FTV Boiler

Model Numbers: FTV110, FTV110C, FTV150, FTV150C, FTV190 & FTV190C
Version Date: 2019-07-05

INSTALLATION AND OPERATION MANUAL

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HAZARD SYMBOLS AND DEFINITIONS

⚠ DANGER — Danger Sign: Indicates a hazardous situation which, if not avoided, will result in serious injury or death.

⚠ WARNING — Warning Sign: Indicates a hazardous situation which, if not avoided, could result in serious injury or death.

⚠ CAUTION — Caution Sign plus Safety Alert Symbol: Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

CAUTION — Caution Sign without Safety Alert Symbol: Indicates a hazardous situation which, if not avoided, could result in property damage.

NOTICE — Notice Sign: Indicates a hazardous situation which, if not avoided, could result in property damage.

⚠ WARNING This Boiler must be installed by a licensed and trained Heating Technician or the **Warranty is Void.** Failure to properly install this unit may result in property damage, serious injury to occupants, or possibly death.

Read Before Proceeding

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

FOR YOUR SAFETY, READ BEFORE OPERATING

A) This boiler 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 boiler 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 boiler.
- 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 turn the gas "shutoff" valve. Never use tools. If the handle will not turn by hand, do not 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 boiler if any part has been under water. Immediately call a qualified service technician to inspect the boiler and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. STOP! Read the safety information above very carefully.
2. Set the thermostat to lowest setting. Turn off all electric power to the boiler.
3. This boiler 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.
4. Turn the manual gas valve to the OFF position. Remove front access panel.
5. 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. If you do not smell gas, go to the next step.
6. Turn the manual gas valve ON. Wait an additional five (5) minutes smelling for gas.
7. Replace the front access panel.
8. Set thermostat to highest setting. Turn on all electric power to the boiler.
9. Ignition sequence is automatic. Combustion will occur after a brief fan purge.
10. If ignition does not occur, follow the instructions "To Turn Off Gas To Boiler" and call your service technician or gas supplier.

TO TURN OFF GAS TO THE BOILER

1. STOP! Read the safety information above very carefully.
2. Turn off all electric power to the boiler.
3. Turn the manual gas valve to the OFF position.

⚠ WARNING **Crystalline Silica** - Certain components confined in the combustion chamber may contain this potential carcinogen. Improper installation, adjustment, alteration, service or maintenance can cause property damage, serious injury (exposure to hazardous materials) or death. Refer to Section 15.0 for information on handling instructions and recommended personal protective equipment. Installation and service must be performed by a qualified installer, service agency or the gas supplier (who must read and follow the supplied instructions before installing, servicing, or removing this boiler. This boiler contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans).

⚠ WARNING **Void Warranty -** This Boiler must have water flowing through it whenever the burner is on or it will damage the unit and void the warranty. Failure to follow these instructions may result in serious injury or death.

1.0 INTRODUCTION

General Installation Requirements

The installation of your NTI FTV gas boiler must conform to the requirements of this manual, your local authority, and the National Fuel Gas Code ANSI Z223.1 and or CAN/CGA B149 Installation Codes. Where required by the Authority, the installation must conform to the standard for "Controls and Safety Devices for Automatically Fired Boilers ANSI/ASME CSD-1."

This document pertains to the correct installation and operation of NTI FTV boiler models FTV110, FTV110C, FTV150, FTV150C, FTV190 and FTV190C. The instructions detailed in this document supersede any and all previous instructions provided by NTI, written or otherwise. Each unit is provided with the following:

1. Installation and Operation Manual,
2. User Information Manual, and
3. Natural Gas to LP Conversion Kit*

* The conversion kit is required to convert the boiler so it will safely operate with Propane Gas.

⚠ DANGER Read and understand this entire document prior to proceeding with the installation of the FTV boiler. These instructions apply to all FTV models, but some specifically indicated sections apply specifically to Combi models FTV110C, FTV150C and FTV190C due to the built-in water heater. Failure to follow the instructions outlined in this document will result in property damage, serious injury or death.

IMPORTANT **Energy Saving Feature** - This boiler is equipped with a feature that saves energy by reducing the boiler water temperature as the heating load decreases. This feature is equipped with an override which is provided primarily to permit the use of an external energy management system that serves the same function. THIS OVERRIDE MUST NOT BE USED UNLESS AT LEAST ONE OF THE FOLLOWING CONDITIONS IS TRUE:

- An external energy management system is installed that reduces the boiler water temperature as the heating load decreases.
- This boiler is not used for any space heating.
- This boiler is part of a modular or multiple boiler system having a total input of 300,000 BTU/hr. or greater.
- This boiler is equipped with a tankless coil.

User Responsibilities

This boiler must be installed and serviced by a qualified installer or service technician. This boiler must be serviced and inspected annually when operating in normal residential applications. Demanding applications or extreme conditions (i.e. when operating with LP-Propane) may require more frequent service and inspection. As the User/Owner of this equipment, you are responsible for ensuring the maintenance is performed at the required intervals (see Section 16.0 – Annual Maintenance and Inspection).

⚠ WARNING Failure to have the boiler properly serviced and inspected on a regular basis by a qualified service technician may result in property damage, serious injury or death.

⚠ WARNING Failure to keep the Vent and Combustion Air-intake clear of ice, snow, and other debris may result in property damage, serious injury, or death.

Installer Responsibilities

As the installing technician it is your responsibility to ensure the installation is performed in accordance with this instruction manual as well as any applicable local or National installation codes. It is also your responsibility to inform the User/Owner of their obligation with respect to the above description under "User Responsibilities." Failure to follow this warning could result in fire, serious injury, or death.

⚠ DANGER

FTV boilers are factory set to operate with Natural Gas; **BEFORE OPERATING WITH PROPANE**, the boiler must be converted using the appropriate *Natural Gas to LP Conversion Kit*; see below. Failure to properly convert the unit to safely operate with Propane will cause dangerous burner operation, resulting in property damage, serious injury or death.

ATTENTION: LIQUEFIED PETROLEUM (LP) PROPANE

Liquefied Petroleum (LP) propane gas is heavier than air; therefore, it is imperative that your FTV boiler is not installed in a pit or similar location that will permit heavier than air gas to collect. Local Codes may require boilers fueled with LP gas be provided with an approved means of removing unburned gases from the room. Check your local codes for this requirement.

Natural Gas to LP Conversion Kit

Model	Natural Gas to LP Conversion Kit (part no.)	LP-Venturi Insert (part no.)
FTV110 & FTV110C	**85995-1**	**85989**
FTV150 & FTV150C	**85446-1**	**85536**
FTV190 & FTV190C	**85934-1**	**85812**

Note:
FTV models are converted to Propane using a replacement LP-Venturi Insert, not by installing an orifice. Follow the Natural Gas to LP Conversion Instructions provided with the Kit.

Exhaust Vent / Air-Inlet Piping

⚠ DANGER

The FTV is certified as a "Category IV" boiler, and require a "Special Venting System" designed for pressurized venting. The exhaust gases must be piped directly to the outdoors using the vent materials and rules outlined in these instructions. Failure to follow these instructions will result in serious injury or death.

IN THE STATE OF MASSACHUSETTS ONLY

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

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

a. In the event that the side wall horizontally vented gas fueled equipment is installed in a crawl space or an attic, the hard wired carbon monoxide detector with alarm and battery back-up may be installed on the next adjacent floor level.
b. In the event that the requirements of this subdivision cannot be met at the time of completion of installation, the owner shall have a period of 30 days to comply with the above requirements; provided, however, that during said 30 day period a battery operated carbon monoxide detector with an alarm shall be installed.

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

3. SIGNAGE A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating boiler 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**" (plate included with boiler).*

4. INSPECTION The state or local gas inspector of the side wall horizontally vented gas fueled equipment shall not approve the installation unless, upon inspection, the inspector observes carbon monoxide detectors and signage installed in accordance with the provisions of 248 CMR 5.08(2)(a)1 through 4.

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

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

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

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

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

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

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

2.0 SPECIFICATIONS

Table 2-1 FTV Specifications

DESCRIPTION	FTV110	FTV150	FTV190	FTV110C	FTV150C	FTV190C
CSA Input Modulation [MBH] [1]	11 - 110	15 - 150	19 - 190	11-110	15 - 150	19 - 190
DOE Heating Capacity [MBH] [1,2]	101	138	176	101	138	176
Net I=B=R Rating [MBH] [1,2]	88	120	153	88	120	153
DOE AFUE [%] [2]	95					
Boiler Water Connections – NPT [in.]	1" (Male)			3/4" (Male) [4]		
DHW Connections – NPT [in.]	NA			3/4" (Male)		
Gas Connection – NPT [in.]	1/2" (Female)					
Vent/Air-inlet Connections [in.] [3]	3					
Dimensions H x W x D [in.]	37.25 x 19.5 x 18.5					
Approx. Boiler Weight with Water [lbs.]	100	115	140	110	125	150
Approx. Boiler Water Content [Gallons]	1.4	2.0	2.7	1.4	2.0	2.7
Electrical Rating	120V/1Ph/60Hz/less than 12A					

Notes:
[1] Listed Input and Output ratings are at minimum vent lengths using 3" venting, at an altitude of 0-2000 ft. Numbers will be lower with longer venting and/or altitudes greater than 2000 ft.
[2] Ratings based on standard test procedures prescribed by the U.S. Department of Energy.
[3] FTV boilers require a special venting system, use only vent materials and methods detailed in these instructions.
[4] Combi models are factory supplied with a Low Loss Header manifold that adapts from ¾" NPT to 1" sweat joints. See Figure 10-2(d).

⚠ CAUTION Wall mounting of unit requires two people to lift the boiler into place. Failure to follow these instructions may result in property damage or personal injury.

High Altitude Operation

The FTV is designed to operate at its maximum listed capacity in installations located at 0-2000 ft above Sea Level. Since the density of air decreases as elevation increases, maximum specified capacity should be de-rated for elevations above 2000 ft [610 m] in accordance with Table 2-2.

Table 2-2 De-rate % for High Altitudes

Elevations	2001 ft [610 m]	3000 ft [914 m]	4000 ft [1219 m]	4500 ft [1372 m]	5000 ft [1524 m]
In Canada [1]	de-rate by 10%	de-rate by 10%	de-rate by 10%	de-rate by 10%	de-rate % may vary
In USA [2]	-	de-rate by 12%	de-rate by 16%	de-rate by 18%	de-rate by 20%

Notes:
[1] Canada: Altitudes between 2000-4500 ft [610-1372 m], de-rate by 10%. Consult local authorities for de-rating for altitudes above 4500ft [1372 m].
[2] USA: De-rate capacity by 4% for every 1000 ft [305 m], if altitude is above 2000 ft [610 m].

⚠ WARNING **Combustion** – At elevations above 2000 feet, the combustion of the boiler must be checked with a calibrated combustion analyzer to ensure safe and reliable operation. **It is the <u>Installers responsibility</u> to check the combustion and to adjust the combustion in accordance with Section 9.0.** Failure to follow these instructions may result in property damage, serious injury, or death.

3.0 BOILER LOCATION

In all cases, the FTV boiler must be installed indoors in a dry location where the ambient temperature must be maintained above freezing and below 100°F [38°C]. All boiler components must be protected from dripping, spraying water, or rain during operation and servicing. Consider the proximity of system piping, gas and electrical supply, condensate disposal drain, and proximity to vent termination when determining the best boiler location.

⚠ WARNING Water or flood damaged components must be replaced immediately with new factory-approved components as failure to do so may result in fire, serious injury, or death.

Boiler Area Ventilation Air Openings

If boiler area clearances are less than the recommended clearances specified in Table 3-1, the boiler area must be ventilated (**Exception**: if the boiler area/room has a volume of 150 ft^3 or greater, ventilation of the boiler room is not required). Each ventilation air opening must meet the minimum requirements of 1 in^2 per 1000 Btu/hr., but not less than 100 in^2. The lower ventilation opening must be located within 6 in. of the floor while the upper opening must be located 6 in. from the top of the space.

NOTICE If the "Boiler Area" does not meet the recommended clearances listed in Table 3-1, and if the boiler area has a volume less than 150 ft^3, it is considered a Closet or Alcove. In US/Canada, PVC vent pipe and fittings shall not be used within the closet or alcove; only approved CPVC, Polypropylene or Stainless Steel vent pipe and fittings can be used. See Table 4-5 for a list of approved materials. Under all circumstances, the minimum clearances listed in Table 3-1 must be provided.

Closet Installations

For closet installations it is necessary to provide two ventilation air openings as shown in Figure 3-1, each providing a minimum area equal to 1 in^2 per 1000 Btu/hr., but not less than 100 in^2 and within 6 in. of the top and bottom of the closet door. See Table 3-1 for minimum clearances.

Alcove Installations

Alcove installations have the same minimum clearances as closet installations, except the front must be completely open to the room at a distance no greater than 18 in. [457 mm] from the front of the boiler and the room is at least three (3) times the size of the alcove. Provided these conditions are met, the boiler requires no extra ventilation air openings to the space. See Table 3-1 for minimum clearances.

Residential Garage Installations

When installed in a residential garage, mount the boiler a minimum of 18 in. [457 mm] above the floor. Locate or protect the boiler so it cannot be damaged by a moving vehicle. Check with your local authorities for other possible regulations pertaining to the installation of a boiler in a garage.

Wall Mounting Installations

FTV boilers are provided with integrated wall mounting brackets. Refer to Figure 3-2 for instructions and illustrations on wall mounting.

Table 3-1 Minimum Clearances for Installation and Service

Clearances	Dimensions – inches					
	Front	Top	Sides	Back	Bottom	Flue Pipe
Minimum	24[1]	12	4	0	9	1
Recommended	36	24	12	0	24	1

Notes:
[1] 6 in. if surface is removable allowing a minimum of 24 in. clearance (i.e. closet installation). See Ventilation Air Opening dimensions in Figure 3-1.

⚠ WARNING Closet/Alcove installations in US and Canada require approved **CPVC, Polypropylene or Stainless Steel** vent and air-inlet pipe and fittings (see Table 4-5); PVC is not permitted. Failure to follow these instructions may result in damage or serious injury.

Figure 3-1 Closet Installation, Minimum Clearances

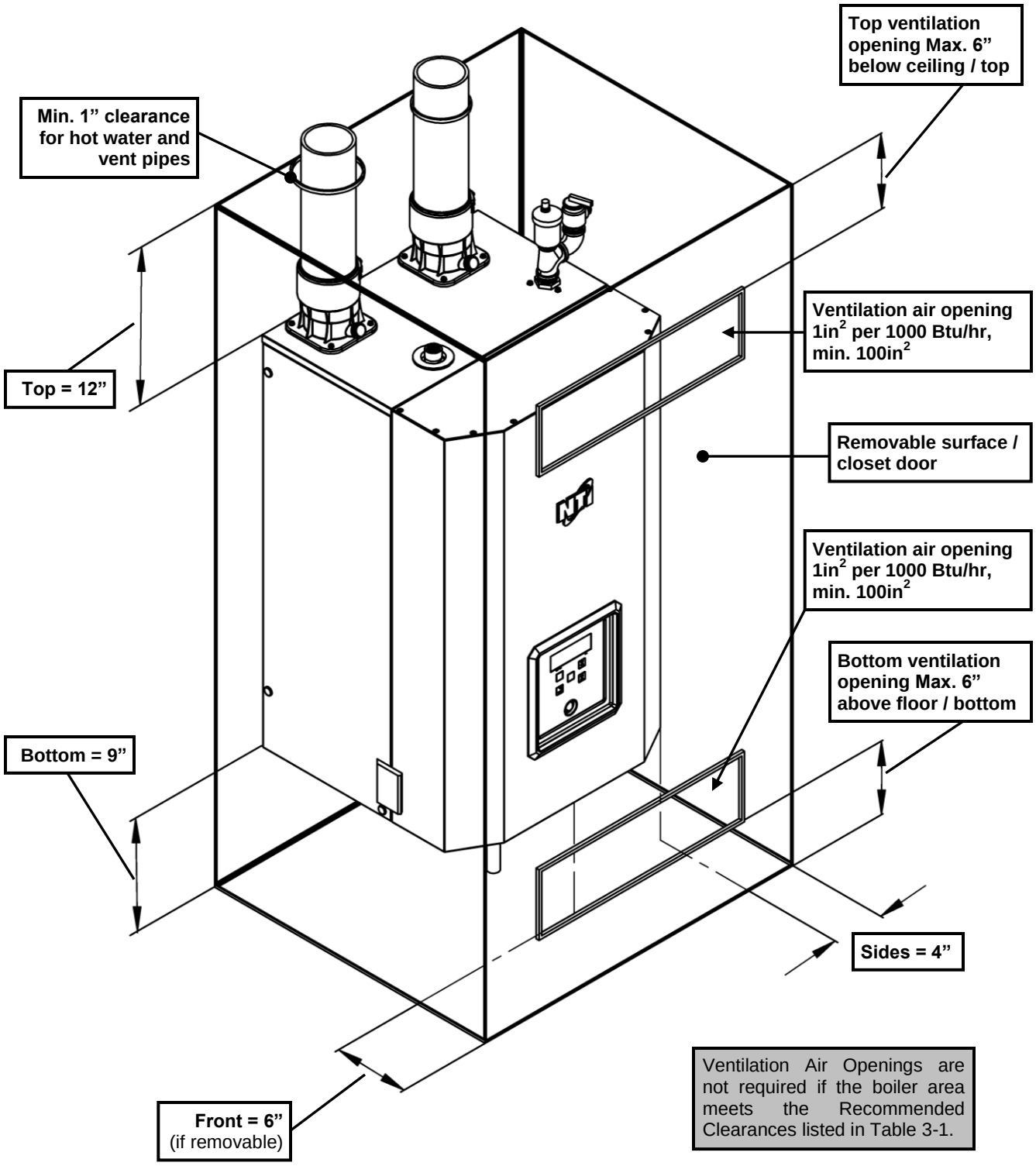


Figure 3-2 Wall Mounting Instructions

❶ Leave the **Top Wall-mount Bracket (A)** intact and remove the **Bottom Wall-mount Bracket (B)** that is attached to the bottom-back of the boiler.

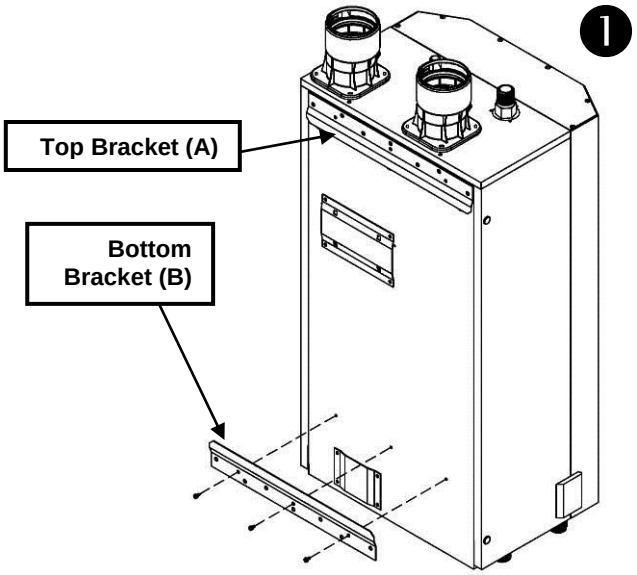
❷ Secure **Bottom Bracket (B)**, removed from the bottom back of the boiler in Step 1, to a solid wall using field supplied lag screws (anchors when mounting to a concrete wall) that are adequate to support the weight of the appliance when filled with water (refer to Table 2-1 Specifications). Ensure the bracket is level and flush to the wall. Mounting holes to be on the bottom with flange pointed upward and angled away from the wall.

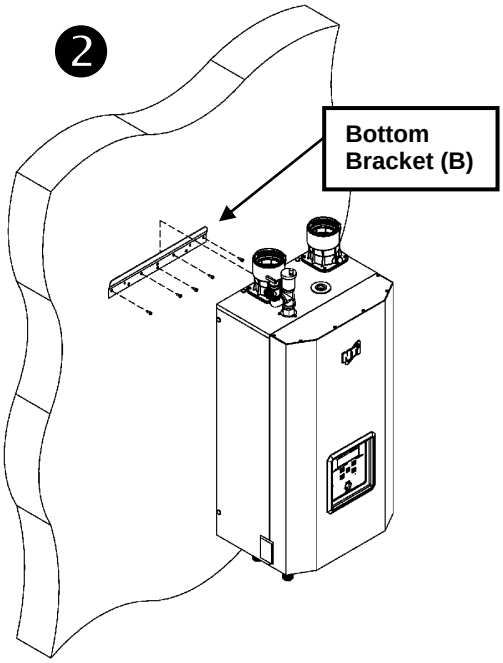
❸ Mount the boiler to the wall by aligning the two wall mount brackets, **Top Bracket (A)** with the **Bottom bracket (B)**. Slide the top bracket fastened to the boiler down over the wall-mounted bracket until it hooks.

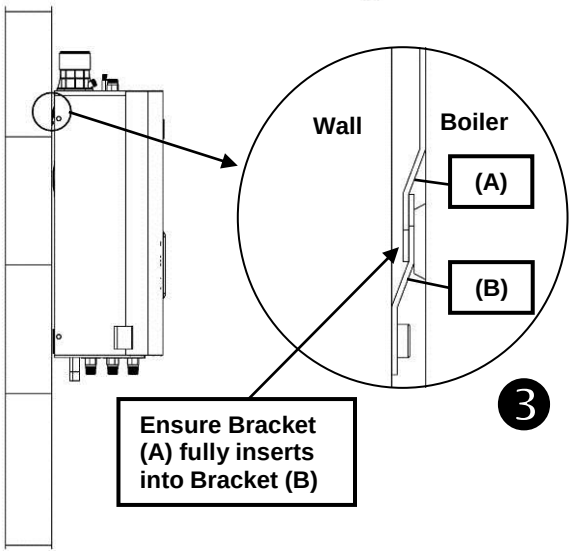
❹ Once the boiler is resting securely on the wall, attach the **L-shaped Brackets (C)** to the underside of the appliance using the mounting hardware supplied in the boiler kit box – adjust to plumb the boiler. Anchor the **L-shaped Brackets (C)** to the wall as shown using field supplied hardware.

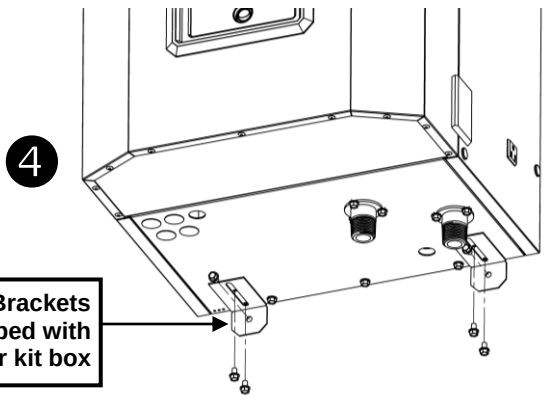
⚠ WARNING Failure to follow instructions may result in fire, serious injury, or death.

⚠ CAUTION This unit requires two people to lift it or damage and injury may result.









4.0 GENERAL VENTING

The FTV is certified as a "Category IV" boiler requiring a "Special Venting System" designed for pressurized venting. The Exhaust Vent must be piped to the outdoors, using the vent materials and rules outlined in this section. Under no conditions may this unit vent gases into a masonry chimney, unless it is vacant, and utilizes the approved venting material and rules described in this section.

⚠ DANGER Vent and Air-inlet are to be piped separately. The FTV cannot share a common vent or air-inlet with multiple boilers. Failure to comply will result in serious injury or death.

Removing an Existing Boiler from Common Venting System

⚠ DANGER Do not install the FTV into a common venting system with any other boiler. Failure to comply with this warning will cause flue gas spillage and leech carbon monoxide emissions into the surrounding air resulting in serious injury or death.

⚠ WARNING 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 boilers connected to it. Instructions have been provided on how to remove the existing boiler and how to resize the remaining venting system. Failure to follow these instructions may result in property damage, serious injury or death.

Upon removal of an existing boiler, the following steps shall be followed for each boiler remaining in the common venting system; prior to commencing this procedure, shutdown all boilers remaining in the common venting system.

Steps to Removing an Existing Boiler:

1. Seal any unused openings in the common venting system.
2. Visually inspect the venting system for proper size and horizontal pitch. Verify that there is no blockage, restriction, leakage, corrosion or other deficiencies which could cause an unsafe condition.
3. Insofar as is practical, close fireplace dampers, all building doors and windows and all doors between the space in which the boilers remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any boiler 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.
4. Place in operation the boiler being inspected. Follow the applicable lighting instructions. Adjust thermostat so boiler will operate continuously.
5. Test for spillage at the draft hood relief opening after 5 minutes of main burner operation. Use the flame of a match or candle, or smoke from a cigarette, cigar or pipe.
6. After it has been determined that each boiler 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 boiler to their previous condition of use.
7. Any improper operation of the common venting system should be corrected so the installation conforms to the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code. 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 11 of the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code.

Direct Vent Installation (Best Practice)

When installed as a Direct Vent boiler the combustion air-inlet must also be piped directly to the outdoors using the methods described in this section and in accordance with the National Fuel Gas Code, ANSI Z223.1 (U.S.) or CSA B149.1 (Canada) and local requirements.

Installation Using Indoor Combustion Air

When the installation uses Indoor Combustion Air (i.e. piping is not directly connecting the appliance air-inlet fitting to the outdoors), provisions for combustion and ventilation air, in accordance with section "Air for Combustion and Ventilation," of the *National Fuel Gas Code, ANSI Z223.1/NFPA 54* (U.S.), or Clause 8.2, 8.3 or 8.4 of *Natural Gas and Propane Installation Code, CAN/CSA B149.1* (Canada), or applicable provisions of the local building codes, must be adhered to.

NOTICE The boiler shall be located so as not to interfere with proper circulation of combustion, ventilation, and dilution air.

⚠ WARNING Make up air requirements for the operation of exhaust fans, kitchen ventilation systems, clothes dryers, and fireplaces shall be considered in determining the adequacy of a space to provide combustion air requirements. Failure to ensure adequate make up air to all appliances may result in personal injury or death.

Combustion Air-inlet Contamination

Be careful not to locate the air-inlet termination in an area where contaminants can be drawn in and used for combustion. Combustion air containing dust, debris or air-borne contaminants will drastically increase the required maintenance and may cause a corrosive reaction in the Heat Exchanger which could result in premature failure, fire, serious injury, or death. See Table 4-1 for a list of areas to avoid when terminating air-inlet piping:

Table 4-1 Corrosive Products and Contaminant Sources

Products to Avoid	Contaminated Sources to Avoid
Antistatic fabric softeners, bleaches, detergents, cleaners	Laundry facilities
Perchloroethylene (PCE), hydrocarbon based cleaners	Dry cleaning facilities
Chemical fertilizer, herbicides/pesticides, dust, methane gas	Farms or areas with livestock and manure
Paint or varnish removers, cements or glues, sawdust	Wood working or furniture refinishing shops
Water chlorination chemicals (chloride, fluoride)	Swimming pools, hot tubs
Solvents, cutting oils, fiberglass, cleaning solvents	Auto body or metal working shops
Refrigerant charge with CFC or HCFC	Refrigerant repair shops
Permanent wave solutions	Beauty shops
Fixer, hydrochloric acid (muriatic acid), bromide, iodine	Photo labs, chemical / plastics processing plants
Cement powder, crack fill dust, cellulose, fiber based insulation	Concrete plant or construction site

⚠ WARNING Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other boiler. Failure to follow instructions may result in serious injury or death.

NOTICE It is **BEST PRACTICE** to pipe the combustion air-inlet directly to the outdoors (Direct Vent installation) to avoid contamination often contained in indoor air.

Flammable Solvents and Plastic Piping

Due to the extremely flammable characteristics of most glues, cements, solvents and primers used in the process of joining plastic vent and air-inlet pipe, explosive solvent vapors must be evacuated from the vent and air-inlet prior to start-up. Avoid using excess cement or primer that may lead to pooling inside the pipe assembly. Freshly assembled piping assembly should be allowed to cure for a minimum of 8 hours before applying power to the gas fired boiler. Refer to **Mandatory Pre-commissioning Procedure for Plastic Venting** in this section.

⚠ DANGER **Flammable Cements and Primers** – It is the installers' responsibility to familiarize themselves with the hazards associated with explosive solvents and to take all precautions to reduce these risks. Failure to follow these instructions can cause explosions, property damage, injury or death.

Mandatory Pre-commissioning Procedure for Plastic Venting (PVC or CPVC)

⚠ WARNING Do not apply power to the boiler prior to Step 4 in the Mandatory Pre-commissioning Procedure for Plastic Venting.

1) Working with the power turned off to the boiler, completely install the vent and air-intake system, securely cementing joints together. If possible, allow primers/cements to cure for 8 hours before firing the burner. If curing time is less than 8 hours, proceed with Steps 2 through 6.
2) Maintain the boiler gas supply shut-off valve in the off position.
3) Remove the cable from the Spark Ignition Electrode and Ignition Controller.

⚠ WARNING **Spark Ignition Circuit** - Maintain a safe distance (2 in. minimum) from the spark ignition circuit to avoid injury from electrical shock.

4) Turn power on to the boiler and apply a heat demand.
5) Allow for 5 complete trials for ignition, consisting of pre and post purge of the combustion blower, until an ignition lockout occurs. Repeat the process one more time (i.e. 10 complete ignition sequences in total).
6) Turn power off and reconnect the cable to the Spark Ignition Transformer.

Near Boiler Vent/Air-inlet Piping

The FTV employs universal Exhaust-vent and Air-inlet appliance adapters that accept 3 in. PVC/CPVC, Polypropylene (PP) or FasNSeal Stainless Steel (SS) piping, without the need for additional adapters. The universal adapters incorporate three seals, one for 3 in. PVC/CPVC pipe (3.5 in. OD), one for 3 in. PP pipe (3.15 in. OD) and one for 3 in. FasNSeal SS pipe (3 in. OD). See Figure 4-2(a) for gasket identification and pipe insertion depth based on pipe material used. Prior to inserting the piping into the universal adapter, ensure it is properly bevel (approximately 1/8 in.) to avoid damaging or dislodging the sealing gasket during installation; see Figure 4-2(b).

⚠ WARNING **Gasket Seating** - Improper seating can cause leakage and eventual failure of the sealing gasket. Ensure the vent pipe is properly beveled, prior to installation, and that the pipe is fully inserted into universal appliance adapter. Failure to follow these instructions may result in serious injury or death.

PVC/CPVC Piping – Ensure the **upper** gasket of the universal appliance adapter is in place and properly positioned prior to installation. Ensure the venting system does not apply a load or strain on the boiler flue outlet adapter; recommend using two elbows to create a "swing joint" to reduce potential strain on vent piping and cemented joints. When exhaust venting with PVC, use the supplied 5" long CPVC Transition Pipe provided with the boiler; insert the CPVC pipe into the exhaust adapter and cement the other end to the PVC exhaust venting using a field supplied PVC or CPVC coupling. See Figures 4-3(a) and 4-3(b).

⚠ WARNING **PVC Exhaust Venting** – **DO NOT** insert PVC pipe directly into the appliance exhaust adapter, as it can deform from the clamping force of the gear clamp. Failure to follow these instructions may result in gasket failure and/or the dislodging of the exhaust pipe from the appliance adapter, resulting in property damage, serious injury or death.

PP Piping – Ensure the **middle** gasket of the universal appliance adapter is in place and properly positioned prior to installation. Ensure the venting system does not apply a load or strain on the boiler flue outlet adapter; recommend using an elbow with an offset to reduce potential strain on vent piping and cemented joints. See Figure 4-3(c).

Stainless Steel Piping – The FTV universal appliance adapter is designed to connect directly to DuraVent – FasNSeal AL29-4C Stainless Steel Special Gas Vent. Ensure the **lower** gasket of the universal appliance adapter is in place and properly positioned prior to installation. Ensure the venting system does not apply a load or strain on the boiler flue outlet adapter; recommend using two elbows to create a "swing joint" to reduce potential strain on vent piping and cemented joints. See Figure 4-3(d).

⚠ DANGER Exhaust venting must be supported to reduce strain on piping joints. Failure to follow these instructions may result in result in damage, serious injury or death.

NOTICE In Canada, the first **3 ft (915 mm)** of vent piping must be readily accessible for inspection.

Figure 4-2 (a) Universal Appliance Adapter – Pipe Insertion Depth

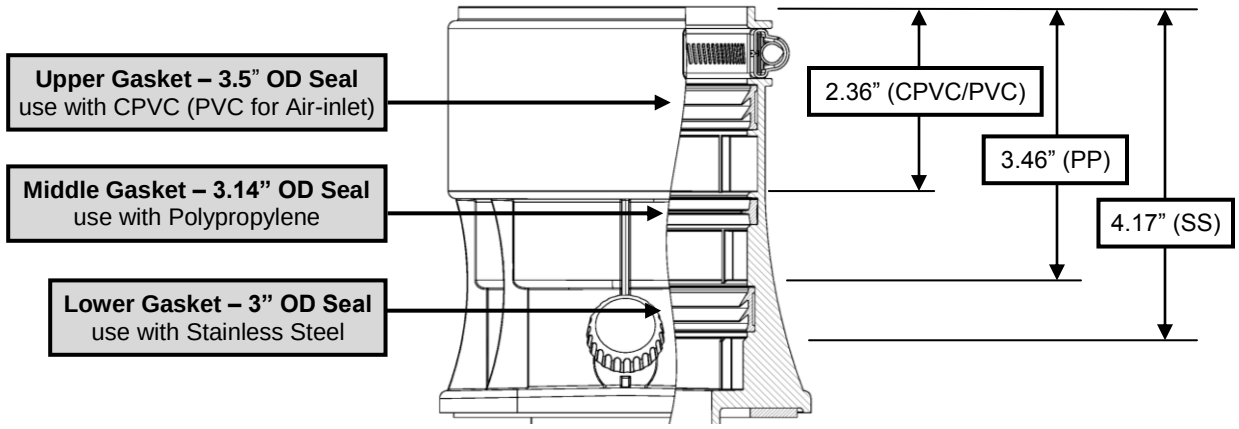


Figure 4-2 (b) Exhaust Vent Connection – FTV110(C)

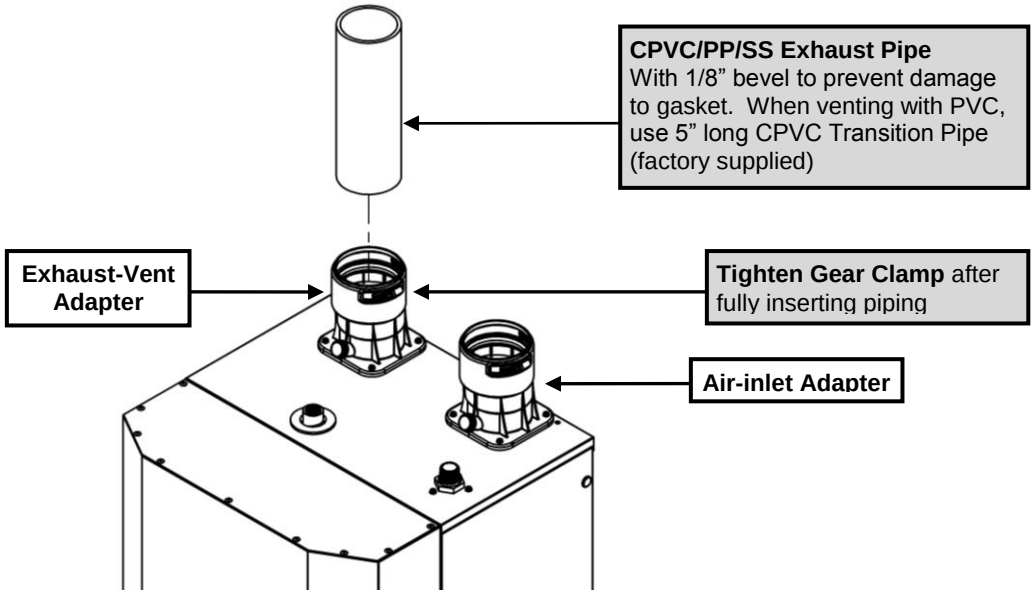


Figure 4-2 (c) Exhaust Vent Connection – FTV150-190(C)

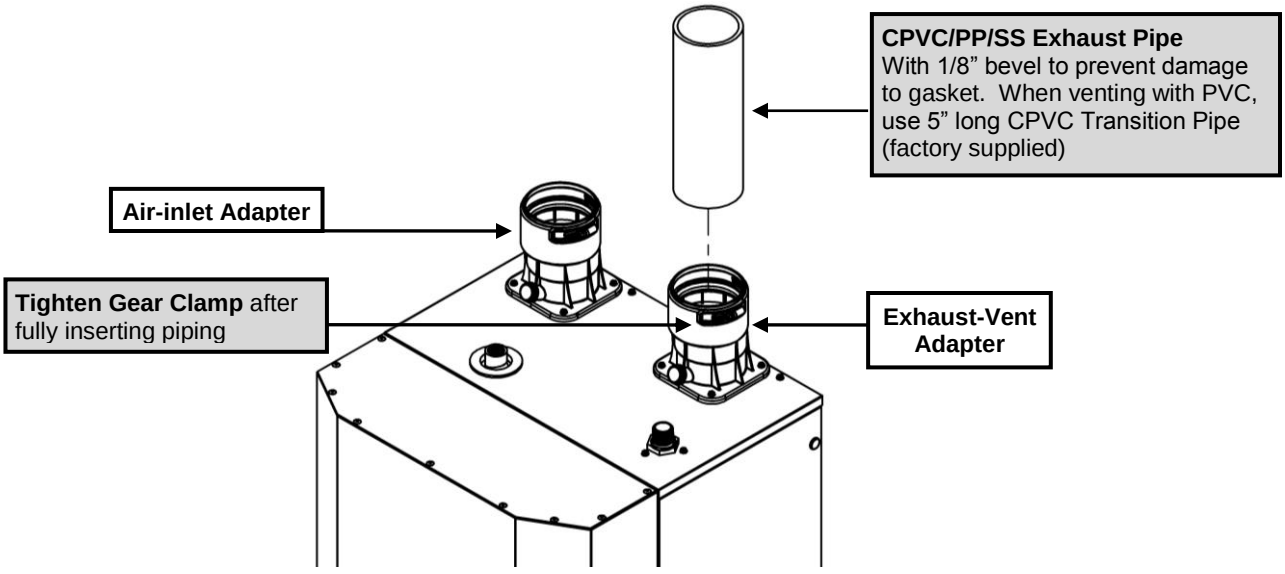


Figure 4-3(a) FTV110(C)
Near Boiler Venting (PVC)

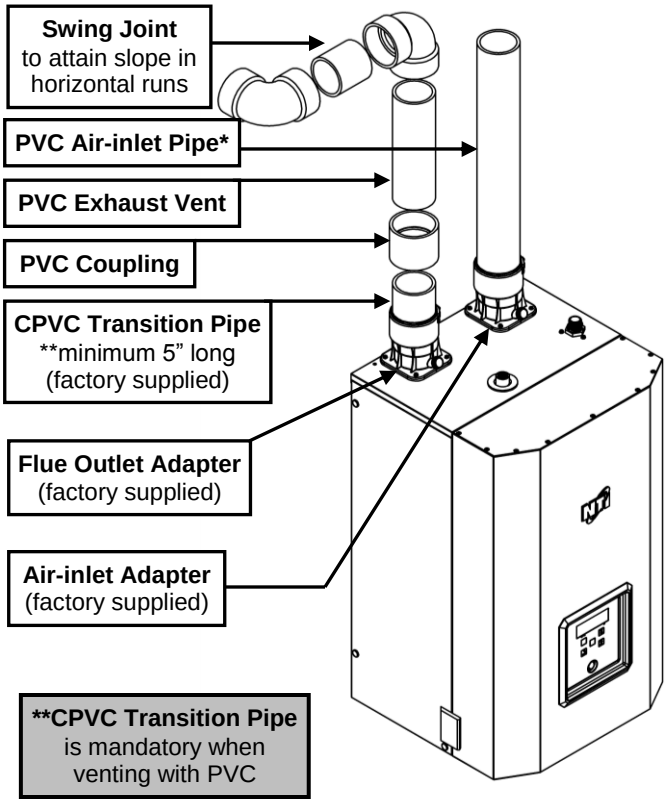


Figure 4-3(b) FTV110(C)
Near Boiler Venting (CPVC)

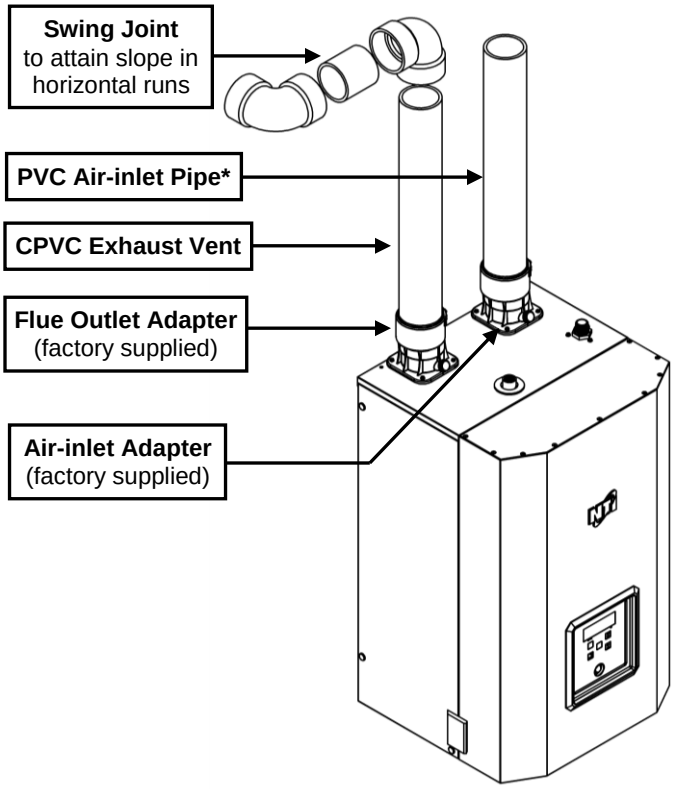


Figure 4-3(c) FTV110(C)
Near Boiler Venting (PP)

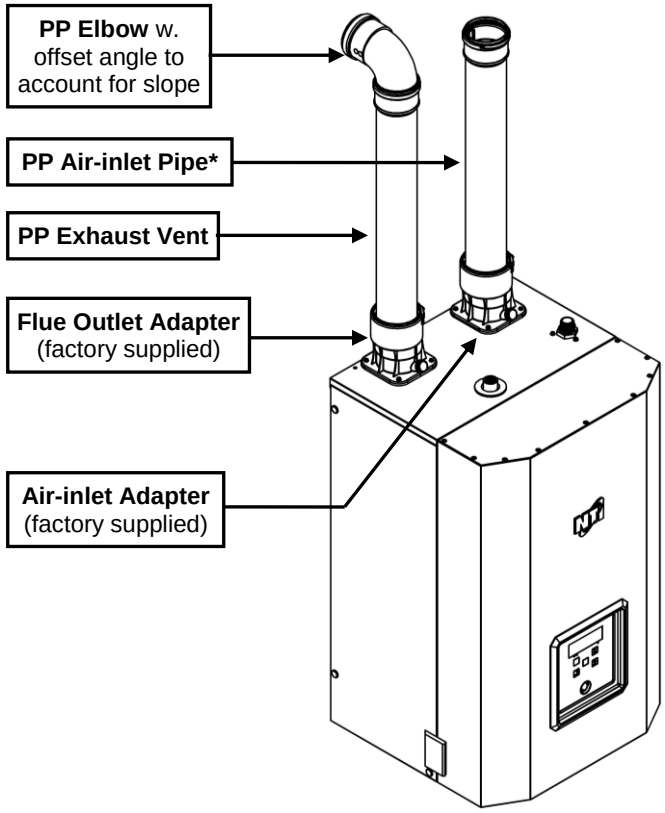
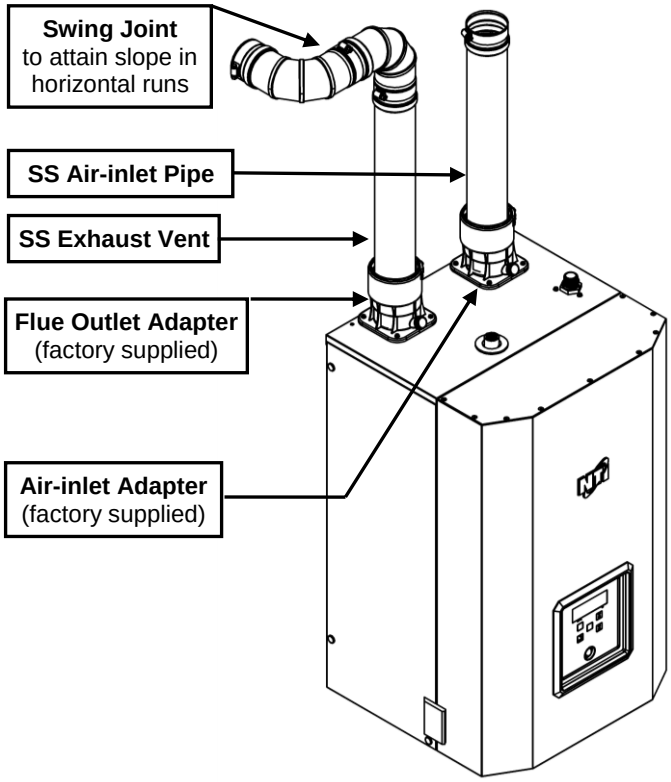


Figure 4-3(d) FTV110(C)
Near Boiler Venting (SS)



★ **Air-inlet** - check with applicable local codes for acceptable pipe material.

