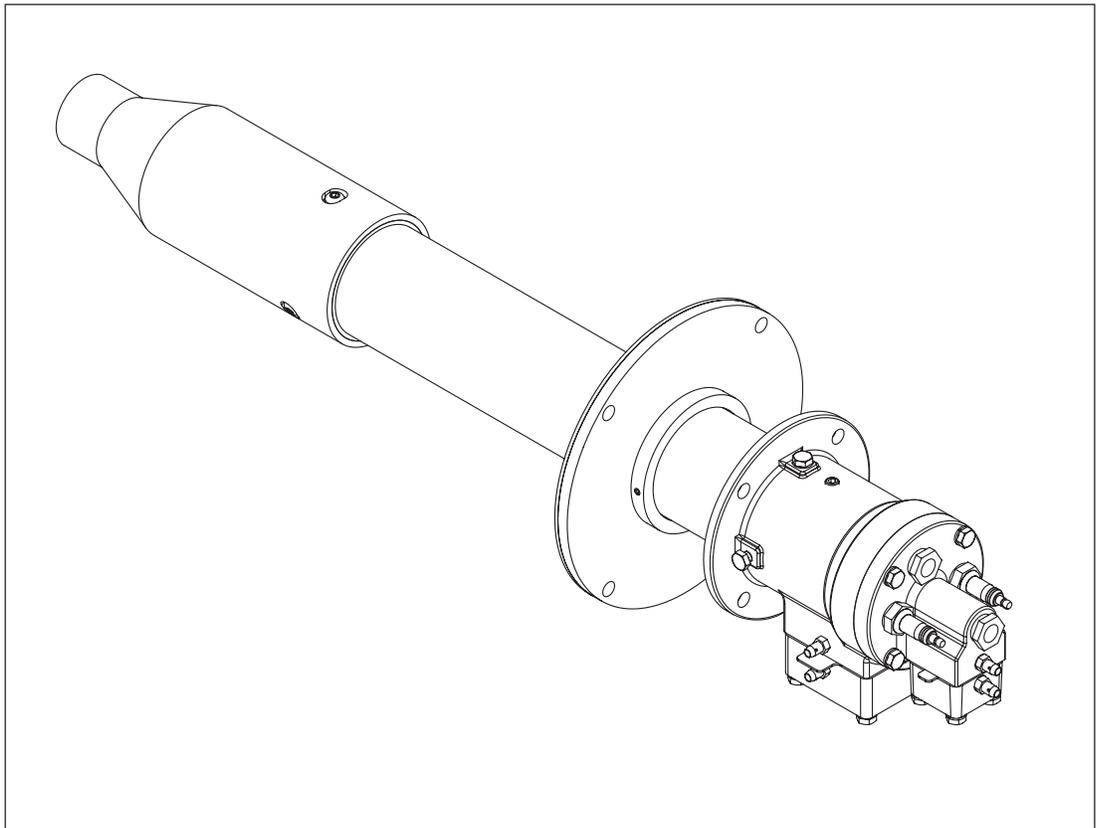




# *ExtensoJet* *Burners*

*Models EJ025 – EJ075*

*Version 2*



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# 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.

## EXTENSOJET DOCUMENTS

### ***Design Guide No. 230***

- This document

### ***Data Sheet No. 230-1 through 230-3***

- Available for individual EJ models
- Required to complete design calculations in this guide

