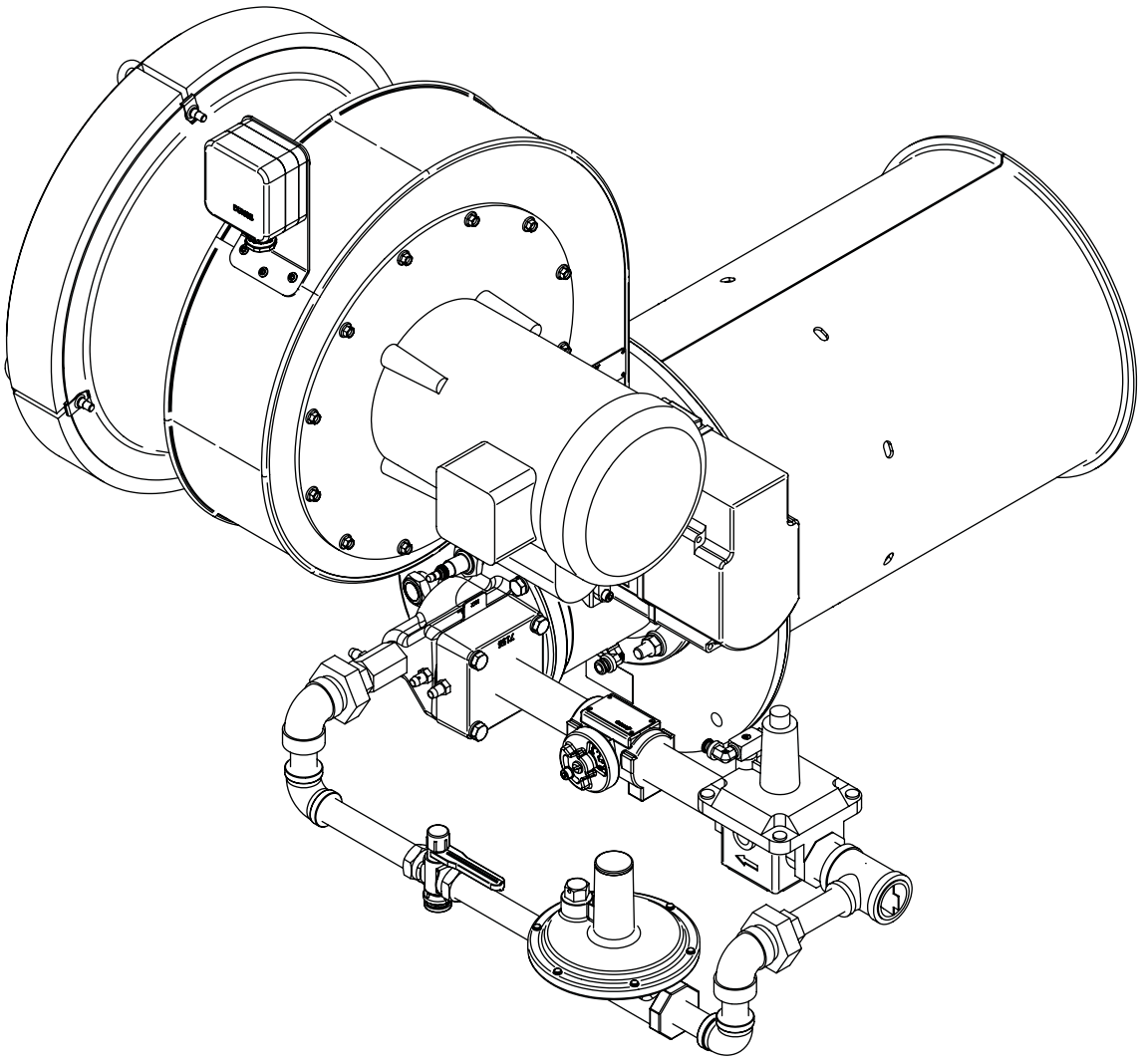
Design Guide 111
2/26/2010

Eclipse Winnox Burners

WX Series

Version 2



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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 injury 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

Introduction 1

Product Description

The Winnox is a nozzle-mix, low-emissions burner designed for direct and indirect air heating, as well as oven applications up to 1800°F (980°C).