Figure 4-3(a) FTV150-190(C)
Near Boiler Venting (PVC)

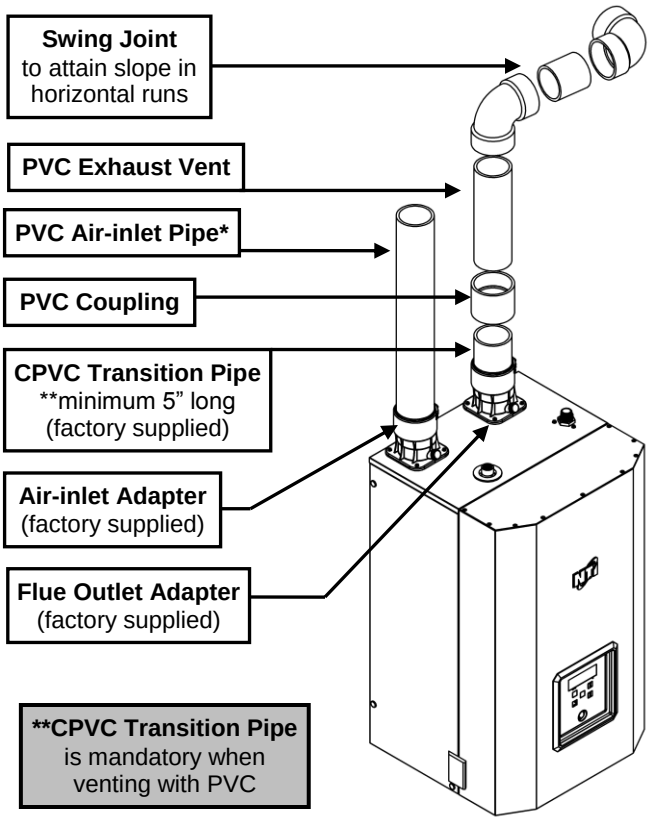


Figure 4-3(b) FTV150-190(C)
Near Boiler Venting (CPVC)

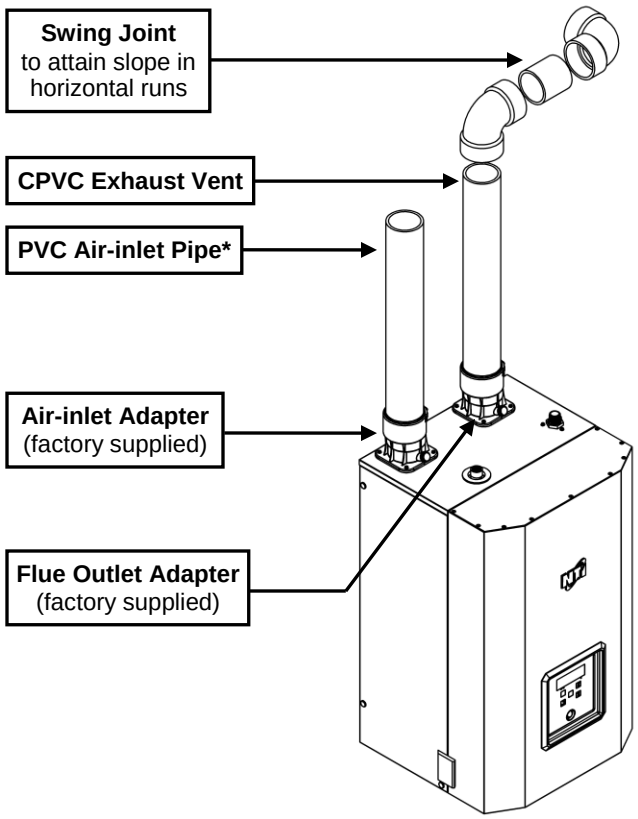


Figure 4-3(c) FTV150-190(C)
Near Boiler Venting (PP)

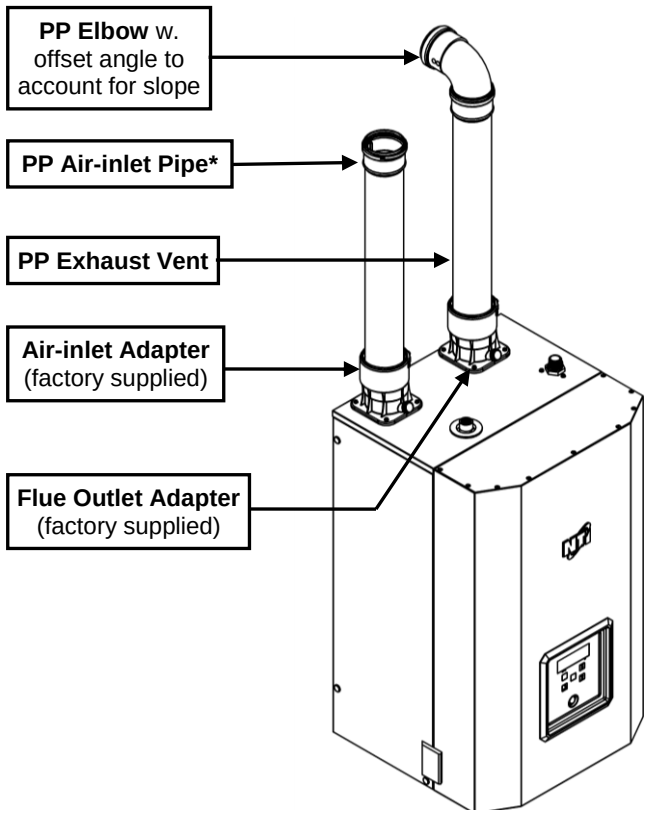
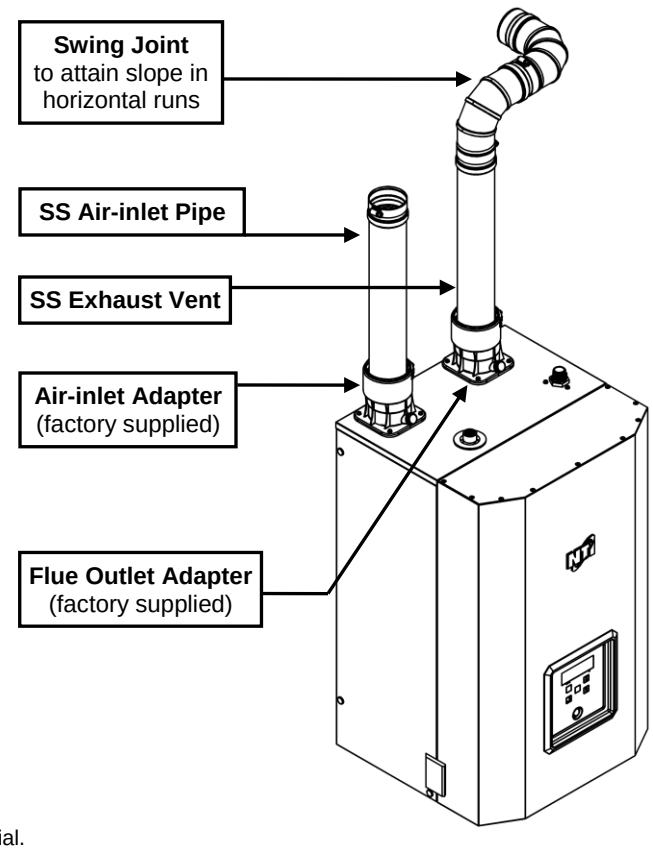


Figure 4-3(d) FTV150-190(C)
Near Boiler Venting (SS)



★ **Air-inlet** - check with applicable local codes for acceptable pipe material.

Vent/Air-inlet Pipe Material

Table 4-2 Approved Vent and Air-inlet Pipe Material

Items [1]	Materials [2, 3]	Venting System Standards		WARNING
		United States	Canada	
Vent Piping and Fittings	PVC - DWV	ANSI/ASTM D2265	In Canada, all exhaust vent material must be **ULC S636 approved**.	All Vent and Air-Inlet materials installed on gas fired appliances in CAN/US must meet the specifications provided in this Table. Failure to comply could result in fire, serious injury or death.
	PVC Schedule 40	ANSI/ASTM D1785		
	CPVC Schedule 40	ANSI/ASTM F441		
	Stainless Steel (SS)	UL-1738		
	Polypropylene (PP)	-		
Pipe Cement	PVC	ANSI/ASTM D2564		
	CPVC	ANSI/ASTM F493		
Primers	PVC / CPVC	ANSI/ASTM F656		

Notes:
[1] Refer to Table 4-5 for Allowable Vent and Air-inlet Pipe Sizes and Lengths.
[2] PVC venting (exhaust and air-inlet) is not permitted within the Closet/alcove of a Closet/alcove installation.
[3] The Air-inlet does not require high temperature pipe material; ABS and PVC Foam Core piping is acceptable. Check applicable local codes for acceptable materials.

WARNING The use of cellular core PVC (ASTM F891), cellular core CPVC, or Radel® (polyphenolsulfone) in the exhaust venting system is prohibited. Failure to follow these instructions may result in property damage, personal injury or death.

WARNING Covering non-metallic vent pipe and fittings with thermal insulation is prohibited. Failure to follow these instructions may result in property damage, personal injury or death.

Vent/Air-inlet Pipe Length Determination

Use Table 4-3 to determine the maximum pipe length that can be used. The table calculates 90º elbows, and 45º elbows at 5 equivalent feet each.

***Example*:** When using 3 in. pipe, the FTV can be installed with 150 equivalent feet of air-inlet piping and 150 equivalent feet of exhaust-vent piping. See Table 4-3 for more details.

Table 4-3 Allowable Vent and Air-inlet Pipe Size and Lengths

Models	Pipe Size (in.)	Length (ft.) [2]	Number of Elbows (90's or 45's) and Equivalent Feet								
			1	2	3	4	5	6	7	8	9
FTV110/110C & FTV150/150C Only	2 [1]	100	95	90	85	80	75	70	65	60	55
All FTV Models	3	150	145	140	135	130	125	120	115	110	105

Notes:
[1] See WARNING below.
[2] Minimum length of each the exhaust vent and combustion air-inlet piping is 6 feet equivalent.

WARNING **PVC Exhaust Venting** – When using 2 inch PVC venting, the first seven (7) equivalent feet of exhaust venting must be approved 2 inch CPVC or 3 inch PVC.

Termination Options – Direct Vent Installation

The venting system of the FTV boilers may be terminated using field supplied piping to construct a "Two-Pipe" termination, see Figures 4-4(a), 4-5(a), 4-5(d), 4-6(a), 4-7(a) and 4-7(d); alternatively the venting may be terminated using a factory kit selected from Table 4-5.

IMPORTANT

Sidewall Termination - Due to potential moisture loading (build-up) along the exterior wall, sidewall venting may not be the preferred venting option. Refer to Figures 4-5 and 4-7 for roof top venting options.

⚠ WARNING

The vent for this appliance shall not terminate over public walkways; or near soffit vents or crawl space vents or other area where condensate of vapor could create a nuisance or hazard or cause property damage; or where condensate or vapor could cause damage or could be detrimental to the operation of regulators, relief valves, or other equipment.

⚠ WARNING

Extra precaution must be taken to adequately support the weight of the Vent/Air-inlet piping in applications using roof-top terminations. Failure to follow these instructions may result in venting or boiler component failure resulting in flue gas spillage leading to property damage, serious injury or death.

Optional Termination Kits – Direct Vent Installation

Kits certified with the FTV are listed in Table 4-5 and available from the manufacturers listed in Table 4-4. Kits with an NTI part number listed in Table 4-5, are available directly from NTI.

Table 4-4 Optional Termination Kit OEMs

Venting Brand	Vent Manufacturer	Contact Information
System 636®	IPEX Inc.	www.ipexinc.com
PolyPro®	DuraVent	www.duravent.com
InnoFlue®	Centrotherm Eco Systems	www.centrotherm.us.com
Z-DENS®	Z-Flex Venting Systems	www.z-flex.com

Table 4-5 Optional Vent Termination Kits

Description	Vent Size	Supplier p/n	Figure	Vent Material Compatibility	Vent Option	
					Roof	Wall
IPEX Low Profile (Wall)[7]	2”	196984 (NTI p/n 85062)	4-4(b), 4-6(c)	PVC/CPVC[7]	×	✓
	3”	196985 (NTI p/n 84357)				
IPEX Concentric (Wall/Roof)[4,5,6,7]	2”	196125	4-4(c), 4-5(c), 4-6(b), 4-7(b)		✓	✓
	3”	196116 (NTI p/n 84634)				
		197117				
PolyPro® Concentric (Wall)	2-3”	2PPS-HK, 3PPS-HK	4-4(c), 4-6(d)	PolyPro® Polypropylene	×	✓
PolyPro® Concentric (Roof)	2-3”	2PPS-VK, 3PPS-VK	4-5(c), 4-7(c)		✓	×
InnoFlue® Flush Mount (Wall)	2-3”	ISLPT0202, ISLPT0303	4-4(b), 4-6(c)	InnoFlue® Polypropylene	×	✓
InnoFlue® Concentric (Wall)	2-3”		4-4(c), 4-6(d)		×	✓
InnoFlue® Concentric (Roof)	2-3”	(ICRT2439 & ICTC0224), (ICRT3539 & ICTC0335)	4-5(c), 4-7(c)		✓	×
Z-DENS® Concentric (Wall)	2-3”	2ZDHK2, 2ZDHK3	4-4(c), 4-6(d)	Z-DENS® Polypropylene	×	✓
Z-DENS® Concentric (Roof)	2-3”	2ZDVK2, 2ZDVK3	4-5(c), 4-7(c)		✓	×

Notes:

1 Instructions included with termination kits contain detailed assembly and installation instructions.

2 Clearance requirements in this manual supersede those of the instructions included with the vent terminal.

3 Piping **MUST** be secured to the vent terminal during installation.

4 IPEX Concentric Terminal **MUST** be cemented together and to the vent pipes during installation.

5 Vent Screens provided with boiler may be used with the IPEX Concentric Vent Kits; otherwise use IPEX vent screens (2 in. vent screen p/n 196050; 3 in. vent screen p/n 196051 – each sold separately).

6 IPEX Low Profile and Concentric kits (excluding p/n 197117) are constructed out of ULC S636 approved **PVC**; check with your local authority for the acceptance of PVC as a venting material prior to use.

7 IPEX Concentric kits can be shortened to fit the requirements of the installation; see instructions included with the kit for more details.

IMPORTANT

PVC In Canada - Authorities in some jurisdictions may not allow the use of any PVC venting materials with condensing boilers; check with the local safety inspector to verify compliance prior to installing a PVC Concentric Vent Kit with a FTV.

Sidewall Venting Options – Direct Vent Installation

Figure 4-4 (a) Two-pipe Termination (Sidewall)

⚠ WARNING

Location of exhaust and air-inlet connections vary between models, see Figure 4-3.

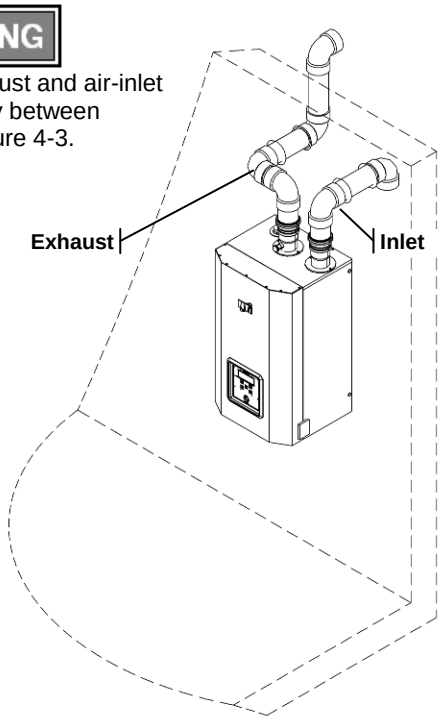


Figure 4-4 (b) Low Profile Termination (Sidewall)

⚠ WARNING

Location of exhaust and air-inlet connections vary between models, see Figure 4-3.

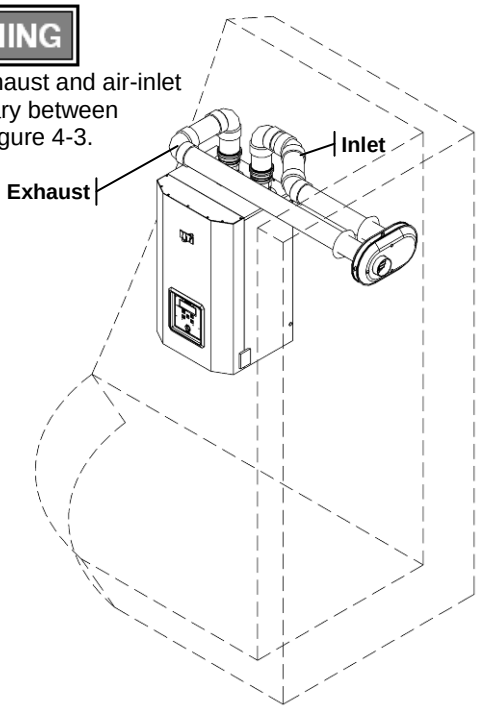
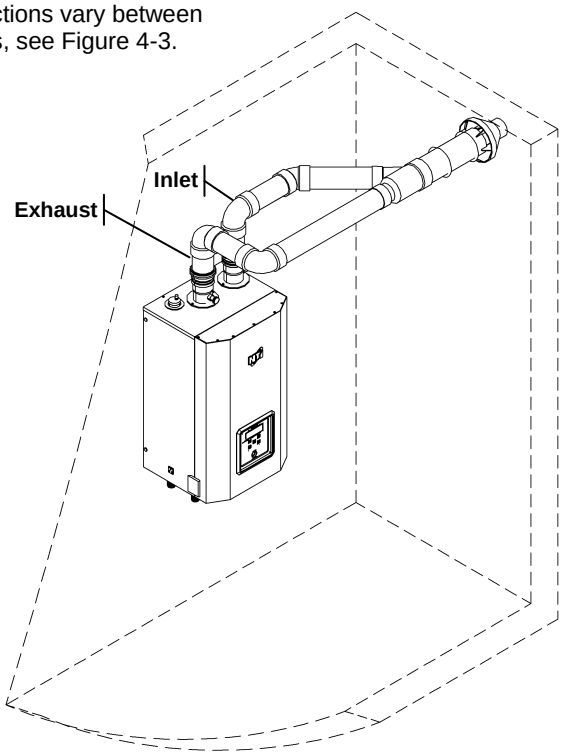


Figure 4-4 (c) Concentric Termination (Sidewall)

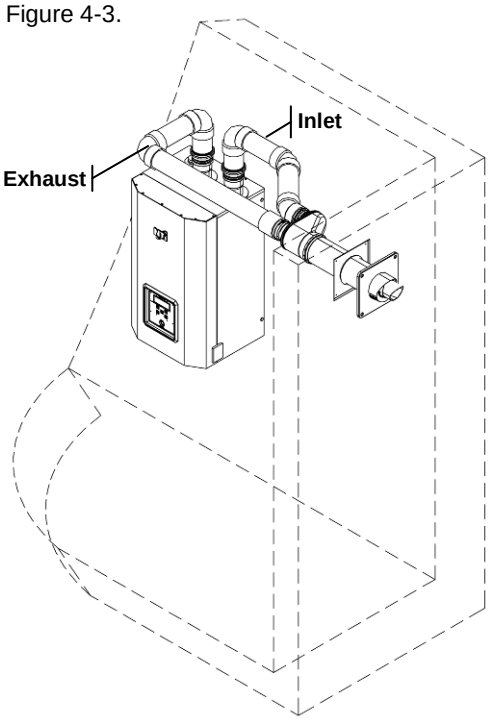
⚠ WARNING

Location of exhaust and air-inlet connections vary between models, see Figure 4-3.



⚠ WARNING

Location of exhaust and air-inlet connections vary between models, see Figure 4-3.



Roof Venting Options – Direct Vent Installation

Figure 4-5 (a) Two-pipe Termination (Roof)

⚠ WARNING

Location of exhaust and air-inlet connections vary between models, see Figure 4-3.

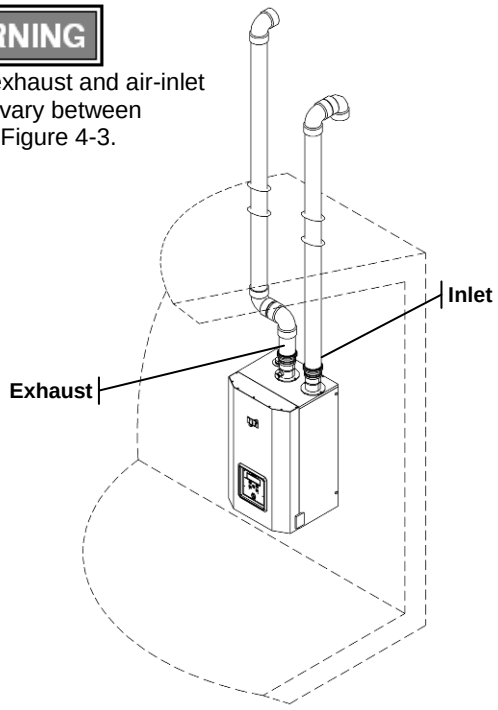


Figure 4-5 (b) Two-pipe Termination (Roof/Sidewall)

⚠ WARNING

Location of exhaust and air-inlet connections vary between models, see Figure 4-3.

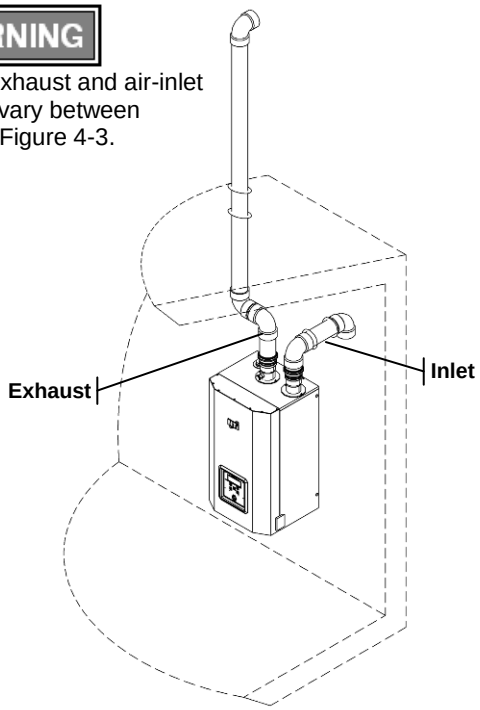
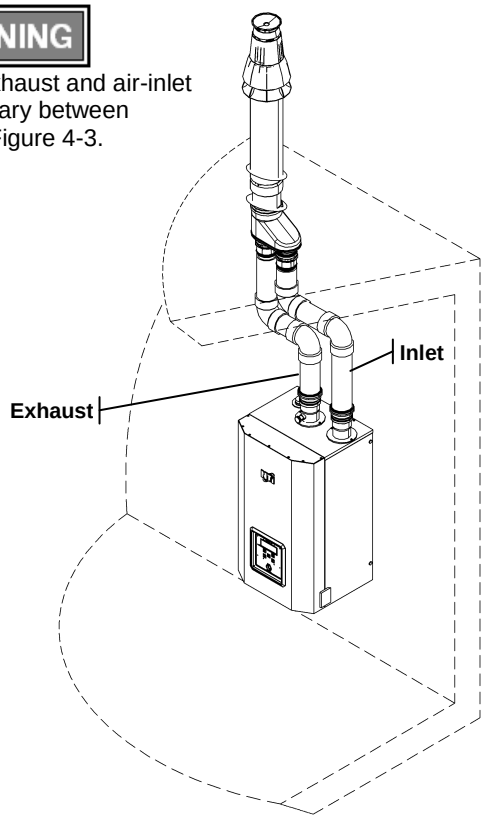


Figure 4-5 (c) Concentric Termination (Roof)

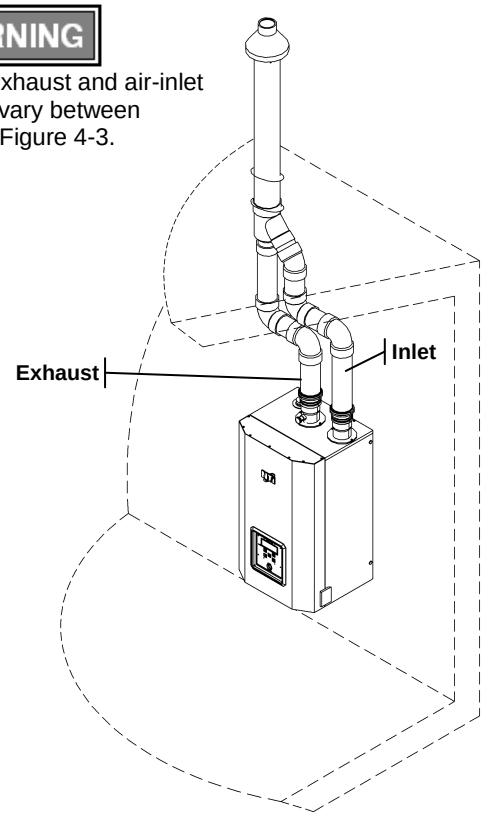
⚠ WARNING

Location of exhaust and air-inlet connections vary between models, see Figure 4-3.



⚠ WARNING

Location of exhaust and air-inlet connections vary between models, see Figure 4-3.



Sidewall Termination Details – Direct Vent Installation

Figure 4-6 (a) Two-Pipe Termination (Sidewall)

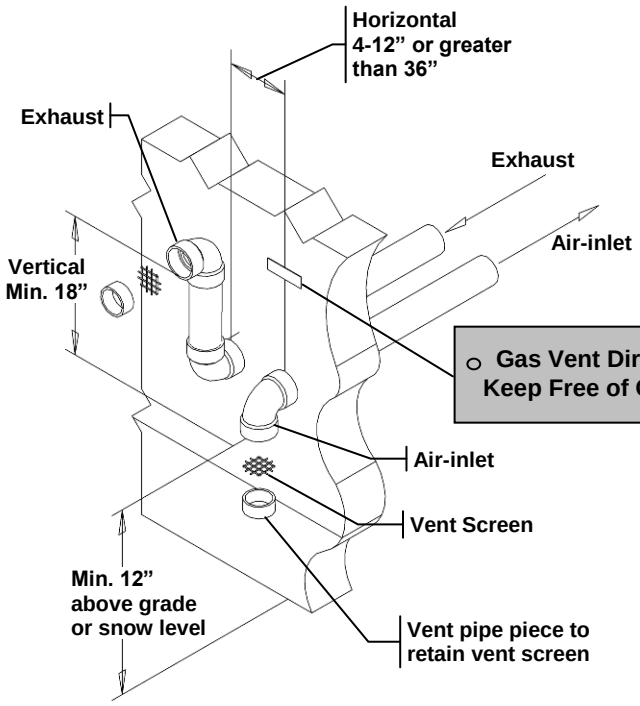


Figure 4-6 (b) IPEX Concentric Termination

⚠ WARNING

Refer to documentation included with termination kit for complete installation instructions.

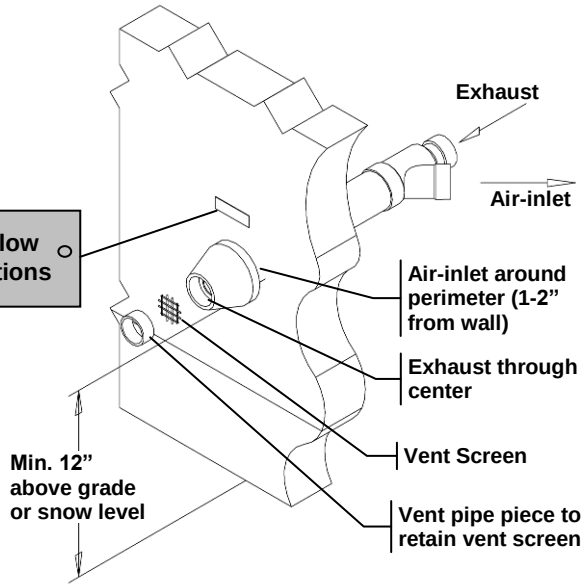


Figure 4-6 (c) Low Profile Termination (Sidewall)

⚠ WARNING

Refer to documentation included with termination kit for complete installation instructions.

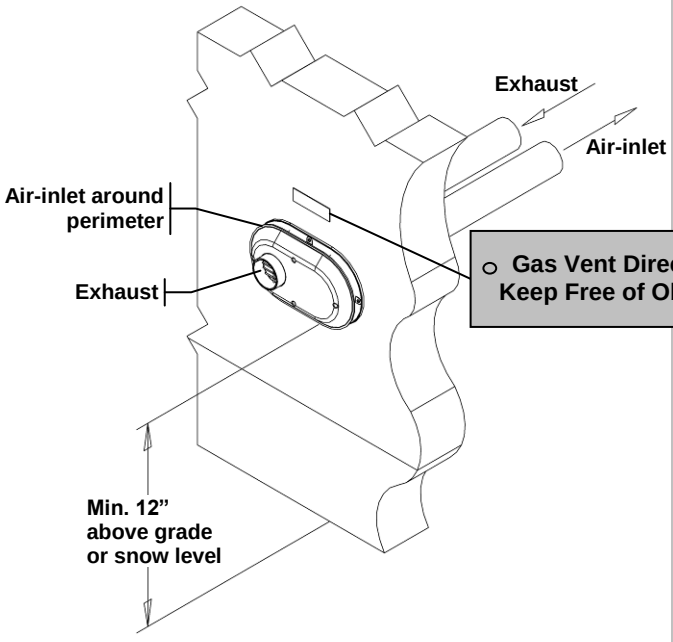
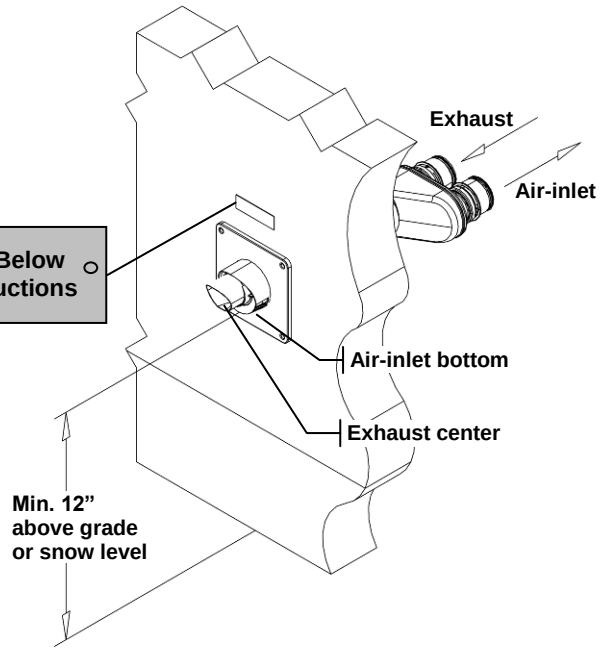


Figure 4-6 (d) PolyPro / InnoFlue Termination

⚠ WARNING

Refer to documentation included with termination kit for complete installation instructions.



Roof Termination Details – Direct Vent Installation

Figure 4-7 (a) Two-Pipe Termination (Roof)

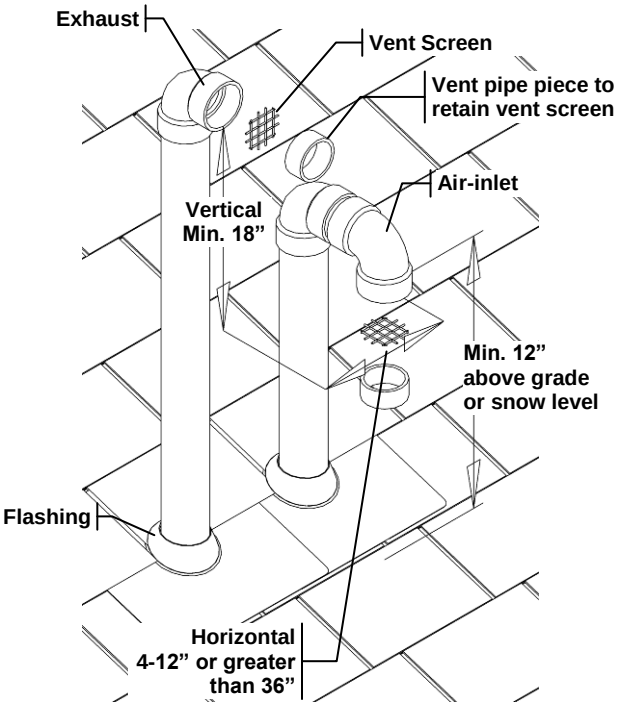


Figure 4-7 (b) IPEX Concentric Termination (Roof)

⚠ WARNING

Refer to documentation included with termination kit for complete installation instructions.

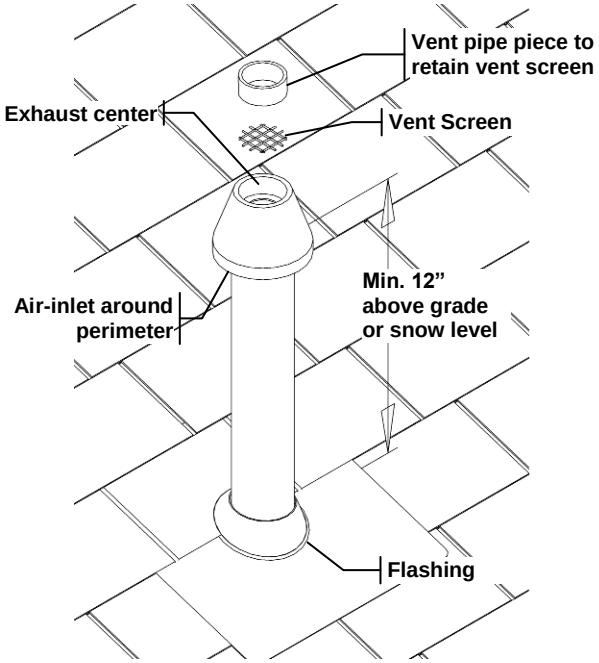


Figure 4-7 (c) PolyPro / InnoFlue Termination (Roof)

⚠ WARNING

Refer to documentation included with termination kit for complete installation instructions.

