Matrix

Model Numbers: M100 & M100V
Version Date: 2015-08-10

INSTALLATION AND OPERATION INSTRUCTIONS FOR Matrix 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 appliance.
- Do not touch any electric switch.
- Do not use any phone in your building.
- Immediately call your gas supplier from a neighbor's phone. Follow the gas supplier's instructions.
- If you cannot reach your gas supplier, call the fire department.

C) Use only your hand to push in or turn the gas control knob. Never use tools. If the knob will not 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 18.0 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 Matrix 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 Matrix boiler models M100 and M100V. 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. Matrix User's 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 Matrix. 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 (see Section 18 – Annual Maintenance and Inspection).

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

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

Installer Responsibilities

A qualified installer is a licensed person who has appropriate training and a working knowledge of the applicable codes, regulations, tools, equipment and methods necessary to install a boiler. The Installer assumes all responsibility for a safe installation and that it meets the requirements of the boiler instruction manuals, as well as National and local installation codes. It is also the installer's responsibility to inform the User/Owner of their obligation with respect to the 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 Matrix 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 Matrix 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 (Each kit comes with conversion instructions).

Liquefied Petroleum (LP) propane gas is heavier than air; therefore, it is imperative that your Matrix 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
M100, M100V	**82650-1**	**52 (5.2mm)**

Boiler Vent / Air-Inlet Piping

⚠ DANGER

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

IN THE STATE OF MASSACHUSETTS ONLY

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

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

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

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

3. SIGNAGE A metal or plastic identification plate shall be permanently mounted to the exterior of the building at a minimum height of eight (8) feet above grade directly in line with the exhaust vent terminal for the horizontally vented gas fueled heating boiler or equipment. The sign shall read, in print size no less than one-half (1/2) inch in size, *"**GAS VENT DIRECTLY BELOW. KEEP CLEAR OF ALL OBSTRUCTIONS**" (plate included with boiler).*

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

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

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

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

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

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

1. The referenced "special venting system" instructions shall be included with the 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 INTRODUCTION

Table 2-1 General Specifications

Model	CSA Input (MBH)[1, 2]	DOE Heating Capacity (MBH)[1,3]	Net I=B=R Rating (MBH)[1,3]	DOE AFUE (%)[3]	Supply Plenum (inches)	Return Plenum (inches)	Airflow Heating (CFM)	Airflow Cooling (CFM)	Ventilation (CFM)	Dimensions H-W-D (inches)	Vent/Air Size[4]
M100	25-150	136	118	93.5	22.5x18.5	18x18	400-1200	400-1600	-	53-28-38	3”
M100V	25-150	136	118	93.5	22.5x18.5	18x18	400-1200	400-1600	70-150	53-28-38	3”

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 than 2000 feet.
2 – The maximum output when operating on LP-Gas is limited to 145MBH.
3 – 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).
4 – Matrix units require a special venting system, use only vent materials and methods detailed in these instructions.

High Altitude Operation

The Matrix 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 to 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 Matrix 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 4-2 for a list of approved materials.

Closet Installations

For closet installations, it is necessary to provide two ventilation air openings, each providing a minimum area equal to 1 in^2 per 1000 Btu/hr, but not less than 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 than 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 3-1 for minimum recommended clearances.

⚠ WARNING Closet/alcove installations in US and Canada require approved CPVC, Polypropylene or Stainless Steel vent and air-inlet pipe, fittings, cements and primers (Table 4-2).

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.

Table 3-1 Minimum Clearances for Installation and Service

Model No.	Clearances	Dimensions - inches					
		Front	Top	Left Side	Right Side	Rear	Flue Pipe
M100	Minimum	24[1]	12	12	12	2	1
	Recommended	24	24	24[2]	24[2]	2	1
M100V	Minimum	24[1]	12	24	24	2	1
	Recommended	24	24	24	24	2	1

Notes:
[1] 6" if surface is removable allowing 24" clearance (i.e. closet installation).
[2] Clearance can be as low as 12" on one side, if clearance on the other side is 24".

4.0 GENERAL VENTING

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

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

Removing an Existing Boiler from Common Venting System

⚠ DANGER Do not install the Matrix 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 all Matrix 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-intake 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



Do not store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance. 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-intake 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 appliance. Refer to **Mandatory Pre-commissioning Procedure for Plastic Venting** in this section.



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.

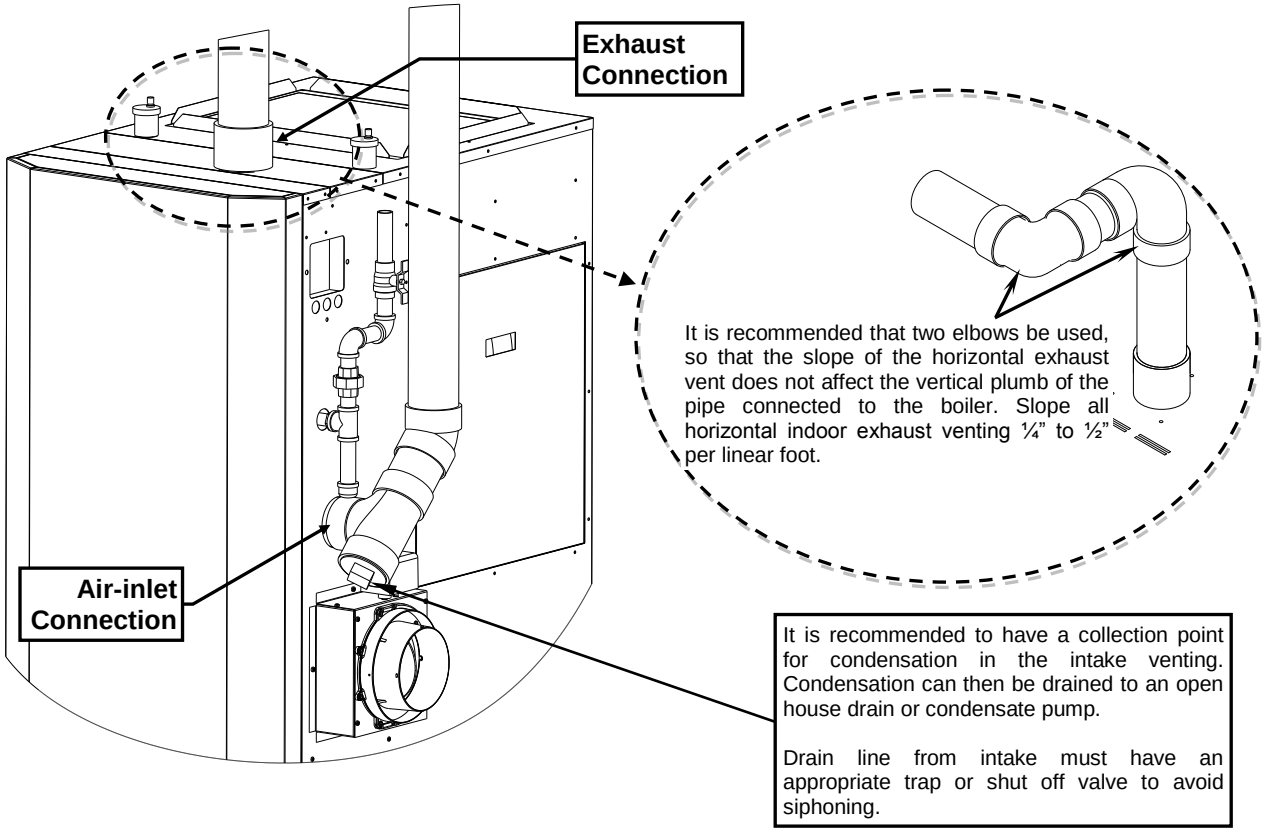
Near Boiler Vent/Air-inlet Piping

The Matrix air-inlet and exhaust fittings are 3" male PVC; use approved cement to secure to the venting system (see Table 4-2). Check the flue outlet gasket (inside the boiler cabinet) for proper insertion and sealing prior to and after attaching the venting. Ensure the venting system does not apply a load or stain on the flue outlet of the boiler; this manufacturer recommends using two elbows to create a "swing joint"; see Figure 4-1.

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

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

Figure 4-1 Near Boiler Venting



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

Vent/Air-inlet Pipe Material

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

Items [1]	Materials [2, 3]	Installation Standards		WARNING
		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.	All Vent and Air-inlet materials installed on gas fired appliances in CAN/US must meet the Standards listed in Table 4-2. 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)	-		
Pipe Cement	PVC	ANSI/ASTM D2564		
	CPVC	ANSI/ASTM F493		
Primers	PVC / CPVC	ANSI/ASTM F656		

Notes:
[1] Refer to Table 4-3 for Allowable Vent and Air-inlet Pipe Sizes and Lengths.
[2] PVC venting (exhaust and air-intake) 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 boiler 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 and Air-inlet Pipe Length Determination

Use Table 4-3 to determine the maximum pipe length that can be used. The table calculates sweep, 90º elbows, and 45º elbows at 5 equivalent feet each. Note: there are limitations when operating with Propane Gas (LP).

***Example*:** A Matrix can be installed with 105 equivalent feet of air-inlet piping and 105 equivalent feet of exhaust vent piping when operating with Natural Gas. When operating with Propane Gas (LP), the maximum length of each the exhaust vent and air-inlet pipe is limited to 50 equivalent feet (3" diameter pipe).

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

Model	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
M100 & M100V	3"	LP	50	45	40	35	30	25	20	15	10	5
	3"	NG	105	100	95	90	85	80	75	70	65	60
	4"	NG & LP	105	100	95	90	85	80	75	70	65	60

Termination Options

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

Kits certified with the Matrix are listed in Table 4-4 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 4-4 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)	4-2(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)	PVC/CPVC[7]	✓	✓
		197117				
	4"	196021 (NTI P/N 84355)				
		197021				
DuraVent - PolyPro Concentric (Wall)	3"	3PPS-HK	4-2(d)	PVC/CPVC/PP	×	✓
	4"	4PPS-HK				
DuraVent - PolyPro Concentric (Roof)	3"	3PPS-VK	4-3(c)	PVC/CPVC/PP	✓	×
	4"	4PPS-VK				
Centrotherm – InnoFlue (Flush Mount)	3"	ISLPT0303	4-2(c)	PVC/CPVC/PP	×	✓
Centrotherm – InnoFlue Concentric (Wall)[9]	3"	ICWS3513 & ICTC0335	4-2(d)	PVC/CPVC/PP	×	✓
		ICWT352 & ICTC0335				
	4"	ICWS4639 & ICTC0446				
Centrotherm – InnoFlue Concentric (Roof)[9]	3"	ICRT3539 & ICTC0335	4-3(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's 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 Matrix.

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 Figure 4-3 for roof top venting options.

Sidewall Termination Details

Figure 4-2(a)

Two-Pipe Termination (Sidewall)

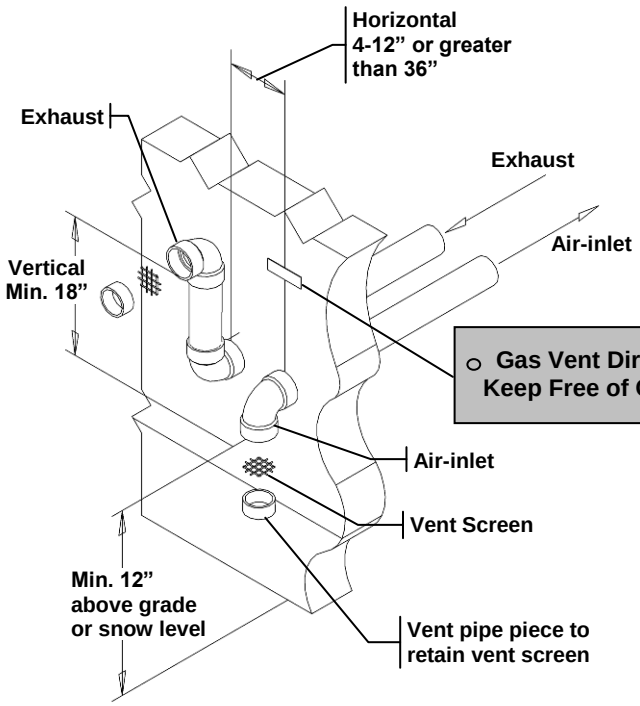


Figure 4-2(b)

IPEX Concentric Termination (Sidewall)

⚠ WARNING

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

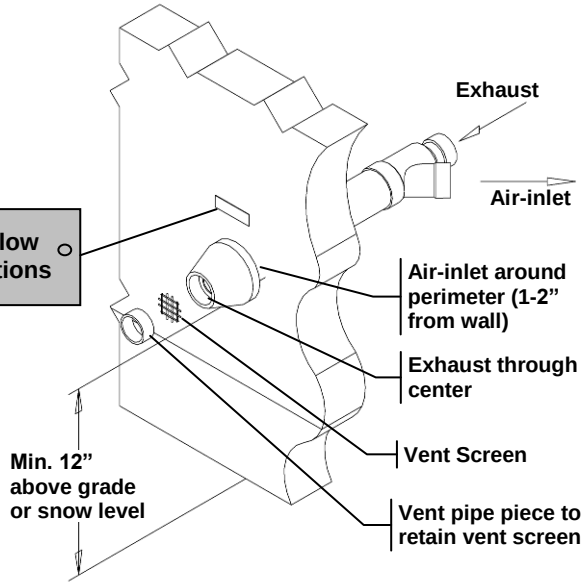


Figure 4-2(c)

Low Profile Termination (Sidewall)

⚠ WARNING

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

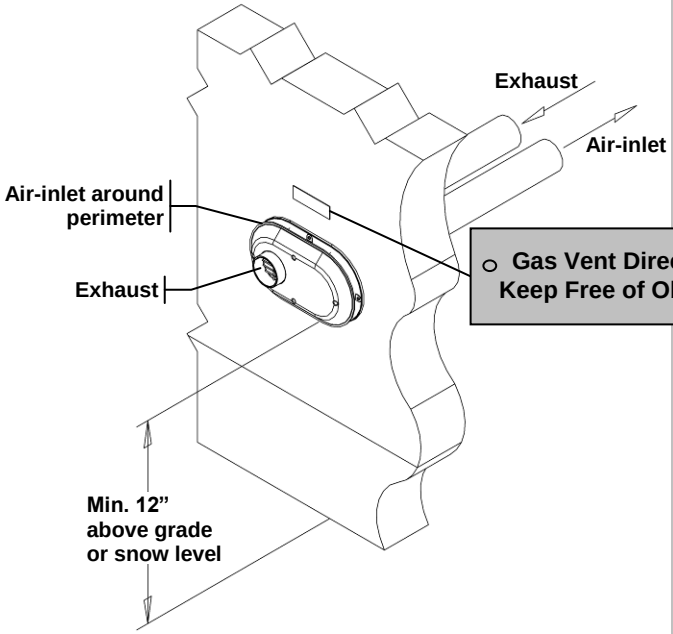
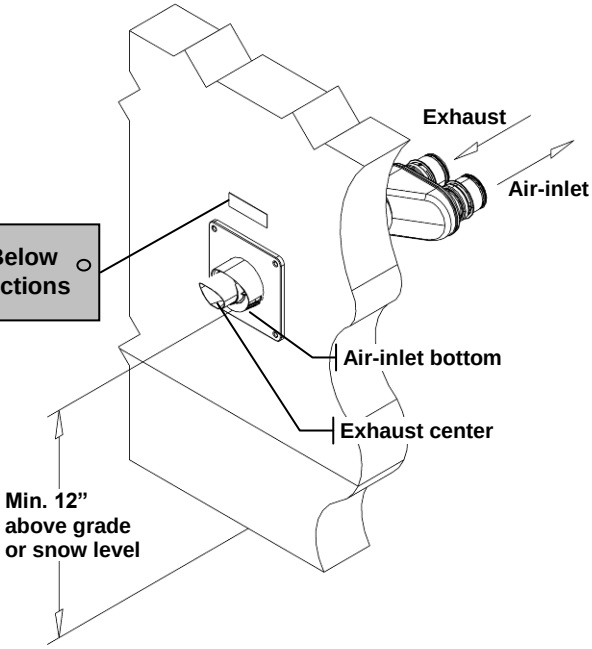


Figure 4-2(d)

PolyPro / InnoFlue Termination (Sidewall)

⚠ WARNING

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



Roof Termination Details

Figure 4-3(a)

Two-Pipe Termination (Roof)

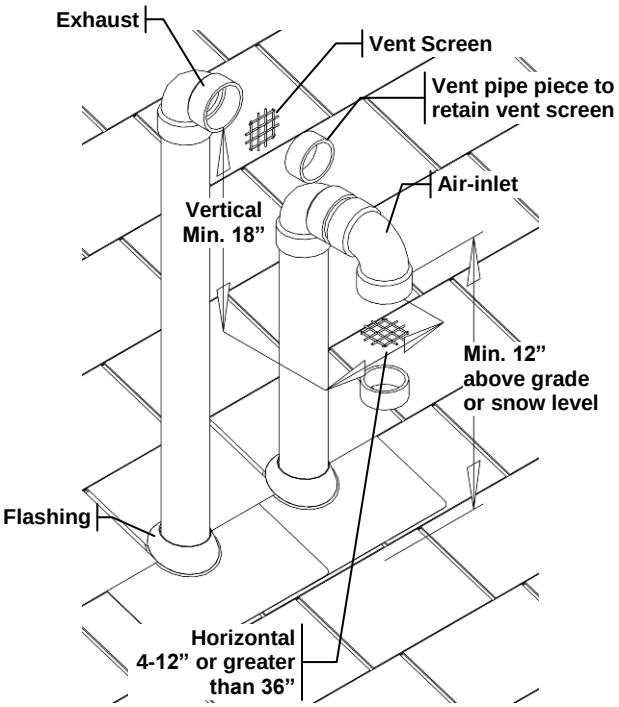


Figure 4-3(b)

IPEX Concentric Termination (Roof)

⚠ WARNING

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

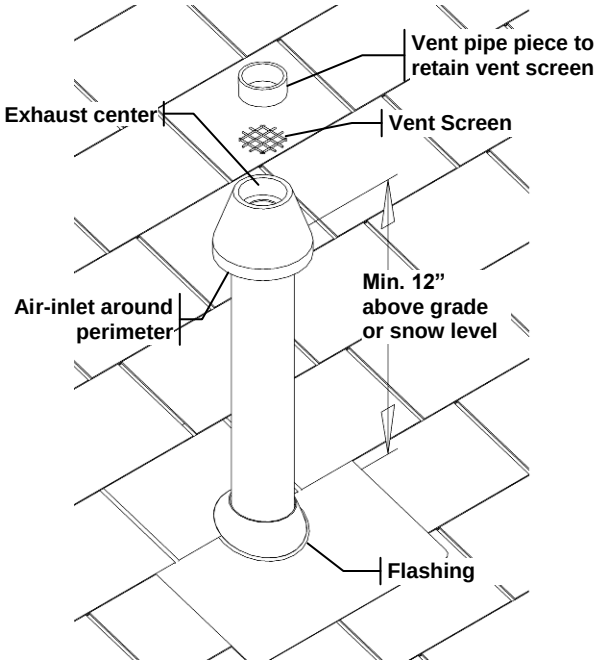


Figure 4-3(c)

PolyPro / InnoFlue Termination (Roof)

⚠ WARNING

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

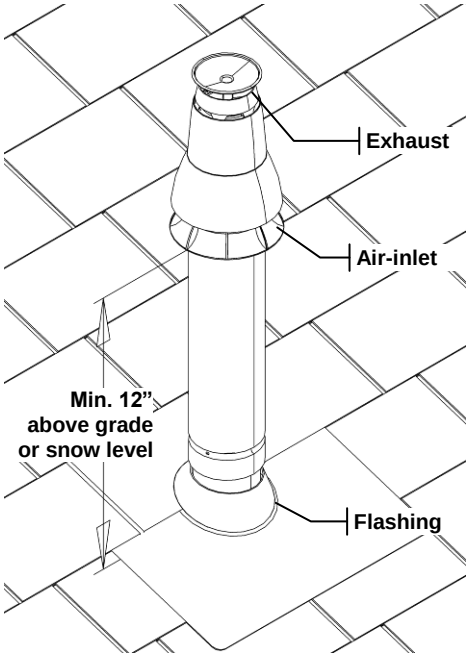
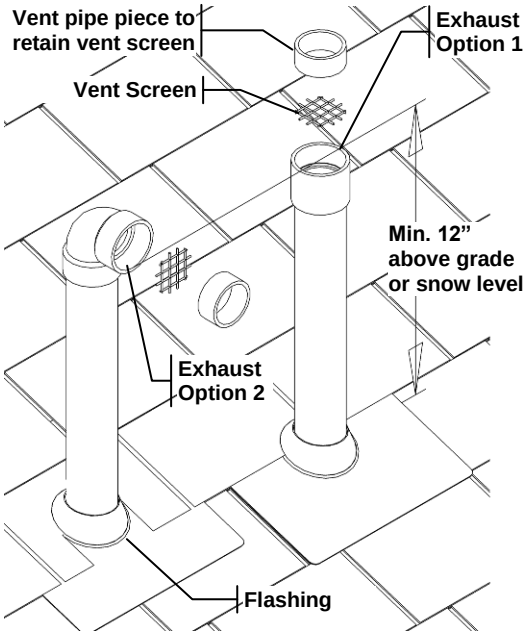


Figure 4-3(d)

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 4-4.
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 4-2 and 4-3.
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 4-2.
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 Figure 4-3 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.

⚠ 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 4-4 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.

