horizontal distance between adjacent vent terminations.

q. The minimum horizontal distance between any adjacent individual module (boiler) roof vent terminations is one (1) foot.

7. Use noncombustible ¾" pipe strap to support horizontal runs and maintain vent location and slope while preventing sags in pipe. Do not restrict thermal expansion or movement of vent system. Maximum support spacing four (4) feet. Avoid low spots where condensate may pool. Do not penetrate any part of the vent system with fasteners.
8. Maintain minimum clearance to combustible materials. See Figure 2 for details.
9. Enclose vent passing through occupied or unoccupied spaces above boiler with the material having a fire resistance rating of at least equal to the rating of adjoining floor or ceiling.

   Note: For one or two family dwellings, fire resistance rating requirement may not need to be met, but is recommended.
10. Multiple individual module vertical vent pipes may be piped through a common conduit or chase so that one roof penetration may be made.

B. CPVC/PVC Venting

WARNING

All CPVC vent components (supplied with boiler) must be used for near-boiler vent piping before transitioning to Schedule 40 PVC pipe (ASTM 2665) components for remainder of vent system.

WARNING

CPVC vent components must be used within any interior space where air cannot circulate freely, such as air inside a stud wall, and in any boiler closet or chase way.

When using the CPVC/PVC vent options, the use of CPVC is required when venting in vertical or horizontal chase ways.

All condensate that forms in the vent must be able to drain back to the boiler.

1. **Components and Length Restrictions**
   a. See Table 5A for CPVC/PVC Vent & Air Intake Components included with boiler, Table 5B for CPVC/PVC Vent and Air Intake Components (Installer Provided) required for Optional

Table 5A: CPVC/PVC Vent & Air Intake Components Included With Boiler

Vent & Air Intake Components	Part Number	Quantity	
		APX399 and APX500 Standard Termination Vent Kit (P/N 102189-03) includes	APX800 Standard Termination Vent Kit (P/N 103253-01) includes
4” Schedule 40 PVC Tee (Vent or Air Intake Terminals)	102190-02	2	N/A
6” Schedule 40 PVC 90° Elbow (Vent or Air Intake Terminal)	103313-01	N/A	2
4” Stainless Steel Rodent Screen	102191-02	2	N/A
6” Stainless Steel Rodent Screen	102191-03	N/A	2
4” x 30” Schedule 40 CPVC Pipe	102193-02	1	N/A
6” x 30” Schedule 40 CPVC Pipe	103267-01	N/A	1
4” Schedule 80 CPVC 90° Elbow	102192-02	1	N/A
6” Schedule 80 CPVC 90° Elbow	103268-01	N/A	1
4 oz. Bottle of Transition Cement	102195-01	1	
4 oz. Bottle of Primer	102194-01	1	
4" Vent/4" Combustion Air CPVC/PVC Connector	102183-03	1	N/A
6" Vent/6" Combustion Air CPVC/PVC Connector	103270-01	N/A	1
4" Vent/4" Combustion Air CPVC/PVC Connector Gasket	102185-02	1	N/A
6" Vent/6" Combustion Air CPVC/PVC Connector Gasket	103248-01	N/A	1

Table 5B: CPVC/PVC Vent & Air Intake Components (Installer Provided) required for Optional Horizontal (Snorkel) Termination

Vent Components	Part Number	Quantity	
		APX399 and APX500 Horizontal (Snorkel) Termination	APX800 Horizontal (Snorkel) Termination
4" Schedule 40 PVC Pipe x up to 7 ft. max. vertical run	N/A Supplied by Others	2	N/A
6" Schedule 40 PVC Pipe x up to 7 ft. max. vertical run		N/A	2
4" Schedule 40 PVC 90° Elbow		4	N/A
6" Schedule 40 PVC 90° Elbow		N/A	4
4" Schedule 40 PVC Pipe x ½ ft. min. horizontal run		2	N/A
6" Schedule 40 PVC Pipe x ¾ ft. min. horizontal run		N/A	2

Table 5C: CPVC/PVC Vent & Air Intake Components (Installer Provided) required for Optional Vertical (Roof) Termination

Vent Components	Part Number	Quantity	
		APX399 and APX500 Vertical (Roof) Termination	APX800 Vertical (Roof) Termination
4" Schedule 40 PVC Coupler	N/A Supplied by Others	1	N/A
6" Schedule 40 PVC Coupler		N/A	1
4" Schedule 40 PVC 90° Elbow		2	N/A
6" Schedule 40 PVC 90° Elbow		N/A	2
4" Schedule 40 CPVC Pipe x ½ ft. min. horizontal run		1	N/A
6" Schedule 40 CPVC Pipe x ¾ ft. min. horizontal run		N/A	1

Horizontal (Snorkel) Termination and Table 5C for CPVC/PVC Vent and Air Intake Components (Installer Provided) required for Optional Vertical (Roof) Termination.

b. Vent length restrictions are based on equivalent length of vent/combustion air pipe (total length of straight pipe plus equivalent length of fittings). Maximum vent/combustion air lengths are listed in Table 8. Do not exceed maximum vent/combustion air lengths. Table 6 lists equivalent lengths for fittings. Do not include vent/combustion air terminals in equivalent feet calculations. See “Combustion Air/Vent, Equivalent Length Work Sheet”.

c. The vent termination location is restricted as per 'General Guidelines', Paragraph A, 6. (Refer to Figure 4).

2. **System Assembly**

a. Plan venting system to avoid possible contact with plumbing or electrical wires. Start at vent connector at boiler and work towards vent termination.

b. Do not exceed maximum Vent/Combustion Air length. Refer to Table 8.

c. Design the Vent System to allow 3/8" of thermal expansion per 10 feet of CPVC/PVC pipe. Runs of 20 feet or longer that are restrained at both ends must use an offset or expansion loop. Refer to Figure 5 and Table 7.

d. Follow all manufacturer instructions and warnings when preparing pipe ends for joining and using the primer and the cement.

3. **Field Installation of CPVC/PVC Two-Pipe Vent System Connector**

Refer to Figure 6 and Steps below:

a. Position the CPVC/PVC vent connector and gasket onto boiler rear/bottom panel and insert vent connector inner stainless steel vent pipe into heat exchanger vent outlet.

b. Align vent connector plate and gasket clearance holes with rear/bottom panel engagement holes; than, secure the connector and gasket to the panel with six mounting screws.

c. Apply supplied dielectric grease (grease pouch attached to two-pipe vent connector) to gasket inside vent section of two-pipe vent connector, The grease will prevent gasket rupture when inserting vent pipe and gasket deterioration due to condensate exposure.

Table 6: Vent System and Combustion Air System Components Equivalent Length vs. Component Nominal Diameter

Vent or Combustion Air System Component Description	Equivalent Length (Ft.) for Vent or Combustion Air System Component vs. Component Nominal Diameter (In.)	
Component Nominal Diameter, In.	**4”**	**6”**
90° Elbow (Sch. 80 or Sch.40)	13	22
45° Elbow (Sch. 80 or Sch. 40)	4.5	7.5
Sch. 40 CPVC Pipe x 30 In. Long	2.5	
Sch. 40 PVC Pipe x 1 Ft. Long	1	
Sch. 40 PVC Pipe x 2 Ft. Long	2	
Sch. 40 PVC Pipe x 3 Ft. Long	3	
Sch. 40 PVC Pipe x 4 Ft. Long	4	
Sch. 40 PVC Pipe x 5 Ft. Long	5	

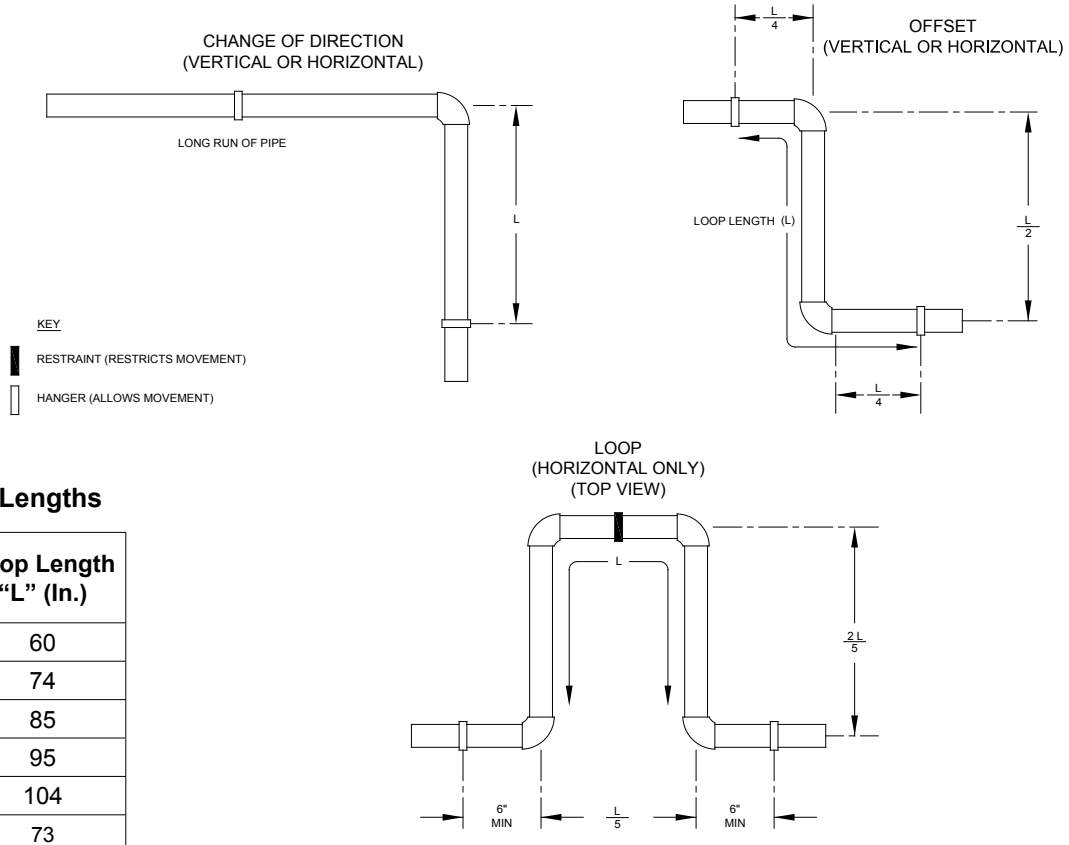


Figure 5: Expansion Loop and Offset

Table 7: Expansion Loop Lengths

Nominal Pipe Dia. (In.)	Length of Straight Run (Ft.)	Loop Length “L” (In.)
4	20	60
	30	74
	40	85
	50	95
	60	104
6	20	73
	30	90
	40	103
	50	116
	60	127

WARNING

Apply supplied dielectric grease to gasket inside vent section of two-pipe vent connector. Failure to apply the grease could result in gasket rupture during vent pipe installation and gasket deterioration due to condensate exposure.

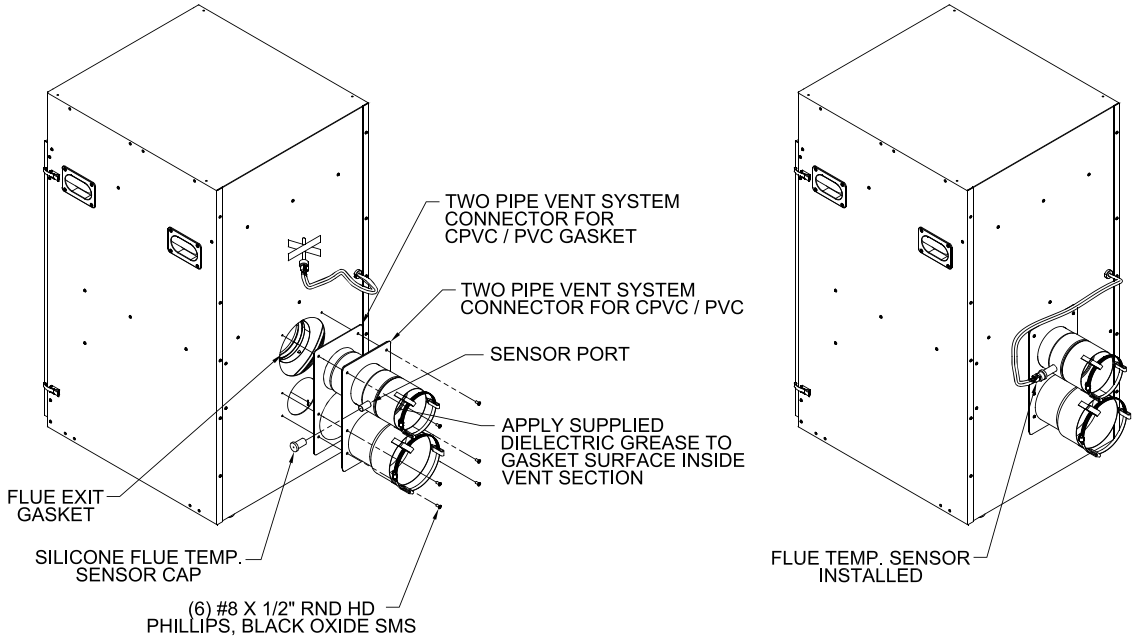


Figure 6: Field Installation of CPVC/PVC Two-Pipe Vent System Connector

4. **Near-Boiler Vent/Combustion Air Piping**

   Refer to Figure 7 and the following Steps:

   <u>APX399 and APX500 Boiler Models:</u>

   a. 4" x 4" Two-Pipe CPVC/PVC Vent System Connector (P/N 102183-03), used on APX399 and APX500 boiler models, has factory installed internal sealing gaskets at both vent and air intake sections.

   b. Install provided 4" Schedule 40 x 30" long CPVC pipe into the connector vent section with a slight twisting motion and secure by tightening the metal strap.

   c. All CPVC vent components supplied with boiler inside vent carton (4" Schedule 40 x 30" long CPVC pipe and 4" Schedule 80 CPVC 90° Elbow) must be used for near-boiler piping before transitioning to Schedule 40 PVC (ASTM 2665) pipe components for reminder of vent system. The CPVC 30" long straight pipe may be cut to accommodate desired vent configuration provided both pieces are used in conjunction with CPVC 90° Elbow before any PVC components are used. Ensure that the CPVC 90° Elbow is the first elbow used in the vent system as it exits the boiler.

   d. Insert 4" Schedule 40 PVC combustion air pipe (installer provided) into the connector air intake section with a slight twisting motion and secure by tightening the metal strap.

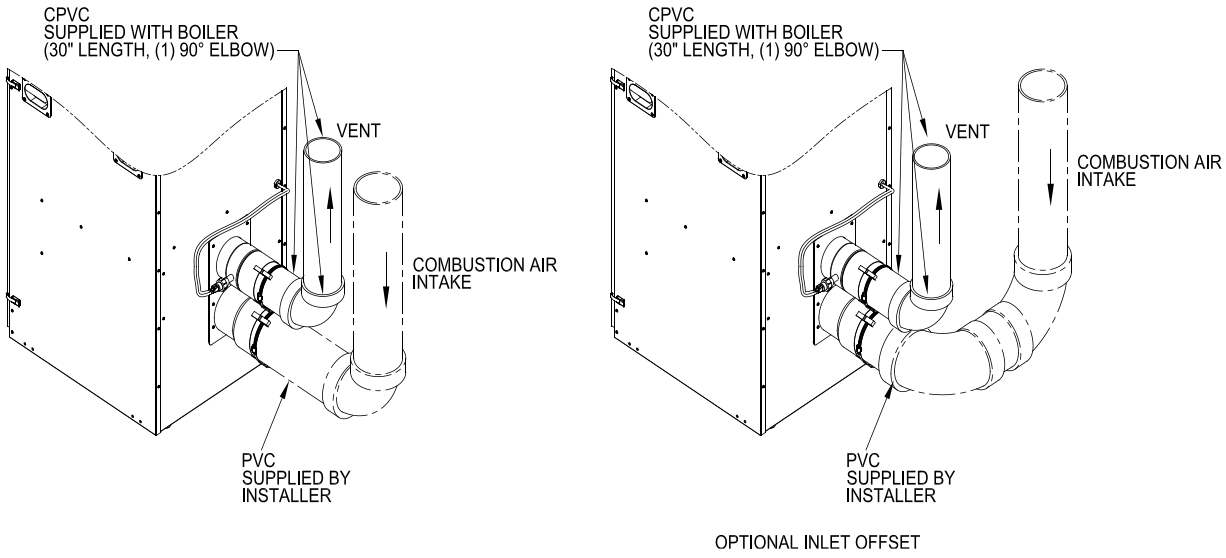


Figure 7: Near-Boiler Vent/Combustion Air Piping

Table 8: Vent/Combustion Air Pipe Length – Two-Pipe Direct Vent System Options
CPVC/PVC
Polypropylene (PP) or Polypropylene (PP)/PVC
Stainless Steel/PVC or Galvanized Steel)

Boiler Model	4" Combustion Air Pipe (Equivalent Length)		6" Combustion Air Pipe (Equivalent Length)		4" Vent Pipe (Equivalent Length)		6" Vent Pipe (Equivalent Length)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
APX399	30 In.	100 Ft.			30 In.	100 Ft.		
APX500	30 In.	100 Ft.			30 In.	100 Ft.		
APX800			30 In.	200 Ft.			30 In.	200 Ft.

Vent/Combustion Air Equivalent Length Calculation Work Sheet

Combustion Air				**Vent**			
90° Elbow(s) PVC (Installer Supplied)				**90° Elbow(s) CPVC (Supplied with Boiler)**			
Nominal Diameter, In.	Quantity (Pc)	Equivalent Length, Ft/Pc	Subtotal, Equivalent Ft. (A)	Nominal Diameter, In.	Quantity (Pc)	Equivalent Length, Ft/Pc	Subtotal, Equivalent Ft. (D)
4		13		4	1	13	13
6		22		6	1	22	22
45° Elbow(s) PVC (Installer Supplied)				**90° Elbow(s) PVC (Installer Supplied)**			
Nominal Diameter, In.	Quantity (Pc)	Equivalent Length, Ft/Pc	Subtotal, Equivalent Ft. (B)	Nominal Diameter, In.	Quantity (Pc)	Equivalent Length, Ft/Pc	Subtotal, Equivalent Ft. (A)
4		4.5		4		13	
6		7.5		6		22	
Straight Pipe, PVC (Installer Supplied)				**45° Elbow(s) PVC (Installer Supplied)**			
Nominal Diameter, In.	Quantity (Length, Ft.)	Equivalent Length, Ft/Ft	Subtotal, Equivalent Ft. (C)	Nominal Diameter, In.	Quantity (Length, Ft.)	Equivalent Length, Ft/Ft	Subtotal, Equivalent Ft. (B)
4		1		4		4.5	
6		1		6		7.5	
*** Total Equivalent Length, Ft. (A+B+C) =**				**30" (2.5 Ft.) Straight Pipe, CPVC (Supplied with Boiler)**			
				Nominal Diameter, In.	Quantity (Length, Ft.)	Equivalent Length, Ft/Ft	Subtotal, Equivalent Ft. (E)
				4	2.5	1	2.5
				6	2.5	1	2.5
				Straight Pipe, PVC (Installer Supplied)			
				Nominal Diameter, In	Quantity (Length, Ft.)	Equivalent Length, Ft/Ft	Subtotal, Equivalent Ft. (C)
				4		1	
				6		1	
				*** Total Equivalent Length, Ft. (A+B+C+D+E) =**			
*** Note: Total Equivalent Length Calculated Value Cannot Exceed Max. Equivalent Length Values shown in Table 8.**							
Vent and Combustion Air Terminals Do Not Count Towards Total Equivalent Length.							

e. Clean all vent and combustion air pipe joints with primer and secure with transition cement (4-oz. bottles of primer and cement are supplied with boiler inside vent carton). Follow application instructions provided on primer and cement bottles.

APX800 Boiler Model:

f. 6” x 6” Two-Pipe CPVC/PVC Vent System Connector (P/N 102183-03), used on APX800 boiler model, does not have factory installed internal sealing gaskets at both vent and air intake sections and requires use of supplied red RTV silicon sealant to seal vent and combustion air pipes to the connector.

g. Apply a coating of the sealant, at least 1” wide, onto provided 6” Schedule 40 x 30” long CPVC pipe.

h. Insert the coated end of the CPVC pipe with a slight twisting motion into the connector vent section and secure by tightening the metal strap.

i. All CPVC vent components supplied with boiler inside vent carton (6” Schedule 40 x 30” long CPVC pipe and 6” Schedule 80 CPVC 90° Elbow) must be used for near-boiler piping before transitioning to Schedule 40 PVC (ASTM 2665) pipe components for remainder of vent system. The CPVC 30” long straight pipe may be cut to accommodate desired vent configuration provided both pieces are used in conjunction with CPVC 90° Elbow before any PVC components are used. Ensure that the CPVC 90° Elbow is the first elbow used in the vent system as it exits the boiler.

j. Apply a coating of the sealant, at least 1” wide, onto 6” Schedule 40 PVC combustion air pipe (installer provided).

k. Insert the coated end of the PVC pipe with a slight twisting motion into the connector air intake section and secure by tightening the metal strap.

l. Clean all vent and combustion air pipe joints with primer and secure with transition cement (4-oz. bottles of primer and cement are supplied with boiler inside vent carton). Follow application instructions provided on primer and cement bottles.

5. **Horizontal Vent Termination**

a. Standard Two-Pipe Termination

See Figures 8 through 11.

i. Vent Piping

Running PVC vent pipe inside Enclosures and thru Walls:

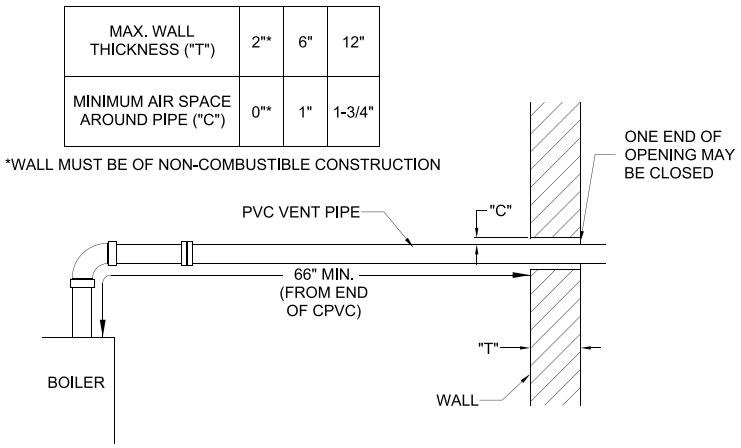


Figure 8: Wall Penetration Clearances for PVC Vent Pipe

- PVC vent pipe must be installed in such way as to permit adequate air circulation around the outside of the pipe to prevent internal wall temperature rising above ANSI Z21.13 standard specified limit.
- Do not enclose PVC venting – use higher temperature rated CPVC pipe in enclosed spaces, or, to penetrate combustible or non-combustible walls.
- PVC vent pipe may not be used to penetrate combustible or non-combustible walls unless all following three conditions are met simultaneously (see Figure 8 “ Wall Penetration Clearances for PVC Vent Pipe”):
  - The wall penetration is at least 66 inches from the boiler as measured along the vent

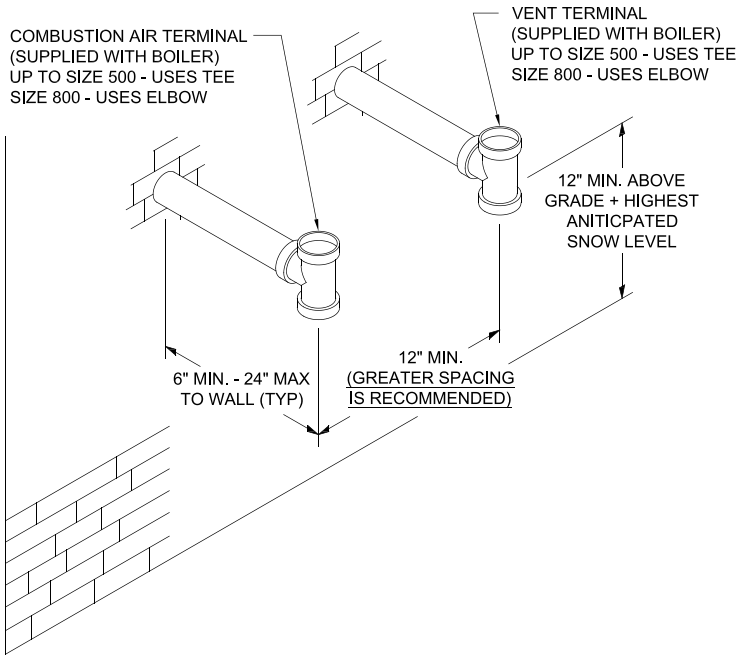


Figure 9A: Direct Vent - Sidewall Terminations

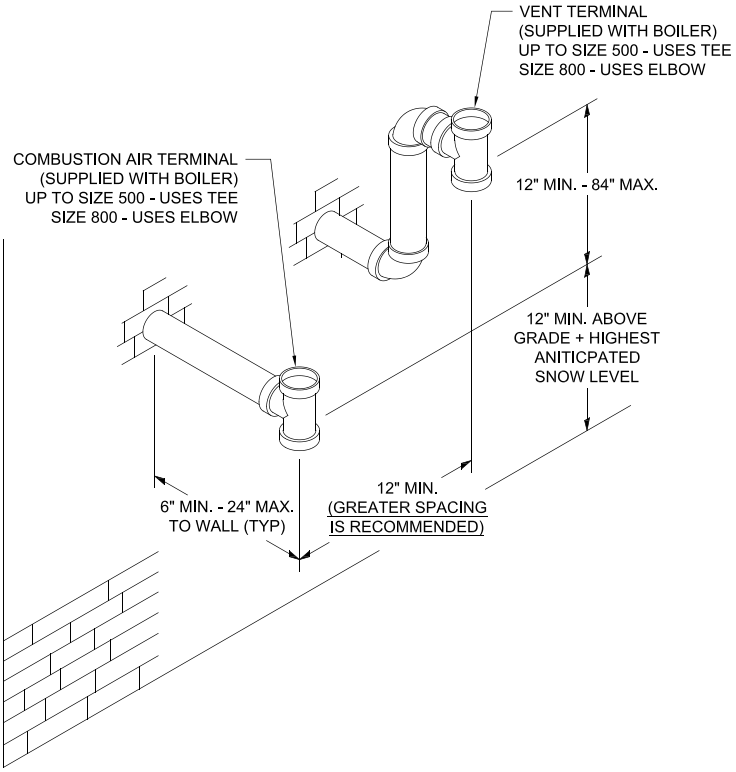


Figure 9B: Direct Vent - Sidewall Terminations (Optional)

- The wall is 12” thick or less
- An air space of at least of that shown in Figure 8 is maintained around outside of the vent pipe to provide air circulation

- If above three conditions cannot be met simultaneously when penetrating a combustible wall, use a single wall thimble [Burnham Commercial part numbers 102181-01 (4”) and 103419-01 (6”)].
- Thimble use is optional for non-combustible wall.
- Insert thimble into cut opening from outside. Secure thimble outside flange to wall with nails or screws and seal ID and OD with sealant material.
- When thimble is not used for non-combustible wall, size and cut wall opening such that a minimal clearance is obtained and to allow easy insertion of vent pipe.
- Apply sealant between vent pipe and thimble or wall opening to provide weather-tight seal. Sealant should not restrain the expansion of the vent pipe.
- Install Rodent Screen and Vent Terminal (supplied with boiler). See Figure 10 for appropriate configuration details.

WARNING

All CPVC pipe supplied with boiler vent carton must be used as part of vent system prior to connecting supplied PVC vent terminal.

Methods of securing and sealing terminals to the outside wall must not restrain the thermal expansion of the vent pipe.

ii. Combustion Air Piping

- Do not exceed maximum combustion air pipe length. Refer to Table 8.
- Size combustion air pipe wall penetration opening to allow easy insertion of the pipe.
- Install Rodent Screen and Combustion Air Terminal (supplied with boiler). See Figure 10 for appropriate configuration details.
- Apply sealant between combustion air pipe and wall opening to provide weather-tight seal.

b. Optional Two-Pipe Snorkel Termination

See Figures 10 and 11.

This installation will allow a maximum of seven (7) feet vertical exterior run of the vent/combustion air piping to be installed on the CPVC/PVC horizontal venting application.

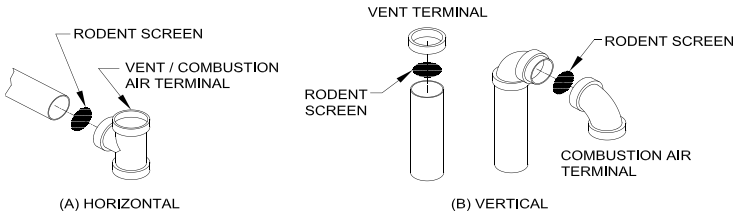


Figure 10: Rodent Screen Installation

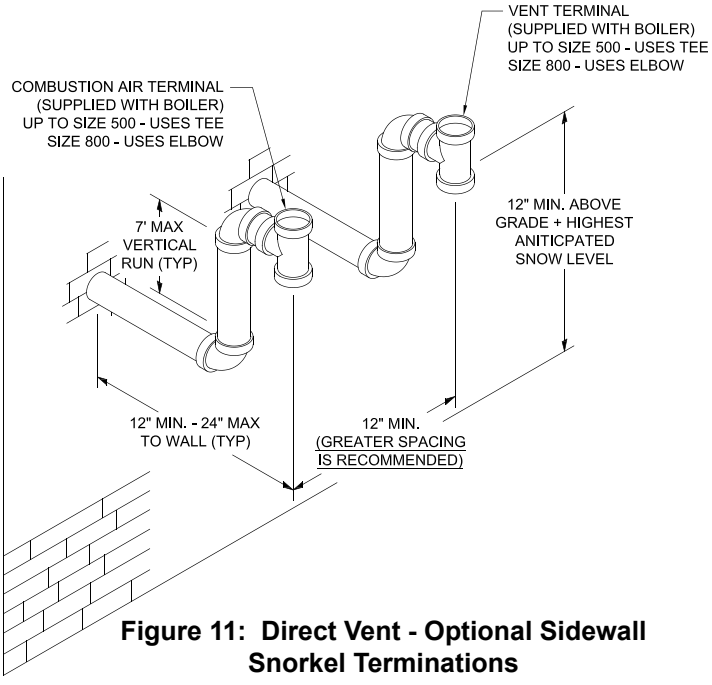


Figure 11: Direct Vent - Optional Sidewall Snorkel Terminations

NOTICE

Exterior run to be included in equivalent vent/ combustion air lengths.

i. Vent Piping

- After penetrating wall, install a Schedule 40 PVC 90° elbow so that the elbow leg is in the up direction.
- Install maximum vertical run of seven (7) feet of Schedule 40 PVC vent pipe. See Figure 11.
- At top of vent pipe length install another PVC 90° elbow so that elbow leg is opposite the building's exterior surface.
- Install Rodent Screen and Vent Terminal (supplied with boiler), see Figure 10 for appropriate configuration.
- Brace exterior piping if required.

ii. Combustion Air Piping

- After penetrating wall, install a Schedule 40 PVC 90° elbow so that elbow leg is in the up direction.
- Install maximum vertical run of seven (7) feet of Schedule 40 PVC vent pipe. See Figure 11.
- At top of air pipe length install another PVC 90° elbow so that elbow leg is opposite the building's exterior surface.
- Install Rodent Screen and Combustion Air Terminal (supplied with boiler), see Figure 10 for appropriate configuration.
- Brace exterior piping if required.

6. **Vertical Vent Termination**

a. Standard Two-Pipe Termination
Refer to Figures 10, 12 and 13.

i. Vent Piping

- Install fire stops where vent passes through floors, ceilings or framed walls. The fire stop must close the opening between the vent pipe and the structure.
- Whenever possible, install vent straight through the roof. Refer to Figures 12 and 13.
  - Size roof opening to maintain minimum clearance of 1" from combustible materials.
  - Extend vent pipe to maintain minimum vertical and horizontal distance of twelve (12) inches from roof surface. Additional vertical distance for expected snow accumulation. Provide brace as required.

CAUTION

Vertical venting and combustion air roof penetrations (where applicable) require the use of roof flashing and storm collar, which are not supplied with boiler, to prevent moisture from entering the structure.

  - Install storm collar on vent pipe immediately above flashing. Apply Dow Corning Silastic 732 RTV Sealant between vent pipe and storm collar to provide weather-tight seal.
- Install Rodent Screen and Vent Terminal (supplied with boiler), see Figure 10 for appropriate configuration.
- Brace exterior piping if required.

WARNING

All CPVC pipe and elbow supplied with boiler vent carton must be used as part of vent system prior to connecting supplied PVC vent terminal.

Do not operate boiler without the rain cap over vent pipe in place.

ii. Combustion Air Piping

- Locate combustion air termination on the same roof location as the vent termination to prevent nuisance boiler shutdowns. Combustion air terminal can be installed closer to roof than vent.

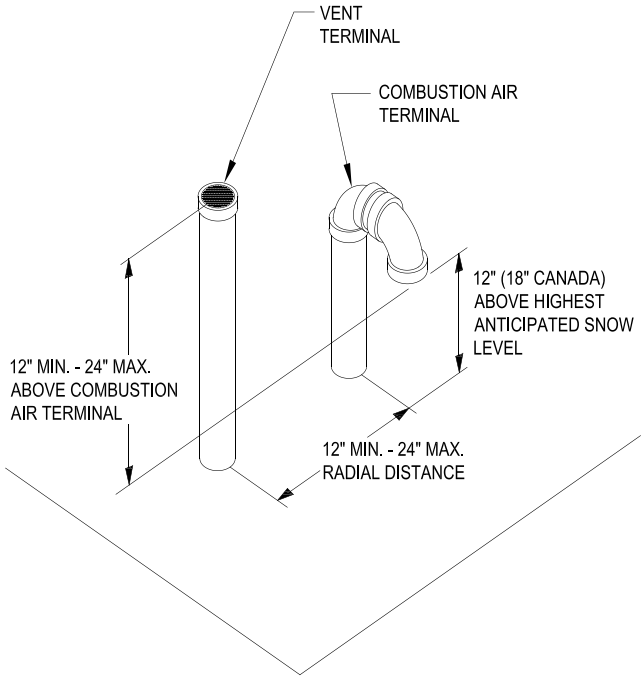
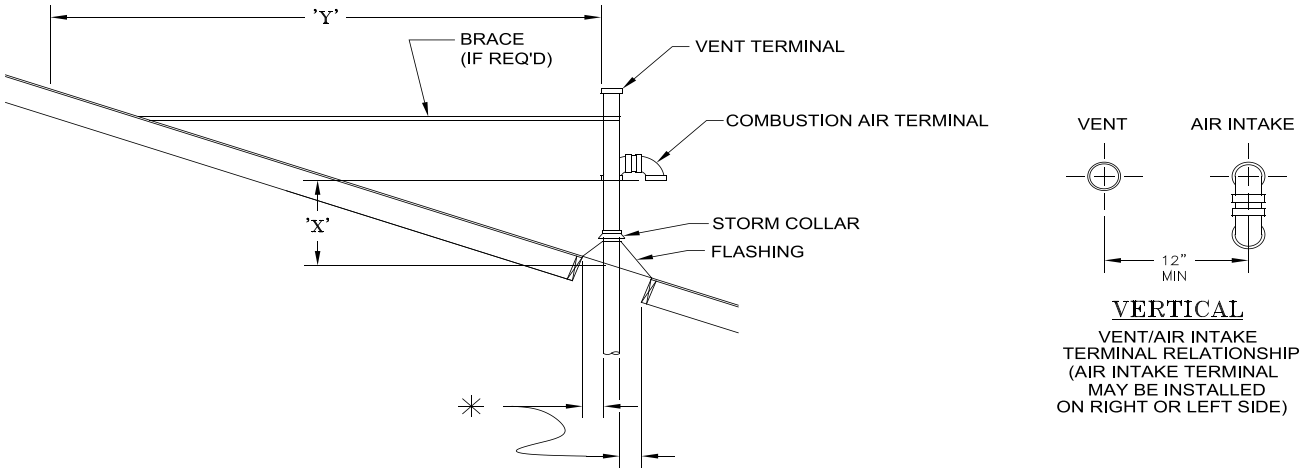


Figure 12: Direct Vent - Vertical Terminations



✳ VENT PIPE MINIMUM CLEARANCE TO COMBUSTIBLE MATERIAL IS ONE (1) INCH. COMBUSTION AIR PIPE MINIMUM CLEARANCE TO COMBUSTIBLE MATERIAL IS ZERO (0) INCHES.

Figure 13: Direct Vent - Vertical Terminations with Sloped Roof

Extend vent/combustion air piping to maintain minimum vertical ('X') and minimum horizontal ('Y') distance of twelve (12) inches (18 inches Canada) from roof surface. Allow additional vertical ('X') distance for expected snow accumulation.

- Size roof opening to allow easy insertion of combustion air piping and allow proper installation of flashing and storm collar to prevent moisture from entering the structure.
  - Use appropriately designed vent flashing when passing through roofs. Follow flashing manufacturers' instructions for installation procedures.
  - Extend combustion air pipe to maintain minimum vertical and horizontal distance of twelve (12) inches from roof surface. Allow additional vertical distance for expected snow accumulation. Provide brace as required.
  - Install storm collar on combustion air pipe immediately above flashing. Apply Dow Corning Silastic 732 RTV Sealant between combustion air pipe and storm collar to provide weather-tight seal.
- Install Rodent Screen and Combustion Air Terminal (supplied with boiler), see Figure 10 for appropriate configuration.
- Brace exterior piping if required.

C. Polypropylene Venting

Apex boilers have been approved for use with polypropylene vent system.

It is an installing contractor responsibility to procure listed below polypropylene vent system pipe and related components.

Polypropylene vent system manufactures are listed below:

Approved Polypropylene Vent System Manufacturers	
Make	Model
M&G/DuraVent	**PolyPro Single Wall** Rigid Vent **PolyPro Flex** Flexible Vent (APX399 and APX500)
Centrotherm Eco Systems	**InnoFlue SW** Rigid Vent **Flex** Flexible Vent (APX399 and APX500)

NOTE: Do not mix vent components from approved manufacturers.

M&G/DuraVent PolyPro Single Wall Rigid Vent and PolyPro Flex Flexible Vent comply with the requirements of ULC-S636-08 'Standard for Type BH Gas Venting Systems'.
Centrotherm Eco Systems InnoFlue SW Rigid Vent and Flex Flexible Vent comply with the requirements of UL 1738 'Standard for Safety for Venting Systems' and ULC-S636-08 'Standard for Type BH Gas Venting Systems'.

For polypropylene vent system installation details refer to an approved manufacturer either Rigid Single Wall Polypropylene Vent Installation Instructions, or Flexible Polypropylene Vent Installation Instructions provided with a manufacturer specific kits. See Tables 9 and 10.

Refer to Table 8 'Vent/Combustion Air Pipe Length – Two-Pipe Direct Vent System Options' for minimum and maximum listed equivalent length values.

All terminations must comply with listed options for two-pipe venting system. See Figures 8 thru 12 for details.

Table 9: Approved Polypropylene Pipe, Fittings and Terminations - M&G/DuraVent

Boiler Model	M&G / DuraVent Part Numbers/Sizes					
	Male Boiler Adapter, PVC to PP	Rigid Pipe	Flex Pipe	Pipe Joint Locking Band	Side Wall Termination Tee	Chimney Kit for Venting Only
APX399	4PPS-04PVCM-4PPF	100 mm	100 mm	43PPS-LB	43PPS-TB	4PPS-FK
APX500						
APX800	6PPS-06PVCM-6PPF	150 mm	N/A	6PPS-LBC	6PPS-E90B	N/A

Table 10: Approved Polypropylene Pipe, Fittings and Terminations - Centrotherm Eco

Boiler Model	Centrotherm Eco Part Numbers/Sizes					
	Male Boiler Adapter, PVC to PP	Rigid Pipe	Flex Pipe	Pipe Joint Locking Band	Side Wall Termination Tee	Chimney Kit for Venting Only
APX399	ISAA0404 ISSAL0404	110 mm	110 mm	IANS04	ISTT0420	IFCK0425 and IFCK0435
APX500						
APX800	ISAA0606 ISSAL0606	160 mm	N/A	IANS06	ISTT0620	N/A

When using flexible polypropylene vent pipe (liner):

- Flexible pipe must be treated carefully and stored at temperatures higher than 41°F (5°C).
- Do not bend or attempt to install flexible pipe if it has been stored at lower ambient temperature without allowing the pipe to warm up to a higher temperature first.

CAUTION

Bending or attempting to install flexible pipe if it has been stored at ambient temperature below 41°F (5°C) will cause material to become brittle and lead to cracks.

When flexible polypropylene pipe (liner) is used **for combustion product venting, it must not be installed at an angle greater than 45 degrees from vertical plane.** This will insure proper condensate flow back towards the boiler.

CAUTION

Do not install flexible polypropylene pipe at an angle greater than 45 degrees from vertical plane when used for combustion product venting. Failure to do so will result in improper condensate drainage towards the boiler and possible subsequent vent pipe blockage.

- When flexible polypropylene pipe (liner) is used for **combustion air supply** to a boiler, the pipe (liner) can be installed in vertical or horizontal position.
- Follow flexible polypropylene pipe (liner) manufacturer specific installation instructions regarding application/listing, permits, minimum clearances to combustibles; installation details (proper joint assembly, pipe support and routing, gasket and fitting installation, optional tooling availability/usage, routing thru masonry chimney for combustion product venting or, combination of combustion product venting and combustion air supply).
- When there is a conflict between flexible polypropylene pipe (liner) manufacturer installation instructions and Apex boiler Installation, Operating and Service Instructions, the more restrictive instructions shall govern.

Apex Boiler Two-Pipe Vent System Connector Field Modification Procedure To Accept Polypropylene Vent Piping:

Apex boilers are factory supplied with a model-specific boiler two-pipe CPVC/PVC vent system connector shipped within a model-specific boiler CPVC gasketed vent kit carton.

Locate and remove a model-specific boiler two-pipe CPVC/PVC vent system connector.

When using M&G/DuraVent polypropylene pipe for combustion product venting and/or air supply, male PVC to PP boiler adapter (4PPS-04PVCM-4PPF or 6PPS-06PVCM-6PPF as applicable) is installed into the two-pipe vent system connector vent or combustion air supply port as follows (see Figure 14):

1) **APX399 and APX500 models** - Apply provided dielectric grease (grease pouch taped to the vent system connector) all around to the vent or air connection inner red silicon gasket.
2) **APX399 and APX500 models** - Push and twist PVC to PP boiler adapter (4PPS-04PVCM-4PPF) into two-pipe vent system connector vent connection or air supply port until bottomed out.

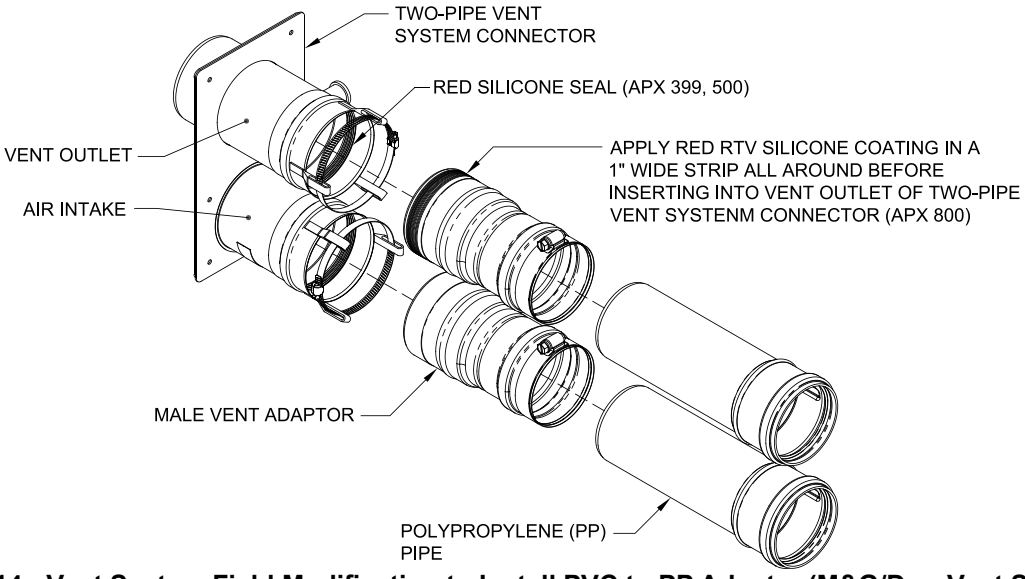


Figure 14: Vent System Field Modification to Install PVC to PP Adapter (M&G/DuraVent Shown)

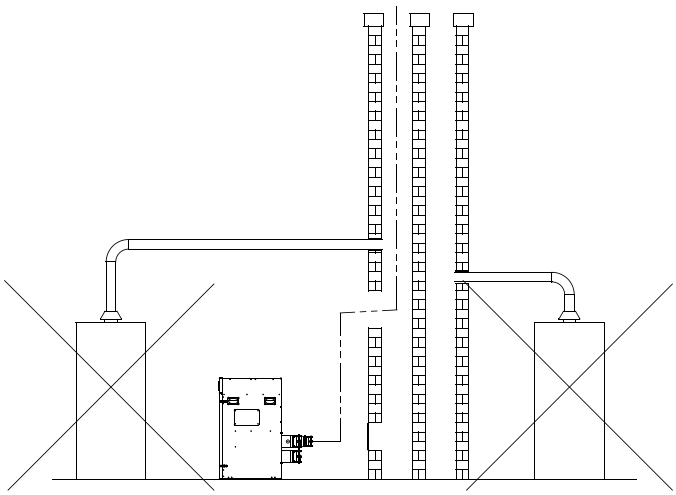
3) Tighten the worm band clamp screw to secure PVC to PP boiler adapter.
4) Do not install PVC to PP boiler adapter at the lower combustion air supply port of the two-pipe vent system connector when using PVC pipe for combustion air supply to boiler.
5) **APX800 model** - Apply a coating of supplied red RTV silicon sealant, at least 1" wide, to PVC to PP boiler adapter (6PPS-06PVCM-6PPF) male end, **when used for combustion product venting.** If polypropylene pipe is also used for combustion air supply, application of the silicon sealant to PVC to PP boiler adapter (6PPS-06PVCM-6PPF) male end is not required.
6) **APX800 model** - Push and twist PVC to PP boiler adapter (6PPS-06PVCM-6PPF) into two-pipe vent system connector vent port or air supply port until bottomed out.
7) Tighten the worm band clamp screw to secure PVC to PP boiler adapter.
8) Do not install PVC to PP boiler adapter at the lower combustion air supply port of the two-pipe vent system connector when using PVC pipe for combustion air supply to boiler.

When using **Centrotherm Eco** polypropylene pipe for combustion product venting and/or air supply PVC to PP boiler adapter (ISAA0404 or ISAAL0404 and ISAA0606 or ISAAL0606 as applicable) is installed into the two-pipe vent system connector vent or combustion air supply port as follows (see Figure 14):

9) **APX399 and APX500 models** - Apply provided dielectric grease (grease pouch taped to the vent system connector) all around to the vent or air connection inner red silicon gasket.
10) **APX399 and APX500 models** - Push and twist PVC to PP boiler adapter (ISAA0404 or ISAAL0404) into two-pipe vent system connector vent connection or air supply port until bottomed out.
11) Tighten the worm band clamp screw to secure PVC to PP boiler adapter.
12) Do not install PVC to PP boiler adapter at the lower combustion air supply port of the two-pipe vent system connector when using PVC pipe for combustion air supply to boiler.
13) **APX800 model** - Apply a coating of supplied red RTV silicon sealant, at least 1" wide, to PVC to PP boiler adapter (ISAA0606 or ISAAL0606) male end, **when used for combustion product venting.** If polypropylene pipe is also used for combustion air supply, application of the silicon sealant to PVC to PP boiler adapter (ISAA0606 or ISAAL0606) male end is not required.
14) **APX800 model** - Push and twist PVC to PP boiler adapter (ISAA0606 or ISAAL0606) into two-pipe vent system connector vent port or air supply port until bottomed out.
15) Tighten the worm band clamp screw to secure PVC to PP boiler adapter.
16) Do not install PVC to PP boiler adapter at the lower combustion air supply port of the two-pipe vent system connector when using PVC pipe for combustion air supply to boiler.

Optional Two-pipe Vertical Venting Installation – Running Flexible Polypropylene Vent (Liner) Thru Unused Chimney Chase (see Figure 15).

Apex APX399 and APX500 boilers are approved for vertical venting by installing Flexible Vent in an UNUSED masonry chimney/chase and supplying combustion air thru a separate wall or roof air intake terminal.



Venting of Other Appliances (or Fireplace) into Chase or Adjacent Flues Prohibited!

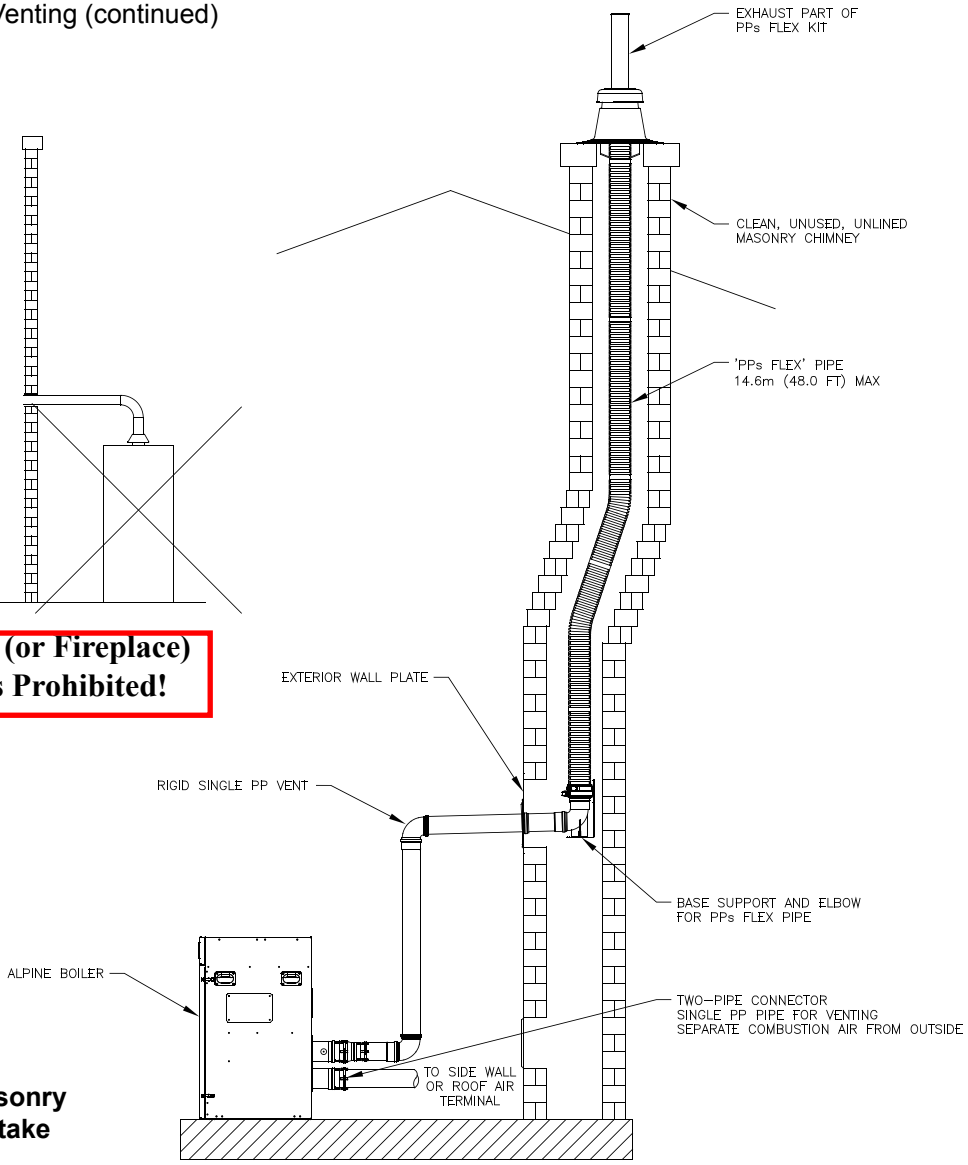


Figure 15: Flexible Vent in Masonry Chimney with Separate Air Intake

WARNING

Follow installation instructions included by the original polypropylene venting component manufacturers, M&G/DuraVent or Centrotherm, whichever applicable.

Flexible Polypropylene Vent must be installed in an UNUSED chimney. A chimney, either single or multiple flue type, is considered UNUSED when none of the flues is being used for any appliance venting.
Where one of the multiple flues is being used for an appliance venting, the flexible vent installation is not permitted thru any of adjacent flues.

Observe all precautions outlined in either M&G/DuraVent or Centrotherm instructions in addition to those outlined in these instructions.

Examine all components for possible shipping damage prior to installation.

Proper joint assembly is essential for safe installation.