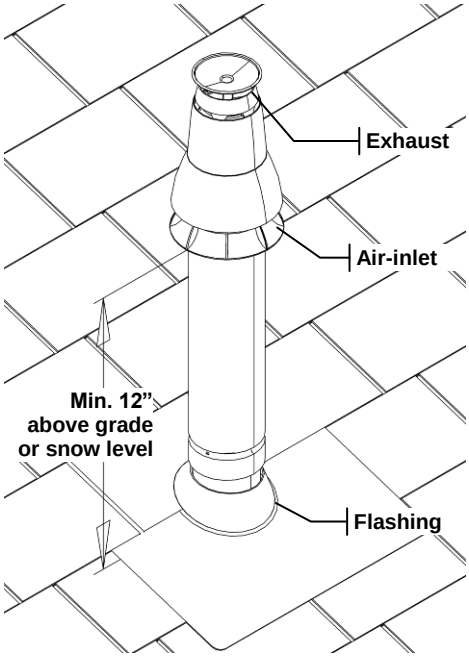
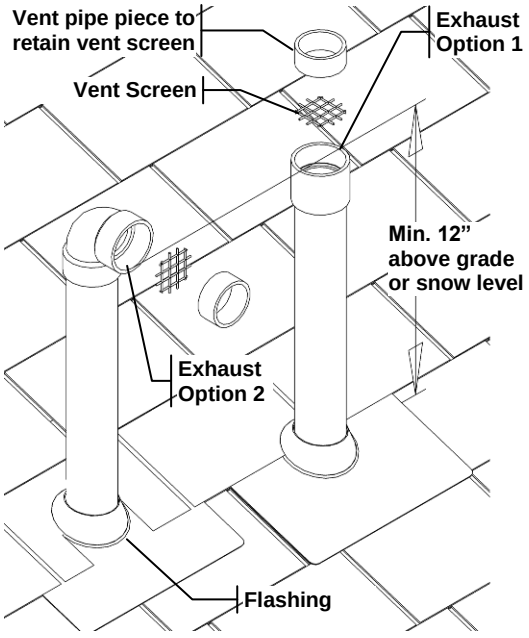


Figure 4-7 (d) Exhaust only Termination (Roof)

⚠ WARNING

Figure illustrates two options for exhaust termination only; neither vent pipe illustrated is for combustion air-inlet.



Venting Rules and Guidelines

1. **Prevailing Winds:** Ensure the vent is located where it will not be exposed to normal prevailing winds.
2. **Combustion Air-inlet Contamination:** Air for combustion must be drawn from an area free of dust and contaminants. Combustion air containing chemicals such as chloride, fluoride, bromine or iodine or dust and debris will cause corrosion damage of the heat exchanger voiding your NTI warranty. Refer to Table 4-1 for a list of corrosive products and contaminants sources to avoid.
3. **Vertical Separation:** The exhaust must be a minimum of 18 in. above the air-inlet, and the air-inlet must always be a minimum of 12 in. plus snow allowance above any surface that will support snow. (Two feet plus snow allowance is highly recommended). Consult your weather office for the maximum typical snowfall for your region.
   E*xample*: New Brunswick Canada - typical maximum snowfall is 19 in., thus the inlet must be (12"+19") = 31 in. above grade and exhaust must be (31"+18") = 49" above grade.
4. **Horizontal Separation:** The horizontal distance between the inlet and exhaust must be a minimum of 4" [102 mm] center to center.
5. **Wall Flashing:** Under normal operating conditions this boiler will produce a plume of white gases, and should be taken into consideration when selecting an adequate location. A 36 in. diameter stainless, plastic, or vinyl shield can be used to flash the exterior of the residence.
6. **Flue Gas Hazard:** Position the vent termination where vapors cannot make accidental contact with people and pets or damage nearby shrubs and plants.
7. **Elbow Extensions:** Elbows on outside of wall must be no more than ½ in. away from the wall.
8. **Vent Sloping:** All indoor exhaust piping must be on a slope back to the boiler a minimum of ¼ in. per linear foot of vent. For applications where excessive condensation is possible ½ in. per linear foot is recommended.
9. **Vent Supports:** Where required Vent and Air-inlet piping shall be secured to the wall for more rigidity. All interior vent pipe shall be supported a minimum of every 36 in..
10. **Roof Exhaust:** In all roof applications the discharge must point away from the pitch of the roof.
11. **Roof Flashing:** Install adequate flashing where the pipe enters the roof, to prevent water leakage.
12. **Rain Cap:** Install and seal a rain cap over existing chimney openings, in vacant chimney applications.
13. **Venting Below Grade:** For installations that exit the wall below grade refer to Figure 4-8.
14. **Vent Screens:** Install factory supplied vent screens on the outside of the last elbow for both the inlet and exhaust vent terminal elbows. Install the screen into the female opening of the elbow, and then cut a small piece of pipe to sandwich the screen into the elbow. NOTE: ensure the small piece of pipe cut, does not extend past the end of the elbow. Two screens are provided in the package. See Figures 4-6 and 4-7.
15. **Condensate Hazard:** Do not locate vent over public walkways, driveways or parking lots. Condensate could drip and freeze resulting in a slip hazard or damage to vehicles and machinery.
16. **Warning Plate:** For Sidewall Venting, install the warning plate "Gas Vent Directly Below", directly above (within 4 ft. vertically) the location of the air-inlet pipe, so it is visible from at least 8 ft away. See Figure 4-6.
17. **Wall Thickness:** Direct vent terminations are designed to work with any standard wall thickness. Installation guidelines for min/max wall thickness are as follows: Min. = 1 in., Max. = 60 in..
18. **Venting Options:** Due to potential moisture loading (build-up) along the exterior wall, sidewall venting may not be the preferred venting option. Refer to Figures 4-5 and 4-7 for roof top venting options.

Figure 4-8 Venting Below Grade

For installations that exit the wall below grade:

1. Excavate site to a point below where the pipes are to exit as shown.
2. Ensure the wall is fully sealed where the pipes penetrate.
3. The Vent/Air-inlet piping MUST be secured to the side of the building above grade, as shown, to provide rigidity.
4. Ensure that the Vent/Air-inlet clearances are maintained, see Section 5.0 for details.

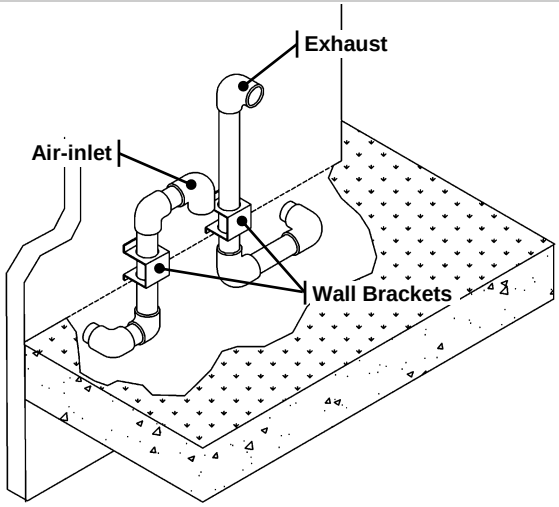


Figure 4-9 Outdoor Venting

Vent piping outside the building is permitted under the following conditions:

1. The maximum length outside the building is 20 ft. Note that outdoor length must be included in the overall vent length calculation.
2. All normal termination clearances are maintained.
3. The pipe is supported every 24 in..
4. The exhaust and inlet are sloped back to the boiler ½ in. elevation for every linear foot.

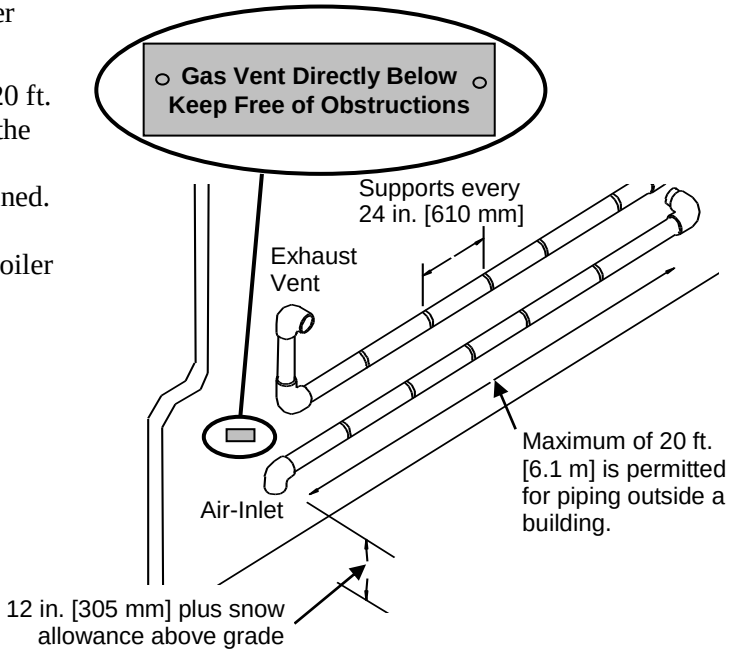
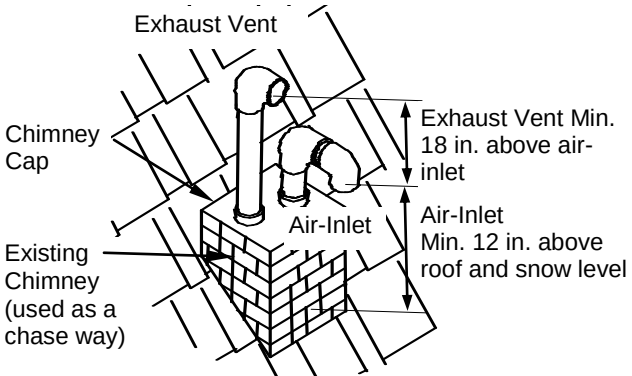


Figure 4-10 Existing Chimney Chase Way

It is permissible to use an existing chimney as a chase way to run the Vent/Air-inlet piping as long as:

1. The chimney is not being used by any other boiler.
2. Flue gases do not enter the vacant chimney.
3. Only FTV certified venting materials are used, see Table 4-2.
4. Vent lengths are within the maximums specified.
5. The top of the chimney is capped and the Vent/Air-inlet pipes are flashed to prevent leakage into the vacant chimney.



⚠ DANGER Under no circumstances may an existing chimney or chase-way be used to vent or provide combustion intake air to a FTV. Failure to follow these instructions will result in fire, property damage, serious injury or death.

5.0 VENT/AIR-INLET TERMINATION CLEARANCES

⚠ WARNING The quick reference table below is to be read in conjunction with the numbered notes as indicated, Figures 5-1 and 5-2, and the Venting Rules and Guidelines in Section 4.0. The instructions detailed in this section are a combination of FTV specific and National Gas Code restrictions. Compliance alone does not insure a satisfactory installation as good common sense must also be applied. Failure to follow these instructions may result in fire, property damage, serious injury or death.

Table 5-1 Termination Clearances Quick Reference Table (See Figures 5-1 and 5-2)

Clearances to Air-inlet Termination		**Canada** [1]		**USA** [2]	
		Min. Distance		**Min. Distance**	
A	Above grade/roofline and snow level [8]	12 in.	305 mm	12 in.	305 mm
B	Above roof line - Concentric Vent [6, 11, 13]	24 in.	610 mm	24 in.	610 mm
C	To exhaust vent from any other boiler	36 in.	915 mm	12 in.	305 mm
Clearances to Exhaust Vent Termination		**Min. Distance**		**Min. Distance**	
A	Above grade/roofline and snow level [8]	12 in.	305 mm	12 in.	305 mm
D	Minimum vertical separation above air-inlet [9]	18 in.	457 mm	18 in.	457 mm
E	Minimum horizontal separation from air-inlet [3]	4 in.	102 mm	4 in.	102 mm
F	Window or door that may be opened, or other building opening	36 in.	915 mm	12 in.	305 mm
G	To combustion air-inlet of any other appliance	36 in.	915 mm	12 in.	305 mm
H	Non-mechanical air supply inlet to building	36 in.	915 mm	12 in.	305 mm
I	Mechanical air supply inlet to building [4]	6 ft.	1.83 m	3 ft.	915 mm
J	Soffit, overhang, eave or parapet	24 in.	610 mm	24 in.	610 mm
K	Soffit vent or vent opening in an overhang, eave or parapet	6 ft.	1.83 m	6 ft.	1.83 m
L	Outside corner [10]	-	-	-	-
M	Inside corner of an L-shaped structure (including walls and fences)	36 in.	915 mm	36 in.	915 mm
N	Service regulator / vent outlet	36 in.	915 mm	36 in.	915 mm
P	Each side of center line above or below meter / regulator assembly [5]	36 in.	915 mm	36 in.	915 mm
Q	Above a paved sidewalk, driveway, or parking lot on public property if adjacent [12]	7 ft.	2.13 m	7 ft.	2.13 m
R	Above a public walkway	x	x	x	x
S	Above a sidewalk or paved driveway that is located between two single family dwellings and services both dwellings	x	x	x	x
T	Under a concrete veranda, porch, deck, or balcony [7]	24 in.	610 mm	24 in.	610 mm
U	Above, under or near exterior stairs	x	x	x	x
V	Into a canopy or carport	x	x	x	x

Notes:

1 - Canadian installations must comply with the current CSA B149.1 Natural Gas and Propane Installation Code and local building codes.

2 - US installations must comply with current ANSI Z223.1/ NFPA 54 National Fuel Gas Code and local building codes.

3 - Horizontal separation center-to-center (c.c.) 4”-12” (102-305 mm).

4 - For US installations, an exhaust vent must be 3 ft above a mechanical air supply inlet if within 10 ft. [3 m] horizontally.

5 - Horizontal clearance must be observed up to a height of 15 ft. [4.6 m] above/below the meter, regulator, or relief devices.

6 - Concentric Vent must protrude from the roof precisely 24” [610 mm] measuring from the terminal end-cap vanes.

7 - Permitted if veranda, porch, deck, or balcony is made of concrete and a minimum of two sides are fully open beneath.

8 - 24” is the recommended snow level allowance above grade/roofline or any surface that will support snow, debris, or ice (i.e. for roof venting clearances - roofline and snow level). If living in a snowfall region, consult your local weather office for the maximum typical snowfall for your area.

9 - Note that the vent must maintain a minimum vertical distance above the air-inlet. Example: Vent height = 18” (457 mm) above air-inlet + 12” (305 mm) for air-inlet above grade/roof line and snow level = 30” (762 mm) above grade and snow level.

10 - Clearances to an outside corner to be in accordance with local installation codes.

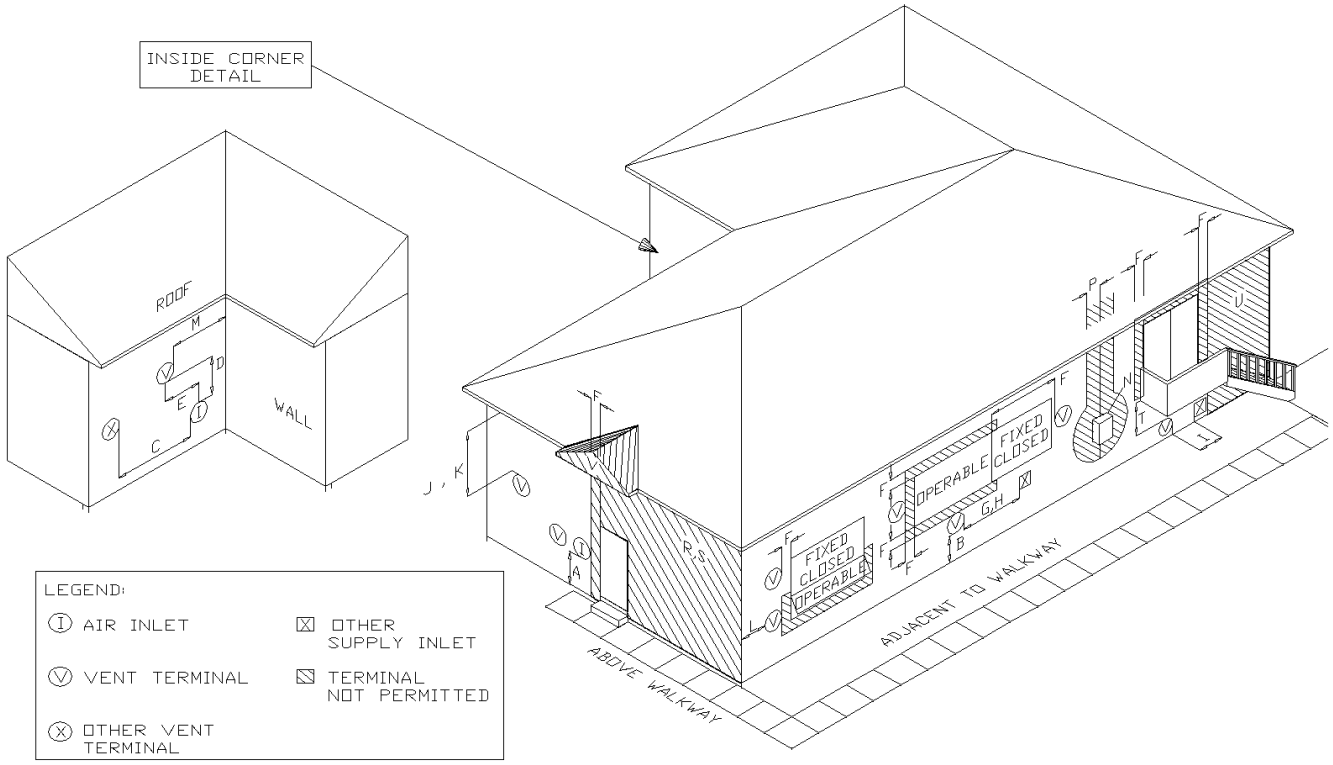
11 - In Canada, concentric vent materials are subject to approval by local inspectors. See Termination Kits in Section 4.0.

12 - Above public walkways, driveways or parking lots if adjacent to it and condensate cannot drip, freeze, or create a hazard.

13 - Contact the manufacturer for special exemptions relating to multiple boiler installations using concentric vents.

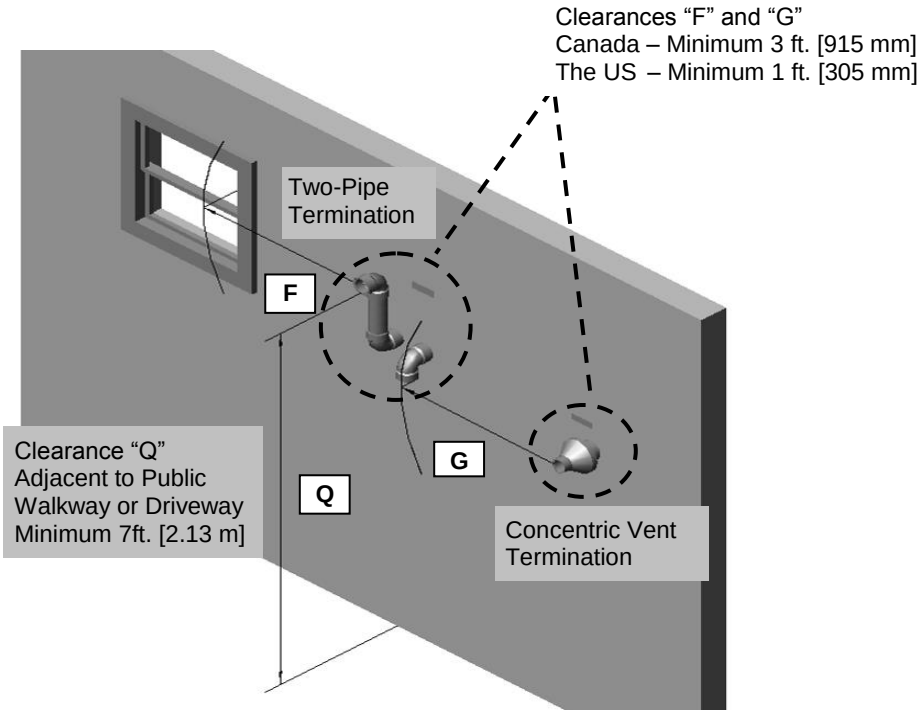
X - Not permitted by National gas code(s) and/or recommended by boiler manufacturer.

Figure 5-1 Termination Clearance Quick Reference Diagram (See Table 5-1)



Illustrations of Termination Clearances

Figure 5-2 Sidewall Termination (See Table 5-1)



G – Letter represents a specific Termination Position. Refer to Table 5-1 for corresponding termination clearances.

6.0 CONDENSATE DRAIN

The FTV boilers produce liquid condensate in the heat exchanger and venting system as a product of combustion. Steps must be taken to ensure condensate does not collect in the venting system; therefore, all exhaust piping must slope back to the boiler a minimum ¼ in. per linear foot of vent. Condensate must be drained from the unit into a household drain.

NOTICE

Check with your municipality, or local gas company to determine if the disposal of combustion condensate is permitted in your area (e.g. in the **State of Massachusetts** the condensate must be neutralized prior to entering a drain).

The following are important notes that must be taken into consideration when constructing the condensate drain system (see Condensate Trap Installation Instructions for further details):

- **DO NOT** install condensate lines outside. A frozen or blocked drain will cause the condensate to back-up and leak. This may result in damage to boiler components resulting in a no heat condition; property damage may also occur.
- **NEVER** use copper, steel, or galvanized piping in the construction of the condensate system (condensate is very corrosive and will corrode most metals).
- When a condensate pump is used or required, select a pump that is designed for residential furnaces.

CAUTION

All tubing, drains and surfaces that come in contact with condensate draining from the boiler, must be constructed out of corrosion resistant material; copper, steel and galvanized are not acceptable materials for draining condensate. Failure to abide by this caution will result in property damage.

Condensate Trap Installation Instructions (see Figure 6-1)

(Note: the Condensate Trap is factory supplied with the boiler and must be field installed)

1. **Inspect Condensate Trap Assembly** – Inspect the Condensate Trap to ensure all parts were shipped with the assembly (see Figure 6-1). The Condensate Trap must be periodically disassembled and cleaned as part of a regular maintenance plan.
2. **Attach Corrugated Outlet Tube** – Remove the **Outlet Retaining Nut** and **Outlet Gasket** and slide components onto the **Corrugated Outlet Tube** – note orientation (gasket should be positioned approximately 1/8" from the edge of the outlet tube – see Figure 6-1). Press the **Corrugated Outlet Tube** into the **Condensate Trap Outlet** and firmly hand-tighten the **Outlet Retaining Nut**.
3. **Attach to Boiler Condensate Drain (A)** – Ensure the **Ball-float** is placed inside the condensate trap, position the **Inlet Gasket** in between the condensate trap and boiler condensate outlet (See Figure 6-1).
4. **Attach to Boiler Condensate Drain (B)** – Secure the **Condensate Trap** into place by firmly hand-tightening the **Inlet Retaining Nut**.
5. **Outlet to Drain** – Route the condensate from the Corrugated Outlet Tube to a household drain, condensate pump or neutralizer (check with your local authority regarding the disposal of condensate), being careful NOT to route it higher than the Condensate Trap outlet (see Figure 6-1).

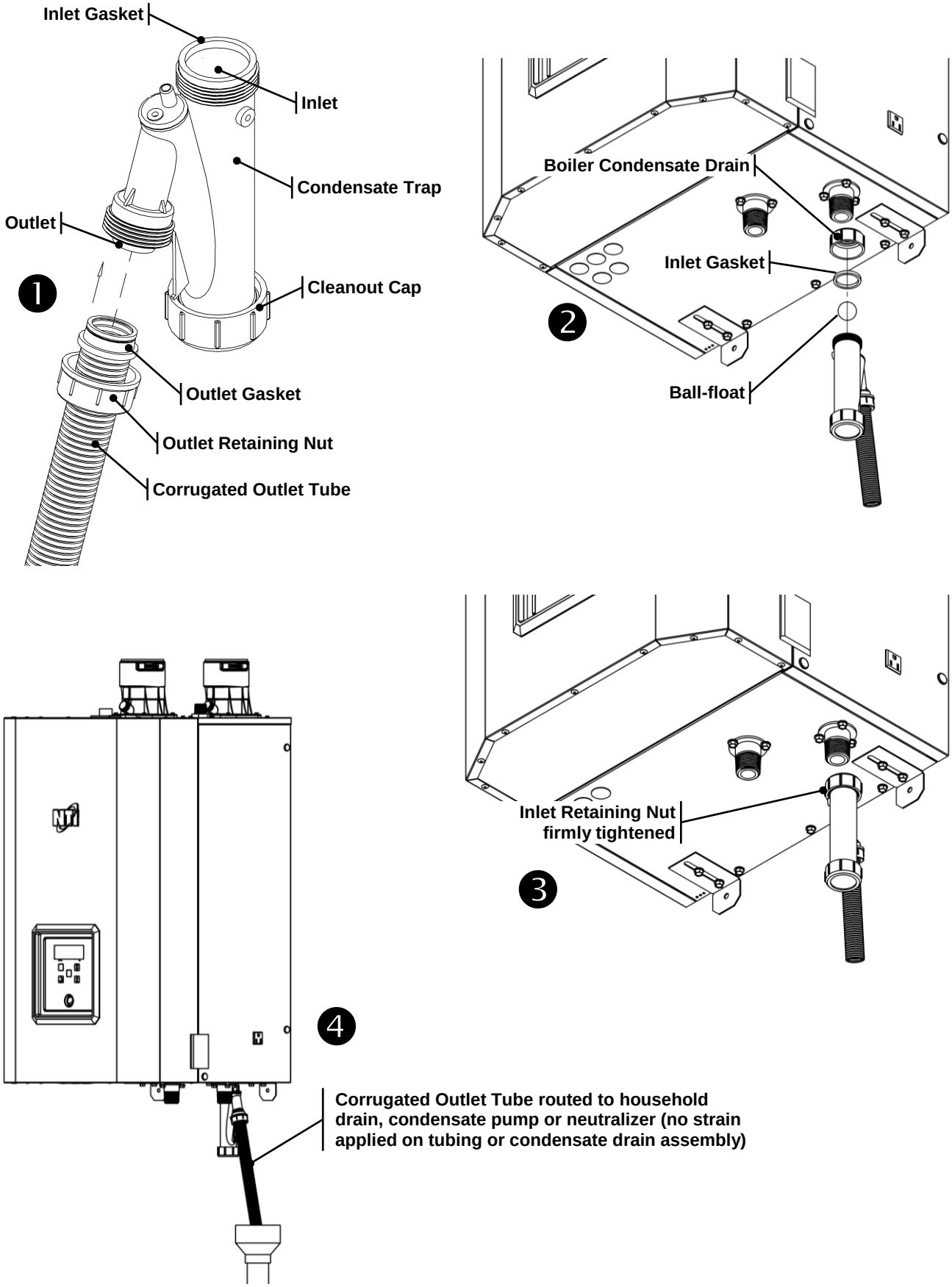
⚠ CAUTION

The Condensate Trap must be periodically disassembled and cleaned as part of a regular maintenance plan. Failure to clean the trap regularly can cause condensate drain blockage leading to boiler malfunction, property damage and even personal injury.

⚠ DANGER

Carefully follow the above instructions and the accompanying figure – check to ensure the condensate trap is secure to the bottom of the boiler and that no strain is placed on it. Failure to install the condensate trap properly will result in flue gas spillage and leeching of carbon monoxide emissions into the surroundings resulting in serious injury or death.

Figure 6-1 Condensate Drain Piping



7.0 INSTALLING GAS PIPING

⚠ DANGER

FTV boilers are factory set to operate with Natural Gas; **BEFORE OPERATING WITH PROPANE**, the boiler must be converted using the appropriate *Natural to LP Conversion Kit*; see Table 7-1. Failure to properly convert the unit to safely operate with Propane will cause dangerous burner operation, resulting in property damage, serious injury or death.

⚠ WARNING

Liquefied Petroleum (LP) propane gas is heavier than air. Do not install the boiler in a pit or similar location that will permit heavier than air gas to collect. Check with Local Codes as they may require boilers fueled with LP gas to be provided with an approved means of removing unburned gases from the room. Failure to follow these instructions may result in serious injury or death.

Table 7-1 Natural Gas to LP Conversion Kit

Model	Kit Number	LP-Venturi Insert (part no.)
FTV110 & FTV110C	85995-1	85989
FTV150 & FTV150C	85446-1	85536
FTV190 & FTV190C	85934-1	85812
Note: FTV models are converted to Propane using a replacement LP-Venturi Insert, not by installing an orifice. Follow the Natural Gas to LP Conversion Instructions provided with the Kit.		

Installation

Refer to the current **National Fuel Gas Code ANSI Z223.1/NFPA 54 or CAN/CGA B149.1** installation codes, and local codes for gas piping requirements and sizing. Pipe size running to the unit depends on:

- Length of pipe.
- Number of fittings.
- Type of gas.
- Maximum input requirement of all gas boilers in the residence.

Ensure that:

- The gas line connection to the boiler does not apply any weight to the gas valve. NTI recommends using approved flexible gas piping (if acceptable by local codes) to connect the boiler to the gas supply (see Figure 7-1 for details).
- You plan the installation so the piping does not interfere with the vent pipe, or the removal of the valve, burner, and serviceable components.
- The Boiler is installed such that the gas ignition system components are protected from water (dripping, spraying, rain etc.) during installation and servicing.
- The gas piping is large enough for all the gas appliances in the home. No appreciable drop in line pressure should occur when any unit (or combination of units) lights or runs. Use common gas-line sizing practices.
- Always use a pipe-threading compound that is resistant to Propane (LP) gas solvent action. Apply sparingly to all male threads, starting at two threads from the end. Over doping or applying dope to the female end, can result in a blocked gas line.
- DO NOT TIGHTEN FITTINGS WITHOUT SUPPORTING THE INTERNAL GAS LINE CONNECTION WITHIN THE BOILER as damage to the boiler's internal gas carrying components could occur.
- Install a manual "Equipment Shut-Off Valve" as shown in Figure 7-1. Valve must be listed by a nationally recognized testing laboratory.
- The gas line piping can safely be removed from the boiler for servicing, by strategically placing the gas line shutoff and union; see example in Figure 7-1.
- All gas piping, including gas components in the boiler, are checked for leaks using a "Bubble Test", prior to operating the boiler.

⚠ WARNING

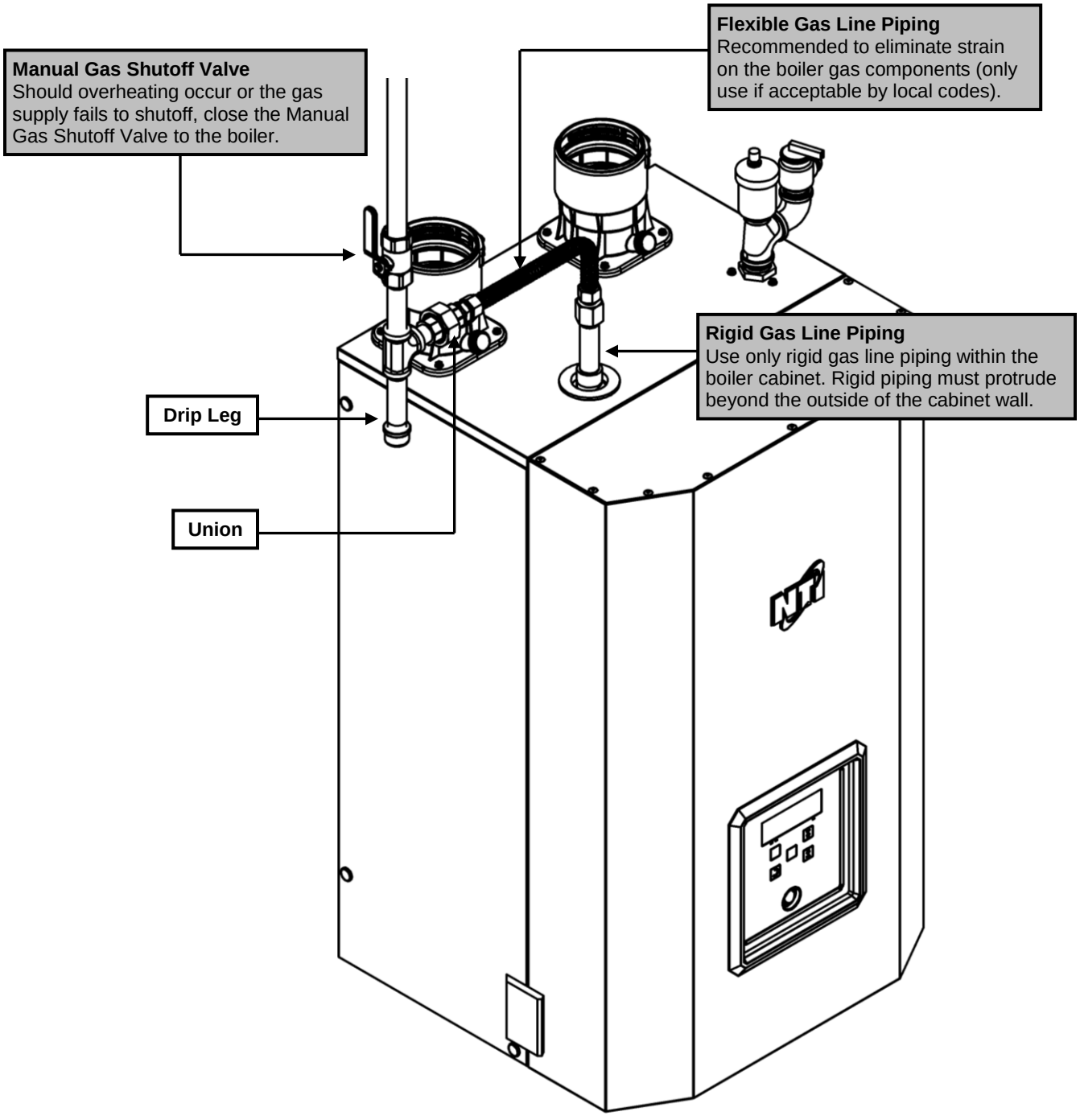
Strain on the gas valve and fittings may result in vibration, premature component failure and leakage and may result in a fire, explosion, property damage, serious injury or death.

⚠ WARNING

Do not use an open flame to test for gas leaks. Failure to follow these instructions may result in fire, property damage, serious injury or death.

⚠ WARNING When performing a pressure test on the gas line piping, be sure the boiler is disconnected or isolated if the test pressure is expected to exceed 1/2 PSI (14 in. w.c.), as damage to the gas valve could occur resulting in fire, property damage, serious injury or death.

Figure 7-1 Gas Line Connection (Typical)



⚠ WARNING Test all gas piping, internal and external to the boiler, for leaks. Failure to follow these instructions may result in fire, property damage, serious injury or death.

8.0 LIGHTING THE BOILER

⚠ DANGER Before Start-up refer to **Mandatory Pre-commissioning Procedure for Plastic Venting** in Section 4.0. Failure to follow these instructions can result in explosions, injury or death.

⚠ DANGER Prior to turning the gas supply on and lighting the boiler, ensure all aspects of the installation are complete and in conformance with the instructions provided in this manual, including the Vent/Air-inlet, Condensate Drain, and System Water Piping. Failure to precisely follow these instructions will cause a fire or explosion resulting in property damage, serious injury or death.

⚠ WARNING Do not store or use gasoline or other flammable vapors & liquids in the vicinity of this or any other boiler. Failure to follow instructions could result in explosion causing property damage, serious injury or death.

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

⚠ WARNING Should overheating occur or the gas supply fails to shutoff, close the Manual Gas Shutoff Valve to the boiler. Failure to follow instructions could result in explosion causing property damage, serious injury or death.

FOR YOUR SAFETY, READ BEFORE OPERATING

A) This boiler 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 boiler 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 boiler.
- 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 turn the gas "shutoff" valve. Never use tools. If the handle will not turn by hand, do not 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 boiler if any part has been under water. Immediately call a qualified service technician to inspect the boiler and to replace any part of the control system and any gas control which has been under water.

OPERATING INSTRUCTIONS

1. STOP! Read the safety information above very carefully.
2. Set the thermostat to lowest setting. Turn off all electric power to the boiler.
3. This boiler 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.
4. Turn the manual gas valve to the OFF position. Remove front access panel.
5. 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. If you do not smell gas, go to the next step.
6. Turn the manual gas valve ON. Wait an additional five (5) minutes smelling for gas.
7. Replace the front access panel.
8. Set thermostat to highest setting. Turn on all electric power to the boiler.
9. Ignition sequence is automatic. Combustion will occur after a brief fan purge.
10. If ignition does not occur, follow the instructions "To Turn Off Gas To Boiler" and call your service technician or gas supplier.

TO TURN OFF GAS TO THE BOILER

1. STOP! Read the safety information above very carefully.
2. Turn off all electric power to the boiler
3. Turn the manual gas valve to the OFF position

⚠ WARNING The initial lighting of the boiler must be performed by a licensed Gas Technician. Failure to follow instructions may result in property damage, serious injury or death.

- Ensure the boiler is wired in accordance with this manual.
- Ensure the gas shutoff valve is turned on, and that the gas system has been fully tested for leaks.
- Ensure the system is completely filled with water, and that ALL the air is purged out.
- Ensure the Vent and Air-inlet piping is completely installed in accordance with this manual.

⚠ DANGER Allow primers/cements to cure for 8 hours prior to Start-up. If curing time is less than 8 hours, first perform Steps 2 through 6 of **Mandatory Pre-commissioning Procedure for Plastic Venting** in Section 4.0. Failure to follow these instructions can result in explosion, serious injury or death.

Initial Start-Up

Each time the power is turned on to the boiler, the control will go through a "de-air" sequence designed to purge air from the boiler. The de-air sequence takes 14 minutes to execute, during which time the circulators will be operating in a cyclical manner and the burner will not attempt to function. Once the de-air sequence has been executed at least once, subsequent de-air sequences can be bypassed by holding the "OK" button until "de-Air" is no longer displayed on the screen; see Section 17.0 for more details.

1. Turn on power to the boiler and turn-up the Thermostat(s). The boiler should run through a purge, and combustion should occur. (The control system has a built-in ignition retry, allowing the system to try at least five times, before locking-out).
2. With the unit operating at full capacity, verify that the gas line pressure is 4-10.5 inches w.c. for Natural gas, and 9-13 inches w.c. for Propane (see Section 9.0 for details).
3. Using an appropriate Oxygen (O_2) or Carbon Dioxide (CO_2) analyzer, take a sample of the flue gas. The sample must fall within the acceptable ranges for CO_2 (see Section 9.0 for details).
4. Perform at least three ignitions in succession to ensure proper operation.
5. After the three successive ignitions, unplug the flame sensor and allow the unit to cycle again. The flame safety system will allow the unit to go through 5 ignition cycles before going to "Loc 1". Once you have confirmed this behavior, reinstall the wire on the flame sensor, press the reset button and reconfirm proper ignition.

⚠ WARNING The flame probe is located in the burner plate; it has a single white/semi-transparent wire connected to it. DO NOT remove the orange spark cable from the ignition electrode (also located in the burner plate); this device is used for spark ignition and produces 20,000 Volts potential which would result in an EXTREME ELECTRICAL SHOCK possibly causing serious injury or death.

⚠ WARNING If the unit fails to light consistently and smoothly, contact NTI for technical assistance at 1-800-688-2575. Never allow the boiler to operate if the ignition or operation of the burner is rough or erratic. Failure to follow these instructions may result in serious injury or death.

Re-lighting Unit

1. Stop and read these instructions very carefully.
2. Set the thermostat to the lowest setting, and then turn off all power to the boiler.
3. This boiler does not have a pilot. It is equipped with an ignition device that automatically lights the burner. Do not try to light the burner by hand.
4. Turn the gas shutoff valve to the off position, and then remove the front cover.
5. Wait five (5) minutes to clear out any gas. Then check for gas, including near the floor. If you smell gas "Stop" and follow "B" above (see **FOR YOUR SAFETY, READ BEFORE OPERATING**). If you do not detect any gas proceed to the next step.
6. Turn the gas shutoff valve to the on position, wait an addition five (5) minutes and check for gas.
7. Replace the front cover.
8. Set the thermostat to the highest setting, and then turn on all power to the boiler.
9. Ignition sequence is automatic, combustion will occur after a brief fan purge. Ignition will retry 3 times.
10. If ignition does not occur, "Turn off the gas and electricity to the boiler" and contact a qualified service technician, or gas supplier.

