Trinity Ts

Model Numbers: Ts80
Version Date: 2015-05-12

NEW PRODUCT LINE
High Efficiency
Condensing Gas Boiler

INSTALLATION AND OPERATION INSTRUCTIONS FOR TRINITY Ts80 BOILER

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HAZARD SYMBOLS AND DEFINITIONS

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

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

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

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

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

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

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

D) Do not use this 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 don't 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 12.0 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 Trinity Ts80 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 Trinity boiler model Ts80. 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 Operating Instructions,
2. Trinity Users Manual, and
3. Natural Gas to LP Conversion Kit.*

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

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

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

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

User Responsibilities

This boiler must be installed and serviced by a qualified installer or service technician. This boiler must be serviced and inspected annually when operating in normal residential applications. Demanding applications or extreme conditions (i.e. commercial) 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.

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

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

Installer Responsibilities

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

⚠ DANGER

Failure to use the appropriate Natural to LP Conversion Kit and Orifice when operating the Trinity Ts with Propane will result in extremely dangerous burner operation leading to property damage, serious injury or death. Refer to section titled **ATTENTION: LIQUEFIED PETROLEUM (LP) PROPANE** for applicable conversion kit and LP orifice numbers.

ATTENTION: LIQUEFIED PETROLEUM (LP) PROPANE

The Trinity Ts is factory set to operate with Natural Gas. BEFORE OPERATING WITH PROPANE, the specified LP Conversion Kit and Orifice must be installed to convert the boiler so it will operate safely with LP Propane. The correct kit and LP orifice is listed below. Liquefied Petroleum (LP) propane gas is heavier than air; therefore, it is imperative that your Trinity Ts 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 to LP Propane Conversion Kit		
Model Number	**Kit Number**	**LP Orifice**
Ts80	**82650-1**	**34 (3.4mm)**

Boiler Vent / Air-inlet Piping

⚠ DANGER

The Trinity Ts is a "Direct Vent" boiler requiring a "Special Venting System". Vent and Combustion-Air Intake piping must be piped to the outdoors, using the vent material and rules outlined in these instructions. Failure to follow 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 boiler 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 boiler or equipment at the completion of the installation.

2.0 SPECIFICATIONS

Table 2-1 Specifications

DESCRIPTION	Ts80
CSA Input Modulation [1] btu/hr [kw]	16,000-80,000 [4.7-23.4]
DOE Heating Capacity [1,2] btu/hr [kw]	72,000 [21.1]
Net I=B=R Rating [1,2] btu/hr [kw]	62,000 [18.1]
DOE AFUE % [2, 4]	93.4
Water Connections - NPT, in.	1
Gas Connection - NPT, in.	1/2
Vent/Air-inlet Pipe Diameter respectively, in. [mm] [3]	3 or 4 [76 or 102]
Vent/Air-inlet, Max. Length, ft. [m]	105 [32]
Dimensions H x W x D in. [mm]	28x17x12 [711x432x305]
Approx. Boiler Weight with Water, lbs [kg]	70 [31.8]
Electrical Rating	120V/1Ph/60Hz/12A

Notes:
[1] Listed Input and Output ratings are at minimum vent lengths at Sea Level. Numbers will be lower with longer venting and/or altitudes greater then 2000 feet [610 m].
[2] Based on rating plate input capacities, using standard test procedures prescribed by the U.S. Department of Energy. Ratings have been confirmed by AHRI (GAMA).
[3] Trinity Ts requires a special venting system, use only vent materials and methods detailed in these instructions.

High Altitude Operation

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

Table 2-2 De-rate % for High Altitudes

Elevations	2000 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 capacities for altitudes above 4500 ft [1372 m].
[2] USA: De-rate capacity by 4% for every 1000 ft [305 m], if altitude is over 2000 ft [610 m].

⚠ WARNING

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

3.0 BOILER LOCATION

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

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

Boiler Area Ventilation Air Openings

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

NOTICE If the "Boiler Area" does not meet the recommended clearances listed in Table 3-1, and if the boiler area has a volume less than 150 ft^3, it is considered a Closet or Alcove. 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 4-3 for a list of approved materials.

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 then 100 in^2 and within 6" of the top and bottom of the closet door. See Table 3-1 for minimum recommended 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 then 18" [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 3-1for minimum recommended clearances.

Residential Garage Installations

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

Wall Mounting Installations

The Ts80 is provided with integrated wall mounting brackets. Refer to Figures 3-3(a) and 3-3(b) for instructions and illustrations on wall mountings.

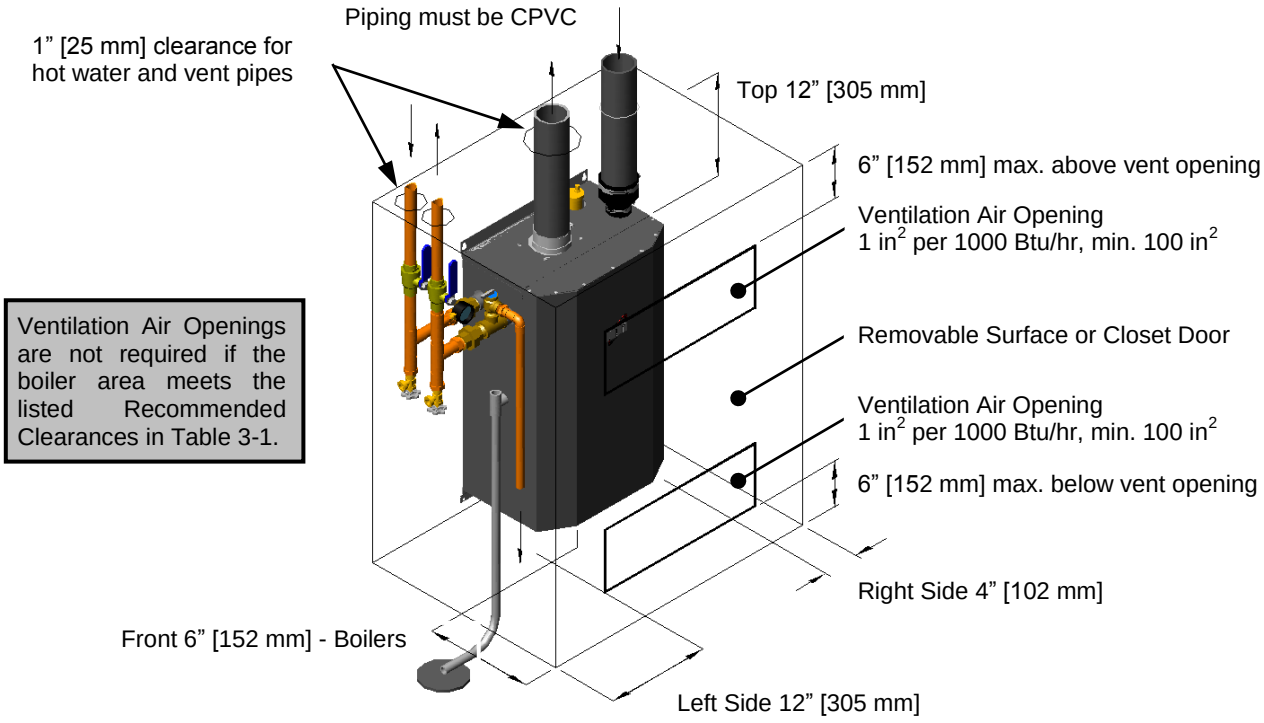
Table 3-1 Minimum Clearances for Installation and Service

Model No.	Clearances	Dimensions - inches [mm]					
		Front	Top	Left Side	Right Side	Bottom	Flue Pipe
Trinity Ts80	Minimum	24 [610][1]	12 [305]	12 [305]	4 [102][3]	0[4]	1 [25]
	Recommended	24 [610]	24 [610]	24 [610][2]	12 [305]	12 [305]	1 [25]

Notes:
[1] 6" if surface is removable allowing a minimum of 24" [610 mm] clearance (i.e. closet installation). See Ventilation Air Opening dimensions in Figure 3-1.
[2] Clearances can be as low as 12" [305 mm] so long as the sum of the right and left side clearances is 36" [914mm].
[3] The gas line exits the right side; ensure adequate service clearances are maintained.
[4] The field electrical connections are made at the bottom; ensure adequate service clearances are maintained.

Figure 3-1 Ts80 Model

Closet Installation, Minimum Clearances



Ventilation Air Openings are not required if the boiler area meets the listed Recommended Clearances in Table 3-1.

Figure 3-2 Ts80 Model

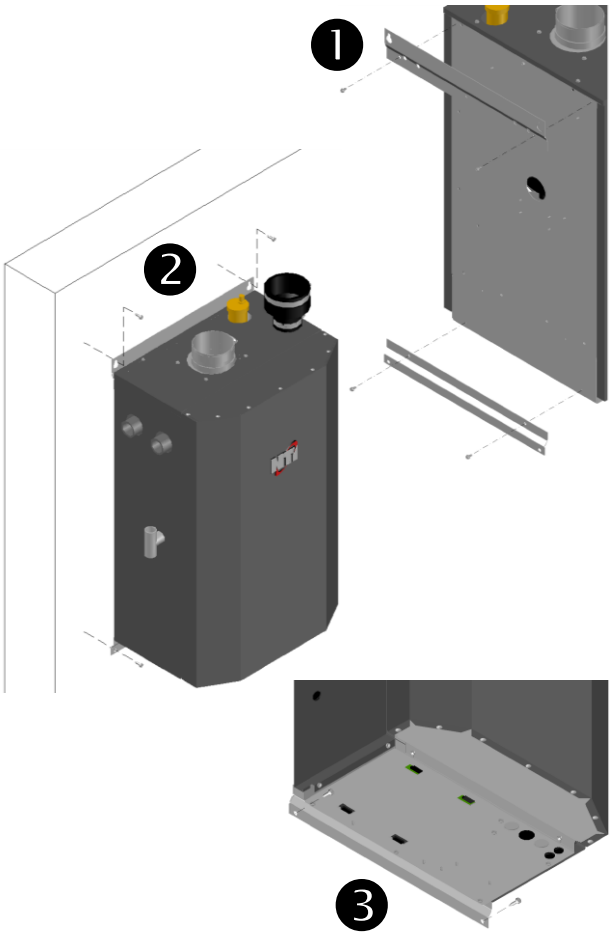
Wall Mounting Installation

❶ Secure the wall mount brackets to the back of the boiler as shown. Align the keyhole slots on the upper bracket so they are visible above the top of the unit before securing in place.

Ensure that the field supplied lag screws and anchors (when mounting to a concrete wall) are adequate to support the weight of the boiler (refer to Table 2-1 Specifications). Secure the lag screws to a solid wall and align so unit will mount level against the wall.

❷ Mount the boiler to the wall by sliding the upper bracket down over the lag screws on the wall until it hooks.

❸ Once the boiler is resting securely on the upper bracket, anchor the bottom bracket to the wall as shown.



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

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

4.0 GENERAL VENTING

The Trinity Ts is a "Direct Vent" boiler requiring a "Special Venting System" designed for pressurized venting. Both the Vent and Air-inlet piping must be piped to the outdoors, using the vent material 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. Installations must comply with the National Fuel Gas Code, ANSI Z223.1 (U.S.) or CSA B149.1 (Canada) and local requirements.

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

Removing an Existing Boiler from Common Venting System

⚠ DANGER Do not install the Trinity Ts into a common venting system with any other appliances. 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 appliances 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.

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

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 appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliance not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan.
4. Place in operation the boiler being inspected. Follow the 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 appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other gas burning appliance to their previous condition of use.
7. Any improper operation of the common venting system should be corrected so the installation conforms with the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code. When resizing any portion of the common venting system, the common venting system should be resized to approach the minimum size as determined using the appropriate tables in Part 11 of the National Fuel Gas Code, ANSI Z223.1/NFPA 54 and/or CAN/CSA B149.1, Natural Gas and Propane Installation Code.

Direct Vent Installation (Mandatory for Trinity Ts boilers)

Direct Vent installation dictates that the combustion air-inlet must 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.

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.

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-inlet 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) Disconnect electrical leads to the Hot Surface or Spark Igniter. Ensure the cables are placed in a fashion where they will not arc to ground or other conductor. Refer to warning regarding Spark Igniter Cable.
4) Turn power on to the boiler and apply a heat demand.
5) Allow for 3 complete trials for ignition, consisting of pre and post purge of the combustion blower, until an ignition lockout occurs. Repeat the process two more times (i.e. 9 complete ignition sequences in total).
6) Turn power off and reconnect the electrical leads to the Igniter.

Near Boiler Vent/Air-inlet Piping

Each Trinity Ts is equipped with a short piece of approved CPVC vent pipe. Insert one end into the boiler flue outlet adapter and cement the other to field venting (see Table 4-3 for approved venting material). The CPVC vent pipe should extend fully into the boiler flue outlet adapter (see Table 4-2). **DO NOT** insert PVC pipe directly into the flue outlet connection as it can deform from the clamping force of the gear clamp. Ensure that the venting system does not apply a load or strain on the boiler flue outlet adapter. The manufacturer recommends using two elbows to create a "swing joint" to reduce potential strain on vent piping and cemented joints. See Figures 4-1 through 4-3 for illustrations.

⚠ WARNING

Gasket Seating - Improper seating can cause leakage and eventual failure of the sealing gasket. Failure to follow these instructions may result in serious injury or death.

⚠ WARNING

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

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

Model No.	CPVC Vent Pipe Size	CPVC Transition Vent Pipe Length	Full Insertion Depth
Ts80	3"	Minimum 5" [127 mm]	2-7/8" [73 mm]

⚠ WARNING

Polypropylene or Stainless Steel Venting – When using Polypropylene or Stainless Steel piping, the appropriate boiler adapters must be used to transition the boiler vent connections to accept the respective Polypropylene or Stainless Steel venting. See Table 4-3 for a list of approved adapters. Failure to use the correct adapter will result in flue gas leakage resulting in property damage, serious injury or death.

Table 4-3 Boiler Adapters for Polypropylene and Stainless Steel Venting

Model No.	Vent Material	Venting Brand	Adapter Part No. [1,2]
Ts80	Polypropylene	DuraVent – PolyPro	300150
		Centrotherm - InnoFlue	ISAA0303
	Stainless Steel	DuraVent – FasNSeal	300715

Notes:
[1] Listed boiler adapters are only approved for use with the respective venting brand; i.e. a PolyPro boiler adapter shall not be used with InnoFlue venting.
[2] PolyPro and FasNSeal boiler adapters are available from DuraVent (1-800-835-4429 or www.duravent.com); InnoFlue boiler adapters are available from Centrotherm Eco Systems (1-877-434-3432 or www.centrotherm.us.com).

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

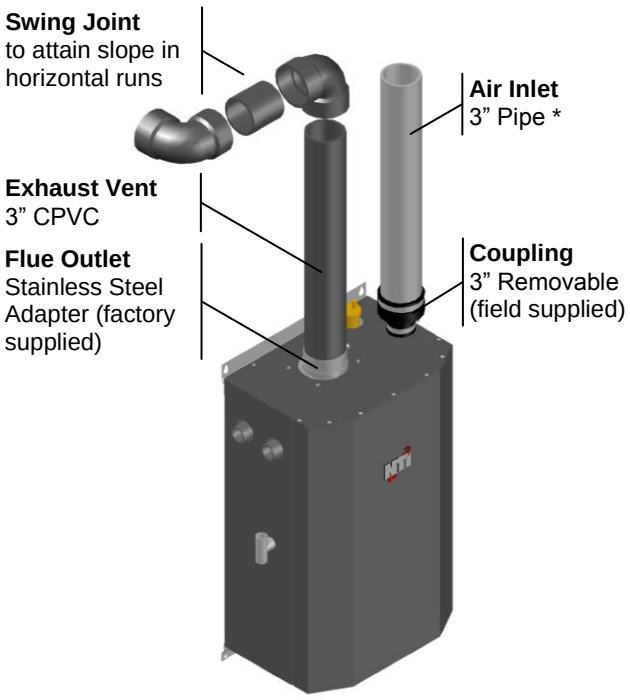
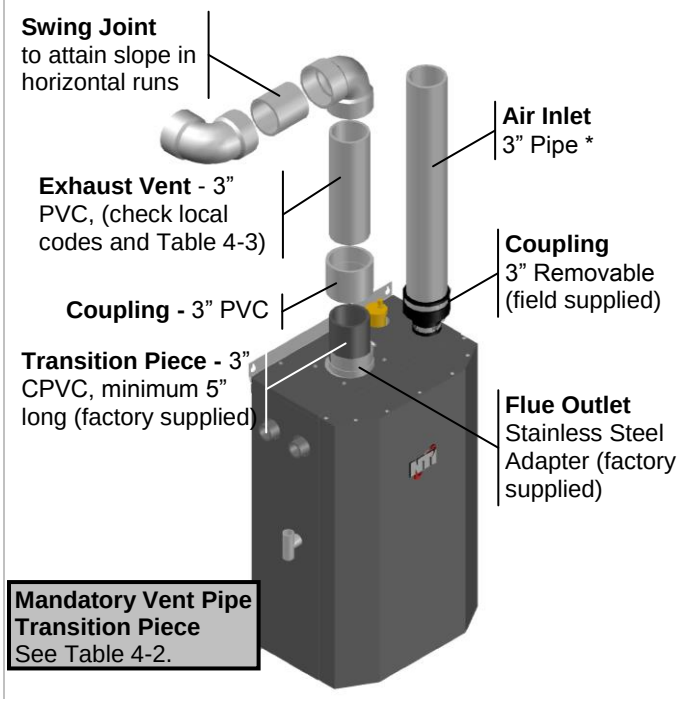


Figure 4-1(b) Near Boiler Venting (PVC)



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

⚠ 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.

Vent/Air-inlet Pipe Material

Table 4-4 Acceptable Vent and Air-inlet Pipe Material

Items [1]	Materials [2, 3]	Installation Standards		
		United States	Canada [4]	
Vent Piping and Fittings	PVC - DWV	ANSI/ASTM D2265	All venting material in Canada must be **ULC S636 approved**. See Note 4 below for appropriate temperature applications.	⚠ WARNING All Vent and Air-inlet materials installed on gas fired appliances in CAN/US must meet the Standards listed in Table 4-4. Failure to comply could result in fire, serious injury or death.
	PVC Schedule 40	ANSI/ASTM D1785		
	CPVC Schedule 40	ANSI/ASTM F441		
	AL29-4C	UL-1738		
	Polypropylene (PP)	n/a		
Pipe Cement	PVC	ANSI/ASTM D2564		
	CPVC	ANSI/ASTM F493		
Primers	PVC / CPVC	ANSI/ASTM F656		

Notes:
1 Refer to Table 4-5 for Allowable Vent and Air-inlet Pipe Sizes and Lengths.
2 PVC venting (exhaust and air-inlet) is not permitted within the Closet/alcove of a Closet/alcove installation.
3 The Air-inlet does not require high temperature pipe material. Check applicable local codes for acceptable materials.
4 ULC S636 PVC is approved for flue gas temperatures up to 149°F (65°C) and must only be used for low temperature applications. High temperature applications requiring appliance supply water temperatures greater than 140°F (60°C) must use ULC S636 CPVC, PP or AL29-4C.

⚠ 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 sweep, 90º elbows, and 45º elbows at 5 equivalent feet each. Length calculations need not include the three 90° elbows of the exterior vent piping (two outlet, one inlet).

***Example*:** A Ts80 can be installed with 105 equivalent feet of air-inlet piping and 105 equivalent feet of vent piping. See Table 4-5 for more details.

NOTICE The length of one vent pipe (air-inlet or exhaust) may not exceed the length of the other vent pipe by more than 20 equivalent feet.

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

Model No.	Pipe Size	Gas	Length ft.	Number of Elbows (90's or 45's) and Equivalent Feet								
				1	2	3	4	5	6	7	8	9
Trinity Ts80	3" or 4"	NG & LP	105	100	95	90	85	80	75	70	65	60

Termination Options

The venting system of the Trinity Ts may be terminated using field supplied piping to construct a "Two-Pipe" termination, see Figures 4-2(a), 4-3(a), 4-4(a) and 4-5(a); alternatively the venting may be terminated using a factory kit selected from Table 4-6.

