

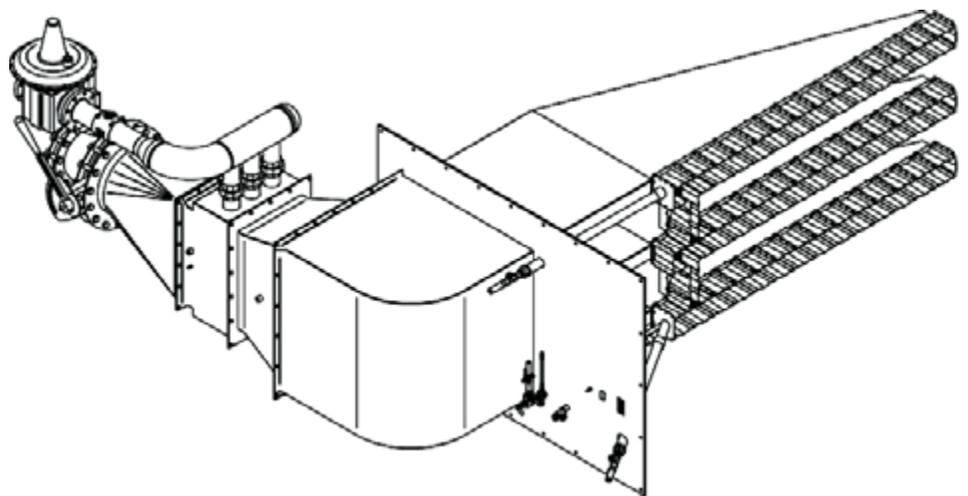
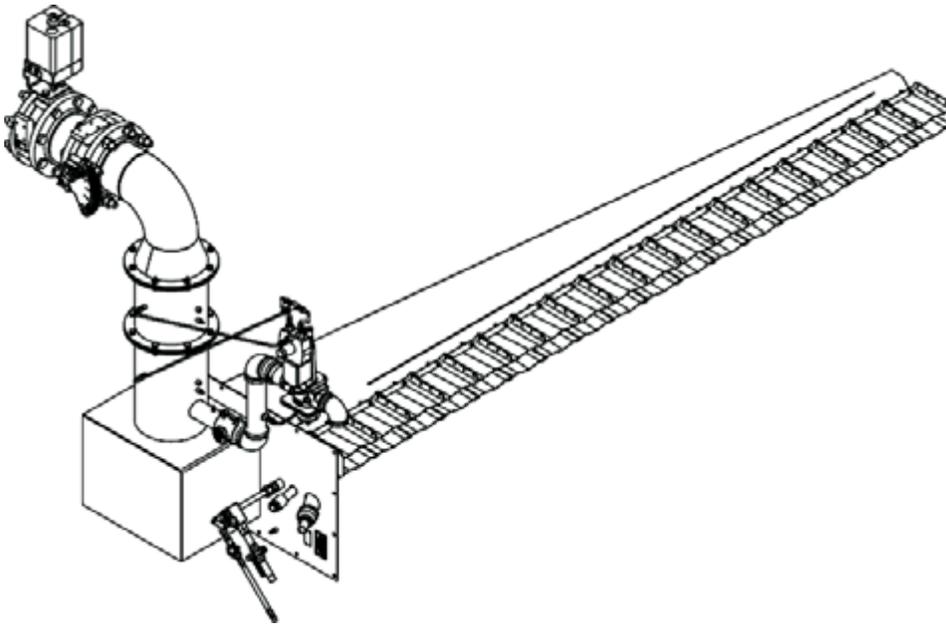
# *Eclipse Linnox Burners*

---

*Models Straight ULE and Tee ULE*

*Operating Instructions Edition 6.15*

*Version 1*



**Copyright**

Copyright 2011 by Eclipse, inc. All rights reserved worldwide. This publication is protected by federal regulation and shall not be copied, distributed, transmitted, transcribed or translated into any human or computer language, in any form or by any means, to any third parties, without the express written consent of Eclipse, inc.

**Disclaimer Notice**

In accordance with the manufacturer’s policy of continual product improvement, the product presented in this brochure is subject to change without notice or obligation.

The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

**Liability & Warranty**

We have made every effort to make this manual as accurate and complete as possible. Should you find errors or omissions, please bring them to our attention so that we may correct them. In this way we hope to improve our product documentation for the benefit of our customers. Please send your corrections and comments to our Technical Documentation Specialist.

It must be understood that Eclipse’s liability for its product, whether due to breach of warranty, negligence, strict liability, or otherwise is limited to the furnishing of replacement parts and Eclipse will not be liable for any other injury, loss, damage or expenses, whether direct or consequential, including but not limited to loss of use,

income, or damage to material arising in connection with the sale, installation, use of, inability to use, or the repair or replacement of Eclipse’s products.

Any operation expressly prohibited in this manual, any adjustment, or assembly procedures not recommended or authorized in these instructions shall void the warranty.

**Document Conventions**

There are several special symbols in this document. You must know their meaning and importance.

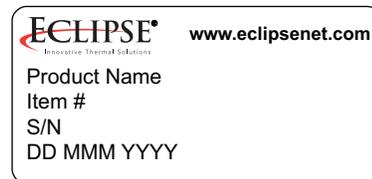
The explanation of these symbols follows below. Please read it thoroughly.

**How To Get Help**

If you need help, contact your local Eclipse representative. You can also contact Eclipse at:

1665 Elmwood Rd.  
 Rockford, Illinois 61103 U.S.A.  
 Phone: 815-877-3031  
 Fax: 815-877-3336  
<http://www.eclipsenet.com>

Please have the information on the product label available when contacting the factory so we may better serve you.



This is the safety alert symbol. It is used to alert you to potential personal injunt hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



Indicates a hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

**NOTICE**

Is used to address practices not related to personal injury.

**NOTE**

Indicates an important part of text. Read thoroughly.



# Table of Contents

<b>1 Introduction</b> .....	<b>4</b>
Product Description .....	4
Audience .....	4
Purpose .....	4
Linnox Straight ULE and Tee ULE Documents .....	4
Related Documents.....	4
<b>2 Safety</b> .....	<b>6</b>
Introduction .....	6
Safety Warnings .....	6
Capabilities.....	6
Operator Training .....	6
Replacement Parts.....	6
<b>3 Installation</b> .....	<b>7</b>
Introduction .....	6
Handling .....	6
Storage.....	6
Position of Components .....	6
Approval of Components.....	6
Checklist Before Installation.....	7
General Installation Conditions .....	7
Burner Mounting.....	7
Flame Sensor Installation.....	7
Gas Piping.....	7
Air Piping .....	10
Electrical Supply.....	10
Profile Plates .....	10
Burner Support.....	10
Checklist After Installation .....	10
<b>4 Adjustment, Start and Stop</b> .....	<b>12</b>
Introduction .....	12
Checklist Before Burner Start-Up .....	12
Adjustment Procedure.....	13
Start Procedure .....	14
Stop Procedure .....	17
<b>5 Maintenance and Troubleshooting</b> .....	<b>18</b>
Introduction .....	18
Maintenance.....	18
Troubleshooting.....	20
<b>Appendix</b> .....	<b>i</b>
<b>Notes</b> .....	<b>ii</b>





# Introduction

1

## Product Description

The Linnox is a line model burner designed for applications where a maximum linear heat distribution is required.

