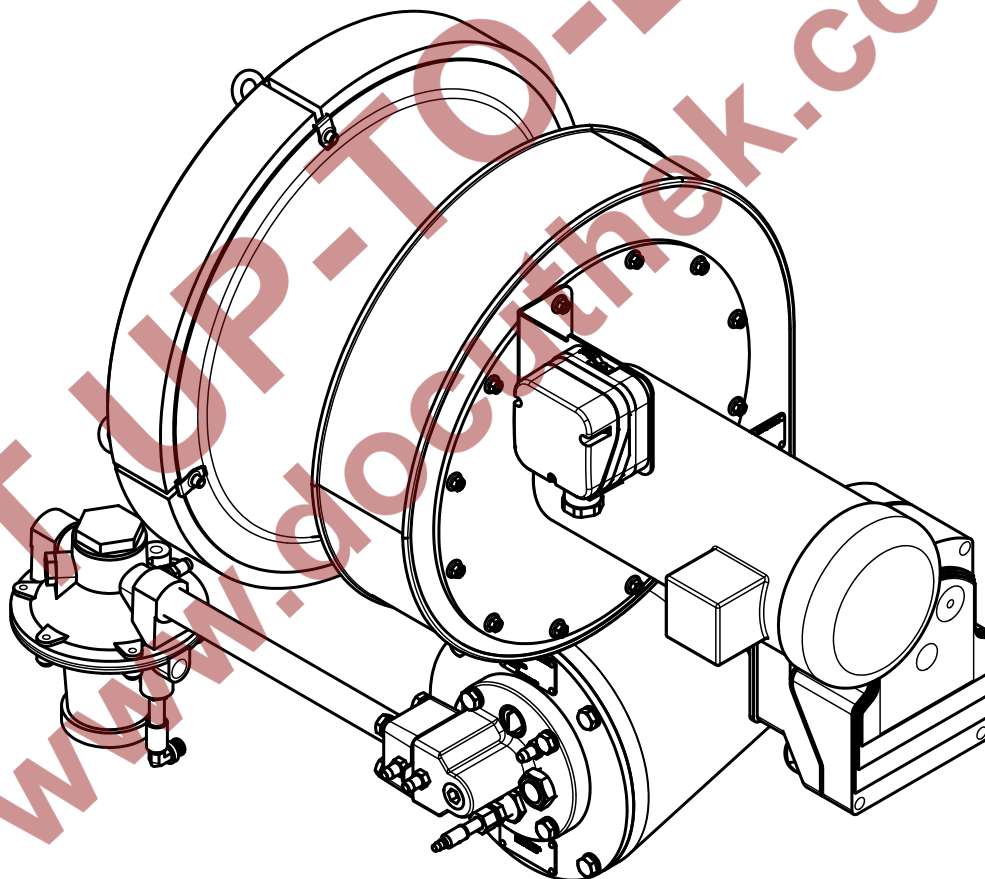


# *ImmersoJet* *Burner*

Version 3



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

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

## **How To Get Help**

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

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

Please be sure to know your equipment's information found on the product label when contacting the factory so we may better serve you.

<b>ECLIPSE</b> <small>Innovative Thermal Solutions</small>	<b>www.eclipsenet.com</b>
Product Name	
Item #	
S/N	
DD MMM YYYY	



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



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



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



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

**NOTICE**

Is used to address practices not related to personal injury.

**NOTE**

Indicates an important part of text. Read thoroughly.