Kits certified with the Trinity Ts are listed in Table 4-6 and available from IPEX, DuraVent, Centrotherm and/or NTI. For more information on System 636 Vent Kits or wholesaler locations contact IPEX directly **USA:** 1-800-463-9572 or www.IPEXamerica.com | **CAN:** 1-866-473-9462 or www.ipexinc.com. For more information on PolyPro Vent Kits or wholesaler locations contact DuraVent directly 1-800-835-4429 or www.duravent.com. For more information on InnoFlue Vent Kits or wholesaler locations contact Centrotherm directly at 1-877-434-3432 or www.centrotherm.us.com.

Table 4-6 Optional Vent Termination Kits

Description	Vent Size	Supplier P/N	Figure	Vent Material Compatibility	Vent Option	
					Roof	Wall
IPEX Low Profile (Flush Mount)[7]	3"	196985 (NTI P/N 84357)	4-4(c)	PVC/CPVC[7]	×	✓
	4"	196986 (NTI P/N 84358)				
IPEX Concentric (Wall/Roof)[5,6,7,8]	3"	196116 (NTI P/N 82666)	4-2(b), 4-3(b), 4-4(b), 4-5(b)	PVC/CPVC[7]	✓	✓
		197117				
	4"	196021 (NTI P/N 84355)				
		197021				
DuraVent - PolyPro Concentric (Wall)	3"	3PPS-HK	4-4(d)	PVC/CPVC/PP	×	✓
	4"	4PPS-HK				
DuraVent - PolyPro Concentric (Roof)	3"	3PPS-VK	4-5(c)	PVC/CPVC/PP	✓	×
	4"	4PPS-VK				
Centrotherm – InnoFlue (Flush Mount)	3"	ISLPT0303	4-4(c)	PVC/CPVC/PP	×	✓
Centrotherm – InnoFlue Concentric (Wall)[9]	3"	ICWS3513 & ICTC0335	4-4(d)	PVC/CPVC/PP	×	✓
		ICWT352 & ICTC0335				
	4"	ICWS4639 & ICTC0446				
Centrotherm – InnoFlue Concentric (Roof)[9]	3"	ICRT3539 & ICTC0335	4-5(c)	PVC/CPVC/PP	✓	×
	4"	ICRT4679 & ICTC0446				

Notes:
[1] Instructions included with termination kits contain detailed assembly and installation instructions.
[2] All factory termination kits are ULC S636 approved.
[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 (3 in. vent screen P/N 196051 – each sold separately).
[7] IPEX Low Profile and Concentric kits (excluding P/N 197117 & 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] IPEX Concentric kits can be shortened to fit the requirements of the installation; see instructions included with the kit for more details.
[9] Centrotherm Concentric termination kits must use the applicable "Twin pipe to concentric adapter," part number ICTC0335 or ICTC0446.

IMPORTANT

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

IMPORTANT

Sidewall Termination - Due to potential moisture loading (build-up) along the exterior wall, sidewall venting may not be the preferred venting option. Refer to Figures 4-3 and 4-5 for roof top venting options.

Sidewall Termination Examples

Figure 4-2(a) Two-Pipe Sidewall Termination

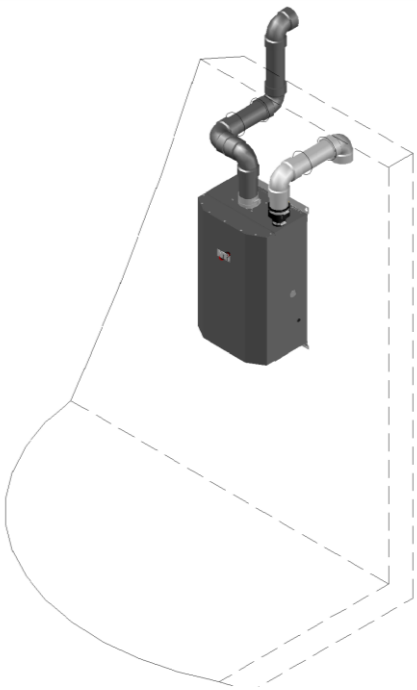
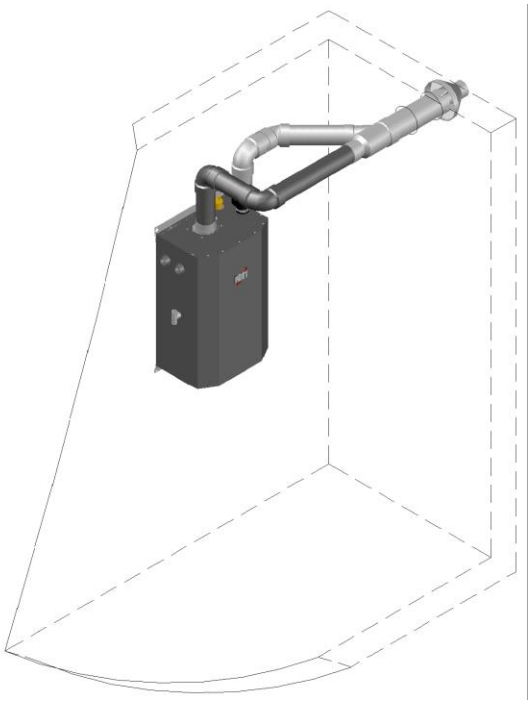


Figure 4-2(b) Concentric Sidewall Termination



Roof Termination Examples

⚠ 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.

Figure 4-3(a) Two-Pipe Roof Termination

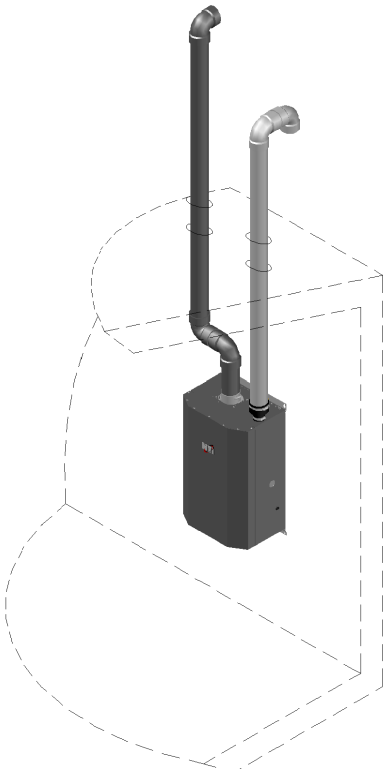
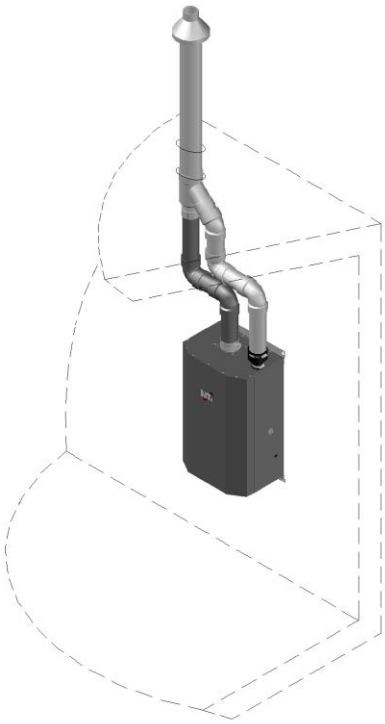


Figure 4-3(b) Concentric Roof Termination



Sidewall Termination Details

Figure 4-4(a)

Two-Pipe Termination (Sidewall)

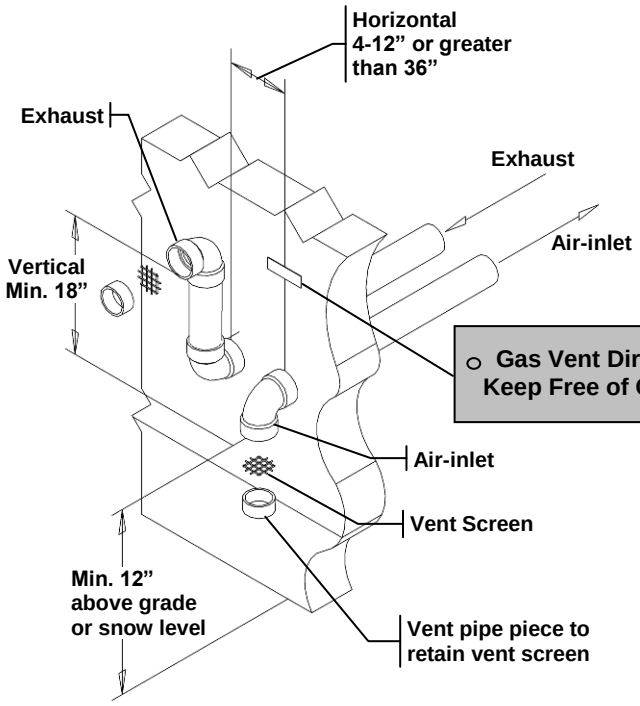


Figure 4-4(b)

IPEX Concentric Termination (Sidewall)

⚠ WARNING

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

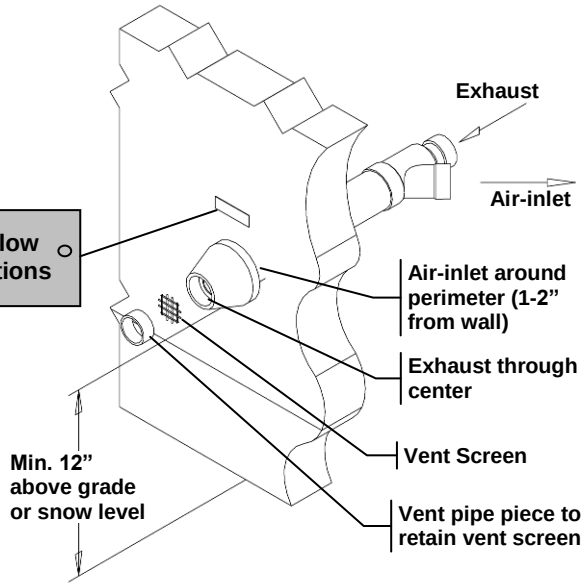


Figure 4-4(c)

Low Profile Termination (Sidewall)

⚠ WARNING

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

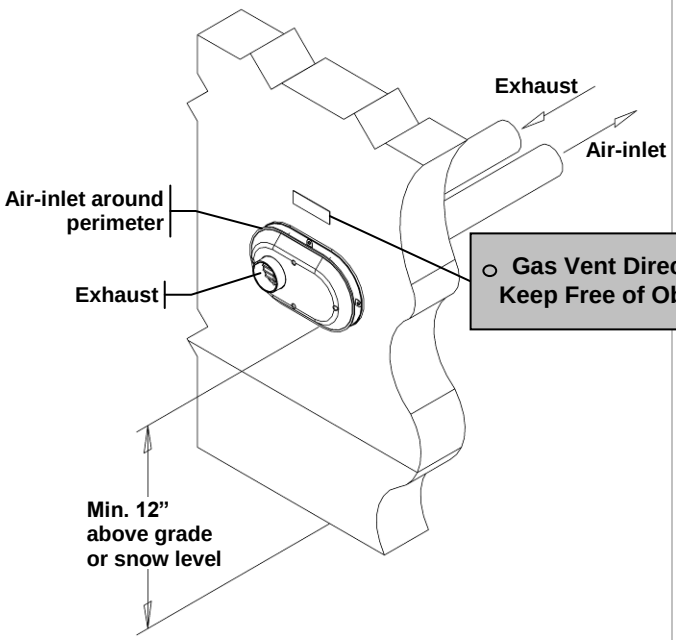
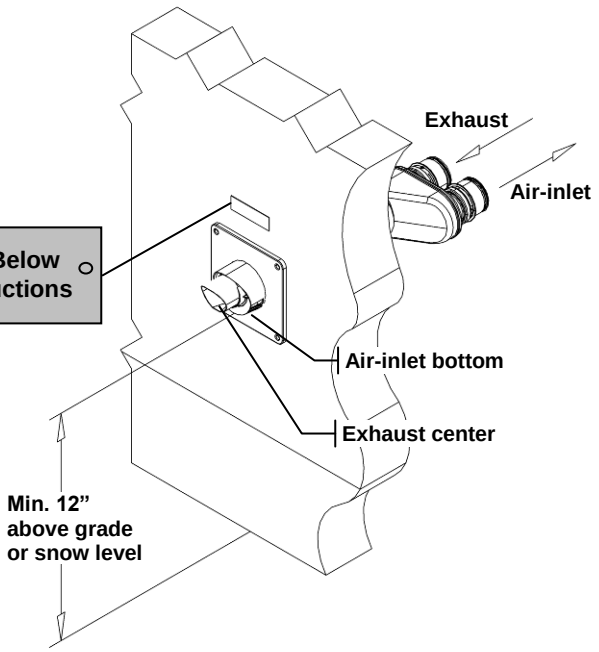


Figure 4-4(d)

PolyPro / InnoFlue Termination (Sidewall)

⚠ WARNING

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



Roof Termination Details

Figure 4-5(a)

Two-Pipe Termination (Roof)

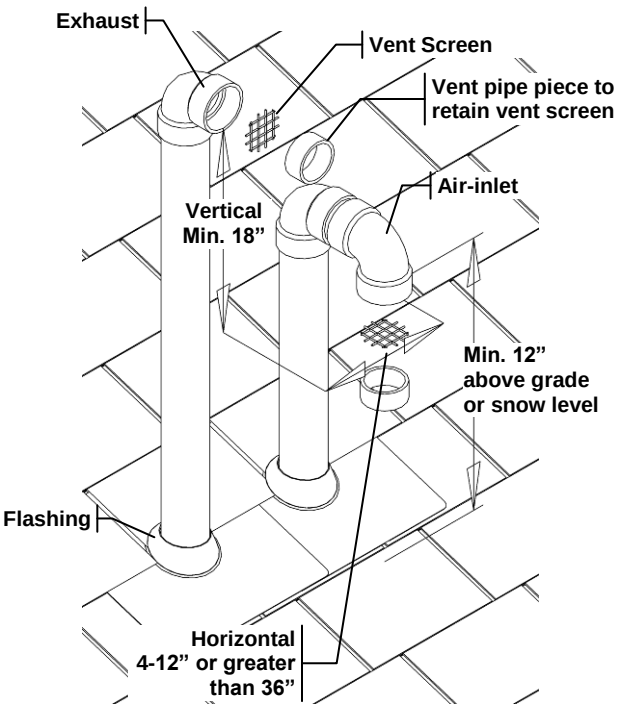


Figure 4-5(b)

IPEX Concentric Termination (Roof)

⚠ WARNING

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

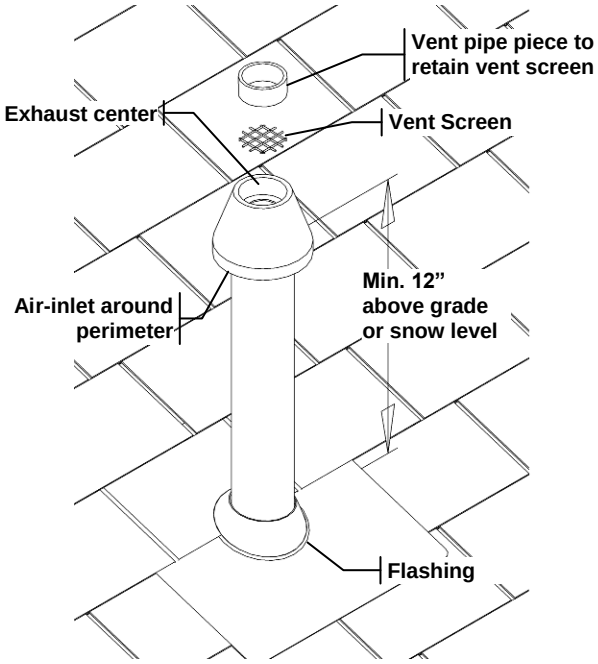


Figure 4-5(c)

PolyPro / InnoFlue Termination (Roof)

⚠ WARNING

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

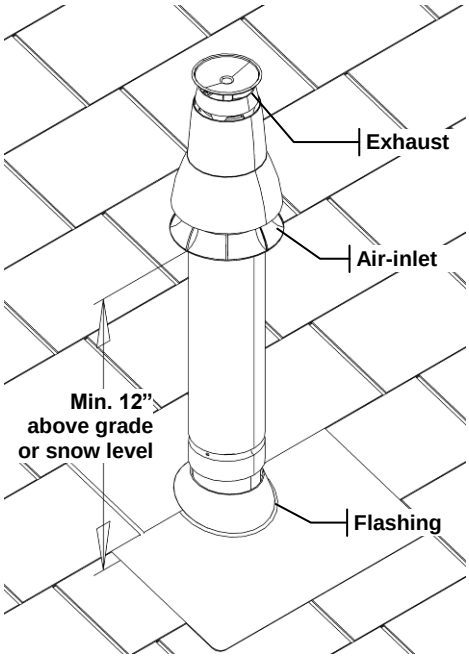
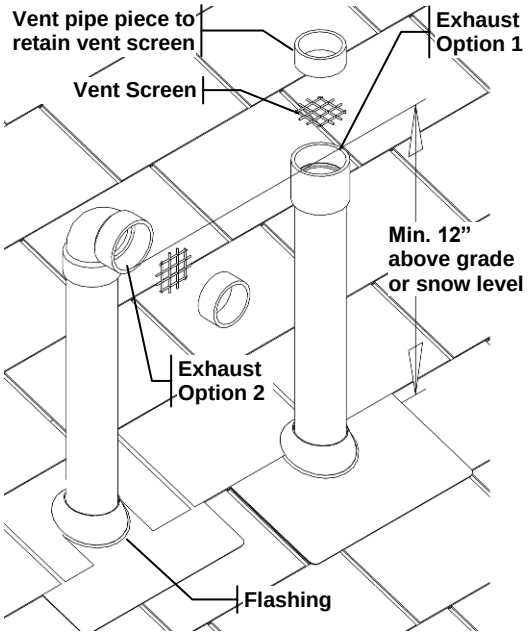


Figure 4-5(d)

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 elbow for both the inlet and exhaust vent terminal elbows. Install the screen into the female opening of the elbow, and then cut a small piece of pipe to sandwich the screen into the elbow. NOTE: ensure the small piece of pipe cut, does not extend past the end of the elbow. Two screens are provided in the package. See Figures 4-4 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 4-3 and 4-5 for roof top venting options.

⚠ WARNING

The vent for this boiler 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.

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. Optional mounting bracket P/N. 82075 for securing the exhaust pipes (only applicable for 3 in. PVC/CPVC venting).
5. Ensure that the Vent/Air-inlet clearances are maintained, see Section 5.0 for details.

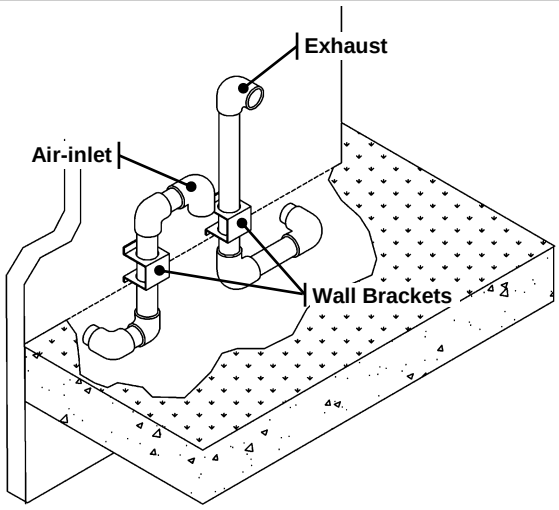


Figure 4-7 Outdoor Venting

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.