### ***Installation Guide No. 230***

- Used with Data Sheet to complete installation

### ***Price List No. 230***

- Used to order burners

## RELATED DOCUMENTS

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

### **Purpose**

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

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



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# Introduction

# 1

## PRODUCT DESCRIPTION

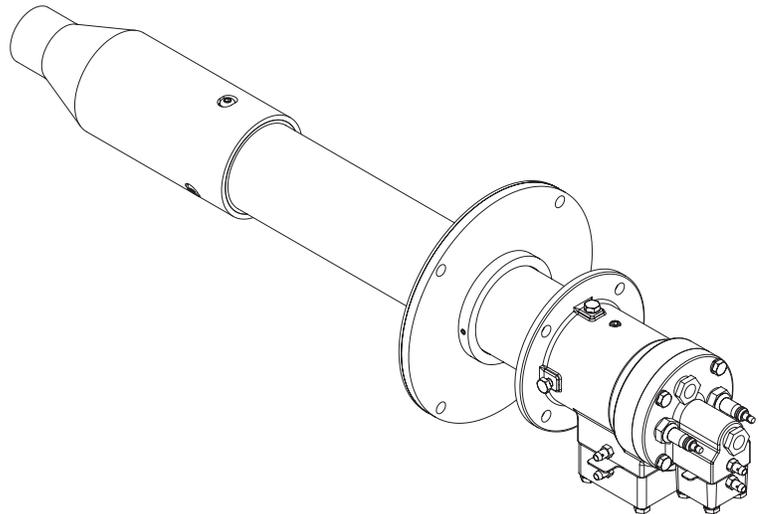
The Extensojet is a nozzle-mix burner that is designed to fire an intense stream of hot gases through a silicon tipped extended combustor using ambient combustion air.

The high velocity of the gases improves temperature uniformity, product quality and system efficiency. The gas velocity can be as high as 500/ft/s. The combustor comes in varying lengths from 20 inches to 56 inches.

The burner is designed for:

- On-Ratio control
- Direct Spark Ignition
- Flame Rod Supervision
- Multiple Fuel Capability

**Figure 1.1 The Extensojet Burner**





# 2

## INTRODUCTION

## SAFETY

Important notices about safe burner operation will be found in this section.



### **Danger:**

---

**The burners covered in this manual are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions when 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 is likely to have HOT surfaces. Always wear protective clothing when approaching the burner.**



### **Note:**

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

*Read this entire manual before attempting to start the system. If any part of the information in this manual is not understood, then contact your local Eclipse Combustion representative or Eclipse Combustion before continuing.*

## **CAPABILITIES**

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

## **OPERATOR TRAINING**

The best safety precaution is an alert and competent operator. Thoroughly instruct new operators so they demonstrate an adequate understanding of the equipment and its operation. Regular retraining must be scheduled to maintain a high degree of proficiency.

## **REPLACEMENT PARTS**

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



# System Design

# 3

## DESIGN

### *Step 1: Burner model selection*

### Design structure

Designing a burner system is a straight-forward exercise of combining modules that add up to a reliable and safe system.

The design process is divided into the following steps:

1. Burner model selection:
  - a. the burner size and quantity
  - b. the fuel type and pressure
2. Control methodology
3. Ignition system
4. Flame monitoring system
5. Combustion air system: blower and air pressure switch
6. Main gas shut-off valve train selection
7. Process temperature control system

### Burner size and quantity

Select the size and number of burners based on the heat balance. For heat balance calculations, refer to the Combustion Engineering Guide (EFE 825).

Performance data, dimensions and specifications are given for each ExtensoJet model in:

- Data Sheets 230-1 through 230-3

### Fuel type & fuel pressure

The usable fuel types are:

- natural gas
- propane
- butane

For other fuels less than 800 Btu/ft (330 MJ/m<sup>3</sup>) contact Eclipse Combustion with an accurate breakdown of the fuel contents.

The gas pressure must be at the minimum level shown.

The required gas pressure at the burner can be found in:

- ExtensoJet Data Sheets 230-1 through 230-3

## Step 2: Control Methodology

The control methodology is the basis for the rest of the design process. Once it is known what the system will look like, the components that are in it can be selected. The control methodology chosen depends on the type of process to be controlled.



### Note:

*The stated operational characteristics only apply if the described control circuits are followed. Use of different control methods will result in unknown operational performance characteristics. Use the control circuits contained within this section or contact Eclipse Combustion for written, approved alternatives.*

### Control methods

On-Ratio control using a ratio regulator is the preferred control method for an Extensojet system.

In the pages that follow, you will find a schematic of the control method.

### Automatic gas shut-off by burner or shut-off by zone

The automatic gas shut-off valve can be installed in two operational modes:

#### 1. Automatic gas shut-off by burner

If the flame monitoring system detects a failure, the gas shut-off valves close the gas supply to the burner that caused the failure.