The Linnox burner is a pre-mix type burner, designed for direct-air heating applications where the lowest achievable NO<sub>x</sub> and CO levels are required.

Linnox combustion is based on high excess air, pre-mix combustion to keep the flame temperatures low. At the same time, the burner geometry establishes an internal recirculating flame pattern. These two factors result in ultra low NO<sub>x</sub> and CO emissions across the turndown range while maintaining extremely stable combustion.

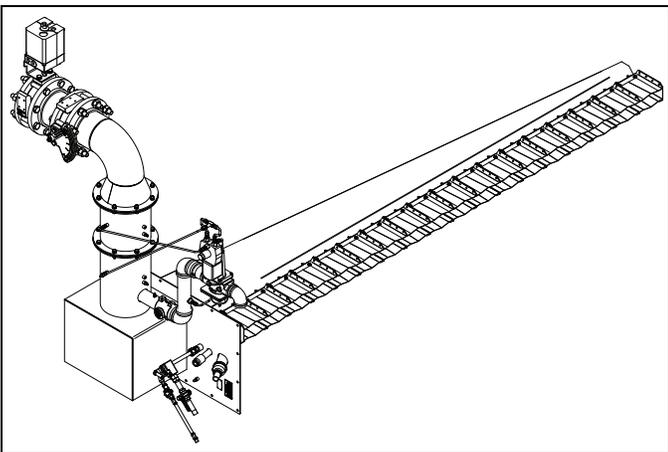
This burner can be easily configured for many different capacities by choosing from a wide range of burner modules each 300 mm in length.

The Linnox is designed to provide:

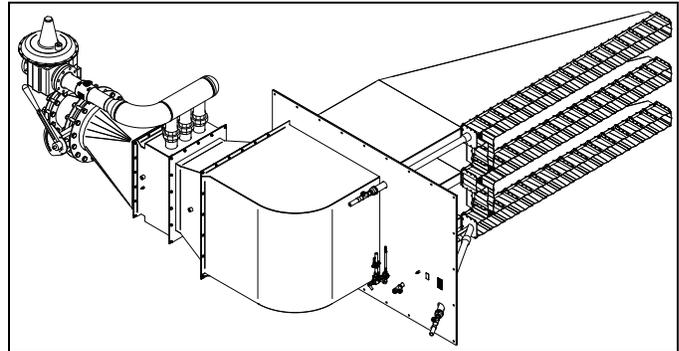
- Reliable operation
- Simple adjustments
- Efficient ratio controlled combustion
- Burner modules varying from 90 to 2700 kBtu/h (26 to 791 kW per 300 mm).

## Purpose

The purpose of this manual is to ensure a safe, effective and trouble-free installation.



**Figure 1.1 Linnox Straight ULE Burner**



**Figure 1.2 Linnox Tee ULE Burner**

## Audience

This manual has been written for personnel already familiar with all aspects of pre-mix burners.

These aspects include:

- Installation
- Use
- Maintenance
- Safety

The audience is expected to be qualified and have experience with this type of equipment and its working environment.

## Linnox Straight ULE and Tee ULE Documents

### **Design Guide 159**

- Used with Datasheets to design the burner system

### **Datasheet Series 159**

- Required to complete design and selection

### **Installation Guide 159**

- This document

### **Worksheet 159**

- Required to provide application information to Eclipse Engineering

### **Spare Parts List Series 159**

- Recommended replacement part information

## Related Documents

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Information Guides: 610, 710, 720, 730, 742, 744, 760, 930

# Safety

## 2

Important notices which help provide safe burner operation will be found in this section. To avoid personal injury and damage to the property or facility, the following warnings must be observed. All involved personnel should read this entire manual carefully before attempting to start or operate this system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

### Safety Warnings



#### **DANGER**

- **The burners, described herein, are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled or maintained.**
- **Do not bypass any safety feature; fire or explosion could result.**
- **Never try to light a burner if it shows signs of damage or malfunction.**



#### **WARNING**

- **The burner and duct sections are likely to have HOT surfaces. Always wear the appropriate protective equipment when approaching the burner.**
- **Eclipse products are designed to minimize the use of materials that contain crystalline silica. Examples of these chemicals are: respirable crystalline silica from bricks, cement or other masonry products and respirable refractory ceramic fibers from insulating blankets, boards, or gaskets. Despite these efforts, dust created by sanding, sawing, grinding, cutting and other construction activities could release crystalline silica. Crystalline silica is known to cause cancer, and health risks from the exposure to these chemicals vary depending on the frequency and length of exposure to these chemicals. To reduce the risk, limit exposure to these chemicals, work in a well-ventilated area and wear approved personal protective safety equipment for these chemicals.**

#### **NOTICE**

- **This manual provides information regarding the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written approval from Eclipse.**

### Capabilities

Only qualified personnel, with sufficient mechanical aptitude and experience with combustion equipment, should adjust, maintain or troubleshoot any mechanical or electrical part of this system. Contact Eclipse for any needed commissioning assistance.

### Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency. Contact Eclipse for any needed site-specific training.

### Replacement Parts

Order replacement parts from Eclipse only. All Eclipse approved valves or switches should carry UL, FM, CSA, CGA and/or CE approval where applicable.

# Installation

## Introduction

This section provides guidance for correct installation of Eclipse Linnox burners.

**NOTE:** Information in Datasheet Series 159 may be necessary to complete some of the installation procedures.



### **WARNING**

- **Only qualified, competent personnel with combustion system experience are allowed to install, adjust and maintain the burner.**
- **All installation work must be carried out in compliance with jurisdictional codes.**

## Handling

- Inspect the burner and its components ensuring that all components are clean and free of damage.
- Use the appropriate support equipment when lifting the burner and its components.
- Protect the burner and its components from the weather, damage, dirt and moisture.

## Storage

- Make sure the burner and its components are clean and free of damage.
- Store the burner and its components in a cool, clean, dry room.
- After you have made sure everything is present and in good condition, keep the components in the original package as long as possible.

## Position of Components

The position and amount of components are determined by three factors: burner design, system design and chosen control method. All three factors are considered in "System Design" chapter of the Linnox Design Guide 159. Use the information in that chapter to build your system.