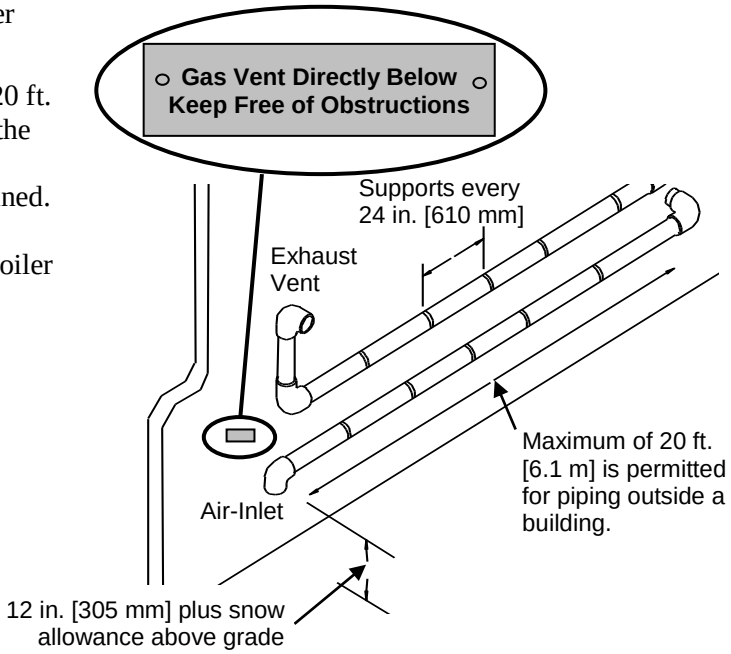
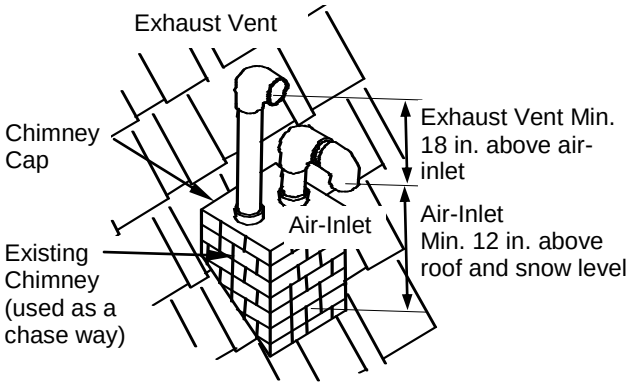


Figure 4-8 Existing Chimney Chase Way

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 Trinity Ts 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.



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

5.0 VENT/AIR-INLET TERMINATION CLEARANCES

⚠ WARNING The quick reference table below is to be read in conjunction with the numbered notes as indicated, Figures 5-1 through 5-6, and the Venting Rules and Guidelines in Section 4.0. The instructions detailed in this section are a combination of Trinity Ts specific and National Gas Code restrictions. Compliance alone doesn't 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

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 Clearances Quick Reference Diagram

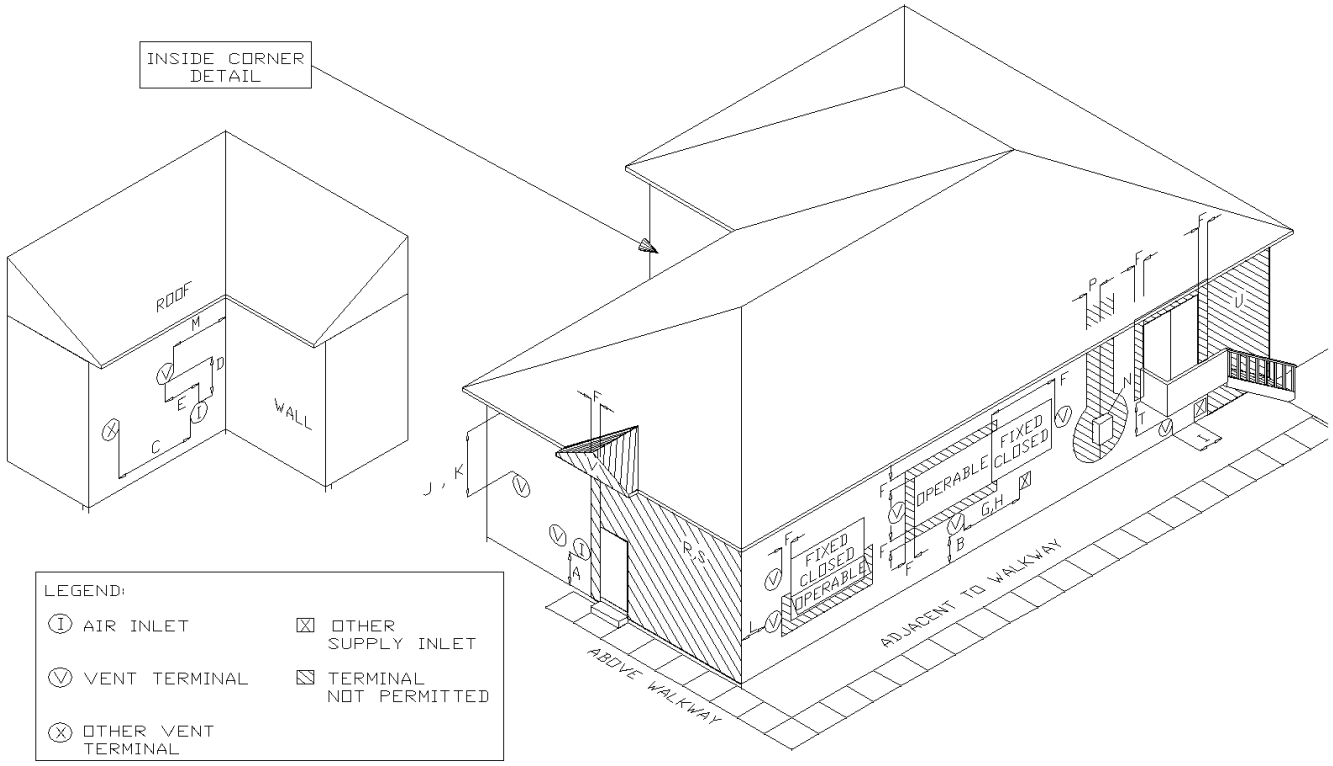
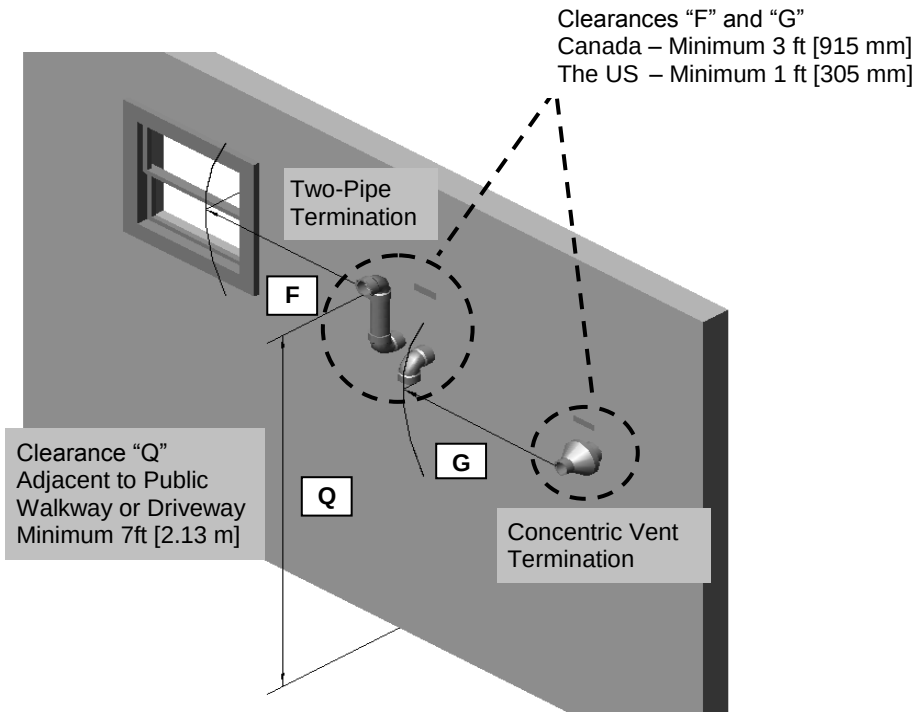


Figure 5-2 Side Wall Termination - Clearances Above Grade



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

6.0 CONDENSATE DRAIN

This unit produces liquid condensate in the heat exchanger and venting system as a product of combustion. Steps must be taken to ensure that condensate does not collect in the venting system; therefore, all exhaust piping must slope back to the boiler a minimum 1/4" 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).

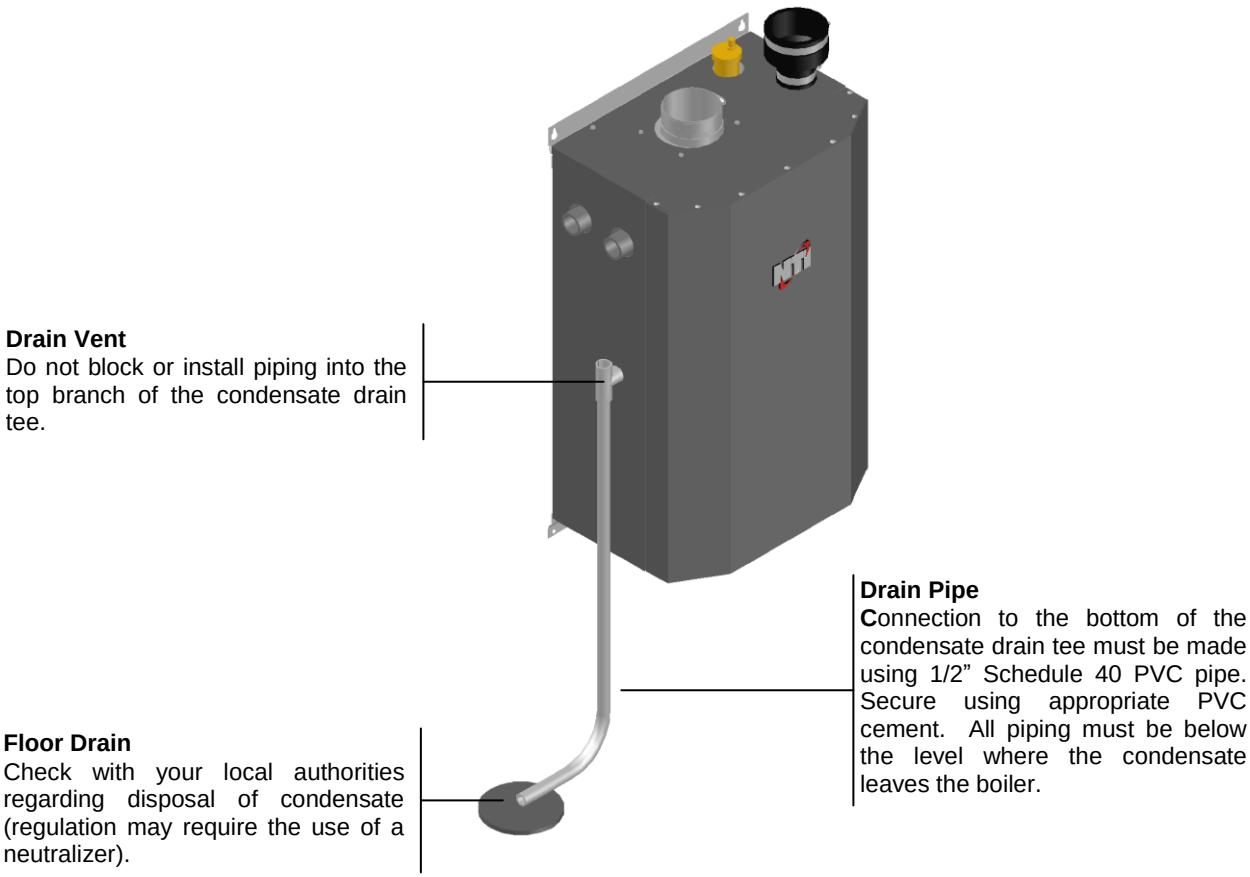
The following are important notes that must be taken into consideration when constructing the condensate drain system (See Figure 6-1 for further details):

- **DO NOT** install condensate lines outside. A frozen or blocked drain will cause the condensate to fill the combustion chamber. This will result in a no heat condition, as the unit will shut down, and damage to the flame sensor, and components can 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.

⚠ WARNING

If the combustion chamber has been flooded due to the condensate drain backing up, or for any other reason, the combustion chamber door must be removed and the inside of the boiler must be inspected for component damage, e.g. the internal insulation at the front and back of the chamber. Failure to follow these instructions may result in fire, property damage, serious injury or death.

Figure 6-1 Condensate Drain Piping



7.0 INSTALLING GAS PIPING

⚠ WARNING

The Trinity Ts is factory equipped to operate with Natural Gas, the installation of a conversion kit is required prior to operating with Propane Gas. The Natural to LP Conversion Kit (see Table 7-1) must be installed prior to installing the gas piping to the boiler. Failure to properly convert the unit to operate with Propane may result 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 be provided with an approved means of removing unburned gases from the room. Failure to follow these instructions may result in serious injury or death.

Table 7-1 Natural to LP Propane Conversion Kit

Model	Kit Number	Orifice Number
Trinity Ts80	82650-1	34 (3.4mm)

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 that the piping does not interfere with the vent pipe, or the removal of the valve, burner, and serviceable components.
- The Boiler shall be 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 boilers 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 GAS VALVE as damage to the valve or blower motor can occur.
- Install a manual "Equipment Shut-Off Valve" as shown in Figure 7-1. Valve must be listed by a nationally recognized testing lab.
- 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

Flexible gas piping cannot be used within the boiler cabinet and cannot pass through the cabinet wall, use rigid piping as shown in Figure 7-1. Failure to follow these instructions may result in fire, property damage, serious injury or death.

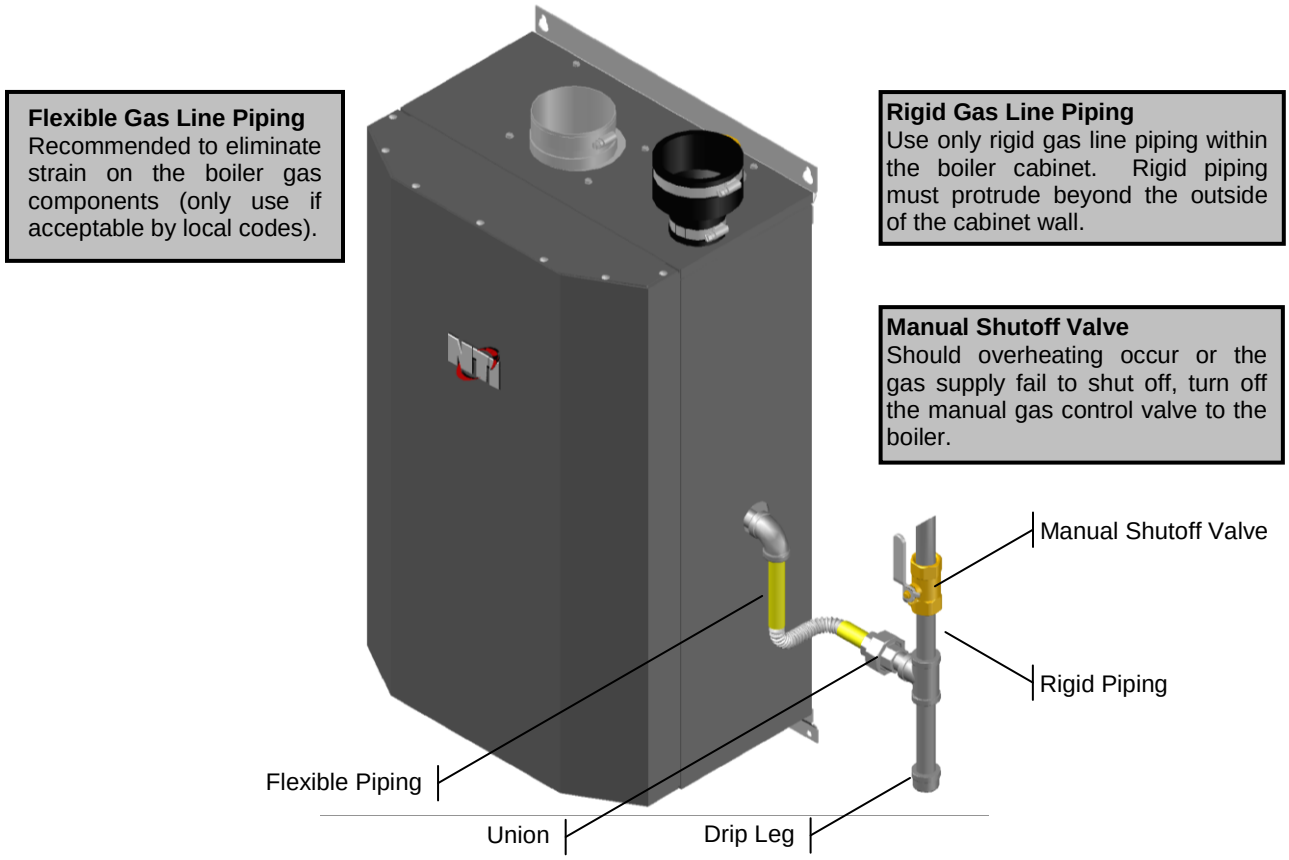
⚠ WARNING

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" w.c.), as damage to the valve could occur resulting in fire, property damage, serious injury or death.

Figure 7-1 Gas Line Connection (Typical)



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

D) Do not use this 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 don't 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 shut-off 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.

⚠ 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 Trinity Ts 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 three times, before locking-out.)
2. With the unit operating at full capacity, verify that the gas line pressure is 4-10.5 inches w.c. for Natural gas, and 9-13 inches w.c. for Propane (See Section 9.0 for details).
3. Using an appropriate Oxygen or Carbon Dioxide analyzer, take a sample of the flue gas. The sample must fall within the acceptable ranges for Carbon Dioxide, which is 8.5% - 9.5% for Natural gas, and 9.5%-10.5% for propane (See Section 9.0 for details).
4. Perform at least three lights in succession to ensure proper operation.
5. After the three successive lights, unplug the flame probe, and allow the unit to cycle again. Ensure that it tries to light, and locks out on safety reset. Once you have successfully activated the flame safety system, replace the wire on the flame sensor, and reconfirm proper lighting.

⚠ 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.

⚠ WARNING The flame probe uses a single electrode located in the burner door at the 6 O'clock position. DO NOT remove the wire from the dual electrode located in the burner door at the 3 O'clock position; this device is used for spark igniting and delivers a high voltage potential which would result in an EXTREME ELECTRICAL SHOCK possibly causing 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 shut-off 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. If you don't detect any gas proceed to the next step.
6. Turn the gas shut-off valve to the on position, wait an addition five (5) minutes and check for gas.
7. Replace the front cover.
8. Set the thermostat to the highest setting, and then turn on all power to the boiler.
9. Ignition sequence is automatic, combustion will occur after a brief fan purge. Ignition will retry 3 times.
10. If ignition does not occur, "Turn off the gas and electricity to the boiler" and contact a professional 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 shut-off valve to the off position.

9.0 GAS VALVE AND BURNER SET-UP

⚠ WARNING Set-up of the Trinity Ts 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.

Gas Line Pressure

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

1. Turn the supply of gas to the boiler off.
2. Open the bleed screw of the line pressure test port approximately 1-1/2 turns. This port is directly connected to the gas line feeding the boiler. See Figure 9-1.
3. Force 1/4" ID tubing over the housing of the line pressure test port; install the other end of the tubing to an appropriate line pressure test gauge or manometer. Ensure both ends of the tubing make a tight connection.
4. Open the supply of gas to the boiler and check for gas leaks.
5. Observe the line pressure under static conditions and compare it to Table 9-1. The pressure will be greatest under static conditions.
6. With all other gas boilers in the applications running, operate the burner to the maximum firing rate (See Table 9-2) and compare the observed line pressure with Table 9-1. The pressure will be lowest during the maximum flow of gas.
7. Adjust the gas line pressure to ensure the parameters in Table 9-1 are attained under all conditions. 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, incase adjustments need to be made.
9. Complete pressure testing, and then return the bleed screw of the Line Pressure Test Port to the closed position.

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

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

Table 9-1 Line Pressure and Combustion Parameters

Gas	Line Pressure (inches wc)			CO_2 (%)*		CO (ppm) Max.
	Nominal/Desired	Min.	Max.	Min.	Max.	
Natural	7	4	10.5	8.8	9.8	175
Propane	11	8	13	10	11	175

*Note: it is permissible to have higher CO_2 values with the burner operating at the minimum modulation rate.