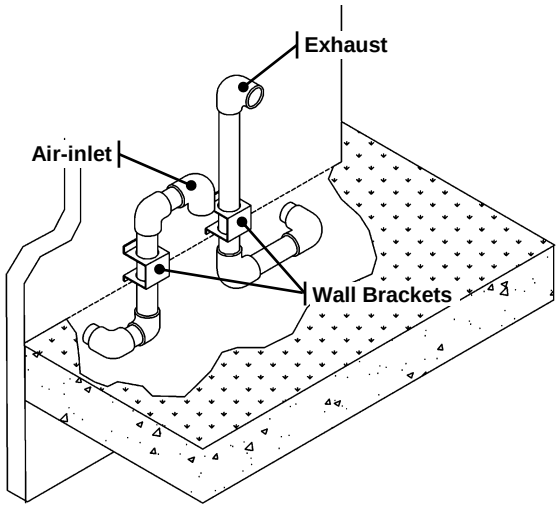


Figure 4-5 Outdoor Venting

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.

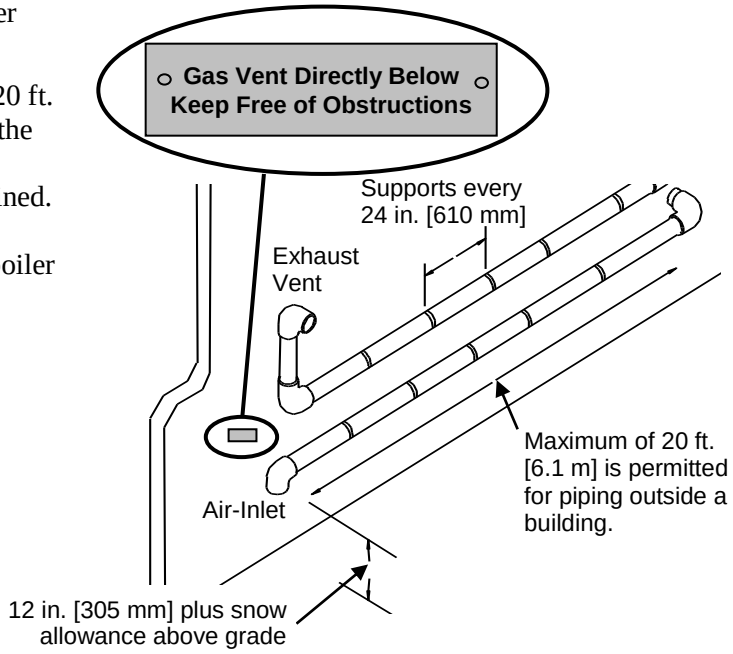
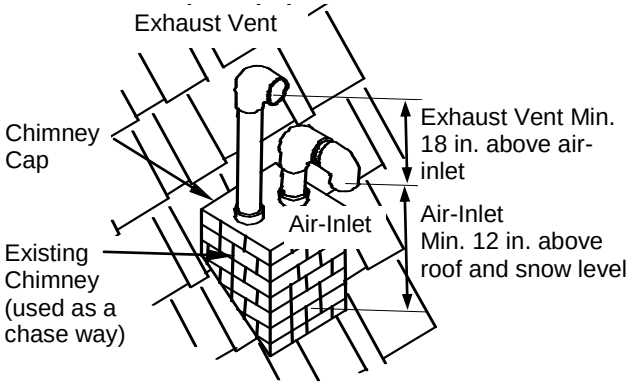


Figure 4-6 Existing Chimney Chase Way

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 Matrix certified venting materials are used, see Table 4-2.
4. Vent lengths are within the maximums specified.
5. The top of the chimney is capped and the Vent/Air-inlet pipes are flashed to prevent leakage into the vacant chimney.



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

5.0 VENT AND AIR-INTAKE 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 Matrix 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

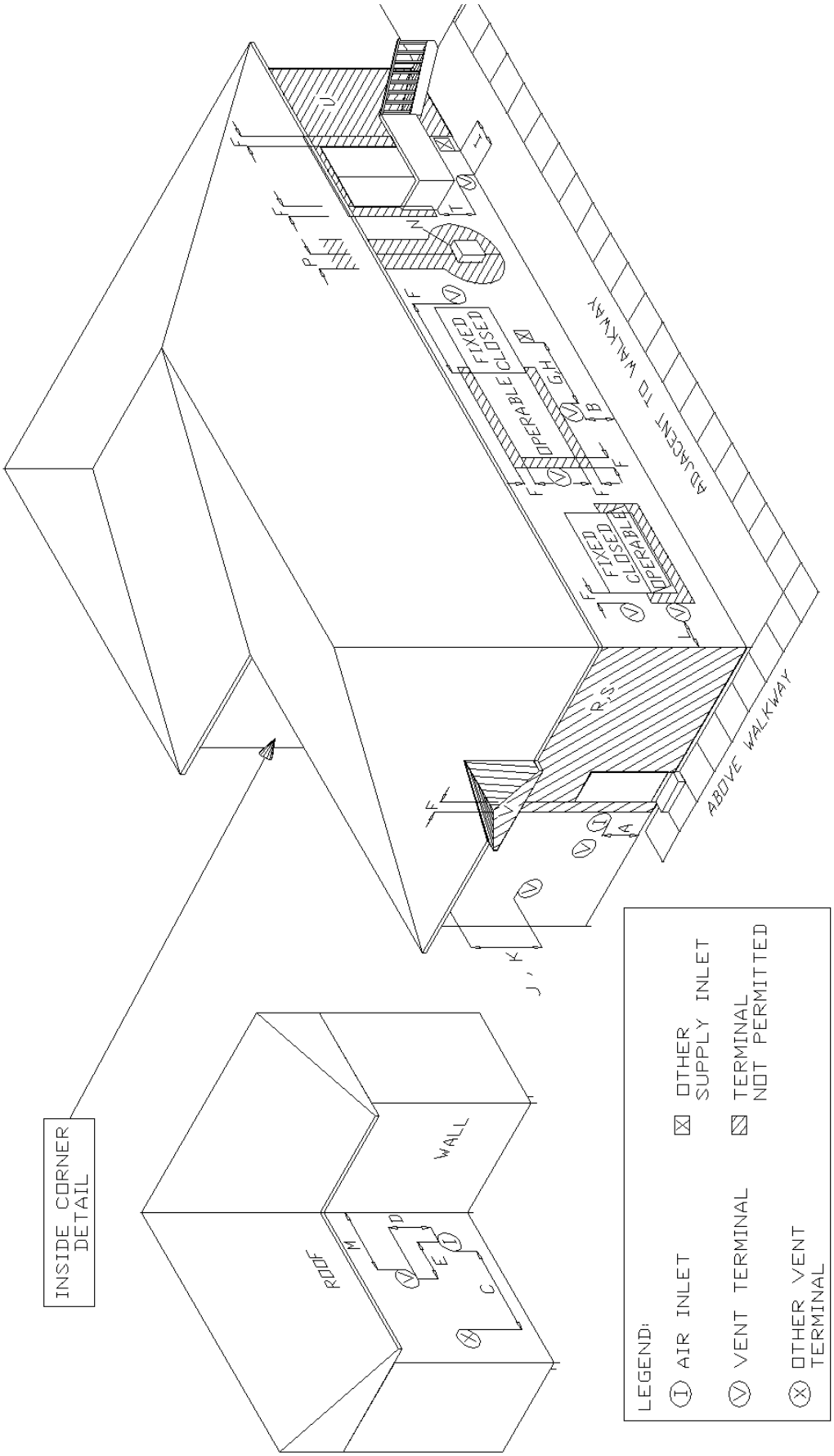
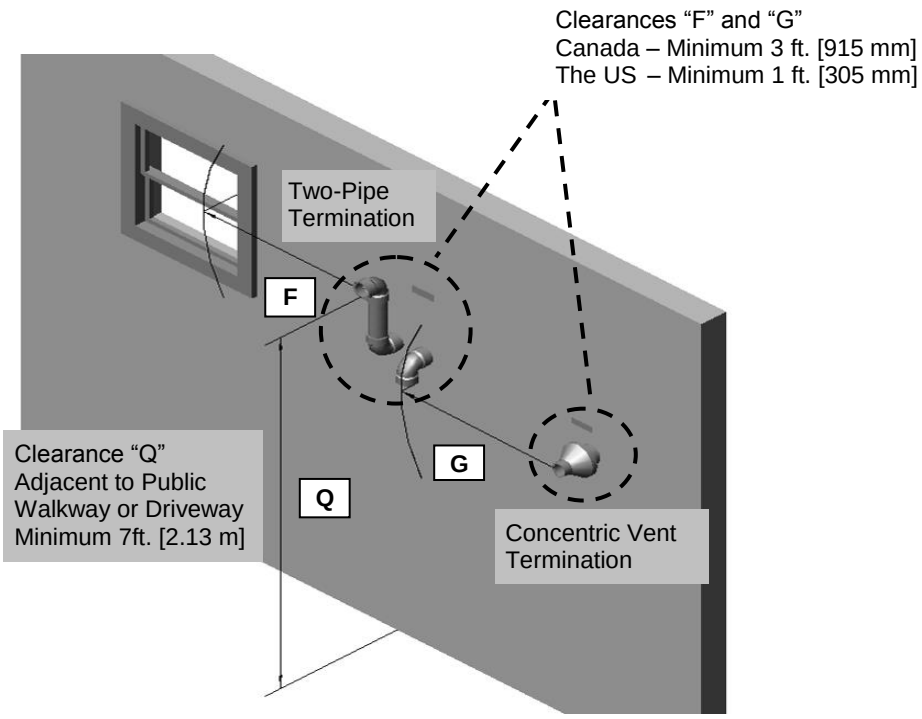


Figure 5-2 Sidewall Termination Clearances (See Table 5-1)



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).

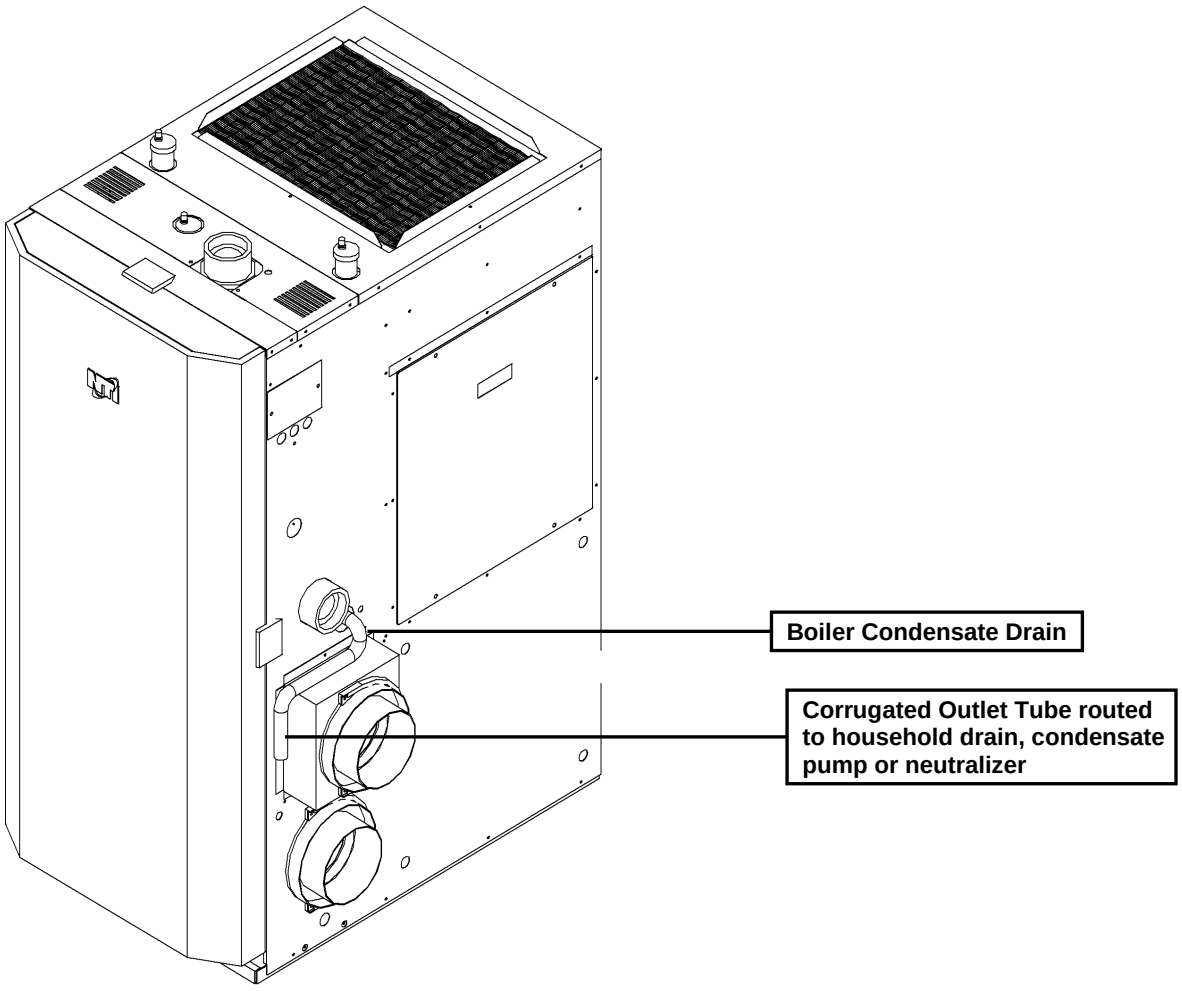
The following are important notes that must be taken into consideration when constructing the condensate drain system (See Figure 6-1 for further details):

- **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 disposal system as condensate is very corrosive and will corrode most metallic drains and sewer pipes.
- 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 Matrix 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 appliances fueled with LP gas to be provided with an approved means of removing unburned gases from the room. Failure to follow these instructions may result in serious injury or death.

Table 7-1 Natural Gas to LP Propane Conversion Kit

Model Number	LP Conversion Kit Number	LP Orifice
M100 & M100V	82650-1	52 (5.2 mm)

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 appliances 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 appliances in the home. No appreciable drop in line pressure should occur when any unit (or combination of units) lights or runs. Use common gas-line sizing practices.
- Always use a pipe-threading compound that is resistant to propane (LP) gas solvent action. Apply sparingly to all male threads, starting at two threads from the end. Over doping or applying dope to the female end, can result in a blocked gas line.
- DO NOT TIGHTEN FITTINGS WITHOUT SUPPORTING THE GAS VALVE as damage to the gas valve or combustion blower 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.

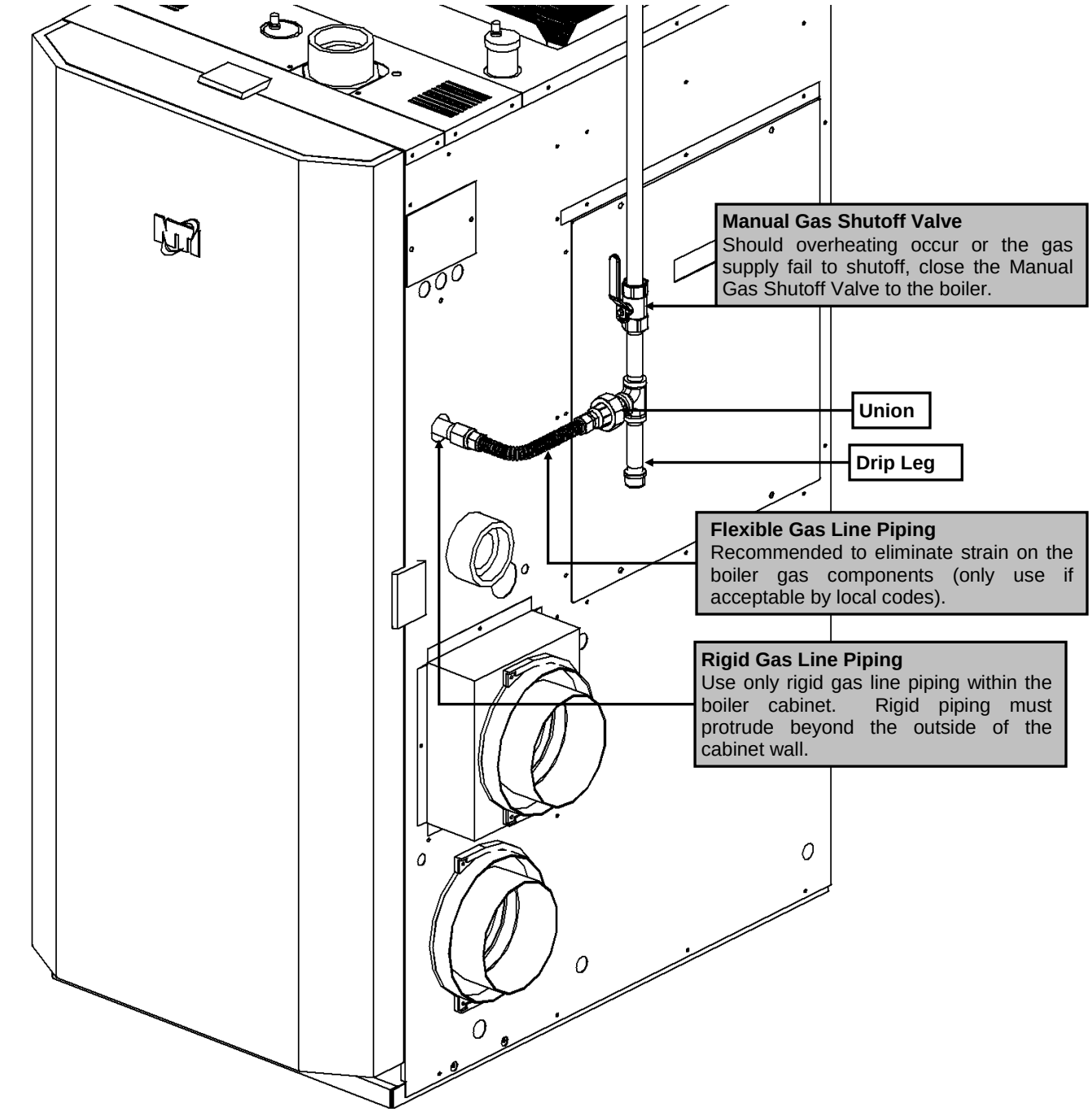
⚠ WARNING Strain on the gas valve and fittings may result in vibration, premature component failure and leakage and may result in a fire, explosion, property damage, serious injury or death.

⚠ 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 appliance. 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 Matrix 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 5.5-10.5 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 8.8% - 9.8% for Natural gas, and 9.8%-10.8% 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 The Matrix gas valve must be set-up by a licensed Gas Technician. Improper set-up may result in incorrect operation, damage to components or property, 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 appliances 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. Upon completion of the line pressure testing, 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 (%) [1]		CO (ppm) Max.
	Nominal/Desired	Min.	Max.	Min.	Max.	
Natural	7	4	10.5	8.8	9.8	175
Propane	11	8	13	9.8	10.8	175

Notes:
[1] It is permissible to have higher CO_2 values with the burner operating at the minimum modulation rate.

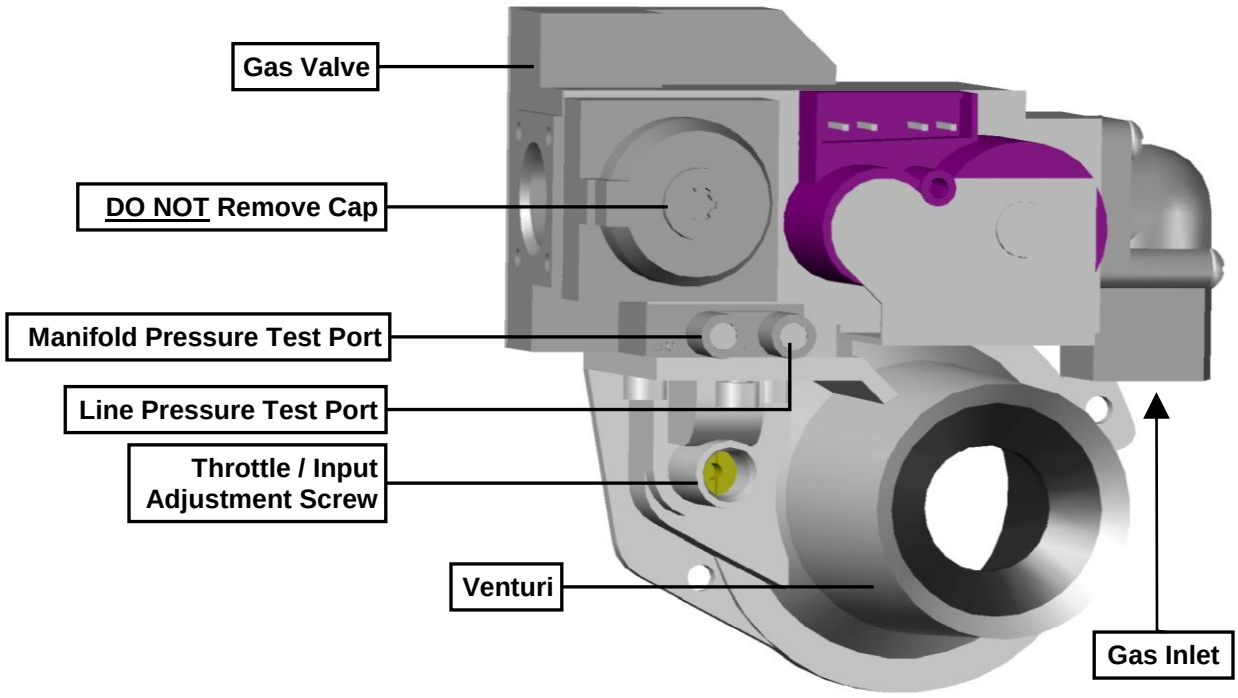
Table 9-2 Minimum and Maximum "Gas Input Values" (Modulation Rates)

Model	Minimum Gas Input Value	Maximum Gas Input Value
M100, M100V	50	240

⚠ WARNING **Carbon Monoxide** - Never leave the boiler operating if emitting Carbon Monoxide (CO) concentrations in excess of 175ppm. Failure to comply may result in injury of 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.

