FTG Firetube Giant Boiler

Models: FTG 600 through FTG 2400
Version Date: 2020-02-27

INSTALLATION AND OPERATION MANUAL

TABLE OF CONTENTS

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 FTG 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 FTG boiler models FTG 600, FTG 800, FTG 1200, FTG 1400, FTG 2000, FTG 2200 and FTG 2400. 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. Appendix A – Controller and Touchscreen Display Instructions,
3. FTG Users' Manual, and
4. Natural Gas to LP Conversion Kit*

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

Read and understand this entire document prior to proceeding with the installation of the FTG boiler. Failure to follow the instructions outlined in this document will result in property damage, serious injury or death.

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 15.0 – Annual Maintenance and Inspection).

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.

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

FTG 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; each kit comes with conversion instructions. Failure to properly convert the unit to safely operate with Propane will cause severe boiler failure, 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 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	Kit Part Number	LP-Orifice
FTG 600-1400	**85418-1**	**N/A**
FTG 2000-2400	**85758-1**	**N/A**

Exhaust Vent / Air-Inlet Piping

⚠ DANGER

The FTG is certified as a "Category IV" boiler, and requires 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 General Specifications

DESCRIPTION	FTG 600	FTG 800	FTG 1200	FTG 1400	FTG 2000	FTG 2200	FTG 2400
Gas Connection (inches, NPT)	1		1-1/4		1-1/2		
Water Inlet (inches, groove-joint)	3						
Water Outlet (inches, groove-joint)	2		3				
Exhaust Vent Connection (inches)	6		8				
Air-inlet Connection (inches)	6		8				
Overall Height (inches)	68-1/2		64-3/8				
Overall Width (inches)	33-7/8						
Overall Depth (inches)	38-3/8		54		70		
Approximate Weight with water (lb.)	930		1500		2140		
Water Content (gallons)	17		34		51		
Electrical Rating	120V / 1Ph / 60Hz / less than 12A				(Note 1)	(Note 2)	(Note 3)

Notes:
[1] FTG 2000 electrical rating is 120V / 1Ph / 60Hz / less than 16A.
[2] FTG 2200 electrical rating is 208V / 3Ph / 60Hz / less than 16A.
[3] FTG 2400 electrical rating is 240V / 3Ph / 60Hz / less than 16A.

Table 2-2 Boiler Performance Specifications

DESCRIPTION	FTG 600	FTG 800	FTG 1200	FTG 1400	FTG 2000	FTG 2200	FTG 2400
CSA Input Modulation (MBH)[1]	80 - 600	80 - 800	120-1200	140-1400	235-2000	235-2200	235-2350
DOE Heating Capacity (MBH)[1,2]	576	760	1153	1344	1920	2103	2237
Net I=B=R Rating (MBH)[1,2]	500	660	1003	1169	1670	1829	1945
Combustion Efficiency (%)[2]	97	96	96.2	96	96.1	95.7	95.3
Thermal Efficiency (%)[2]	96	95	96.1	96	96	95.6	95.2

Notes:
[1] Listed Input and Output ratings are at Sea Level. Numbers will be lower with altitudes greater than 2000 feet.
[2] Based on standard test procedures prescribed by the U.S. Department of Energy. Ratings have been confirmed by AHRI.

High Altitude Operation

The FTG 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 2-3.

Table 2-3 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].

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 Installers responsibility 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 FTG 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.

Floor Mounting

The FTG boiler can be mounted directly on combustible flooring, with the exception of carpeting. Installing the boiler on carpeting is not permissible. Ensure the boiler is mounted above any anticipated flood level. Units include factory supplied/field installed leveling legs. Once the unit is removed from the pallet, thread the leveling legs into the allocated threaded inserts in the bottom of the unit.

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 365 ft^3 or greater (275 ft^3 for models FTG 600-800; 320 ft^3 for models FTG 1200-1400), 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 365 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 4-4 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.

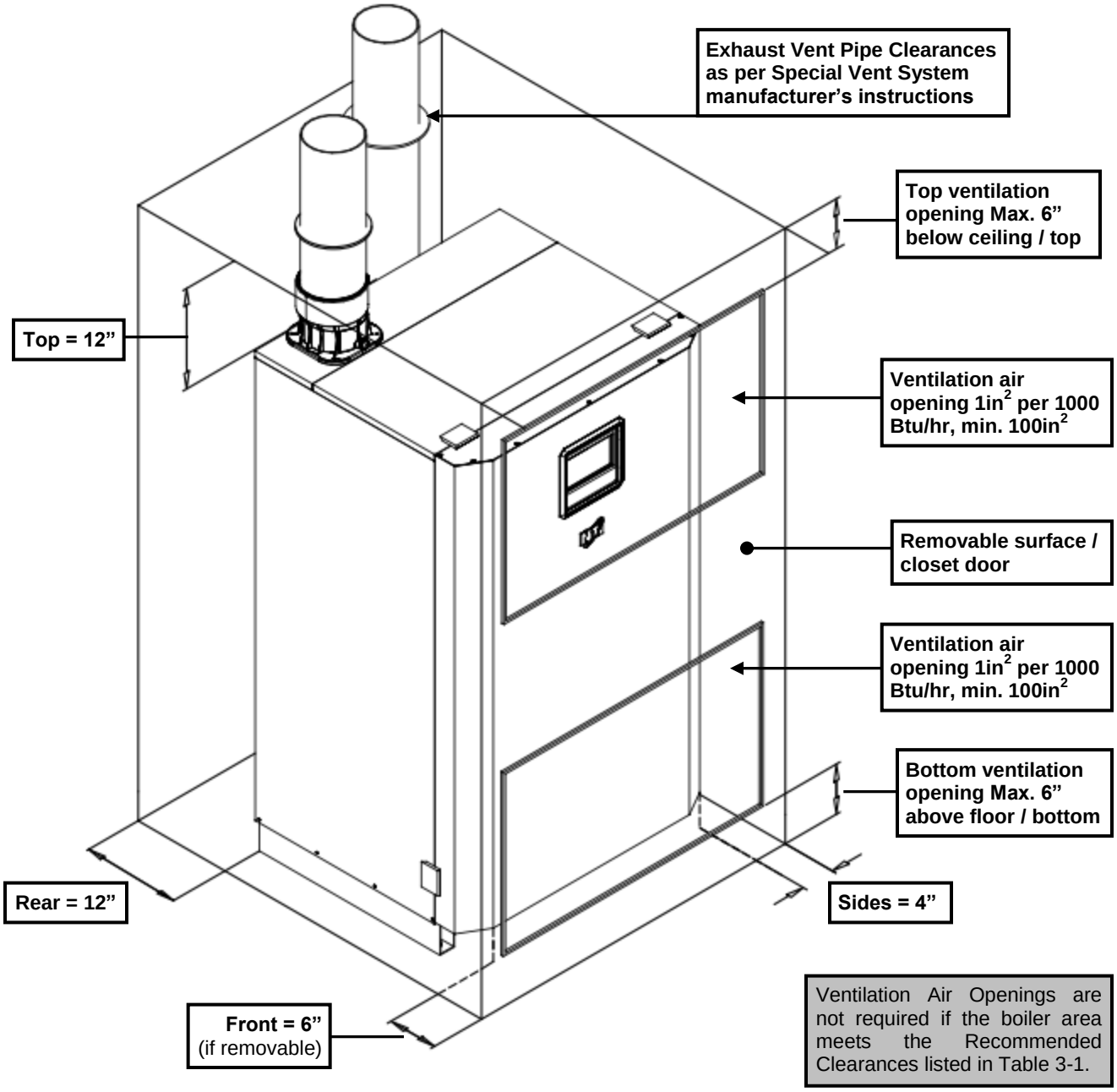
Table 3-1 Minimum Clearances for Installation and Service

Clearances	Dimensions - inches				
	Front	Top	Sides	Rear [3]	Flue Pipe
Minimum	24 [1]	12	4	12	1
Recommended	36	24	24 [2]	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.
[2] Recommend allowing 24" clearance on at least one side for servicing, clearance on opposite side can be as little as 4".
[3] Notice: the rear of the boiler must be accessible for installation and service.

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

Figure 3-1 Closet Installation, Minimum Clearances



4.0 GENERAL VENTING

The FTG boiler 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 FTG boiler cannot share a common vent or air-inlet with multiple boilers. Failure to comply will result in serious injury or death.

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 Transformer.

⚠ 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 a complete trial for ignition, consisting of pre and post purge of the combustion blower, until an ignition lockout occurs.
6) Turn power off and reconnect the cable to the Spark Ignition Electrode and Ignition Transformer.

Near Boiler Vent/Air-inlet Piping

Exhaust-vent Connector – the FTG exhaust-vent connector is designed to accept single-wall FasNSeal® Stainless Steel (SS) Special Gas Venting. To use other types of venting, the appropriate adaptor must be inserted into the boiler exhaust-vent connector; see Table 4-4 for a list of approved venting materials and Table 4-3 for a list of approved boiler exhaust-vent adaptors.

⚠ WARNING Failure to use the appropriate exhaust-vent adaptor for the type of venting being used, will lead to flue gas leakage possibly resulting in property damage, Carbon Monoxide poisoning or death.

Air-inlet Connector (FTG 600-800) – the FTG 600 & 800 employ a universal air-inlet connector that accepts DuraVent's 6 in. PolyPro® Polypropylene (PP) or FasNSeal® Stainless Steel (SS) pipe, as well as 6 in. PVC/CPVC/ABS pipe, without the need for additional adapters. The universal connector incorporates three seals, one for 6 in. PVC/CPVC/ABS pipe (6.625 in. OD), one for 6 in. PolyPro® PP pipe (5.94 in. OD) and one for 6 in. FasNSeal® SS pipe (6 in. OD).

Air-inlet Connector (FTG 1200-2400) – the FTG 1200 through 2400 employ an 8 in. rubber coupling that directly accepts most 8 in. diameter air-inlet pipe material.

PVC Exhaust Venting – When exhaust venting with PVC, insert a length of CPVC Pipe (see Table 4-2) into the PVC/CPVC exhaust-vent adapter (see Table 4-3); cement the other end of the CPVC Transition Pipe to the PVC exhaust venting using a field supplied PVC or CPVC coupling; see Figure 4-1(a). Where PVC cements to CPVC, be sure to use approved transition cement, see Table 4-4.

Table 4-2 CPVC Vent Pipe Transition Piece (used when venting with PVC)

Model No.	Vent Pipe Size	CPVC Transition Vent Pipe Length	Full Insertion Depth
FTG 600-800	6"	Minimum 6.5" (factory supplied)	2-7/8"
FTG 1200-2400	8"	Minimum 9"	2-7/8"

NOTICE When assembling the venting, follow the instructions provided with the Special Venting System. Take care not to damage gaskets when inserting pipe into fittings, bevel cut ends of piping to avoid damaging or dislodging the sealing gasket during installation. For PVC/CPVC bevel by approximately 1/8 in.

⚠ WARNING **Gasket Seating** - Improper gasket 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 the exhaust-vent adapter. Failure to follow these instructions may result in serious injury or death.

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

⚠ 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.

Table 4-3 Exhaust-vent and Air-inlet Adapters

Material	Vent Brand	FTG 600-800		FTG 1200-2400	
		Inlet	Exhaust	Inlet	Exhaust
Stainless Steel	**FasNSeal®** (DuraVent)	(See Note 1)	(See Note 2)	(See Note 3)	(See Note 4)
	Z-Vent® (Z-Flex)				
	Secure Seal® SS (Security Chimneys)	SS6PVCU	SS6FFNSAU		SS8FFNSAU
	Corr/Guard® (Metal-Fab)	TBD			TBD
	Saf-T Vent® (Heatfab / Selkirk)				
	VIC (ICC Chimney)				
	SWKL-Vt (Jeremias)				
Poly-propylene	**PolyPro®** (DuraVent)	(See Note 1)	FSA-06M-6PPF		FSA-08M-8PPF
	Z-Dens® (Z-Flex)	2ZDCPVCG6	2ZDZV6		2ZDZV8
	InnoFlue® (Centrotherm)	ISAAL0606	ISSA0606		ISSA0808
PVC/ CPVC	N/A	(See Note 1)	FSA-6FNSM-6PVCF (factory supplied)		FSA-8FNSM-8PVCF (NTI p/n 86687)

Notes:
1. The FTG 600-800 combustion air-inlet connector is designed to directly accept 6 in. PVC/CPVC, PolyPro®, FasNSeal® or Z-Vent® Special Gas Venting; no separate adapter is required.
2. The FTG 600-800 exhaust vent outlet connector is designed to directly accept 6 in. FasNSeal® or Z-Vent® Special Gas Venting; no separate adapter is required.
3. The FTG 1200-2400 use an 8 in. rubber adapter as the combustion air-inlet connector; no special adapter is required to adapt to the respective brand of combustion air-inlet piping.
4. The FTG 1200-2400 exhaust vent outlet connector is designed to directly accept 8 in. FasNSeal® or Z-Vent® Special Gas Venting; no separate adapter is required.

Figure 4-1(a) Near Boiler Venting (PVC)

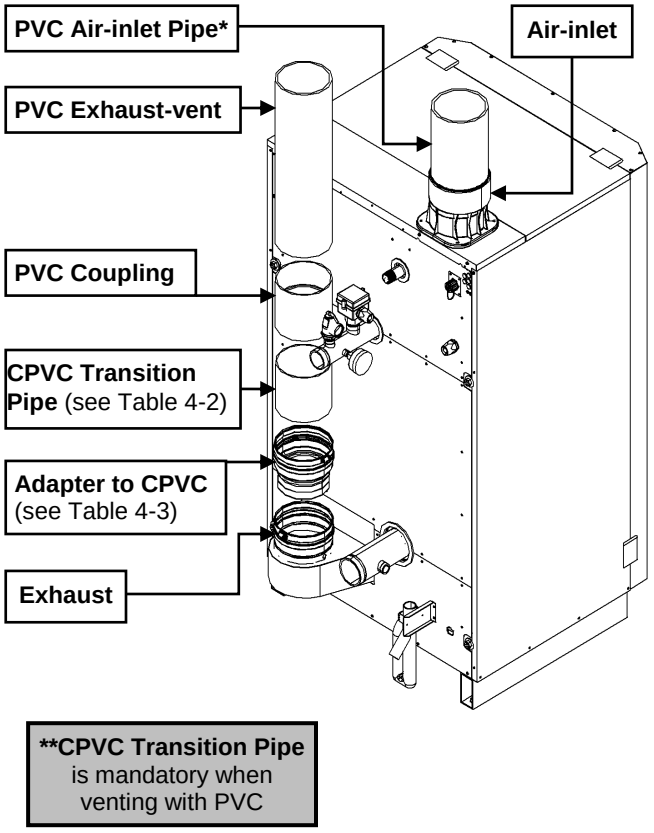


Figure 4-1(b) Near Boiler Venting (CPVC)

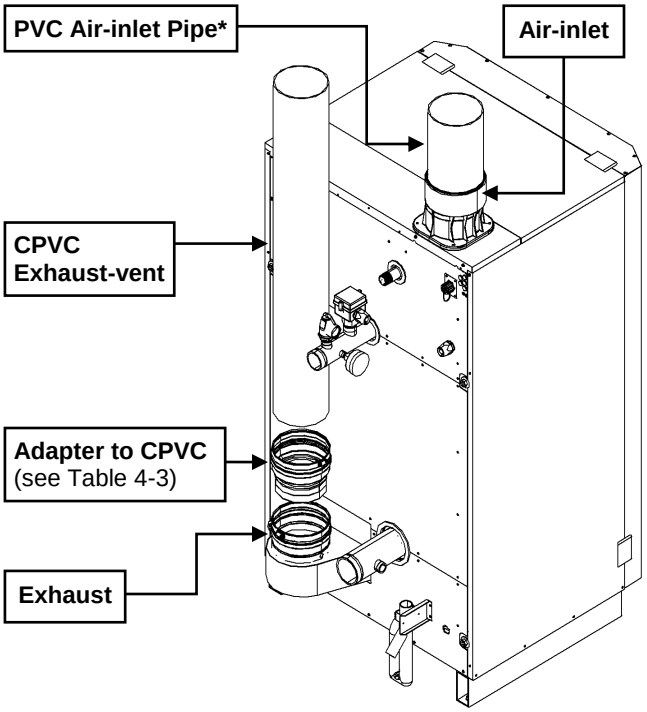


Figure 4-1(c) Near Boiler Venting (PP)

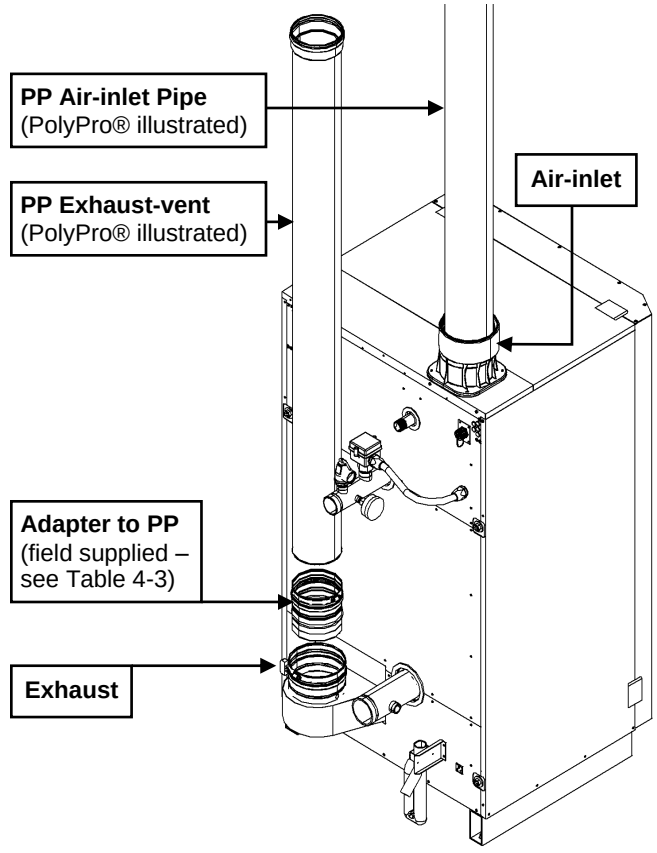
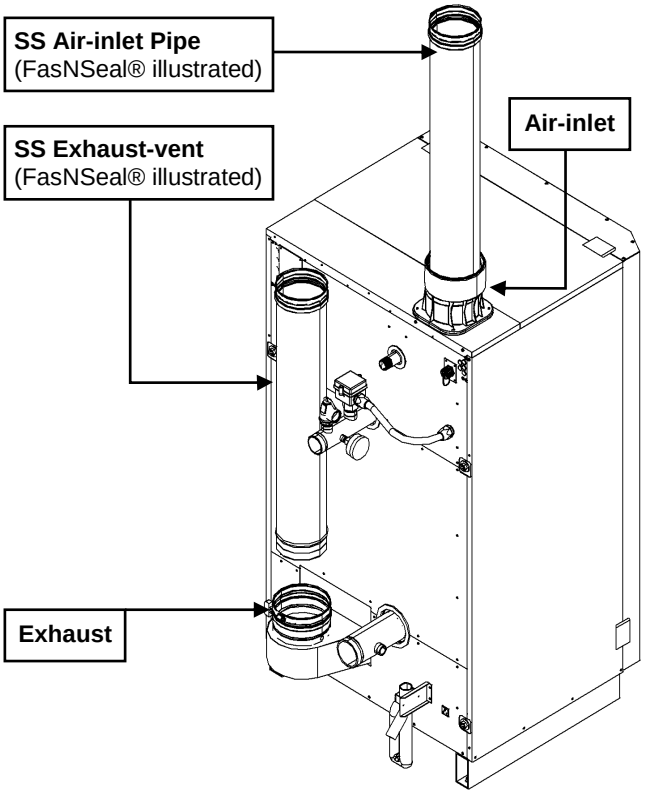


Figure 4-1(d) Near Boiler Venting (SS)



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

Exhaust-vent/Air-inlet Pipe Material

Table 4-4 Approved Vent and Air-Inlet Pipe Material

Items [1]	Materials [2, 3]	Venting System Standards	
		United States	Canada
Vent Piping and Fittings	PVC - DWV	ANSI/ASTM D2665	All venting material in Canada must be **ULC S636 approved**.
	PVC Schedule 40	ANSI/ASTM D1785	
	CPVC Schedule 40	ANSI/ASTM F441	
	Stainless Steel (SS)	UL-1738	
	Polypropylene (PP)	ULC S636	
Pipe Cement	PVC	ANSI/ASTM D2564	
	CPVC	ANSI/ASTM F493	
Primers	PVC / CPVC	ANSI/ASTM F656	

WARNING

All Vent and Air-Inlet materials installed on gas fired appliances in CAN/US must meet the Standards listed in this Table. Failure to comply could result in fire, serious injury or death.

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

Table 4-5 Allowable Vent and Air-inlet Pipe Size and Lengths

Model No.	Fuel	Pipe Dia. (in.)	Length (ft.)	Number of Elbows (90's or 45's) and Equivalent Feet								
				1	2	3	4	5	6	7	8	9
FTG 600-800	NG	6	150	145	140	135	130	125	120	115	110	105
	LP	6	100	95	90	85	80	75	70	65	60	55
FTG 1200-2400	NG/LP	8	150	145	140	135	130	125	120	115	110	105

Notes:
[1] Minimum length of each the exhaust vent and combustion air-inlet piping is 5 feet equivalent.
[2] For models FTG 600-800, the last 6 ft. of exhaust vent piping (vent termination) can be reduced to 4 or 5 in. diameter vent pipe.
[3] For models FTG 1200-2400, the last 6 ft. of exhaust vent piping (vent termination) can be reduced to 6 or 7 in. diameter vent pipe.

Termination Options – Direct Vent Installation

The venting system of the FTG boiler may be terminated using field supplied piping to construct a "Two-Pipe" termination, see Figures 4-2, 4-4(a) and 4-5(a); alternatively the venting may be terminated using a factory kit selected from Table 4-6.

IMPORTANT

Venting Options - Due to potential moisture loading (build-up) along the exterior wall, sidewall venting may not be the preferred venting option; see Figures 4-2(a), 4-2(c), 4-3(a) and 4-5.

NOTICE

When sidewall venting, it is recommended to reduce the diameter of the exhaust vent at the termination, to increase exhaust gas velocity, further directing it away from the building. The final 6 ft. of exhaust vent can be reduced to a diameter of 4 in. for models FTG 600-800, and 6 in. for models FTG 1200-2400; see Figures 4-2(a) and 4-2(c).

⚠ 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.

Optional Termination Kits – Direct Vent Installation

Kits certified with the FTG boiler are listed in Table 4-6 and are available from the respective vent pipe manufacturer. For more information on each kit, contact the kit manufacturer.

Table 4-6 Optional Vent Termination Kits

Description	Vent Size	Supplier P/N	Figure	Vent Material Compatibility	Termination	
					Roof	Wall
IPEX Low Profile (Wall)[7]	4"	196986 (NTI P/N 84358)	4-4(c)	PVC/CPVC[7]	-	✓
IPEX Concentric (Wall/Roof)[5,6,7]	4"	196021 (NTI P/N 84355), 197021	4-3(a), 4-4(b), 4-5(b)		✓	✓
PolyPro® Twin Pipe (Wall)	4"	4PPS-HTPL	4-4(c)	PolyPro® Polypropylene	-	✓
PolyPro® Concentric (Wall)	4"	4PPS-HK	4-3(b), 4-4(d)			
PolyPro® Concentric (Roof)	4"	4PPS-VK	4-3(a), 4-5(c)		✓	-
InnoFlue® Concentric (Wall)[8]	4"	(ICWT462 & ICTC0446)	4-3(b), 4-4(d)	InnoFlue® Polypropylene	-	✓
InnoFlue® Concentric (Roof)[8]	4"	(ICRT4679 & ICTC0446)	4-3(a), 4-5(c)		✓	-
Z-DENS® Horizontal Kit Low Profile (Wall)	4"	2ZDHKLP4	4-4(c)	Z-DENS® Polypropylene	-	✓
Z-DENS® Concentric (Wall)	4"	2ZDHK4	4-3(b), 4-4(d)			
Z-DENS® Concentric (Roof)	4"	2ZDVK4	4-3(a), 4-5(c)		✓	-
Z-VENT® Termination Hood – Exhaust (Wall)	4-5"	2SVSHTX04, 2SVSHTX05		Z-VENT® Stainless Steel	-	✓
SS Miter Cut – Exhaust (Wall)	4-8"	SS4MCU – SS8MCU		Secure Seal® Stainless Steel	-	✓
Saf-T Vent® Mitered Termination – Exhaust (Wall)	4-8"	9490, 9590, 9690, 9790 & 9890		Saf-T Vent® Stainless Steel	-	✓
ICC Miter Cut – Exhaust (Wall)	5-8"	HM-5MC – HM-8MC		ICC Chimney Stainless Steel	-	✓

Notes:

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

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

[3] Clearance requirements in this manual supersede those of the instructions included with the vent terminal.

[4] Piping **MUST** be secured to the vent terminal during installation.

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

[6] Vent Screens provided with boiler may be used with the IPEX Concentric Vent Kits; otherwise use IPEX vent screens (4 in. vent screen P/N 196052 – each sold separately).

[7] IPEX Low Profile and Concentric kits (excluding P/N 197021) 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.

[8] Centrotherm Concentric termination kits must use the applicable "Twin pipe to concentric adapter," part number ICTC0446.

[9] 4 & 5 in. Vent Termination Kits may only be used with models FTG 600-800.

[10] 7 & 8 in. Vent Termination Kits may only be used with models FTG 1200-2400.

