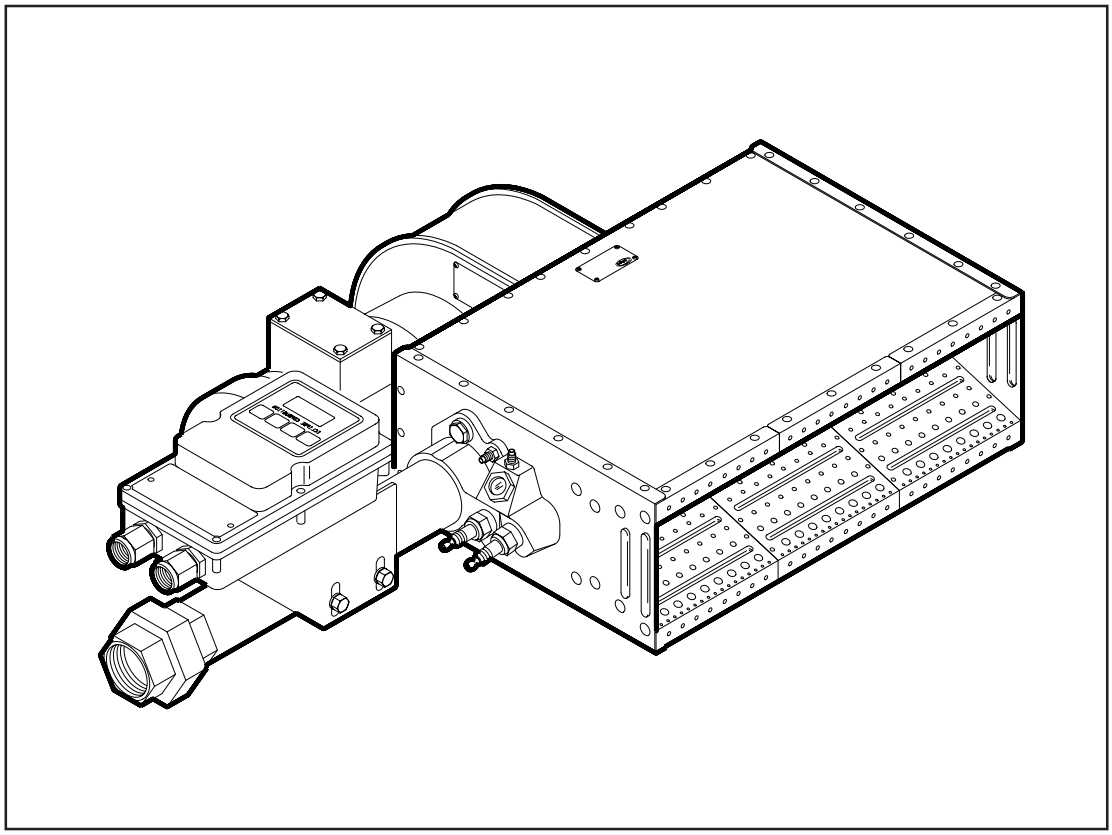
Design Guide
No. 135, 7/99
L00060

Eclipse AirHeat Burners

AH Series Version 2.00

(Patent Pending)



Eclipse Combustion

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DISCLAIMER NOTICE

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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 Documentation Manager.

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

About this manual

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 had experience with this kind of equipment.

Purpose

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

Air Heat v2.00 Documents

Design Guide No. 135

- This document

AirHeat Data Sheet 135

- Available for all AH v. 2.00 models
- Required to complete design & selection

Installation Guide No. 135

Used with Data Sheet to complete installation

Air Heat Price List No. 135

Used to order burners

Related Documents

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides: 710, 720, 732, 742, 760, 818, 832, 852, 854, 856, 610, 620, 630, 826, 820, 930, I-354.

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.

Danger:

Indicates hazards or unsafe practices which WILL result in severe personal injury or even death. Only qualified and well trained personnel are allowed to carry out these instructions or procedures.
Act with great care and follow the instructions.

Warning:

Indicates hazards or unsafe pratices which could result in severe personal injury or damage.
Act with great care and follow the instructions.

Caution:
Indicates hazards or unsafe practices which could result in damage to the machine or minor personal injury, Act carefully.

Note:
Indicates an important part of the text. Read thoroughly.

How to Get Help

If you need help, contact your local Eclipse Combustion representative. You can also contact Eclipse Combustion at any of the addresses listed on the back of this document.