# Table of Contents

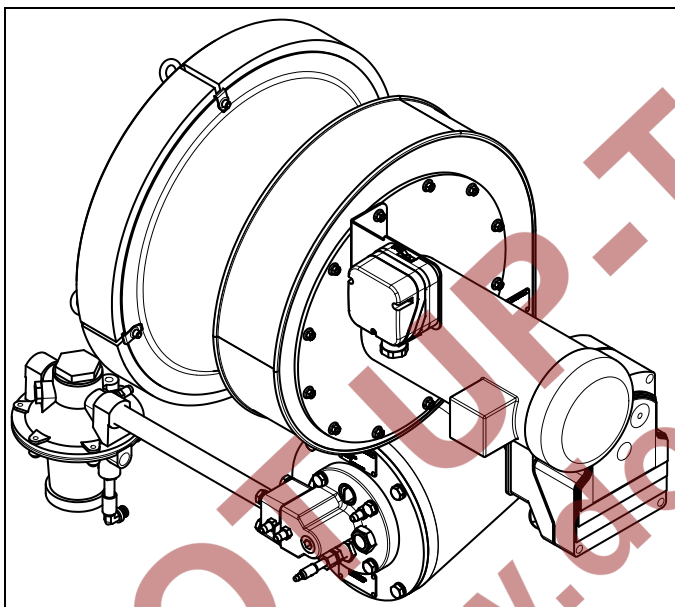
<b>1 Introduction</b>	<b>4</b>
Product Description	4
Audience	4
Purpose	4
ImmersoJet Documents	4
Related Documents	4
<b>2 Safety</b>	<b>5</b>
Safety Warnings	5
Capabilities	5
Operator Training	5
Replacement Parts	5
<b>3 Installation</b>	<b>6</b>
Introduction	6
Handling & Storage	6
Position of Components	6
Approval of Components	6
Checklist Before Installation	7
Prepare the Burner	7
Installation	8
Checklist After Installation	9
<b>4 Adjustment, Start &amp; Stop</b>	<b>10</b>
Introduction	10
Adjustment Procedure	10
Reset the System	10
Verify Air Flow	10
Set Low Fire Air	11
Ignite the Burner	11
Verify Settings	12
<b>5 Maintenance &amp; Troubleshooting</b>	<b>13</b>
Introduction	13
Maintenance	13
Monthly Checklist	13
Yearly Checklist	13
Troubleshooting Guide	14
<b>Appendix</b>	<b>i</b>
Conversion Factors	i
Notes	ii

# Introduction

1

## **Product Description**

The ImmersoJet (IJ) is a nozzle-mix tube-firing burner that is designed to fire at high velocities through small diameter immersion tubes. The standard burner includes a packaged blower, actuator control motor, integral butterfly valve, ratio regulator, burner body, combustion chamber, nozzle (specific to fuel used), rear cover, spark and flame rods, and gas orifice (also specific to fuel used).



**Figure 1.1. Eclipse ImmersoJet Burner**

## **Audience**

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

These aspects are:

- Installation
- Use
- Maintenance

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

## **Purpose**

The purpose of this manual is to make sure that you carry out the installation of a safe, effective, and trouble-free system.

## **ImmersoJet Documents**

### **Installation Guide No. 330**

- This document

### **Datasheet No. 330-2, 330-3, 330-4, 330-6, 330-7, 330-8**

- Available for individual IJ models
- Required to complete installation

### **Design Guide No. 330**

- Used with Datasheets to design burner system

## **Related Documents**

### **Eclipse Bulletins and Information Guides**

- EFE 825 (Combustion Engineering Guide)
- 610, 710, 720, 730, 744, 760, 930

# Safety

# 2

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

## Safety Warnings



### **DANGER**

- The burners 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; fire or explosion could result.
- Never try to light the burner if it shows signs of damage or malfunction.



### **WARNING**

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

### **NOTICE**

- This manual 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.

## Capabilities

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

## Operator Training

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

## Replacement Parts

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

# Installation

# 3

## **Introduction**

In this section you will find the information and instructions needed to install the burner and system components.

## **Handling & Storage**

### **Handling**

- Make sure the area is clean.
- Protect the components from weather, damage, dirt and moisture.
- Protect the components from excessive temperatures and humidity.

### **Storage**

- Make sure the components are clean and free of damage.
- Store the components in a cool, clean, dry room.
- After making sure everything is present and in good condition, keep the components in original packages as long as possible.

## **Position of Components**

The position and amount of components are determined by the kind of control method chosen. All the control methods can be found in Design Guide 330, Chapter 3 "System Design". Use the schematics in that chapter to build your system.

