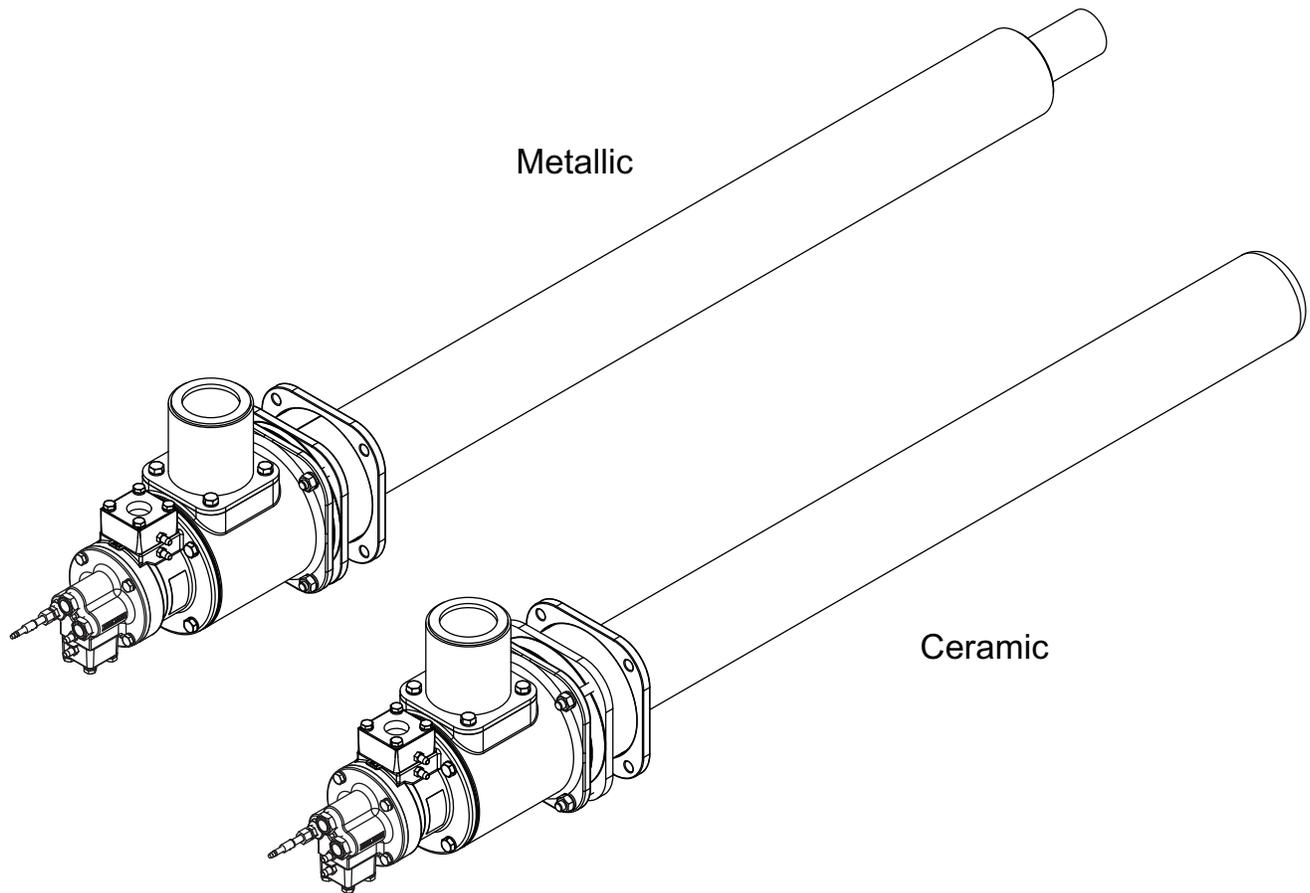


# *Eclipse Single-Ended Radiant Tube Burners*

*Models SER450, SER600 & SER800*

*Operating Instructions Edition 7.16*

*Version 5*



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## Document Conventions

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

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

## How To Get Help

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

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

Please have the information on the product label available when contacting the factory so we may better serve you.

 <b>ECLIPSE</b> <small>Innovative Thermal Solutions</small>	<a href="http://www.eclipsenet.com">www.eclipsenet.com</a>
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.

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# Introduction

# 1

## Product Description

Eclipse Model SER Single-Ended Radiant Tube Burners incorporate the components of a tube firing burner system in a compact package. The SER burner is a nozzle mixing burner and recuperator coaxially mounted inside a single-ended radiant tube. Combustion air entering the SER burner is preheated in the recuperative section by exhaust gases providing higher efficiencies than stand alone burners. The ceramic combustor yields high efficiency and long life. The insulated exhaust housing and mounting extension keep the working environment cooler and more comfortable. SER burners are available in three diameters (4-1/2", 6", 8") with the radiant tube length tailored to the application. SER burners have the added features of internal flue gas recirculation resulting in lower NO<sub>x</sub> emissions and ceramic inner tube sections allowing higher flux rates and promoting longer tube life.