The burner package includes a combustion air blower and ratio regulator to fire over a wide gas turndown range at a controlled ratio.

The burner is designed for:

- low NO_x and CO emissions
- efficient ratio controlled combustion
- reliable burner operation
- simple burner adjustment
- direct spark ignition
- multiple fuel capability

The wide variety of options and configurations are available due to the modular design of the burner.

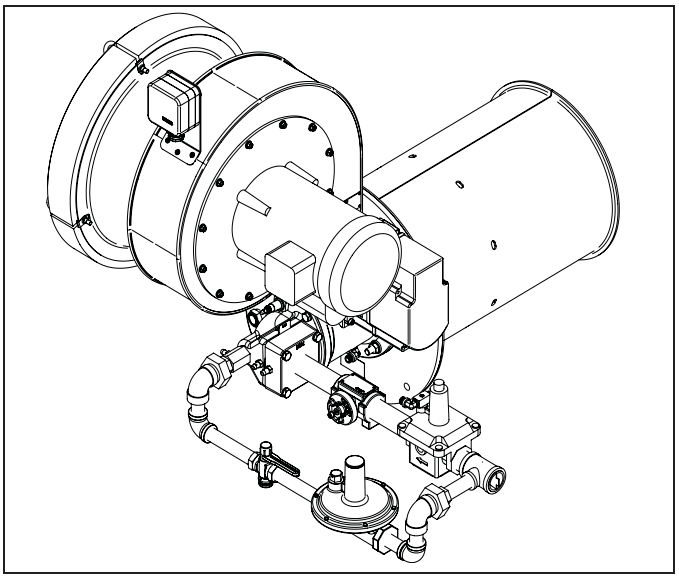

Figure 1.1 Winnox Burner

Audience

This manual has been written for people who are already familiar with all aspects of a nozzle-mix burner and its add-on components, also referred to as “the burner system”.

These aspects are:

- Design / Selection
- Use
- Maintenance

The audience is expected to have previous experience with this type of equipment.

Winnox Documents

Design Guide No. 111

- This document

Datasheet, Series 111

- Available for individual WX models
- Required to complete design and selection

Installation Guide No. 111

- Used with Datasheet to complete installation

Related Documents

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides: 684, 710, 732, 742, 756, 760, 902, 930

Purpose

The purpose of this manual is to ensure the design of a safe, effective, and trouble-free combustion system.

Safety

2

Introduction

This section is provided as a guide for the safe operation of the Winnox burner system. All involved personnel should read this section carefully before operating this system.

Safety

DANGER

- **The Winnox burners 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. Fires and explosions can be caused.**
- **Never try to light the burner if the burner shows signs of damage or malfunctioning.**

WARNING

- **The burner might have HOT surfaces. Always wear protective clothing when approaching the burner.**

NOTICE

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

Capabilities

Adjustment, maintenance and troubleshooting of the mechanical and the electrical parts of this system should be done by qualified personnel who have experience with combustion equipment.

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.

Replacement Parts

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

System Design 3

Design

The design process is divided into the following steps:

1. **Burner Option Selection Including:**
   - Burner Model / Size Selection
   - Firing Position
   - Burner Configuration
   - Fuel Type
   - Pilot Configuration
   - Combustor Type
   - Air Supply
   - Control Motor
   - Limit Switch
   - Loading Line Type
   - Air Pressure Switch
   - Pipe Connections
   - Flame Supervision
2. **Packaged Blower Option Selection Including:**
   - Power Supply Frequency
   - Pressure & Flow
   - Blower Motor Type
   - Blower Inlet
   - Blower Configuration
3. **Control Methodology Including:**
   - Burner Control
4. **Ignition System Including:**
   - Ignition Transformer
   - Trial for Ignition
   - Ignition Gas Piping
5. **Flame Monitoring Control System Including:**
   - Flame Sensor
   - Flame Monitoring Control
6. **Main Gas Shut-Off Valve Train Including:**
   - Component Selection
   - Fuel Flow Measurement
   - Valve Train Size
7. **Verify Chamber Design:**
   - Firing Chamber Dimensions
   - Flame Shielding