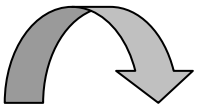
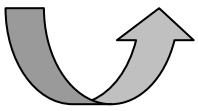
Figure 9-1 Gas Valve and Venturi Assembly



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 Matrix 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 Matrix 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 Matrix is not equipped with an integrated flue gas test port, flue gases must be sampled at the vent termination or at the condensate drain. 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. When measuring from the condensate drain, remove the condensate drain trap and insert the combustion analyzer probe into the condensate drain line while still allowing some flue gases to vent into the room. 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. If testing is performed via the condensate drain, ensure the flue gases are checked immediately to prevent high levels of Carbon Monoxide from entering the room. Once testing is complete, re-install the condensate drain assembly and check for leaks.

⚠ DANGER Failure to re-install the condensate trap assembly will result in flue gas leakage into the room resulting in a risk of Carbon Monoxide poisoning causing serious injury or death.

10.0 BOILER AND HEATING SYSTEM PIPING

The heat exchanger of the Matrix 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.

The Matrix boiler itself is a hydronic heating system, incorporating piping, a circulating pump, expansion tank, air-purging devices and a heating load (hydronic heating coil). When installed as a "stand-alone" unit, i.e. no external hydronic heating, the installer only needs to install the Pressure Relief Valve, Pressure Gauge and LWCO (if applicable), as well as guarantee a source of make-up water via a Feed Water Pressure Regulator.

When installed in combination with a hydronic heating system (external to the Matrix), additional components and set-up must be considered; carefully follow this section for details.

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 Matrix boiler is 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 Matrix 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 Matrix 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 Matrix 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 and must be field installed at the boiler outlet in the vertical position, as shown in Figure 10-2, 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 – Matrix 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 10-2.

Low Water Cutoff (LWCO) – Matrix 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. In applications where the boiler is located above the radiation, or where required by the Authority having jurisdiction, an external LWCO must be installed; see Figure 10-2 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.

Figure 10-1 Fitting Identification

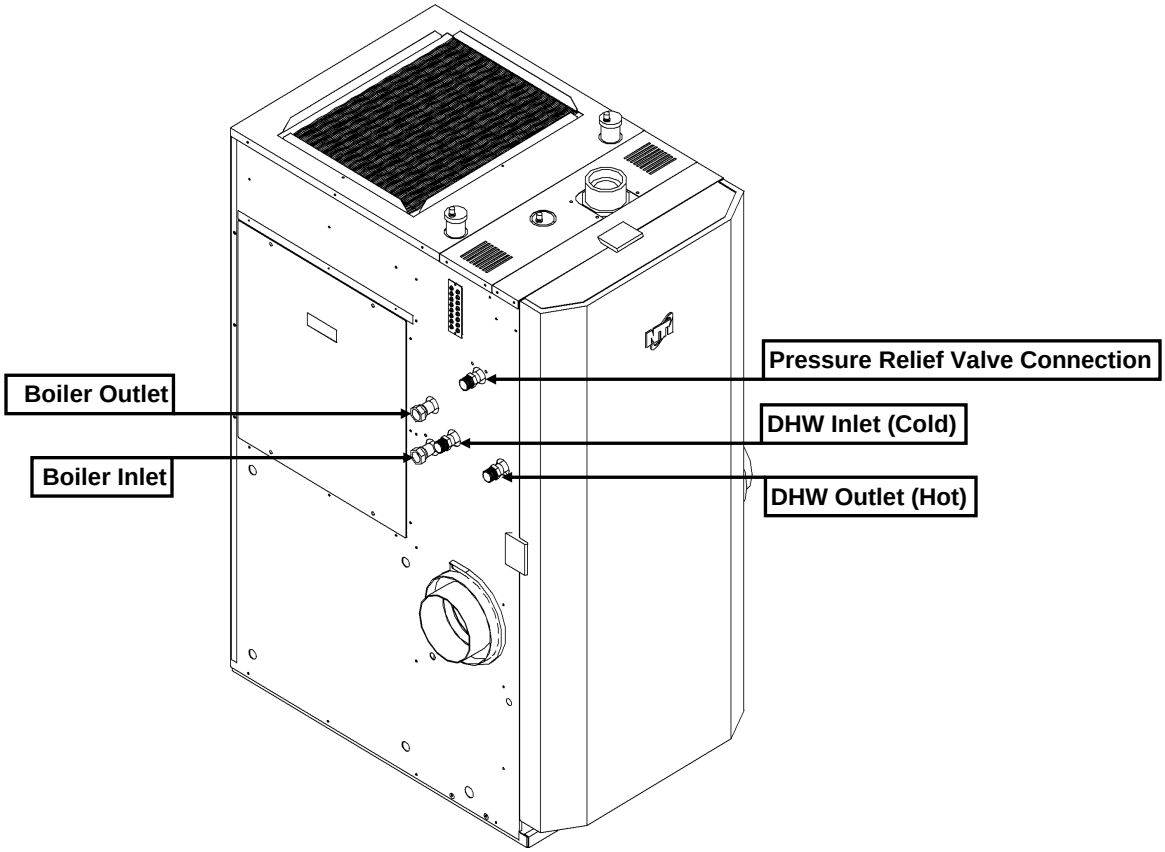
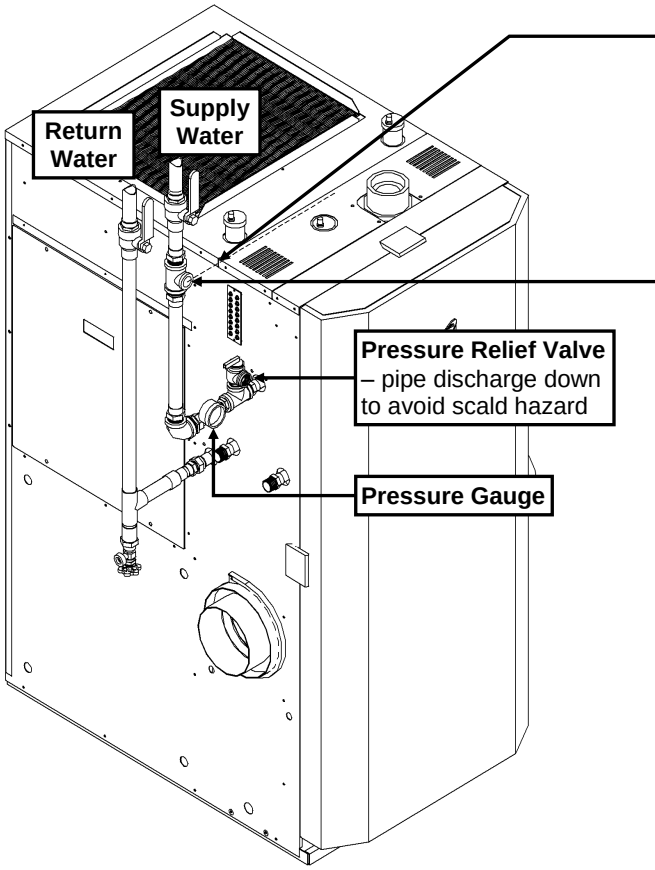


Figure 10-2 Near Boiler Piping



Low Water Cutoff Location

(when required – see above)

Install the LWCO in a suitable tee *(reference installation instructions provided with the LWCO)*, located in a vertical flow pipe in the boiler outlet piping, at a level at least as high as the top of the boiler cabinet (see illustration). **DO NOT** install isolation valves between the boiler outlet connection and the LWCO. The LWCO switch must be wired to break the boiler limit circuit or line power to the boiler.

When the installation is complete, **TEST THE LWCO** to ensure the burner shuts down when the water level drops.

Boiler System Plumbing

Feed Water Pressure Regulator (Factory Supplied)**:** The Matrix operates as a boiler to provide heat, thus it must be installed and operated as such. A 12-15 PSI pressure regulator is provided with the Matrix and must be field installed as per the installation instructions. Note: Local authorities may require the installation of a certified "back-flow preventer" immediately before the pressure regulator.

Circulating Pump (Factory Supplied)**:** The Matrix has a built-in circulator to pump water from the boiler to either the internal forced-air heating coil or the internal domestic coil (brazed plate heat exchanger). An external circulator is only required if the Matrix is also being used to supply heat to a hydronic heating system, the external circulator must be sized for the requirements of the hydronic heating system.

Air Removal: Boilers are designed to operate with airless water in the system. The Matrix design allows for the evacuation of air from the internal plumbing. For installations in conjunction with a hydronic heating system an 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, must be installed

NOTICE

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

Expansion Tank (Factory Supplied)**:** The Matrix comes with a built-in expansion tank that is sized to handle the volume of water in the Matrix unit. An external expansion tank must be field sized, supplied and installed for Matrix units installed in systems with hydronic heat.

⚠ 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.

Mixing Controls – During "forced-air" heating demands, the Matrix will operated at a constantly varying boiler water temperature; this temperature may at times exceed the maximum allowable temperature for certain types of hydronic heating systems (i.e. infloor heating). Therefore, for low temperature heating applications, mixing controls, such as a thermostatic mixing valve or injection system, must be used to limit the temperature of the water entering the heating system.

⚠ CAUTION

Failure to employ mixing controls where necessary, may lead to property damage caused by excessive heat.

NOTICE

Figures 10-3 to 10-5 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 10-3(a) Plumbing High Temperature Zones (w/ Zone Valves)

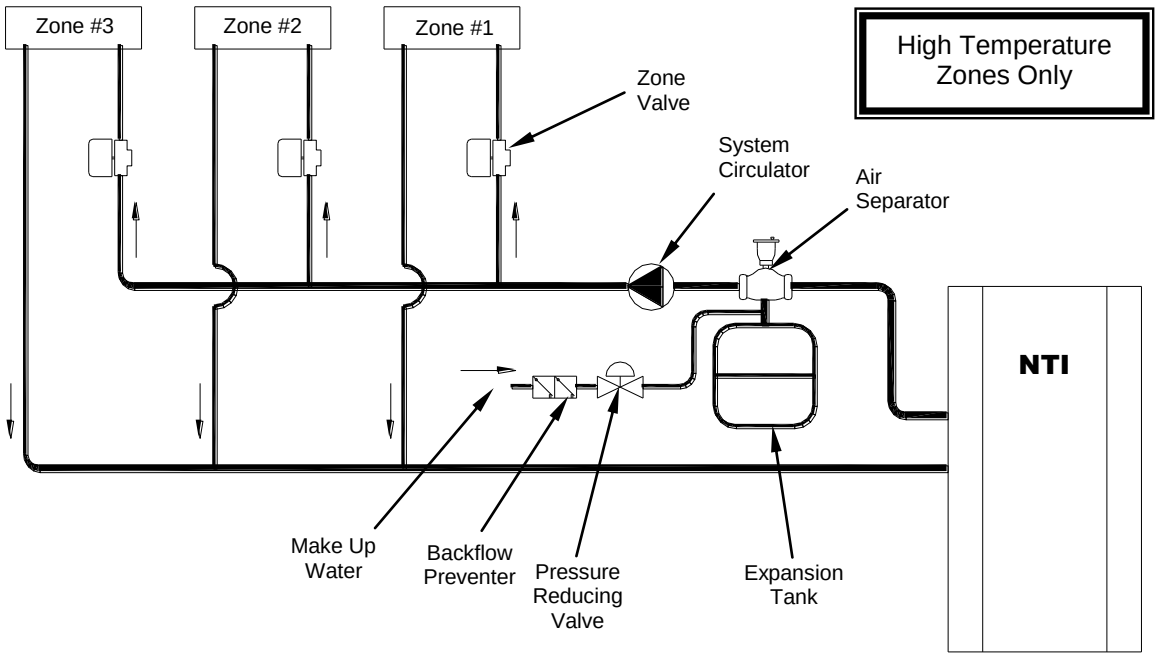


Figure 10-3(b) Wiring Zones (w/ Zone Valve Controller)

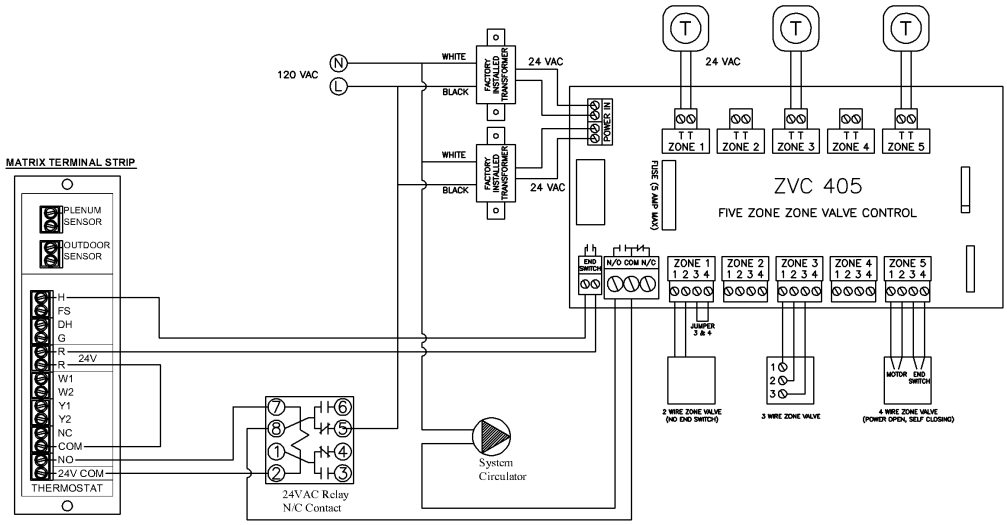


Figure 10-3(c) Wiring Zones (w/o Zone Valve Controller)

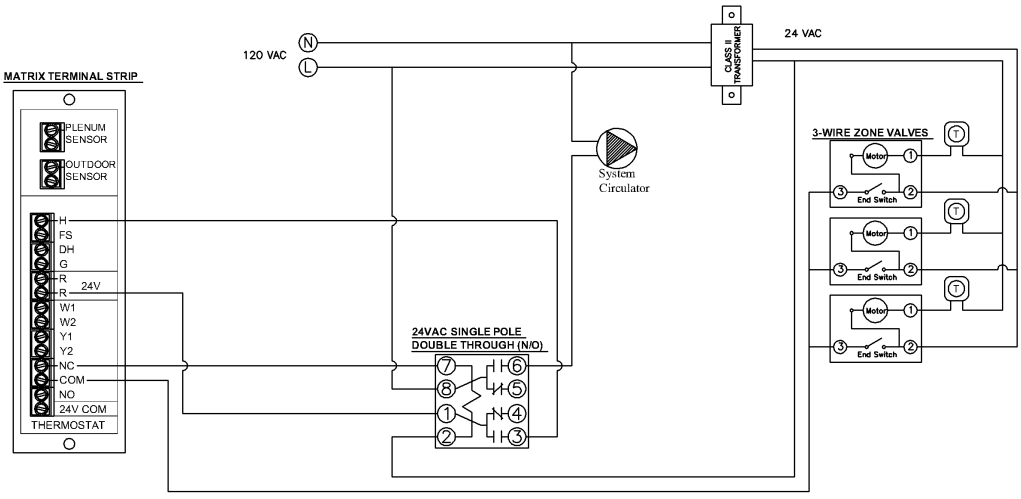


Figure 10-4(a) Plumbing High Temperature Zones (w/ Zone Circulators)

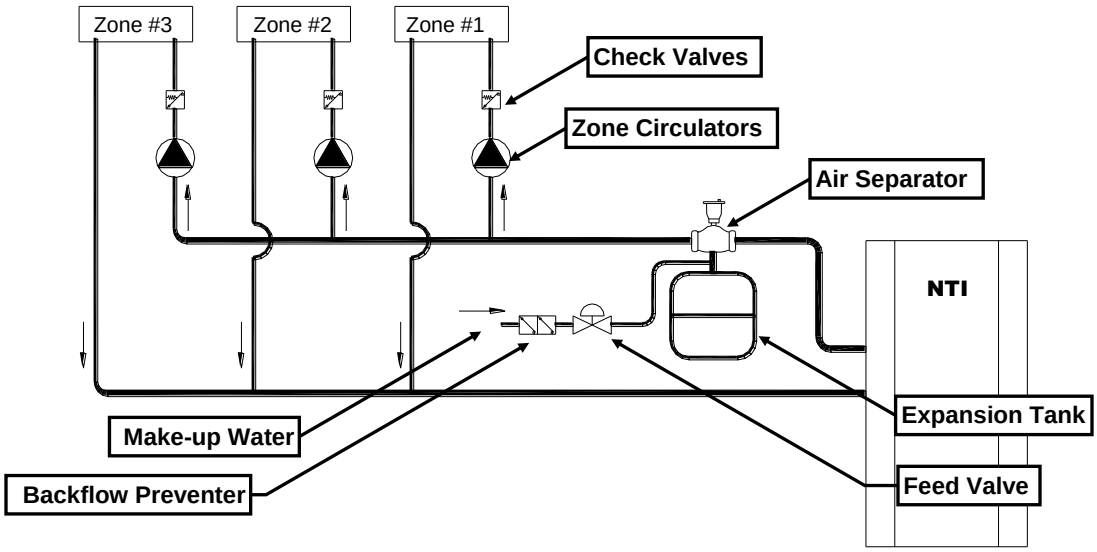


Figure 10-4(b) Plumbing Low Temperature Zones (w/ Mixing Valves)

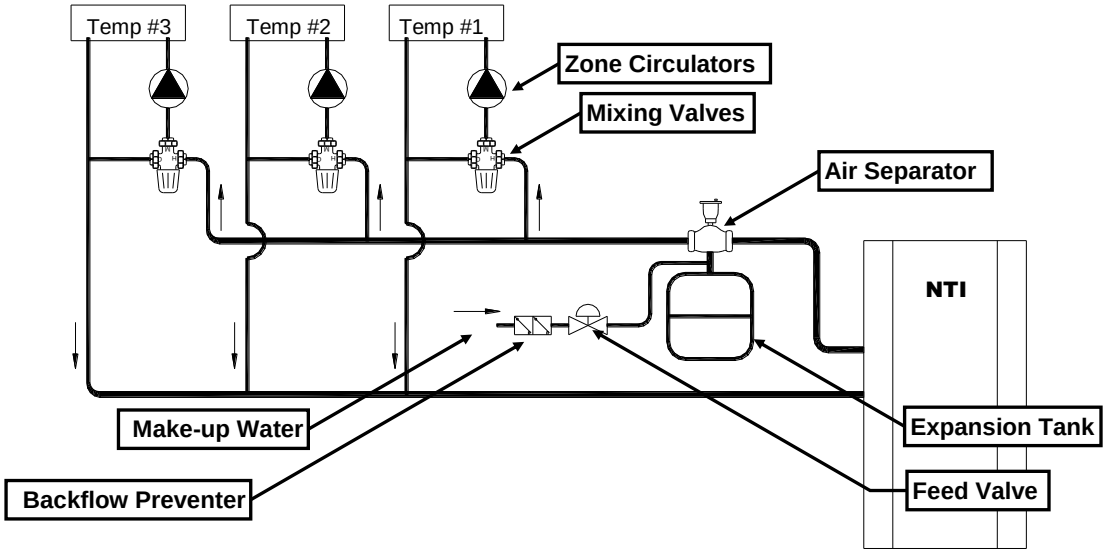


Figure 10-4(c) Wiring Zones (w/ Zone Pump Controller)

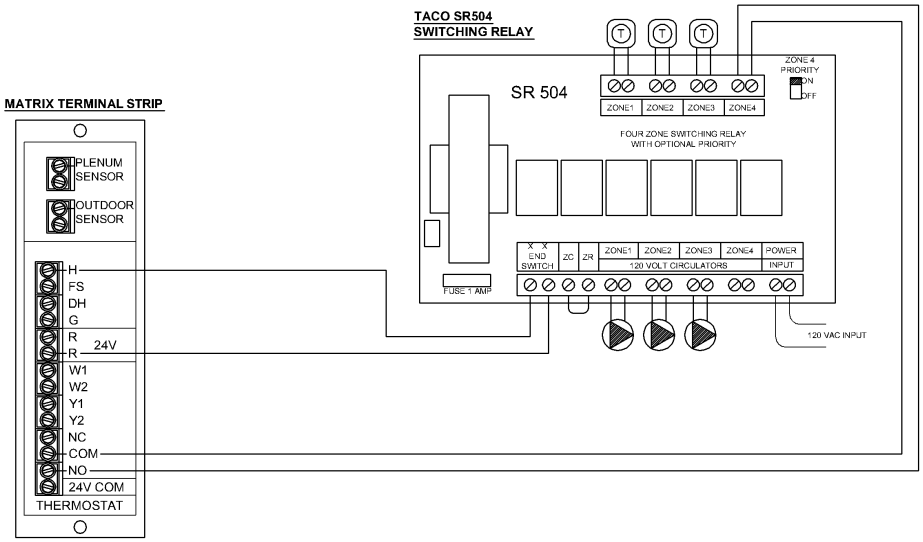


Figure 10-5(a) Plumbing Single Temperature Zones (w/ Injection System)