Table of Contents

Introduction

1

Product Description

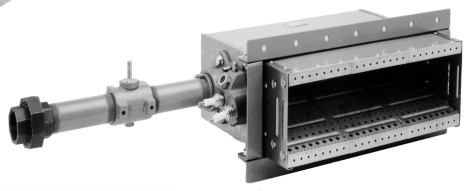
Eclipse AirHeat v2.00 Burners are line type burners ideal for generating large volumes of clean, hot air. Applications include ovens, dryers, fume incinerators, and similar industrial equipment. Burners are constructed of aluminum burner bodies and diverging stainless steel air wings. The burner bodies supply fuel to the center of the air wings. The air and fuel mixture inside the burner is controlled to optimize emissions and efficiency.

AirHeat v2.00 Burners are assembled from straight sections allowing for customized inputs. An integral combustion air blower can be ordered mounted on the back of the burner's steel case. By supplying the correct air volume and pressure to the burner, the blower allows stable operation over a wide range of duct velocities without installing a profile plate around the burner.

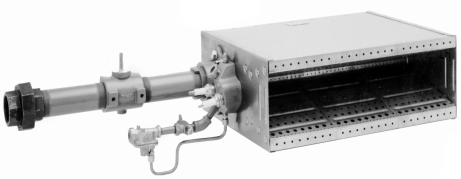
Brackets are available for slot firing or duct mounting and flanges are available for continuous flange mounting. Right hand or left hand gas piping can be supplied with BSP or NPT connections. A reduced port fuel control valve can be supplied with a variety of control motor and linkage options. Ignition can be by direct spark or by spark ignited pilot. Flame rod flame supervision can be from either or both ends. Several air flow switches are also available factory mounted on the burner.

AirHeat v2.00 Burners

Burner with blower



Burner less blower with inlet gas piping and fuel control valve and continuous mounting flanges.



Burner less blower with inlet gas piping and fuel control valve and spark ignited pilot.

Safety

2

INTRODUCTION

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

SAFETY

Danger:

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

Note:

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 Combustion.

Read the entire manual before attempting to start this system. If you do not understand any part of the information contained in this manual, contact your local Eclipse representative or Eclipse Combustion before continuing.

CAPABILITIES

Only qualified personnel, with good mechanical aptitude and experience on combustion equipment, should adjust, maintain, or troubleshoot any mechanical or electrical part of this system.

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

System Design

3

DESIGN

Design structure

The design process is divided into the following steps:

1. **Burner Option Selection including:**
   - Burner Model / Size Selection
   - Burner Style
   - Air Supply
   - Fuel Type
   - Manifold Type
   - Mounting Flange
   - Burner Configuration
   - Gas Pipe Connection
   - Control Valve
   - Ignition Type
   - Flame Supervision
   - Control Motor
   - Air Flow Switch
2. **Blower Option Selection including:**
   - Power Supply Frequency
   - Blower Motor Type
   - Blower Inlet
   - Motor Orientation
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
   - Valve Train Size

Step 1: Burner Option Selection

Step 1 describes how to select burner options to suit an application. Use the AirHeat Price List 135 and Data Sheet, 135 when following this selection process.

Caution:
Consult EFE-825, Eclipse Combustion Engineering Guide, or contact Eclipse Combustion 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.
- **Combustion Chamber Pressure**. Consider the effects that large or varying chamber pressures have on burner performance.
- **Altitude.** Data supplied is based on burner operation at sea level.
- **Combustion Air Supply.** Combustion air should be fresh (20.9% O_2) and clean (without corrosives).
- **Combustion Air Temperature.** Changes in air supply temperature can affect the burner performance. The combustion air supply temperature should not exceed 250° F.
- **Fuel Type.** Variation in calorific value and density will affect burner performance.

Burner Style

AH v2.00 Burners are available in straight sections only.

Air Supply

AirHeat Version 2.00 burners can be ordered with or without a combustion air blower directly mounted to the burner. For remote blower applications, see page 12, Remote Blower Sizing.

Fuel Type

Fuel	Symbol	Gross Heating Value Btu/ft^3 (MJ/m^3)	Specific Gravity	Stoichiometric Air/Gas Ratio ft^3(m^3)$_{air}$ / ft^3(m^3)$_{gas}$
Nat. gas	CH_4 90%+	1000 (40)	0.60	10
Propane	C_3H_8	2570 (103)	1.52	25
Butane	C_4H_{10}	3250 (130)	1.95	33
BTU/ft^3 @ standard conditions (MJ/m^3 @ normal conditions)				

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

Manifold Type

AH v2.00 Burners are available with aluminum burner manifolds only.

