Eclipse Velocity Burners
ThermJet Series (version 1.0)
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About this manual

AUDIENCE

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

These aspects are:

- design/selection
- installation
- use
- maintenance.

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

SCOPE

Contents

This manual contains essential information that you need to deal with all the above mentioned aspects of the burner system.

Purpose

The purpose of this manual is to make sure that you carry out design, installation, use and maintenance in a safe, effective and trouble-free way.

IMPORTANT NOTICES

- Read this manual carefully. Make sure that you understand the structure and contents of this manual.
- Obey all the safety instructions.
- Do not deviate from any instructions or application limits in this manual without written advice from Eclipse Combustion, Inc.
- If you do not understand any part of the information in this manual, then do not continue. Contact your Eclipse representative or Eclipse Combustion, Inc.
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 the text thoroughly.

**RELATED DOCUMENTS**

- EFE 825 (Combustion Engineering Guide)
- Eclipse bulletins and Info Guides: 610, 710, 720, 730, 742, 744, 760, 930, 1-354.

**HOW TO GET HELP**

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

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Fax: +1 815 877 3120

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Tel.: +31 182 515988
Fax: +31 182 533269

Eclipse ThermJet Instruction Manual 205-11/95
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The ThermJet is a nozzle-mix burner that is designed to fire an intense stream of hot gases through a combustor into a furnace chamber.

The high velocity of the gases improves temperature uniformity, product quality and system efficiency. The burner gives you these benefits throughout the entire operating range.

The ThermJet burner comes in two types:

- High Velocity
- Medium Velocity.

The velocity of the gases can be as high as 250 ft/s for the Medium Velocity burner, and 500 ft/s for the High Velocity burner.

**Figure 1.1** The ThermJet burner
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INTRODUCTION

In this section you will find important notices about safe operation of a burner system.

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. You can cause fires and explosions.

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.

Note:

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

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.
**INTRODUCTION**

This section gives a detailed overview of the burner specifications. It also lists several options that are available for the ThermJet.

*Figure 3.1 The ThermJet burner*

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>OPTIONS</th>
<th>OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuel</td>
<td>• natural gas</td>
<td>For any other mixed gas, contact Eclipse for orifice sizing.</td>
</tr>
<tr>
<td></td>
<td>• propane</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• butane</td>
<td></td>
</tr>
<tr>
<td>Flame detection</td>
<td>• U.V. scanner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• flame rod, for use with alloy or silicon carbide firing tubes only.</td>
<td></td>
</tr>
<tr>
<td>Ignition</td>
<td>• direct spark ignition (6 kV AC).</td>
<td></td>
</tr>
<tr>
<td>Combustor</td>
<td>• alloy firing tube</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• silicon carbide firing tube</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• refractory block</td>
<td></td>
</tr>
</tbody>
</table>
## SPECIFICATIONS

### Main specifications

#### Table 3.2 ThermJet performance data

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>BURNER TYPE (VELOCITY)</th>
<th>BURNER SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>50</td>
</tr>
<tr>
<td>High fire input (Btu/hr)</td>
<td>Medium &amp; High velocity</td>
<td>500,000</td>
</tr>
<tr>
<td>Low firing rate, on-ratio (Btu/hr)</td>
<td>Medium &amp; High velocity</td>
<td>50,000</td>
</tr>
<tr>
<td>Low firing rate, fixed air (Btu/hr)</td>
<td>Medium &amp; High velocity</td>
<td>10,000</td>
</tr>
<tr>
<td>Static air pressure (&quot;w.c.&quot;)</td>
<td>High velocity</td>
<td>12.0</td>
</tr>
<tr>
<td>• 15% excess air, at maximum input with standard orifice plate installed. measured at tap A (See Figure 3.1)</td>
<td>Medium velocity</td>
<td>7.5</td>
</tr>
<tr>
<td>Static gas pressure (&quot;w.c.&quot;)</td>
<td>High velocity</td>
<td>11.0</td>
</tr>
<tr>
<td>• at maximum input with standard orifice plate installed. measured at tap B (See Figure 3.1)</td>
<td>Medium velocity</td>
<td>6.0</td>
</tr>
<tr>
<td>Flame length (in) (from end of firing tube)</td>
<td>High velocity</td>
<td>Nat. gas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Propane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Butane</td>
</tr>
<tr>
<td></td>
<td>Medium velocity</td>
<td>Nat. gas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Propane</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Butane</td>
</tr>
<tr>
<td>Maximum flame velocity (ft/s)</td>
<td>High velocity</td>
<td>500</td>
</tr>
<tr>
<td>• 15% excess air, at maximum input</td>
<td>Medium velocity</td>
<td>250</td>
</tr>
</tbody>
</table>

* all information is given for general sizing purposes only
* refer to data sheet for burner specific information
* all inputs based on gross calorific values
The graphs that follow give you an approximate picture of the performance. Should you want more exact information, contact Eclipse Combustion.

**Figure 3.2 NO\textsubscript{x} emissions**

The emissions from the burner are influenced by:
- the fuel type
- the combustion air temperature
- the firing rate
- the chamber conditions
- the percent of excess air.

For estimates of other emissions, contact Eclipse Combustion.

**Figure 3.3 Operational zone**
Eclipse Combustion, Inc. has determined through laboratory testing, that anywhere within the designated zone, the user can ignite the burner and will develop a stable flame signal.

**Figure 3.4 Flame length**  
Measured from the end of the combustor

**Figure 3.5 Flame velocity**
Specifications

Dimensions & weights

Figure 3.6 Burner housing

Table 3.3 Burner - Dimensions /weights

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>BURNER SIZE</th>
<th>50 &amp; 75</th>
<th>100 &amp; 150</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (In)</td>
<td>7⅞</td>
<td>8⅞</td>
<td></td>
</tr>
<tr>
<td>B (In)</td>
<td>¾</td>
<td>¾</td>
<td></td>
</tr>
<tr>
<td>C (In)</td>
<td>7⅞</td>
<td>7⅞</td>
<td></td>
</tr>
<tr>
<td>D (In)</td>
<td>5</td>
<td>5½</td>
<td></td>
</tr>
<tr>
<td>E (In)</td>
<td>3</td>
<td>3⅛</td>
<td></td>
</tr>
<tr>
<td>F (In)</td>
<td>3⅛</td>
<td>4⅛</td>
<td></td>
</tr>
<tr>
<td>G (In)</td>
<td>3</td>
<td>3⅛</td>
<td></td>
</tr>
<tr>
<td>H (In)</td>
<td>7⅞</td>
<td>9⅛</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>Gas Inlet thread</td>
<td>1&quot; NPT or BSP</td>
<td>1½&quot; NPT or BSP</td>
</tr>
<tr>
<td>K</td>
<td>Air Inlet thread</td>
<td>2¾&quot; NPT or BSP</td>
<td>3&quot; NPT or BSP</td>
</tr>
<tr>
<td>Weight (lb)</td>
<td>37.0</td>
<td>42.3</td>
<td></td>
</tr>
</tbody>
</table>
### Table 3.4 Alloy tube: dimensions/weights