The venting system must be free to expand and contract and supported in accordance with installation instructions included by the original polypropylene venting component manufacturers, M&G/DuraVent or Centrotherm, whichever applicable.

Do not mix vent components or joining methods for different vent systems.

Where a conflict arises between M&G/DuraVent or Centrotherm instructions and these instructions, the more restrictive instructions shall govern.

Do not apply thermal insulation to vent pipe and fittings.

Do not obtain combustion air from within the building.

D. Stainless Steel Venting

CAUTION

Vent systems made by Heat Fab, Protech and Z-Flex rely on gaskets or proper sealing. When these vent systems are used, take the following precautions:

- **Make sure that gasket is in position and undamaged in the female end of the pipe.**
- **Make sure that both the male and female pipes are free of damage prior to assembly.**
- **Only cut vent pipe as permitted by the vent manufacturer in accordance with their instructions. When pipe is cut, cut end must be square and carefully de-burred prior to assembly.**

WARNING

All condensate that forms in the vent must be able to drain back to the boiler.

1. **Vent Length Restrictions**
   a. Vent length restrictions are based on equivalent length of vent/combustion air pipe (total length of straight pipe plus equivalent length of fittings). Maximum vent/combustion air lengths are listed in Table 8. Do not exceed maximum vent/combustion air lengths. Do not include vent/combustion air terminals in equivalent feet calculations. See "Combustion Air/Vent, Equivalent Length Work Sheet".
   b. The vent termination location is restricted as per 'General Guidelines', Section A.5. (Refer to Figure 4)
   c. Where the use of "silicone" is called for in the following instructions, use GE RTV 106 or equivalent for the vent collar. Air inlet piping sections are sealed with any general-purpose silicone sealant such as GE RTV102. PVC air inlet piping sections are connected with PVC cement.
   d. Longitudinal welded seams should not be placed at the bottom of horizontal sections of exhaust pipe.
   e. Do not drill holes in vent pipe.
   f. Do not attempt to mix vent components of different vent system manufacturers.
2. **Near Boiler Connection**

   To install the stainless steel vent adapter [P/N 102220-01 (4")]:
   a. Push the stainless steel vent adapter onto the CPVC/PVC connector with a slight twisting motion. Make sure that the stainless steel vent adapter is inserted at least 1" (refer to Figure 16).
   b. Secure the adapter to the CPVC/PVC connector by tightening the metal strap.

   To install the stainless steel vent adapter [P/N 103285-01 (6")]:
   c. Apply a coating of supplied red RTV silicone sealant, at least 1" wide, all around male end of the stainless steel vent adapter.
   d. Afterwards, insert the male end of the adapter with a slight twisting motion into vent section of installed two-pipe CPVC/PVC vent connector.
   e. Secure the adapter to the two-pipe CPVC/PVC vent connector by tightening the metal strap.
3. **System Assembly**
   a. Plan venting system to avoid possible contact with plumbing or electrical wires. Start at vent connector at boiler and work towards vent termination.
   b. Refer to Tables 11A and 11B for approved AL29C Vent Systems.
   c. Do not exceed maximum Vent/Combustion air length. Refer to Table 8.
   d. Follow all manufacturer instructions and warnings when preparing pipe ends for joining and using the primer and the cement.
   e. Assemble the air intake system using either galvanized or PVC pipe.
      i. If PVC piping is used, use PVC cement to assemble the PVC intake system components. See Part B for air intake installation instructions.
      ii. If galvanized piping is used, use at least two sheet metal screws per joint. Seal the outside of all joints.
4. **Horizontal Vent Termination**
   a. Standard Two-Pipe Termination
   Refer to Figure 9A.
      i. Vent Termination
         - Use Burnham Commercial stainless exhaust terminal [P/N 100184-01 (4")]. The outer edge of this terminal must be between 6" and 12" from the surface of the wall. **The joint between the terminal and the last piece of pipe must be outside of the building**.
         - Male end of terminal will fit into the female end of any of the approved stainless vent systems.

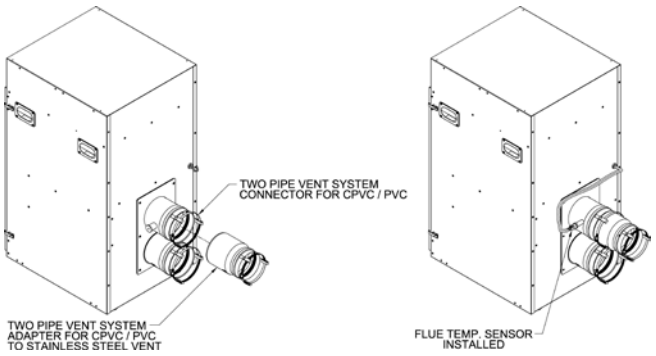


Figure 16: Field Installation of Two-Pipe Vent System Adapter for Stainless Steel

- Apply a heavy bead of silicone to the male end of the terminal before inserting it into the last piece of pipe. Orient the terminal so that the seam in the terminal is at 12:00.
- Smooth the silicone over the seam between the terminal and the last piece of pipe, applying additional silicone if necessary to ensure a tight seal.
- Allow the silicone to cure per the silicone manufacturer's instructions before operating the boiler.

ii. Combustion Air Termination

- Horizontal intake terminal is a tee in the upright position. Tee should protrude the same distance from the wall as the exhaust terminal. See Figure 9A.
- Install a rodent screen (not supplied) in the inlet terminal. Use a screen having 1/2" x 1/2" mesh.

b. Optional Two-Pipe Snorkel Termination
Refer to Figure 11.

This installation will allow a maximum of seven (7) feet vertical exterior run of the vent/ combustion air piping to be installed on the approved AL29-4C Stainless Steel horizontal venting application.

i. Vent Termination

- After penetrating wall, install the appropriate manufacturer's 90° elbow so that the elbow leg is in the up direction.
- Install maximum vertical run of seven (7) feet of appropriate manufacturer's vent pipe. See Figure 11.
- At top of vent pipe length install another appropriate manufacturer's 90° elbow so that the elbow leg is opposite the building's exterior surface.
- Install horizontal vent terminal.
- Brace exterior piping if required.

Table 11A: Burnham Commercial Vent System Components (Stainless Steel)

Vent System Component	Part Numbers		Equivalent Feet of Pipe
	APX399 and APX500	APX800	
	4" Vent	6" Vent	
SS Vent Kit	102501-02		N/A
Horizontal Vent Terminal (Included in Kit)	8116313		
PVC to SS Vent Adapter (Included In Kit)	102220-01		
Vertical Vent Terminal	102680-02		
Pipe x 1 Ft.	100176-01		1
Pipe x 3 Ft.	100177-01		3
Pipe x 5 Ft.	100178-01	N/A	5
Pipe x Adjustable	100179-01		Equal to Installed Length (1.06 to 1.64)
90° Elbow	100180-01		8.0 (4")
45° Elbow	100181-01		4.5 (4")
Horizontal Drain Tee	100182-01		2
Vertical Drain Tee	100183-01		7½
Single Wall Thimble	100184-01		N/A

Table 11B: Alternate Vent Systems and Vent Components (Stainless Steel)

Manufacturer	Vent System	Size	Wall Thimbles	Horizontal Termination	Vertical Termination
Protech Systems Inc..	FasNseal	4	FSWT4	Tee: FSTT4	FSBS4
		6	FSWT6	Tee: FSTT6	FSBS6
Z-Flex	SVE Series III ("Z-Vent III")	4	2SVSWTEF04	Tee: 2SVSTTF04	24SVSTPF04
		6	N/A	N/A	N/A
Flex-L Intl.	Star-34	4	SR04WT15	Tee: SRTT-04	SRTP-04
		6	N/A	N/A	N/A

NOTE: See vent system manufacturer's literature for other part numbers that are required such as straight pipe, elbows, firestops and vent supports.

ii. Combustion Air Termination

- After penetrating wall, install a 90° elbow so that the elbow leg is in the up direction.
- Install maximum vertical run of seven (7) feet of combustion air pipe. See Figure 11.
- At top of vent pipe length install another 90° elbow os that the elbow leg is opposite the building's exterior surface.
- Install Rodent Screen (not supplied) and horizontal vent terminal.
- Brace exterior piping if required.

5. **Vertical Vent Termination**

a. Standard Two-Pipe Termination
Refer to Figures 12 and 13.

i. Vent Termination

- Use the terminal supplied by the vent system manufacturer shown in Table 11B. Follow manufacturer's instructions to attach terminal to vent system.

ii. Combustion Air Termination

- Install vertical combustion air terminal. Vertical combustion air terminal consists of an 180° bend (comprised of two (2) 90° elbows) as shown in Figure 12.
- Install rodent screen (not supplied) in the combustion air terminal. Use a screen having 1/2" (2 x 2) or larger mesh.

E. Concentric Polypropylene Venting

1. Vent Length Restrictions

a. Vent length restrictions are based on equivalent length of vent pipe i.e. total length of straight pipe plus equivalent length of fittings. See Table 12 for specified vent length details. Do not exceed maximum vent length. Table 13 lists available concentric vent components and includes equivalent vent length for fittings.

b. The vent termination location is restricted as per 'General Guidelines', Paragraph A, 5 (refer to Figure 4).

2. **Field Installation of Boiler Concentric Vent Collar**

a. Locate and remove six mounting screws from the Miscellaneous Parts Carton.

b. Position the Collar onto jacket combination rear/ bottom panel and insert collar inner stainless steel vent pipe into the heat exchanger vent outlet.

Table 12: Concentric Vent Length

Boiler Model	Inner/Outer Pipe Dia., mm	Vent Length (Equiv. Ft.)		Wall Opening Diameter
		Minimum	* Maximum	
APX399	100/150 mm	32 in.	60	6-1/2 in
APX500	100/150 mm	32 in		
APX800	N/A	N/A	N/A	N/A
* with optional concentric vent components, see Table 13 for details.				

Table 13: Concentric Vent Components (Applicable to APX399 and APX500 only)

Part Number	Component Description	Size	Component Equivalent Vent Length, Ft	Comments
101548-01	90° Elbow – Long Radius	100/150 mm	8.0	
101549-01	45° Elbow - Long Radius	100/150 mm	3.0	
101550-01	1 Cut -To-Length Extension, 500 mm (19-1/2")	100/150 mm	1.63	** Can be cut
101551-01	Cut -To-Length Extension, 1000 mm (39")	100/150 mm	3.25	** Can be cut
101553-01	Fixed Extension, 2000 mm (78")	100/150 mm	6.5	*** Must not be cut
101809-01	Horizontal (Wall) Terminal	100/150 mm	* NA	Supplied with boiler
101557-01	Vertical (Roof) Terminal	100/150 mm	* NA	See Note 1
101558-01	Flat Roof Flashing	100/150 mm		
101559-01	Sloped Roof Flashing	100/150 mm		See Note 2
101560-01	Support Elbow with Chimney Chase Bracket	100/150 mm	10.0	See Note 3
101561-01	Hanger Wall Bracket	100/150 mm		

Notes:

* NA – do not include vent terminal into total vent length calculations.
** These sections have plain male end and beaded female end. See Figure 18 for details.
*** These sections have beaded male end and beaded female end. See Figure 19 for details.

1. Vertical terminal can be used with either of the roof flashings listed beneath it.
2. Sloped roof flashing suitable for roof angles between 25° and 45°.
3. Used at base of vertical run inside unused masonry chimney.

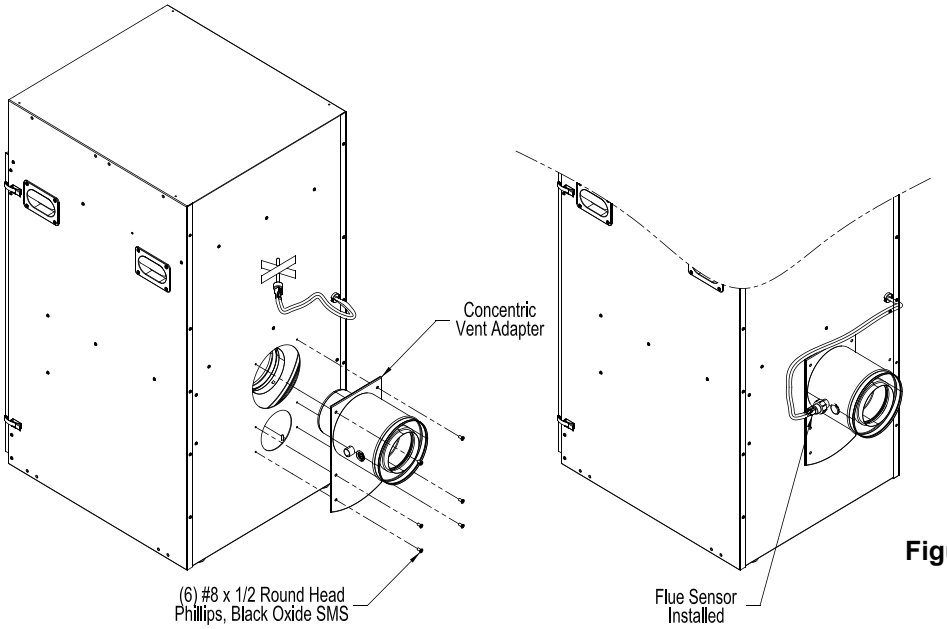


Figure 17: Field Installation of Boiler Concentric Vent Collar

c. Align collar plate clearance holes with rear/bottom panel engagement holes; then secure the collar to rear/bottom panel with six mounting screws. See Figure 17.

d. Flue temperature sensor, factory attached to the boiler wiring harness, is secured to the left boiler jacket panel with tape.

e. Remove the tape and push the sensor rubber plug into Concentric Vent Collar sensor port until the plug is securely engaged. See Figure 17.

The installation of the Concentric Vent Collar is now completed.

3. **System Assembly**

a. Plan venting system to avoid possible contact with plumbing or electrical wires. Start at vent connector at boiler and work towards vent termination.

b. Do not exceed maximum Concentric vent length. Refer to Table 12.

c. If additional concentric vent piping is needed:

i. Concentric Vent Cut-To-Length Extension pipes, **identified in Table 13 CAN BE CUT** to required length when used as an extension. **These pipes have plain male end and beaded female end. Always cut the pipe from plain male end.** See Figure 18 'Cut-To-Length Extension (Cuttable)".

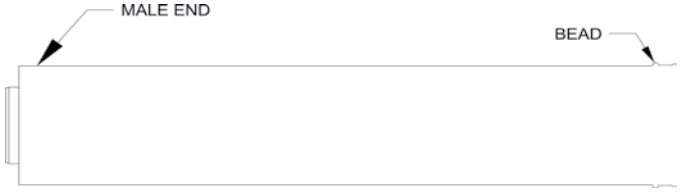


Figure 18: Cut-To-Length Extension (Cuttable)

ii. The remaining Concentric Vent Fixed Extensions shown in Table 13 CANNOT BE CUT. These pipes have beaded male and beaded female ends. See Figure 19 "Fixed Extension (Non-Cuttable)'.

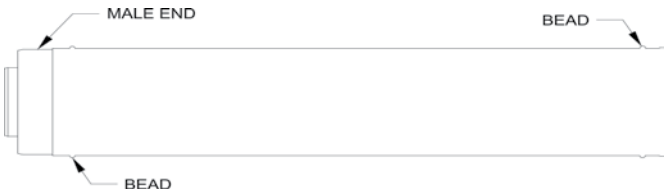


Figure 19: Fixed Extension (Non-Cuttable)

d. To cut the Concentric Vent Straight pipe to required length refer to Figure 20 "Cutting Straight Pipe" and the following procedure:

i. Determine the required length of the outer pipe. When doing this allow an additional 1" of length for insertion into the female end of the adjoining pipe. Mark the cut line on the outer pipe.

ii. Remove the plastic inner pipe by pulling it out from the female end.

iii. Cut the **OUTER PIPE ONLY** at the point marked in Step (a) using aviation shears, a hacksaw, or an abrasive wheel cutter. Be careful to cut the pipe square. De-burr the cut end with a file or emery cloth.

iv. Make an insertion mark 1" from the male end of the outer pipe.

v. Cut the plastic inner pipe so that it will protrude 3/8" beyond the male end of the outer pipe when reinstalled in the outer pipe. Use a fine tooth hacksaw or a PVC saw to cut the plastic pipe and be careful to cut the

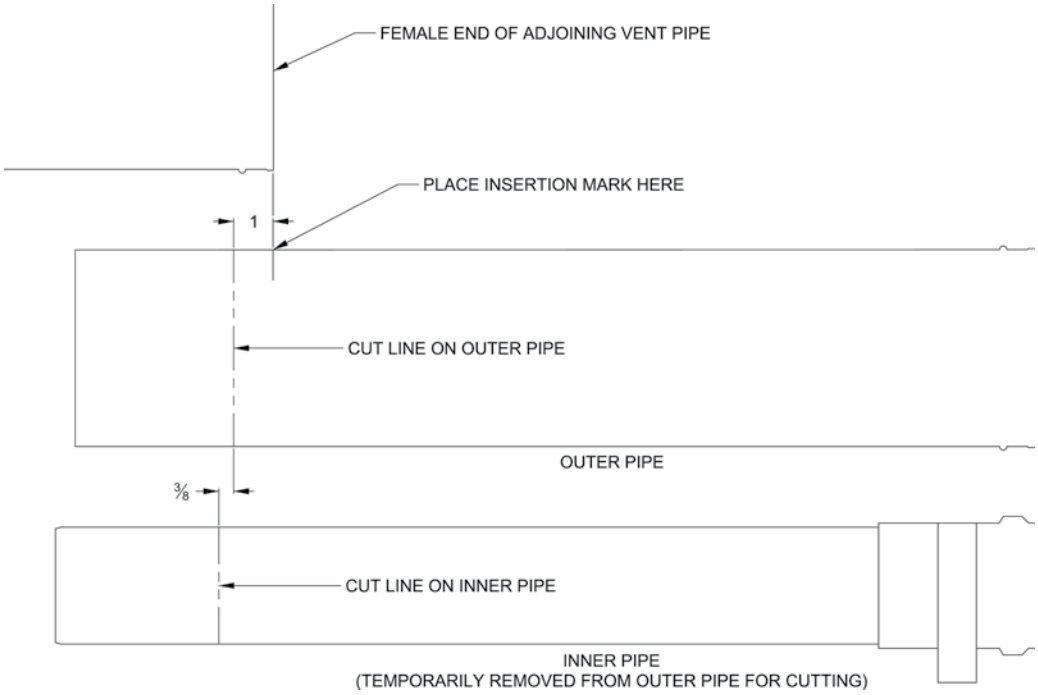


Figure 20: Cutting Straight Pipe

pipe square. De-burr the cut edge of the plastic pipe with a file, razor blade or fine sandpaper.

vi. Reinstall the inner pipe.

e. To join Concentric Vent Pipe refer to Figure 21 "Joining Cuttable Pipe" and Figure 22 "Joining Non-Cuttable Pipe" and follow the procedure below:

i. Start assembly of the vent system at the boiler. Lubricate the brown gasket in the boiler vent collar with a few drops of water.

ii. Push the male end of the first fitting into the boiler collar until it bottoms out. The male end of cuttable sections should go 1" into the collar until the insertion mark (made in Step 4 above) is covered. On other fittings, the bead on the male pipe will be bottom out on the collar (see Figure 22).

iii. The male end of cuttable fittings must be held to the collar with three (3) #10 x 1/2" sheet metal screws. Drill a 1/8 hole through both outer pipes to start this screw. **Use a drill stop or other means to ensure that the drill bit does not penetrate more than 3/8" into the outer pipe. Do not use a sheet metal screw longer than 1/2"** (see Figure 21).

iv. Use locking bands (provided with all fittings) to secure non-cuttable pipe, as well as fittings, to the boiler collar (see Figure 22).

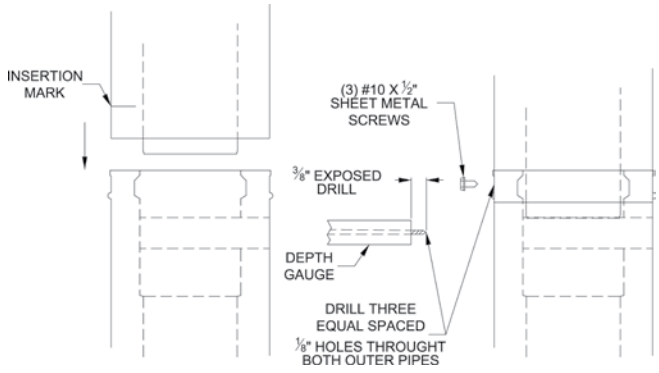


Figure 21: Joining Cuttable Pipe

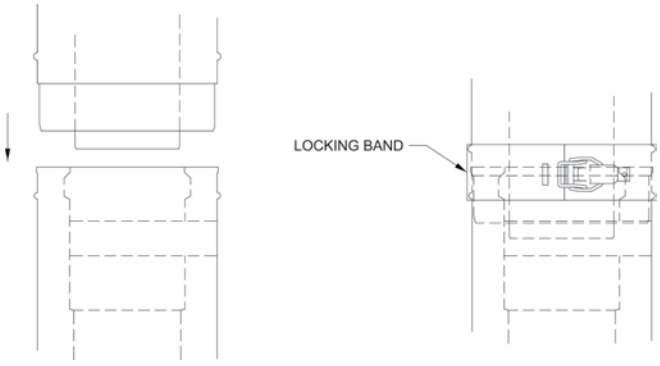


Figure 22: Joining Non-Cuttable Pipe

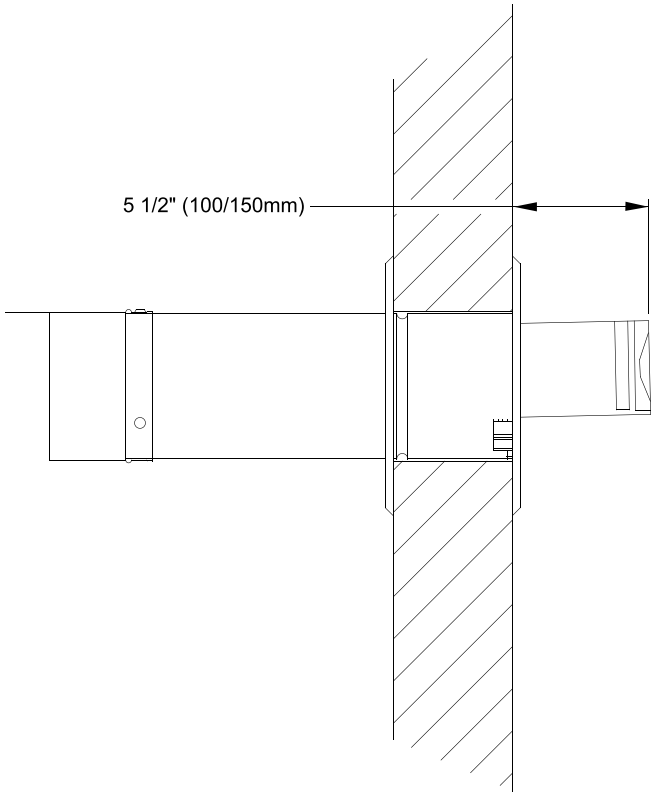


Figure 23: Horizontal Concentric Venting

v. Use the same method to join all remaining vent components except for the terminal.

4. **Horizontal Vent Termination**

a. Standard Concentric Termination
Refer to Figure 23.

i. Permitted terminals for horizontal venting:
Horizontal (Wall) Terminal, [100/150 mm (P/N 101809-01)] - see Table 13.

ii. Concentric Vent components supplied with the boiler are packed inside boiler carton and include the following:

- Horizontal (Wall) Terminal,
- Horizontal (Wall) Terminal consists of Straight section having plain male end with locking band clamp installed; Terminal Assembly with offset vent termination, and Outside Wall Plate, both riveted on the opposite end; overall length is approximately 28-1/8".
- Separate Inside Wall Plate
- Two Hardware Bags (each bag contains four screws and four anchors) to attach vent terminal Outside Wall Plate to exterior wall and Inside Wall Plate to interior wall.

iii. For horizontal (sidewall) installation, the Horizontal (Wall) Terminal will extend past outer wall surface by 5½" (100/150 mm). See Figure 23 "Horizontal Concentric Venting".

iv. Install the Horizontal (Wall) Terminal:

- Cut a 6½" (for 100/150 mm) at the planned location of the horizontal terminal.
- Measure dimension "L" from exterior wall outer surface to the end of the last fitting. See Figure 24 'Dimension "L"'.

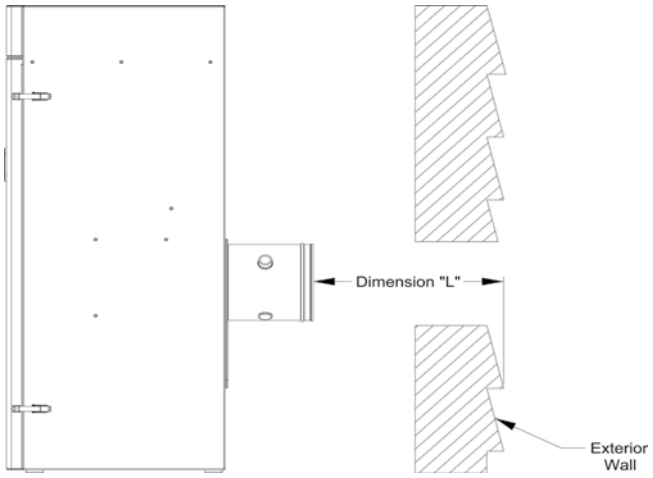


Figure 24: Dimension "L"

- When factory Horizontal (Wall) Terminal needs to be shortened, measure dimension "L" plus 1¼" from inside of the attached Outside Wall Plate and mark the Horizontal (Wall) Terminal outer pipe. To achieve a square cut of the outer pipe, place several marks around the outer pipe to establish a cut line. See Figure 25 ' Cutting Vent Terminal Pipe'.
- Carefully cut the outer pipe at the marked line using aviation shears, a hacksaw etc. Ensure the pipe is cut square and cut end is de-burred.
- Mark the end of the Horizontal (Wall) Terminal inner polypropylene vent pipe to extend 3/8" past the cut end of the outer pipe. To achieve a square cut of the inner pipe, place several marks around the inner pipe to establish a cut line.
- Cut off the marked end of inner polypropylene vent pipe with a fine tooth blade hacksaw etc. and de-burr. See Figure 25 "Cutting Vent Terminal Pipe.
  This pipe can be removed from the terminal to ease cutting, if desired.

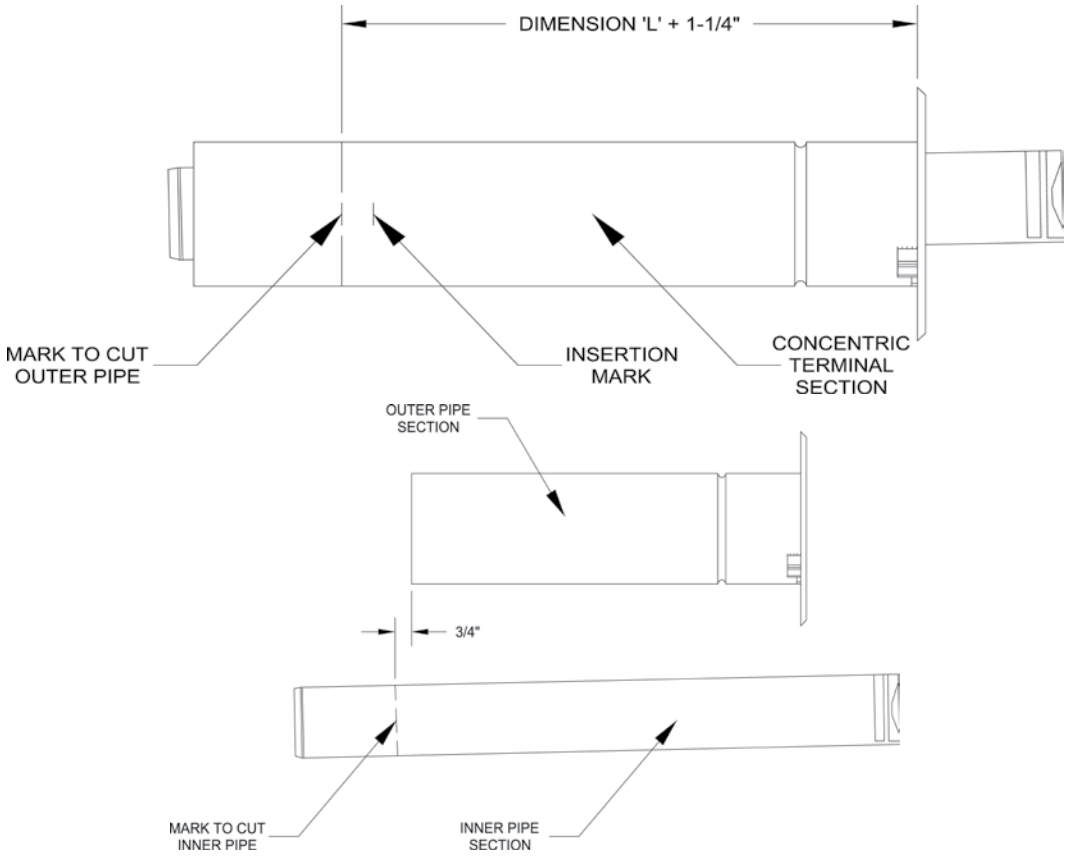


Figure 25: Cutting Vent Terminal Pipe

CAUTION

Exterior wall surface must be reasonably flat to attach the Outside Wall Plate. When exterior wall surface is not flat (covered with vinyl or wood shingle siding etc.) the siding must be removed, and a flat surface build up flash or above siding exterior surface to secure/seal the terminal Outside Wall Plate.

- •. Install the supplied Inside Wall Plate onto the shortened Horizontal (Wall) Terminal interior end and move the plate to cover interior wall cut opening. Secure the plate with provided fasteners, then, apply the sealant around plate sides to seal it to interior wall (refer to Figure 26).
- Lubricate the brown gasket inside boiler concentric vent collar or the last section of the vent pipe with small amount of water.
- Ensure that inner pipe of the terminal is evenly engaged into the gasket all around, then push the termination male end inside boiler concentric vent collar or the last section of the vent pipe, until the mark (see Step *v*) is no longer visible.
- Re-install locking band clamp onto the joint to secure the terminal to the collar or the last section of the vent pipe.

5. **Vertical Vent Termination**

   a. Standard Concentric Termination
   Refer to Figures 27 thru 31.

   i. In addition to the vertical terminal, either a Flat Roof Flashing or Sloped Roof Flashing is required for this installation. Refer to Table 12 'Concentric Vent Components' for details.

   - Determine the centerline of the terminal location on the roof. For flat roof, cut 6½" (100/150 mm) for the terminal. For sloped roof, cut a hole in the roof large enough for the terminal to pass through the roof while remaining plumb.

CAUTION

If the boiler is located directly under the hole, cover it while cutting the hole to prevent debris from falling onto boiler.

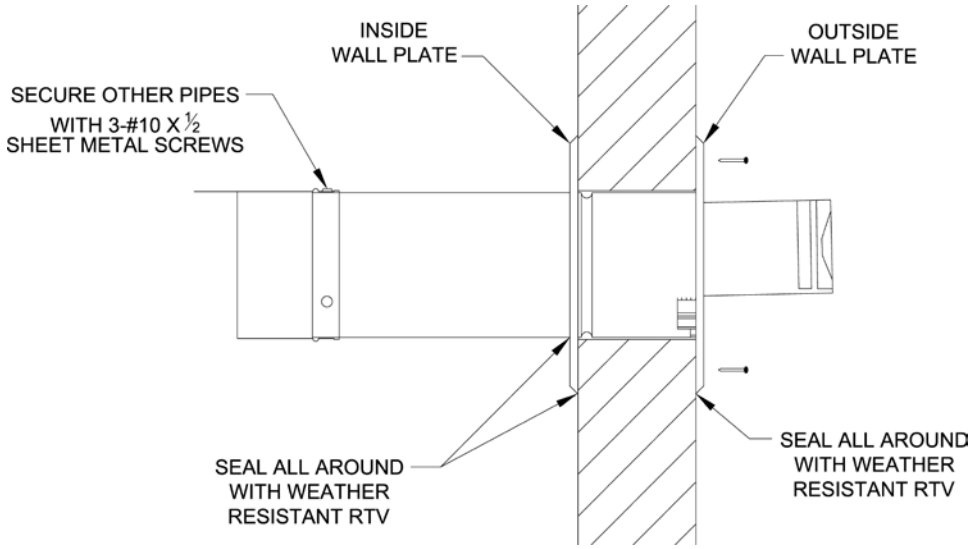


Figure 26: Completing Horizontal (Wall Terminal Installation)

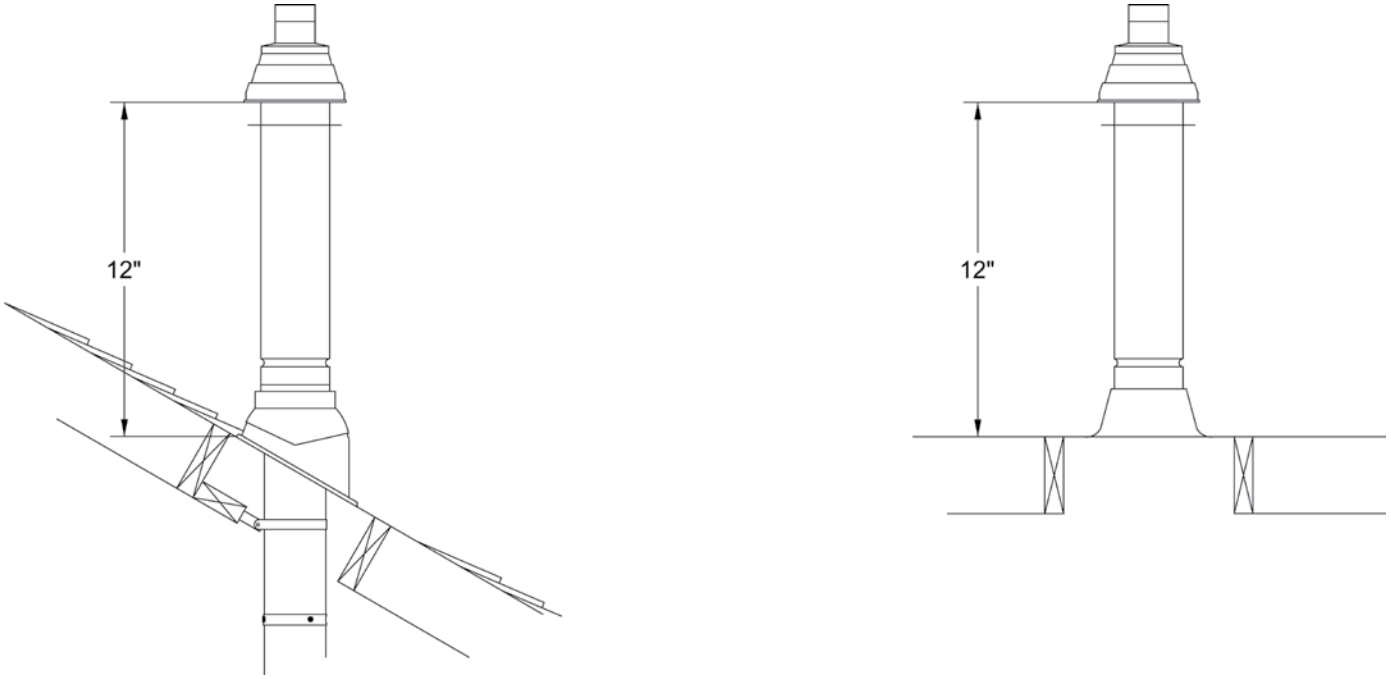


Figure 27: Vertical Concentric Vent Installation

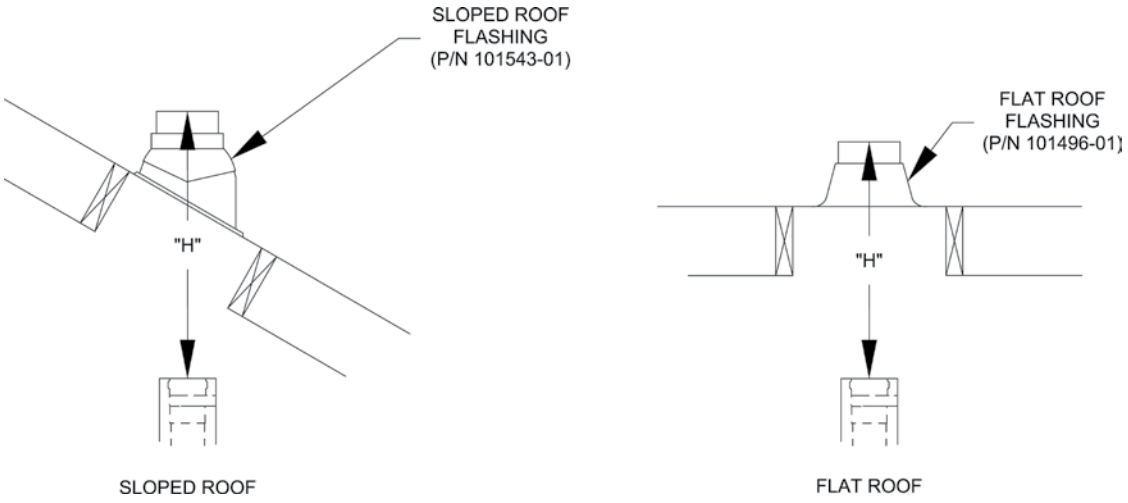


Figure 28: Dimension "H"

- Install the roof flashing using standard practice on the roofing system of the structure.
- If not already done, assemble the venting system inside the building. The last section of pipe needs to be on the same center line as the terminal and within 19-1/4" of the top edge of the roof flashing.
- Measure distance "H" from the top edge of the storm collar to the end of the last fitting as shown in Figure 28.
- Add 1" to distance "H". Carefully mark this length on the pipe as shown in Figure 29.
- Cut the **outer pipe only** at the point marked in Step (e) using aviation shears, a hacksaw, or an abrasive wheel cutter. Be careful to cut the pipe square. De-burr the cut end with a file or emery cloth.
- Place a mark on the plastic inner pipe 3/8" beyond the end of the outer pipe (Figure 29). Use a fine tooth hacksaw to cut the plastic pipe and be careful to cut the pipe square. De-burr the cut edge of the plastic pipe with a file or emery cloth.
- Make a mark on the terminal section 1" from the cut end of the outer pipe as shown in Figure 29.

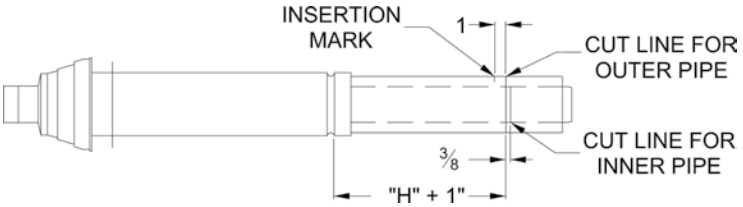


Figure 29: Cutting Vertical Terminal

- Slip the terminal section through the roof from the outside. Push into the last section of vent pipe until the mark made in Step (h) is not longer visible. Secure the terminal to the last piece of pipe with three #10 x 1/2" sheet metal screws. Drill a 1/8" hole through both outer pipes to start these screws. **Use a drill stop or other means to ensure that the drill bit does not penetrate more than 3/8" into the outer pipe. Do not use a sheet metal screw longer than 1/2".**
- Secure the terminal section to the inside of the roof structure using the mounting bracket provided with the terminal (Figure 30).

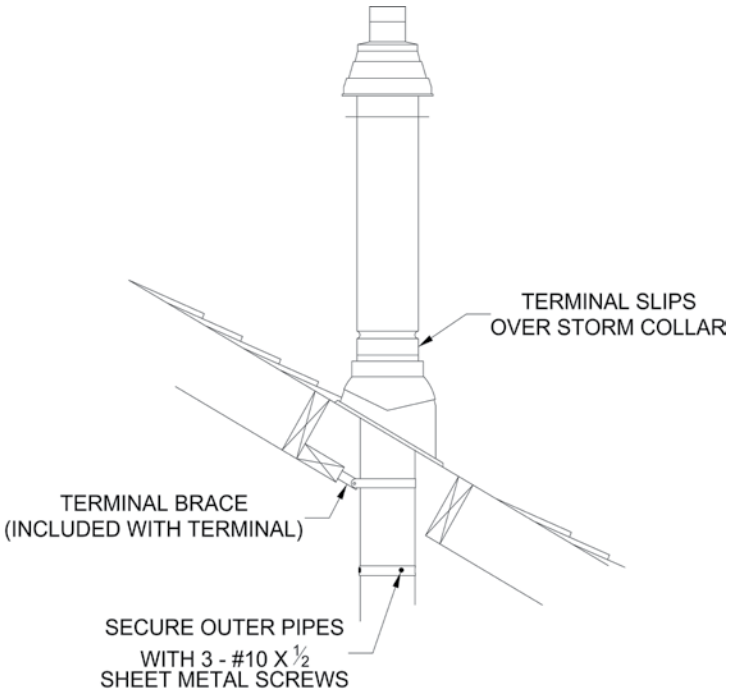


Figure 30: Completing Vertical Terminal Installation

b. Optional Concentric Chimney Chase Installation Refer to Figure 31.

i. A vertical concentric vent system can be installed in an UNUSED masonry chimney.

- The Chimney chase Support Elbow with attached Mounting Bracket is used at the base of the chimney. Refer to Table 12 'Concentric Vent Components' for details. Slip the elbow over the M10 x 35 screw in the support bracket. Determine the desired vertical location of the support elbow in the chimney and mark the location of the pin, positioned on the back of the support bracket, onto the chimney rear wall. Drill a 7/16" diameter x 3-1/2" deep hole in the marked location, then, insert the back bracket pin into the hole. The front of the elbow mounting bracket should be supported either by bottom of the opening into chimney or installer supplied spacer.
- Construct a weather-tight flat roof to cover the top of the old chimney. Install the vertical terminal through this roof using the flat roof flashing.

F. Removing the Existing Boiler

For installations not involving the replacement of an existing boiler, proceed to Step B.

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 remaining appliances. 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 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 (or Operating) Instructions. Adjust thermostat so appliance will operate continuously.
5. Test for spillage at the draft hood relief opening after five (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 the installation conforms with the *National Fuel Gas Code*, NFPA 54/ANSI Z223.1. 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 in Part II in the *National Fuel Gas Code*, NFPA 54/ ANSI Z223.1.

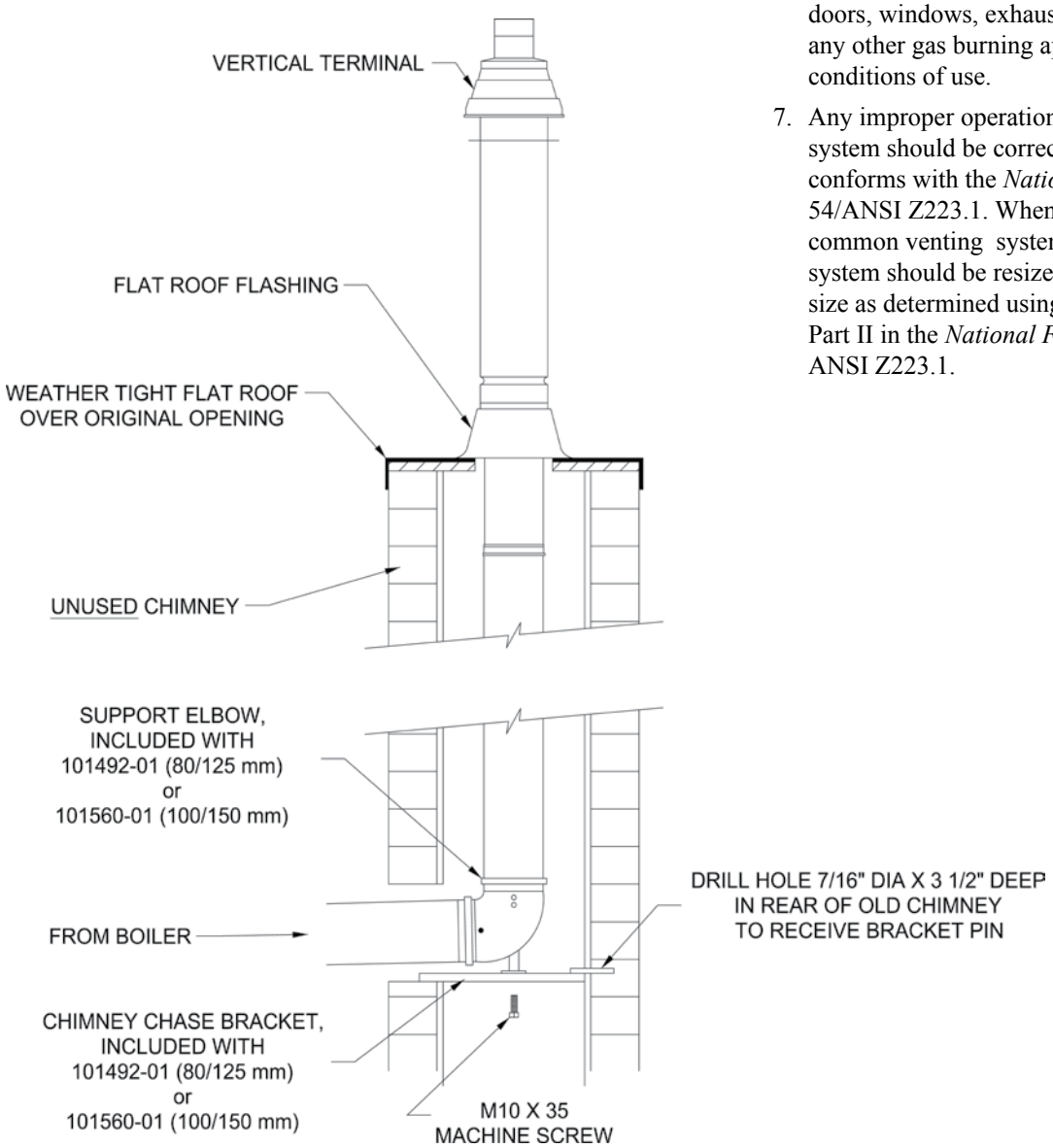


Figure 31: Chimney Chase Installation

G. Multiple Boiler Installation Venting

1. **CPVC/PVC or Polypropylene Venting**
   a. Multiple Boiler CPVC/PVC or polypropylene direct venting is shown in Figure 32.
   b. Each individual module (boiler) must have own vent pipe and vent terminal. Refer to Paragraphs B thru E (as applicable) for individual module (boiler) venting guidelines and options.

WARNING

No common manifolded venting (vent piping and vent terminals) is permitted.

   c. The individual module (boiler) maximum vent length - see Table 8.
   d. For sidewall venting the minimum horizontal distance between any adjacent individual module (boiler) vent terminations is twelve (12) inches.

   Additional horizontal spacing between any adjacent individual module (boiler) vent terminations as well as extending the distance from building surfaces to vent termination end are recommended to avoid frost damage to building surfaces where vent terminations are placed.

CAUTION

Installing multiple individual module (boiler) vent terminations too close together may result in combustion product water vapor condensation on building surfaces, where vent termination are placed, and subsequent frost damage. To avoid/ minimize frost damage, extend the distance from building surfaces to vent termination end and increase the horizontal distance between adjacent vent terminations.

   e. Individual module (boiler) sidewall vent terminals must be placed at least twelve (12) inches above the ground plus the expected snow accumulation.
   f. Multiple individual module vertical vent pipes may be piped through a common conduit or chase so that one roof penetration may be made.

   The minimum horizontal distance between any adjacent individual module (boiler) roof vent terminations is one (1) foot.

2. **PVC Pipe Air Intake Piping**
   a. Multiple Boiler PVC air intake piping is shown in Figure 32.
   b. Each individual module (boiler) must have own combustion air intake pipe and combustion air intake terminal. Refer to Paragraphs B thru E (as applicable) for individual module (boiler) combustion air intake guidelines and options.
   c. The individual module (boiler) maximum combustion air intake pipe length - see Table 8.
   d. If possible, locate each individual module (boiler) both combustion air intake termination and vent termination on the same sidewall, to prevent nuisance boiler shutdowns.

   However, if same sidewall placement is problematic, an individual module (boiler) may be installed using vertical venting and sidewall combustion air intake termination (or, vice versa)

3. **Concentric Combination Venting/Combustion Air Intake Piping**
   a. Concentric Combustion Venting and air intake is shown in Figure 33.
   b. Each individual module (boiler) must have own concentric vent pipe and vent termination. Follow Section IV "Venting" of this manual for individual module (boiler) concentric venting guidelines.

WARNING

No common manifolded concentric venting is permitted.

   c. The individual module (boiler) maximum concentric vent length - see Table 8.
   d. For sidewall venting any adjacent individual module (boiler) concentric vent terminals must be spaced no closer than 12 inches horizontally and three (3) feet vertically from each other to prevent combustion air contamination.

   Additional horizontal spacing between any adjacent individual module (boiler) concentric vent terminations and increased distance from building surfaces to concentric vent termination end are recommended to avoid frost damage to building surfaces where vent terminations are placed.
   e. Individual module (boiler) sidewall concentric vent terminals must be placed at least twelve (12) inches above the ground plus the expected snow accumulation.
   f. For vertical through the roof venting any adjacent individual module (boiler) vertical vent terminals, if level with each other, must be spaced no closer than 12 inches horizontally.

   If vertical vent terminals cannot end in one plane, they must be spaced no closer than three (3) feet horizontally.
   g. Chimney chase concentric venting is permitted for modules, when stackable, providing concentric vertical (roof) vent terminals, if level with each other, are spaced no closer then 12 inches horizontally.