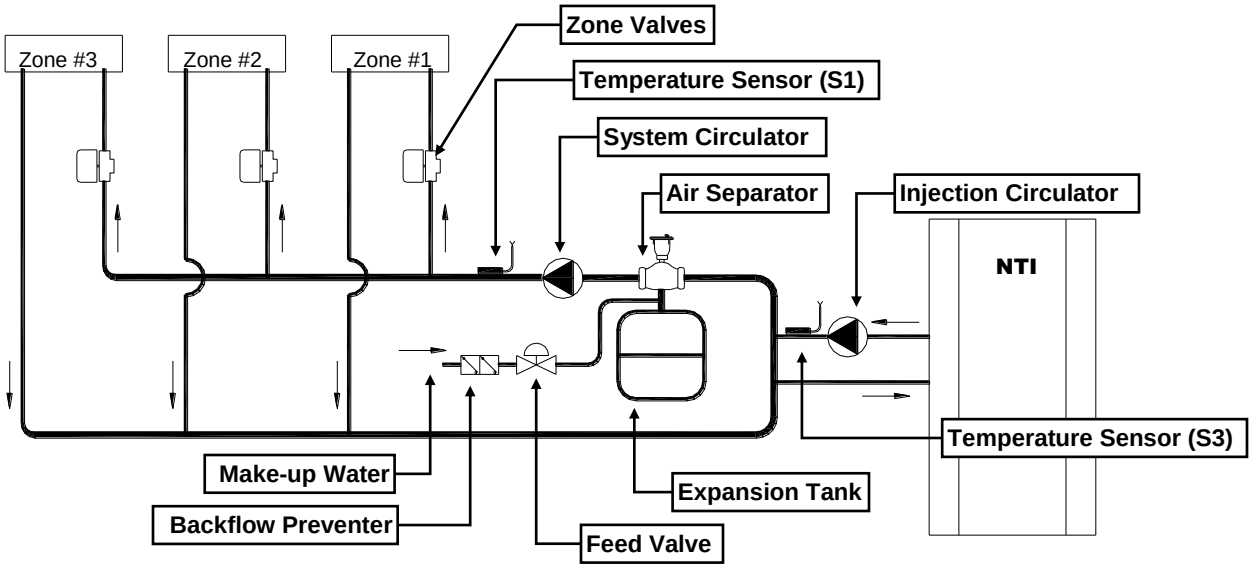


Figure 10-5(b) Plumbing Multiple Temperature Zones (w/ Injection System)

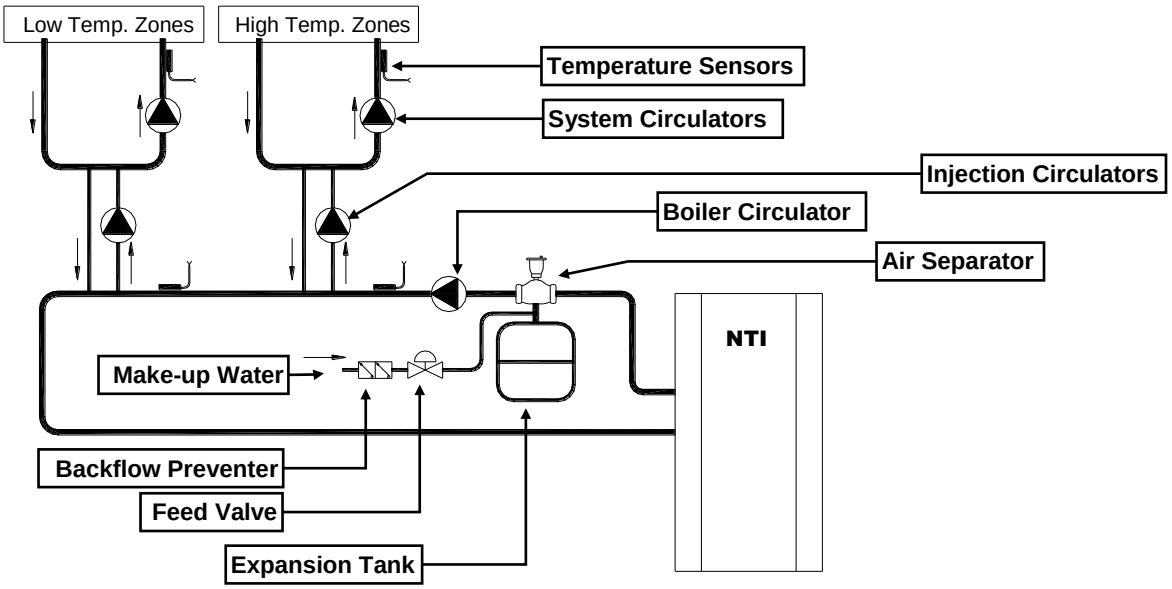
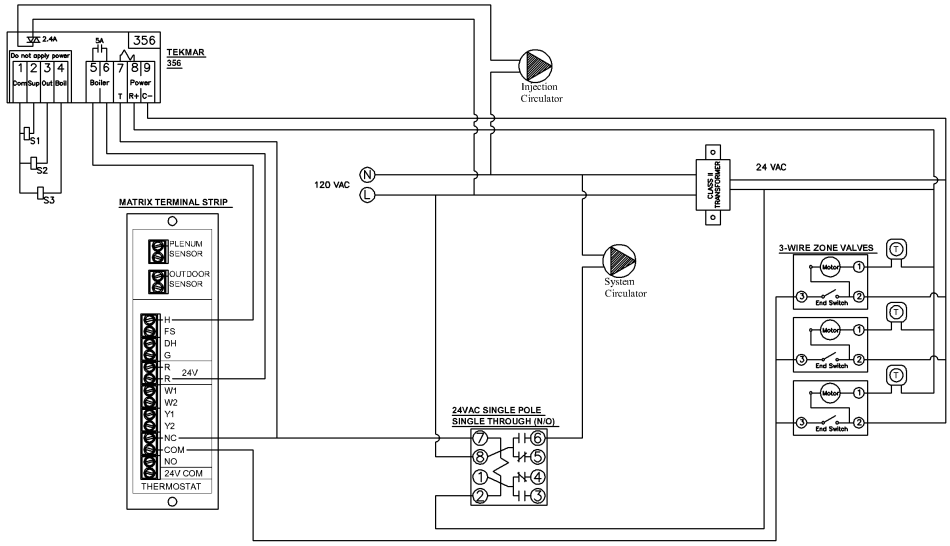


Figure 10-5(c) Wiring Injection System (w/ Tekmar 356 Controller)



11.0 DOMESTIC HOT WATER PLUMBING AND OPERATION

DHW Description of Operation

The Matrix heats domestic hot water on demand, indirectly, using a brazed plate heat exchanger. Using an internal flow meter, the Matrix recognizes a DHW demand when the DHW flow rate is greater than 0.4 gpm. The Matrix immediately goes into domestic mode, regardless of what other systems may have been operating, the burner fires and the Matrix attempts to achieve a calculated set point which depends on the sensed water flow rate and the programmed H20 setting (See Section 13.0). The H20 setting is accessed via the menu in the Matrix Fan (blue) controller, and should be set at a value equal to (or slightly greater) than the temperature required at the hot water fixtures, e.g. 125ºF. The Fan control will communicate to the Boiler (red) controller a boiler water temperature set point applicable for the sensed flow rate and the H20 setting selected. The higher the flow rate and/or H20 setting, the higher the boiler water set point (boiler water setting will not exceed the H20 setting by more than 30ºF). NTI provides a Thermostatic Mixing Valve adjustable from 100 to 145°F; the mixing valve shall be installed between the Matrix DHW supply fitting and the hot water supply pipe to the fixtures (See Figures 11-1 and 11-2), thus providing user protection from scalding hot water.

NOTICE

Code requirements may require the maximum setting of the Thermostatic Mixing Valve to be fixed at 120°F or lower, see "Thermostatic Mixing Valve" below and the instructions included with the valve.

DHW Plumbing & Set-up

DHW Inlet & Outlet Connections – The Matrix has two potable water connections, Inlet & Outlet, which exit the left side of the Matrix Cabinet; on the inside of the cabinet the two lines are connected to the Brazed Plate Heat Exchanger. The cold Inlet line flows through an integrated brass flow meter before connecting to the rear fitting of the Brazed Plate Heat Exchanger. The hot Outlet line flows directly from the front fitting of the Brazed Plate Heat Exchanger. See Figures 11-1 and 11-2 for installation details.

Thermostatic Mixing Valve (Factory Supplied) **–** A Sparcomix AM101-US-1 is provided with your package. This valve regulates the water temperature leaving the plate heat exchanger, and must be used in every instance. The dial can be set to the desired temperature required. Consult the Honeywell manual SD/IS150 for detailed instructions and settings. (Note: the valve must be set to a supply temperature of not more than 120˚F. It is the responsibility of the installer to set the valve and remove the dial.)

⚠ WARNING

Scald Hazard - Hotter water increases the risk of scald injury. There is a hot water scald potential if the thermostatic mixing valve is set too high. Be sure to follow the adjustment instructions provided with the thermostatic mixing valve. Failure to follow these instructions may result in serious injury or death.

DHW Filter / Y-Strainer (Factory Supplied) **–** To protect the Matrix's internal flow meter, it is important to install the factory supplied Y-Strainer in the location shown in Figures 11-1 and 11-2; dirt and other debris can cause the flow meter to malfunction.

Check Valve – A check valve must be field provided and installed on the outlet of the mixing valve to prevent expansion devises downstream from back flowing when the water pressure drops during cold water draws. Failure to prevent the backflow will cause water to flow forward through the Matrix flow sensor, activating it, when the cold-water draw has ended and the water pressure increases.

Throttling Valve – Install a throttling valve, after the mixing valve, to regulate the maximum hot water flow rate. The Combi is limited to a firing rate of 150 MBH; therefore excessive flow rates will result in cooler hot water temperatures.

Drain and Isolation Valves – Install drain and isolation valves on the inlet and outlet of the brazed plate heat exchanger, as shown in Figures 11-1 and 11-2 so it can be flushed free of possible build-up caused by dirt or hard water.

Hard Water – To prevent the formation of scale on the inside of the brazed plate heat exchanger and other components in the domestic hot water system, water with hardness higher than 50 ppm Calcium Carbonate must be treated with a "Water Softener" prior to entering the appliance. Plugging of the domestic system by scaling or accumulation of dirt is not the responsibility of NY Thermal Inc., and suitable steps shall be taken to avoid it.

Cleaning – Brazed plate heat exchangers operate with high turbulence flow, even at low flow rates. This high turbulence keeps small particles in suspension minimizing fouling and scaling. However, in some applications the fouling tendency can be very high, e.g. when using extremely hard water at high temperatures. In such cases it is always possible to clean the exchanger by circulating a cleaning liquid. Use a tank with weak acid, 5% phosphoric acid or, if the exchanger is frequently cleaned, 5% oxalic acid. Pump the cleaning liquid through the exchanger. For optimum cleaning, the cleaning solution flow rate should be a minimum of 1.5 times the normal flow rate, preferably in a back-flush mode. After use, do not forget to rinse the heat exchanger carefully with clean water. A solution of 1-2% sodium hydroxide (NaOH) or sodium bicarbonate (NaHCO3) before the last rinse ensures that all acid is neutralized. Clean at regular intervals.

Instantaneous DHW (w/o Storage Tank)

The Matrix will provide domestic hot water continuously when flow is sensed by the flow sensor. This method is the most efficient means of heating water by allowing the boiler to operate at a lower return water temperature, thus increasing combustion efficiency, and by minimizing standby losses. See Figure 11-1 for installation details.

DHW Limitations – As the Matrix produces domestic hot water instantaneously; there are inherent limitations of the system:

- NO STORAGE - As there is no water storage, the boiler can only provide water at the temperature specified at the corresponding flow rates. Flow through the fixtures must be regulated so not to exceed the ability of the boiler to heat the water. MORE FLOW = LESS TEMPERATURE. See "Procedure for Setting up Domestic Hot Water" and Table 11-1.
- DOESN'T MAINTAIN TEMPERATURE – When there is no call for domestic hot water, the unit is off. From a dead stop the unit will detect flow and start providing heat in 15 seconds, and be up to capacity by 25 seconds. Once running, the unit can provide an endless amount of hot water. If the flow is momentarily turned off for whatever reason, the unit will turn off. Once off, the unit must relight, and not provide heat for 45-75 seconds. This will cause cold unheated water to pass through the unit, and advance through the domestic plumbing between the previously heated (hot) water, and the new (hot) water. This can be mistaken for an inability to adequately heat the water.

"Storage" Feature (St0) – For improved domestic hot water comfort, the Matrix incorporates a "Storage" feature. This storage feature, when enabled, will keep the boiler water hot for a period of 1 to 24 hours following a call for domestic hot water (See Section 13.0 for further information of setting control). When the boiler water drops below 140°F the boiler will fire and bring the boiler to 180°F before shutting off. This "Storage" feature helps in reducing the wait time associated with a tankless hot water system. In systems where a storage tank is used (See Figure 11-2), this feature should be disabled, e.g. set to OFF.

Procedure for Setting up Domestic Hot Water – If the Matrix is being installed in an application that uses municipal water, often the pressure is high enough to generate flow rates at the faucets that will exceed the appliances capacity to heat it. See the following tables to determine what flow can be expected at various inlet and outlet water temperatures.

Table 11-1 Matrix DHW Flow Rates (USgpm)

		Inlet Water Temperature (deg. F)						
		40	**45**	**50**	**55**	**60**	**65**	**70**
Outlet Water (F)	**110**	3.9	4.2	4.5	4.9	5.4	6.0	6.7
	115	3.6	3.9	4.2	4.5	4.9	5.4	6.0
	120	3.4	3.6	3.9	4.2	4.5	4.9	5.4
	125	3.2	3.4	3.6	3.9	4.2	4.5	4.9
	130	3.0	3.2	3.4	3.6	3.9	4.2	4.5
	135	2.8	3.0	3.2	3.4	3.6	3.9	4.2
	140	2.7	2.8	3.0	3.2	3.4	3.6	3.9

To avoid having too much flow at the faucets use the throttling valve located at the "Cold Supply" in Figure 11-1 to limit the overall flow of domestic hot water. Follow these instructions to achieve the best delivery of DHW:

- Open throttle valve fully.
- Turn the dial on the mixing valve to the desired setting (do not exceed 120˚F).
- Create the maximum amount of DHW flow that is likely to occur on a regular basis. (Usually tub faucet, or choose two other faucets)
- Allow the boiler to reach steady state, and then throttle the shut-off valve until the hot water exiting the plate heat exchanger is slightly warmer than the mixed water exiting the mixing valve. Ensure the boiler is firing at the maximum rate, if not increase the "H20" setting and repeat this step. (It is beneficial to keep the "H20" setting as low as possible to limit short cycling and maintain efficiency).

NOTICE If the flow rates listed in Table 11-1 are not high enough for the application, install a storage tank with re-circulating loop as per below and Figure 11-2.

Matrix w/ DHW Storage Tank

To completely avoid the DHW limitations inherent with on demand hot water heating, install a DHW storage tank as per the DHW plumbing schematic shown in Figure 11-2. When the tank temperature is insufficient, an Aqua-stat (T-stat) located within the storage tank completes a 120VAC circuit to a potable (bronze or Stainless Steel) circulating pump. The pump circulates water from the bottom of the storage tank (typical location of a drain fitting) to the DHW inlet fitting of the Matrix (see Figure 10-1 for identification of plumbing fittings). The DHW flow meter senses the water flow and triggers a DHW demand; heated water flows from the Matrix and enters the inlet fitting of the storage tank.

Figure 11-1 DHW Piping (Tankless – On demand)

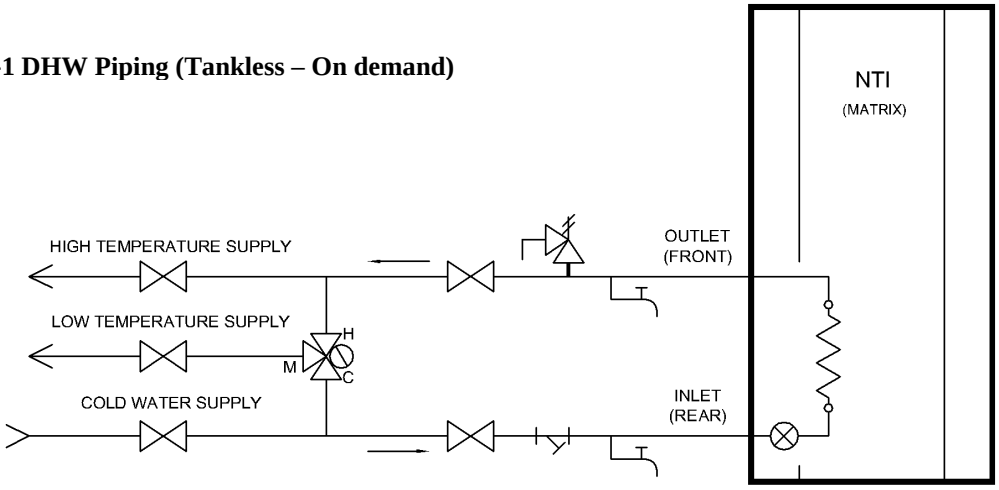
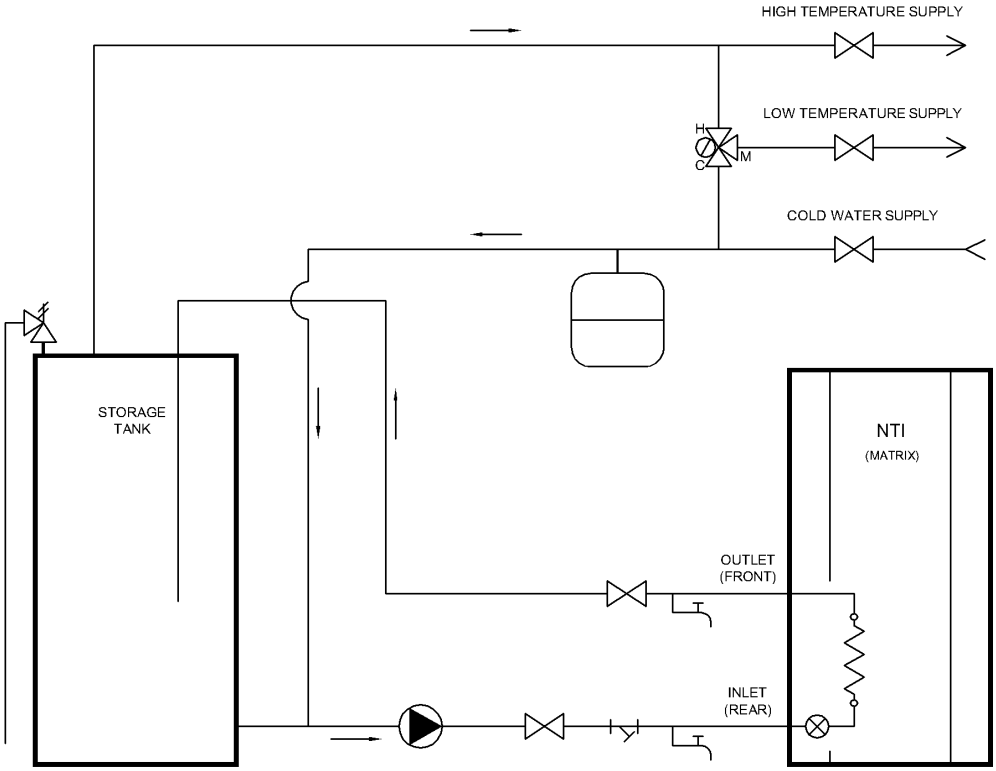


Figure 11-2 DHW Piping (w/ Storage Tank)



LEGEND					
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	ISOLATION / THROTTLE VALVE		BRONZE PUMP		FLOW METER
	DRAIN VALVE	H C M	THERMOSTATIC MIXING VALVE		Y STRAINER
	EXPANSION TANK		TEMPERATURE AND PRESSURE RELIEF VALVE		BRAZED PLATE HEAT EXCHANGER

12.0 FIELD WIRING

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

⚠ 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

The Matrix line voltage junction box is located on the right-hand side of the boiler cabinet. Each unit is provided with three knockouts for routing field wiring into the line voltage junction box. Line voltage field connections are to be installed in accordance with Figure 12-1 and Table 12-1.

Fuse (120 VAC) – The Matrix Sentry controller is equipped with one 15 Amp fuse to protect the 120VAC pump output. The fuse is located under the cover of the Sentry 2100 control (red control).

⚠ 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 Matrix is designed to be powered using a single phase 120 VAC 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 120 VAC to ground; neutral must measure zero. Failure to follow instructions may damage the unit.