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>BURNER SIZE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A (In)</td>
<td>50 &amp; 75</td>
<td>100 &amp; 150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>B (In)</td>
<td>4%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>C (In)</td>
<td>3%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>D (In)</td>
<td>7%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Weight (lb)</td>
<td>5.1</td>
<td>3.1</td>
<td></td>
</tr>
<tr>
<td>Max. chamber temperature (°F)</td>
<td>1950</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3.5 Silicon carbide tube: dimensions/weights

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>BURNER SIZE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A (In)</td>
<td>50 &amp; 75</td>
<td>100 &amp; 150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>B (In)</td>
<td>5%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>C (In)</td>
<td>3%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>D (In)</td>
<td>7%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>Weight (lb)</td>
<td>4.3</td>
<td>4.2</td>
<td></td>
</tr>
<tr>
<td>Max. chamber temperature (°F)</td>
<td>2500</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 3.6 Refractory block: dimensions/weights

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>BURNER SIZE</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A (In)</td>
<td>50 &amp; 75</td>
<td>100 &amp; 150</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8%</td>
<td>8%</td>
<td></td>
</tr>
<tr>
<td>B (In)</td>
<td>8%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>C (In)</td>
<td>3%</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>D (In)</td>
<td>10%</td>
<td>7%</td>
<td></td>
</tr>
<tr>
<td>E (In)</td>
<td>12</td>
<td>57</td>
<td></td>
</tr>
<tr>
<td>Weight (lb)</td>
<td>63</td>
<td>57.5</td>
<td></td>
</tr>
<tr>
<td>Max. chamber temperature (°F)</td>
<td>2800</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 flame velocity
   c. the fuel type and pressure
   d. the combustor type

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

Step 1: Burner model selection

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).

All the sizes and the performances are in:
- Table 3.2 "ThermJet performance data" on page 3-2
- "Performance graphs" on page 3-3.

Flame velocity

Each burner size comes in two versions, High or Medium Velocity. Select the version that you need, based on the requirements for temperature uniformity, circulation, chamber size, air pressure and overall operating costs.
Flame velocity information is in:
- Table 3.2 "ThermJet performance data" on page 3-2
- Figure 3.5 "Flame velocity" on page 3-4.

**Fuel type & fuel pressure**

The usable fuel types are:
- natural gas
- propane
- butane.

For other fuels, (<800 Btu/ft³) contact Eclipse Combustion with an accurate breakdown of the fuel contents.

The gas pressure must be at the minimum level shown.
You can find the gas pressure that is required at the burner in:
- Table 3.2 "ThermJet performance data" on page 3-2

**Combustor**

The combustor that you choose depends on the temperature and the construction of the furnace.

The furnace temperature limits of the combustors can be found in these tables:
- Table 3.4 "Alloy tube: dimensions/weights" on page 3-6
- Table 3.5 "Silicon carbide tube: dimensions/weights" on page 3-6
- Table 3.6 "Refractory block: dimensions/weights" on page 3-6.
The control methodology is the basis for the rest of the design process. Once you know what your system will look like, you can select the components that are in it. Which control methodology you choose depends on the type of process that you want to control.

Control methods

There are two main methods to control the input of a ThermJet system. Each of these methods also has two variants.

The methods and variants are:

1. Modulating control
   a. "Modulating gas & air, On-ratio control or excess air @ low fire" on page 4-4
   b. "Modulating gas with fixed-air control" on page 4-5.

2. High/low control
   a. "High/low air & gas control (pulse firing)" on page 4-6
   b. "High/low gas with fixed-air control (Can also be used for pulse firing.)" on page 4-7.

In the pages that follow you will find schematics of these control methods. The symbols in the schematics are explained in the Key to the system schematics (see Appendix).

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, then the gas shut-off valve closes the gas supply to the burner that causes the failure.

2. Automatic gas shut-off by zone
   If the flame safeguard detects a failure, then the gas shut-off valve closes the gas supply to all the burners in the zone that caused the failure.
Modulating gas & air, On-ratio control or excess air at 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

Figure 4.1 Modulating gas & air: On-ratio control or excess air at low fire

Automatic shut-off at the burner

Automatic shut-off by zone
Modulating gas with fixed-air control

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 amount of air to the burner is fixed (15% excess air at high fire input).

2. Gas

The control valve 0 is in the gas line. It can modulate to any position between low and high fire.

Figure 4.2  Modulating gas with fixed-air control
High/low air & gas control (pulse firing)

A burner system with high/low control gives a high or low fire input to the process. No input between high and low fire is possible.

1. Air
   a. Low fire:
      A control input closes the solenoid valve ①. As a result of that, the CRS valve ② quickly moves to low fire.
   b. High fire:
      A control input opens the solenoid valve ①. As a result of that, the CRS valve ② quickly moves to high fire.

2. Gas
   a. Low fire:
      A control input closes the solenoid valve ①. Low fire gas passes through the butterfly valve ③.
   b. High fire:
      A control input opens the solenoid valve ①.

Figure 4.3  High/low air & gas control (pulse firing)

1. If fast high/low control is not necessary, then you can replace the CRS valve with a two-position automatic butterfly valve.
High/low gas with fixed-air control
(Can also be used for pulse firing.)

A burner system with high/low control gives a high or a low input to the process. NO input between high and low fire is possible.

1. Air

The amount of air is always the same.

2. Gas

a. Low fire:
   A control input closes the solenoid valve ①.
   Low fire gas passes through the butterfly valve ②.

b. High fire:
   A control input opens the solenoid valve ①.
   High fire gas passes through the open solenoid valve ①.

**Figure 4.4** High/low gas with fixed-air control (Can also be used for pulse firing.)
Step 3: Ignition System

ThermJet burners are capable of direct spark ignition anywhere within the operating range. However, it is recommended that low fire start be used. Local safety and insurance requirements demand that you limit the maximum time that a burner takes to ignite. These time limits vary from country to country. For the USA the time limit is 15 seconds, for Europe it is 3 seconds.

The time that a burner takes 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.

In the USA, with a time of 15 seconds to ignition, there should be sufficient time to ignite the burners when using on-ratio control. However, when using excess air on low fire, it is possible to have the low fire too low to ignite within the time limit. Under these circumstances you must consider the following options:

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

**Bypassed start gas**

Bypass gas provides an increased gas flow around the zone gas control valve during the trial for ignition period. This should only be used if excess air is being used on low fire; it should NOT be used when on-ratio low fire is being used. During the trial for ignition period, the solenoid valve in the bypass plus the automatic gas shut-off valves (either at each burner or each zone) are opened. If a flame is established, the bypass solenoid valve closes at the end of the trial for ignition period. If a flame is not established, then the bypass solenoid valve and the automatic gas shut-off valve close.

**Figure 4.5  Bypass schematics**

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Eclipse ThermJet Instruction Manual 205-11/95
Figure 4.5  Bypass schematics (Continued)

High flow air & gas control and high flow gas with fixed air control

to other zones

The figure below shows a typical burner wiring. The figure shown is suggested or typical only. The actual terminal numbers etc. may vary from system to system. Refer to Bulletin 1-620 for the more detailed information.

Figure 4.6  Typical Burner Wiring

NOTE: Set control for intermittent pilot
Step 4: Flame monitoring system

A flame monitoring system consists of two main parts:
- a flame sensor
- flame safeguard.