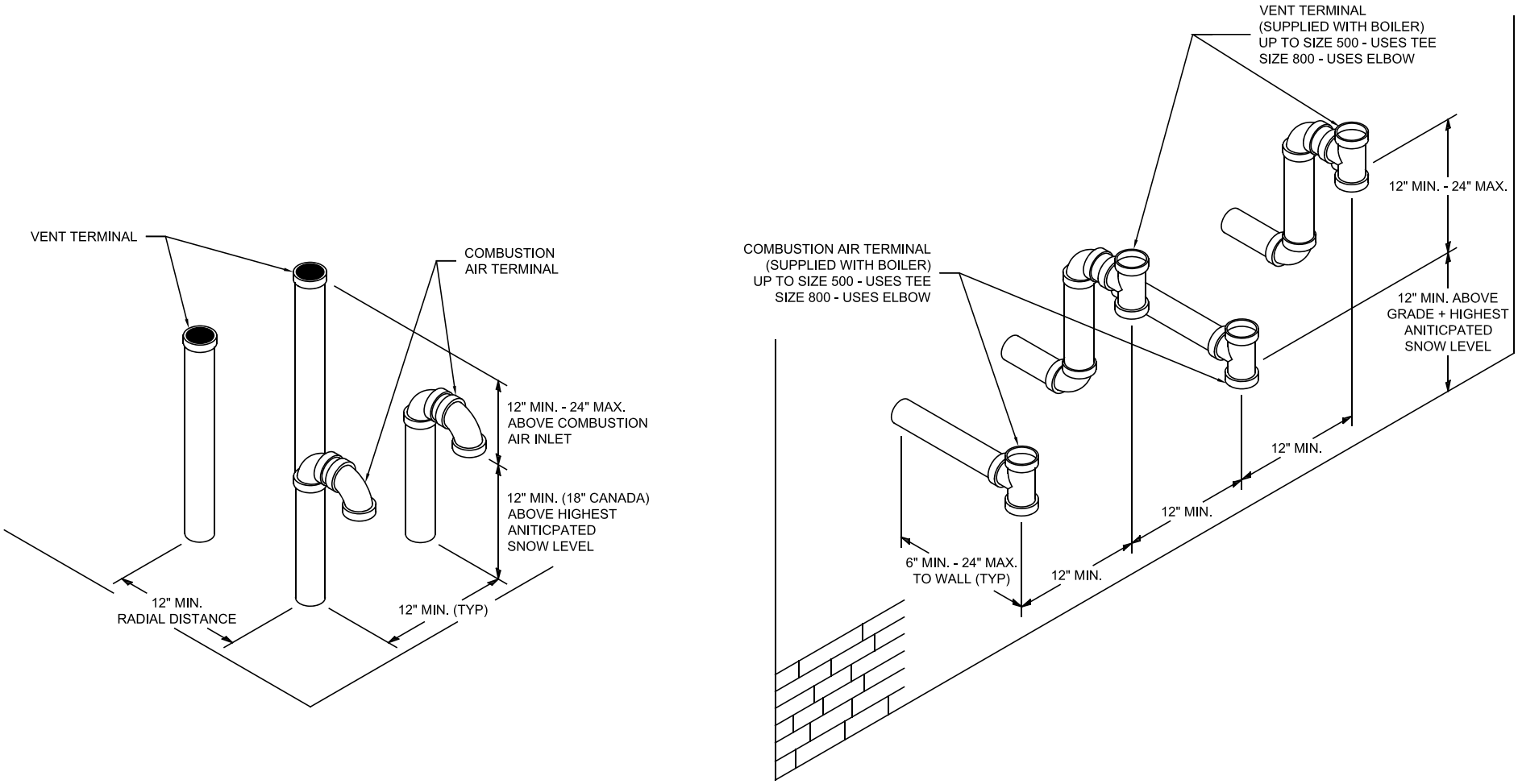
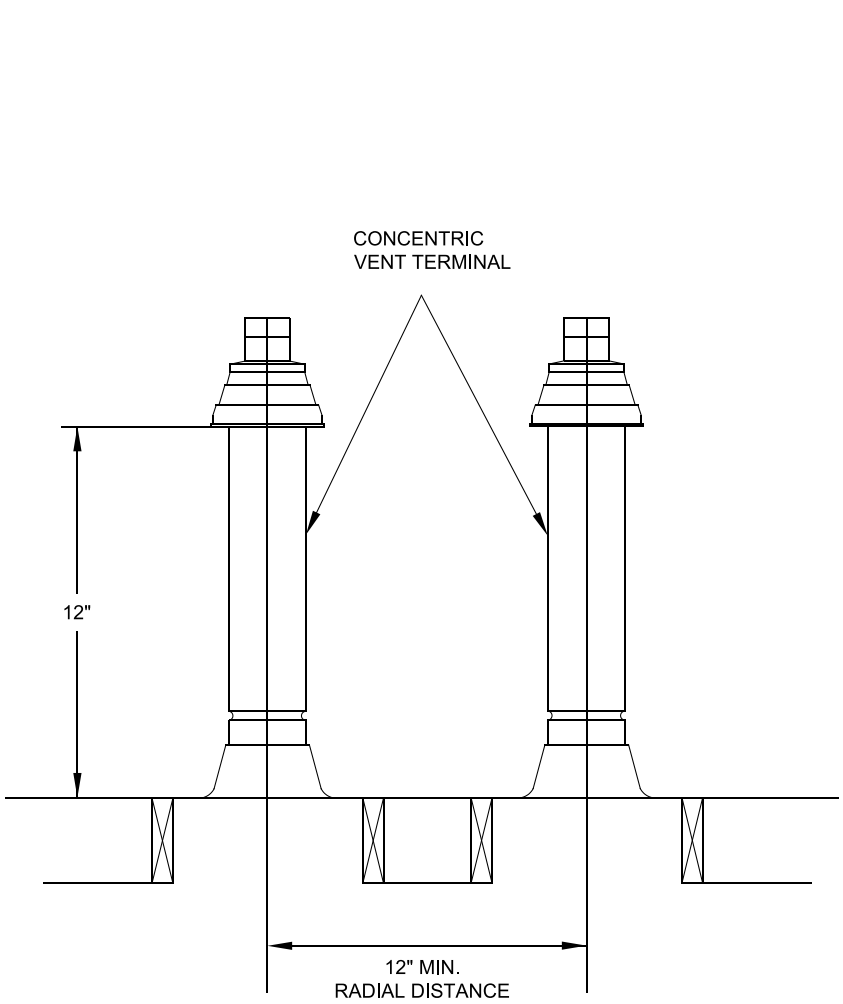
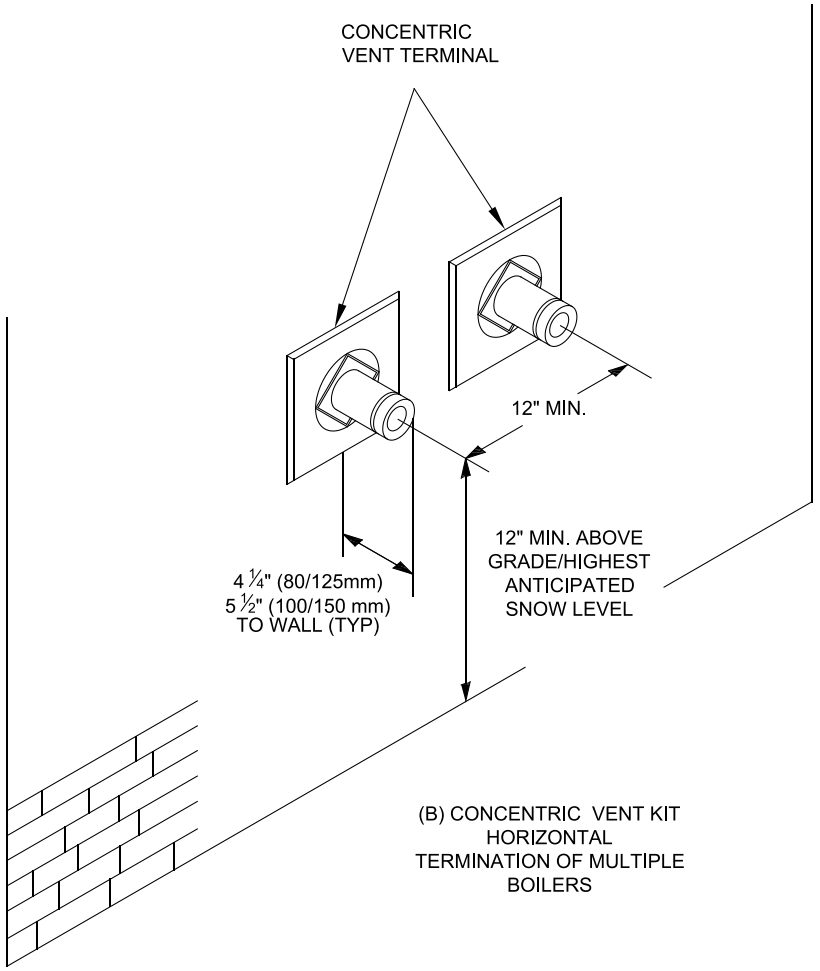


Figure 32: Multiple Boiler Direct Vent Termination



(A) CONCENTRIC VENT KIT
VERTICAL
TERMINATION OF MULTIPLE
BOILERS



(B) CONCENTRIC VENT KIT
HORIZONTAL
TERMINATION OF MULTIPLE
BOILERS

Figure 33: Multiple Boiler Concentric Vent Termination

If vertical vent terminals cannot end in one plane, they must be spaced no closer then three (3) feet horizontally.

h. When individual modules (boilers) are installed in the same horizontal plane, chimney chase vertical concentric venting is permitted provided:

i. Sufficient inside space available at the base of the chimney to install multiple chimney chase brackets and support elbows.

ii. Spacing between adjacent vertical vent terminals is in accordance with Item 'g' above.

V. Condensate Disposal

A. Condensate Trap and Drain Line.

1. All condensate, which forms in the boiler or vent system, collects in the sump under heat exchanger and leaves the boiler through factory installed condensate trap.
2. The trap allows condensate to drain from sump while retaining flue gases in the boiler. The trap has factory installed overflow switch, which shuts down the boiler in the event the drain line becomes obstructed, preventing proper condensate removal. Refer to Section XI "Service and Maintenance" for condensate trap and condensate overflow switch removal and replacement procedure, if required.
3. Note the following when disposing of the condensate:
   a. Condensate is slightly acidic, typical pH around 3.5 - 4.5. Do not use metallic pipe or fittings in the condensate drain line. Do not route the drain line through areas that could be damaged by leaking condensate.
   b. Do not route or terminate the condensate drain line in areas subject to freezing temperatures.
   c. If the point of condensate disposal is above the trap, a condensate pump is required to move the condensate to the drain. Select a condensate pump approved for use with condensing furnaces. If overflow from the pump would result in property damage, select a pump with an overflow switch. Wire this switch in series with installer provided external high limit, to shut off the boiler, and, if desired, in series with installer-supplied alarm, to trigger an alarm in the event of overflow.
   d. Do not attempt to substitute another trap for one provided with the boiler.
   e. In order for boiler to work properly, the boiler must be leveled during installation.
4. The condensate trap stub is located at boiler left side, below inlet and outlet water pipe connections. Refer to Figures 1A and 1B.
5. **Condensate trap must be filled up with water, prior to boiler start-up and before connecting any condensate line to the boiler, to insure combustion products cannot escape from operating boiler.** To fill the trap, inject water in the amount of 1 cup (8 fluid ounces) through condensate trap stub opening. Do not overfill the trap.
6. If any additional condensate drain line is needed, construct the extension from PVC or CPVC Schedule 40 pipe. The factory supplied ¾" x 5-5/8" long PVC coupling, located in the Part Carton, must be used to connect drain line to the condensate trap stub. Do not over tighten coupling compression nuts when connecting drain line and condensate trap stub.

WARNING

Failure to install the condensate trap and condensate drain in accordance with the above instructions could cause flue gas to enter the building, resulting in personal injury or death.

CAUTION

Boiler condensate is corrosive. Route condensate drain line in a manner such that any condensate leakage will not cause property damage.

Some jurisdictions may require that condensate be neutralized prior to disposal.

NOTICE

Use materials approved by the authority having jurisdiction.

B. Condensate Neutralizer Installation

1. Some jurisdictions may require that the condensate be neutralized before being disposed of. Follow local codes pertaining to condensate disposal.

V. Condensate Disposal (continued)

2. A Condensate Neutralizer Kit (P/N 101867-01) is available as optional equipment. Follow local codes and instructions enclosed with the kit for Condensate Neutralizer installation.
3. Limestone chips will get coated by neutral salts (product of chemical reaction between limestone and acidic condensate) and lose neutralizing effectiveness over time. Therefore, periodic condensate neutralizer maintenance and limestone chip replacement must be performed. A pH test or acid test kits are available from HVAC/plumbing distributors and should be used to measure condensate acidity before/after neutralizer thus indicating a need for service and chip replacement.

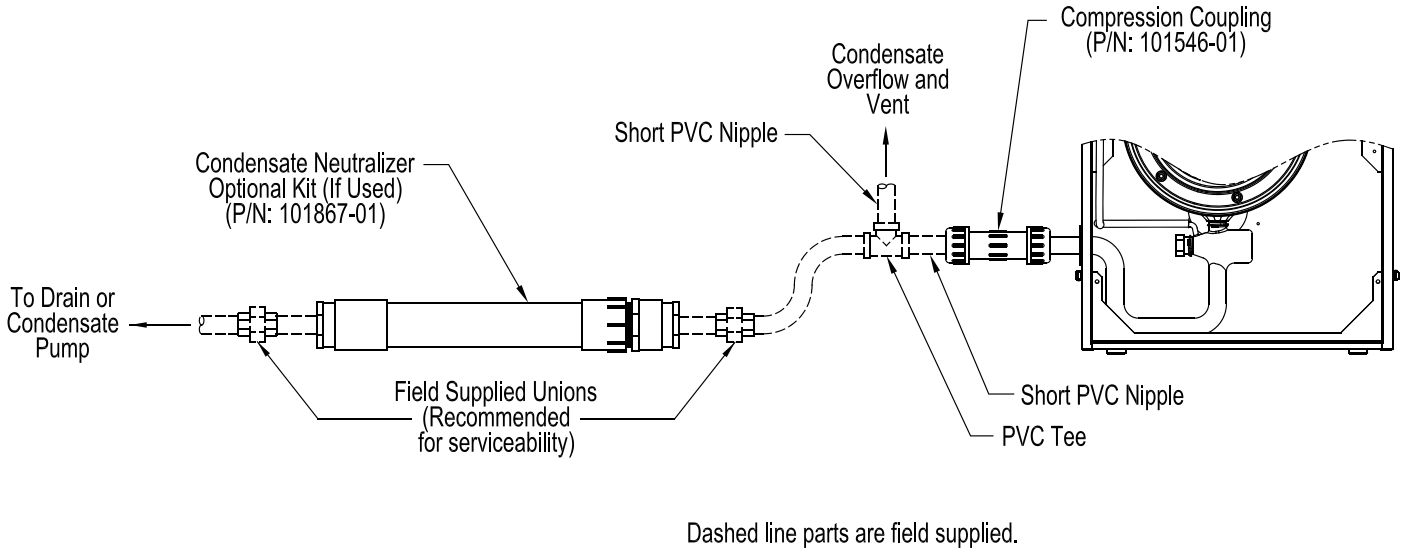


Figure 34: Condensate Trap and Drain Line

VI. Water Piping and Trim

WARNING

Failure to properly pipe boiler may result in improper operation and damage to boiler or structure.

Install boiler so that the gas ignition system components are protected from water (dripping, spraying, rain, etc.) during appliance operation and service (circulator replacement, etc.).

Oxygen contamination of boiler water will cause corrosion of iron and steel boiler components, and can lead to boiler failure. Burnham Commercial's Standard Warranty does not cover problems caused by oxygen contamination of boiler water or scale (lime) build-up caused by frequent addition of water.

Do not fill boiler with softened water to prevent chloride contamination.

A. Installation of Factory Supplied Piping and Trim Components

Apex (APX) boilers have factory supplied Miscellaneous Part Carton (P/N 102942-04 – APX399 & APX500; P/N 103259-01 – APX800), which includes supply piping components, gas piping components, Temperature & Pressure Gauge, Pressure Relief Valve and Drain Valve. See Figure 35 "Factory Supplied Piping and Trim Installation".

Install these components prior to connecting boiler to system piping as follows:

1. APX399 and APX500 Boiler Models
   a. Locate and remove (1) ¾" NPT x close black nipple, (1) ¾" NPT x 12" black nipple, ¾" NPT black tee, ¾" FPT x ¾" FPT Pressure Relief Valve, ¾" NPT Drain Valve.
   b. Install close nipple into tee branch, then, screw the assembly into boiler left side front ¾" FPT tapping making sure tee run outlets are in vertical plane and parallel to boiler side.
   c. Install the ¾" NPT x 12" black nipple into tee run top outlet.
   d. Mount ¾" FPT x ¾" FPT Pressure Relief Valve onto 12" nipple.
   e. Install Drain Valve into the tee bottom outlet.

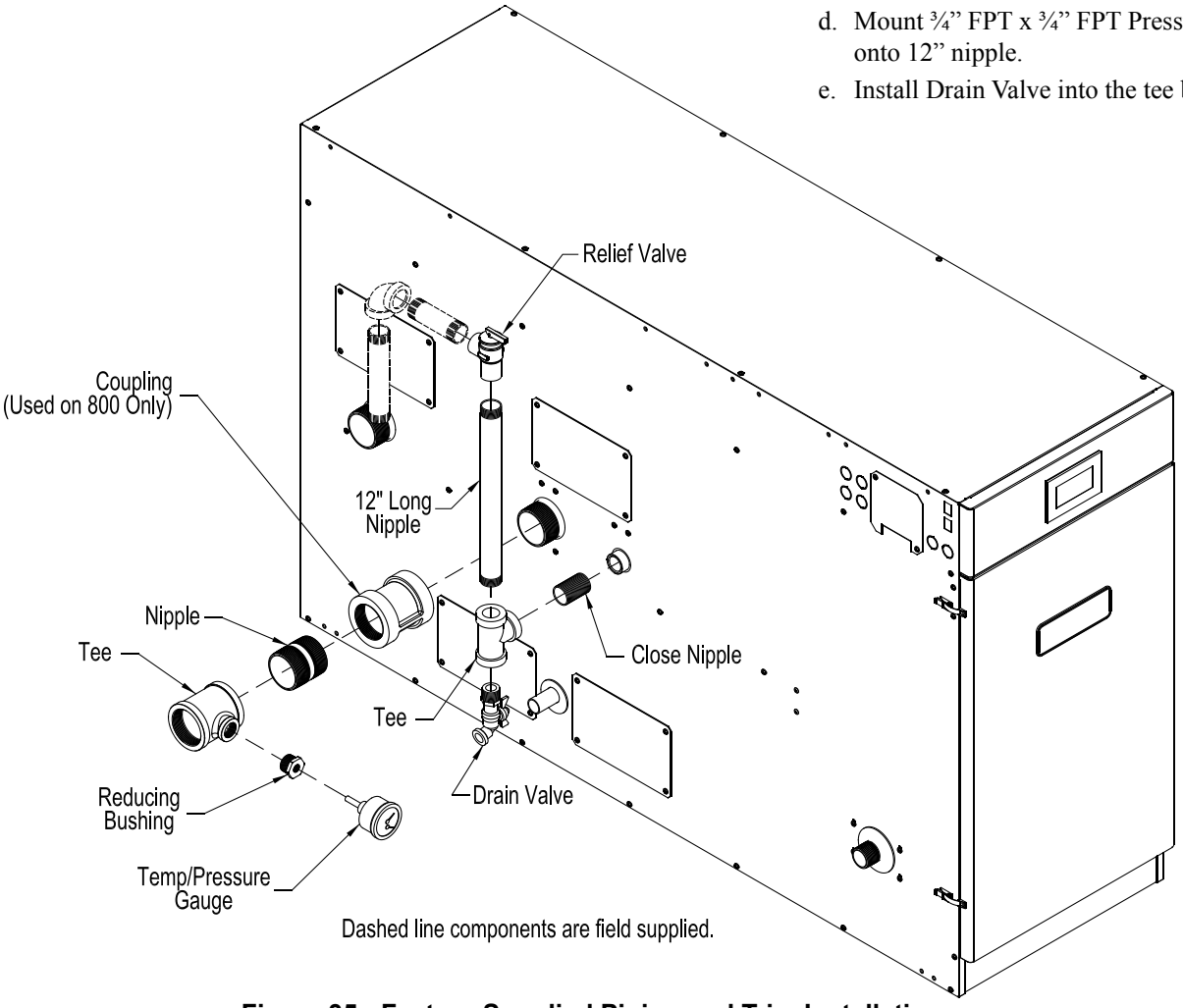


Figure 35: Factory Supplied Piping and Trim Installation

f. Locate and remove 1½" NPT x 2" long black nipple, 1½" x 1½" x ¾" NPT black tee, ¾" x ¼" NPT black reducing bushing and Temperature & Pressure Gauge.

g. Mount the nipple into 1½" FPT boiler supply tapping (see Figures 1A and 1B), then, install the tee onto the nipple, making sure ¾" branch outlet is in horizontal plane and facing the boiler front.

h. Install ¾" x ¼" NPT black reducing bushing into the tee branch, then, put in Temperature & Pressure Gauge.

2. APX800 Boiler Model

a. Locate and remove (1) ¾" NPT x close black nipple, (1) ¾" NPT x 12" black nipple, ¾" NPT black tee, ¾" FPT x 1" FPT Pressure Relief Valve, ¾" NPT Drain Valve.

b. Install close nipple into tee branch, then, screw the assembly into boiler left side front ¾" tapping making sure tee run outlets are in vertical plane and parallel to boiler side.

c. Install the ¾" NPT x 12" black nipple into tee run top outlet.

d. Mount ¾" FPT x 1" FPT Pressure Relief Valve onto 12" nipple.

e. Install Drain Valve into the tee bottom outlet.

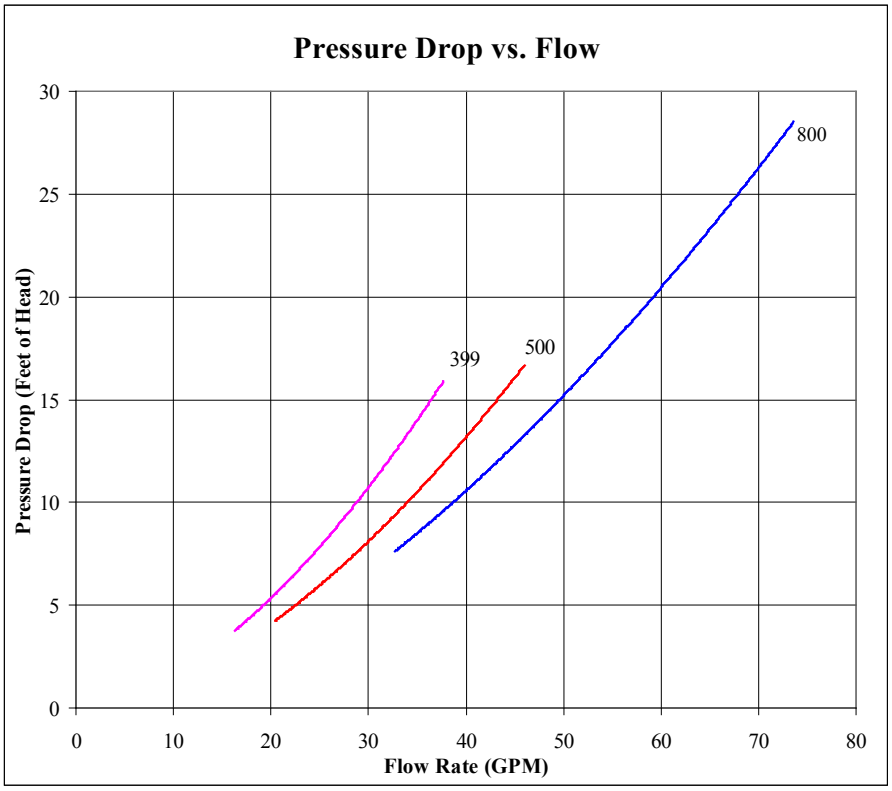
f. Locate and remove 2" NPT steel coupling, 2" NPT x 2-1/2" long black nipple, 2" x 2" x ¾" NPT black tee, ¾" x ¼" NPT black reducing bushing and Temperature & Pressure Gauge.

g. Mount 2" NPT coupling onto 2" MPT boiler supply stub (see Figure 1C), then, install 2" NPT x 2-1/2" long black nipple into the coupling

Table 14: Flow Range Requirement Through Boiler

Boiler Model	Boiler Supply Connection, Inch, FPT	Boiler Return Connection, Inch, FPT	Minimum Required Flow (GPM) @ 35°F ΔT	Boiler Head Loss, Ft. @ 35°F ΔT	Required Flow, (GPM) @ 30°F ΔT	Boiler Head Loss, Ft. @ 30°F ΔT	Required Flow, (GPM) @ 25°F ΔT	Boiler Head Loss, Ft. @ 25°F ΔT	Maximum Required Flow (GPM) @ 20°F ΔT	Boiler Head Loss, Ft. @ 20°F ΔT
APX399	1½	1½	21.5	6.1	25.1	7.9	30.2	10.8	37.7	15.9
APX500	1½	1½	27.1	6.9	31.7	8.9	38.0	12.1	47.5	17.6
APX800	2	2	43.4	12.1	50.7	15.5	60.8	20.9	76.0	30.0

Notes: Required Flow (GPM) = ** Output (MBH) * 1000/500 * ΔT
** Output (MBH) - Select Value for specific Boiler Model from Table 2A or 2B
Using boiler antifreeze will result in higher fluid density and may require larger circulators.



outlet, then, attach 2" x 2" x ¾" tee onto the nipple opposite end, making sure ¾" branch outlet is in horizontal plane and facing the boiler front.

h. Install ¾" x ¼" NPT black reducing bushing into the tee branch, then, put in Temperature & Pressure Gauge.

B. Piping System To Be Employed.

Apex (APX) boilers are designed to operate in a closed loop pressurized system. Minimum pressure in the boiler must be 12 PSI. Proper operation of the Apex (APX) boiler requires that the water flow through the boiler remain within the limits shown in Table 14, any time the boiler is firing.

NOTICE

Failure to maintain the flow through boiler within specified limits could result in erratic operation or premature boiler failure.

1. **Near boiler piping must isolate APX boiler from system piping via closely spaced tees** to insure specified flow range through boiler any time the boiler is firing:
   a. The flow rate through the isolated near-boiler loop is maintained by factory recommended and installer supplied boiler circulator.
   b. The flow rate through the isolated near-boiler loop **is completely independent** of the flow rate through the heating system loop(s).
   c. The flow rate through the heating system loop(s) is controlled by installer sized/provided system loop circulator(s).
   d. This piping arrangement can be used either for space heating-only applications or space heating with indirect water heater(s) applications.
      i. **Space heating only** - refer to Table 15 and Figure 36 "Near Boiler Piping - Heating Only" as applicable.
      ii. **Space heating plus indirect water heater(s)** - refer to Table 15 and Figure 37 "Near Boiler Piping - Heating Plus Indirect Water Heater" as applicable.

NOTICE

Where it is not possible to install a separate boiler loop, the system circulator must be sized to ensure that the flow through boiler stays within the defined parameters to prevent overheating when the boiler is fired at it's full rated input. Install a flow meter to measure the flow, or fire the boiler at full rate and ensure the boiler ΔT does not exceed 35°F.

2. **Direct connection of Apex (APX) boiler to heating system**, similar to a conventional boiler, is NOT RECOMMENDED because:
   a. The flow rate through system must be the same as through boiler and fall within limits specified in Table 14.
   b. Pressure drop through entire system must be known, added to pressure drop through boiler, and, a circulator selected to provide required flow at total calculated pressure drop.
   c. It is often very difficult to accurately calculate the pressure drop through the system.
   d. In replacement installations, it may be nearly impossible to get an accurate measurement of piping amount and number of fittings in the system. If system is zoned, the system flow rate may drop well below recommended minimum flow when only a single zone is calling for heat.

Table 15: Recommended Circulator Models for Apex (APX) Boilers Based on 25°F Temperature Differential and Up to 75 ft. Equivalent Length Near-Boiler Piping - Space Heating Circulator

Boiler Model	Boiler Supply Connection, Inch, FPT	Boiler Return Connection, Inch, FPT	Near-Boiler Piping Supply Pipe Size, Inch	Near-Boiler Piping Return Pipe Size, Inch	Flow, GPM @ 25°F Temp. Differential	Combined Boiler & Piping Loop Head Loss, Ft.	* Recommended Circulator Make & Model
APX399	1½	1½	2	2	30.2	12.0	Taco 2400-20 Grundfos UPS 32-80/2 F (second speed)
APX500	1½	1½	2	2	37.8	13.9	Taco 2400-30 Grundfos UPS 32-80/2 F (third speed) or 40-80/2 F (second speed)
APX800	2	2	2½	2½	60.8	21.5	Taco 1400-70 Grundfos UPS 50-80/2 F (third speed)

Notes:
* Circulator Models shown are not equipped with internal flow check valve (IFC).
When selecting Circulators with IFC contact Circulator Manufacturer for sizing information.
Near-Boiler Piping Size shown is based on 2 to 5.5 Ft/Sec. velocity range to avoid potential noise and pipe erosion.

C. Standard Installation Requirements.

Observe the following guidelines when making the actual installation of the boiler piping:

1. **Safety Relief Valve (Required)** - The relief valve is packaged loose with boiler and must be installed in the location shown in Figure 35 "Factory Supplied Piping and Trim Installation". The relief valve must be installed with spindle in vertical position. Installation of the relief valve must comply with ASME Boiler and Pressure Vessel Code, Section IV. The standard factory shipped relief valve is rated for 50 PSI maximum working pressure. Optional 80 PSI and 100 PSI maximum working pressure rated relief valves are available. If the valve is to be replaced, the replacement valve must have a relief capacity equal or exceeding the boiler AHRI Gross Output rating (model APX500). Pipe the relief valve discharge to a location where hot water or steam will not create hazard or property damage if the valve opens. The end of the discharge pipe must terminate in an unthreaded pipe. If the relief valve is not piped to a drain, it must terminate at least 6" above the floor. Do not run relief valve discharge piping through an area prone to freezing. The termination of discharge piping must be in an area where it will not become plugged by debris.

WARNING

Safety relief valve discharge piping must be piped such that the potential of severe burns is eliminated. DO NOT pipe in any area where freezing could occur. DO NOT install any shut-off valves, plugs or caps. Consult Local Codes for proper discharge piping arrangement.

2. **Circulator (Required)** – Usually at least two circulators will be required to properly install a Apex™ Series boiler. See Paragraph B above for information on sizing the circulators.
3. **Expansion Tank (Required)** – If this boiler is replacing an existing boiler with no other changes in the system, the old expansion tank can generally be reused. If the expansion tank must be replaced, consult the expansion tank manufacturer's literature for proper sizing.
4. **Fill Valve (Required)** – Either manual (recommended) or automatic fill valve may be used. However, if automatic refill is employed, a water meter must be added to evaluate the makeup water volume taken after initial fill and eliminate any water leakage as early as possible.
5. **Automatic Air Vent (Required)** –At least one automatic air vent is required. Manual vents will usually be required in other parts of the system to remove air during initial fill.
6. **Manual Reset High Limit (Required by some Codes)** - This control is required by ASME CSD-1 and some other codes. Install the high limit in the boiler supply piping just above the boiler with no intervening valves. Set the manual reset high limit to 200°F. Wire the limit per Figures 44 and 45A, in Section VIII "Electrical".
7. **Y-strainer (Recommended)** – A Y-strainer or equivalent strainer removes heating system debris from hydronic systems and protects boiler heat exchanger from fouling up. Install the strainer downstream of full port isolation valve, at the inlet side of the circulator, for easy service.
8. **Flow Control Valve (Strongly Recommended)** – The flow control valve prevents flow through the system unless the circulator is operating. Flow control valves are used to prevent gravity circulation or "ghost flows" in circulator zone systems through zones that are not calling for heat.
9. **Isolation Valves (Strongly recommended)** – Isolation valves are useful when the boiler must be drained, as they will eliminate having to drain and refill the entire system.
10. **Drain Valve (Required)** – Drain valve is packaged loose with boiler and must be installed in the location shown in Figure 35 "Factory Supplied Piping and Trim Installation".
11. **Low Water Cutoff (Required by some Codes) –** LWCO with harness and LWCO transformer are available as optional components. Order Complete Kit (Part No. 102097-01) when required.

Table 16: Fitting and Valve Equivalent Length

Copper Fitting and Sweat Valve Equivalent Length (Ft)				
Fitting or Valve Description	**Copper Pipe or Valve Size**			
	1	**1¼**	**1½**	**2**
90° Elbow	2.5	3.0	4.0	5.5
45° Elbow	1.0	1.2	1.5	2.0
Tee (thru flow)	0.5	0.6	0.8	1.0
Tee (Branch flow)	4.5	5.5	7.0	9.0
Diverter Tee (typical)	23.5	25.0	23.0	23.0
Gate Valve	0.3	0.4	0.5	0.7
Globe Valve	25.0	36.0	46.0	56.0
Angle Valve	5.3	7.8	9.4	12.5
Ball Valve (standard port)	4.3	7.0	6.6	14.0
Ball Valve (full port)	1.9	1.4	2.2	1.3
Swing Check Valve	4.5	5.5	6.5	9.0
Flow-Check Valve (typical)	54.0	74.0	57.0	177.0
Butterfly Valve	2.7	2.0	2.7	4.5

Table 16: Fitting and Valve Equivalent Length (cont'd)

Threaded Fitting and Valve Equivalent Length (Ft)				
Fitting or Valve Description	**Black Threaded Pipe or Valve Size**			
	1	**1¼**	**1½**	**2**
90° Elbow	2.6	3.5	4.0	5.2
Long Radius Elbow (45° or 90°)	1.4	1.8	2.2	2.8
Tee (thru flow)	1.8	2.3	2.7	3.5
Tee (Branch flow)	5.3	6.9	8.1	10.0
Close Return Bend	4.4	5.8	6.7	8.6
Gate Valve (full open)	0.7	0.9	1.1	1.4
Globe Valve (full open)	30.0	39.0	46.0	59.0
Angle Valve (full open)	13.0	17.0	20.0	26.0
Swing Check Valve (full open)	8.7	12.0	13.0	17.0
Flow-Check Valve (typical)	42.0	60.0	63.0	83.0

NOTE: Table 16 is provided as reference to assist in piping design and specifies equivalent length of typical piping fittings and valves.

NOTICE

The Apex (APX) boiler heat exchanger is made from stainless steel tubular coil having relatively narrow waterways. Once filled with water, it will be subject to the effects of corrosion. Failure to take the following precautions to minimize corrosion and heat exchanger waterways overheating could result in severe boiler damage.

- **Before connecting the boiler, insure the system is free of impurities, grease, sediment, construction dust, sand, copper dust, flux and any residual boiler water additives. Flush the system thoroughly and repeatedly, if needed, with clear water mixed with concentrated rinse agent to remove these contaminants completely.**
- **Iron oxide (red oxide sludge Fe_2O_3) is produced during oxygenation. To minimize any oxygen presence in the system, the system must be air free and leak tight. Do not connect the boiler to radiant tubing without an oxygen barrier. Using automatic water refill is not recommended, however, if such refill is employed, a water meter must be added to evaluate the makeup water volume taken after initial fill and eliminate any water leakage as early as possible.**
- **Maintain the water pressure in the boiler at a minimum of 12 PSI.**
- **The boiler water pH must be within 7.5 < pH < 9.5. If the system contains any aluminum components, pH must be less than 8.5.**
- **Black oxide sludge (magnetite Fe_3O_4) forms as the result of continuous electrolytic corrosion in any system not protected by an inhibitor.**
- **Scale deposit is made up of lime scale contained in most distributed water and settles over the warmest surfaces of boiler heat exchanger causing subsequent overheating and eventual failure. Water hardness must be maintained within 3 to 9 grain/gal range.**
- **Refer to Section XI "Service and Maintenance" for recommended heating system water treatment products (corrosion/scale inhibitors, cleaners etc) and their suppliers.**

VI. Water Piping and Trim C. Standard Installation Requirements (continued)

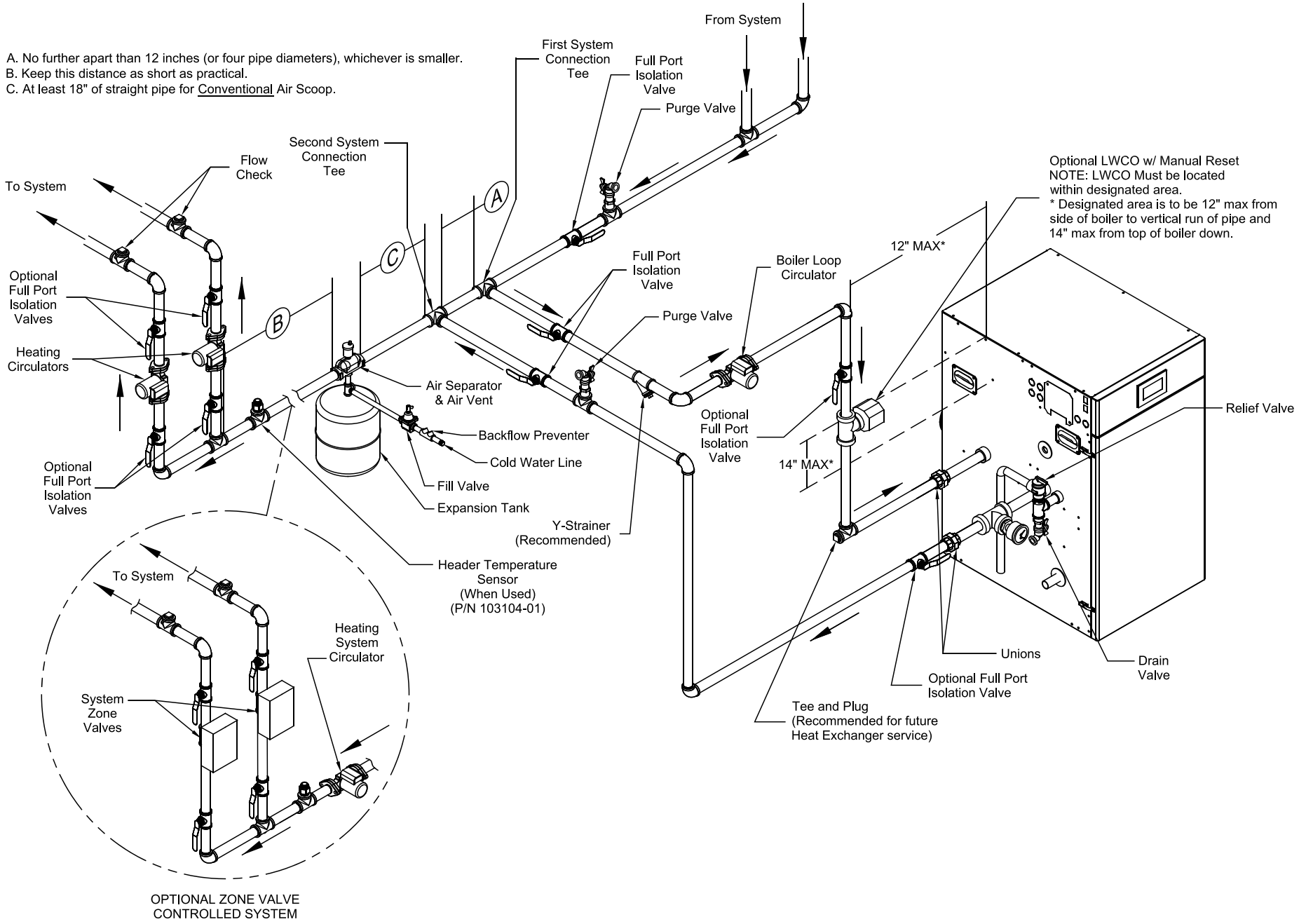


Figure 36: Near Boiler Piping - Heating Only

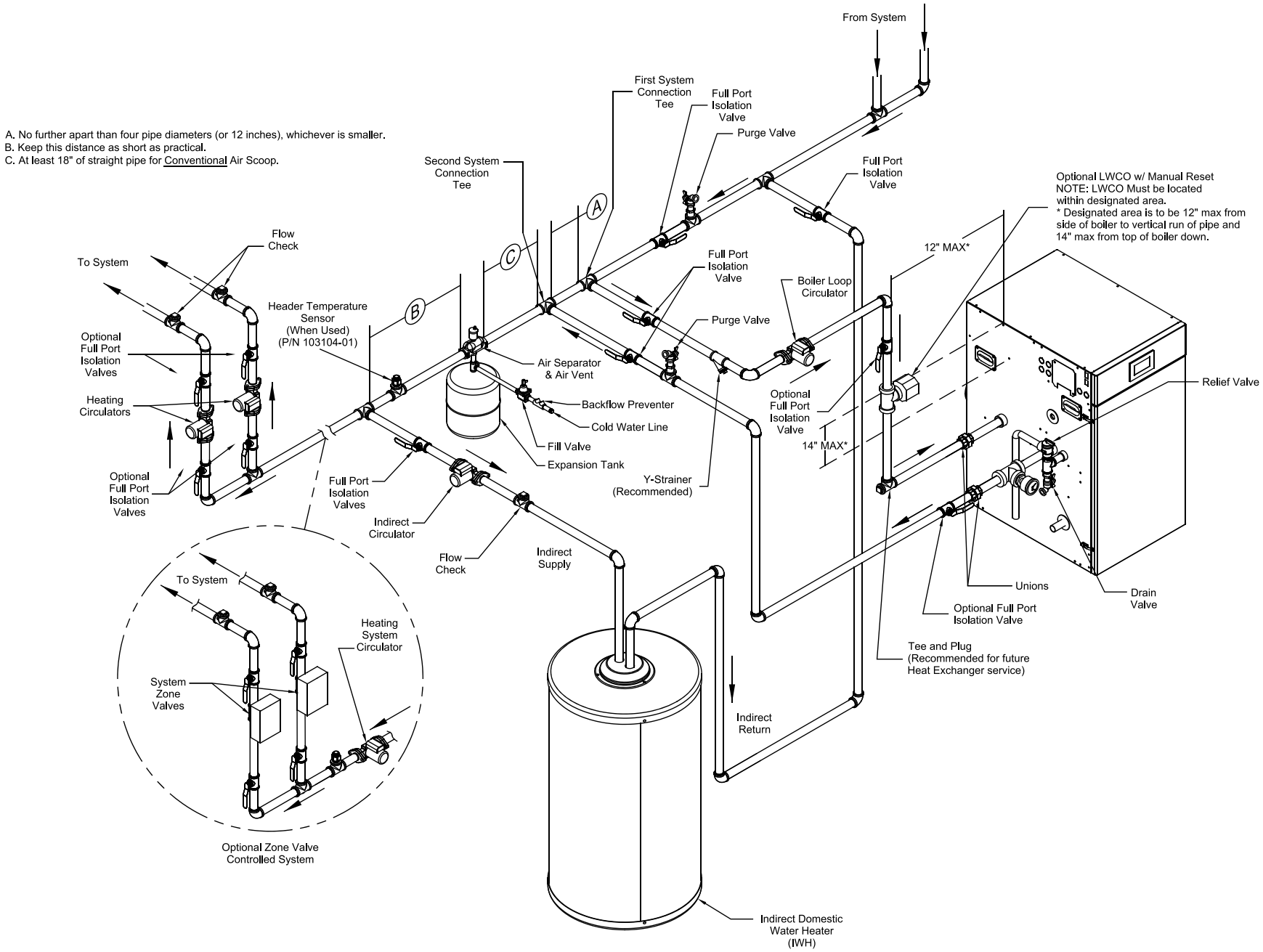


Figure 37: Near Boiler Piping - Heating Plus Indirect Water Heater

D. Special Situation Piping Installation Requirements

Observe the following guidelines when making the actual installation of the boiler piping for special situations:

1. Systems containing high level of dissolved oxygen – Many hydronic systems contain enough dissolved oxygen to cause severe corrosion damage to Apex (APX) boiler heat exchanger. Some examples include but not limited to:
   - Radiant systems employing tubing without oxygen barrier
   - Systems with routine additions of fresh water
   - Systems open to atmosphere

   If the boiler is used in such a system, it must be separated from oxygenated water being heated with a heat exchanger as shown in Figures 38A and 38B. Consult the heat exchanger manufacturer for proper heat exchanger sizing as well as flow and temperature requirements. All components on the oxygenated side of the heat exchanger, such as the pump and expansion tank, must be designed for use in oxygenated water.
2. Piping with a Chiller - If the boiler is used in conjunction with a chiller, pipe the boiler and chiller in parallel. Use isolation valves to prevent chilled water from entering the boiler.
3. Boiler Piping with Air Handlers - Where the boiler is connected to air handlers through which refrigerated air passes, use flow control valves in the boiler piping or other automatic means to prevent gravity circulation during the cooling cycle.

Table 17: Multiple Boiler Water Manifold Sizing

Boiler Model	Number of Units						
	2	3	4	5	6	7	8
	Recommended Minimum Common Water Manifold Size (NPT)						
APX399	2½”	3”	3”	4”	5”	5”	5”
APX500	3”	4”	4”	5”	5”	6”	6”
APX800	3”	5”	5	6”	6”	8”	8”

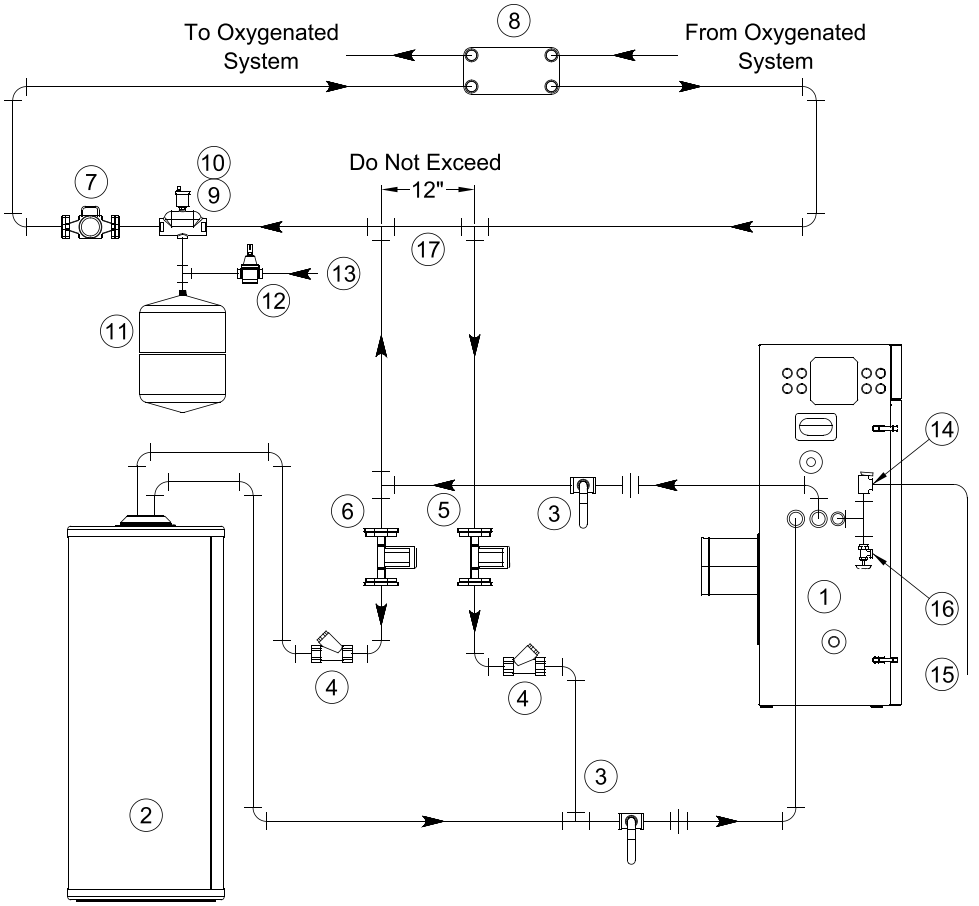


Figure 38A: Isolation of the Boiler From Oxygenated Water with A Plate Heat Exchanger (IWH Piped as Part of Boiler Piping)

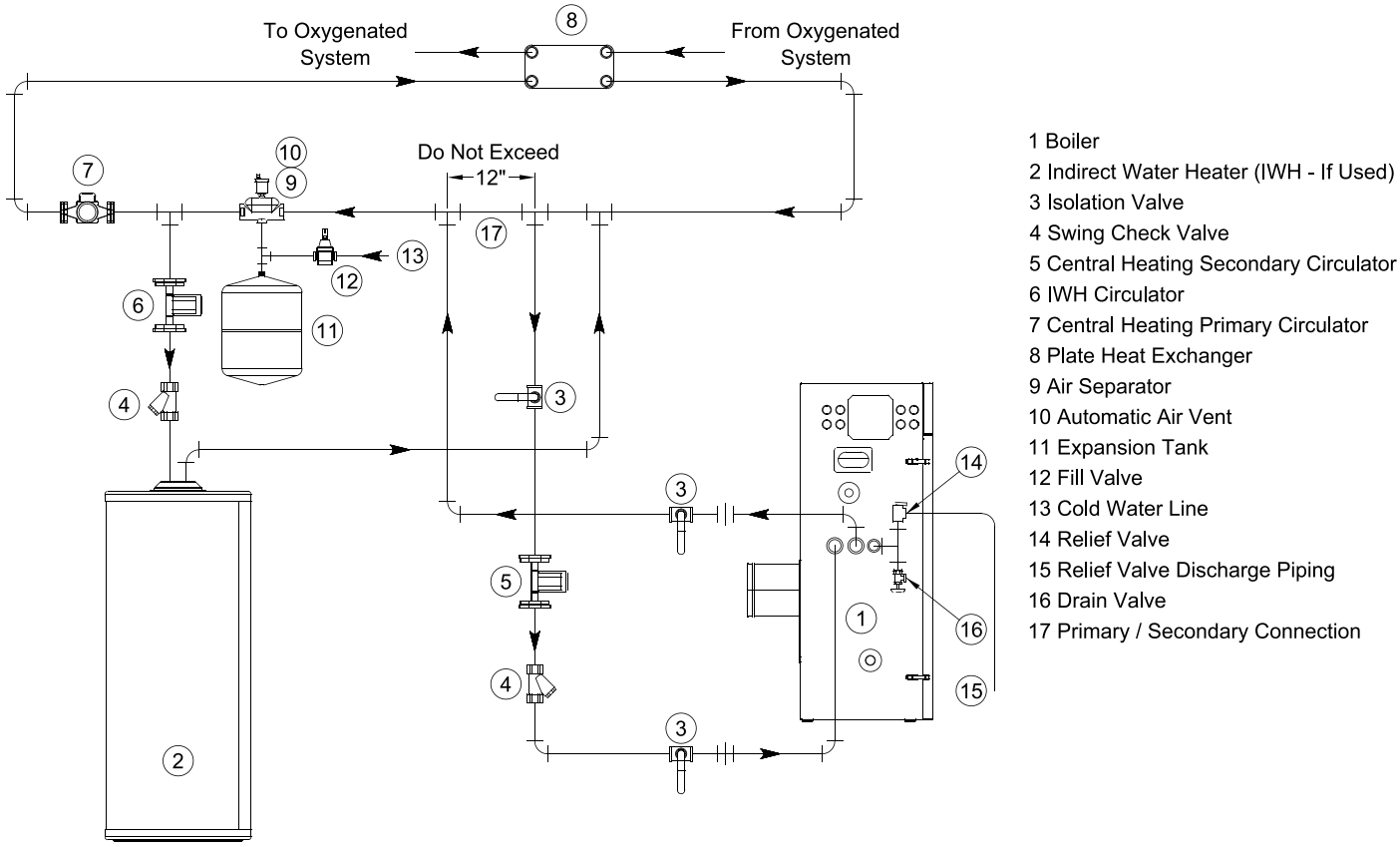
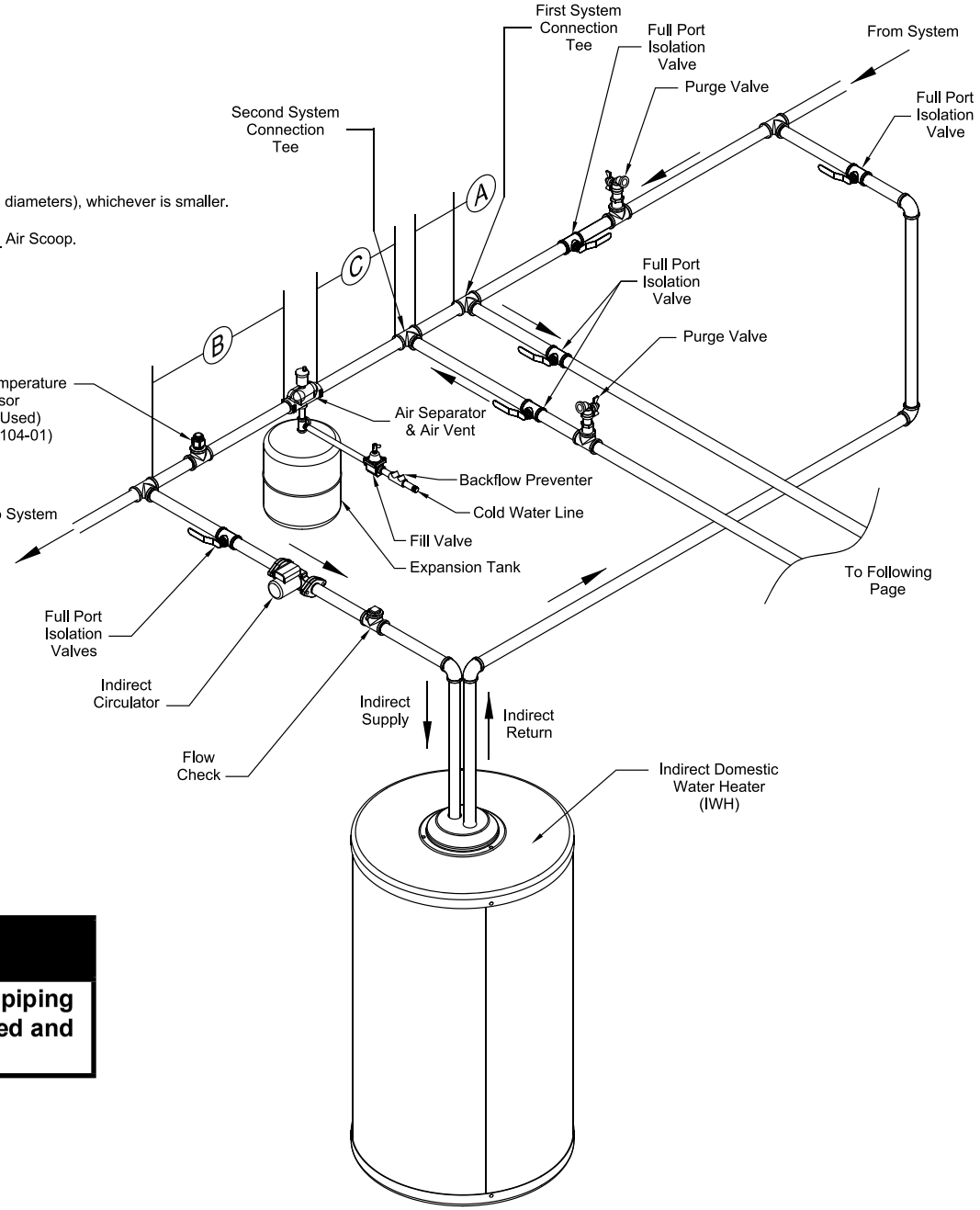


Figure 38B: Isolation of the Boiler From Oxygenated Water with A Plate Heat Exchanger (IWH Piped Off System Header)

E. Multiple Boiler Installation **Water Piping -** See Table 17 and Figures 39B and 40B**.**

1. Refer to this Section of this manual for:
   a. Installation of Factory Supplied Piping and Trim Components for an individual module (boiler).
   b. Regarding an individual module (boiler) piping system specific details.
   c. Selection criteria for individual module (boiler) space heating and/or DHW circulators.
2. For installations where indirect domestic hot water heater is combined with space heating, the Alliance SL™ model must be **piped as a separate heating zone off the system header**. The circulator must be sized based on the Alliance SL™ model coil flow and combined coil pressure drop and the zone piping total equivalent length. Refer to Alliance SL™ Indirect Water Heater literature for a specific model coil flow and pressure drop. Refer to Table 18 and Figures 40A and 40B.