Step 1: Burner Option Selection

Step 1 describes how to select burner options to suit an application. Use the Winnox Price List and Datasheets, series 111 when following this selection process.

⚠ CAUTION

- **Consult EFE-825 Eclipse Engineering Guide or contact Eclipse if you have special conditions or questions.**

Burner Model / Size Selection

Consider the following when selecting the burner size:

- **Heat Input:** Calculate the required heat input to achieve the required heat balance. The burner air supply option selected will affect available heat output from the burner.
- **Power Supply Frequency:** Burner capacity will vary with power supply frequency (50 Hz or 60 Hz power).
- **Combustion Chamber Pressure:** Consider the effects that large or varying chamber pressures have on burner performance.
- **Altitude:** The maximum burner capacity is reduced by approximately 3% each 1000 feet (300 meters) above sea level.
- **Combustion Air Supply:** Combustion air should be fresh (20.9% O_2) and clean (without particles or corrosives).
- **Combustion Air Temperature:** Changes in air supply temperature can affect the burner capacity. The combustion air supply temperature should not exceed 250°F.
- **Fuel Type:** Variation in calorific value and density will affect burner performance. Nominal burner performance is based on fuel properties in Table 3.1.

Firing Position

- Vertical down firing
- Vertical up firing
- Horizontal firing

Burner Configuration

Select configuration. See Figure 3.1.

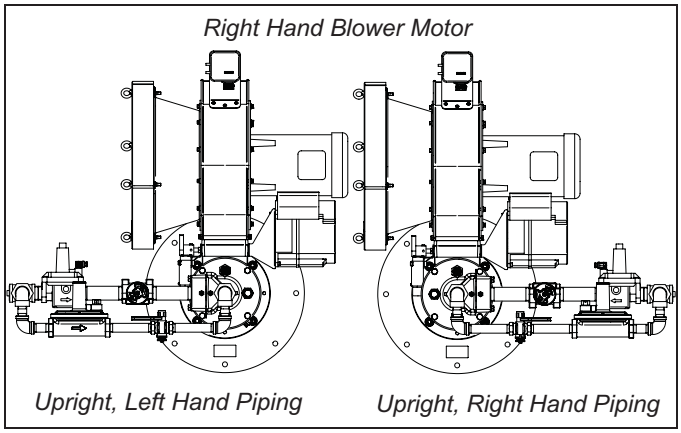

Figure 3.1 Burner Configuration & Motor Orientation Choice

Fuel Type

Table 3.1 Fuel Type

Fuel	Symbol	Gross Heating Value	Specific Gravity
Natural Gas	$CH_4$90%+	1000 BTU/ft^3 (40.1 MJ/m^3)	0.60
Propane	C_3H_8	2525 BTU/ft^3 (101.2 MJ/m^3)	1.55
Butane	C_4H_{10}	3330 BTU/ft^3 (133.7 MJ/m^3)	2.09
BTU/ft^3 @ standard conditions (MJ/m^3 @ normal conditions)			

If using an alternative fuel supply, contact Eclipse with an accurate breakdown of the fuel components.

Pilot Configuration

Winnox burners are equipped with a standard integral bypass pilot. No additional hookups are required to operate this pilot. All bypass regulators are supplied with a vent limiting orifice or a vent protector. For additional configurations contact Eclipse.