#### 2. Automatic gas shut-off by zone

If the flame monitoring system detects a failure, the gas shut-off valves close the gas supply to all the burners in the zone that caused the failure.



### Note:

*All Extensojet control schematics on the following pages reflect a single gas automatic shut-off valve.*



*This may be changed to conform to local safety and/or insurance requirements (Refer to page 9 of Extensojet Installation Guide No. 230).*

**Step 2: Control Methodology (continued)**

**Modulating gas & air**

**On-ratio control or excess air @ low fire**

A burner system with modulating control gives an input that is in proportion with the demands of the process. ANY input between high and low fire is possible.

**1. Air**

The control valve ① is in the air line. It can modulate air flow to any position between low and high fire air.

**2. Gas**

The ratio regulator ② allows the on-ratio amount of gas to go to the burner. Low fire gas is limited by the ratio regulator ②. High fire gas is limited by the manual butterfly valve ③.



Note:

The ratio regulator can be biased to give excess air at low fire

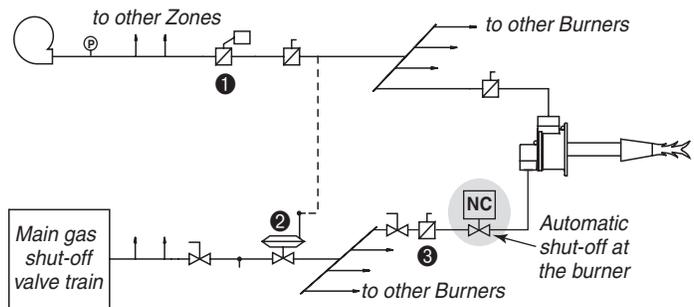


Note:

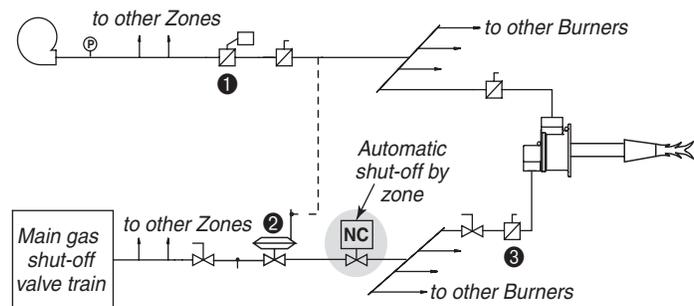
Do not use an adjustable limiting orifice (ALO) as the high fire gas limiting valve ③. ALO's require too much pressure drop for use in a proportional system.

**Figure 3.1 Modulating gas & air. On-ratio control or excess air @ low fire**

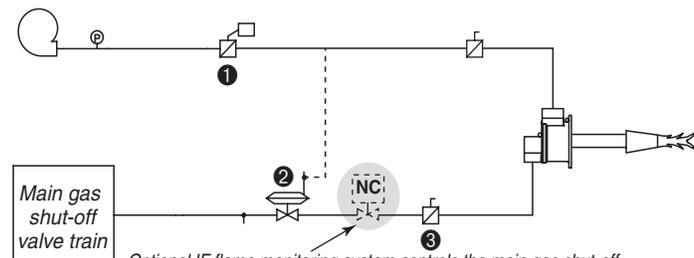
Multiple burners  
Automatic shut-off at the burner



Multiple burners  
Automatic shut-off by zone



Single burner



Optional IF flame monitoring system controls the main gas shut-off valve train AND ignition above 40% of maximum is NOT required.

### Step 3: Ignition System

#### For the ignition system use:

- 6,000 VAC transformer
- full-wave spark transformer
- one transformer per burner

#### **DO NOT USE:**

- 10,000 VAC transformer
- twin outlet transformer
- distributor type transformer
- half-wave transformer

It is recommended that low fire start be used.



#### Note:

*You must follow the control circuits described in the previous section, "Control Methodology," to obtain reliable ignition.*

Local safety and insurance require limits on the maximum trial for ignition time. These time limits vary from country to country.

