

Trinity

High Efficiency Condensing Gas Boilers



Models Numbers: T, Ti, Ts & Lx Series
Version Date: 2010-07-01

DETAILED SERVICE AND INSPECTION PROCEDURE

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IMPORTANT

SAVE THESE INSTRUCTIONS: Installing Contractors, leave these instructions with the customer as they contain important information regarding annual inspection requirements, maintenance check lists, and shut down procedures. Affix instructions close or adjacent to the appliance.



T Series



Ti Series



Ts Series



Lx Series

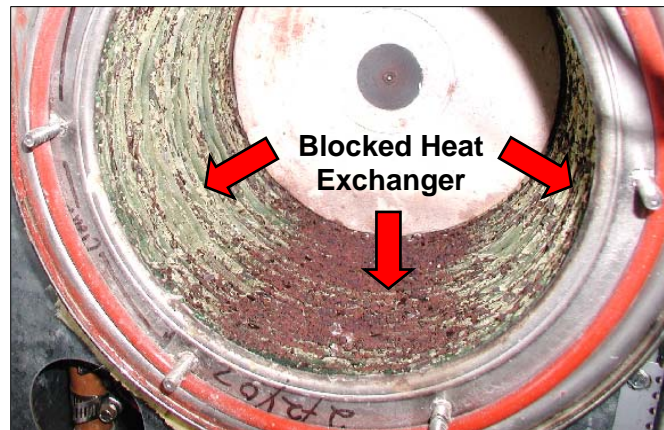
1.0 Service Requirements

To maintain peak operating performance of any heat exchanger it is important that the heat exchanging surfaces be kept clean and free of foreign debris. Foreign debris will act as an insulator and prevent the efficient exchange of heat. Failure to clean the Trinity heat exchanger will result in the following problems:

- 1) Increased flue temperature.
- 2) Blocked combustion passages.
- 3) Reduction in heating capacity.
- 4) Rough ignition or pulsating rough combustion.
- 5) Ignition failure.
- 6) Heat exchanger failure.

The main factors contributing to the build up of dirt in the heat exchanger are:

- 1) Cleanliness of the combustion air.
- 2) Sulfur content in the gas.
- 3) Level and frequency of condensation forming in the heat exchanger.
- 4) Amount of burner operation.



The build up of burnt dust and cooked-on Sulfur residue only occurs in the primary side of the heat exchanger. Build-up does not occur in the secondary side of the heat exchanger due to a lack of direct heat from the burner acting as a catalyst.

The rate of build-up will vary in every application due to variations in the factors mentioned above. Units operating with LP Gas or in an industrial environment must be cleaned a minimum of once per year. Other applications will require a combustion chamber cleaning after the first year of operation, with subsequent cleanings scheduled based on the condition of the combustion chamber at that time. Once you have established the rate of build up for each installation, you will be able to develop a cleaning schedule. Unless a step is identified as model specific, the Combustion Chamber Cleaning Procedure is the same for all models.

Refractory Ceramic Fibers (RFC)



Prior to Cleaning - Read the warnings and handling instructions for Refractory Ceramic Fibers carefully before commencing any service work in the combustion chamber.



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



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 1-1 may result in serious injury or death.



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 1-1 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 appliance. This appliance contains materials that have been identified as carcinogenic, or possibly carcinogenic, to humans).

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

Reduce the Risk of Exposure	Precautions and Recommended Personal Protective Equipment
Avoid contact with skin and eyes	<ul style="list-style-type: none"> Wear long-sleeved clothing, gloves, and safety goggles or glasses.
Avoid breathing in silica dust	<ul style="list-style-type: none"> Wear a respirator with 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	<ul style="list-style-type: none"> 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	<p>If irritation persists after implementing first aid measures consult a physician.</p> <ul style="list-style-type: none"> 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>.

2.0 Lighting / Shutting Down the Appliance

WARNING

Read Before Proceeding - 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 appliance 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 appliance 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 appliance if any part has been under water. Immediately call a qualified service technician to inspect the appliance 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 appliance.
3. This appliance 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 appliance.
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 Appliance" and call your service technician or gas supplier.

TO TURN OFF GAS TO THE APPLIANCE

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

WARNING

Should overheating occur or the gas supply fails to shut off, turn off the manual gas control valve to the appliance. Failure to follow instructions could result in explosion causing property damage, serious injury or death.

WARNING

Do not use this appliance if any part has been underwater. Immediately contact a qualified service technician to inspect the unit and replace any damaged components. Failure to follow instructions could result in explosion causing property damage, serious injury or death.