Flame sensor

There are two types that you can use for a ThermJet burner:
- U.V. scanner
- flame rod.

You can use a U.V. scanner with all combustor types (including burners with Alloy or Silicon carbide firing tubes).

You can find information in:
- Info Guide 852; 90° U.V. scanner
- Info Guide 854; straight U.V. scanner

A flame rod will not work for burners with refractory block.
You CAN use a flame rod for burners with Alloy or Silicon carbide firing tubes.

You can find information in:

Flame Safeguard

The flame safeguard is the equipment that processes the signal from the flame rod or the U.V. scanner.

For flame safeguard selection you have several options:
- flame safeguard for each burner: if one burner goes down, only that burner will be shut off.
- multiple burner flame safeguard: if one burner goes down, all burners will be shut off.

There are three flame safeguards that are recommended:
- Bi-flame series; see Bulletin/Info guide 826
- Multi-flame series 6000; see Bulletin/Info guide 820
- Veri-flame; see Bulletin/Info guide 610, 620, 630.

All industrial models are acceptable.
**Step 5: Combustion Air System: Blower and air pressure switch**

**Effects of atmospheric conditions**

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

- sea level
- 29.92" Hg
- 70°F.

If you are above sea level or in a hot area, the make-up of the air is different. 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 for 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:


Follow these steps:

1. **Calculate the outlet pressure.**

   When you calculate the outlet pressure of the blower, you must calculate the total of these pressures:

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

2. **Calculate the flow.**

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

   \[ \text{Air flow} = \text{Gas flow} \times \text{Air/gas ratio} \times \text{Air factor} \times \text{Number of burners} \]
Example:

- 4 burners 75 TJ
- input 750,000 Btu/hr burner
- natural gas → heating value = 1000 Btu/ft³
  air/gas ratio (stoichiometric) = 9.41:1
- 15% excess air → excess air ratio = 1.15

\[
\text{Gas flow} = \frac{\text{Input}}{\text{Heating value}} \\
\text{Gas flow} = \frac{750,000}{1000} = 750 \text{ scfh}
\]

\[
\text{Air flow} = 750 \times 9.41 \times 1.15 \times 4 = 32465 \text{ scfh}
\]

Note:
scfh = standard cubic feet per hour = ft³/hr at standard conditions.

3. Find the blower catalog number and motor Horse Power (HP).

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

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 Clock Wise (CW) or Counter Clock Wise (CCW).

Note:
The standard direction of rotation is CCW. If you order a CW version, the unit is more expensive and has a longer delivery time.

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 data that you should have now:

- blower catalog number
- motor HP
- TEFC
- voltage, number of phases, frequency
- rotation direction (CW or CCW).

This is everything that you need to order a blower with motor.

**Air pressure switch**

The air pressure switch gives a signal to the safety system when there is not enough air pressure from the blower. The suggested pressure switch for the ThermJet combustion system is:

- Eclipse-Dungs Model A2.

You can find more information on this switch in:

- blower Bulletin 610
- Bulletin 1-354.

**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 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 equipment and measuring equipment available.

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

**INTRODUCTION**

In this section you will find the information and instructions that you need to install the burner and the add-ons.

**HANDLING AND STORAGE**

Handling

1. Make sure that the area is clean.
2. Protect the components from the weather, damage, dirt and moisture.
3. Protect the components from excessive temperatures and humidity.

Storage

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

**POSITION OF COMPONENTS**

The position and the amount of components are determined by the kind of control method that you choose. All the control methods can be found in chapter 4 "System Design" on page 4-1. Use the schematics in that chapter to build your system.
APPROVAL OF COMPONENTS

Limit controls and safety equipment

All limit controls and safety equipment must comply with the current standards that follow:

- NFPA Standard 86
- NFPA Standard 86C
- UL
- FM
- CGA
- EN 746-2
- all applicable local codes and/or standards.

Electrical wiring

All the electrical wiring must comply with one of these standards:

- NFPA Standard 70
- ANSI-C11981
- EN 746-2
- the electrical wiring must be acceptable to the local authority having jurisdiction.

Gas piping

All the Gas piping must comply with one of these standards:

- NFPA Standard 54
- ANSI Z223
- EN 746-2
- the gas piping must be acceptable to the local authority having jurisdiction.

Where to get the standards

The NFPA Standards are available from:
National Fire Protection Agency
Battery March Park
Quincy, MA 02269

The ANSI Standards are available from:
American National Standard Institute
1430 Broadway
New York, NY 10018

The UL Standards are available from:
333 Pfingsten Road
Northbrook, IL 60062

The FM Standards are available from:
1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood, MA 02062
The CGA Standards are available from:
55 Scarsdale Road
Toronto, Ontario
Canada M3B 2R3

Information on the EN standards, and where to get the standards is available from:
Comité Européen de Normalisation
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196811
Fax: +32-25196819

Comité Européen de Normalisation Electronique
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196871
Fax: +32-25196919

CHECKLIST BEFORE INSTALLATION

Intake
To admit fresh combustion air from outdoors, provide an opening in the room of at least 1 in\(^2\) per 4000 Btu/hr.
If there are corrosive fumes or materials in the air, then supply the burner with clean air from an uncontaminated area.

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

Access
Make sure that you install the system in such a way that you can get easy access to the burner for inspection and maintenance.

Environment
Make sure that the local 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
• humidity, altitude and temperature of air
• presence of damaging corrosive gases in the air.
PREPARE THE BURNER

There are several components that must be installed to a burner before it can operate. Instructions to do that follow below.

It is possible to change the relative position of the gas inlet to the air inlet. This can be convenient for the routing of the piping.

To rotate the rear cover, do the steps that follow:

1. Disconnect the piping by using either a union in the piping or the inlet flanges provided on the burner.

   Note: Be careful not to lose or damage the orifice plate or the O-rings.

2. Remove the four bolts.
3. Remove the rear cover from the burner housing.

4. Rotate the rear cover to the position that you want.
5. Put the rear cover in position against the burner housing.
6. Install the four bolts.

7. Reconnect the piping. Make sure that the O-rings show no signs of damage.
1. Install the flame sensor into the opening in the rear cover.
2. Make sure that you connect the flame sensor of a burner to the electrical circuit of that burner.

**Danger:**

If you connect the flame sensor of a burner to the electrical circuit of the wrong burner, then you can cause fires and explosions.

There are two different types of flame sensors:

- **U.V. scanner:**
  
  For detailed information on how to install and connect a U.V. scanner, refer to:
  - straight U.V. scanner; Bulletin / Info Guide 854
  - 90° U.V. scanner; Bulletin / Info Guide 852

- **Flame rod:**
  You can use a flame rod only for burners with alloy or silicon carbide firing tubes.

  For detailed information on how to install and connect a flame rod, refer to: Bulletin / Info guide 832.

Install the spark plug into the opening in the rear cover.

**Note:**

*Do not apply any grease to the threads of the spark plug.*

You can cause bad grounding of the spark plug if you apply grease to it. Bad grounding of the spark plug results in a weak spark.
**INSTALLATION**

**Burner**

**Dimensions**

The burner attaches to the wall of the furnace with bolts through holes "C". The pitch diameter of these holes is distance "D". For full information on the dimensions, refer to "Combustor" on page 3-6.