Figure 12-1 Line Voltage Field Wiring

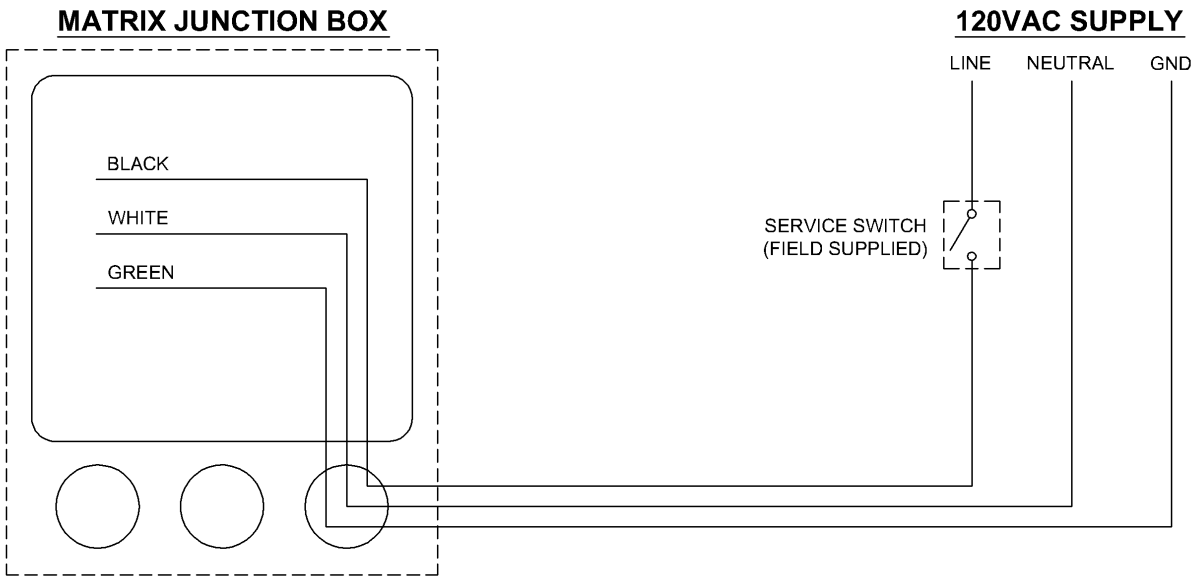


Table 12-1 Line Voltage Field Connections

Connection	Color	Description
L1 (120VAC)	Black	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.
L2 (Neutral)	White	Location for connecting neutral of the power supply.
Ground	Green	Location for connecting earth ground and for grounding all of the circulators.

Low Voltage Connections

The Matrix low voltage (thermostat) connections are located on a terminal strip on the left-hand side of the unit, on the outside of the boiler cabinet. Low voltage field connections are to be installed in accordance with Figure 12-2 and Table 12-2.

Fuse (24 VAC) – The Matrix is equipped with a "blade style" 2 Amp fuse to protect the internal transformer located on the control panel.

NOTICE

The Matrix terminal strip is for low voltage (max 24 VAC) and low load (max 1 Amp) connections. Any electrical loads in excess of 24 VAC or 1 Amp must be isolated using relays. Failure to follow these instructions can result in component malfunction.

Figure 12-2 Low Voltage Field Wiring

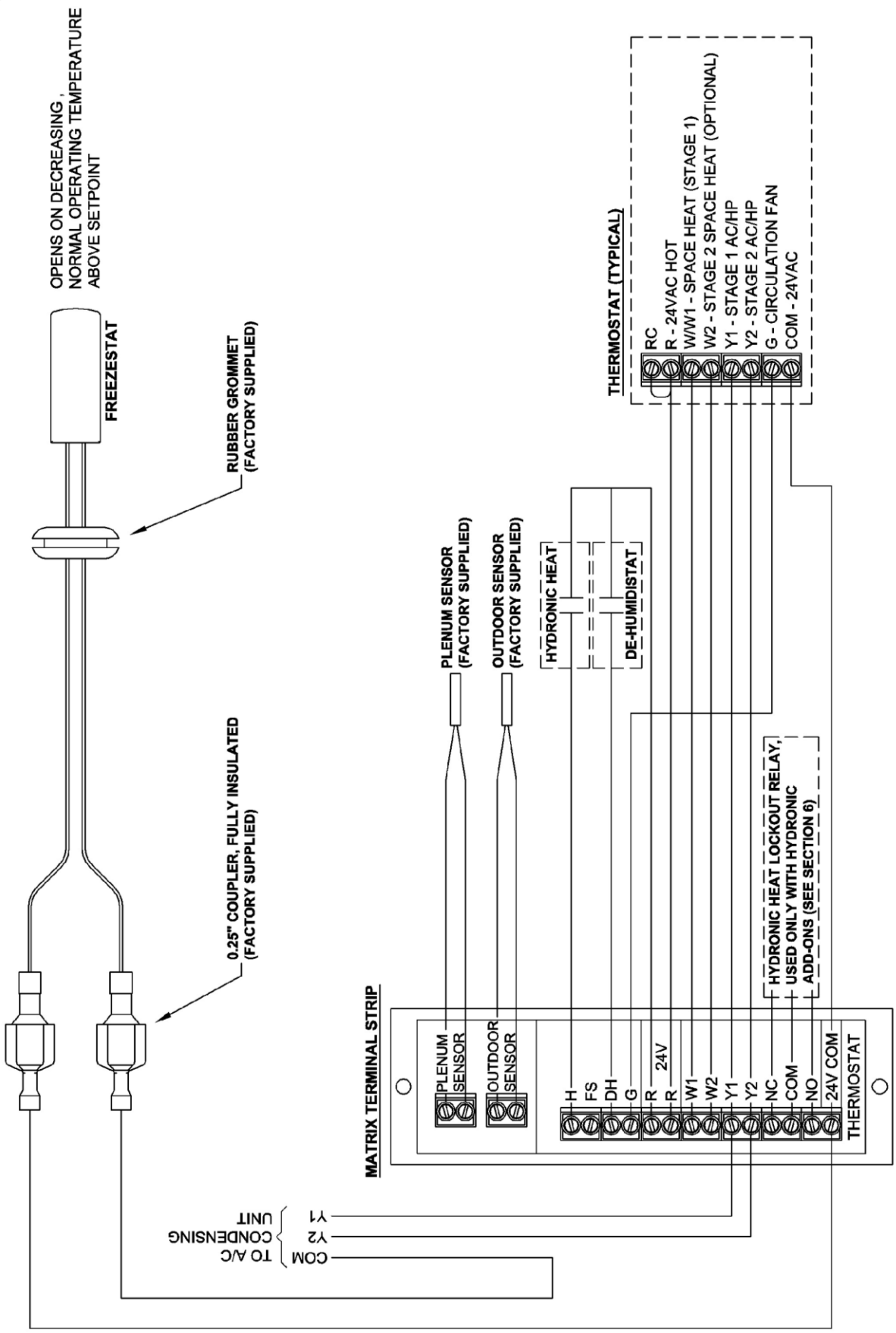


Table 12-2 Low Voltage Field Connections

Connection	Description
Plenum Sensor	**Plenum Temperature Sensor** – Each Matrix is provided with a temperature sensor that is to be field installed in the supply plenum. When installed the Matrix Fan (blue) controller will display the plenum temperature and may provide additional features depending on the application.
Outdoor Sensor	**Outdoor Temperature Sensor** – Each Matrix is provided with an outdoor temperature sensor that may be field installed to provide Outdoor Reset for applications were the Matrix is providing heat to a Hydronic Heating System.
H	**Hydronic Heat Input** – Input requiring 24VAC from terminal R to initiate a demand for Hydronic Heat. Switch is made using an isolated end switch (dry contact), e.g. hydronic zone controller. Not used in applications w/o Hydronic Heating. Boiler temperature setting is made via the HYD setting in the (red) Boiler Controller, see Table 13-4.
FS	**DHW Heat Input** – Input requiring 24VAC from terminal R to initiate a demand for DHW Heat. Switch is made using an isolated end switch (dry contact), e.g. dhw flow switch or tank aqua-stat. Note: this input is normally not used, as the Matrix incorporates a DHW Flow Meter to detect DHW demands.
DH	**De-humidistat Input** – Input requiring 24VAC from terminal R to initiate a demand for high ventilation with the optional built-in HRV (Heat Recovery Ventilator). Switch is made using an isolated end switch (dry contact), e.g. centrally located De-humidistat (may be incorporated in Thermostat), or "wet room" timers. Note: this function only acts to de-humidify during colder weather by increasing ventilation, it is not intended for de-humidification during warmer months.
G	**Circulation Fan Input** – Input requiring 24VAC from terminal R to initiate a demand for the Circulation Fan. Switch is made using an isolated end switch (dry contact) normally incorporated in the home thermostat. Air circulation rate is set via the FAN setting in the (blue) Fan Controller, see Table 13-5.
R	**24VAC Hot** – Power supply for inputs H, FS, DH, W1, W2, Y1 and Y2.
W1	**Forced Air Central Heat Input** – Input requiring 24VAC from terminal R to initiate a demand for the Forced Air Central Heat. Switch is made using an isolated end switch (dry contact) normally incorporated in the home thermostat.
W2	**Forced Air Central Heat Input (Stage 2)** - Input requiring 24VAC from terminal R to initiate a demand for Stage 2 Forced Air Central Heat. Switch is made using an isolated end switch (dry contact) normally incorporated in the home thermostat. Note: most applications will not require the use of input W2; NTI recommends using W1 only for Forced Air Central Heating.
Y1	**Air-Conditioning / Heat Pump Input (Stage 1)** – Input requiring 24VAC from terminal R to initiate a demand for stage 1 cooling (or heat pump). Switch is made using an isolated end switch (dry contact) normally incorporated in the home thermostat. CFM rate adjustable via Y1 setting in the (blue) Fan Controller, see Table 13-5.
Y2	**Air-Conditioning / Heat Pump Input (Stage 2)** – Input requiring 24VAC from terminal R to initiate a demand for stage 2 cooling (or heat pump). Switch is made using an isolated end switch (dry contact) normally incorporated in the home thermostat. CFM rate adjustable via Y2 setting in the (blue) Fan Controller, see Table 13-5. Note: Y2 demand overrides a Y1 demand.
NC	**Hydronic Heat Lockout Relay Contacts** – The Matrix Fan control incorporates a Normally Closed (NC) and a Normally Open (NO) relay contact that switches position on a demand for DHW. The contacts are to be used to lockout the Hydronic Heat draw during concurrent DHW demands in order to maintain DHW priority. Maximum switching capacity of 2 Amps at 24VAC.
COM	
NO	
24V COM	**24VAC Common** – Neutral for the 24VAC power supply from the Matrix. This contact can be used in conjunction with terminal R to provide a power source for a digital thermostat. NOTICE: 24V COM to the A/C Condenser Unit must be broken by the Matrix AC Freeze-stat included with the installation package, see Figure 12-2.

13.0 CONTROL SETUP

The Matrix uses two devices to control the functions required by the Matrix. The Matrix Boiler Control (red face) controls and ensures the safe operation of the boiler functions of the Matrix, much the same as the Sentry 2100 does in the Trinity products. The Matrix Fan Control (blue face) controls all of the operation functions related to air handling and hot water dispatching. The fan controller controls the forced air modulation, ventilation, as well as priority of domestic hot water and secondary heating systems.

NOTICE

The Matrix boiler control (Sentry) is different from the Sentry controller used in any other NTI product, and is NOT INTERCHANGEABLE. Using the incorrect boiler control will result in incorrect boiler operation.

Controller Navigation

Matrix Boiler Control (Red Face Plate) – The Matrix Boiler Control communicates to the user what is happening in the system by using a 7-segment LED display and a series of LED indicators; see Table 13-1.

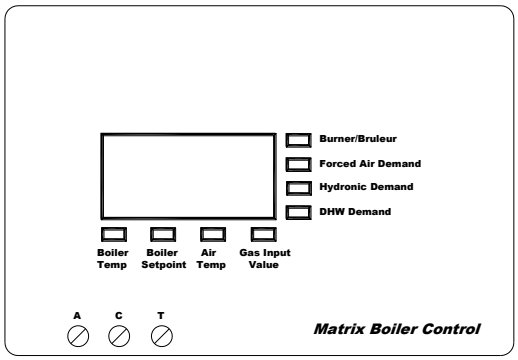


Table 13-1 Matrix Boiler Control Navigation

LED	Description
Burner/Brûleur	Indicates that the ignition system is activated
Forced Air Demand	Indicates a call for forced air heat. Note: there may still be a call for forced air heat even when thermostat is satisfied (off).
Hydronic Demand	Indicates a call for hydronic heat
DHW Demand	Indicates a call for domestic hot water
Boiler Temp	When illuminated, display is showing boiler water temperature
Boiler Setpoint	When illuminated, display is showing boiler water set point
Air Temp	When illuminated, display is showing outdoor temperature
Gas Input Value	When illuminated, display is showing current gas input value.

Matrix Fan Control (Blue Face Plate) – The Matrix Fan Control communicates to the user what is happening in the system by using a 7-segment LED display and a series of LED indicators; see Table 13-2.

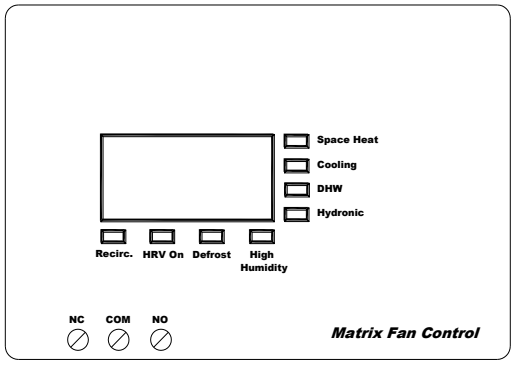


Table 13-2 Matrix Fan Control Navigation

LED	Description
Space Heat	Indicates a call for forced air heating
Cooling	Indicates a call for cooling
DHW	Indicates a call for domestic hot water
Hydronic	Indicates a call for hydronic heat
ReCirc.	Indicates a call for continuous circulation/ventilation
HRV On	Indicates the HRV is ventilating
Defrost	Indicates the HRV is in defrost mode
High Humidity	Indicates a call for high ventilation of HRV

Operation and Set-up

The Matrix employs a pneumatic modulation system. This modulation system increases or decreases the velocity of the combustion blower, to meet the demand for heating. The gas valve senses this change in blower pressure and introduces the required amount of gas to ensure correct combustion. The (Red) Boiler Controller reads the boiler water temperature, compares it to the set point, and adjusts the burner firing rate accordingly by varying the speed of the combustion blower.

The (Blue) Fan Controller communicates the appropriate demand and temperature set point to the (Red) Boiler Controller via a series of digital and analog inputs. Tables 13-3(a) and 13-3(b) show the Boiler Controller's response to each demand. For more information on 'RESET MODE' see section "Outdoor Sensor (10K)".

Table 13-3(a) Operation – Conventional Mode

	Standby/Storage Mode		**Primary Forced Air Call (W1)**	**Auxiliary Forced Air Call (W2)**	**Shared Call Forced Air/Hydronic**	**Hydronic Demand (H)**	**DHW Demand**
Condition	Storage Off	Storage On	Heat (W1)	Aux Heat (W2)	Shared (W1/W2 and H)	Hydronic Call	Domestic Only
Set Point	-	160°F	SP[Note 1]	HI	Greater of SP/ HI and HYD	HYD	H2O to H2O+30
Burner On	-	140°F	SP [Note 1]	HI	Greater of SP/HI and HYD	HYD-DIF	H2O+30
Burner Off	-	180°F	210°F	210°F	210°F	HYD + 10	210°F
Heat Circ.	Off	On	On	On	On	On	On

Table 13-3(b) Operation – Reset Mode

	Standby/Storage Mode		**Primary Forced Air Call (W1)**	**Auxiliary Forced Air Call (W2)**	**Shared Call Forced Air/Hydronic**	**Hydronic Demand (H)**	**DHW Demand**
Condition	Storage Off	Storage On	Heat (W1)	Aux Heat (W2)	Shared (W1/W2 and H)	Hydronic Call	Domestic Only
Set Point	-	160°F	SP[Note 1]	$HI_{Calc.}$	Greater of SP/ $HI_{Calc.}$ and $HYD_{Calc.}$	$HYD_{Calc.}$	H2O to H2O+30
Burner On	-	140°F	SP [Note 1]	$HI_{Calc.}$	Greater of SP/ $HI_{Calc.}$ and $HYD_{Calc.}$	$HYD_{Calc.}$-DIF	H2O+30
Burner Off	-	180°F	210°F	210°F	210°F	$HYD_{Calc.}$+ 10	210°F
Heat Circ.	Off	On	On	On	On	On	On

Note 1: SP (Setpoint) received from Matrix Fan Controller.

Setting Matrix Boiler Control (Sentry)

Programming is accomplished by a series of three push buttons located on the bottom side of the control. (Function, ↑ and ↓). To enter the programming mode, press the function key once. To scroll through the various menu options depress ↑ until the menu is displayed. To alter the value press Function once, and the current value will be displayed, then use ↑ for up, and ↓ for down, until the desired value is obtained. To enter the selected value press Function, which will return to the menu. When all desired values are selected, scroll to the RUN menu, and press Function, which exits the Programming Mode and initiates normal operation. A safety feature has been added to ensure that if the control is left in the Program Mode, the unit will turn off if left in program mode longer than 30 seconds without receiving an input. Press Function once to continue programming or to start boiler operation. See Table 13-4 for a description of the boiler control settings.

Table 13-4 Matrix Boiler Control Programming

Menu Item	Settable Range	Description	Typical Settings
RUN		**Program Mode** - When Run is displayed controller is in 'Prog' mode. Arrow up or down to scroll through menus	
HYD	80-200	**Hydronic Call Setpoint**	100-120 Infloor (High Mass) 140-160 Infloor (Low Mass) 140-160 Fan Coil
HI	80-200	**Auxiliary Heat Setpoint** – prior to outdoor reset adjustment	190
DIF	1-40	**Differential Setting** - Applies only to Hydronic setpoint. Temperature difference below setpoint at which burner will re-light.	10
RES	70-HI	**Sets Outdoor Reset Curve Slop***e* – See Determining Reset Temperature for more information.	85
SFS	75-100	**Starting Gas Input Value**	80
HFS	100-240	**Maximum Gas Input Value**	240
LFS	46-100	**Minimum Gas Input Value**	48 (min 46)
FrE	ON/OFF	**Freeze Protection** – Operates burner and circulator if temperature drops below 40ºF.	ON
St0	OFF-24	**Storage Feature Timer** – Length of time in hours storage feature will keep boiler hot.	2

To start the control operation, you must return to RUN in the menu, and press Function. Normal operation will begin. Controller will return to RUN mode if no button is pressed for 2 minutes.

Setting Matrix Fan Control

Just as the Matrix Boiler Controller controls all of the operation and safety functions of the boiler, the Matrix Fan Controller controls all of the operational functions related to air handling and hot water dispatching. The fan controller controls the forced air modulation, ventilation, as well as priority of domestic hot water and secondary heating systems. See Table 13-5 for a description of the fan control settings.

Table 13-5 Matrix Fan Control Programming

Menu Item		Settable Range	Default	Description
Main	**Sub**			
RUN				When Run is displayed, controller is in 'Prog' mode. Arrow up or down to scroll through menus
HRV		OFF / ON	ON	HRV Mode – Always off unless call for high ventilation (DH)
				HRV Mode – Continuous Ventilation. HRV will exchange air at low ventilation rate during a call for forced air heat (W1 or W2) or continuous circulation (G). Will increase to high ventilation rate with a high ventilation call (24vac @ DH)
HEA		PF1- PF3	PF1	Heat Profile 1 400 to 1000CFM; 50,000 Btu/h max.
				Heat Profile 2 400 to 1100CFM; 77,000 Btu/h max.
				Heat Profile 3 400 to 1200CFM; 105,000 Btu/h max.
Y1		40-Y2	80	Stage 1 AC/HP Flow x 10 = CFM, settable from 400 up to Y2 (1600 max).
Y2		Y1-160	120	Stage 2 AC/HP Flow x 10 = CFM, settable from Y1 (400 min) up to 1600.
FAN		40-160	40	Fan circulation rate (G) x 10 = CFM, settable from 400 to 1600.
BAL	SCL	30-100	60	HRV Balancing – (see HRV section for more details)
	ECL	30-100	60	
	SCH	30-100	60	
	ECH	30-100	60	
	SOL	30-100	100	
	EOL	30-100	100	
	SOH	30-100	100	
	EOH	30-100	100	
H2O		100-160	125	Set point for desired DHW temperature in degrees Fahrenheit.
rAd		1 or 2	2	Determines the anticipated supply plenum size. For units with the 20x16" Supply Plenum, set to 1. For units with the 22.5x18.5" Supply Plenum, set to 2.

Outdoor Sensor (10K)

To fully take advantage of the energy saving features of the Matrix, it is necessary to install the outdoor sensor provided. Install the sensor preferably on the north, or coldest side of the building, not within 10 feet of the discharge of the gas vent outlet, or other sources of heat. The outdoor sensor connects to the low voltage terminal strip, on the left-hand side of the boiler, to the terminals labeled "Outdoor Sensor"; see Figure 12-2.

Calculating Outdoor Reset Curve (RES)

Formula:

Operating Temperature = {(RES – Outdoor Temp) x (HYD – RES) / RES} + RES

Note: Substitute HYD for HI during a call for Emergency Heat.

Example:

- There is a call for Hydronic heat; therefore the control uses the HYD programmed setting.
- The HYD is programmed to be 160°F.
- The RES is programmed to be 85°F.
- The outdoor temperature is 40°F.

Operating Temperature = {(85 – 40) x (160 – 85) / 85} + 85 = **125°F**

The following chart illustrates the effect of changing outdoor temperature on the boiler operating temperature for the above example.