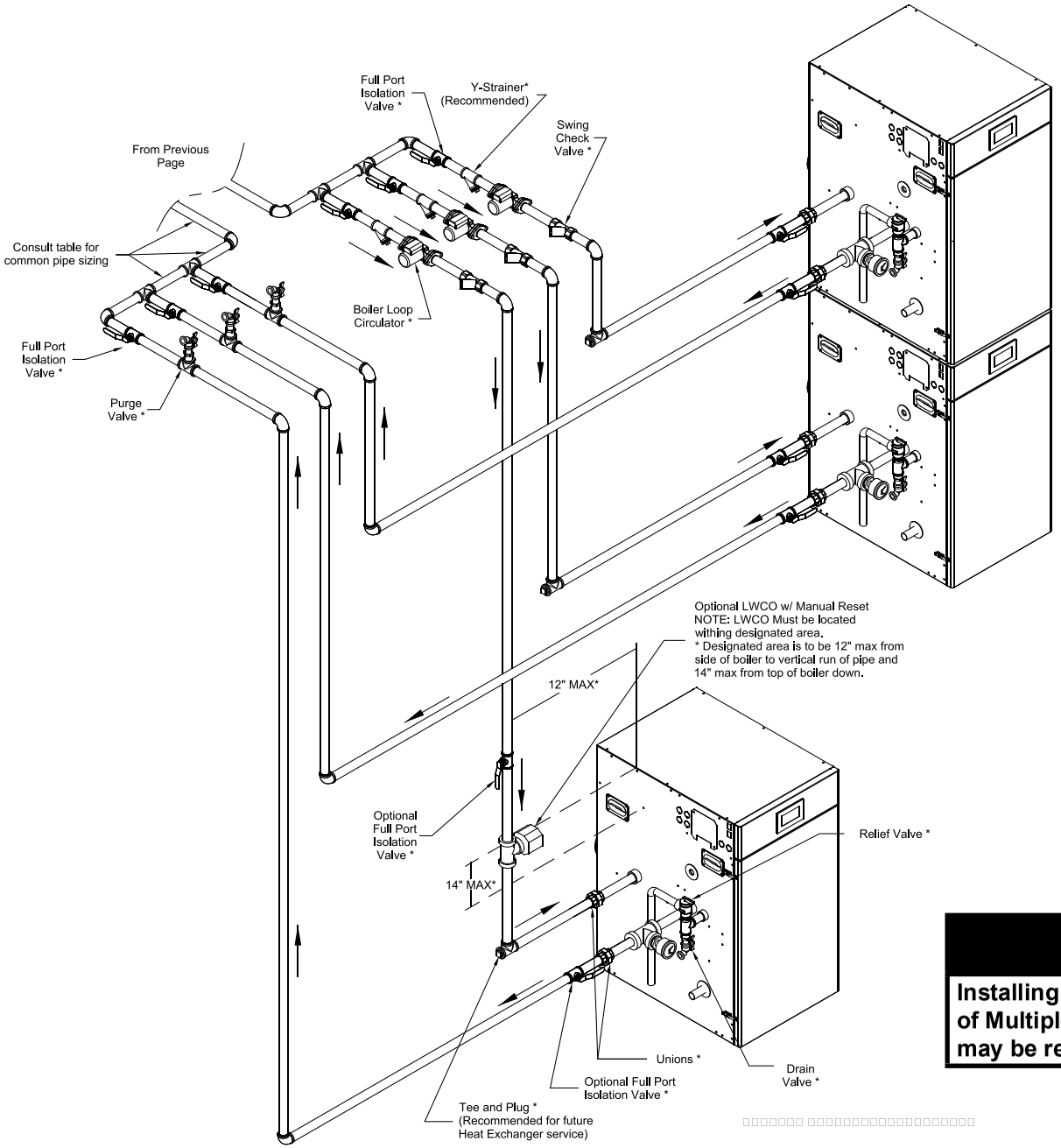
A. No further apart than 12 inches (or four pipe diameters), whichever is smaller.
B. Keep this distance as short as practical.
C. At least 18" of straight pipe for Conventional Air Scoop.



NOTICE

Installing a low water cutoff in the system piping of Multiple boilers is strongly recommended and may be required by Local Codes.

Figure 39A: Multiple Boiler Water Piping w/Domestic Hot Water Heater (Page 1 of 2)



NOTICE

Installing a low water cutoff in the system piping of Multiple boilers is strongly recommended and may be required by Local Codes.

Figure 39B: Multiple Boiler Water Piping w/Domestic Hot Water Heater (Page 2 of 2)

CAUTION

It is the installers responsibility to select pumps and boiler piping configurations that provide the proper flow rates and performance for the boiler and indirect water heater.
Refer to Table 15 for recommended Boiler Loop Circulator.

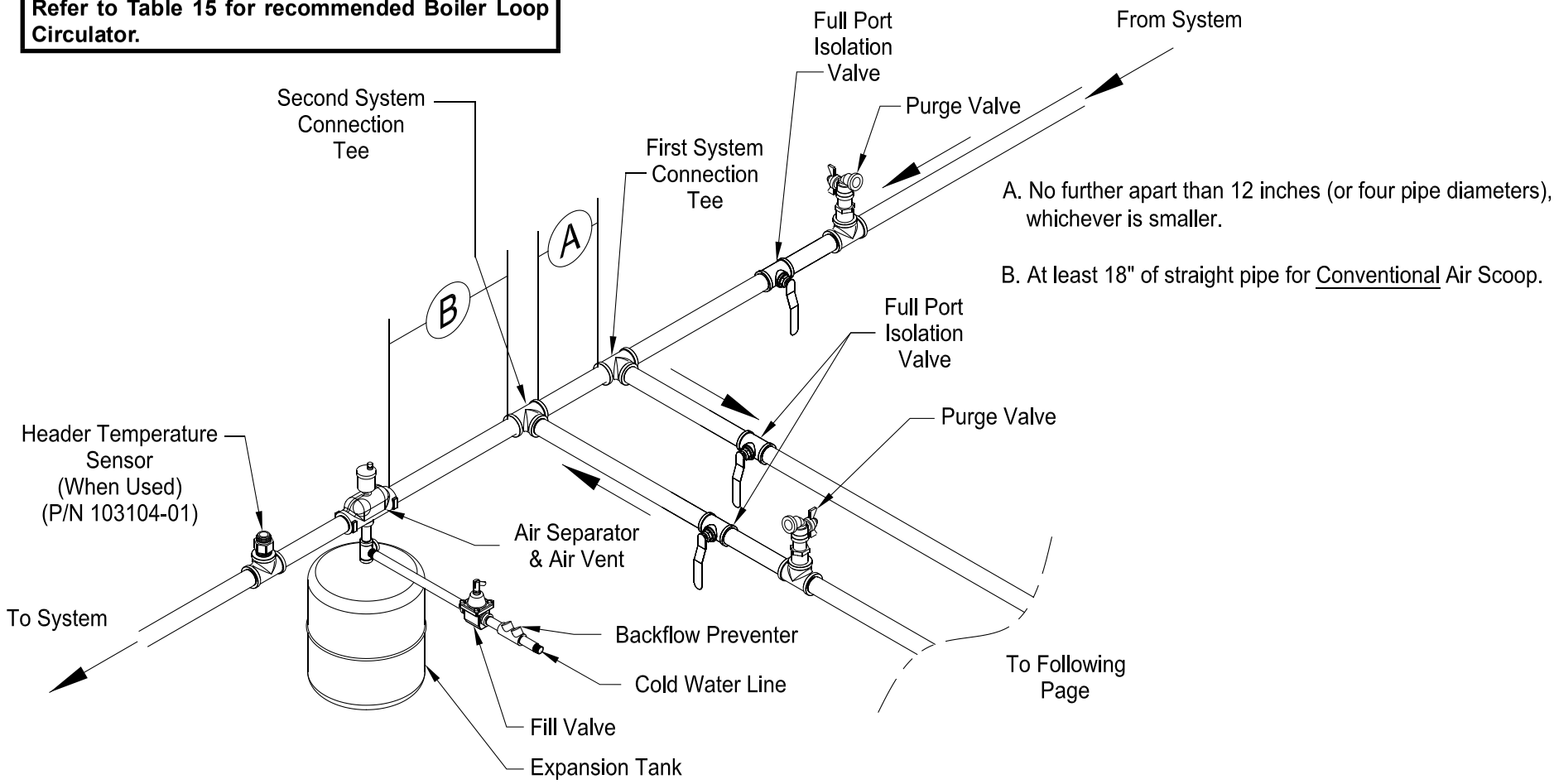


Figure 40A: Alternate Multiple Boiler Water Piping w/ Indirect Domestic Hot Water Heater (Page 1 of 2)

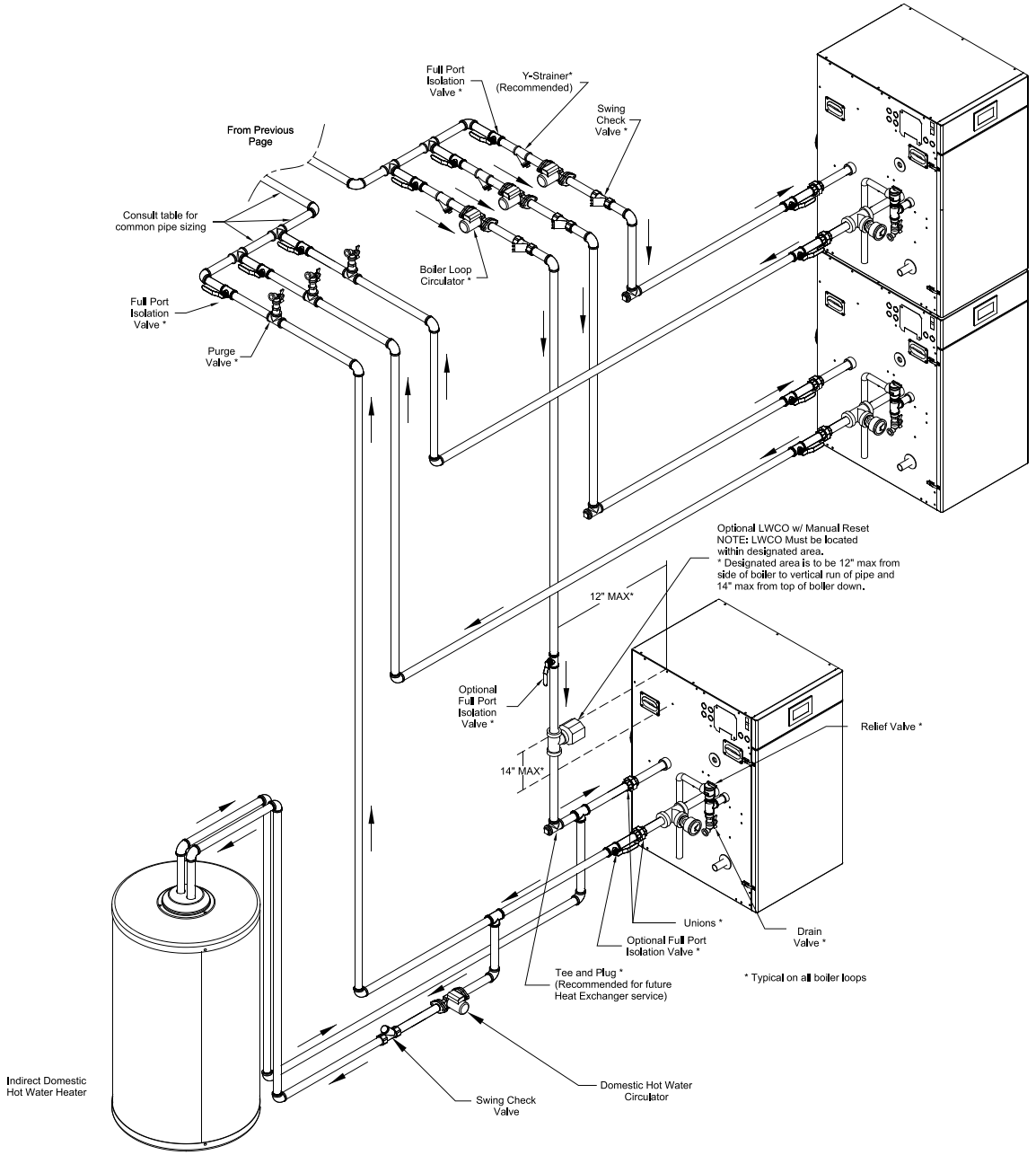


Figure 40B: Alternate Multiple Boiler Water Piping w/Indirect Domestic Hot Water Heater (Page 2 of 2)

Table 18: Recommended Circulator Models for Apex (APX) Boilers and Alliance SL Indirect Water Heaters Installed as Part of Near-Boiler Piping Up to 75 Ft. Equivalent Length - Domestic Hot Water Circulator

Boiler Model	Boiler Supply Connection, Inch, FPT	Boiler Return Connection, Inch, FPT	Near-Boiler Piping Supply Pipe Size, Inch (Note 2)	Near-Boiler Piping Return Pipe Size, Inch (Note 2)	Max Allowable Flow thru Boiler, GPM @ 20°F ΔT	Flow, GPM @ 25°F ΔT	Min Req'd Flow thru Boiler, GPM @ 35°F ΔT	Alliance SL Models to be installed As Part of Near-Boiler Piping	Alliance SL Coil Required Flow Rate, GPM	Alliance SL Coil Head Loss, Ft @ Required Flow Rate	Combined Boiler, Alliance SL & Piping Loop Head Loss, Ft	*Recommended Circulator Make & Model for Alliance SL installed as Part of Near-Boiler Piping	Reference Figure	Notes
APX399	1-1/2	1-1/2	2	2	37.7	30.2	21.5	SL27	6	9	NA	*Not Recommended (see Notes 1 and 2)	40A & 40B	Note 1
								SL35	6	9				
								SL50	6	9.5				
								SL70	6	10				
								SL119	14	17.0				
APX500					47.2	37.8	27.0	SL27	6	9			40A & 40B	Note 2
								SL35	6	9				
								SL50	6	9.5				
								SL70	6	10				
								SL119	14	17.0				
APX800	2	2	2½	2½	76.0	60.8	43.4	SL27	6	9				
								SL35	6	9				
								SL50	6	9.5				
								SL70	6	10				
								SL119	14	17.0				

NOTES:

Note 1: All Alliance SL Coil Flow Rates are below Min Required Flow Rate thru Boiler corresponding to boiler maximum firing rate. These Alliance models can only be installed as separate heating zone off system header - see Figure 39A and 39B for IWH piping.
Indirect Water Heater Circulator must be selected by an installer based on Alliance SL required coil flow and corresponding coil head loss shown as well as total equivalent length of such separate zone.

Note 2: * The IWH may be installed as part of Boiler piping when boiler DHW modulation rate (input) is adjusted to closely match the IWH rated heating capacity required to satisfy DHW demand (see Figures 40A and 40B).

IMPORTANT – Shared or Isolated DHW Demand

When the IWH parameter is set to "Primary Piped", the Sequence Master will be sequencing all required boilers to satisfy the DHW setpoint (default 180°F). Do not use the "Boiler Piped" parameter for 500 and 800 models, unless IWH is piped off an individual boiler having DHW modulation rate (input) adjusted to closely match the IWH rated heating capacity required to satisfy DHW demand. Otherwise, piping an IWH of an individual boiler could cause higher than normal velocities or DT's thru that boiler because of required IWH flow. For commercial applications, it is recommended to pipe IWH's off the common header piping. A header sensor must be installed to prevent rapid header temperature rise when the Sequence Master is sequencing all required boilers to satisfy the DHW setpoint (default 180°F).

Note 3: Near-Boiler Piping Size shown is based on 2 to 5.5 Ft/sec velocity range to avoid potential noise and pipe erosion.

VII. Gas Piping

WARNING

Failure to properly pipe gas supply to boiler may result in improper operation and damage to the boiler or structure. Always assure gas piping is absolutely leak free and of the proper size and type for the connected load.

An additional gas pressure regulator may be needed. Consult gas supplier.

WARNING

Size corrugated stainless steel tubing (CSST) to ensure proper capacity and minimize flow restrictions.

A. Size gas piping. Design system to provide adequate gas supply to boiler. Consider these factors:

1. Allowable pressure drop from point of delivery to boiler. Maximum allowable system pressure is ½ psig. Actual point of delivery pressure may be less; contact gas supplier for additional information. Minimum gas valve inlet pressure is stamped on the rating label located in the boiler's vestibule compartment.
2. Maximum gas demand. Refer to the boiler's input as printed on its rating label. Also consider existing and expected future gas utilization equipment (i.e. water heater, cooking equipment).
3. Length of piping and number of fittings. Refer to Tables 19A (natural gas) or 19B (LP gas) for maximum capacity of Schedule 40 pipe. Table 20 lists equivalent pipe length for standard fittings.
4. Specific gravity of gas. Gas piping systems for gas with a specific gravity of 0.60 or less can be sized directly from Tables 19A or 19B, unless authority having jurisdiction specifies a gravity factor be applied. For specific gravity greater than 0.60, apply gravity factor from Table 21. If exact specific gravity is not shown choose next higher value.

For materials or conditions other than those listed above, refer to *National Fuel Gas Code*, NFPA 54/ANSI Z223.1, or size system using standard engineering methods acceptable to authority having jurisdiction.

Table 19A: Maximum Capacity of Schedule 40 Black Pipe in CFH* (Natural Gas) For Gas Pressures of 0.5 psig or Less

Inlet Pressure 0.5 PSI or less; 0.3 Inch W.C. Pressure Drop											
Nominal Pipe Size, In.	Inside Diameter, In.	Length of Pipe, Ft.									
		10	20	30	40	50	60	70	80	90	100
½	0.622	131	90	72	62	55	50	46	42	40	38
¾	0.824	273	188	151	129	114	104	95	89	83	79
1	1.049	514	353	284	243	215	195	179	167	157	148
1¼	1.380	1056	726	583	499	442	400	368	343	322	304
1½	1.610	1582	1087	873	747	662	600	552	514	482	455
2	2.067	3046	2094	1681	1439	1275	1156	1063	989	928	877
2½	2.469	4856	3337	2680	2294	2033	1842	1695	1576	1479	1397
3	3.068	8584	5900	4738	4055	3594	3256	2996	2787	2615	2470

Inlet Pressure 0.5 PSI or less; 0.5 Inch W.C. Pressure Drop											
Nominal Pipe Size, In.	Inside Diameter, In.	Length of Pipe, Ft.									
		10	20	30	40	50	60	70	80	90	100
½	0.622	172	118	95	81	72	65	60	56	52	50
¾	0.824	360	247	199	170	151	137	126	117	110	104
1	1.049	678	466	374	320	284	257	237	220	207	195
1¼	1.380	1392	957	768	657	583	528	486	452	424	400
1½	1.610	2085	1433	1151	985	873	791	728	677	635	600
2	2.067	4016	2760	2217	1897	1681	1523	1402	1304	1223	1156
2½	2.469	6401	4400	3533	3024	2680	2428	2234	2078	1950	1842
3	3.068	11316	7778	6246	5345	4738	4293	3949	3674	3447	3256

*** 1 CFH of Natural Gas is approximately equal to 1 MBH; contact your gas supplier for the actual heating value of your gas.**

VII. Gas Piping (continued)

B. Connect boiler gas valve to gas supply system.

WARNING

Failure to use proper thread compounds on all gas connectors may result in leaks of flammable gas.

WARNING

Gas supply to boiler and system must be absolutely shut off prior to installing or servicing boiler gas piping.

Table 19B: Maximum Capacity of Schedule 40 Black Pipe in CFH* (LP Gas) For Gas Pressures of 0.5 psig or Less

Inlet Pressure 11.0 Inch W.C.; 0.3 Inch W.C. Pressure Drop											
Nominal Pipe Size, In.	Inside Diameter, In.	Length of Pipe, Ft.									
		10	20	30	40	50	60	70	80	90	100
½	0.622	88	60	48	41	37	33	31	29	27	25
¾	0.824	184	126	101	87	77	70	64	60	56	53
1	1.049	346	238	191	163	145	131	121	112	105	100
1¼	1.380	710	488	392	336	297	269	248	231	216	204
1½	1.610	1064	732	588	503	446	404	371	346	324	306
2	2.067	2050	1409	1131	968	858	778	715	666	624	590
2½	2.469	3267	2246	1803	1543	1368	1239	1140	1061	995	940
3	3.068	5776	3970	3188	2729	2418	2191	2016	1875	1760	1662

Inlet Pressure 11.0 Inch W.C.; 0.5 Inch W.C. Pressure Drop											
Nominal Pipe Size, In.	Inside Diameter, In.	Length of Pipe, Ft.									
		10	20	30	40	50	60	70	80	90	100
½	0.622	116	80	64	55	48	44	40	38	35	33
¾	0.824	242	166	134	114	101	92	85	79	74	70
1	1.049	456	314	252	215	191	173	159	148	139	131
1¼	1.380	937	644	517	442	392	355	327	304	285	269
1½	1.610	1403	964	775	663	588	532	490	456	427	404
2	2.067	2703	1858	1492	1277	1131	1025	943	877	823	778
2½	2.469	4308	2961	2377	2035	1803	1634	1503	1399	1312	1239
3	3.068	7615	5234	4203	3597	3188	2889	2658	2472	2320	2191

*** 1 CFH of LP Gas is approximately equal to 2.5 MBH; contact your gas supplier for the actual heating value of your gas.**

Table 20: Equivalent Lengths of Standard Pipe Fittings & Valves

Nominal Pipe Size, Inc.	Inside Diameter, In.	Valves (Screwed) - Fully Open				Screwed Fittings				
		Gate	Globe	Angle	Swing Check	45° Elbow	90° Elbow	180 Close Return Bend	90 Tee Flow Thru Run	90 Tee, Flow Thru Branch
½	0.622	0.4	17.3	8.7	4.3	0.7	1.6	3.5	1.6	3.1
¾	0.824	0.5	22.9	11.4	5.7	1.0	2.1	4.6	2.1	4.1
1	1.049	0.6	29.1	14.6	7.3	1.2	2.6	5.8	2.6	5.2
1¼	1.38	0.8	38.3	19.1	9.6	1.6	3.5	7.7	3.5	6.9
1½	1.61	0.9	44.7	22.4	11.2	1.9	4.0	9.0	4.0	8.0
2	2.067	1.2	57.4	28.7	14.4	2.4	5.2	11.5	5.2	10.3
2½	2.469	1.4	68.5	34.3	17.1	2.9	6.2	13.7	6.2	12.3
3	3.068	1.8	85.2	42.6	21.3	3.6	7.7	17.1	7.7	15.3

Table 21: Specific Gravity Correction Factors

Specific Gravity	Correction Factor	Specific Gravity	Correction Factor
0.60	1.00	0.90	0.82
0.65	0.96	1.00	0.78
0.70	0.93	1.10	0.74
0.75	0.90	1.20	0.71
0.80	0.87	1.30	0.68
0.85	0.81	1.40	0.66

1. Use methods and materials in accordance with local plumbing codes and requirements of gas supplier. In absence of such requirements, follow *National Fuel Gas Code*, NFPA 54/ANSI Z223.1.
2. Use thread (joint) compounds (pipe dope) resistant to action of liquefied petroleum gas.
3. Apex (APX) boilers have factory supplied Miscellaneous Part Cartons (P/N 102942-03 – APX500, or, P/N 103259-01 – APX800), which include gas-piping components to connect boiler gas valve(s) to gas supply system. Install these components prior to connecting boiler to gas supply system piping as follows:

   APX500

   a. Locate and remove the ¾" NPT x 6" long black nipple and ¾" NPT external gas shutoff valve (required for APX500).
   b. APX500 boiler has ¾" NPT x 12" long black nipple and left side panel grommet factory installed (disregard the supplied ¾" NPT x 6" long black nipple in the Miscellaneous Part Carton).
   c. Mount the ¾" NPT external gas shutoff valve onto the nipple threaded end outside of the jacket left side panel.
   d. Install sediment trap, ground-joint union and manual shut-off valve upstream of mounted factory supplied manual shut-off valve. See Figure 41 " Recommended Gas Piping ".

   APX800

   e. Locate and remove 1" NPT external gas shutoff valve.
   f. APX800 boiler has 1" NPT x 3" long black nipple and left side panel grommet factory installed.
   g. Mount the 1" NPT external gas shutoff valve onto the nipple threaded end outside of the jacket left side panel.
   h. Install sediment trap, ground-joint union and manual shut-off valve upstream of mounted factory supplied manual shut-off valve. See Figure 41 " Recommended Gas Piping".

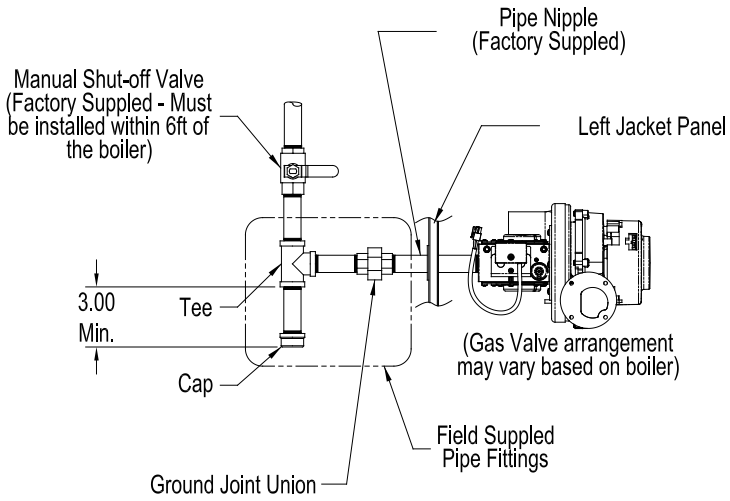


Figure 41: Recommended Gas Piping

4. All above ground gas piping upstream from manual shut-off valve must be electrically continuous and bonded to a grounding electrode. Do not use gas piping as grounding electrode. Refer to *National Electrical Code*, NFPA 70.

C. Pressure test. See Table 22 for Apex Min./Max. Pressure Ratings. The boiler and its gas connection must be leak tested before placing boiler in operation.

1. Protect boiler gas control valve. For all testing over ½ psig, boiler and its individual shutoff valve must be disconnected from gas supply piping. For testing at ½ psig or less, isolate boiler from gas supply piping by closing boiler's individual manual shutoff valve.
2. Locate leaks using approved combustible gas non-corrosive leak detector solution.

Table 22: Min./Max. Pressure Ratings

Boiler Model No.	Natural/LP Gas Max. Pressure (in. w.c.)	Natural Gas Min. Pressure Inlet to Gas Valve (in. w.c.)	LP Gas Min. Pressure Inlet to Gas Valve (in. w.c.)
APX399	14	4,0	11.0
APX500	13.5	4.5	
APX800			

DANGER

Do not use matches, candles, open flames or other ignition source to check for leaks.

D. Apex Models 500 and 800 (if equipped with optional low and high gas pressure switches):

1. The low gas pressure switch must be reset after the boiler is piped to the gas supply and before it is fired.

2. For the low and high gas pressure switches proper operation, the boiler inlet gas pressure must be within 4.5" w.c. to 13.5" w.c range.
3. The gas pressure can be measured at the gas valve inlet pressure port. Refer to Figure 42 "Gas Inlet Pressure Tap and Pressure Switch Location ".
4. If either pressure switch is tripped, it must be manually reset before the boiler can be restarted.

E. Gas Piping for Multiple Boiler Installation

1. Individual module (boiler) gas pipe sizing specific details - see Paragraph A.
2. Individual module (boiler) recommended gas piping detail - see Figure 41.
3. An additional gas pressure regulator(s) may need to be installed to properly regulate inlet gas pressure at the smallest individual module (boiler).

WARNING

If gas pressure in the building is above ½ psig, an additional gas pressure regulator is required. Using one additional regulator for multiple boilers may result in unsafe boiler operation. The additional regulator must be able to properly regulate gas pressure at the input of the smallest boiler. If the regulator cannot do this, two or more additional regulators are required. Consult regulator manufacturer and/or local gas supplier for instructions and equipment ratings.

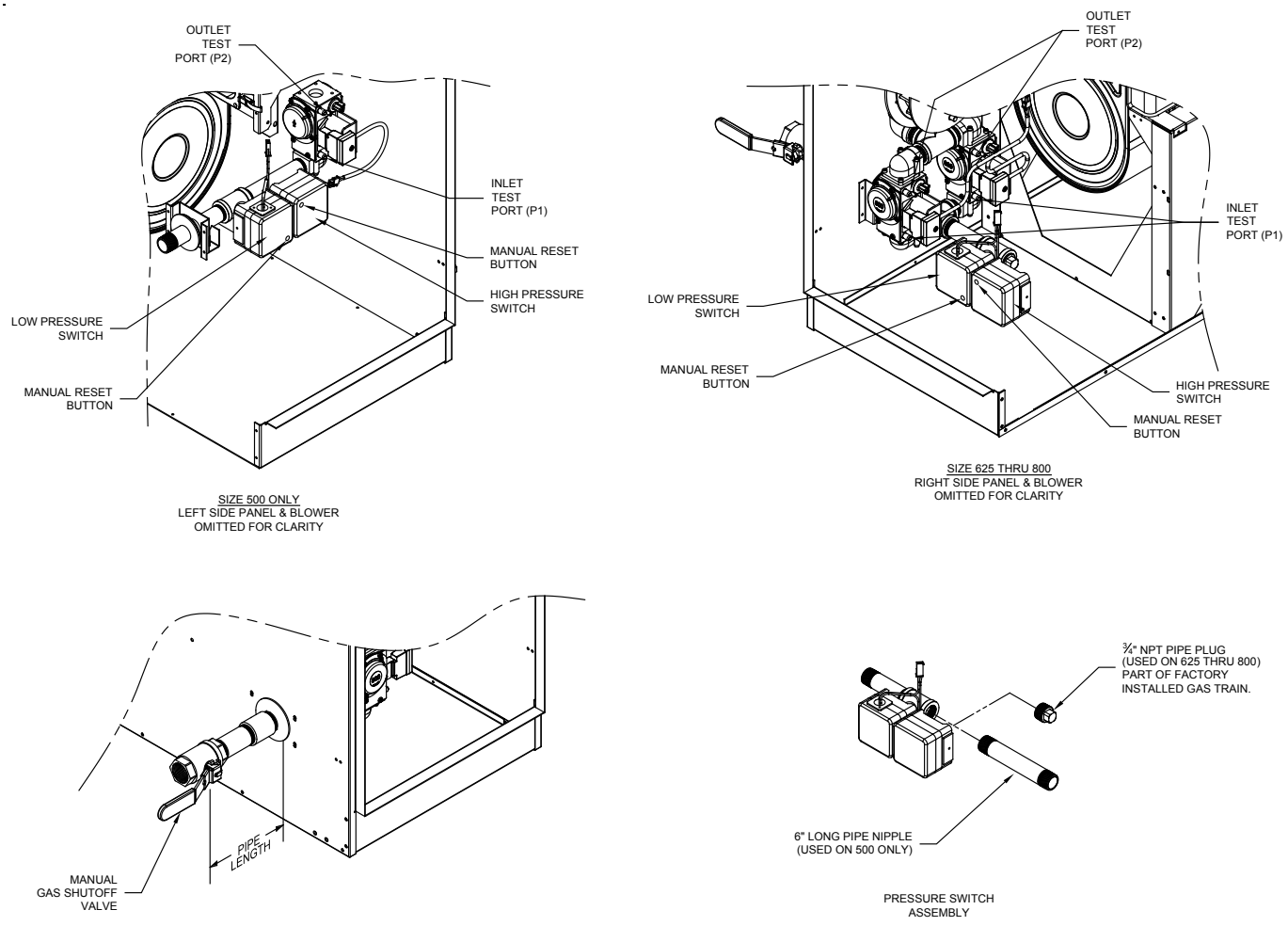


Figure 42: Gas Inlet Pressure Tap and Pressure Switch Location

VIII. Electrical

DANGER

Positively assure all electrical connections are unpowered before attempting installation or service of electrical components or connections of the boiler or building. Lock out all electrical boxes with padlock once power is turned off.

WARNING

Failure to properly wire electrical connections to the boiler may result in serious physical harm.

Electrical power may be from more than one source. Make sure all power is off before attempting any electrical work.

Each boiler must be protected with a properly sized over-current device.

Never jump out or make inoperative any safety or operating controls.

The wiring diagrams contained in this manual are for reference purposes only. Each boiler is shipped with a wiring diagram attached to the front door. Refer to this diagram and the wiring diagram of any controls used with the boiler. Read, understand and follow all wiring instructions supplied with the controls.

NOTICE

This boiler is equipped with a high water temperature limit located inside the internal wiring of the boiler. This limit provides boiler shutdown in the event the boiler water temperature exceeds the set point of the limit control. Certain Local Codes require an additional water temperature limit. In addition, certain types of systems may operate at temperatures below the minimum set point of the limit contained in the boiler.

If this occurs, install an additional water temperature limit (Honeywell L4006 Aquastat). Wire as indicated in the Electrical Section of this manual.

NOTICE

All wire, wire nuts, controls etc. are installer supplied unless otherwise noted.

A. **General.** Install wiring and electrically ground boiler in accordance with authority having jurisdiction or, in the absence of such requirements, follow the *National Electrical Code*, NFPA 70, and/or CSA C22.1 Electrical Code.

B. **A separate electrical circuit must be** run from the main electrical service with an over-current device/disconnect in the circuit. A service switch is recommended and may be required by some local jurisdictions. Install the service switch in the line voltage "Hot" leg of the power supply. Locate the service switch such that the boiler can be shut-off without exposing personnel to danger in the event of an emergency. Connect the main power supply and ground to the three (3) boiler wires (black, white and green) located in the junction box at the inside top of the boiler jacket.

C. **Refer to** Figures 43 and 44 or details on the internal boiler wiring.

Line Voltage (120 VAC) Connections - see Figure 44.

1. The line voltage connections are located in the junction box on the left side of the vestibule. The terminal block TB-1 in conjunction with terminal screw identification label is attached to the junction box combination cover/inside high voltage bracket.
2. The conductor insulation colors are:
   a. Black – L1 line voltage "Hot"
   b. White – L2 line voltage "Neutral" for boiler and circulators
   c. Red – Line voltage "Hot" for "Heating" circulator, "System" circulator and "DHW" circulator
   d. Green – Ground connection

Low Voltage (24 VAC) Connections - see Figure 44.

3. The terminal block TB-2 in conjunction with terminal screw identification label is attached to the junction box front and located inside Sage2.1 Control compartment on the left side.
4. The connections are (listed identification label top to bottom):
   - 1 – "Heating Thermostat"
   - 2 – "Heating Thermostat"
   - 3 – "DHW Temperature Switch"
   - 4 – "DHW Temperature Switch"
   - 5 – "Outdoor Sensor"
   - 6 – "Outdoor Sensor"
   - 7 – "Header Sensor"
   - 8 – "Header Sensor"
   - 9 – "Remote Firing Rate -"
   - 10 – "Remote Firing Rate +"
   - 11 – "External Limit"
   - 12 – "External Limit"
5. If the outdoor sensor is connected to terminals 5 and 6 "Outdoor Sensor", the boiler will adjust the target space heating set point supply water temperature downwards as the outdoor air temperature increases. If used, this sensor should be located on the outside of the structure in an area where it will sense the average air temperature around the house. Avoid placing this sensor in areas where it may be covered with ice or snow. Locations where the sensor will pick up direct radiation from the sun should also be avoided. Avoid placing the sensor near potential sources of electrical noise such as transformers, power lines, and fluorescent lighting. Wire the sensor to the boiler using 22 gauge or larger wire. As with the sensor, the sensor wiring should be routed away from sources of electrical noise. Where it is impossible to avoid such noise sources, wire the sensor using a 2 conductor, UL Type CM, AWM Style 2092, 300Volt 60°C shielded cable. Connect one end of the shielding on this cable to ground.

WARNING

When making low voltage connections, make sure that no external power source is present in the thermostat or limit circuits. If such a power source is present, it could destroy the boiler's Microprocessor Control (Sage2.1). One example of an external power source that could be inadvertently connected to the low voltage connections is a transformer in old thermostat wiring.

D. Power Requirements

Nominal boilers current draw is provided in Table 23. These values are for planning purposes only and represent only the boiler's power consumption. To obtain total system power consumption add any selected circulator and component current draws.

Table 23: Boiler Current Draw

Model Number	Nominal Current (amps)
APX399	<7
APX500	<6
APX800	<8

E. Multiple Boiler Wiring

Install over-current protection in accordance with authority having jurisdiction or, in the absence of such requirements, follow the National Electric Code, NFPA 70, and/or CSA C22.1 Electrical Code. Do not provide over-current protection greater than 15 amperes. If it becomes necessary to provide greater amperes (because of the number of boilers provided) use separate circuits and over-current protection for additional boilers.

F. External Multiple Boiler Control System

As an alternate to the Sage2.1 Control internal sequencer, the Sage2.1 Control also accepts an input from an external sequencer. Follow multiple boiler control system manufacturer (Honeywell, Tekmar, etc.) instructions to properly apply amultiple boiler control system. The Tekmar Model 264 and Model 265 based control wiring diagrams (Figures 44A and 44B) are provided as examples of typical multiple boiler control systems.

VIII. Electrical (continued)

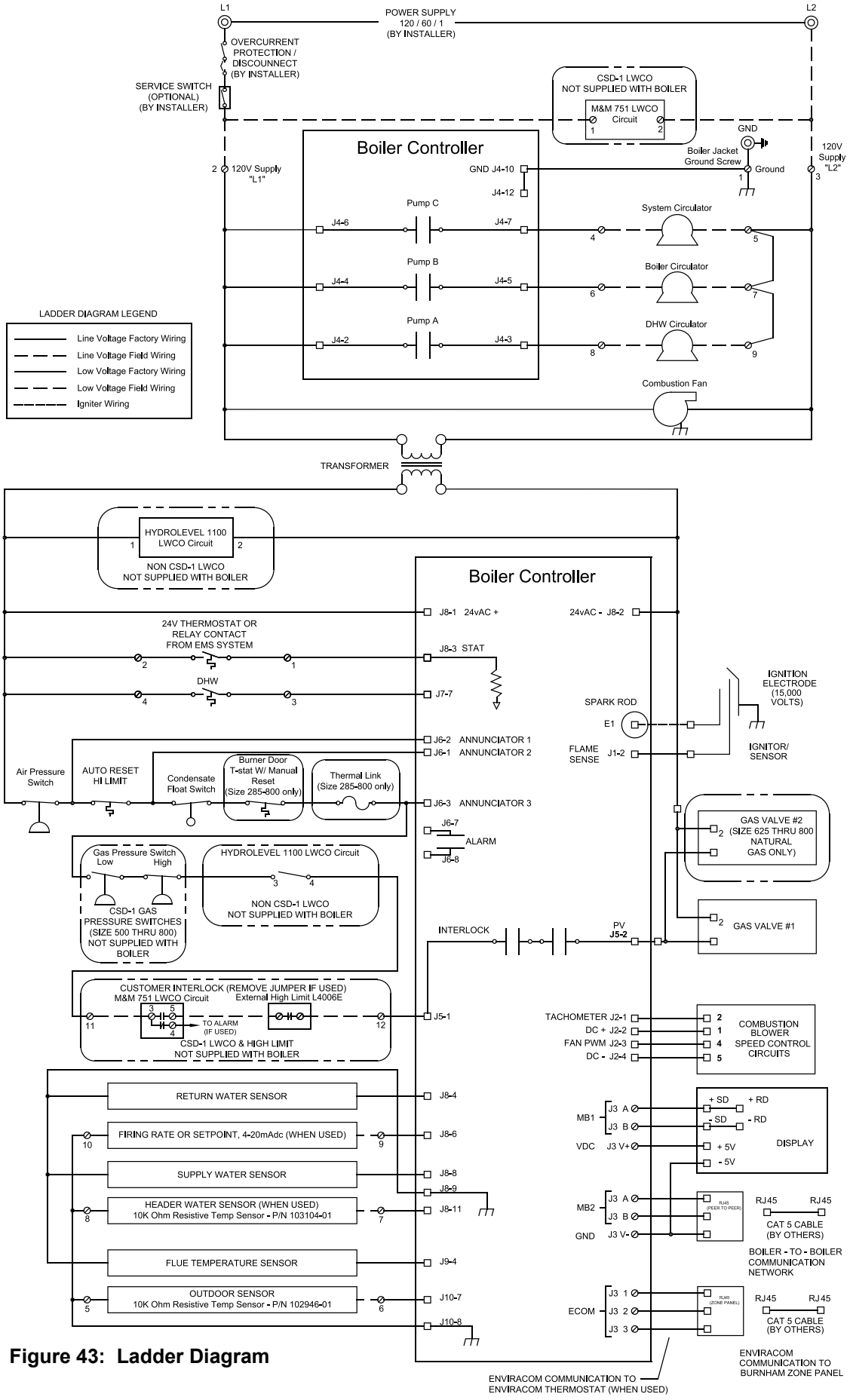
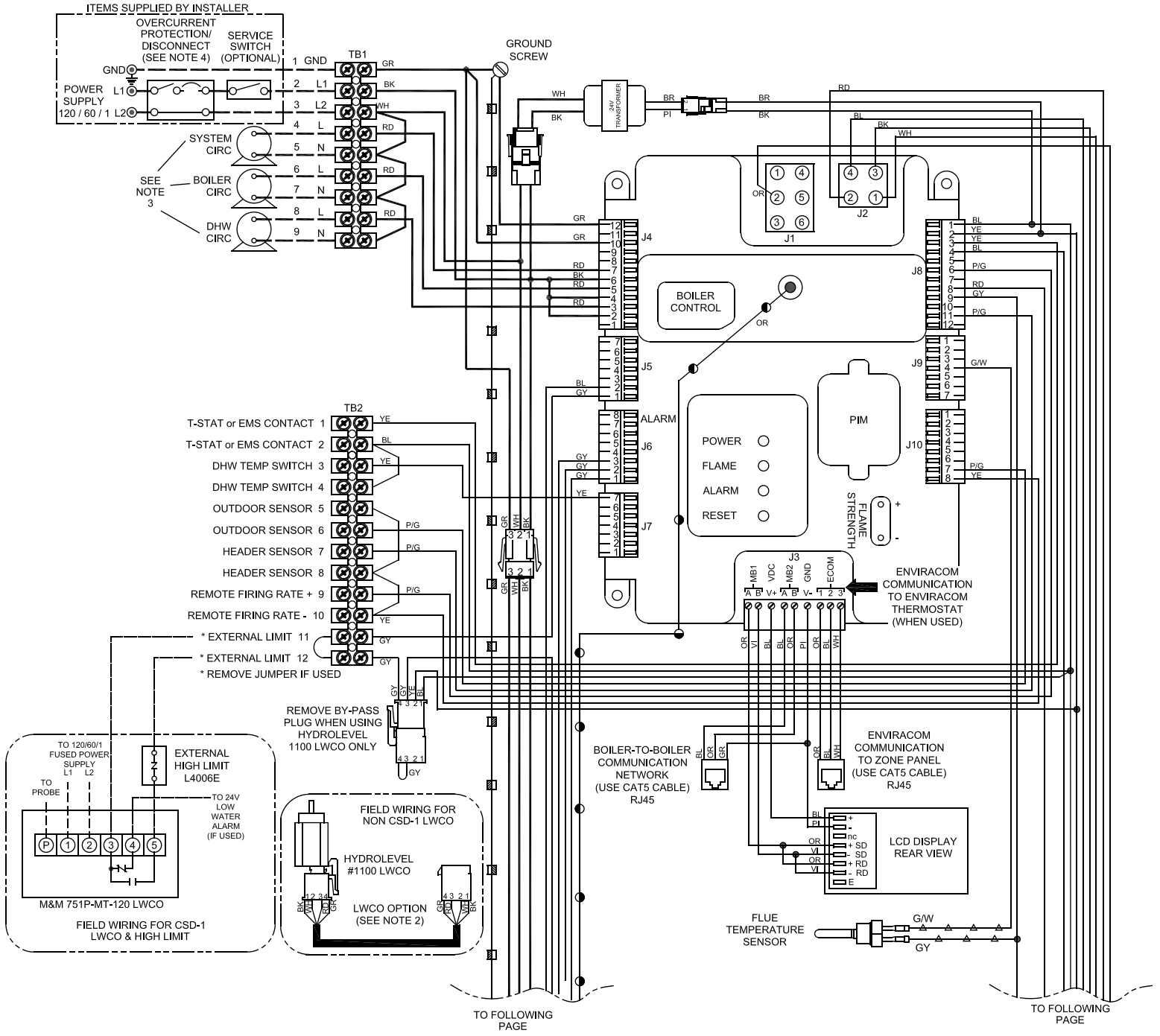
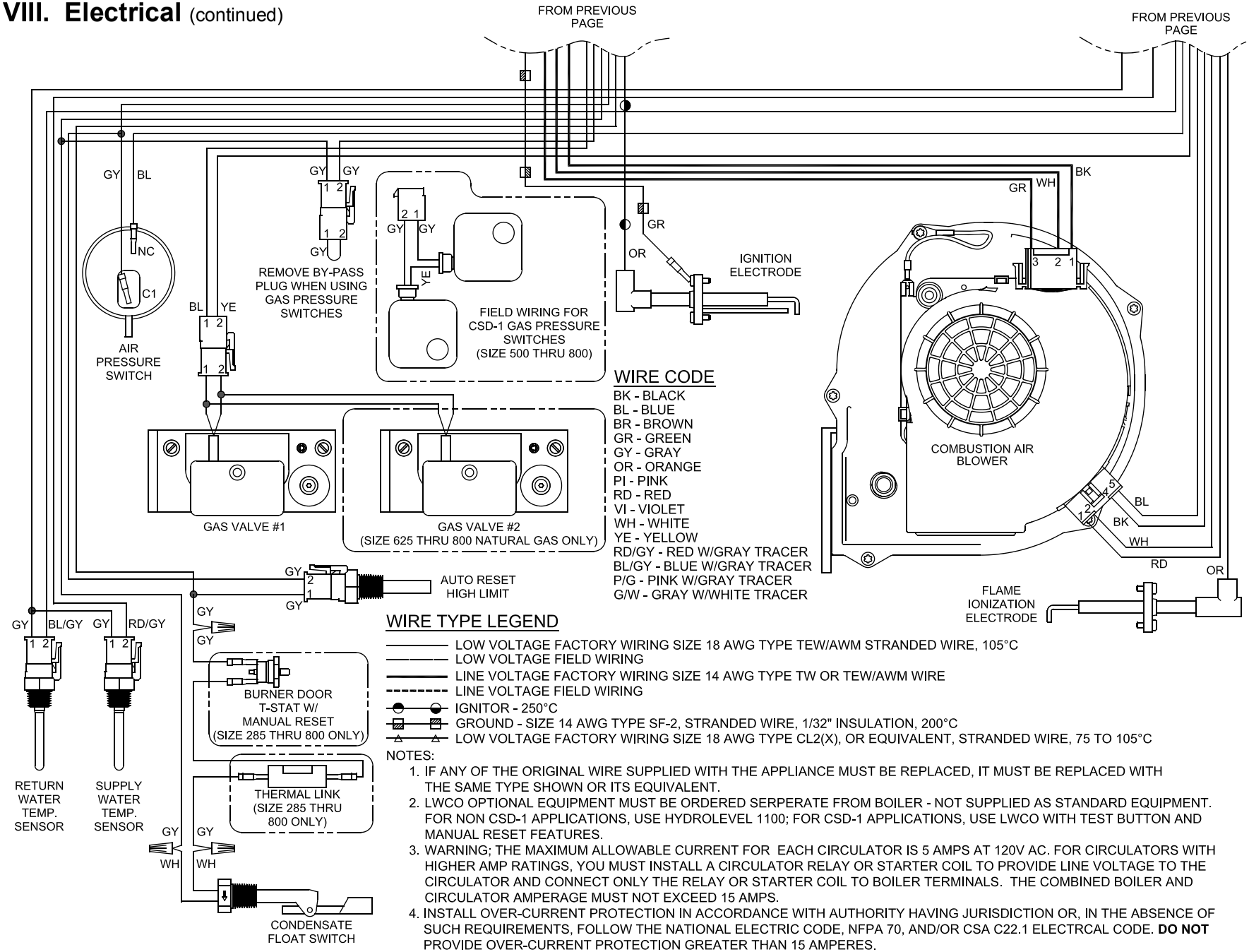


Figure 43: Ladder Diagram

VIII. Electrical (continued)





WIRE CODE

BK - BLACK
BL - BLUE
BR - BROWN
GR - GREEN
GY - GRAY
OR - ORANGE
PI - PINK
RD - RED
VI - VIOLET
WH - WHITE
YE - YELLOW
RD/GY - RED W/GRAY TRACER
BL/GY - BLUE W/GRAY TRACER
P/G - PINK W/GRAY TRACER
G/W - GRAY W/WHITE TRACER

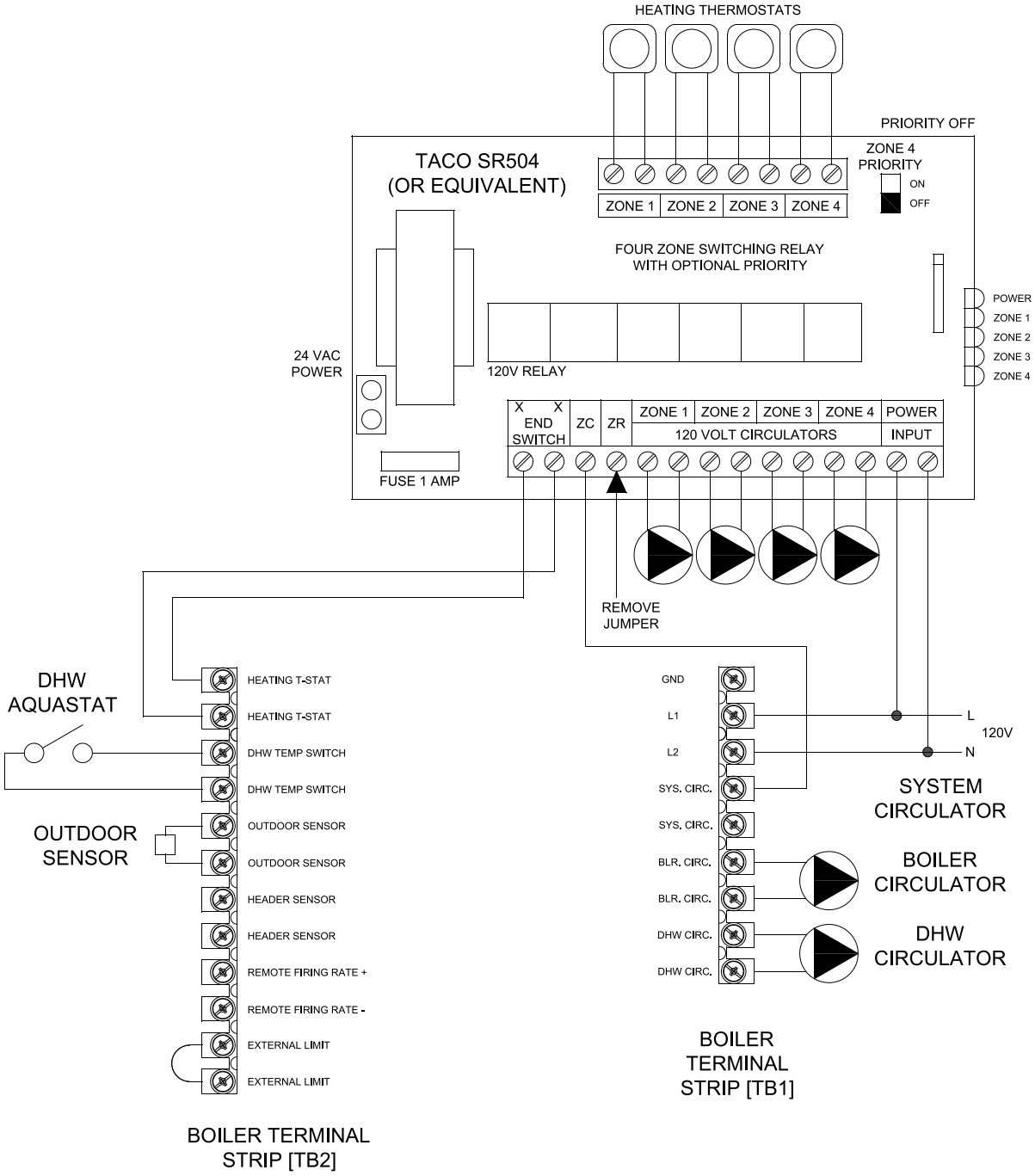
WIRE TYPE LEGEND

- LOW VOLTAGE FACTORY WIRING SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE, 105°C
- LOW VOLTAGE FIELD WIRING
- LINE VOLTAGE FACTORY WIRING SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
- LINE VOLTAGE FIELD WIRING
- IGNITOR - 250°C
- GROUND - SIZE 14 AWG TYPE SF-2, STRANDED WIRE, 1/32" INSULATION, 200°C
- LOW VOLTAGE FACTORY WIRING SIZE 18 AWG TYPE CL2(X), OR EQUIVALENT, STRANDED WIRE, 75 TO 105°C

NOTES:

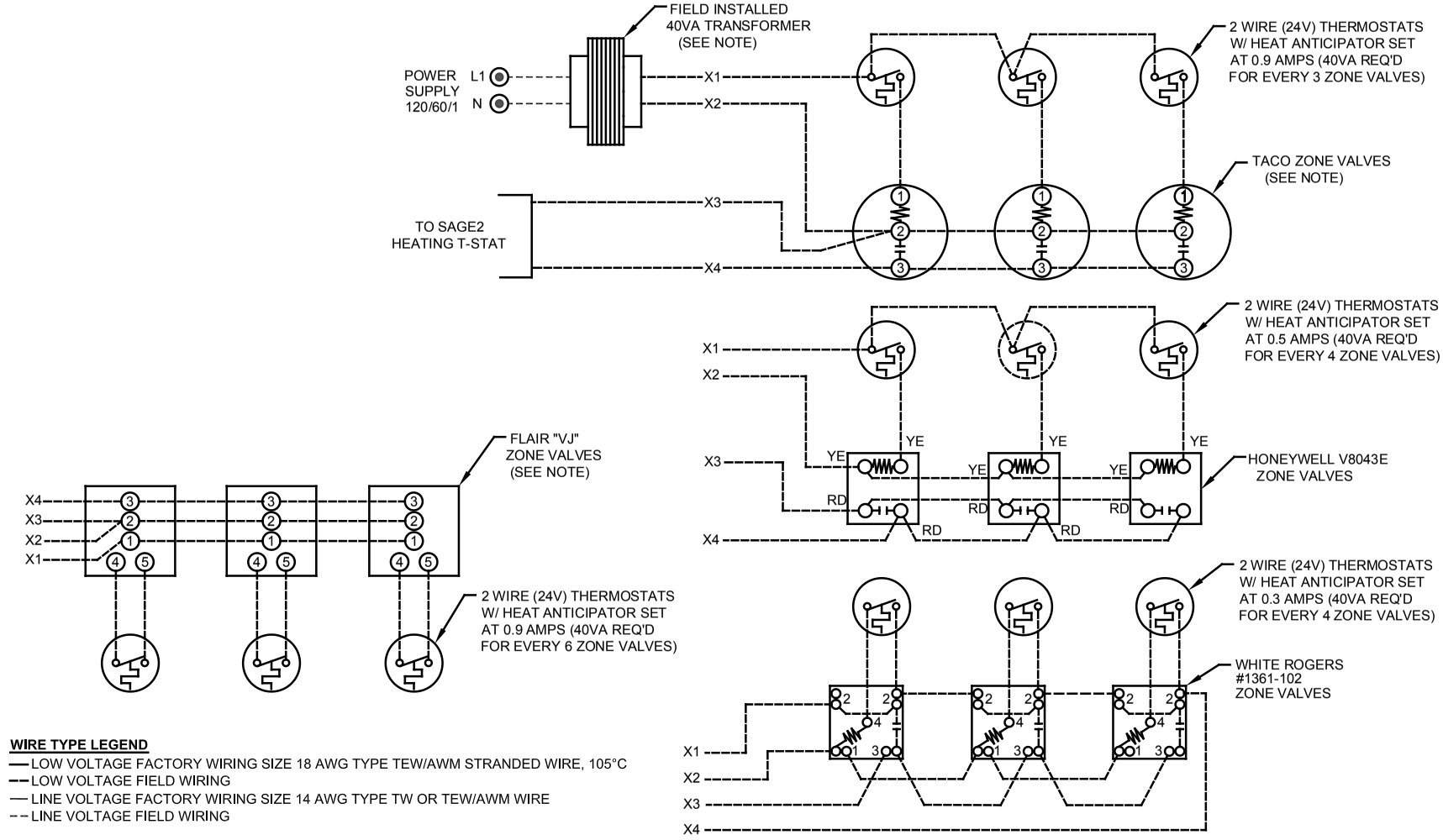
1. IF ANY OF THE ORIGINAL WIRE SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH THE SAME TYPE SHOWN OR ITS EQUIVALENT.
2. LWCO OPTIONAL EQUIPMENT MUST BE ORDERED SERPERATE FROM BOILER - NOT SUPPLIED AS STANDARD EQUIPMENT. FOR NON CSD-1 APPLICATIONS, USE HYDROLEVEL 1100; FOR CSD-1 APPLICATIONS, USE LWCO WITH TEST BUTTON AND MANUAL RESET FEATURES.
3. WARNING; THE MAXIMUM ALLOWABLE CURRENT FOR EACH CIRCULATOR IS 5 AMPS AT 120V AC. FOR CIRCULATORS WITH HIGHER AMP RATINGS, YOU MUST INSTALL A CIRCULATOR RELAY OR STARTER COIL TO PROVIDE LINE VOLTAGE TO THE CIRCULATOR AND CONNECT ONLY THE RELAY OR STARTER COIL TO BOILER TERMINALS. THE COMBINED BOILER AND CIRCULATOR AMPERAGE MUST NOT EXCEED 15 AMPS.
4. INSTALL OVER-CURRENT PROTECTION IN ACCORDANCE WITH AUTHORITY HAVING JURISDICTION OR, IN THE ABSENCE OF SUCH REQUIREMENTS, FOLLOW THE NATIONAL ELECTRIC CODE, NFPA 70, AND/OR CSA C22.1 ELECTRCAL CODE. **DO NOT** PROVIDE OVER-CURRENT PROTECTION GREATER THAN 15 AMPERES.