Combustor Type

Select a combustor type based on the application:

Table 3.2 Recommended Maximum Chamber Temp

Recommended Maximum Chamber Temperature °F (°C)			
Model	**Standard Alloy Tube**	**High Temp Alloy Tube**	**Refractory Plug**
100, 200	1300° (704°)	1550° (843°)	1800° (982°)
300, 400	1300° (704°)	1550° (843°)	1800° (982°)
500, 600	1300° (704°)	1550° (843°)	1800° (982°)
850	1100° (593°)	1400° (760°)	Not Available

Tube and plug temperatures should be reduced 150°F (65°C) when using propane or butane.

NOTE: When using a refractory plug, the customer must provide their own refractory combustion tube set up per Eclipse dimensions, see Datasheet series 111 and Installation Guide 111.

Air Supply

Select either a combustion air blower mounted directly to the burner body, or a pipe connection type for remote blower operation.

Control Motor

Select a control motor. Standard control motor options include various models, provided mounted to the burner. Winnox burners can be ordered with control motor bracket and mounting hardware only. Customer supplied control motors must conform to these specifications:

- rotation not to exceed 2 rpm
- minimum torque of 25 in-lb (2,8 Nm)
- 90° stroke
- continuous modulating or high/low modulating control
- reversible direction of rotation
- certain applications may require control motors with a limit switch or switches if:
  - the burner capacity is to be limited to fit an application
  - the chamber is to be fired with positive or negative pressure
  - the chamber pressure is outside the range -1" w.c. to +1" w.c. (-2,5 to 2,5 mbar)
  - there is a need to indicate a high and/or low fire air butterfly valve position

Limit Switch

Limit switches monitor the position of the integral air butterfly valve. Select high, low, high and low, or no limit switch option. Proper selection is based on preference, control system, and local code.

Loading Line Type

All Winnox burners have the option of plastic, flexible braided stainless steel or rigid stainless tubing loading line. Selection depends on application and environment.

Air Pressure Switch

The air pressure switch provides a signal to the monitoring system when there is not enough air pressure from the blower. If a switch is selected, it will be factory mounted.

⚠ WARNING

- **Eclipse supports the NFPA regulation requiring, as a minimum standard for main gas shut-off**

systems, the use of an air pressure switch in conjunction with other system components.

Pipe Connections

Select the gas pipe connection thread type. The piping, burner gas inlet, and fuel train components are threaded using the customer selected pipe thread option.

Flame Supervision

Select a flame rod or an ultraviolet (UV) scanner. Both are available on all Winnox burners. If a flame rod is selected, it will be factory mounted in the burner. If a UV scanner is selected, it must be ordered separately. See step 5 for additional information on flame supervision selection.

Step 2: Packaged Blower Option Selection

NOTE: Standard blower options are listed in Price List 111, additional blower options are available through Eclipse. Price and leadtime may vary.

Power Supply Frequency

Select the 50Hz or 60Hz option. The 50Hz blower motors have IEC frames and are CE marked. The 60Hz motors have NEMA frames.

Pressure & Flow

Eclipse integrated packaged blowers are designed to provide the required pressure and flow in standard conditions. For information regarding non-standard conditions, please refer to the appropriate datasheet series 111.

Blower Motor Type

Motor types include various options: voltages, single or three phase, TEFC or automotive duty enclosures.

Blower Inlet

When selecting an inlet, consider the following:

- amount and size of particles in the air
- sound requirements
- space limitations
- cleanliness requirements of the process

Blower Configuration

Right-hand blower motor is the standard blower configuration. If left-hand blower motor is required, contact factory. Refer to Figure 3.1.