Mounting Flange

Select the mounting hardware best suited to your application. Hardware is available for Duct Mounting, Slot Firing and Continuous Flange Mounting.

Burner Configuration

Select configuration. Left hand or right hand piping is available. Configuration is based on viewing the burner from the air inlet.

Gas Pipe Connection

Select the gas pipe connection.

The piping, burner gas inlet, and fuel modulating valve (if selected) are threaded using the customer selected pipe thread option.

Control Valve

AirHeat Burners can be supplied with the following control options:

- Reduced Port Packaged. The control valve is sized based on burner input and fuel type. (See pages 3 & 4 of Data 135)
- Reduced Port Separate. Order when fuel control valve cannot be mounted directly to the burner due to system considerations.
- Less Control Valve. If not supplied by Eclipse, customer must supply a suitable fuel control valve capable of suppling fuel in accordance with the burners operating range.

Ignition Type

Ignition can be by direct spark or spark ignited pilot.

Flame Supervision

Flame supervision is by flame rod or UV scanner. Depending on configuration selected, flame sensor can be mounted at either or both ends of the burner. (Page 5, Data 135)

Control Motor

Select a control motor. Standard control motor options include various models which Eclipse will mount to the burner. Burners can be ordered with control motor bracket and mounting hardware only. Customer supplied control motors must conform to the 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.
  - there is a need to indicate a high and/or low fire butterfly valve (BV) position.

Step 1: Burner Option Selection *(continued)*

Air Flow Switch

The air flow 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 Combustion 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.

Step 2: Blower Option Selection

Note:

Standard blower options are listed in Price List 135, additional blower options are available through Eclipse Combustion. Price and leadtime may vary.

Power Supply Frequency

Blowers are available with 60Hz motors. Motors have NEMA frames.

Blower Motor Type

Motor types include various options: voltages, single or three phase.

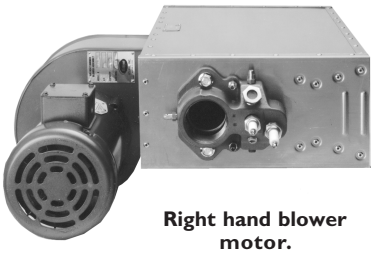
Blower Inlet

When selecting an inlet, consider the following:

- amount and size of particles in the air.
- cleanliness requirements of the process.

Motor Orientation

All AirHeat v2.00 Burners are assembled with a right-hand blower motor orientation.



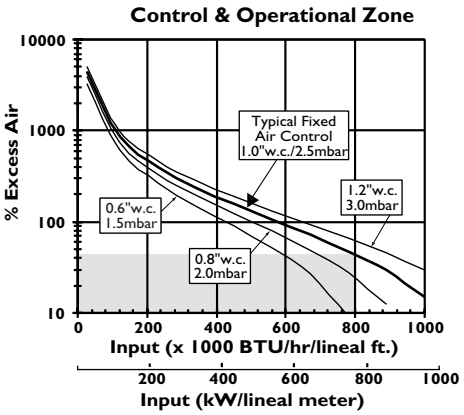
Right hand blower motor.

Remote Blower Sizing

For remote blower applications, the blower should be sized to supply sufficient flow and pressure to the burner to ensure proper burner performance.

Example

Fire an AH0200 burner on natural gas at 800,000 Btu/hr/lineal ft. resulting in maximum input of 1,600,000 Btu/hr at an air pressure drop of 1" w.c. In the chart at left, locate 800,000 Btu/hr/LF and read up to the 1" w.c. ΔP curve and then left to determine the excess air percentage. In this case, *44% excess air*.



Step 1: Determine Air Factor (1+ excess air %) = *1.44*

Step 2: Determine Fuel Flow $\left(\frac{\text{Input}}{\text{Gross Heating Value*}}\right)$