## Approval of Components

### **Limit Controls & Safety Equipment**

All limit controls and safety equipment must comply with all applicable local codes and/or standards and must be listed for combustion safety by an independent testing agency. Typical application examples include:

- American: NFPA 86 with listing marks from UL, FM, CSA
- European: EN 746-2 with CE mark from TuV, Gastec, Advantica

### **Electrical Wiring**

All electrical wiring must comply with all applicable local codes and/or standards such as:

- NFPA Standard 70
- IEC60364
- CSA C22
- BS7671

### **Piping**

All gas piping must comply with all applicable local codes and/or standards such as:

- NFPA Standard 54
- ANSI Z223
- EN 746-2

The gas piping must meet jurisdictional codes.

### **Where to Get the Standards:**

The NFPA Standards are available from:  
National Fire Protection Agency  
Batterymarch Park  
Quincy, MA 02269  
[www.nfpa.org](http://www.nfpa.org)

The ANSI Standards are available from:  
American National Standard Institute  
1430 Broadway  
New York, NY 10018  
[www.ansi.org](http://www.ansi.org)

The UL Standards are available from:  
333 Pfingsten Road  
Northbrook, IL 60062  
[www.ul.com](http://www.ul.com)

The FM Standards are available from:  
 1151 Boston-Providence Turnpike  
 PO Box 9102  
 Norwood, MA 02062  
[www.fmglobal.com/approvals](http://www.fmglobal.com/approvals)

**Information on the EN standards and where to get them is available from:**

Comité Européen de Normalisation  
 Stassartstraat 36  
 B-1050 Brussels  
 Phone: +32-25196811  
 Fax: +32-25196819  
[www.cen.eu](http://www.cen.eu)

Comité Européen de Normalisation Electronique  
 Stassartstraat 36  
 B-1050 Brussels  
 Phone: +32-25196871  
 Fax: +32-25196919  
[www.cenelec.org](http://www.cenelec.org)

## Checklist Before Installation

### **Air Supply**

To admit fresh combustion air from outdoors, provide an opening in the room of at least one square inch per 4,000 Btu/h (6 cm<sup>2</sup> per 1 kW). If there are corrosive fumes or materials in the air, supply the burner with clean air from an uncontaminated area, and always provide a sufficient air filtering system.

### **Exhaust**

Do not allow exhaust fumes to accumulate in the work area. Provide some positive means for exhausting fumes from the furnace and the building.

### **Access**

Make sure to install the burners in such a way that you can gain easy access for inspection and maintenance.

### **Environment**

Make sure the burner operating environment matches the original operating specifications. Check the following items:

- Voltage, frequency and stability of the electrical power
- Type and supply pressure of the fuel
- Availability of enough fresh, clean combustion air
- Adequate oxygen concentration for combustion on the process gases
- Humidity, altitude and temperature of the air
- Presence of damaging corrosive gases in the air
- Prevent direct exposure to water

## General Installation Conditions

Perform the following audits before installing the burner:

- Remove all dirt, dust, and other particles from inside the burner air/gas piping, and avoid further soiling during piping and accessory installation.
- Check that there are no obstructions in the burner duct or in the supply piping connections.

### **Electrical**

Install the high-voltage ignition transformer (as applicable) as close to the burner as possible.

### **Burner Mounting**

Make sure the chamber wall is strong enough to support the weight of the burner. If necessary, reinforce the mounting area.

Mount burner to process duct using customer supplied bolts, nuts, and lockwashers.

The burner mounting plate is provided with:

- a peep sight for pilot flame observation
- a pressure tap for measuring process pressure
- a pipe nipple to mount the UV scanner and the UV scanner cooling air connection
- or without an insulation box (refer to assembly drawing)

### **Flame Sensor Installation**

Install the UV scanner onto the 3/4" NPT pipe nipple extending from the outside of the burner mounting plate. The UV scanner must be connected to the flame safety for that burner. Cooling air piping must be supplied to the tee connection located between the UV scanner and the mounting plate.



- **The burner flame shields can reach a temperature of 1650°F (900°C) at 480°F (250°C) process temperature upstream from the burner. Measurements should be taken to prevent excessive thermal load on the process ducting.**

### **Gas Piping**

Care should be taken to ensure that the incoming gas pipe is adequately sized for the necessary gas flow and burner pressure (See Datasheets 159-1 and 159-2 for gas pressure requirements).

Gas piping not supplied with the burner must be supported independently of the burner.