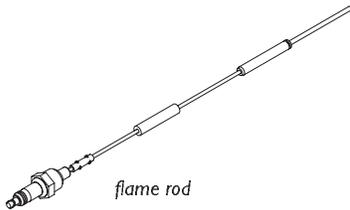
The time it takes for a burner to ignite depends on:

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

It is possible to have the low fire too low to ignite within the trial for ignition period. Under these circumstances you must consider the following options:

- start at higher input levels.
- resize and/or relocate the gas controls.

#### Step 4: Flame monitoring system



A flame monitoring system consists of two main parts:

- a flame sensor
- flame monitoring control

#### Flame sensor

There is one type that can be used with an ExtensoJet burner:

- flame rod

#### Flame Monitoring Control

The flame monitoring control is the equipment that processes the signal from the flame rod.

For flame monitoring control you may select several options:

- flame monitoring control for each burner: if one burner goes down, only that burner will be shut off
- multiple burner flame monitoring control: if one burner goes down, all burners will be shut off

There are three recommended flame monitoring controls:

- Bi-flame series; see instruction manual 826
- Multi-flame series 6000; see Instruction Manual 820
- Veri-flame; see Instruction Manual 818

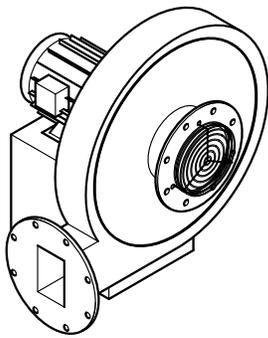
Eclipse recommends the use of flame monitoring control systems which maintain spark for the entire trial for ignition period with U.V. scanners. Some of these flame monitoring models are:

- Landis & Gyr
- Kromschroder
- Honeywell RM7895 series (**except** RM7895A1048 & RM7895C1020)
- PCI manual ignition

**DO NOT** use:

- PCI automatic
- Honeywell RM7890 series

**Step 5: Combustion Air System: Blower and air pressure switch**



Series SMJ turbo blower

**Effects of atmospheric conditions**

The blower data is based on the International Standard Atmosphere (ISA) at Mean Sea Level (MSL), which means that it is valid for:

- sea level
- 29.92" Hg (1,013 mbar)
- 70°F (21°C)

The make-up of the air is different, above sea level or in a hot area. The density of the air decreases, and as a result, the outlet pressure and the flow of the blower decrease. An accurate description of these effects is in the Eclipse Combustion Engineering Guide (EFE 825). The Guide contains tables to calculate the effect of pressure, altitude and temperature on air.

**Blower**

The rating of the blower must match the system requirements. You can find all the blower data in:

- Bulletin / Info Guide 610

Follow these steps:

1. Calculate the outlet pressure.

When calculating the outlet pressure of the blower, the total of these pressures must be calculated.

- the static air pressure required at the burner
- the total pressure drop in the piping
- the total of the pressure drops across the valves
- the pressure in the chamber (suction or pressurized)
- recommend a minimum safety margin of 10%

**Step 5: Combustion Air System: Blower and air pressure switch (continued)**

**2. Calculate the required flow**

The blower output is the air flow delivered under standard atmospheric conditions. It must be enough to feed all the burners in the system at high fire.

Combustion air blowers are normally rated in terms of standard cubic feet per hour (scfh) of air.

An example calculation follows the information tables below:

**Table 3.1 Required calculation information**

DESCRIPTION	UNIT OF MEASURE	FORMULA SYMBOL
Total system heat input	Btu/hr	Q
Number of burners	-	-
Type of fuel	-	-
Gross heating value of fuel	Btu/ft <sup>3</sup>	q
Desired excess air percentage (Typical excess air percentage @ high fire is 15%)	percent	%
Air/Gas ratio (Fuel specific, see table below)	-	$\alpha$
Air flow	scfh	V <sub>air</sub>
Gas flow	scfh	V <sub>gas</sub>

**Table 3.2 Fuel gas heating values**

FUEL GAS	STOICHIOMETRIC* AIR/GAS RATIO $\alpha$ (ft <sup>3</sup> <sub>air</sub> /ft <sup>3</sup> <sub>gas</sub> )	GROSS HEATING VALUE q (Btu/ft <sup>3</sup> )
Natural gas (Birmingham, AL)	9.41	1,002
Propane	23.82	2,572
Butane	30.47	3,225

\* Stoichiometric: No excess air. The precise amount of air and gas are present for complete combustion.