Termination Examples – Direct Vent Installation

Figure 4-2(a) Two-pipe (Sidewall)

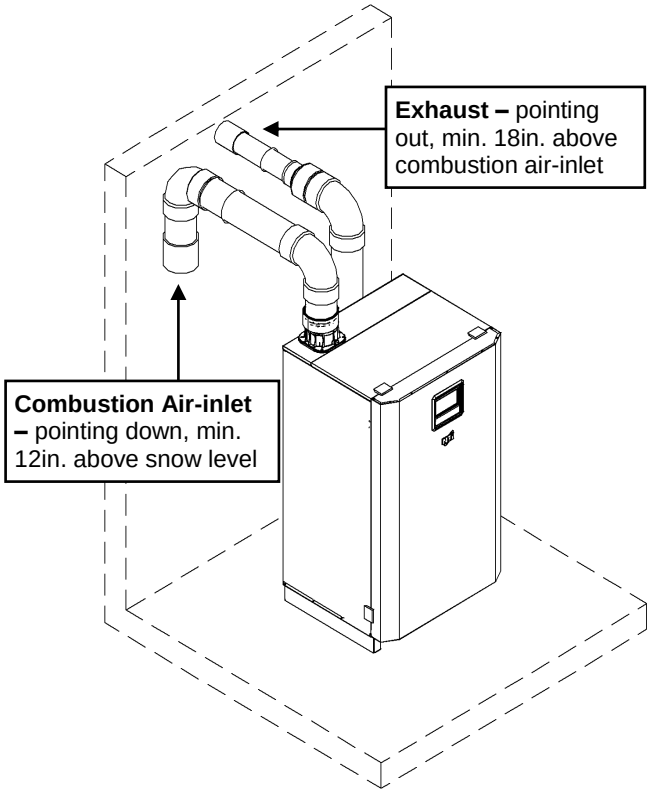


Figure 4-2(b) Two-pipe (Roof)

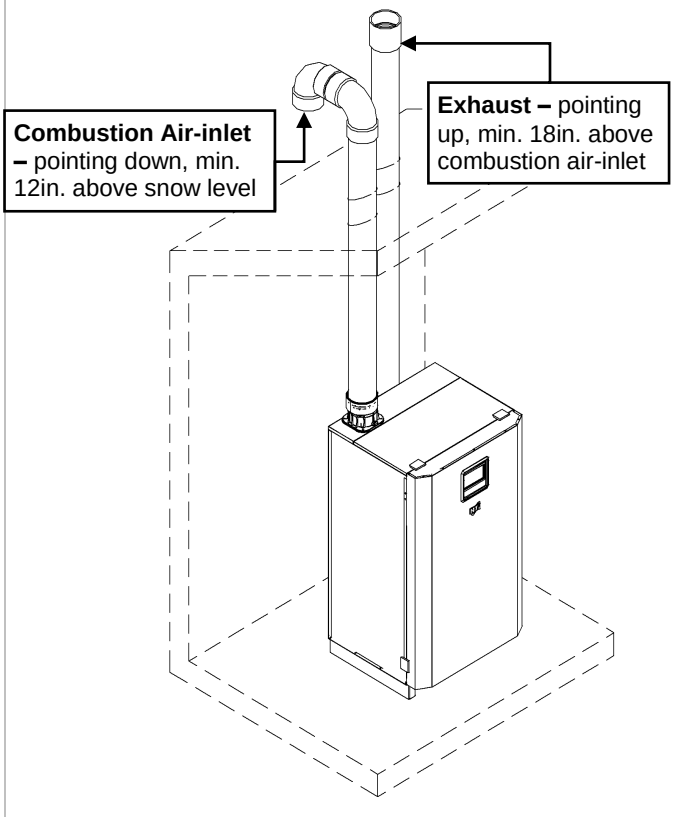
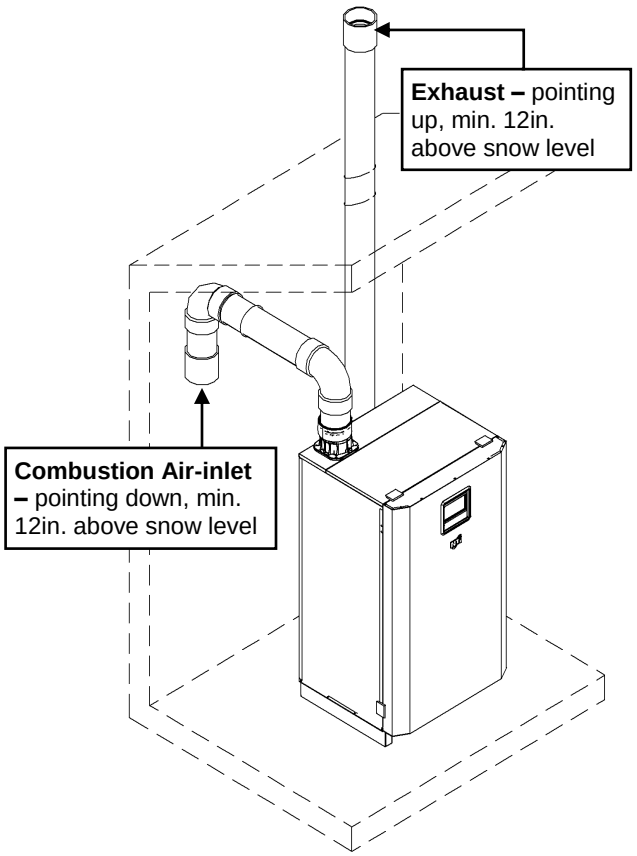


Figure 4-2(c) Two-pipe (Rooftop / Sidewall)



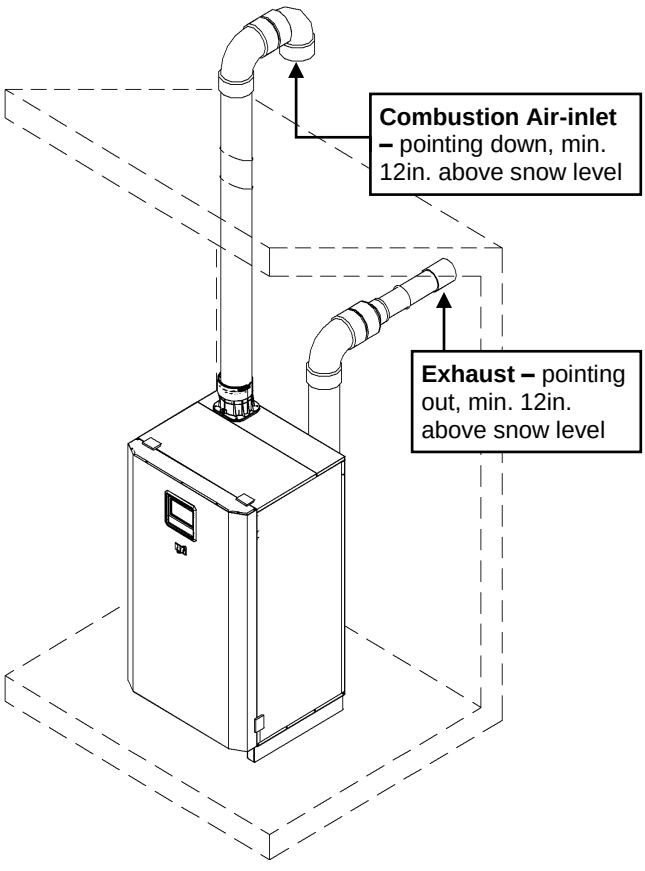


Figure 4-3(a) Concentric (Roof)

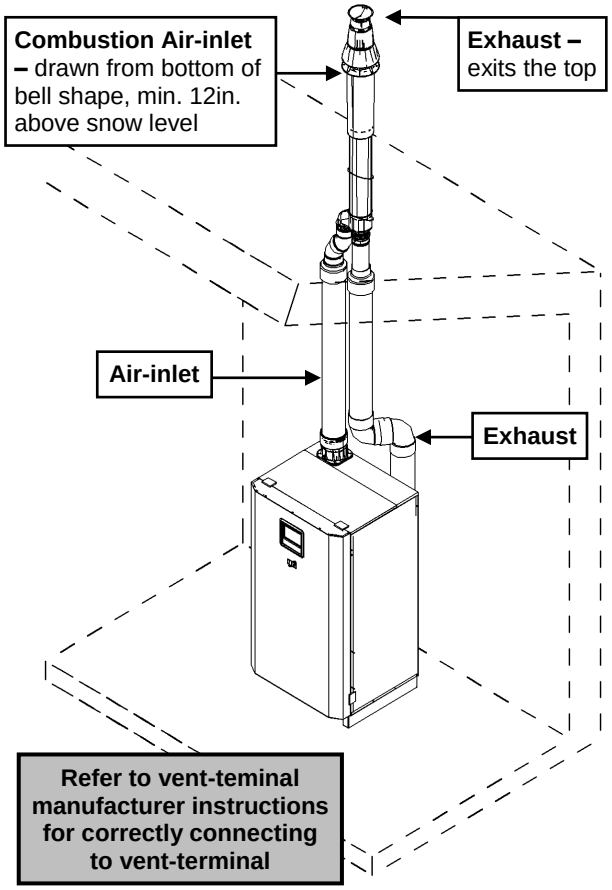
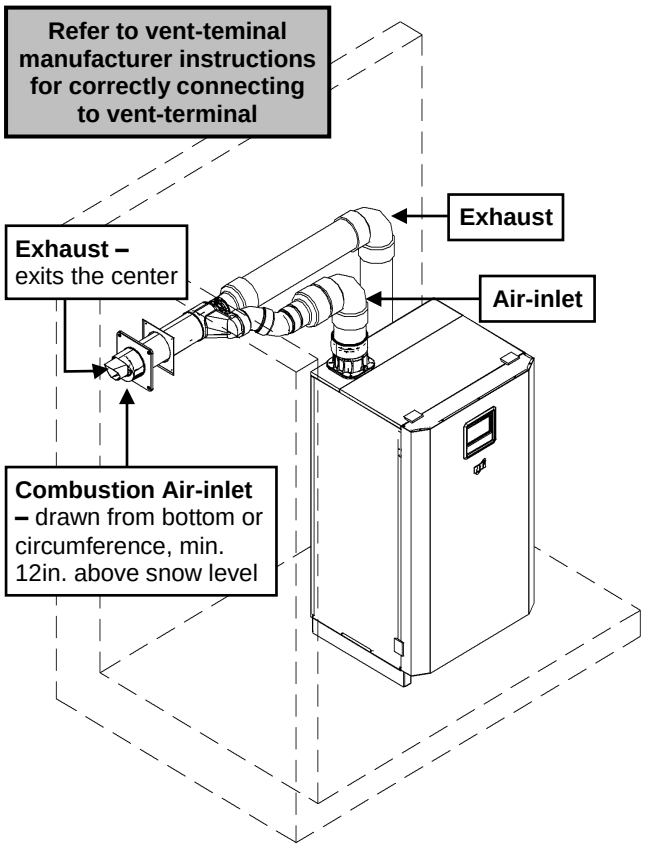


Figure 4-3(b) Concentric (Sidewall)



NOTICE

Concentric and Low Profile Vent Termination Kits are only available in sizes up to 4 in.; therefore they are not an option for models FTG 1200-2400.

Sidewall Termination Details – Direct Vent Installation

Figure 4-4(a)

Two-Pipe Termination (Sidewall)

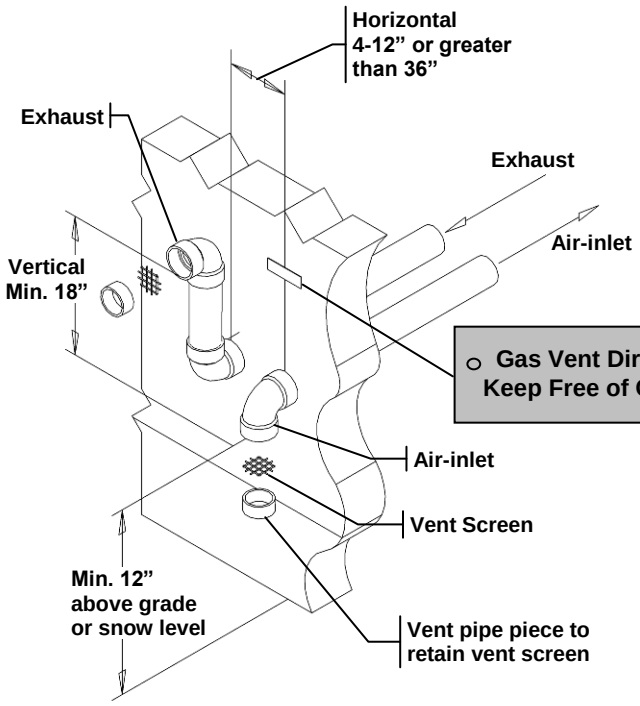


Figure 4-4(b)

IPEX Concentric Termination (Sidewall)

⚠ WARNING

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

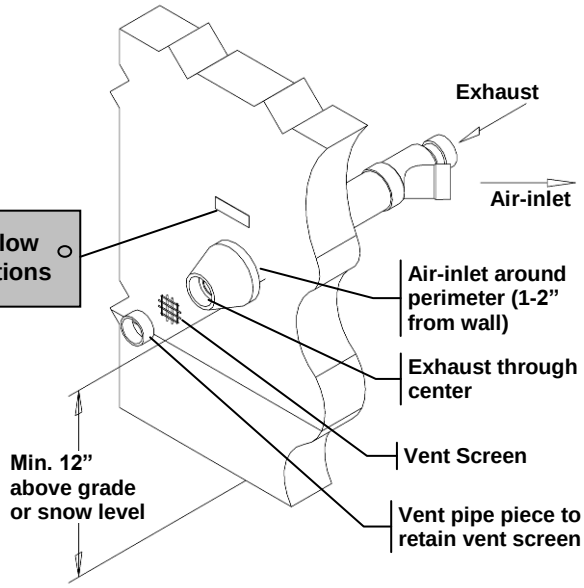


Figure 4-4(c)

Low Profile Termination (Sidewall)

⚠ WARNING

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

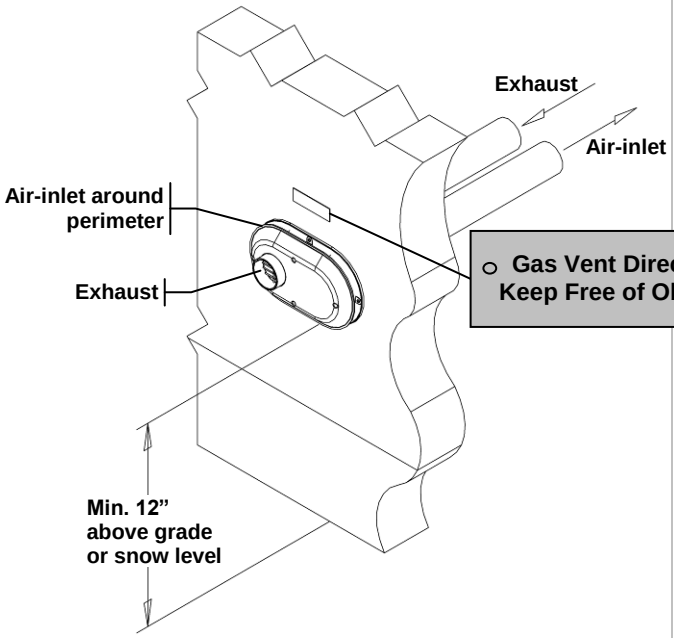
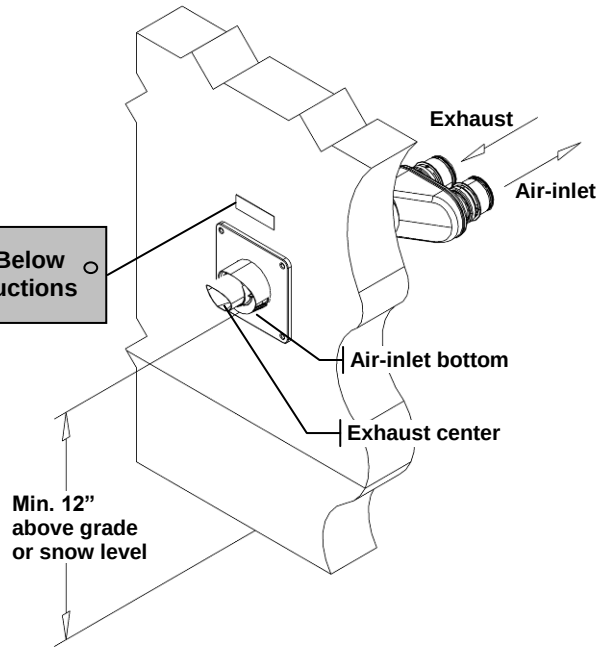


Figure 4-4(d)

PolyPro / InnoFlue Termination (Sidewall)

⚠ WARNING

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



Roof Termination Details – Direct Vent Installation

Figure 4-5(a)

Two-Pipe Termination (Roof)

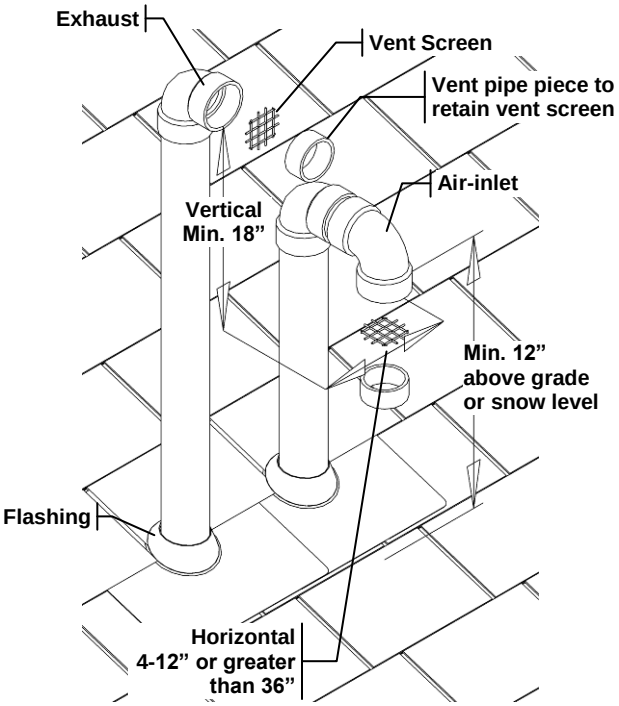


Figure 4-5(b)

IPEX Concentric Termination (Roof)

⚠ WARNING

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

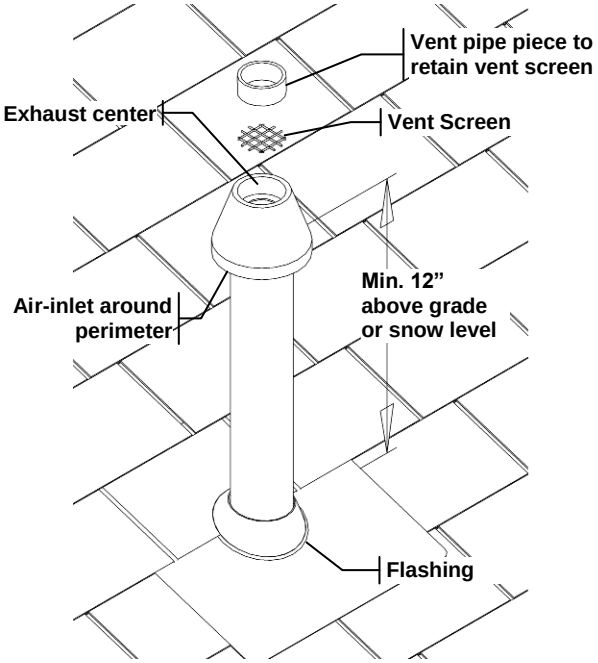


Figure 4-5(c)

PolyPro / InnoFlue Termination (Roof)

⚠ WARNING

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

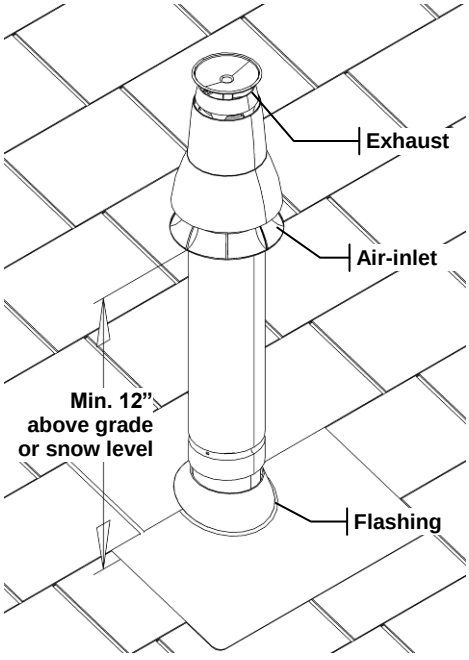
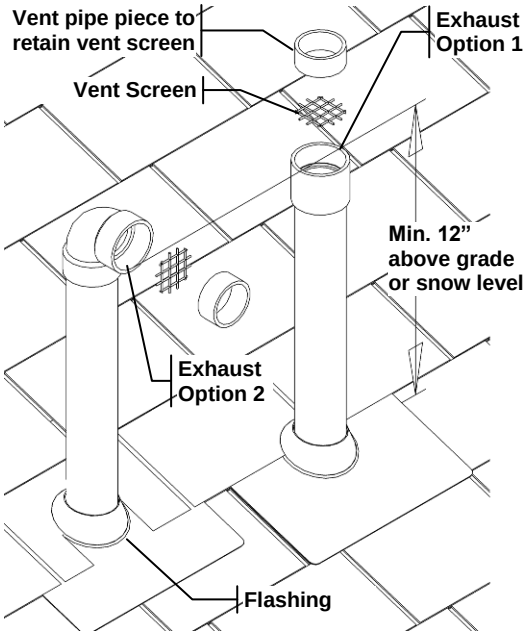


Figure 4-5(d)

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 4-6.
14. **Vent Screens:** Install factory supplied vent screens on the outside of the last fitting for both the inlet and exhaust vent terminations. Install the screen into the female opening of the fitting, then cut a small piece of pipe to sandwich the screen into the elbow. NOTE: ensure the small piece of cut pipe, does not extend past the end of the fitting. Two screens are provided in the package. See Figures 4-4 and 4-5.
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 4-4.
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 4-2(a), 4-2(c), 4-3(a) and 4-5 for roof top venting options.

Figure 4-6 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.

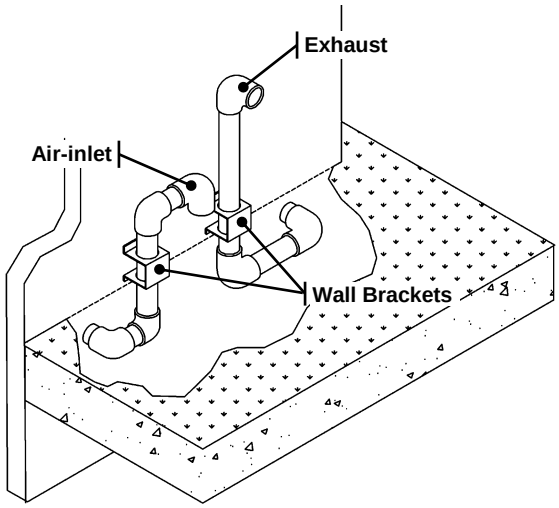


Figure 4-7 Outdoor Venting

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.

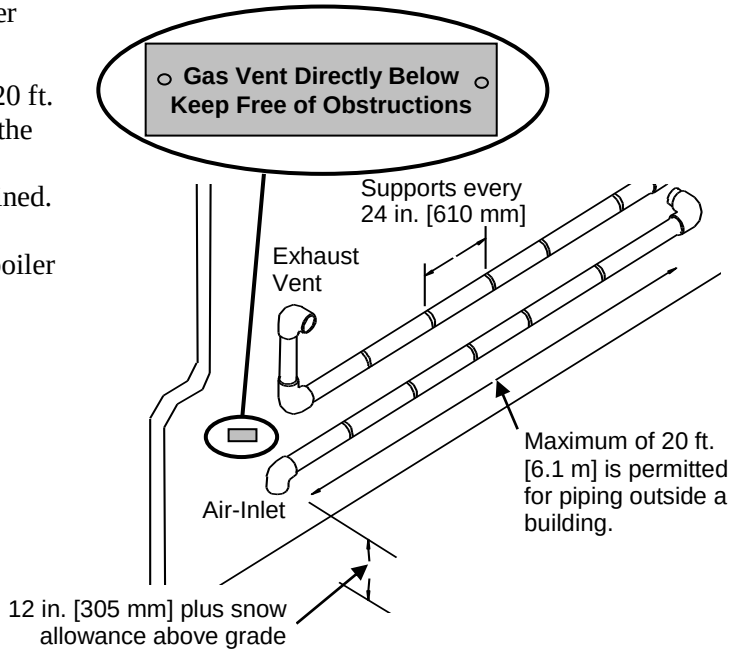
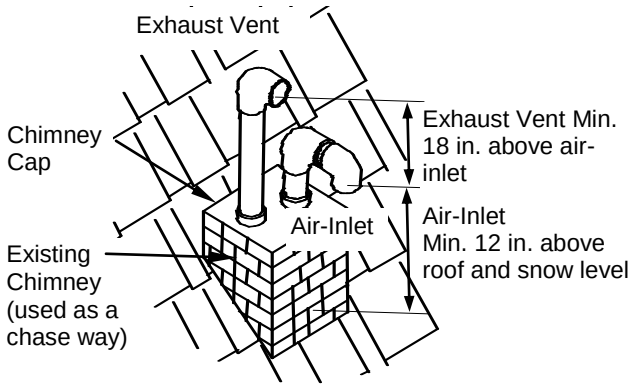


Figure 4-8 Existing Chimney Chase Way

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 FTG certified venting materials are used, see Table 4-4.
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.



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 FTG 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.

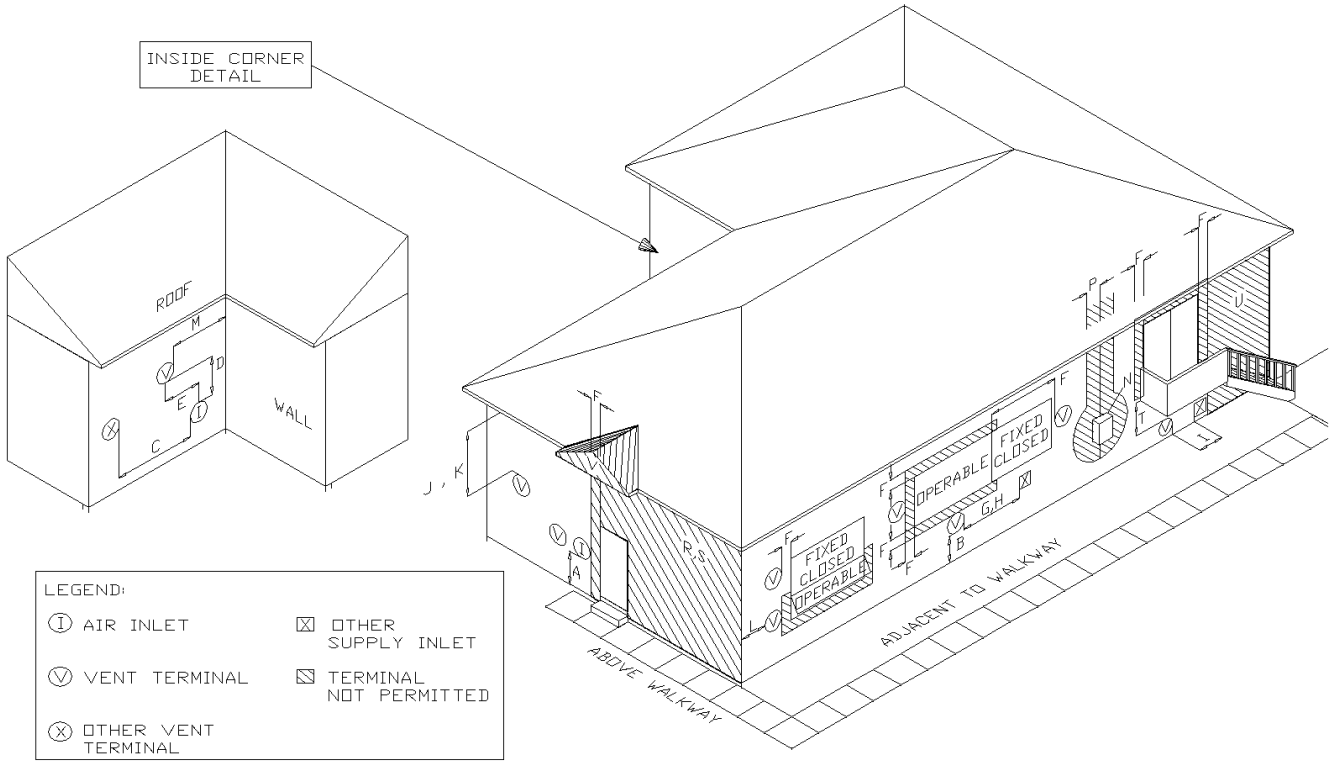
Table 5-1 Termination Clearances Quick Reference Table (See Figures 5-1 and 5-2)

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:

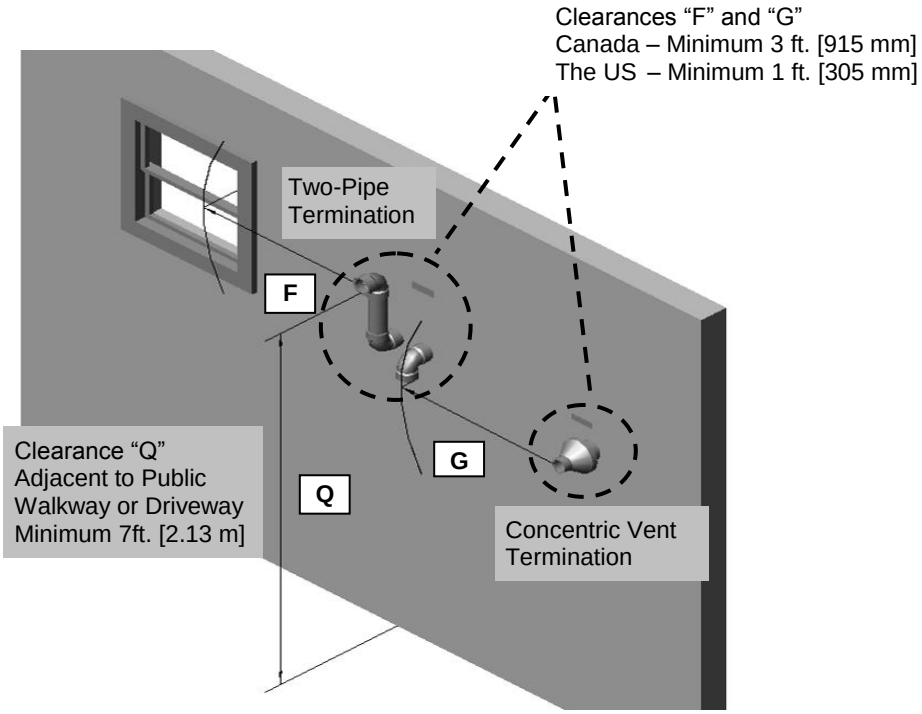
1 - Canadian installations must comply with the current CSA B149.1 Natural Gas and Propane Installation Code and local building codes.
2 - US installations must comply with current ANSI Z223.1/ NFPA 54 National Fuel Gas Code and local building codes.
3 - Horizontal separation center-to-center (c.c.) 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.

⚠ 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.

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

Removing an Existing Boiler from Common Venting System

⚠ DANGER Do not install the FTG boiler 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.