## **Approval of Components**

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

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

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

## **Electrical Wiring**

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

- NFPA Standard 70
- IEC60364
- CSA C22
- BS7671

## **Gas Piping**

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

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

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

### **The NFPA Standards are available from:**

National Fire Protection Agency  
Batterymarch Park  
Quincy, MA 02269  
[www.nfpa.org](http://www.nfpa.org)

### **The ANSI Standards are available from:**

American National Standard Institute  
1430 Broadway  
New York, NY 10018  
[www.ansi.org](http://www.ansi.org)

### **The UL Standards are available from:**

333 Pfingsten Road  
Northbrook, IL 60062  
[www.ul.com](http://www.ul.com)

### **The FM Standards are available from:**

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



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

Comité Européen de Normalisation  
Stassartstraat 36  
B-1050 Brussels  
Phone: +32-25196811  
Fax: +32-25196819  
www.cen.eu

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

## Checklist Before Installation

### Intake

Provide an opening in the burner room of at least one square inch per 4000 BTU/hr (6 cm<sup>2</sup> per 1 kW) to supply the burner intake with fresh, outdoor, combustion air.

If there are corrosive fumes or materials in the surrounding air, find an uncontaminated source to supply air to the burner, or provide a sufficient air filtering system.

### Exhaust

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

### Access

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

### Environment

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

- Voltage, frequency and stability of the electrical power
- Fuel 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
- Prevent direct exposure to water

## Configuration

Verify the configuration of the ImmersoJet burner package:

- Make sure piping orientation is correct. See page 7 of this manual for guidance on changing the orientation.
- Make sure spark plug is installed and adjusted correctly.

- Make sure flame sensor is installed. It may be either a flame rod or a UV scanner, depending on the type of flame monitoring control system being used.

For detailed information on how to install and connect a flame rod, refer to:

- Bulletin / Info guide 832.

For detailed information on how to install and connect a UV scanner, refer to:

- straight UV scanner; Bulletin / Info Guide 854
- 90° UV scanner; Bulletin / Info Guide 852
- self-check UV scanner; Bulletin / Info Guide 856
- solid state UV IR scanner; Bulletin / Info Guide 855

## Prepare the Burner

ImmersoJet burners are designed to be easily installed under a variety of conditions. Some minor preparation may be required to install the new ImmersoJet into specific systems.

## Burner Piping

The burner is factory assembled and shipped as ordered.

**NOTE:** It is not recommended to redirect piping. If necessary, be sure the:

- ratio regulator spring column ❶ is pointing down.
- arrow on the ratio regulator points in the direction of gas flow.
- integral fuel orifice and o-rings ❷ are re-installed.
- same straight run of pipe ❸ remains between the ratio regulator and the burner.

## Redirecting Piping

To redirect piping, rotate the rear cover plate assembly:

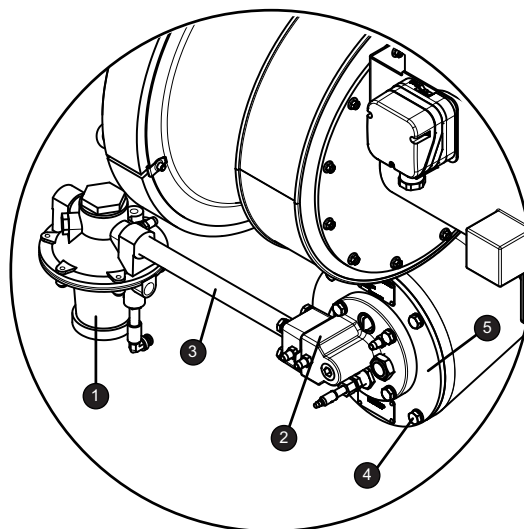


Figure 3.1. Component Location

1. Disconnect loading line at ratio regulator.
2. Remove outer bolts. ④
3. Rotate rear cover plate assembly ⑤ to desired position.
4. Reinstall outer bolts. ④

### CAUTION

- The rear cover is connected to the combustion housing which slides into the burner housing on the tube mounting end. Be certain the combustion housing seats in the burner housing as indicated by no gap between the rear cover and the housing. Do not use the bolts to seat the cover.
5. Position the ratio regulator with the spring housing in a vertical downward position.
  6. Reconnect loading line at ratio regulator. If necessary, connect loading line to the burner pressure tap connection on opposite side of air inlet.