*Figure 5.1 Burner attachment*

**Furnace wall**

Make sure that the wall of the furnace is strong enough to carry the weight of the burner. If necessary, reinforce the area where you install the burner to support the weight of the burner.

**Avoid radiation losses**

To make sure that radiated heat does not go back to the casing of the furnace, it is important that the clearance A around the firing tube is not larger than \( \frac{1}{2} \)". If the clearance A is larger (on diameter) than \( \frac{3}{8} \)", then you must fill the gap with ceramic fiber.

*Figure 5.2 Alloy & Silicon Carbide Firing tubes - Insulation*

1. Make sure that you install the gasket 1 between the burner and the furnace casing 2.
2. Make sure that the gasket 3 does not leak.
3. Check the size of the clearance. If the gap around the firing tube is larger than ½", then pack the gap with ceramic fiber, as stated above.

Lay-out
 Install all the piping as shown in the schematics. Refer to Chapter 6 "Adjustment, Start & Stop" on page 6-1.

Support the piping
 Use brackets or hangers to support the piping. If you have questions, consult your local gas company.

Straight run of pipe before a metering orifice
 It is recommended that there is a run of pipe with a length (L) of at least 10 pipe diameters between the burner balancing valve and the metering orifice. If you do not do this, the pressure readings may be inaccurate.

Pipe connections
 1. Install a pipe union in the line to each burner. This simplifies removal of the burner.
 2. The use of flexible pipe nipples in the air and gas lines to the burner is optional. Flexible nipples can absorb stresses due to heat expansion.
 3. Flexible pipe nipples may cause higher pressure drops than equivalent standard pipes. Consider that when you size the air lines.

Avoid large pressure drops

Note:
The pressure drop of the gas and the air in the piping is a critical parameter. Make sure that the size of all the piping is large enough to prevent excessive pressure losses.
Valves

Valve orientation
Install all the valves in such a way that the arrow (if present) on the valve body points in the direction of flow.

Gas cocks
Make sure that the handle of a gas cock is at a right angle to the valve body when the valve is in the closed position. This is an important position indicator. If you do not do that, somebody may think that the gas cock is in the closed position, while it is actually in the open position.

Air balancing valves
An air balancing valve is typically the same as a manual butterfly valve. For more information, refer to the section below.

Manual butterfly valves
2. Install manual butterfly valves in the air line and the gas line to each burner.

Note:
It is recommended that there is a run of pipe with a length of at least 10 pipe diameters between the burner balancing valve and the metering orifice on the burner.

Automatic butterfly valve
An automatic butterfly is driven by an actuator (actuator and mounting bracket not illustrated).

1. Install the control valve in accordance with Bulletin / Info Guide 720.

Ratio regulator
1. Connect an impulse line to the ratio regulator and to the air supply line.
2. Install the ratio regulator in accordance with Bulletin / Info Guide 742.
CHECKLIST AFTER INSTALLATION

CRS valve
Install the CRS valve in accordance with Bulletin / Info Guide 744.

The flame safeguard system can be installed in two operational modes:

• one flame out, one burner off
• one flame out, all burners off.

See also "Flame Safeguard" on page 4-10.
For more details, refer to the Bulletins of the flame safeguard system:
• Veriflame; Bulletins 1-610, 1-620, 1-630
• Multiflame; Bulletin 820
• Bi-Flame; Bulletin 826.

To make sure that the system is installed correctly, do the steps that follow:

1. Make sure that there are no leaks in the gas lines and the air lines.

Danger:
If simulated limits or simulated flame failures do not shut down the fuel system within the required failure response time, then immediately correct the problem.

2. Make sure that the blower rotates in the correct direction. If incorrect, then have a qualified electrician rewire the blower to reverse its rotation.

3. Set the air pressure switch so that it drops out at 4" w.c. below the pressure rating of the blower.

4. Set the low gas pressure switch at 4" w.c. below the gas pressure that you measure at the inlet to the main gas valve train.

5. Set the high gas pressure switch so that it comes on at 4" w.c. above the gas pressure that you measure at the inlet to the main gas valve train.

6. Close all the burner gas cocks.
7. Try to light a burner before the purge and other timers have finished their cycles. Make sure that the flame safeguard system indicates a flame failure.

8. Trip out pressure switches and other limit interlocks. Make sure that the main gas valve train closes.
INTRODUCTION

In this chapter you will find instructions on how to adjust a system, and how to start and stop a system. The chapter starts with general instructions that are useful for adjustment.

Danger:
Do not bypass any safety feature. You can cause fires and explosions. Obey the safety precautions in Chapter Safety.

Adjustment

There are two adjustment procedures:

- Adjust a modulating gas and air ratio system
  (Refer to "Modulating Gas and Air Ratio system" on page 6-1)
- Adjust a fixed-air system
  (Refer to "Fixed-air system" on page 6-5).

If you adjust an on-ratio system for the first time, you must follow these steps (Refer to Figure 4.1 and Figure 4.3):

1. Reset the system
2. Set high fire air
3. Set low fire air
4. Verify the air settings
5. Ignite the burners
6. Set high fire gas
7. Set low fire gas
8. Verify the gas settings.

Step 1: Reset the system

1. Close the automatic gas valves and the gas cocks.
2. Fully open the manual air butterfly valve at each burner.
   a. Drive the automatic zone air control valve to high fire.
b. Adjust the automatic zone air control valve so that it is fully open. The automatic zone air control valve can be either a butterfly valve or a CRS valve.

3. Start the blower.

   **Caution:**
   *Make sure that the blower rotates in the correct direction. If incorrect, then have a qualified electrician rewire the blower to reverse its rotation.*

1. Make sure that the system is at high fire.

2. Use the air curves in "Orifice curves" on page 6-10 thru page 6-17 to find the air pressure-differential that you need at high fire. This is now your target value for high fire.

3. Set high fire.

   **Note:**
   *A pressure tap is open when the screw inside the tap is unscrewed approximately half a turn.*

**Single Burner System:**

a. Make sure that pressure tap A and pressure tap C of the burner are open.

b. Connect the manometer to tap A and tap C of the burner (across the air orifice).

c. Adjust the manual butterfly valve until the high-fire air pressure-differential is at the target value.

d. Remove the manometer.

e. Close the pressure taps.

**Multiple Burner System:**

a. Make sure that pressure tap A and pressure tap C of the first burner are open.

b. Connect the manometer to tap A and tap C of the first burner (across the air orifice).

c. Adjust the zone air manual butterfly valve to achieve the target value for the first burner.

d. Measure and note the air pressure-differential across the next burner in the zone.

e. Repeat d. and for all the other burners in the zone (if any).

f. If all the measured differential pressures are within 0.3" w.c. of each other, then proceed to the next section.