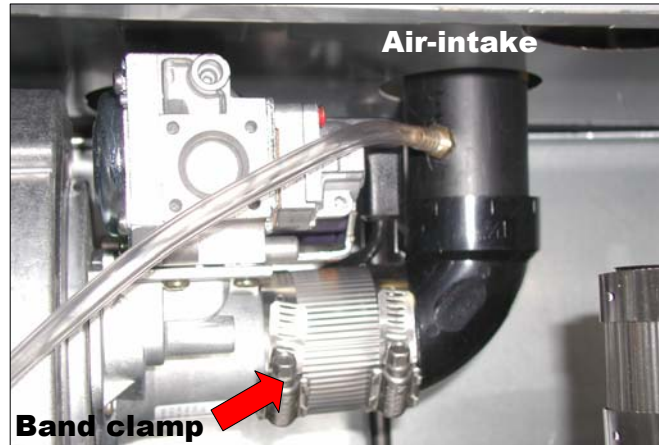
DANGER

Explosion Hazard (Lx300 – 800 models) - Metallic tubing connecting the blower to the high-vent pressure switch contains Fuel/Air Mixture. Failure to follow tubing disconnection instructions in Detailed Combustion Chamber Cleaning Procedure will result in serious injury or death.

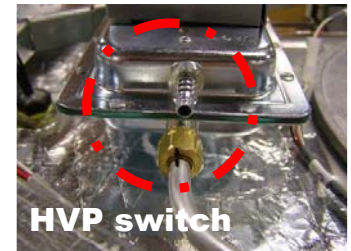
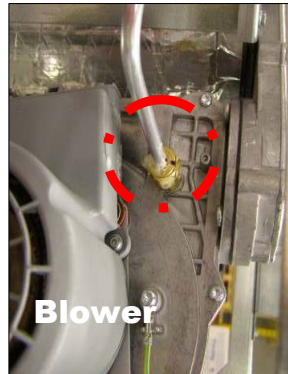
3.0 Detailed Combustion Chamber Cleaning Procedure

1. Turn the manual gas shut-off valve off and then turn off the power to the unit. Refer to instructions in Section 2.0 "Lighting / Shutting Down the Appliance".

2. Remove front cover on all units. For T Series boilers, also remove left side panel, igniter, and flame probe. Disconnect the gas line. Disassemble air-intake by removing band clamp between air-intake and venturi on applicable models, before removing air-intake pipe. T Series shown in photo.



3. **Lx300-800:** Refer to **DANGER Explosion Hazard** in Section 2.0 (previous page) before proceeding. Disconnect the metallic tubing between the blower and high-vent pressure (HVP) switch by loosening the compression fitting at the high-vent pressure switch with a 9/16" wrench. At the blower, support the brass fitting body with a 1/2" wrench to keep it from rotating while loosening the compression fitting nut with a 9/16" wrench. Remove tubing assembly from blower.

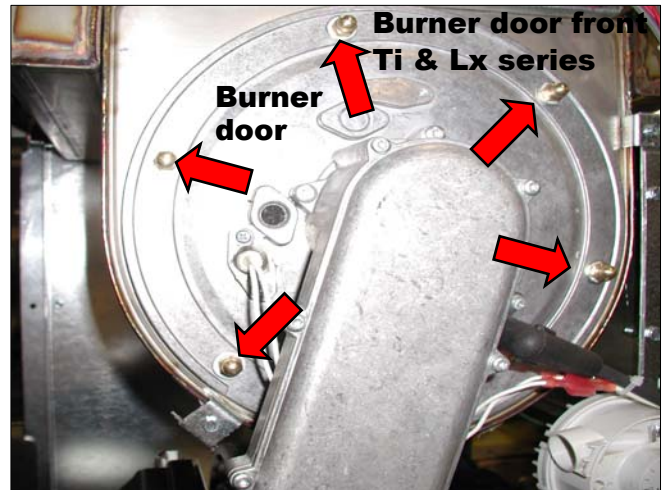
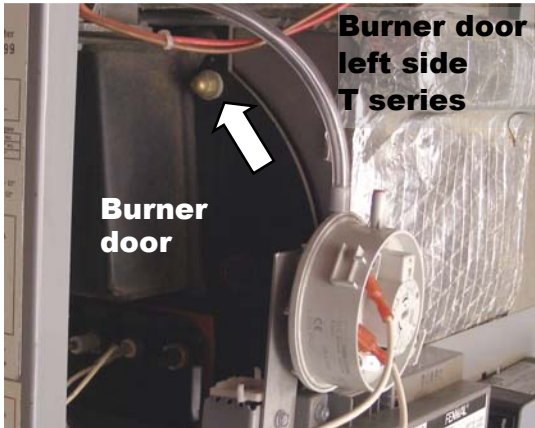


4. Remove wiring harnesses and tubes from combustion blower gas valve assembly, igniter, and flame probe. Carefully label the proper location for each tube removed if not familiar with the unit.

NOTICE

Note location of wiring and tubing prior to disassembly or removal for servicing.

- Access the combustion chamber by removing the burner door assembly of the appliance. Remove the nuts along the perimeter of the burner door as illustrated. The burner door configuration may vary depending on the series or model number. All models have 6 burner door nuts. Not all nuts shown in pictures some are obstructed from view.



- Document or photograph the heat exchanger and record the duration of the service interval as this will aid in developing a cleaning schedule.