## Installation

### Dimensions

Bolt the burner to the immersion tank wall or immersion tube flange. For bolt hole patterns, see the datasheet for your ImmersoJet model.

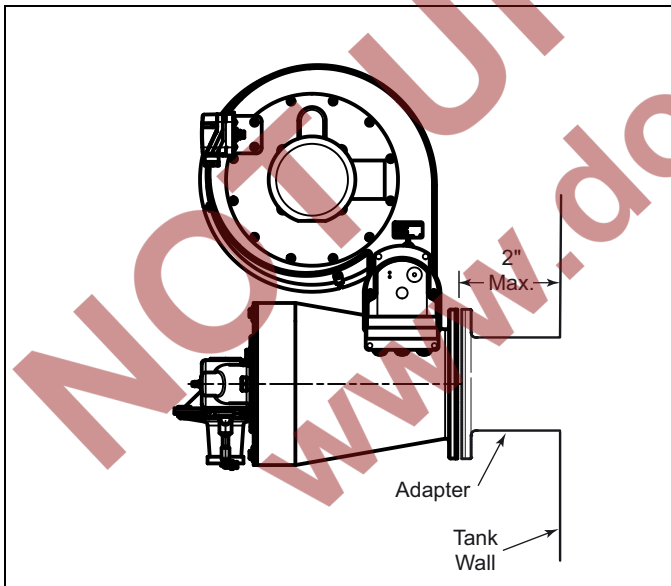


Figure 3.2. Burner Installation

### CAUTION

- If adapters are used, burner flange should not be spaced farther than 2" from tank wall.

## Tank Wall

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

### CAUTION

- Burner body surface temperature near the flange can exceed 200°F (100°C) if an adapter flange is used, higher temperatures may occur. Allow a free, convective flow of air around the burner and do not cover with insulation.

## Piping

### Layout

Install all the piping as shown in the system schematics found in Chapter 3 of IJ Design Guide 330.

### Supply Piping

Install the piping using the following steps:

- Locate the valve train close to the burner. The gas must reach the burner during the fixed trial for ignition.
- Sufficiently size shut off valves in the valve train.
- Make sure piping is large enough.
- Minimize piping elbows.

### Pipe Connections

- Installation of a pipe union in the gas line is recommended to simplify burner removal.
- Use of flexible pipe is optional.

**NOTE:** Flexible pipe causes higher pressure drops than standard pipe. Consider this when sizing your gas lines.

### Support the Piping

Use brackets or hangers to support the piping; don't let burner support the weight of the piping. If you have questions, consult your local gas company.

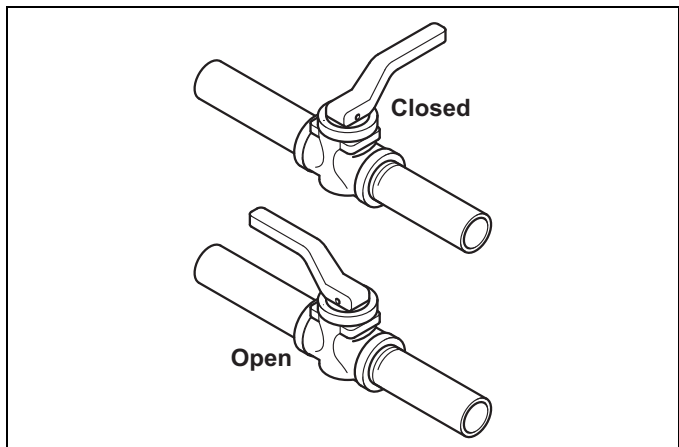
**NOTE:** The pressure drop of the gas and the air in the piping is a critical parameter. Make sure that the size of all the piping is large enough to prevent excessive pressure losses. Refer to Eclipse Engineering Guide EFE 825 for details.

## 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.





**Figure 3.3. Valve Orientation**

### 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.

### Ratio Regulator

The ratio regulator is installed on the burner at the factory. When mounting the burner, be sure that gas flow through the regulator is horizontal and the spring housing points downward.