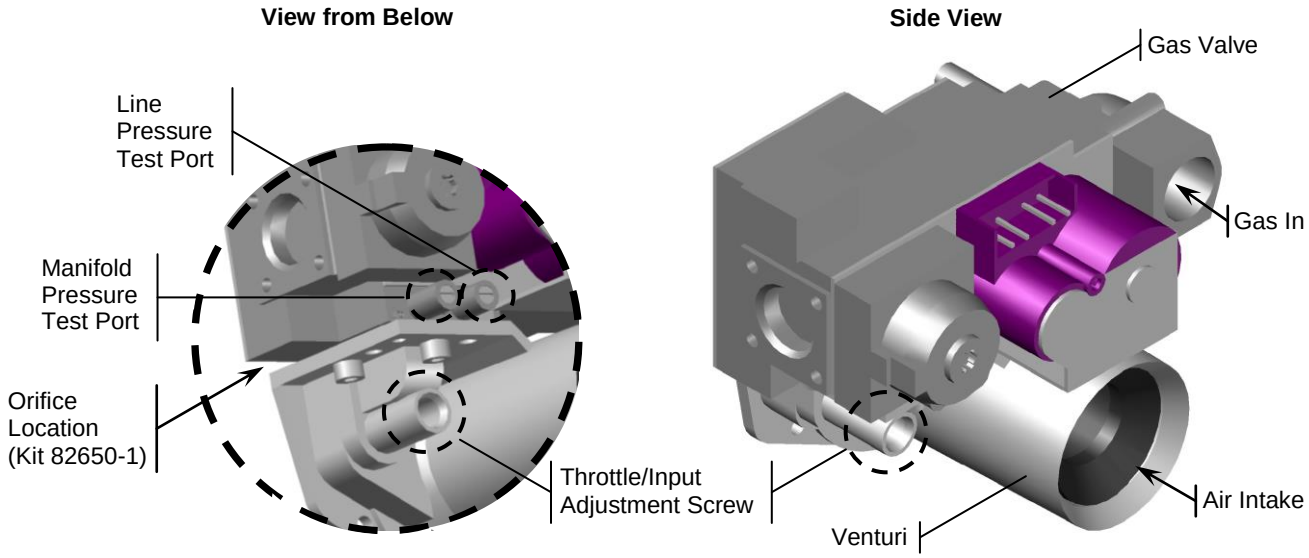
Table 9-2 Minimum and Maximum Modulation Rates

Model	Min. Modulation Rate (RPM)	Max. Modulation Rate (RPM)
Ts80	1700 (24%)	6400 (90%)

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

⚠ WARNING **Manifold Pressure** - DO NOT adjust or measure the Manifold Pressure of the boiler. Correct manifold pressure is factory set. Field adjustment could result in improper burner operation resulting in fire, explosion, property damage or death.

Figure 9-1 Gas Valve and Venturi Assembly

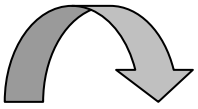


Adjustment

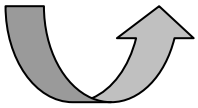
Input Screw Adjustments - The boiler is equipped with a Throttle/Input Adjustment Screw, located on the Gas Valve and Venturi Assembly. The Throttle screw is used to adjust the flow of gas leaving the gas valve, entering the Venturi and hence entering the combustion air stream. By turning the adjustment screw in, clockwise, the flow of gas is reduced and the combustion becomes leaner, thus reducing the concentration of CO_2 in the flue gases. To increase the CO_2 the Throttle screw must be adjusted out, counterclockwise, thus increasing the flow of gas from the gas valve to the combustion air stream. Typical adjustment required for Natural Gas is 0-1 full turns in or out from the factory setting. Typical adjustment for LP Gas is 0-3 full turns in or out from the factory setting upon inserting the LP orifice as per the applicable Propane conversion instructions. See Figure 9-1 for throttle screw location.

Figure 9-2 Throttle/Input Adjustment Screw (All Models)

Decrease Gas - Turn Clockwise



Increase Gas - Turn Counter Clockwise



IF FOR ANY REASON THE INPUT SCREW IS ADJUSTED, A "COMBUSTION ANALYZER" MUST BE USED TO ENSURE SAFE AND PROPER OPERATION OF THE GAS VALVE.

⚠ WARNING

Adjustments to the Throttle screw may only be made by a qualified gas technician, while using a calibrated combustion analyzer capable of measuring CO_2 and CO. Failure to follow these instructions may result in serious injury or death.

⚠ WARNING

Adjustments to the Throttle screw 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.

Combustion Calibration - To calibrate burner operation, perform the following procedure using a calibrated combustion analyzer capable of measuring CO_2 and CO from Natural and Propane Gas burning appliances:

1. Operate the unit at the maximum modulation rate, see Table 9-2.
2. Ensure the gas line pressure is maintained within tolerance, see Table 9-1.
3. While at the maximum modulation rate, measure the CO_2 and CO; adjust as necessary, using the Throttle Screw, to be within the limits listed in Table 9-1.
4. Operate the unit at the minimum modulation rate (Table 9-2). Ensure the combustion remains smooth and CO_2 and CO remain within the limits (Table 9-1). If not, do not adjust further, contact NTI for assistance.

Flue Gas Analysis and Adjustment

Each Trinity Ts is factory set to operate with Natural Gas, for boilers field converted to operate with Propane Gas, a flue gas analysis and adjustment is mandatory. See Table 7-1 and propane conversion instructions.

⚠ DANGER

Trinity Ts boilers require the installation of an LP orifice prior to operating with Propane Gas, see Propane conversion instructions for more details. Failure to follow these instructions will result in property damage, personal injury or death.

⚠ WARNING

Failure to perform the flue gas analysis and adjustment detailed in this section may result in erratic and unreliable burner operation, leading to reduced efficiency, increased fuel consumption, reduced component life, heat exchanger combustion deposits, and general unsafe operation. Failure to follow these instructions may result in serious injury or death.

Analysis - The Trinity Ts is not equipped with an integrated flue gas test port, flue gases must be sampled at the vent termination. When measuring from the termination, ensure the combustion gases are sampled from within the exhaust pipe by inserting the combustion analyzer probe several inches into the exhaust pipe. Perform the flue gas analysis and adjust the gas Throttle/Input Screw as required until CO_2 and CO levels are within acceptable limits, see Table 9-1.

10.0 BOILER AND HEATING SYSTEM PIPING

The heat exchanger of the Trinity boiler is designed to attain the highest level of heat transfer in a compact design. To accomplish this, the heating water flows through a series of fin shaped tubes, designed to maximize the heat transfer area. 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 all build-up including sludge and scale. All systems, old and new, must be cleansed to remove flux, grease and carbon residue. NTI recommends cleansing the boiler system with "Fernox F3 Cleaner". For retrofit applications with heavy limescale 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 cleansing, follow the instructions included with the Fernox DS-40 System Cleaner. See Table 10-1 for a list of recommended boiler cleansing 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 limescale and sludge deposits.

Boiler Water

Pressure - The Trinity boilers are intended solely for use in pressurized closed loop heating systems operating with a minimum pressure of 15 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 (oxygen) 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 Trinity Ti boiler 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 Trinity Ti 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 7.5 and 9.5.
- Chloride – less than 125mg/l.
- Iron – less than 0.5mg/l.
- Copper – less than 0.1mg/l.
- Conductivity – 100 to 300µS/cm (at 25ºC); [TDS 50 to 150ppm or Total Hardness 3 to 9grains/USgal.]

Treatment - Boiler water that falls outside of the conditions listed above must be treated with a corrosion inhibitor. Each Trinity Ti boiler is provided with 1 bottle of "Fernox F1" corrosion inhibitor, adequate to treat a 26.4 gallon (100 liter) heating system to a minimum required concentration of 0.5%. Systems with greater volume will require more inhibitor. For information on performing the treatment, follow the instructions included with the Fernox F1 Protector. See Table 10-1 for a list of recommended boiler system cleansers 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 "de-rated" by limiting the maximum operating capacity and/or the maximum water temperature. NTI recommends against exceeding 35% concentration of glycol.

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

Near Boiler Plumbing

Pressure Relief Valve - A Pressure Relief Valve is factory supplied with each unit. Trinity Ts boilers have a maximum allowable operating pressure of 160PSI. A pressure relief valve with a higher discharge pressure rating (up to the MAWP of the boiler) may be used as long as the relieving capacity is in excess of the maximum input capacity of the boiler. The pressure relief valve must be installed at the boiler outlet and in the vertical position, as shown in Figure 10-1, with the drain pipe outlet exiting the side of the pressure relief valve horizontally and elbowing down.

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

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

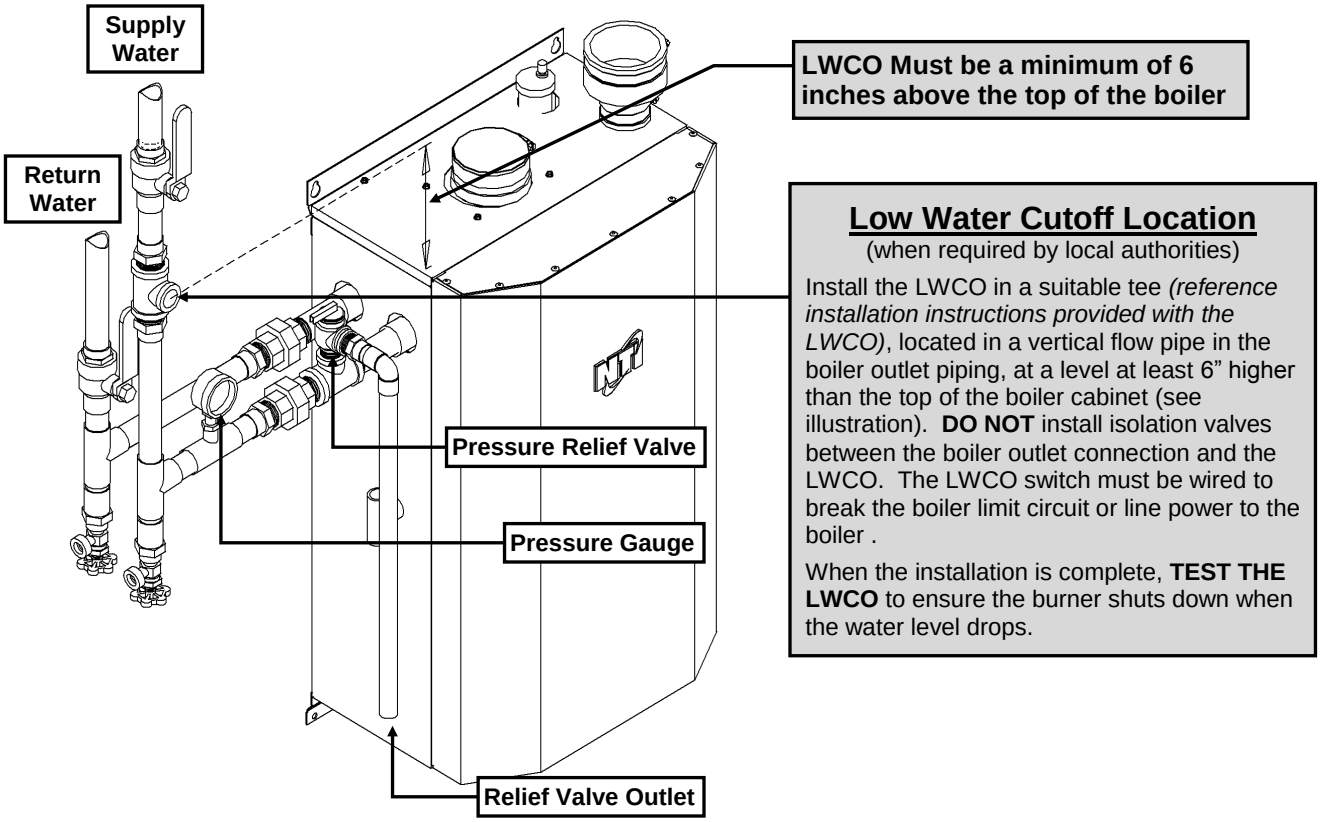
Pressure Gauge – Trinity Ts units come with a factory supplied Pressure Gauge. The pressure gauge must be installed at the boiler outlet prior to any circulators and in the vicinity of the pressure relief valve. See Figure 10-1.

Low Water Cutoff (LWCO) / Safety Flow Switch – Trinity Ts boilers are provided with a factory installed Water Pressure Switch; in the event the pressure drops below 10 psi, the burner is inhibited from firing. Where required by the Authority having jurisdiction, an external LWCO, or Safety Flow Switch, must be installed; see Figure 10-1 for LWCO installation.

⚠ DANGER Operating the boiler without sufficient water level will result in overheating and may result in property damage, fire, personal injury or loss of life.

NOTICE When external safety devices are used, such as a LWCO, Flow Switch, or a Temperature Limiting Switch, they must be wired as per the instructions provided in this manual. Refer to Section 11.0 for more information.

Figure 10-1 Near Boiler Piping



Boiler System Plumbing

The Trinity Ts boiler uses a low mass heat exchanger that requires a minimum rate of forced water circulation any time the burner is operating (See Table 10-4 for minimum flow rates). To ensure the minimum flow rate is attained, the boiler must be installed in a "Primary/Secondary" plumbing configuration utilizing "Closely Spaced Tees" to de-couple the Boiler-Primary loop from the System-Secondary loop(s). See the examples of Primary/Secondary Loop configurations in Figures 10-2 and 10-3.

System Components – As well as a Primary/Secondary Loop Configuration utilizing closely spaced tees a properly installed system will include the following major components identified in Table 10-3 as a minimum.

Table 10-3 System Major Component Checklist

Factory Supplied	Field Supplied Components
☐ Pressure Relief Valve	☐ Boiler Loop Circulator (Pump B in Figure 10-2 or Pump C in Figure 10-3)
☐ Pressure Gauge	☐ DHW Loop Circulator (Pump A in Figure 10-2 and Figure 10-3, for applications utilizing Indirect Fired Water Heater only)
	☐ Central Heat (CH) Loop Circulator(s) (CH Circulator - Pump C in Figure 10-2; Zone Circulators in Figure 10-3)
	☐ Central Air Removal Devices (i.e. Micro Bubbler or Air-Scoop)
	☐ Pressure Regulating "Fill Valve"
	☐ Backflow Preventor
	☐ Expansion Tank

Circulating Pumps – Trinity Ts boilers are equipped with three 120VAC pump outputs:

1. PUMP A "DHW Pump" - operates during a Domestic Hot Water demand (DHW).
2. PUMP B "Boiler Pump" - operates during any demand.
3. PUMP C "CH Pump" - operates during a Central Heat/Thermostat demand (THERMOSTAT).

Ensure pumps are oriented as per the manufacturers' instructions. Wiring of these circulators will depend on the system configuration selected; see Figures 10-2 and 10-3. For further wiring details see Section 10.0.

NOTICE

Circulators responsible for forcing the water flow rate through the boiler must be sized according to Table 10-4, see Figures 10-2 and 10-3 for details.

⚠ WARNING

Failure to ensure the minimum water flow rate through the boiler when the burner is on will not only reduce the operating efficiency of the boiler, but may also cause premature failure, overheating and void the warranty. Failure to follow instructions may result in fire, property damage, serious injury or death.

Table 10-4 Minimum Circulator and Pipe Sizes

Model	Restriction Head Loss	Minimum Pipe Size	Min. Flow (GPM)	Max Temp. Rise	Minimum Primary Loop Pump Size			
					B&G	Grundfos	Taco	Armstrong
80	6' at 4 GPM	¾"	3.5	45°F	NRF-22	UPS 15-58	007[1]	Astro 30

Notes:
[1] Recommend using a Taco 008 for DHW indirect circulator when installed as per Figure 10-3.

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.

NOTICE

Trinity boilers are equipped with an automatic air removal device to aid in the purging of air from the boiler during the initial fill. This device is **NOT** intended, nor is it sufficient to remove the air from the system plumbing, even if the air makes it back to the boiler. A strategically located air removal device must be installed in the system.

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 10-2 and 10-3.

⚠ CAUTION

Ensure the expansion tank cannot become isolated from the boiler anytime the system is operating. Failure to follow these instructions may result in discharge of the Pressure Relief Valve may result in property damage or personal injury.

NOTICE

The installation of flow checks, motorized valves or other shutoff devices (other than for the purpose of servicing) are not permitted between the location of the "Closely Spaced Tees" and the expansion tank; see Figures 10-2 and 10-3.

Indirect Fired Water Heater – When installed as per Figure 10-3, the indirect fired water heater is in series with the boiler during a demand for DHW. Therefore when using this configuration it is important to use an Indirect Fired Water Heater that has minimal head loss. Indirect fired water heater head loss must not exceed 4' at 4 GPM when installed as per Figure 10-3.

Figures 10-2 and 10-3 are examples of plumbing configurations using a single system circulator and multiple system circulators, respectively.

Figure 10-2: Single System Circulator Configuration - Often used in applications zoned with "Zone Valves". During a demand for central heat, the boiler energizes the System Circulator via the Central Heating (CH) pump output (PUMP C). The System Circulator must be sized to provide adequate circulation throughout the heating system. During a Domestic Hot Water (DHW) demand, the boiler de-energizes the System Circulator (PUMP C) and energizes the DHW Circulator (Pump A). With this configuration the Boiler Circulator is the only pump that causes flow through the boiler and it is powered during any demand via the boiler pump output (PUMP B). This circulator must be sized according to Table 10-4.

NOTICE

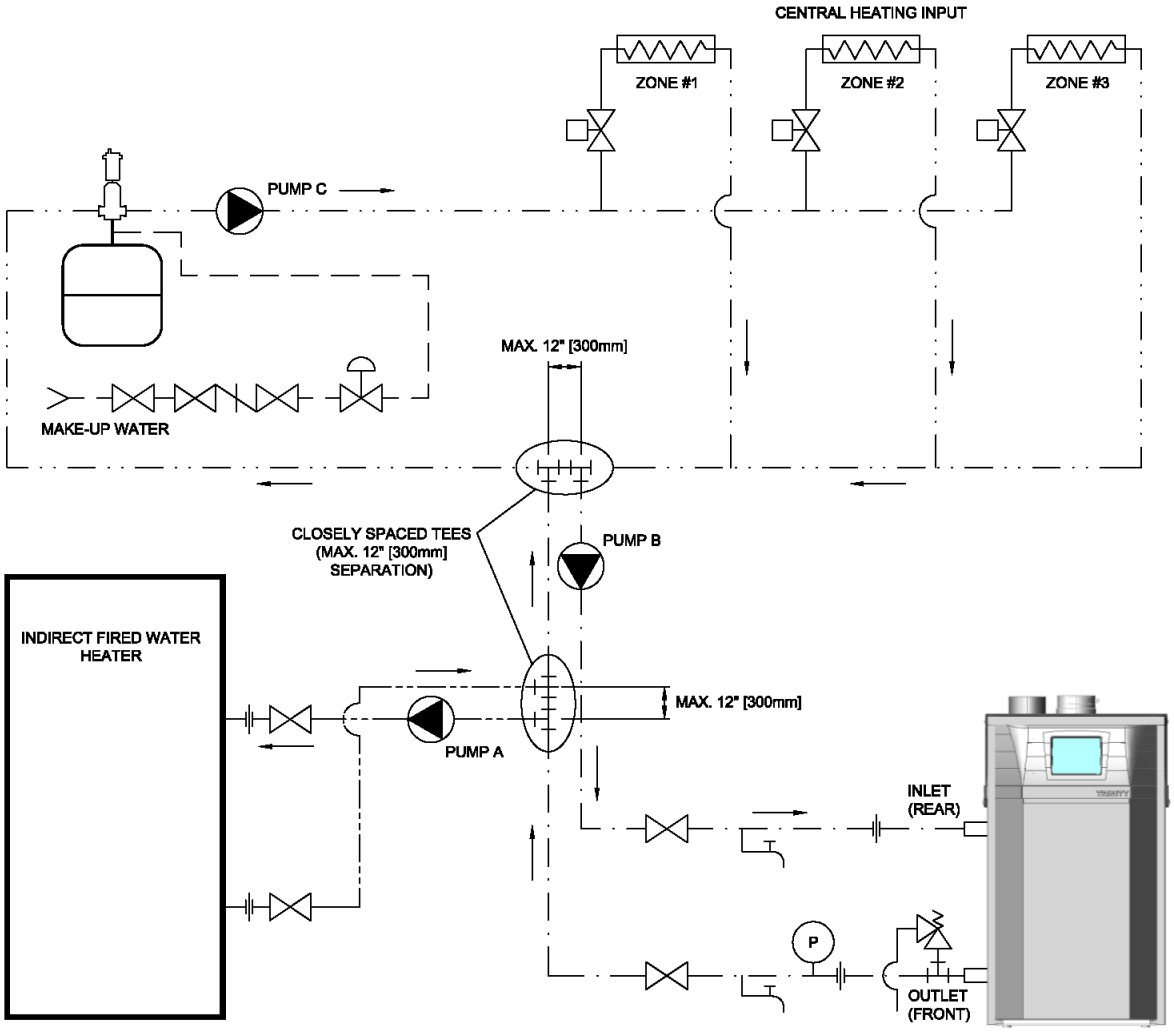
The piping configuration described above requires the Central Heating system and DHW system to be de-coupled from the "Primary Loop" via closely spaced tees (Figure 10-3).