⚠ WARNING Allowing any Trinity appliance to operate with a dirty combustion chamber will not only adversely affect its operation, but also 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.

IMPORTANT The Surface of the tubes may appear clean but in between the tubes could be blocked or restricted



7. Remove 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.



Replace any gaskets or insulation discs that show signs of damage. Replace any worn components that are damaged. Failure to follow these instructions may result in fire, property damage or death.



8. Use a vacuum with a high efficiency filter to remove any loose debris or dust, refer to Refractory Ceramic fibers section 1 page 2. Place a bucket under the condensate drain.



9. 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. Use dry rags or plastic bags to protect electrical components from being damaged by dripping or spraying water. Allow water to drain out the condensate drain.

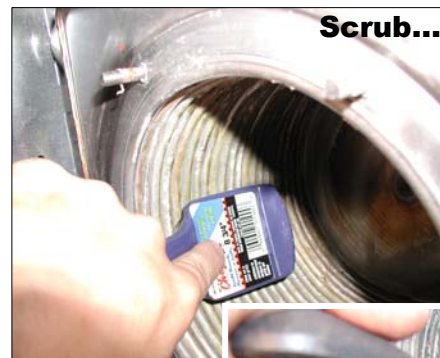


10. Use a nylon or other non-metallic brush to loosen the incrustations and any other contaminants that have remained on and in-between the tubes.



11. Repeat steps 9 and 10 until the heat exchanger is clean and water from the condensate drain runs clear.

Clean the condensate trap by flushing out any debris that may be caught. Use dry rags for oily or sticky residue. Reinstall trap and pre-charge it with water.



12. Re-install the insulation disc to the back of the combustion chamber.



Replace any gaskets or insulation discs that show any signs of damage. Failure to follow these instructions may result in fire, property damage or death.

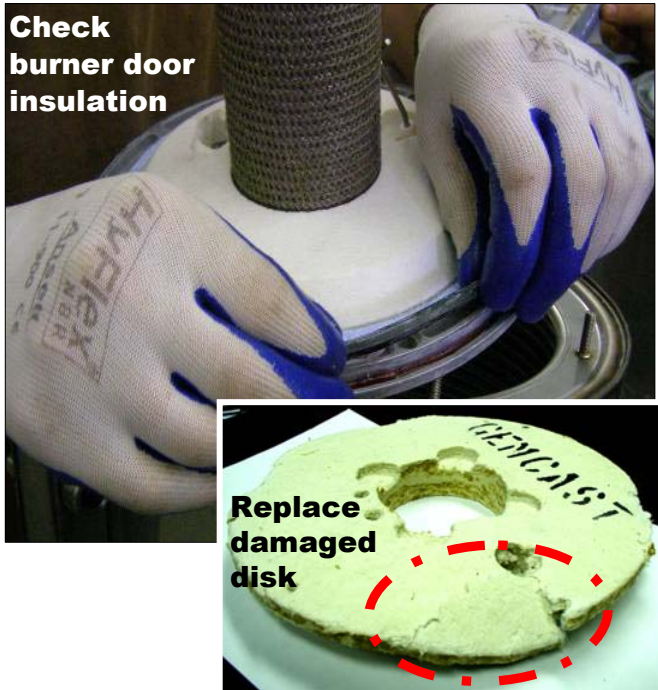


13. Inspect the insulation disc located on the back-side of the burner door.

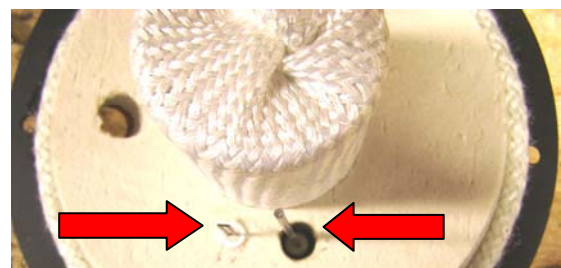
Trinity Parts List - Refer to Table 3-1 for a list of parts commonly requiring replacement due to wear or damage.

T series Burner inspection - T series boilers are equipped with a ceramic fiber sock that covers the burner. This sock should be inspected for sags, tears, or stretching. If any of these problems exists or the sock is excessively dirty it must be replaced. See Table 3-1 for part numbers.

T Series refractory inspection - The refractory surrounding the igniter must be a snug fit (bottom picture). The gap between the refractory and the flame rod must be no less than 1/16". If the gap is less than 1/16", gently ream out the refractory until the desired size is achieved (bottom picture).



As seen from inside the combustion chamber the bottom picture indicates the correct position of the flame rod and igniter in a T series boiler.