Turning Off the Boiler

1. Set the thermostat to the lowest setting, and then turn off all power to the boiler.
2. Turn the gas shutoff valve to the off position.

9.0 GAS VALVE AND BURNER SET-UP

⚠ WARNING Set-up of the FTV gas valve must be performed by a licensed Gas Technician. Failure to perform the set-up correctly may result in incorrect operation, component failure, property damage, serious injury or death.

Combustion Calibration Procedure

To calibrate burner combustion, perform the following procedure using a calibrated combustion analyzer capable of measuring CO_2 and CO from a Natural Gas or Propane burning appliance:

1. **Set analyzer** to the appropriate fuel (Natural Gas or Propane).
2. **Gas Line Pressure Test** – monitor gas line pressure throughout all combustion tests and verify it is maintained within tolerance. See *Gas Line Pressure Test* below.
3. **Set Throttle Screw** – operate burner to the maximum modulation rate (see Table 9-2); set combustion according to Table 9-1 using the Throttle Screw; allow time for the analyzer readings to stabilize between adjustments – record CO_2 value. See *Throttle Screw Adjustment* below.
4. **Set Offset Screw** – operate burner to the minimum modulation rate (see Table 9-2); using the Offset Screw, set the CO_2 to 0.4-0.8% lower than the value obtained during the maximum modulation rate test (e.g. if CO_2 at Max = 9.5%, then CO_2 at Min must = 8.7-9.1%). See *Offset Screw Adjustment* below.

⚠ WARNING **Combustion Calibration is mandatory** upon installation and during each annual service. Failure to perform the Combustion Calibration in accordance with these instructions may result in incorrect combustion leading to burner damage or excessive Carbon Monoxide concentrations causing property damage, personal injury or death.

⚠ WARNING **Carbon Monoxide** - Never leave the unit operating while producing Carbon Monoxide (CO) concentrations in excess of 175 ppm. Failure to follow this warning may result in serious injury or death.

Throttle Screw Adjustment

The gas valve Throttle Screw (see Figure 9-1) is used to calibrate the CO_2 concentration with the burner operating at or near the maximum modulation rate (see Table 9-2). Turning the Throttle Screw in (clockwise) decreases the CO_2 concentration. Turning the Throttle Screw out (counterclockwise) increases the CO_2 concentration. Typical adjustment required is $0 - {}^{1}/_{2}$ of a turn in or out from the factory setting.

NOTE: Calibration of the Throttle Screw should only be performed with the burner operating at or near the maximum modulation rate (see Table 9-2).

⚠ WARNING Adjustments to the **Throttle Screw** may only be made by a qualified gas technician using a calibrated combustion analyzer capable of measuring CO_2 and CO. Adjustments may only be performed if the gas line pressure is maintained above minimum levels throughout the duration of the test (see Table 9-1). Failure to follow these instructions may result in serious injury or death.

Offset Screw Adjustment

The gas valve Offset Screw (see Figure 9-1) is used to calibrate the CO_2 offset at minimum modulation vs. maximum modulation. Turning the Offset Screw in (clockwise) increases the CO_2 concentration at minimum modulation rate. Turning the Offset Screw out (counterclockwise) decreases the CO_2 concentration at minimum modulation rate. Typical adjustment required is $0 - {}^{1}/_{8}{}^{th}$ of a turn in or out from the factory setting.

NOTE: Calibration of the Offset Screw must only be performed with the burner operating at the minimum modulation rate (see Table 9-2).

⚠ WARNING Adjustments to the **Offset Screw** may only be made by a qualified gas technician using a calibrated combustion analyzer capable of measuring CO_2 and CO, and only with the burner at the minimum modulation rate (see Table 9-2). Attempting to set the Offset Screw while the burner is operating at a modulation rate other than the minimum will result in incorrect combustion and may lead to burner damage or excessive CO.

Gas Line Pressure Test

The boiler gas valve is equipped with a line pressure test port; see Figure 9-1. Use the following procedure to measure the gas line pressure to the boiler to ensure if falls within the range given in Table 9-1:

1. Turn the supply of gas to the boiler off.
2. Open the bleed screw of the line pressure test port approximately 1-1/2 turns. This port is directly connected to the gas line feeding the boiler. See Figure 9-1.
3. Force ¼ in. ID tubing over the housing of the line pressure test port; install the other end of the tubing to an appropriate line pressure test gauge or manometer. Ensure both ends of the tubing make a tight connection.
4. Open the supply of gas to the boiler and check for gas leaks.
5. Observe the line pressure under static conditions and compare it to Table 9-1. The pressure will be greatest under static conditions.
6. With all other gas appliances in the application running, operate the burner to the maximum firing rate (see Table 9-2) and compare the observed line pressure with Table 9-1. The pressure will be lowest during the maximum flow of gas.
7. Adjust the gas line pressure to ensure the parameters in Table 9-1 are attained under all conditions (see NOTICE below). If possible adjust the line pressure to the "Nominal/Desired" value listed in Table 9-1, while the unit is operating at the maximum modulation rate, see Table 9-2.
8. Continue observing the gas line pressure until the completion of the combustion analyses, in case adjustments need to be made.
9. Complete pressure testing, and then return the bleed screw of the Line Pressure Test Port to the closed position.

NOTICE

The line pressure is a function of the gas supply and is affected solely by field provided parameters such as line size and regulator settings. Under no circumstances can the boiler gas valve influence or be used to adjust the gas line pressure.

⚠ DANGER

Failure to close the bleed screw of the Line Pressure Test Port will cause a severe leakage of gas, resulting in a fire or explosion causing property damage, serious injury or death.

Table 9-1 Line Pressure and Combustion Parameters

Gas	Line Pressure (inches w.c.)			CO_2 (%)		CO (ppm) Max.
	Nominal/Desired	Min.	Max.	Min.	Max.	
Natural	7	4	10.5	9	10	175
Propane	11	8	13	10	11	175

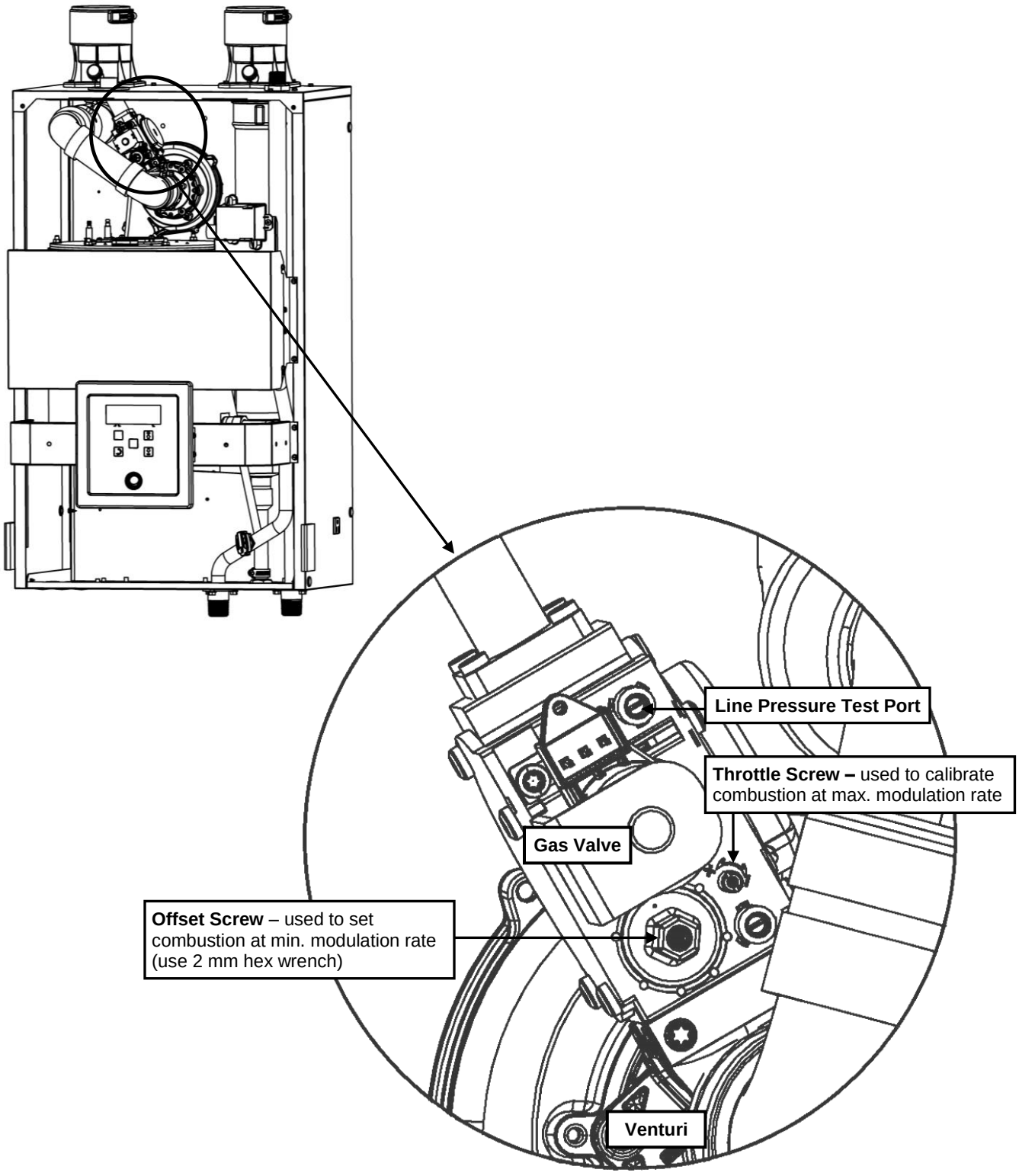
Notes:
[1] Combustion calibration must only be performed with the burner operating at maximum modulation rate; when tested at minimum modulation rate the CO_2 must be 0.4-0.8% lower than CO_2 at maximum modulation rate.

Table 9-2 Minimum and Maximum Modulation Rates

Model	Gas	Appliance Number	Min. Modulation Rate (RPM)	Max. Modulation Rate (RPM)	Input Rate (MBH)	
					Min	Max *
FTV110	NG	16	1620	7620	11	110
	LP	22	1860	8040		
FTV110C	NG	19	1620	7620		
	LP	23	1860	8040		
FTV150	NG/LP	17	1740	8220	15	150
FTV150C	NG/LP	20				
FTV190	NG/LP	18	1620	8280	19	190
FTV190C	NG/LP	21				

Notes:
[1] Use Installer Menu setting 2-15 to force the burner to operate at the max. (2-15 = 3) and min. (2-15 = 1) modulation rates; see Section 17.0 DISPLAY MENU GUIDE.

Figure 9-1 Gas Valve and Venturi Assembly (FTV150 Illustrated)



10.0 BOILER AND HEATING SYSTEM PIPING

The fire tube design of the FTV heat exchanger results in minimal head loss, however it must be considered when sizing system piping and circulators. Furthermore, the low mass of the FTV heat exchanger requires a minimum flow rate anytime the burner is operating. To maintain the efficient and reliable operation of the heat exchanger, and to avoid heat exchanger failure, it is critical to ensure the rules and guidelines in this section are followed.

⚠ WARNING Failure to follow the instructions provided in this section will void the NTI warranty and may result in property damage, fire, serious injury or death.

Water Quality

Water Quality is important to the proper operation and lifespan of the boiler; the information on water quality provided in this document must be followed. Damage caused by failure to follow these requirements will not be covered by the warranty.

During installation and yearly maintenance, the water quality must be checked. Common water quality heat exchanger failures, are easily prevented when properly addressed.

Follow these system water best practices:

- Test system fill water and understand what you are putting into the system.
- Ensure that there is adequate air elimination in the system.
- Treat all boiler feed water as though it is hard water.
- Use chemical inhibitors on every job
  (note: some glycols contain inhibitors – do not mix dissimilar inhibitors).
- Flush old and new systems with fresh clean water before commissioning a new boiler.
- Use magnetic dirt separators on systems containing large amounts of iron.
- Use Dirt Separators to remove debris from system water.
- Where possible, treat boiler feed water.
- Repair system leaks immediately to prevent oxygen (air) and untreated water from entering the system.

Proper equipment must be used to test the water. Digital meters are highly recommended because they can be calibrated. The use of test strips is not recommended because they degrade over time and can be influenced by many factors.

System Cleaning – Existing and new heating systems must be cleaned with a hydronic system cleaner; see list of recommended hydronic system cleaners below; equivalent products from other manufacturers may also be used. System cleaner must be drained and thoroughly flushed with clean water to remove any residual cleaner, prior to installing a new boiler. NEVER leave a system cleaner for longer than recommended by the manufacturer of the cleaner; follow the instructions provided by the system cleaner manufacturer.

- Noble Noburst Hydronic System Cleaner
- Fernox F3 Cleaner (NTI part no. 83449)
- Rhomar Hydro-Solv 9100
- Sentinel X400

Air Elimination – A micro bubble air elimination device must be installed on every boiler installation. Automatic air-vents alone are not an acceptable substitute for a micro bubble air elimination device. Below are a few examples of acceptable devices.

- Spirovent
- Caleffi Discal
- Taco 4900 series

Automatic feed valves should not be left open indefinitely. In the event of a leak, an automatic feed valve will continue to supply fresh untreated water into the heating system. Fresh water contains both oxygen and added minerals, one or both of these could lead to scaling and/or corrosion of the heat exchanger.

Dirt Removal – A dirt removal device should be installed in all systems. In older systems containing cast iron radiators/baseboard or large amount black iron or steel pipe, a magnetic dirt separator must be installed.

Glycol, Snow Melt, and Oxygen Permeable Piping – When freeze protection is required, only multi metal inhibited propylene glycol, at a minimum of 20% and a maximum of 50%, is allowed for use with boiler system. If the boiler is being used with a snow melt system that requires a concentration of glycol higher than 50%, then a plate heat exchanger is required to separate the snow melt system from the boiler water. Note: the use of glycol may reduce the usable output capacity of the boiler, thus requiring the unit to be "down-fired" by limiting the maximum operating capacity and/or the maximum water temperature. If oxygen permeable piping (non-oxygen barrier tubing) is used in the system a plate heat exchanger is required to separate it from the boiler water.

NOTICE Ethylene glycol is prohibited for use with the boiler, only inhibited propylene glycol is allowed for use with the boiler.

Water Treatment – When filling the boiler system, the water must be tested. Table 10-1 outlines the parameters that should be tested for, and the corresponding ranges that are permitted. Water quality that does not fall within the stated ranges will void the warranty of the boiler. Utilize proper testing equipment, such as digital meters, to verify water quality.

NOTICE Never use petroleum based compounds in the system for cleaning or sealing.

Inhibitors should be used for all installations in both new and existing heating systems. Follow the instructions provided by the inhibitor manufacturer when adding to the system to ensure the correct concentration. A list of approved inhibitors is provided below.

- Rhomar Pro-tek 922
- Sentinel X100
- Fernox Protector F1 (NTI part no. 83448)

Table 10-1 Boiler System Cleansers and Corrosion Inhibitors

Parameter	Range	Information
pH	7 to 9	The total pH scale ranges from 1 to 14, with 7 considered to be neutral. A pH less than 7 is said to be acidic and solutions with a pH greater than 7 are basic or alkaline.
Conductivity	100 to 400 µS/cm	Conductivity is an indirect method of determining the total dissolved solids in the water. High conductivity in *untreated* water indicates hard water. Higher conductivity levels are acceptable when corrosion inhibitors are used.
Hardness	50 to 200 ppm (3 to 11.7 gpg)	Artificially soft water can damage the system. The use of un-softened water is recommended. Do **not** use distilled or purified water.
Chlorine	150 ppm	High Chlorine content in the water can damage the boilers heat exchanger.
Glycol (if applicable)	20-50%	Concentrations below 20% can promote bacteria growth, and concentrations above 50% will dramatically reduce efficiency and may require de-rating the boiler. Inhibited glycol mixed at 50% should have a pH 8-9. Check with glycol manufacturer.
Total Dissolved Solids (TDS)	50 to 300 ppm	TDS includes calcium and magnesium associated with lime scale but also includes other harmful solids such as magnetite, chlorides, sodium and other organic and inorganic materials. Higher TDS levels are acceptable when corrosion inhibitors are used.
Bacteria/Mold	none	Glycol above 20% will kill any bacteria.
Molybdate Corrosion Inhibitor	100 to 300 ppm	Film-forming inhibitor that protects against iron corrosion.

Near Boiler Plumbing (Central Heating)

FTV boilers are intended solely for use in pressurized closed-loop heating systems operating with a minimum pressure of 12 PSI at the boiler outlet. Carefully follow the instructions and piping diagrams illustrated in this section.

NOTICE FTV boilers are not approved for operation in an "open system," thus it cannot be used for direct potable water heating or process heating of any kind.

Pressure Relief Valve – A Pressure Relief Valve is factory supplied with each unit, and must be field installed in the vertical position, with the outlet facing horizontally and piped towards the floor away from where it could be harmful; see Figure 10-2(a). **NOTICE:** FTV boilers have a maximum allowable operating pressure of 50 PSI.

⚠ CAUTION If installed in the incorrect orientation (horizontally with drain pipe out the bottom) the relief valve may not function properly resulting in property damage or personal injury.

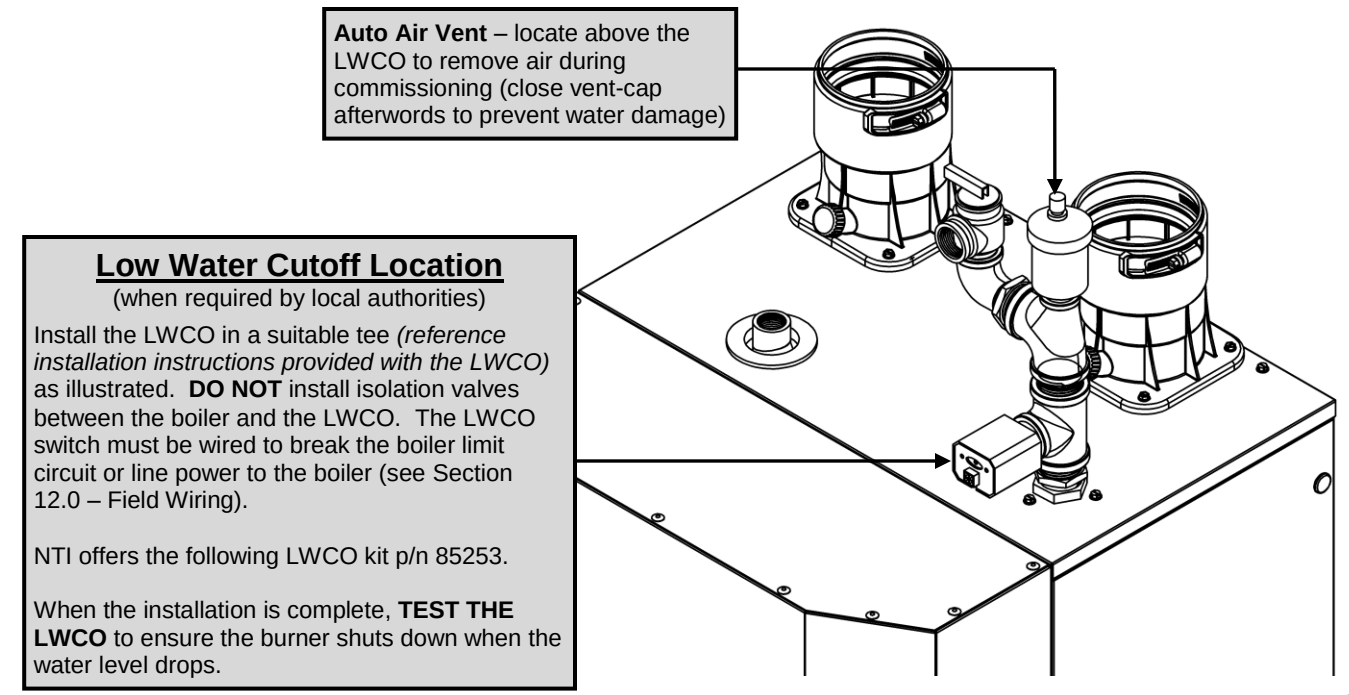
⚠ WARNING Ensure the discharge of the pressure relief is piped to a location where the steam or water will not cause property damage or serious injury.

Pressure & Temperature Gauge – FTV boilers come with a factory supplied Pressure and Temperature Gauge. The gauge must be installed at the boiler outlet prior to any circulators. See Figures 10-2(b), 10-2(c), and 10-2(d).

Auto Air Vent – Install the factory supplied auto air vent directly above the outlet fitting on the top of the unit as illustrated in Figure 10-2(a). Open the auto air vent's vent-cap to promote the removal of air during commissioning of the boiler and to avoid malfunctioning of the LWCO. Once the air is removed from the system, close the vent-cap to prevent water from leaking onto the boiler.

Low Water Cutoff (LWCO) – FTV boilers are provided with a factory installed Water Pressure Sensor. The sensor provides a reading of the boiler inlet water pressure on the display; in the event the pressure drops below 7 PSI, the control will go to a blocking error "FILL", inhibiting burner operation. Where required by the Authority having jurisdiction, an external LWCO may have to be installed; see Figure 10-1.

Figure 10-1 Installation of Optional LWCO



Near Boiler Piping (Central Heating – CH)

Figure 10-2(a) Top (All Models)

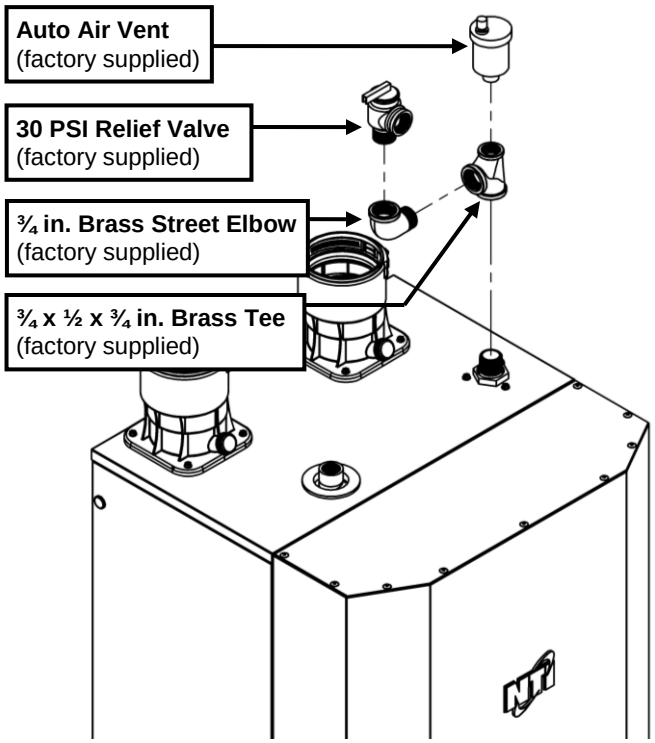


Figure 10-2(b) Bottom (non-Combi)

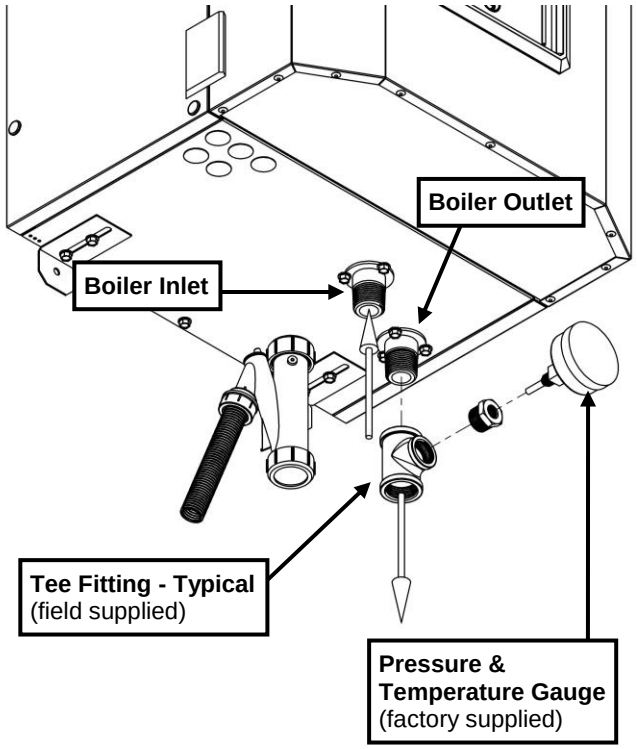


Figure 10-2(c) Bottom (Combi – Option A)

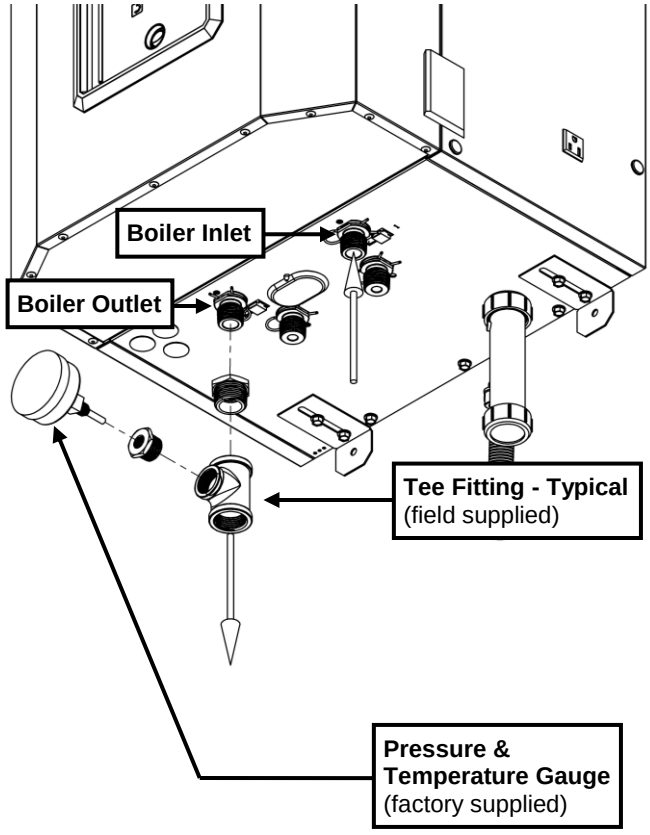
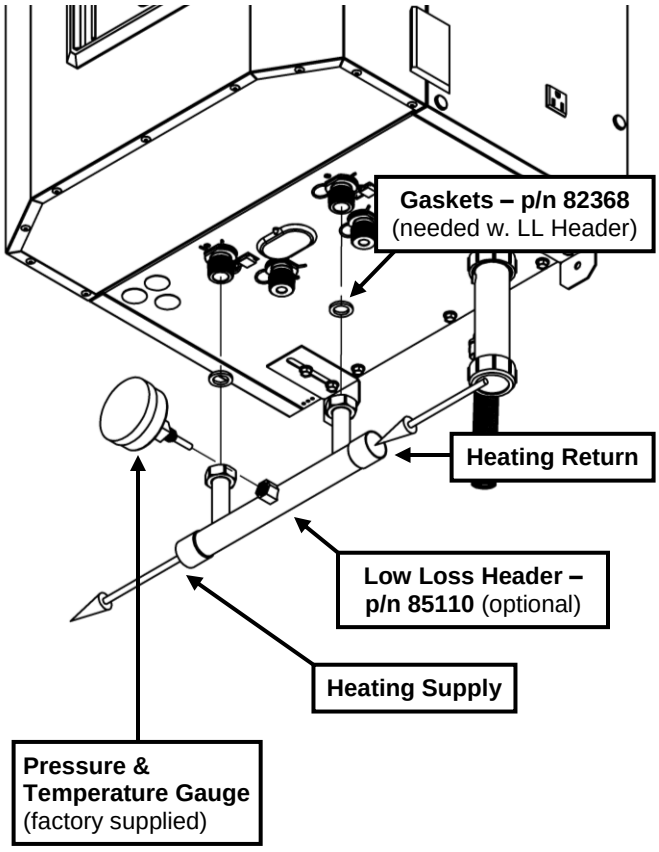


Figure 10-2(d) Bottom (Combi – Option B)



Boiler System Plumbing

FTV boilers use a low mass heat exchanger that requires a minimum rate of forced water circulation any time the burner is operating (See Table 10-2 for minimum flow rate requirements). To ensure the minimum flow rate is attained, NTI strongly recommends installing the boiler in a "Primary/Secondary" plumbing configuration utilizing "Closely Spaced Tees" or a "Low Loss Header" to de-couple the Boiler-Primary loop from the System-Secondary loop(s). See the examples of Primary/Secondary Loop configurations in Figures 10-6 through 10-9.

Table 10-2 Minimum Flow Rate Requirements

Model	Flow (US gpm)
FTV110	4.4
FTV150	6
FTV190	8

NOTICE

The flow rate through the FTV-Combi is determined by the available head of the internal pump (see Figure 10-4). When piped "Direct to Zones" the boiler flow rate will be influenced by the piping losses of the distribution system; to avoid no/low occurances, set the manual bypass valve to "MAX" (see Figure 10-3).

When piped Primary/Secondary the FTV-Combi boiler flow rate will be fixed at approximately 8 GPM for space heating demands.

⚠ WARNING

Failure to ensure the minimum water flow rate through the boiler when the burner is operating will result in "short-cycling", reduced performance and operating efficiency, and may also cause overheating and premature failure which will void the warranty. Failure to follow instructions may result in fire, property damage, serious injury or death.

Circulating Pump Outputs – FTV boilers are equipped with three 120VAC pump outputs:

1. DHW PUMP – operates during a Domestic Hot Water (DHW) demand. The DHW PUMP output is not used on Combi models.
2. CH PUMP – operates during a Central Heat (CH) demand.
3. BOILER PUMP – operates during any demand. The internal pump for Combi models is factory wired to the BOILER PUMP output.

Use of these circulator outputs will depend on the system configuration selected; see Figures 10-6 through 10-9. For further pump output details and wiring instructions see Section 12.0.

NOTICE

Circulators responsible for forcing water flow through the boiler must be sized to account for the head loss of the boiler and boiler piping at the required flow rate; see Table 10-3 and Figure 10-5.

Internal Circulating Pump (FTV-Combi Only) – the FTV-Combi encorporates the ciculating pump responsible for forcing water flow through the boiler, an can be utilized in one of two configurations:

1. Primary/Secondary – the internal circulator drives flow through the boiler only; see Figures 10-8 and 10-9.
2. Direct to Zones – the internal circulator drives flow through the boiler and the distribution system; see Figure 10-10. This configuration is limited to zone valve (or non-zone circulator) distribution systems with small flow requirements, i.e., systems requiring no more than 6 GPM at 9 ft. of head pressure. Plot the expected head-loss of the distribution system against the "FTV-Combi Available Pump Head" curve (Figure 10-4) to verify sufficient performance; **NOTICE:** if the available head from the internal pump cannot support the needs of the distribution system, then a Primary/Secondary configuration must be utilized.

NOTICE

Pressure Bypass Valve – to avoid no/low water flow occurances in applications of the FTV-Combi in "Direct to Zone" configurations must fully utilize the FTV-Combi's internal pressure bypass valve. The internal pressure bypass valve is utilized by adjusting the manual bypass valve to "MAX"; see Figure 10-3.

Figure 10-3 Activating Pressure Bypass Valve (FTV-Combi Only)

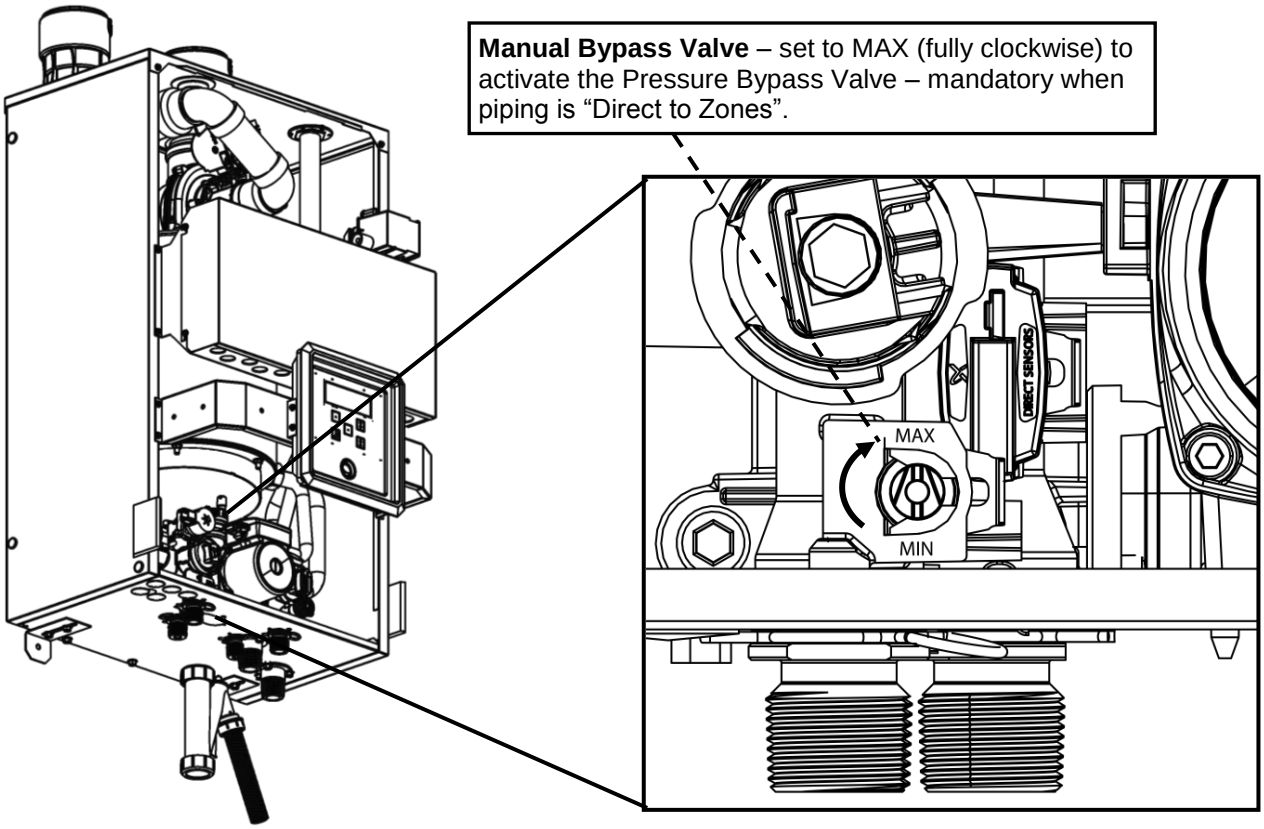
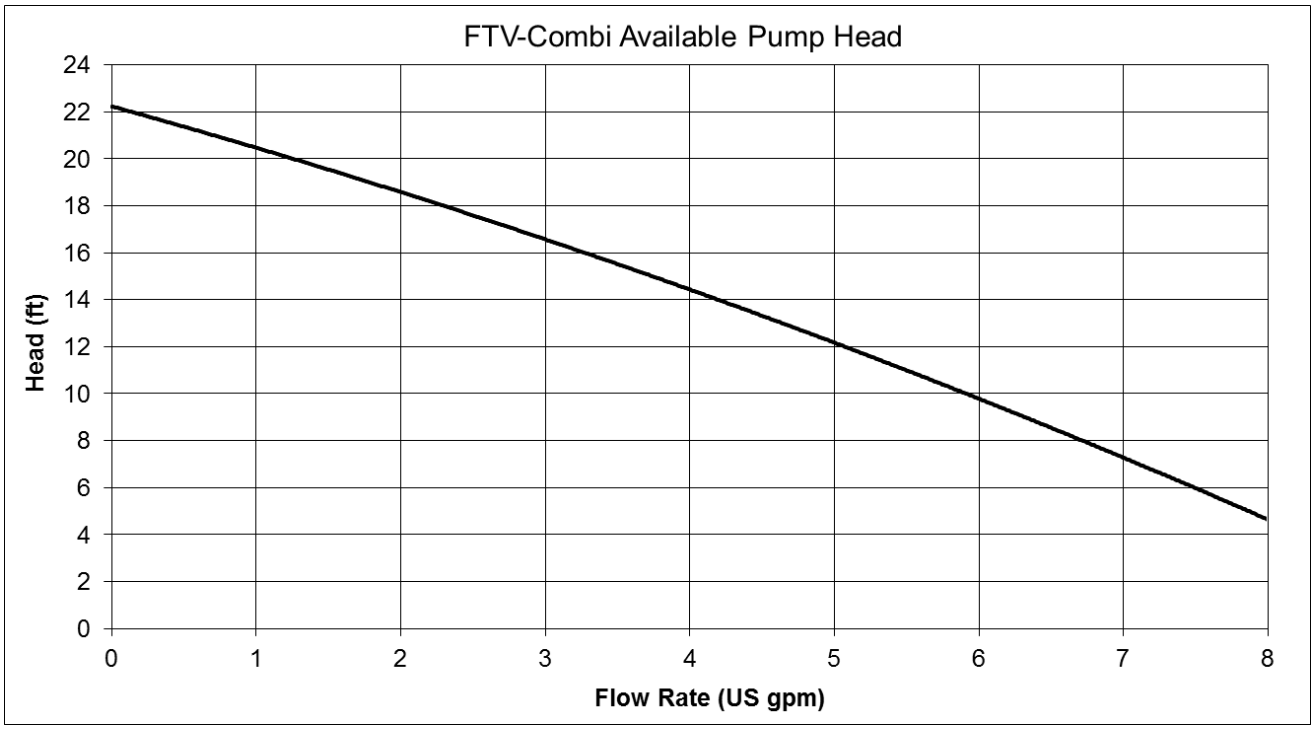


Figure 10-4 Available Pump Head (FTV-Combi Internal Pump)



Notes:

[1] Graph depicts available pump head of FTV-Combi internal pump, after boiler internal flow losses.

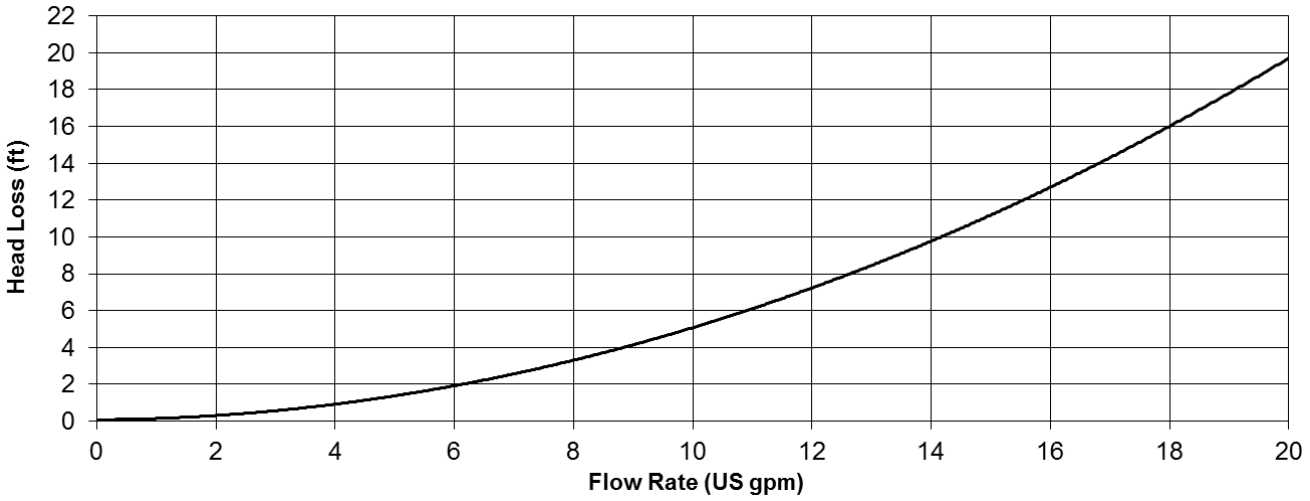
Table 10-3 Boiler Circulator and Pipe Size Requirements

Model	Temp. Rise (ºF)	Boiler Flow Rate (GPM)	Boiler Head Loss (ft)	Minimum Pipe Size	Minimum Primary Loop Pump Size[(1)]			
					B&G	Grundfos	Taco	Armstrong
FTV 110	20	10.5	5.5	1 in.	NRF-25	UPS26-99	0013-MS	ASTRO 250
	25	8.4	3.7		NRF-22	UPS15-58	0015-MS	ASTRO 230
	35	7	2.5		NRF-22	UPS15-58	0015-MS	ASTRO 230
FTV 150	20	14.3	10.1	1.25 in.	NRF-36	UPS26-99	0013-MS	ASTRO 250
	25	11.4	6.5	1 in.	NRF-36	UPS26-99	0013-MS	ASTRO 210
	35	9.5	4.7		NRF-25	UPS15-58	0015-MS	ASTRO 230
FTV 190	20	18.0	16	1.25 in.	NRF-36	UPS26-99	2400-30	ASTRO 286
	25	14.4	10.2		NRF-36	UPS26-99	0015-MS	ASTRO 250
	35	10.3	5.4	1 in.	NRF-25	UPS26-99	0013-MS	ASTRO 250

Notes:
1 Pump sizing based on Primary/Secondary plumbing configuration with specified minimum pipe diameter with up to 50' equivalent length.