6.0 CONDENSATE DRAIN

The FTG boiler produces 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. **Identify Condensate Trap & Accessories Provided with the Boiler** – A Condensate Trap, Gear Clamp and Support Bracket (c/w screws) are factory supplied with each FTG boiler, and are needed for properly securing the Condensate Trap to the boiler (see Figure 6-1).
2. **Attach to Boiler Condensate Drain** – As illustrated in Figure 6-1(a), slide the Condensate Trap inlet fitting over the Boiler Condensate Drain; use the factory supplied Gear Clamp to secure the Condensate Trap in place (ensure that the Condensate Trap cannot be pulled off). With the factory supplied screws, fasten the Support Bracket into place while trapping the top of the Condensate Trap between the Support Bracket and boiler, thus ensuring the Condensate Trap stays in the vertical position.
3. **Prime Condensate Trap** – Fill the Condensate Trap with water to prevent flue gases from escaping during initial firing of the burner.
4. **Outlet to Drain** – Direct condensate from the outlet of the Condensate Trap to a household drain, condensate pump or neutralizer (check with your local authority regarding the disposal of condensate). If necessary connect suitable tubing to the outlet of the Condensate Trap and route it to drain, 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 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(a) Condensate Drain Trap – Exploded View

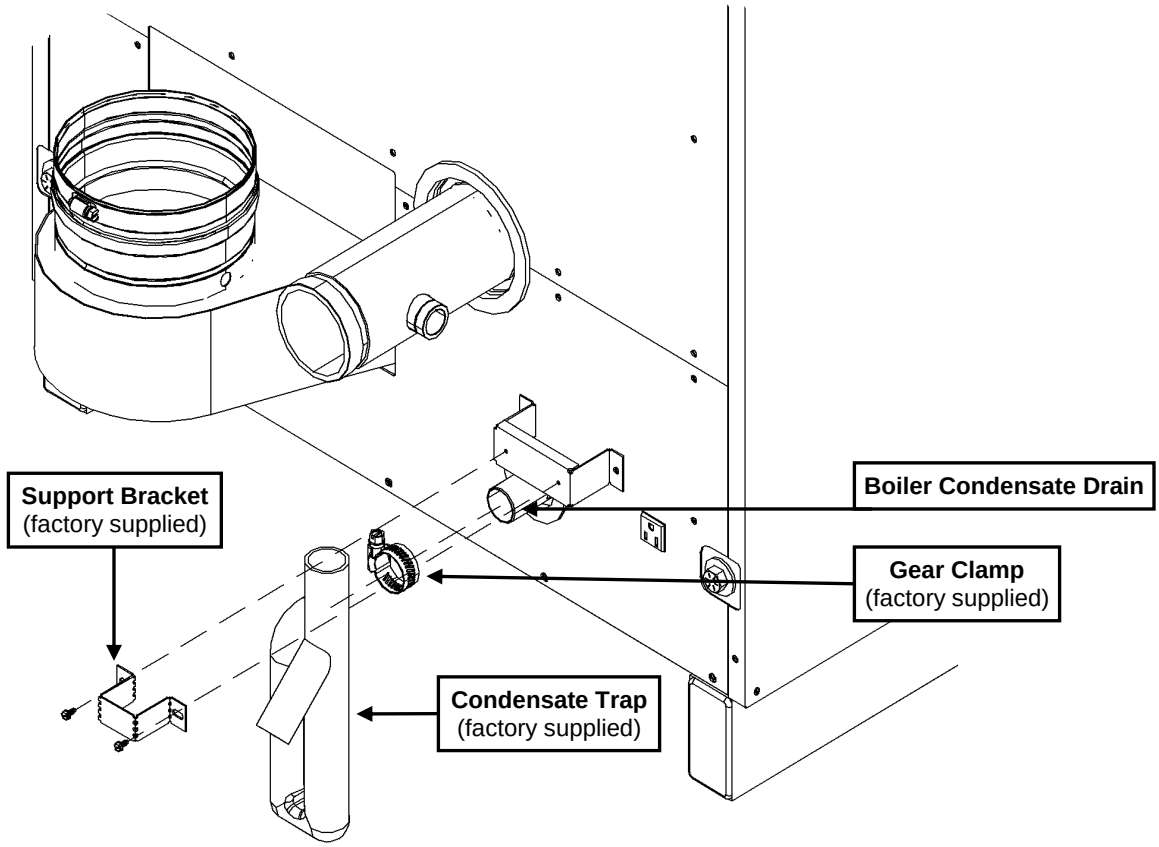
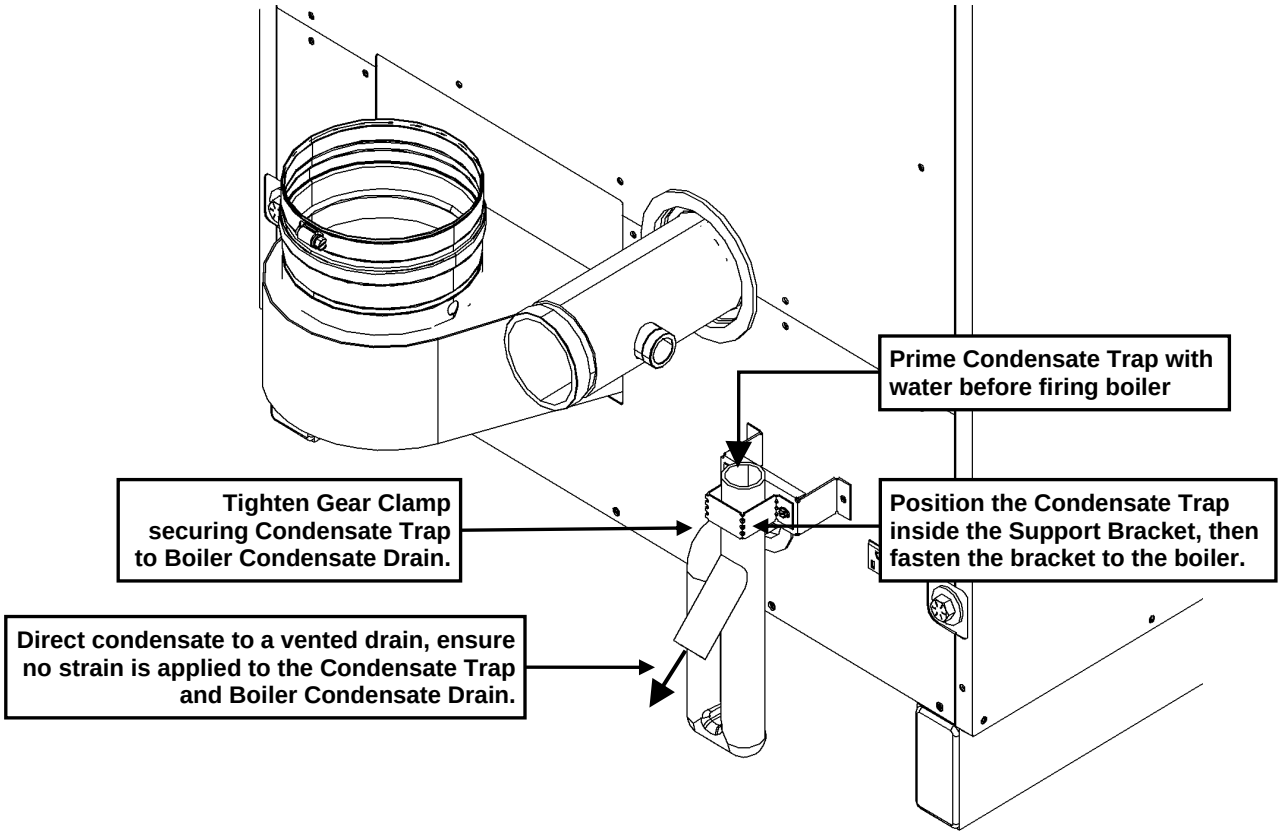


Figure 6-1(b) Condensate Drain Trap - Assembled



7.0 INSTALLING GAS PIPING

⚠ DANGER

FTG boilers are factory set to operate with Natural Gas; **BEFORE OPERATING WITH PROPANE,** the boiler's gas valve must be adjusted in accordance with the applicable *Natural Gas to LP Conversion Instructions*. Failure to properly convert the unit to safely operate with Propane will cause severe boiler failure, 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.

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.

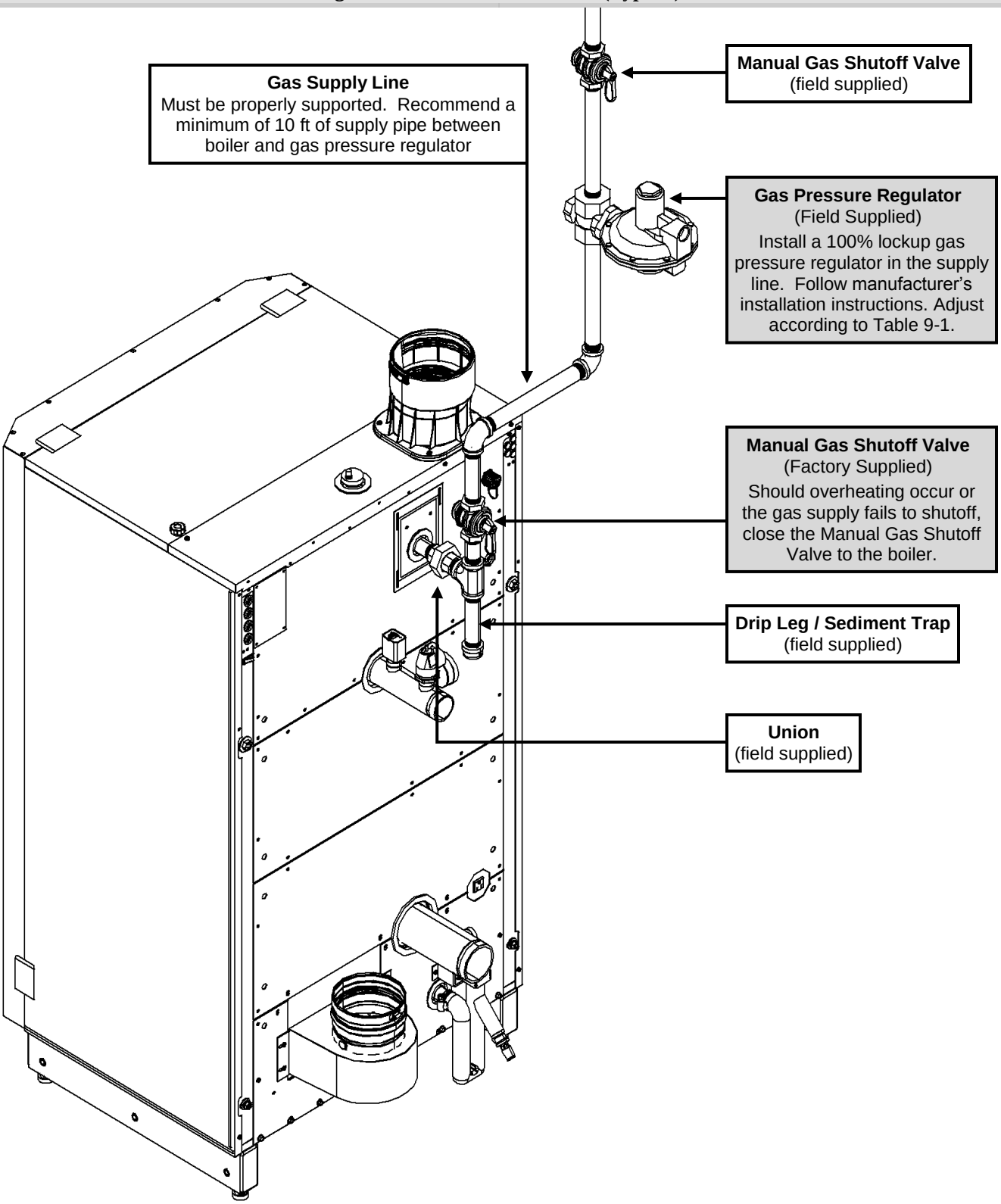
⚠ WARNING

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 Apply propane gas compatible pipe sealing compound to the male-end of all treaded connections before assembly. Support boiler gas line connection during assembly of gas piping to prevent damage to internal boiler components. Failure to follow these instructions may result in fire, property damage, serious injury or death.

⚠ 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

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 two 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 8-13 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 2 ignition cycles before going to "Lockout 110 – Ignition failure occurred". Once you have confirmed this behavior, reinstall the wire on the flame sensor, clear the lockout 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 once.
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 FTG 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 0.5-1.0% lower than the value obtained during the maximum modulation rate test (e.g. if CO_2 at Max = 9%, then CO_2 at Min must = 8.0-8.5%). For FTG 2000-2400 models, perform the Gas Valve Offset Check/Adjustment procedure detailed in Figure 9-2. 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 - $^1/_8{}^{th}$ 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. For FTG 2000-2400 models follow the instructions on the screw; negative (-) reduces offset/CO_2.

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 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. For models FTG 600-1400, use a 3/16 in. hex wrench to remove the plug from the inlet flange of the gas valve, and install a *1/8 NPT x hose barb adapter* suitable for connecting the tubing of the gas pressure manometer being used to measure gas line pressure. Models FTG 2000-2400 incorporate a bleed screw on the inlet flange of the gas valve; open it approximately 1-1/2 turns. See **Line Pressure Test Port** in Figures 9-1(a) and 9-1(b).
3. Slide the gas pressure manometer tubing over the *hose barb adapter* located on the inlet flange of the gas valve (bleed screw fitting for models FTG 2000-2400); connect the other end of the tubing to the gas pressure 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 modulation 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. Upon completion of the line pressure testing, turn the gas supply off, and then reinstall the Line Pressure Test Port plug, applying appropriate thread sealant to the threads prior to installing. For models FTG 2000-2400, close the bleed screw. Turn gas on and check for leaks.

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 properly re-install the **Line Pressure Test Port** plug (FTG 600-1400), or close the **Line Pressure Test Port** bleed screw (FTG 2000-2400) will cause 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.)			Offset Pressure (inches w.c. / [Pa]) [2]	CO_2 (%) [1]		Max. CO (ppm)
	Nominal/ Desired	Min.	Max.		Min.	Max.	
Natural	7	4	10.5	-0.01 to 0 / [-3 to -1]	8.3	9.3	175
Propane	11	8	13	-0.04 to -0.03 / [-10 to -8]	9.6	10.6	175

Notes:
[1] Combustion values listed are for burner operation at maximum modulation rate; when tested at minimum modulation rate the CO_2 must be 0.5-1.0% lower than CO_2 at maximum modulation rate.
[2] The Offset Pressure for models FTG 2000-2400 must be checked, and if necessary adjusted, in accordance with the procedure detailed in Figure 9-2.

Table 9-2 Minimum and Maximum Modulation Rates

Model	Min. Modulation Rate (RPM)	Max. Modulation Rate (RPM)
FTG 600	1150	5600
FTG 800	1150	7450
FTG 1200	1050	8100
FTG 1400	1050	7800

Model	Min. Modulation Rate (RPM)	Max. Modulation Rate (RPM)
FTG 2000	1050	7100
FTG 2200	1050	7200
FTG 2400	1050	8000

Note: use *Diagnostic Test*, accessed from the *Diagnostic* menu of the display, to force max. and min. modulation rates; see Appendix A – Controller and Touchscreen Display Instructions, Section 5 DIAGNOSTICS PAGE.

Figure 9-1(a) Gas Valve Assembly (FTG 600-1400)

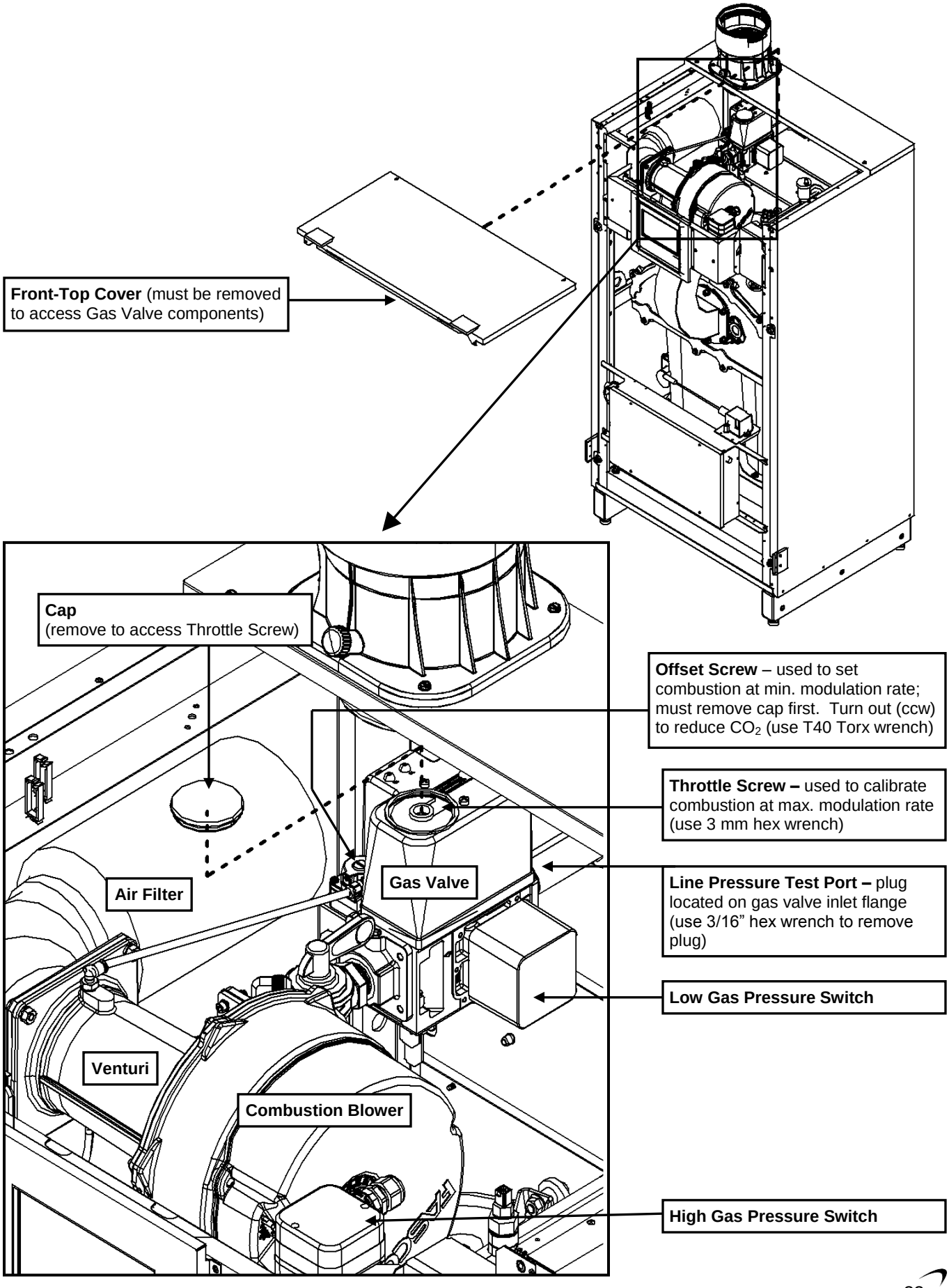


Figure 9-1(b) Gas Valve Assembly (FTG 2000-2400)

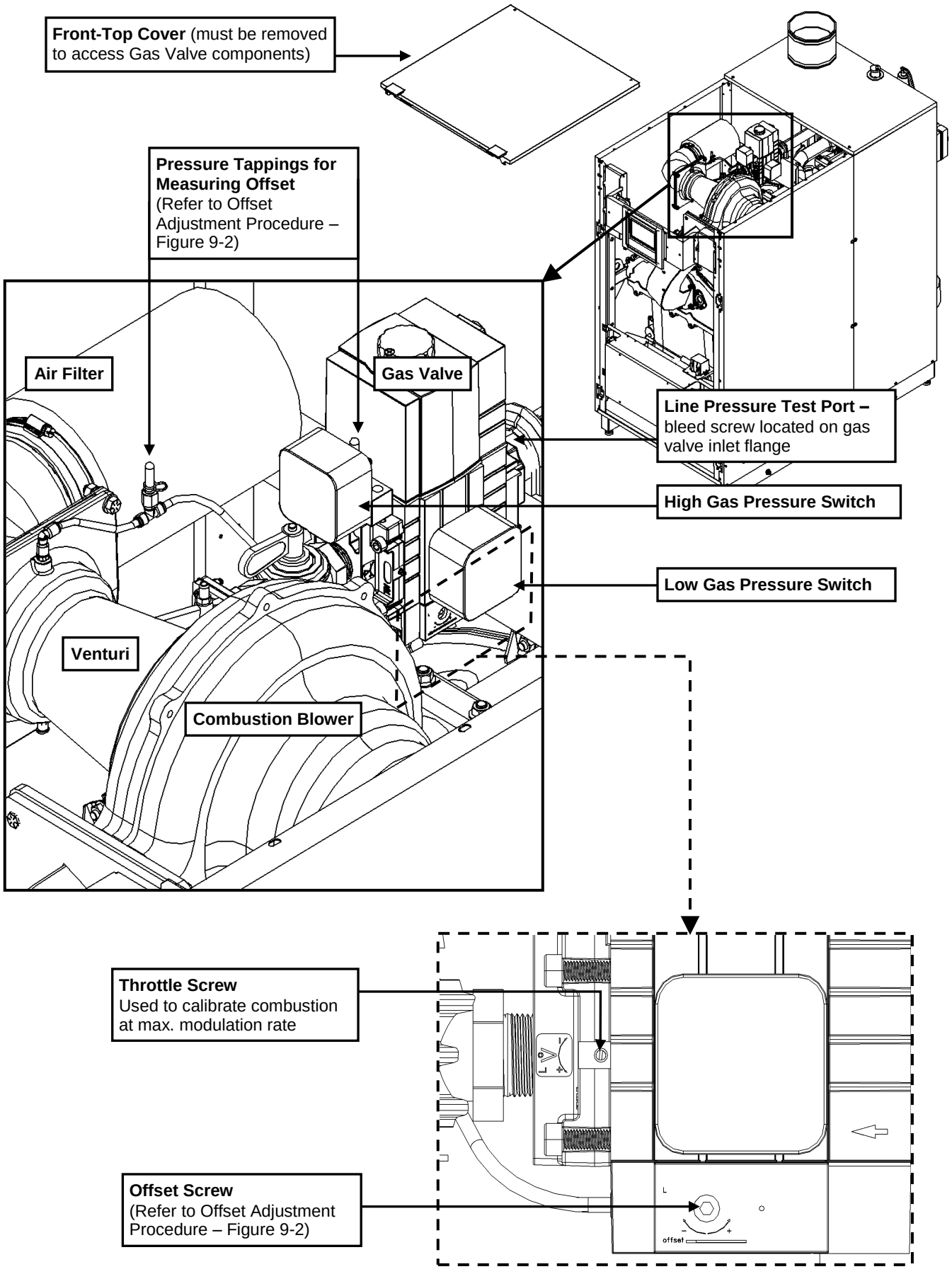
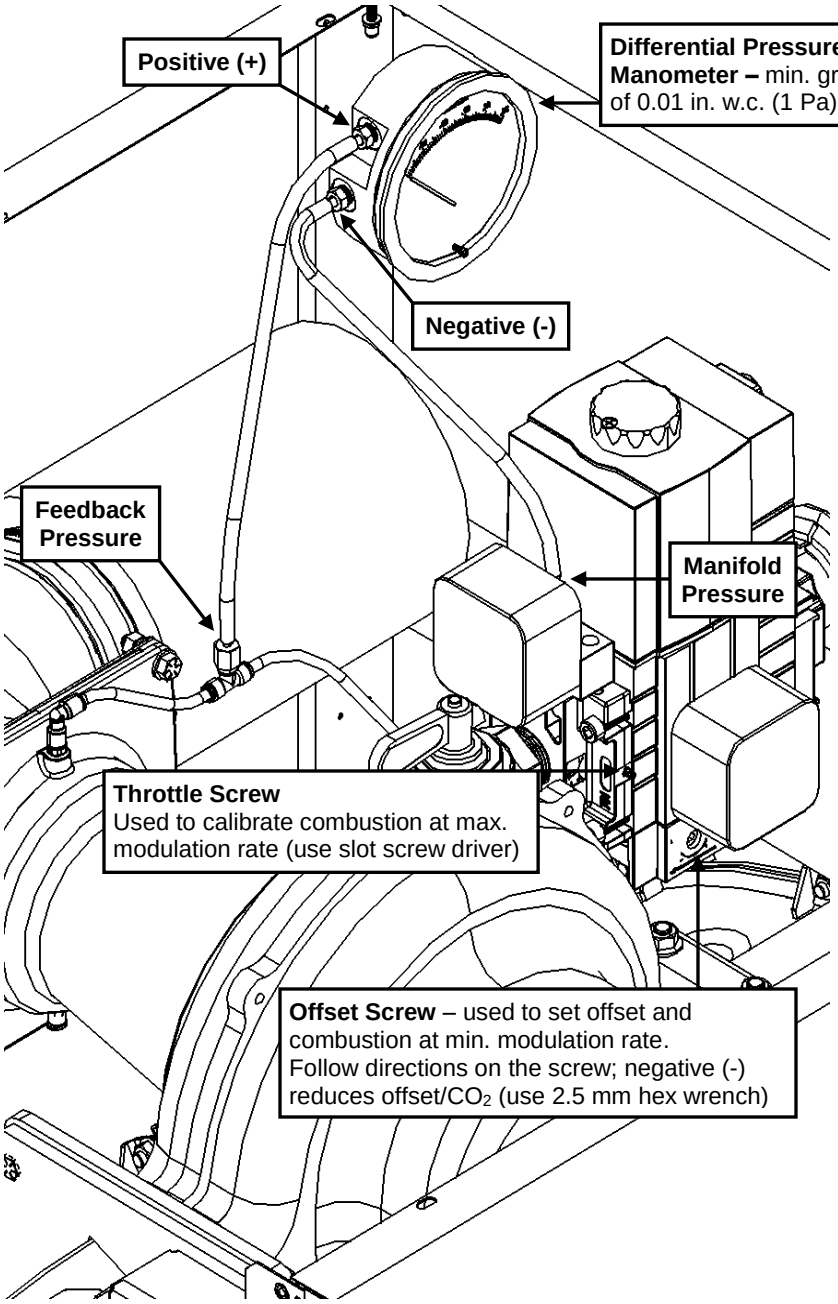


Figure 9-2 Gas Valve Offset Check/Adjustment (FTG 2000-2400)



Offset Adjustment Procedure:

1) **Differential Pressure Manometer** – obtain a meter capable of measuring differential pressure ("+" and "-" ports) with a minimum graduation of 0.01 inches w.c. (or 1 Pa).
2) **Installation** – with the burner off, remove the caps from the pressure tappings. Connect the Feedback Pressure Tapping to the Positive (+) port of the manometer; connect the Manifold Pressure Tapping to the Negative (-) port of the manometer. Verify that the manometer is reading zero – zero the meter if necessary.
3) **Set Throttle Screw** – operate burner to maximum modulation rate (see Table 9-2), ensuring gas line pressure is maintained above 4 inches w.c.; set combustion according to Table 9-1 using the Throttle Screw – record CO_2 value.
4) **Set Offset Screw** – operate burner to minimum modulation rate (see Table 9-2); set offset pressure according to Table 9-1 using the Offset Screw.

   NOTE: Since the Manifold Pressure Tapping is connected to the Negative (-) port of the manometer, a negative Offset Pressure will read positive (e.g. to achieve an offset pressure of -0.03, manometer will read +0.03).
5) **Verify Combustion** – with the burner remaining in operation at the minimum modulation rate, measure combustion and compare to readings obtained during maximum modulation – CO_2 must be 0.5 to 1.0% lower at minimum modulation. If readings are out of tolerance – CONTACT NTI FOR ASSISTANCE.
6) **Complete Test** – shutdown the burner, remove the manometer tubing and reinstall the factory caps on Offset Pressure Tappings.

NOTICE The Gas Valve Offset Pressure is factory set for Natural Gas; units converted to Propane must have the offset pressure field adjusted. Offset pressure must be checked during each annual service for all applications.

⚠ WARNING Improperly adjusted Gas Valve Offset Pressure will result in incorrect combustion leading to burner damage or excessive Carbon Monoxide concentrations causing property damage, personal injury or death.

10.0 BOILER AND HEATING SYSTEM PIPING

The fire tube design of the FTG heat exchanger results in minimal head loss, however it must be considered when sizing system piping and circulators. Furthermore, the low mass of the FTG 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.

Boiler System Preparation

Prior to connecting plumbing to the boiler, flush the entire system to ensure it is free of sediment, flux, solder, scale, debris or other impurities that may be harmful to the system and boiler. During the assembly of the heating system, it is important to keep the inside of the piping free of any debris including construction and copper dust, sand and dirt.

For retrofits, all system piping, including radiators, must be cleansed of build-up including sludge and scale. All systems, old and new, must be cleansed to remove flux, grease and carbon residue; NTI recommends cleaning the boiler system with "Fernox F3 Cleaner". For retrofit applications with heavy lime scale and sludge deposits, a heavier duty cleaner may be required; NTI recommends the use of "Fernox DS-40 System Cleaner". For information on performing the cleaning, follow the instructions included with the applicable Fernox Cleaner. See Table 10-1 for a list of recommended boiler system cleaning and treatment products.

CAUTION Failure to rid the heating system of the contaminants listed above will void your NTI warranty and may result in premature heat exchanger failure and property damage.

Table 10-1 Boiler System Cleansers and Corrosion Inhibitors

Application	Fernox Product	NTI Part #	Description
Boiler Water Treatment	F1 Protector	83448	Corrosion inhibitor.
Cleanser for new and old systems	F3 Cleaner	83449	Removes flux, grease and carbon residue.
Cleanser for Retrofits	DS-40 System Cleaner	83450	Removes heavy lime scale and sludge deposits.

Boiler Water

Pressure - FTG boilers are intended solely for use in pressurized closed-loop heating systems operating with a minimum pressure of 12 PSI at the boiler outlet. To obtain the minimum system design pressure, follow the piping diagrams illustrated in this section.

Oxygen Elimination - This boiler may only be installed in a pressurized closed-loop heating system, free of air and other impurities. To avoid the presence of oxygen, ensure all of the air is removed from the system during commissioning via strategically placed, adequately sized air-removal devices; located throughout the heating system. See figures in this section detailing the location of the primary air-removal device required for the boiler. Immediately repair any leaks in the system plumbing to avoid the addition of make-up water; make-up water provides a source of oxygen and minerals that may lead to heat exchanger failure. Failure to follow these instructions will result in poor performance, unnecessary wear of system components and premature failure.