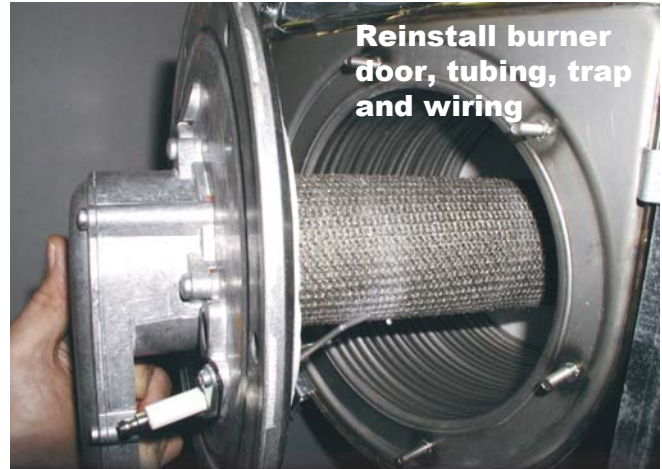


Refractory tight to the igniter

1/16" gap to the ceramic portion of the flame rod

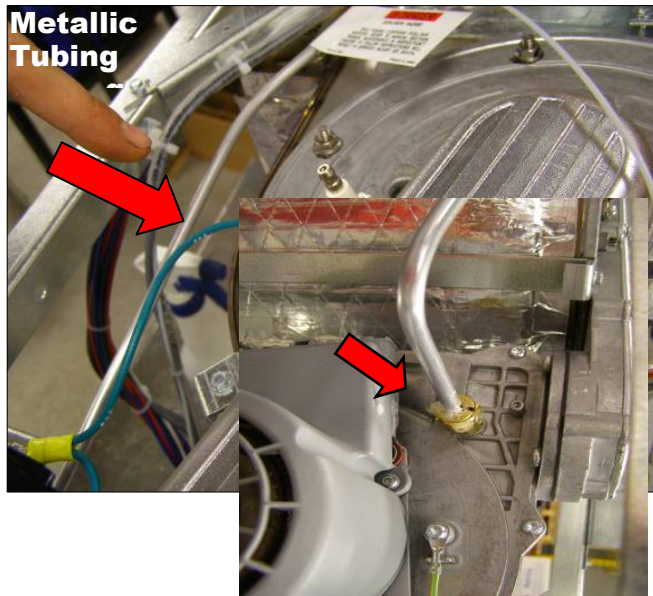
14. Re-install the burner door, air-inlet pipe, and gas-supply. Reconnect the wiring harnesses, and properly reinstall the condensate trap and pre fill with water. Ensure the spark igniter cable is securely reconnected to avoid risk of arcing.

⚠ WARNING **Spark Igniter Cable** - Maintain a minimum 2" separation between spark igniter circuit and conductors. Failure to follow instructions may result in component failure, injury or death.



15. **Lx300-800:** Reconnect the metallic tubing between the blower and the high-vent pressure switch. Ensure the brass fitting body at the blower remains stationary and does not rotate during reconnection.

⚠ DANGER Explosion Hazard (Lx300 – 800 models) - **Metallic tubing connecting the blower to the high-vent pressure switch contains Fuel/Air Mixture. Failure to follow tubing disconnection and reconnection instructions in Detailed Combustion Chamber Cleaning Procedure will result in serious injury or death.**



16. Once everything is reassembled, check the entire unit for combustion leaks. With the gas turned off, remove low voltage plug (5 pin connector) from the blower motor. This will cause the blower to run at high speed. Then temporarily block the exhaust vent and use a soap and water mixture to check for leaks throughout the boiler assembly. Confirm no leaks are found, then remove the blockage from the exhaust and reconnect low voltage wire harness to blower. Check for proper operation including smooth ignitions, correct combustion and flame signal refer to Section 4.0 Combustion Check below.

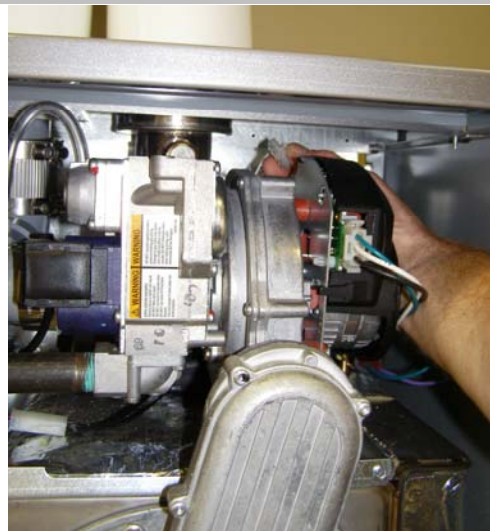


Table 3-1 Trinity Parts List Part Description	Part Number				
	Trinity T Series	Ts80	Trinity Ti	Trinity Lx150-400	Lx800
Insulation disk (back of heat exchanger)	83112	83112	83112	83112	83112
Insulation disk (inside of burner-door)	82231 ⁴	82769	82769	83808,83950 ⁵	84137
Igniter	82059 ¹	83870	82708 ¹	83870 ²	84154 ²
Burner Door O-ring	82673 ^{3,4}	82770 ³	82770 ³	82770 ³	84136 ³
Burner Door Assembly	82379,82381 ⁴	82767	82767	83885,83949 ⁶	84135