Figure 44: Wiring Connections Diagram



***USE SAME POWER SOURCE FOR ALL CONTROLS AND
ENSURE POLARITY TO ALL CONTROL DEVICES IS CORRECT

Figure 45A: Modified Wiring For DHW Priority When Using Low Flow Circulator Piped Off System Header - Heating (with Central Heating Circulators) Plus Alternately Piped Indirect Water Heater



WIRE TYPE LEGEND

— LOW VOLTAGE FACTORY WIRING SIZE 18 AWG TYPE TEW/AWM STRANDED WIRE, 105°C
– – LOW VOLTAGE FIELD WIRING
— LINE VOLTAGE FACTORY WIRING SIZE 14 AWG TYPE TW OR TEW/AWM WIRE
– – LINE VOLTAGE FIELD WIRING

NOTE:

CHECK FOR CROSS-PHASING BETWEEN BOILER TRANSFORMER AND FIELD SUPPLIED TRANSFORMER ON TACO AND FLAIR ZONE VALVE CIRCUITS. IF CROSS-PHASING OCCURS, CORRECT BY SWITCHING X1 AND X2 OR X3 AND X4. ALSO, BOILER SECONDARY SIDE (24V) IS GROUNDED ON EI AND CANADIAN MODELS AND THE ZONE CIRCUIT MAY NOT OPERATE IF A SEPARATE GROUND IS MADE IN THE ZONE CIRCUIT.

Figure 45B: Modified Wiring For DHW Priority When Using Low Flow Circulator Piped Off System Header - Heating (with Central Heating Zone Valves) Plus Alternately Piped Indirect Water Heater

VIII. Electrical (continued)

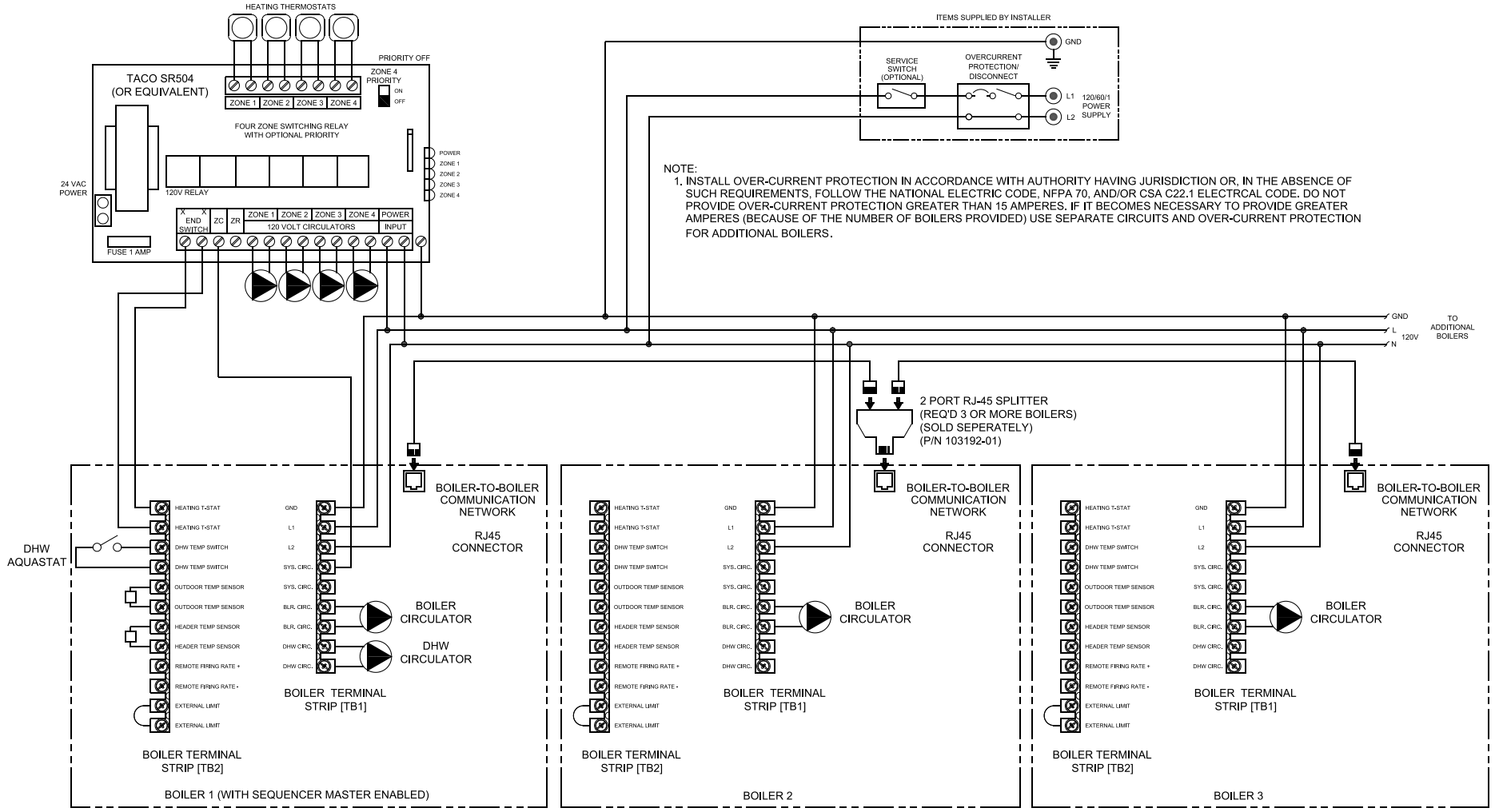


Figure 46: Multiple Boiler Wiring Diagram
Internal Sage2.1 Multiple Boiler Control Sequencer
(Three Boilers Shown, Typical Connections for up to Eight Boilers)

VIII. Electrical (continued)

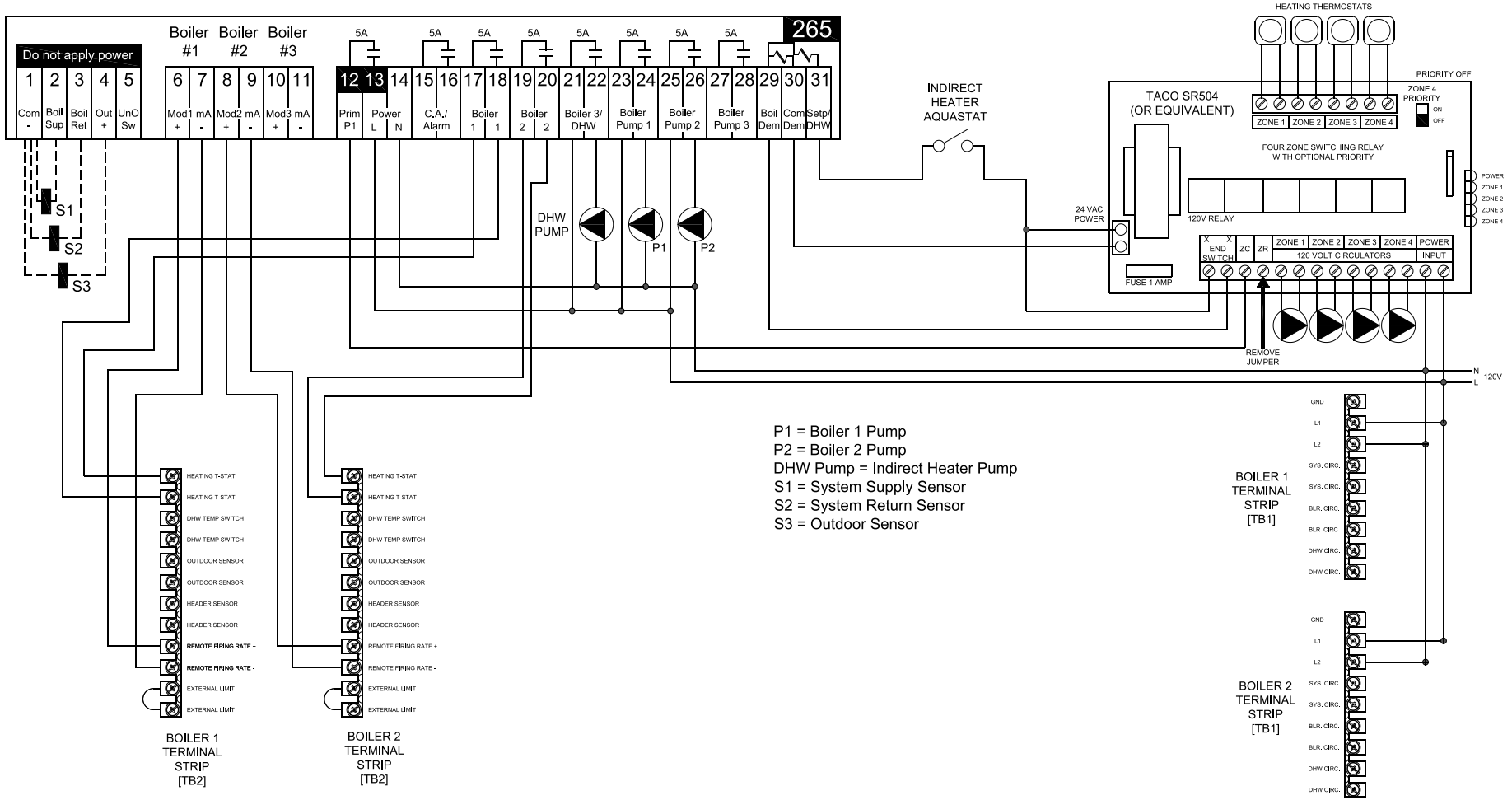
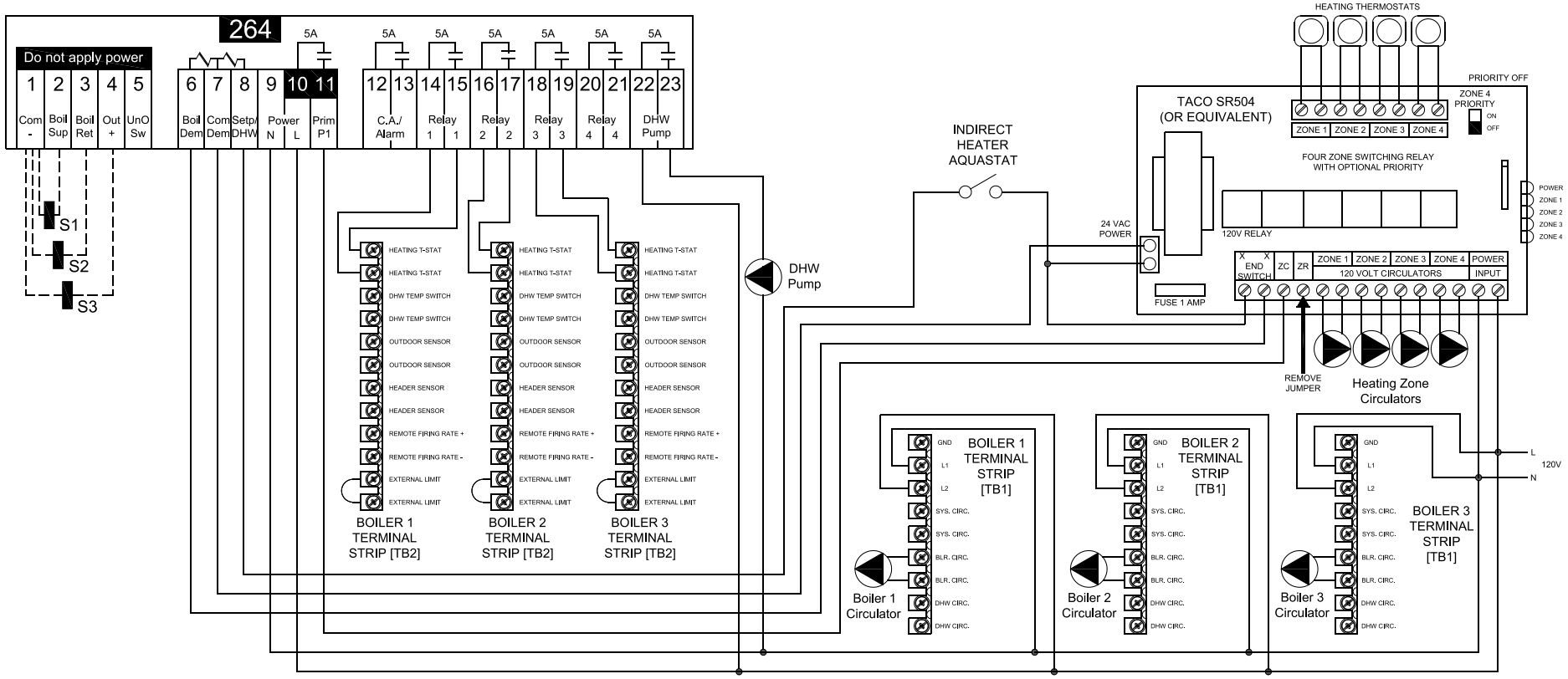


Figure 47A: Multiple Boiler Wiring Diagram w/Tekmar 265 Control

Tekmar 265 Based Control System (or equal) Sequence of Operation

The Tekmar 265 Control (or equal) can control up to three (3) boilers and an Indirect Water Heater. When a call for heat is received by the Tekmar 265 Control, the control will fire either one or more boilers in either parallel or sequential firing mode to establish a required reset water temperature in the system supply main based on outdoor temperature. The boilers will modulate based on an Analog communication signal established between the Tekmar 265 Control and each boiler's Sage2.1™ Control. The boiler(s) and system supply water temperature will be reset together to maintain the input that is needed to the system. When a call for Indirect Hot Water is generated to the Tekmar 265, the control will de-energize the zone pump control (ZC terminal), energize the Indirect pump and modulate the boiler firing to establish a setpoint temperature in the main for the Indirect Heater using Priority. The Tekmar 265 also controls each boiler's pump and a post purge of leftover temperature in the boilers will occur at the end of the call for Indirect Hot Water.

VIII. Electrical (continued)



DHW Pump = Indirect Heater Pump
S1 = System Supply Sensor
S2 = System Return Sensor
S3 = Outdoor Sensor

Figure 47B: Multiple Boiler Wiring Diagram w/Tekmar 264 Control

Tekmar 264 Based Control System (or equal) Sequence of Operation

The Tekmar 264 Control (or equal) can control up to four (4) boilers and an Indirect Water Heater by utilizing stage firing. When a call for heat is received by the Tekmar 264 Control, the control will fire either one or more boilers in sequential firing mode to establish a required reset water temperature in the system supply main based on outdoor temperature. The boilers will modulate on their own based on each boiler's Sage2.1™ Control and will target a setpoint temperature to supply enough input to the system main to satisfy the desired reset water temperature in the main established by the Tekmar 264 Control. When a call for Indirect Hot Water is generated to the Tekmar 264, the control will de-energize the zone pump control (ZC terminal), energize the Indirect pump and sequentially fire the boilers to establish a setpoint temperature in the main for the Indirect Heater using Priority. The Tekmar 264 Control will disable the stage firing and post purge the Indirect Pump to reduce the temperature in the Supply Main near the end of the Indirect Mode to a point where it will need to be when it changes back to Space Heating Mode. The Tekmar 264 Control also has the ability to rotate the lead-lag firing of the boilers to establish equal operating time for each boiler stage.

G. Multiple Boiler Operating Information

1. Required Equipment and Setup
   a. Header Sensor (P/N 101935-01 or 103104-01)

      A header sensor must be installed and wired to the Master Sequencer "enabled" Sage2.1 Controller. The header sensor is installed on the common system piping and provides blended temperature information to the Sequence Master. Refer to piping diagram Figures 39A and 40A for installation location and Figure 48 or 49 for installation detail.

   b. RJ45 Splitters (P/N 103192-01)

      RJ45 Splitters are required for installing communications between three or more boilers. When two boilers are connected the splitter is not required.

   c. Ethernet Cables

      Ethernet cables are used to connect the boiler network together. These are standard "straight through" cables that can be purchased at electrical distributors.

      Alternately, the network can be wired together by simply wiring terminal J3, Modbus 2, terminals A, B and V- between each boiler. Refer to Figures 43 and 44 terminal J3 for wiring location.

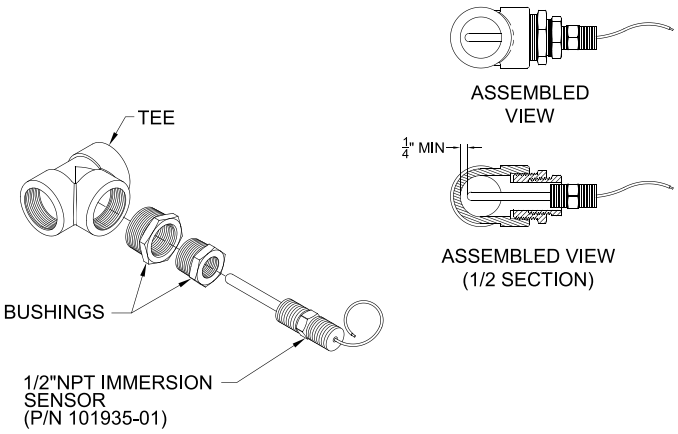


Figure 48: Recommended Direct Immersion Header Sensor Installation Detail

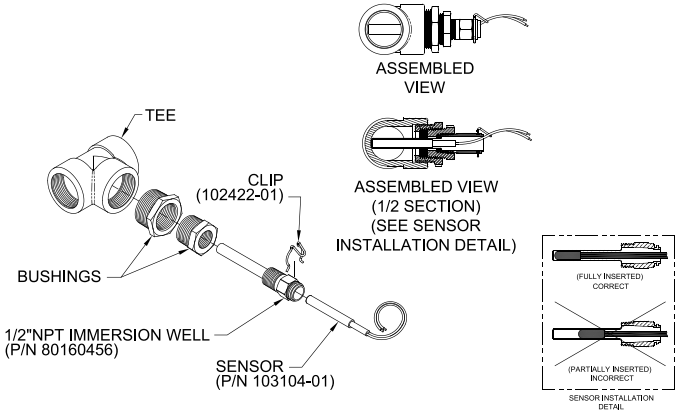


Figure 49: Alternate "Immersion" type Header Sensor Installation Detail

VIII. Electrical (continued)

G. Multiple Boiler Operating Information (continued)

1. Required Equipment and Setup (continued)

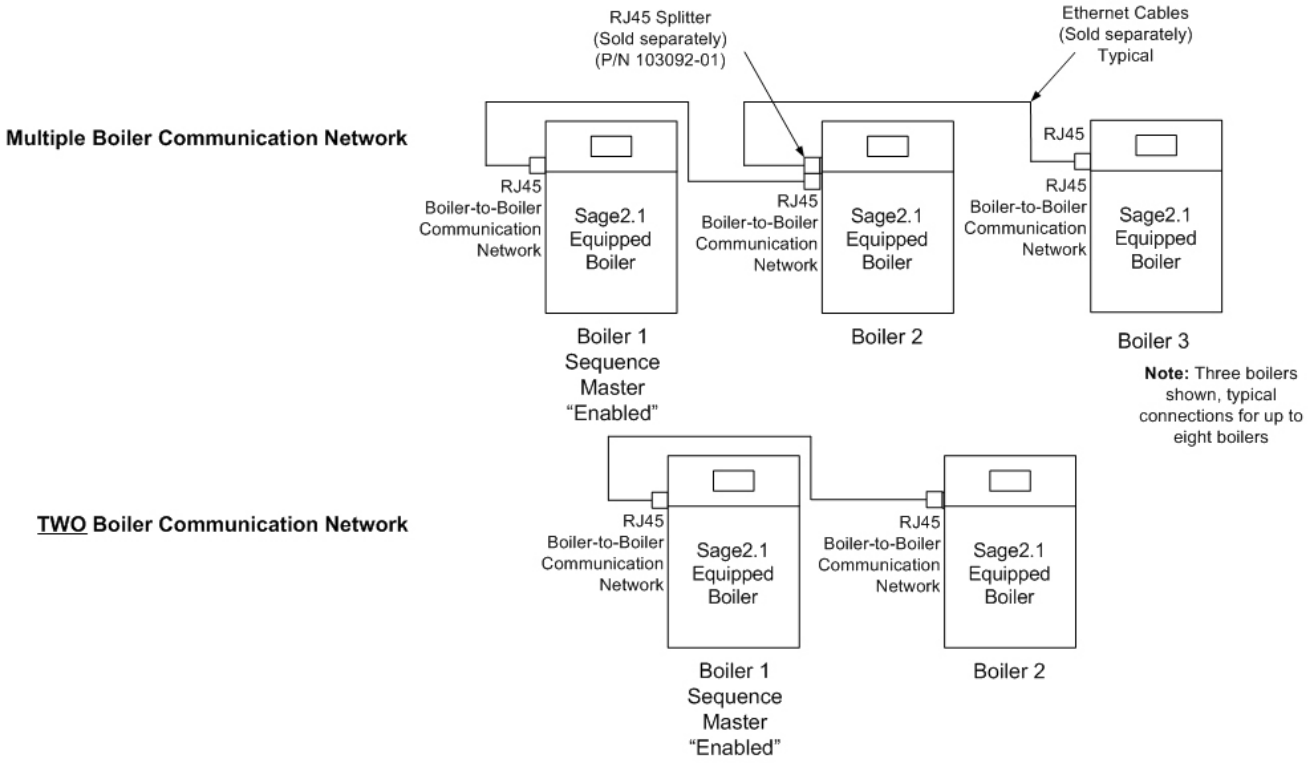


Figure 50: RJ45 Splitter Installation Detail

d. Multiple Boiler Setup

Step	Description	Comments
1	Install and wire the Header Sensor	Wire the header sensor to low voltage terminal strip terminals "Header sensor". **NOTE** This step can not be skipped. The Sequence Master can not be "enabled" unless a Header Sensor is installed.
2	Install Ethernet Cables between boilers	Standard Ethernet type cables with RJ45 connectors are "plugged in" to the Boiler-to-Boiler Communication Network connection located on the side of the boiler. When more than two boilers are connected an RJ45 splitter may be used to connect the boilers. Refer to Figure 50.
3	Apply Power to All Boilers	
4	Set Unique Boiler Addresses	Assign all boilers a unique Boiler Address using any number from 1 through 8. **WARNING** When two boiler's addresses are the same undesirable simultaneous operation occurs.
5	Enable 1 Boiler Master	Enable only one Sage2.1 Control's Sequencer Master. **WARNING** When more than one Sequencer Master is enable erratic behavior will result.
6	Power Down All Boilers	
7	Power Up Master Sequencer "Enabled" Boiler First	
8	Power Up Other Boilers	
9	Confirm Communication	From the Home Screen of the Sage2.1 Control with the Master Sequencer "enabled", select the Status button. The Sequencer display shows the boiler address of the communicating boilers. Additionally, from the "Home" screen select the "Detail" button and then the "Networked Boilers" buttons to view boiler communication status. If a boiler is not shown, check Ethernet cable connections and confirm all boilers have unique addresses.

IX. System Start-up

A. **Verify** that the venting, water piping, gas piping and electrical system are installed properly. Refer to installation instructions contained in this manual.

B. **Confirm** all electrical, water and gas supplies are turned off at the source and that vent is clear of obstructions.

C. **Confirm** that all manual shut-off gas valves between the boiler and gas source are closed.

WARNING

Completely read, understand and follow all instructions in this manual before attempting start up.

D. **If not already done**, flush the system to remove sediment, flux and traces of boiler additives. **This must be done with the boiler isolated from the system.** Fill entire heating system with water meeting the following requirements:

NOTICE

pH between 7.5 and 9.5.

Chlorides< 50 ppm

If system contains aluminum components, pH must be less than 8.5

Total Dissolved Solids - less than 2500 PPM

Hardness - 3 to 9 grains/gallon.

Pressurize the system to at least 12 PSI. Purge air from the system.

WARNING

The maximum operating pressure of this boiler is 30 psig, 50 psig, 80 psig or 100 psig depending on the model and relief valve option selected. Never exceed these pressures. Do not plug or change pressure relief valve.

E. **Confirm that the boiler and system have no water leaks.**

F. **Prepare to check operation.**

1. Obtain gas heating value (in Btu per cubic foot) from gas supplier.
2. Apex gas valves have inlet and outlet pressure taps with built-in shut off screw. Turn each screw from fully closed position three to four turns counterclockwise to open taps. Connect manometers to pressure taps on gas valve.

NOTICE

If it is required to perform a long term pressure test of the hydronic system, the boiler should first be isolated to avoid a pressure loss due to the escape of air trapped in the boiler.

To perform a long term pressure test including the boiler, ALL trapped air must first be removed from the boiler.

A loss of pressure during such a test, with no visible water leakage, is an indication that the boiler contained trapped air.

3. Temporarily turn off all other gas-fired appliances.
4. Turn on gas supply to the boiler gas piping.
5. Open the field installed manual gas shut-off valve located upstream of the gas valve on the boiler.
6. Confirm that the supply pressure to the gas valve is 14 in. w.c. or less. Refer to Table 22 for minimum supply pressure.
7. Using soap solution, or similar non-combustible solution, electronic leak detector or other approved method. Check that boiler gas piping valves, and all other components are leak free. Eliminate any leaks.

DANGER

Do not use matches, candles, open flames or other ignition source to check for leaks.

8. Purge gas line of air.

G. **Operating Instructions**

Start the boiler using the lighting instructions, see Figure 51. After the boiler is powered up, it should go through the following sequence. Refer to Section X, “Operation” to locate and view sequence status.

Apex™ Series Lighting and Operating Instructions

FOR YOUR SAFETY READ BEFORE OPERATING/POUR VOTRE SECURITE LISÉZ AVÁNT DE METTRE EN MARCHE

WARNING: If you do not follow these instructions exactly, a fire or explosion may result causing property damage, personal injury or loss of life.

AVERTISSEMENT: Quiconque ne respecte pas à la lettre les instructions dans la présente notice risque de déclencher un incendie ou une explosion entraînant des dommages, des blessures ou la mort.

A. This appliance does not have a pilot. It is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.

B. BEFORE OPERATING smell all around the appliance area for gas. Be sure to smell next to the floor because some gas is heavier than air and will settle on the floor.

WHAT TO DO IF YOU SMELL GAS:

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

C. Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not turn by hand, don't try to repair it, call a qualified service technician. Force or attempted repair may result in a fire or explosion.

D. Do not use this appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance and to replace any part of the control system and any gas control which has been under water.

A. Cet appareil ne comporte pas de veilleuse. Il est muni d'un dispositif d'allumage qui allume automatiquement le brûleur. Ne tentez pas d'allumer le brûleur manuellement.

B. AVANT DE FAIRE FONCTIONNER, reniflez tout autour de l'appareil pour déceler une odeur de gaz. Reniflez près du plancher, car certains gaz sont plus lourds que l'air et peuvent s'accumuler au niveau du sol.

QUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAZ:

- **Ne pas tenter d'allumer d'appareil.**
- **Ne touchez à aucun interrupteur ; ne pas vous servir des téléphones se trouvant dans le bâtiment.**
- **Appelez immédiatement votre fournisseur de gaz depuis voisin. Suivez les instructions du fournisseur.**
- **Si vous ne pouvez rejoindre le fournisseur, appelez le service des incendies.**

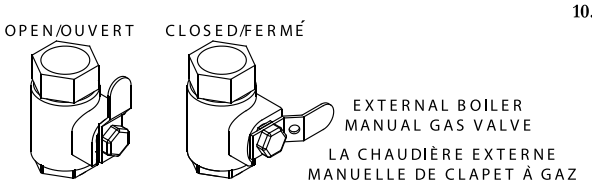
C. Ne poussez ou tournez la manette d'admission du gaz qu'à la main ; ne jamais utiliser d'outil. Si la manette reste coincee, ne pas tenter de la réparer ; appelez un technicien qualifié. Le fait de forcer la manette ou de la réparer peut déclencher une explosion ou un incendie.

D. N'utilisez pas cet appareil s'il a été plongé dans l'eau, même partiellement. Faites inspecter l'appareil par un technicien qualifié et remplacez toute partie du système de contrôle et toute commande qui ont été plongés dans l'eau.

OPERATING INSTRUCTIONS/INSTRUCTIONS DE FONCTIONNEMENT

1. STOP! Read safety information above (to the left) on this label.
2. Set the thermostat to lowest setting.
3. Turn off all electric power to the appliance.
4. This appliance is equipped with an ignition device which automatically lights the burner. Do not try to light the burner by hand.
5. Turn the external boiler manual gas valve handle clockwise to close the gas supply.
6. Wait five (5) minutes to clear out any gas. Then smell for gas, including near the floor. If you smell gas, STOP! Follow "B" in the safety information above (to the left) on this label. If you don't smell gas, go to the next step.
7. Turn the external boiler manual gas valve handle counterclockwise to open the gas supply.
8. Turn on all electric power to the appliance.
9. Set the thermostat to the desired setting.
10. If the appliance will not operate, follow the instructions "To Turn Off Gas To Appliance" and call your service technician or gas supplier.

1. ARRÊTEZ ! Lisez les instructions de sécûrité sur la portion supérieure (a gauche) cette étiquette.
2. Réglez le thermostat à la température la plus basse.
3. Coupez l'alimentation électrique de l'appareil.
4. Cet appareil est équipé de l' dispositif d'allumage qui automobile allume matically brûleur. Ne pas essayer d'allumer le brûleur près main.
5. Tourner la chaudière externe manuelle poignée en clapet à gaz dans le sens des aiguilles d'une montre pour fermerl'offre de gaz.
6. Attendre cinq (5) minutes pour laisser échapper tout le gaz. Reniflez tout autour de l'appareil, y compris près du plancher, pour déceler une odeur de gaz, ARRÊTEZ ! Passez à l'étape B des instructions de sécûrité sur la portion supérieure (a gauche) cette étiquette. S'il n'y a pas d'odeur de gaz, passez à l'étape suivante.
7. Tourner la chaudière externe manuelle compteur de poignée en clapet à gaz ouvrir dans le sens des aiguilles d'une montre le gaz approvisionnement.
8. Allumer toute l'énergie électrique au appareil.
9. Réglez le thermostat à la température désirée.
10. Si l'appareil ne se met pas en marche, suivez les instructions intitulées « Comment couperl'admission de gaz de l'appareil » et appelez un technicien qualifié ou le fournisseur de gaz.



TO TURN OFF GAS TO APPLIANCE/COMMENT COUPER L'ADMISSION DE GAZ DE L'APPAREIL

1. Set the thermostat to lowest setting.
2. Turn off all electirc power to the appliance if service is to be performed.
3. Turn the external boiler manual gas valve handle clockwise to close gas supply.

1. Réglez le thermostat à la température la plus basse.
2. Coupez l'alimentation électrique de l'appareil s'il faut procéder à l'entretien.
3. Tourner la chaudière externe manuelle poignée en clapet à gaz dans le sens des aiguilles d'une montre pour fermerl'offre de gaz.

Figure 51: Lighting Instructions

Status	Control Action
Initiate	Power-up
Standby Delay	This state is entered when a delay is needed before allowing the burner control to be available and for sensor errors.
Standby	Boiler is not firing. There is no call for heat or there is a call for heat and the temperature is greater than setpoint.
Safe Startup	Tests flame circuit then checks for flame signal.
Drive Purge	Driving blower to purge rate setting and waiting for the proper fan feedback.
Prepurge	Purges the combustion chamber for the 10 second purge time.
Drive Light-off	Driving blower to light-off rate setting and waiting for the proper fan feedback.
Pre-ignition Test	Tests the safety relay and verifies that downstream contacts are off.
Pre-ignition	Energizes the igniter and checks for flame.
Direct Ignition	Opens main fuel valve and attempts to ignite the main fuel directly from the ignition source.
Running	Normal boiler operation. Modulation rate depends on temperature and setpoint selections and modulating control action.
Postpurge	Purges the combustion chamber for the 30 second purge time.
Lockout	Prevents system from running due to a detected problem and records fault in Lockout History.

H. Purge Air From Gas Train

Upon initial start-up, the gas train will be filled with air. Even if the gas line has been completely purged of air, it may take several tries for ignition before a flame is established. If more than 5 tries for ignition are needed, it will be necessary to press the reset button to restart the boiler. Once a flame has been established for the first time, subsequent calls for burner operation should result in a flame on the first try.

I. Check Burner Flame

Inspect the flame visible through the window. On high fire the flame should be stable and mostly blue (Figure 52). No yellow tipping should be present; however, intermittent flecks of yellow and orange in the flame are normal.

J. Check Gas Inlet Pressure

Check the inlet pressure and adjust if necessary. Verify that the inlet pressure is between the upper and lower limits shown on the rating plate with all gas appliances on and off.

WARNING

The outlet pressure for the gas valve has been factory set and requires no field adjustment. This setting is satisfactory for both natural gas and propane. Attempting to adjust the outlet pressure may result in damage to the gas valve and cause property damage, personal injury or loss of life.

K. **For LP Gas,** perform procedure as described in Paragraph R "Field Conversion From Natural Gas to LP Gas" before starting Paragraph L "Checking/Adjusting Gas Input Rate".

For natural gas, proceed to Paragraph L "Checking/ Adjusting Gas Input Rate".

L. Checking /Adjusting Gas Input Rate

1. Turn off gas supply to all appliances other than gas-fired boiler.
2. Light main burner by adjusting thermostat to highest setting.
3. Clock gas meter for at least two (2) revolutions of the dial typically labeled ½ or 1 cubic foot per revolution on a typical gas meter.
4. Determine gas flow rate in Cubic Feet per Hour based on elapsed time for two revolutions.

   Example:

   Using a meter with dial labeled 1 cubic foot per revolution, measured time is 72 Seconds for (2) Revolutions, i.e. 36 seconds per 1 cubic foot.

   Calculate hourly gas flow rate:

   3600 sec/hr ÷ 36 sec/cu ft = 100 cu ft/hr
5. Obtain gas-heating value (Btu per cubic foot) from gas supplier.
6. Multiply hourly gas flow rate by gas heating value to determine the boiler input rate, BTU/hr

   Example:

   Natural gas heating value provided by local gas utility is 1050 Btu per cubic foot.

   Measured and calculated hourly gas flow rate is 100 cu ft/hr.

   Measured boiler input rate is:

   100 cu ft/hr * 1050 BTU/ cu ft = 105, 000 BTU/hr
7. Compare measured input rate to input rate value stated on rating label. Strive to adjust the boiler input rate within 88% to 100% of the value listed on the boiler rating label.
8. If measured input is too high, reduce input rate by rotating gas valve throttle screw clockwise (see Figure 53) in ¼ turn increments and checking the rate after every adjustment until the measured input rate value falls within 88% to 100% of the

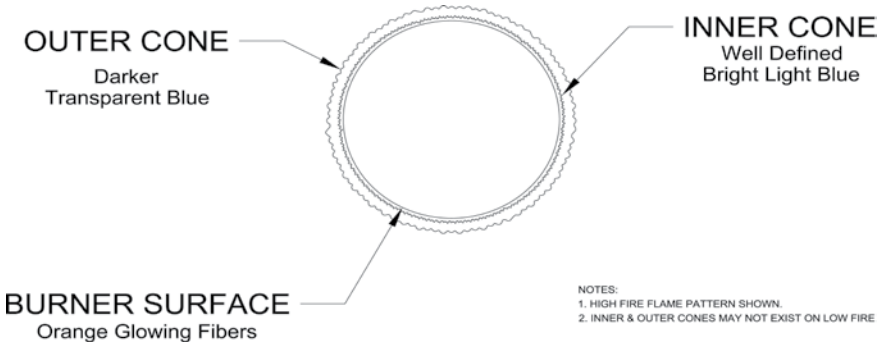


Figure 52: Burner Flame

value listed on the boiler rating label. If a boiler is equipped with two gas valves, throttle screw adjustments must be done to both gas valves equally and simultaneously.

9. If measured input is too low, increase input rate by rotating gas valve throttle screw counterclockwise (see Figure 53) in ¼ turn increments and checking the rate after every adjustment until the measured input rate value falls within 88% to 100% of the value listed on the boiler rating label. If a boiler is equipped with two gas valves, throttle screw adjustments must be done to both gas valves equally and simultaneously.
10. To lock the boiler in low fire, select "Low" from manual control screen. If measured % O_2 on LF, is out of spec (see Table 24 or 26), then turn offset screw clockwise (see Figure 53) to lower % O_2 or vice versa.

WARNING

Offset screw on each Apex Series boiler is adjusted at the factory to the specification. DO NOT touch the offset screw if measured 0_2 on Low Fire is in the spec (see Table 24 or 26).

11. Once the boiler input rate adjusted/confirmed, recheck main burner flame and perform combustion test as described below (see Paragraph L " Perform Combustion Test").
12. Upon completion, return other gas-fired appliances to previous condition of use.

M. Perform Combustion Test

Boilers are equipped with Flue Temperature Sensor installed into:

- Flue sensor port of boiler CPVC/PVC two-pipe vent system connector - See Figures 5 and 16.
- Flue sensor port of boiler concentric vent collar - see Figure 17.

Remove Flue Temperature Sensor and insert the analyzer probe through Flue Temperature Sensor silicon cap opening, or if required, remove also the Flue Temperature Sensor silicon cap and insert the analyzer probe directly into flue sensor port. Reinstall the sensor and the cap upon combustion testing completion.

Check CO_2 (or O_2) and CO at both high and low fire. The boiler may be locked into high of low fire as follows:

1. To lock the boiler in high fire enter the Manual control screen by first entering the Adjust screen. To access the Adjust screen, touch the Adjust button, then Login using the contractor password "076". Press Save and then select the adjust button. Enter the Manual Control button and select "High". Allow the boiler to operate for approximately 5 minutes before taking combustion readings.
2. To lock the boiler in low fire select "Low" from the Manual Control screen. Allow the boiler to operate for approximately 5 minutes before taking combustion readings.
3. Normal modulation of the boiler will only occur after the "Auto" button is selected in the Manual Control screen.

Typical CO_2 readings are shown in Table 24 (Natural Gas or Table 26 (LP Gas).

WARNING

Each Apex Series boiler is tested at the factory and adjustments to the air fuel mixture are normally not necessary. Improper gas valve or mixture adjustments could result in property damage, personal injury, or loss of life.

Table 24: Typical Combustion Settings, Natural Gas

Boiler Model	Altitude Range		
	0 - 7000 Ft.		
	% CO_2	% O_2 Range	CO, PPM
APX399	9.9 - 8.2 (High Fire) 9.3 - 7.9 (Low Fire)	3.5 - 6.5 (High Fire) 4.5 - 7.0 (Low Fire)	Less than 100 PPM
APX500 APX800	9.3 - 7.9 (High Fire) 9.3 - 7.9 (Low Fire)	4.5 - 7.0 (High Fire) 4.5 - 7.0 (Low Fire)	

N. Test External Limits

Test any external limits or other controls in accordance with the manufacturer's instructions.

O. Check Thermostat Operation

Verify that the boiler starts and stops in response to calls for heat from the heating thermostat and indirect water heater thermostat. Make sure that the appropriate circulators also start and stop in response to the thermostats.

P. Adjust Supply Water Temperature

As shipped, the heating set point supply temperature is set to 180°F and, indirect water heater set point supply temperature is set to 170°F. If necessary, adjust these to the appropriate settings for the type of system to which this boiler is connected. See Section X "Operation" (parameter Table on page 97) of this manual for information on how to do this.

Q. Adjust Thermostats

Adjust the heating and indirect water heater thermostats to their final set points.

R. Field Conversion From Natural Gas to LP Gas

Apex boiler models APX399 and APX500 are factory shipped as Natural Gas builds and can be field converted to LP gas. Follow steps below for field conversion from Natural Gas to LP Gas.

Boiler model APX800 is factory shipped as either Natural Gas build or LP Gas build. Field conversions of model APX800 are not permitted.

1. Conversion of Apex models APX399 and APX500 from one fuel to another is accomplished using the throttle screw on the gas valve. Figure 53 "Dungs Gas Valve Detail" shows the location of the throttle screw on the Dungs valve. Locate the throttle screw on the boiler being converted.

WARNING

This conversion should be performed by a qualified service agency in accordance with the manufacturer's instructions and all applicable codes and requirements of the authority having jurisdiction. If the information in these instructions is not followed exactly, a fire, an explosion or production of carbon monoxide may result causing property damage, personal injury, or loss of life. The qualified service agency is responsible for proper conversion of these boilers. The conversion is not proper and complete until the operation of the converted appliance is checked as specified in this manual.

2. If conversion is being made on a new installation, install the boiler in accordance with the installation instructions supplied with the boiler. If an installed boiler is being converted, connect the new gas supply to the boiler, check for gas leaks, and purge the gas line up to the boiler in accordance with the National Fuel Gas Code (ANSI Z223.1) or the requirements of the authority having jurisdiction.

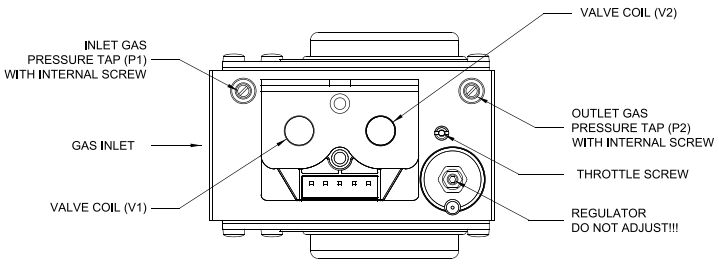


Figure 53: Dungs Gas Valve Detail

3. Before attempting to start the boiler, make the number of turns to the throttle screw called for in Table 25.
4. Attempt to start the boiler using the lighting instructions located inside the lower front cover of the boiler. If the boiler does not light on the first try for ignition, allow to boiler to make at least four more attempts to light. If boiler still does not light, turn the throttle counter clockwise in 1/4 turn increments, allowing the boiler to make at least three tries for ignition at each setting, until the boiler lights.
5. After the burner lights, force the burner to high fire. Allow the boiler to operate for approximately 5 minutes before taking combustion readings.
6. Check/adjust rate (see Paragraph L), then perform a combustion test (see Paragraph M).

WARNING

The throttle adjustments shown in Table 25 are approximate. The final throttle setting must be found using a combustion analyzer. Leaving the boiler in operation with a CO level in excess of the value shown in Table 26 could result in injury or death from carbon monoxide poisoning.

Table 25: Number of Clockwise Throttle Screw Turns for LP Conversion

Boiler Model	Gas Valve	Throttle Screw Turns at Altitude Range
		0 - 7000 Ft.
APX399	Dungs GB-057 HO (¾" NPT)	1¾
APX500	Dungs GB-057 HO (¾" NPT)	1
APX800	Dungs GB-ND057 D01 S00 XP (¾" NPT)	N/A See Tables 2A & 2B Notes

WARNING

These instructions include a procedure for adjusting the air-fuel mixture on this boiler. This procedure requires a combustion analyzer to measure the CO_2 (or Oxygen) and Carbon Monoxide (CO) levels in flue gas. Adjusting the air-fuel mixture without a proper combustion analyzer could result in unreliable boiler operation, personal injury, or death due to carbon monoxide poisoning.

7. While the burner is at high fire adjust the throttle as needed to obtain the CO_2 (or O_2) settings shown in the Table 26:
   - To reduce the CO_2 (increase the O_2) turn the throttle clockwise
   - To increase the CO_2 (reduce the O_2) turn the throttle counter-clockwise

   Make adjustments in increments of 1/8 to 1/4 turn and allow the boiler at least a minute to respond to each adjustment before making another. In general, the CO level will be at its lowest somewhere in the CO_2 range shown in this table.
8. Verify that the gas inlet pressure is between the upper and lower limits shown in Table 22 with all gas appliances (including the converted boiler) both on and off.
9. A label sheet is provided with the boiler for conversions from natural to LP gas. Once conversion is completed, apply labels as follows:
   - Apply the "Rating Plate Label" adjacent to the rating plate.
   - Apply the "Gas Valve Label" to a conspicuous area on the gas valve.
   - Apply the "Boiler Conversion Label" to a conspicuous surface on, or adjacent to, the outer boiler jacket. Fill in the date of the conversion and the name and address of the company making the conversion with a permanent marker.

Table 26: Typical Combustion Settings, LP Gas

Boiler Model	Altitude Range 0 - 5000 Ft. 5001 - 10000 Ft.		
	% CO_2	% O_2 Range	CO, PPM
APX399	11.4 - 9.5 (High Fire) 11.4 - 9.1 (Low Fire)	3.5 - 6.5 (High Fire) 3.5 - 7.0 (Low Fire)	Less than 100 PPM
APX500 APX800	10.8 - 9.1 (High Fire) 10.8 - 9.1 (Low Fire)	4.5 -7.0 (High Fire) 4.5 - 7.0 (Low Fire)	

NOTICE

If the throttle is very far out of adjustment on the "rich" (counter-clockwise) side, the boiler burner may be running at 0% Excess Air or even with air deficiency.

At 0% Excess Air the CO_2 readings will be either 11.9% CO_2 for Natural Gas or 13.8% CO_2 for LP Gas (O_2 will be 0%) and CO level will be extremely high (well over 1000 PPM).

If the burner operates with air deficiency, the following phenomena may be observed:

% CO_2 will actually drop (% O_2 will increase) as the throttle is turned counterclockwise

% CO_2 will actually increase (% O_2 will drop) as the throttle is turned clockwise

If the boiler appears to operate with air deficiency, turn the throttle clockwise to increase the amount of Excess Air to the burner.

As the throttle is turned clockwise, the CO_2 level will rise, eventually peaking @ 11.8% or 13.8%, depending of the type of gas being used, before falling (conversely, O_2 level will drop to 0% before rising). After this happens, continue turning the throttle clockwise, until CO_2 level drops (or O_2 level increases) to the values shown in Table 24 or Table 26.

WARNING

The pressure regulator (offset screw) has been factory set using precision instruments and must never be adjusted in the field unnecessarily. The gas valve outlet pressure is the same for both natural gas and propane. Make sure that all adjustments are made with the throttle, not the pressure regulator. Attempting to adjust the pressure regulator unnecessary, will result in damage to the gas valve and may cause property damage, personal injury or loss of life.

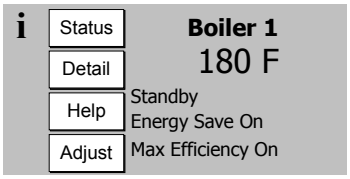
X. Operation

A. Overview

1. **Sage 2.1 Controller**

   The Sage 2.1 Controller (Control) contains features and capabilities which help improve heating system operation, and efficiency. By including unique capabilities, the Control can do more, with less field wiring, and fewer aftermarket controls and components – improving the operation of both new and replacement boiler installations.

2. **Advanced Touch Screen Display**



Home Screen

   Boiler status and setup selections are available from an easy to use, dual color, LCD Touch Screen Display. Over one hundred helpful information screens are provide to explain status information and setup functions. In the event of a fault condition the user is guided by "blinking" touch buttons to Help screens that explain the problem cause and corrective action. Operation evaluation and problem-solving is enhanced by historical capability including graphic trends, lockout history records as well as boiler and circulator cycle counts and run time hours.

3. **Advanced Modulating Control**

   The Control modulates the boiler input by varying the fan speed. As the fan speed increases, so does the amount of fuel gas drawn into the blower. As a result, a fairly constant air-fuel ratio is maintained across all inputs. The Control determines the input needed by looking at both current and recent differences between the measured temperature and the setpoint temperature. As the measured temperature approaches the setpoint temperature, the fan will slow down and the input will drop. The Control also utilizes boiler return water and flue gas temperatures to adjust fan speed.