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

Water Chemistry – The installer of the FTG boiler must consider the condition of the water in the heating system. Ensure the condition of the boiler water falls within the following parameters:

- PH – between 6.6 and 8.5.
- Chloride – less than 125mg/l.
- Iron – less than 0.5mg/l.
- Copper – less than 0.1mg/l.
- Conductivity – less than 400µS/cm (at 25ºC); [TDS < 200ppm or Total Hardness < 11.6grains/USgal.]

Treatment - Boiler water that falls outside of the conditions listed above must be treated with a corrosion inhibitor. For information on performing the treatment, follow the instructions included with the corrosion inhibitor. See Table 10-1 for a list of recommended boiler system cleaners and corrosion inhibitors.

IMPORTANT To maintain protection, the level of corrosion inhibitor must be monitored periodically for the correct concentration.

Anti-freeze - For systems requiring freeze protection, use only inhibited propylene glycol, specially formulated for hydronic heating systems; use of other types of antifreeze may be harmful to the system and will void the warranty. 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.

CAUTION DO NOT use inhibited glycol with non-compatible boiler inhibitors. Non-compatible inhibitors may counteract each other rendering them ineffective.

Near Boiler Piping

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 10-1. **NOTICE:** FTG boilers have a maximum allowable operating pressure of 160 PSI.

⚠ CAUTION If installed in the incorrect orientation (horizontally with outlet pointing down) 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 exiting steam or hot water will not cause property damage or serious injury.

Pressure & Temperature Gauge – FTG units come with a factory supplied Pressure & Temperature Gauge. The gauge must be installed in the boiler outlet fitting, as illustrated in Figure 10-1.

Auto Air Vent – An automatic air vent is factory installed on the boiler; see Figure 10-1. 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) – FTG boilers are provided with a factory installed LWCO switch which incorporates a Test Button and Power and Low Water indicator lights. Perform the following Operational Test Procedure before placing the boiler in service, and ensure Maintenance is carried out with the following schedule.

⚠ WARNING Do not run the boiler unattended until the following procedure is completed. Failure to follow procedure may lead to unsafe boiler operation resulting in fire, property damage and loss of life.

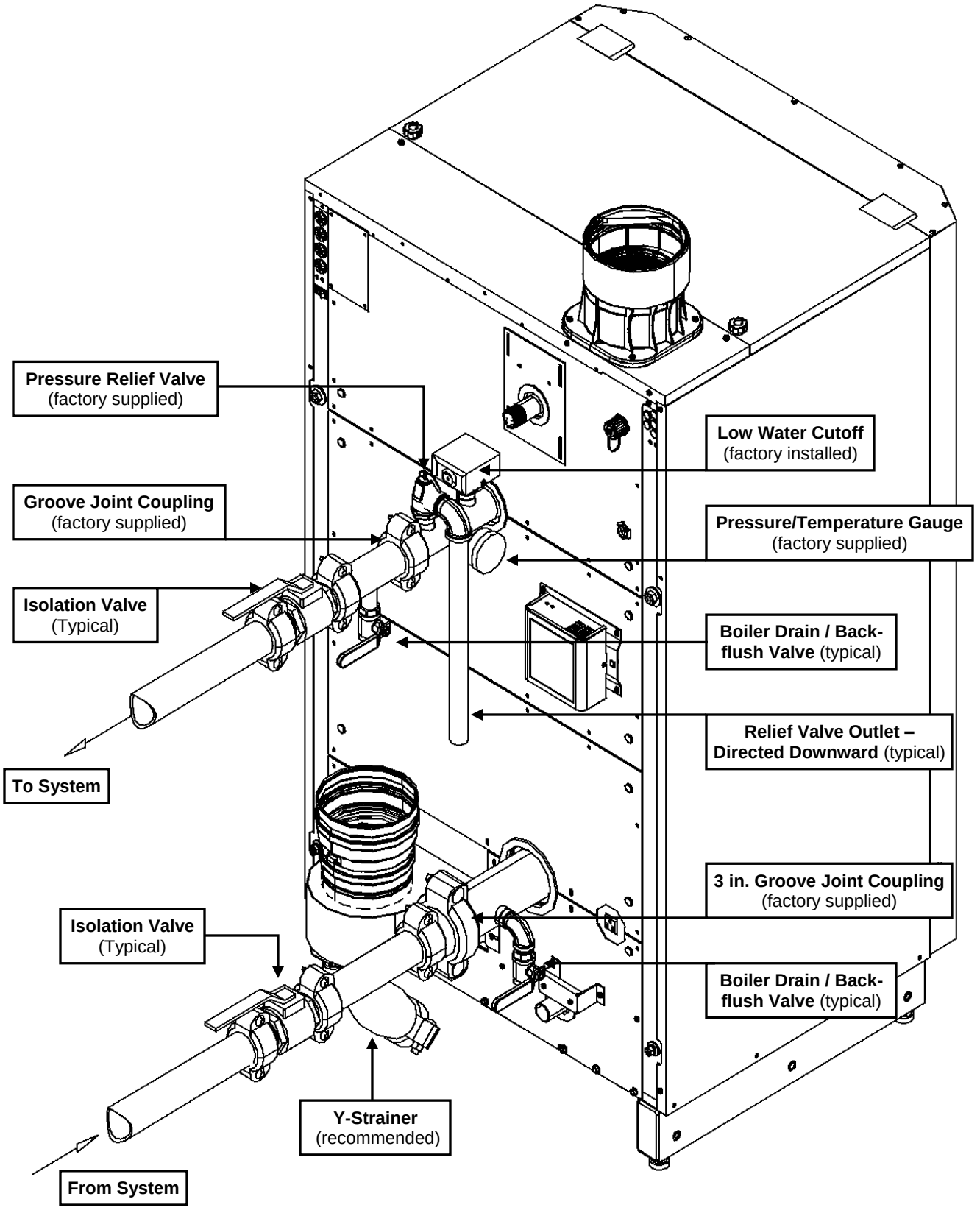
Operational Test Procedure (LWCO)

1. Before introducing water to the boiler, turn the power on; both the green "POWER" LED and amber "LOW WATER" LED should illuminate. Generate a burner demand; the burner should not fire and "Lockout 67 ILK OFF" should appear on the screen. Contact NTI for assistance if this does not happen.
2. Fill the boiler with water; the "LOW WATER" LED should turn off. Press the TEST / RESET button on the LWCO and clear the Lockout from the display board – burner should now fire.
3. With the burner firing, press the TEST / RESET button to simulate a low water condition; the amber "LOW WATER" LED should illuminate and the burner should turn off.

Maintenance (LWCO)

- Every Year – perform Step 3 from the Operational Test Procedure.
- Every 5 Years – Remove the LWCO and clean all surfaces in contact with water.

Figure 10-1 Near Boiler Piping



ATTENTION: Boiler piping can be adapted to ANSI pipe thread, flange, or other style piping connection, immediately upon exiting the boiler. With the exception of the boiler inlet and outlet fittings, Grooved Joint style piping connections are **NOT** required.

Boiler System Plumbing

FTG 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, carefully follow the plumbing instructions in this section.

Table 10-2 Minimum Flow Rate Requirements

Model	Flow (US gpm)
FTG 600	19
FTG 800	25
FTG 1200	38
FTG 1400	44

Model	Flow (US gpm)
FTG 2000	63
FTG 2200	69
FTG 2400	74

⚠ 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 Pumps – FTG boilers are equipped with three sets of pump contacts:

1. DHW PUMP - operates during a Domestic Hot Water demand (DHW).
2. CH PUMP - operates during a Central Heat demand (CH).
3. BOILER PUMP - operates during any demand.

Ensure circulating pumps are oriented as per the manufacturers' instructions. Wiring of these circulators will depend on the system configuration selected; see Figures 10-3 and 10-4. For wiring details 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 10-2.

Table 10-3 Boiler Piping Size Requirements

Model	Temp. Rise (°F)	Boiler Flow Rate (GPM)	Boiler Head Loss (ft.)	Minimum Pipe Size
FTG 600	20	56	6.7	2-1/2 in.
	25	45	4.2	2 in.
	35	32	2.1	2 in.
FTG 800	20	74	12	2-1/2 in.
	25	59	7.6	2-1/2 in.
	35	42	3.8	2 in.
FTG 1200	20	115	7.8	3 in.
	25	92	5.4	2-1/2 in.
	35	66	3.5	2-1/2 in.
FTG 1400	20	134	10	3 in.
	25	108	6.9	3 in.
	35	77	4.5	2-1/2 in.

Model	Temp. Rise (°F)	Boiler Flow Rate (GPM)	Boiler Head Loss (ft.)	Minimum Pipe Size
FTG 2000	20	192	11.2	4 in.
	25	154	7.2	3 in.
	35	110	4	3 in.
FTG 2200	20	210	13.2	4 in.
	25	168	8.3	4 in.
	35	120	4.5	3 in.
FTG 2400	20	224	15	4 in.
	25	179	9.7	4 in.
	35	128	5	3 in.

Figure 10-2(a) FTG 600-800 Head Loss Curve

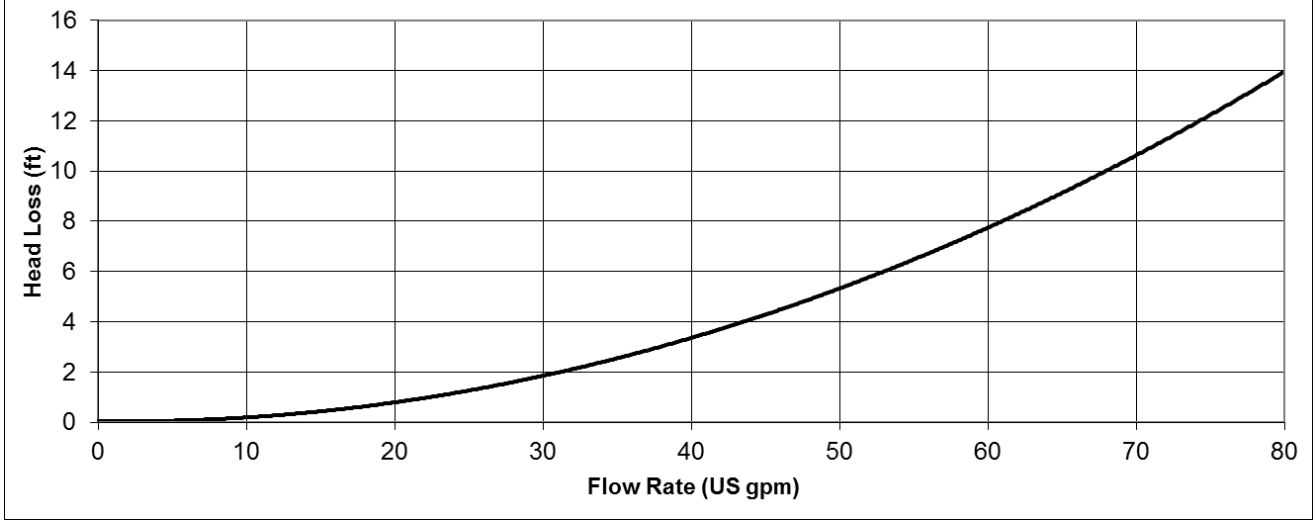


Figure 10-2(b) FTG 1200-1400 Head Loss Curve

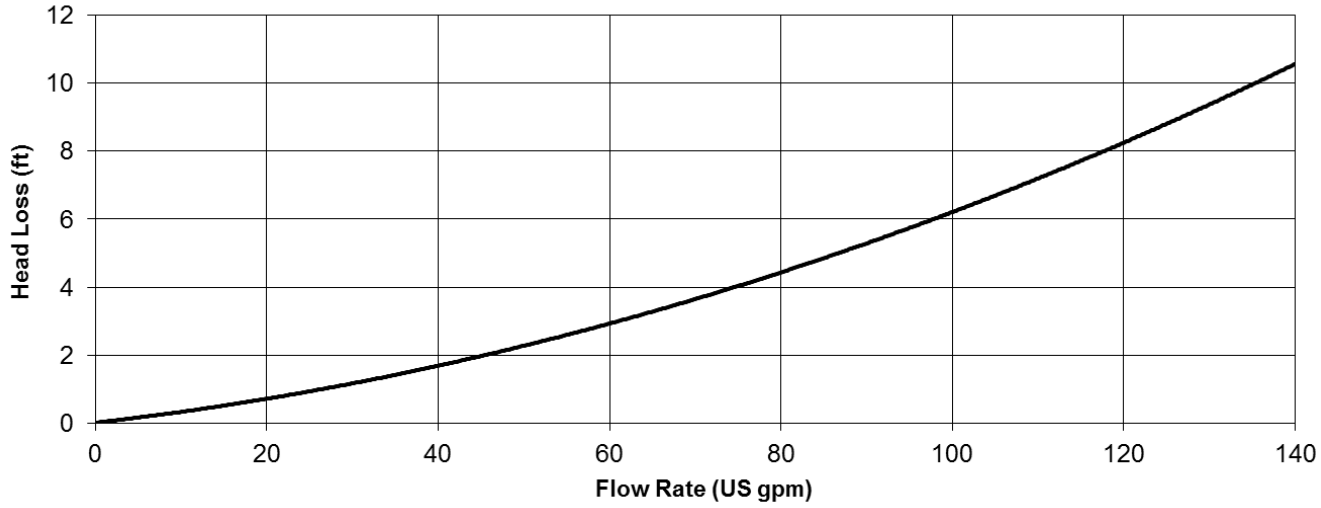
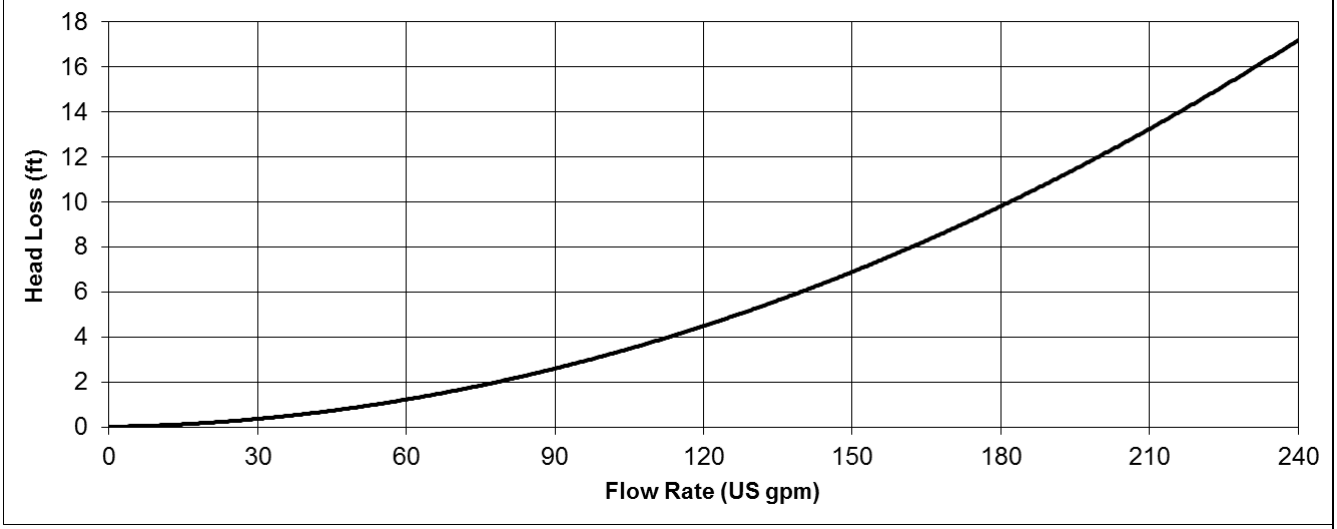


Figure 10-2(c) FTG 2000-2400 Head Loss Curve



Air Removal – The boiler and system plumbing layout must be configured to promote the removal of air from the water. Air vents and bleeders must be strategically placed throughout the system to aid in purging the air from the system during commissioning of the boiler. The system must also employ the use of a strategically located air removal device, such as an air-scoop or micro-bubbler, designed to remove the air from the water as it flows through the system.

NOTICE

Follow the installation instructions included with the air removal device when placing it in the system; air removal devices generally work better when placed higher in the system. Always locate air removal devices in areas of the system that have a guaranteed positive pressure, e.g., in close proximity to the water fill and expansion tank.

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 10-3 and 10-4.

⚠ CAUTION

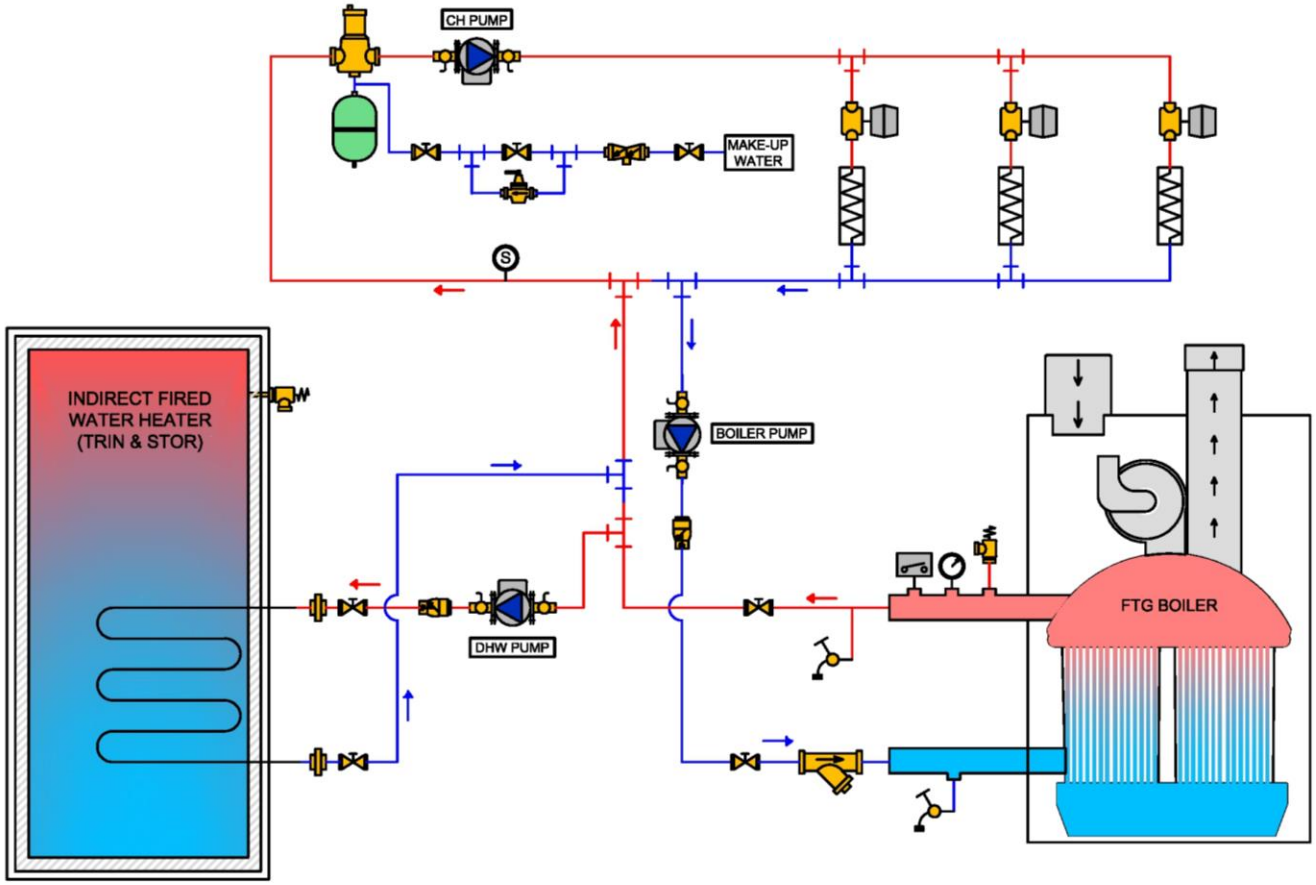
Ensure the expansion tank cannot become isolated from the boiler anytime the system is operating. The installation of flow checks, motorized valves or other shutoff devices (other than for the purpose of servicing) are not permitted between the outlet of the boiler and the expansion tank; see Figures 10-3 and 10-4. Failure to follow these instructions may result in discharge of the Pressure Relief Valve resulting in property damage or personal injury.

Indirect Water Heater (IWH) – When installed as per Figure 10-4, the indirect 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 10-3 and 10-4 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 10-3 Plumbing Schematic – Single Central Heating Circulator

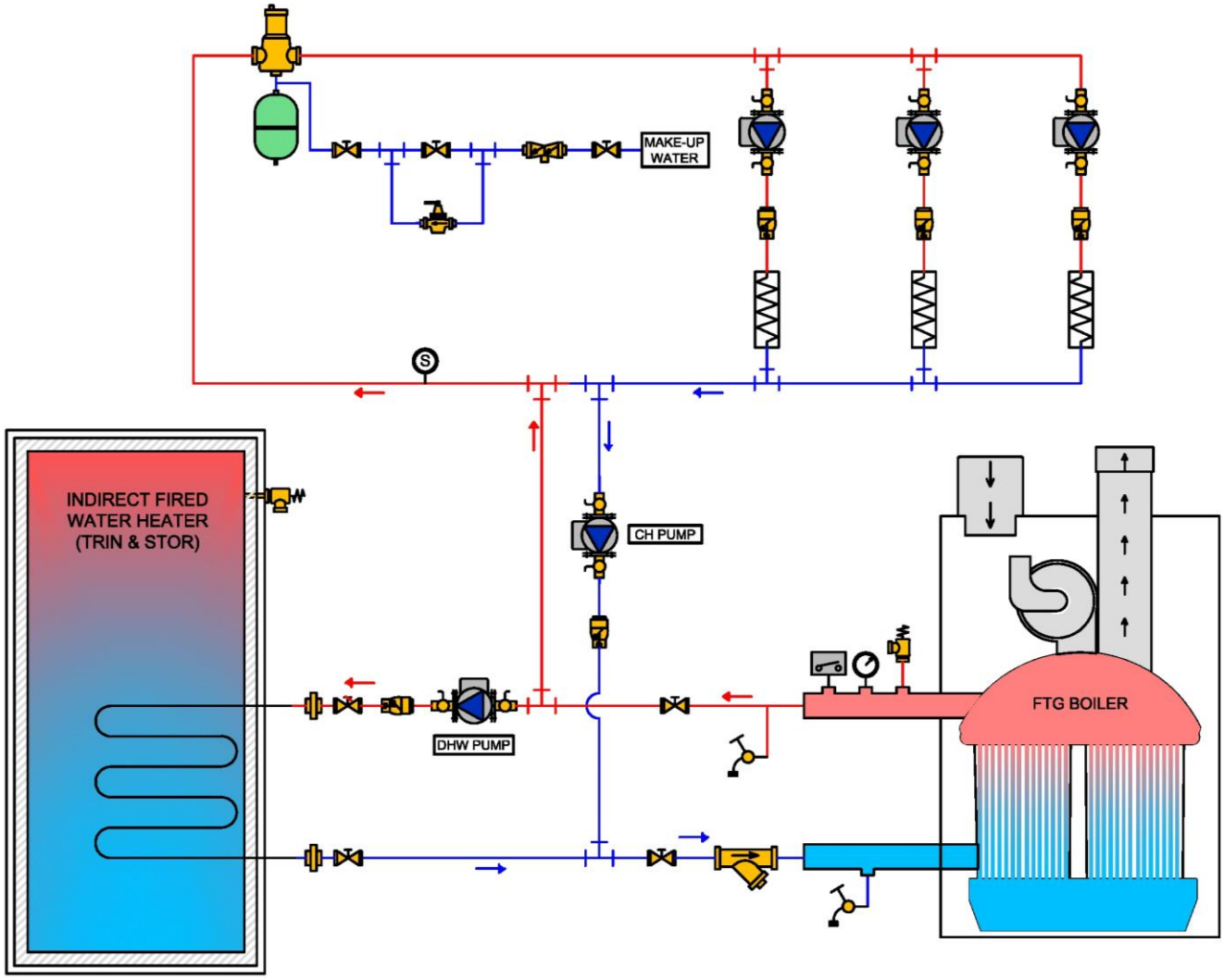


LEGEND							
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	central air seperator		isolation valve		check valve		lwco
	temp/press guage		circulator w/ isolation flanges		union	S	system sensor
	auto air vent		pressure reducing valve		strainer		zone load
	backflow preventor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

NOTICE

Figure illustrates the basic plumbing requirements for an FTG boiler installation with a single Central Heating circulator, and an Indirect Water Heater. Refer to Figure 10-1 for boiler fitting identification.

Figure 10-4 Plumbing Schematic – Multiple Central Heating Circulators



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

NOTICE

Figure illustrates the basic plumbing requirements for an FTG boiler installation with a multiple Central Heating circulators, and an Indirect Water Heater. Refer to Figure 10-1 for boiler fitting identification.

11.0 LEAD LAG INSTRUCTIONS

Multiple Boiler Applications

The FTG controller has the internal capacity to stage or Lead-Lag up to 8 boilers configured in a cascade. This Lead-Lag capability allows a designated "Master" boiler to communicate with and effectively control each boiler in a multiple boiler system. This function is accomplished by "Daisy Chaining" a 3-wire cable between each of the boilers and enabling the Master parameter in the boiler of your choice. The boiler with the Master parameter enabled becomes the single point of contact for Central Heating, Domestic Hot Water and Outdoor Reset settings and control wiring. Use the instructions detailed in this section to set-up and install the cascade boiler system; reference *Appendix A – Controller and Touchscreen Display Instructions* for details on more advanced settings and for assistance with navigating the touchscreen display.

Lead Lag Instructions - Common

Plumbing – install as many as 8 FTG boilers in parallel in a primary/secondary plumbing configuration as illustrated in Figure 11-1. Size common piping as per Table 11-1.

Boiler Pump – each boiler must have its own circulator (see Figure 11-1) which is controlled by its *BOILER PUMP* output; see *Field Wiring* Figure 12-2 and Table 12-1. The Boiler Pump must be sized according to Table 10-3.

Communication Wiring – using 3-wire cable, daisy-chain terminals *LL DATA +*, *LL DATA –* and *COMMUN. COM* of each boiler in parallel; see *Field Wiring* Table 12-2 and Figure 12-3.

System Sensor (Optional) – install a system sensor (NTI P/N: 84010) on the outlet (supply) pipe feeding the heating system, see Figure 11-1. Wire the system sensor to the *SYSTEM SENSOR* terminals of the Master Boiler; see *Field Wiring* Table 12-2 and Figure 12-3. The system sensor automatically becomes the modulation sensor for the boiler system, i.e. the control attempts to achieve setpoint temperature at the location of the sensor. If a system sensor is **NOT** used, at the Master boiler set the applicable sensor input to *Unconfigured* as follows:

Configure – Sensor Configuration – S10 (J10-7) sensor

Outdoor Sensor (Optional) – wire the outdoor sensor to the *OUTDOOR SENSOR* terminals of any one of the boilers in the cascade; see *Field Wiring* Table 12-2 and Figure 12-3. Note: only one outdoor sensor is needed for the multiple boiler system.