### Features:

- Direct spark ignition
- Reliable burner operation
- Uniform tube temperature
- Improved tube life
- Simple burner adjustment with integral orifice plates
- Multi-fuel capability

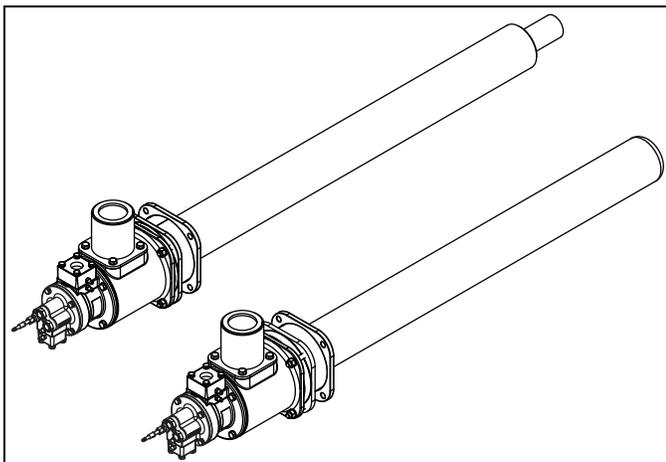


Figure 1.1. Single-Ended Radiant Tube Burner

## Audience

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

These aspects are:

- Installation
- Use
- Maintenance

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

## SER Documents

### **Installation Guide No. 325**

- This document

### **Datasheet, Series No. 325**

- Available for individual SER models
- Required to complete design, selection, & installation

### **Design Guide No. 325**

- Used with Datasheet to complete installation

### **Worksheet No. 325**

- Required to provide application information to Eclipse Engineering

### **Spare Parts List No. 325**

- Recommended replacement part information

## Related Documents

- EFE 825 (Combustion Engineering Guide)
- SP456 (White paper on combustion control by pulse firing)

## Purpose

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

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



### **WARNING**

- **The burner and duct sections are likely to have HOT surfaces. Always wear the appropriate protective equipment 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 provides information regarding the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written approval from Eclipse.**

## Capabilities

Only qualified personnel, with sufficient mechanical aptitude and experience with combustion equipment, should adjust, maintain or troubleshoot any mechanical or electrical part of this system. Contact Eclipse for any needed commissioning assistance.

## 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. Contact Eclipse for any needed site-specific training.

## Replacement Parts

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

# Installation

# 3

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

## **Handling**

- Use the appropriate support and handling equipment when lifting the burner.
- Make sure that the area is clean.
- Protect the components from the weather, damage, dirt and moisture.
- Protect the components from excessive temperatures and humidity.
- Take care not to drop or damage components.

## **Storage**

- Make sure that the components are clean and free of damage.
- Store the components in a cool, clean, dry room.
- 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 amount of components are determined by the kind of control method chosen. All the control methods can be found in Design Guide 325, Chapter 3 “System Design”. Use the schematics 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**

**Air Supply**

Provide an opening in the burner room of at least one square inch per 3000 BTU/hr (5 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. Ensure local standards are met.

**Exhaust**

Do not allow exhaust gases to accumulate in the work area. Provide a means for exhausting these gases from the building.

**Access**

Install the burners so they may be easily accessed for inspection and maintenance.

**Environment**

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

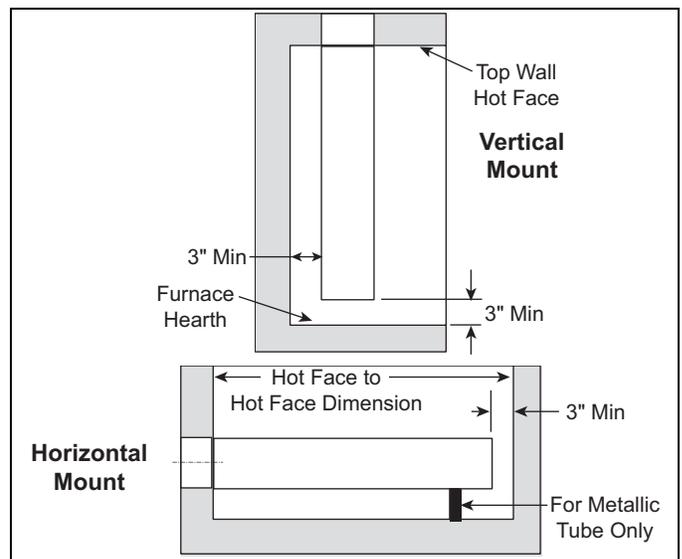
- Voltage, frequency and stability of the electrical power
- Type and supply pressure of the fuel
- Adequate fresh, clean, combustion air
- Humidity, altitude, and temperature of the supply air
- Presence of damaging corrosive gases in the air
- Prevent direct exposure to water

**Confirm Burner/Furnace Compatibility**

Prior to the installation of the SER burner assembly, it is important to check that the unit supplied will fit the furnace correctly. If vertically mounted, measure the distance from the top wall hot face to the hearth.