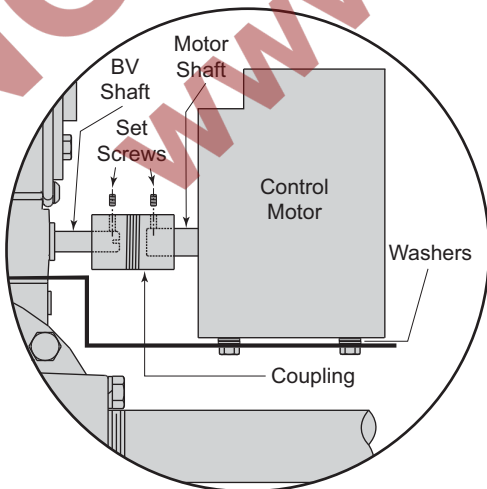
### Flame Monitoring Control System

For information, refer to the Bulletins of the flame monitoring control system:

- Veriflame; Bulletin 818
- Multiflame; Bulletin 820
- Bi-Flame; Bulletin 826

### Control Motor

Install a control motor to modulate the air butterfly valve if not previously installed on the burner.



**Figure 3.4. Control Motor**

**NOTE:** Be sure the control motor shaft and air butterfly valve shaft are aligned properly. If using an Eclipse Actuator Mounting Parts Kit, the supplied washers may be used as shims (stacked 0, 1, or 2 high) to ensure proper alignment. Additionally, a flexible coupling can be used to handle minor misalignment.

### Checklist After Installation

To verify the system was properly installed, perform the following checks:

1. Be sure there are no leaks in the gas lines.
2. Be sure all the components contained in the flame monitoring and control system are properly installed. This includes verifying that:
  - all the switches are installed in the correct locations.
  - all wiring, pressure, and impulse lines are properly connected.
3. Be sure all components of the spark ignition system are installed and functioning properly.
4. Be sure the blower rotates in the proper direction. If the rotation is incorrect, have a qualified electrician rewire the blower to rotate in the proper direction.
5. Be sure all valves are installed in the proper location and correctly oriented relative to the flow direction.

# Adjustment, Start & Stop

4

## Introduction

In this chapter, you will find instructions on how to adjust, start, and stop the burner system. Become familiar with burner control methods before attempting to make adjustments.

### DANGER

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

## Adjustment Procedure

### Step 1: Reset the System

1. Set the air pressure switch so that it drops out at 4" w.c. (10 mbar) below the air inlet pressure listed in the appropriate IJ Data Sheet.
2. Set the low gas pressure switch at 4" w.c. (10 mbar) below the gas pressure measured at the inlet to the main gas valve train.
3. Set the high gas pressure switch at 4" w.c. (10 mbar) above the gas pressure measured at the inlet to the main gas valve train.
4. Close all the burner gas cocks.

### DANGER

- If simulated limits or simulated flame failures do not shut down the fuel system within the required failure response time, immediately correct the problem before proceeding.
5. Start the combustion air blower.

6. Try to light the burner to be sure that the flame monitoring system indicates a flame failure.
7. Activate pressure switches and other limit interlocks. Make sure that the main gas valve train closes.
8. Adjust main gas inlet pressure to the ratio regulator within the range specified in the appropriate data sheet.

### WARNING

- Gas inlet pressures must stay within the specified range. Pressure above the specified range can damage the ratio regulator.
- Pressure below the specified range can impair the ability of the ratio regulator to control the gas flow.
- Operating the system outside the specified range can cause excess fuel consumption and the possible accumulation of unburned fuel in the tube.
- In extreme cases, this accumulation of unburned fuel may cause fires or explosions.

### Step 2: Verify Air Flow

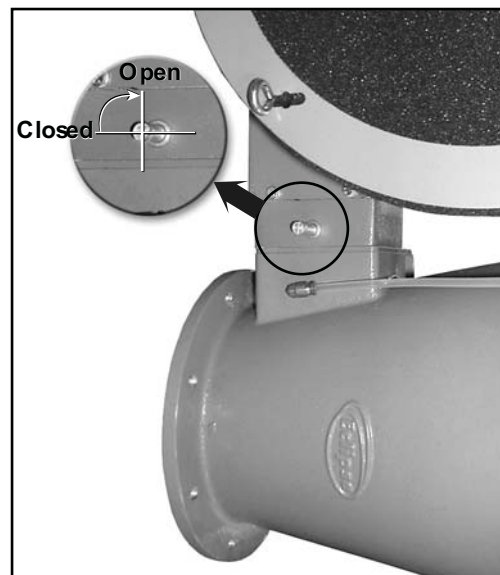


Figure 4.1. Verify Air Flow

1. With manual and automatic gas valves remaining closed, set the system to high fire. **DO NOT** ignite the burner(s).

**NOTE:** The slot on the end of the butterfly valve shaft is parallel to the plane of the butterfly. This can be used as a visual indication of valve position.

