Trinity Lx

Model Numbers: Lx150-400 Version Date: 2009-06-29

APPENDIX B - BOILER APPLICATIONS: PLUMBING AND WIRING INSTRUCTIONS

For Optional Configuration, refer to "Appendix C – Water Heater Applications", Models Lx200 and 400 Only

TABLE OF CONTENTS





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 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 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.

















1.0 INTRODUCTION

IMPORTANT

Boiler Applications – These instructions apply to the plumbing and wiring for Trinity Lx150-400 units operating as boilers and covers instructions that are specific to boiler applications. When units Lx200 and Lx400 are installed and operated as a water heater, refer to "Appendix C - Water Heater Applications: Plumbing & Wiring Instructions". See Table 1-1 for a list of Application Manuals.

Terminology – The following terms in the instruction manuals are used to differentiate between which instructions are common-to-both and which are appliance-specific. The term "APPLIANCE" applies to both kinds of applications (boiler and water heater) and is used when conveying instructions which are commonto-both. The term "BOILER" or "WATER HEATER" is used when conveying instructions which are appliance-specific or specific to one or the other, but not both.

Table 1-1 Instruction Manuals

Appliance	Model No.	Installation and Operation Instructions (Common-to-Both)	Application Manuals (Appliance-Specific)
Boiler	Lx150-400	Trinity Lx Series	Appendix B Boiler Applications
Water Heater	Lx200 & 400	Trinity Lx Series	Appendix C Water Heating Applications

General Installation Requirements

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

This document pertains to the correct installation and operation of NTI Trinity boiler models Lx150, Lx150E, Lx200 and Lx400. The instructions detailed in this document supersede any and all previous instructions provided by NTI, written or otherwise. Each unit is provided with the following:

- 1) Installation and Operation Instructions for Trinity Lx Series,
- 2) Appendix A Control and Touch Screen Display Instructions for Trinity Lx Series,
- 3) Appendix B Boiler Applications: Plumbing and Wiring Instructions,
- 4) Appendix C Water Heater Applications: Plumbing and Wiring Instructions, and
- 5) Natural to LP Conversion Kit *
- * The conversion kit is required to convert the water heater so it will safely operate with Propane Gas.



Read and understand this entire document prior to proceeding with the installation of the Trinity Lx boiler. Failure to follow the instructions outlined in this document will result

in property damage, serious injury or death.

User Responsibilities

This appliance may only be installed and serviced by a qualified boiler installer/service technician. For normal residential applications this boiler must be serviced / inspected annually, by a qualified boiler technician. Other applications (e.g. commercial or other more strenuous conditions) may require more frequent service/inspection. As the User/owner of this equipment, you are responsible for ensuring the maintenance is performed at the required intervals.



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

2.0 BOILER AND HEATING SYSTEMS PIPING

The heat exchanger of the Trinity boiler is designed to attain the highest level of heat transfer in a compact design. To accomplish this, the heating water flows through a series of fin shaped tubes, designed to maximize the heat transfer area. To maintain the efficient and reliable operation of the heat exchanger, and to avoid heat exchanger failure, it is critical to ensure the rules and guidelines in this section are followed.

A WARNING

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

Boiler System Preparation

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

For retrofits, all system piping including radiators, must be cleansed of all build-up including sludge and scale. All systems, old and new, must be cleansed to remove flux, grease and carbon residue. NTI recommends cleansing the boiler system with "Fernox F3 Cleaner". For retrofit applications with heavy limescale and sludge deposits, a heavier duty cleaner may be required; NTI recommends the use of "Fernox DS-40 System Cleaner". For information on performing the cleansing, follow the instructions included with the Fernox DS-40 System Cleaner. See Table 2-1 for 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.

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.

Table 2-1 Boiler System Cleansers and Corrosion Inhibitors

Boiler Water

Pressure - The Trinity 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 guarantee this 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 "Boiler Application" is not approved for operation in an "open system", thus it cannot be used for direct potable water heating or process heating of any kind.

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

- Water hardness between 3 and 9 Grains/gal.
- PH between 7.5 and 9.5.

Treatment - Boiler water that falls outside of the conditions listed above must be treated with a corrosion inhibitor. Each Trinity Lx boiler is provided with a 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 2-1 for a list of recommended boiler system cleansers and corrosion inhibitors.