Figure 10-3: Multiple System Circulator Configuration - Often used in applications with "Zone Circulators". This configuration requires the installation of a check valve located at each circulator. During a central heating demand the boiler energizes the Central Heat Circulator via the Central Heat pump out (PUMP C). During a Domestic Hot Water (DHW) demand, the boiler de-energizes PUMP C and energizes the DHW Circulator (Pump A). Both Pump A and C, used in this configuration, are responsible for water flow through the boiler and must be sized according to Table 10-4. Pump output, PUMP B is not used in this configuration.

NOTICE

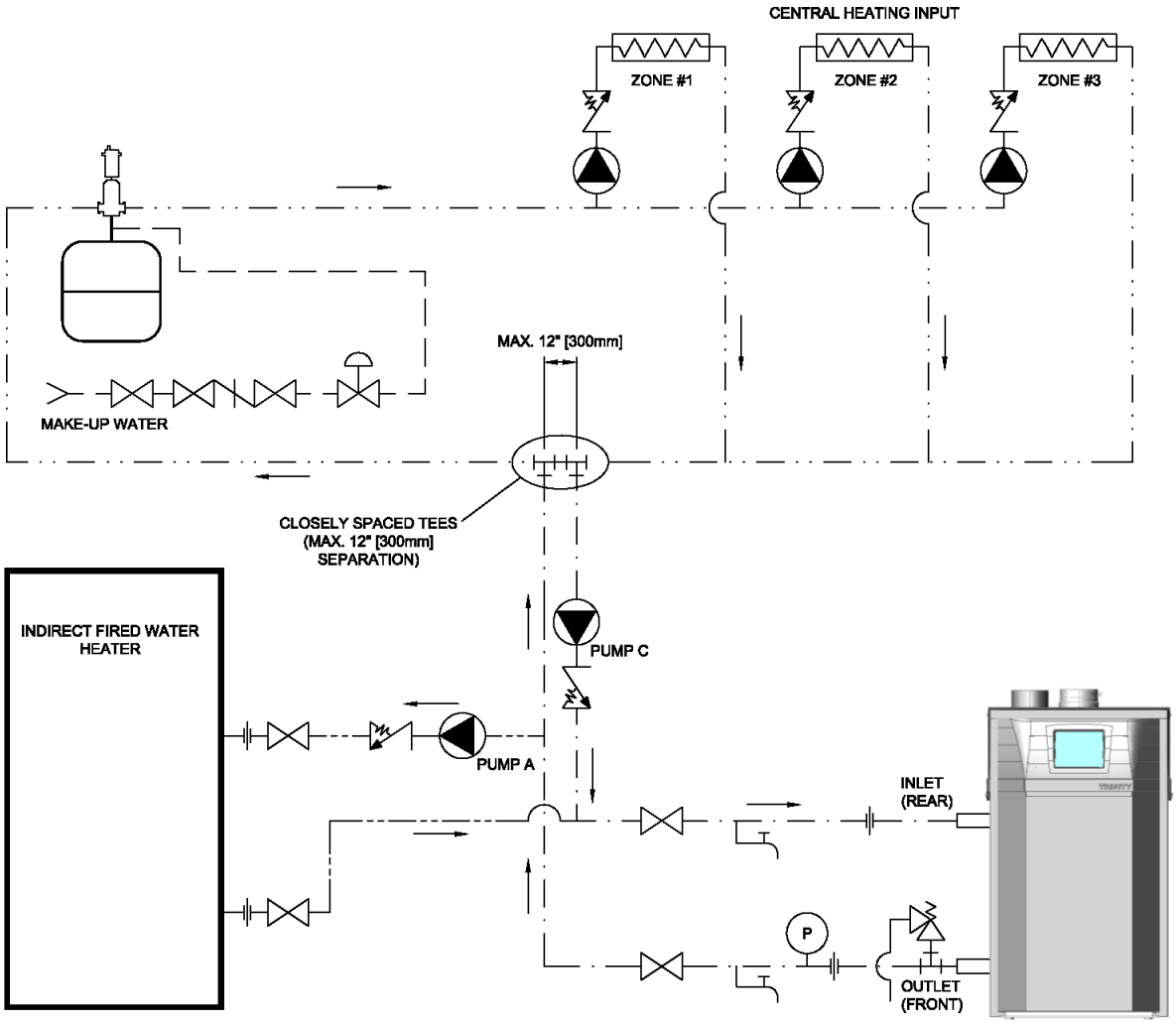
Figures 10-2 and 10-3 illustrate typical piping systems. These piping schematics do not illustrate all of the required concepts and components required to have a proper installation. Concepts not shown include: prevention of thermal-siphoning (heat traps), isolation valves, drain and purge valves, etc. 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.

Figure 10-2 Boiler Plumbing Primary/Secondary Loop
(Single System Circulator Configuration)



LEGEND					
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
— — —	MAKE-UP WATER		BACKFLOW PREVENTOR		AIR SEPARATOR
— · —	PRIMARY LOOP		PRESSURE RELIEF VALVE		PUMP
— · · —	CENTRAL HEATING SECONDARY LOOP		PRESSURE REGULATING VALVE		UNION
— - - —	DHW SECONDARY LOOP		DRAIN VALVE		TEE
	ISOLATION VALVE		AIR VENT		FLOW DIRECTION
	ZONE VALVE		EXPANSION TANK		
	ZONE LOAD	P	PRESSURE GAUGE		

Figure 10-3 Boiler Plumbing Primary/Secondary Loop
(Multiple System Circulator Configuration)



LEGEND					
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MAKE-UP WATER		BACKFLOW PREVENTOR		AIR SEPARATOR
	PRIMARY LOOP		PRESSURE RELIEF VALVE		PUMP
	CENTRAL HEATING SECONDARY LOOP		PRESSURE REGULATING VALVE		UNION
	DHW SECONDARY LOOP		DRAIN VALVE		TEE
	ISOLATION VALVE		AIR VENT		FLOW DIRECTION
	ZONE VALVE		EXPANSION TANK		SPRING CHECK VALVE
	ZONE LOAD	P	PRESSURE GAUGE		
H C M	THERMOSTATIC MIXING VALVE		OPTIONAL		

11.0 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.

⚠ 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.

CAUTION

Field Wiring - Wire grommets must be used to secure wiring and prevent chafing when passing wiring through the cabinet wall. Failure to follow instructions may damage unit.

Line Voltage Connections

Electrical rating for the Trinity Ts is 120V / 1 Phase / 60 Hz / 12A. All line voltage wiring connections to the Trinity Ts are made at the junction box in the control panel located at the bottom of the boiler cabinet. The connections are accessed by removing the front door of the boiler, followed by the removal of the control panel cover. Field connections are to be installed in accordance with Figure 11-1 and Table 11-1. Holes are located on the bottom (underside) of the control panel junction box.

Fuse (120VAC) – The Trinity Ts is equipped with a 7 Amp fuse to protect 120VAC system components. The fast-acting fuse is located on the front of the control panel box and can be easily accessed from the outside of the control panel.

⚠ WARNING

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

⚠ WARNING

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

⚠ CAUTION

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

CAUTION

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

NOTICE

Max Load - Circulator outputs (PUMP A, B, C) are each limited to operating a circulator with a maximum current load of 3 Amps or a maximum 1/6 hp motor. See Table 11-1.

Figure 11-1 Line Voltage Field Wiring

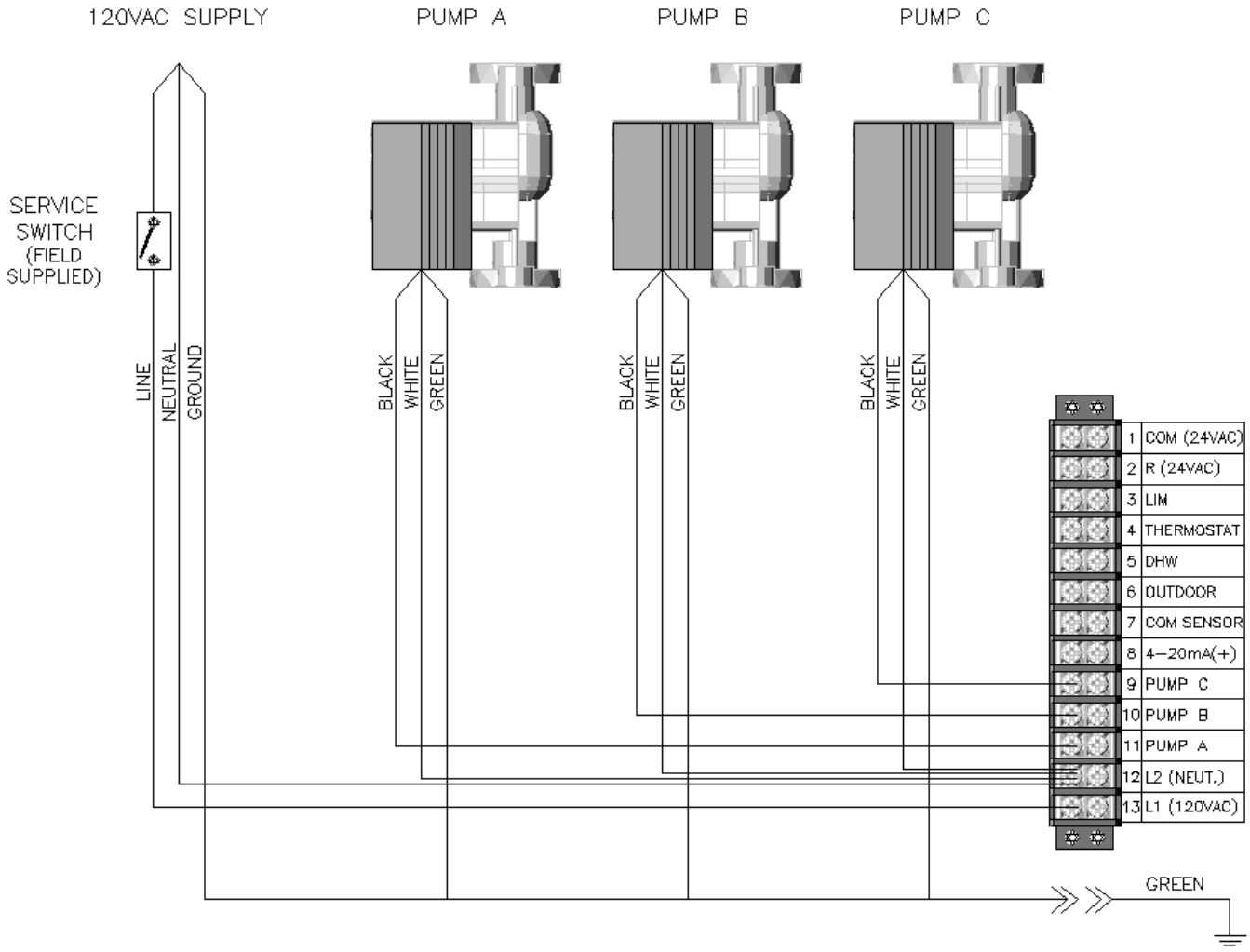


Table 11-1 Line Voltage Field Connections

Connection	Location	Description
PUMP C	9	120VAC output to the Central Heating circulator; powered during a demand for Central Heat (Thermostat).
PUMP B	10	120VAC output to the Boiler circulator; powered during all demands for DHW, and Central Heat (Thermostat). This output is not used for all plumbing configurations, see "Field Wiring".
PUMP A	11	120VAC output to the DHW circulator; powered during a demand for DHW.
L2 (NEUT.)	12	Location for connecting neutral of the power supply and all circulators.
L1 (120VAC)	13	Location for connecting line voltage of the power supply. Note most installation codes require the installation of a service switch to break line voltage to the appliance.

Low Voltage Connections

All line voltage wiring connections to the Trinity Ts are made at the junction box in the control panel located at the bottom of the boiler cabinet. The control panel junction can be accessed by removing the front door of the boiler, followed by the removal of the control panel junction box cover. Each boiler is provided with one hole and two knockouts for routing line voltage wiring and two grommets for routing low voltage wiring into the bottom of the control panel junction box. Low voltage field connections identified in Table 11-2 are to be read in conjunction with Figure 11-2.

Table 11-2 Low Voltage Field 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 LIM and Thermostat.
LIM	3	**External Limit** – Input requiring 24VAC from terminal R 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 LWCO, Flow Switch, or auxiliary temperature limit, remove the factory installed jumper and install the normally open isolated contacts of the additional limit in its place.
THERMOSTAT	4	**Central Heat Demand** – Input requiring 24VAC from terminal R to initiate a Central Heat call. Switch is made using an isolated end switch (dry contact) via thermostat, zone controller or other device.
DHW	5	**DHW Tank Demand** – Input requiring closure of terminals 5 and 7 to initiate a demand for DHW. Switch made via isolated end switch (dry contact) from a thermostat (aquastat) located in an Indirect Fired Water Heater.
OD SENSOR	6	**Outdoor Temperature Sensor** – A wall mountable OD Sensor is included with each boiler. When connected to terminals 6 and 7, the control will indicate the outdoor temperature and adjust the boiler temperature set point during a Central Heat demand.
SENSOR COM	7	**Sensor Common** – Common port for field inputs DHW, OD Sensor and 4-20mA(+).
4-20mA(+)	8	**External Modulation Control** – Using a 4-20mA signal connected to terminals 7 and 8, 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 Building Automation Systems.

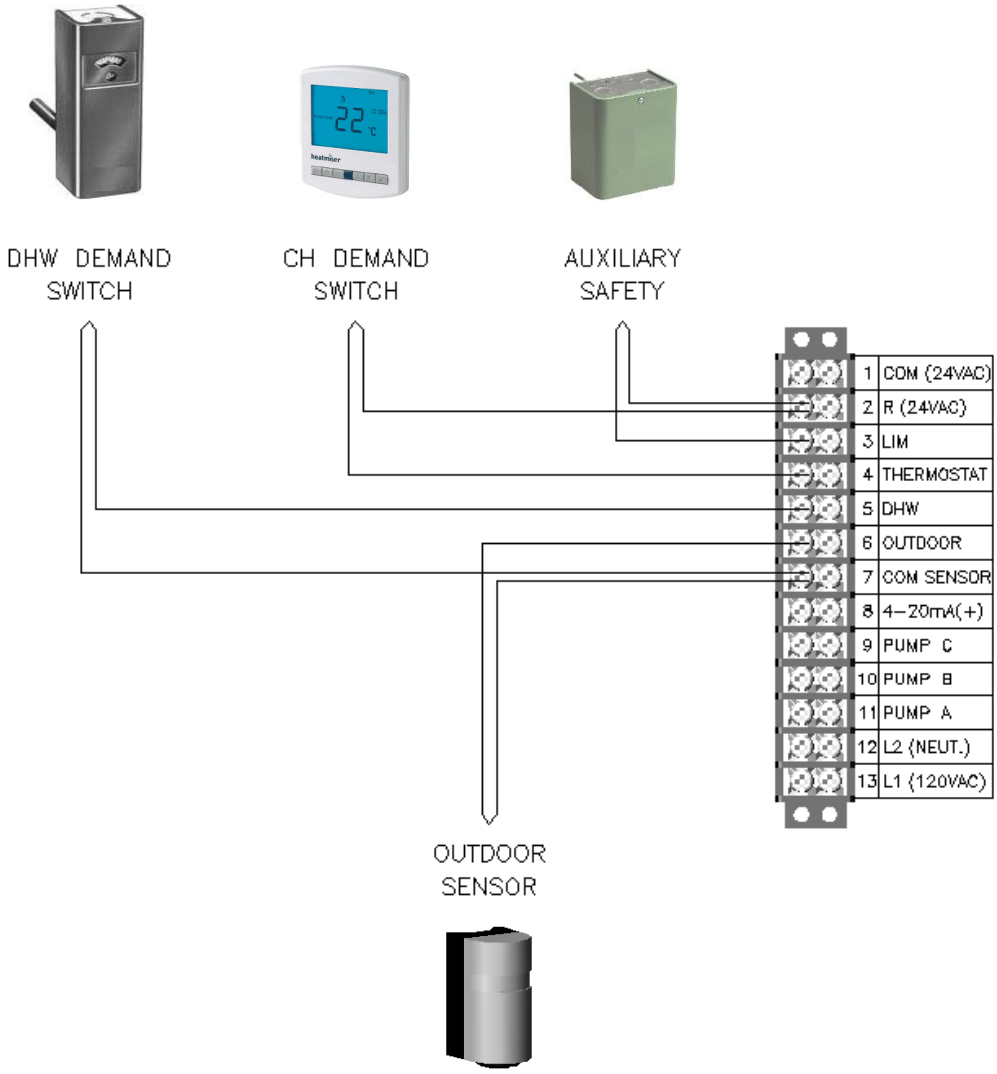
CAUTION

Low Voltage Terminals – Terminal 2 (R) has 24VAC potential from the internal transformer. Do not connect power from this terminal to any other terminal other than terminals 3 and 4 (LIM and Thermostat). Failure to follow these instructions may damage the unit.

NOTICE

Fuse (24VAC) - Trinity Ts models are equipped with a "blade style" 2 Amp fuse to protect the internal transformer located within the control panel box.