Step 3: Control Methodology

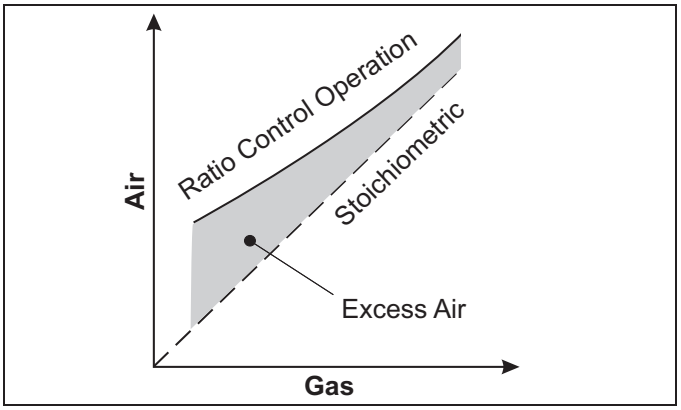

Figure 3.2 Air : Gas Flow

All standard Winnox burners are designed for:

- air : gas ratio controlled combustion
- 40 - 70% excess air at high fire
- higher excess air at low fire

Burner Control

Winnox burners come with a ratio regulator that maintains the air : gas ratio. An integral minimum fuel bypass line is used to maintain and control a reliable low fire input flow.

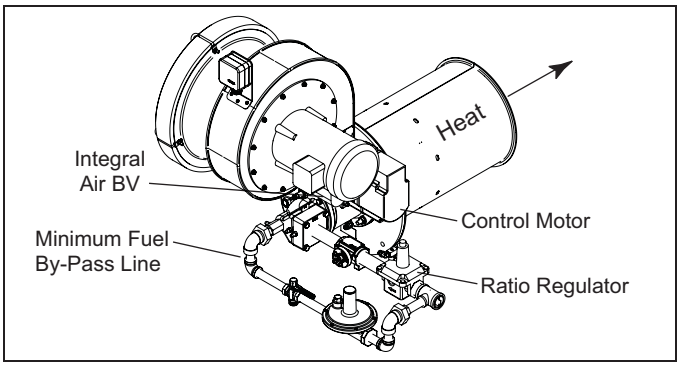

Figure 3.3 Basic Burner Components

- A control signal is sent from a process temperature controller (sold separately) to the control motor. (Contact Eclipse for further information on temperature controllers.)

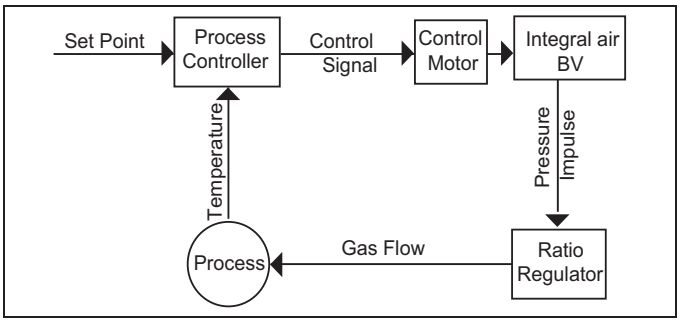

Figure 3.4 Basic Control Loop

- The control motor modulates the integral air butterfly valve which controls the combustion air flow.

- Air pressure in the burner body sends an impulse through the loading line to the ratio regulator.
- The ratio regulator controls the gas flow in proportion to the air flow.

WARNING

- **Do not use other control methods, such as, a fixed-air control, and do not alter the ratio regulator or burner piping without prior approval from Eclipse. See Installation Guide 111 "Adjustment, Start & Stop" section.**

Step 4: Ignition System

Ignition Transformer

For the ignition system, use a transformer with:

- secondary voltage 6,000 to 8,000 VAC
- minimum secondary current 0.02 amps continuous
- full wave output

DO NOT USE the following:

- twin outlet
- distributor type
- half wave output

Trial for Ignition

The burner may only be lit with low fire settings.

Most local safety codes and insurance requirements limit the maximum trial for ignition time (the time it takes for a burner to ignite). These requirements vary from one location to another; check your local codes and comply to the strictest codes applicable.

The time it takes for a burner to ignite depends on the following:

- the distance between the gas shut-off valve and the burner
- the air : gas ratio
- the gas flow conditions at start-up

Ignition Gas Piping

Winnox burners are capable of ignition with either low fire or bypass start gas.