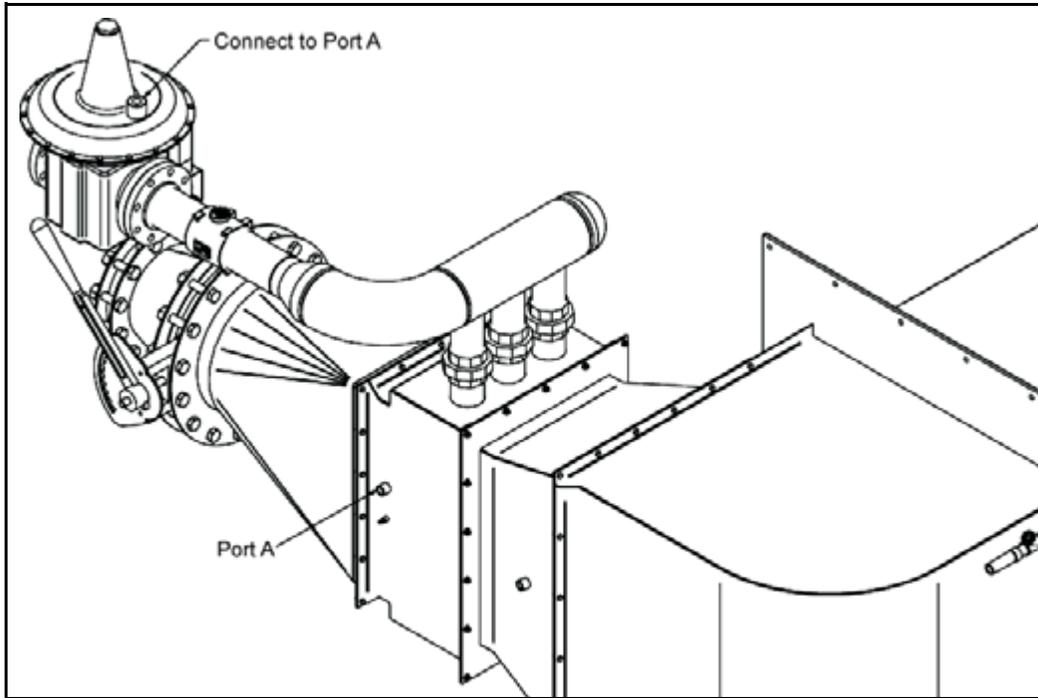


Figure 3.1. 8:1 Ratio Regulators Impulse Line Piping

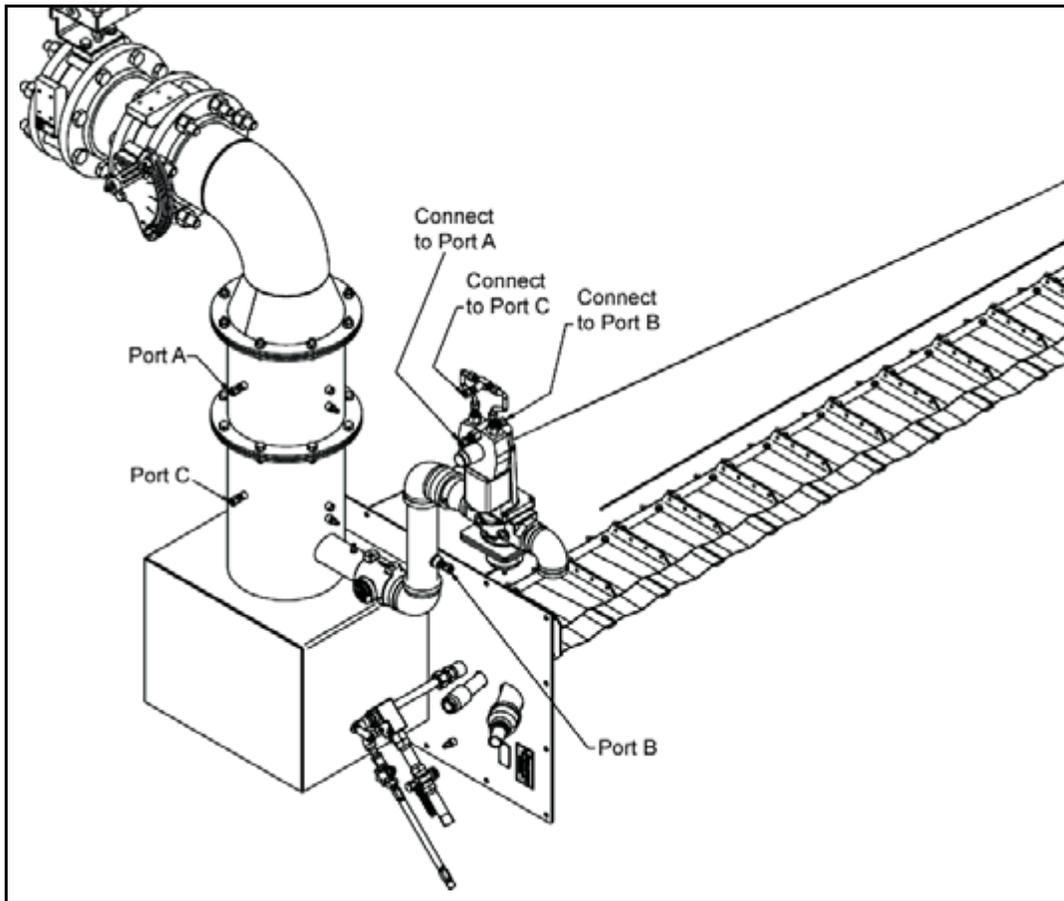


Figure 3.2. 10:1 Ratio Regulators Impulse Line Piping

**WARNING**

- Gas inlet pressures must stay within the specified range. Pressure above the specified range can damage the ratio regulator.
- Pressure below the specified gas inlet pressure range can impair the ability of the ratio regulator to control the gas flow.

**Air Piping**

Combustion air piping between the blower and the burner air connection point must be supported independently of the burner.

**Electrical Supply**

The burner must be controlled via a sequence programmer, approved according to jurisdictional codes.

**NOTICE**

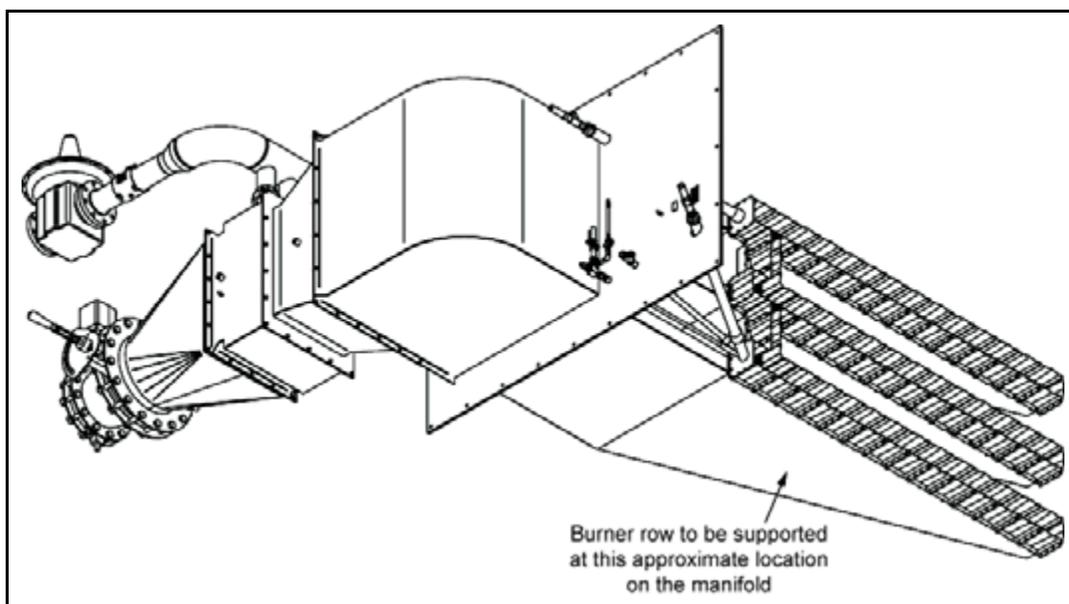
- Wiring to the burner must be in accordance with jurisdictional wiring standards. It is vital that the live and neutral wires are connected correctly as reversal could present a hazard. Also the grounding must be checked to ensure a good connection. (Wiring diagrams are provided only for a burner system that incorporates an Eclipse furnished control panel.)
- **GAS PIPEWORK MUST NOT BE USED FOR GROUNDING PURPOSES.**
- If burner control signals are supplied via a flame safeguard control panel provided by others, Eclipse Combustion shall not accept any responsibility for incorrect interfacing.

**Profile Plates**

Profile plates need to be installed to obtain the proper process air axial velocity as specified in Datasheets 159-1 and 159-2. See Figure 3.4 for suggested profile plate locations. Profile plates must be supported independently from the burner.

**Burner Support**

Burners with rows over four feet long must be supported, but not constrained, on the manifold at the end opposite the pilot in order to prevent excessive stress caused by thermal expansion. Reference Figure 3.3 for manifold support location.