   If the variation is greater than 0.3" w.c., then it will be necessary to adjust the manual air butterfly valve at each burner to improve the balance.

g. Make sure that all the pressure taps are closed.
Step 3: Set low fire air

1. Set the system to low fire.
2. Use the air curves in "Orifice curves" on page 6-10 thru page 6-17 to find the air pressure-differential that you need at low fire. This is now your target value for low fire.
3. Connect the manometer to tap A and tap C of a burner (across the air orifice)
4. Adjust the automatic zone air control valve until the low-fire air-pressure differential is at the target value.
5. Repeat 3. and 4. for the other zones (if any).

Step 4: Verify the air settings

Make sure that all the settings are still the same after you cycle the system several times between high fire and low fire.

Step 5: Ignite the burners

Note:
This procedure assumes that automatic flame safety is installed and is serviceable. It also assumes that normal low fire start is being used.
If low fire gas is too low to be used for ignition, refer to option in "Set the bypass gas (optional)" on page 6-8.

1. Drive the zone air automatic control valve to low fire.
2. Make sure the combustion air blower is running.
3. Set the manual gas butterfly valve at each burner to 50% o
4. Set the adjusting screw on the ratio regulator 6 turns do9 from the top (initial setting).
5. Open zone manual gas cock.
6. Open manual gas cock at each burner.
7. Initiate the ignition sequence through the flame safety.
8. Check that all the burners is the zone have ignited.
   If gas shut off solenoid valve is fitted at each burner, th' repeat 7. for all burners in the zone.

Note:
Initially it may be necessary to repeat step 7. two or times to purge air out of the gas pipework.
9. If all the burners have ignited, drive the zone air butt to high fire. Make sure that the burners stay ig
**Step 6: Set high fire gas**

1. Use the gas curves in "Orifice curves" on page 6-10 thru page 6-17 for the gas being used to find the gas pressure differential that you need at high fire. This is your target value for high fire.

2. Connect the manometer to tap B and tap D of the burner (across the gas orifice).

3. Measure the high fire gas-pressure drop for the first burner.

4. Adjust the gas butterfly valve at the burner until the gas flow is at the target value.

5. Repeat 3. thru 4. for the other burners in the zone

6. Check the gas pressure at the inlet to the zone ratio regulator. This should be at least 5"w.c. higher than the loading line pressure. It should not exceed the maximum pressure rating of the ratio regulator.

**Step 7: Set low fire gas**

1. Drive the system to low fire.

2. Use the gas curves in "Orifice curves" on page 6-10 thru page 6-17 for the gas being used to determine the differential required for low fire. This is your target value for low fire.

3. Measure the gas pressure at the first burner.

4. Adjust the ratio regulator until the gas flow is on the target value. (Refer to Bulletin 742 for adjustment.)

**Note:**

It is very difficult to measure the very low pressures experienced at low fire, and it may be necessary to rely on visual inspection. This is especially true when gas turndowns in excess of 10 to 1 are being used. The main intent is to provide a clean stable flame with a good flame signal that will not cause the furnace temperature to overshoot.

If the pressure required is too low to be measured, then adjust the ratio regulator until a gas flow is obtained that will provide a clean stable flame with a strong flame signal.
Step B: Verify the gas settings

Make sure that all the settings are still the same after you cycle the system several times between high fire and low fire.

Note:
When all the settings have been completed, mark the position of the indicator on the butterfly valves to indicate valve position. This will save time later.

Fixed-air system

When you adjust a fixed-air system for the first time, you must follow these steps (Refer to Figure 4.2 and Figure 4.4):

1. Reset the system
2. Set high fire air
3. Ignite the burners
4. Set high fire gas
5. Set low fire gas
6. Verify the gas settings.

Step 1: Reset the system

1. Close these valves:
   - the automatic gas valves
   - the gas cocks.
2. Fully open the manual air butterfly valve at each burner.
   a. Drive the automatic zone air control valve to high fire.
   b. Adjust the automatic zone air control valve so that it is fully open. The automatic zone air control valve can be either a butterfly valve or a CRS valve.
3. Set the manual gas butterfly valve at each burner to 50% open.
4. Set the system to high fire, but do not ignite the burner(s).
5. Start the blower.

Caution:
Make sure that the blower rotates in the correct direction. If incorrect, then have a qualified electrician rewire the blower to reverse its rotation.

Step 2: Set high fire air

1. Set the system to high fire.
2. Use the air curves in "Orifice curves" on page 6-10 thru page 6-17 to find the air pressure-differential that you need at high fire. This is now your target value for high fire.
3. Set high fire.
Note:
A pressure tap is open when the screw inside the tap is unscrewed approximately half a turn.

Single Burner System:

a. Make sure that pressure tap A and pressure tap C of the burner are open.
b. Connect the manometer to tap A and tap C of the burner (across the air orifice).
c. Adjust the manual butterfly valve until the high-fire air pressure-differential is at the target value.
d. Remove the manometer.
e. Close the pressure taps.

Multiple Burner System:

a. Make sure that pressure tap A and pressure tap C of the first burner are open.
b. Connect the manometer to tap A and tap C of the first burner (across the air orifice).
c. Adjust the manual butterfly valve for the zone, until the high-fire air pressure-differential is at the target value for the first burner.
d. Measure the air pressure-differential across the next burner in the zone.
e. Repeat d. and for all the other burners in the zone (if any).
f. If all the measured differential pressures are within 0.3"w.c. of each other, then proceed to the next section. If the variation is greater than 0.3"w.c., then it will be necessary to adjust the manual air butterfly valve at each burner to improve the balance.
g. Make sure that all the pressure taps are closed.

4. Repeat 3. for other zones (if any).

Step 3: Ignite the burners

Note:
This procedure assumes that automatic flame safety is installed.
It also assumes that normal low fire start is being used. If low fire gas is too low to be used for ignition, refer to options in section "Set the bypass gas (optional)" on page 6-8.

1. Drive the zone gas automatic butterfly valve to low fire.
2. Make sure the combustion air blower is running.
3. Set the burner manual gas butterfly valve to low fire.
4. Set the adjusting screw on the ratio regulator 6 turns down from the top (initial setting).

5. Select the valve according to the control method:
   a. with high/low control:
      set the gas bypass butterfly valve 25% open.
   b. with modulating gas control:
      set the zone gas automatic butterfly value to approximately 10% open. stroke the valve to the open position to ensure 100% open. readjust if necessary.

6. Open the zone gas manual gas cock.

7. Open the manual gas cock at each burner.

8. Initiate the ignition sequence through the flame safety.
   a. Check that all the burners in the zone have ignited.
   b. If safety shut-off solenoid valve is installed at each burner, then repeat 6. and 7. for all the burners in the zone.

   Note:
   Initially it may be necessary to repeat step 6. and 7. two or three times to purge gas out of the gas pipework.

9. If all the burners have ignited, drive the zone to high fire. Make sure that the burners stay ignited.

Step 4: Set high fire gas

1. Use the gas curves in "Orifice curves" on page 6-10 thru page 6-17 for the gas being used to find the gas pressure differential that you need at high fire. This is your target value for high fire.