## EXAMPLE BLOWER CALCULATION

### Application example:

“A batch furnace has been designed and requires a heat input of 2,900,000 btu/hr. It has been decided to provide the required heat input with four burners operating on natural gas using 15% excess air.”

### Calculation example:

- a. Decide which ExtensoJet burner model is appropriate:

$$\frac{Q \text{ (total heat input) of } 2,900,000 \text{ btu/hr}}{4 \text{ burners}} = 725,000 \text{ Btu/hr/burner}$$

- Select 4 Model EJ075 ExtensoJet burners based on the required heat input of 725,000 Btu/hr for each burner.

- b. Calculate required gas flow:

$$V_{\text{gas}} = \frac{Q}{q} = \frac{2,900,000 \text{ btu/hr}}{1,002 \text{ Btu/ft}^3} = 2,894 \text{ ft}^3/\text{hr}$$

- Gas flow of 2,894 ft<sup>3</sup>/hr is required

- c. Calculate required stoichiometric air flow:

$$V_{\text{air-Stoichiometric}} = \alpha \text{ (air/gas ratio)} \times V_{\text{gas}} = 9.41 \times 2,894 \text{ ft}^3/\text{hr} \\ = 27,235 \text{ ft}^3/\text{hr}$$

- Stoichiometric air flow of 27,235 scfh required

- d. Calculate final blower air flow requirement based on the desired amount of excess air:

$$V_{\text{air}} = (1 + \text{excess air \%}) \times V_{\text{air-Stoichiometric}} \\ = (1 + 0.15) \times 27,235 \text{ ft}^3/\text{hr} = 31,320 \text{ ft}^3/\text{hr}$$

- For this example, final blower air flow requirement is 31,320 scfh at 15% excess air.



#### Note:

*It is common practice to add an additional 10% to the final blower air flow requirement as a safety margin.*

3. Find the blower model number and motor horsepower (hp).

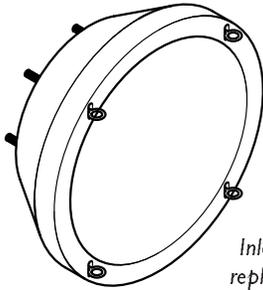
With the output pressure and the specific flow, you can find the blower catalog number and the motor hp in Bulletin / Info Guide 610.

4. Eclipse Combustion recommends that you select a Totally Enclosed Fan Cooled (TEFC) motor.

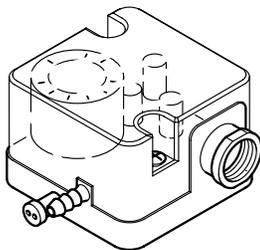
5. Select the other parameters:

- inlet filter or inlet grille
- inlet size (frame size)
- voltage, number of phases, frequency
- blower outlet location, and rotation direction Clockwise (CW) or Counter Clockwise (CCW).

**Step 5: Combustion Air System: Blower and air pressure switch (continued)**



Inlet filter with replaceable filter element



Air pressure switch

**Step 6: Main gas shut-off valve train**



**Step 7: Process Temperature Control System**



**Note:**

The use of an inlet air filter is strongly recommended. The system will perform longer and the settings will be more stable.



**Note:**

When selecting a 60 Hz Blower for use on 50 Hz, a pressure and capacity calculation is required. See Eclipse Combustion Engineering Guide (EFE 825)

The total selection information you should now have:

- blower model number
- motor hp
- motor enclosure (TEFC)
- voltage, number of phases, frequency
- rotation direction (CW or CCW).

**Air pressure switch**

The air pressure switch gives a signal to the monitoring system when there is not enough air pressure from the blower.