Modbus Address – assign a unique *MB2 Modbus Address* to each boiler in the cascade. Access the *MB2 Modbus Address* setting via the *System Identification & Access* menu as follows:

Configure – System Identification & Access – MB2 Modbus Address

Master Enable – choose **one** (and only one) boiler in the cascade to be the Master, this boiler will receive all control wiring and will be used for setting control parameters (see steps below). On this one boiler, set *Master enable* equal to *Enabled* via the *Lead Lag Master Configuration* menu, accessed as follows:

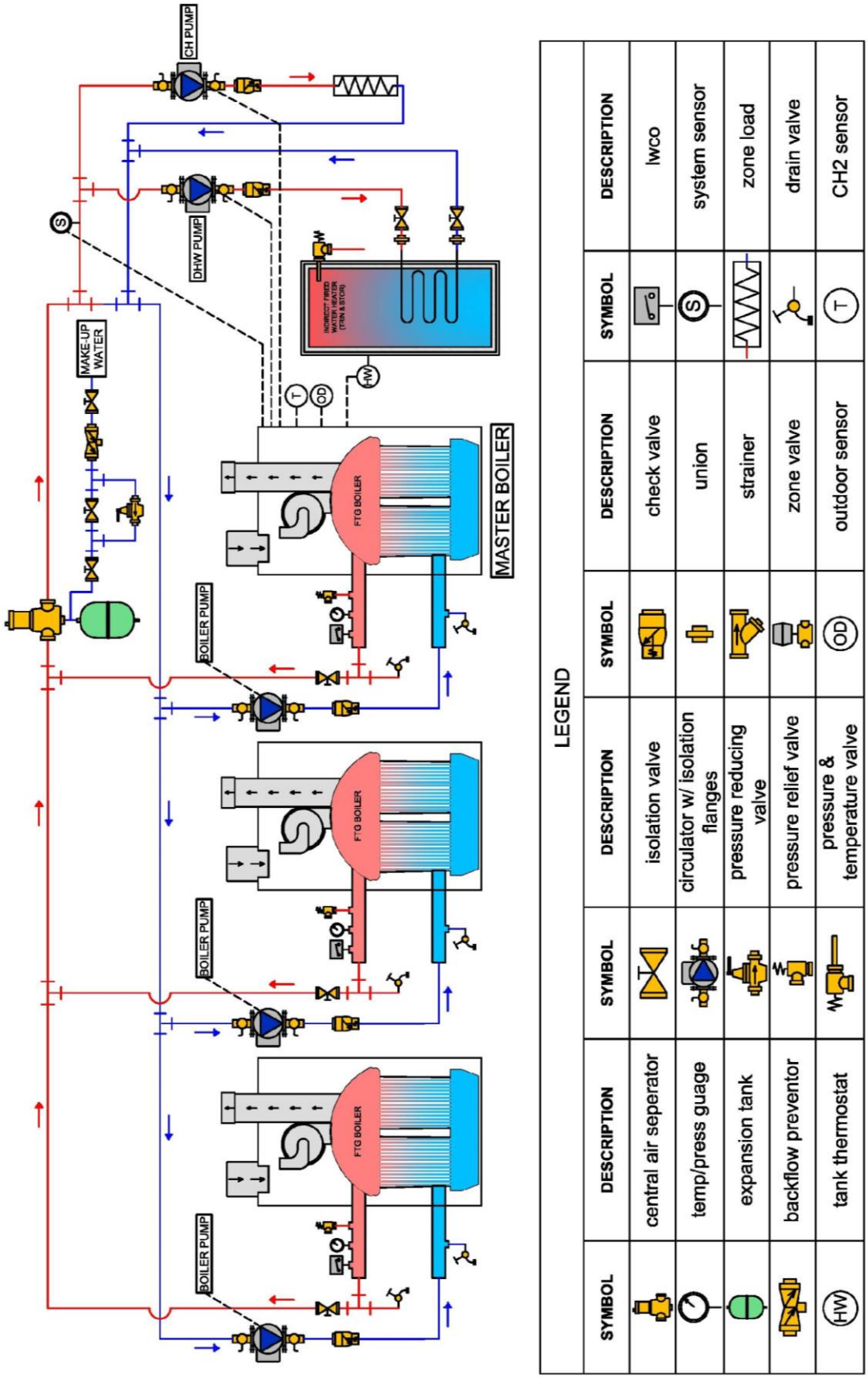
Configure – Lead Lag Master Configuration – Master enable

Table 11-1 Minimum Pipe Sizes for Multiple Boiler Applications

# of Units	Model						
	FTG 600	FTG 800	FTG 1200	FTG 1400	FTG 2000	FTG 2200	FTG 2400
2	3 in.	4 in.	4 in.	4 in.	5 in.	5 in.	5 in.
3	4 in.	4 in.	5 in.	5 in.	6 in.	6 in.	6 in.
4	4 in.	4 in.	5 in.	5 in.	6 in.	6 in.	8 in.
5	4 in.	5 in.	6 in.	6 in.	8 in.	8 in.	8 in.
6	5 in.	5 in.	6 in.	6 in.	8 in.	8 in.	8 in.
7	5 in.	5 in.	6 in.	8 in.	8 in.	8 in.	8 in.
8	5 in.	6 in.	8 in.	8 in.	8 in.	8 in.	8 in.

Note: Minimum pipe size based on assumed temperature rise of 25ºF at maximum firing rate.

Figure 11-1 Multiple Boiler Cascade – Plumbing Configuration



NOTICE	Figure illustrates the basic plumbing requirements for multiple FTG boilers installed in cascade configuration. Refer to Figure 10-1 for boiler fitting identification.

Lead Lag Instructions – Central Heating

Central Heat Demand Switch (Room Thermostat) – connect to *R (24VAC)* and *CH2 (LL)* of the Master Boiler; see *Field Wiring* Table 12-2 and Figure 12-3. Switch must be an isolated end switch (dry contact).

Central Heat Setpoint – at the Master boiler only, set the *CH setpoint* via the *Lead Lag Master Configuration* menu, accessed as follows:

Configure – Lead Lag Master Configuration – CH setpoint

Outdoor Reset Settings – at the Master boiler only, set the *Outdoor reset* parameters via the *Lead Lag Master Configuration* menu, accessed as follows:

Configure – Lead Lag Master Configuration – Advanced Settings – Outdoor reset

CH Pump – one boiler in the cascade can be chosen to operate the Central Heating pump via its *CH PUMP* output; see *Field Wiring* Figure 12-2 and Table 12-1. From the respective boiler display, check the box next to *Use for Lead Lag Master demands* for the CH Pump to ensure proper pump behavior. Menu access to the CH Pump parameters is as follows:

Configure – Pump Configuration – Central Heat pump – Use for Lead Lag Master demands

Lead Lag Instructions – Domestic Hot Water

Tank Thermostat – connect to terminals *DHW* of the Master Boiler; see *Field Wiring* Table 12-2 and Figure 12-3. Switch must be an isolated end switch (dry contact).

DHW Setpoint – at the Master boiler only, set the *DHW setpoint* via the *Lead Lag Master Configuration* menu, accessed as follows:

Configure – Lead Lag Master Configuration – DHW setpoint

DHW switch (Lead Lag) – at the Master boiler only, set *DHW switch* equal to *DHW (S6) sensor shorted* via the *Lead Lag Master Configuration* menu, accessed as follows:

Configure – Lead Lag Master Configuration – Advanced Settings – Domestic Hot Water – DHW switch

DHW enable (Local) – at the Master boiler only, set *DHW enable* equal to *Disabled* via the *Domestic Hot Water Configuration* menu, accessed as follows:

Configure – Domestic Hot Water Configuration – DHW enable

DHW Pump – one boiler in the cascade can be chosen to operate the DHW pump via its *DHW PUMP* output; see *Field Wiring* Table 12-1 and Figure 12-2. From the respective boiler display, check the box next to *Use for Lead Lag Master demands* for the DHW Pump to ensure proper pump behavior. Menu access to the DHW Pump parameters is as follows:

Configure – Pump Configuration – DHW pump – Use for Lead Lag Master demands

NOTICE

Tank Sensor – when operating in a cascade system, the boiler controls do not support the use of a tank sensor; a tank thermostat (switch) must be used.

12.0 FIELD WIRING

All wiring must be in accordance with the Canadian Electrical code, CSA C22.2 and any applicable local codes. Ensure that the wiring complies with this manual. The boiler must be electrically grounded in accordance with the National Electrical Code ANSI/NFPA 70, local codes, and/or the Canadian Electrical Code CSA C22.1.

Power Supply – The required power supply varies between boiler models; connect a power supply matching the description provided below for the respective boiler model:

- FTG 600-1400 – 120V / 1Ph / 60Hz, fused (or protected via a circuit breaker) to a maximum of 15 Amps.
- FTG 2000 – 120V / 1Ph / 60Hz, fused (or protected via a circuit breaker) to a maximum of 20 Amps.
- FTG 2200 – 208V / 3Ph / 60Hz, fused (or protected via a circuit breaker) to a minimum of 15 Amps.
- FTG 2400 – 240V / 3Ph / 60Hz, fused (or protected via a circuit breaker) to a minimum of 15 Amps.

⚠ WARNING — Failure to connect the correct power supply, fused as specified, 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.

⚠ WARNING — **Wire Protection** - When passing any wiring through the cabinet of the boiler, the installer must use wire grommets, or strain reliefs, 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.

Line Voltage Connections

Line voltage field wiring enters the back of the boiler through strain reliefs (field supplied), then routes internally via a chase-way on the right-hand side of the boiler, to the line voltage junction box located at the front of the boiler on the right-hand side. Remove the Front and Top-Front panels to access the junction box and chase-way; see Figure 12-1. Secure field wiring to the chase-way using the factory supplied wire supports. Terminate line voltage field wiring in accordance with instructions provided in Figure 12-2 and Table 12-1.

FTG 2200-2400 – the 3-phase power supply connects at a factory installed disconnect switch at the back of the boiler; see Figure 12-1. From the disconnect, the 3-phase wiring is factory routed internally to a Fuse Block where it is distributed to the combustion blower and 120V transformer; see Figure 12-2. **NOTICE:** 120V is factory wired to the Line Voltage Junction Box.

Pump Relays – The FTG incorporates three non-powered isolation relay contacts for switching high capacity pumps. Contact Secondary Maximum rating is 1.5HP @ 120V, 3.0HP @ 240V, or 30A. Refer to Figure 12-2 for Field Wiring requirements.

Low Voltage Connections

Low voltage field wiring enters the back of the boiler through grommets (factory supplied), then routes internally, via a chase-way on the left-hand side of the boiler, to the low voltage junction box located at the front of the boiler on the left-hand side. Remove the Front and Top-Front panels to access the junction box and chase-way; see Figure 12-1. Secure field wiring to the chase-way using the factory supplied wire supports. Terminate low voltage field wiring in accordance with instructions provided in Figure 12-3 and Table 12-2.

Figure 12-1 Wiring Terminal Access

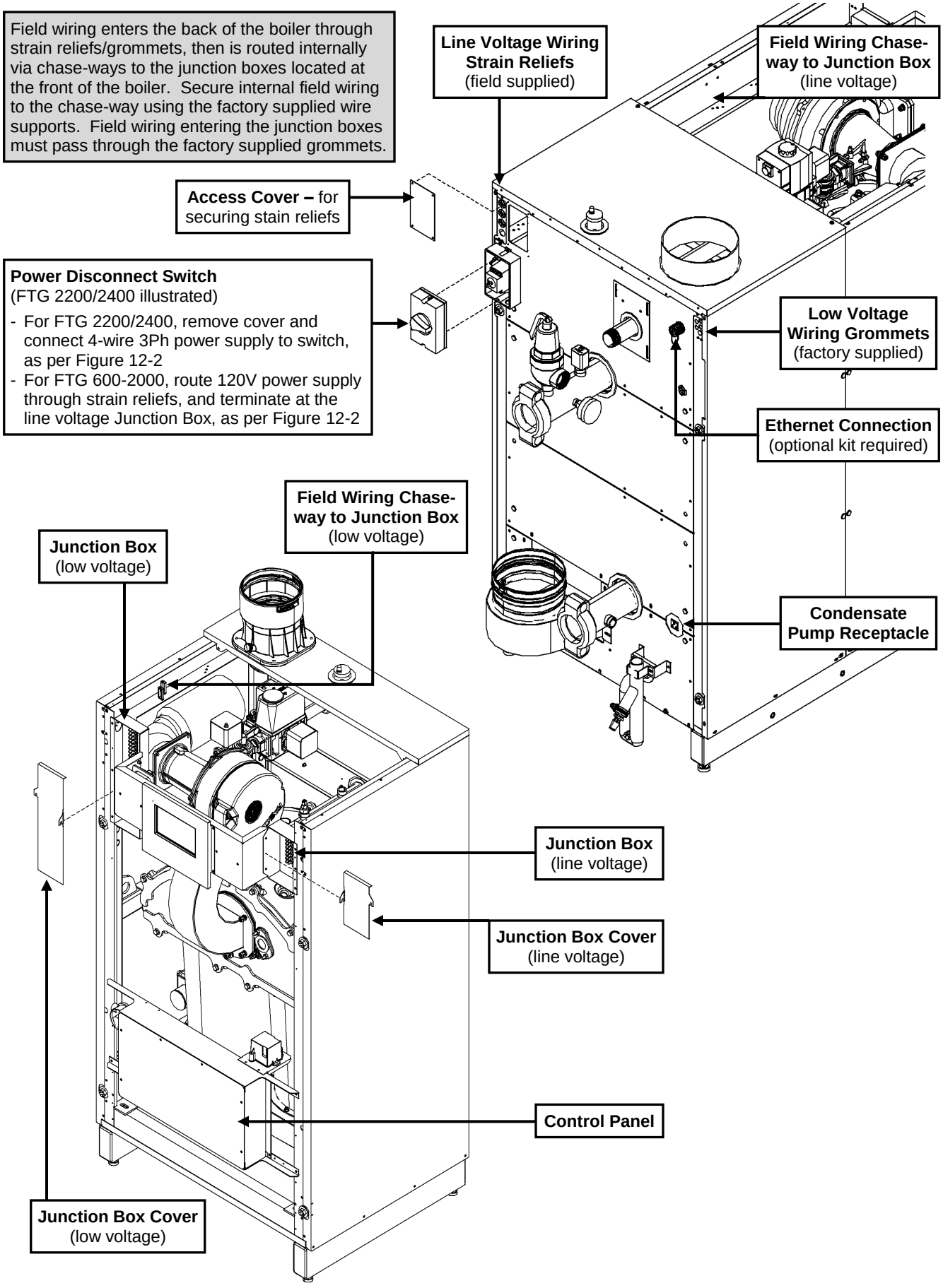


Figure 12-2 Line Voltage Field Wiring

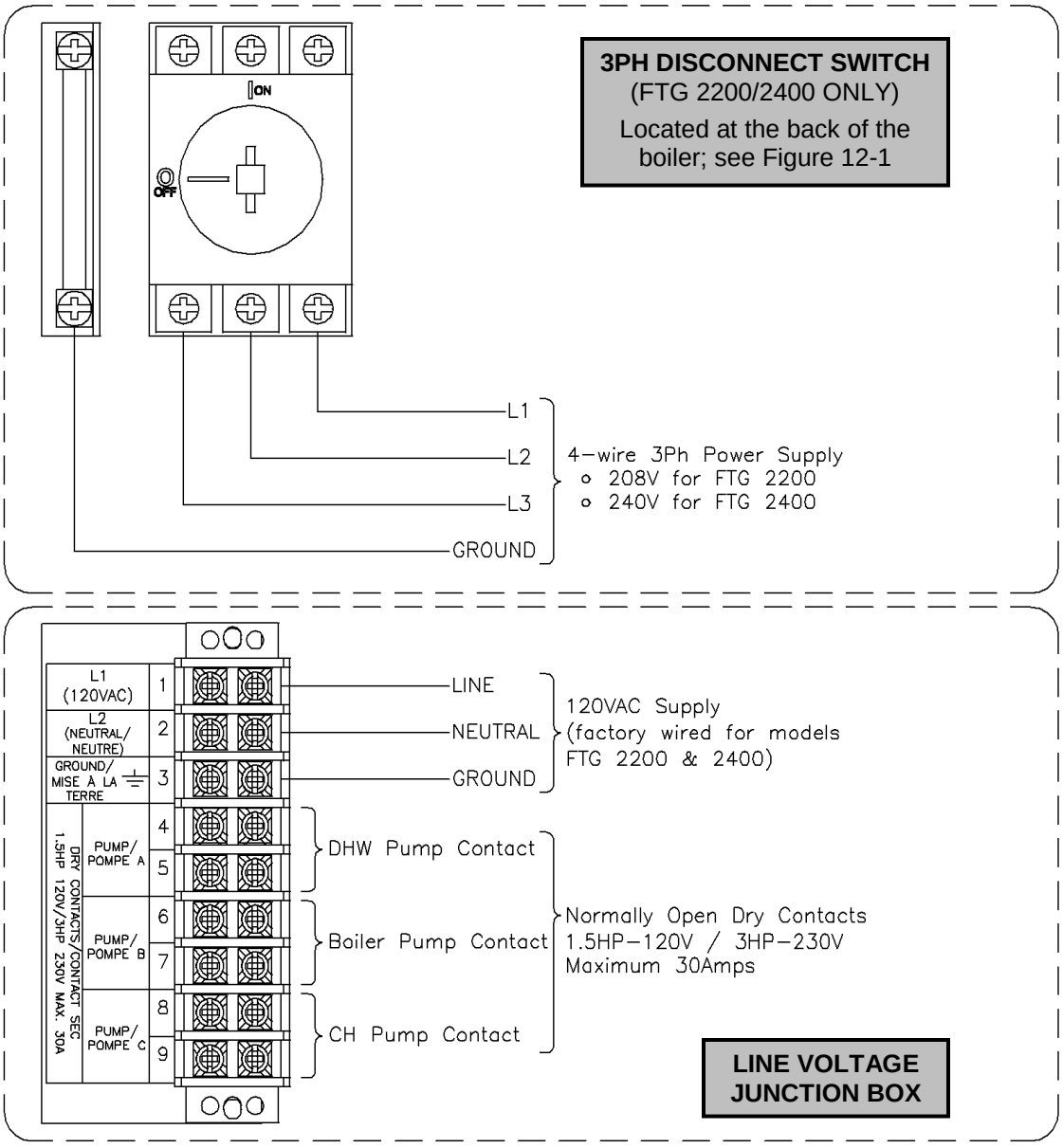


Table 12-1 Line Voltage Field Wiring Connections

Connection		Location	Description	
L1 (120VAC)		1	Location for connecting line wire of 120V power supply.	**NOTICE:** 120V power supply is factory wired for models FTG 2200 & 2400.
L2 (Neutral)		2	Location for connecting neutral wire of 120V power supply.	
GROUND		3	Location for connecting earth ground.	
Non-Powered (Dry Contacts)	DHW PUMP (PUMP A)	4	**DHW Pump Relay** – Normally Open Dry Contact for DHW circulator; contact closes during a demand for DHW. Maximum rating is 1.5HP @ 120V, 3.0HP @ 240V, or 30A.	
		5		
	BOILER PUMP (PUMP B)	6	**Boiler Pump Relay** – Normally Open Dry Contact for Boiler circulator; contact closes during all demands. Maximum rating is 1.5HP @ 120V, 3.0HP @ 240V, or 30A.	
		7		
	CH PUMP (PUMP C)	8	**CH Pump Relay** – Normally Open Dry Contact for Central Heating circulator; contact closes during a demand for CH. Maximum rating is 1.5HP @ 120V, 3.0HP @ 240V, or 30A.	
		9		

Figure 12-3 Low Voltage Field Wiring

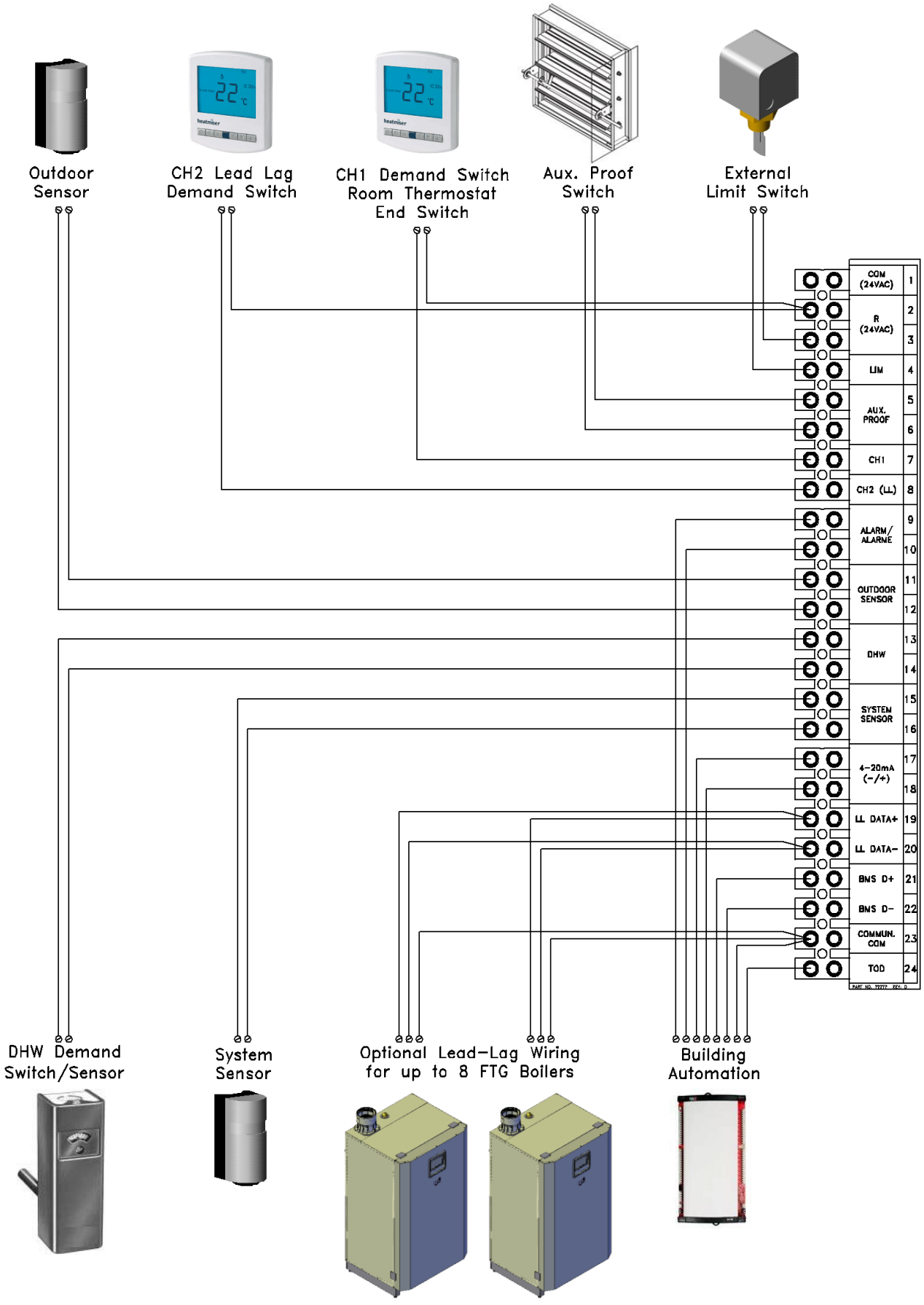


Table 12-2 Low Voltage Field Wiring Connections

Connection	Location	Description
COM (24VAC)	1	**24VAC Common** – Neutral for the 24VAC power supply from the boiler. COM can be used in conjunction with terminal R to provide a power source for a digital thermostat.
R (24VAC)	2	**24VAC Hot** - Power supply for inputs EXT. LIMIT, CH1, and CH2 (LL).
	3	
EXT. LIMIT	4	**External Limit** – Input requiring 24VAC from R-terminal to permit the burner to operate. Comes factory equipped with a jumper to the R-terminal. For installations requiring the use of an additional safety switch, such as a Flow Switch or auxiliary temperature limit, remove the factory installed jumper and install the normally open isolated contacts of the field supplied additional limit.
AUX. PROOF	5	**Auxiliary Proof** – Comes factory equipped with a jumper. For applications using Indoor Combustion Air, remove jumper and replace with field supplied end switch incorporated with motorized damper/louver control.
	6	
CH1	7	**Central Heat Demand** (Local) – Input requiring 24VAC from R-terminal to initiate a "local" CH call. Switch is made using an isolated end switch (dry contact) via thermostat, zone controller or other device. Typically used as the lone heat input or as the high temperature input in dual CH temperature systems.
CH2 (LL)	8	**Central Heat Demand** (Lead-Lag) – Input requiring 24VAC from R-terminal to initiate a "lead-lag" CH call. Switch is made using an isolated end switch (dry contact) via thermostat, zone controller or other device. Typically used as a lead-lag input for cascaded boilers or as the low temperature input in dual CH temperature systems.
ALARM	9	**Normally Open Alarm Contacts** – Contacts close during a lockout or other alarm condition. May be connected to a BMS, maximum capacity of 0.63Amps at 24VAC.
	10	
OUTDOOR SENSOR	11	**Outdoor Temperature Sensor** – A wall mountable OD Sensor is included with each boiler. When connected to terminals 11 and 12, the control will indicate the outdoor temperature and adjust the boiler temperature set point during a Central Heat demand.
	12	
DHW	13	**DHW Tank Demand** – Input requiring closure of terminals 13 and 14 to initiate a demand for DHW. Switch made via isolated end switch (dry contact) from a thermostat (aquastat) located in an Indirect Water Heater, or optional Tank Sensor (P/N 84632), see Appendix A. (**NOTICE**: tank sensor cannot be used for cascade boiler arrangements).
	14	
SYSTEM SENSOR	15	**System Water Temperature** – An optional strap-on System Sensor is available from NTI (P/N 84010). When connected to terminals 15 and 16, the control will indicate a "CH" or "Lead-Lag" temperature, which can be used for direct modulation of system temperature. By default, the System Sensor becomes the Modulation Sensor for a Lead Lag demand.
	16	
4-20mA (– / +)	17	**External Modulation Control** – Using a 4-20mA signal, an external control can be used to directly modulate the burner firing rate or adjust the active set point. This can be useful for applications using external staging controls or BAS.
	18	
LL DATA+	19	**Lead-Lag** – Connects internally to the controller's MB2, Modbus communication port. Terminals 19, 20 and 23 (COMMUN. COM) can be "daisy-chained" to multiple boilers (up to 8 in total) for the purpose of staging.
LL DATA-	20	
BMS D+	21	**Building Management System (BMS)** – Connects internally to the display's COM2, Modbus communication port. Terminals 21, 22 and 23 (COMMUN. COM) can be connected to a Gateway for communication to a BMS or other device.
BMS D-	22	
COMMUN. COM	23	**Communication Common** – Common port for LL and BMS Communication wiring, as well as the TOD input.
TOD	24	**Time of Day (Night Time Setback)** – Input requiring closure of terminals 24 and 23 (COMMUN. COM) to initiate TOD setback settings. Switch is made using an isolated end switch (dry contact) using a timer, BAS or other device.

13.0 WIRING SCHEMATICS

Figure 13-1 FTG Connection Diagram

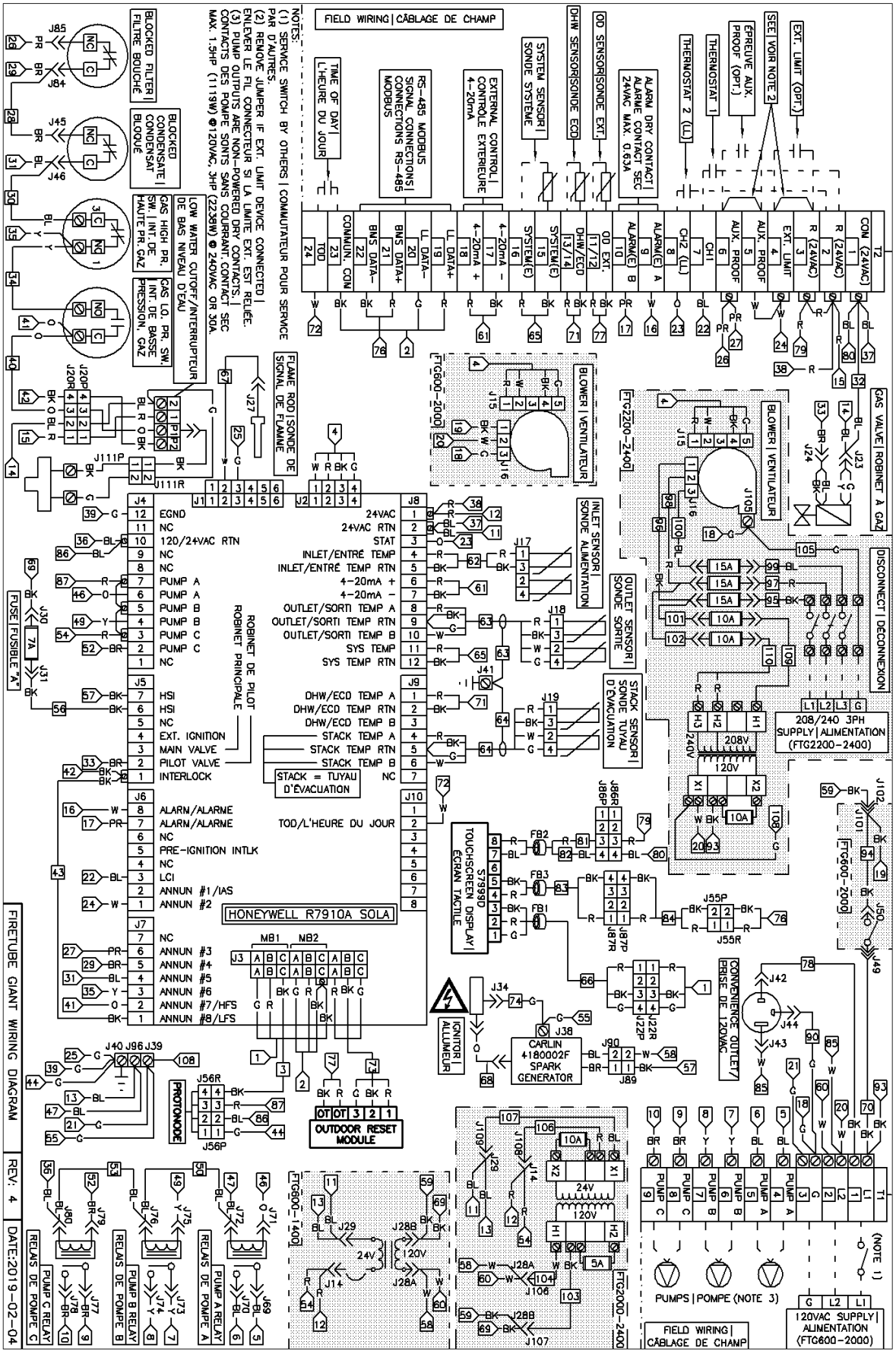
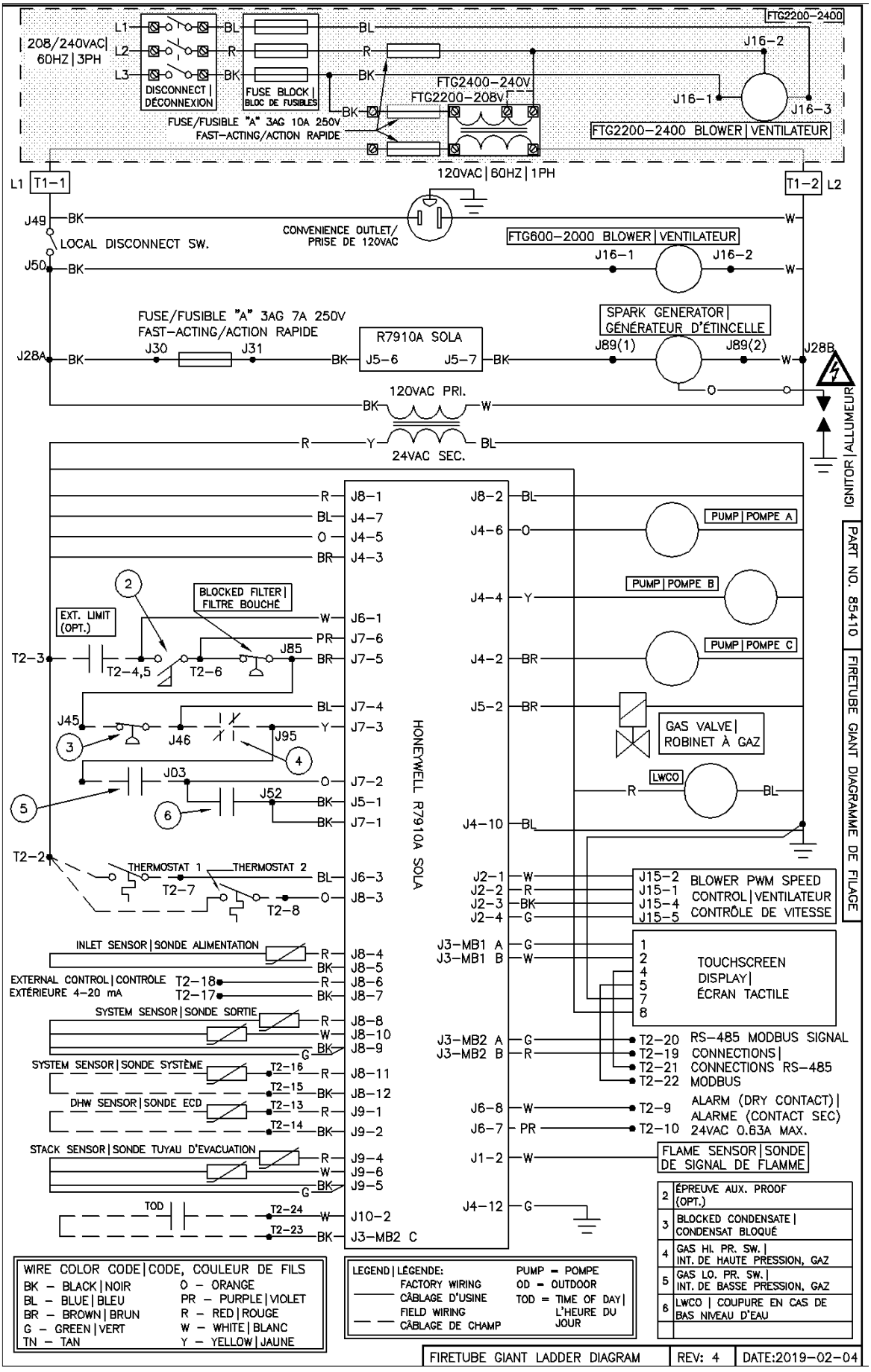


Figure 13-2 FTG Ladder-Logic Diagram



14.0 INSTALLATION CHECKLIST

Installation

- ☐ 1. If operating on Propane Gas, convert boiler using the applicable *Natural Gas to LP Conversion Instructions*.
- ☐ 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. Seal the Line Pressure Test Port fitting on the inlet flange of the gas valve;, test for leaks. See Section 9.0.
- ☐ 2. Install flue gas test port plug 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.