NOTICE The flow rate through the FTV-Combi is determined by the available head of the internal pump (see Figure 10-4). When piped "Direct to Zones" the boiler flow rate will be influenced by the piping losses of the distribution system; to avoid no/low occurances, set the manual bypass valve to "MAX" (see Figure 10-3). When piped Primary/Secondary the FTV-Combi boiler flow rate will be fixed at approximately 8 GPM for space heating demands.

Figure 10-5 FTV110-190 Head Loss Curve



Expansion Tank – The expansion tank must be sized in accordance with the water volume of the system as well as the firing rate of the appliance. It is important to locate the expansion tank, and make-up water fill, on the inlet side of any circulator in the system, as doing so will guarantee the lowest pressure in the system will be at least equal to the tank and make-up water pressure. See examples in Figures 10-6 through 10-10.

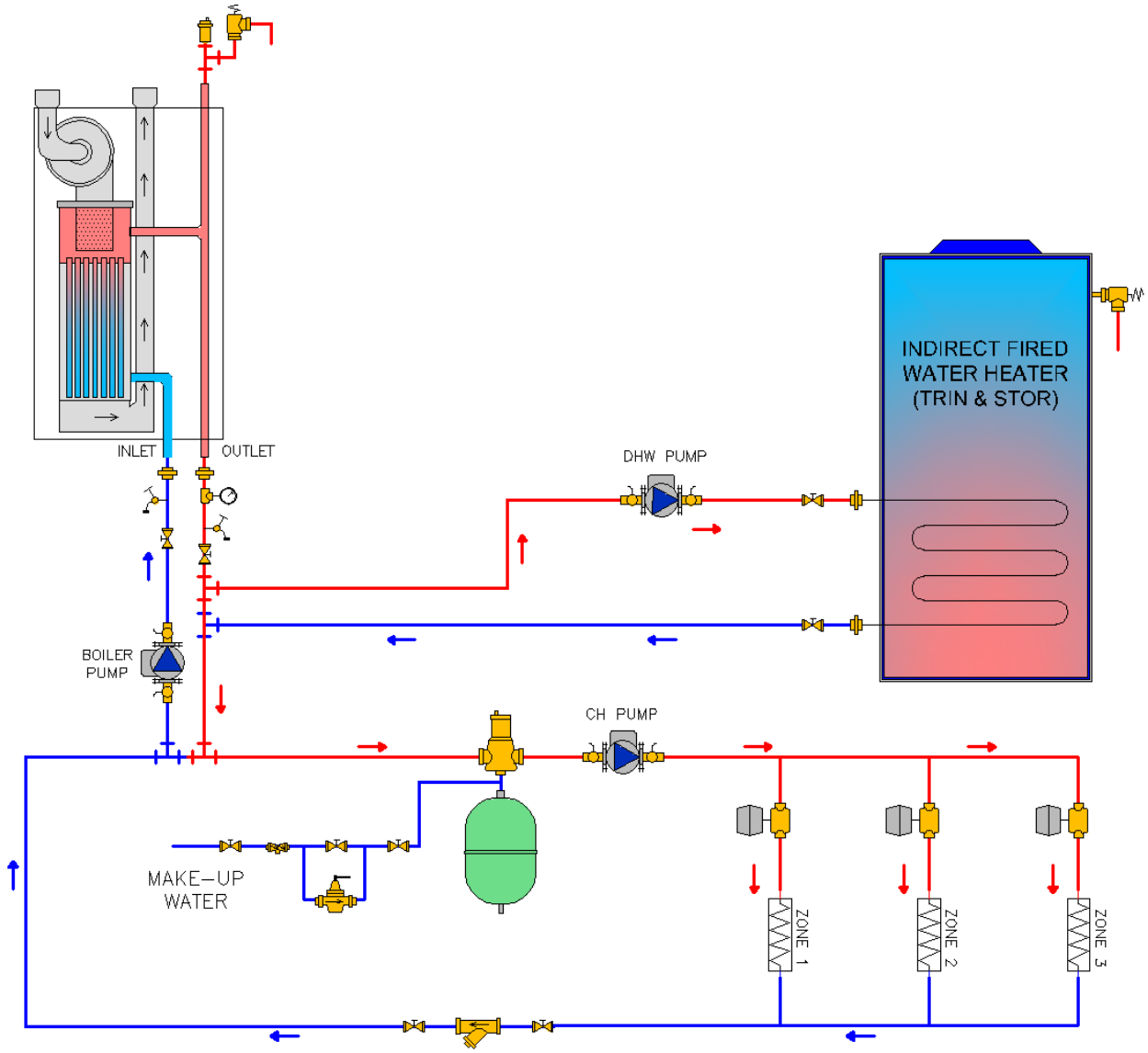
⚠ CAUTION Ensure the expansion tank cannot become isolated from the boiler anytime the system is operating. The installation of flow checks, motorized valves or other shutoff devices (other than for the purpose of servicing) are not permitted between the outlet of the boiler and the expansion tank; see Figures 10-6 through 10-10. Failure to follow these instructions may result in discharge of the Pressure Relief Valve resulting in property damage or personal injury.

Indirect Fired Water Heater – When installed as per Figure 10-7, the indirect fired water heater is in series with the boiler during a demand for DHW. Therefore, its head loss, along with the head loss of the boiler and associated piping, must be considered when sizing the circulator.

NOTICE

Figures 10-6 through 10-10 illustrate typical piping systems. These piping schematics do not illustrate all of the required concepts and components required to have a proper installation. Concepts not shown include: prevention of thermal-siphoning (heat traps), isolation valves, drain and purge valves, etc. It is the responsibility of the installing contractor and system designer to determine which system best meets the need of the installation and to consider all aspects of a proper system design. Contractor modifications to these instructions may be required, based upon existing piping and system design; consult NTI for required assistance (1-800-688-2575).

Figure 10-6 Plumbing Schematic – Single Central Heating Circulator (non-Combi)



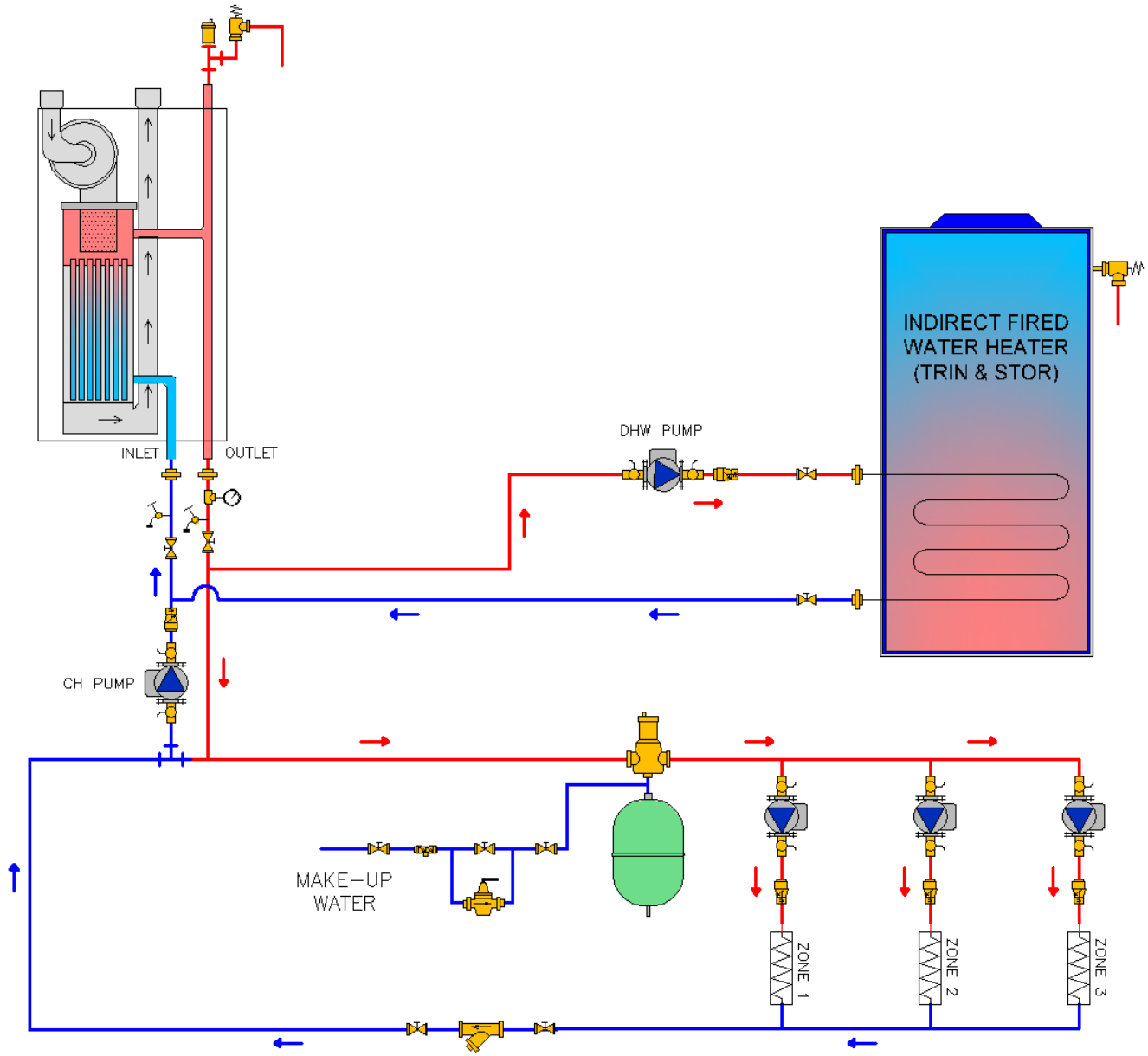
LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	central air seperator		isolation valve		check valve		pressure & temperature valve
	temp/press guage		circulator w/ isolation flanges		union		auto air vent
	expansion tank		pressure reducing valve		strainer		zone load
	backflow preventor		pressure relief valve		zone valve		drain valve

NOTICE

Figure 10-6 illustrates the basic plumbing requirements for a non-Combi FTV boiler installation with a single Central Heating circulator, and an Indirect Water Heater.

Figure 10-7 Plumbing Schematic – Multiple Central Heating Circulators (non-Combi)

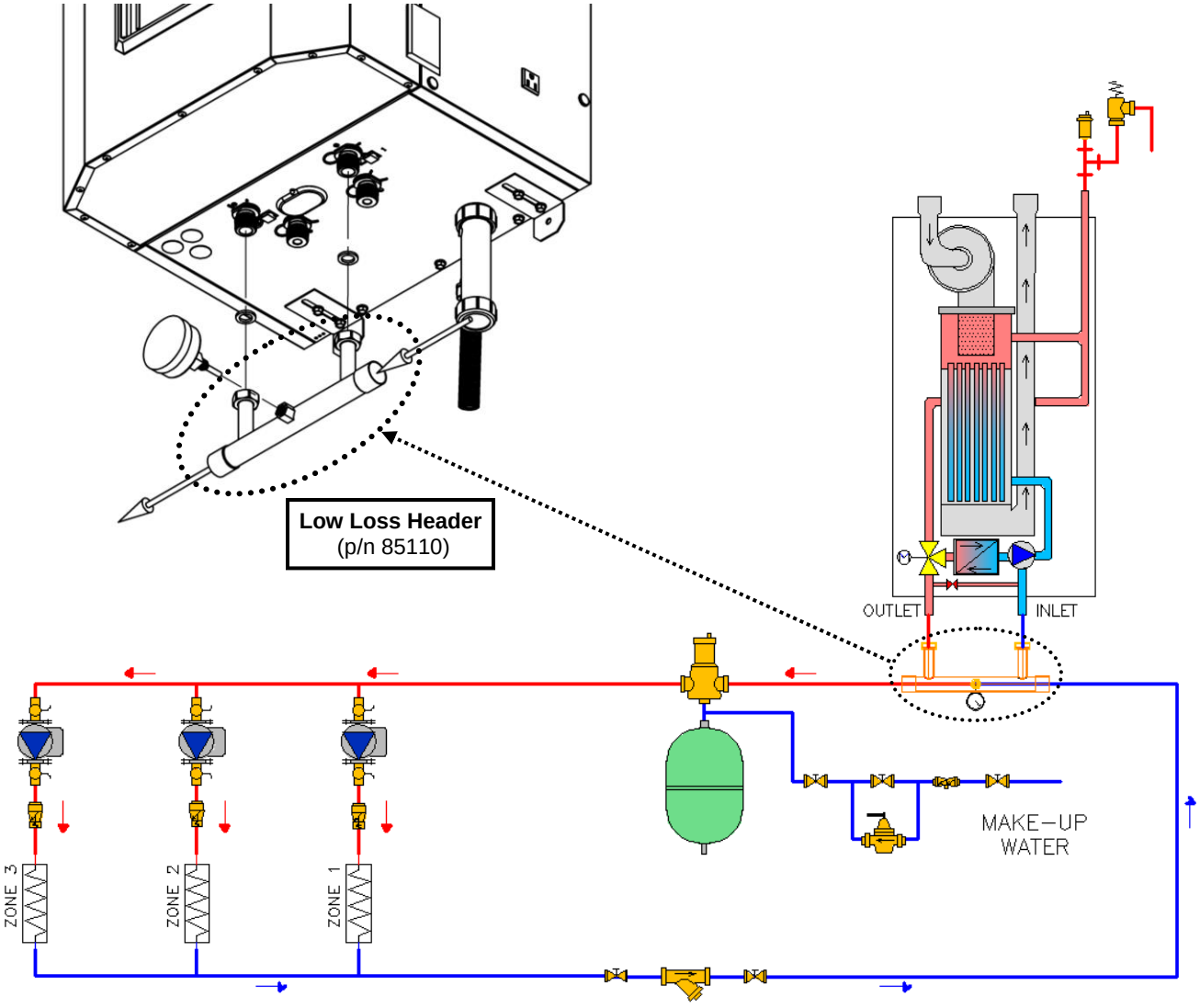


LEGEND							
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	central air seperator		isolation valve		check valve		pressure & temperature valve
	temp/press guage		circulator w/ isolation flanges		union		auto air vent
	expansion tank		pressure reducing valve		strainer		zone load
	backflow preventor		pressure relief valve		zone valve		drain valve

NOTICE

Figure 10-7 illustrates the basic plumbing requirements for a non-Combi FTV boiler installation with multiple Central Heating circulators, and an Indirect Water Heater.

Figure 10-8 Plumbing Schematic – Multiple Central Heating Circulators (Combi)

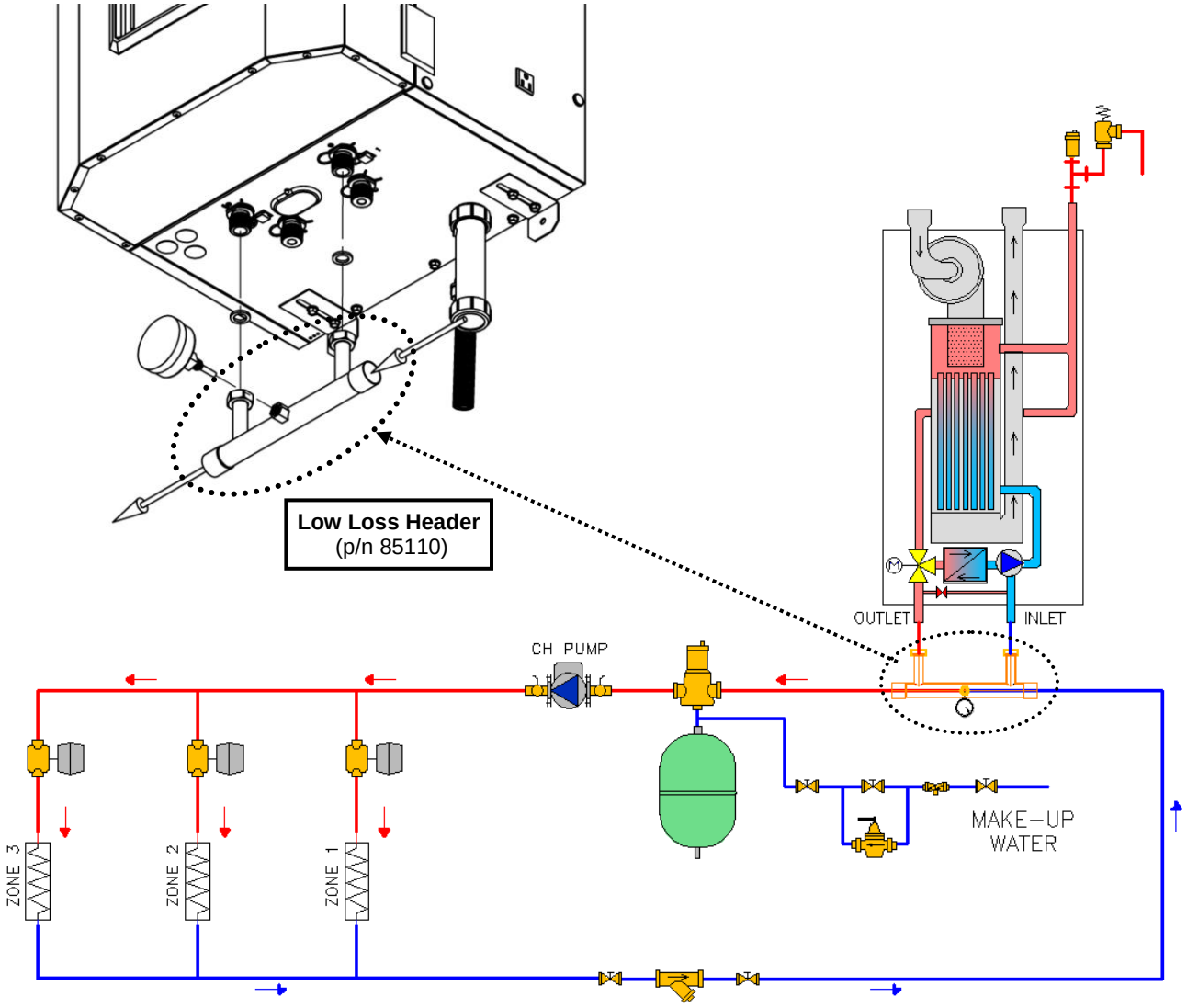


LEGEND							
SYMBOL	**DESCRIPTION**	**SYMBOL**	**DESCRIPTION**	**SYMBOL**	**DESCRIPTION**	**SYMBOL**	**DESCRIPTION**
	central air seperator		isolation valve		check valve		pressure & temperature valve
	temp/press guage		circulator w/ isolation flanges		union		auto air vent
	expansion tank		pressure reducing valve		strainer		zone load
	backflow preventor		pressure relief valve		zone valve		drain valve

NOTICE

Figure 10-8 illustrates the basic plumbing requirements for an FTV-Combi boiler installation with multiple Central Heating circulators.

Figure 10-9 Plumbing Schematic – Single Central Heating Circulator – Primary/Secondary (Combi)

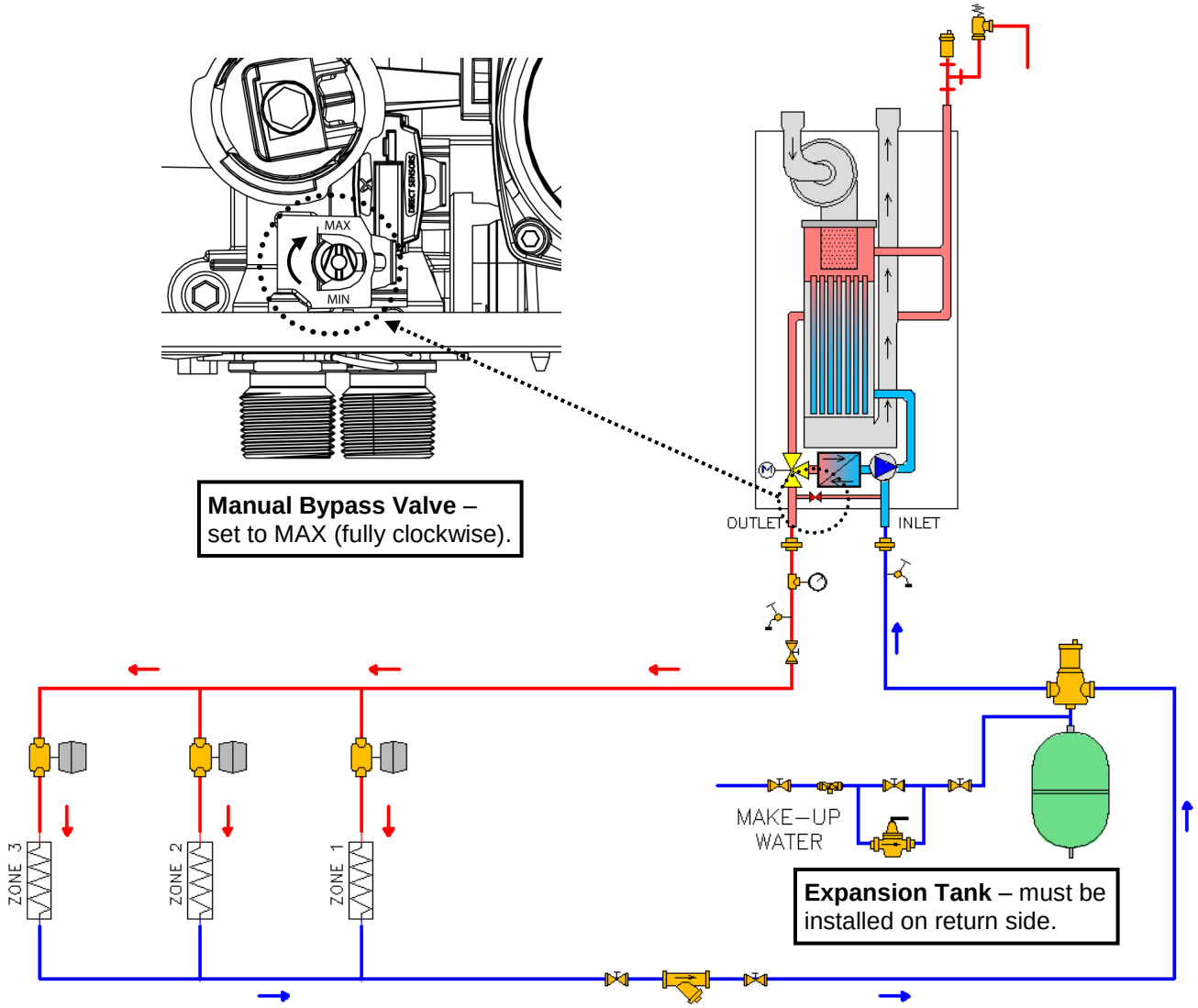


LEGEND							
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	central air seperator		isolation valve		check valve		pressure & temperature valve
	temp/press guage		circulator w/ isolation flanges		union		auto air vent
	expansion tank		pressure reducing valve		strainer		zone load
	backflow preventor		pressure relief valve		zone valve		drain valve

NOTICE

Figure 10-9 illustrates the basic plumbing requirements for an FTV-Combi boiler installation with a single Central Heating circulator in Primary/Secondary configuration.

Figure 10-10 Plumbing Schematic – Direct to Zones (Combi)



LEGEND							
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	central air seperator		isolation valve		check valve		pressure & temperature valve
	temp/press guage		circulator w/ isolation flanges		union		auto air vent
	expansion tank		pressure reducing valve		strainer		zone load
	backflow preventor		pressure relief valve		zone valve		drain valve

NOTICE

Figure 10-10 illustrates the basic plumbing requirements for an FTV-Combi boiler installation piped "Direct to Zones". Limited to zone valve (or non-zone circulator) distribution systems with small flow requirements, i.e., systems requiring no more than 6 GPM at 9 ft. of head pressure.

11.0 DOMESTIC HOT WATER (DHW) PIPING – COMBI ONLY

DHW Description of Operation

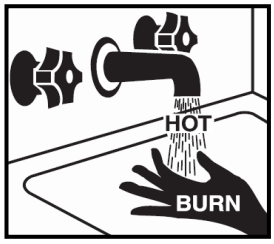
FTV Combi models incorporate a DHW heat exchanger (Brazed Plate) and the controls necessary to heat DHW without requiring a separate water heater. When the internal flow sensor detects potable water flow in excess of 0.3gpm the controller operates in DHW mode, whereby the potable water is heated to the "DHW Setpoint" (Installer Menu setting 2-07). Set "DHW Setpoint" to the desired hot water temperature; to avoid the risk of scalding a Thermostatic Mixing Valve **MUST** be installed, see Figure 11-1.



Thermostatic Mixing Valve – due to the potentially high hot water temperatures exiting the water heater, a thermostatic mixing valve (or equivalent anti-scald device) must be installed according to Figure 11-1, local code and the installation instructions provided with the thermostatic mixing valve, to reduce scald hazard potential. Failure to follow these instructions may result in serious injury or death.



Scald Hazard - Hotter water increases the risk of scald injury. There is a hot water scald potential if a thermostatic mixing valve is not used or is set too high. Be sure to follow the adjustment instructions provided with the thermostatic mixing valve. Failure to follow these instructions may result in serious injury or death.



A scald injury can occur when hot steam or liquid makes contact with one or more layers of skin. Scald severity (degree of burn) is directly impacted by exposure time and temperature. Refer to Table 11-1. The following basic precautions are common sense:

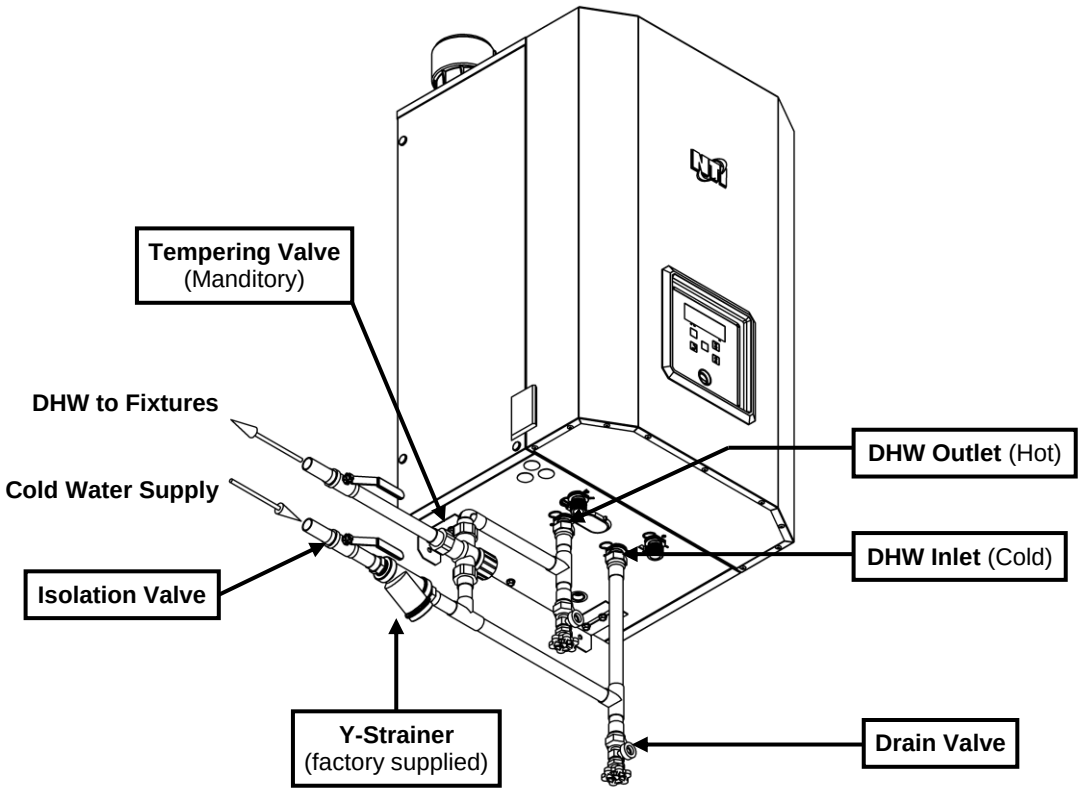
- Young children and elderly adults burn more quickly and should use cooler water.
- Never leave a child alone while drawing water in a bathtub.
- Test the water temperature before bathing or showering.
- Turn cold water on first and then add hot water until the temperature is comfortable.

DHW Preheat Mode

For improved domestic hot water comfort, the FTV-Combi incorporates a "Preheat Mode" feature (Installer Menu setting 2-10). When set to ON the boiler control will function to keep the DHW preheated to limit the wait time associated with a tankless hot water system.

Preheat Operation – Once per hour, the controller will operate the boiler in DHW mode, firing the burner at minimum power until the boiler Return achieves a temperature within 25°F of the DHW setpoint. Note: if the DHW or boiler Return temperature is within 34°F of the DHW Setpoint, Preheat mode will not initiate.

Figure 11-1 Near Boiler DHW Piping (Combi models)



DHW Plumbing (FTV-Combi)

DHW Inlet & Outlet Connections – The FTV-Combi has two potable water connections, Inlet & Outlet, which exit the bottom of the unit, nearest the back. The Inlet fitting is on the right and the Outlet fitting is on the left, see Figure 11-1.

DHW Filter – Install the factory supplied Y-strainer prior to the inlet fitting, as illustrated in Figure 11-1. The serviceable Y-strainer has a 100 micron filter and will protect the internals from damage caused by dirt and debris.

Check Valve – The installation of a check valve in the hot water line is recommend to prevent expansion devises downstream from back flowing when the water pressure drops during cold water draws. Failure to prevent the backflow will cause a momentary forward flow of water through the flow sensor when the cold-water draw has ended and the water pressure increases. This forward flow of water will momentarily activate DHW mode.

Throttling Valve – Use one of the isolation valves, installed hot water line, as a throttle valve to regulate the maximum hot water flow rate. The FTV-Combi has a limited firing rate (e.g.: only 110 MBH for model FTV110C); therefore excessive flow rates will result in cooler hot water temperatures.

Drain and Isolation Valves – Install drain and isolation valves on the cold water inlet and hot water outlet lines, as shown in Figure 11-1, to allow for servicing of the internal brazed plate heat exchanger and other potable water components. It will be necessary to flush or clean the brazed plate heat exchanger, if it is exposed to hard water.

12.0 FIELD WIRING

All wiring must be in accordance with the Canadian Electrical code CSA C22.1 and/or the National Electrical Code ANSI/NFPA 70, local codes, and this manual. NOTICE: the boiler must be electrically grounded. The electrical rating of the FTV is 120V/1 Phase/60 Hz/12A.

⚠ WARNING

Power Supply - FTV are designed to be powered using a single phase 120VAC power supply that is fused (or protected via a circuit breaker) to allow a maximum of 15 Amps. Failure to follow instructions may result in component failure, serious injury or death.

⚠ WARNING

Avoid Shocks – To Avoid Electrical Shock, turn off electrical power to the boiler prior to opening any electrical box within the unit. Ensure the power remains off while any wiring connections are being made. Failure to follow these instructions may result in component failure, serious injury or death.

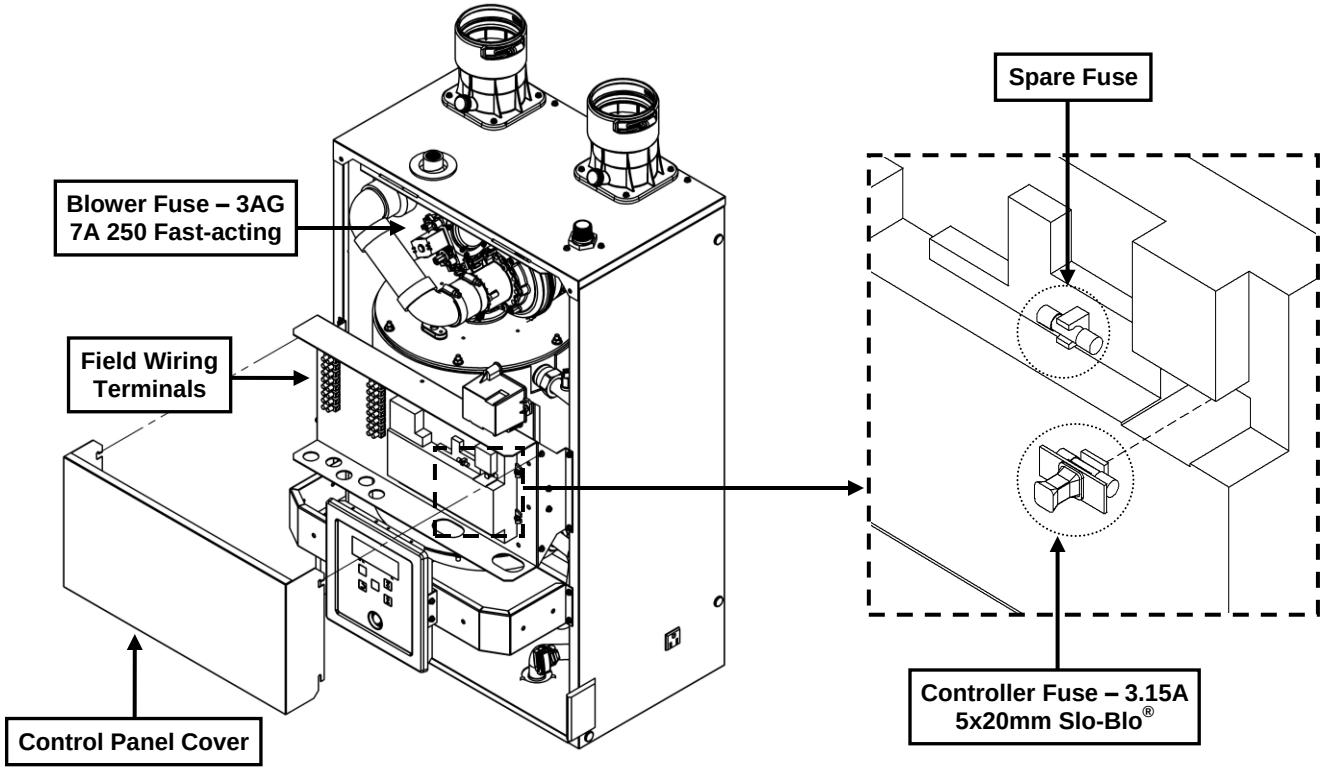
Wiring Connections

All field wiring connections to the boiler are made at barrier strips located on FTV control panel. The connections are accessed by removing the front door of the boiler, followed by the removal of the control panel cover; see Figure 12-1. Field wiring enters the cabinet through holes located on the bottom of the boiler cabinet, then must be routed through holes in the bottom of the control panel; protect the wires from stain and chaffing by using suitable strain-relief grommets when passing the wiring through the holes. Field wiring connections are to be installed in accordance with instructions provided in Figure 12-2 and Table 12-1.

Controller Fuse (120VAC) – the FTV controller is equipped with a 3.15 Amp fuse that protects most 120VAC circuits within the boiler, as well as any circulators connected to it. A spare fuse is located to the left of the operating fuse in an open holder; see Figure 12-1.

Blower Fuse (120VAC) – an inline 7 Amp fuse, located in a fuse holder in the blower's power wire (black wire near the blower), protects the 120VAC circuit of the combustion blower; see Figure 12-1.

Figure 12-1 Wiring Terminal Access



⚠ WARNING

Wire Protection – When passing wiring through the cabinet of the boiler, the installer must use wire grommets suitable for securing the wiring and preventing chafing. Failure to follow instructions may result in component failure, serious injury or death.

CAUTION

Labeling - Label all wires prior to disconnecting them when servicing controls. Wiring errors can cause improper and dangerous operation. Failure to follow instructions may result in property damage or personal injury.

CAUTION

Continuity - Before connecting the line voltage wiring, perform a continuity check between all wires and ground to make sure that there are no electrical leaks that could blow a fuse or damage electrical components. Also check the polarity of the line and neutral wires. Line must measure 120VAC to ground; neutral must measure zero. Failure to follow instructions may damage the unit.