4. **Built-in Safety Control**

   The Control includes safety controls designed to ensure safe and reliable operation. In addition to flame safety controls the Control includes supply water temperature, differential water temperature, and stack temperature safety limits and stepped modulation responses. Boiler modulation is adjusted when required to help avoid loss of boiler operation due to exceeding limits. Additionally, the Control accepts the optional field installation of low water cut-off and auxiliary safety limits.

5. **Outdoor Air Reset**

   When selected the modulation rate setpoint is automatically adjusted based on outside air temperature, time of day and length of demand (boost) settings. Outdoor air "reset" setpoint saves fuel by adjusting the water temperature of a heating boiler lower as the outside air temperature increases.

6. **Warm Weather Shutdown (WWSD)**

   Some boilers are used primarily for heating buildings, and the boilers can be automatically shutdown when the outdoor air temperature is warm. When outside air temperature is above the WWSD setpoint, this function will shut down the boiler, boiler pump and/or the system pump.

7. **Domestic Hot Water Priority (DHWP)**

   Some boilers are used primarily for building space heating, but also provide heat for the domestic hot water users. When the outdoor temperature is warm, the outdoor reset setpoint may drop lower than a desirable domestic hot water temperature. Also, often it is required to quickly recover the indirect water heater. When DHWP is enabled, heating circulators are stopped, the domestic circulator is started and the domestic hot water setpoint is established in response to a domestic hot water demand. Priority protection is provided to allow the heating loop to be serviced again in the event of an excessively long domestic hot water call for heat.

8. **Energy Management System (EMS) Interface**

   The control accepts a 4-20mAdc input from the EMS system for either direct modulation rate or setpoint.

9. **Circulator Control**

   The Control may be used to sequence the domestic hot water, boiler and system circulators. Service rated relay outputs are wired to a line voltage terminal block for easy field connection. Simple parameter selections allow all three pumps to respond properly to various hydronic piping arrangements including either a boiler or primary piped indirect water heater. Circulators are automatically run for a 20 second exercise period after not being used for longer than 7 days. Circulator exercise helps prevent pump rotor seizing.

10. **Multiple Boiler Sequencer Peer-To-Peer Network**

    The Control includes state-of-the-art modulating lead-lag sequencer for up to eight (8) boilers capable of auto rotation, outdoor reset and peer-to-peer communication. The peer-peer network is truly "plug and play". Communication is activated by simply connecting a RJ45 ethernet cable between boilers. The Control provides precise boiler coordination by sequencing boilers based on both header water temperature and boiler modulation rate. For example, the lead boiler can be configured to start a lag boiler after operating at 50% modulation rate for longer than an adjustable time. The boilers are modulated in "unison" (parallel) modulation rate to ensure even heat distribution

11. **Modbus Communication Interface**

    A factory configured RS485 Modbus interface is available for Energy Management System (EMS)monitoring when not used for Multiple Boiler Sequencer Peer-To-Peer Network. Consult factory if this interface must be used in addition to the boiler Peer-to-Peer Network.

B. Supply Water Temperature Regulation

1. **Priority Demand**

   The Control accepts a call for heat (demand) from multiple places and responds according to it's "Priority". When more than 1 demand is present the higher priority demand is used to determine active boiler settings. For example, when Domestic Hot Water (DHW) has priority the setpoint, "Diff Above", "Diff Below" and pump settings are taken from DHW selections. Active "Priority" is displayed on the "Boiler Status" screen.

Table 27: Order of Priority

Priority	Status Screen Display	Boiler Responding to:
1st	Sequencer Control	The boiler is connected to the peer-to-peer network. The boiler accepts demand from the Sequencer Master.
2nd	Domestic Hot Water	DHW call for heat is on and selected as the priority demand. DHW is always higher priority than Central Heat. It also has higher priority than the Sequencer Control when DHW priority is "enabled" and "Boiler Piped" IWH is selected.
3rd	Central Heat	Central Heat call for heat is on and there is no DHW demand or DHW priority time has expired.
4th	Frost Protection	Frost Protection is active and there is no other call for heat. Frost protection will be a higher priority than Sequencer Control if the Sequence Master has no active call for heat.
5th	Warm Weather Shutdown (WWSD)	WWSD is active and the boiler will not respond to central heat demands. DHW demand is not blocked by WWSD.
6th	Standby	There is no demand detected.

2. **Setpoint Purpose**

   The Control starts and stops the boiler and modulates the boiler input from minimum (MBH) to maximum (MBH) in order to heat water up to the active setpoint. The setpoint is determined by the priority (Central Heat or Domestic Hot Water) and as described in the following paragraphs.

3. **Central Heat Setpoint**

   Upon a Central Heat call for heat the setpoint is either the user entered Central Heat Setpoint or is automatically adjusted by a thermostat's "Sleep" or "Away" modes and/or Outdoor Air Reset or a Energy Management System (EMS) supplied 4-20mAdc setpoint.

4. **Outdoor Air Reset**

   If an outdoor temperature sensor is connected to the boiler and Outdoor Reset is enabled, the Central Heat setpoint will automatically adjust downwards as the outdoor temperature increases. When the water temperature is properly matched to heating needs there is minimal chance of room air temperature overshoot. Excessive heat is not sent to the room heating elements by "overheated" (supply water temperature maintained too high a setting) water. Reset control saves energy by reducing room over heating, reducing boiler temperature & increasing combustion efficiency and reducing standby losses as a boiler and system piping cool down to ambient following room over heating.

5. **Boost Time**

   When the Central Heat Setpoint is decreased by Outdoor Air Reset settings the Boost function can be enabled to increase the setpoint in the event that central heat demand is not satisfied for longer than the Boost Time minutes. The Boost feature increases the operating temperature setpoint by 10°F every 20 minutes (field adjustable) the central heat demand is not satisfied. This process will continue until heat demand is satisfied (indoor air is at desired temperature). Once the heat demand is satisfied, the operating setpoint reverts to the value determined by the Outdoor Air Reset settings. If Boost Time is zero, then the boost function is not used.

6. **Domestic Hot Water (DHW) Setpoint**

   Upon a DHW call for heat the setpoint is either the user entered DHW setpoint or the Thermostat's "Sleep" or "Away" DHW setpoint. The optimal value of this setpoint is established based on the requirements of the indirect water heater.

7. **Domestic Hot Water Priority (DHWP)**

   When domestic hot water priority is selected and there is a DHW call for heat, the system pump will be turned off (when system pump run pump for parameter is set for "Central Heat Optional Priority") and the DHW pump will be turned on. Additionally, if outdoor reset is active, the active setpoint is adjusted to the DHW Setpoint. Priority protection is provided to ensure central heat supply in the case of excessively long DHW call for heat.

8. **"Setback" Setpoints**

   User adjustable Thermostat "Sleep" or "Away" Setback Setpoints are provided for both Central Heat and DHW demands. The Setback setpoint is used when the EnviraCOM thermostat is in "leave" or "sleep" modes. When setback is "on" the thermostat setback setpoint shifts the reset curve to save energy while the home is in reduced room temperature mode. The Honeywell VisionPro IAQ (part number TH9421C1004) is a "setback" EnviraCOM enabled thermostat.

C. Boiler Protection Features

1. **Supply Water Temperature High Limit**

   The boiler is equipped with independent automatic reset and a manual reset High Limit devices. The automatic reset high limit is provided by a supply manifold mounted Limit Device. The automatic high limit is set to 200°F. The Control monitors a supply water temperature sensor that is also mounted in the supply water manifold and supplies an internal, manual reset high limit. If supply water temperature exceeds 190°F, the control begins to reduce the blower maximum speed setting. If the temperature exceeds 200°F, a forced recycle results. If the temperature exceeds 210°F, a manual reset hard lockout results. Additionally, if the supply temperature rises faster than the degrees Fahrenheit per second limit a soft lockout is activated.

2. **High Differential Temperature Limit**

   The Control monitors the temperature difference between the return and supply sensors. If this difference exceeds 43°F the control begins to reduce the maximum blower speed. If temperature difference exceeds 53°F a forced boiler recycle results. If the temperature difference exceeds 63°F the control will shut the unit down. The unit will restart automatically once the temperature difference has decreased and the minimum off time has expired.

3. **Low Water Cut Off (LWCO)**

   The Control shuts down the boiler when either the supply water temperature is too high or supply to return temperature differential temperature is too high. This ensures the boiler is shutdown in the event of a low water level or low water flow condition.

   Some codes and jurisdiction may accept these integral features instead of requiring a low water cutoff. ADHERE TO ALL LOCAL CODE REQUIREMENTS. Contact your local code inspector prior to installation. If required, a LWCO four-position wire harness connection is provided for an external LWCO kit (p/n 102097-01) to be added. If the LWCO opens, the boiler will shut down and an open limit indication and error code is provided. If the limit installed is a manual reset type, it will need to be reset before the boiler will operate.

4. **Return Temperature Higher Than Supply Temperature (Inversion Limit)**

   The Control monitors the supply and return temperature sensors. If the return water temperature exceeds the supply water temperature for longer than a limit time delay the Control shuts down the boiler and delays restart. If the inverted temperature is detected more than five times the boiler manual reset Hard Lockout is set. This condition is the result of incorrectly attaching the supply and return piping.

5. **External Limit**

   An external limit control can be installed between terminals 11 and 12 on the low voltage terminal strip. Be sure to remove the jumper when adding an external limit control to the system. If the external limit opens, the boiler will shut down and an open limit indication and error code is provided. If the limit installed is a manual reset type, it will need to be reset before the boiler will operate.

6. **Boiler Mounted Limit Devices**

   The Control monitors individual limit devices: pressure switch, high limit device, condensate level switch, Thermal Link, Burner Door Thermostat with manual reset, low water cutoff (optional), fuel gas pressure switches (optional) and external limit (optional). If any of these limits opens, the boiler will shut down and an individual open limit indication is provided.

7. **Stack High Limit**

   The Control monitors the flue gas temperature sensor located in the vent connector. If the flue temperature exceeds 184°F, the control begins to reduce the maximum blower speed. If the flue temperature exceeds 194°F, a forced boiler recycle results. If the flue temperature exceeds 204°F, the control activates a manual reset Hard Lockout.

8. **Ignition Failure**

   The Control monitors ignition using a burner mounted flame sensor. In the event of an ignition failure:

   - APX399 - the control retries five (5) times and then goes into soft lockout for one hour.
   - APX500 and APX800 - the control retries one (1) time and then goes into hard lockout. Manual reset is required to resume boiler operation.

9. **Central Heating System Frost Protection**

   When enabled, Frost Protection starts the boiler and system pump and fires the boiler when low outside air and low supply water temperatures are sensed. The Control provides the following control action when frost protection is enabled:

Table 28: Frost Protection

Device Started	Start Temperatures	Stop Temperatures
Boiler & System Pump	Outside Air < 0°F Supply Water < 45°F	Outside Air > 4°F Supply Water > 50°F
Boiler	Supply Water < 38°F	Supply Water > 50°F

FROST PROTECTION NOTE

The Control helps provide freeze protection for the boiler water. Boiler flue gas condensate drain is not protected from freezing. Since the Control only controls the system and boiler circulators individual zones are not protected. It is recommended that the boiler be installed in a location that is not exposed to freezing temperatures.

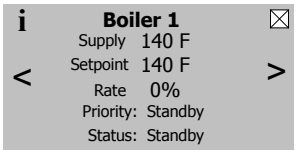
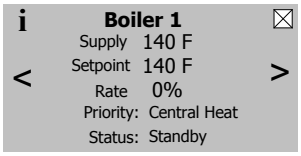
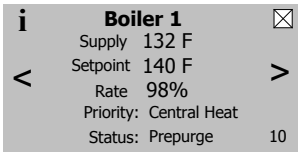
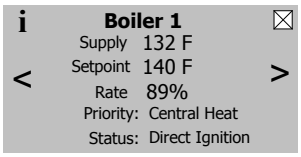
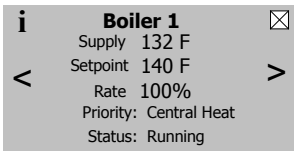
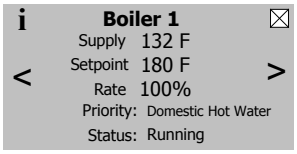
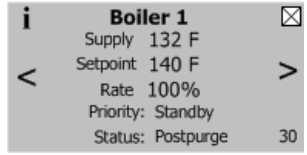
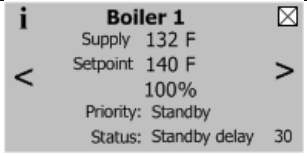
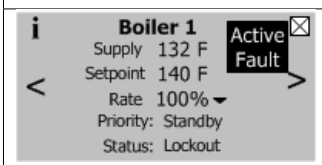
D. Multiple Boiler Control Sequencer

1. **"Plug & Play" Multiple Boiler Control Sequencer**
   When multiple boilers are installed, the Control's Sequencer may be used to coordinate and optimize the operation of up to eight (8) boilers. Boilers are connected into a "network" by simply "plugging in" standard ethernet cables into each boiler's "Boiler-To-Boiler Communication" RJ45 connection.
2. **Sequencer Master**
   A single Control is parameter selected to be the Sequencer Master. The call for heat, outdoor and header sensors, and common pumps are wired to the Sequencer Master "enabled" Control.
3. **Lead/Slave Sequencing & Equalized Run Time**
   One boiler is a "Lead" boiler and the remaining networked boilers are "Slaves". When demand is increasing, the Lead boiler is the first to start and the Slave boilers are started in sequential order (1,2,3,…) until the demand is satisfied. When demand is decreasing, the boilers are stopped in reverse order with the Lead boiler stopped last (…,3,2,1). To equalize the run time the sequencer automatically rotates the Lead boiler after 24 hours of run time.
4. **Improved Availability**
   The following features help improve the heat availability:
   a. Backup Header Sensor: In the event of a header sensor failure the lead boiler's supply sensor is used by the Sequence Master to control firing rate. This feature allows continued coordinated sequencer control even after a header sensor failure.
   b. "Stand Alone" Operation Upon Sequence Master Failure: If the Sequence Master Control is powered down or disabled or if communication is lost between boilers, individual boilers may be setup to automatically resume control as a "stand alone" boiler.
   c. Slave Boiler Rate Adjustment: Each slave boiler continues to monitor supply, return and flue gas temperatures and modifies the Sequence Master's firing rate demand to help avoid individual boiler faults, minimize boiler cycling and provide heat to the building efficiently.
   d. Slave Boiler Status Monitoring: The Sequence Master monitors slave boiler lockout status and automatically skip over disabled boilers when starting a new slave boiler.
5. **Customized Sequences**
   Normally, boilers are started and stopped in numerical order. However, custom sequences may be established to optimize the heat delivery. For example, in order to minimize boiler cycling, a large boiler may be selected to run first during winter months and then selected to run last for the remainder of the year.
6. **Multiple Demands**
   The Sequence Master responds to Central Heat, DHW and frost protection demands similar to the stand alone boiler. For example, when selected and DHW priority is active, the sequence master uses DHW setpoint, "Diff Above", "Diff Below" and pump settings.
7. **Shared or Isolated DHW Demand**
   When the Indirect Water Heater (IWH) parameter is set to "Primary Piped" the Sequence Master sequences all required boilers to satisfy the DHW setpoint (default 180 F). When "Boiler Piped" is selected only the individual slave boiler, with the wired DHW demand and pump, fires to satisfy the DHW setpoint.
8. **DHW Two boiler Start**
   When the Indirect Water Heater (IWH) parameter is set to "Primary Piped" and the DHW Two Boiler Start parameter is set to "Enabled" two boilers are started without delay in response to a DHW call for heat. This feature allows rapid recovery of large IWH's and multiple IWH's.
9. **Optimized Boiler Modulation**
   Boiler firing rate is managed to increase smoothly as boilers are started. For example, when a second boiler is started the initial firing rate is 100%/2 or 50%, when the third boiler is started the firing rate starts at 200%/3 or 66%. After the initial start, the Sequence Master develops a unison firing rate demand based on it's setpoint and sensed header temperature.
10. **Innovative Condensing Boiler Control**
    During low loads, the Sequence Master limits firing rates to a 'Base Load Common Rate" to ensure peak operating efficiency. Lower firing rates boost efficiency by helping increase the amount of flue gas water vapor condensation. The Control maintains a "Base Load Common Rate" until the last lag boiler is started. At this point, the "Base Load Common Rate" is released to allow boilers to modulated as required to meet heat load.
11. **Advanced Boiler Sequencing**
    After there is a Call For Heat input, both header water temperature and boiler firing rate percent are used to start and stop the networked boilers. The control starts and stops boilers when the water temperature is outside the user selected "Diff Above" and "Diff Below" settings. Also, in order to minimize temperature deviations, the control adjusts the number of boilers running based on the firing rate. This combination allows the boilers to anticipate slow load changes before they disrupt water temperature yet still respond quickly to sudden load changes. These special sequencer features help reduce energy wasting system temperature swings and the resulting unnecessary boiler cycling.
12. **Stop All Boilers**
    All boilers are stopped without delay if the Call for Heat input is removed or if the header temperature is higher than 195°F (field adjustable).

E. Boiler Sequence of Operation

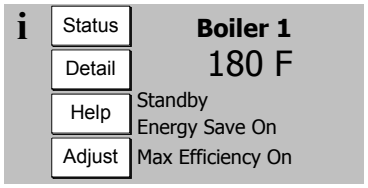
1. Normal Operation

Table 29: Boiler Sequence of Operation

Status Screen Display	Description
 **Priority:** Standby **Status:** Standby	(burner **Off**, circulator(s) **Off**) Boiler is not firing and there is no call for heat, priority equals standby. The boiler is ready to respond to a call for heat.
 **Priority:** Central Heat **Status:** Standby	(burner **Off**, circulator(s) **On**) Boiler is not firing. There is a Central Heat call for heat and the Supply temperature is greater than setpoint minus the “Diff Below”.
 **Priority:** Central Heat **Status:** Prepurge	When supply temperature drops burner demand continues with following Status shown: Safe Startup: Flame circuit is tested. Drive purge: The blower is driven to the fan purge speed. Prepurge: After the blower reaches the fan purge speed setting the 10 second combustion chamber purge is conducted.
 **Priority:** Central Heat **Status:** Direct ignition	After purge time is complete the following Status is shown: Drive light-off: The blower is driven to light-off rate. Pre-Ignition Test: After the blower reaches light-off rate a safety relay test is conducted. Pre-ignition: Spark is energized and it is confirmed that no flame is present Direct Ignition: Spark and Main fuel valve are energized.
 **Priority:** Central Heat **Status:** Running	(burner **On**, circulator(s) **On**) After flame is proven normal boiler operation begins. Modulation rate depending on temperature and setpoint selections and modulating control action.
 **Priority:** Domestic Hot Water **Status:** Running	If the Central Heat call for heat is active and a Domestic Hot Water (DHW) call for heat received the DHW demand becomes the “priority” and the modulation rate, setpoint, “Diff Above” and “Diff Below” are based on DHW settings.
 **Priority:** Standby **Status:** Post-purge	(burner **Off**, circulator(s) **Off**) If there is no call for heat the main fuel valve is closed and the blower is driven to the fan post-purge speed. After the blower reaches the fan post-purge speed setting the 30 second combustion chamber purge is conducted.
 **Priority:** Standby **Status:** Standby Delay	This state is entered when a delay is needed before allowing the burner control to be available. For example, when Anti-Short Cycle time is selected Standby delay is entered after the Central Heat call for heat ends. Select “Help” button from the “Home Screen” to determine the cause of the Standby Delay.
 **Priority:** Standby **Status:** Lockout	A lockout Status is entered to prevent the boiler from running due to a detected problem. Select “Help” button from the “Home Screen” to determine the cause of the Lockout. The last 10 Lockouts are recorded in the Lockout History.

2. **Using The Display**

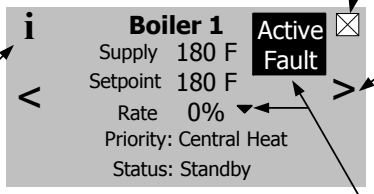
The Control includes a touch screen LCD display. The user monitors and adjusts boiler operation by selecting screen navigation "buttons" and symbols. Navigation features are shown below.
The "Home Screen" and menu selections are shown below. When no selection is made, while viewing any screen, the display reverts to the "Home Screen" after 4 minutes. The "Home Screen" displays boiler temperature, boiler status and Efficiency Information. "Energy Save On" indication appears when the outdoor reset or setback features have lowered the Central Heat Setpoint based on outside air temperature measurement or time of day. "Max Efficiency On" appears when the boiler return temperature has been reduced low enough to cause energy saving flue gas condensation.



Home Screen

Menu Button

The Home Screen Menu Buttons connect the displays four main display groups; Status, Detail, Help and Adjustment Screens.



Status Screen

Close Symbol

The "Close" symbol returns to the display to previous menu or screen. Repeatedly pressing the "Close" symbol will always return the display to the "Home" screen.

Arrow Symbol

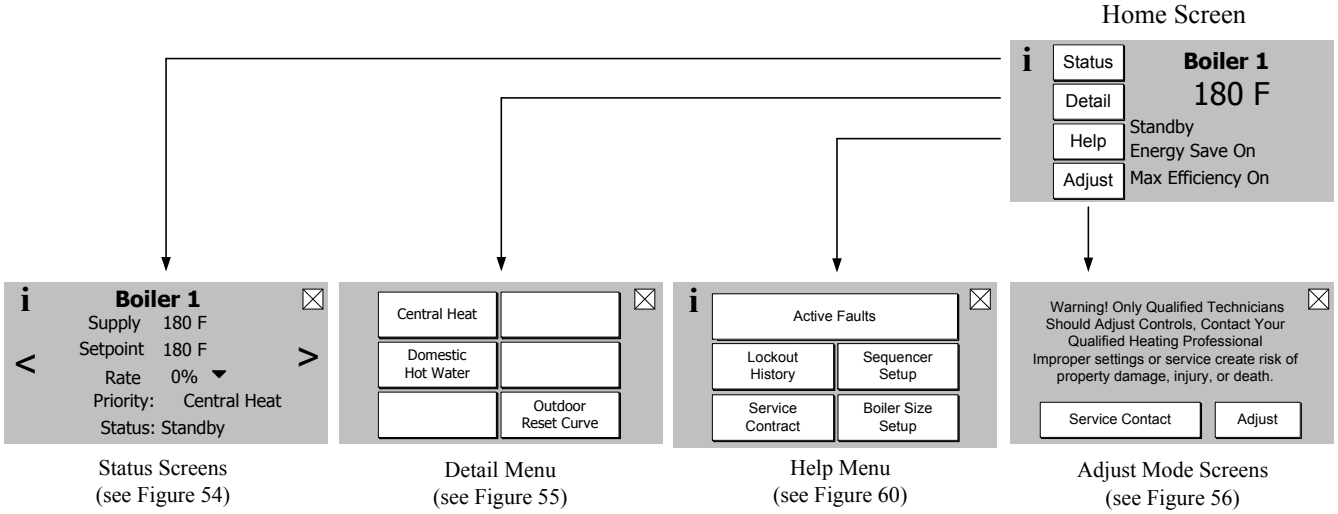
The "Arrow" symbol links together all screens in the selected group. For example, repeated pressing the right "Arrow" symbol will rotate the display around all the screens in the Status group. Using this feature the user can review all the boiler status and adjustment mode screens.

Fault Symbols

"Active Fault" and "Rate Limit" symbols provide a link to the cause of a boiler fault or firing rate limit. The first boiler status screen provides an overview of boiler operation including fault status.

Information Symbol

"Information" symbol links most screens to screen content explanations. New terminology used in status and adjustment screens are explained in plain words.



Status Screens (see Figure 54)

Detail Menu (see Figure 55)

Help Menu (see Figure 60)

Adjust Mode Screens (see Figure 56)

F. Viewing Boiler Status

1. Status Screens

Boiler Status screens are the primary boiler monitoring screens. The user may simply "walk" though boiler operation by repeatedly selecting the right or left "arrow" symbol. These screens are accessed by selected the "Status" button from the "Home" screen.

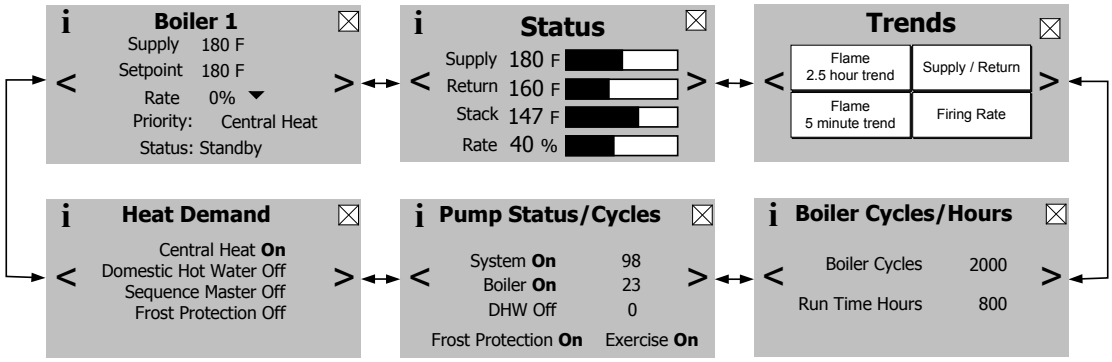


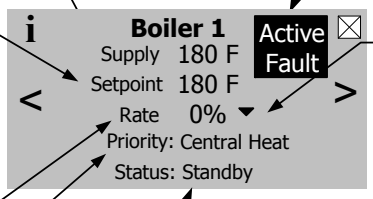
Figure 54: Status Screens

Supply:
measured supply water temperature. This is the temperature being used to start/stop and fire boiler when there is a call-for- heat.

Setpoint:
this is the active setpoint. This temperature is the result of Outdoor Air Reset, Setback and Domestic Hot Water (DHW) selections.

Rate:
The rate % value is equal to the actual fan speed divided by the maximum fan speed.

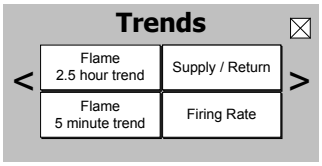
Priority:
The selected Priority is shown. Available Priorities are: Standby (no call for heat is present), Sequencer Control, Central Heat, Domestic HW, Frost Protection or Warm Weather Shutdown.



Active fault:
A hard lockout will cause the active fault indication to appear. When visible the text becomes a screen link to the "Help" Menu.

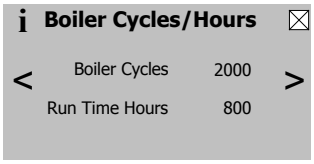
Rate Limit:
The "▼" symbol appears to the right of the Rate % when firing rate is limited or overridden in any way. During the start-up and shutdown sequence it is normal for the rate to be overridden by the purge and light-off requirements. When a rate limit is the result of boiler protection logic the "▼" symbol blinks and becomes a screen link

Status:
Information found at the bottom of the Status screen and on the Home screen. Table 29 shows each status and the action the control takes during the condition.



Data Logging

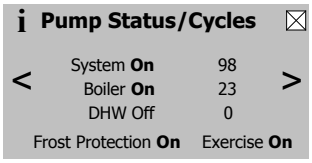
Real time graphic trends allow users to observe process changes over time providing valuable diagnostic information. For example, flame current performance over start up periods and varying loads can be an indication of gas supply issues. Additionally, supply and return temperature dual pen trends brings a focused look at heat exchanger and pump performance. For example, studying a differential temperature trend may indicate pump speed settings need to be changed.



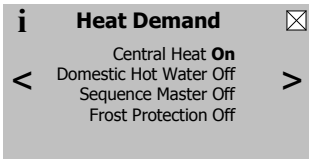
Cycles and Hours

Boiler cycles and hours are used to monitor the boilers overall compatibility to the heating load. Excessive cycling compared to run time hours may be an indication of pumping, boiler sizing or adjustment issues.

1. **Status Screens** (continued)



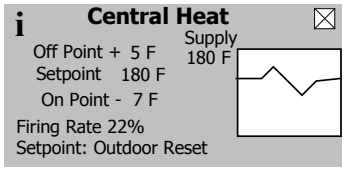
Pumping is a major part of any hydronic system. This screen provides the status of the boiler's demand to connected pumps as well as the status of Frost Protection and pump Exercise functions.



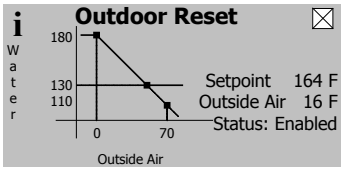
This screen provides the status of the boiler's 4 possible heat demands. When demand is off the Control has not detected the call-for-heat.

2. **Detail Screens**

Detail screens are accessed by selected the "Detail" button from the "Home" screen and provide in depth operating parameter status such as "On Point", "Off Point" and Setpoint Source information.



Demand detail screens are provided for Central Heat (shown), DHW and Sequencer demands.



Outdoor Reset saves energy and improves home comfort by adjusting boiler water temperature . This screen presents the active reset curve. The curve shows the relationship between outside air and outdoor reset setpoint. The curve shown is adjustable by entering the display's adjust mode.

Figure 55: Detail Screens

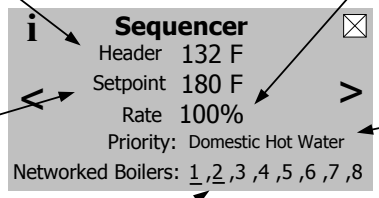
3. **Multiple Boiler Sequencer Screens**

When the Sequence Master is enabled the following screens are available:

The Sequencer Status screen is selected by "pressing" "Status" button from the "Home" screen when Sequence Master is enabled.

Header:
measured header water temperature. This is the temperature being used to start, stop and fire boiler when there is a call-for-heat.

Setpoint:
this is the active setpoint. This temperature is the result of Outdoor Air Reset, Setback and Domestic Hot Water (DHW) selections.



Rate:
The rate % value is equal to the Sequence Master demand to the individual boiler. Actual boiler firing rate is found on the individual boiler status pages.

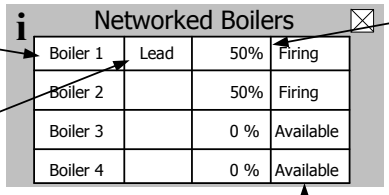
Priority:
The selected Sequencer Priority is shown. Available Priorities are: Standby (no call for heat is present), Central Heat, Domestic Hot Water, Frost Protection or Warm Weather Shutdown.

Networked Boiler Status:
Provides connected, start sequence and firing rate status information for all connected boiler addresses. The boiler number is underlined if the boiler is running and blinks if the boiler has the start sequence in progress. For example the status for boiler address 1 is provided as follows:
1 - Boiler 1 is connected to the network
1 - "Blinking underline" - boiler 1 is starting
1 - "Solid underline" - boiler 1 is running

The "Networked Boilers" screen is selected by "pressing" the "Detail" button from the "Home" screens and "pressing" Networked Boilers" from the "Detail" screen.

Boiler Number:
Up to eight (8) boiler's status is shown

Lead Boiler:
Upon power up the lowest numbered boiler becomes the lead boiler. The lead boiler is the first to start and last to stop. The lead boiler is automatically rotated after 24 hours of run time. Additionally, the lead is rotated if there is a lead boiler fault.



Firing Rate:
Demanded firing rate is provided.

Sequence Status:

Slave boiler status is provide as follows:

Available:	Boiler is ready and waiting to be started by the Sequencer Master.
Add Stage:	Boiler has begun the start sequence but has not yet reached the boiler running status.
Running:	Boiler is running.
On Leave:	Boiler has left the network to service a DHW demand.
Recovering:	Boiler is in the process of returning to the network. For example, the slave boiler is in the Postpurge state.
	Note: The recovery time is normally 30 seconds. However, if the slave boiler fails to start the recovery time increases from 30 seconds to 5, 10 and 15 minutes.
Disabled:	Boiler has a lockout condition and is unable to become available to the Sequencer Master.

G. Changing Adjustable Parameters

1. Entering Adjust Mode

The Control is factory programmed to include basic modulating boiler functionality. These settings are password protected to discourage unauthorized or accidental changes to settings. User login is required to view or adjust these settings:

- Press the "Adjust" button on the "Home" screen.
- Press the "Adjust" button on the Adjust Mode screen or Press Contractor for service provider contact information.
- Press "Login" button to access password screen.
- Press 5-digit display to open a keypad. Enter the password (Installer Password is 76) and press the return arrow to close the keypad. Press the "Save" button.
- Press the "Adjust" button to enter Adjustment mode.

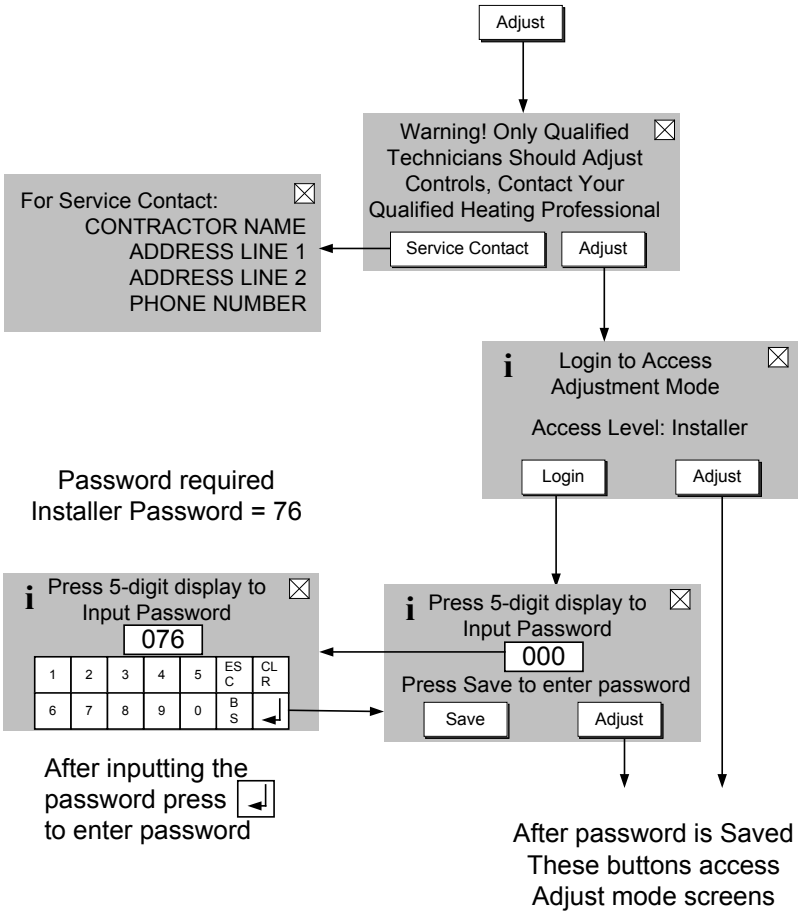
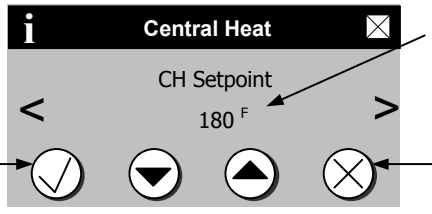


Figure 56: Adjust Mode Screens

2. **Adjusting Parameters**

Editing parameters is accomplished as follows:



Accept Value

Press the ✓ button to confirm newly edited value.
The value modified with the increase and decrease buttons is not accepted unless this button is also pressed

Cancel edit

Press the ✗ button to cancel newly edited value and go back to the original

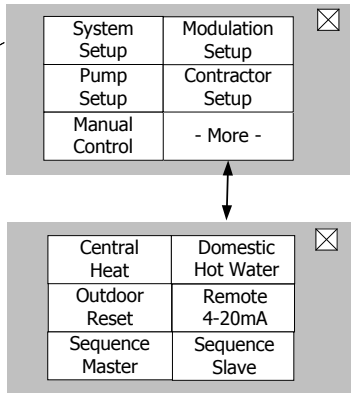
Edit Value

Press the ▼ ▲ buttons to edit a value. While editing a value **it will blink until it has been accepted** or cancelled. A value is also cancelled by leaving the screen without accepting the value.

2. **Adjusting Parameters (**continued**)**

From the "Home" screen select the Adjust button to access the adjustment mode screens show below (if required, refer to the previous page to review how to enter Adjustment mode):

The following pages describe the Control's adjustable parameters. Parameters are presented in the order they appear on the Control's Display, from top to bottom and, left to right



"Press" System Setup button to access the following parameters:

Factory Setting	Range / Choices	Parameter and Description
Fahrenheit	Fahrenheit, Celsius	**Temperature Units** The Temperature Units parameter determines whether temperature is represented in units of Fahrenheit or Celsius degrees.
4	0-14	**Display Brightness** Display brightness is adjustable from 0 to 14.
8	0-14	**Display Contrast** Display contrast is adjustable from 0 to 14.
Wired	Not Installed, Wired Wireless	**Outdoor Sensor Source** Not Installed Outdoor Sensor is not connected to the boiler, the sensor is not monitored for faults. Wired Outdoor Sensor is installed directly on the boiler terminal Strip-TB2. Wireless Outdoor sensor is installed and wireless.
Enabled	Enable/Disable	**Frost Protection** Disable Frost Protection is not used. Enable Boiler and system circulators start and boiler fires when low outside air, supply and return temperatures are sensed as follows: **Device Started** / **Start Temperatures** / **Stop Temperatures** Boiler & System / Outside Air < 0°F / Outside Air > 4°F
0 Secs	0-900 Secs	**Anti-Short Cycle Time** Anti-short cycle is a tool that helps prevent excessive cycling resulting from a fast cycling Thermostat or Zone valves. It provides a minimum delay time before the next burner cycle. DHW demand is serviced immediately, without any delay.
Disabled	Enable/Disable	**Warm Weather Shutdown Enable** Disable Warm Weather Shutdown (WWSD) is not used. Enable The boiler will not be allowed to start in response to a central heat call for heat if the outside temperature is greater than the WWSD setpoint. WWSD is initiated as soon as outside air temperature is above WWSD Setpoint. The control does not require call for heat to be satisfied. The boiler will still start in response to a Domestic Hot Water call for heat.
70°F	0-100°F	**Warm Weather Shutdown Setpoint** The Warm Weather Shutdown (WWSD) Setpoint used to shutdown the boiler when enabled by the "WWSD Enable" parameter.

2. **Adjusting Parameters (**continued**)**

WARNING

Boiler type is factory set and must match the boiler model. Only change the boiler type setting if you are installing a new or replacement Control. The boiler type setting determines minimum and maximum blower speeds. Incorrect boiler type can cause hazardous burner conditions and improper operation that may result in PROPERTY LOSS, PHYSICAL INJURY OR DEATH.

"Press" [Modulation Setup] button to access the following parameters:

Factory Setting	Range / Choices	Parameter and Description
See Table 30	See Table 30	**Boiler Type** Boiler Size Setup To verify the boiler size selection, a qualified technician should do the following: 1. Check boiler's label for actual boiler size. 2. Set "Boiler Type" to match actual boiler size. 3. Select "Confirm". The Boiler Type parameter changes the minimum and maximum modulation settings. This parameter is intended to allow a user to set the parameters in a spare part Sage2.1 Controller to a particular boiler type.
See Table 30	Minimum to Maximum Modulation	**Central Heat Maximum Modulation** This parameter defines the highest modulation rate the Control will go to during a central heat call for heat. If the rated input of the installed home radiation is less than the maximum output of the boiler, change the Central Heat Maximum Modulation (fan speed) setting to limit the boiler output accordingly.
See Table 30	Minimum to Maximum Modulation	**Domestic Hot Water (DHW) Max Modulation** This parameter defines the highest modulation rate the Control will go to during a Domestic Hot Water call for heat. If the rated input of the indirect water heater is less than the maximum output of the boiler, change the DHW Maximum Modulation (fan speed) setting to limit the boiler output accordingly.
See Table 30	Minimum - 100 to Maximum	**Minimum Modulation** This parameter is the lowest modulation rate the Control will go to during any call for heat.
See Table 30	2500 - Maximum Light-off Rate	**Lightoff Rate** This is the blower speed during ignition and flame stabilization periods.

Table 30: Parameters Changed Using the Boiler Type Parameter Selections:

Spare Part:	**Sage2.1 Controller - P/N 104471-01 Maximum Light-off Rate = 4000**	**Sage2.1 Controller - P/N 104471-04 Maximum Light-off Rate = 4000**		
Altitude	**0 -7000 ft.**		**0 - 5000 ft.**	
Boiler Type	399 **-07**	500 **-07**	800N **-05**	800P **-05**
Maximum Modulation Rate	7600	5900	5200	5150
Minimum Modulation Rate	2100	1400	1200	1200
Absolute Maximum Modulation Rate	8500	6550	5900	5600

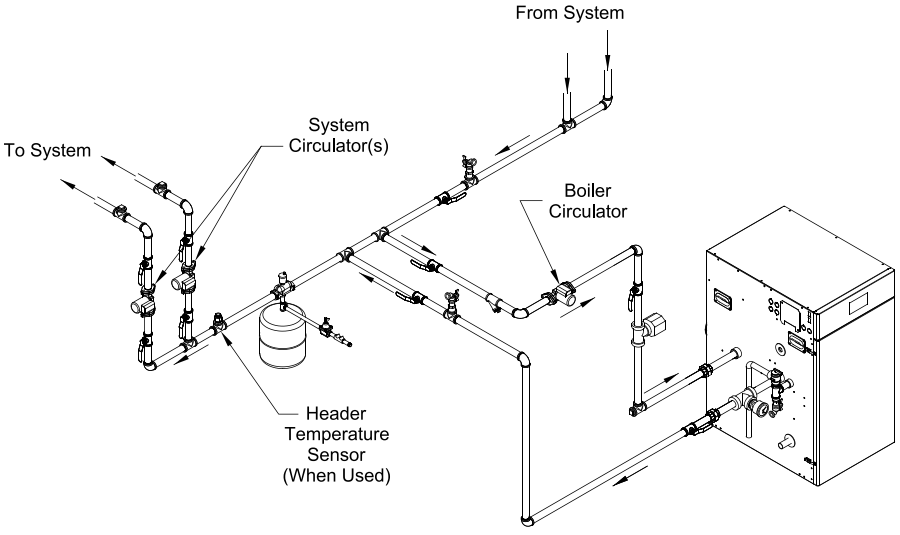
NOTE: Maximum Modulation Rates are designed for 100% nameplate rate at 0°F combustion air. Contact factory before attempting to increase the Maximum Modulation Rate.

"Press" Pump Setup button to access the following parameters:

Factory Setting	Range / Choices	Parameter and Description
Central Heat, Optional Priority	Never, Any Demand, Central heat, No Priority, Central Heat, Optional Priority	**System Pump run pump for:** Activates the system pump output according to selected function. Never: Pump is disabled and not shown on status screen. Any Demand: Pump Runs during any call for heat. Central Heat, No Priority: Pump Runs during central heat and frost protection call for heat. Pump does not start for a DHW call for heat and continues to run during Domestic Hot Water Priority. Central heat, Optional Priority: Pump Runs during central heat and frost protection call for heat. Pump does not start for a DHW call for heat and will be forced off if there is a DHW call for heat and Domestic Hot Water Priority is active.
Any Demand	Any Demand, Central heat, off DHW demand	**Boiler Pump run pump for:** Activates the boiler pump output according to selected function. Any Demand: Pump Runs during any call for heat. Central heat, off DHW demand: Pump Runs during central heat and frost protection call for heat. Pump does not start for a DHW call for heat and will be forced off if there is a DHW call for heat and Domestic Hot Water Priority is active.
Primary Loop Pipe IWH	Never, Primary Loop Piped IWH, Boiler Piped IWH	**Domestic Pump run pump for:** Activates the Domestic pump output according to selected function. Never: Pump is disabled and not shown on status screen. Primary Loop Piped IWH: Pump Runs during domestic hot water call for heat. Domestic Hot Water Priority enable/disable does not affect pump operation. Boiler Piped IWH: Pump Runs during domestic hot water call for heat. Pump is forced off during a central heat call for heat when Domestic Hot Water Priority "disabled" is selected and when Domestic Hot Water Priority "enable" has been selected and the DHW call for heat has remained on for longer than 1 hour (priority protection time).

Example Pump Parameter selections:

Single boiler with no Indirect Water Heater



Parameter Selections:

System Pump= "any demand"

Boiler Pump = "any demand"

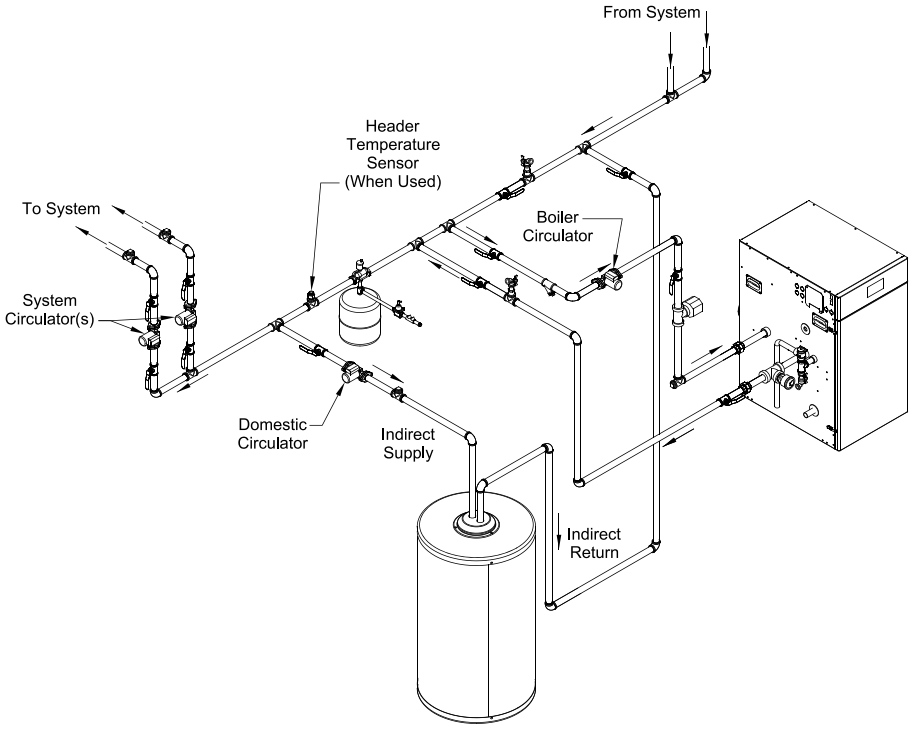
DHW Pump = "never"

Explanation:

This piping arrangement only services central heat. When there is any demand both boiler and system pumps turn on.

Example Pump Parameter selections (continued):

Single boiler Indirect Water Heater Piped to Primary, Optional Domestic Hot Water Priority.



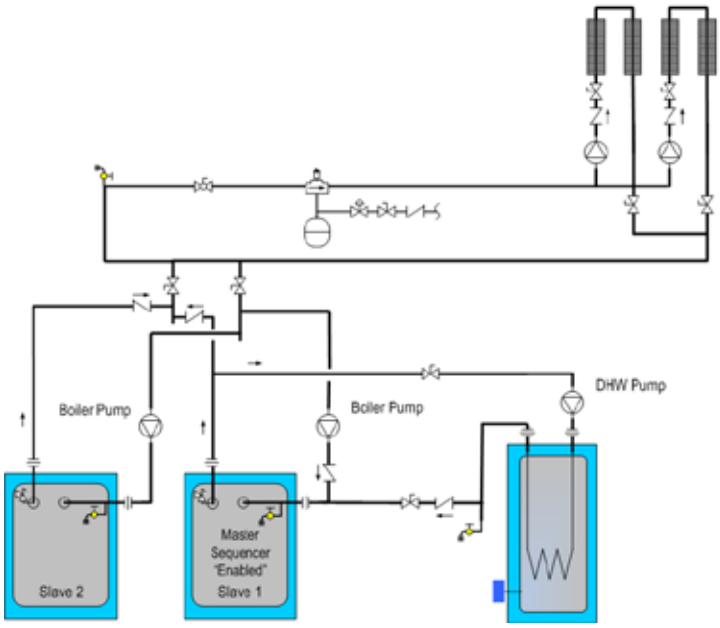
Parameter Selections:

System Pump= "Central Heat , Optional Priority"
Boiler Pump = "any demand"
DHW Pump = "Primary Loop Piped IWH"
DHW Priority Enable is optional

Explanation:

This piping arrangement permits the system pump to run or not run when there is a domestic hot water call for heat. Domestic hot water priority is optional. It is permissible for the domestic and system pumps to run at the same time. The boiler pump must run for every call for heat.

Multiple Boilers with Boiler Piped IWH, System and DHW Wired to Master



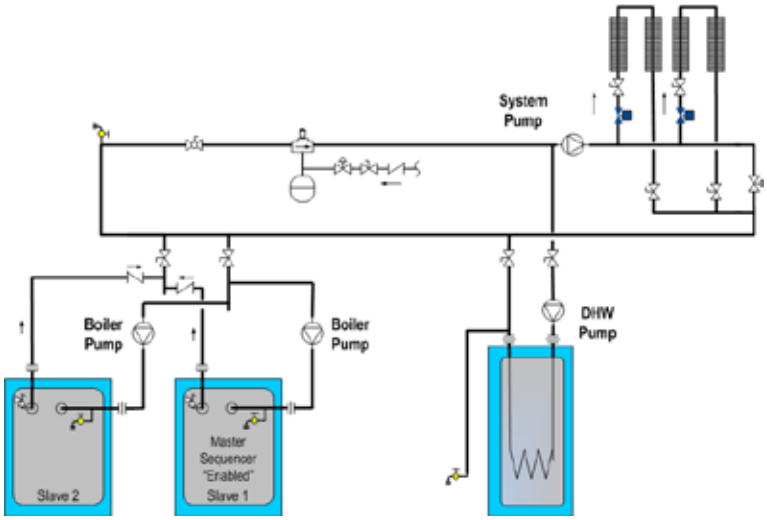
	Sequencer Master (Boiler 1)	Boiler 2
Wiring locations:		
Thermostat	X	
DHW call for heat	X	
System pump	X	
DHW pump	X	
Boiler Pump	X	X
Sequencer Master Parameter Selections:		
Sequencer Master	Enabled	
Indirect Water Heater	"Boiler Piped"	
Pump Parameter Selections:		
System Pump =	Central Heat, No Priority	Never
Boiler Pump =	Central Heat, Off DHW Priority	Any demand
DHW Pump =	Boiler Piped IWH	Never

Explanation:

This piping arrangement does not allow both the Slave 1's boiler and domestic hot water pump to run at the same time. When call for Domestic Hot Water is received the DHW pump is turned on and the boiler pump is turned off. However, the system pumps may run to satisfy a central heat demand that is being satisfied by a different slave. The central heat demand is ignored by Slave 1 until the domestic hot water demand is ended. If domestic hot water priority is enabled and priority protection time is exceeded the domestic hot water pump turns off to allow the boiler pump to run.

Example Pump Parameter selections (continued)**:**

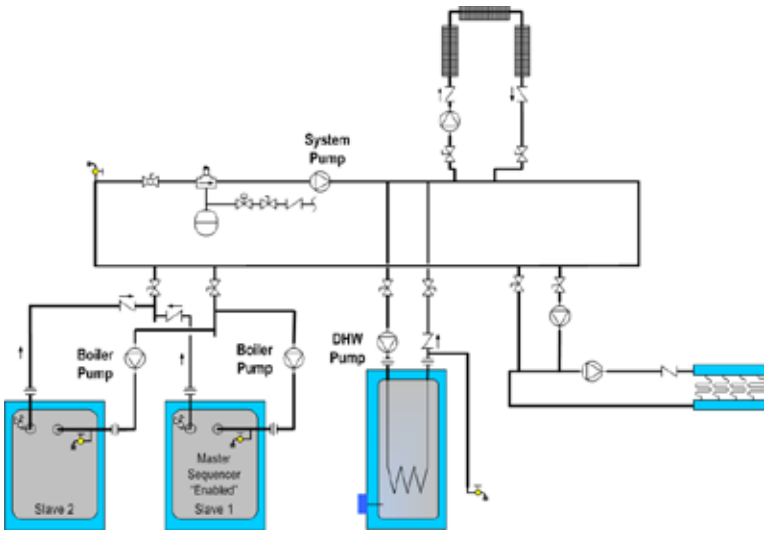
Multiple boilers IWH Piped to Primary, Optional Domestic Hot Water Priority



	Sequencer Master (Boiler 1)	Boiler 2
Wiring locations:		
Thermostat	X	
DHW call for heat	X	
System pump	X	
DHW pump	X	
Boiler Pump	X	X
Sequencer Master Parameter Selections:		
Sequencer Master	Enabled	
Indirect Water Heater	"Primary Piped"	
Pump Parameter Selections:		
System Pump =	Central Heat, Optional Priority	Never
Boiler Pump =	Any demand	Any demand
DHW Pump =	Primary Loop Piped IWH	Never

Explanation:
This piping arrangement permits the system pump to run or not run when there is a domestic hot water call for heat. Domestic hot water priority is optional. It is permissible for the domestic and system pumps to run at the same time. The boiler pump must run for every call for heat.