2. Connect the manometer to tap B and tap D of the burner (across the gas orifice).

3. Measure the high fire gas-pressure drop for the first burner.

4. Adjust the gas butterfly valve at the burner until the gas flow is at the target value.

5. Repeat 3. thru 4. for the other burners in the zone

6. Check the gas pressure at the inlet to the zone ratio regulator. This should be at least 5"w.c. higher than the loading line pressure. It should not exceed the maximum pressure rating of the ratio regulator.
ORIFICE CURVES

Burner size: 50
Air & Natural gas

Air Factor (50 TJ)

Input, x1000 BTU/hr (kW)

High fire

Low fire on Ratio

Air ΔP wrench (mbar)

3.5

(8.7)

High fire

(7.5)

2

(5)

1

(2.5)

0.06

(0.15)

Low fire on Ratio

0

50

100

200

300

400

500

(14.7)

(29.3)

(58.6)

(87.9)

(117)

(147)

Max

High fire

Natural Gas (50 TJ)

Input, x1000 BTU/hr (kW)

High fire

Low fire on Ratio

Fuel ΔP wrench (mbar)

5

(12.5)

4.6

(11.5)

High fire

(10)

(7.5)

(5)

(2.5)

0.03

(0.07)

Low fire on Ratio

0

50

100

200

300

400

500

(14.7)

(29.3)

(58.6)

(87.9)

(117)

(147)

Max

High fire

Eclipse Thermjet Instruction Manual 205-11/95
ORIFICE CURVES

Burner size: 50
Propane & Butane

Propane (50 Tj)

Butane (50 Tj)
**ORIFICE CURVES**

Burner size: 100
Air & Natural gas

---

**Air Factor (100 TJ)**

<table>
<thead>
<tr>
<th>Input, x1000 BTU/hr (kW)</th>
<th>Low fire</th>
<th>Low fire Max</th>
<th>High fire</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>2000%</td>
<td>15%</td>
</tr>
<tr>
<td>100</td>
<td>100%</td>
<td>500%</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>200%</td>
<td>200%</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>50%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>10%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>0%</td>
<td>0%</td>
<td>15%</td>
</tr>
</tbody>
</table>

---

**Natural Gas (100 TJ)**

<table>
<thead>
<tr>
<th>Input, x1000 BTU/hr (kW)</th>
<th>Low fire</th>
<th>Low fire Max</th>
<th>High fire</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>2000%</td>
<td>15%</td>
</tr>
<tr>
<td>100</td>
<td>100%</td>
<td>500%</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td>200%</td>
<td>200%</td>
<td></td>
</tr>
<tr>
<td>400</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>600</td>
<td>50%</td>
<td>50%</td>
<td></td>
</tr>
<tr>
<td>800</td>
<td>10%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>1000</td>
<td>0%</td>
<td>0%</td>
<td>15%</td>
</tr>
</tbody>
</table>
ORIFICE CURVES

Burner size: 100
Propane & Butane

Propane (100 TJ)

Butane (100 TJ)
**Orifice Curves**

**Burner size: 150**

**Air & Natural gas**

---

**Air Factor (150 TJ)**

<table>
<thead>
<tr>
<th>Air Factor</th>
<th>4.3 (10,7)</th>
<th>High fire</th>
<th>200%</th>
<th>500%</th>
<th>200%</th>
<th>100%</th>
<th>50%</th>
<th>15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Air, ( \Delta P, ) wc (mbar)</th>
<th>0.05 (0,12)</th>
<th>Low fire on Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>150 (44)</td>
<td>Low fire</td>
</tr>
<tr>
<td>1</td>
<td>200 (58,6)</td>
<td>Low fire</td>
</tr>
<tr>
<td>2</td>
<td>400 (117)</td>
<td>Low fire</td>
</tr>
<tr>
<td>3</td>
<td>600 (176)</td>
<td>Low fire</td>
</tr>
<tr>
<td>4</td>
<td>800 (234)</td>
<td>Low fire</td>
</tr>
<tr>
<td>5</td>
<td>1000 (293)</td>
<td>Low fire</td>
</tr>
<tr>
<td>6</td>
<td>1200 (352)</td>
<td>Low fire</td>
</tr>
<tr>
<td>7</td>
<td>1400 (410)</td>
<td>Low fire</td>
</tr>
<tr>
<td>8</td>
<td>1500 (440)</td>
<td>High fire</td>
</tr>
</tbody>
</table>

**Input, x1000 BTU/hr (kW)**

---

**Natural Gas (150 TJ)**

<table>
<thead>
<tr>
<th>Natural Gas</th>
<th>4.5 (11,2)</th>
<th>High fire</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel, ( \Delta P, ) wc (mbar)</th>
<th>0.10 (0.25)</th>
<th>Low fire on Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>Low fire</td>
</tr>
<tr>
<td>1</td>
<td>150 (44)</td>
<td>Low fire</td>
</tr>
<tr>
<td>2</td>
<td>200 (58,6)</td>
<td>Low fire</td>
</tr>
<tr>
<td>3</td>
<td>400 (117)</td>
<td>Low fire</td>
</tr>
<tr>
<td>4</td>
<td>600 (176)</td>
<td>Low fire</td>
</tr>
<tr>
<td>5</td>
<td>800 (234)</td>
<td>Low fire</td>
</tr>
<tr>
<td>6</td>
<td>1000 (293)</td>
<td>Low fire</td>
</tr>
<tr>
<td>7</td>
<td>1200 (352)</td>
<td>Low fire</td>
</tr>
<tr>
<td>8</td>
<td>1400 (410)</td>
<td>Low fire</td>
</tr>
<tr>
<td>9</td>
<td>1500 (440)</td>
<td>High fire</td>
</tr>
</tbody>
</table>

**Input, x1000 BTU/hr (kW)**
ORIFICE CURVES

Burner size: 150
Propane & Butane

Propane (150 TJ)

Butane (150 TJ)
**INTRODUCTION**

This section is divided into two parts:

- The first part describes the maintenance procedures.
- The second part helps you to identify problems that may occur, and gives advice on how to solve these problems.

**MAINTENANCE**

Preventive maintenance is the key to a reliable, safe and efficient system. The core of any preventive maintenance program is a list of periodic tasks.

In the paragraphs that follow are suggestions for a monthly list and a yearly list.

Note:
The monthly list and the yearly list are an average interval. If your environment is dirty, then the intervals may be shorter.

**Monthly Checklist**

1. Inspect flame-sensing devices for good condition, and cleanliness.
2. Check for proper inlet air/gas ratios.
3. Test all the alarm systems for proper signals.
4. Check ignition spark electrodes and check proper gap.
5. Check valve motors and control valves for free, smooth action and adjustment.
6. Check for proper operation of the ventilating equipment.
7. Test interlock sequence of all safety equipment manually make each interlock fail, noting that related equipment closes or stops as specified by the manufacturer.
   Test flame safeguard by manually shutting off gas to burner.
8. Test main fuel hand-valves for operation.
9. Clean or replace the combustion air blower filter.
Yearly Checklist

1. Test (leak test) safety shut-off valves for tightness of closure.
2. Test pressure switch settings by checking switch movements against pressure settings and comparing with actual impulse pressure.
3. Visually check ignition cable and connectors.
4. Inspect impulse piping for leaks.
5. Remove, clean and inspect all the burners.
6. Make sure that the following components are not damaged or distorted:
   - the burner nozzle
   - the spark plugs
   - the flame sensors
   - the flame tube or combustion block.
7. If applicable, remove and clean all the orifice plates.
## TROUBLE-SHOOTING