- 1) Recommend replacement every service
- 2) Replacement is not required for routine cleaning and service
- 3) Replace gaskets that are deformed or torn in all cases, recommend replacing T series burner door gasket each service
- 4) T series burner doors include burner, insulation disk (82231) and associated gaskets (82673), T200 models use door 82381, T150 models use 82379
- 5) Lx150-200 use insulation disk 83808 and Lx300-400 use disk 83950
- 6) Lx150-200 use burner door 83885, Lx300-400 use disk 82767

4.0 Combustion Check

WARNING The Trinity 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 appliance gas valve is equipped with a line pressure test port; refer to Figures 4-1 through 4-5. Use the following procedure to measure the gas line pressure to the appliance to ensure it falls within the range given in Table 4-1:

1. Turn the supply of gas to the appliance off.
2. Open the bleed screw of the line pressure test port approximately 1-1/2 turns refer to Figures 4-1 through 4-5. This port is directly connected to the gas line feeding the appliance. For Lx800 models, replace 1/8" NPT plug in the inlet flange of the gas valve with a hose barb fitting suitable for manometer tubing used. Refer to Figure 4-5.
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 appliance and check for gas leaks.
5. Observe the line pressure under static conditions and compare it to Table 4-1. The pressure will be greatest under static conditions.
6. With all other gas appliances in the application running, operate the burner to the maximum firing rate (refer to Table 4-2, or 4-3) and compare the observed line pressure with Table 4-1. The pressure will be lowest during the maximum flow of gas.
7. Adjust the gas line pressure to ensure the parameters in Table 4-1 are attained under all conditions. If possible adjust the line pressure to the "Nominal/Desired" value listed in Table 4-1, while the unit is operating at the maximum modulation rate, see Table 4-2, or 4-3.
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. For the Lx800, replace the installed hose barb fitting with the factory 1/8" NPT plug; use NG/LP approved thread sealant refer to Figure 4-5.

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 appliance 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 4-1 Line Pressure and Combustion Parameters

Gas	Line Pressure (inches wc)			CO ₂ (%)*		CO (ppm) Max.
	Nominal/Desired	Min.	Max.	Min.	Max.	
Natural	7	4	10.5	8.5	9.5	175
Propane	11	8	13	9.5	10.5	175

*Note: it is permissible to have higher CO₂ values with the burner operating at the minimum modulation rate.

Table 4-2 Minimum and Maximum Modulation Rates Ts and LX boilers

Model	Min. Modulation Rate (RPM)	Max. Modulation Rate (RPM)
Ts80	24%	100%
Lx150	1150	5850
Lx150E	925	4450
Lx200	925	5950
Lx300	1250	5850
Lx400	1550	7250
Lx800	1250	5300

Table 4-3 Minimum and Maximum “Gas Input Values” (Modulation Rates) T and Ti series boilers

Model	Minimum Gas Input Value	Maximum Gas Input Value
Ti100/150	50	240
T150/200	45	205
Ti200	40	240
Ti400	35	195



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



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

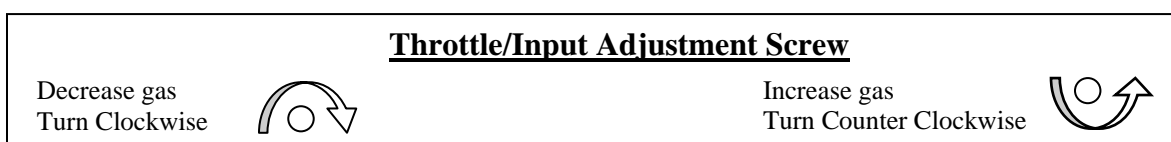
Adjustment

Input Screw Adjustments - The appliance 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 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 CO₂ in the flue gases. To increase the CO₂ the Throttle screw must be adjusted out, counterclockwise, thus increasing the flow of gas from the gas valve to the combustion air stream.

Ts, T, Ti, Lx 150-300 Adjustments - The input screw for models T, Ti, Lx150-300 is a multiple turn valve. Fully open to close is approximately 17 turns. Typical adjustment for Natural Gas is 0-1 full turns in or out. Typical adjustment for LP Gas is 0-3 full turns in or out. Refer to Figures 4-1 through 4-4 for input screw location.

Ti400 and Lx400 Adjustments - The input screw for the Ti400 and Lx400 is a geared valve with a 4:1 ratio. Adjusting input screw 4 complete turns will returned the valve to the original location, 2 turns from fully open will completely close the valve. Typical adjustment required is 0-1/4 turns in or out. Refer to Figure 4-4 for input screw location.

Lx800 Adjustments - Remove the cap and adjust the input screw by turning it clockwise to decrease gas flow and counter-clockwise to increase gas flow. Typical adjustment required is 0-1/8 turns in or out. Refer to Figure 4-5 for input screw location.