You can find more information on pressure switches in:

- Blower Bulletin 610



**Warning:**

**Eclipse Combustion supports NFPA regulations, which require the use of an air pressure switch in conjunction with other safety components, as a minimum standard for main gas safety shut-off systems.**

**Consult Eclipse**

Eclipse can help you design and obtain a main gas shut-off valve train that complies with the current safety standards.

The shut-off valve train must comply with all the local safety standards set by the authorities that have jurisdiction.

For details, please contact your local Eclipse Combustion representative or Eclipse Combustion.



**Note**

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

**Consult Eclipse**

The process temperature control system is used to control and monitor the temperature of the system. There is a wide variety of control and measuring equipment available.

For details, please contact your local Eclipse Combustion representative or Eclipse Combustion.



# Appendix

## CONVERSION FACTORS

### Metric to English.

FROM	TO	MULTIPLY BY
cubic meter (m <sup>3</sup> )	cubic foot (ft <sup>3</sup> )	35.31
cubic meter/hour (m <sup>3</sup> /h)	cubic foot/hour (cfh)	35.31
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C × 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 ("wc)	0.401
millibar (mbar)	pounds/sq in (psi)	14.5 × 10 <sup>-3</sup>
millimeter (mm)	inch (in)	3.94 × 10 <sup>-2</sup>

### Metric to Metric.

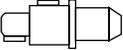
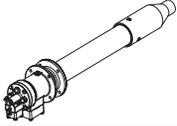
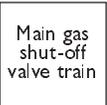
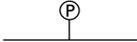
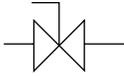
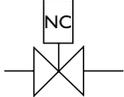
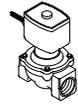
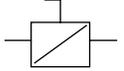
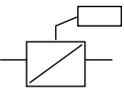
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

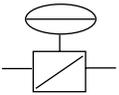
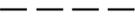
### English to Metric.

FROM	TO	MULTIPLY BY
Btu/hr	kilowatt (kW)	0.293 × 10 <sup>-3</sup>
cubic foot (ft <sup>3</sup> )	cubic meter (m <sup>3</sup> )	2.832 × 10 <sup>-2</sup>
cubic foot/hour (cfh)	cubic meter/hour (m <sup>3</sup> /h)	2.832 × 10 <sup>-2</sup>
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

## KEY TO SYSTEM SCHEMATICS

These are the symbols used in the schematics.

SYMBOL	APPEARANCE	NAME	REMARKS	BULLETIN/ INFO GUIDE
		ThermJet burner		
		Main gas shutoff valve train	Eclipse Combustion, Inc. strongly endorses NFPA as a minimum	756
		Combustion air blower	The combustion air blower provides the combustion air pressure to the burner (s).	610
		Air pressure switch	The air pressure switch gives a signal to the safety system when there is not enough air pressure from the blower.	610
		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 burner systems.	760
		Manual butterfly valve	Manual butterfly valves are used to balance the air or gas flow at each burner, and/or to control the zone flow.	720
		Automatic butterfly valve	Automatic butterfly valves are typically used to set the output of the system.	720

SYMBOL	APPEARANCE	NAME	REMARKS	BULLETIN/ INFO GUIDE
		Ratio regulator	<p>A ratio regulator is used to control the air/gas ratio. The ratio regulator is a sealed unit that adjusts the gas flow in ratio with the air flow. To do this, it measures the air pressure with a pressure sensing line, the impulse line. This impulse line is connected between the top of the ratio regulator and the air supply line.</p> <p>The cap must stay on the ratio regulator after adjustment.</p>	742
		CRS valve	<p>A CRS valve is used in a high/low time-proportional control system to quickly open and close the air supply.</p>	744
		Pressure taps	<p>The schematics show the advised positions of the pressure taps.</p>	
		Impulse line	<p>The impulse line connects the ratios regulator to the air supply line.</p>	





**Offered By:**

Power Equipment Company  
2011 Williamsburg Road  
Richmond, Virginia 23231  
Phone (804) 236-3800  
Fax (804) 236-3882

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