2. Start the combustion air blower.
3. Use the data from the appropriate ImmersoJet Data Sheet to find the static air pressure at high fire. This is now the target value for high fire.

**NOTE:** Tube back pressure may limit the burner from reaching the data sheet value.

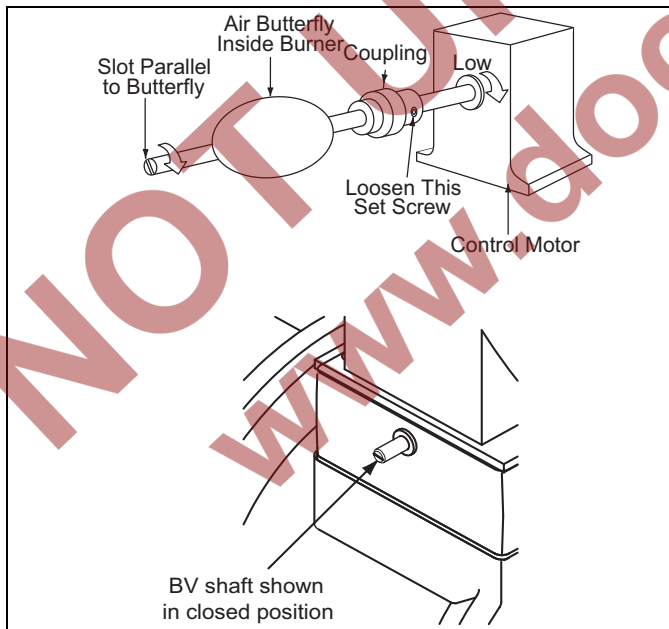
**NOTE:** A pressure tap is open when the screw inside the tap is unscrewed approximately half a turn.

- a. Make sure that pressure tap "A" is open.
- b. Connect the manometer to tap "A".
- c. Verify target value from step 3 above.

**Packaged Blower:** Verify that the slot on the end of the butterfly valve shaft (if applicable) is parallel to flow (fully open). If necessary, adjust the control motor travel for high fire.

**Remote Blower:** Adjust the manual butterfly valve to achieve the target value.

### Step 3: Set Low Fire Air



**Figure 4.2. Air Butterfly Valve Shaft**

1. Start combustion air blower.
2. Drive control motor to low fire position.
3. Set low fire air.

### Packaged Blower:

- a. Loosen the set screw on burner side of coupling.

**NOTE:** The BV is closed when the shaft slot is perpendicular to the direction of air flow through the BV.

- b. Rotate air BV shaft to fully closed position. (Holes in BV damper will supply low fire air.)

- c. Hold BV shaft firmly in place and tighten set screw.

### Remote Blower:

- a. Adjust automatic butterfly position for low fire air.

4. Check the pressure at tap "A". It should be 0.1" w.c. to 0.4" w.c. The low fire butterfly valve position can be adjusted to change the pressure.

**NOTE:** The pressure at tap "A" without the blower on is a pressure that must be overcome to ignite the burner. The pressure measured in step four should be approximately two times higher.