Figure 11-2 Low Voltage Field Wiring



12.0 WIRING SCHEMATICS

Figure 12-1(a) Connection Diagram

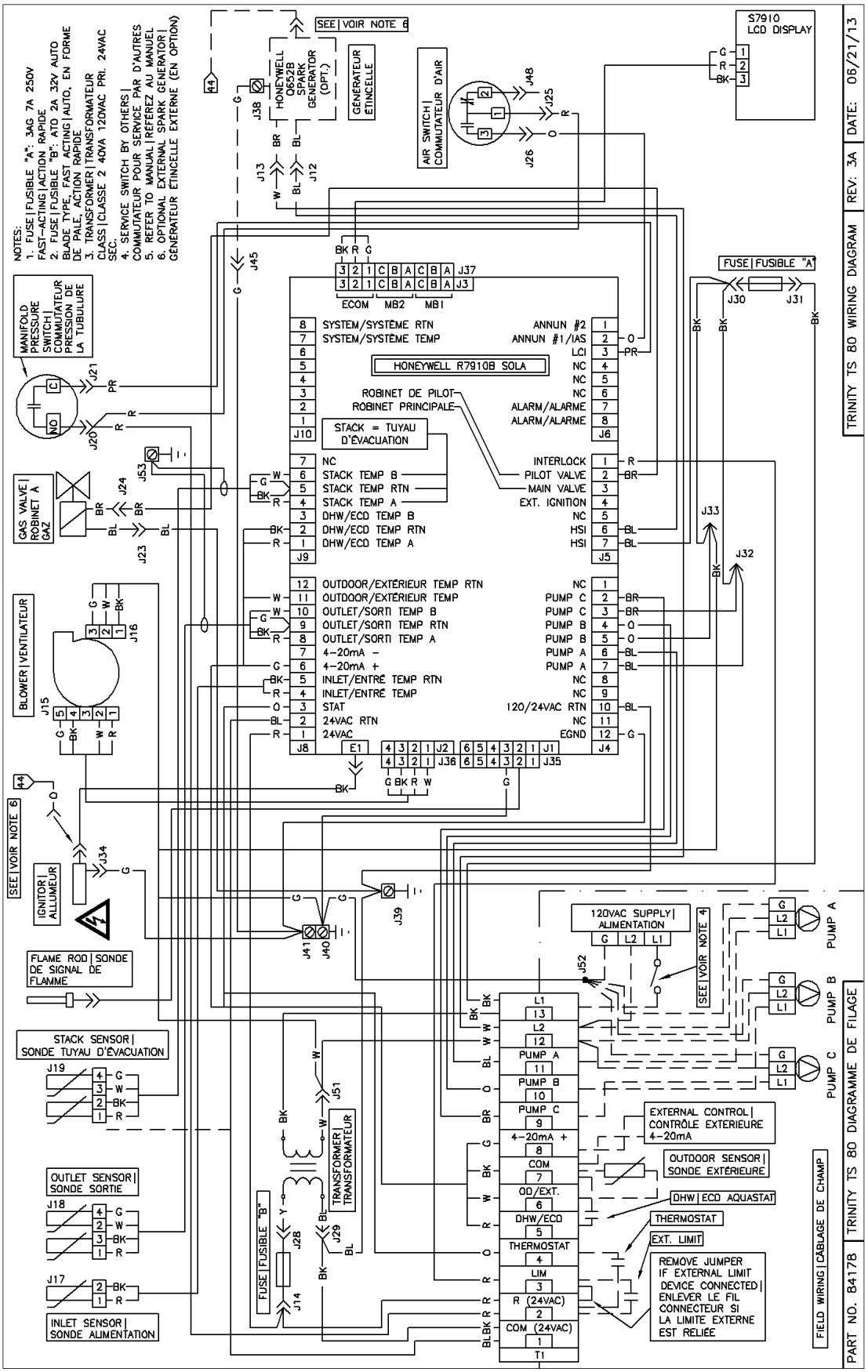
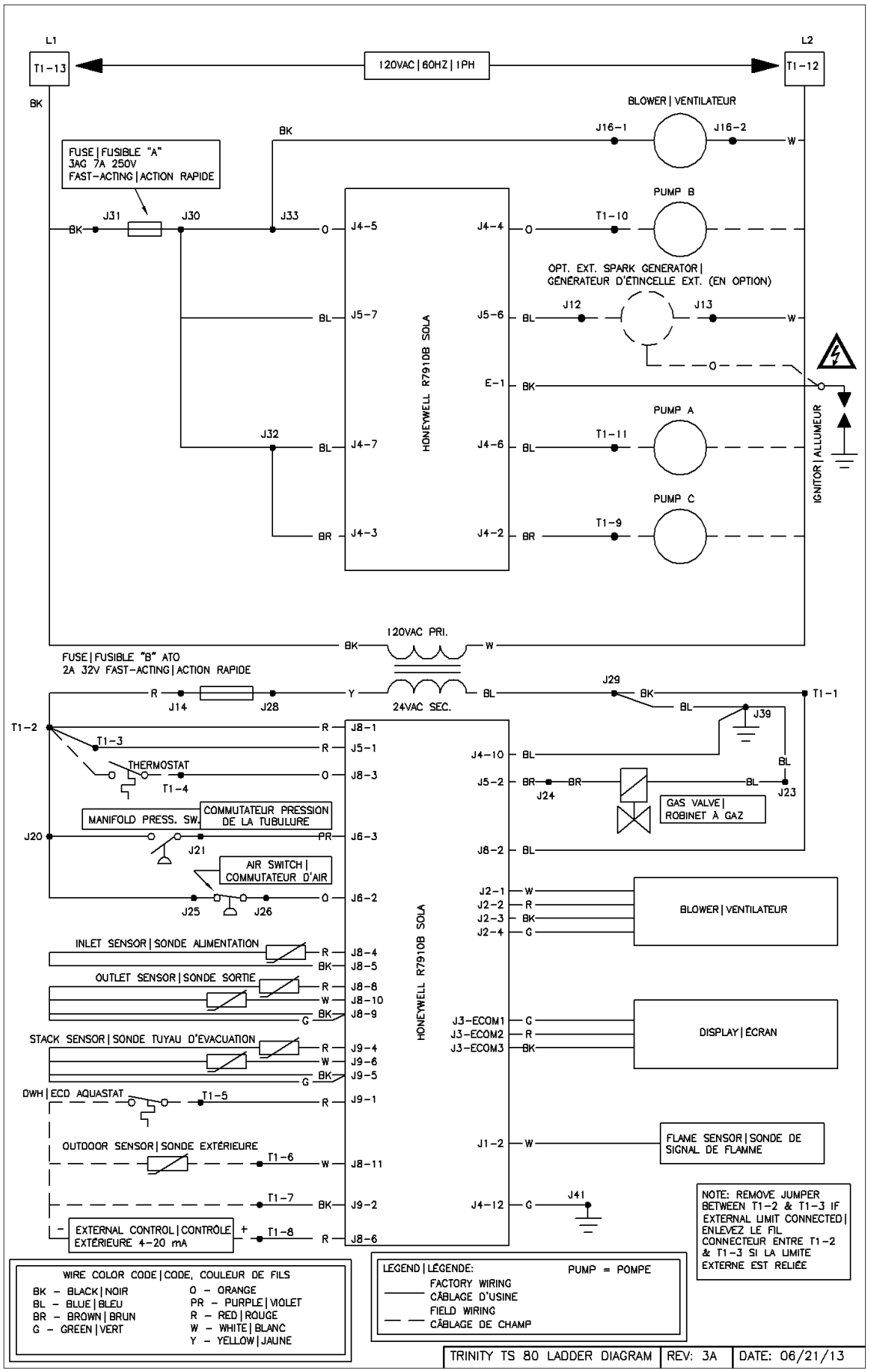


Figure 12-1(b) Ladder/Logic Diagram



13.0 CONTROLLER AND DISPLAY

Introduction

The Controller and Display, together, form the control system of the Trinity Ts. All control configuration parameters are stored in non-volatile memory in the Ts controller. Access to controller status and configuration is achieved with the display; however, the controller is completely capable of operating with the display disconnected. Controller factory settings must be field adjusted to suit the application and system requirements.

IMPORTANT Please read the following document carefully as factory settings are not configured for a particular application and may require adjustment in order to satisfy system requirements.

Example: The factory setting for central heat setpoint is 180°F [82°C] which is well suited for many "low mass-high temperature" systems; however, it should be adjusted down for "high mass-low temperature" heating systems (i.e. 100-130°F for infloor heat or 130-160°F for cast iron radiator systems).

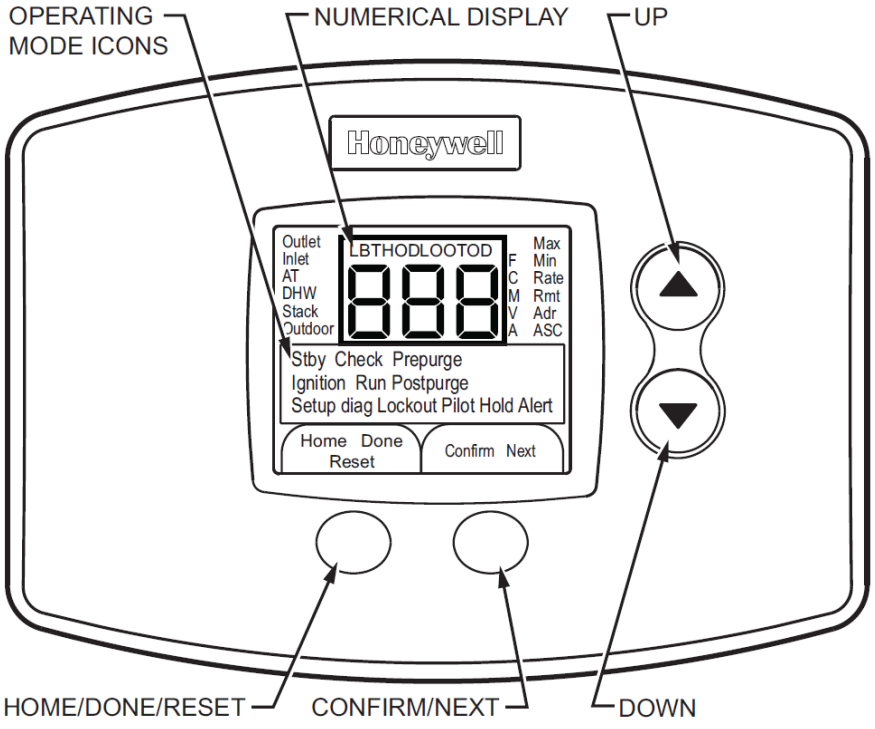
It is the responsibility of the installer, a licensed qualified heating technician, to configure and commission the unit and adjust any parameters required to comply with the application and satisfy the system requirements. See Table 13-1 for a list of the minimum parameters to be considered/adjusted prior to putting the unit into operation.

Table 13-1 Settings Quick Reference Table

Setting	Description	Defau	Menu	Menu Item
Central Heat Temperature	Sets the maximum boiler target temperature for a call for central heat (Thermostat); access via menu item "Outlet" in the User menu.	180ºF	User (Table 13-2)	Outlet
DHW Temperature	Sets the boiler target temperature for a call for domestic hot water (DHW); access via menu item "DHW" in the User menu.	180ºF	User (Table 13-2)	DHW
Low Boiler Temperature (LBT)	Sets the minimum boiler target temperature for a call for central heat; temperature is achieved when outdoor reset is used and the outdoor temperature reaches the HOD (High Out-Door temperature) setting.	95ºF	Setup (Tables 13-4 and 13-6)	LBT
High Out-Door temperature (HOD)	Sets the maximum outdoor temperature threshold; temperature where the boiler target temperature stops decreasing with increasing outdoor temperature, see above.	70ºF	Setup (Tables 13-4 and 13-6)	HOD
Low Out-Door temperature (LOD)	Outdoor design temperature – sets the minimum outdoor temperature; temperature where the boiler target temperature stops increasing with decreasing outdoor temperature.	0ºF	Setup (Tables 13-4 and 13-6)	LOD

Display Layout

Figure 13-1 Display Layout



User interaction with the display is accomplished with buttons, two beneath the LCD screen and two on the right side of the screen. The function of the two lower buttons varies depending on the screen that the user has selected. The two right-hand buttons are used to change the value of parameters, as selected by scrolling through the various information screens.

Display Modes

The display operates in 3 separate modes: User, Setup and Diagnostic. Each mode consists of a number of individual screens or pages of information, described below. The following controller functions are accessible with the display:

- **User Mode**
  - Burner control state, sequence
  - Firing rate
  - Lockout code
  - Alert and Hold Reason
  - CH set point
  - DHW set point
  - System status and diagnostics provided through the LCD
  - Outlet temperature
  - Inlet temperature
  - Delta T (Outlet-Inlet)
  - Stack temperature
  - Outdoor temperature
- **Set-up Mode**
  - Temperature units (°F/°C) selection
  - Outdoor reset parameter settings
  - Anti-Short Cycle enable/disable and setting
  - Warm weather shutdown setting
  - PIM Operation (requires PIM memory module, purchased separately)
  - Modbus address setting (1–250) (see Note 1)
  - Lead Lag Control (see Note 1)
  - LL on/off hysteresis (see Note 1)
  - LL baseload % (see Note 1)
- **Diagnostic Mode**
  - Flame signal measurement (μA)
  - Previous Alert
  - Previous Lockout code displayed
  - Outlet Temp high limit
  - Stack temp high limit
  - DHW temp high limit
  - Min/Max/Manual firing rate testing

Note 1: Not applicable to the Ts80 model.

User Mode

On power-up, after briefly displaying its software version number, the display enters User mode. In User mode, the display shows current boiler operating data such as Outlet temperature, CH setpoint, or burner firing rate. User mode consists of the screen items listed in Table 13-2.

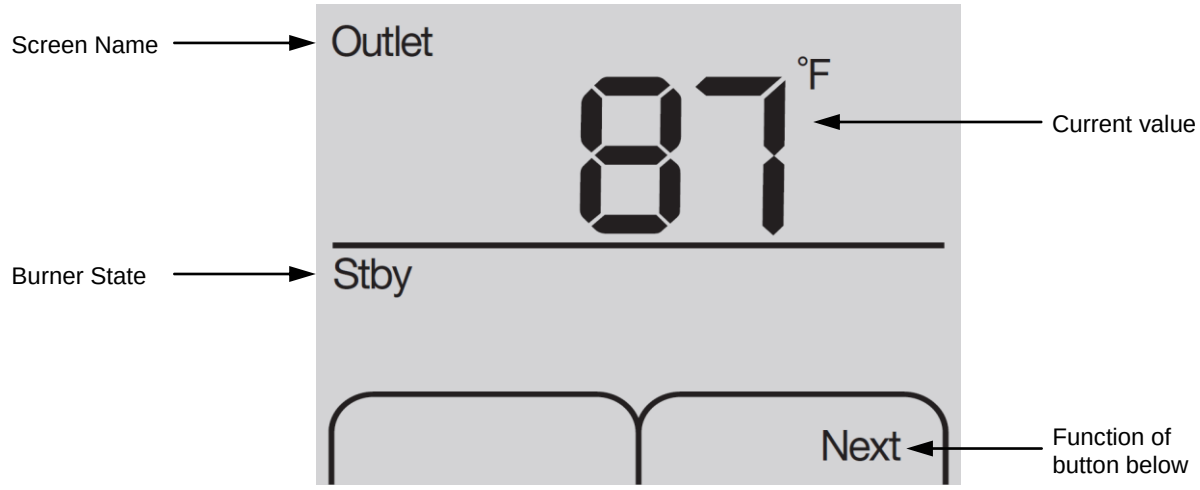
Table 13-2 User Mode Screens

Setting	Description	Factory Setting
Outlet	Shows current outlet water temperature (temperature of hot water exiting boiler to load); press the Up or Down button to enter a screen wherein the Central Heat setpoint temperature may be set. Use the Up and Down buttons to modify the setting as desired. Range 60°F to 195°F [15°C to 90°C].	180°F [82°C]
Inlet	Shows current inlet water temperature (temperature of cooled water entering the boiler from load). No user action required.	N/A
DeltaT	Shows the current temperature difference of Outlet minus Inlet. No user action required.	N/A
DHW	Displays "---" indicating that no Domestic Hot Water tank sensor is connected (the Ts80 model does not support a tank sensor); press the Up or Down button to enter a screen wherein the DHW indirect setpoint temperature may be set. Use the Up and Down buttons to modify the setting as desired. Range 60°F to 195°F [15°C to 90°C].	180°F [82°C]
Stack	Shows current stack temperature (temperature of exhaust gas). No user action required.	N/A
Outdoor	Shows current outdoor temperature (if factory provided outdoor sensor is connected). No user action required.	N/A
Rate	Shows current firing rate in %. No user action required.	N/A
LL	**This parameter does not apply to the Ts80 model.**	N/A

Depending on the controller mode of operation, in User mode the display distinguishes between two "home" screens:

- If CH (Thermostat) call for heat is active, the display considers Outlet to be the home screen.
- If DHW call for heat is active, then DHW will be the home screen.

Figure 13-2 Typical Screen Format



To advance through the screens, press the "Next" button (right-hand oval button under the screen). The following is a detailed description of a typical screen, in this example Outlet Water Temperature. See Figure and Table 13-2.

On screens where parameter adjustment is possible, use the Up and Down arrow buttons (located immediately to the right of the screen) to, respectively, increase or decrease the displayed value by 1 (Note: if a button is held in continuously the value changes more rapidly). For example, to change the CH setpoint, ensure that the Outlet screen is selected, then press either the Up or Down button to immediately show the current CH setpoint value, then continue pressing either Up or Down to modify the value. When the desired value is displayed, press the "Done" button (left-hand oval button below the screen) or simply allow the screen to timeout. Table 13-3 lists the timeout duration of User mode screens.

Table 13-3 User Mode Screen Timeouts

Screen Displayed	Length of Inactivity that Causes Timeout
Outlet water temp	1 minute
CH water setpoint temperature	10 seconds
Inlet water temp	1 minute
Delta T	
DHW water temp	
DHW water setpoint temperature	10 seconds
Stack temp	1 minute
Outdoor temp	
Firing Rate	
Lead Lag Header temperature (see Note 1)	
Lead Lag Setpoint temperature (see Note 1)	10 seconds

Note 1: Not applicable to the Ts80 model.

After the timeout period has elapsed, the display will revert to the current "home" screen in User mode, as explained above.

Setup Mode

To enter Setup mode from User mode, press and hold both the Up and Down buttons for 5 seconds.

IMPORTANT Entering Setup mode will force the controller to shut down the burner and enter Standby mode. The controller will remain in this state until the "Done" button is pressed or the inactivity timeout period elapses.

As with User mode, pressing the Next button will cause each successive screen to appear on the display.

Table 13-4 Outdoor Reset Explanation

Parameter	Description	Factory Settings	Comments
Low Boiler Temperature (LBT)	Exiting boiler water temperature that the controller maintains corresponding to the High Outdoor Temperature (HOD). *Example:* If the LBT is 95°F, and the HOD setting is 70°F, the boiler water temperature setpoint will be 95°F when the outdoor temperature reaches 70°F. Range 50°F to 95°F [10°C to 35°C].	95°F [35°C]	
High Outdoor Temperature (HOD)	Outdoor temperature that corresponds to the Low Boiler Temperature (LBT). *Example:* If the LBT is 95°F, and the HOD setting is 70°F, the boiler water temperature setpoint will be 95°F when the outdoor temperature reaches 70°F. Range 50°F to 90°F [10°C to 32°C].	70°F [21°C]	
Low Outdoor Temperature (LOD)	Outdoor temperature that corresponds to the maximum water temperature, or Central Heat setpoint. *Example:* If the CH setpoint is 180°F, and the LOD setting is 0°F, the boiler water temperature setpoint will be 180°F when the outdoor temperature reaches 0°F. Range -40°F/C to 40°F [4°C].	0°F [-18°C]	Outdoor Design Temperature: - set higher for warmer climates - set lower for colder climates

Figure 13-3 Example Outdoor Reset Curve

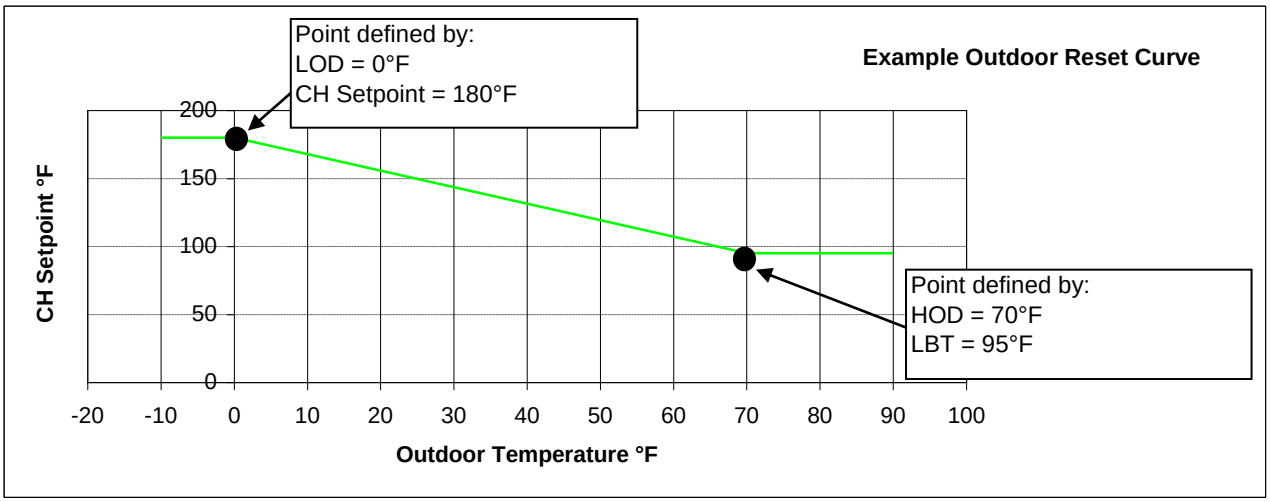


Table 13-5 Setup Mode Screen Timeouts

Screen Displayed	Length of Inactivity that Causes Timeout
Temperature units	1 minute
Outdoor reset on/off	
Outdoor reset temperatures	
Rmt Adr (see Note 1)	5 minutes
LL (see Note 1)	
HS (see Note 1)	
bL (see Note 1)	
Sd (see Note 1)	
ASC	
BAC/rES (see Note 2)	

Note 1: Not applicable to the Ts80 model.
Note 2: Requires optional PIM memory module.