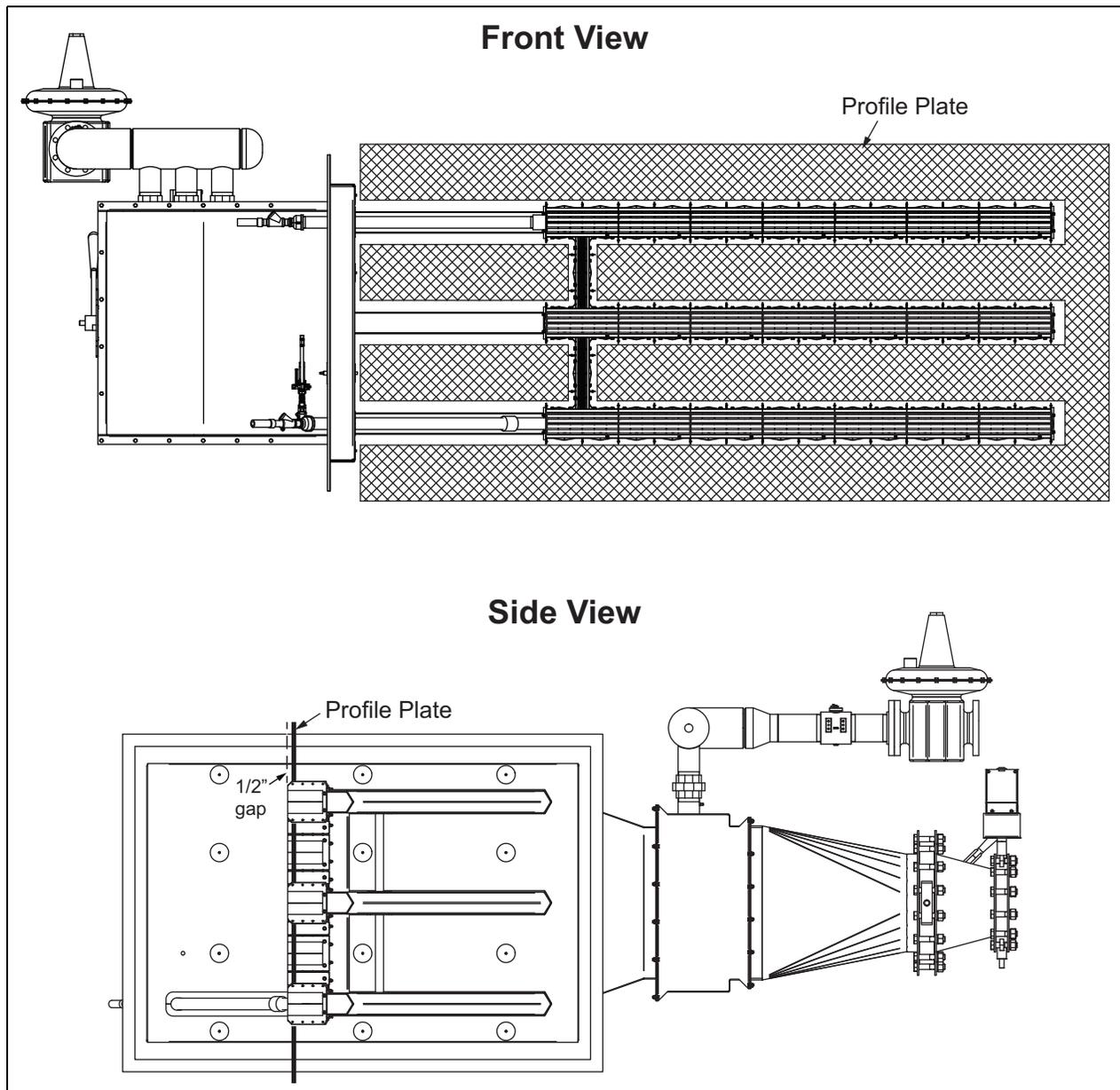


**Figure 3.3.**

**Checklist After Installation**

To verify proper system installation, perform the following audits:

1. Make sure there are no leaks in the gas piping or the air piping.
2. Make sure all the components of the flame monitoring system and the control system are properly installed. This includes making sure that all the switches are installed in the correct locations and that all the wiring, pressure lines, and impulse lines are properly connected.
3. Make sure all interlocks and safety components are installed and working properly.
4. Make sure the required air and gas pressures are available. Verify that the blower wheel rotation is correct. If it is incorrect, have a qualified electrician rewire the blower to reverse its rotation.
5. Make sure all components of the spark ignition system are installed and functioning properly.
6. Make sure the burner control system operates under interrupted pilot timing; i.e. the controller should shut the pilot off after the trial for ignition period.



**Figure 3.4. Suggested profile plate locations**

# Adjustment, Start and Stop

## Introduction

In this chapter you will find instructions on how to adjust, start and stop a Linnox burner.



**DANGER**

- **The burners covered by this guide are designed to burn a mixture of gas and air. All gas burning devices are capable of producing fires and explosions if improperly applied, installed, adjusted, controlled or maintained.**
- **Do not bypass any safety feature. This can cause fires and explosions.**
- **Obey the safety precautions in the “Safety” chapter of this document, and read this chapter thoroughly before starting your system.**
- **Never try to light a burner if it shows signs of damage or malfunction.**

**NOTE:** Adjustment requires two guides: Installation Guide 159 and Datasheet 159. This chapter refers to the component information explained in Design Guide 159.

## Checklist Before Burner Start-up

### **Preliminary Installation Checks**

- Verify that the process control setpoints are correct.
- Check that the main control panel switch is ON.
- Verify that the process air and combustion air blowers are operating correctly.
- Confirm that the burner, the system interlocks, the customer interlocks, and the safeties are in working order.
- Open the main manual gas supply valve.
- Verify that the main gas inlet pressure is correct.

## **Preparation**

1. Ensure all installation work has been completed in compliance with jurisdictional codes.
2. Ensure all gas supply pipework has been purged of air in compliance with jurisdictional codes.
3. Ensure all required utilities are available.
4. Ensure all pre-checks have been completed in compliance with jurisdictional codes.
5. Ensure a digital or “U”-tube manometer for pressure measurement is available.
6. Set the low gas pressure switch to 20% below the lowest pressure given in the “Main Gas Inlet Pressure” range specified in DataSheet 159.
7. Set the high gas pressure switch to 20% above the highest pressure given in the “Main Gas Inlet Pressure” range specified in DataSheet 159.
8. Verify the location of the pilot tube with respect to the end shield prior to installing the burner. Reference Figure 4.1 for proper pilot location.