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

Anti-freeze - For systems requiring freeze protection, use only inhibited propylene glycol, specially formulated for hydronic heating systems; use of other types of antifreeze may be harmful to the system and will void the warranty. Note: the use of glycol may reduce the usable output capacity of the boiler, thus requiring the unit to be "down-fired" by limiting the maximum operating capacity and/or the maximum water temperature. NTI recommends against exceeding 35% concentration of glycol.

Near Boiler Plumbing

Pressure Relief Valve - A Pressure Relief Valve is provided with each boiler (125PSI-Lx200/400; 30PSI-all other modes) which must be installed at the boiler outlet as shown in Figures 2-1(a) and (b). All Trinity Lx boilers, excluding Lx150's sold in Canada (MAWP=30PSI), have a maximum operating pressure of 145PSI; therefore, a relief valve with a higher discharge pressure rating (up to the MAWP of the boiler) may be used, so long as the relieving capacity is in excess of the maximum input capacity of the boiler.

Install the pressure relief valve, provided with the unit, in the vertical position as shown in Figures 2-1(a) and (b) with the drain pipe outlet exiting the side of the pressure relief valve horizontally and elbowing down. 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.

A 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 - A Pressure Gauge is provided with each boiler (160PSI-Lx200/Lx400; 30PSI-all other modes), which must be installed at the boiler outlet prior to any circulators, and in the vicinity of the pressure relief valve, see Figures 2-1(a) and (b). If using a higher pressure relief valve (e.g. 125PSI), ensure the pressure gauge is sized to display the higher pressure valve.



Low Water Cutoff / Flow Switch – The Trinity Lx boiler is not provided with a LWCO or Flow Switch, check with your local authorities for the requirements of these devices prior to installing the boiler. If a Flow Switch is installed it must be located in series with the boiler and in accordance with the instructions provided with the flow switch. NTI recommends a "McDonnell & Miller" flow switch installed in a 1"diameter line for all models except the Lx400, which requires an 1-1/2" diameter line.

When external safety devices are used, such as a LWCO, Flow Switch, or a Temperature Limiting Switch, they must be wired as per the instructions provided in this manual. Refer to Section 3.0 for more information.

Boiler System Plumbing

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

System Components – As well as a Primary/Secondary Loop Configuration utilizing closely spaced tees a properly installed system will include the following major components identified in Table 2-2.

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

Table 2.2 System Major Component Checklist

Circulating Pumps – The Trinity Lx boiler is equipped with three 120VAC pump outputs:

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

Ensure pumps are oriented as per the manufacturers' instructions. Wiring of these circulators will depend on the system configuration chosen, see Figures 2-2 and 2-3. For further wiring details see Section 3.0.

NOTICE

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



Failure to ensure the minimum water flow rate through the boiler when the burner is on will not only reduce the operating efficiency of the boiler, but may also cause premature

failure, overheating and void the warranty. Failure to follow instructions may result in fire, property damage, serious injury or death.

Model	Restriction	Minimum	Min. Flow	Max. Temp.	Minimum Pr	imary Loop Pu	ımp Size
Wiodei	Head Loss	Pipe Size	(GPM)	Rise	B&G	Grundfos	Taco
150	7' at 6 GPM	1"	6	45°F	PL-30	UP 26-64	0011
150E	3' at 6 GPM	1"	6	45°F	PL-30	UP 26-64	0011
200	5' at 8 GPM	1-1/4"	8	45°F	PL-36	UP 26-99	0011
400	10' at 20 GPM	1-1/2"	16	45°F	PL-36	UP 26-99	0011^{1}
Notes:						•	
400 Notes:	10' at 20 GPM	1-1/2"	16	45°F	PL-36	UP 26-99	00

Table 2.3 Minimum Cinculaton and Dina Sizes

- Recommend using a Taco 0013 for DHW indirect circulator on the Lx400 when installed as per Figure 2-3.

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

NOTICE

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

in close proximity to the water fill and expansion tank.

NOTICE

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

Expansion Tank – The expansion tank must be sized in accordance with the water volume of the system as well as the firing rate of the appliance. It is important to locate the expansion tank, and make-up water fill, on the inlet side of any circulator in the system, as doing so will guarantee the lowest pressure in the system will be at least equal to the tank and make-up water pressure. See examples in Figures 2-2 and 2-3.

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.