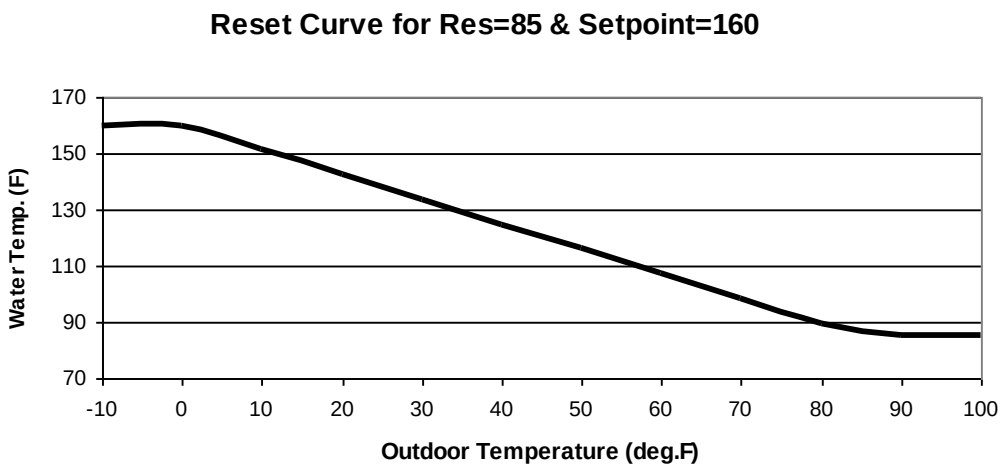


Table 13-6 Outdoor Reset RES Setting Recommendations

Boiler Set Point – HYD	Outdoor Reset – RES
80 – 110	70 – 80
110 – 140	80 – 90
140 – 170	90 – 100
170 – 200	100 – 110

14.0 MATRIX BLOWER OPERATION

Forced Air Heating

The Matrix forced-air heating module is a step-modulated system, which provides varying heat output rates by adjusting air flow and water temperature through a fan coil.

Table 14-1 Fan Coil Output Chart

	Heat Profile 1 (PF1)				Heat Profile 2 (PF2)				Heat Profile 3 (PF3)				
Heating Stage	CFM	Set Point (°F)	Air Temp (°F)	Btu/Hr Out	CFM	Set Point (°F)	Air Temp (°F)	Btu/Hr Out	CFM	Set Point (°F)	Air Temp (°F)	Btu/Hr Out	
1	400	108	104	14000	400	108	104	14000	400	108	104	14000	*Actual Output rates may vary from what is shown*
2	550	110	104	19000	550	110	104	19000	550	110	104	19000	
3	670	113	105	24000	670	113	105	24000	670	113	105	24000	
4	720	117	108	27700	730	122	112	31500	750	128	116	35500	
5	760	120	110	31400	790	131	118	39100	820	141	125	47100	
6	810	124	112	35100	850	138	122	46700	900	152	132	58700	
7	860	127	114	38800	910	145	127	54200	975	163	139	70200	
8	900	130	115	42500	970	152	131	61800	1050	172	144	81800	
9	950	133	117	46300	1030	158	134	69400	1120	181	149	93400	
10	1000	136	118	50000	1100	164	137	77000	1200	190	153	105000	

Example: At stage 4 (Profile 1) the Matrix provides 720 CFM across the fan coil, which is receiving 117°F water from the boiler. The coil then supplies plenum air at 108° F or ~27700 BTU/hr.

On an initial thermostat call (24VAC @ W1), space heating begins by providing heat at Stage 3 (~24,000 BTU/hr) (if hydronic heat is also calling (24VAC @ H) heating will begin at stage 1) and so long as the thermostat is not satisfied, incrementally increases to a maximum of Stage 10 (maximum output). When the thermostat becomes satisfied, an average of the heat output rate during the call is calculated. The boiler remains lit and the space heat output begins an incremental decrease in heat output rate beginning with the stage just below the calculated average and ending with either the thermostat re-calling or if the thermostat never re-calls, the output rate decreases to minimum stage after which the boiler shuts off.

If the thermostat re-calls prior to the minimum heat stage, a new calculated average of the thermostat off cycle is calculated and the boiler again begins an increasing ramp, only this time it begins at the calculated stage and not necessarily at the minimum stage.

This computation "hunts" for the heat loss of the dwelling based on the reaction of the thermostat to the rise and fall of the space temperature and the heat cycle rate of the thermostat.

If at any time the plenum temperature exceeds 160°F, the boiler will stop supplying heat until the temperature in the supply plenum drops below 140ºF, during which time an AL2 error message will be displayed.

NOTICE The burner will remain on, and the Matrix will provide heat, when the thermostat is off. This is normal and is required to provide efficient heat.

Call for Heat (24VAC @ W1) – Normal Thermostat call, Matrix operates as a step-modulating furnace as described above. If HRV set to 'ON', HRV will operate at the low (continuous) ventilation rate.

Call for Auxiliary Heat (24 VAC @ W2) – When calling, furnace will provide heat at a stage 10 output rate. With a call for auxiliary heating the Matrix will function as a single stage, full fire appliance. This means the burner will come on with a thermostat call and go off when the call is satisfied. If HRV set to 'ON', HRV will operate at the low (continuous) ventilation rate.

Outdoor Sensor – The auxiliary heating function (24VAC @ W2) will utilize the outdoor sensor if available. The outdoor reset function is not used for W1 heating. This function is also active during a hydronic heat demand (24VAC @ H).

Plenum Sensor – The Matrix is equipped with a plenum temperature sensor that must be field installed in the supply plenum and wired to the furnaces external terminal strip. When installed the Matrix fan control displays the plenum temperature and will use it to detect problems in the supply of heat to the space.

Call for Circulating Fan (24VAC @ G) – Matrix operates at the programmed air circulation rate according to the "FAN" setting in the Fan (blue) controller (400-1600 CFM). If HRV is set to 'ON' (see Section 13.0), the HRV will ventilate at the low (Continuous) ventilation rate.

Call for Dehumidification (24VAC @ DH) – Matrix operates at the minimum air circulation rate (400 CFM). HRV will ventilate at the high (Override) ventilation rate.

Call for Cooling Fan (24VAC @ Y1): Matrix operates at the prescribed air circulation rate (Y1x10 CFM – see Section 13.0). HRV will not operate during a call for cooling unless there is a concurrent call for DH – Dehumidification or G – Continuous and HRV is set to ON.

Call for Cooling Fan (24VAC @ Y2): Matrix operates at the prescribed air circulation rate (Y2x10 CFM – see Section 13.0). HRV will not operate during a call for cooling unless there is a concurrent call for DH – Dehumidification or G – Continuous and HRV is set to ON.

Duct Sizing

When sizing ductwork, a maximum flow velocity of 800 fpm is desired. Table 14-2 shows common duct sizes at specified flows. The maximum flows that can be expected are shown in Table 14-3. It is important to maintain the return plenum pressure as low as possible. Keeping this ductwork as free flowing as possible will offer more supply static pressure to overcome A/C coils, closed registers, etc while maintaining constant flow.

Any additional filtration, humidification, or de-humidification equipment should be installed external to the return or supply ducts so not to create additional restriction.

Table 14-2 Duct Size vs. Air Flow

Airflow (CFM)	Area (sqft)	Duct Sizing (inches)				
1600	2	24x12	20x16			
1200	1.5	24x10	20x12	18x12		
1000	1.25		20x10	18x10	16x12	
800	1			18x8	16x10	12x12

Based on 800 fpm max airflow velocity

Table 14-3 Maximum Air Flow Rates

Fan Control Setting			
Heating (HEA)	**Cooling (COO)**	**ESPmax***	**CFM**
	160 max	.35 inwg	1600
	160 max	.6 inwg	1500
	160 max	.75 inwg	1400
	120 (3 Ton)		1200
	80 (2 Ton)		800
PF3	No Cooling	<1 inwg	1200
PF2	No Cooling	<1 inwg	1100
PF1	No Cooling	<1 inwg	1000

Example #1 No cooling function with Heating profile of PF2 selected. Maximum airflow will be 1100 CFM.

Example #2 Cooling set to 800 CFM for 2 tons of cooling with Heating profile of PF3 selected. Maximum airflow will be greater of cooling or heating function. Maximum 1200 CFM.

**Measured from return plenum to supply plenum prior to A/C coil. ECM motor can produce near constant flow provided horsepower or maximum speed of motor is not exceeded.*

15.0 HEAT RECOVERY VENTILATION

Ventilation Requirements

With the evolution toward more energy efficient, tighter homes, air quality problems have increased. With less natural ventilation, pollutants such as pet dander, humidity, tobacco smoke and wood ash now become trapped inside the home. Mechanical ventilation is the process of exhausting the polluted air from the space and replacing it with fresh air from outside. The amount of ventilation required varies from home to home and can be estimated using one of two methods, "Room Count Calculation Method" or "Air Changes per Hour Method"; see below:

Table 15-1 Room Count Calculation Method

Living Space	Number of Rooms	CFM (L/S)		CFM Req'd
Master Bedroom		x 20 cfm (10 L/s)	=	
With Basement		x 20 cfm (10 L/s)	=	
Without Basement				
Single Bedroom		x 10 cfm (5 L/s)	=	
Living Room		x 10 cfm (5 L/s)	=	
Dining Room		x 10 cfm (5 L/s)	=	
Family Room		x 10 cfm (5 L/s)	=	
Recreational Room		x 10 cfm (5 L/s)	=	
Other				
Kitchen		x 10 cfm (5 L/s)	=	
Bathroom		x 10 cfm (5 L/s)	=	
Laundry Room		x 10 cfm (5 L/s)	=	
Utility Room		x 10 cfm (5 L/s)	=	
Total Ventilation Requirement (sum last column)			=	

Air Change per Hour Method:

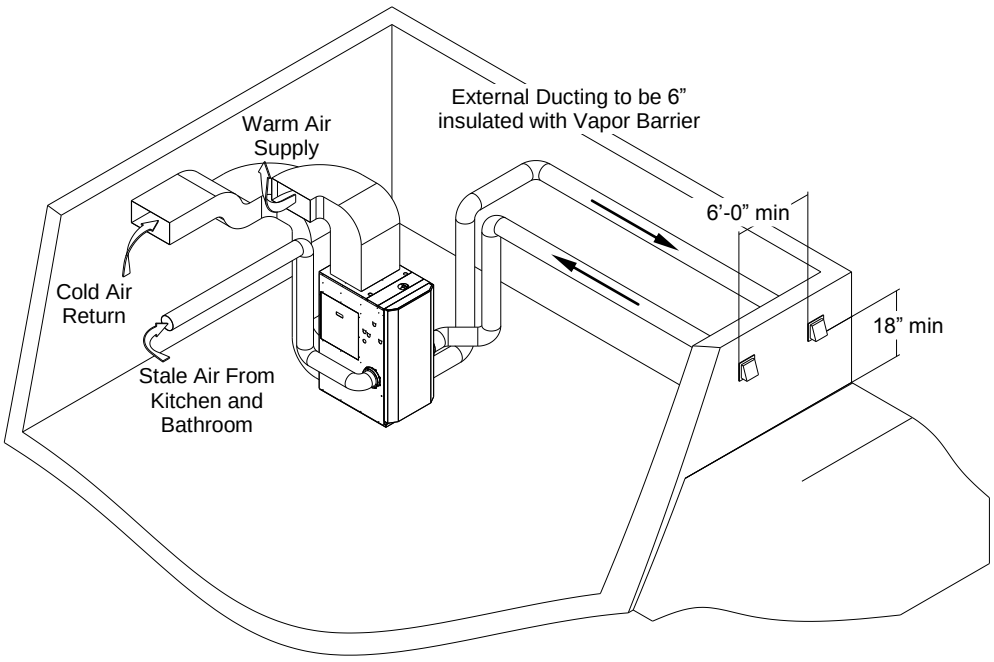
Total cu.ft x 0.3 / 60 = Total Ventilation Required

Example: A 25' x 40' house with basement
1000 sqft x 8' high x 2(main floor and basement) = 16,000 cu.ft
16,000 x .3 air changes per hour = 4,800 cu.ft/hr
4,800 cu.ft/hr / 60 = 80 cfm
80 cfm is ventilation requirement

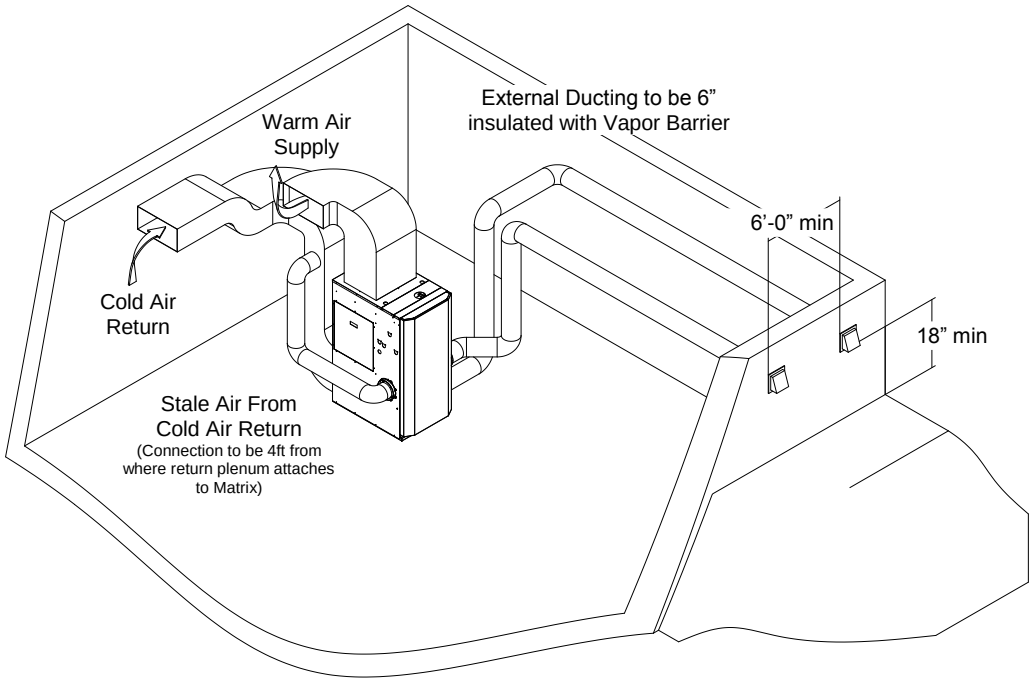
Types of Installation

There are two basic methods of installing the ventilator in the Matrix:

1) **Exhaust at the source.**
   - Stale air is drawn from the kitchen and bathrooms.



2) **Exhaust from the return (Simplified System)**
   - Stale air is drawn from the return plenum.



IMPORTANT

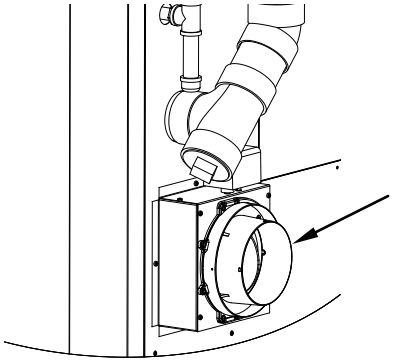
When using the Simplified System method, exhaust connection to the return must be 4' from where the return connects to the Matrix.

IMPORTANT

All main HRV ductwork to be 6" round.
Exterior connections are to be insulated and include a vapor barrier.

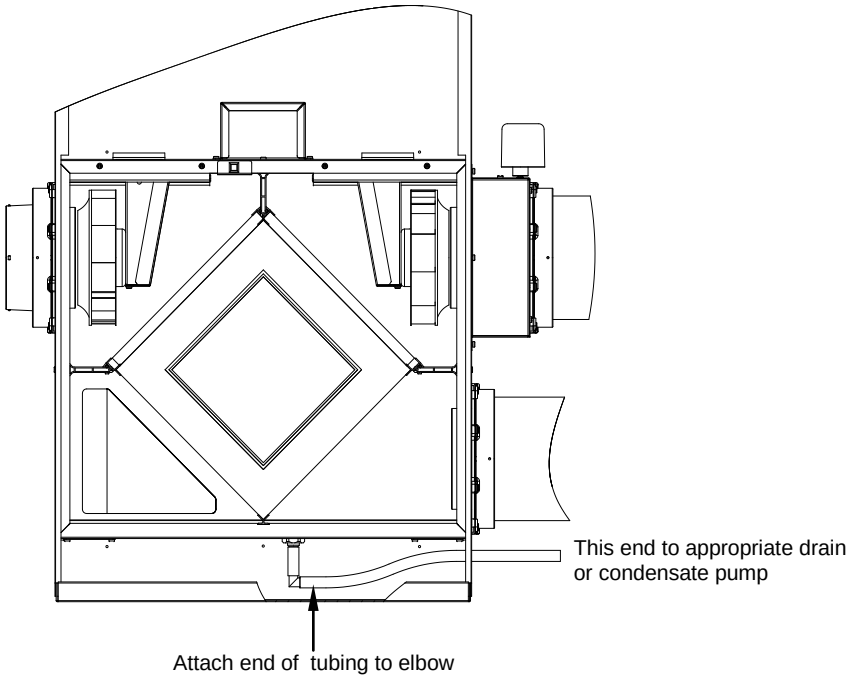
Damper Box

Included in the installation kit is a damper box. This damper box eliminates the infiltration of cold outside air when the HRV is off or in defrost mode. It is to be installed with the actuator on the top side and screw to the Matrix using the four screws provided.



Condensate Drain

Condensation from defrost will collect in the ventilator and drain from the sloped drain pan. This condensation must be evacuated from the unit. The condensate tubing provided must be routed through the hole in the side of the appliance and attached to the 90° elbow directly underneath the ventilation module. From there the condensate tube must be emptied into a suitable floor drain or if necessary the emptying drain must have a trap to prevent the infiltration of toxic gases.



HRV Balancing

The HRV must be balance properly in order to operate at maximum efficiency and avoid problems.

The balancing process ensures the volume of fresh air being brought into the home, is equal to the amount of stale air being expelled from the home, over all air handler conditions. A variation of 10% is acceptable, with the greater volume being stale air drawn from the home.

The Matrix uses motor speed to balance airflows. This method of balancing provides quieter operation and reduced energy consumption over the traditional balancing damper approach.

Flow is measured with the use of a Magnehelic (0-.25 inwg range) and an airflow grid, flow collar or "Flow Measuring Station". NTI offers an airflow grid, PN: 83554, that is designed to be installed in a 1" hole located in a 6" duct. It is important that the flow grid be the same size as the ductwork, and be installed according to the manufacturer's instructions. Typically a straight run of 18" on either side of the flow grid is adequate to avoid false readings. It is helpful if a flow grid is installed in each of the supply and exhaust ducts.

Procedure:

1. Attach the upflow port of the flow grid to the positive pressure port of the Magnehelic and the down flow port to the negative port.
2. Zero the Magnehelic.
3. Begin by selecting the heating profile required in the Matrix Fan Controller 'HEA' menu. Refer to the heating section of the manual for more explanation. The heating profile selected dictates the air handler blower speeds and is important to the proper functioning of the HRV. Every time the heating profile is changed the HRV will require re-balancing.
4. Once the heating profile is selected, advance to the 'BAL' menu. By pressing the 'FUNCTION' button you will enter the balancing mode of the HRV. Press the up arrow button and advance through the menus until you reach the 'EOH' menu item. By pressing the 'FUNCTION' button you will enter the 'EOH' menu. A number will appear. You will notice the HRV start, if it is not already running, and the main blower of the air handler will come up to speed. The number on the display represents the speed of the HRV fan in percentage. In the case of 'EOH' the number shown represents the speed of the exhaust 'E' fan during a call for high ventilation 'O' (override) while the air handler blower is running at the high 'H' heating speed. The maximum speed setting is 100%, the minimum 30%. Adjust the speed up or down until the desired flow rate is achieved. Table 15-2, on the following page, has been provided to help in explaining the different settings.
5. Complete the table adjusting each of the setting to the HRV Ventilation Rate provided. These rates are a guideline only and can be adjusted to meet the specific application.

-Note- When adjusting the exhaust speeds, the supply fan will increase to full speed.

When the balancing is complete, the HRV will maintain balance at any ventilation rate during any air handler blower condition. This is a unique feature of the Matrix and is essential in providing efficient and adequate ventilation in this integrated system.

ATTENTION

The HRV balance must be checked and if necessary rebalanced every time the Heating (HEA) setting is changed, or if there is change to the system which would significantly change the static pressure at the return plenum or the exterior ducts to the HRV.