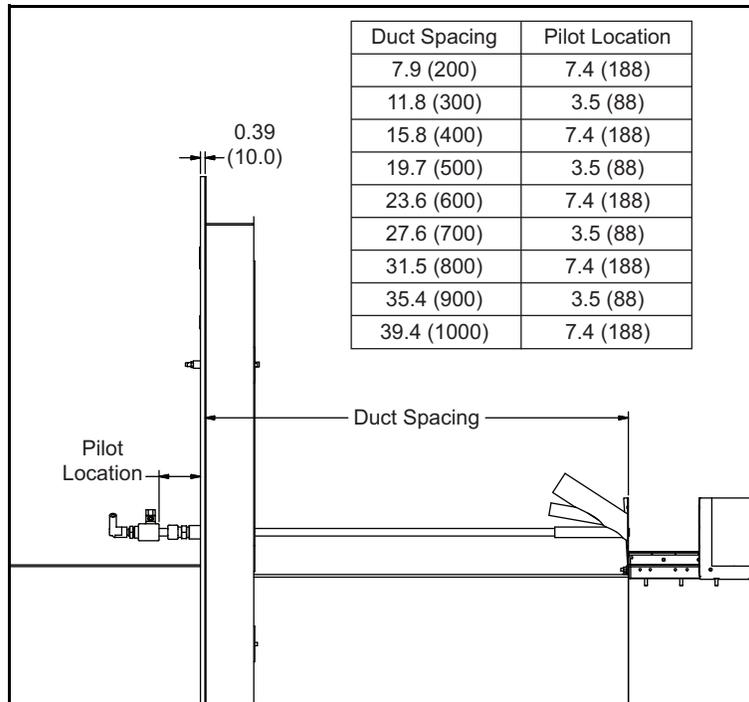


Figure 4.1. Pilot Location - All dimensions shown in inches (mm)

**NOTE:** Eclipse authorized personnel should perform the initial start of all Eclipse burners.

### Adjustment Procedure

Become familiar with burner methods before attempting to make adjustments.

Follow these steps to adjust the Linnox system for the first time:

#### Step 1: Dry Run

1. Ensure that the process air blower is running.
2. Close all the manual and automatic gas valves.
3. Initiate the electrical supply to start the operating sequence. The combustion air blower will start running. If the sequence is operating correctly, the system will run through to the point of ignition, the safety shut-off valves will open and, in absence of a flame, the system will proceed to a lockout condition.



- **If simulated limits or simulated flame failure do not shut down the fuel system within the required response time, immediately correct the problem before proceeding.**

#### Step 2: Combustion Air Check

**NOTE:** On multiple burner systems with a central combustion air blower, one should remember that the combustion air pressure will change depending on the total air demand. If one burner is adjusted, it is advised to set the combustion air of all other burners to at least 50% of the maximum capacity if the burners are not in operation. This will prevent flame failures or inability to reach the high-fire capacity when the installation is switched to normal operation.

**NOTE:** Start all process air blowers that affect chamber pressure.

## Low-Fire and High-Fire Air Adjustment

### Procedure:

1. Start the combustion air blower.
2. Drive control motor to low-fire position (activate the manual switch or lock first).
3. Measure air differential pressure (Tap A to Tap D).
4. Adjust low-fire air if necessary.

**NOTE:** The slot at the end of the BV (air damper) shaft indicates the position of the BV. The BV is closed when the shaft slot is perpendicular to the direction of air flow through the BV. For adjustment of the BV, adjust the lever mechanism.

5. Verify ignition position
  - a. Drive the combustion air control valve to ignition position, 30% open.
  - b. Adjust air pressure if necessary.
6. Verify high-fire air
  - a. Drive combustion air control valve to high fire, fully open.
  - b. Adjust high fire air if necessary.
7. Return the combustion air control valve to low-fire position.
8. Close the pressure taps

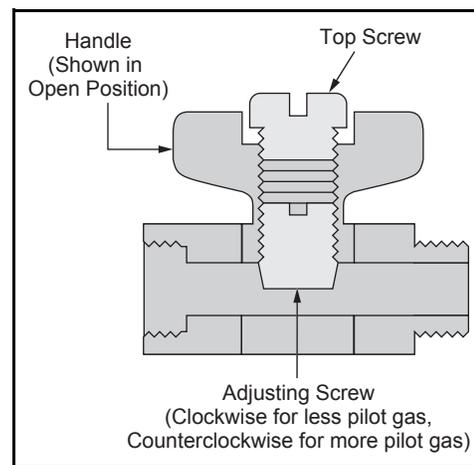
## Start Procedure

### Step 3: StartUp Procedure

**NOTE:** The maximum gas pressure allowed at the inlet of the adjustable port pilot gas cock is 1/2 psig. Do not exceed this pressure.

1. Check the pre-setting of the adjustment valves.
2. Switch the combustion air control valve to “automatic”.
3. Open all gas manual isolating ball valves.
4. Initiate the burner management system to start the operating sequence. The combustion air control valve will be driven to the start position after which the ignition will take place.

The pilot flame should be approximately 1 - 2 inches (25 - 51 mm) long and be contained within the flame shields in a mixed blue and yellow color. If the flame is too weak or too big, adjust the pilot flame to the pressures indicated in Datasheets 159-1 and 159-2. Adjustment of the adjustable port pilot gas cock is outlined in Figure 4.2. Pilot flame appearance also depends on the start position of the combustion air control valve and process air conditions.



**Figure 4.2. Adjustable Port Pilot Gas Cock**

After the trial for ignition period determined by local regulations, the safety shut-off valves will open, and the main flame will ignite. A clear blue line flame will appear at the burner base. The appearance will vary for the different capacity ratings of the burner elements.

If the burner does not light the first time, it will be necessary to reset the sequence and follow the start procedure again.

5. If the burner did not ignite after several attempts:
  - a. Verify that the air has been purged from the main and pilot gas piping.
  - b. If the pilot flame does not appear, adjust the gas and air pressures to the values listed in the datasheet.
  - c. If the flame appears at ignition, but the main burner does not light, turn the bias adjusting screw of the gas ratio regulator one turn clockwise to increase gas flow and try to ignite the burner again.
  - d. Repeat steps b and c several times until the burner ignites. If the burner does not ignite, follow the guidelines in Section 7 of this document, “Maintenance and Troubleshooting”.

### Low-Fire Settings

- Set the system control to stay at low fire during and after the ignition sequence, or set the control motor to manual.

Ensure the combustion air control valve stops at low fire.

- Adjust ratio regulator bias adjustment for lowest gas flow that maintains a stable flame signal:
  - clockwise for more fuel
  - counterclockwise for less fuel

Ensure that the lowest flame signals are stable.

At low fire the gas differential pressure across the mixer will be too low, for a reliable reading.

Eventually, the static gas pressure at the mixer can be used as a pre-setting for the burner.

**NOTE:** A visual check of the flame is important to ensure the correct burner adjustment.

**NOTE:** If the recirculating process air is cold, < 212°F (100°C), the burner elements will not glow or will partially glow.

**NOTE:** If the recirculating process air is hot, > 390°F (200°C), the burner elements will glow.

**NOTE:** The visual appearance of the low-fire flame should be clear blue with some of the burner elements glowing.



**Figure 4.3. Low Fire Flame Appearance**

When operating at high fire, if the flame becomes too rich, carefully close the manual gas adjustment valve until the flame starts blowing off. Open the valve again to pull the flame back in. The flame should look like the center image in Figure 4.3. The flame shields may be slightly red and the flame may extend beyond these shields.