WARNING Adjustments to the Throttle screw may only be made by a qualified gas technician, while using a calibrated combustion analyzer capable of measuring CO₂ 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 4-1. Failure to follow these instructions may result in serious injury or death.

Combustion Calibration - To calibrate burner, perform the following procedure using a calibrated combustion analyzer capable of measuring CO₂ and CO from Natural and Propane Gas burning appliances:

1. Operate the unit at the maximum modulation rate, see Table 4-2 or 4-3.
2. Ensure the gas line pressure is maintained within tolerance, see Table 4-1.
3. While at the maximum modulation rate, measure the CO₂ and CO; adjust as necessary, using the Throttle Screw, to be within the limits listed in Table 4-1.
4. Operate the unit at the minimum modulation rate (Table 4-2 or 4-3). Ensure the combustion remains smooth and CO₂ and CO remain within the limits (Table 4-1). If not, do not adjust further, contact NTI for assistance.

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 – Trinity Lx flue gas test ports are located in the flue outlet adapter assembly. Test port access is either from inside the appliance cabinet (Lx150-200) or from outside the appliance cabinet (Lx300-800). Remove the test port plug, perform flue gas analysis, and adjust throttle/input screw as required until CO₂ and CO levels are within acceptable limits. Once flue gas sampling completed, re-install test port plug. For models with a threaded plug, seal threads with Teflon tape before reinstalling plug.

Ts, T, and, Ti series boilers do not have an integral flue gas test port. Flue gas samples can be taken at the exhaust termination or the condensate trap under the boiler can be removed and the tubing exiting the boiler can be used as a test port.

DANGER Failure to re-install the test port plug or condensate drain will result in damage to the unit, property damage, fire, explosion, serious injury or death.