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start-up sequence runs but burner does not light.</td>
<td>No ignition: • There is no power to the ignition transformer.</td>
<td>Restore the power to the ignition transformer.</td>
</tr>
<tr>
<td></td>
<td>No ignition: • Open circuit between the ignition transformer and the ignition rod.</td>
<td>Repair or replace the wiring to the ignition rod.</td>
</tr>
<tr>
<td></td>
<td>No ignition: • The spark plug needs cleaning.</td>
<td>Clean the spark plug.</td>
</tr>
<tr>
<td></td>
<td>No ignition: • The spark plug is not correctly grounded to the burner.</td>
<td>Clean the threads of the spark plug and the burner. Do not apply grease to the thread of the spark plug.</td>
</tr>
<tr>
<td></td>
<td>Too much gas: • Manual gas butterfly valves have been opened too far.</td>
<td>Check pressures and settings against start-up report and adjust as necessary.</td>
</tr>
<tr>
<td></td>
<td>Too much gas: • Gas pressure out of ratio regulator is too high.</td>
<td>Check adjustments. If necessary, remove regulator and investigate.</td>
</tr>
<tr>
<td></td>
<td>Not enough gas: • The gas pressure into the ratio regulator is too low.</td>
<td>Check start-up settings. Measure the gas pressures and adjust where necessary.</td>
</tr>
<tr>
<td></td>
<td>Not enough gas: • The impulse line to the ratio regulator is leaking.</td>
<td>Repair any leaks.</td>
</tr>
<tr>
<td></td>
<td>Not enough gas: • Start gas solenoid valve does not open.</td>
<td>Check solenoid valve coil for proper operation. Replace if necessary.</td>
</tr>
<tr>
<td></td>
<td>Not enough gas: • Air in the gas line.</td>
<td>Repeat start-up several times.</td>
</tr>
<tr>
<td></td>
<td>Not enough gas: • Ratio regulator incorrectly set.</td>
<td>Adjust to proper setting.</td>
</tr>
<tr>
<td></td>
<td>Not enough gas: • Manual gas butterfly valves have been closed</td>
<td>Check pressures and settings against start-up report and adjust as necessary.</td>
</tr>
<tr>
<td>Problem</td>
<td>Possible Cause</td>
<td>Solution</td>
</tr>
<tr>
<td>---------</td>
<td>---------------</td>
<td>----------</td>
</tr>
<tr>
<td>The low fire flame is weak or unstable</td>
<td>• Not enough gas.</td>
<td>Check start-up settings and adjust to increase gas flow.</td>
</tr>
<tr>
<td></td>
<td>• Not enough air.</td>
<td>Check start-up settings and adjust to increase air flow or decrease gas flow.</td>
</tr>
<tr>
<td>The burner goes off when it cycles to high fire.</td>
<td>• Not enough gas pressure into the ratio regulator.</td>
<td>Check start-up settings. Measure gas pressures and adjust where necessary.</td>
</tr>
<tr>
<td></td>
<td>• The burner gas adjusting valve is not open enough.</td>
<td>Check start-up settings (See &quot;Adjustment, Start &amp; Stop&quot; on page 6-I).</td>
</tr>
<tr>
<td></td>
<td>• Loading line to the ratio regulator is leaking.</td>
<td>Repair the loading line.</td>
</tr>
<tr>
<td></td>
<td>• Insufficient air (flame too rich).</td>
<td>Check start-up settings and adjust the high fire air.</td>
</tr>
<tr>
<td>The burner is erratic and does not respond to adjustment</td>
<td>Internal damage to the burner:</td>
<td>Contact your Eclipse representative or the Eclipse factory.</td>
</tr>
<tr>
<td></td>
<td>• Some parts inside the burner are loose, dirty or burned out.</td>
<td></td>
</tr>
<tr>
<td>The burner is unstable or produces soot, smoke or excessive carbon monoxide.</td>
<td>• The air/gas ratio is out of adjustment.</td>
<td>Measure all the gas pressures and air pressures. Compare to initial start-up settings, and adjust them where necessary. (See &quot;Adjustment, Start &amp; Stop&quot; on page 6-I).</td>
</tr>
<tr>
<td>Cannot achieve full capacity</td>
<td>• Air filter is blocked.</td>
<td>Clean the filter.</td>
</tr>
<tr>
<td></td>
<td>• Gas pressure too low into the ratio regulator.</td>
<td>Adjust gas pressure.</td>
</tr>
</tbody>
</table>

*After this step it is important that you clean the spark plug and flame rod, and make sure that there is no excessive soot on the nozzle. Clean where necessary.*
<table>
<thead>
<tr>
<th><strong>PROBLEM</strong></th>
<th><strong>POSSIBLE CAUSE</strong></th>
<th><strong>SOLUTION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cannot initiate start sequence</td>
<td>• Air pressure switch has not made contact.</td>
<td>Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower.</td>
</tr>
<tr>
<td></td>
<td>• High gas pressure switch has tripped.</td>
<td>Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.</td>
</tr>
<tr>
<td></td>
<td>• Low gas pressure switch has tripped.</td>
<td>Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.</td>
</tr>
<tr>
<td></td>
<td>• Malfunction of flame safeguard system such as shorted out flame sensor or electrical noise in the sensor line.</td>
<td>Have qualified electrician investigate and rectify.</td>
</tr>
<tr>
<td></td>
<td>• Purge cycle not completed.</td>
<td>Check flame safeguard system, or purge timer.</td>
</tr>
<tr>
<td></td>
<td>• Main power is off.</td>
<td>Make sure power is on to control system.</td>
</tr>
<tr>
<td></td>
<td>• No power to control unit.</td>
<td>Call qualified electrician to investigate.</td>
</tr>
</tbody>
</table>
This page is intentionally left blank!
### Metric to English.

This table also contains a few Metric to Metric conversions

<table>
<thead>
<tr>
<th>FROM</th>
<th>TO</th>
<th>MULTIPLY BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>kg</td>
<td>lb</td>
<td>2.205</td>
</tr>
<tr>
<td>kPa</td>
<td>mbar</td>
<td>10</td>
</tr>
<tr>
<td>kW</td>
<td>Btu/hr</td>
<td>3414</td>
</tr>
<tr>
<td>m</td>
<td>ft</td>
<td>3.28</td>
</tr>
<tr>
<td>m³</td>
<td>ft³</td>
<td>35.31</td>
</tr>
<tr>
<td>m³/h</td>
<td>cfm</td>
<td>35.31</td>
</tr>
<tr>
<td>mbar</td>
<td>ln wc</td>
<td>0.401</td>
</tr>
<tr>
<td>mbar</td>
<td>kPa</td>
<td>0.1</td>
</tr>
<tr>
<td>mbar</td>
<td>Psi</td>
<td>14.5 x 10⁻³</td>
</tr>
<tr>
<td>mm</td>
<td>ln</td>
<td>3.94 x 10⁻²</td>
</tr>
</tbody>
</table>