$$= \frac{1{,}600{,}000}{1000} = 1{,}600 \text{ scfh}$$

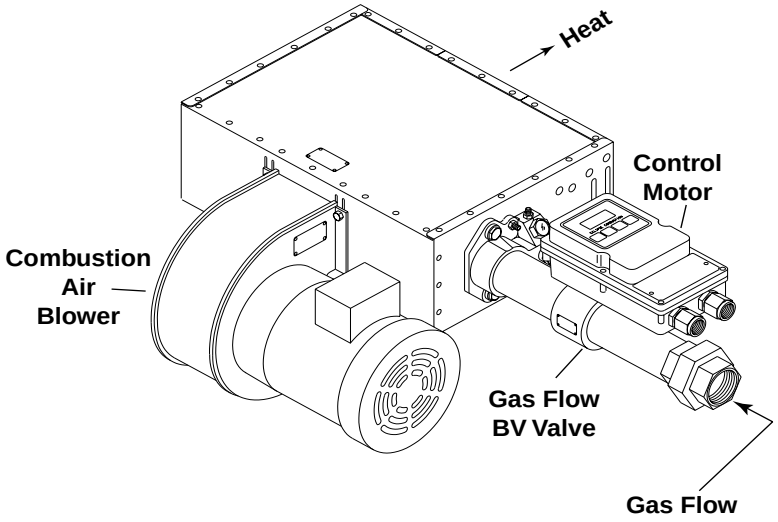
Step 3: Determine Air Flow
(Air Factor x Stoichiometric Air Requirement* x Fuel Flow).
1.44 x 10 x 1,600 = ***23,040 scfh air flow.***

(See Fuel Type Table on page 10.)*

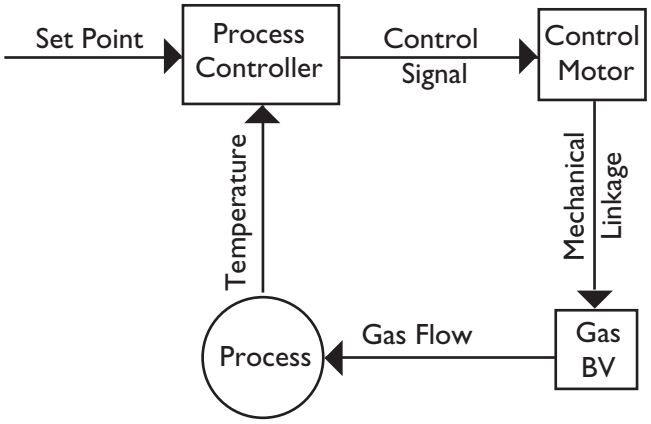
Step 3: Control Methodology

Turndown Method

Input is normally controled by a motorized butterfly valve in the gas line to the burner.



- A control signal is sent from a process temperature controller (sold separately) to the control motor. (Refer to Bulletin 818C or contact Eclipse Combustion for further information on temperature controllers.)



- The control motor modulates the gas butterfly valve (BV) which controls the fuel flow to the burner.
- Air pressure and flow in the burner body remain fixed throught the operating range.
- Modulation of fuel flow only, provides turndowns of 40:1

Warning:

Do not use other control methods without prior approval from Eclipse Combustion.

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 transformer
- distributor type transformer.

Trial For Ignition

It is recommended that low fire start be used. However, under certain circumstances AirHeats are capable of direct spark ignition at higher gas inputs.

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 gas flow conditions at start-up.

The possibility exists where the low fire is too low to ignite the burner within the maximum trial for ignition time. The following options must be considered under these conditions:

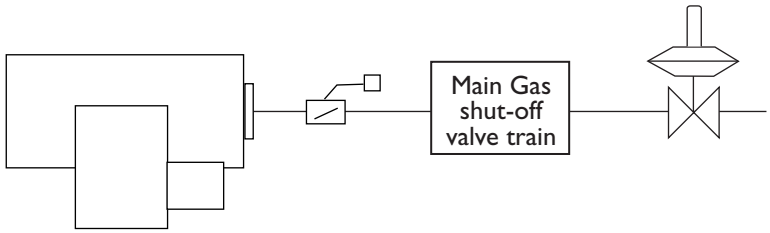
- start at higher gas input levels.
- resize and/or relocate the gas controls.
- use spark ignited pilot.

Step 4: Ignition System (continued)

Ignition Gas Piping

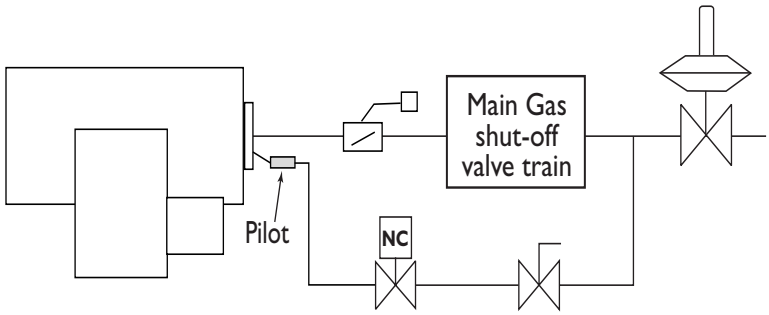
AirHeats are capable of ignition with either direct spark or spark ignited pilot.