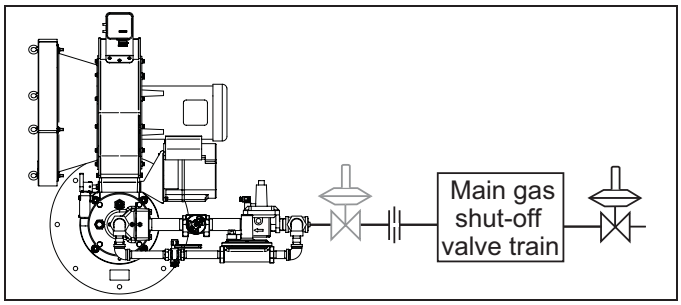

Figure 3.5 Low Fire Start

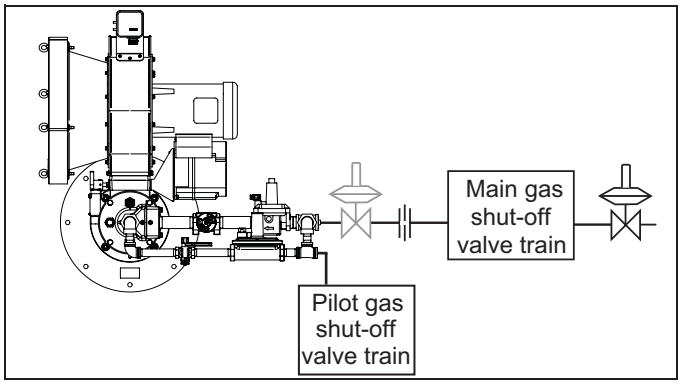

Figure 3.6 Pilot Start (Optional)

Piping for pilot start option needs to be sized to accommodate low fire gas flows as stated in Datasheet, series 111.

Step 5: Flame Monitoring Control System

The flame monitoring control system consists of two main components:

- Flame Sensor
- Flame Monitoring Control

Flame Sensor

Two types can be used on a Winnox Burner:

- Flame rod
- UV scanner

Flame rods are available for all Winnox burner sizes. Further information can be found in:

- Info Guide 832

A UV scanner can be used on all Winnox burner sizes. The UV scanner must be compatible to the flame monitoring control that is used. Refer to the manual of your selected control for proper selection of the scanner.

Flame Monitoring Control

The flame monitoring control processes the signal from the flame sensor and controls the start-up and shut-down sequences.

Eclipse recommends the following flame monitoring controls:

- Trilogy series T400; see Instruction Manual 830
- Veri-Flame series 5600: see Instruction Manual 818
- Bi-Flame series 6500: see Instruction Manual 826
- Multi-Flame series 6000; see Instruction Manual 820

If other controls are considered, contact Eclipse to determine how burner performance may be affected. Flame monitoring controls that have lower sensitivity flame detecting circuits may limit burner turndown and change the requirements for ignition. Flame monitoring controls that stop the spark as soon as a signal is detected may prevent establishment of flame, particularly when using UV scanners. The flame monitoring control must

maintain the spark for a fixed time interval that is long enough for ignition.

DO NOT USE the following:

- Flame monitoring relays which interrupt the trial for ignition when the flame is detected
- Flame sensors which supply a weak signal
- Flame monitoring relays with low sensitivity

WARNING

- **A UV scanner can possibly detect another burner's flame if it is in the line of sight, and falsely indicate flame presence. Use a flame rod in this situation. This helps prevent accumulation of unburned fuel which, in extreme situations, could cause a fire or an explosion.**

Step 6: Main Gas Shut-Off Valve Train

Component Selection

Eclipse can help in the design of or provide a main gas shut-off valve train that satisfies the customer and complies with all local safety standards and codes set by the authorities within that jurisdiction. Contact Eclipse for further information.

NOTE: Eclipse supports NFPA regulations (two gas shut-off valves as a minimum standard for main gas shut-off systems).