15.0 ANNUAL MAINTENANCE AND INSPECTION

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

Annual Inspection Checklist

- ☐ 1. Lighting is smooth and consistent, and the combustion fan is noise & vibration free.
- ☐ 2. The condensate drain flows freely, and is cleaned of sediment.
- ☐ 3. Pressure Relief Valve and air vents are not weeping.
- ☐ 4. Low water cut off is tested (remove and clean a minimum of once every 5 years, see Section 10.0)
- ☐ 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 cleaned (cleaning frequency based on need for application – see below)
- ☐ 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.

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 Instructions (contact NTI for a more detailed procedure)

1. **Power Down** – Remove the demand for heat, allow the post-purge cycle to finish, turn gas and power supply off. Ensure the combustion chamber has cooled before proceeding.
2. **Remove Display Assembly** – Working inside the cabinet, disconnect tubing and wiring from the display assembly, remove the display assembly as a whole, leaving the junction boxes attached to the boiler cabinet.
3. **Remove Blower, Venturi & Transfer-tube as an Assembly** – Disconnect wiring from the Blower, unbolt the gas-line and remove tubing from the Venturi, and then disconnect the Transfer-tube for the Burner Door. Remove the Blower, Venturi and Transfer-tube as an assembly. Be careful not to damage or misplace any of the gaskets – replace if damaged.
4. **Remove Burner** from the Burner Door; be careful not to damage the gasket – replace if damaged. Inspect burner for signs of damage – do not re-use a damaged burner.
5. **Remove Burner Door –** Disconnect wiring from the ignition and flame sensing electrodes, remove the 12 nuts/bolts securing the door to the heat exchanger. Remove the Burner Door, being careful not to damage the combination gasket/insulation on the inside of the door – replace if damaged.
6. **Remove Rear Combustion Chamber Door (if necessary) –** From the rear of the boiler, remove the screws securing the middle access panel to the back of the boiler cabinet. Remove the 12 nuts/bolts securing the rear door to the heat exchanger and remove the door; be careful not to damage the combination gasket/insulation on the inside of the door – replace if damaged.
7. **Inspect Combustion Chamber** – Assess the level of debris inside combustion chamber and at the entrance to the flue passageways; future cleanings should be scheduled based on this assessment.
8. **Clean Combustion Chamber** – Vacuum any loose debris or dust, then 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 back. 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.

9. **Condensate Trap** – Disassemble the condensate trap and thoroughly clean it; then reassemble and securely connect it to the boiler condensate drain, see Section 6.0.
10. **Reassemble** – Assembly is in the reverse order as disassembly. Inspect all gaskets and insulation prior to assembly – replace if damaged.
11. **Perform the Start-up and Operational Checklist** – See Section 14.0.

⚠ WARNING Replace gaskets and insulation that show any signs of damage – **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 15-1 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 15-1 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 15-1 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.

[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.

16.0 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.

Internal Fusing

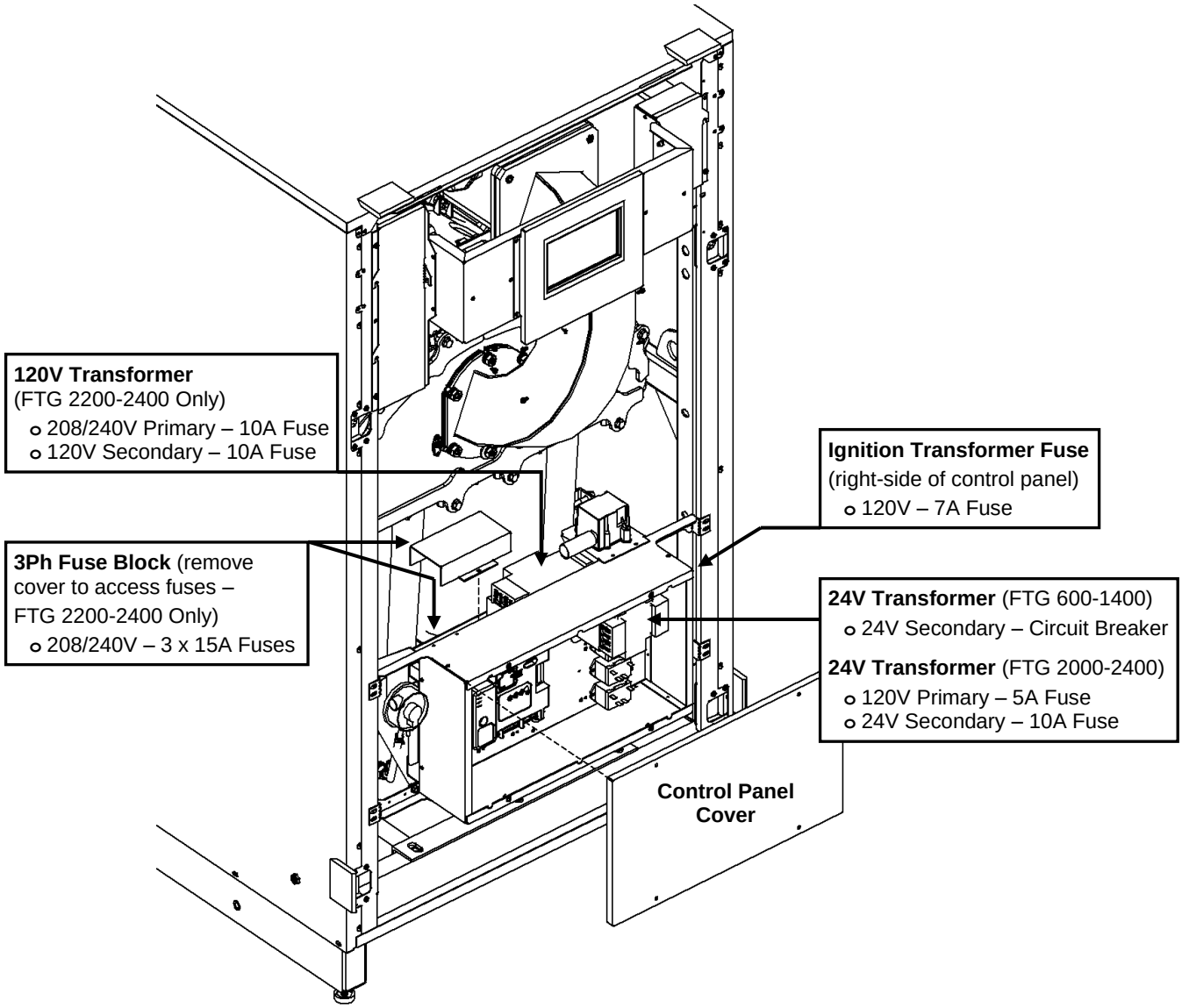
The power supply to the FTG boiler must be externally fused (or protected via a circuit breaker) according to its rating plate. In addition, each FTG integrates internal circuit protection, as defined in Table 16-1.

Table 16-1 Internal Circuit Protection – Fusing

Applicable Models	Description	Location	Component(s) Fused
FTG 600-2400	Ignition Transformer (120V, 7A)	Right side of control panel	Ignition Transformer
FTG 600-1400	24V Transformer (24V, 3A – Circuit Breaker)	24V Transformer (on control panel)	All 24V Components: - Control board - Touchscreen display - Gas Valve - Limit switches - Thermostat circuit - Pump Relays
FTG 2000-2400	24V Transformer – Secondary (24V, 10A)	Secondary/left-side of 24V Transformer (on control panel)	
	24V Transformer – Primary (120V, 5A)	Primary/right-side of 24V Transformer (on control panel)	24V Transformer
FTG 2200-2400	120V Transformer – Primary (208/240V, 10A)	Primary/left-side of 120V Transformer (behind control panel)	120V Transformer
	120V Transformer – Secondary (120V, 10A)	Secondary/right-side of 120V Transformer (behind control panel)	All 120V Components: - 24V Transformer - Ignition Transformer - Convenience Outlet - L1 120V Power Supply to Line Voltage Junction Box
	3Ph Fuse Block (208/240V, 15A, X 3)	3Ph Fuse Block, left of 120V Transformer (behind control panel)	All 208/240V Components: - Combustion Blower - 120V Transformer

Note:
[1] Refer to Figure 16-1 for locating internal fusing.

Figure 16-1 FTG Internal Fusing



WARNING **SHOCK HAZARD** – Failure to turn the power supply off at the source prior to accessing and testing fuses may result in electrical short causing component failure, fire and property damage, or electrical shock causing serious injury or death.

WARNING Only replace fuses with identical parts, see Figure 16-1. Failure to follow this warning may result in component failure, fire, property damage, serious injury or death.

Summary and Diagnostics Display – The FTG controller and Touchscreen display provides detailed operational and diagnostic information for aid in troubleshooting. When power is applied to the appliance the initial page displayed is the Summary page. Information presented on the Summary page includes Demand source, Burner state, status of sensors and pumps, and so forth. Any current Alert or Lockout condition is also displayed. Accessible from the Summary page are the Configuration, Diagnostics, Details and History pages. Refer to ***Appendix A - Controller and Touchscreen Display Instructions*** for more information.

Lockout and Alert History – The controller maintains a record of the fifteen (15) most recent events for both Lockouts and Alerts. To display the logs, touch the History button on the Summary page (refer to ***Appendix A - Controller and Touchscreen Display Instructions***). In any situation where a malfunction is suspected, always check the Alerts and Lockouts history. Entries recorded in the history provide useful information for determining the cause of the malfunction.

Table 16-2 Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Burner not operating	Heat demand satisfied; no call for heat	Check Demand and Setpoints via Touchscreen. Check thermostat and DHW aquastat settings (as applicable).
	Appliance outlet temperature exceeds "Setpoint - On Hysteresis"	Check outlet temperature, setpoint and hysteresis settings via Touchscreen.
	Hold, Delay or Lockout	Check Summary page on Touchscreen for code.
	Burner switch off	Check Summary page, if Demand indicates "Burner switch off" go to diagnostics burner test page and switch on.
Lockout 2 – Waiting for safety data verification	Safety parameter(s) has been adjusted	Changing settings that are considered safety parameters require "Safety data verification". Refer to Appendix A.
Lockout 9 – Flame bias out of range	4-20mA input being overdriven.	If using 4-20mA input, check to ensure current is not greater than 21mA.
	Control malfunction	Cycle power, if problem returns replace control.
Hold 27 – Flame sensor shorted to ground detected	A flame circuit shorted to ground may show up as a flame circuit timeout. Zero-Ohm shorts can display as Hold 27.	Check to ensure condensate drain is not blocked. Check to ensure no external voltage is applied to R & CH terminals. If using 4-20mA input, check to ensure current is not greater than 21mA.
Hold 61 – Anti short-cycle	Normal operation	Allow timer to expire, or reduce Anti short-cycle setting as needed (See Appendix A)
Hold 62 – Fan speed not proved	Normal Operation (Drive to Lightoff)	Hold 62 is momentarily displayed prior to burner ignition during the Drive to Lightoff.
	Wiring defect	Inspect blower wiring, ensure connectors at Sola controller and blower are securely attached.
	- Faulty Sola controller - Faulty Blower	If Hold 62 persists for 15 seconds or more, while the blower is running, check "Fan speed" indicated on display. If "LOW RPM", "HIGH RPM", "0" or rapidly changing RPM value is displayed, try connecting another Sola controller. If problem remains, replace blower.
Hold 63 – LCI OFF (Limit control input)	Incorrect Sola controller.	Replace control with correct model (Replacement part number 85421)
Hold 65 – Interrupted Air Switch OFF	Incorrect Sola controller.	Replace control with correct model (Replacement part number 85421)
Hold 66 – Interrupted air switch ON	Incorrect Sola controller.	Replace control with correct model (Replacement part number 85421)
Hold / Lockout 67 – ILK OFF	LWCO Switch	Low Water Cutoff switch has opened – check for proper water level and pressure; ensure the air is adequately purged from the boiler system. Reset the LWCO then clear lockout. If error continues, clean LWCO probe or replace LWCO.
	Bloc'd Condensate Switch	Blocked Condensate Switch has opened – condensate is not draining from the boiler, or the exhaust venting is too restrictive or has a blockage. Check for blockages in the condensate trap and drain; clean accordingly. If drain is not blocked, check for blockages/restrictions in the exhaust venting, then clear the lockout.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
	Bloc'd Filter Switch	Blocked Air Filter Switch has opened – clean or replace the air filter and clear the lockout. **WARNING: DO NOT OPERATE THE BOILER WITHOUT THE AIR FILTER, CONTAMINANTS WILL ENTER THE BURNER RESULTING IN IMPROPER OPERATION LEADING TO PROPERTY DAMAGE, PERSONAL INJURY OR DEATH.**
	Lo Gas Pres. Switch	Low Gas Pressure Switch has opened – the incoming gas line pressure has dropped below 3.5 in. w.c., causing the low gas pressure switch (mounted to the side of the gas valve) to open. Correct gas line pressure problem then clear the lockout.
	Hi Gas Pres. Switch	High Gas Pressure Switch has opened – the gas valve manifold pressure exceed 3 in. w.c., causing the high gas pressure switch (installed down-stream of the gas valve) to open. CONTACT NTI FOR ASSISTANCE
	Ext. Limit Switch	An External Limit Device (field installed and wired to the "Ext. Limit" contact of the boiler) has opened. Not a problem with boiler, check the external limit device.
	Aux. Proof Switch	Auxiliary Proof Switch (field installed and wired to the "Aux. Proof" contact of the boiler) has opened. Not a problem with the boiler, check the auxiliary proof switch.
Lockout or Hold 79 – Outlet High Limit	CH or DHW settings	Check if CH and/or DHW setpoint temperature plus off hysteresis exceed "High limit" setpoint – factory setting = 210°F (99°C).
	CH or DHW pump problem	See "Inoperative CH or DHW pump" below.
	Incorrect "Outlet high limit" setting	Increase "Outlet high limit" setting; maximum setting = 210°F (99°C).
Lockout or Hold 81 – Delta T limit OR Appliance making banging or hissing sounds	Insufficient water flow	• Check appliance pump. • Ensure plumbing is correct. Refer to Section 10.0 System Piping. Check that water pressure is at least 15PSI. • Boiler heat transfer surfaces may be fouled with scale or magnetite. Clean with Fernox DS-40 Descaler and Cleanser. See Table 10-1.
Lockout 82 – Stack limit	Dirty heat exchanger	Inspect and if required clean the combustion chamber and/or heat exchanger. Refer to Section 15.0 Annual Maintenance and Inspection and Section 10.0 Boiler and Heating System Piping.
	Incorrect "Stack limit setpoint"	Unless installed in Canada with PVC exhaust venting, set "Stack limit setpoint" to maximum setting of 220ºF (104ºC). In Canada PVC exhaust venting is limited to 149ºF (65ºC).
	Faulty sensor	Check resistance of sensor and compare to thermistor resistance chart, see Table 16-2.
Lockout or Hold 85 – Inlet/Outlet Inversion Limit	Pump flowing in the wrong direction	Ensure water circulation through the boiler is in the correct direction, see Figure 10-1.
	Incorrect factory sensor wiring	Disconnect flue sensor cable; screen should display "Hold 95 – Stack sensor fault"; if not contact NTI.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Lockout or Hold 88 – Outlet T Rise limit	Insufficient water flow	See Lockout or Hold 81.
Hold 91– Inlet sensor fault	Sensor disconnected	Check sensor connection located on the bottom of the heat exchanger. Check connection on control board.
	Faulty sensor	Check resistance of sensor and compare to thermistor resistance chart, see Table 16-2.
Hold 92 – Outlet sensor fault	Sensor disconnected	Check sensor connection located on the top of the heat exchanger. Check connection on control board.
	Faulty sensor	Check resistance of sensor and compare to thermistor resistance chart, see Table 16-2. (Note the Outlet sensor incorporates two sensors, check resistance individually.)
Hold 95 – Stack sensor fault	Sensor disconnected	Check sensor connection located at the bottom of the flue pipe inside the boiler cabinet. Check connection on control board.
Hold 95 – Stack sensor fault	Faulty sensor	Check resistance of sensor and compare to thermistor resistance chart, see Table 16-2. (Note the Outlet sensor incorporates two sensors, check resistance individually.)
Lockout 109 – Ignition failure occurred	Incorrect spark igniter gap or faulty spark igniter	Check spark igniter gap – gap between electrodes should be 3/16 to 1/4 inch.
	Spark cable disconnected	Ensure that the high voltage spark cable is securely connected to the spark generator and the igniter electrode. Check that the green ground wire is securely attached to the ¼" quick connect tab on the igniter electrode.
	Blocked venting	Check for blockage of the exhaust-vent, air-inlet, combustion blower, gas valve venturi, burner heat exchanger etc.
	Blocked condensate drain.	Clean condensate trap, inspect condensate drain for blockages and build-up – correct accordingly.
	Insufficient gas line pressure	Ensure the manual gas shutoff valve is open. Refer to Section 9.0 GAS VALVE AND BURNER SETUP.
	Flame sensor disconnected	Verify that the flame rod signal wire is securely attached to the flame rod and the Sola controller.
	Blown fuse – see Figure 16-1	Check ignition transformer fuse (see Figure 16-1) – replace as necessary. If still no 120 VAC at ignition transformer during trial for ignition – check electrical connections at Sola controller (J5-6 & 7).
	Faulty Spark Generator	During trial for ignition check for arc on spark electrode via the observation port located next to the spark electrode in the burner door. If the spark generator is receiving 120VAC and no spark is observed, replace the spark generator.
	No 24VAC to Gas Valve	Check the wiring harness for loose or interrupted connections of the gas valve wiring. With an AC voltmeter, measure the voltage between Sola controller terminals J5-2 to J4-10. There should be 24VAC present during trial for ignition, if not replace Sola controller.

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
	Faulty Gas Valve	The gas valve emits an audible click when it switches on or off. If the Sola controller is providing 24VAC to the gas valve, and the wiring is intact, it should be possible to detect if the valve is responding.
Lockout 113 – Flame circuit timeout	A flame circuit shorted to ground may show up as a flame circuit timeout. High resistance shorts can display as Lockout 113.	Check to ensure condensate drain is not blocked. Check to ensure no voltage is applied to R & CH terminals. If using 4-20mA input, check to ensure current is not greater than 21mA.
Lockout 122 – Lightoff rate proving failed Lockout 123 – Purge rate proving failed	Blower is not turning on	See "Blower not operating" below.
	Missing or incorrect blower feedback signal	See Hold 62 above.
	Blower is always on	See "Blower operating at high speed while burner is off" below.
Alert 128 - Modulation rate was limited due to IAS open	Incorrect Sola controller.	Replace control with correct model.
Hold 137 – ILK failed to close	See Hold / Lockout 67	
Lockout 138 – Flame too low	Blocked venting	Check for blockage of the exhaust-vent, Air-inlet, combustion blower, gas valve venturi, heat exchanger etc.
	Fowled or faulty flame sensor	Inspect flame sensor for cracks of fowling, clean or replace as necessary.
	Incorrect combustion settings	Check combustion settings, correct accordingly.
Lockout 173 - Pilot relay feedback incorrect Lockout 174 – Safety relay feedback incorrect	External Electrical Noise	Look for sources of electrical noise, i.e. a large motor or multiple pieces of equipment starting at the same time.
	Failing Limit Switch in ILK circuit	Check operation of internal LWCO, and/or external limit (i.e. devise connected between "R" and "LIM"); replace as necessary
	Hardware failure of Sola controller	Reset power, If problem persists replace Sola controller.
Alert 206 – Lead Lag header temperature was invalid	System Sensor not connected	If desired, install System Sensor and wire to SENSOR input connections "SYSTEM" and "COM". Otherwise ignore Alert 206
Alert 233 – Lead Lag outdoor temperature was invalid	See Alert 248	
Alert 248 – CH outdoor temperature was invalid	Outdoor sensor not connected	The FTG is factory set with Outdoor Reset enabled. Connect outdoor sensor or disable Outdoor Reset.
	Outdoor sensor wiring	Check wiring of outdoor sensor. Wires should connect to SENSOR inputs "OUTDOOR" and "COM".
	Faulty sensor	Check sensor. Should be free of ice and snow. Check resistance of sensor and compare to thermistor resistance chart, see Table 16-2.
Alert 448 – Flame too low	Blocked venting, dirty heat exchanger, failing flame sensor, poor combustion settings.	Indicates that the burner had to shut down due to insufficient flame signal. If Alert persists, refer to Lockout 138.
Alert 449 – Modulation rate was limited due to flame strength	Normal operation	Indicates that the minimum permissible modulation rate was temporarily increased due to low flame signal strength. If Alert persists, refer to Lockout 138.
Inoperative CH and/or DHW	Blown fuse	Check Fuse "B".

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
pump	Faulty Sola controller	If Fuse "B" not blown, and Sola controller is operating, navigate to pump diagnostic on display. Manually switch pump on, check for 120VAC at pump connection terminal on line voltage barrier strip. If 120VAC not detected, replace Sola controller.
	Faulty pump	If 120VAC supplied to pump, and pump does not operate, replace pump.
Blower operating at high speed while burner is off	Blower signal cable disconnected	• Verify that the 5-position Molex connector on the wiring harness is securely connected to its mating connector on the blower. • Check that the 4-position Molex connector on wiring harness is securely connected to its mating connector on the Sola controller.
	No 24VAC to Sola controller	• Check Power LED on Sola controller. • Reset breaker at 24VAC transformer. • With an AC voltmeter measure voltage at terminals J8 1 & 2, 24VAC should be present.
Blower not operating	Blower power disconnected	Verify that the 3-position Molex connector on the wiring harness is securely connected to its mating connector on the blower.
	Faulty blower	Measure voltage across pins 1 & 2 (black and white wires) of 3-position connector on wiring harness. If 120VAC detected, reconnect then and remove 5-position signal connector. Blower should rotate at high speed. If blower does not rotate, replace blower.