Table 13-6 Setup Mode Screens

Setting	Description	Factory Settings	Comments
°F/°C	Set display to Fahrenheit or Celsius; press the Up or Down button to switch between choices	°F	
LBT HOD LOD	Enable or disable outdoor reset; press the Up or Down button to switch between choices: If On, proceed to Low Boiler Temperature (LBT) setting If Off, proceed to Remote Address (Rmt Adr) setting	On	
LBT	Set the Low Boiler Temperature (target temperature of water leaving the boiler); press the Up or Down button to show the current setting; use the Up or Down button to modify the value as desired. Range 50°F to 95°F [10°C to 35°C].	95°F [35°C]	
HOD	Set the High Outdoor Temperature (outdoor temperature corresponding to the Low Boiler Temperature on the Outdoor Reset Curve); press the Up or Down button to show the current setting; use the Up or Down button to modify the value as desired. Range 50°F to 70°F [10°C to 21°C].	70°F [21°C]	
LOD	Set the Low Outdoor Temperature (outdoor temperature corresponding to the CH setpoint on the Outdoor Reset Curve); press the Up or Down button to show the current setting; use the Up or Down button to modify the value as desired. Range -40°F/C to 40°F [4°C].	0°F [-18°C]	
Rmt Adr	**This parameter does not apply to the Ts80 model. DO NOT MODIFY THIS SETTING. Press the Done or Next button to bypass.**	**1**	Do Not Adjust
LL	**This parameter does not apply to the Ts80 model. DO NOT MODIFY THIS SETTING. Press the Done or Next button to bypass.**	**OFF**	
HS	**This parameter does not apply to the Ts80 model. DO NOT MODIFY THIS SETTING. Press the Done or Next button to bypass.**	**10ºF [6ºC]**	
bL	**This parameter does not apply to the Ts80 model. DO NOT MODIFY THIS SETTING. Press the Done or Next button to bypass.**	**70%**	
Sd	Set-point value for Warm Weather Shutdown. Prevents response to CH (Thermostat) demand calls when the outdoor temperature is above the setting. Activate function by adjusting down. Range 32°F-120°F [0°C-49°C].	120ºF [49ºC]	
ASC	Set the Anti-Short Cycle time interval. Used to prevent rapid burner cycling e.g. in low-load situations. Range 0 minutes to 10 minutes.	5.0 minutes	Displayed in increments of 0.1 minute (6 seconds)
bAC	The controller supports backup and restore of non-safety parameters. To use this function requires installing a PIM memory module in the controller (optional, purchased separately).	N/A	Requires an optional PIM memory module
PAS	Permits entry of a 3 digit passcode; press the Up or Down button to display the entry screen; select individual digits using the Next button; alter each digit with the Up and Down buttons; press Done to accept.	475	

Diagnostic Mode

Diagnostic mode is entered from User mode by pressing and holding the "Next" button for 3 seconds. Successive screens are selected by pressing the "Next" button. Diagnostic mode may be exited by pressing the "Done" button or allowing the timeout interval to elapse. Diagnostic screens are listed in Table 13-7.

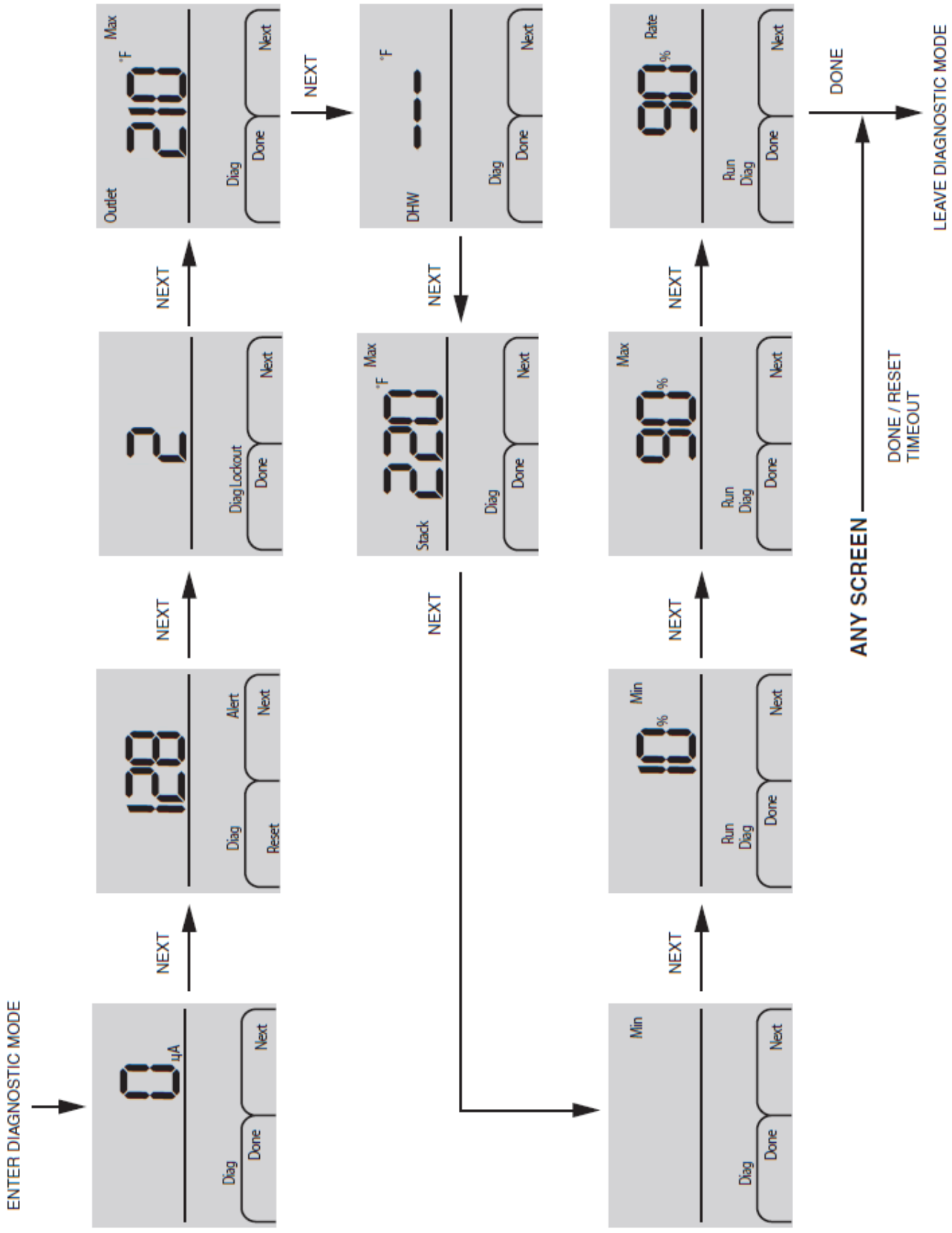
Table 13-7 Diagnostic Mode Screens

Setting	Description	Factory Setting	Comments
Flame signal	Shows current flame strength in units of microAmps/volt. No user action required.	N/A	
Alert	Shows most recent Alert code. See Table nn-nn for a list of codes. Alerts are events that do not require manual intervention to reset the controller.	N/A	
Lockout	Shows most recent Lockout code. See Table nn-nn for a list of codes. User action may be required to correct the condition that caused the lockout. To clear the lockout and allow the controller to resume normal operation, press the "Reset" button or cycle power to the controller i.e. turn power off, then on.	N/A	
Outlet High Limit	Shows current Outlet High Limit temperature setting. No user action required.	210°F [99°C]	
DHW High Limit	**This parameter does not apply to the Ts80 model.**	**N/A**	
Stack High Limit	Shows current Stack High Limit temperature setting. No user action required.	220°F [104°C]	
Firing Rate initial	Shows "Min" on the display; press "Next" to proceed to minimum firing rate test, or "Done" to exit Diagnostic mode.	N/A	
Firing Rate minimum	Forces demand to ignite the burner; alternates display of the current Outlet temperature with display of minimum firing rate of 10%; press "Next" to proceed to maximum firing rate test, or "Done" to exit Diagnostic mode.	N/A	
Firing Rate maximum	Forces demand to ignite the burner; alternates display of the current Outlet temperature with display of maximum firing rate of 90%; press "Next" to proceed to manual firing rate test, or "Done" to exit Diagnostic mode.	N/A	
Firing Rate manual	Forces demand to ignite the burner; alternates display of the current Outlet temperature with display of manual firing rate set by pressing the Up or Down buttons; firing rate may be varied in 1% increments between 0% and 90%; press "Next" to proceed to manual firing rate test, or "Done" to exit Diagnostic mode.	N/A	Actual firing rate will not drop below the minimum modulation rate, which is equal to approximately 24%.

Table 13-8 Diagnostic Mode Screen Timeouts

Screen Displayed	Length of Inactivity that Causes Timeout
Flame signal	5 minutes
Alert	
Lockout	
Outlet High Limit	
DHW High Limit	
Stack High Limit	
Firing Rate initial	
Firing Rate minimum	
Firing Rate maximum	
Firing Rate manual	

Figure 13-4 Diagnostic Mode Screens



Holds, Alerts and Lockouts

The controller dynamically reports status by means of codes. These codes are classified as Hold, Alert, and Lockout and are listed in the Troubleshooting Section of this manual. Refer to Table 16-3 for Hold and Lockout codes and Table 16-4 for a list of Alert codes.

In a Hold state the controller is waiting for an event to occur, such as closing of the air proving switch. Typically no manual intervention is needed; Hold conditions are transient in nature and a normal part of appliance operation. Alert codes are used to report non-critical events that do not require manual intervention.

Lockouts occur when a safety limit is exceeded, e.g. stack temperature limit of 220°F [104°C], or the air proving switch cannot prove. Lockouts force burner shutdown and require manual action to restore the appliance to normal operation. A Lockout persists until a) the "Reset" button on the display is pressed and released; b) the Reset button on the controller is pressed and released; c) power to the appliance is turned off and turned on again.

14.0 INSTALLATION CHECKLIST

Installation

- ☐ 1. If operating on Propane Gas, convert boiler using appropriate Kit number. See Table 7-1.
- ☐ 2. Locate the boiler in accordance with Section 3.0 of this manual.
- ☐ 3. Install the Vent/Air-inlet piping in accordance with Sections 4.0 and 5.0 of this manual. Ensure all joints are secured and cemented properly. Both the Vent and Air-inlet pipes must terminate outdoors. Perform the **Mandatory Pre-commissioning Procedure for Plastic Venting** in Section 4.0.
- ☐ 4. Connect the condensate 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.
- ☐ 7. Connect field wiring in accordance with Section 11.0 of this manual.
- ☐ 8. Advise home/building owner of their responsibilities with respect to maintaining the boiler.

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

Start-up

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

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

Operational Checklist

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

Before Leaving

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

Instructions to Installing Contractor

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

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

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

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 freely flows from the unit, and is cleaned of sediment.
- ☐ 3. Relief Valve and air vents are not weeping.
- ☐ 4. Low water cut off is tested (remove and clean as per manufacturer's instructions)
- ☐ 5. Examine all venting for evidence of leaks. Ensure vent screens are cleaned and clear of debris.
- ☐ 6. Check the burner plate for signs of leaking.
- ☐ 7. The combustion chamber must be inspected and cleaned.
- ☐ 8. 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).

IMPORTANT

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

Combustion Chamber Cleaning Procedure

Units operating with LP Gas or in an industrial environment will have to be cleaned a minimum of once per year. Other applications will require the combustion chamber to be cleaned after the first year of operation, with subsequent cleanings scheduled based on the condition of the combustion chamber at the time. Unless a step is identified as model specific, the following combustion chamber cleaning procedure is the same for all models.

IMPORTANT

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

Cleaning Checklist

- ☐ 1. Initiate a post-purge cycle to clear any gas from the combustion chamber, then turn gas valve off.
- ☐ 2. Access the combustion chamber by removing the aluminum burner door assembly of the boiler.
- ☐ 3. Remove (or cover) the insulation disc (P/N 83112) located in the back of the combustion chamber to avoid damaging it during the cleaning process. The disc is held in place with a 2.5mm "Allen-head" screw.
- ☐ 4. Use a vacuum with a high efficiency filter to remove any loose debris or dust.
- ☐ 5. Wet the inside of the combustion chamber with water. Use a garden hose with a trigger nozzle to direct pressurized water through the gaps between the heat exchanger tubes. The water should pass in-between the heat exchanger tubes and exit via the condensate drain. This process may require the use of some dry rags or plastic to protect electrical components from being damaged by dripping or spraying water.
- ☐ 6. Use a nylon or other non-metallic brush to loosen the incrustations and any other contaminates that have remained stuck on and in-between the tubes.
- ☐ 7. Repeat steps 5 and 6 until the heat exchanger is clean and water from the condensate drain runs clear.
- ☐ 8. Re-install the insulation disc (part no. 83112) to the back of the combustion chamber.
- ☐ 9. Inspect the insulation disc located on the back-side of the burner door (p/n 83884). Replace if damaged.
- ☐ 10. Re-install the burner door, gas-supply and Air-inlet pipe, check for gas leaks.
- ☐ 11. Perform the Operational Check List detailed in the previous section.

⚠ WARNING

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

Refractory Ceramic Fibers (RFC)

IMPORTANT

Personal Protective Equipment Recommended - Read the following warnings and handling instructions carefully before commencing any service work in the combustion chamber. The insulating material on the inside of the burner door and at the back of the combustion chamber contain *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 14-1 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 a N95-rated filter efficiency or better. [1] • Use water to reduce airborne dust levels when cleaning the combustion chamber. • Do not dry sweep silica dust. Pre-wet or use a vacuum with a high efficiency filter.
Avoid transferring contamination	• When installing or removing RFCs, place the material in a sealable plastic bag. • Remove contaminated clothing after use. Store in sealable container until cleaned. • Wash contaminated clothing separately from other laundry.
First Aid Measures	If irritation persists after implementing first aid measures consult a physician. • **Skin** - Wash with soap and water. • **Eyes** - Do not rub eyes; flush with water immediately. • **Inhalation** – Breathe in fresh air; drink water, sneeze or cough to clear irritated passage ways.

Notes:

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

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

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

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

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 shut off 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.

Check 120VAC and 24VAC at the Boiler

First, verify the following:

- There is 120V being supplied to the boiler:
  - The circuit breaker in the electrical panel supplying power to the boiler is not tripped.
  - The service switch (if applicable) is in the ON position.
- There is a heat call from the thermostat:
  - Verify 24VAC to thermostat.
  - The thermostat is placed at a sufficiently high setting to create a call for heat to the boiler.

To check for the presence of 120VAC and 24VAC at the boiler follow this procedure:

- Remove the boiler front cover.
- 120VAC
  - Disconnect the spark cable from the burner door.
  - Remove the control panel cover. First loosen the two #8 hex-head sheet metal screws securing the cover to the control panel. Lift the cover off and remove it from the unit, this will expose the field wiring barrier strip. Note: once the cover is partially removed the spark cable can be disconnected from the controller.
  - With an AC voltmeter set on the appropriate scale, measure the voltage across the L1 and L2 terminals (terminals 12 and 13).
  - If 120VAC is not detected, check the electrical service as suggested above. If the service is verified, inspect the circuit wiring from the panel to the boiler for broken or disconnected conductors.
  - If 120VAC is detected, turn power off to the boiler at the service switch and check the 120VAC fuse located on the right side of the control panel; refer to Figure 16-1 – replace if necessary.
- 24VAC (only check if 120VAC supply is verified).
  - Disconnect the spark cable from the burner door.
  - Remove the control panel cover. First loosen the two #8 hex-head sheet metal screws securing the cover to the control panel. Lift the cover off and remove it from the unit, this will expose the field wiring barrier strip. Note: once the cover is partially removed the spark cable can be disconnected from the controller.
  - With an AC voltmeter set on the appropriate scale, measure the voltage between the R and COM terminals (terminals 1 and 2).
  - If 24VAC is not detected, check the 24VAC fuse located at the transformer in the control panel; refer to Figure 16-1 – replace if necessary.

⚠ 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.

Figure 16-1 Ts80 Control Panel

Fuse Operation

There are two (2) fuses associated with the Trinity Ts controller. Check this fuse before replacing the controller or any other electrical component. If the fuse is blown, it will prevent the protected device(s) from functioning. Check the condition of the fuse as follows:

- Remove all 120VAC power to the boiler. Check that the unit is not powered from multiple sources.
- Remove the front cover.
- The 120VAC fuse is accessible by removing the spring-loaded knurled knob of its holder. Push the knob toward the panel and twist approximately 1/4 turn counter-clockwise.
- To 24VAC fuse is located inside the control panel. Disconnect the spark cable from the burner door, loosen the two #8 hex-head sheet metal screws securing the cover, slide out to remove and disconnect the spark cable from the control. The auto blade type fuse is installed in an "inline" style fuse holder near the transformer.
- Inspect fuses and replace if necessary.
- Feed spark cable through the panel cover and secure in place. Replace front cover. Restore power to the boiler and confirm proper operation.

Fuse Locations

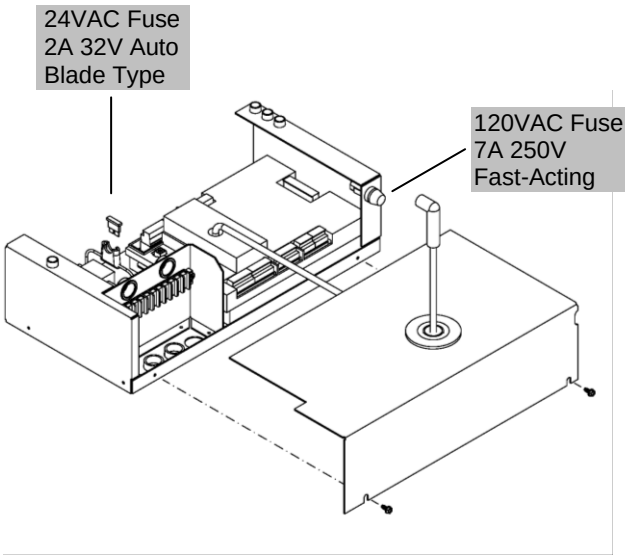


Table 16-1 Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Burner not operating	Heat demand satisfied; no call for heat	No action needed. Check operation by turning thermostat up or jumping heat call (Thermostat to R), or by turning DHW aquastat up or jumping DHW call (DHW to Sensor COM).
	Boiler outlet temperature is in range	Compare outlet temperature to Central Heat (Thermostat) and DHW setpoints. Be sure to factor in the outdoor reset curve – temporarily disconnect the outdoor sensor to test – adjust outdoor reset settings if necessary.
	Hold or Delay Lockout	Check Operating Mode Icons for Hold or Lockout. Obtain Hold or Lockout code number from the Diagnostic Mode by pressing and holding the "Next" button for 3 seconds.
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.
Hold 27 – Flame rod 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 voltage applied to R & Thermostat terminals. If using 4-20mA input, check to ensure current is not greater than 21mA.
Hold 61 – Anti short-cycle	Anti short-cycle timer is preventing short-cycling.	Normal during small loads, delay is adjustable via the Setup mode in the display.
Hold 62 – Fan speed not proved	- Blower problem - Faulty controller	**If blower is off:** (1) Check for 120VAC power supply to blower, correct wiring if necessary. (2) Remove the low voltage cable from blower, if blower remains off – replace blower If blower turns on check VDC signal between black and green wires, if between 12 and 16VDC – replace blower, if not – replace controller. **If blower is on:** (1) Check low voltage cable from blower to control. (2) Replace blower. (3) Replace controller.