### High-Fire Settings

8. Set the burner to high fire:
  - a. Check the differential air pressure against the values given in Datasheets 159-1 and 159-2.
  - b. Adjust the corresponding gas pressure with the adjustment butterfly valve.

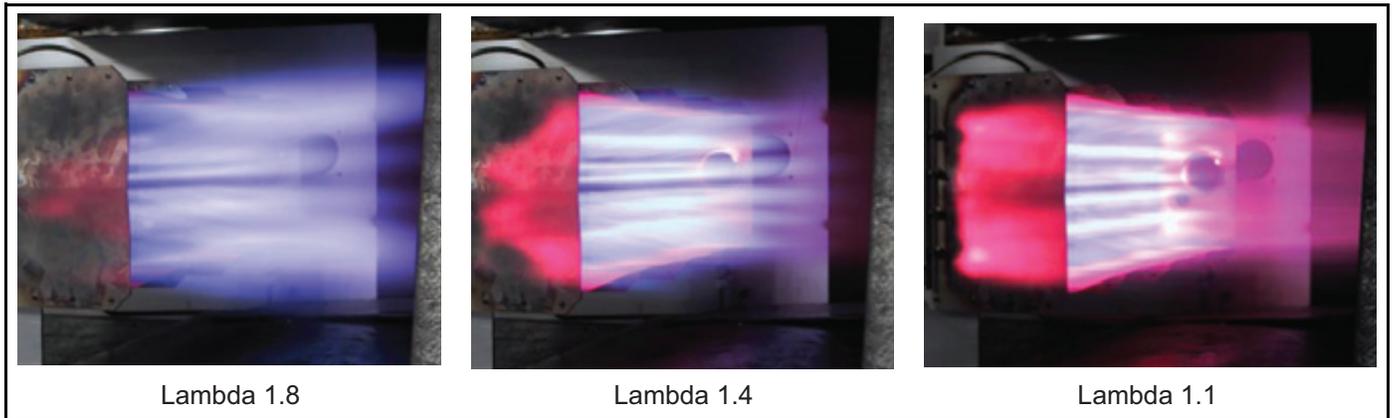
Fasten the lock screw, by tightening gently, at the adjustment butterfly valve after finishing adjustment.

**NOTE:** A visual check of the flame is important to ensure the correct burner adjustment. The flame will be sharp blue-white with a slightly orange glowing tip. The length of this tip depends on the burner capacity rating.

**NOTE:** If the flame tip is dominantly orange, the burner may be set too gas rich. Refer to the “Troubleshooting” section of this document.

**NOTE:** The burner flame shields are allowed to glow red hot depending on the burner capacity rating and the process temperatures.

9. If the setting of adjustment valve has been changed, repeat Steps 6 and 7 to check and readjust the low-fire setting.



**Figure 4.4. High Fire Flame Appearance**

A flame that is too lean ( $\text{Lambda} > 1.4$ ) will produce too much CO and have a fluctuating flame signal. A rich flame ( $\text{Lambda} < 1.4$ ) will create too much NOx and burner parts will overheat

2. Have a qualified technician check high gas pressure switch for correct operation.
3. Have a qualified technician check the combustion air pressure switch for correct operation.
4. Measure and record the gas and air differential pressure and flame signal at low and high fire for future reference.

 **CAUTION**

- **Adjusting the burner too gas rich will shorten the lifetime of the burner elements and flame shields. Therefore, have a qualified Eclipse engineer adjust and regularly check the burner settings.**

 **DANGER**

### Step 4: Operation Inspections

1. Simulate a flame-out condition by closing the manual inlet ball valve. Run the ignition cycle again.

- **If simulated limits or simulated flame failures do not shut down the fuel system within the required response time, immediately correct the problem before proceeding.**

**CAUTION**

- **Do not turn the combustion air blower off until the chamber temperature is below 250°F (120°C). This will prevent hot gases from flowing back through the burner, which would cause damage to the burner.**

**Stop Procedure**

1. Shut off the load, or the control system demand switch to initiate shutdown.
2. Shut off main and pilot manual gas supply valves.
3. Drive combustion air valve to high-fire position.
4. Leave the combustion air at high fire until the combustion chamber is cooled to under 250°F (120°C); once cooled, shut off the combustion air fan. Higher shutdown temperatures may be allowed depending on the system design. Consult Eclipse for more information.
5. Shut down all manual valves as required.

All initial settings shall be documented in a proper manner and kept as the initial commissioning data for future reference.

# Maintenance and Troubleshooting

## 5

### Introduction

This section is divided into two parts. The first part describes the maintenance procedures. The second part identifies problems that may occur and gives advice on how to solve these problems.

### Maintenance

Preventative maintenance is the key to a reliable, safe and efficient system. The following are suggested guidelines for periodic maintenance. Burners in severe environments or operational conditions should be checked more frequently.

**NOTE:** The monthly and yearly lists are an average interval. If your environment is dirty, the intervals may be shorter. Check with the local authorities that have jurisdiction over recommended maintenance schedules.



### CAUTION

- Turn off power to burner and controls before proceeding with burner inspection.
- Turn off the main gas supply.

### One Month after Startup

1. Check and compare burner adjustments with the original recorded settings. Correct the settings if they are outside the specified tolerance range.
2. Check and clean or replace the gas filter if necessary.
3. Check all gas piping and connections for leakage. Leaks must be repaired immediately.
4. Check tightness of all bolted/screwed joints.
5. Check burner and mixer unit for leakage, damage or deterioration. Those parts in contact with the process environment, must be inspected thoroughly.
6. Check the flame shields, burner elements and all joints for wear and damage.

7. Check if the burner module fastening nuts are tight.
8. Check the burner surroundings for signs of excessive corrosion or deformation due to thermal overload or moisture. Repair or replace insulation or thermal protection shields if necessary.

### Every Three Months

1. Visually check all components for damage.
2. Check manual shut-off valve for correct operation.
3. Visually check all cables and connectors for damage and tightness.
4. Visually check the condition of the blower inlet filter; replace if necessary.

### Every Six Months

1. Check burner and mixer unit for leakage, damage or deterioration. Those parts in contact with the process environment must be inspected thoroughly.
2. Check the flame shields, burner elements and all joints for wear and damage.
3. Check if the burner element fastening nuts are tight.
4. Check and clean or replace the igniter.
5. Check the flame quality, verifying both visually and via the air-fuel ratio that the flame is neither too lean or too rich.

It is important that the flame at low fire is stable and doesn't blow off, which happens when the mixture is too lean (has too much excess air).

If the mixture is too rich (not enough excess air), the parts in the burner modules will begin to glow immediately and possibly overheat. Simultaneously, the NOx emissions will increase. An incorrectly tuned flame will also result in a low flame signal and could create a flame failure.