Table 16-2 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	-	-

Table 16-3 Hold and Lockout Codes

Code	Description	Note
0	None	Hold / No lockout
1	Unconfigured safety data	Lockout
2	Waiting for safety data verification	Lockout
3	Internal fault: Hardware fault	Hold
4	Internal fault: Safety Relay key feedback error	Hold
5	Internal fault: Unstable power (DCDC) output	Hold
6	Internal fault: Invalid processor clock	Hold
7	Internal fault: Safety relay drive error	Hold
8	Internal fault: Zero crossing not detected	Hold
9	Internal fault: Flame bias out of range	Hold
10	Internal fault: Invalid Burner control state	Lockout
11	Internal fault: Invalid Burner control state flag	Lockout
12	Internal fault: Safety relay drive cap short	Hold
13	Internal fault: PII shorted to ILK	Hold / Lockout
14	Internal fault: HFS shorted to LCI	Hold / Lockout
15	Internal fault: Safety relay test failed due to feedback ON	Lockout
16	Internal fault: Safety relay test failed due to safety relay OFF	Lockout
17	Internal fault: Safety relay test failed due to safety relay not OFF	Lockout
18	Internal fault: Safety relay test failed due to feedback not ON	Lockout
19	Internal fault: Safety RAM write	Lockout
20	Internal fault: Flame ripple and overflow	Hold
21	Internal fault: Flame number of sample mismatch	Hold
22	Internal fault: Flame bias out of range	Hold
23	Internal fault: Bias changed since heating cycle starts	Hold
24	Internal fault: Spark voltage stuck low or high	Hold
25	Internal fault: Spark voltage changed too much during flame sensing time	Hold
26	Internal fault: Static flame ripple	Hold
27	Internal fault: Flame rod shorted to ground detected	Hold
28	Internal fault: A/D linearity test fails	Hold
29	Internal fault: Flame bias cannot be set in range	Hold
30	Internal fault: Flame bias shorted to adjacent pin	Hold
31	Internal fault: SLO electronics unknown error	Hold
32	Internal fault: Safety Key 0	Lockout
33	Internal fault: Safety Key 1	Lockout
34	Internal fault: Safety Key 2	Lockout
35	Internal fault: Safety Key 3	Lockout
36	Internal fault: Safety Key 4	Lockout
37	Internal fault: Safety Key 5	Lockout
38	Internal fault: Safety Key 6	Lockout
39	Internal fault: Safety Key 7	Lockout
40	Internal fault: Safety Key 8	Lockout
41	Internal fault: Safety Key 9	Lockout
42	Internal fault: Safety Key 10	Lockout
43	Internal fault: Safety Key 11	Lockout
44	Internal fault: Safety Key 12	Lockout
45	Internal fault: Safety Key 13	Lockout
46	Internal fault: Safety Key 14	Lockout
47	Flame rod to ground leakage	Hold
48	Static flame (not flickering)	Hold

Table 16-3 Hold and Lockout Codes

Code	Description	Note
49	24VAC voltage low/high	Hold
50	Modulation fault	Hold
51	Pump fault	Hold
52	Motor tachometer fault	Hold
53	AC inputs phase reversed	Lockout
54	Safety GVT model ID doesn't match application's model ID	Lockout
55	Application configuration data block CRC errors	Lockout
56-57	RESERVED	
58	Internal fault: HFS shorted to IAS	Lockout
59	Internal fault: Mux pin shorted	Lockout
60	Internal fault: HFS shorted to LFS	Lockout
61	Anti short cycle	Hold
62	Fan speed not proved	Hold
63	LCI OFF	Hold
64	PII OFF	N/A
65	Interrupted Airflow Switch OFF	Hold
66	Interrupted Airflow Switch ON	Hold
67	ILK OFF	Hold
68	ILK ON	N/A
69	Pilot test hold	Hold
70	Wait for leakage test completion	Hold
71	Input power frequency mismatch	Lockout
72-77	RESERVED	
78	Demand lost in run	Hold
79	Outlet high limit	Hold
80	DHW high limit	Disabled
81	Delta T limit	Hold / Lockout
82	Stack limit	Lockout
83	Delta T exchanger/outlet limit	Disabled
84	Delta T inlet/exchanger limit	Disabled
85	Inlet/Outlet inversion limit (See Table 16-2)	Hold
86	Exchanger/outlet inversion limit	Disabled
87	Inlet/exchanger inversion limit	Disabled
88	Outlet T-Rise limit (See Table 16-2)	Lockout
89	Exchanger T-rise limit	Disabled
90	Heat exchanger high limit	Disabled
91	Inlet sensor fault	Hold
92	Outlet sensor fault	Hold
93	DHW sensor fault	Hold
94	Header sensor fault	Hold
95	Stack sensor fault	Hold
96	Outdoor sensor fault	Hold
97	Internal fault: A2D mismatch	Lockout
98	Internal fault: Exceeded VSNSR voltage tolerance	Lockout
99	Internal fault: Exceeded 28V voltage tolerance	Lockout
100	Pressure sensor fault	Hold
101	Exchanger sensor fault	Disabled
102-104	RESERVED	
105	Flame detected out of sequence	Hold / Lockout

Table 16-3 Hold and Lockout Codes

Code	Description	Note
106	Flame lost in MFEP	Lockout
107	Flame lost early in run	Lockout
108	Flame lost in run	Lockout
109	Ignition failed	Lockout
110	Ignition failure occurred	Hold
111	Flame current lower than WEAK threshold	Hold
112	Pilot test flame timeout	Lockout
113	Flame circuit timeout	Lockout
114-115	RESERVED	
116	Wait for OK to Run	Disabled
117	Flap valve condensate fault	Disabled
118	Controller interaction system fault	Hold
119	Controller interaction communications fault	Hold
120	Flap valve backflow fault	Disabled
121	Flap valve fault	Disabled
122	Light off rate proving failed	Lockout
123	Purge rate proving failed	Lockout
124	High fire switch OFF	Hold
125	High fire switch stuck ON	Hold
126	Low fire switch OFF	Hold
127	Low fire switch stuck ON	Hold
128	Fan speed failed during pre-purge	Hold / Lockout
129	Fan speed failed during pre-ignition	Hold / Lockout
130	Fan speed failed during ignition	Hold / Lockout
131	Fan movement detected during standby	Hold
132	Fan speed failed during run	Hold
133-135	RESERVED	
136	Interrupted Airflow Switch failed to close	Hold
137	ILK failed to close	Hold
138	Flame too low	Lockout
139-142	RESERVED	
143	Internal fault: Flame bias out of range 1	Lockout
144	Internal fault: Flame bias out of range 2	Lockout
145	Internal fault: Flame bias out of range 3	Lockout
146	Internal fault: Flame bias out of range 4	Lockout
147	Internal fault: Flame bias out of range 5	Lockout
148	Internal fault: Flame bias out of range 6	Lockout
149	Flame detected	Hold / Lockout
150	Flame not detected	Hold
151	High fire switch ON	Hold / Lockout
152	Combustion pressure ON	Hold / Lockout
153	Combustion pressure OFF	Hold / Lockout
154	Purge fan switch ON	Hold / Lockout
155	Purge fan switch OFF	Hold / Lockout
156	Combustion pressure and Flame ON	Hold / Lockout
157	Combustion pressure and Flame OFF	Lockout
158	Main valve ON	Lockout
159	Main valve OFF	Lockout
160	Ignition ON	Lockout

Table 16-3 Hold and Lockout Codes

Code	Description	Note
161	Ignition OFF	Lockout
162	Pilot valve ON	Lockout
163	Pilot valve OFF	Lockout
164	Block intake ON	Lockout
165	Block intake OFF	Lockout
166-168	RESERVED	
169	Safety opto bad in test state	Lockout
170	Safety relay opto feedback incorrect	Lockout
171	Safety relay feedback incorrect in run	Lockout
172	Main relay feedback incorrect	Lockout
173	Pilot relay feedback incorrect	Lockout
174	Safety relay feedback incorrect	Lockout
175	Safety relay open	Lockout
176	Main relay ON at safe start check	Lockout
177	Pilot relay ON at safe start check	Lockout
178	Safety relay ON at safe start check	Lockout
179-180	RESERVED	
181	Invalid Blocked condensate enable setting	Disabled
182	Invalid J7-1 configuration, both LFS and Blocked condensate	Disabled
183	Invalid J7-2 configuration, both HFS and Flap valve	Disabled
184	Invalid BLOWER/HSI output setting	Lockout
185	Invalid Delta T limit enable setting	Lockout
186	Invalid Delta T limit response setting	Lockout
187	Invalid DHW high limit enable setting	Lockout
188	Invalid DHW high limit response setting	Lockout
189	Invalid Flame sensor type setting	Lockout
190	Invalid interrupted air switch enable setting	Lockout
191	Invalid interrupted air switch start check enable setting	Lockout
192	Invalid Igniter on during setting	Lockout
193	Invalid Ignite failure delay setting	Lockout
194	Invalid Ignite failure response setting	Lockout
195	Invalid Ignite failure retries setting	Lockout
196	Invalid Ignition source setting	Lockout
197	Invalid Interlock open response setting	Lockout
198	Invalid Interlock start check setting	Lockout
199	Invalid LCI enable setting	Lockout
200	Invalid light off rate setting	Lockout
201	Invalid Light off rate proving setting	Lockout
202	Invalid Main Flame Establishing Period time setting	Lockout
203	Invalid MFEP flame failure response setting	Lockout
204	Invalid NTC sensor type setting	Lockout
205	Invalid Outlet high limit response setting	Lockout
206	Invalid Pilot Flame Establishing Period setting	Lockout
207	Invalid PII enable setting	Lockout
208	Invalid pilot test hold setting	Lockout
209	Invalid Pilot type setting	Lockout
210	Invalid Post-purge time setting	Lockout
211	Invalid Power up with lockout setting	Lockout
212	Invalid Pre-ignition time setting	Lockout

Table 16-3 Hold and Lockout Codes

Code	Description	Note
213	Invalid Pre-purge rate setting	Lockout
214	Invalid Pre-purge time setting	Lockout
215	Invalid Purge rate proving setting	Lockout
216	Invalid Run flame failure response setting	Lockout
217	Invalid Run stabilization time setting	Lockout
218	Invalid Stack limit enable setting	Lockout
219	Invalid Stack limit response setting	Lockout
220	Unconfigured Delta T limit set point setting	Lockout
221	Unconfigured DHW high limit set point setting	Lockout
222	Unconfigured Outlet high limit set point setting	Lockout
223	Unconfigured Stack limit set point setting	Lockout
224	Invalid DHW demand source setting	Lockout
225	Invalid Flame threshold setting	Lockout
226	Invalid Outlet high limit set point setting	Lockout
227	Invalid DHW high limit set point setting	Lockout
228	Invalid Stack limit set point setting	Lockout
229	Invalid Modulation output setting	Lockout
230	Invalid CH demand source setting	Lockout
231	Invalid Delta T limit delay setting	Lockout
232	Invalid Pressure sensor type setting	Lockout
233	Invalid IAS closed response setting	Lockout
234	Invalid Outlet high limit enable setting	Lockout
235	Invalid Outlet connector type setting	Lockout
236	Invalid Inlet connector type setting	Lockout
237	Invalid DHW connector type setting	Lockout
238	Invalid Stack connector type setting	Lockout
239	Invalid Header connector type setting	Lockout
240	Invalid Outdoor connector type setting	Lockout
241	Exchanger sensor not allowed with stack connector setting	Lockout
242	Invalid DHW auto detect configuration	Lockout
243	Invalid UV with spark interference not compatible with Igniter on throughout	Lockout
244	Internal fault: Safety relay test invalid state	Lockout
245	Invalid Outlet connector type setting for T-rise	Lockout
246	4-20mA cannot be used for both modulation and setpoint control	Lockout
247	Invalid ILK bounce detection enable	Lockout
248	Invalid forced recycle interval	Lockout
249	STAT cannot be demand source when Remote Stat is enabled	Lockout
250	Invalid Fan speed error response	Lockout
251	Lead drop-stage on error setting does not match drop method configuration	Lockout
252	Invalid Line frequency setting	Lockout
253	Lead Lag modulation sensor not valid with setpoint source	Lockout
254	Lead Lag modulation sensor not valid with local setpoint source	Lockout
255	Lead Lag modulation sensor not valid with local modulation source	Lockout
256	Selected Controller interaction enable setting is not allowed	Lockout
257	Controller interaction enable does not match neighbor stack fault setting	Lockout
258	Controller ID must be non-zero if controller interaction is enabled	Lockout
259	Modulation output must be fan if controller interaction is enabled	Lockout
260	Asymmetrical paired (no flap) is set but flap switch input is energized	Lockout
261	Neighbor burner control blower fault detected	Lockout

Table 16-3 Hold and Lockout Codes

Code	Description	Note
262	Blower fault detected during flap test	Lockout
263	Invalid DHW demand temperature setting	Lockout
264	Invalid preferred outlet high limit setting	Lockout
265	Invalid preferred lightoff rate setting	Lockout
266	Invalid preferred stack limit rate setting	Lockout

Table 16-4 Alert Codes

Code	Description
0	None (No alert)
1	Alert PCB was restored from factory defaults
2	Safety configuration parameters were restored from factory defaults
3	Configuration parameters were restored from factory defaults
4	Invalid Factory Invisibility PCB was detected
5	Invalid Factory Range PCB was detected
6	Invalid range PCB record has been dropped
7	EEPROM lockout history was initialized
8	Switched application annunciation data blocks
9	Switched application configuration data blocks
10	Configuration was restored from factory defaults
11	Backup configuration settings was restored from active configuration
12	Annunciation configuration was restored from factory defaults
13	Annunciation configuration was restored from backup
14	Safety group verification table was restored from factory defaults
15	Safety group verification table was updated
16	Invalid Parameter PCB was detected
17	Invalid Range PCB was detected
18	Alarm silence time exceeded maximum
19	Invalid safety group verification table was detected
20	Backdoor password could not be determined
21	Invalid safety group verification table was not accepted
22	CRC errors were found in application configuration data blocks
23	Backup Alert PCB was restored from active one
24	RESERVED
25	Lead Lag operation switch was turned OFF
26	Lead Lag operation switch was turned ON
27	Safety processor was reset
28	Application processor was reset
29	Burner switch was turned OFF
30	Burner switch was turned ON
31	Program Module (PM) was inserted into socket
32	Program Module (PM) was removed from socket
33	Alert PCB was configured
34	Parameter PCB was configured
35	Range PCB was configured
36	Program Module (PM) incompatible with product was inserted into socket
37	Program Module application parameter revision differs from application processor
38	Program Module safety parameter revision differs from safety processor
39	PCB incompatible with product contained in Program Module

Table 16-4 Alert Codes

Code	Description
40	Parameter PCB in Program Module is too large for product
41	Range PCB in Program Module was too large for product
42	Alert PCB in Program Module was too large for product
43	IAS start check was forced on due to IAS enabled
44	Low voltage was detected in safety processor
45	High line frequency occurred
46	Low line frequency occurred
47	Invalid subsystem reset request occurred
48	Write large enumerated Modbus register value was not allowed
49	Maximum cycle count was reached
50	Maximum hours count was reached
51	Illegal Modbus write was attempted
52	Modbus write attempt was rejected (NOT ALLOWED)
53	Illegal Modbus read was attempted
54	Safety processor brown-out reset occurred
55	Application processor watchdog reset occurred
56	Application processor brown-out reset occurred
57	Safety processor watchdog reset occurred
58	Alarm was reset by the user at the control
59	Burner control firing rate was > absolute max rate
60	Burner control firing rate was < absolute min rate
61	Burner control firing rate was invalid, % vs. RPM
62	Burner control was firing with no fan request
63	Burner control rate (non-firing) was > absolute max rate
64	Burner control rate (non-firing) was < absolute min rate
65	Burner control rate (non-firing) was absent
66	Burner control rate (non-firing) was invalid, % vs. RPM
67	Fan off cycle rate was invalid, % vs. RPM
68	Set point was over ridden due to sensor fault
69	Modulation was over ridden due to sensor fault
70	No demand source was set due to demand priority conflicts
71	CH 4-20mA signal was invalid.
72	Flame strength rate differential was invalid
73	Flame strength step rate was invalid
74	Periodic forced recycle
75	Absolute max fan speed was out of range
76	Absolute min fan speed was out of range
77	Fan gain down was invalid
78	Fan gain up was invalid
79	Fan minimum duty cycle was invalid
80	Fan pulses per revolution was invalid
81	Fan PWM frequency was invalid
82-83	RESERVED
84	Lead Lag CH 4-20mA water temperature setting was invalid
85	No Lead Lag add stage error threshold was configured
86	No Lead Lag add stage detection time was configured
87	No Lead Lag drop stage error threshold was configured
88	No Lead Lag drop stage detection time was configured
89	Lead Lag all boiler off threshold was invalid

Table 16-4 Alert Codes

Code	Description
90	Modulation output type was invalid
91	Firing rate control parameter was invalid
92	Forced rate was out of range vs. min/max modulation
93	Forced rate was invalid, % vs. RPM
94	Slow start ramp value was invalid
95	Slow start degrees value was invalid
96	Slow start was ended due to outlet sensor fault
97	Slow start was end due to reference set point fault
98	CH max modulation rate was invalid, % vs. RPM
99	CH max modulation rate was > absolute max rate
100	CH modulation range (max minus min) was too small (< 4% or 40 RPM)
101	DHW max modulation rate was invalid, % vs. RPM
102	DHW max modulation rate was > absolute max rate
103	DHW modulation range (max minus min) was too small (< 4% or 40 RPM)
104	Min modulation rate was < absolute min rate
105	Min modulation rate was invalid, % vs. RPM
106	Manual rate was invalid, % vs. RPM
107	Slow start enabled, but forced rate was invalid
108	Analog output hysteresis was invalid
109	Analog modulation output type was invalid
110	IAS open rate differential was invalid
111	IAS open step rate was invalid
112	Mix max modulation rate was invalid, % vs. RPM
113	Mix max modulation rate was > absolute max or < absolute min rates
114	Mix modulation range (max minus min) was too small (< 4% or 40 RPM)
115	Fan was limited to its minimum duty cycle
116	Manual rate was > CH max modulation rate
117	Manual rate was > DHW max modulation rate
118	Manual rate was < min modulation rate
119	Manual rate in Standby was > absolute max rate
120	Modulation commanded rate was > CH max modulation rate
121	Modulation commanded rate was > DHW max modulation rate
122	Modulation commanded rate was < min modulation rate
123	Modulation rate was limited due to outlet limit
124	Modulation rate was limited due to Delta-T limit
125	Modulation rate was limited due to stack limit
126	Modulation rate was limited due to anti-condensation
127	Fan Speed out of range in RUN
128	Modulation rate was limited due to IAS was open
129	Slow start ramp setting of zero will result in no modulation rate change
130	No forced rate was configured for slow start ramp
131	CH demand source was invalid
132	CH P-gain was invalid
133	CH I-gain was invalid
134	CH D-gain was invalid
135	CH OFF hysteresis was invalid
136	CH ON hysteresis was invalid
137	CH sensor type was invalid
138	CH hysteresis step time was invalid

Table 16-4 Alert Codes

Code	Description
139	CH remote control parameter was invalid
140	CH ODR not allowed with remote control
146	CH control was suspended due to fault
147	CH header temperature was invalid
148	CH outlet temperature was invalid
149	CH steam pressure was invalid
151	Minimum water temperature parameter was greater than setpoint
152	Minimum water temperature parameter was greater than time of day setpoint
155	CH modulation rate source parameter was invalid
157	DHW demand source was invalid
158	DHW P-gain was invalid
159	DHW I-gain was invalid
160	DHW D-gain was invalid
161	DHW OFF hysteresis was invalid
162	DHW ON hysteresis was invalid
163	DHW hysteresis step time was invalid
164	DHW sensor type was invalid
165	Inlet sensor type was invalid for DHW
166	Outlet sensor type was invalid for DHW
167	DHW storage OFF hysteresis was invalid
168	DHW storage ON hysteresis was invalid
169	DHW modulation sensor type was invalid
170	DHW modulation sensor was not compatible for Auto mode
171	DHW control was suspended due to fault
172	DHW temperature was invalid
173	DHW inlet temperature was invalid
174	DHW outlet temperature was invalid
175	DHW high limit must be disabled for Auto mode
176	DHW sensor type was not compatible for Auto mode
177	DHW priority source setting was invalid
178	DHW priority method setting was invalid
179	CH S5 (J8-11) sensor was invalid
180	CH Inlet temperature was invalid
181	CH S10 (J10-7) sensor was invalid
182	Lead Lag CH setpoint source was invalid
183	Lead Lag P-gain was invalid
184	Lead Lag I-gain was invalid
185	Lead Lag D-gain was invalid
186	Lead Lag OFF hysteresis was invalid
187	Lead Lag ON hysteresis was invalid
188	Lead Lag slave enable was invalid
189	Lead Lag hysteresis step time was invalid
190	No Lead Lag Modbus port was assigned
191	Lead Lag base load common setting was invalid
192	Lead Lag DHW demand switch setting was invalid
193	Lead Lag Mix demand switch setting was invalid
194	Lead Lag modulation sensor setting was invalid
195	Lead Lag backup modulation sensor setting was invalid
196	Lead Lag slave mode setting was invalid

Table 16-4 Alert Codes

Code	Description
197	Lead Lag rate allocation setting was invalid
198	Lead selection setting was invalid
199	Lag selection setting was invalid
200	Lead Lag slave return setting was invalid
201	Lead Lag add stage method setting was invalid
202	STAT may not be a Lead Lag CH demand source when Remote Stat is enabled
203	Lead Lag base load rate setting was invalid
204	Lead Lag master was suspended due to fault
205	Lead Lag slave was suspended due to fault
206	Lead Lag header temperature was invalid
207	Lead Lag was suspended due to no enabled Program Module installed
208	Lead Lag slave session has timed out
209	Too many Lead Lag slaves were detected
210	Lead Lag slave was discovered
211	Incompatible Lead Lag slave was discovered
212	No base load rate was set for Lead Lag slave
213	Lead Lag slave unable to fire before demand to fire delay expired
214	Adding Lead Lag slave aborted due to add requirement change
215	No Lead Lag slaves available to service demand
216	No Lead Lag active service was set due to demand priority conflicts
217	No Lead Lag add stage method was specified
218	No Lead Lag drop stage method was specified
219	Using backup Lead Lag header sensor due to sensor failure
220	Lead Lag frost protection rate was invalid
221	Lead Lag drop stage method setting was invalid
222	CH frost protection temperature was invalid
223	CH frost protection inlet temperature was invalid
224	DHW frost protection temperature was invalid
225	No anticondensation setpoint was configured for frost protection
226	RESERVED
227	DHW priority override time was not derated due to invalid outdoor temperature
228	Warm weather shutdown was not checked due to invalid outdoor temperature
229	Lead Lag slave communication timeout
230	RESERVED
231	LL set point was invalid
232	LL time of day set point was invalid
233	LL outdoor temperature was invalid
234	LL ODR time of day set point was invalid
235	LL ODR time of day set point exceeded normal set point
236	LL max outdoor set point was invalid
237	LL min outdoor set point was invalid
238	LL min water set point was invalid
239	LL outdoor temperature range was too small (minimum 12 C / 22 F)
240	LL water temperature range was too small (minimum 12 C / 22 F)
241	Lead Lag DHW setpoint was invalid
243	Lead Lag CH demand switch was invalid
244	Lead Lag ODR min water temperature was invalid
245	RESERVED
246	CH set point was invalid

Table 16-4 Alert Codes

Code	Description
247	CH time of day set point was invalid
248	CH outdoor temperature was invalid
249	CH ODR time of day setpoint was invalid
250	CH ODR time of day set point exceeds normal set point
251	CH max outdoor set point was invalid
252	CH min outdoor set point was invalid
253	CH min water set point was invalid
254	CH outdoor temperature range was too small (minimum 12 C / 22 F)
255	CH water temperature range was too small (minimum 12 C / 22 F)
259	CH ODR min water temperature was invalid
260	RESERVED
261	DHW set point was invalid
262	DHW time of day set point was invalid
263	DHW storage setpoint was invalid
264	STAT may not be a DHW demand source when Remote Stat is enabled
265	No DHW anticondensation setpoint was configured
266	No CH anticondensation setpoint was configured
267	STAT may not be a CH demand source when Remote Stat is enabled
268	CH 4mA water temperature setting was invalid
269	CH 20mA water temperature setting was invalid
270	Steam 4mA water temperature setting was invalid
271	Steam 20mA water temperature setting was invalid
272	Abnormal Recycle: Pressure sensor fault
273	Abnormal Recycle: Safety relay drive test failed
274	Abnormal Recycle: Demand off during Pilot Flame Establishing Period
275	Abnormal Recycle: LCI off during Drive to Purge Rate
276	Abnormal Recycle: LCI off during Measured Purge Time
277	Abnormal Recycle: LCI off during Drive to Light off Rate
278	Abnormal Recycle: LCI off during Pre-Ignition test
279	Abnormal Recycle: LCI off during Pre-Ignition time
280	Abnormal Recycle: LCI off during Main Flame Establishing Period
281	Abnormal Recycle: LCI off during Ignition period
282	Abnormal Recycle: Demand off during Drive to Purge Rate
283	Abnormal Recycle: Demand off during Measured Purge Time
284	Abnormal Recycle: Demand off during Drive to Light off Rate
285	Abnormal Recycle: Demand off during Pre-Ignition test
286	Abnormal Recycle: Demand off during Pre-Ignition time
287	Abnormal Recycle: Flame was on during Safe Start check
288	Abnormal Recycle: Flame was on during Drive to Purge Rate
289	Abnormal Recycle: Flame was on during Measured Purge Time
290	Abnormal Recycle: Flame was on during Drive to Light off Rate
291	Abnormal Recycle: Flame was not on at end of Ignition period
292	Abnormal Recycle: Flame was lost during Main Flame Establishing Period
293	Abnormal Recycle: Flame was lost early in Run
294	Abnormal Recycle: Flame was lost during Run
295	Abnormal Recycle: Leakage test failed
296	Abnormal Recycle: Interrupted air flow switch was off during Drive to Purge Rate
297	Abnormal Recycle: Interrupted air flow switch was off during Measured Purge Time
298	Abnormal Recycle: Interrupted air flow switch was off during Drive to Light off Rate

Table 16-4 Alert Codes

Code	Description
299	Abnormal Recycle: Interrupted air flow switch was off during Pre-Ignition test
300	Abnormal Recycle: Interrupted air flow switch was off during Pre-Ignition time
301	Abnormal Recycle: Interrupted air flow switch was off during Main Flame Establishing Period
302	Abnormal Recycle: Ignition failed due to interrupted air flow switch was off
303	Abnormal Recycle: ILK off during Drive to Purge Rate
304	Abnormal Recycle: ILK off during Measured Purge Time
305	Abnormal Recycle: ILK off during Drive to Light off Rate
306	Abnormal Recycle: ILK off during Pre-Ignition test
307	Abnormal Recycle: ILK off during Pre-Ignition time
308	Abnormal Recycle: ILK off during Main Flame Establishing Period
309	Abnormal Recycle: ILK off during Ignition period
310	Run was terminated due to ILK was off
311	Run was terminated due to interrupted air flow switch was off
312	Stuck reset switch
313	Run was terminated due to fan failure
314	Abnormal Recycle: Fan failed during Drive to Purge Rate
315	Abnormal Recycle: Fan failed during Measured Purge Time
316	Abnormal Recycle: Fan failed during Drive to Light off Rate
317	Abnormal Recycle: Fan failed during Pre-Ignition test
318	Abnormal Recycle: Fan failed during Pre-Ignition time
319	Abnormal Recycle: Fan failed during Ignition period
320	Abnormal Recycle: Fan failed during Main Flame Establishing Period
321	Abnormal Recycle: Main Valve off after 10 seconds of RUN
322	Abnormal Recycle: Pilot Valve off after 10 seconds of RUN
323	Abnormal Recycle: Safety Relay off after 10 seconds of RUN
324	Abnormal Recycle: Hardware flame bias
325	Abnormal Recycle: Hardware static flame
326	Abnormal Recycle: Hardware flame current invalid
327	Abnormal Recycle: Hardware flame rod short
328	Abnormal Recycle: Hardware invalid power
329	Abnormal Recycle: Hardware invalid AC line
330	Abnormal Recycle: Hardware SLO flame ripple
331	Abnormal Recycle: Hardware SLO flame sample
332	Abnormal Recycle: Hardware SLO flame bias range
333	Abnormal Recycle: Hardware SLO flame bias heat
334	Abnormal Recycle: Hardware SLO spark stuck
335	Abnormal Recycle: Hardware SLO spark changed
336	Abnormal Recycle: Hardware SLO static flame
337	Abnormal Recycle: Hardware SLO rod shorted
338	Abnormal Recycle: Hardware SLO AD linearity
339	Abnormal Recycle: Hardware SLO bias not set
340	Abnormal Recycle: Hardware SLO bias shorted
341	Abnormal Recycle: Hardware SLO electronics
342	Abnormal Recycle: Hardware processor clock
343	Abnormal Recycle: Hardware AC phase
344	Abnormal Recycle: Hardware A2D mismatch
345	Abnormal Recycle: Hardware VSNSR A2D
346	Abnormal Recycle: Hardware 28V A2D
347	Abnormal Recycle: Hardware HFS IAS shorted

Table 16-4 Alert Codes

Code	Description
348	Abnormal Recycle: Hardware PII INTLK shorted
349	Abnormal Recycle: Hardware HFS LCI shorted
350	Abnormal Recycle: Hardware HFS LFS shorted
351	Abnormal Recycle: Invalid zero crossing
352	Abnormal Recycle: fault stack sensor
353	Abnormal Recycle: stack limit
354	Abnormal Recycle: delta T limit
355	Abnormal Recycle: fault outlet sensor
356	Abnormal Recycle: outlet high limit
357	Abnormal Recycle: fault DHW sensor
358	Abnormal Recycle: DHW high limit
359	Abnormal Recycle: fault inlet sensor
360	Abnormal Recycle: Check Parameters Failed
361	Internal error: No factory parameters were detected in control
362	Internal error: PID iteration frequency was invalid
363	Internal error: Demand-Rate interval time was invalid
364	Internal error: Factory calibration parameter for modulation was invalid
365	Internal error: CH PID P-scaler was invalid
366	Internal error: CH PID I-scaler was invalid
367	Internal error: CH PID D-scaler was invalid
368	Internal error: DHW PID P-scaler was invalid
369	Internal error: DHW PID I-scaler was invalid
370	Internal error: DHW PID D-scaler was invalid
371	Internal error: Lead Lag master PID P-scaler was invalid
372	Internal error: Lead Lag master PID I-scaler was invalid
373	Internal error: Lead Lag master PID D-scaler was invalid
374	Abnormal Recycle: Hardware flame bias high
375	Abnormal Recycle: Hardware flame bias low
376	Abnormal Recycle: Hardware flame bias delta high
377	Abnormal Recycle: Hardware flame bias delta low
378	Abnormal Recycle: Hardware flame bias dynamic high
379	Abnormal Recycle: Hardware flame bias dynamic low
380	Abnormal Recycle: Fan Speed Not Proven
381	Abnormal Recycle: Fan Speed Range Low
382	Abnormal Recycle: Fan Speed Range High
383	Abnormal Recycle: Pre-Ignition test failed, recycle
384-388	RESERVED
389	Abnormal Recycle: AC power frequency Mismatch
390-447	RESERVED
448	Flame too low
449	Modulation rate was limited due to flame strength
450	RESERVED
451	Circulator control was invalid
452	Circulator P-gain was invalid
453	Circulator I-gain was invalid
454	Circulator temperature was invalid
455	Circulator outlet temperature was invalid
456	Circulator inlet temperature was invalid
457	Circulator outlet temperature was invalid

Table 16-4 Alert Codes

Code	Description
458	Circulator sensor choice was invalid
459	Circulator PID setpoint was invalid
460	LCI demand lost in run
461	Demand lost in run
462	STAT demand lost in run
463	Demand lost in run due to no flame
464	LCI lost in Combustion Pressure Establishing Period
465	LCI lost in Combustion Pressure Stabilizing Period
466	RESERVED
467	Internal error: EEPROM write was attempted before EEPROM was initialized
468	Internal error: EEPROM cycle count address was invalid
469	Internal error: EEPROM days count address was invalid
470	Internal error: EEPROM hours count address was invalid
471	Internal error: Lockout record EEPROM index was invalid
472	Internal error: Request to write PM status was invalid
473	Internal error: PM parameter address was invalid
474	Internal error: PM safety parameter address was invalid
475	Internal error: Invalid record in lockout history was removed
476	Internal error: EEPROM write buffer was full
477	Internal error: Data too large was not written to EEPROM
478	Internal error: Safety key bit 0 was incorrect
479	Internal error: Safety key bit 1 was incorrect
480	Internal error: Safety key bit 2 was incorrect
481	Internal error: Safety key bit 3 was incorrect
482	Internal error: Safety key bit 4 was incorrect
483	Internal error: Safety key bit 5 was incorrect
484	Internal error: Safety key bit 6 was incorrect
485	Internal error: Safety key bit 7 was incorrect
486	Internal error: Safety key bit 8 was incorrect
487	Internal error: Safety key bit 9 was incorrect
488	Internal error: Safety key bit 10 was incorrect
489	Internal error: Safety key bit 11 was incorrect
490	Internal error: Safety key bit 12 was incorrect
491	Internal error: Safety key bit 13 was incorrect
492	Internal error: Safety key bit 14 was incorrect
493	Internal error: Safety key bit 15 was incorrect
494	Internal error: Safety relay timeout
495	Internal error: Safety relay commanded off
496	Internal error: Unknown safety error occurred
497	Internal error: Safety timer was corrupt
498	Internal error: Safety timer was expired
499	Internal error: Safety timings
500	Internal error: Safety shutdown
550	Delta T inlet/outlet limit was exceeded
553	Inlet/outlet inversion occurred
564	Outlet T-rise limit was exceeded
600	Delta T inlet temperature was invalid
601	Delta T outlet temperature was invalid
603	CH ODR boost max offpoint temperature was invalid