Figure 4-1 Ti and T series

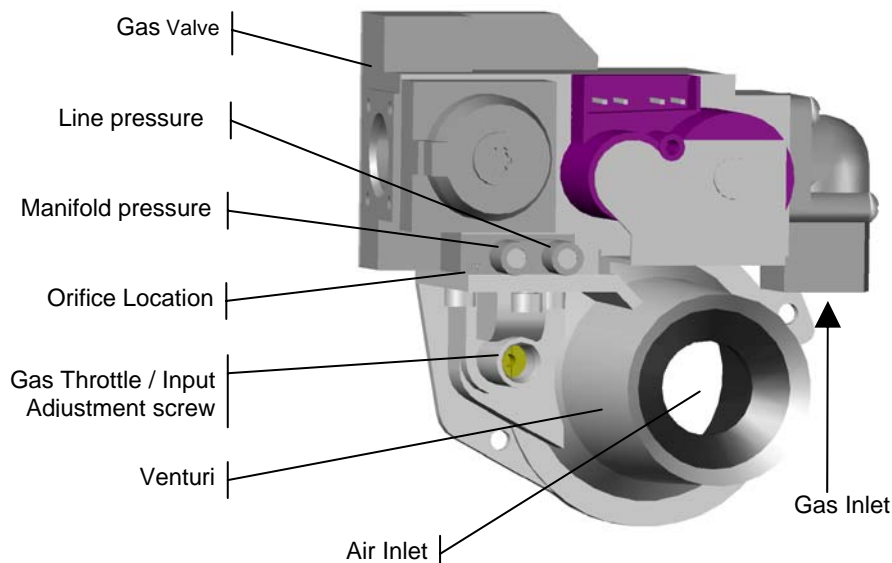


Figure 4-2 Lx150

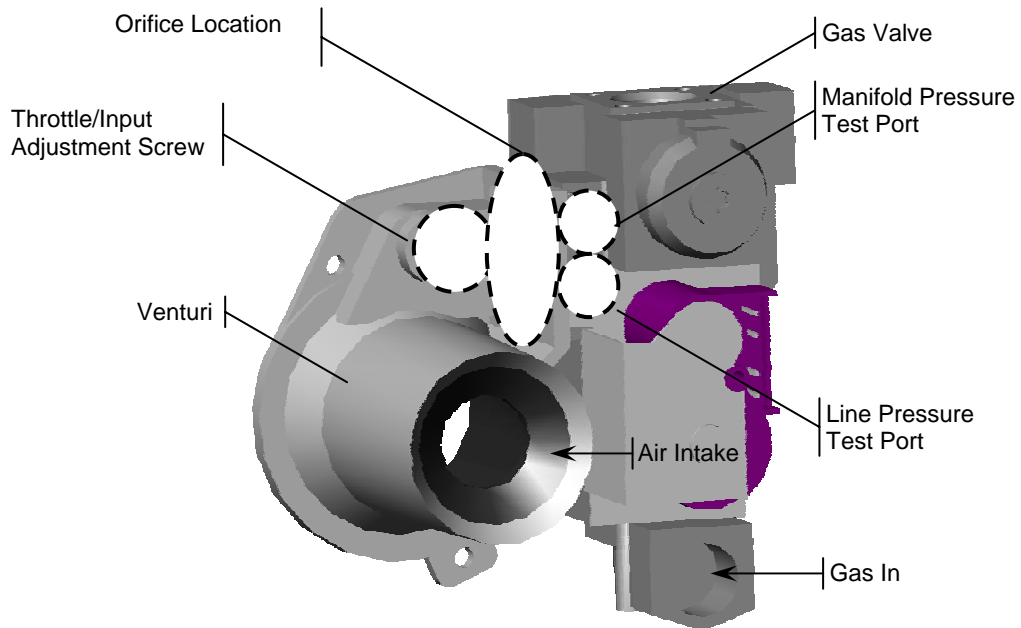


Figure 4-3 Lx150E, 200 and 300

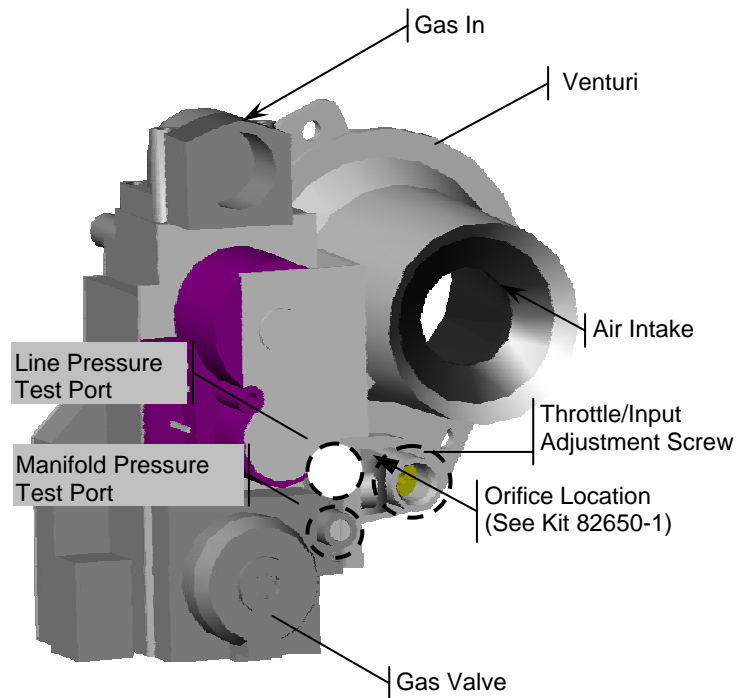


Figure 4-4 Ti400, and Lx400

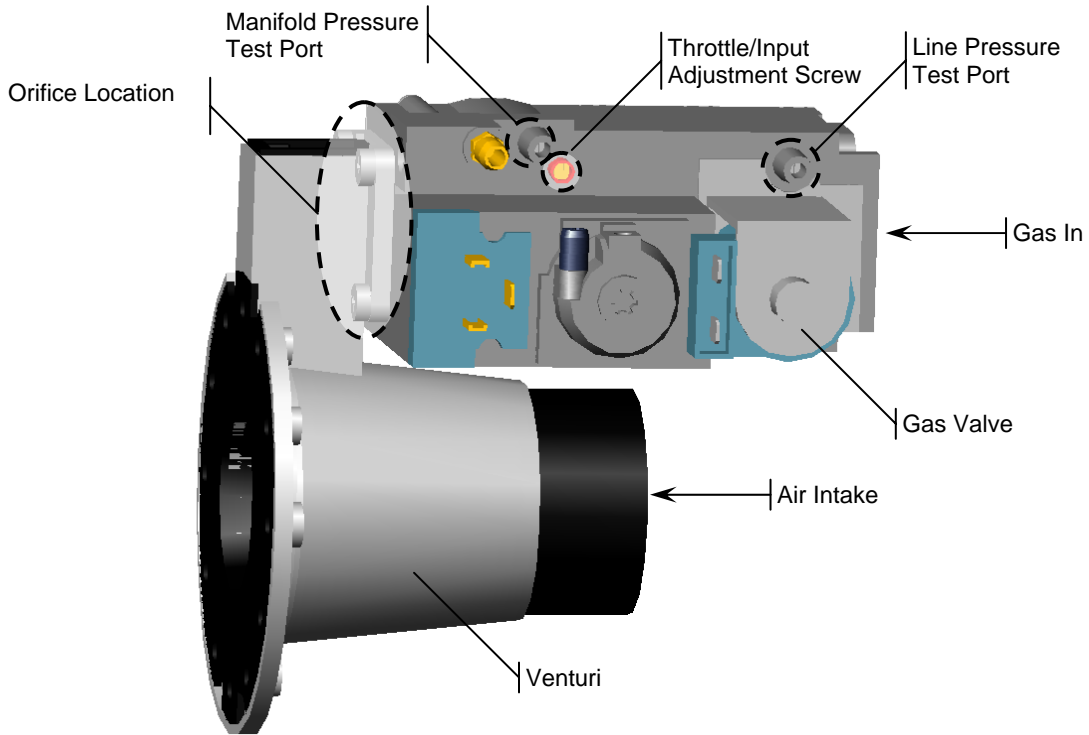
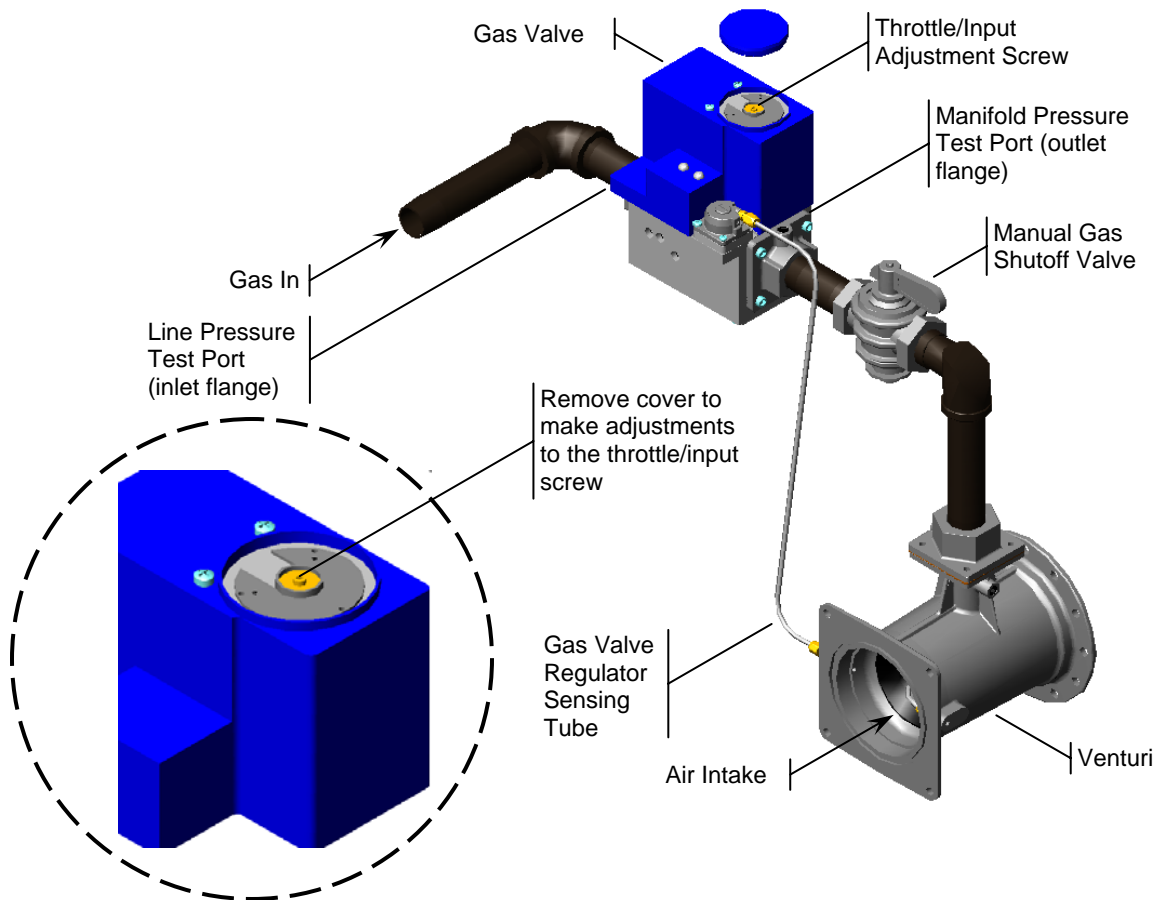


Figure 4-5 Lx800



5.0 Flame Proving Circuit Check

1. Run boiler at high fire.
2. Check, and if necessary, adjust combustion to the proper level as per the Combustion Check process mentioned previously.
3. Check flame signal strength at maximum and minimum firing rates. The minimum acceptable flame signal is $2\mu\text{A}$. To test flame signal place multimeter in series with the flame probe wire (all units): alternately on T and Ti series boilers Place meter leads on terminals FC + - on the Fenwal ignition module. For Lx boilers press the Diagnostics button on the Home screen, then press the Analog I/O button, use the right arrow key to display Flame signal.
4. Ensure the heat exchanger is installed level or slightly sloping toward the condensate drain. Also ensure the condensate drain is free flowing. If the condensate drain becomes plugged, moisture will build-up in the heat exchanger causing an electrical short of the flame probe to ground, which results in flame lockout.

For T series boilers only: If the flame signal strength is below $2\mu\text{A}$ an adjustment can be made to the flame rod to help improve the flame signal. This procedure should only be performed if operating on Lp Gas and the flame signal is less than $2\mu\text{A}$.

Change the position of the flame probe relative to the burner by removing the flame probe and bending as shown in Figure 5-1. When bending of the flame probe is required, start by bending it $1/8$ " further away from the burner Refer to Figure 5-1.

Figure 5-1 T series flame rod