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

Figure 2-2: Single System Circulator Configuration - Often used in applications zoned with "Zone Valves". During a demand for central heating, the boiler energizes the System Circulator via the Central Heating (CH) pump output, PUMP C. The System Circulator must be sized to provide adequate circulation throughout the heating system. During a Domestic Hot Water (DHW) demand, the boiler de-energizes PUMP C and energizes the DHW Circulator via pump output, PUMP A. With this configuration the Boiler Circulator is the only pump that causes flow through the boiler, it is powered during any demand via pump output PUMP B. This circulator must be sized according to Table 2-3.

NOTICE

The piping configuration described above requires the Central Heating system and DHW system to be de-coupled from the "Primary Loop" via closely spaced tees (Figure 2-3).

Figure 2-3: Multiple System Circulator Configuration - Often used in applications with "Zone Circulators". This configuration requires the installation of a check valve located at each circulator. During a central heating demand the boiler energizes the Central Heating (CH) Circulator via pump output, PUMP C. During a Domestic Hot Water (DHW) demand, the boiler de-energizes PUMP C and energizes the DHW Circulator via pump output, PUMP A. Both Pump A and C, used in this configuration, are responsible for water flow through the boiler and must be sized according to Table 2-3. Pump output, PUMP B is not used in this configuration.

Figures 2-2 and 2-3 illustrate typical piping systems. These piping schematics do not NOTICE 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.

Indirect Fired Water Heater – When installed as per Figure 2-3, the indirect fired water heater is in series with the boiler during a demand for DHW. Therefore when using this configuration it is important to use an Indirect Fired Water Heater that has minimal head loss. Indirect fired water heater head loss must not exceed those specified in Table 2-4, when installed as per Figure 2-3.

Table 2-4 Maximum Water Heater Head Loss (Roiler Side) at Minimum Flow

I ubic I i infumination i it	tel lleatel llead Lobb (L	oner Blac) at minimum	1011
Lx150	Lx150E	Lx200	Lx400
10' at 6 GPM	14' at 6 GPM	14' at 8 GPM	9' at 16 GPM
To at o of hi			<i>y</i> at 10 01101



LEGEND					
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MAKE-UP WATER	X	BACKFLOW PREVENTOR	Ļ	AIR SEPARATOR
·	PRIMARY LOOP	凶	PRESSURE RELIEF VALVE	۲	PUMP
<u> </u>	CENTRAL HEATING SECONDARY LOOP	ŀΧ	PRESSURE REGULATING VALVE	÷	UNION
	DHW SECONDARY LOOP	۲	DRAIN VALVE	H	TEE
Χ	ISOLATION VALVE	Û	AIR VENT	-	FLOW DIRECTION
函	ZONE VALVE	-	EXPANSION TANK		
	ZONE LOAD	P	PRESSURE GAUGE		

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	LEGEND					
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	
	MAKE-UP WATER	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	BACKFLOW PREVENTOR	다	AIR SEPARATOR	
<u> </u>	PRIMARY LOOP	×	PRESSURE RELIEF VALVE	۲	PUMP	
<u> </u>	CENTRAL HEATING SECONDARY LOOP	ſX	PRESSURE REGULATING VALVE	*	UNION	
	DHW SECONDARY LOOP	۲	DRAIN VALVE	Ħ	TEE	
Χ	ISOLATION VALVE	Û	AIR VENT	+	FLOW DIRECTION	
必	ZONE VALVE	-	EXPANSION TANK	2	SPRING CHECK VALVE	
	ZONE LOAD	P	PRESSURE GAUGE			

9

3.0 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 is in accordance with this manual. The boiler must be electrically grounded in accordance with the National Electrical Code ANSI/NFPA 70, or local codes, and/or the Canadian Electrical Code CSA C22.1.

To Avoid Electrical Shock, turn off electrical power to the boiler prior to opening any A WARNING 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.

Line Voltage Connections

The Trinity Lx line voltage junction box is located in the lower right corner of the boiler cabinet on models Lx150-200 and can be accessed by removing the front door of the boiler, followed by the removal of the line voltage junction box cover. On Lx400 models, the line voltage junction box is located at the top of the boiler cabinet on the right hand side and can be accessed by removing the top front cover of the boiler. The boiler is provided with one hole and two knockouts for routing field wiring into the line voltage junction box. See Table 9.1 for identification of line voltage field connections.