Figure 15-1 Sample Balancing Setup

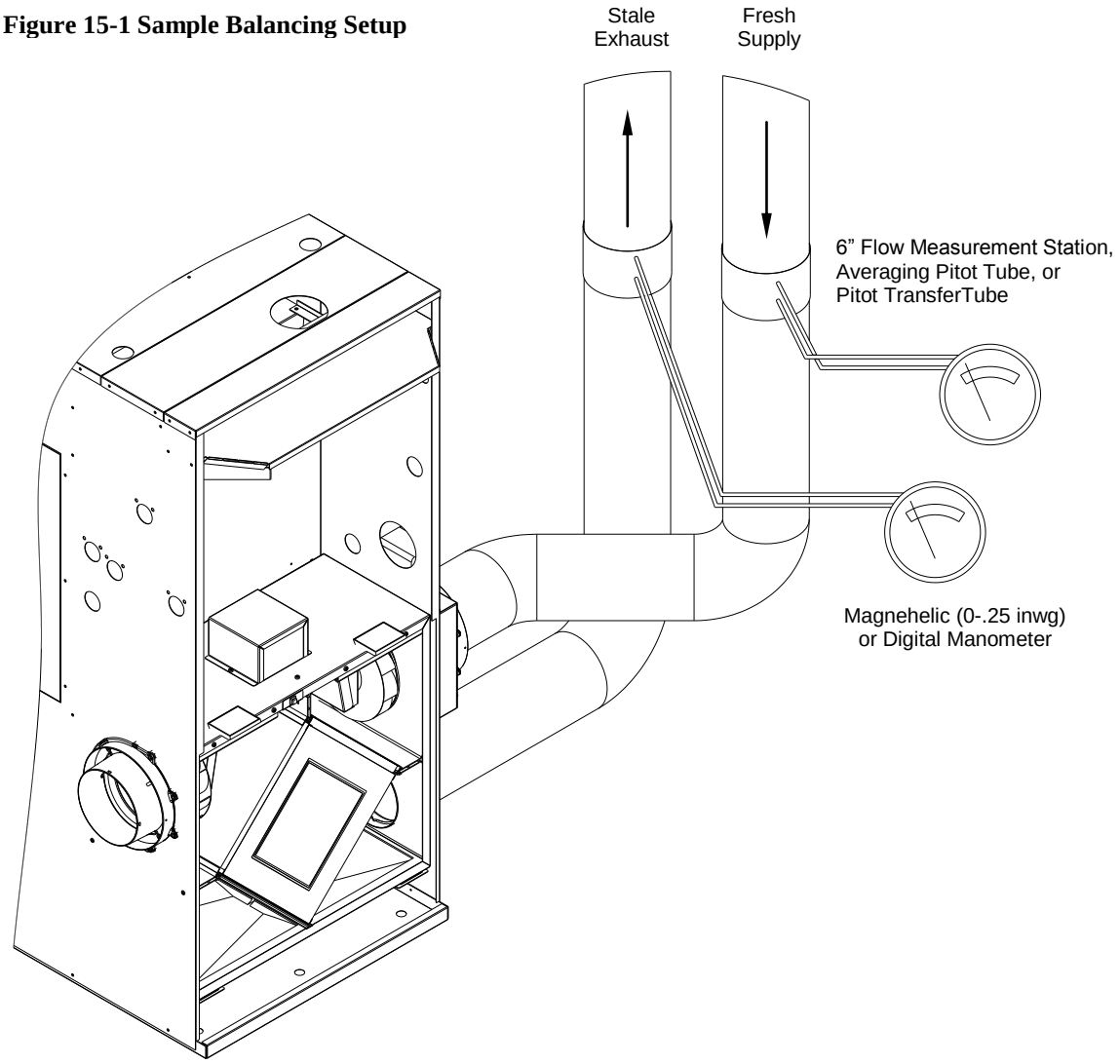


Table 15-2 HRV Balancing Table

Menu Item	Description	Sample HRV Ventilation Rates	Installed Ventilation Rates	Installed Fan Speed
EOH	HRV **Exhaust** at **Override** (high ventilation) rate, balanced during **High** air circulation rate (1000/1100/1200 CFM).	120cfm (55 L/s)		
SOH	HRV **Supply** at **Override** (high ventilation) rate, balanced during **High** air circulation rate (1000/1100/1200 CFM).	120cfm (55 L/s)		
EOL	HRV **Exhaust** at **Override** (high ventilation) rate, balanced during **Low** air circulation rate (400 CFM).	120cfm (55 L/s)		
SOL	HRV **Supply** at **Override** (high ventilation) rate, balanced during **Low** air circulation rate 400 CFM).	120cfm (55 L/s)		
ECH	HRV **Exhaust** at **Continuous** (low ventilation) rate, balanced during **High** air circulation rate (1000/1100/1200 CFM).	70cfm (30 L/s)		
SCH	HRV **Supply** at **Continuous** (low ventilation) rate, balanced during **High** air circulation rate (1000/1100/1200 CFM).	70cfm (30 L/s)		
ECL	HRV **Exhaust** at **Continuous** (low ventilation) rate, balanced during **Low** air circulation rate (400 CFM).	70cfm (30 L/s)		
SCL	HRV **Supply** at **Continuous** (low ventilation) rate, balanced during **Low** air circulation rate (400 CFM).	70cfm (30 L/s)		

16.0 WIRING SCHEMATICS

Figure 14-1(a) Connection Diagram

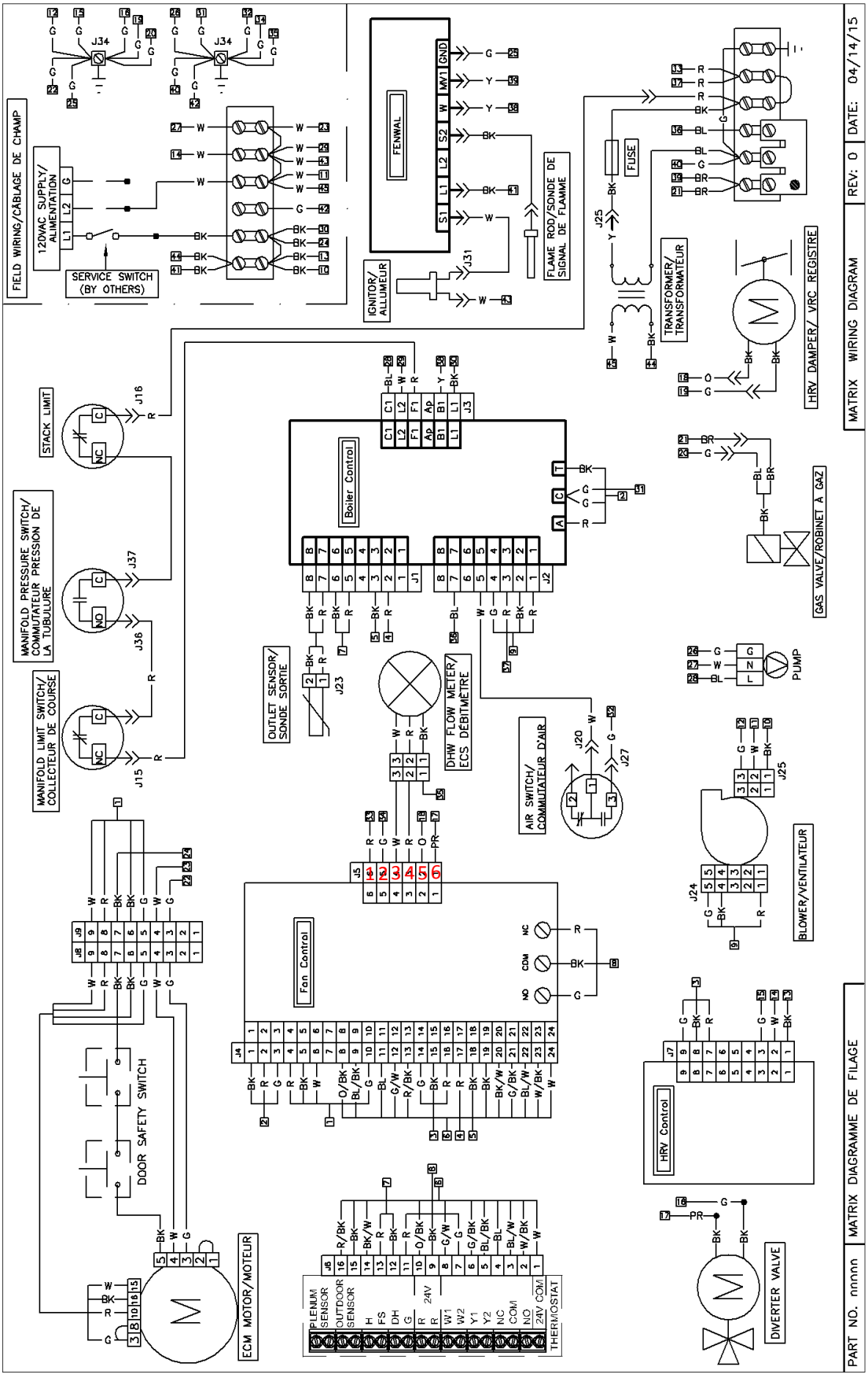
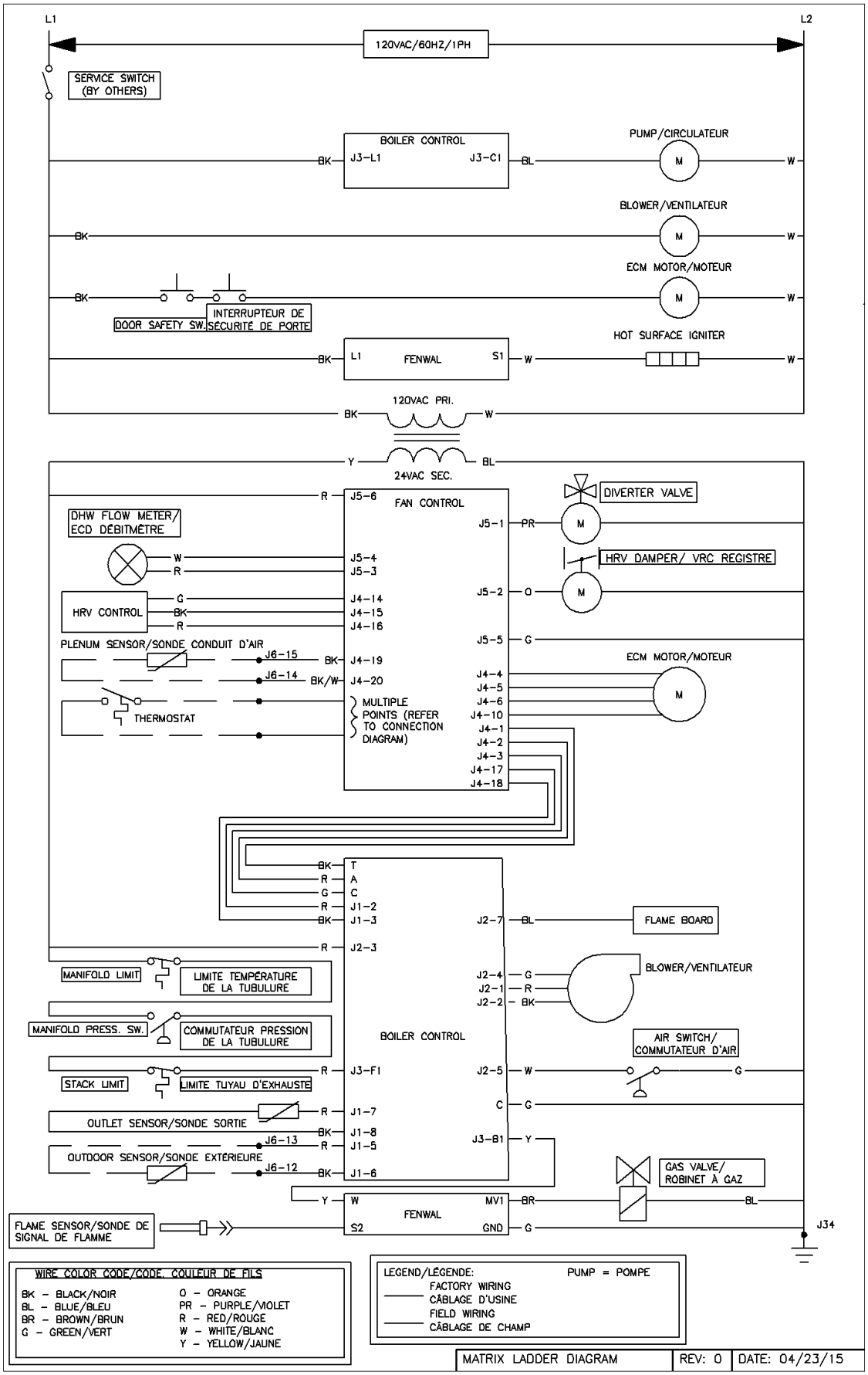


Figure 14-1(b) Ladder/Logic Diagram



17.0 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. 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 the appropriate this Manual. Flush/cleanse the internals of the heating system. Treat system water with Fernox F1 Protector. See Table 10-1.
- ☐ 7. Connect field wiring in accordance with Section 12.0 of this manual.
- ☐ 8. Advise home/building owner of their responsibilities with respect to maintaining the boiler.

⚠ WARNING The building owner is responsible for keeping the Vent/Air-inlet termination free of snow, ice, or other potential blockages and for scheduling routine maintenance on the boiler (see Section 18.0). 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 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.

18.0 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. The hydronic system may need to be flushed to eliminate hard water scale (Use Fernox DS-40 Descaler, NTI PN: 83450; see Table 10-1).

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 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 to the back of the combustion chamber (see Table 19-1, Item 31 – part number 83112).
- ☐ 9. Inspect the insulation disc located on the back-side of the burner door. Replace if damaged (see Table 19-1, Item 34 – part number 82767-1).
- ☐ 10. Re-install the burner door, gas-supply and Air-inlet pipe, check for gas leaks.
- ☐ 11. Perform the Operational Check List detailed in Section 17.0.

⚠ 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 contains *Refractory Ceramic Fibers* and should not be handled without personal protective equipment.

⚠ WARNING

Potential Carcinogen - Use of *Refractory Ceramic Fibers* in high temperature applications (above 1000°C) can result in the formation of Crystalline Silica (cristobalite), a respirable silica dust. Repeated airborne exposure to crystalline silica dust may result in chronic lung infections, acute respiratory illness, or death. Crystalline silica is listed as a (potential) occupational carcinogen by the following regulatory organizations: International Agency for Research on Cancer (IARC), Canadian Centre for Occupational Health and Safety (CCOHS), Occupational Safety and Health Administration (OSHA), and National Institute for Occupational Safety and Health (NIOSH). Failure to comply with handling instructions in Table 15-1 may result in serious injury or death.

⚠ WARNING

Crystalline Silica - Certain components confined in the combustion chamber may contain this potential carcinogen. Improper installation, adjustment, alteration, service or maintenance can cause property damage, serious injury (exposure to hazardous materials) or death. Refer to Table 18-1 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 18-1 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.

HRV/Air Handler Maintenance

WARNING

ALWAYS REMOVE POWER (120V) TO THE UNIT PRIOR TO SERVICING.

Once every three months. Replace furnace filter. May be required more frequently in beginning, especially if new construction.

The Matrix HRV module is relatively maintenance free but does require routine cleaning. Table 14 describes the necessary maintenance.

Table 18-1 HRV Maintenance Items

Heat Recovery Core	Annually or as needed	Vacuum surfaces, let soak in warm water for three hours, spray rinse and let dry
Energy Recovery Core	Annually or as needed	Vacuum surfaces
Filters	Every 3 months or as needed	Vacuum Filters
	Annually or as needed	Replace filters
Inside Surfaces of Unit	Annually or as needed	Clean interior of unit (walls and drain pan) with a mild non-abrasive soap. It is recommended to use products that are environmentally friendly

19.0 PARTS LIST

For a list of parts that corresponds to the item numbers in the bubbles, refer to Table 19-1. 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 19-1 Parts Breakdown

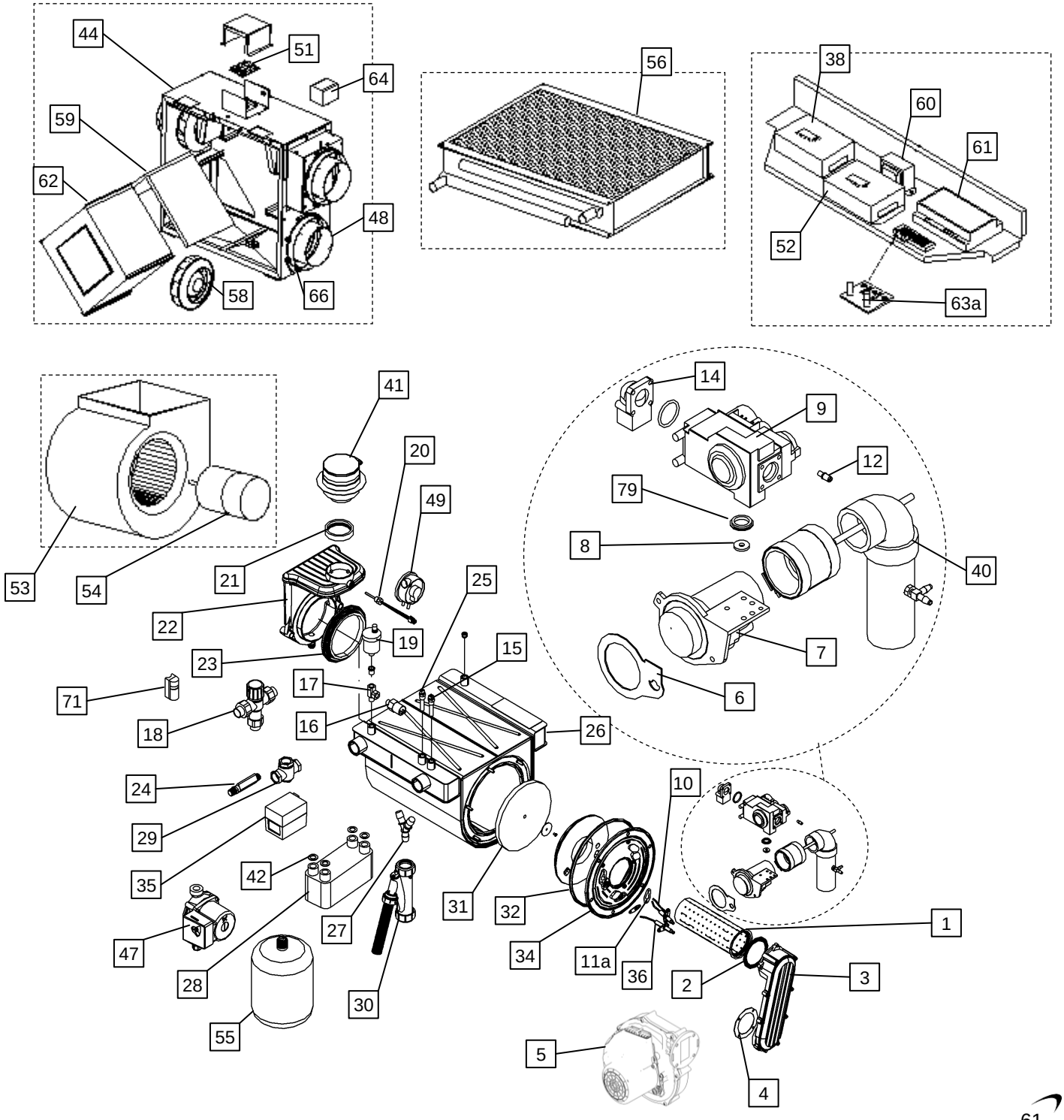


Table 19-1 Parts List:

Item	Part #	Models	Description
1	82657	Lx150, M100(V), Ti100-150	Premix Burner 135.8
2	82761	Lx150–500, M100(V), Ti100-400, Ts80	Premix Burner Gasket, Lx/M/Ti/Ts (80-500)
3	82771	Lx150-200, M100(V), Ti100-200, Ts80	Extended Air Tube Lx/M/Ti/Ts (80-200)
4	82766	Lx150–500, M100(V), Ti100-150, Ti400, Ts80, Tx51-151, Tx151C	Blower Gasket Lx/M/Ti/Ts/Tx (51-500)
5	82052	Lx150, M100(V), Tft60-110, Ti100-150, Ts80	EBM Blower RG130
6	82054-2 (84299)	Lx150-300, M100(V), T150-200, Tft60-250, Ti100-200, Ts80, Tx200, Tx200C	Venturi Gasket, Cork
7	82054-1 (84297)	Lx150-200, M100(V), Ti150-200	Venturi 001
8	82650	Lx150-200, M100(V), Tft110, Ti150-200	Gas Valve Orifice 5.2mm, LP
9	82054 (83204)	Lx150–300, M100(V), T150-200, Tft60-250, Ti100-200, Ts80	Gas Valve VK8115V1341B (Valve Only)
10	82708 (82708-1)	M100(V), Ti100-400	Igniter Hot Surface, Norton 601, SS Shield (Includes Disconnects)
11a	82768	M100(V), Ti100-400	Igniter Gasket, Hot Surface, Ti/M
12	82600 (82600-1)	Lx150-300, M100(V), Tft60-250, Ti100-200, Ts80	Gas Valve Regulator Vent Upgrade Kit c/w Clamp (Includes p/n: 83134)
13	83883	M100(V), Lx150-300, Tft60-250, Ti100-200, Ts80	Gas Valve Inlet O-Ring Gasket
14	82065	Lx150-300, M100(V), T150-200, Ti100-200, Ts80, Tx200, Tx200C	Gas Valve Adapter 1/2" NPT Elbow
15	82671	M100(V), Ti100-200 (see bullets)	Thermister, 1/8" BSP (see bullets) ▪ All non-ASME M100(V) & Ti100-150 models manufactured before 3/20/2008 ▪ All Ti200 models manufactured before 2/1/2008
16	83223-1 (83218)	Lx150-400, M100(V), Ti100-200, Ts80 (see bullets)	Low Water Pressure Switch 1/4" NPT (see bullets) ▪ All M100(V) models sold in US ▪ All Lx150-400 models ▪ All ASME stamped Ti100-150 models ▪ All M100(V) & Ti100-150 models manufactured after 3/20/2008 ▪ All Ti200 models manufactured after 2/1/2008
16	83223	M100(V), Ti100-200 (see bullets)	Low Water Pressure Switch 1/8" BSP (see bullets) ▪ All non-ASME M100(V) & Ti100-150 models manufactured before 3/20/2008 ▪ All Ti200 models manufactured before 2/1/2008