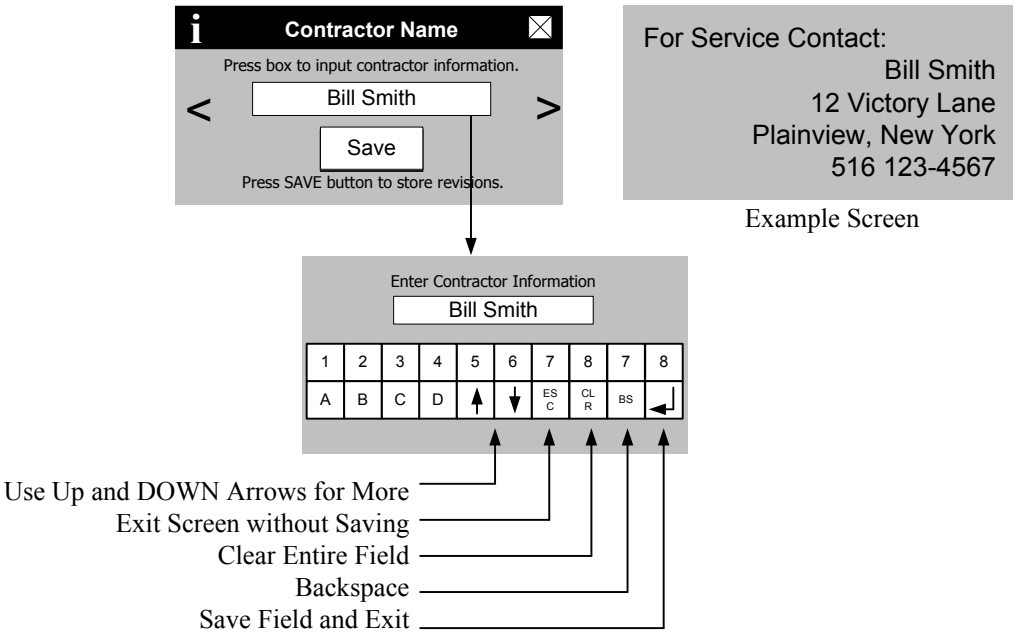
Multiple Boilers, IWH piped to primary, system pump required to run for any call for heat



	Sequencer Master (Boiler 1)	Boiler 2
Wiring locations:		
Thermostat	X	
DHW call for heat	X	
System pump	X	
DHW pump	X	
Boiler Pump	X	X
Sequencer Master Parameter Selections:		
Sequencer Master	Enabled	
Indirect Water Heater	"Primary Piped"	
Pump Parameter Selections:		
System Pump =	Any demand	Never
Boiler Pump =	Any demand	Any demand
DHW Pump =	Primary Loop Piped IWH	Never

Explanation:
This piping arrangement requires the system pump to be running for any calls for heat. Also the boiler pump must run for any call for heat.

"Press" Contractor Setup **button to access the following parameters:**

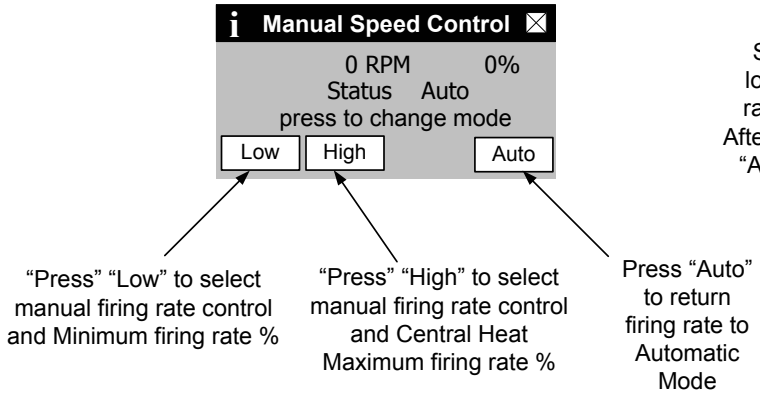


Example Screen

Factory Setting	Range / Choices	Parameter and Description
Contractor Name	User defined	Contractor Name
Address Line 1	User defined	Contractor Address Line 1
Address Line 2	User defined	Contractor Address Line 2
Phone	User defined	Contractor Phone

"Press" Manual Control **button to access the following screen:**

The Manual Speed Control speed screen allows the technician to set firing rate at low or high speed for combustion testing.



NOTE
Selecting "Low" or "High" locks (manual mode) firing rate at min or max Rate %. After combustion testing select "Auto" to return the boiler to normal operation.

"Press" Central Heat button to access the following parameters:

Factory Setting	Range / Choices	Parameter and Description
180°F	80°F to 190°F	**Central Heat Setpoint** Target temperature for the central heat priority. Value also used by the outdoor air reset function.
170°F	80°F to 190°F	**Central Heat Thermostat "Sleep" or "Away" Setback Setpoint** Thermostat setback setpoint is used when the EnviraCOM thermostat is in "leave" or "sleep" modes and sensed at E-COM terminals D, R, and C. When setback is "on" the thermostat setback setpoint shifts the reset curve to save energy while home is in a reduced room temperature mode. The reset curve is shifted by the difference between the High Boiler Water Temperature and the Thermostat Setback Setpoint. Honeywell VisionPro IAQ part number TH9421C1004 is a "setback" EnviraCOM enabled thermostat. When connected, it allows boiler water setback cost savings.
5°F	2°F to 10°F	**Central Heat Diff Above** The boiler stops when the water temperature rises 'Diff Above' degrees above the setpoint.
7°F	2°F to 30°F	**Central Heat Diff Below** The boiler starts when the water temperature drops 'Diff Below' degrees below the setpoint.
3	1 to 5	**Response Speed** This parameter adjusts the Central Heat temperature controller Proportion Integral Derivative (PID) values. Higher values cause a larger firing rate change for each degree of temperature change. If set too high firing rate "overshoots" required value, increases to high fire causing the temperature to exceed the "Diff Above" setpoint and cycle the boiler unnecessarily. Lower values cause a smaller firing rate change for each degree of temperature change. If set too low, the firing rate response will be sluggish and temperature will wander away from setpoint.

"Press" Domestic Hot Water button to access the following parameters:

Factory Setting	Range / Choices	Parameter and Description
170°F	80°F to 190°F	**Domestic Hot Water Setpoint** The Domestic Hot Water (DHW) Setpoint parameter is used to create a minimum boiler water temperature setpoint that is used when DHW heat demand is "on". When the DHW heat demand is not "on" (the contact is open or not wired) this setpoint is ignored.
160°F	80°F to 190°F	**Domestic Hot Water Thermostat "Sleep" or "Away" Setback Setpoint** Thermostat setback setpoint is used when the EnviraCOM thermostat is in "leave" or "sleep" modes and sensed at E-COM terminals D, R, and C. When setback is "on" the thermostat setback setpoint shifts the DHW setpoint to lower the DHW temperature and to save energy while home is in a reduced room temperature mode.
5°F	2°F to 10°F	**Domestic Hot Water Diff Above** The boiler stops when the water temperature rises 'Diff Above' degrees above the setpoint.
7°F	2°F to 30°F	**Domestic Hot Water Diff Below** The boiler starts when the water temperature drops 'Diff Below' degrees below the setpoint.
Enable	Enable Disable	**Domestic Hot Water Priority (DHWP)** When Domestic Hot Water Priority is Enabled and Domestic Hot Water (DHW) heat demand is "on" the DHW demand will take "Priority" over home heating demand. When the System and Boiler pumps are configured as "Central Heat (off DHW priority)" or "Central Heat, Optional Priority" then they will be forced "off" during DHW Priority. Priority protection time is provided to end DHWP in the event of a failed or excessive long DHW demand.
60 Minutes	30 to 120 Minutes	**Priority Time** When DHWP is Enabled the Priority Time Parameter appears and is adjustable.
3	1 to 5	**Response Speed** This parameter adjusts the Domestic Hot Water temperature controller Proportion Integral Derivative (PID) values. Higher values cause a larger firing rate change for each degree of temperature change. If set too high firing rate "overshoots" required value, increases to high fire causing the temperature to exceed the "Diff Above" setpoint and cycle the boiler unnecessarily. Lower values cause a smaller firing rate change for each degree of temperature change. If set too low, the firing rate response will be sluggish and temperature will wander away from setpoint.

"Press" [Outdoor Reset] button to access the following parameters:

Factory Setting	Range / Choices	Parameter and Description
Enabled	Enable Disable	**Outdoor Reset Enable** If an outdoor sensor is installed and Outdoor Reset is Enabled, the boiler will automatically adjust the heating zone set point temperature based on the outdoor reset curve in Figure 57. The maximum set point is defined by the Central Heat Setpoint (factory set to 180°F) when the outdoor temperature is 0°F or below. The minimum set point temperature shown is 130°F (adjustable as low as 80 F) when the outdoor temperature is 50°F or above. As the outdoor temperature falls the supply water target temperature increases. For example, if the outdoor air temperature is 30°F, the set point temperature for the supply water is 150°F. Disable Do Not Calculate setpoint based on outdoor temperature Enable Calculate the temperature setpoint based on outdoor temperature using a reset curve defined by Low Outdoor Temp, High Outdoor Temp, Low Boiler Water Temp, Min Boiler Temp and Central Heat Setpoint and Boost Time parameters.
0°F	-40°F to 100°F	**Low Outdoor Temperature** The Low Outdoor Temperature parameter is also called "Outdoor Design Temperature". This parameter is the outdoor temperature used in the heat loss calculation. It is typically set to the coldest outdoor temperature.
70°F	32°F to 100°F	**High Outdoor Temperature** The High Outdoor Temperature parameter is the outdoor temperature at which the Low Boiler Water Temperature is supplied. This parameter is typically set to the desired building temperature.
110°F	70°F to 190°F	**Low Boiler Water Temperature** The Low Boiler Water Temperature parameter is the operating setpoint when the High Outdoor Temperature is measured. If the home feels cool during warm outdoor conditions, the Low Boiler Water Temperature parameter should be increased.
130°F	80°F to 190°F	**Minimum Boiler Temperature** The Minimum Boiler Temperature parameter sets a low limit for the Reset setpoint. Set this parameter to the lowest supply water temperature that will provide enough heat for the type radiation used to function properly. Always consider the type of radiation when adjusting this parameter.
0 Minutes	0-1800 Seconds (0-30 Minutes)	**Boost Time** When the Central Heat Setpoint is decreased by Outdoor Reset settings, the Boost Time parameter is used to increase the operating setpoint when the home heat demand is not satisfied after the Boost Time setting is exceeded. When heat demand has been "on" continuously for longer than the Boost Time parameter the operating setpoint is increased by 10°F. The highest operating setpoint from Boost Time is current Central Heat Setpoint minus the Central Heat "Diff Above" setting. A setting of 0 seconds disables this feature.

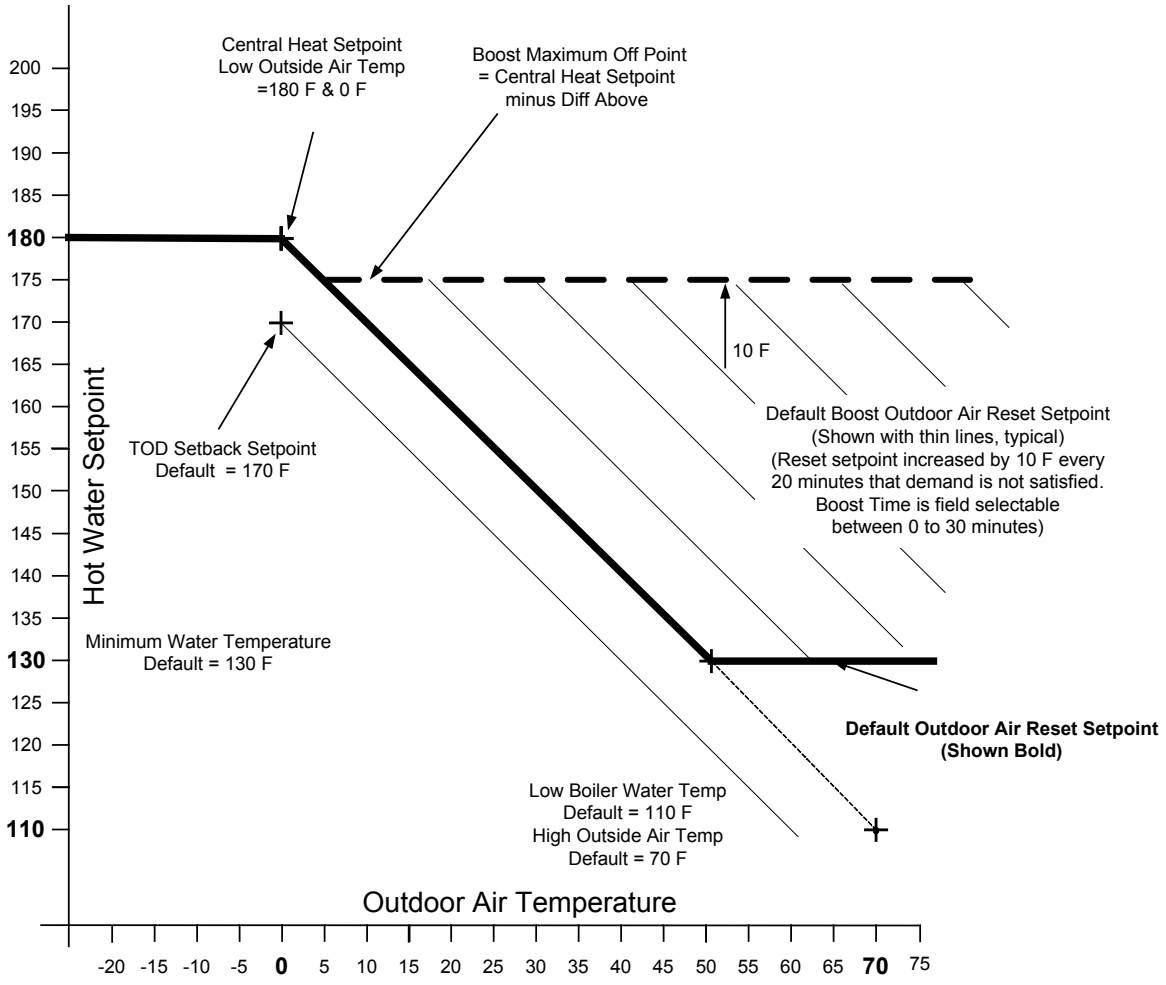
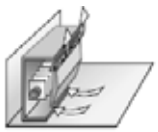
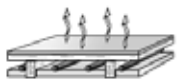


Figure 57: Outdoor Reset Curve

Central Heat Setpoint	Heating Element Type		Central Heat Setpoint	Heating Element Type	
180 to 190°F	Fan Coil		100 to 140°F	In Slab Radiant High Mass Radiant	
160 to 190°F	Convection Baseboard Fin Tube Convective		130 to 160°F	Staple-up Radiant Low Mass Radiant	
130 to 160°F	Radiant Baseboard		140 to 160°F	Radiators	

"Press" Remote 4-20mA button to access the following parameters:

Factory Setting	Range / Choices	Parameter and Description
Local	Local, 4-20mA	**Central Heat Modulation Source** This parameter enables the 4-20mA input to control firing rate and the thermostat input to control boiler on/off demand directly without using the internal setpoint. The 4-20mA selection is used to enable a remote multiple boiler controller to control the Sage2.1 Control: Local: 4-20mA Input on Terminal 9 & 10 is ignored. 4-20mA 4-20mA Input on Terminal 9 & 10 is used to control firing Rate % directly.
Local	Local, 4-20mA	**Central Heat Setpoint Source** Sets the remote (Energy Management System) control mode as follows: Local: Local setpoint and modulation rate is used. 4-20mA input on Terminal 9 & 10 is ignored. 4-20mA 4-20mA Input on Terminal 9 & 10 is used as the temperature setpoint. The following two parameters may be used to adjust the signal range.
130°F	80°F - Central Heat Setpoint	**Central Heat 4-20mAdc Setup, 4 mA Water Temperature*** Sets the Central Heat Temperature Setpoint corresponding to 4mA for signal input on terminal 9 & 10. Current below 4mA is considered invalid, (failed or incorrect wired input).
180°F	80°F - Central Heat Setpoint	**Central Heat 4-20mAdc Setup, 20 mA Water Temperature*** Sets the Central Heat Temperature Setpoint corresponding to 20mA for signal input on terminal 9 & 10. Current above 20mA is considered invalid, (failed or incorrect wired input).

* Only visible when Central Heat Setpoint Source is set to 4-20mA.

"Press" Sequence Master button to access the following parameters:

Factory Setting	Range / Choices	Parameter and Description
Disable	Enable, Disable	**Master Enable/Disable** The Sequencer Master Enable/Disable is used to "turn on" the Multiple Boiler Controller. Warning! enable ONLY one Sequence Master.
Boiler Piped	Boiler Piped, Primary Piped	**Indirect Water Heater (IWH)** Boiler Piped Sequencer to respond to an Isolated DHW demand that is piped to a single boiler. The individual boiler goes on "Leave" from the Sequencer Master and goes to DHW Service. Primary Piped The Sequence Master responds to the DHW Call For Heat. This allows one or more boilers to provide heat to the IWH.
Disabled	Enable, Disable	**DHW Two Boiler Start** The Sequencer to immediately start two boilers for a DHW call for heat. Used when DHW is the largest demand. Only visible when primary piped IWH is selected.
120 Secs	120 - 1200 Secs	**Boiler Start Delay** Slave boiler time delay after header temperature has dropped below the setpoint minus "Diff below" setpoint. Longer time delay will prevent nuisance starts due to short temperature swings.
195°F	Central Heat Setpoint, 195°F	**Stop All Boilers Setpoint** When this temperature is reached all boilers are stopped. This setpoint allows the Sequencer to respond to rapid load increases.
50%	50% - 100%	**Base Load Common Rate** To maximize condensing boiler efficiency, the firing rate is limited to an adjustable value. Boilers are kept at or below this firing rate as long as the boilers can handle the load. After last available boiler has started, the modulation rate limit is released up to 100%.
3	1-5	**Response Speed** This parameter adjusts the Sequence Master temperature controller Proportion Integral Derivative (PID) values. Higher values cause a larger firing rate change for each degree of temperature change. If set too high firing rate "overshoots" required value, increases to high fire causing the temperature to exceed the "Diff Above" setpoint and cycle the boiler unnecessarily. Lower values cause a smaller firing rate change for each degree of temperature change. If set too low, the firing rate response will be sluggish and temperature will wander away from setpoint.

"Press" Sequence Slave button to access the following parameters:

Factory Setting	Range / Choices	Parameter and Description
None	1-8	**Boiler Address** Each boiler must be given a unique address. When "Normal" slave selection order is used, the boiler address is used by the Master Sequencer as the boiler start order. The boiler address is also the Modbus Address when a Energy Management System is connected.
Normal	Use Boiler First, Normal, Use Boiler Last	**Slave Selection Order** "Use Boiler First"; places the Slave in the lead permanently. "Normal"; firing order follows boiler number (1,2,3,..) order. "Use Boiler Last"; places the slave last in the firing order.

XI. Service and Maintenance

DANGER

This boiler uses flammable gas, high voltage electricity, moving parts, and very hot water under high pressure. Assure that all gas and electric power supplies are off and that the water temperature is cool before attempting any disassembly or service.

Do not attempt any service work if gas is present in the air in the vicinity of the boiler. Never modify, remove or tamper with any control device.

WARNING

This boiler must only be serviced and repaired by skilled and experienced service technicians.

If any controls are replaced, they must be replaced with identical models.

Read, understand and follow all the instructions and warnings contained in all the sections of this manual.

If any electrical wires are disconnected during service, clearly label the wires and assure that the wires are reconnected properly.

Never jump out or bypass any safety or operating control or component of this boiler.

Read, understand and follow all the instructions and warnings contained in ALL of the component instruction manuals.

Assure that all safety and operating controls and components are operating properly before placing the boiler back in service.

Annually inspect all vent gaskets and replace any exhibiting damage or deterioration.

NOTICE

Warranty does not cover boiler damage or malfunction if the following steps are not performed at the intervals specified.

A. Continuously:

1. Keep the area around the boiler free from combustible materials, gasoline and other flammable vapors and liquids.
2. Keep the area around the combustion air inlet terminal free from contaminates .
3. Keep the boiler room ventilation openings open and unobstructed.

B. Monthly Inspections:

1. Inspect the vent piping and outside air intake piping to verify they are open, unobstructed and free from leakage or deterioration. Call the service technician to make repairs if needed.
2. Inspect the condensate drain system to verify it is leak tight, open and unobstructed. Call the service technician if the condensate drain system requires maintenance.
3. Inspect the flue temperature sensor cap to verify that it is free from leakage and deterioration. Call the Service Technician to make repairs, if needed.
4. Inspect the water and gas lines to verify they are free from leaks. Call the service technician to make repairs if required.

CAUTION

Water leaks can cause severe corrosion damage to the boiler or other system components. Immediately repair any leaks found.

C. Annual Inspections and Service: In addition to the inspections listed above the following should be performed by a service technician once every year.

1. If equipped, test the low water cutoff by pressing the "Test" button located at its end. The yellow light should come on and "Limit Open" will flash in the Active Faults screen on the display. Push the reset button to restore normal operation. If yellow light does not come on, determine why the low water cutoff is not working properly.
2. Follow the procedure for turning the boiler off per Figure 51 "Lighting Instructions".
3. Inspect the wiring to verify the conductors are in good condition and attached securely.

CAUTION

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

4. Remove the igniter assembly and flame sensor and inspect them for oxide deposits. Clean the oxide deposits from the igniter electrodes and flame sensor rod with steel wool. **Do not use sandpaper for the cleaning.** Inspect the ceramic insulators for cracks and replace the igniter assembly and/or flame sensor if necessary. Check the igniter electrode spacing gap. Refer to Figure 58 "Igniter Electrode Gap" for details.

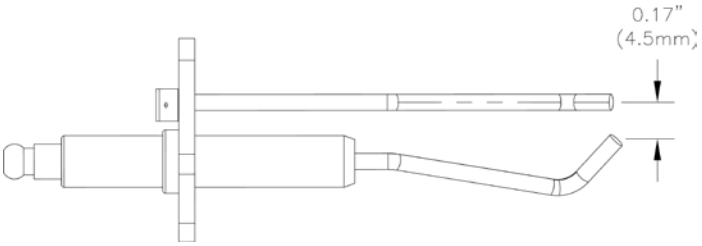


Figure 58: Igniter Electrode Gap

5. To gain access to boiler burner and combustion chamber firstly disconnect and remove gas inlet piping from gas valve, than, remove six M6X1 hex flange nuts and take out the blower/gas valve/burner assembly from the boiler.
6. Inspect the assembly for lint and dust presence. If significant lint and dust accumulations are found, disassemble the blower/gas valve assembly to expose the swirl plate and blower inlet (see the exploded diagram in the parts list at the back of this manual). Vacuum these parts as required, being careful not to damage the vanes on the swirl plate.
7. Vacuum any dust or lint from the burner if present. If the burner shows any visual deterioration or corrosion signs, replace it immediately. Inspect the burner gasket and replace, if necessary.
8. Inspect the heat exchanger combustion chamber, clean and vacuum any debris found on the surfaces. If required, brush the coils of the heat exchanger using a non-metal wire flexible brush. **Any cleaning of the combustion chamber with acid or alkali products is prohibited.** Remove insulation disc and clean the surfaces by flushing with clean water. If the disc has signs of damage, it must be replaced. Drain and flush the inside of the heat exchanger and condensate collector. Do not use any cleaning agents or solvents. Re-install insulation disc upon cleaning completion..
9. Inspect the condensate trap to verify it is open and free from debris. Inspect condensate line integrity between boiler and condensate neutralizer (if used), condensate neutralizer and the drain. Clean/repair if needed.

   If the condensate neutralizer is used, check pH before and after the neutralizer to determine neutralizing effectiveness. Replace limestone chips and clean out the neutralizer if needed.
10. Inspect the flue temperature sensor cap to verify that it is free from leakage and deterioration, replace, if needed.
11. Inspect vent connections and vent connector to heat exchanger seals to verify that they are free from leakage and deterioration, repair as needed.
12. Reinstall the gas valve/blower/burner assembly and secure with M6X1 hex flange nuts.
13. Reconnect any wiring which has been disconnected.
14. Inspect the heating system and correct any other deficiencies prior to restarting the boiler.
15. Follow Section IX "System Start-up" before leaving installation.
16. Perform the combustion test outlined in Section IX "System Start-up".
17. Verify that the system PH is between 7.5 and 9.5.
18. Check for vent terminal obstructions and clean as necessary.

D. Recommended Heating System Water Treatment Products:

1. System Cleaning and Conditioning:
   a. The following heating system water treatment products are recommended for an initial existing heating system sludge removal, initial boiler cleaning from copper dust, flux residue and any boiler debris and for preventive treatment as corrosion/scale inhibitors:
      i. Fernox™ Restorer (universal cleaner, sludge remover, scale remover, flux residue/debris remover, corrosion inhibitor)
      ii. Fernox™ Protector (Alphi 11, CH#, Copal) (sludge remover, corrosion inhibitor)

      Follow manufacturer application procedure for proper heating system/boiler cleaning and preventive treatment.

      Above referenced products are available from Cookson Electronics Company, 4100 Sixth Avenue, Altoona, PA 16602, Tel: (814) 946-1611 and/or selected HVAC distributors. Contact Burnham Commercial for specific details.
      iii. Equivalent system water treatment products may be used in lieu of products referenced above.
2. System Freeze Protection:
   a. The following heating system freeze protection products are recommended for Apex boilers:

i. Fernox™ Protector Alphi 11 (combined antifreeze and inhibitor).

Follow manufacturer application procedure to insure proper antifreeze concentration and inhibitor level.

Above referenced product is available from Cookson Electronics Company, 4100 Sixth Avenue, Altoona, PA 16602, Tel: (814) 946-1611 and/or selected HVAC distributors. Contact Burnham Commercial for specific details.

b. Equivalent system freeze protection products may be used in lieu of product referenced above. In general, freeze protection for new or existing systems must use specially formulated glycol, which contains inhibitors, preventing the glycol from attacking the metallic system components. Insure that system fluid contains proper glycol concentration and inhibitor level. The system should be tested at least once a year and as recommended by the manufacturer of the glycol solution. Allowance should be made for expansion of the glycol solution.

CAUTION

Use only inhibited propylene glycol solutions specifically formulated for hydronic systems. Do not use ethylene glycol, which is toxic and can attack gaskets and seals used in hydronic systems.

E. Condensate Overflow Switch and Condensate Trap Removal and Replacement:

For removal or replacement of the condensate overflow switch and/or condensate trap follow the steps below. For parts identification, refer to Section XIII "Repair Parts".

1. Condensate Overflow Switch Removal and Replacement:
   a. Disconnect power supply to boiler.
   b. Remove two (2) wire nuts and disconnect overflow switch wire pigtails from boiler wiring.
   c. Using pliers, release spring clip securing the overflow switch to condensate trap body and remove the switch. Note that the switch has factory applied silicon adhesive seal, which may have to be carefully cut all around to facilitate the switch removal.
   d. Insure the trap overflow switch port is not obstructed with silicon seal debris, clean as needed.
   e. **Apply silicon seal to the replacement switch threads and install the switch into the trap body making sure it is properly oriented - the arrow molded into the switch hex end side must face down for proper switch operation. See Figure 59 "Condensate Overflow Switch Orientation" for details.**
   f. Reconnect the switch wire pigtails to the boiler wiring and secure with wire nuts.
   g. Restore power supply to boiler. Fill up the trap (see Section V "Condensate Disposal") and verify the switch operation.
2. Condensate Trap Removal and Reinstallation:
   a. Disconnect power supply to boiler.
   b. Remove two (2) wire nuts and disconnect overflow switch wire pigtails from boiler wiring.
   c. Disconnect pressure switch hose from condensate trap.
   d. Disconnect outside condensate compression fitting from condensate trap stab.

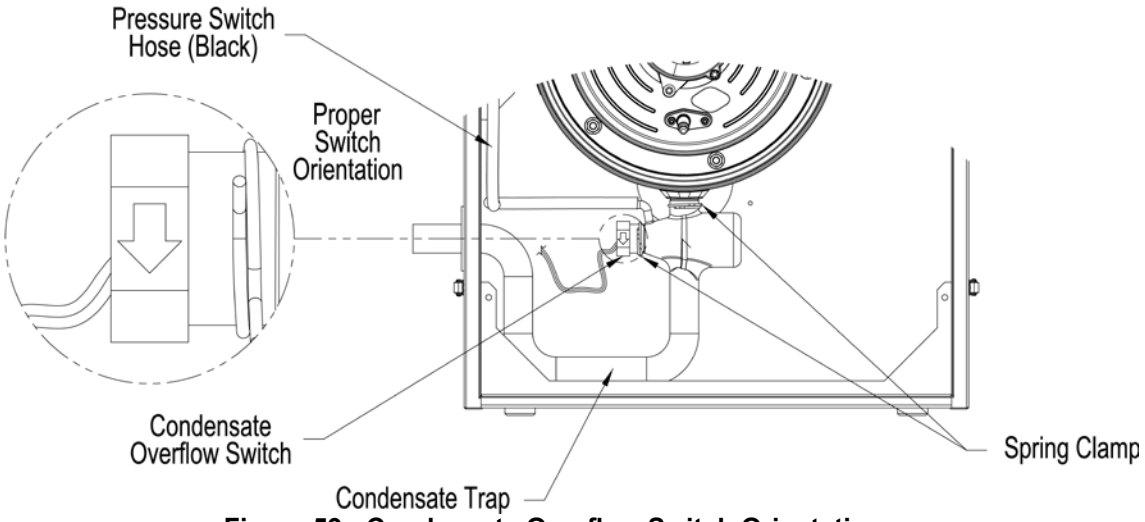


Figure 59: Condensate Overflow Switch Orientation

e. Using pliers, release spring clip securing the overflow switch to condensate trap body and remove the switch. Note that the switch has factory applied silicon adhesive seal, which may have to be carefully cut all around to facilitate the switch removal.

f. Using pliers, release spring clip securing condensate trap body to the heat exchanger bottom drain stab.

g. Firstly, pull the trap downwards to release from the heat exchanger bottom drain stab; secondly, pull the trap end from left side jacket panel sealing grommet and remove the trap from boiler.

h. To reinstall the trap, reverse above steps.

i. If the original condensate overflow switch is to be re-used, follow the appropriate switch removal steps from Condensate Overflow Switch Removal and Replacement procedure above.

j. **Insure that fresh silicon sealant is applied to the overflow switch threads, and the switch is properly oriented relative to the trap body - the arrow molded into the switch hex side end must face down for proper switch operation. See Figure 59 "Condensate Overflow Switch Orientation" for details. Insure that pressure switch hose is reconnected to the trap.**

k. Restore power supply to boiler. Fill up the trap (see Section V "Condensate Disposal") and verify the switch operation.

Outdoor Air Temperature Sensor Temperature versus Resistance (P/N 102946-01)

(10kOhm NTC Sensor)

Outdoor Temperature		Ohms of Resistance
°F	°C	
-20	-28.9	106926
-10	-23.3	80485
0	-17.8	61246
10	-12.2	47092
20	-6.7	36519
30	-1.1	28558
40	4.4	22537
50	10.0	17926
60	15.6	14356
70	21.1	11578
76	24.4	10210
78	25.6	9795
80	26.7	9398
90	32.2	7672
100	37.8	6301
110	43.3	5203
120	48.9	4317

Header Temperature Sensor Temperature versus Resistance (P/N 101935-01 or 103104-01)

(10kOhm NTC Sensor), Beta of 3950

Temperature		Ohms of Resistance
°F	°C	
32	0	32648
50	10	19898
68	20	12492
77	25	10000
86	30	8057
104	40	5327
122	50	3602
140	60	2488
158	70	1752
176	80	1256
194	90	916
212	100	697
248	120	386

Supply, Return and Stack Temperature Sensor Temperature versus Resistance

(12kOhm NTC Sensor), Beta of 3750

Temperature		Ohms of Resistance
°F	°C	
32	0	36100
50	10	22790
68	20	14770
77	25	12000
86	30	9810
104	40	6653
122	50	4610
140	60	3250
158	70	2340
176	80	1710
194	90	1270
212	100	950
230	110	730
248	120	560

XII. Troubleshooting

WARNING

Turn off power to boiler before working on wiring.

A. Troubleshooting problems where no error code is displayed.

Condition	Possible Cause
Boiler not responding to call for heat, “Status” and “Priority” show “Standby”.	Boiler is not seeing call for heat. Check thermostat or zone wiring for loose connection, miswiring, or defective thermostat/zone control.
Boiler not responding to a call for heat, “Status” shows “Standby” and “Priority” shows Central Heat or Domestic Hot Water.	Boiler is not firing, temperature is greater than setpoint.
Boiler Running but System or Boiler Circulator is not running	• Check wiring for loose connection, miswiring • When there is a Domestic Hot Water Heat Request the System or Boiler pumps will be forced “off” when there “Run Pump for” parameter is set to “Central heat, off DHW demand” or “Central Heat, Optional Priority”. This has been set to allow all of the heat to be provided for fast indirect water heater recovery. After one hour of “priority protection” or the end of the Domestic Hot Water Heat Request the system and boiler pumps will be free to run.
Home is cold during mild weather days	• Increase Low Boiler Water Temperature parameter 5°F per day.
Home is cold during cold weather days	• Increase High Boiler Water Temperature parameter 5°F per day

B. Display Faults:

Faults are investigated by selecting the “Help” button from the “Home” screen. When a fault is active the “Help” button flashes and the home screen turns a red color. Continue to select flashing buttons to be directed to the Fault cause.

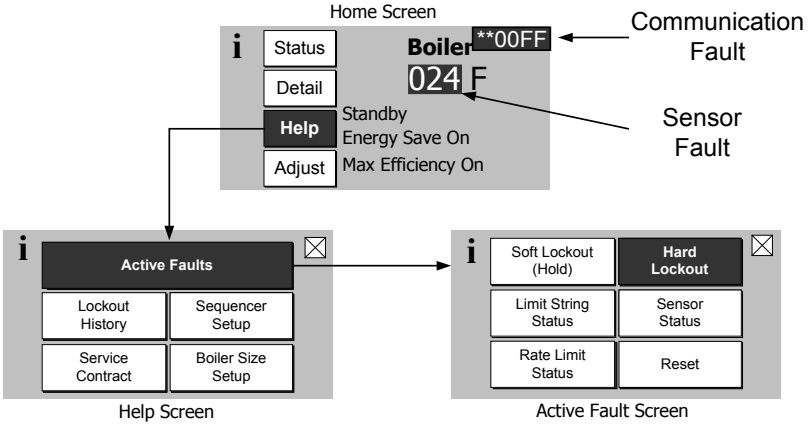


Figure 60: Help Menu

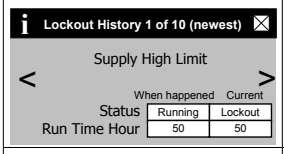
Indication	Condition	Possible Cause
Display Completely Dark Fan off, LWCO lights off, no green power light on Control	No 120Vac Power at Boiler	Check breaker and wiring between breaker panel and boiler.
Display Completely Dark, Fan running	No 24Vac Power to Control	- Loose 120Vac connection wiring between boiler J-Box and transformer - Loose 24 Vac connection wiring between transformer and Control.
Blinking Green power light on Control	Control Fault	- The green light is connected to internal power supply. The power supply is repeatedly starting and stopping (not normal) making the light flash. The microprocessors are not running. - Try disconnecting all terminals except 24VAC to power the Control. The green light should be steady. If it is not then the control is defective. If steady, start plugging in all the connectors while watching the green light. When faulty wiring reconnected green light will begin to flash.
Display Completely Dark but Boiler fires	No 5 Vdc Power to Display	- Loose 5 Vdc connection wiring between display and Control - Defective display.
****00FF**	Display lost communication with control	- Loose or defective display harness - Defective Display - Defective Control
ER0011	Adjustment Mode Password Timeout	- The Control and Display are **NOT** defective. The password has timed out. Simply cycle power to the Display to restore operation.

XII. Troubleshooting (continued)

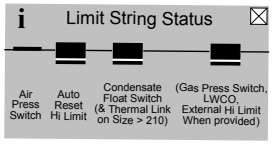
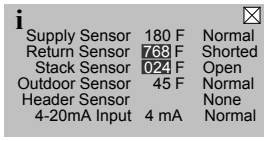
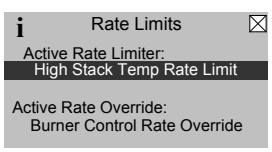
C. Help Screen Faults

Indication	Condition	Possible Cause
 Flashing	Sequencer Setup Fault	This alarm is active if the slave boiler has lost communication with the Sequence Master. Check the following: - RJ 45 peer-to-peer network disconnected - Sequencer Master was Enabled and then Disabled - Master's Boiler has been powered down. - To clear fault restore communication or cycle power
 Flashing	Boiler Size Fault	**WARNING!** Boiler size setting may not match actual boiler size. The Boiler size setting determines min, max and light-off blower speeds. Incorrect boiler size can cause hazardous burner conditions and improper operation that may result in PROPERTY LOSS, PHYSICAL INJURY, OR DEATH. Refer to Page 92 for boiler size setting instructions.

D. Help Screen Diagnostic Features

Indication	Possible Cause
	Lockout History is stored in a first-in, first-out basis. Each History file is stored with boiler run hour of when the lockout occurred. The "When happened" and "Current" provide: - "Current" is the run hour and status the boiler just finished. - "When happened" is the run hour and status when the lockout occurred.
	The user is given the contact information of the responsible service provider. Refer to page 96 for data entry instructions.

E. Active Fault Screen Faults

Indication	Condition	Possible Cause
Limit String Status 	Limit String Fault	The Limit String Status screen shows the faulty safety limit. A contact icon, either "open" or "closed", graphically represents each safety limit. The "closed" contact icon is steady; the "open" contact icon is blinking. For example, the screen shown to the left illustrates a "closed" Air Pressure Switch contact and an "open' Auto Reset High Limit contact. The Auto Reset High Limit is causing the boiler to stop firing. NOTE: Since the limit string items are wired in series, all limits downstream of the "open" limit will also appear on the screen as "open" (blinking) icons regardless of whether or not they are actually open.
Sensor Status 	Sensor Fault	The Sensor Status screen shows the status of all sensors. Possible states include: None: Feature requiring this sensor has not been selected. Normal: Sensor is working normally. Shorted: Sensor is shorted or is defective. Open: There is a break in the wiring between the Control and the sensor or the sensor is defective Out of Range: Sensor is defective or is being subjected to electrical noise. Unreliable: Sensor is defective or is being subjected to electrical noise. When a sensor fails "opened" or "shorted" the value is changed to reverse video (background black and value white) "024" or "768" respectively to indicate that there is a fault with the sensor.
Rate Limit 	High Stack Temperature Rate Limit	The following messages appear when the firing rate is limited or reduced to help avoid a lockout. Refer to lockout section for potential corrective action. - High Stack Temperature Limit - High Supply Temperature Limit - High Differential Temperature Limit The following messages appear as part of a normal start and stop sequence: - Minimum Modulate (normal start/stop sequence) - Forced Modulation (normal start/stop sequence) - Burner Control Rate (normal start/stop sequence) - Manual Firing Rate (User selection)

XII. Troubleshooting (continued)

F. Troubleshooting problems where a Soft Lockout Code is displayed. When a soft lockout occurs, the boiler will shut down, the display will turn red and the "Help" button will "blink". Select the "blinking" "Help" button to determine the cause of the soft lockout. The boiler will automatically restart once the condition that caused the lockout is corrected.

Soft Lockout Codes Displayed

Lockout Number	Condition	Possible Cause
1 Anti Short Cycle	Minimum time between starts has not been reached. Normal delay used to avoid excessive cycles.	
2 Boiler Safety Limit Open	Boiler Safety Limit wired to terminals J6-1, 2 or 3 OPEN: • Condensate Trap Float Switch contact open. • Thermal Link Switch contact open. • Burner Door Thermostat with manual reset contact open. • Air Pressure Switch contact open. • Auto Reset High Limit contact open.	• Loose wiring to limit device. • Auto Reset Supply high limit sensor detected temperature in excess of 200°F. • Defective Auto Reset Supply High Limit Switch. • Plugged Condensate Trap - also check to ensure boiler is level. • ***Thermal Link Switch blown due to temperature rise above 604°F (318°C).*** • Burner Door Thermostat with manual reset contact open due to temperature rise above 500°F (260°C) - check the cause of overheating (burner door insulation, loose mounting, etc.). • Air Pressure Switch contact open - check for blocked vent. • See possible causes for "Hard Lockout 4". NOTE Block Vent Special Note Before a call for heat the air pressure switch is closed. When there is a call for heat with a blocked vent the air pressure switch will open (due to excessive pressure of the blower against a blocked flue pipe) after the blower starts. The control stops the start sequence and stops the blower. After the blower stops the pressure switch re-closes and the cycle continues. The displays shows the cause of trip for only the time the pressure switch is open.
3 Boiler Safety Limit Open	Boiler Safety Limit, or External Limit wired to terminals J5-1 OPEN: • Jumper for External Limit wired to terminals 11 and 12 or device connected to it open. • Jumper for Low Water Cutoff (LWCO) Switch or device connected to it open. • Jumper for Low Gas Pressure Switch or device connected to it open.	• See possible causes for "Hard Lockout 4". • Loose wiring to limit device. • External Limit defective or jumper not installed. • Low Gas Pressure Switch contact open (if installed). • LWCO switch not installed and jumper missing. • If yellow light on LWCO is on, system is low on water. • If neither yellow or green light is on, check LWCO harness.
7 Return sensor fault	Shorted or open return temperature sensor.	• Shorted or mis-wired return sensor wiring. • Defective return sensor.
8 Supply sensor fault	Shorted or open supply temperature sensor.	• Shorted or mis-wired supply sensor wiring. • Defective supply sensor.
9 DHW sensor fault	Shorted or open Domestic Hot Water (DHW) temperature sensor.	• Shorted or mis-wired DHW sensor wiring. • Defective DHW sensor.
10 Stack sensor fault	Shorted or open flue gas (stack) temperature sensor.	• Shorted or mis-wired stack sensor wiring. • Defective stack sensor.
11 Ignition failure	Flame failure after 5 tries to restart.	• No gas pressure. • Gas pressure under minimum value shown on rating plate. • Gas line not completely purged of air. • Defective Electrode. • Loose burner ground connection. • Defective Ignition Cable. • Defective gas valve (check for 24 Vac at harness during trial for ignition before replacing valve). • Air-fuel mixture out of adjustment - consult factory.
13 Flame rod shorted to ground	Flame rod shorted to ground	• Shorted or mis-wired flame rode wiring. • Defective flame rod.
14 ΔT inlet/outlet high	Temperature rise between supply and return is too high.	• Inadequate boiler water flow. Verify that circulator is operating and that circulator and piping are sized per Section VI of this manual.
15 Return temp higher than supply	The Control is reading a return sensor temperature higher than the supply sensor temperature. Condition must be present for at least 75 seconds for this error code to appear.	• Flow through boiler reversed. Verify correct piping and circulator orientation. • No boiler water flow. Verify that system is purged of air and that appropriate valves are open. • Sensor wiring reversed. • Supply or return sensor defective.
16 Supply temp has risen too quickly	Supply water temperature has risen too quickly.	• See possible causes for "Hard Lockout 4". • Inadequate boiler water flow. • Verify that circulator is operating and that circulator and piping are sized per Section VI of this manual.
17 Blower speed not proved	Normal waiting for blower speed to match purge and light-off setpoint.	

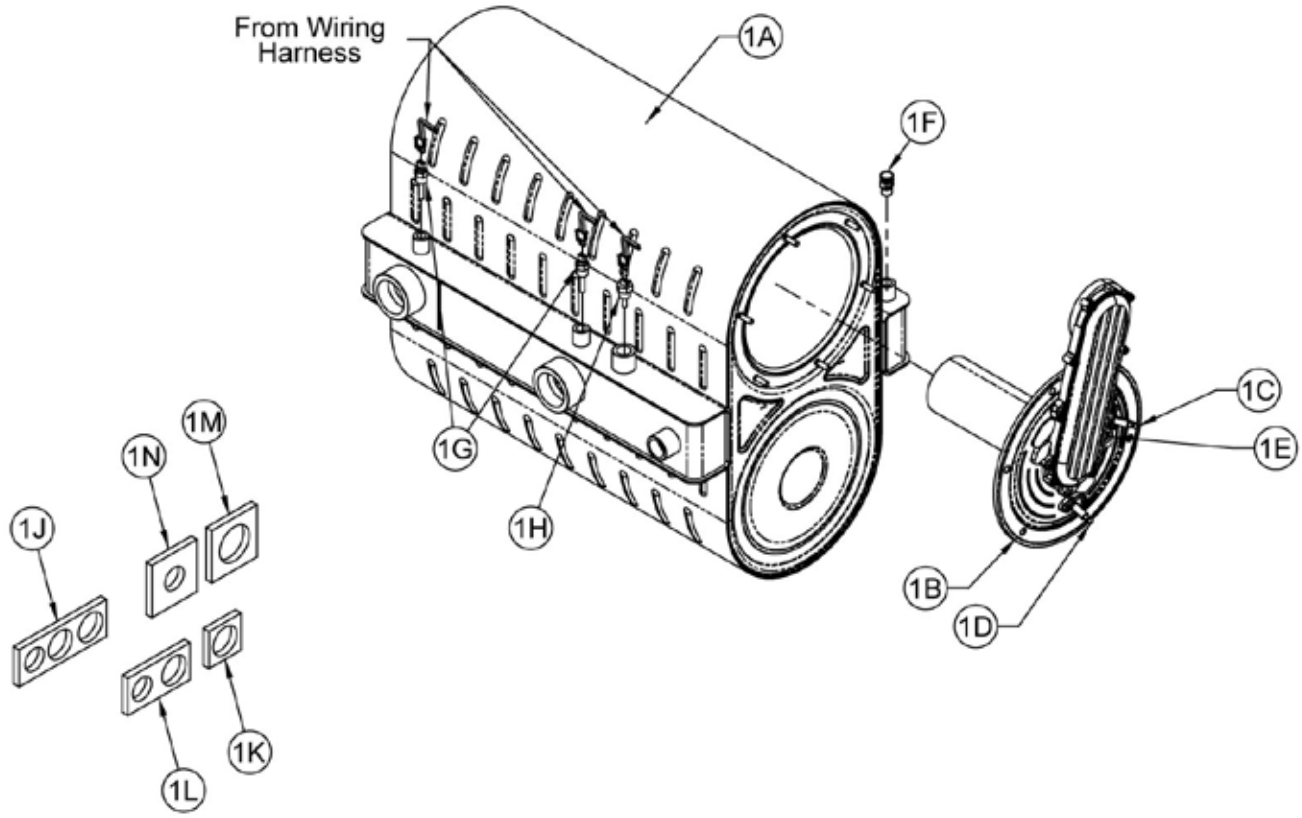
G. Troubleshooting problems where a Hard Lockout Code is displayed. When a hard lockout occurs, the boiler will shut down, the display will turn red and the "Help" button will "blink". Select the "blinking" "Help" button to determine the cause of the Hard Lockout. Once the condition that caused the lockout is corrected, the boiler will need to be manually reset using the Reset button on the "Active Fault" display or located on the Sage2.1 Control.

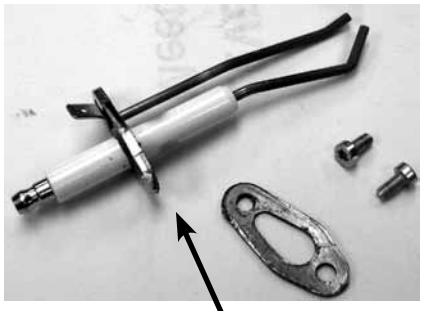
Hard Lockout Codes Displayed

Lockout Number	Condition	Possible Cause
4 Supply high limit	Sage2.1 supply sensor detected temperatures in excess of 210°F.	• Heating load at time of error was far below the minimum firing rate of the boiler. • Defective system circulator or no flow in primary loop. • Defective boiler circulator or no flow in boiler loop. • Control system miswired so that the boiler operation is permitted when no zones are calling.
5 DHW high limit	Sage2.1 DHW sensor detected temperatures in excess of Setpoint.	• DHW load at time of error was far below the minimum firing rate of the boiler. • Control system miswired so that boiler operation is permitted when no DHW are calling.
6 Stack High limit	Sage2.1 Flue gas (Stack) sensor detected temperatures in excess of 204°F.	• Heat exchanger needs to be cleaned. • Boiler over-fired. • Air-fuel mixture out of adjustment - consult factory.
12 Flame detected out of sequence	A flame signal was present when there should be no flame.	• Defective gas valve - make sure inlet pressure is below maximum on rating plate before replacing valve.
18 Light off rate proving failed	Blower is not running at Light-off rate when it should or blower speed signal not being detected by Sage2.1.	• Loose connection in 120 VAC blower wiring. • Loose or miswired blower speed harness. • Defective blower
19 Purge rate proving failed	Blower is not running at Purge rate when it should or blower speed signal not being detected by Sage2.1.	• Loose connection in 120 VAC blower wiring. • Loose or miswired blower speed harness. • Defective blower
20 Invalid Safety Parameters	Unacceptable Sage2.1 control Safety related parameter detected.	Safety Parameter verification required. Contact factory.
21 Invalid Modulation Parameter	Unacceptable Sage2.1 control Modulation related parameter detected.	Reset the control.
22 Safety data verification needed	Safety related parameter change has been detected and a verification has not been completed.	Safety related Sage2.1 control parameter has been changed and verification has not been performed.
23 24VAC voltage low/high	Sage2.1 control 24Vac control power is high or low.	• Loose connection in 24Vac VAC power wiring. • Loose or miswired 24Vac harness. • Miswired wiring harness causing power supply short to ground. • Defective transformer. • Transformer frequency, voltage and VA do not meet specifications.
24 Fuel Valve Error	Power detected at fuel valve output when fuel valve should be off.	• Loose or defective gas valve harness. Check electrical connections. • Defective gas valve (check for 24 Vac at harness during trial for ignition before replacing valve).
25 Hardware Fault	Internal control failure.	• Reset the control. If problem reoccurs, replace the Sage.
26 Internal Fault	Internal control failure.	• Reset the control. If problem reoccurs, replace the Sage.
27 Ignition failure	Model APX500 and APX800: Flame failure after 1 try to restart.	• No gas pressure. • Gas pressure under minimum value shown on rating plate. • Gas line not completely purged of air. • Defective Electrode. • Loose burner ground connection. • Defective Ignition Cable. • Defective gas valve (check for 24 Vac at harness during trial for ignition before replacing valve). • Air-fuel mixture out of adjustment - consult factory.

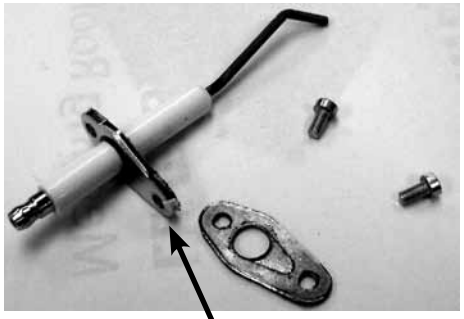
XIII. Repair Parts

All Apex™ Series Repair Parts may be obtained through your local Burnham Commercial Cast Iron Wholesale distributor. Should you require assistance in locating a Burnham Commercial Cast Iron distributor in your area, or have questions regarding the availability of Burnham Commercial Cast Iron products or repair parts, please contact Burnham Commercial Cast Iron Customer Service at (888) 791-3790 or Fax (877) 501-5211.