Figure 12-2 Field Wiring

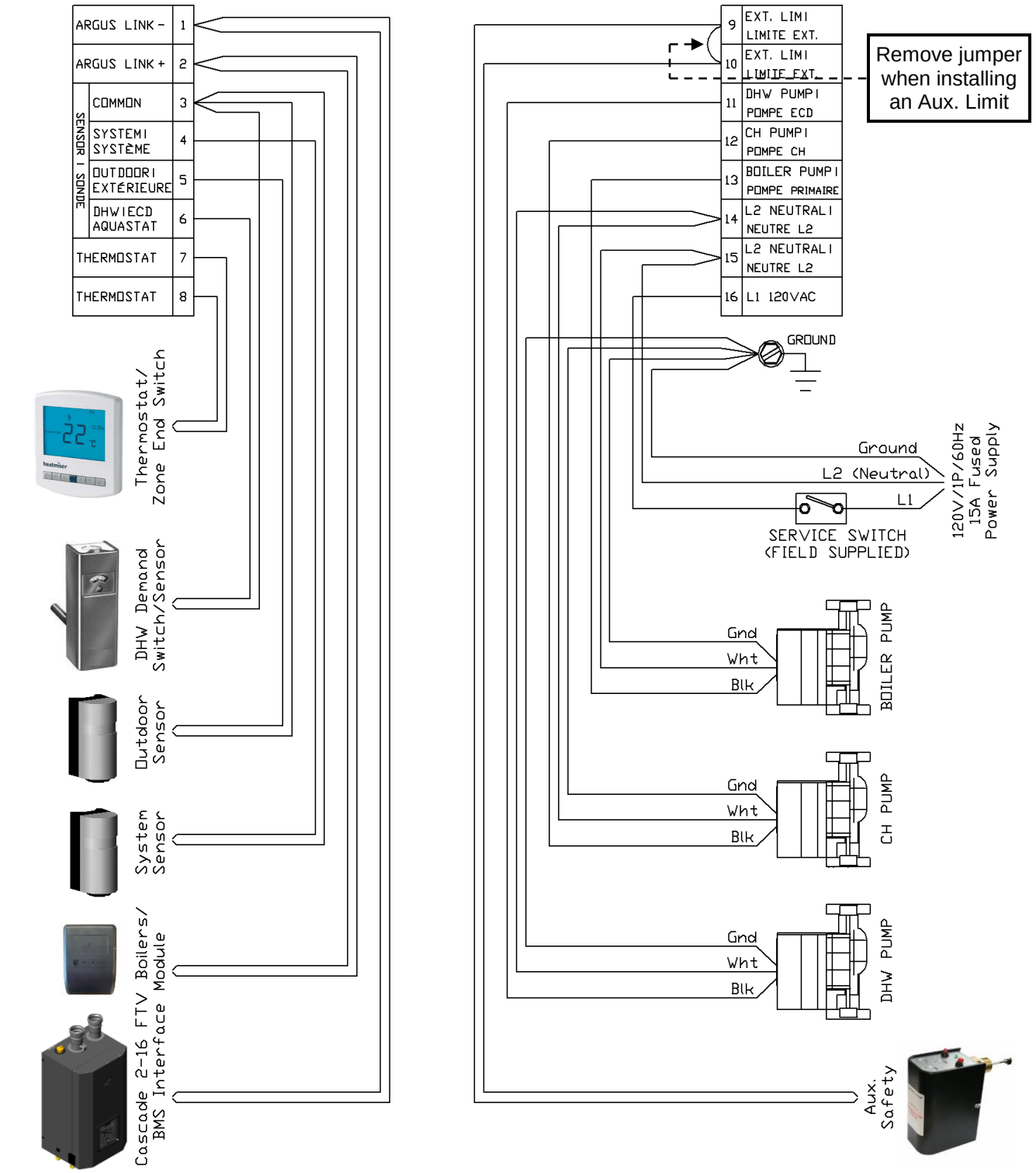


Table 12-1(a) Field Connections – Low Voltage

Connection		Location	Description
ARGUS LINK –		1	**Argus Link Communication** – used to cascade up to 16 boilers. Also for connection to BMS Expansion Interface Module (for remote burner control – 0-10V).
ARGUS LINK +		2	
SENSOR	COMMON	3	**Sensor Common** – Common port for field inputs SYSTEM, OUTDOOR and DHW.
	SYSTEM	4	**System Temperature Sensor (Manditory for Cascade)** – Wire to terminals 3 and 4 of the Manager boiler in a **cascade**. Sensor would be installed on the system supply pipe feeding the Central Heating system to allow accurate control of system temperature. Sensor is available from NTI, p/n: 84010.
	OUTDOOR	5	**Outdoor Temperature Sensor** – A wall mountable OD Sensor is included with each boiler; connect to terminals 3 and 5. In a cascade, the OD Sensor only needs to be connected to the main boiler. The use of the OD Sensor is required to allow the boiler control to automatically infer the heat load of a central heating system.
	DHW	6	**Tank Thermostat / Sensor (**Not Applicable for FTV-Combi models) – Connect the contacts of a DHW Tank Thermostat, or leads of an approved DHW Tank Sensor (NTI p/n: 84632), to terminals 3 and 6. When using a Thermostat, set DHW mode = 2 (menu setting 2-08). When using a Sensor, set DHW mode = 1. See Section 17.0 for more details.
THERMOSTAT		7	**Room Thermostat Input** – Connect central heat demand switch (room thermostats or zone control end switch), **or** "nighttime setback" / "time of day" switch to terminals 7 and 8. Switch must be an isolated end switch.
		8	

Table 12-1(b) Field Connections – Line Voltage

Connection	Location	Description
EXT. LIM	9	**120V Safety Limit Circuit** (Factory jumpered) – wire the output contacts of any optional external limit device (i.e. LWCO) in series with terminals 9 and 10. Note: if using an external limit device, the factory jumper must be removed.
	10	
DHW PUMP	11	120VAC output to the DHW circulator; powered during a demand for DHW. Total load of DHW PUMP and BOILER PUMP must not exceed 2.6Amps. Not applicable for FTV-Combi models.
CH PUMP	12	120VAC output to the Central Heating circulator; powered during a demand for Central Heat. Total load of CH PUMP and BOILER PUMP must not exceed 2.6Amps.
BOILER PUMP	13	120VAC output to the main boiler circulator; powered during all demands. Total load of BOILER PUMP and CH PUMP (or DHW PUMP) must not exceed 2.6Amps. Not applicable to FTV-Combi models – pump is factory wired.
L2 NEUTRAL	14	Location for connecting neutral of the power supply and all circulators.
	15	
L1 120VAC	16	Location for connecting line voltage of the power supply. Note; most installation codes require the installation of a service switch to break line voltage to the appliance.
Ground	Green Wire	Location for connecting earth ground and for grounding all circulators.

NOTICE

ECM Pumps – due to the large inrush current of ECM pumps, they should only be switched via an isolation relay, not directly via the boiler controller. Powering ECM pumps directly will lead to premature failure of the boiler controller's pump relay contacts.

NOTICE

Max Load – The total load rating of circulators powered by outputs BOILER PUMP and CH PUMP, or BOILER PUMP and DHW PUMP cannot exceed 2.6 Amps.

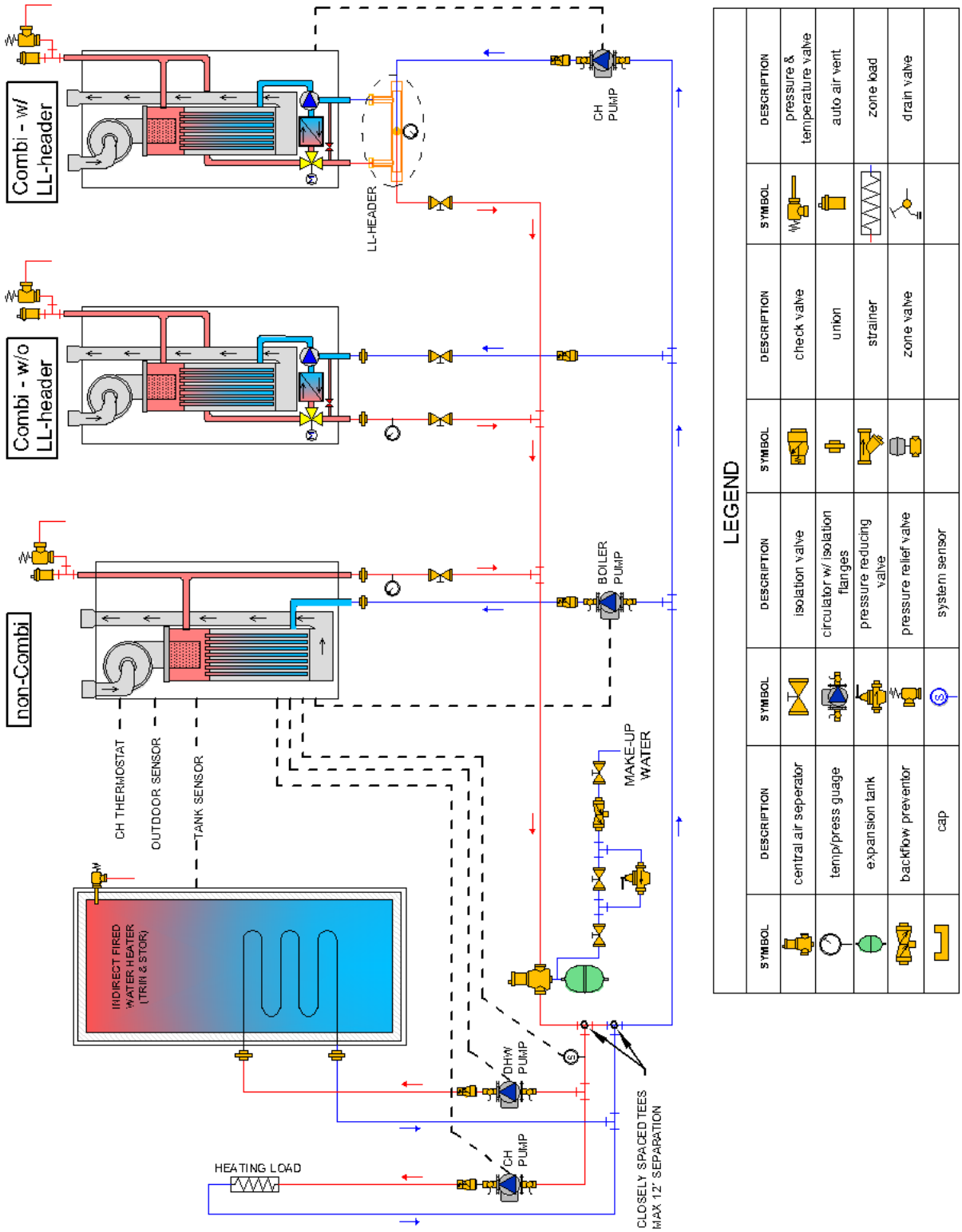
13.0 CASCADE INSTRUCTIONS

The FTV controller has the internal capacity to cascade (lead-lag / stage) up to 16 FTV boilers, without the use of an external controller. Use the instructions detailed in this section to set-up and install the cascade system.

NOTICE

FTV-Combi – cascades heating an Indirect Water Heater (IWH) cannot utilizes an FTV-Combi as the Manager.

Figure 13-1 Cascade Plumbing Schematic



Communication Wiring – for each boiler in the cascade, wire in parallel electrical connections Argus Link (-) and Argus Link (+), terminals 1 and 2 (see Figure 12-2).

Establish Managing Boiler – choose **one** boiler to be the Managing Boiler, this boiler will receive all control wiring and will be used for setting control parameters (see steps below). All non-Managing Boilers (Dependents) must have the "S4" switch (located on the top right side of the control) switched OFF. *
**Note: the "S4" switch is factory set to ON. The switch is in the off position when it is closest to the "S4" marking. The "S4" switch must remain in the ON position on the Managing Boiler.*

Plumbing – install the boilers in parallel in a primary/secondary plumbing configuration as illustrated in Figure 13-1.

System Sensor – install a system sensor (NTI p/n: 84010) on the outlet (supply) pipe feeding the heating system, see Figure 13-1. Wire the system sensor to terminals 3 and 4 of the Managing Boiler (left boiler in illustration).
IMPORTANT: the use of the system sensor is mandatory for proper operation of the boiler cascade system.

Outdoor Sensor – when using an outdoor sensor it must be connected to terminals 3 and 5 of the Managing boiler (left boiler in illustration); outdoor sensors connected to non-Managing boilers will be ignored.

Boiler Pump – each boiler in the cascade must have its own circulator (see Figure 13-1) which is operated by each respective boiler, via the BOILER PUMP output (terminal 13). For the FTV-Combi, the Boiler Pump is located within the boiler, so an external circulator is only necessary if the factory supplied LL Header is employed; in this case the external circulator is operated via the CH PUMP output (terminal 12).

CH Pump (System) – the Managing Boiler can control the System's Central Heating Pump via its CH PUMP output (terminal 12). **IMPORTANT**: due to the limited switching capacity of the CH PUMP output, it may be necessary to use an isolation relay to activate the CH Pump, see Table 12-1.

DHW Pump (System) – the Managing Boiler can control the System's DHW Pump via its DHW PUMP output (terminal 11). **IMPORTANT**: due to the limited switching capacity of the DHW PUMP output, it may be necessary to use an isolation relay to activate the DHW Pump, see Table 12-1.

Central Heat Demand Switch (Room Thermostat) – connect to terminals 7 and 8 (THERMOSTAT) of the Managing Boiler. Switch must be an isolated end switch (dry contact). Central Heat settings are programed from the Managing Boiler only, i.e. Installer menu settings 2-01, 2-02, 2-03, 2-04, 2-05 and 2-06.

Tank Thermostat / Sensor – connect to terminals 3 and 6 of the Managing Boiler. DHW settings are programed from the Managing Boiler only, i.e. Installer menu settings 2-07, 2-08 and 2-09. Set DHW Mode (Installer menu setting 2-08) according to device used; Thermostat = 2, Sensor = 1.

Boiler Address – assign a unique boiler address for each boiler in the cascade via Installer menu setting 2-20. Managing boiler must be set = 1; other boilers must be set from 2 to 16.

Rotation Interval – establishes the time, in days, between advancements of the staging sequence of boilers in the cascade; set via Installer menu setting 2-22 of the Managing Boiler.

Emergency Setpoint – establishes an emergency (back-up) boiler operating setpoint in the event communication is lost between boilers, or if the system sensor is not connected. Set via Installer menu setting 2-21 of each boiler in the cascade.

Table 13-1 Minimum Pipe Sizes for Multiple Boiler Applications

# of Units	FTV110	FTV150	FTV190
2	1-1/4”	1-1/2”	2”
3	1-1/2”	2”	2”
4	2”	2”	2-1/2”
5	2”	2-1/2”	2-1/2”
6	2-1/2”	2-1/2”	3”
7	2-1/2”	3”	3”
8	2-1/2”	3”	3”
9	2-1/2”	3”	3”
10	3”	3”	4”
11	3”	3”	4”
12	3”	4”	4”
13	3”	4”	4”
14	3”	4”	4”
15	3”	4”	4”
16	3”	4”	4”
Note: Minimum pipe size based on assumed temperature rise of 25ºF at maximum firing rate.			

14.0 WIRING SCHEMATICS

Figure 14-1 FTV Connection Diagram

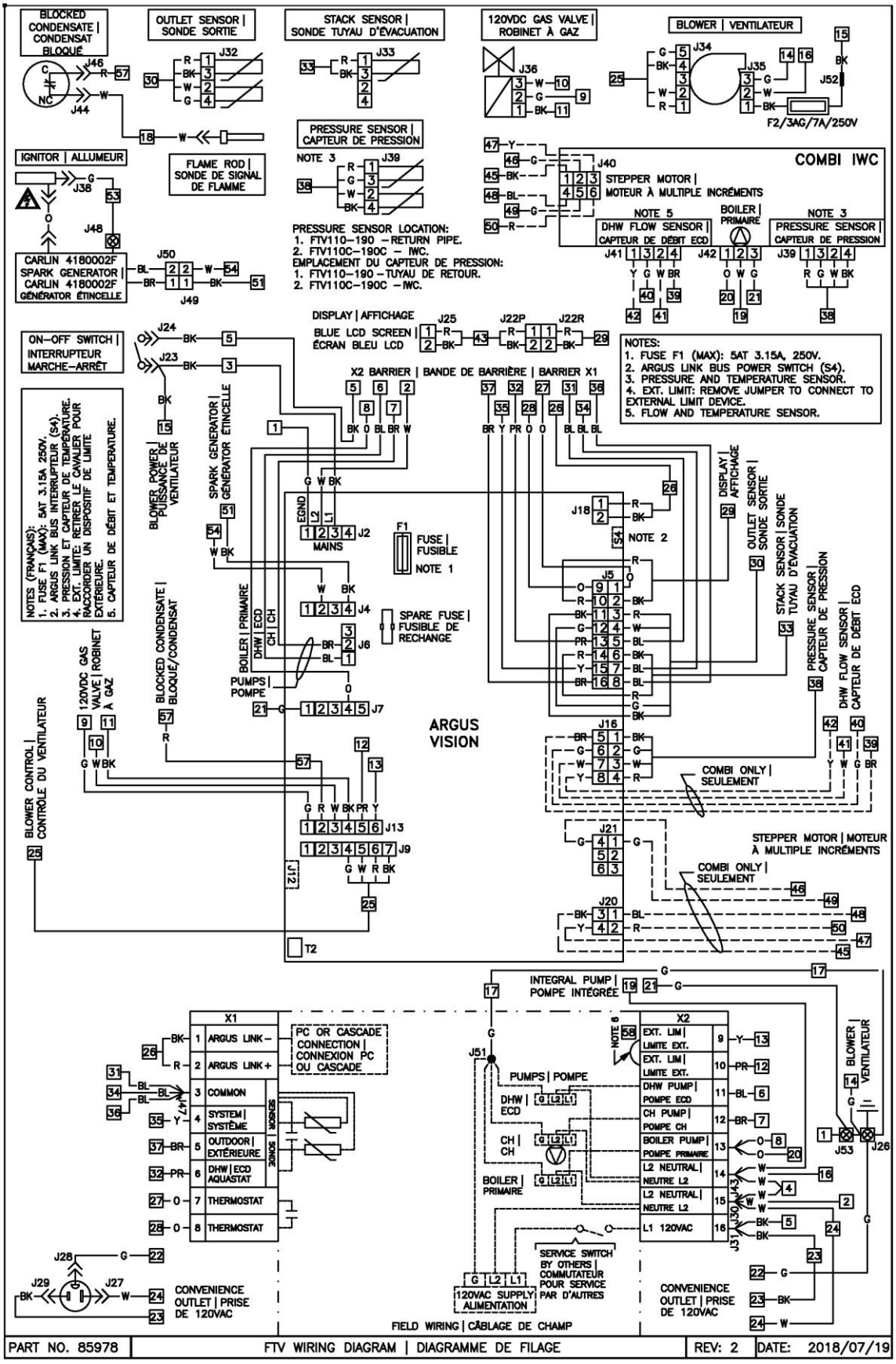
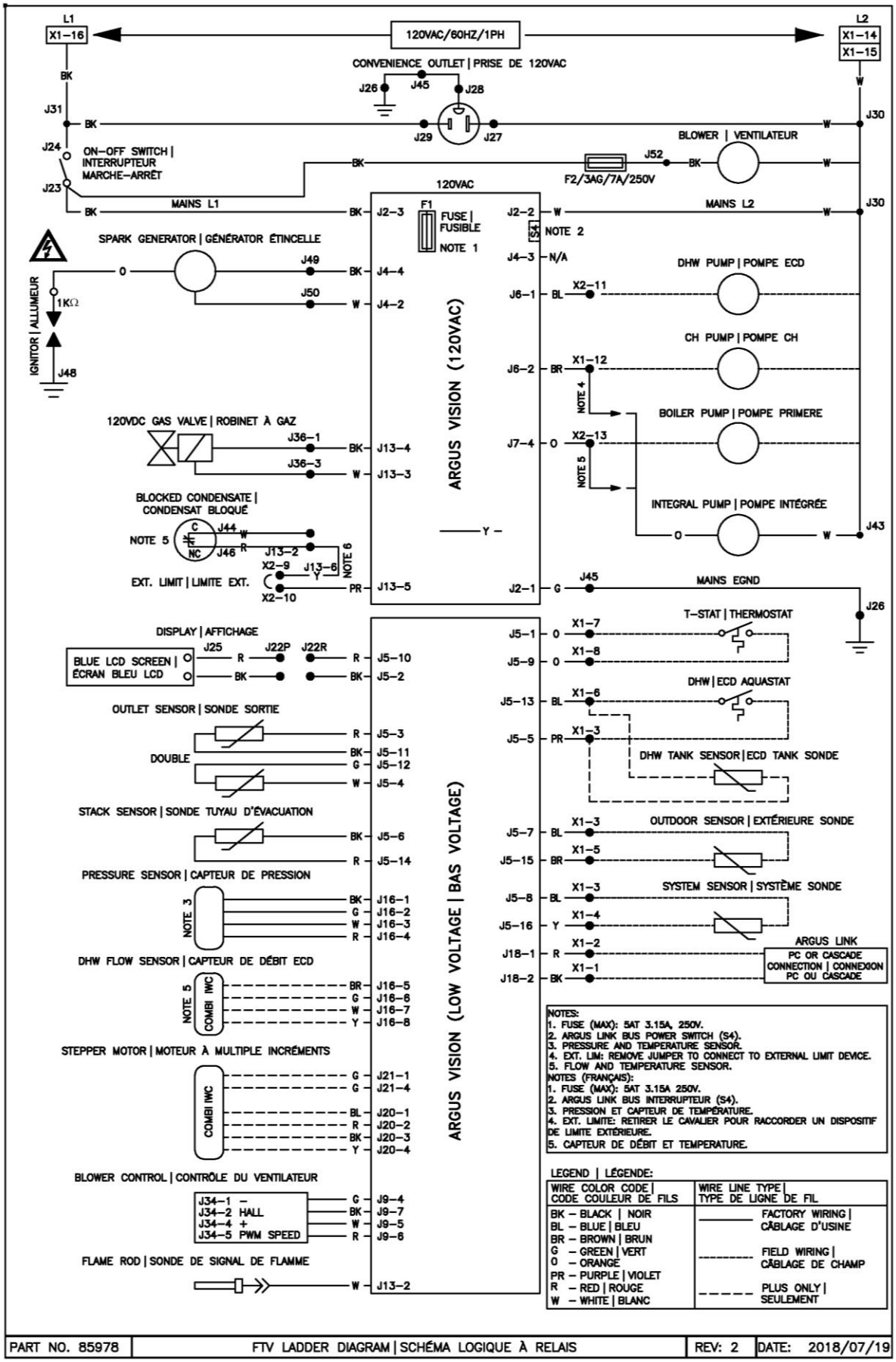


Figure 14-2 FTV Ladder-Logic Diagram



15.0 INSTALLATION CHECKLIST

Installation

- ☐ 1. If operating on Propane Gas, convert boiler using appropriate Conversion Kit. See Table 7-1.
- ☐ 2. Locate the boiler in accordance with Section 3.0 of this manual.
- ☐ 3. Install the Vent/Air-inlet piping in accordance with Sections 4.0 and 5.0 of this manual. Ensure all joints are secured and cemented properly. Perform the Mandatory Pre-commissioning Procedure for Plastic Venting in Section 4.0.
- ☐ 4. Connect the condensate trap and drain in accordance with Section 6.0 of this manual.
- ☐ 5. Connect the gas supply in accordance with Section 7.0 of this manual.
- ☐ 6. Install the plumbing in accordance with this manual. Flush/cleanse the internals of the heating system. Treat system water with Fernox F1 Protector when needed.
- ☐ 7. Connect field wiring in accordance with Section 12.0 of this manual.
- ☐ 8. Advise home/building owner of their responsibilities with respect to maintaining the boiler.

⚠ WARNING The building owner is responsible for keeping the Vent/Air-inlet termination free of snow, ice, or other potential blockages and for scheduling boiler routine maintenance as described in the next section. Failure to properly maintain the boiler may result in serious injury or death.

Start-up

⚠ DANGER Allow primers/cements to cure for 8 hours prior to Start-up. If curing time is less than 8 hours, first perform Steps 2 through 6 of **Mandatory Pre-commissioning Procedure for Plastic Venting** in Section 4.0. Failure to follow these instructions can result in explosion, serious injury or death.

- ☐ 1. Turn gas shut-off valve to the ON position.
- ☐ 2. Turn Power on to the boiler.
- ☐ 3. Set Controller to the desired settings.
- ☐ 4. Turn thermostat up, Ignition will occur.

Operational Checklist

- ☐ 1. System is free of gas leaks.
- ☐ 2. System is free of water leaks.
- ☐ 3. Water pressure is maintained above 15 PSI.
- ☐ 4. All air is purged from the heating system piping.
- ☐ 5. Ensure proper water flow rate; unit must not kettle, bang, hiss or flash the water to steam.
- ☐ 6. Ensure gas line pressure is in accordance with Section 9.0.
- ☐ 7. System is free of combustion leaks.
- ☐ 8. Unit must operate smoothly.
- ☐ 9. Ensure the flue gas combustion readings are within the tolerances listed in Table 9-1.
- ☐ 10. Each ignition must be smooth.
- ☐ 11. Verify that all condensate lines are clean and drain freely.

Before Leaving

- ☐ 1. Remove line pressure gauge from gas valve, tighten bleed screw, test screw for leaks. See Section 9.0.
- ☐ 2. Install plug into the flue gas test port and test for leaks, see Section 9.0.
- ☐ 3. Allow the boiler to complete at least one heating cycle, or to operate for at least 15 minutes.
- ☐ 4. Always verify proper operation after servicing.

Instructions to Installing Contractor

- ☐ 1. Ensure that the customer receives the Warranty Documentation included with the installation manual.
- ☐ 2. Leave the manual with the customer so they know when to call for annual maintenance and inspection.

⚠ WARNING This boiler must have water flowing through it whenever the burner is firing. Failure to comply may damage the unit, void the warranty, and cause serious injury or death.

⚠ WARNING Allowing the boiler to operate with a dirty combustion chamber will adversely affect its operation and void the warranty. Failure to clean the heat exchanger on a frequency that matches the need of the application may result in fire, property damage, or death.

16.0 ANNUAL MAINTENANCE AND INSPECTION

This unit must be inspected at the beginning of every heating season by a Qualified Technician.

Annual Inspection Checklist

- ☐ 1. Ignition is smooth and consistent, and the combustion fan is noise & vibration free.
- ☐ 2. The condensate drain flows freely, and is cleaned of sediment.
- ☐ 3. Relief Valve and air vents are not weeping.
- ☐ 4. Low water cut off device is tested.
- ☐ 5. Examine all venting for evidence of leaks. Ensure vent screens are cleaned and clear of debris.
- ☐ 6. Check the burner plate for signs of leaking.
- ☐ 7. The combustion chamber must be inspected and if necessary cleaned.
- ☐ 8. Keep boiler area clear/free from combustible materials, gasoline, and other flammable vapors and liquids.
- ☐ 9. Ensure there is nothing obstructing the flow of combustion and ventilation air.
- ☐ 10. Listen for water flow noises indicating a drop in boiler water flow rate.
  Important - The hydronic system may need to be flushed to eliminate hard water scale (Use Fernox DS-40 Descaler, NTI PN: 83450).
- ☐ 11. **Verify proper operation after servicing.**

CAUTION

Wiring Labels - Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation.

IMPORTANT

Cleansers and Potable Water - Boiler system cleansers and corrosion inhibitors must not be used to flush contaminants from water heaters or potable water systems.

Combustion Chamber Cleaning Procedure

The combustion chamber must be cleaned after the first year of operation, with subsequent cleanings scheduled based on the condition of the combustion chamber at the time of the first cleaning. Units operating with LP Gas or in an industrial environment may require more frequent cleanings.

IMPORTANT

Crystalline Silica - Read carefully the warnings and handling instructions pertaining to Refractory Ceramic Fibers before commencing any service work in the combustion chamber. Take all necessary precautions and use recommended personal protective equipment as required.

Cleaning Checklist

- ☐ 1. Remove the demand for heat, allow the post-purge cycle to finish, turn gas and power supply off.
- ☐ 2. Working inside the cabinet, disconnect the cabling to the combustion blower, gas valve, spark igniter and flame sensor, then remove the air-inlet piping and gas supply piping.
- ☐ 3. Once the combustion chamber has cooled, remove the combustion blower followed by the burner plate – be careful not to damage the insulation disc located underneath the burner plate.
- ☐ 4. Use a vacuum with a high efficiency filter to remove any loose debris or dust.
- ☐ 5. Remove the condensate trap from the bottom of the boiler and place a drain under the boiler condensate drain.
- ☐ 6. Wet the inside of the combustion chamber with warm water (do not use any chemicals). Use a garden hose with a trigger nozzle to direct pressurized water through the heat exchanger tubes; the water will exit via the condensate drain on the bottom. Continue process until the tubes are clear and the water runs clean. Use dry rags or plastic to protect electrical components from being damaged by dripping or spraying water.
- ☐ 7. Disassemble the condensate trap and thoroughly clean it; then reassemble and securely connect it to the boiler condensate drain, see Section 6.0.
- ☐ 8. Remove the burner from the burner plate; clean if necessary using compressed air. Reattach the burner; ensure the gasket is in perfect condition and is reinstalled (replace if necessary).
- ☐ 9. Inspect the insulation disc located on the under-side of the burner plate. Replace if damaged.
- ☐ 10. Re-install the burner plate; be sure the insulation disc is properly aligned. Reinstall remaining components in the opposite order they were removed.
- ☐ 11. Perform the Start-up and Operational Checklist detailed in the previous section.

⚠ WARNING

Replace any gaskets or insulation discs that show any signs of damage and do not re-use. Failure to follow these instructions may result in fire, property damage or death.

Refractory Ceramic Fibers (RFC)

IMPORTANT

Personal Protective Equipment Recommended - Read the following warnings and handling instructions carefully before commencing any service work in the combustion chamber. The insulating material on the inside of the burner plate contains *Refractory Ceramic Fibers* and should not be handled without personal protective equipment.

⚠ WARNING

Potential Carcinogen - Use of *Refractory Ceramic Fibers* in high temperature applications (above 1000°C) can result in the formation of Crystalline Silica (cristobalite), a respirable silica dust. Repeated airborne exposure to crystalline silica dust may result in chronic lung infections, acute respiratory illness, or death. Crystalline silica is listed as a (potential) occupational carcinogen by the following regulatory organizations: International Agency for Research on Cancer (IARC), Canadian Centre for Occupational Health and Safety (CCOHS), Occupational Safety and Health Administration (OSHA), and National Institute for Occupational Safety and Health (NIOSH). Failure to comply with handling instructions in Table 16-1 may result in serious injury or death.

⚠ WARNING

Crystalline Silica - Certain components confined in the combustion chamber may contain this potential carcinogen. Improper installation, adjustment, alteration, service or maintenance can cause property damage, serious injury (exposure to hazardous materials) or death. Refer to Table 16-1 for handling instruction and recommended personal protective equipment. Installation and service must be performed by a qualified installer, service agency or the gas supplier (who must read and follow the supplied instructions before installing, servicing, or removing this boiler. This boiler contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans).

Table 16-1 Handling Instructions for Refractory Ceramic Fibers (RCF)

Reduce the Risk of Exposure	Precautions and Recommended Personal Protective Equipment
Avoid contact with skin and eyes	• Wear long-sleeved clothing, gloves, and safety goggles or glasses.
Avoid breathing in silica dust	• Wear a respirator with an N95-rated filter efficiency or better. [1] • Use water to reduce airborne dust levels when cleaning the combustion chamber. • Do not dry sweep silica dust. Pre-wet or use a vacuum with a high efficiency filter.
Avoid transferring contamination	• When installing or removing RFCs, place the material in a sealable plastic bag. • Remove contaminated clothing after use. Store in sealable container until cleaned. • Wash contaminated clothing separately from other laundry.
First Aid Measures	If irritation persists after implementing first aid measures consult a physician. • **Skin** - Wash with soap and water. • **Eyes** - Do not rub eyes; flush with water immediately. • **Inhalation** – Breathe in fresh air; drink water, sneeze or cough to clear irritated passage ways.

Notes:
[1] Respirator recommendations based on CCOHS and OSHA requirements at the time this document was written. Consult your local regulatory authority regarding current requirements for respirators, personal protective equipment, handling, and disposal of RCFs.

For more information on Refractory Ceramic Fibers, the risks, recommended handling procedures and acceptable disposal practices contact the organization(s) listed below:

Canada (CCOHS): Telephone directory listing under Government Blue Pages Canada—Health and Safety—Canadian Centre for Occupational Health and Safety; or website http://www.ccohs.ca.

United States (OSHA): Telephone directory listing under United States Government—Department of Labor—Occupational Safety and Health Administration; or website http://www.osha.gov.

17.0 DISPLAY MENU GUIDE

Initial Power-up

Immediately following power-up of the boiler, the display reads, "*conn*", indicating it is connecting to the controller; this is followed by a momentary reading of the display software version, e.g. *init 8A94*. After which the controller performs a de-air sequence that is designed to purge air from the boiler water. The de-air sequence cycles the circulators off and on, for a period of 14 minutes, in an attempt to free air pockets that may exists in the heat exchanger and boiler piping.

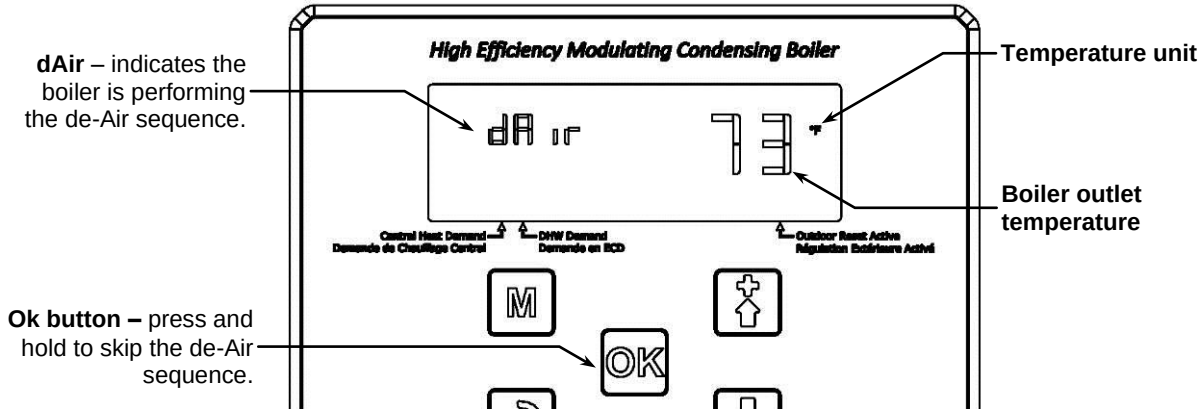
NOTICE

The de-air sequence is initiated following each power-up of the boiler; if air has already been adequately purged from the system the de-air sequence can be stopped by holding the OK button until "dAir" is no longer displayed on the screen, see Figure 17-1.

⚠ WARNING

The de-air sequence is designed to remove air from the system; failure to adequately remove air from the system can damage the heat exchanger and void the warranty, and may lead to property damage and personal injury.

Figure 17-1 de-Air Sequence



Main Screen

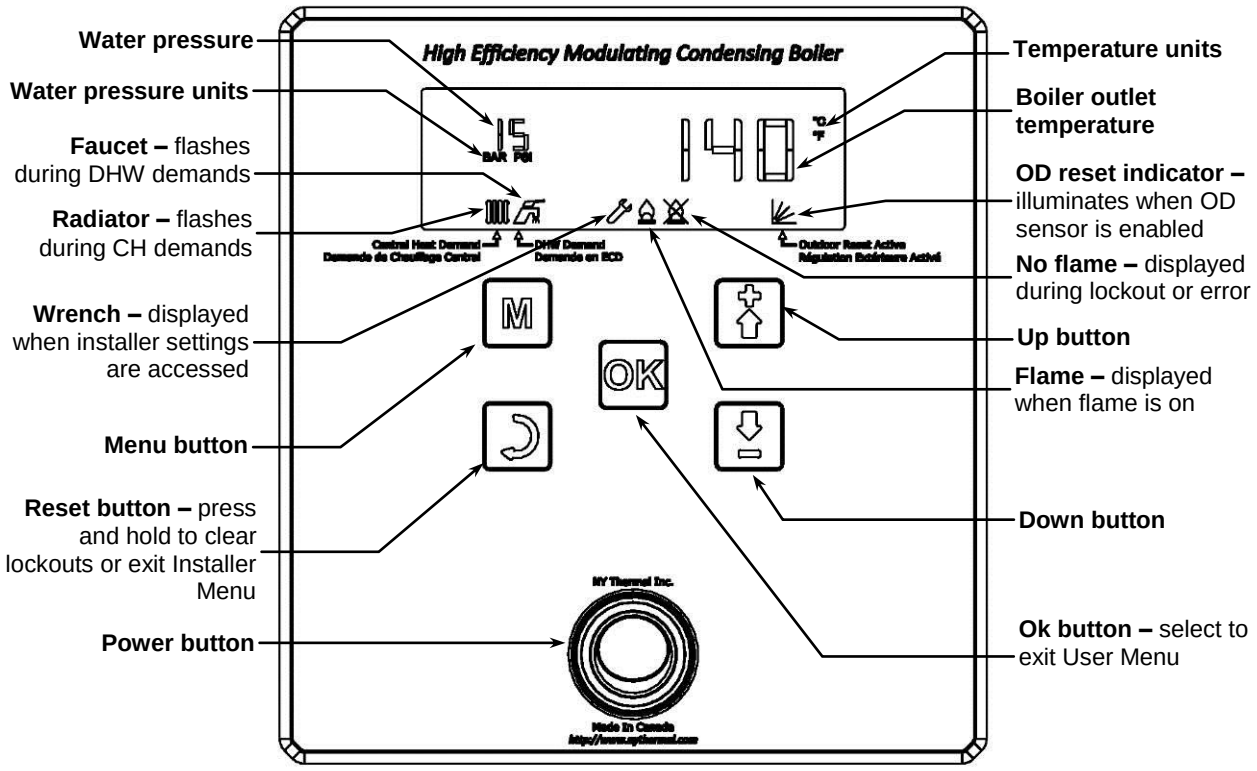
Following power-up of the boiler (after the de-air sequence), or after 60 seconds of inactivity (no buttons pressed), the boiler defaults to the Main Screen, see Figure 17-2. Under normal operating conditions the Main Screen displays the boiler outlet temperature and water pressure, as well as an indication of the current heat demand (CH or DHW), burner status and outdoor reset function. See Figure 17-2 for more details.

User Menu access – from the Main Screen, access to the User Menu is accomplished simply by pressing the UP or DOWN button on the console; see User Menu section below for more details.

Installer Menu access – from the Main Screen or User Menu, access to the Installer Menu is accomplished by pressing and holding the MENU and OK buttons simultaneously; see Installer Menu section below for more details.

Return to Main Screen – from the User Menu, return to the Main Screen by pressing the OK button. From the Installer Menu, return to the Main Screen by pressing and holding the RESET button.

Figure 17-2 Control Console – Main Screen



User Menu

The User Menu allows for easy viewing of the current boiler operating conditions, including pump status, sensor inputs, common set points, and boiler target temperature. Access the User Menu from the Main Screen by pressing the UP or DOWN button on the display console. Exit the User Menu by pressing the OK button.

NOTICE

The User Menu only permits the user to **view** boiler information; editing of settings must be done from the Installer Menu. Access the Installer Menu by pressing and holding the MENU and OK buttons simultaneously; see Installer Menu section for more details.

Figure 17-3 User Menu Navigation

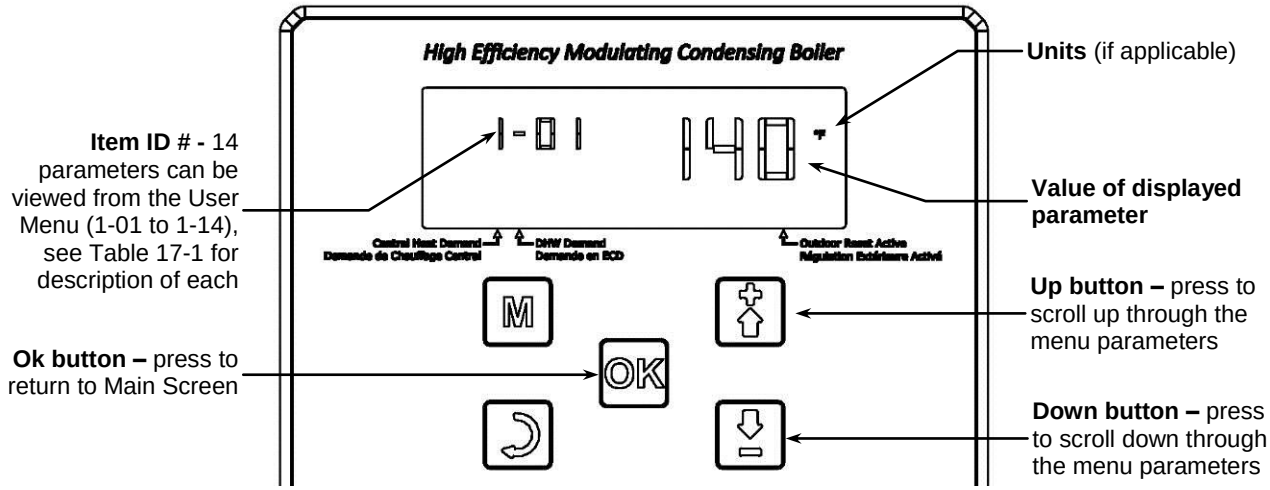


Table 17-1 User Menu

Menu Item	Description
1-01	**Current target temperature** – displays the current target temperature of the boiler outlet sensor for the active demand (DHW or Central Heating). For central heating with outdoor reset, the calculated central heating target temperature will be displayed. The Manager boiler of a cascade system will display the target temperature for the system. **NOTICE:** FTV-Combi models will display "---" during DHW demands.
1-02	**CH setpoint (at OD = 0°F)** – displays the maximum central heat setpoint, set via Installer Menu setting 2-01. Setting establishes the boiler operating temperature during central heat demands when the outdoor temperature is 0°F or less.
1-03	**DHW temperature** – displays the temperature reading from; (i) the Tank sensor (NTI P/N: 84632) located in an indirect water heater or (ii) the DHW sensor inside the FTV-Combi boiler (NTI P/N: 84907). When no sensor is used, "OPEn" indicates an open circuit, and "CLOS" indicates a closed circuit – i.e. contact closure from an indirect thermostat.
1-04	**DHW setpoint** – displays the DHW setpoint, set via Installer Menu setting 2-07.
1-05	**DHW flow rate (USGPM)** – displays the DHW flow rate sensed at the FTV-Combi DHW sensor. **NOTICE:** when the sensor is disconnected, 0.49 is displayed.
1-06	**Fan speed actual (rpm)** – displays speed at which the combustion blower is operating.
1-07	**Flame signal (µA)** – displays the flame strength signal sensed from the ionization electrode, NTI p/n: 85819; minimum signal to sustain normal burner operation is 3µA. Burner operation is completely prohibited when the signal drops below 1.5µA.
1-08	**Outdoor sensor temperature** – displays reading from outdoor temperature sensor, NTI p/n: 83604. **NOTICE:** when sensor is open (not connected) display indicates -40°F/C or "OPEn"; when sensor is shorted display indicates 176°F/80°C or "OPEn". See Table 18-1, Thermistor Resistence vs. Temperature.
1-09	**Return sensor temperature** – displays reading from boiler inlet temperature sensor, NTI p/n: 84745.
1-10	**Flue sensor temperature** – displays reading from boiler flue temperature sensor, NTI p/n: 83608. Burner operation is inhibited when the flue temperature reading is in excess of 205°F. **NOTICE:** an open circuit is displayed as 50°F/10°C and a blocking error "Err 78" occurs; a short circuit is displayed as 278°F/137°C and a blocking error "Err 86" occurs. See Table 18-1, Thermistor Resistence vs. Temperature.
1-11	**Boiler pump** – indicates the status (On/Off) of the Boiler Pump output. Note: the Boiler Pump output is on during all demands.
1-12	**Central heat pump** – indicates the status (On/Off) of the CH Pump output. Note: the CH Pump output is on during central heat demands; the CH Pump will turn off during priority DHW demands.
1-13	**DHW pump** – indicates the status (On/Off) of the DHW Pump output. Note: the DHW Pump output is on during priority DHW demands.
1-14	**System sensor temperature** – for use only in cascade systems, displays reading from a system temperature sensor, NTI p/n: 84010. When used, the system sensor is only wired to the managing boiler, i.e. boiler with S4 switch set to on, and boiler address (Installer Menu setting 2-20) set to 1. **NOTICE:** an open circuit is displayed as "OPEn"; a short circuit is displayed as "CLOS". See Table 18-1, Thermistor Resistence vs. Temperature.