Direct Spark Ignition:



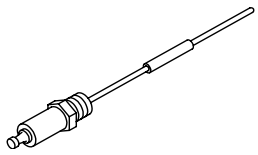
Spark Ignited Pilot:

When ordered, the pilot is packaged with the burner and includes an adjustable flow gas cock and pressure regulator.

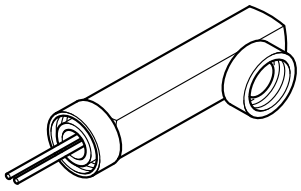


Caution:
It is not possible to use a continuous or intermittent pilot. The pilot fuel flow should be interrupted after the trial for ignition period has expired.

Step 5: **Flame Monitoring Control System**



Flame Rod



U.V. Scanner

The flame monitoring control system consists of two main components:

- Flame Sensor
- Flame Monitoring Control

Flame Sensor

Two types can be used on an AirHeat Burner:

- flame rod
- U.V. scanner

Flame rods are available for all AirHeat Burner sizes. Further information can be found in:

- Info Guide 832

A U.V. scanner can be used on all AirHeat Burner sizes. Further information can be found in:

- Info Guide 852; 90° U.V. scanner
- Info Guide 854; straight U.V. scanner
- Info Guide 856; self-check U.V. scanner

Flame Monitoring Control

The Flame Monitoring Control processes the signal from the flame rod, or U.V. scanner, and controls the start-up sequence and the main gas shut-off valve sequence.

Eclipse Combustion recommends the use of flame monitoring control systems which maintain a spark for the entire trial for ignition time when using U.V. scanners. Some of these flame monitoring models are:

- Veri-Flame; see Bulletin / Info Guide 610, 620, 630
- Bi-Flame series; see Instruction Manual 826
- Multi-Flame series 6000; see Instruction Manual 820

DO NOT USE:

- PCI Automatic flame monitoring
- Honeywell RM7890 series flame monitoring
- 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.

Step 6: Main Gas Shut-Off Valve Train

Component Selection

Eclipse Combustion can help in the design of 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 Combustion for further information.

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

Valve Train Size

Fuel pressure supplied to the burner inlet (Tap "B") must be 10"w.c. The valve train should be sized sufficiently to provide the specified pressure.

Appendix

Conversion Factors

Metric to English.

From	To	Multiply By
cubic meter (m^3)	cubic foot (ft^3)	35.31
cubic meter/hour (m^3/h)	cubic foot/hour (cfh)	35.31
degrees Celsuis (°C)	degrees Fahrenheit (°F)	(°C x 1.8) + 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/m^3 (normal)	BTU/ft^3 (standard)	2.491×10^{-2}

Metric to Metric.

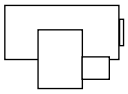
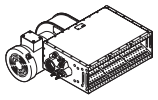
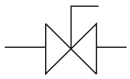
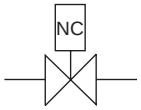
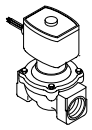
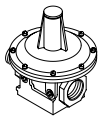
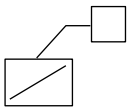
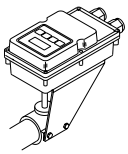
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

English to Metric.

From	To	Mulitply By
BTU/hr	kilowatt (kW)	0.293×10^{-3}
cubic foot (ft^3)	cubic meter (m^3)	2.832×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F – 32) ÷ 1.8
foot (ft)	meter (m)	0.3048
inches (in)	millimeter (mm)	25.4
inches water column (“wc)	millibar (mbar)	2.49
pound (lb)	kilogram (kg)	0.454
pounds/sq in (psi)	millibar (mbar)	68.95
BTU/ft^3 (standard)	MJ/m^3 (normal)	40.14

KEY TO SYSTEM SCHEMATICS

These are the symbols used in the schematics.

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		AirHeat Burner		
		Main Gas Shutoff Valve Train	Eclipse Combustion, Inc. strongly endorses NFPA as a minimum	756
		Gas Cock	Gas cocks are used to manually shut off the gas supply on both sides of the main gas shut-off valve train.	710
		Solenoid Valve (normally closed)	Solenoid valves are used to automatically shut off the gas supply on a bypass gas system or on small capacity burners.	760
		Pressure Regulator	A pressure regulator reduces gas pressure to a stable, usable pressure.	684
		Automatic Gas Control Valve	An automatic gas control valve adjusts gas flow to the burner based on control system requirements.	720

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