### Yearly Checklist

1. Check and compare burner adjustments with the original recorded settings. Correct the settings if they are outside the specified tolerance range.
2. Check for correct operation.
3. Check and clean or replace the gas filter if necessary.
4. Leak test shut-off valves.
5. Check all gas piping and connections for leakage. Leaks must be repaired immediately.
6. Check tightness of all bolted/screwed joints.
7. Check the interlocks by simulating fault conditions. Resolve all flame safety problems before restarting the burner.
8. Check the direct burner surroundings for signs of excessive corrosion or deformation due to thermal overload or moisture. Repair or replace insulation or thermal protection shields if necessary.

#### As per Supplier's Instructions

1. Replace the UV scanner within the time frame as specified by the supplier.

#### Depending on the Circumstances

1. Check and clean or replace the combustion air filter if necessary.
2. Clean the burner. Flame shields and burner modules must not be covered with dust or dirt.

### Troubleshooting

Troubleshooting of electrical circuits should be done by qualified plant electricians, technicians or engineers experienced in all facets of this type of combustion equipment.

Problem	Possible Cause	Solution
Cannot initiate startup sequence.	Air pressure switch has not made contact.	Check air pressure switch adjustment. Check air filter. Check for correct rotation of the blower wheel.
	External interlock failure.	Check all external interlocks.
	High gas pressure switch has activated.	Check pressure switch settings.
	Low gas pressure switch has activated.	Check pressure switch settings.
	Malfunction of the flame safeguard.	Have a qualified electrician troubleshoot and correct the problem.
	No power to the flame safeguard.	
Burner sequence starts but locks out before ignition.	Combustion air fault: Blower failure.	Check blower and remedy the fault.
	Combustion air fault: Blocked blower inlet or filter.	Clean inlet. Clean or replace filter.
	Combustion air fault: Pressure switch failure.	Check operation of the pressure switch and replace it if necessary.
	Combustion air fault: 3-way solenoid valve failure.	Check solenoid valve. Replace coil if necessary.

<b>Problem</b>	<b>Possible Cause</b>	<b>Solution</b>
Startup sequence runs but burner does not light.	No ignition: No power to the ignition transformer.	Check the output from the flame safeguard and the wiring between the flame safeguard and the ignition transformer.
	No ignition: Open circuit between the ignition transformer and the ignition electrode.	Repair or replace wiring to the ignition electrode.
	No ignition: Ignition electrode needs cleaning.	Clean the ignition electrode.
	No ignition: The ignition electrode is not properly grounded to the burner.	Clean the threads on the ignition electrode and burner.
	No ignition: Ignition electrode insulator is broken.	Inspect the ignition electrode and replace if broken.
	Not enough gas: The pilot gas valve is not opening.	Check wiring between the flame safeguard and the pilot gas valve. Check the output from the flame safeguard.
	Not enough gas: The pilot gas flow is adjusted too low.	Open adjusting valve one turn.
Pilot flame appears, but main burner does not ignite.	Not enough gas: Second shut-off valve not opening.	Check the wiring between the flame safeguard and the second shut-off valve. Check output from the flame safeguard. Open manual ball valve. Replace the shut-off valve if necessary.
	Not enough gas: low-fire setting too low or too high.	Adjust ratio controller bias.
	Not enough gas: High-fire adjusting valve closed.	Open adjusting valve to correct pre-setting.
Burner lights and then goes to lock-out.	No flame signal: Dirty UV scanner lens.	Inspect and clean UV scanner.
The high-fire flame is orange or yellow. Burner parts are excessively hot.	Gas/air ratio out of adjustment: Gas mixer nozzle blocked.	Clean nozzle.
	Gas/air ratio out of adjustment: Blocked loading line.	Check/clean loading line.
	Gas/air ratio out of adjustment: Air mixing plate blocked.	Clean gas/air mixer.
	Gas pressure too high: High-fire adjusting valve too far open.	Check burner data for correct pressures
	Gas pressure too high: Gas ratio regulator failure.	Replace gas ratio regulator.
The low-fire flame is orange or yellow. Burner elements are glowing.	Too much gas.	Adjust ratio regulator. If necessary check the low fire fuel/air adjustments.
The low-fire flame is weak and unstable. Flame signals are low.	Insufficient gas flow to the burner or too much air.	Adjust the low-fire setting on the ratio regulator.
	Not enough air.	Adjust combustion air valve. Clean or replace filter. Check blower rotation.

<b>Problem</b>	<b>Possible Cause</b>	<b>Solution</b>
High-fire flame is weak and blue, flame signals are low.	Insufficient gas flow to the burner.	Check burner gas adjustment and readjust. Gas nozzle blocked.
Burner does not reach its specified capacity.	Not enough air: Air butterfly valve does not open.	Check air control motor limit settings.
	Not enough air: Blower is running in reverse.	Check and correct blower wiring.
	Not enough air: Inlet or filter blocked.	Clean inlet or filter. Replace filter if necessary.
	Not enough air: Burner elements blocked.	Clean burner elements.
	Not enough gas (air is ok): Gas pressure into the ratio regulator is too low.	Check for sufficient gas pressure.
Flame has irregular pattern showing holes.	Burner elements blocked. Damaged elements.	Clean burner elements. Replace burner module.



# Appendix

## Conversion Factors

### Metric to English

From	To	Multiply By
actual cubic meter/h (am <sup>3</sup> /h)	actual cubic foot/h (acfh)	35.31
normal cubic meter/h (Nm <sup>3</sup> /h)	standard cubic foot /h (scfh)	38.04
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	Btu/h	3415
meter (m)	foot (ft)	3.281
millibar (mbar)	inches water column ("w.c.)	0.402
millibar (mbar)	pounds/sq in (psi)	14.5 x 10 <sup>-3</sup>
millimeter (mm)	inch (in)	3.94 x 10 <sup>-2</sup>
MJ/Nm <sup>3</sup>	Btu/ft <sup>3</sup> (standard)	26.86

### Metric to Metric

From	To	Multiply By
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

### English to Metric

From	To	Multiply By
actual cubic foot/h (acfh)	actual cubic meter/h (am <sup>3</sup> /h)	2.832 x 10 <sup>-2</sup>
standard cubic foot /h (scfh)	normal cubic meter/h (Nm <sup>3</sup> /h)	2.629 x 10 <sup>-2</sup>
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) x 5/9
pound (lb)	kilogram (kg)	0.454
Btu/h	kilowatt (kW)	0.293 x 10 <sup>-3</sup>
foot (ft)	meter (m)	0.3048
inches water column ("w.c.)	millibar (mbar)	2.489
pounds/sq in (psi)	millibar (mbar)	68.95
inch (in)	millimeter (mm)	25.4
Btu/ft <sup>3</sup> (standard)	MJ/Nm <sup>3</sup>	37.2 x 10 <sup>-3</sup>



# *Notes*