Table 16-4 Alert Codes

Code	Description
604	CH ODR boost max offpoint temperature was too low
605	Lead Lag ODR boost max offpoint temperature was invalid
606	Lead Lag ODR boost max offpoint temperature was too low
609	Time to rotate lead boiler to next firing slave
610	Time to rotate lead boiler to next available slave
611	Time to rotate lead boiler to first firing slave in order
612	Time to rotate lead boiler to lowest running slave
613	Lead boiler was rotated based on new firing sequence order
614	Lead boiler was rotated based on measured run time
615	Parameter PCB was switched to backup
616	Range PCB was switched to backup
622	Lead Lag modulation sensor was not valid with setpoint source
623	Lead Lag modulation sensor was not valid with local setpoint source
624	Lead Lag modulation sensor was not valid with local modulation rate source
629	Disagreement on number of interacting controls

17.0 PARTS LIST

For a list of parts that corresponds to the item numbers in the callouts, refer to Table 17-1. 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 17-1(a) Exploded View - Cabinet

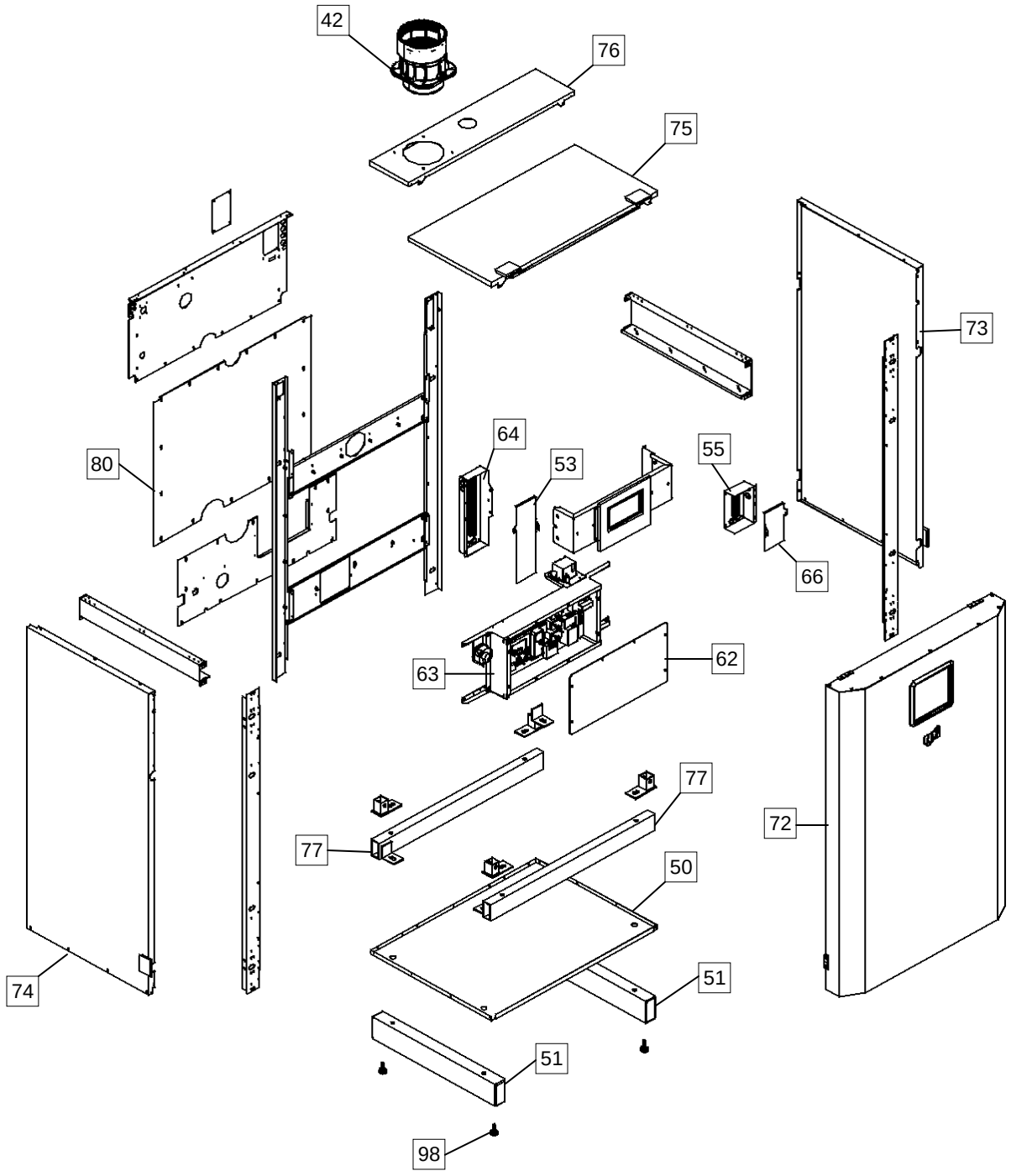


Figure 17-1(b) Exploded View – Control Panel

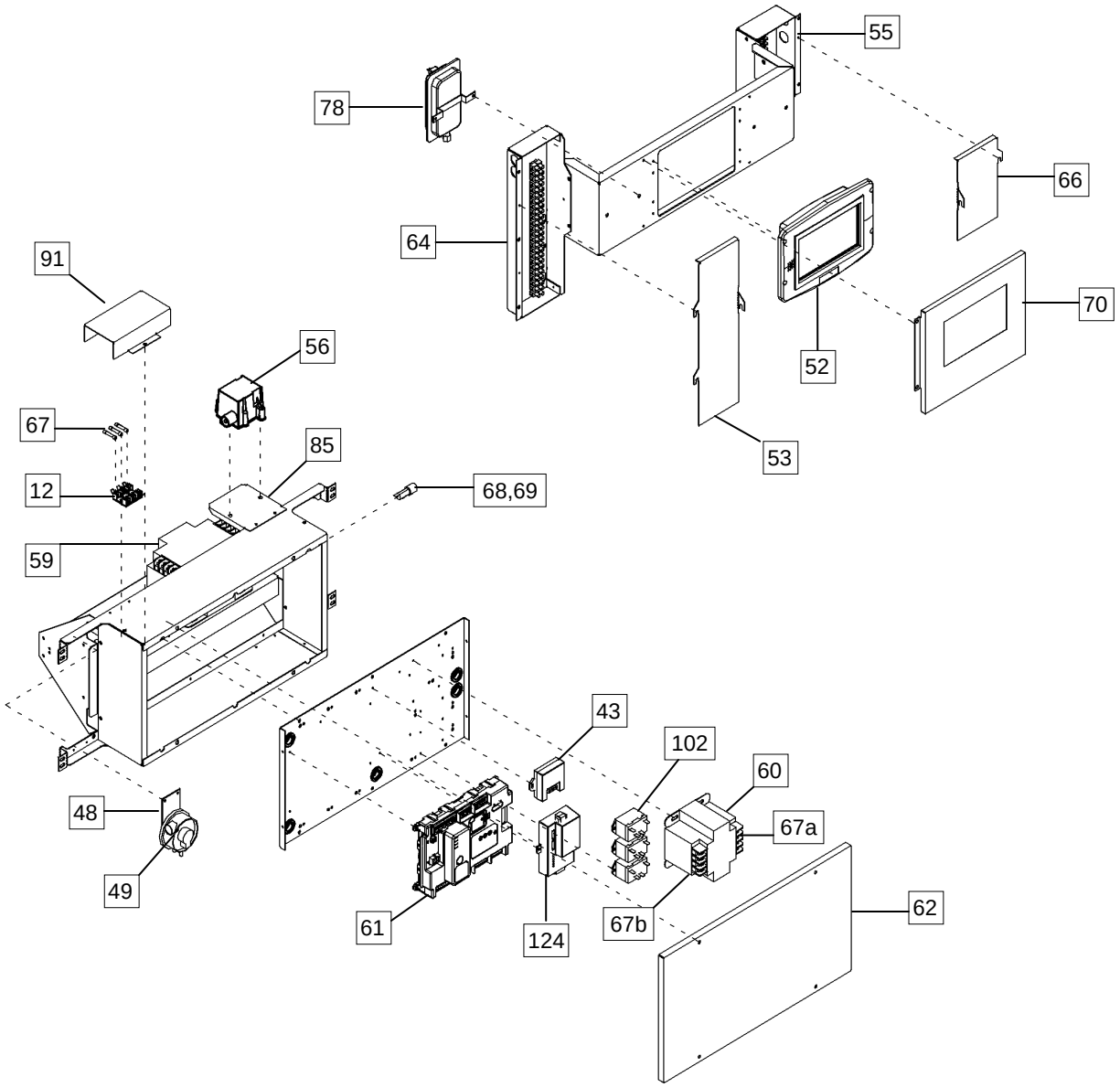
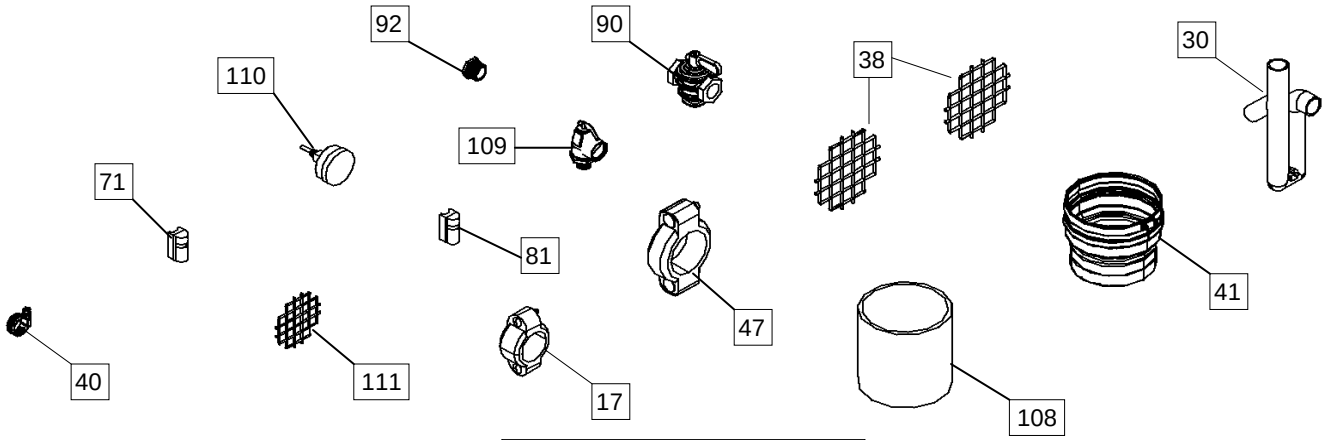


Figure 17-1(c) Exploded View – Trim/Install Kit



112 – LP Conversion Instructions

113 – LP Conversion Label

125 – Install & Operation Manual

126 – App. A, Touchscreen Manual

127 – User Instruction Manual

Figure 17-1(d) Exploded View – Heat Exchanger & Gas Train

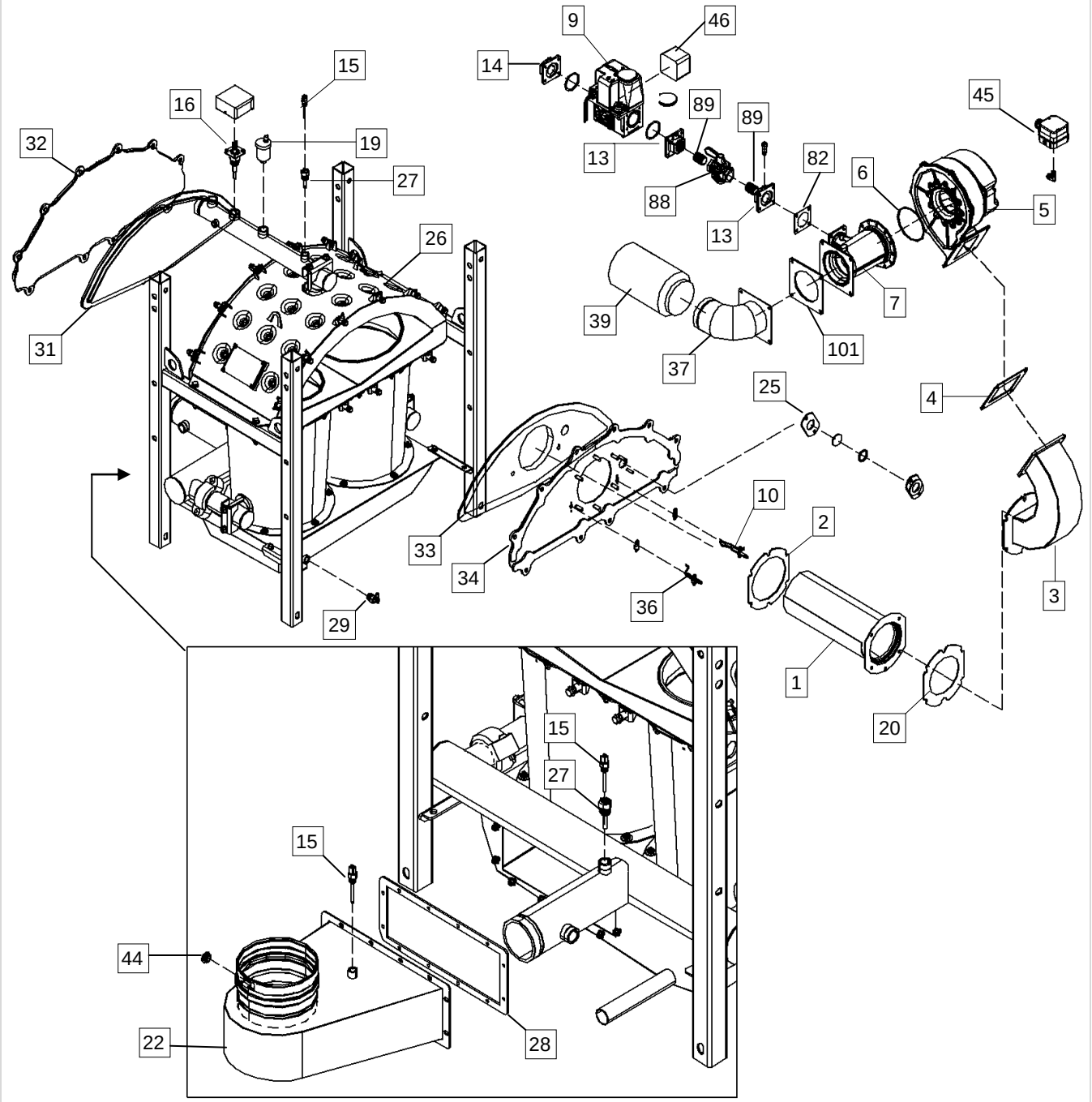


Table 17-1 Parts List: FTG Series

Item	Part #	Model	Description
1	85289	FTG 600-800	Premix Burner, FTG 600-800
1	85744	FTG 1200-1400	Premix Burner, FTG 1200-1400
1	85549	FTG 2000-2400	Premix Burner, FTG 2000-2400
2	85398	FTG 600-2400	Gasket FTG Burner Plate-Burner
3	85335	FTG 600-1400	Blower Transition, FTG 600-1400
3	85527	FTG 2000-2400	Blower Transition, FTG 2000-2400
4	85329	FTG 600-1400	Gasket, Blower-Transition, FTG 600-1400
4	85660	FTG 2000-2400	Gasket, Venturi Inlet / Blower Outlet, FTG 2000-2400
5	85354	FTG 600-1400	Blower Assembly, 7.0H
5	85766	FTG 2000	Blower Assembly, 12.3 in., 120V
5	85682	FTG 2200-2400	Blower Assembly, 12.3 in., 240V 3PH
6	84084	FTG 600-1400	O-Ring, Venturi-Blower, 35101-4-5159
6	85753	FTG 2000-2400	O-Ring, Venturi-Blower,181 x 3.53 mm
7	85290	FTG 600-1200	Venturi, VMU185
7	84013	FTG 1400	Venturi, VMU300
7	85696	FTG 2000-2400	Venturi, VMU500
9	84012	FTG 600-1400	Gas Valve, V8730C
9	85669	FTG 2000-2400	Gas Valve, MBC-SE 2500
10	86220-1	FTG 600-2400	Ignition Electrode, Dual (c/w gasket), gap = 3/16 to ¼”
12	85658	FTG 2200-2400	Fuseblock, 600V/30A
13	85291	FTG 600-1400	Gas Valve Outlet Adapter ¾ in. NPT (c/w O-ring & Hardware)
13	85666	FTG 2000-2400	Gas Valve Outlet Adapter 1 in. NPT (w/adjustable shutter)
14	84035	FTG 600-800	Gas Valve Inlet Adapter 1 in. NPT (c/w O-ring & Hardware)
14	85749	FTG 1200-1400	Gas Valve Inlet Adapter 1.25 in. NPT (c/w O-ring & Hardware)
14	85667	FTG 2000-2400	Gas Valve Inlet Adapter 1.5 in. NPT
15	85315	FTG 600-2400	Outlet/Inlet/Flue Sensor (Dual)
16	86362-1	FTG 600-2400	LWCO Kit, FTG, CSD-1 (includes control and probe)
17	85297	FTG 600-800	Pipe Coupling, groove joint, 2 in. (outlet)
17	85298	FTG 1200-2400	Pipe Coupling, groove joint, 3 in. (outlet/inlet)
18	86221	FTG 600-800	Supply Pipe, FTG 600-800
18	86222	FTG 1200-1400	Supply Pipe, FTG 1200-1400
18	86223	FTG 2000-2400	Supply Pipe, FTG 2000-2400
19	84474	FTG 600-2400	Auto Air Vent, ½” NPT
20	85328	FTG 600-2400	Gasket, Transition-Burner, FTG
21	TBD	FTG 600-2400	Return Pipe, FTG
22	86176	FTG 600-800	Flue Collector, FTG 600-800
22	86177	FTG 1200-2400	Flue Collector, FTG 1200-2400
23	84423	FTG 600-2400	Receptacle, 120VAC

Item	Part #	Model	Description
25	TBD	FTG 600-2400	Sight Glass (c/w gaskets)
26	85274	FTG 600-800	Heat Exchanger ASME, FTG 600-800 (c/w doors)
26	85296	FTG 1200-1400	Heat Exchanger ASME, FTG 1200-1400 (c/w doors)
26	85302	FTG 2000-2400	Heat Exchanger ASME, FTG 2000-2400 (c/w doors)
27	85314	FTG 600-2400	Immersion Well, ½ in. NPT, Inlet/Outlet Sensor
28	85697	FTG 600-2400	Gasket, Flue Collector to Condensate Dish
29	85310	FTG 600-2400	Elbow 0.375 ID x 0.5NPT Polypro
30	85311	FTG 600-2400	Condensate Trap
31	85333	FTG 600-1400	Insulation/Gasket, Rear Door, FTG 600-1400
31	85796	FTG 2000-2400	Insulation/Gasket, Rear Door, FTG 2000-2400
32	85413	FTG 600-1400	Door, Combustion Chamber, Rear, FTG 600-1400
32	85796	FTG 2000-2400	Door, Combustion Chamber, Rear, FTG 2000-2400
33	85332	FTG 600-2400	Insulation/Gasket, Front Door, FTG 600-2400
34	85412	FTG 600-2400	Door, Combustion Chamber, Front, FTG
36	84740-1	FTG 600-2400	Flame Sensor Electrode (c/w gasket)
37	85359	FTG 600-1400	Air-inlet Elbow to Venturi, FTG 600-1400
37	85657	FTG 2000-2400	Air-inlet Elbow to Venturi, FTG 2000-2400
38	83019	FTG 600-2400	Round Mesh Vent Screen, 6”
39	85313	FTG 600-1400	Air Filter, FTG 600-1400
39	85656	FTG 2000-2400	Air Filter, FTG 2000-2400
40	83718	FTG 600-2400	Hose Clamp, 1-1/16 to 1-1/2”
41	85360	FTG 600-800	Flue Outlet Adapter to CPVC, 6 in. (included with trim kit)
41	86687	FTG 1200-2400	Flue Outlet Adapter to CPVC, 8 in. (sold separately)
42	85358	FTG 600-800	Air Inlet Adapter PP/PVC/SS, 6 in.
42	85765	FTG 1200-2400	Air Inlet Adapter, Rubber, 8 in.
43	85317	FTG 600-2400	EnviraCOM - OD sensor
44	84497	FTG 600-2400	Exhaust Test Plug, EPDM
45	86369-1	FTG 600-1400	High Gas Pressure Switch Kit, GMH-A4-4-4
45	85672	FTG 2000-2400	High Gas Pressure Switch GMH-A2-4-4
46	85292	FTG 600-1400	Low Gas Pressure Switch C6097A1210
46	85673	FTG 2000-2400	Low Gas Pressure Switch GAO-A2-4-5
47	85298	FTG 600-2400	Pipe Coupling, groove joint, 3 in. (inlet)
48	TBD	FTG 600-1400	Bracket, Blocked Condensate Switch
48	TBD	FTG 2000-2400	Bracket, Blocked Condensate Switch
49	85163	FTG 600-1400	Blocked Condensate Drain / Blocked Vent Switch
49	84380	FTG 2000-2400	Blocked Condensate Drain / Blocked Vent Switch
50	TBD	FTG 600-800	Bottom, FTG 600-800
50	TBD	FTG 1200-1400	Bottom, FTG 1200-1400
50	TBD	FTG 2000-2400	Bottom, FTG 2000-2400

Item	Part #	Model	Description
51	TBD	FTG 600-800	Leg, FTG 600-800 (c/w hardware)
51	TBD	FTG 1200-1400	Leg, FTG 1200-1400 (c/w hardware)
51	TBD	FTG 2000-2400	Leg, FTG 2000-2400 (c/w hardware)
52	84653	FTG 600-2400	Display S7999D, Black Touch Screen
53	TBD	FTG 600-2400	Electrical Junction Box Cover, Low Volt.
55	TBD	FTG 600-2400	Electrical Junction Box, Line Volt. (c/w barrier-strip)
56	85054-1	FTG 600-2400	Ignition Coil 4180002F
57	83724	FTG 600-2400	Spark Igniter Cable 12”
59	85664	FTG 2200-2400	Transformer 120V, 1kVA
60	84047	FTG 600-1400	Transformer 24V, 75VA
60	85659	FTG 2000-2400	Transformer 24V, 250VA
61	85421	FTG 600-2400	Controller, R7910A, FTG
62	TBD	FTG 600-2400	Control Panel Cover, FTG
63	TBD	FTG 600-2400	Control Panel
64	TBD	FTG 600-2400	Electrical Junction Box, Low Volt. (c/w barrier-strip)
66	TBD	FTG 600-2400	Electrical Junction Box Cover, Low Volt.
67	82625	FTG 2200-2400	Fuse, 15A, 250VAC, Barrel Style, Slow Blow
67a	85754	FTG 2000-2400	Fuse, 5A, 250VAC, Barrel Style, Trans Primary
67b	85755	FTG 2000-2400	Fuse, 10A, 250VAC, Barrel Style, Trans Secondary
68	84192	FTG 600-2400	Fuse Holder, Panel Mount, 20A, 250VAC max
69	83837	FTG 600-2400	Fuse, 7A, 250VAC, Barrel Style, Fast Blow
70	TBD	FTG 600-2400	Display Cover, FTG
71	83604	FTG 600-2400	Outdoor Sensor
72	TBD	FTG 600-2400	Front Cover, FTG
73	TBD	FTG 600-800	Right Side, FTG 600-800
73	TBD	FTG 1200-1400	Right Side, FTG 1200-1400
73a	TBD	FTG 2000-2400	Right Side Front, FTG 2000-2400
73b	TBD	FTG 2000-2400	Right Side Rear, FTG 2000-2400
74	TBD	FTG 600-800	Left Side, FTG 600-800
74	TBD	FTG 1200-1400	Left Side, FTG 1200-1400
74a	TBD	FTG 2000-2400	Left Side Front, FTG 2000-2400
74b	TBD	FTG 2000-2400	Left Side Rear, FTG 2000-2400
75	TBD	FTG 600-800	Front Top, FTG 600-800
75	TBD	FTG 1200-1400	Front Top, FTG 1200-1400
75	86680	FTG 2000-2400	Front Top, FTG 2000-2400
76	86686	FTG 600-800	Rear Top, FTG 600-800
76	TBD	FTG 1200-1400	Rear Top, FTG 1200-1400
76	86913	FTG 2000-2400	Rear Top, FTG 2000-2400
77	TBD	FTG 600-800	Heat Exch. Support Frame, FTG 600-800 (c/w hardware)

Item	Part #	Model	Description
77	TBD	FTG 1200-1400	Heat Exch. Support Frame, FTG 1200-1400 (c/w hardware)
77	TBD	FTG 2000-2400	Heat Exch. Support Frame, FTG 2000-2400 (c/w hardware)
78	84380	FTG 600-2400	Blocked Filter Switch
80	TBD	FTG 600-800	Rear Access Cover, FTG 600-800 (Set)
80	TBD	FTG 1200-2400	Rear Access Cover, FTG 1200-2400 (Set)
81	84010	FTG 600-2400	System Sensor, Pipe Sensor
82	84087	FTG 600-1400	Gasket, Cork, Square
85	TBD	FTG 600-2400	Spark Generator Support Bracket
88	84347	FTG 600-1400	Manual Shut Off Valve, 3/4" NPT
88	84025	FTG 2000-2400	Manual Shut Off Valve, 1" NPT
89	84599	FTG 600-1400	Nipple, ¾", cls, blk
89	84351	FTG 2000-2400	Nipple, 1", cls, blk
90	84025	FTG 600-800	Manual Shut Off Valve, 1" NPT
90	85312	FTG 1200-1400	Manual Shut Off Valve, 1.25" NPT
90	85688	FTG 2000-2400	Manual Shut Off Valve, 1.5" NPT
91	TBD	FTG 2200-2400	Cover, Fuseblock
96	84069	FTG 600-800	Clamp, U-Bolt, 1" IPS
96	85653	FTG 1200-1400	Clamp, U-Bolt, 1.25" IPS
96	85691	FTG 2000-2400	Clamp, U-Bolt, 1.5" IPS
98	85355	FTG 600-2400	Leg Leveler
101	84011	FTG 600-1400	Gasket, Venturi Inlet, FTG 600-1400
101	85660	FTG 2000-2400	Gasket, Venturi Inlet / Blower Outlet, FTG 2000-2400
102	84056	FTG 600-2400	Relay, Omron
107	85970	FTG 600-2000	Rocker Power Switch, On/Off
107	85663	FTG 2200-2400	Switch Disconnect, 3-PH
108	84092	FTG 600-800	CPVC Pipe 6 in., System 636, 6.5 in. Long
109	84088	FTG 600-800	Pressure Relief Valve, ¾ x 1, ASME, 50 PSI
109	85768	FTG 1200-1400	Pressure Relief Valve, 1 x 1-1/4, ASME, 50 PSI
109	85690	FTG 2000-2400	Pressure Relief Valve, 1-1/4, ASME, 50 PSI
110	85295	FTG 600-2400	Pressure/Temp Gauge
111	83018	FTG 600-800	Round Mesh Vent Screen, 4 in.
112	85445	FTG 600-1400	Natural Gas to LP Conversion Instructions, FTG 600-1400
112	85759	FTG 2000-2400	Natural Gas to LP Conversion Instructions, FTG 2000-2400
113	85418	FTG 600-1400	LP Conversion Decal, FTG 600-1400
113	85758	FTG 2000-2400	LP Conversion Decal, FTG 2000-2400
119	85418-1	FTG 600-1400	NG to LP Conversion Kit, FTG 600-1400
119	85758-1	FTG 2000-2400	NG to LP Conversion Kit, FTG 2000-2400
123	FTG 800 Kit	FTG 600, FTG 800	Installation Kit, FTG 600-800

Item	Part #	Model	Description
123	FTG 1200 Kit	FTG 1200, FTG 1400	Installation Kit, FTG 1200-1400
123	FTG 2400 Kit	FTG 2000, FTG 2200, FTG 2400	Installation Kit, FTG 2000-2400
124	84946	FTG 600-2400	ProtoNode RER Modbus-BACnet/N2 Gateway FPC-N34-0855 (Optional)
124	84947	FTG 600-2400	ProtoNode RER Modbus-LonWorks Gateway FPC-N35-0856 (Optional)
125	85422	FTG 600-2400	Installation and Operation Manual, FTG
126	86570	FTG 600-2400	App. A, Controller & Display Manual
127	84491	FTG 600-2400	User Information Manual

NOTES

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