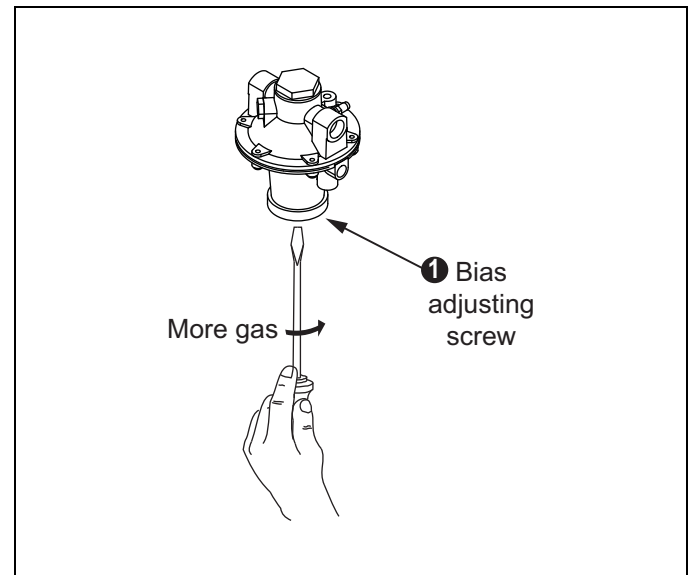
5. Cycle the control motor several times, checking high and low fire positions. If they don't repeat, check for a loose valve shaft coupling or binding of the motor or valve.
6. Close the pressure taps.



### WARNING

- This procedure is written with the assumption the burner has a flame monitoring control system installed and operating. A proper purge cycle must be part of the system and purge timing should not be bypassed.

### Step 4: Ignite the Burner



**Figure 4.3. Ratio Regulator**

1. Drive the air butterfly valve to low fire.
2. Be sure combustion air blower is running.
3. Open main gas manual shut off valves.
4. Set system control to stay at low fire during and after ignition sequence.
5. Attempt to ignite burner.
6. If burner does not ignite:

**a.** Attempt to ignite burner again to purge air from the gas piping.

**b.** If burner still does not ignite, turn bias adjusting screw ① a half turn to increase gas flow.

**c.** Attempt to ignite burner.

**d.** Repeat steps **b** and **c** until burner ignites. If necessary, refer to Chapter 5 for troubleshooting tips.

7. Flame signal strength:

Adjust gas flow with bias adjusting screw ① for lowest gas flow that maintains a stable flame signal and provides reliable ignition.

**NOTE:** If viewing the flame, it should be blue with flashes of yellow. When firing propane or butane, a proper low fire flame may have sustained flashes of yellow.

8. Verify low fire flame:

**a.** Shut off gas. Allow process to cool.

**b.** Verify repeatability of ignition and low fire flame signal at cold conditions.

6. Cycle burner from high to low several times to check repeatability of settings.
7. Readjust burner if the settings do not repeat as expected. If necessary, refer to Chapter 5, Maintenance & Troubleshooting.
8. Record all setup data as an aid for future troubleshooting and setup operations.



## CAUTION

- Do not turn the combustion air blower off immediately.
  - Allow time for the process to cool. This will prevent hot gases from flowing back into the burner and blower causing damage to the burner.
9. Stop the burner.

## Step 5: Verify Settings

1. With burner lit, go to high fire. Make sure the burner stays lit.
2. Wait for the process to reach normal operating conditions.
3. Measure high fire fuel differential pressure between tap “D” and tap “B”. Compare this to the “Fuel Orifice  $\Delta P$  vs. Input” graph in the data sheet for your burner.

**NOTE:** Adjustment of the control motor to set high fire gas to the desired input /efficiency calculated for your process may be necessary.

4. Measure high fire air  $\Delta P$  between tap “A” and tap “C”. Compare this pressure to the Data Sheet for your burner. Check  $O_2$  levels at maximum burner input.  $O_2$  levels should be between 2.5 and 5%.

5. Go to low fire and verify low fire flame signal and flame appearance (if viewing).

**NOTE:** Gas pressure at low fire will be too low to measure and verify the fuel settings.

# Maintenance & Troubleshooting

6

## **Introduction**

This section is divided into two parts:

- The first part describes the maintenance procedures.
- The second part helps 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.

Following 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. Other standards may take precedence for your particular application.

## **Monthly Checklist**

- Inspect flame-sensing & ignition devices for good condition and cleanliness.
- Test all the alarm systems for proper signals.
- Check valve motors and control valves for free, smooth action and adjustment.
- Test the interlock sequence of all safety equipment; manually make each interlock fail, noting that related equipment closes or stops as specified by the manufacturer.
- Test main fuel hand-valves for operation.
- Clean or replace the combustion air blower filter

## **Yearly Checklist**

Perform all monthly checklists plus:

- Leak test shut-off valves for tightness of closure.
- Inspect loading lines for leaks.
- Make sure that the following components are not damaged or distorted:
  - the burner nozzle
  - the spark plug
  - the flame sensor
- Inspect the immersion tube for leaks and excessive corrosion.