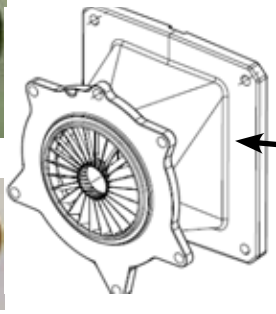
1C



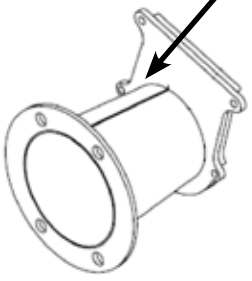
1D

1E

1P-1

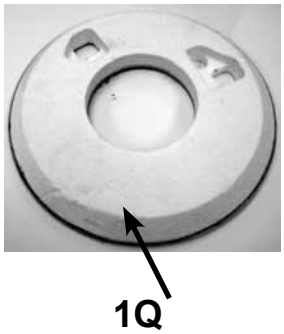


1P-2



1P-3

XIII. Repair Parts (continued)



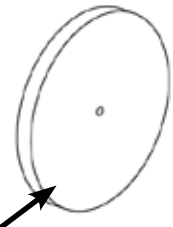
1Q

1R

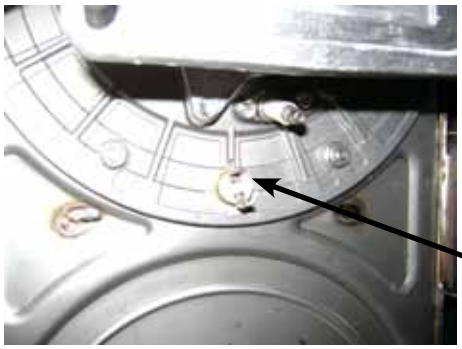
1S

1T

1U



1V

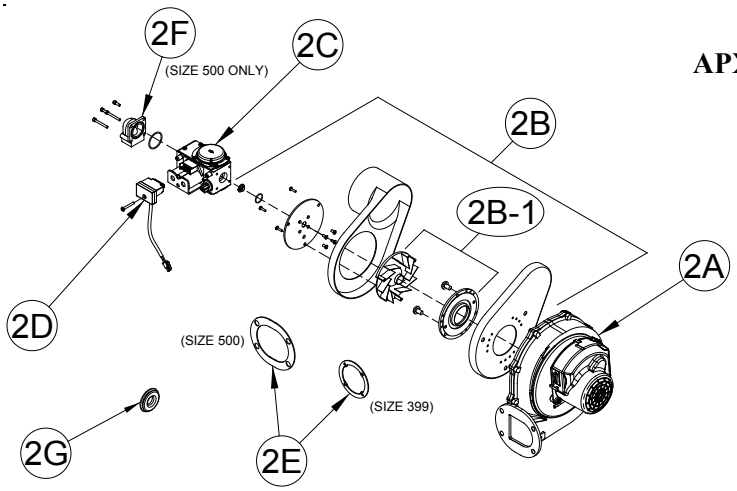


1W

Key No.	Description	(Quantity) Part Number		
		APX399	APX500	APX800
1A	Bare Heat Exchanger	101931-06	101931-07	103261-01
1B	Burner Head Assembly	101933-06	101933-07	103108-01
1C	Replacement Igniter Kit	103005-01	103005-02	103308-01
1D	Replacement Flame Sensor Kit	103339-01		103310-01
1E	Replacement Partially Assembled Burner Door	102696-01		104597-01
1F	Air Vent Valve	101586-01		
1G	Water Temp Sensor	(2) 101685-01		
1H	High Limit	101653-01		
1J	Gasket, Header (All Three)	N/A		
1K	Gasket, Header, 1” NPT	N/A		
1L	Gasket, Header, 1” & 3/4” NPT	N/A		
1M	Gasket, Header, 1-1/2” NPT	101372-03		
1N	Gasket, Header, 3/4” NPT	101372-01		
1P-1	Gas/Air Intake Duct Assembly	101725-02	N/A	N/A
1P-2	Gas/Air Intake Duct Assembly	N/A	N/A	103338-01
1P-3	Gas/Air Intake Duct Weldment	N/A	102615-01	N/A
1Q	Burner Plate Insulation (Warning: Contains RCF, Not Shown)	101728-01		103610-01
1R	Burner Plate Inner Seal	101729-01		
1S	Burner Plate Outer Seal	101730-01		
1T	Burner Head	101731-06	102658-01	104584-01
1U	Burner Head Seal	101732-01		
1V	Insulation Disc (Warning: Contains RCF)	101996-02		
1W	Burner Door Thermostat with Manual Reset	104569-01		
	M6x1 Hex Flange Nut (Not Shown)	(6) 101724-01		
	M5x14 mm Pan Hd Thread Forming Screw, T25 Drive (Not Shown)	(4) 101742-01	N/A	
	M5x10mm Pan Hd Thread Forming Screw, Phillips Drive (Not Shown)	N/A	(5) 102671-01	
	Thermal Link Switch (Backside of Duo Heat Exchanger) (Not Shown)	103321-01		
	Flue Exit Gasket Kit (Inside of Vent Termination of Heat Exchanger), (Not Shown)	104501-01		104502-01

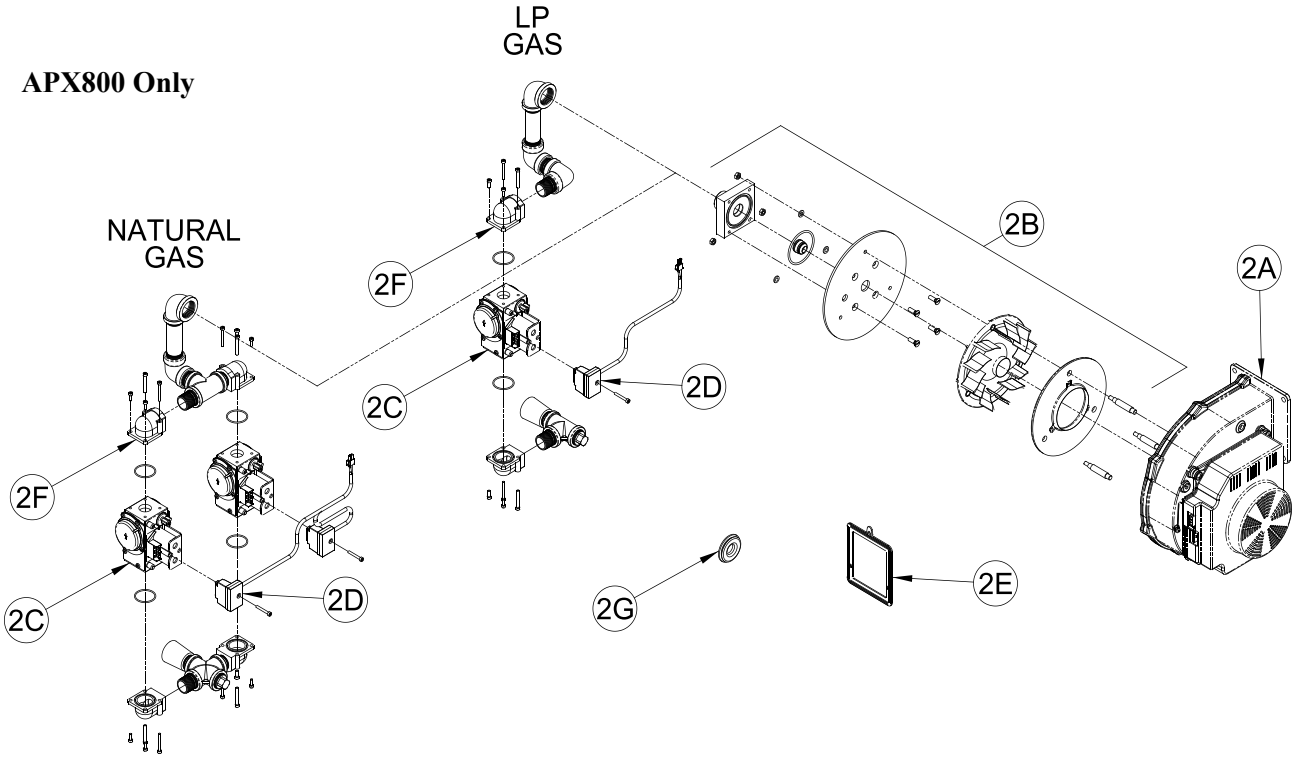
XIII. Repair Parts (continued)

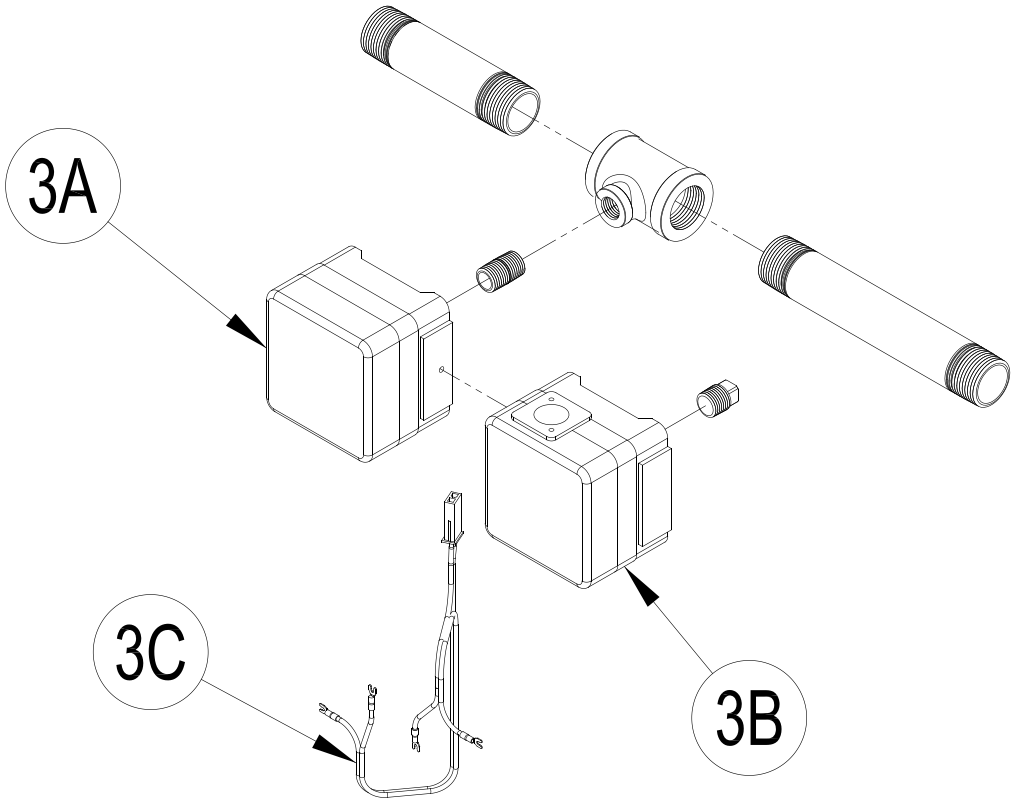
APX399 and APX500 Only



Key No.	Description	(Quantity) Part Number		
		APX399	APX500	APX800
2A	Blower	101530-01	101531-01	103222-01
2B	Blower Inlet Shroud Assembly (includes Gas Orifice; Gas Orifice O-Ring; (3x) M4x20 mm or (3x) M4x25 mm Self-threading Screws; Injector Plate; (4x) M4 x 10 mm Flat Head Screws; Air Intake Adapter - Air Connection Side; Swirlplate; (2x) M5 x 16 mm Phillips Flat Head Screws; Blower Adapter Plate; Air Intake Adapter - Blower Side).	101704-04	101704-05	103223-01
2B-1	Blower Inlet Repair Kit (includes Blower Adapter Plate, Swirlplate and Mounting Hardware)	104620-04	104620-05	N/A
2C	Gas Valve	102975-06	102975-07	(2) 103224-01 (Nat. Gas)
				103299-01 (LP)
2D	Gas Valve Harness with Plug	102971-01		103300-01 (LP)
	Gas Valve Harness with Two Plugs	N/A		103225-01 (Nat. Gas)
2E	Blower Outlet Gasket	101345-01	102614-01	103263-01
2F	Gas Valve Flange Kit	N/A	102972-03	(4) 102972-03
2G	Rubber Grommet, Gas Line	101638-01		103252-01

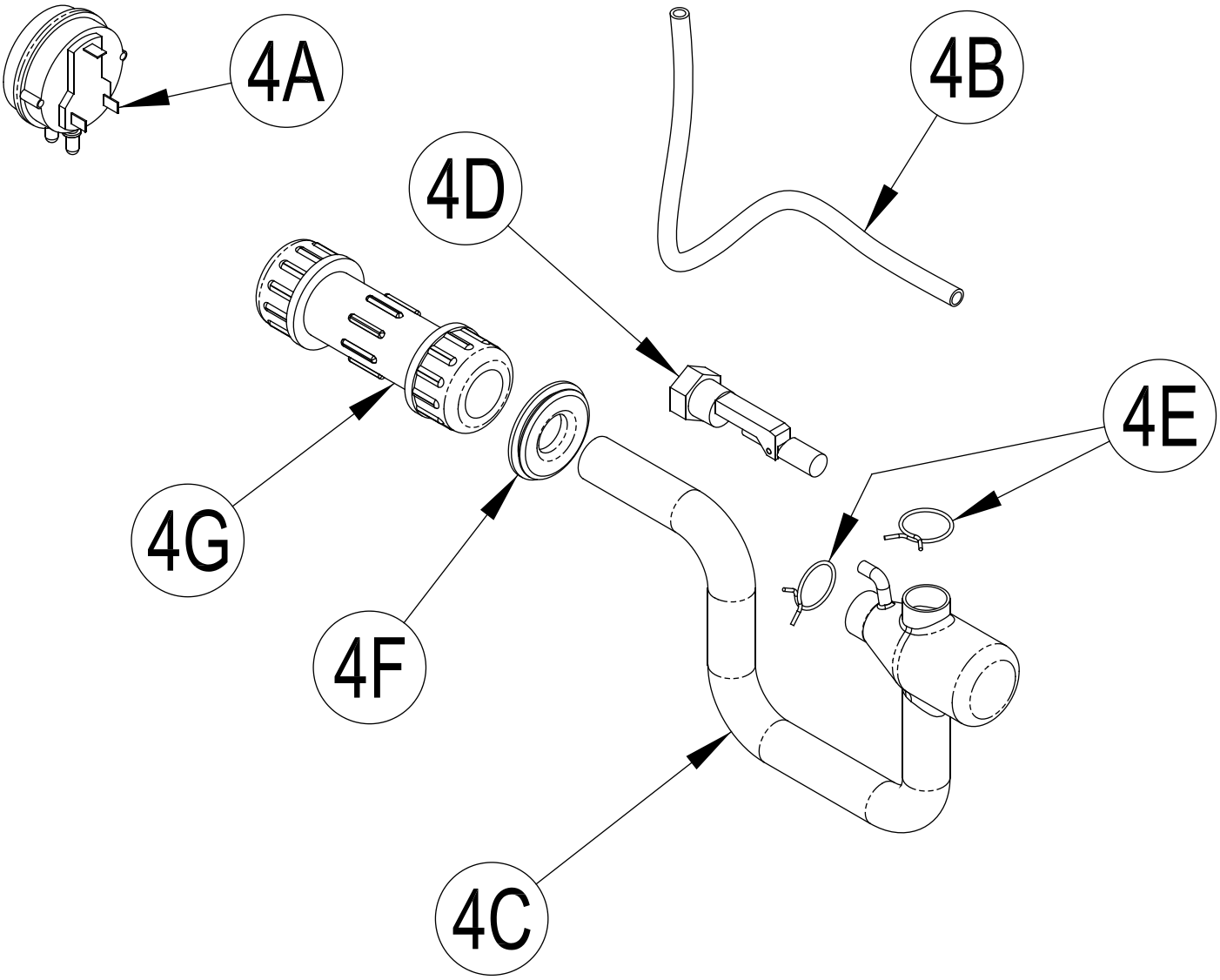
APX800 Only



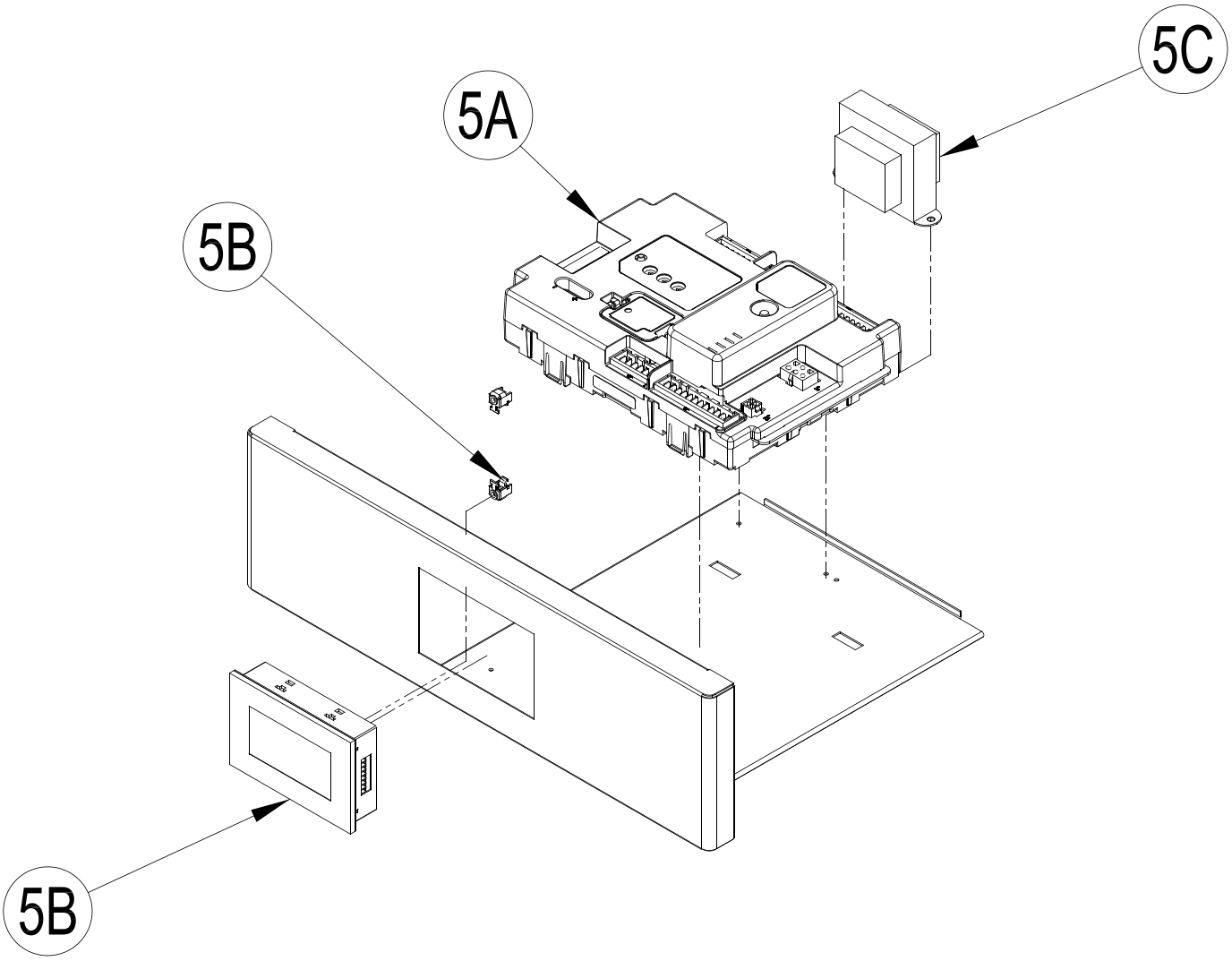


Key No.	Description	(Quantity) Part Number		
		APX399	APX500	APX800
3A	Low Gas Pressure Switch	N/A	102702-01	
3B	High Gas Pressure Switch	N/A	102703-01	
3C	Gas Pressure Switch Wire Harness	N/A	102704-01	

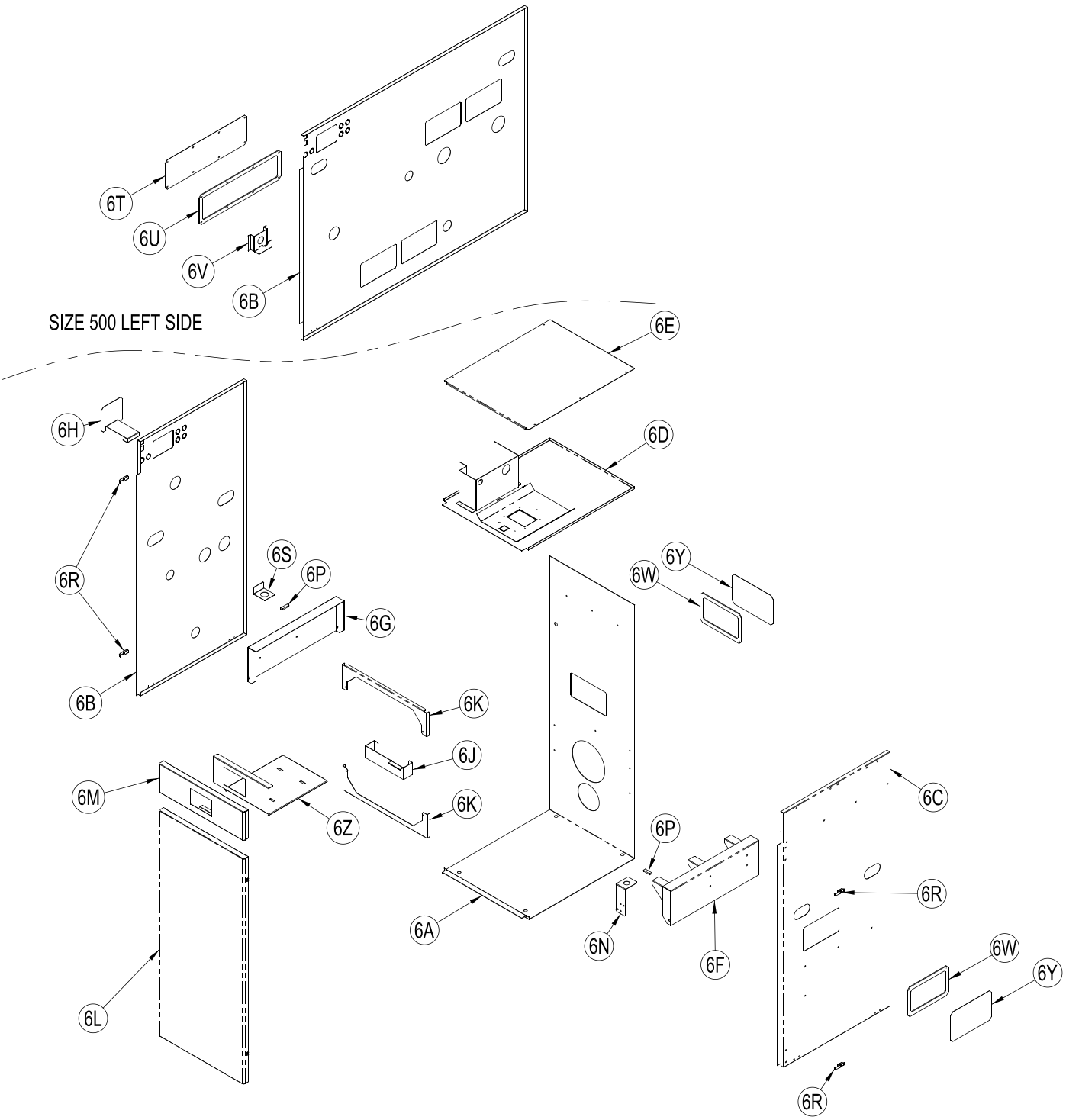
XIII. Repair Parts (continued)



Key No.	Description	(Quantity) Part Number		
		APX399	APX500	APX800
4A	Air Pressure Switch	104426-01		
4B	Air Pressure Switch Tubing, Black	7016041	102770-01	103257-01
4C	Condensate Trap, Blow Molded	101239-01		
4D	Blocked Condensate Drain Switch	101587-01		
4E	Spring Clip, Condensate Trap	(2) 101632-01		
4F	Rubber Grommet, Condensate Trap	101595-01		
4G	Condensate Comp. Fitting	101546-01		



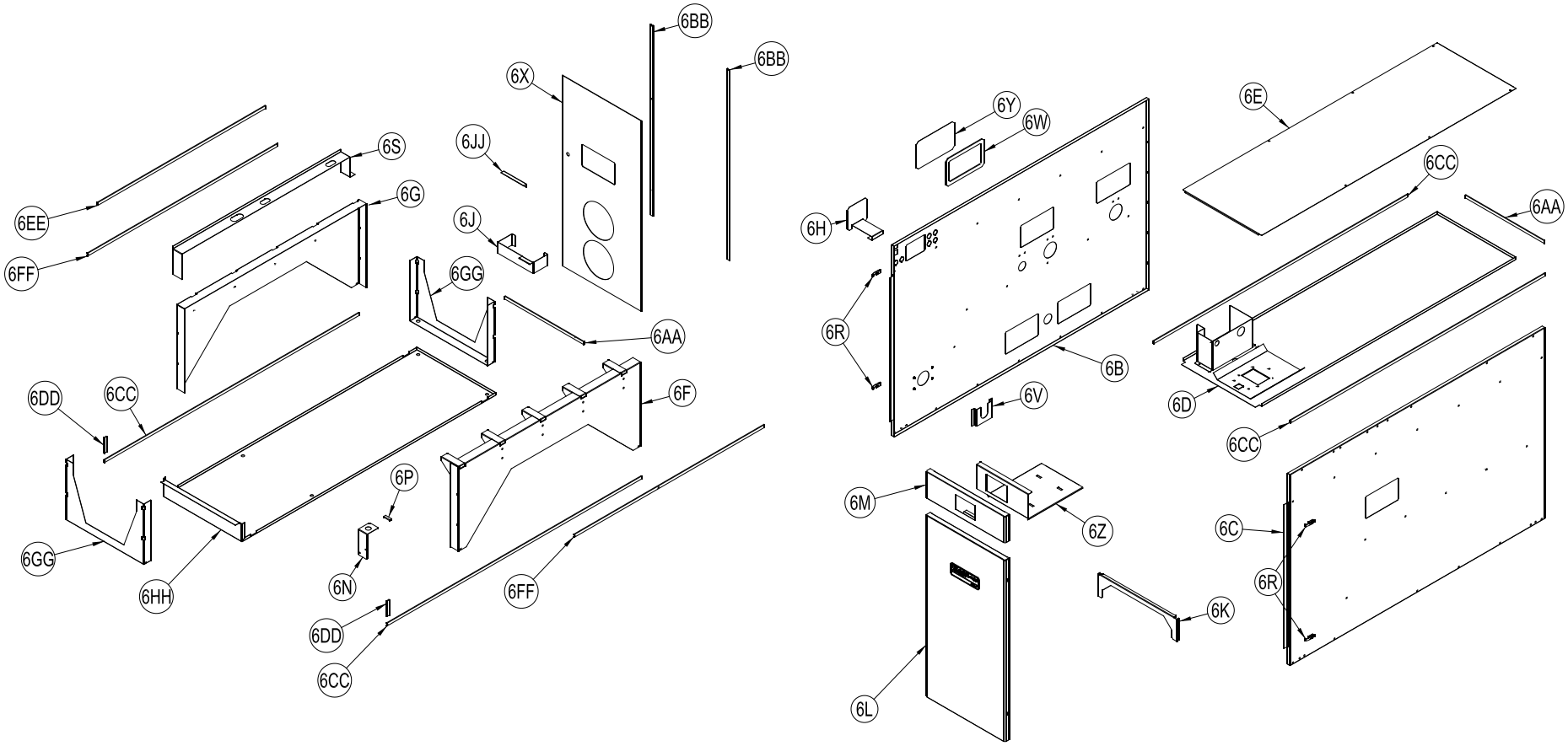
Key No.	Description	(Quantity) Part Number		
		APX399	APX500	APX800
5A	Sage2.1 (Programmed)	104472-01	104472-04	
5B	Programmed Display (with Mounting Hardware)	104427-01		
5C	Transformer	102516-01		103193-01


6T
6U
6V
6B
SIZE 500 LEFT SIDE
6E
6H
6D
6R
6S
6P
6G
6Y
6W
6B
6K
6J
6K
6M
6Z
6A
6N
6P
6F
6C
6R
6W
6Y
6L
6R

XIII. Repair Parts (continued)

Key No.	Description	(Quantity) Part Number		
		APX399	APX500	APX800
6A	Jacket, Rear/Bottom Panel	103406-02	103407-01	N/A
6B	Jacket, Left Side Panel	102776-06	102776-07	103232-01
6C	Jacket, Right Side Panel	101766-02	102610-01	103233-01
6D	Partition Shelf Assembly	102831-06	102831-07	103237-01
6E	Jacket, Top Panel	101218-06	101218-07	103234-01
6F	Heat Exchanger Support Assembly, Right Side	101232-06	101232-07	103228-01
6G	Heat Exchanger Support, Left Side	101224-06	101224-07	103227-01
6H	Bracket, High Voltage Terminal	102780-01		
6J	Bracket, Rear HX Support	101381-01		
6K	Jacket Support Bracket	(2) 101593-01	(1) 101593-01	N/A
6L	Lower Front Door Assembly	101227-02	101227-01	
6M	Jacket, Upper Front Panel	101509-01		
6N	Bracket, Right Clip	101508-01		
6P	Rubber Pad, Right Clip	101245-01		
6R	Draw Latch	101037-01		
6S	Bracket, Left Clip	101507-02		N/A
	Bracket, HX Strap	N/A		103229-01
6T	Access Panel (5’ x 16’)	N/A	102612-01	N/A
6U	Gasket, Access Panel (5’ x 16’)	N/A	102613-01	N/A
6V	Bracket, Gas Train	N/A	102611-01	103240-01
6W	Gasket, Access Panel (5’ x 8’)	(1) 102877-01	(2) 102877-01	(6) 102877-01
6X	Jacket, Rear Panel	N/A		103230-01
6Y	Access Panel (5’ x 8’)	(1) 102873-01	(2) 102873-01	(6) 102873-01
6Z	Control, Slid Tray	102777-01		103336-01
6AA	Gasket, Rear to Base & Partition	N/A		103241-01
6BB	Gasket, Rear to Side	N/A		103242-01
6CC	Gasket, Side to Base & Partition	N/A		103243-01
6DD	Gasket, Side to Base Support	N/A		103244-01
6EE	Gasket, Side to Header Strap	N/A		103245-01
6FF	Gasket, Side to HX Support	N/A		103246-01
6GG	Heat Exchanger Support, Front/Rear	N/A		103231-01
6HH	Base Pan	N/A		102226-01
6JJ	Bracket, Partition Shelf Support	N/A		103239-01
	Nylon Glide	(4) 8186006		(6) 8186006

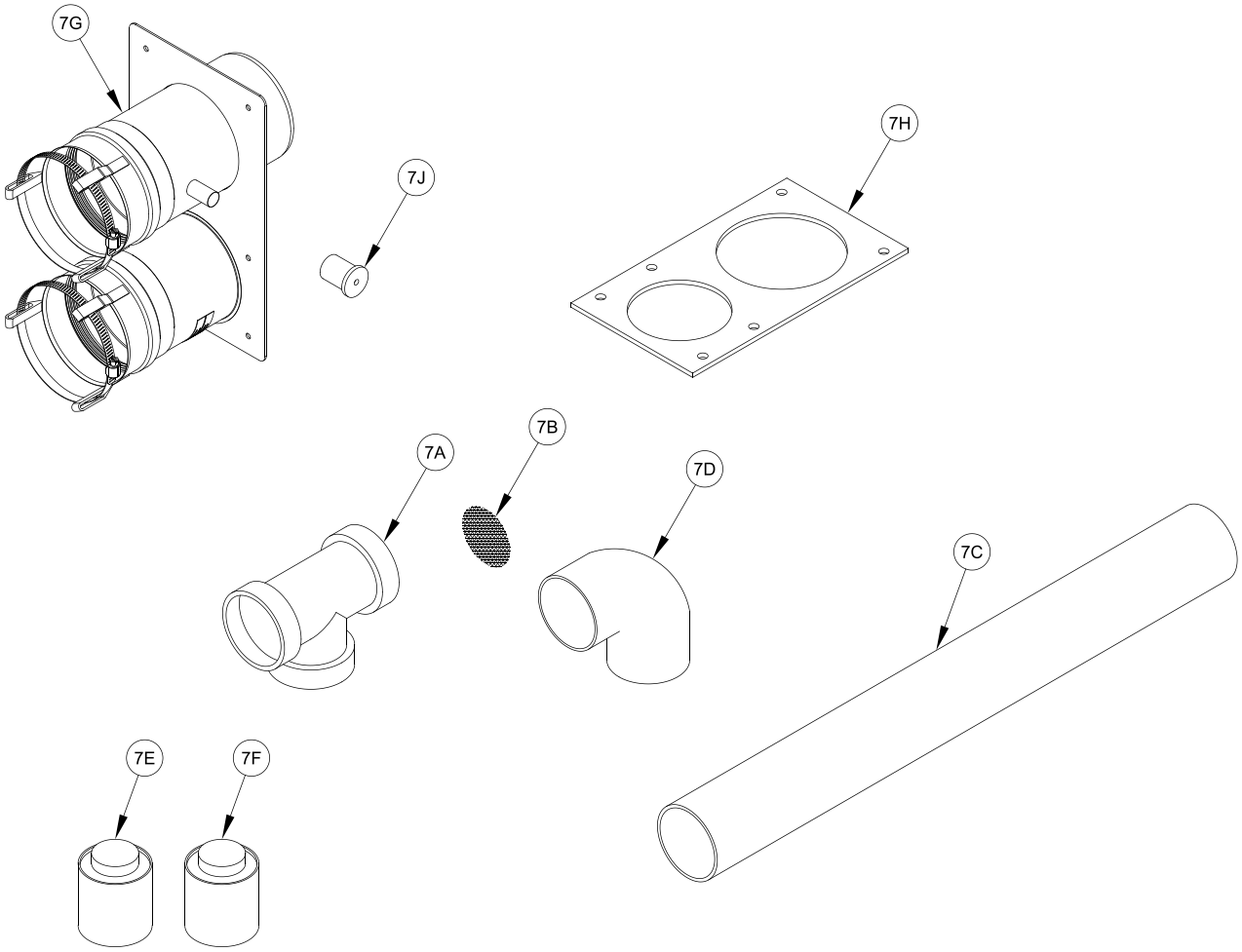
XIII. Repair Parts (continued)



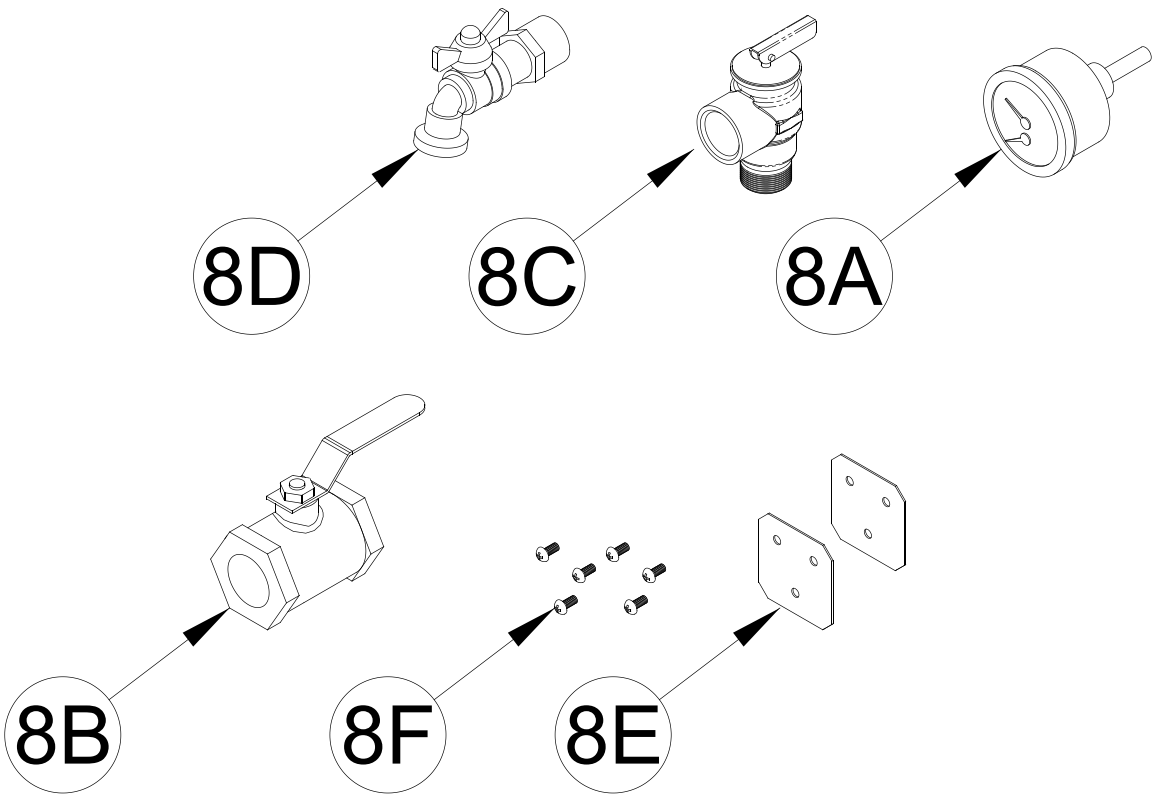
XIII. Repair Parts (continued)

Key No.	Description	(Quantity) Part Number		
		APX399	APX500	APX800
6A	Jacket, Rear/Bottom Panel	103406-02	103407-01	N/A
6B	Jacket, Left Side Panel	102776-06	102776-07	103232-01
6C	Jacket, Right Side Panel	102776-02	102610-01	103233-01
6D	Partition Shelf Assembly	102831-06	102831-07	103237-01
6E	Jacket, Top Panel	101218-06	101218-07	103234-01
6F	Heat Exchanger Support Assembly, Right Side	101232-06	101232-07	103228-01
6G	Heat Exchanger Support, Left Side	101224-06	101224-07	103227-01
6H	Bracket, High Voltage Terminal	102780-01		
6J	Bracket, Rear HX Support	101381-01		
6K	Jacket Support Bracket	(2) 101593-01	(1) 101593-01	N/A
6L	Lower Front Door Assembly	101227-02	101227-01	
6M	Jacket, Upper Front Panel	101509-01		
6N	Bracket, Right Clip	101508-01		
6P	Rubber Pad, Right Clip	101245-01		
6R	Draw Latch	101037-01		
6S	Bracket, Left Clip	101507-02		N/A
	Bracket, HX Strap	N/A		103229-01
6T	Access Panel (5’ x 16’)	N/A	102612-01	N/A
6U	Gasket, Access Panel (5’ x 16’)	N/A	102613-01	N/A
6V	Bracket, Gas Train	N/A	102611-01	103240-01
6W	Gasket, Access Panel (5’ x 8’)	(1) 102877-01	(2) 102877-01	(6) 102877-01
6X	Jacket, Rear Panel	N/A		103230-01
6Y	Access Panel (5’ x 8’)	(1) 102873-01	(2) 102873-01	(6) 102873-01
6Z	Control, Slid Tray	102777-01		103336-01
6AA	Gasket, Rear to Base & Partition	N/A		103241-01
6BB	Gasket, Rear to Side	N/A		103242-01
6CC	Gasket, Side to Base & Partition	N/A		103243-01
6DD	Gasket, Side to Base Support	N/A		103244-01
6EE	Gasket, Side to Header Strap	N/A		103245-01
6FF	Gasket, Side to HX Support	N/A		103246-01
6GG	Heat Exchanger Support, Front/Rear	N/A		103231-01
6HH	Base Pan	N/A		103226-01
6JJ	Bracket, Partition Shelf Support	N/A		103239-01
	Nylon Glide	(4) 8186006		(6) 8186006

XIII. Repair Parts (continued)

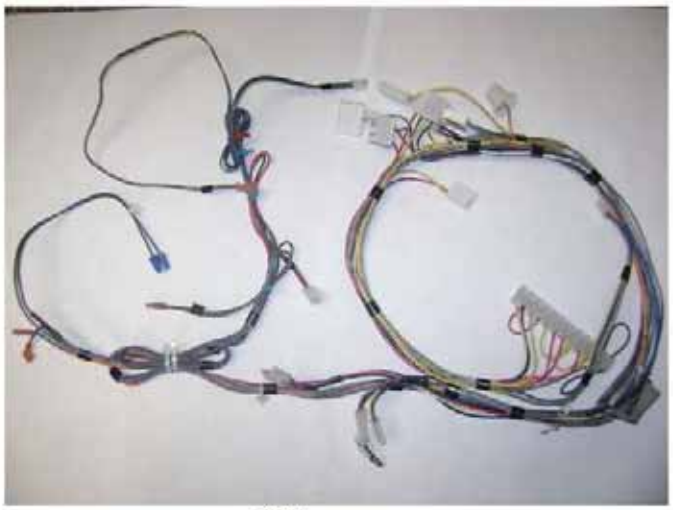


Key No.	Vent System Components	Part Number	(Quantity) Part Number		
			APX399	APX500	APX800
7A	4” Schedule 40 PVC Tee Vent/Combustion Air Terminal	102190-02	2		N/A
7B	4” Stainless Steel Rodent Screens	102191-02	2		N/A
	6” Stainless Steel Rodent Screens	102191-03	N/A		2
7C	4” x 30” Schedule 40 CPVC Pipe	102193-02	1		N/A
	6” x 30” Schedule 40 CPVC Pipe	103267-01	N/A		1
7D	4” Schedule 80 CPVC 90° Elbow	102192-02	1		N/A
	6” Schedule 80 CPVC 90° Elbow	103268-02	N/A		1
	6” Schedule 40 PVC 90° Elbow	103313-01	N/A		2
7E	8 oz. Bottle of Transition Cement	102195-01	1		
7F	8 oz. Bottle of Primer	102194-01	1		
7G	4” x 4” CPVC/PVC Vent System Connector	102183-03	1		N/A
	6” x 6” CPVC/PVC Vent System Connector	103270-01	N/A		1
7H	4” x 4” CPVC/PVC Vent System Connector Gasket	102185-02	1		N/A
	6” x 6” CPVC/PVC Vent System Connector Gasket	103248-01	N/A		1
7J	Flue Temperature Sensor Cap	102153-01	1		
	Flue Temperature Sensor (Not Shown)	101687-01	1		

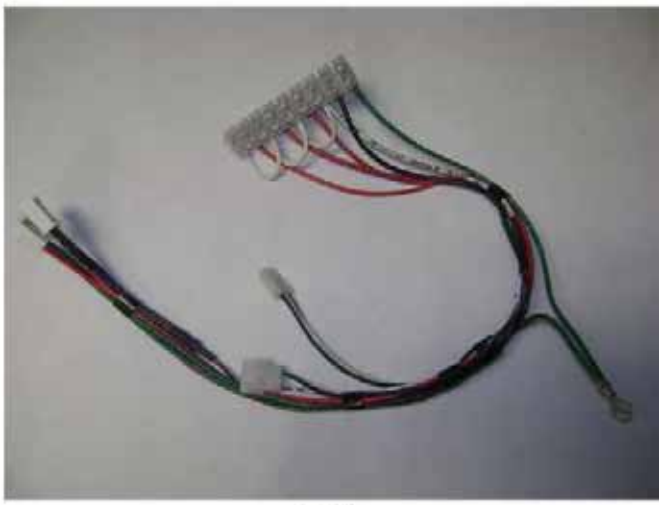


Key No.	Description	(Quantity) Part Number		
		APX399	APX500	APX800
MISCELLANEOUS PARTS CARTON		102942-03	102942-03	102942-04
8A	Temperature/Pressure Gauge	100282-01		
8B	External Gas Shut Off Valve	101615-01		816SOL0015
8C	Relief Valve	81660302		81660375
8D	Boiler Drain Valve	806603061		
8E	Boiler Stacking Brackets	(2) 101679-01		
8F	Boiler Stacking Bracket Screws	(8) 80860743		
	Outdoor Temperature Sensor (Not Shown)	102946-01		

XIII. Repair Parts (continued)



10A



10B

10C

10D

10E

10F

Key No.	Description	Part Number		
		APX399	APX500	APX800
---	Complete Wiring Harness (includes 10A, 10B, 10C & 10D)	102701-02		
10A	Main (Low Voltage) Harness	103009-02		
10B	High Voltage Harness	103010-02		
10C	Blower Power Harness	103012-01		
10D	Communication Harness	103011-01		
10E	Igniter Harness	103486-01		
10F	Wiring Harness, Thermal Link and Burner Door Thermostat	104574-01		

Important Product Safety Information
Refractory Ceramic Fiber Product

Warning:

The Repair Parts list designates parts that contain refractory ceramic fibers (RCF). RCF has been classified as a possible human carcinogen. When exposed to temperatures about 1805°F, such as during direct flame contact, RCF changes into crystalline silica, a known carcinogen. When disturbed as a result of servicing or repair, these substances become airborne and, if inhaled, may be hazardous to your health.

AVOID Breathing Fiber Particulates and Dust

Precautionary Measures:

Do not remove or replace RCF parts or attempt any service or repair work involving RCF without wearing the following protective gear:

1. A National Institute for Occupational Safety and Health (NIOSH) approved respirator
2. Long sleeved, loose fitting clothing
3. Gloves
4. Eye Protection

- Take steps to assure adequate ventilation.
- Wash all exposed body areas gently with soap and water after contact.
- Wash work clothes separately from other laundry and rinse washing machine after use to avoid contaminating other clothes.
- Discard used RCF components by sealing in an airtight plastic bag. RCF and crystalline silica are not classified as hazardous wastes in the United States and Canada.

First Aid Procedures:

- If contact with eyes: Flush with water for at least 15 minutes. Seek immediate medical attention if irritation persists.
- If contact with skin: Wash affected area gently with soap and water. Seek immediate medical attention if irritation persists.
- If breathing difficulty develops: Leave the area and move to a location with clean fresh air. Seek immediate medical attention if breathing difficulties persist.
- Ingestion: Do not induce vomiting. Drink plenty of water. Seek immediate medical attention.

Appendix A - Figures

Appendix A - Figures (continued)

Appendix A - Figures (continued)

Appendix B - Tables

Appendix B - Tables (continued)

SERVICE RECORD

DATE SERVICE PERFORMED

SERVICE RECORD

DATE SERVICE PERFORMED

SERVICE RECORD

DATE SERVICE PERFORMED

Limited Warranty

For Commercial Grade Boilers

Using Cast Iron, Carbon Steel,
or Stainless Steel Heat Exchangers
and Parts / Accessories

Subject to the terms and conditions set forth below, Burnham Commercial, Lancaster, Pennsylvania hereby extends the following limited warranties to the original owner of a commercial grade water or steam boiler or Burnham Commercial supplied parts and/or accessories manufactured and shipped on or after October 1, 2009:

ONE YEAR LIMITED WARRANTY ON COMMERCIAL GRADE BOILERS AND PARTS / ACCESSORIES SUPPLIED BY BURNHAM COMMERCIAL.
Burnham Commercial warrants to the original owner that its commercial grade water and steam boilers and parts/accessories comply at the time of manufacture with recognized hydronic industry standards and requirements then in effect and will be free of defects in material and workmanship under normal usage for a period of one year from the date of original installation. If any part of a commercial grade boiler or any part or accessory provided by Burnham Commercial is found to be defective in material or workmanship during this one year period, Burnham Commercial will, at its option, repair or replace the defective part (not including labor).

HEAT EXCHANGER WARRANTIES
Burnham Commercial warrants to the original owner that the heat exchanger of its commercial grade boilers will remain free from defects in material and workmanship under normal usage for the time period specified in the chart below to the original owner at the original place of installation. If a claim is made under this warranty during the "No Charge" period from the date of original installation, Burnham Commercial will, at its option, repair or replace the heat exchanger (not including labor). If a claim is made under this warranty after the expiration of the "No Charge" period from the date of original installation, Burnham Commercial will, at its option and upon payment of the pro-rated service charge set forth below, repair or replace the heat exchanger. The service charge applicable to a heat exchanger warranty claim is based upon the number of years the heat exchanger has been in service and will be determined as a percentage of the retail price of the heat exchanger model involved at the time the warranty claim is made as follows:

	Service Charge as a % of Retail Price									
Years in Service	1	2	3	4	5	6	7	8	9	10+
Cast Iron	No Charge									100
Carbon Steel	No Charge	100								
Stainless Steel	No Charge					20	40	60	80	100

NOTE: If the heat exchanger involved is no longer available due to product obsolescence or redesign, the value used to establish the retail price will be the published price as set forth in Burnham Commercial Repair Parts Pricing where the heat exchanger last appeared or the current retail price of the then nearest equivalent heat exchanger, whichever is greater.

ADDITIONAL TERMS AND CONDITIONS

1. Applicability: The limited warranties set forth above are extended only to the original owner at the original place of installation within the United States and Canada. These warranties are applicable only to boilers, parts, or accessories designated as commercial grade by Burnham Commercial and installed and used exclusively for purposes of commercial space heating or domestic hot water generation through a heat exchanger (or a combination for such purposes) and do not apply to residential grade products or industrial uses.
2. Components Manufactured by Others: Upon expiration of the one year limited warranty on commercial grade boilers, all boiler components other than heat exchangers manufactured by others but furnished by Burnham Commercial (such as oil burner, circulator and controls) will be subject only to the manufacturer's warranty, if any.
3. Proper Installation: The warranties extended by Burnham Commercial are conditioned upon the installation of the commercial grade boiler, parts, and accessories in strict compliance with Burnham Commercial installation instructions. Burnham Commercial specifically disclaims liability of any kind caused by or relating to improper installation.
4. Proper Use and Maintenance: The warranties extended by Burnham Commercial conditioned upon the use of the commercial grade boiler, parts, and accessories for its intended purposes and its maintenance accordance with Burnham Commercial recommendations and hydronics industry standards. For proper installation, use, and maintenance, see all applicable sections of the Installation and Operating, and Service Instructions Manual furnished with the unit.
5. This warranty does not cover the following:
   a. Expenses for removal or reinstallation. The owner will be responsible for the cost of removing and reinstalling the alleged defective part or its replacement and all labor and material connected therewith, and transportation to and from Burnham Commercial.
   b. Components that are part of the heating system but were not furnished by Burnham Commercial as part of the commercial boiler.
   c. Improper burner adjustment, control settings, care or maintenance.
   d. This warranty cannot be considered as a guarantee of workmanship of an installer connected with the installation of the Burnham Commercial boiler, or as imposing on Burnham Commercial liability of any nature for unsatisfactory performance as a result of faulty workmanship in the installation, which liability is expressly disclaimed.
   e. Boilers, parts, or accessories installed outside the 48 contiguous United States, the State of Alaska and Canada.
   f. Damage to the boiler and/or property due to installation or operation of the boiler that is not in accordance with the boiler installation and operating instruction manual.
   g. Any damage or failure of the boiler resulting from hard water, scale buildup or corrosion the heat exchanger.
   h. Any damage caused by improper fuels, fuel additives or contaminated combustion air that may cause fireside corrosion and/or clogging of the burner or heat exchanger.
   i. Any damage resulting from combustion air contaminated with particulate which cause clogging of the burner or combustion chamber including but not limited to sheetrock or plasterboard particles, dirt, and dust particulate.
   j. Any damage, defects or malfunctions resulting from improper operation, maintenance, misuse, abuse, accident, negligence including but not limited to operation with insufficient water flow, improper water level, improper water chemistry, or damage from freezing.
   k. Any damage caused by water side clogging due to dirty systems or corrosion products from the system.
   l. Any damage resulting from natural disaster.
   m. Damage or malfunction due to the lack of required maintenance outlined in the Installation and Operating Manuals furnished with the unit.
6. Exclusive Remedy: Burnham Commercial obligation for any breach of these warranties is limited to the repair or replacement of its parts (not including labor) in accordance with the terms and conditions of these warranties.
7. Limitation of Damages: Under no circumstances shall Burnham Commercial be liable for incidental, indirect, special or consequential damages of any kind whatsoever under these warranties, including, but not limited to, injury or damage to persons or property and damages for loss of use, inconvenience or loss of time. Burnham Commercial liability under these warranties shall under no circumstances exceed the purchase price paid by the owner for the commercial grade boiler involved. Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.
8. Limitation of Warranties: These warranties set forth the entire obligation of Burnham Commercial with respect to any defect in a commercial grade boiler, parts, or accessories and Burnham Commercial shall have no express obligations, responsibilities or liabilities of any kind whatsoever other than those set forth herein. These warranties are given in lieu of all other express warranties.

ALL APPLICABLE IMPLIED WARRANTIES, IF ANY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY LIMITED IN DURATION TO A PERIOD OF ONE YEAR EXCEPT THAT IMPLIED WARRANTIES, IF ANY, APPLICABLE TO THE HEAT EXCHANGER IN A COMMERCIAL GRADE BOILER SHALL EXTEND TO THE ORIGINAL OWNER FOR THE TIME SPECIFIED IN THE HEAT EXCHANGER SECTION SHOWN ABOVE AT THE ORIGINAL PLACE OF INSTALLATION. SOME STATES DO NOT ALLOW LIMITATION ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATION MAY NOT APPLY TO YOU.

PROCEDURE FOR OBTAINING WARRANTY SERVICE
In order to assure prompt warranty service, the owner is requested to complete and mail the Warranty Card provided with the product or register product online at www.burnhamcommercialcastiron.com within ten days after the installation of the boiler, although failure to comply with this request will not void the owner's rights under these warranties. Upon discovery of a condition believed to be related to a defect in material or workmanship covered by these warranties, the owner should notify the installer, who will in turn notify the distributor. If this action is not possible or does not produce a prompt response, the owner should write to Burnham Commercial, P.O. Box 3939, Lancaster, PA 17604, giving full particulars in support of the claim. The owner is required to make available for inspection by Burnham Commercial or its representative the parts claimed to be defective and, if requested by Burnham Commercial to ship these parts prepaid to Burnham Commercial at the above address for inspection or repair. In addition, the owner agrees to make all reasonable efforts to settle any disagreement arising in connection with a claim before resorting to legal remedies in the courts.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.

BURNHAM®
Commercial Boilers

Burnham Commercial, P.O. Box 3939, Lancaster, PA 17604
Revised November 1, 2009

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