Notes:

1. Enter User Menu by pressing the UP or DOWN button; to scroll through menu options, continue pressing the UP or DOWN button.
2. Exit User Menu by pressing the OK button.
3. User Menu is for viewing only; to adjust settings refer to the Installer Menu.

Installer Menu

The Installer Menu allows access to all settings for adjustment, as well as viewing of statistical data for troubleshooting. Access the Installer Menu from any screen by pressing the MENU and OK buttons simultaneously until "2-01" is displayed on the top left of the screen. Exit the Installer Menu by pressing and holding the RESET button.

⚠ WARNING

Installer Menu settings shall only to be adjusted by a qualified installer or service technician that understands the repercussions of incorrect control settings. Improper control settings may negatively affect the operation of the boiler and/or the heating system; resulting in property damage, serious injury or even death.

Adjusting settings – once the Installer Menu is accessed; adjust settings using the following procedure:

1. Use the UP or DOWN button to scroll through the menu until the desired setting number is displayed in the top-left of the screen (i.e. 2-01).
2. Press the OK button to access the setting; at this time the setting will flash (Note: if the value does not flash after pressing the OK button, then the parameter is not adjustable – refer to Table 17-2).
3. With the value flashing, use the UP or DOWN button to increase or decrease the setting. Once the desired value is displayed, press the OK button to enter/save the new value. At this point the value will stop flashing.
4. Repeat for the next setting. Once complete, return to the Main Screen by holding the RESET button.

Figure 17-4 Installer Menu Navigation

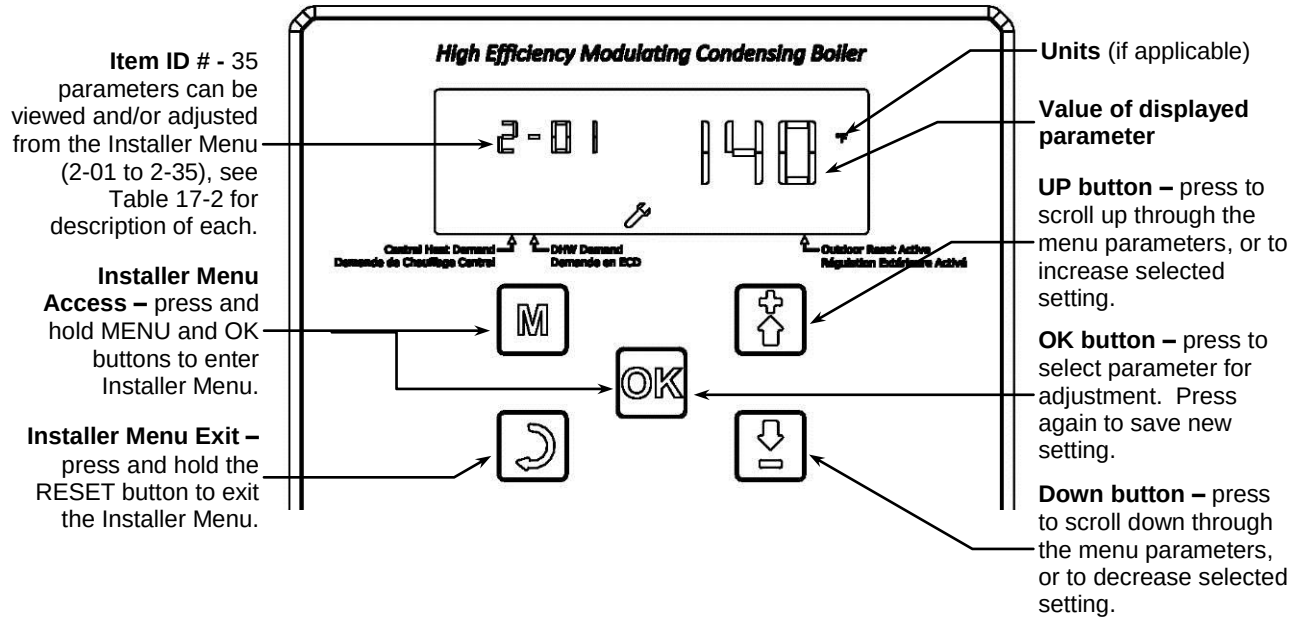


Table 17-2 Installer Menu

Setting	Description	Factory Setting
2-01	**CH setpoint (at OD = 0°F)** – establishes the boiler operating temperature during central heat demands when the outdoor temperature is 0°F or less. Set to the maximum desired boiler temperature for the application, e.g. 100-120°F for infloor; 140-160°F for cast-iron; 160-190°F for baseboard. Range = 80 to 190°F	140°F
2-02	**CH setpoint differentia**l – establishes how much the boiler outlet temperature must exceed the CH setpoint before the burner is turned off. Also establishes how much the boiler outlet temperature must drop below the CH setpoint before the burner is turned on. Range = 3 to 36°F	11°F

Setting	Description	Factory Setting
2-03	**CH mode** – determines the operational mode for central heating: • 0 – no outdoor sensor is needed; central heat demand is generated by a thermostat call to boiler terminals 7 and 8. Boiler operates to setting 2-01; there is no outdoor reset. • 1 – outdoor sensor is needed; central heat demand is generated by a thermostat call to boiler terminals 7 and 8. Boiler operates in-between settings 2-01 and 2-05 depending on OD temp. • 2 – outdoor sensor is needed; central heat demand is generated when the OD temp is below the Warm weather shutdown setting (2-04). Boiler operates in-between settings 2-01 and 2-05 depending on OD temp. An optional "nighttime setback" or "time of day" switch can be applied to terminals 7 and 8; contact closure initiates "Night Setback Mode", where the boiler target temperature is reduced by the Night Setback Temperature setting (2-33). • 3 – same as 0 • 4 – setpoint from external analog input (0-10VDC); 2 volts for minimum CH setpoint, 10 volts for maximum CH setpoint. Use of an addition interface board through Argus Link is required. • 5 – modulation from external analog input (0-10VDC); 2 volts for minimum modulation, 10 volts for maximum modulation. Use of an addition interface board through Argus Link is required.	1
2-04	**Warm weather shutdown** – inhibits central heat operation when the outdoor temperature reading goes above this setting. Range = 35 to 100°F	100°F
2-05	**CH setpoint (at OD = 70°F)** – establishes the boiler operating temperature during central heat demands when the outdoor temperature is 70°F or greater. Set to the minimum desired boiler temperature for the application, e.g. 70-90°F for infloor; 100-120°F for cast-iron; 110-140°F for baseboard. Range = 60 to 140°F	95°F
2-06	**Temperature boos**t – determines the increase in boiler target temperature for every 15 minutes of continuous central heat demand. Only applicable when an outdoor sensor is used (i.e. CH modes 1 & 2). Target temperature will not exceed CH setpoint setting 2-01. Range = 0 to 36°F **NOTICE:** Boost feature does not function when the boiler is operating as part of a cascade.	0°F
2-07	**DHW setpoint** – establishes: a) tank temperature setting for DHW mode 1 [e.g. 130-140°F], b) boiler outlet setpoint for DHW mode 2 [e.g. 170-190°F] or c) DHW temperature for FTV-Combi [e.g. 120-140°F]. Range = 104-190°F	136°F
2-08	**DHW mode** – determines the operational mode for DHW; for non-combi models choose between options 0, 1 and 2; for FTV-Combi models choose between options 0 and 5: • 0 – off; boiler will not attempt to heat DHW in any way. • 1 – tank sensor, NTI P/N: 84632, is installed in the indirect water heater and wired to boiler terminals 3 and 6. Tank temperature is adjusted via setting 2-07. • 2 – tank thermostat is installed in the indirect water heater and wired to boiler terminals 3 and 6. Setting 2-07 determines boiler outlet temperature during DHW demands. (Default setting for FTV110-190) • 3 & 4 – settings are not applicable. • 5 – DHW mode setting for FTV-Combi models. Setting 2-07 determines DHW outlet temperature.	2 or 5
2-09	**DHW priority timer** – a timer that accumulates during a simultaneous DHW and CH demand. Each time the timer exceeds the "DHW priority timer" setting, the priority switches from one demand to the other (i.e. DHW to CH). Note: DHW is assigned priority first. Range = 1-240 minutes	60 min
2-10	**Preheat mode** (only applicable to FTV-Combi models) – when set to ON, the preheat mode acts to keep the boiler and internal DHW circuit warm, to reduce the time required for hot water to reach the fixture, and helps limit the effect of the phenomena known as "cold water sandwich". When set to OFF, the boiler is not preheated. Range = ON/OFF	ON
2-11	**Appliance selection (type)** – indicates what boiler model the controller is configured to operate with: • 16 = FTV110 (NG) • 17 = FTV150 • 18 = FTV190 • 19 = FTV110C (NG) • 20 = FTV150C • 21 = FTV190C • 22 = FTV110 (LP) • 23 = FTV110C (LP) (See Section 17.0 for instruction on changing the appliance selection {type}).	16-23

Setting	Description	Factory Setting
2-12	**Minimum firing rate** – allows the installer to increase the minimum modulation/firing rate of the boiler; this may be necessary for troubleshooting. Range = 20-44%	20%
2-13	**Maximum firing rate CH** – allows the installer to decrease the maximum modulation/firing rate of the boiler when operating on a central heat demand; this may be necessary for troubleshooting or de-rating the boiler for operation with glycol. Range = 60-100%	100%
2-14	**Maximum firing rate DHW** – allows the installer to decrease the maximum modulation/firing rate of the boiler when operating on a domestic hot water demand; this may be necessary for troubleshooting or de-rating the boiler for operation with glycol. Range = 60-100%	100%
2-15	**Firing rate test** – allows the installer to force maximum or minimum modulation rates for the purpose of troubleshooting and burner setup (i.e. combustion analysis): • 0 = Automatic; burner modulation is controlled by the controller. • 1 = Minimum; burner operates at the minimum modulation rate. • 2 = Ignition; burner operates at the ignition/light-off modulation rate. • 3 = Maximum; burner operates at the maximum modulation rate. Note: control will end test (return setting to 0) if the boiler outlet temperature exceeds 176°F. Return setting to 0 when testing is complete.	0
2-16	**Service reminder status** – a service reminder, indicated by "Att 7" on the screen, occurs every 365 days. The service reminder is reset by adjusting 2-16 to "OFF".	OFF
2-17	**Cascade pump postpurge** – length of time the pumps remain powered at the end of a cascade DHW or CH demand. Applicable to the Manager only. Timer commences immediately following the end of the cascade demand, and will be overridden by a longer CH or DHW pump postpurge time. Range = 10-90seconds	30 sec
2-18	**CH pump postpurge** – length of time the CH & Boiler Pumps remain powered at the end of a central heat demand. Timer commences following the combustion fan postpurge. Range = 0-90seconds	30 sec
2-19	**DHW pump postpurge** – length of time the DHW & Boiler Pumps remain powered at the end of a DHW demand. Timer commences following the combustion fan postpurge. Range = 0-255seconds	10 sec
2-20	**Cascade boiler address** – assign a unique boiler address for each boiler in a cascade; managing boiler address must be set to 1. Managing boiler must have S4 switch set to ON; all others must be set to OFF. Central heat and DHW demands and setpoints are received and set at the managing boiler only. A boiler that is not part of a cascade must have the boiler address set to 0. Range = 0-16	0
2-21	**Emergency setpoint** – used only for a cascade system, assigns a permanent boiler operating temperature that is used if communication between boilers is lost, or if the system temperature sensor becomes disconnected. Must be set on each boiler in the cascade. Range = 104-190°F	113°F
2-22	**Rotation interval** – establishes the time between the rotation of start and stop sequences of boilers in a cascade. Range = 0-30days (0=disable)	5 days
2-25	**Flame failures** – accumulation of the number of flame outages that occurred during run.	NA
2-26	**Ignition attempts success** – accumulation of the number of successful ignitions.	NA
2-27	**Ignition attempts failed** – accumulation of the number of failed ignition attempts.	NA
2-28	**Run time CH** – accumulation of the number of hours that the burner has been firing for the purpose of central heating.	NA
2-29	**Run time DHW** – accumulation of the number of hours that the burner has been firing for the purpose of DHW.	NA
2-30	**Post purge time** – length of time the combustion blower operates at the end of a burner sequence. Recommend increasing post purge time for installations with long exhaust venting. Range = 5-255seconds	255 sec
2-31	**Units selection** – allows the installer to select US or metric units. Range = °F or °C	°F
2-32	**External Ignition –** determines the power source for the igniter spark. Parameter must be set to On.	On
2-33	**Night Setback Temperature –** applicable only when CH mode is set to 2 (menu setting 2-03), determines the reduction in boiler target temperature during "Night Setback Mode", i.e. when terminals 7 and 8 receive a demand (contact closure) from a "nighttime setback" or "time of day" switch. Range = 0-54°F	15°F

Setting	Description	Factory Setting
2-34	**Lockout History** – displays the last 16 lockouts (Loc) and the time interval between each. The most recent lockout is displayed first; see description below.	NA
2-35	**Blocking Error History** – displays the last 16 blocking errors (Err) and the time interval between each. The most recent error is displayed first; see description below.	NA

Lockout & Error History

The FTV controller stores in its memory the 16 most recent Lockouts (Loc) and Blocking Errors (Err); these errors can be accessed from the Installer Menu via settings 2-34 (Lockout History) and 2-35 (Blocking Error History). The History submenus indicate which Lockout or Error occurred, and the time interval between each occurrence. Navigate the Lockout and Error History submenus as follows:

1. Navigate to Installer Menu setting 2-34 (Lockout History) or 2-35 (Blocking Error History). From this screen the display indicates how long ago the most recent error occurred; see Figure 17-5(a).
2. Press the "OK" button to display the most recent error, and the time between it and the preceding error; see Figure 17-5(b).
3. Press the UP button to display the next most recent error, and time between it and the preceding error; see Figure 17-5(b). When you have reached the end of the recorded errors, the display will indicate "End 0." To exit the History submenu, press the "OK" button; see Figure 17-5(c).

Figure 17-5(a) Lockout and Error History Navigation

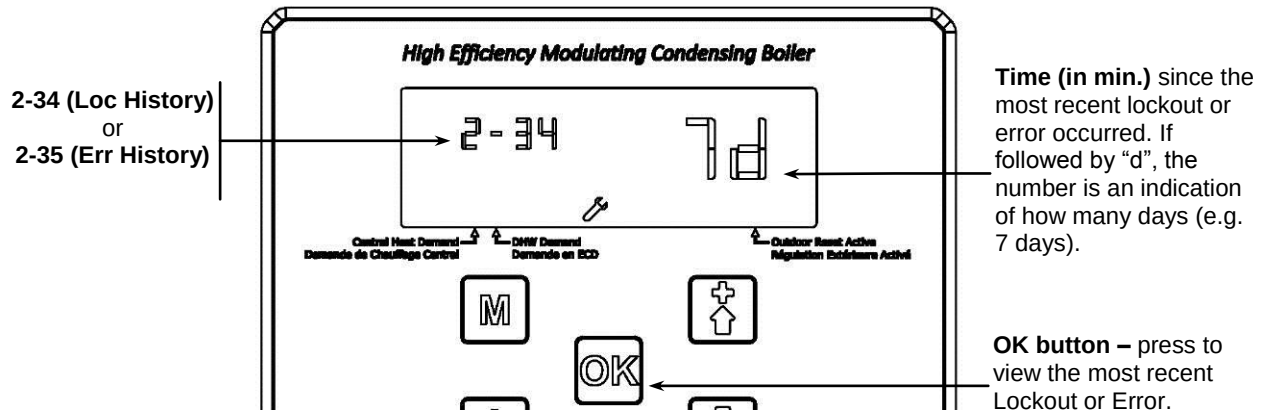


Figure 17-5(b) Lockout and Error History Navigation (Submenu)

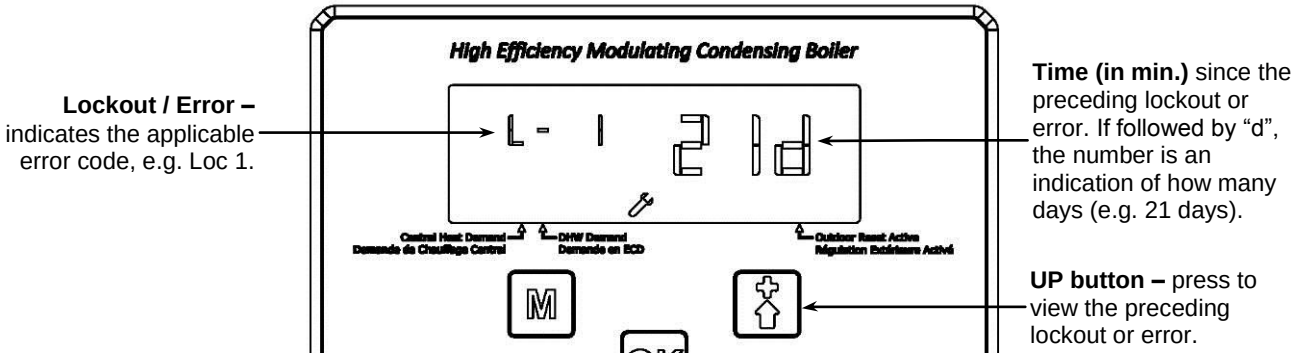
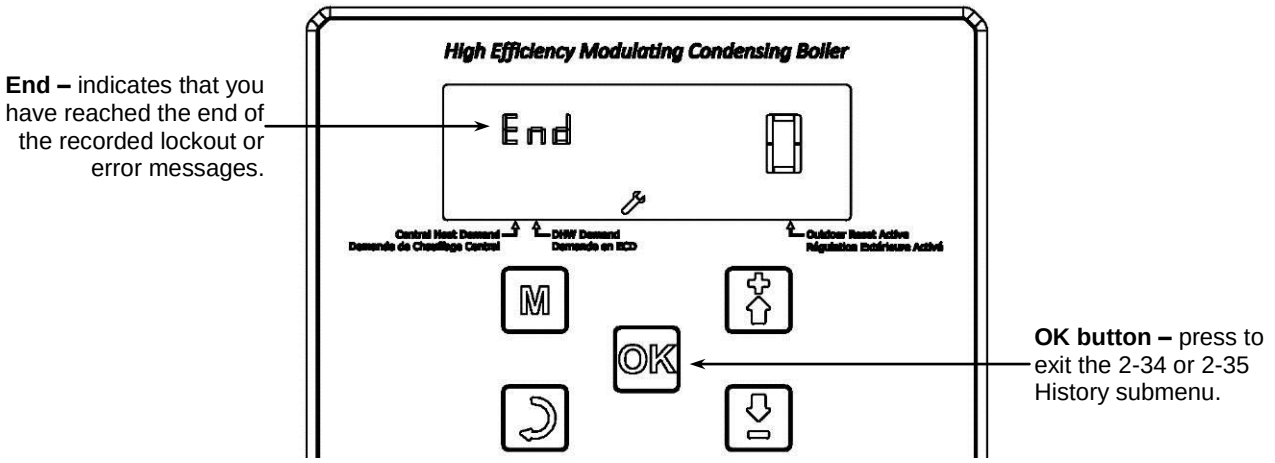


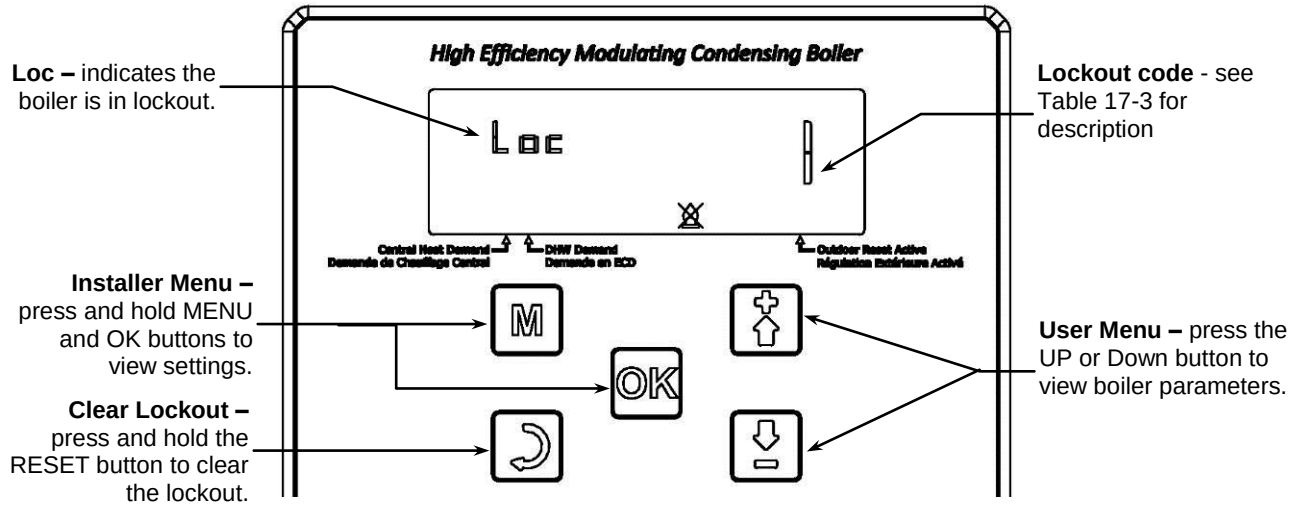
Figure 17-5(c) Lockout and Error History Navigation (End)



Lockouts

A lockout is indicated when "Loc" is displayed at the top-left of the screen; the specific lockout code/number is displayed in large text to the right, see Figure 17-6. Some lockouts (e.g. Loc 1 and 2) are considered "hard lockouts," meaning the lockout cannot be cleared by cycling the power supply off and on; the lockout can only be cleared by pressing and holding the RESET button on the display console. While the boiler is in lockout, the User and Installer Menus are still accessible as before, and may be accessed to identify boiler sensor readings and settings.

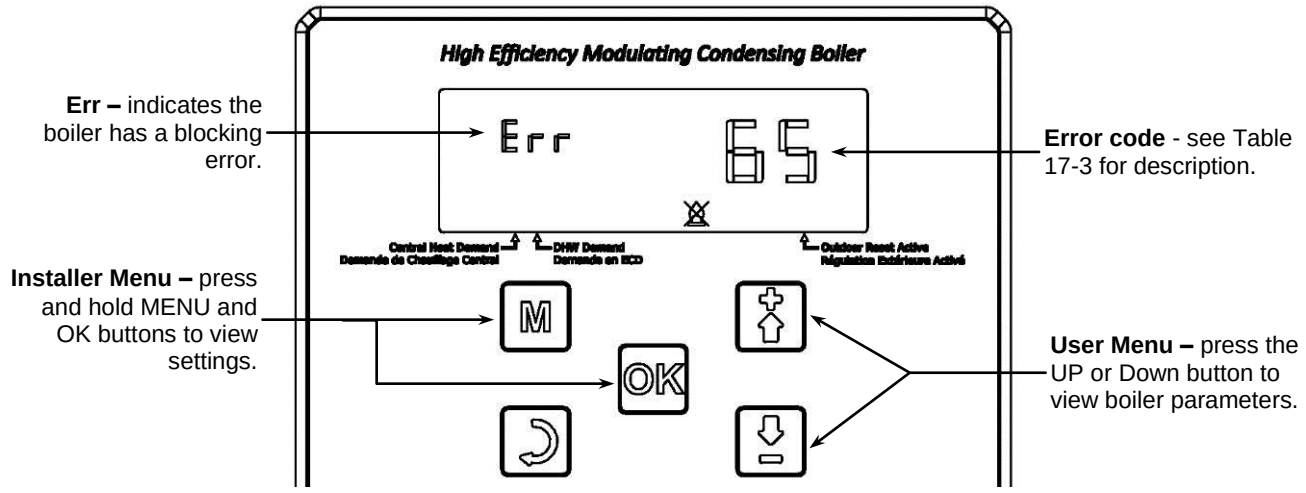
Figure 17-6 Lockout Navigation



Blocking Errors

A blocking error is indicated when "Err" is displayed at the top-left of the screen; the specific error code/number is displayed in large text to the right, see Figure 17-7. Blocking errors are only displayed while a problem exists; during which time the burner is not permitted to operate. To clear a blocking error the problem must be corrected, i.e. the blocking error will not be cleared by cycling the power off and on, or by pressing the RESET button. While the blocking error is display, the User and Installer Menus are still accessible as before, and may be accessed to identify boiler sensor readings and settings.

Figure 17-7 Blocking Error Navigation



Fill – Low Water Pressure

The FTV boiler is equipped with a water pressure sensor located in the return piping inside the boiler cabinet, see Figure 19-1(b & c), item 24 for sensor location; the reading from the sensor is displayed on the Main Screen, see Figure 17-2. If the control senses a pressure below 7 PSI, burner operation is inhibited and "FILL" is displayed on the screen, see Figure 17-8. As long as the water pressure is above 3 PSI the circulators will be permitted to operate; otherwise they are only operated 5 seconds every minute.

Figure 17-8 Fill – Low Water Pressure

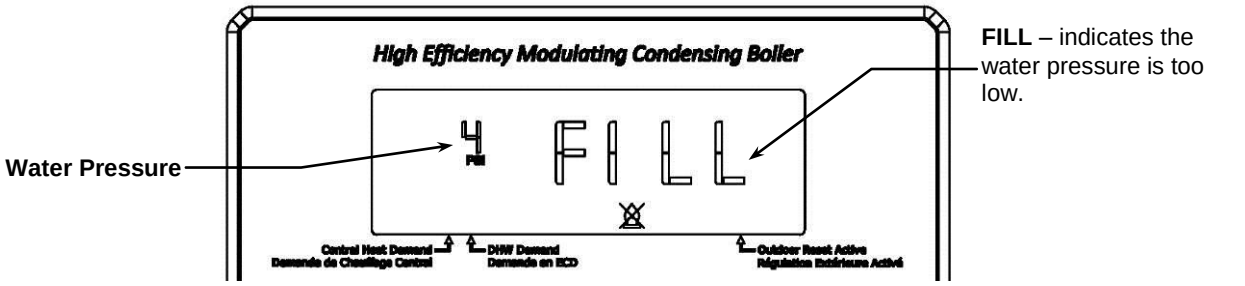


Table 17-3 Lockout and Error Code Descriptions

Code	Description
Loc 0	**E2PROM Error** – if problem persists, replace main control board.
Loc 1	**Ignition Error** – five unsuccessful ignition attempts in a row; perform the following checks: 1. If a new installation, and the burner ignites but immediately goes out, then check polarity of the120VAC power supply. 2. Check venting for blockages. 3. Check condensate trap from proper draining. 4. Static gas pressure – if insufficient check gas supply-lines and regulator. 5. Gas pressure during ignition – if the static gas pressure is sufficient, check pressure during ignition sequence, i.e. when gas valve opens. a. If pressure drops below minimum (4" for NG / 8" for LP), check gas supply-line and regulator. b. If pressure does not move, verify 120VDC at valve during ignition; if no power, check wiring – replace control; if power is present – replace gas valve. c. If pressure drops slightly – proceed to next step 6. Unit ignites but immediately goes out – check flame sensor (clean or replace) and flame sensor cable, clean combustion chamber, replace control. If a combustion analyzer is available, adjust throttle screw out 1 turn – check/adjust combustion once unit is operational. 7. Unit fails to ignite – check spark electrode and cable (replace). Verify the spark electrode is arcing. **WARNING!! – maintain clearance from ignition components while the power is on to avoid risk of severe electrical shock.** 8. Check spark igniter gap – gap between electrodes should be $^{3}/_{16}$ to ¼ inch. 9. Ensure the gas regulator is a minimum of 6' upstream of the gas valve of the boiler. 10. Unit ignites and runs – check combustion at maximum and minimum modulation rates.
Loc 2 - 4	**Gas Valve Circuit Fault (Safety)** – control has sensed a fault in the gas valve electrical circuit, check for a loose connection in the gas valve wiring harness. Also see "Loc 5". **Power Supply Electrical Interference –** see "Loc 6 & 7"
Loc 5	**Limit Circuit Open (Safety)** – control has sensed a fault in the safety limit circuit; check the following: 1. External Limit – if an external limit device (i.e. LWCO) is connected to "EXT. LIM" at field wiring terminals 9 &10, check to ensure it has not tripped, and that it is wired correctly. 2. Bad Electrical Connection in Safety Limit Circuit – check J13 connections at the controller (purple and yellow wires), and EXT. LIM connections at field terminals 9 & 10. **Power Supply Electrical Interference –** see "Loc 6 & 7"
Loc 6 & 7	**Power Supply Electrical Interference –** check for poor line, neutral and ground connections in the wiring leading to the boiler. Check the internal ground connections within the boiler. Eliminate sources of electrical noise, i.e. welders, large pump inverters, etc. If power is being supplied by a generator, install an appropriately sized UPS (Uninterruptible Power Supply). If source of problem cannot be located, replace controller. **Limit Circuit Open (Safety)** – see "Loc 5"
Loc 8-9	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Loc 10	**Supply Sensor Fault** – controller has sensed an invalid reading at the Supply/Outlet sensor; check cable, then replace sensor [see Figure 19-1(a), item 15].
Loc 11	**Uncorrected Blocking Error** – a blocking error (Err) has lasted for 20 consecutive hours.
Loc 12	**Incorrect Fan Speed** – measured fan speed is not reaching target fan speed within 60 seconds – check wiring to fan for loose connections. If fan is not turning on, inspect the inline Blower Fuse – replace if necessary (see Figure 12-1).
Loc 13-24	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Loc 25	**Limit Circuit Open (Safety)** – see "Loc 5". **Power Supply Electrical Interference –** see "Loc 6 & 7" **Outlet Sensor Detected Max Temp Reading** – verify proper water flow through the boiler, test Outlet Sensor and Outlet Sensor cable for short circuit; see "Err 81".
Loc 26	**Flue Sensor Fault** – controller has sensed an invalid reading at the Flue sensor; check cable, then replace sensor [see Figure 19-1(a), item 20].

Code	Description
Loc 27	**Flame present 10 seconds after closing gas valve** – verify flame is going out immediately following the end of a burner demand; check flame sensor (replace); check condensate drain for blockages; increase post purge setting (Installer Menu setting 2-30).
Loc 28	**Flame present before ignition** – check flame sensor (replace); check condensate drain for blockages; increase post purge setting (Installer Menu setting 2-30).
Loc 29-30	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Loc 31	**Flame lost three times during one demand –** see Loc 1.
Loc 32 up	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Err 45-51	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Err 52	**Incorrect Field Wiring –** check electrical connections to field terminal strip; ensure the Thermostat is connected to terminals 7 and 8.
Err 53	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Err 54	**Flame detected out of sequence** – check/replace flame sensor; check flame sensor wiring; check condensate drain for blockages; replace controller. **Water on control board** – if the controller got wet, replace controller.
Err 55-57	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Err 58-59	**Water Pressure Error –** increase system water pressure to a minimum of 12 PSI. If water pressure reading at the external pressure gauge exceeds 15 PSI, inspect water pressure sensor and cable; if water pressure sensor is dirty, gently clean with a calcium/rust remover. If necessary, replace water pressure sensor [see Figure 19-1(b & c), item 24].
Err 60	**Flue Sensor Error –** flue temperature reading had exceeded 205°F; the combustion fan remains operating at minimum modulation rate until the error clears (when flue temperature drops below 153°F). Occurrence of the error suggests that the combustion chamber needs cleaned or the heat exchanger needs descaled. If the error persists after the flue has cooled, temporarily disconnect the electrical connector from the flue sensor; if problem goes away replace flue sensor [see Figure 19-1(a), item 20]; if problem persists, replace the controller [see Figure 19-1(d), item 61].
Err 61	**Return Sensor Error** – inlet temperature exceeded 203°F; error clears when inlet temperature drops below 190°F: (1) ensure there is water flow through the boiler, (2) check for correct return sensor reading (menu reading 1-09), (3) check wiring to return sensor; replace sensor [see Figure 19-1(b & c), item 24].
Err 62-63	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Err 64	**Faulty Grounding** – check appliance grounding to breaker panel, check internal ground connections.
Err 65	**Incorrect Polarity** – controller has sensed reversed polarity of the 120VAC power supply; check field wiring to L2 NEUTRAL (terminals 14 &15) and L1 120VAC (terminal 16). There should be 120VAC potential between L1 120VAC and ground, and 0VAC potential between L2 NEUTRAL and ground.
Err 66	**Incorrect Frequency –** the controller accepts a line voltage frequency of 60Hz ± 2%; if outside this range the controller may be damaged or function incorrectly. If using a generator as a power source, install a UPS (uninterruptible power supply) between the generator and boiler.
Err 67	**Faulty Earth Ground** – check grounding of boiler and power supply; replace controller.
Err 68-71	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Err 72	**Supply Sensor Open** – check wiring to supply sensor; replace sensor [see Figure 19-1(a), item 15].
Err 73	**Supply Sensor Fault** – check wiring to supply sensor; replace sensor [see Figure 19-1(a), item 15].
Err 74-77	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Err 78	**Flue Sensor Open (or Flue Temperature too cold) –** wiring to flue sensor broken/disconnection, flue sensor failure or boiler flue temperature is too low: (1) check wiring to flue sensor, (2) if boiler temperature is really cold, remove flue sensor and warm it with you hand until the boiler fires and warms-up, (3) replace sensor [see Figure 19-1(a), item 20].
Err 79	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Err 80	**Supply Sensor Shorted** – check wiring to supply sensor; replace sensor [see Figure 19-1(a), item 15].
Err 81	**Supply Sensor Shorted** – check wiring to supply sensor; replace sensor [see Figure 19-1(a), item 15].
Err 82-85	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Err 86	**Flue Sensor Shorted** – see Err 60.

Code	Description
Err 87	**Reset Button Error** – controller has sensed that the "Reset" button (see Figure 17.2) is stuck, inspect button, try pressing and releasing it to "unstick" it, if necessary remove plastic overlay from display. Turn power off and on, if problem persists, replace display.
Err 88-92	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Err 93	**Appliance Type –** the appliance type stored in the display does not match the appliance type stored in the controller. Set the appropriate appliance type using the procedure described under "Controller Replacement Instructions"; see page 77.
Err 94 & up	**Controller Malfunction** – contact NTI, check field wiring, replace controller.
Afro	**Anti-Frost –** indicates that the boiler is in Frost Protection. When the controller has sensed a supply or return temperature below 50°F, the Boiler and CH Pumps are switched ON. If the temperature drops below 41°F the burner is started and operates at minimum modulation until both the supply and return temperatures reach 60°F.
Att 2	**Outdoor Sensor Shorted –** controller has sensed a short circuit at the Outdoor sensor; check wiring to terminals 3 and 5 and outdoor sensor.
Att 3	**DHW Sensor Open –** controller has sensed an open circuit at the DHW tank sensor; check wiring to terminals 3 and 6 and tank sensor. If no tank sensor is being used, set DHW Mode (setting 2-08) to the appropriate setting; see Table 17-2.
Att 4	**DHW Sensor Shorted –** controller has sensed a short circuit at the DHW tank sensor; check wiring to terminals 3 and 6 and tank sensor. If no tank sensor is being used, set DHW Mode (setting 2-08) to the appropriate setting; see Table 17-2.
Att 6	**Warm Weather Shutdown (WWSD) Active –** when the outdoor temperature (menu reading 1-08) exceeds the WWSD setting (menu setting 2-04), "Att 6" is displayed during central heat demands, and the boiler only responds to DHW demands. To avoid this error, increase menu setting 2-04. If the indicated temperature reading does not match the actual outdoor temperature, inspect the outdoor sensor wiring. If wiring is fine, disconnect the outdoor sensor, menu reading 1-08 should indicate "OPEn," if not, replace the controller, if "OPEn" is indicated replace the outdoor sensor.
Att 7	**Service Reminder –** occurs every 365 days; service the boiler and clear the warning by adjusting menu setting 2-16 to "OFF".
FILL	**Low Water Pressure** – increase system water pressure to a minimum of 12 PSI. If water pressure reading at the external pressure gauge exceeds 15 PSI, inspect water pressure sensor and cable; if water pressure sensor is dirty, gently clean with a calcium/rust remover. If necessary, replace water pressure sensor [see Figure 19-1(b & c), item 24].

Notes:

[1] While displaying a lockout or blocking error, the User and Installer Menus can be accessed to view the status of boiler sensors and settings.

[2] Blocking errors (Err) and some lockouts (Loc) will not clear until the fault is correct.

[3] Some lockouts (Loc) can only be cleared by holding the RESET button on the display console.

Controller Replacement Instructions

This section provides important information necessary to successfully replace the boiler controller, NTI p/n 84712, in the event the original controller fails. The replacement controller must be field configured to operate on the FTV boiler model it is being installed on. This is achieved by adjusting the controller's Appliance Type setting.

Appliance Type – the Appliance Type setting is retained in the boiler controller; the setting determines certain operating characteristics specific to a particular boiler model, such as combustion blower RPM (i.e. firing rate); see Table 17-4 for a list of Appliance Types and corresponding boiler models.

Table 17-4 Appliance Type Setting by Boiler Model

Model	FTV110 (NG)	FTV150 (NG/LP)	FTV190 (NG/LP)	FTV110C (NG)	FTV150C (NG/LP)	FTV190C (NG/LP)	FTV110 (LP)	FTV110C (LP)
Appliance Number	16	17	18	19	20	21	22	23

Replacement Procedure – the replacement controller is factory set with an Appliance Type setting of zero (0); upon replacement of the control the display will prompt you to set the appliance type, i.e. "*tYPE 0*" will automatically be displayed on the screen (see Notice below). Adjust to the applicable Appliance Type setting (see Table 17-4) using the UP & DOWN buttons; press the OK button to enter the value. Check the appliance setting via Installer Menu setting 2-11; make sure it matches the correct boiler model as per Table 17-4. Set the remainder of the control settings as desired. Verify proper boiler operation for DHW and Central Heat demands.