Fuel Flow Measurement

Eclipse requires a fuel flow measurement device ❶ to ensure proper operation of the Winnox Burner. Eclipse recommendations can be found in the appropriate Winnox Datasheet, series 111.

Valve Train Size

Fuel pressure supplied to the ratio regulator inlet must be within the range specified on the Winnox Datasheet, series 111. The valve train should be sized sufficiently to provide the specified pressure. A second main gas pressure regulator ❷ immediately upstream from the burner gas inlet might be necessary to maintain inlet pressure to the burner.

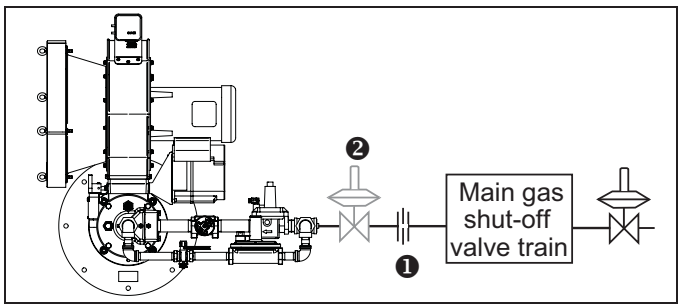

Figure 3.7 Low Fire Start

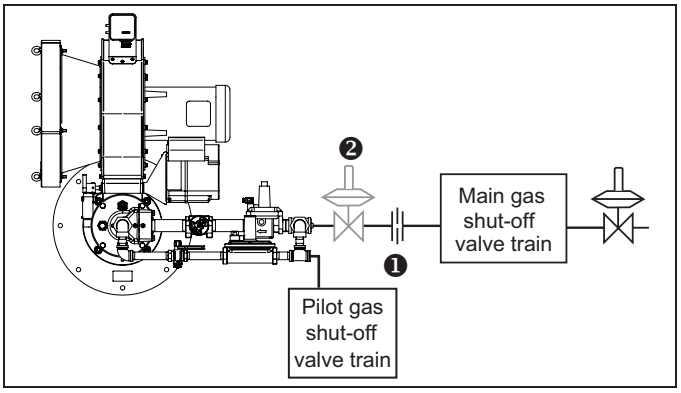

Figure 3.8 Pilot Start Option

WARNING

- **Do not operate Winnox burners with gas inlet pressure less than the minimum listed on the Winnox Datasheet. Lower gas inlet pressures may cause the ratio regulator to remain fully open at lower inputs as the burner transitions from low to high fire. This could result in the possible accumulation of unburned fuel in the burner which, in extreme situations, could cause a fire or an explosion.**

Step 7: Verify Chamber Design

Firing Chamber Dimensions

The Winnox is a low emissions burner that might require a larger firing chamber than a standard burner.

Chamber dimensions are a function of chamber temperature, process air volume and burner input. Contact your Eclipse representative to review your chamber design.

NOTE: See the Installation Guide for recommendations on wall and insulation construction when only installing the refractory plug.

Flame Shielding

In applications where process air may be flowing perpendicular over the combustor, a metal shroud should be installed around the combustor that is 20% larger than the combustor diameter and with a length that covers the combustor slots by 100 mm (4"). Slot dimensions can be found in Datasheet, series 111.

System Summary

Conversion Factors

Metric to English

From	To	Multiply By
cubic meter (m^3)	cubic foot (ft^3)	35.31
cubic meter/hr (m^3/h)	cubic foot/hr (cfh)	35.31
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	BTU/hr	3414
meter (m)	foot (ft)	3.28
millibar (mbar)	inches water column ("w.c.)	0.401
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/Nm^3	BTU/ft^3 (standard)	2.491×10^{-2}

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
BTU/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
cubic foot/hour (cfh)	cubic meter/hour (m^3/h)	2.832×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) ÷ 5/9
foot (ft)	meter (m)	0.3048
inch (in)	millimeter (mm)	25.4
inches water column ("w.c.)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95
BTU/ft^3 (standard)	MJ/Nm^3	40.14

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