°F = 9/5°C + 32

### English to Metric.

This table also contains a few English to English conversions

<table>
<thead>
<tr>
<th>FROM</th>
<th>TO</th>
<th>MULTIPLY BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Btu/hr</td>
<td>kW</td>
<td>0.293 x 10⁻³</td>
</tr>
<tr>
<td>cfm</td>
<td>m³/h</td>
<td>2.832 x 10⁻²</td>
</tr>
<tr>
<td>ft</td>
<td>m</td>
<td>0.3048</td>
</tr>
<tr>
<td>ft</td>
<td>ln</td>
<td>12</td>
</tr>
<tr>
<td>ft³</td>
<td>m³</td>
<td>2.832 x 10⁻²</td>
</tr>
<tr>
<td>ln</td>
<td>ft</td>
<td>8.333 x 10⁻²</td>
</tr>
<tr>
<td>ln</td>
<td>mm</td>
<td>25.4</td>
</tr>
<tr>
<td>ln wc</td>
<td>mbar</td>
<td>2.49</td>
</tr>
<tr>
<td>lb</td>
<td>kg</td>
<td>0.454</td>
</tr>
<tr>
<td>Psi</td>
<td>mbar</td>
<td>68.95</td>
</tr>
</tbody>
</table>

°C = 5/9 (°F - 32)
These are the symbols that are used in the schematics.

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>APPEARANCE</th>
<th>NAME</th>
<th>REMARKS</th>
<th>BULLETIN/INFO GUIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Thermjet burner" /></td>
<td>Thermjet burner</td>
<td>Eclipse Combustion, Inc. strongly endorses NFPA as a minimum.</td>
<td>756</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Main gas shut-off valve train" /></td>
<td>Main gas shut-off valve train</td>
<td>The combustion air blower provides the combustion air pressure to the burner(s).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Combustion air blower" /></td>
<td>Combustion air blower</td>
<td>The air pressure switch gives a signal to the safety system when there is not enough air pressure from the blower.</td>
<td>610</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Air pressure switch" /></td>
<td>Air pressure switch</td>
<td>Gas cocks are used to manually shut off the gas supply on both sides of the main gas shut-off valve train.</td>
<td>710</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Gas cock" /></td>
<td>Gas cock</td>
<td>Solenoid valves are used to automatically shut off the gas supply on a bypass gas system or on small capacity burner systems.</td>
<td>760</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Solenoid valve" /></td>
<td>Solenoid valve</td>
<td>Manual butterfly valves are used to balance the air or gas flow at each burner, and/or to control the zone flow.</td>
<td>720</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Manual butterfly valve" /></td>
<td>Manual butterfly valve</td>
<td>Automatic butterfly valves are typically used to set the output of the system.</td>
<td>720</td>
<td></td>
</tr>
</tbody>
</table>
### Key to the system schematics

<table>
<thead>
<tr>
<th>SYMBOL</th>
<th>APPEARANCE</th>
<th>NAME</th>
<th>REMARKS</th>
<th>BULLETIN/INFO GUIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Ratio regulator symbol" /></td>
<td><img src="image" alt="Ratio regulator" /></td>
<td>Ratio regulator</td>
<td>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. The cap must stay on the ratio regulator after adjustment.</td>
<td>742</td>
</tr>
<tr>
<td><img src="image" alt="CRS valve symbol" /></td>
<td><img src="image" alt="CRS valve" /></td>
<td>CRS valve</td>
<td>A CRS valve is used in a high/low time-proportional control system to quickly open and close the air supply.</td>
<td>744</td>
</tr>
<tr>
<td><img src="image" alt="Pressure taps" /></td>
<td></td>
<td>Pressure taps</td>
<td>The schematics show the advised positions of the pressure taps.</td>
<td></td>
</tr>
<tr>
<td><img src="image" alt="Impulse line" /></td>
<td></td>
<td>Impulse line</td>
<td>The impulse line connects the ratio regulator to the air supply line.</td>
<td></td>
</tr>
</tbody>
</table>

---

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A-3
Write down the settings for each burner in the two tables that follow:

**General system parameters**

<table>
<thead>
<tr>
<th></th>
<th><strong>SYSTEM 1</strong></th>
<th><strong>SYSTEM 2</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer PO</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customer signature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furnace type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furnace temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of burners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High fire input per burner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Orifice sizes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating voltage &amp; freq.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altitude</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Burner settings

<table>
<thead>
<tr>
<th></th>
<th>LOW FIRE</th>
<th>HIGH FIRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main gas pressure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas pressure into the ratio regulator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas pressure out of the ratio regulator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air pressure from the blower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure drop across each burner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Gas orifice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure drop across each burner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Air orifice</td>
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<td>Flame signal strength</td>
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<td>Loading line pressure</td>
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</table>
## Illustrated Parts List

<table>
<thead>
<tr>
<th>POS. NO.</th>
<th>QTY.</th>
<th>PART NAME</th>
<th>ECLIPSE PART NUMBER</th>
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<td>SIZE 50</td>
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<td>1</td>
<td>Gasket, Mounting</td>
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<td>Plug, Test, 3/8 NPT</td>
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<td>Housing, Silicon Carbide</td>
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<td>Nozzle, Machined</td>
<td>7000-1</td>
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<td>2</td>
<td>Screw, Set, M6 x 10, Soc. Cup</td>
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<td>8</td>
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<td>Cover, Rear</td>
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<td>9</td>
<td>13</td>
<td>Washer, Lock, M8</td>
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<td>4</td>
<td>Screw, HH, M8 x 18, Zinc Plated</td>
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<td>Plug, Spark, 2.50 lg., 14 mm</td>
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<td>3/8 Peep Sight</td>
<td>10509</td>
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<td>Rod, Flame, 3/4&quot; Pipe x 10 1/2&quot;</td>
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<td>Seal, O'Ring</td>
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<td>Plate, Orifice, Natural Gas</td>
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<td>Plate, Orifice, Butane</td>
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<td>Block, Inlet, Air - Rc</td>
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<td>Screw, HH, M8 x 70 Zinc</td>
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<td>Screw</td>
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<td>Tube, Firing, Burner, High Vel., Silicon Carbide</td>
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<td>Tube, Firing, Burner, Medium Velocity, Silicon Carbide</td>
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<td>Tube, Combustion, High Vel. Alloy Tube</td>
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<td>Tube, Combustion, Medium Velocity Alloy Tube</td>
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<td>31</td>
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<td>32</td>
<td>4</td>
<td>Screw, 3/8&quot;, Ig. #2 Drive</td>
<td>18933</td>
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</table>
To make sure that the downtime of the system is as short as possible in case of a failure, you should keep a stock of spare parts.

**Recommended spare parts**

<table>
<thead>
<tr>
<th>PART NAME</th>
<th>QUANTITY</th>
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<tr>
<td>spark plug</td>
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<tr>
<td>ignition transformer</td>
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<tr>
<td>ignition cable</td>
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</tr>
<tr>
<td>U.V. scanner/flame rod</td>
<td></td>
</tr>
<tr>
<td>flame safeguard</td>
<td></td>
</tr>
<tr>
<td>flame safety relay</td>
<td></td>
</tr>
<tr>
<td>nozzle</td>
<td></td>
</tr>
<tr>
<td>combustor</td>
<td></td>
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<tr>
<td>gasket</td>
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