Table 16-1 Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Hold 63 – LCI OFF (Limit control input)	Insufficient water pressure	Ensure pressure is at or above 15PSI; if problem persists after exceeding 20PSI – replace low water pressure switch (PN:83223-1)
Lockout or Hold 65 – Interrupted Air Switch OFF	Faulty blower	If blower remains off after the lockout is cleared, check 120VAC supply to blower, if present replace blower.
	Blocked venting	Check for blockage of the exhaust vent.
	Blocked air inlet	Check for blockage of the air inlet.
	Disconnected, damaged or blocked tubing	Inspect the clear vinyl tubing connecting the air switch + and – ports to the air metering elbow. Condensation or other foreign matter may be obstructing the tubing, preventing the switch from sensing differential pressure caused by air flow through the metering elbow.
	Incorrect air switch setting	Contact NTI technical support.
	Faulty air switch	If venting and air inlet are clear, temporarily jumper the air switch. If the unit lights and operates smoothly – replace air switch. If the unit fails to light or lights but runs rough or abruptly shuts down – check boiler internals for blockage. **WARNING** Only jumper the air switch for diagnosing purposes.
	Incorrect air switch wiring	Check that the red and orange wires are connected to quick connect tabs 3 and 1 respectively.
Hold 66 – Interrupted air switch ON (and blower is off)	Incorrect air switch setting	Contact NTI technical support.
	Incorrect air switch wiring	Check that the red and orange wires are connected to quick connect tabs 3 and 1 respectively.
	Faulty air switch	Disconnect red and orange wires from air switch and check for open circuit between terminals 1 & 3. If continuity detected, replace air switch.
Hold 66 – Interrupted air switch ON (and blower is on)	- Blower problem - Faulty controller	Check low voltage wiring from blower to controller. Check VDC signal from red–green and black-green; if not 28-32VDC and 0 VDC respectfully – replace controller. If signal is correct – replace blower.
Lockout or Hold 67 – ILK OFF	External Limit Tripped	Indication that an external limit (wired to "LIM") had opened. Not a problem with boiler.
Hold 79 – Outlet High Limit	High Central Heat or DHW set point.	Reduce Central Heat and DHW set points.
	Insufficient water flow or pressure	See lockout 81 below.
Lockout or Hold 81 – Delta T limit OR Boiler making banging or hissing sounds	Insufficient water flow	• Check boiler pump. • Ensure plumbing is correct. 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.
	Faulty sensor	Check resistance of stack 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 is flowing into the boiler at the fitting closest to the wall.

Table 16-1 Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
Lockout or Hold 88 – Outlet T Rise limit OR Boiler making banging or hissing sounds	Insufficient water flow	See Lockout 81.
Hold 91– Inlet sensor fault	Sensor disconnected	• Verify that 2-position Molex connector on wiring harness is securely attached to mating connector on inlet sensor. • Inspect sensor wiring.
	Faulty sensor	Check resistance of sensor and compare to thermistor resistance chart, see Table 16-2.
Hold 92 – Outlet sensor fault	Sensor disconnected	• Verify that 4-position Molex connector on wiring harness is securely attached to mating connector on outlet sensor. • Inspect sensor wiring.
	Faulty sensor	Check resistance of sensor and compare to thermistor resistance chart, see Table 16-2.
Hold 95 – Stack sensor fault	Sensor disconnected	• Verify that 4-position Molex connector on wiring harness is securely attached to mating connector on stack sensor. • Inspect sensor wiring.
	Faulty sensor	Check resistance of sensor and compare to thermistor resistance chart, see Table 16-2.
Hold 110 – Ignition failure occurred (failure to prove flame after 3 ignition attempts) (Unit will not ignite)	Insufficient gas line pressure	Ensure the manual gas shutoff valve is open. Check gas line pressure during ignition attempt. Refer to Section 9.0 GAS VALVE AND BURNER SETUP.
	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 from controller terminals J5-2 to J4-10. There should be 24VAC present during trial for ignition.
	Faulty Gas Valve	The gas valve emits an audible click when it switches on or off. If the controller is providing 24VAC to the gas valve, and the wiring is intact, it should be possible to detect if the valve is responding.
	Spark cable disconnected	Ensure that the high voltage spark cable is securely connected to the controller and the igniter electrode. Check that the green ground wire is securely attached to the ¼" quick connect tab on the igniter electrode.
	Faulty Spark Igniter/Circuit	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 no spark is observed – replace the igniter, spark cable then controller.
	Blocked Venting or Dirty Heat Exchanger	Check venting system and boiler for blockages and dirt build-up – clean heat exchanger.
Hold 110 – Ignition failure occurred (failure to prove flame after 3 ignition attempts) (Unit lights and immediately goes out)	Flame rod disconnected	Verify that the flame rod signal wire is securely attached to the flame rod, which is located bottom center of the burner door.
	Blocked/Backed-up Condensate Drain	Remove condensate trap and flush.
	Blocked Venting or Dirty Heat Exchanger	Check venting system and boiler for blockages and dirt build-up – clean heat exchanger.
	Faulty Flame Rod/Circuit	Replace flame rod then controller.

Table 16-1 Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE	CORRECTIVE ACTION
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 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	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 was open (Air switch open while burner firing)	Blocked venting	Check for blockage of the exhaust vent.
	Blocked air inlet	Check for blockage of the air inlet.
Lockout 174	External Electrical Noise	Look for sources of electrical noise, i.e. a large motor starting, multiple pieces of equipment starting at the same time.
	Failing Limit Switch in ILK circuit	Check operation of internal water pressure switch, and/or external LWCO or safety flow switch; replace as necessary
	Hardware failure of controller	If problem persists, replace Sola boiler control (pn: 83589)
Alert 981	Loss of communication between display and controller.	Check 3-conductor cable between display and controller – verify proper wiring with wiring schematic. Replace display, replace controller.
Inoperative CH and/or DHW pump	Normal Operation	Pump output A will only have power during a DHW demand. Pump output B will have power during any demand. Pump output C will only have power during a Thermostat demand when a DHW demand is not present.
	Faulty pump	If 120VAC supplied to pump, and pump does not operate – replace pump.
	Faulty controller	If 120VAC is not supplied to the pump given conditions described under "Normal Operation" above – replace controller.
Blower operating at high speed while burner 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 controller.
	No 24VAC to controller	• Check Power LED on controller. • Check 24VAC Transformer Fuse. • 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, replace power connector 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

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

Table 16-3 Hold and Lockout Codes

Code	Description	Note
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
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 17-1)	Hold
86	Exchanger/outlet inversion limit	Disabled
87	Inlet/exchanger inversion limit	Disabled
88	Outlet T-Rise limit (See Table 17-1)	Lockout

Table 16-3 Hold and Lockout Codes

Code	Description	Note
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
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

Table 16-3 Hold and Lockout Codes

Code	Description	Note
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
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

Table 16-3 Hold and Lockout Codes

Code	Description	Note
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
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

Table 16-3 Hold and Lockout Codes

Code	Description	Note
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
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

Table 16-4 Alert Codes

Code	Description
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
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

Table 16-4 Alert Codes

Code	Description
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
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

Table 16-4 Alert Codes

Code	Description
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
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

Table 16-4 Alert Codes

Code	Description
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
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

Table 16-4 Alert Codes

Code	Description
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
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 setp oint 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

Table 16-4 Alert Codes

Code	Description
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
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

Table 16-4 Alert Codes

Code	Description
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
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

Table 16-4 Alert Codes

Code	Description
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
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

Table 16-4 Alert Codes

Code	Description
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
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 bubbles, refer to Table 17-1. Note that 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) Ts80 Models

Heat Exchanger, Gas Valve, Blower and Burner Assembly

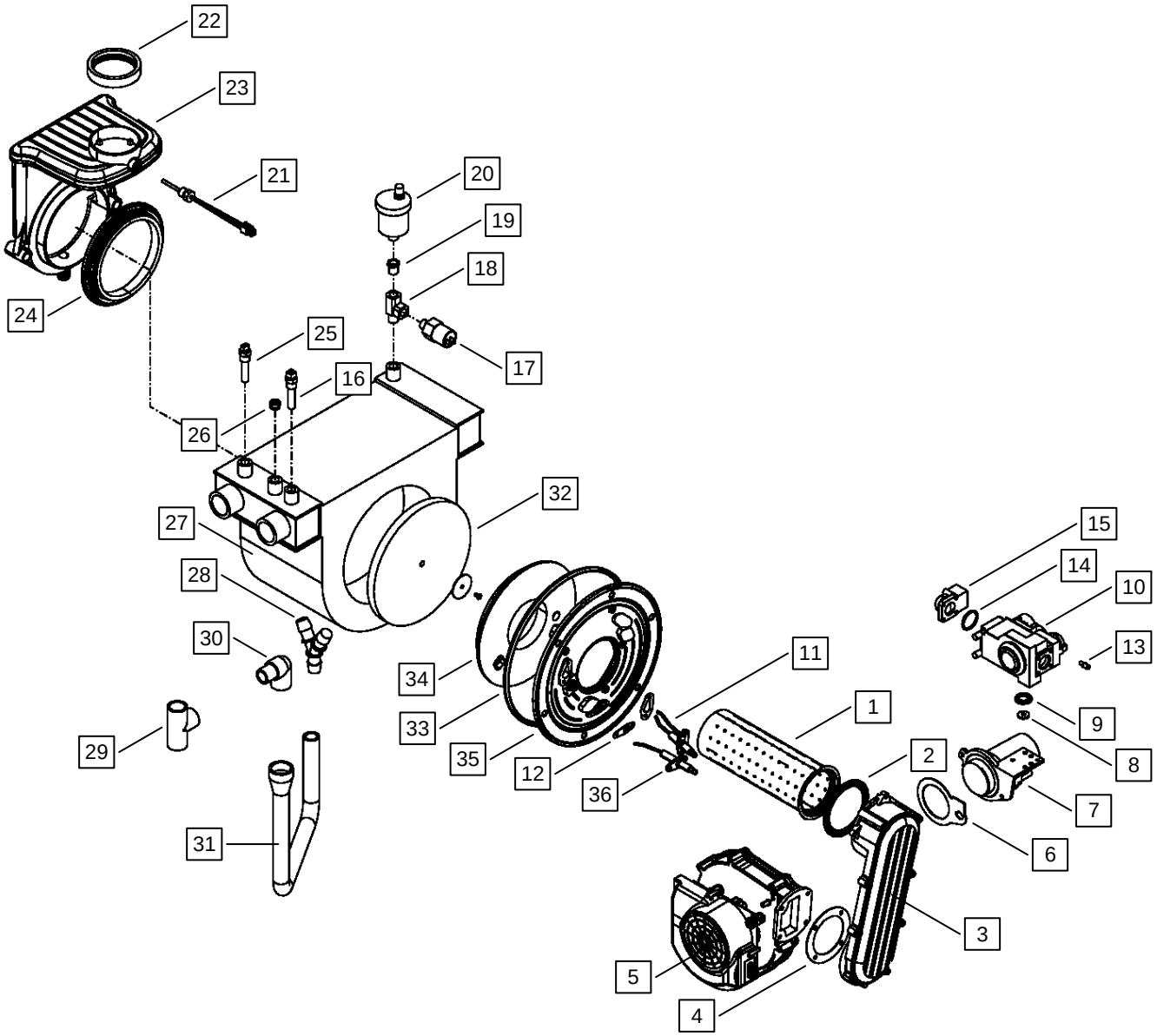


Figure 17-1(b) Ts80

Cabinet, Vent and Air-inlet Parts

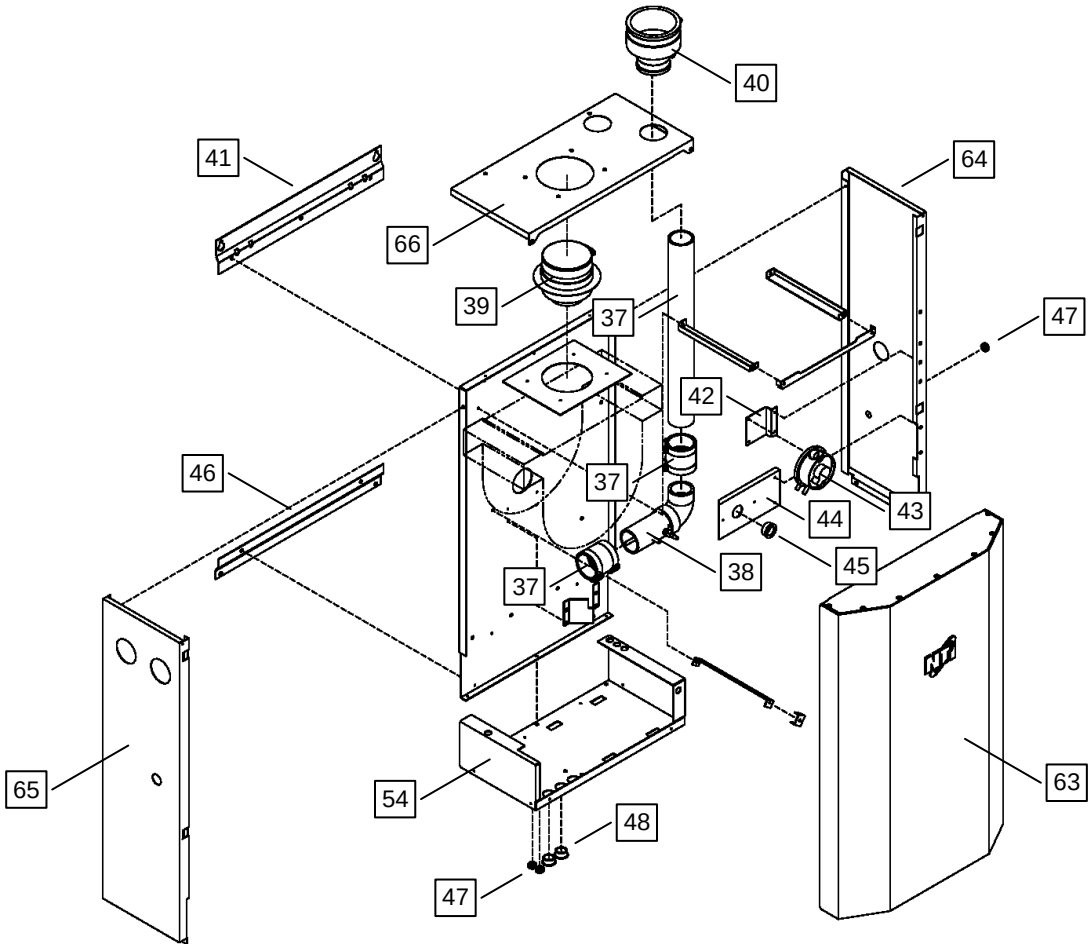


Figure 17-1(c) Ts80

Electrical Housing, Controller, and Display Module

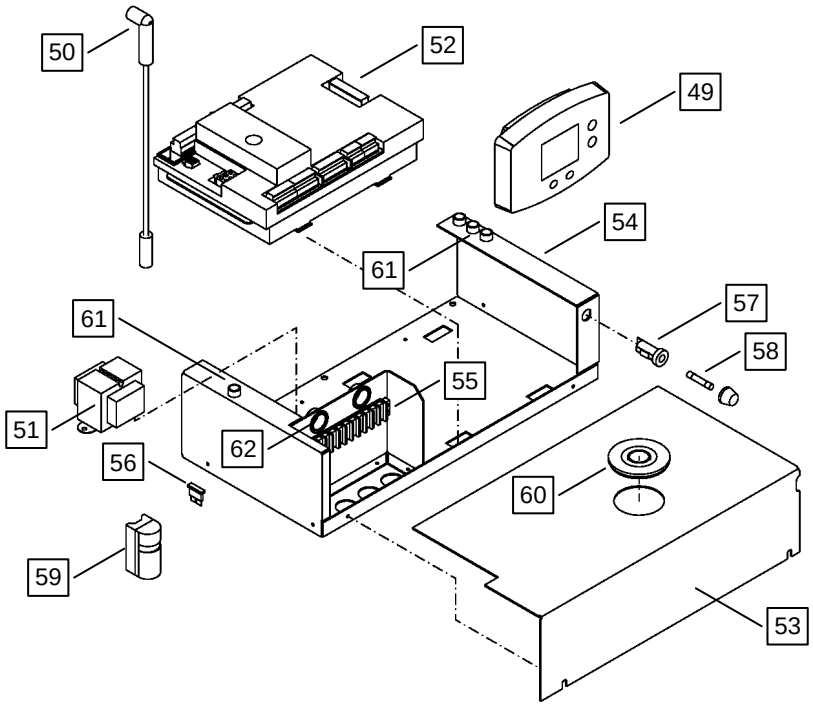


Table 17-1 Parts List: Ts80 Model

Item	Part #	Description
1	84248	Premix burner
2	82761	Premix Burner Gasket
3	82771	Extended Air Tube
4	82766	Blower Gasket
5	82052	EBM Blower RG130
6	82054-2	CVI Venturi Gasket or O-ring
7	83205	CVI Venturi 003
8	83216	CVI 3.40mm Orifice #45.900.444.120B (field installed on LP converted units)
9	83206	Gasket
10	82054	Gas Valve (CVI) VK8115F1134B (Valve Only)
11	83870	Ignition Electrode, Dual – c/w gasket
12	82774	Flame Probe Gasket
13	82600	Gas Valve Regulator Vent Adapter
14	83883	CVI Gas Valve Inlet O-ring Gasket
15	82065	Gas Valve (CV1) 1/2" NPT elbow #45.900.400-132B
16	83606	Sensor, Supply, Tasseron, Dual
17	83218	Switch, Water Pressure, 1/4" NPT
18	83462	Street Tee, Brass, 1/4"
19	83007	1/4"x 1/8" Bushing, Brass
20	82539	Automatic Air Vent 1/8"
21	83608	Sensor, Flue, Tasseron, Dual
22	82765	Composite Flue Outlet Gasket
23	82763	Composite Flue Box
24	82764	Trinity Flue Box to Heat Exchanger Gasket
25	83605	Sensor, Return, Tasseron, Single
26	83706	Plug, Brass, 1/4" NPT
27	84021	Heat Exchanger-ASME
28	83042	Y-Drain Fitting 5/8", White
29	83721	Tee, PVC, 1/2", Sch.40, White
30	83720	Elbow, Street, PVC, 1/2", Sch.40, White
31	83715	Condensate Drain Tube
32	83112	Trinity Divider Plate Insulation c/w Washer & Screw
33	82770	Burner Door Viton Gasket
34	83950	Burner Door Ceramic Disc
35	83949	Cast Alum Burner Door
36	82762	Flame Rod
37	82099	1-1/2" MJ Coupling
38	84235	Air Metering Assembly
39	84170	Flue Outlet Adapter
40	84215	Coupling, Rubber , 3" x 1.5”, Fernco
41	84236	Wall Mounting Bracket, Top
42	84239	Air Switch Support Bracket
43	82662	Air Switch Huba 604.E021180 set @ .15" w.c.
44	84238	Display Mounting Bracket
45	82250	Snap Bushing, 1”
46	84237	Wall Mounting Bracket, Bottom
47	84214	Grommet, Diaphragm, 1/2”
48	84095	Dome Plug, 7/8”
49	83590	ICP Honeywell Segment Display
50	83140	Spark Igniter Cable, 21”
51	83190	Transformer, 24V, 40VA
52	83589	Controller

Item	Part #	Description
53	84241	Control Panel Cover
54	84242	Control Panel Base
55	84206	Terminal, Barrier Double Row, Line/Low Voltage
56	83517	Fuse, Matrix/Lx/Ts, 2 Amp, Plug Style
57	84192	Fuse Holder, Panel Mount, 20 Amp at 250VAC Max
58	83837	Fuse, Littelfuse 7A, 250VAC, Fast Blow
59	81027-1	Outdoor Sensor, 10K
60	83505	Grommet, Vinyl, 7/8” OD
61	53044	Snap Bushing, ½”
62	83927	Snap Bushing, 7/8”
63	84246	Front Cover
64	84244	Right Side
65	84243	Left Side
66	84245	Top

NOTES

Visit us
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Website: www.ntiboilers.com
Fax: 1-506-432-1135