## Troubleshooting

Problem	Possible Cause	Solution
Cannot initiate start sequence	Main power is off	Make sure power is on to control system
	No power to control	Call qualified electrician to investigate
	Air pressure switch has not made contact	Check air-pressure switch adjustment Check air filter Check blower rotation Check outlet pressure from blower Check tubing and electrical connections to pressure switches
	High gas pressure switch has tripped	Check incoming gas pressure Adjust gas pressure if necessary Check pressure switch setting and operation
	Low gas pressure switch has activated	Check incoming gas pressure Adjust gas pressure if necessary Check pressure switch setting and operation
	Malfunction of flame monitoring control system such as shorted out flame sensor or electrical noise in the sensor line	Have a qualified electrician investigate and rectify
	Purge cycle not completed	Check flame monitoring control system, purge timer, interlocks and limit switches
Start-up sequence runs but burner does not light	No ignition: • There is no power to the ignition transformer	Restore power to the ignition transformer Check flame monitor control
	No ignition: • Open circuit between the ignition transformer and the spark plug	Repair or replace the wiring and connectors to the spark plug Check ground connection to the transformer
	No ignition: • The spark plug needs cleaning	Clean the spark plug
	No ignition: • The spark plug is not correctly grounded to the burner	Clean the threads of the spark plug and the burner Do not apply grease to the thread of the spark plug
	Too much gas: • Wrong orifice or no orifice installed or wrong nozzle	Check orifice size for fuel type Check nozzle number for fuel type
	Too much gas: • Damaged ratio regulator	Replace ratio regulator
	Too much gas: • Gas pressure out of the main gas pressure regulator is too high	Adjust main gas regulator If necessary, remove regulator and investigate



Problem	Possible Cause	Solution
Start-up sequence runs but burner does not light, <i>continued</i>	Not enough gas: • Gas valve not open	Check all manual valves Check wiring to automatic gas shut-off valve
	Not enough gas: • Start gas solenoid valve does not open	Check solenoid valve coil for proper operation. Replace if necessary
	Not enough gas: • Air in the gas line	Open gas cock Purge gas line
	Not enough gas: • Damaged or missing ratio regulator loading line	Inspect and replace as required
	Not enough gas: • Damaged ratio regulator	Inspect and replace as required
	Not enough gas: • Improper orifice	Check orifice size for fuel type
	Not enough gas: • The gas pressure out of the main gas pressure regulator is too low	Adjust main gas regulator If necessary, remove regulator and investigate
	Not enough gas: • Wrong nozzle for fuel type	Check nozzle number for fuel type
The low fire flame is weak or unstable	• Low fire adjusted too low	Increase low fire gas setting
	• Not enough gas	Check gas adjustment and modify to increase gas flow
	• Not enough air	Check air adjustment Investigate any change, i.e. blocked filter, loose connections
The burner goes off when it cycles to high fire	• Insufficient air (flame too rich)	Check air adjustment Check air filter, clean or replace if required Check ratio regulator and loading line
	• Insufficient gas	Check ratio regulator and loading line Check main gas regulator
The burner is erratic and does not respond to adjustment	• Flame signal weak	Check condition of flame monitoring device
	• Internal damage to the burner. Some parts inside the burner may be loose or dirty	Contact your Eclipse Combustion representative or the Eclipse factory
The burner is unstable or produces soot or smoke	• The air/gas ratio is out of adjustment	Check adjustments, ratio regulator and loading lines
Cannot achieve full capacity	• Air filter is blocked	Clean or replace the air filter
	• Gas pressure is too low into the main gas pressure regulator	Adjust gas pressure
	• Increased tube pressures	Check for blockage
	• Poor piping practices	Contact factory

# Appendix

## Conversion Factors

### Metric to English

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

### Metric to Metric

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

### English to Metric

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

# *Notes*

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