Item	Part #	Models	Description
17	83462	Lx150-200, M100(V), Ti100-200, Ts80 (see bullets)	Street Tee, Brass, 1/4" Lx150-200 (see bullets) ▪ All M100(V) models sold in US ▪ All Lx150-200 models ▪ All ASME stamped Ti100-150 models ▪ All M100(V) & Ti100-150 models manufactured after 3/20/2008 ▪ All Ti200 models manufactured after 2/1/2008
18	82228	Combi (T/Ti), M100(V)	Tempering Valve # AM101-US-1
19	82539	Lx150-800, M100(V), Ti100-400, Ts80	Auto Air Vent, 1/8" NPT
20	82660 (82660-1)	M100(V), Ti100-200	Stack Limit 1/4BSP, 190F, Dif=30 (c/w Disconnects)
21	82765	Lx150-200, M100(V), Ti100-200, Ts80	Composite Flue Outlet Gasket Lx150-200
22	82763	Lx150-200, M100(V), Ti100-200, Ts80	Composite Flue Box
23	82764	Lx150-200, M100(V), T150-200, Ti100-200, Ts80	Trinity Flue Box To Heat Exchanger Gasket
24	83507	M100(V)	Flow Meter [M100(V) manufactured after 2/21/2008]
25	82659	M100(V), Ti100-200 (see bullets)	Manifold Limit 1/8" BSP (see bullets) ▪ All non-ASME M100(V) & Ti100-150 models manufactured before 3/20/2008 ▪ All Ti200 models manufactured before 2/1/2008
25	82992 (82992-1)	M100(V), Ti100-400 (see bullets)	Manifold Limit 1/4" NPT c/w Disconnects (see bullets) ▪ All M100(V) models sold in US ▪ All Ti400 models ▪ All ASME stamped Ti100-150 models ▪ All M100(V) & Ti100-150 models manufactured after 3/20/2008 ▪ All Ti200 models manufactured after 2/1/2008
26	83012	Lx150 (US), M100(V) (US), Ti100-150 (US)	Heat Exchanger ASME, Lx/Ti100-150 (Not Lx150E), US Only
26	82596	M100(V) (CAN), Ti100-150 (CAN)	Heat Exchanger Kit Ti100-150 (Kit includes p/n: 83395)
27	83042	Lx150-200, M100(V), Ti100-200, Ts80	Y Drain Fitting 5/8" White
28	82011	Combi (T/Ti), M100(V)	Heat Exchanger, Brazed Plate LA1430
29	82160	Combi (T/Ti), M100(V)	3 Way Valve VU54S2016B, 3/4"
30	82913 (83510)	M100(V), Tft60-399, Ti100-400, Tx51-200, Tx151C, Tx200C	Condensate Trap
31	83112 (83112-1)	Lx150-800, M100(V), T150-200, Ti100-400, Ts80	Trinity Divider Plate Insulation Kit c/w Screws & Washers
32	82770	Lx150-500, M100(V), Ti100-400, Ts80	Burner Door Viton Gasket (Not Lx600-800)
34	82767-1	M100(V), Ti100-200, Ts80	Cast Aluminum Burner Door Kit – **NOT FOR USE W/ Lx300-400 OR Ti400**
35	82973	M100(V)	3 Way Actuator VU844A1003B

Item	Part #	Models	Description
36	82762 (82762-1)	Lx150-500, M100(V), Tft60-399, Ti100-400, Ts80, VM110, VM110P	Flame Rod Lx/Ti/Ts/Tft/VM (60-500) (Includes p/n: 82774)
37	82099	Lx150-300, M100(V), T150-200, Tft60-250, Ti100-200, Ts80, Tx200, Tx200C	1-1/2" MJ Coupling
38	83083	M100(V)	Fan Control Matrix
40	83425-1 (82622-3)	Lx150-200, M100(V)	Air Metering Elbow Lx150-200, Matrix
41	83291-2	M100(V)	Flue Adapter Assembly 2" CPVC x 3.5" (Models manufactured before 12/9/2009)
41	83291-3	M100(V)	Flue Adapter Assembly 2" CPVC x 4.75" (Models manufactured after 12/9/2009)
42	82368	M100(V), T150-200, Ti100-150 (CAN), Combi (Ti)	Compression Nut Washer, Water Connection, 3/4"
44	83084	M100V	HRV Assembly Matrix
45	83222	M100(V)	Plenum Sensor Matrix
46	83553 (83208)	M100(V)	Door Safety Switch Matrix
47	81396	M100(V)	Circulator Pump Grundfos UP15-42B7
48	83551	M100V	Double Collar, 6"
49	82662	Lx150-800, M100(V), Ti100-400, Ts80	Air Switch Huba 604.E021180 (Set @ .2" wc)
51	83548	M100V	HRV HVC Board
52	83160	M100(V)	Sentry 2100 Version B3.2
53	53035	M100(V)	Furnace Blower Matrix
54	83081 (82831)	M100(V)	ECM Motor 3/4 HP
55	82285	M100(V)	Expansion Tank
56	83154	M100(V)	Fin Tube Coil 20" x 15" (Models manufactured before 12/9/2009)
56	83363	M100(V)	Fin Tube Coil 22.5" x 18" (Models manufactured after 12/9/2009)
58	83547	M100V	HRV Fan
59	83549	M100V	HRV Pleated Filter x 2
60	82457 (83190)	Lx150-400, M100(V), T150-200, Tft60-399, Ti100-400, Ts80	Transformer 24V, 40VA
61	82058	M100(V), T150-200, Ti100-400	Ignition Module, Fenwal
62	83550	M100V	HRV Core
63a	82754-1 (82984)	M100(V), Ti100-400	PCB Optocoupler
64	83555	M100V	HRV Damper Actuator 24V
66	83552	M100V	Keeper, 6" Collar
71	81027-1 (83604)	Lx150-800, M100(V), T150-200, Tft60-399, Ti100-400, Ts80, Tx51-200, Tx151C, Tx200C, VM110, VM110P	Outdoor Sensor 10K

Item	Part #	Models	Description
79	83206	Lx150-300, M100, M100V, T150-200, Tft60-250, Ti100-200, Ts80, Tx200, Tx200C	Gas Valve to Venturi Screws & Seal
105	82064	Lx150-300, M100(V), T150-200, Ti100-200, Tft60-250, Ts80	Gas Valve Harness
108	83991	Lx150-200, M100(V), Tft60-250, Ti100-200, Ts80, VM110, VM110P	CPVC Pipe 3", System 636, 5" Long
109	13701	Lx150-400, M100(V), Tft60-399, Ti100-400, Ts80, Tx51-200, Tx151C, Tx200C, VM110, VM110P	Pressure Relief Valve, ASME, 3/4" NPT, 30psi
110	84090	Lx150-400, M100(V), Tft60-399, Ti100-400, Ts80, Tx51-200	Pressure Gauge, Bottom Stem Mount, 60psi
111	82616	Lx150-200, M100(V), T150-200, Tft60-250, Ti100-200, Ts80, Tx51-200, Tx151C, Tx200C, VM110, VM110P	Round Mesh Vent Screen, 3"
112	84492	Lx150-300, M100(V), Tft60-250, Ti100-200, Ts80, Tx200, Tx200C	Natural Gas To LP Conversion Instructions (Included in 82650-1)
113	82782	Lx150-300, M100(V), Tft60-250, Ti100-200, Ts80, Tx200, Tx200C	Conversion Decal (Included In 82650-1)
119	82650-1	Lx150-300, M100(V), Tft60-250, Ti100-200, Ts80, Tx200, Tx200C	NG to LP Conversion Kit (Various Models)

20.0 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 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:
  - 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 at the boiler follow this procedure:

- Remove the junction box cover.
- With an AC voltmeter set on the appropriate scale, measure the voltage across Line and Neutral (Black and White wires).
- 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.

Table 20-1 Troubleshooting Chart

	Symptom	Detected Problem	Solution
Boiler Control (Red Face)	ER1	"Water Temperature Excessive" Sentry has sensed a water temperature in excess of 250ºF at the Water Sensor.	1. If the boiler is extremely hot check for adequate water pressure and circulation, contact NTI for assistance. 2. If not hot, check for sources of grounding or shorting at the Water Sensor electrical connections, check wiring from Sensor to Boiler (Red) Control. 3. Replace Water Sensor if the resistance is not in the correct range. (See thermister resistance charts in Figures 20-1 and 20-2)
	ER2	"Water Sensor Short Circuit" Control has sensed a short circuit in the Water Sensor circuit.	See ER1
	ER3	"Water Sensor Open Circuit" Control has sensed an open circuit in the Water Sensor circuit.	1. Check wiring to Water Sensor for open circuits or shorting to ground. (Note: ER3 will be displayed if temperature sensed is less than 0°F.) 2. Replace Water Sensor if the resistance is not in the correct range. (See thermister resistance charts in Figures 20-1 and 20-2)

	Symptom	Detected Problem	Solution
Boiler Control (Red Face)	ER4	"24V Limit Error" Control has sensed a lack of 24V on the outlet of the burner relay (B1). Lockout lasts for one hour before automatically resetting.	1. Reset power, if error goes away the problem is intermittent and was likely caused by a tripped limit that has automatically reset, check for adequate water pressure and flow rate. Allow the boiler to cycle and verify proper operation including outlet water temperature and flue temperature. If operation is unsuccessful and the error reoccurs: 2. Matrix boilers are equipped with a low water pressure switch on the boiler return that requires a minimum of 10PSI to complete the 24VAC ignition circuit. Ensure the field-installed pressure gauge is reading a minimum of 12PSI. Replace water pressure switch if plumbing and pressure is correct and if it measures an open circuit. 3. Check for continuity through the 24VAC limit wiring and manifold and stack limits, replace limits or wiring that are not a closed circuit.
	ER6	"Flame Lock Out" Control has sensed a lack of 24V to the gas valve during operation or a Fenwal ignition lockout.	There is a problem in the ignition sequence; it could be caused by a faulty igniter, flame sensor, gas valve or improper line pressure or combustion. Check ignition sequence to determine which component is not functioning. *(Control will retry ignition sequence 1 hour after ER6 code originally occurs or if control is reset)*
	ER9	Internal Controller Fault	Indicates that the Controller has lost communication with an internal processor, contact NTI.
	ASO Air Switch Open	This is displayed when the boiler is expecting the air switch to be closed by a differential pressure generated when the combustion blower turns on. It can occur momentarily during normal operation. A problem is indicated when ASO is displayed continuously.	1. Ensure the vinyl tubes, connected between the air switch and the ports on the inlet pipe, are in the proper locations. Negative side of switch connects to the port on the 1-1/2" PVC elbow. 2. Check for blockage on the intake and exhaust vents. 3. If fan is running the air switch may be faulty, ensure it is set at 0.2"wc. 4. If fan is not running, check 120V wiring to blower, if ok remove low voltage harness from blower, if blower fails to start, replace blower, if blower does start the problem may be with blower or Controller.
	ASC Air Switch Closed	This is displayed when the boiler has turned the blower off and is expecting the air switch to be open. It can occur momentarily during normal operation. A problem is indicated when ASC is displayed continuously.	1. Does the combustion fan run continuously at full speed while the error is displayed? If so check for 24V from transformer, also check transformer fuse. If 24V is present check the low voltage wiring from Controller to combustion blower, replace Controller or Blower. 2. Is the combustion fan off? If so check for water in the air switch and air switch tubes, replace switch if necessary. 3. Check venting termination with required venting described in manual.
	Controller Locks-up	Excessive noise, current, or voltage spikes in the 120V power supply.	Contact NTI.
	Display Goes Blank	No power to control or control failure	1. Check for 120V between terminals L1 and L2. 2. If 120V exists turn power off and remove line voltage harness from Control. Then check for resistance between L1 and L2 of control, if the circuit is open (O.L) the internal fuse has blown. Check for shorts in wires leading to circulator prior to replacing controller. (Note: If fuse is good the circuit will read between 300 and 400 Ohms.) 3. If 120V not present, check wiring and for 120V at source.

	Symptom	Detected Problem	Solution
Fan Control (Blue Face)	AL1	Communication Error with HRV	1. Check wiring connections between HRV and Fan Controller. 2. Check door switch on HRV. 3. Cycle power to appliance; contact NTI.
	AL2	Plenum Temperature Limit of 160ºF Exceeded	1. If plenum is hot, check operation of blower fan; contact NTI. 2. If plenum is not hot, check plenum sensor and wiring for shorts or damage. 3. Remove plenum sensor, PSO should be displayed, if so replace plenum sensor, if not inspect wiring from Terminal Strip to Fan Control. Replace Fan Control if necessary.
	AL5	"DHW Time-Out" The Control has locked out DHW due to the demand lasting longer than 2.5 hours.	1. Reset the AL5 error by resetting the power or cycling the DHW call. Check for proper operation of the DHW call. 2. Matrix units are provided with an integrated DHW flow meter, if the control is registering a flow rate when the water is turned off; disconnect the electrical lead to the flow meter. If the indicated flow rate drops to 0, replace flow meter, if not, replace fan controller. 3. Ensure nothing is connected to the FS terminal of the terminal strip (unless using a DHW tank aqua-stat to trigger a demand – check operation of aqua-stat).
	AL7	'Boiler Control Error' Fan controller has failed to receive run status from Boiler Control.	1. Check for error code on Boiler Control. 2. Check control wiring from Boiler Control to Fan Control (Pins 17 and 18 on Fan Control – See wiring schematic in Section 16.0).
	AL8 (& Blower Off)	'Furnace Blower Error' Blower has failed to meet a minimum speed.	1. Check for 120V to blower; ensure door switches are making the circuit. 2. Check wiring from Pin 6 at Fan Control (white wire) to Pin 15 at blower motor. 3. Check for 24VDC at blower Pin 15, if present replace blower, if not replace Fan Control.
	AL8 (& Blower On)	'Furnace Blower Error' Control has failed to sense that the blower has reached a minimum speed.	1. Check wiring from Pin 5 at Fan Control (black wire), to Pin 16 at blower motor. 2. Check for 3-5VDC at blower Pin 16, if present replace blower, if not replace Fan Control.
	F3.5 Flashing	Lack of 24 V at fan controller	1. Check/Replace 2A fuse – blown fuse indicates 24V supply shorted to ground, or excessive load.
Fenwal Ignition Control	Two Flashes on Fenwal	The Fenwal controller thinks that there is a flame prior to ignition. Indicates Ignition Lockout.	If the combustion sequence is normal, and there is no flame prior to ignition, the Fenwal control is defective, and must be replaced.
	Three Flashes on Fenwal	"Ignition Lockout"	If the condensate drain gets blocked, the boiler will become flooded and terminate operation as the flame rod becomes immersed. This will damage the flame probe. To correct, free the drain blockage, and permanently prevent it from reoccurring. Remove and dry off the probe. Reinstall the probe and try for ignition, if it fails to stay lit, leave the fan run for up to three hours to dry out the insulation and probe.
			1. Reset Boiler so it will attempt to ignite. 2. Check for proper operation of ignition components. Make sure igniter glows and gas valve opens. 3. Check for proper line pressure at gas valve when it opens. 4. If boiler lights check for flame signal between FC1 and FC2 on Fenwal control (If lower than 1.2 DC µAmps see "Boiler will not stay lit"). 5. Check combustion properties.

	Symptom	Detected Problem	Solution
General	Boiler will not stay lit.	Indicates lack of a flame signal. In order to stay running the flame signal must be at least 0.7 µAmps	1. If the Burner light on the Burner (Red) Control is going out, go to "Burner shutting off". 2. Check condensate drain for blockage and check the inlet piping for ingested snow or water (if the flame rod gets wet, it may need to be replaced). Check for resistance from flame rod to ground, must be an open circuit (O.L), if not, remove rod and bend it away from the burner slightly. 3. Check for proper polarity of line and neutral wiring to the boiler.
	Boiler bangs or hisses	Bangs or sounds like a kettle while burner is running indicates insufficient flow	1. Ensure the plumbing is as shown in manual. Check to see if pumps are operating properly and water pressure is above 15psi. This problem can lead to boiler overheating! 2. Boiler may be plugging with scale or magnetite, clean with Fernox DS-40 Descaler and Cleanser (NTI PN: 83450). 3. If glycol is being used the concentration may be to high, recommend using a concentration lower than 35%.
	Boiler Lights rough or pulsates	Typically an imbalance in the Air to gas ratio	1. Ensure that the venting lengths are in compliance with Section 4.0 2. Ensure that the line pressure during operation does not drop more than 20% from the static line pressure. 3. Momentarily remove the intake vent from the boiler during ignition, if unit lights smoothly with intake vent disconnected reconnect and check for proper combustion if unit maintains smooth operation after ignition. (See Section 9.0) Calibrate for proper combustion. If problem persists contact NY Thermal. 4. Heat exchanger may be dirty, remove burner door and inspect, clean if necessary.
	Fan appears to be creating a noise in the house	Slight vibration can cause noise in the residence (This is not a warranty issue)	1. Use flexible gas line to isolate the vibration noises between the gas valve and the line. 2. Don't hang gas lines from floor joists. 3. Use rubber insulators with gas line supports.
		Making a rubbing noise. ((This is not a warranty issue))	1. If gas valve is not held when the gas nipple is connected, the force of tightening the fitting can damage the valve, and warp the fan housing. 2. If pipe is used, the gas line must not create any forces to the valve, either vertically (weight of line), or horizontally (misaligned connection)

The following are the thermistor curves for diagnosing the water and outdoor air sensors:

- Measure the resistance of the thermistor when disconnected.
- Using the appropriate chart, find the resistance and move either vertical (water probe) or horizontal (air probe) until the line is intersected.
- Move 90 degrees to the corresponding temperature.
- If the temperature is plus or minus 10 degrees, then the probe is operating correctly.

Figure 20-1 Thermistor Resistance Chart – 1 MOhm Water Probe (Low Temp.)

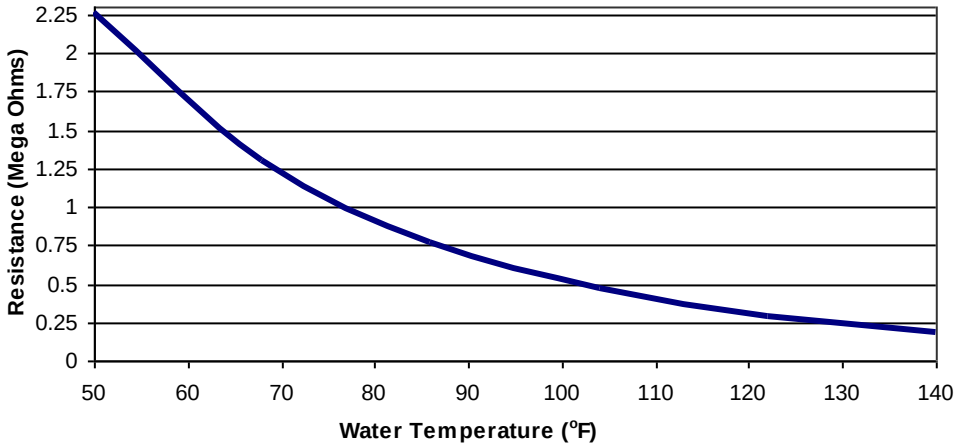


Figure 20-2 Thermistor Resistance Chart – 1 MOhm Water Probe (High Temp.)

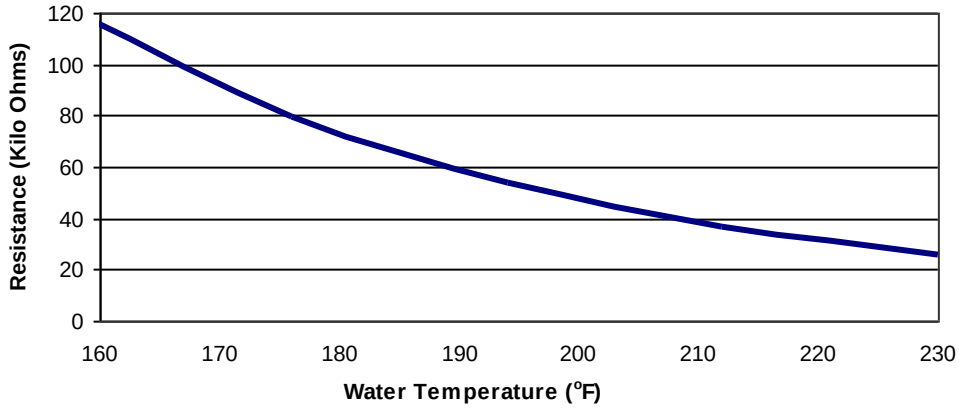
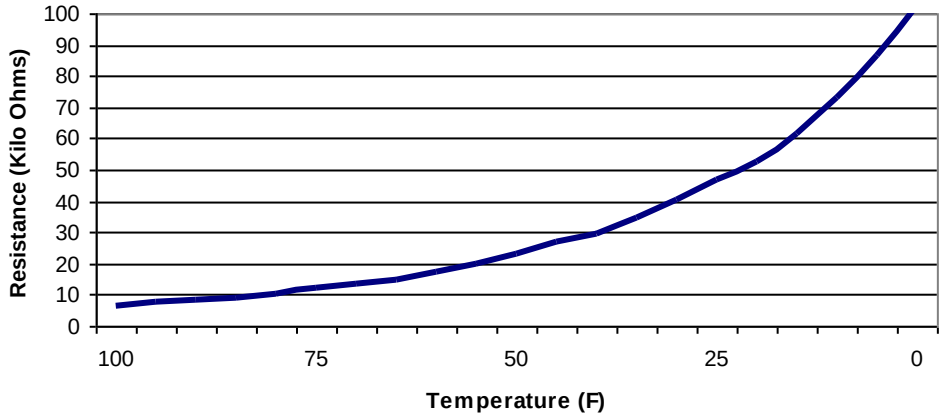


Figure 20-3 Thermistor Resistance Chart – 10 kOhm Outdoor Sensor



NOTES

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