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 these instructions may result in component failure, serious injury or death.



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

CAUTION

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

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

The circulator outputs, PUMP A through C, are each limited to operating a circulator with a maximum current load of 3 Amps or a maximum 1/6 hp motor. See Table 3-1.

Fuses (120VAC) – The Trinity Lx is equipped with two 7 Amp fuses to protect 120VAC system components. The fuses are located on the front of slide-out control panel box.

- Fuse A: Protects the blower, spark generator and PUMP B output circuits.
- Fuse B: Protects PUMP A and C output circuits.

Figure 3-1 All Models

Line Voltage Field Wiring



Connection	Location	Description
L1 (120VAC)	1	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.
PUMP A	2	120VAC output to the DHW circulator; powered during a demand for DHW.
PUMP B	3	120VAC output to the Boiler circulator; powered during all demands; Central Heat and DHW. Note, this output is not used for all plumbing configurations, see Section 2.0.
PUMP C	4	120VAC output to the Central Heating circulator; powered during a demand for Central Heating.
L2	5	Location for connecting neutral of the power supply and all circulators
(Neutral)	6	Location for connecting neutral of the power suppry and an encurators.
Ground	7	Location for connecting earth ground and for grounding all of the circulators
Giouna	8	Location for connecting earth ground and for grounding an of the circulators.
No Conn.	9	This terminal is used only for factory wiring, do not add or remove wires from this location.

Low Voltage Connections

The Trinity Lx low voltage junction box is located in the lower left corner of the boiler cabinet on Lx150-200 models and can be accessed by removing the front door of the boiler, followed by the removal of the low voltage junction box cover. On Lx400 models, the low voltage junction box is located at the top of the boiler cabinet on the left hand side and can be accessed by removing the top front cover of the boiler. The boiler is provided with one hole and two knockouts for routing field wiring into the low voltage junction box. See Table 9.2 for identification of low voltage field connections.

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 these instructions may damage the unit.

Connection	Location	Description
COM	1	24VAC Common - Neutral for the 24VAC power supply from the boiler. This contact can
(24VAC)	2	be used in conjunction with terminal R to provide a power source for a digital thermostat.
R	3	24VACHet Demensionale for image T and LDM
(24VAC)	4	24VAC Hot - Power suppry for inputs 1 and LIM.
LIM	5	External Limit – Input requiring 24VAC from terminal R to permit the burner to operate. Comes factory equipped with a jumper to the R terminal. For installations requiring the use of an additional safety switch, such as an auxiliary temperature limit, LWCO or Flow Switch, remove the factory installed jumper and install the normally open isolated contacts of the additional limit in its place.
Т	6	Central Heat Demand – Input requiring 24VAC from terminal R to initiate a call for Central Heating. Switch is made using an isolated end switch (dry contact) via room thermostats or the end switch of a zone controller or other device.
	7	DHW Tank Demand – Input requiring closure of terminals 7 and 8 to initiate a demand for
DHW 8		DHW. Switch is made using an isolated end switch (dry contact) via a Thermostat located in an Indirect Tank Hot Water Heater.
1.20	9	External Modulation Control – Using a 4-20mA signal, an external control can be used to
4-20mA	10	directly modulate the firing rate of the burner, or adjust the active set point. This can be useful for applications using external staging controls or Building Automation Systems.
OD	11	Outdoor Temperature Sensor – An OD Sensor is included with each boiler, when
SENSOR 12		adjust the boiler temperature set point during a Central Heat demand.
DATA +	13	
12VDC	14	Remote Display – Terminals 13 through 16 can be used to connect a second user interface
COM	15	remotely.
DATA -	16	
	17	Normally Open Alarm Contacts – Contacts close during a lockout or other alarm
ALANN	18	condition. May be connected to a BMS, maximum capacity of 0.63Amps at 24VAC.

Table 3-2 Low Voltage Field Connections (See Figure 3-2)

CAUTION

Low Voltage terminals 3 and 4 (R), have 24VAC potential from the internal transformer; do not connect power from these terminals to any other terminal with the exception of terminals 5 and 6 (LIM and T). Failure to follow these instructions may damage the unit.

Fuse (24VAC) – The Trinity Lx is equipped with a "blade style" 2 Amp fuse to protect the internal transformer. The fuse is located within the slide-out control panel box.



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