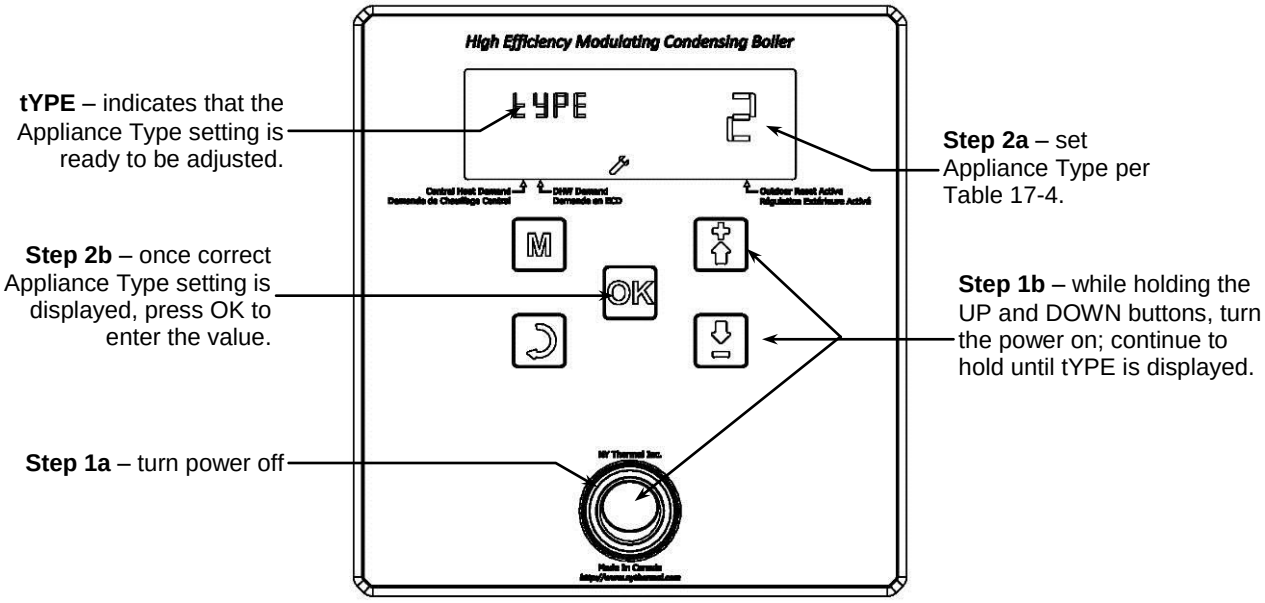
NOTICE

If *"tYPE 0"* does not automatically display upon replacing the controller, the Appliance Type setting must be adjusted using the "Appliance Selection Method" detailed below.

Appliance Selection Method – to change the Appliance Type setting, perform the following steps:

1. Turn the power off; while holding the UP and DOWN buttons, turn the power on using power switch on the display console; see Figure 17-9. Continue holding the UP and DOWN buttons until "*tYPE 0*" is displayed on the screen, then release the UP and DOWN buttons.
2. Increase the setting by press the UP button. When the correct setting is displayed, see Table 17-4; press the OK button to enter the value.
3. Wait for a minimum of 1 minute, then cycle the power off and on.
4. Check the appliance setting via Installer Menu setting 2-11; make sure it matches the correct boiler model as per Table 17-4. Set the remainder of the control settings as desired. Verify proper boiler operation on Domestic Hot Water and Central Heat demands.

Figure 17-9 Appliance Selection



18.0 TROUBLESHOOTING

⚠ WARNING Observe the following precautions when servicing the boiler. Failure to comply with these may result in fire, property damage, serious injury or death.

Servicing the Boiler

- Disconnect or shutoff all energy sources to the boiler: 120VAC power, water and gas.
- Identify and mark wires before disconnecting or removing them.
- Never bypass electrical fuses or limit devices except temporarily for testing.
- Use proper personal protective equipment (PPE) i.e. eye protection, safety footwear.

These procedures should only be performed by qualified service personnel, when abnormal operation of the boiler is suspected. The boiler incorporates a sophisticated microprocessor based control which normally responds appropriately to varying conditions. If the boiler operation appears to be incorrect, or it is not responding at all to a demand for heat, the following is suggested to determine and correct the problem.

NOTICE Before undertaking any troubleshooting procedures it is highly recommended to have available a digital multimeter (s) capable of measuring AC and DC volts, Amperes, Resistance (Ohms) and Continuity.

Diagnosing an Inoperative Boiler

1) **Blank Display** – perform the following steps:

- Ensure the boiler service switch located on the front of the boiler is in the ON (1) position.
- Ensure the main service switch (if applicable) is in the ON position.
- Ensure the circuit breaker in the electrical panel supplying power to the boiler in on.
- Measure across boiler terminals 16 and 15 (L1 120VAC and L2 NEUTRAL) for 120VAC, see Figure 12-2. If 120VAC is present, check fuse located on the boiler controller, see Figure 12-1. If 120VAC is not present, check wiring between the boiler and electrical panel for poor connections.
- Check the electrical connection to the display – connector is located behind display.

⚠ WARNING Only replace FTV controller fuse with identical part (3.15A, 250V Slo-Blo®). Failure to follow this warning may result in component failure or property damage.

2) **Display Normal but no heat to radiators** – perform the following steps:

- Ensure there is a heat call from the thermostat (radiator symbol on the display will flash during a thermostat demand). If uncertain about thermostat operation, place a jumper between the boiler's Thermostat terminals. If the radiator symbol does not display, check outdoor sensor reading (User Menu reading 1-08), and compare to the warm weather shutdown setting (Installer Menu setting 2-04); central heat call will not activate if the outdoor temperature is above the warm weather shutdown setting.
- If the radiator symbol is flashing, but the boiler is not firing, compare the boiler outlet temperature (temperature displayed on the main screen) with the *Current target temp* (User Menu reading 1-01). Boiler will not fire until the outlet temperature drops below the *Current target temp* by the *CH setpoint differential* (Installer Menu setting 2-02 – default setting = 11ºF).
  - Ensure the central heating pump(s) is running – if not ensure it is wired to pump output CH PUMP or BOILER PUMP.
  - If *Current target temp* is insufficient, increase *CH setpoints* (Installer Menu settings 2-01 and 2-05).
- If the radiator symbol is on but not flashing, and the faucet symbol is flashing, then the boiler is actively servicing a DHW demand; at which time no hot water will go to the radiators. If condition continues, consider increasing the *DHW setpoint* (Installer Menu setting 2-07), or decreasing the *DHW priority time* (Installer Menu setting 2-09).

3) **Display Normal but no DHW** – perform the following steps:

- FTV Combi:
  - Verify DHW Mode is set to 5 (Installer Menu setting 2-08).
  - Verify there is DHW flow – check *DHW flow rate* (User Menu reading 1-05); boiler goes to DHW mode when the flow exceeds 0.3gpm. If flow is insufficient, check water supply and DHW piping; check Y-strainer for blockage. Check wiring to flow sensor – replace flow sensor if necessary.
  - Compare *DHW setpoint* (User Menu reading 1-04) with *DHW temp* (User Menu reading 1-03); burner fires immediately if the flow exceeds 0.3gpm. If necessary increase *DHW setpoint* (Installer Menu setting 2-07) – 120 to 140ºF recommended.
  - If the radiator symbol is flashing on the display, the *DHW priority time* may have expired. Cycle power and consider increasing the *DHW priority time* (Installer Menu setting 2-09).
- Indirect Tank with Tank Sensor:
  - Verify DHW Mode is set to 1 (Installer Menu setting 2-08).
  - Verify there is a Tank sensor wired to COMMON and DHW (boiler terminals 3 and 6), see Figure 12-2. Tank sensor temperature, *DHW temp*, is viewed from User Menu reading 1-03.
  - Compare *DHW setpoint* (User Menu reading 1-04) with the *DHW temp* (User Menu reading 1-03). DHW Tank demand is generated when the *DHW temp* drops 4ºF below the *DHW setpoint*; after which burner demand starts when the boiler outlet temperature (displayed on Main Screen) drops below the *Current target temp* (User Menu reading 1-01) by 15ºF. *Current target temp* for a DHW Tank demand is equal to *DHW setpoin*t + 40ºF; if necessary increase *DHW setpoint* (Installer Menu setting 2-07) – 130 to 140ºF recommended.
  - If the radiator symbol is flashing on the display, the *DHW priority time* may have expired. Cycle power and consider increasing the *DHW priority time* (Installer Menu setting 2-09) and/or *DHW setpoint* (Installer Menu setting 2-07).
  - If the faucet symbol is flashing on the display, verify the DHW circulator is operating – DHW circulator should be wired to DHW PUMP and L2 NEUTRAL (boiler terminals 9 and 12/13); see Figure 12-2.
  - Verify plumbing is in accordance with Figure 10-4 or 10-4.
- Indirect Tank with Tank Thermostat:
  - Verify DHW Mode is set to 2 (Installer Menu setting 2-08).
  - Verify there is a Tank thermostat wired to COMMON and DHW (boiler terminals 3 and 6), see Figure 12-2.
  - Verify there is a demand from the thermostat; when the demand is on, *DHW temp* (User Menu reading 1-03) will indicate "CLOS" (or 242ºF/117ºC); when demand is off, *DHW temp* will indicate "OPEn" (or 14ºF/-10ºC). If uncertain about thermostat operation, place a jumper between terminals 3 and 6; the faucet symbol will flash on display when there is a DHW demand.
  - Compare *DHW setpoint* (User Menu reading 1-04) with the boiler outlet temperature (displayed on Main Screen); burner demand starts with the boiler outlet temperature drops below the *DHW setpoint* by 15ºF. If necessary increase *DHW setpoint* (Installer Menu setting 2-07) – 160 to 190ºF recommended.
  - If the radiator symbol is flashing on the display, the *DHW priority time* may have expired. Cycle power and consider increasing the *DHW priority time* (Installer Menu setting 2-09) and/or *DHW setpoint* (Installer Menu setting 2-07).
  - If the faucet symbol is flashing on the display, verify the DHW circulator is operating – DHW circulator should be wired to DHW PUMP and L2 NEUTRAL (boiler terminals 9 and 12/13); see Figure 12-2.
  - Verify plumbing is in accordance with Figure 10-4 or 10-4.

4) **Display Normal but DHW is not hot enough** – perform the following steps:

- Increase *DHW setpoint* (Installer menu setting 2-07):
  - FTV Combi (DHW Mode = 5) – recommended setting = 120 to 140ºF.
  - Indirect Tank with Tank Sensor (DHW Mode = 1) – recommended setting = 130 to 140ºF.
  - Indirect Tank with Tank Thermostat (DHW Mode = 2) – recommended setting = 160 to190ºF.
- FTV Combi – DHW flow rate is too great; report *DHW flow rate* (User Menu reading 1-05) to NTI. If necessary, restrict overall DHW flow rate.
- Indirect Tank – verify plumbing is in accordance with Figure 10-6 or 10-7.

5) **Display indicates an error (Err), lockout (Loc) or warning (Att);** reference Table 17-3 in Section 17.0.

Table 18-1 Thermistor Resistance vs. Temperature

Temp °F (°C)	Resistance Ohms (Ω)	Temp °F (°C)	Resistance Ohms (Ω)
-22 (-30)	176,133	122 (50)	3,603
-4 (-20)	96,761	131 (55)	2,986
14 (-10)	55,218	140 (60)	2,488
32 (0)	32,650	149 (65)	2,083
41 (5)	25,390	158 (70)	1,752
50 (10)	19,900	167 (75)	1,481
59 (15)	15,710	176 (80)	1,258
68 (20)	12,490	185 (85)	1,072
77 (25)	10,000	194 (90)	918
86 (30)	8,057	203 (95)	789
95 (35)	6,531	212 (100)	680
104 (40)	5,327	230 (110)	506
113 (45)	4,369	-	-

* Not applicable for Return Sensor, p/n 84745

19.0 PARTS LIST

For a list of parts that corresponds to the item numbers in the callouts, refer to Table 19-1. Note that some item numbers may appear more than once in the parts list depending on which model number is being referenced.

Building Owners - Replacement parts are available from your stocking wholesaler. Contact your local Installer or Wholesaler for assistance with parts.

Wholesalers - Contact NY Thermal Inc. directly when ordering replacement parts, 1-506-657-6000.

Installers - Contact NY Thermal Inc. directly if technical assistance required, 1-800-688-2575.

Figure 19-1(a) Cabinet & Controls

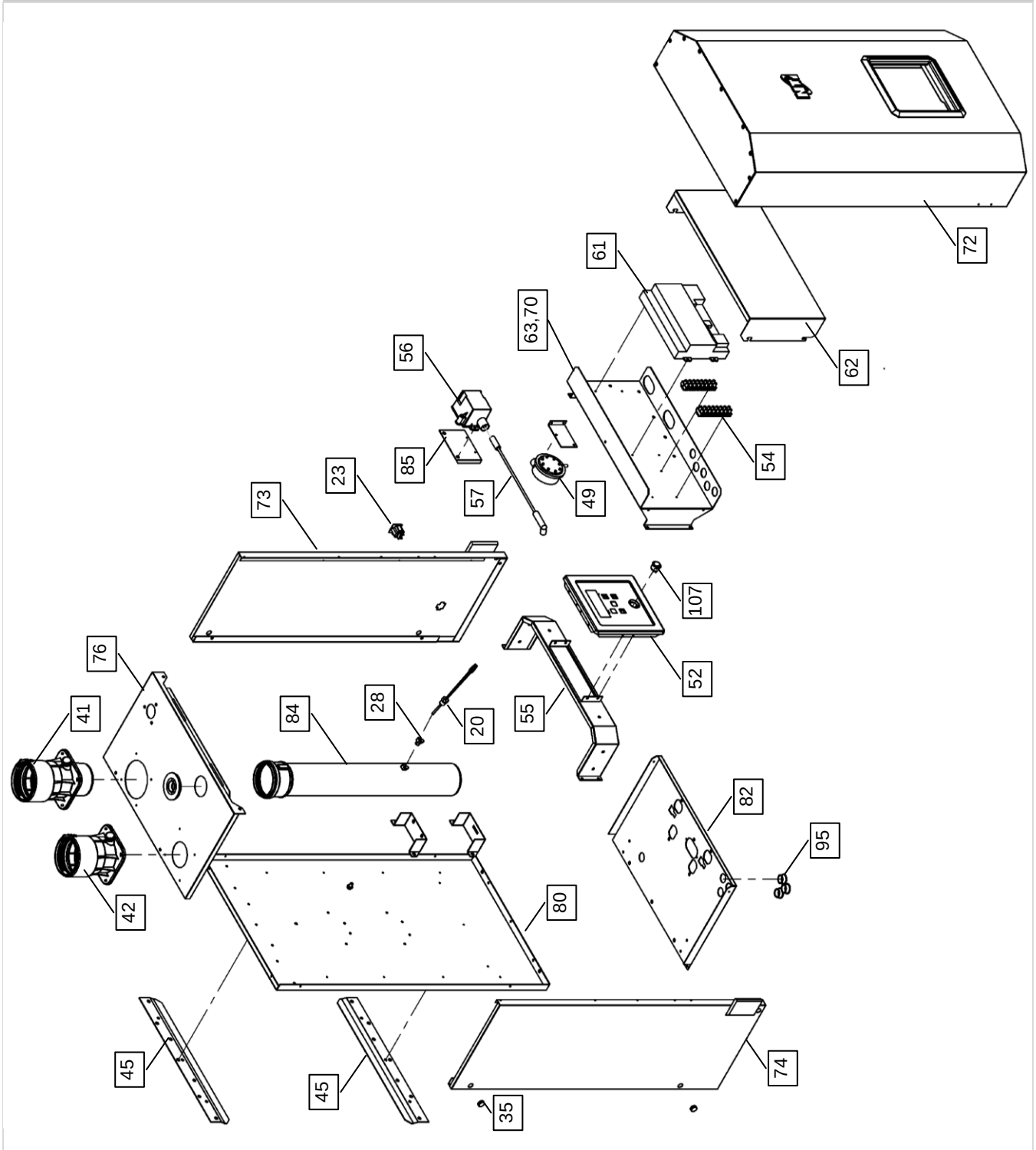


Figure 19-1(b) Heat Exchanger, Water Piping & Sensors (FTV110C, FTV150C, FTV190C)

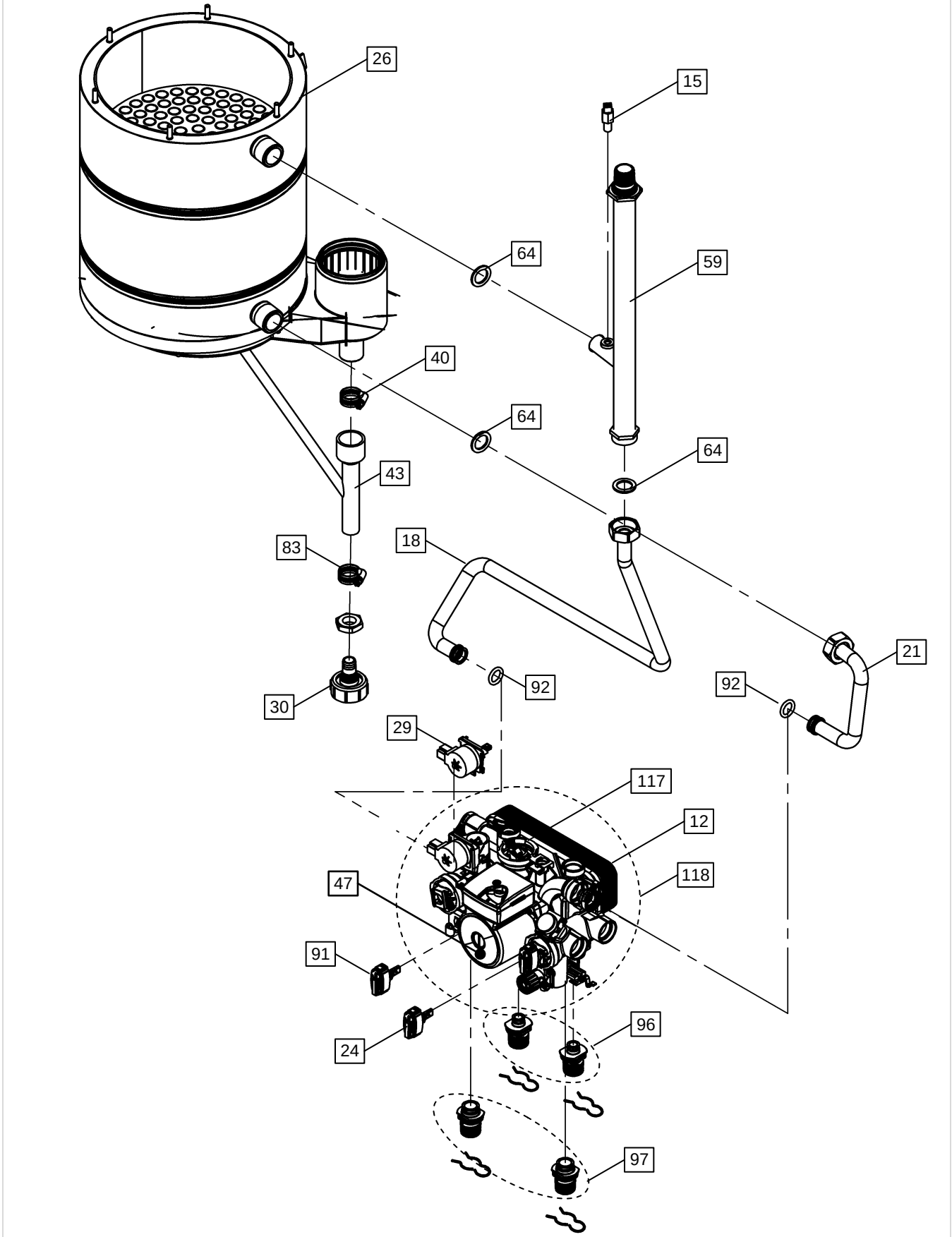


Figure 19-1(c) Heat Exchanger, Water Piping & Sensors (FTV110, FTV150, FTV190)

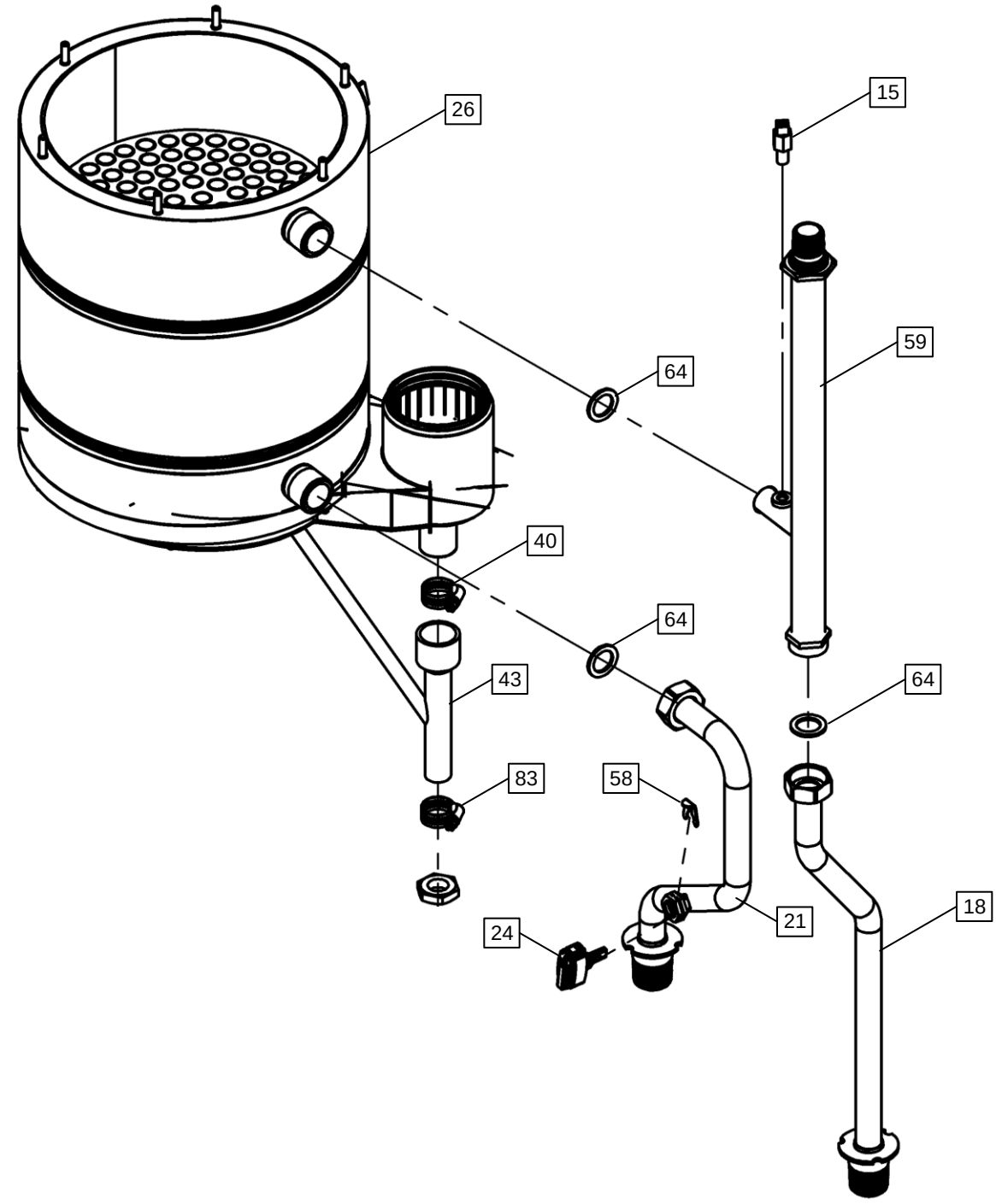


Figure 19-1(d) Gas Train / Burner Assembly (All FTV)

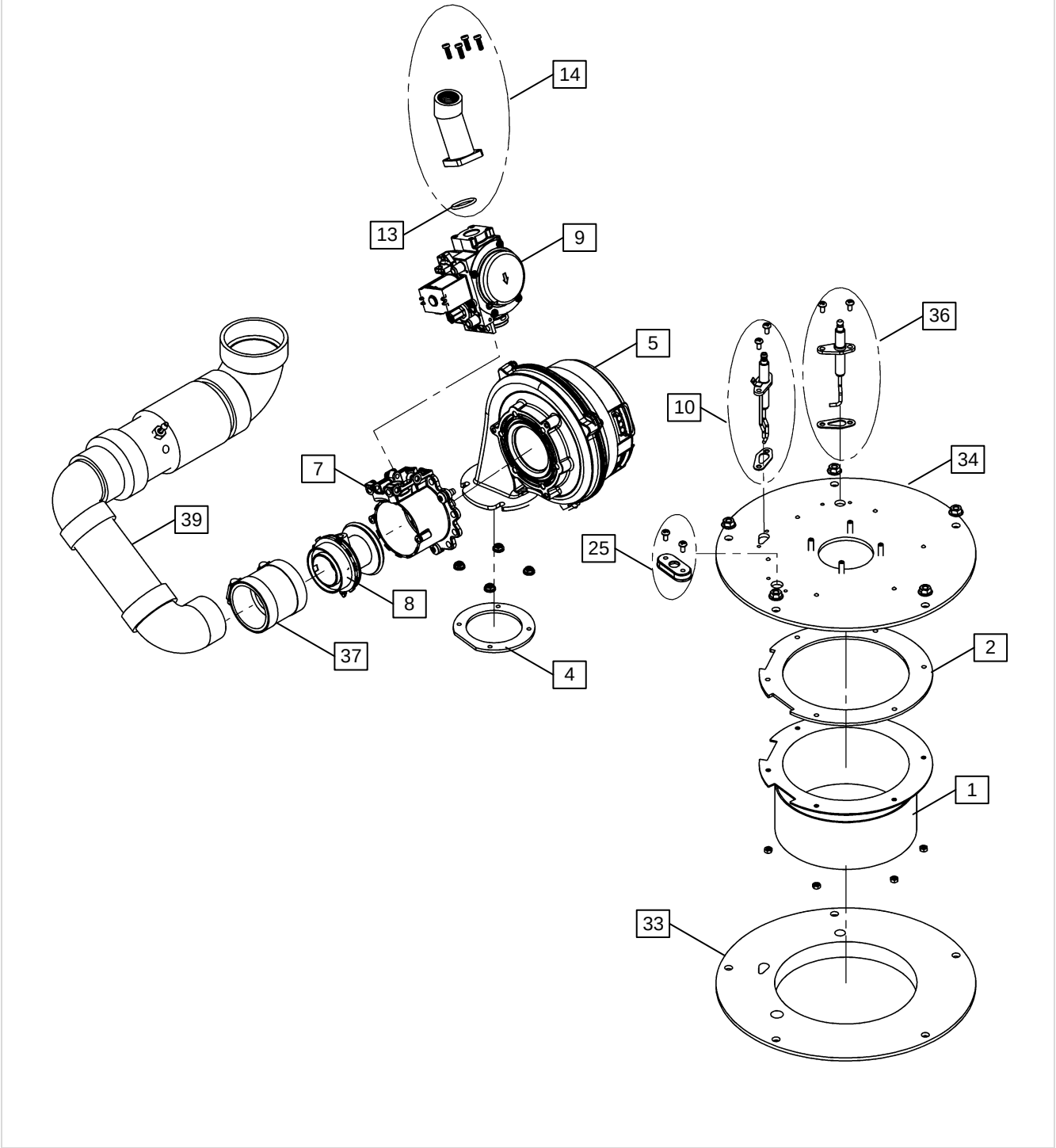


Figure 19-1(e) Installation Kit Box (All FTV)

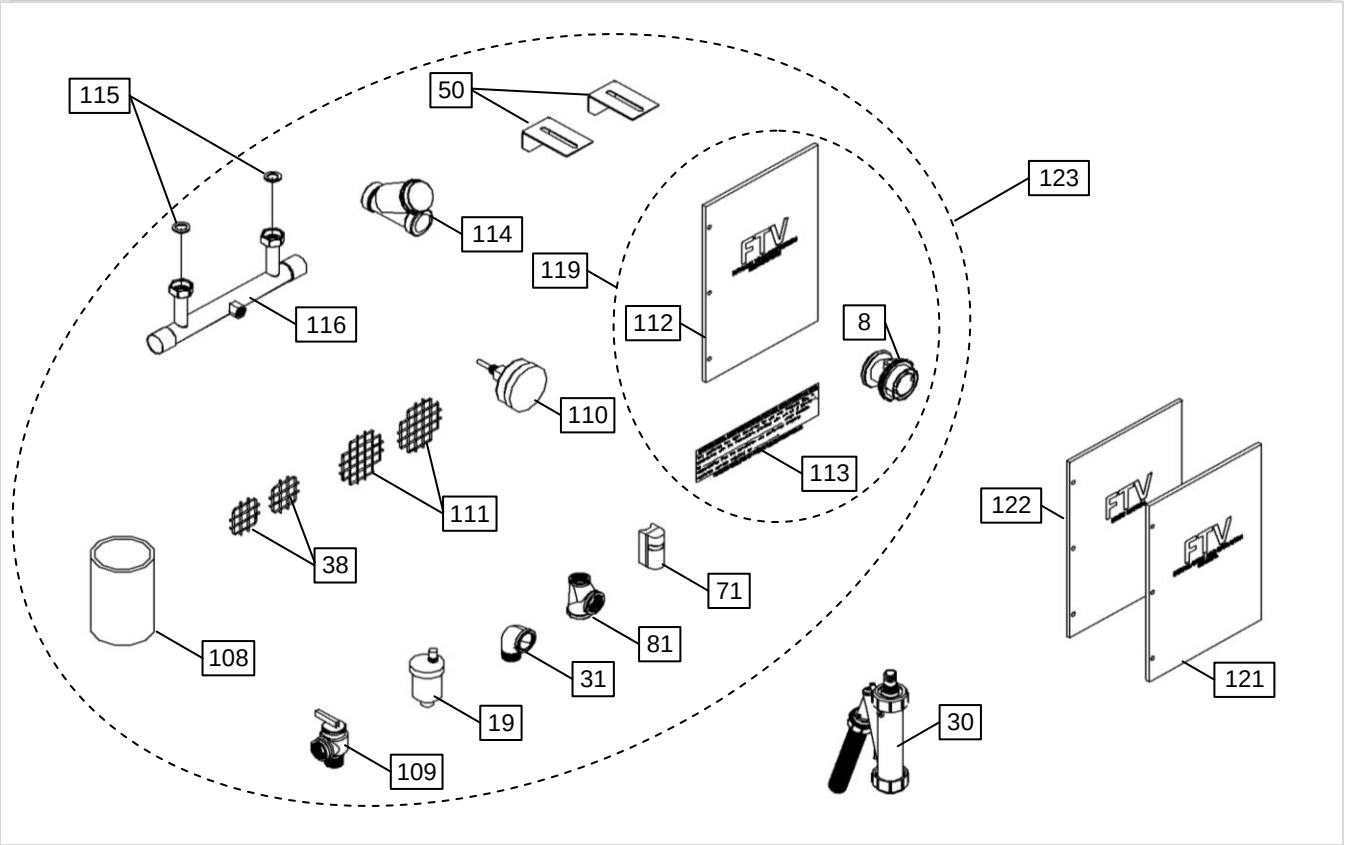


Table 19-1 Parts List: FTV Series

Item	Part #	Model	Description
1	85947	FTV110, FTV110C	Premix Burner
1	85948	FTV150, FTV150C, FTV190, FTV190C	Premix Burner
2	85953	FTV110, FTV110C	Premix Burner Gasket
2	85955	FTV150, FTV150C, FTV190, FTV190C	Premix Burner Gasket
4	84441	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Blower Gasket
5	85379	FTV110, FTV110C, FTV150, FTV150C	Blower/Venturi/Gas_Valve Assembly
5	85809	FTV190, FTV190C	Blower/Venturi/Gas_Valve Assembly
5	85460	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Blower, w/o Venturi & Gas Valve
6	86091	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	O-ring Seal, Venturi to Blower
7	85461	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Venturi Housing (w/o Venturi Insert)
8	85989	FTV110, FTV110C	LP - Venturi Insert (27453 39741)
8	85536	FTV150, FTV150C	LP - Venturi Insert (27453 39669)
8	85812	FTV190, FTV190C	LP - Venturi Insert (27453 39676)
8	85537	FTV110, FTV110C, FTV150, FTV150C	NG - Venturi Insert

Item	Part #	Model	Description
8	86117	FTV190, FTV190C	NG - Venturi Insert
9	84713	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Gas Valve
10	85818-1	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Ignition Electrode, Dual (c/w gasket), gap = 3/16 to 1/4 inch
12	84914	FTV110C, FTV150C, FTV190C	Brazed Plate Heat Exchanger
13	85112	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Gas Valve Inlet O-Ring Gasket
14	85108	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Gas Valve Adapter ½" NPT (c/w screws & O-ring)
15	84419	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Outlet Sensor (Dual)
18	85739	FTV110, FTV150, FTV190	Supply Pipe, FTV non-combi
18	85741	FTV110C, FTV150C, FTV190C	Outlet Pipe to Hydroblock
19	84474	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Auto Air Vent, ½" NPT
20	83608	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Flue Sensor, Dual
21	85738	FTV110, FTV150, FTV190	Return Pipe, FTV non-combi
21	85740	FTV110C, FTV150C, FTV190C	Return Pipe, from Hydroblock
23	84423	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Receptacle, 120VAC
24	84745	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Inlet Temperature/Pressure Sensor
25	84546	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Sight Glass Assembly
26	85792	FTV110, FTV110C	Heat Exchanger ASME
26	85793	FTV150, FTV150C	Heat Exchanger ASME
26	85794	FTV190, FTV190C	Heat Exchanger ASME
28	85208	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Flue Sensor Grommet
29	84915	FTV110C, FTV150C, FTV190C	Diverter Valve Stepper Motor
30	83510	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Condensate Trap

Item	Part #	Model	Description
31	84479	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Elbow, Brass, Street 90, ¾”
33	85954	FTV110, FTV110C	Burner Plate Insulation & Gasket
33	85956	FTV150, FTV150C	Burner Plate Insulation & Gasket
33	85957	FTV190, FTV190C	Burner Plate Insulation & Gasket
34	85950	FTV110, FTV110C	Burner Plate
34	85951	FTV150, FTV150C	Burner Plate
34	85952	FTV190, FTV190C	Burnter Plate
35	84214	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Grommet, Diaphragm, ½”
36	85819	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Flame Sensor
37	82099	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	MJ Coupling, 1-1/2”
38	82615	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Round Mesh Vent Screen, 2”
39	85948-1	FTV110, FTV110C	Air-inlet Assembly, FTV110/C
39	85949-1	FTV150, FTV150C, FTV190, FTV190C	Air-inlet Assembly, FTV150-190/C
40	83718	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Hose Clamp, 1-1/16 to 1-1/2”
41	85132	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Flue Outlet Adapter PP 3”
42	85133	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Air-inlet Adapter PP 3”
43	85826	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Condensate Drain Adapter Tube
45	TBD	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Wall Mounting Bracket Top, VM110
47	84917	FTV110C, FTV150C, FTV190C	Circulator Cartridge, UPS15-78
49	85163	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Blocked Condensate Drain / Blocked Vent Switch
50	TBD	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Bottom Wall Mounting Bracket Set
52	86002-1	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Display Assembly, 210LB…6R
54	84476	FTV110, FTV110C, FTV150, FTV150C,	Terminal, Barrier Double Row, 8 Position

Item	Part #	Model	Description
		FTV190, FTV190C	
55	TBD	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Control Panel Support, FTV
56	85054-1	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Ignition Coil 4180002F
57	85055	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Spark Igniter Cable 12”
58	84803	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Pressure & Flow Sensor Retaining Clip
59	85737	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Outlet Manifold, FTV
61	86129	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Ignition Controller, 210MN_FTV
62	TBD	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Control Panel Cover
63	TBD	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Control Panel, Complete, w/o controller
64	85167	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Gasket
67	84918	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Fuse, LFT 3.15, 250V
70	TBD	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Control Panel, Sheet Metal Only
71	83604	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Outdoor Sensor
72	TBD	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Front Cover, FTV
73	TBD	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Right Side, FTV
74	TBD	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Left Side, FTV
76	TBD	FTV110, FTV110C	Top, FTV110/C
76	TBD	FTV150, FTV150C	Top, FTV150/C
76	TBD	FTV190, FTV190C	Top, FTV190/C
77	TBD	FTV110, FTV110C	Bottom Heat Exchanger Support, FTV110/C
77	TBD	FTV150, FTV150C	Bottom Heat Exchanger Support, FTV150/C
77	TBD	FTV190, FTV190C	Bottom Heat Exchanger Support, FTV190/C
78	TBD	FTV110, FTV110C	Top Heat Exchanger Support, FTV110/C

Item	Part #	Model	Description
78	TBD	FTV150, FTV150C	Top Heat Exchanger Support, FTV150/C
78	TBD	FTV190, FTV190C	Top Heat Exchanger Support, FTV190/C
79	84919	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Gas Valve to Venturi Gasket
80	TBD	FTV110, FTV110C	Back, FTV110/C
80	TBD	FTV150, FTV150C, FTV190, FTV190C	Back, FTV150/C, 190/C
81	85116	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Tee, Brass, ¾ x ½ x ¾”
82	TBD	FTV110	Bottom, FTV110
82	TBD	FTV110C	Bottom, FTV110C
82	TBD	FTV150	Bottom, FTV150
82	TBD	FTV150C	Bottom, FTV150C
82	TBD	FTV190	Bottom, FTV190
82	TBD	FTV190C	Bottom, FTV190C
83	83135	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Hose Clamp, 9/16 to 1-1/16”
84	85817	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Flue Outlet Pipe, 80mm PP
85	TBD	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Spark Generator Support Bracket
91	84907	FTV110C, FTV150C, FTV190C	DHW Temperature/Flow Sensor, VFS
92	84749	FTV110C, FTV150C, FTV190C	O-ring (large), Hydroblock Inlet/Outlet, 4 x 17 mm
93	84921	FTV110C, FTV150C, FTV190C	Retaining Clips, Hydroblock Inlet/Outlet
95	84095	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Plug, 7/8” Black Dome
96	84922	FTV110C, FTV150C	DHW Fitting Set, ¾” NPT, c/w O-rings
96	85126	FTV190C	DHW Fitting Set, ¾” NPT, c/w O-rings
97	84923	FTV110C, FTV150C, FTV190C	CH Fittings, IWC, ¾” NPT
107	84422	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Rocker Power Switch, On/Off
108	83991	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	CPVC Pipe 3”, System 636, 5” Long
109	13701	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Pressure Relief Valve, ASME, ¾” NPT, 30 PSI (Boiler)
110	85295	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Pressure & Temperature Gauge
111	82616	FTV110, FTV110C, FTV150, FTV150C,	Round Mesh Vent Screen, 3”

Item	Part #	Model	Description
		FTV190, FTV190C	
112	85996	FTV110, FTV110C	Natural Gas to LP Conversion Instructions
112	85451	FTV150, FTV150C	Natural Gas to LP Conversion Instructions
112	85935	FTV190, FTV190C	Natural Gas to LP Conversion Instructions
113	85995	FTV110, FTV110C	LP Conversion Decal
113	85446	FTV150, FTV150C	LP Conversion Decal
113	85934	FTV190, FTV190C	LP Conversion Decal
114	83645	FTV110C, FTV150C, FTV190C	Y-Strainer, Brass, ¾", 100M Screen
115	82368	FTV110C, FTV150C, FTV190C	Compression Gasket, Rubber
116	85110	FTV110C, FTV150C, FTV190C	Low Loss Header Pipe
117	85294	FTV110C, FTV150C, FTV190C	Auto Air Vent – Hydroblock
118	84744	FTV110C, FTV150C, FTV190C	IWC – Integrated Water Control
119	85995-1	FTV110, FTV110C	NG to LP Conversion Kit
119	85446-1	FTV150, FTV150C	NG to LP Conversion Kit
119	85934-1	FTV190, FTV190C	NG to LP Conversion Kit
121	85939	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	Installation and Operation Manual, FTV
122	84491	FTV110, FTV110C, FTV150, FTV150C, FTV190, FTV190C	User Information Manual
123	86119	FTV110	FTV110 Kit Box
123	86120	FTV110C	FTV110C Kit Box
123	86121	FTV150	FTV150 Kit Box
123	86122	FTV150C	FTV150C Kit Box
123	86123	FTV190	FTV190 Kit Box
123	86124	FTV190C	FTV190C Kit Box

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