If the burner is horizontally mounted, measure the distance between the two furnace wall surfaces. This dimension should agree with the Hot Face to Hot Face dimension provided on SER Worksheet 325.

**NOTE:** The end of the outer tube must be at least 3 inches (75 mm) from the hearth brickwork when mounted vertically or from the far wall if mounted horizontally to allow the metallic outer tube to expand freely during operation. In addition, a 3 inches (75 mm) minimum clearance from all furnace walls is recommended to allow the tube to radiate freely.



**Figure 3.1 Dimensional Check**

## **Furnace Wall Preparation**

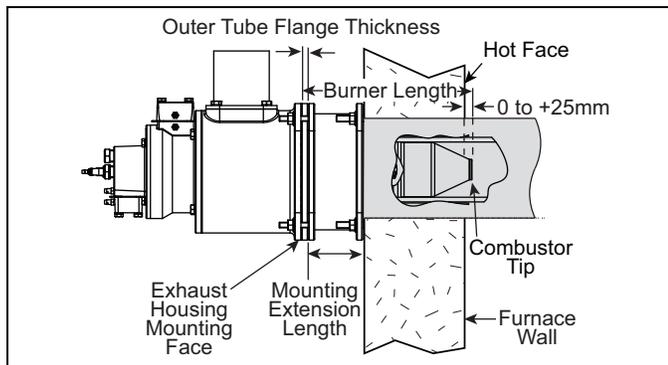
Make sure the furnace wall is capable of supporting the weight of the burner to be installed. If necessary, reinforce the mounting area. A round opening approximately 0.5 inches (12.7 mm) larger than the OD of the radiant tube must be provided in the casing of the furnace. A larger hole through the refractory is acceptable and should be filled with insulation. To verify proper burner position within the furnace wall, determine the burner length. Measure from the exhaust housing mounting face to the tip of the combustor. This is the burner length. Compare the burner length to the furnace wall thickness plus the mounting extension length plus the outer tube flange thickness. The burner length should be longer by 0 - 1 inches (0 - 25 mm).

Burner Length = (Exhaust Housing to Combustor Tip)

Burner Length - Furnace Wall Thickness -

Mounting Extension Length -

Outer Tube Flange Thickness = 0 - 1 inches (0 - 25 mm)

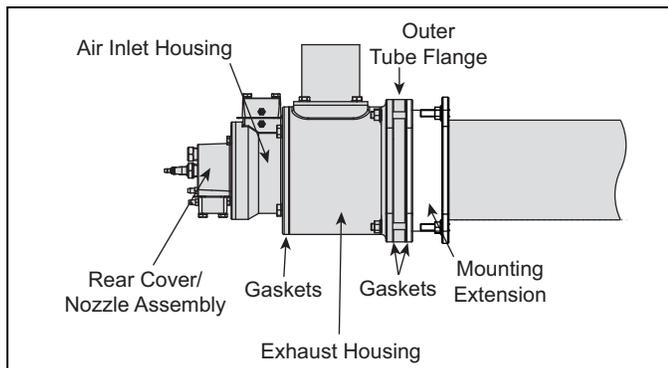


**Figure 3.2 Burner Position Verification**

## **Burner Installation**

### **Step 1: Remove Mounting Extension from Burner Assembly**

**NOTE:** Outer tube is shipped separately.



**Figure 3.3 Burner Assembly**

### **Step 2: New Mounting Extension Installation**

The mounting extension, if utilized, must be bolted to the casing of the furnace. Four studs must be provided on the furnace casing (see datasheet for bolt pattern) to mate with the mounting extension. In order to ensure proper alignment of the mounting flange:

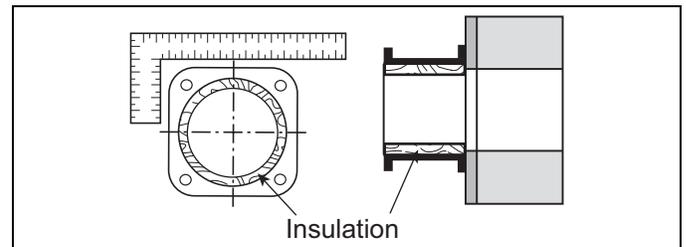
1. Center the mounting extension on the opening in the furnace wall.
2. Ensure the face of the mounting extension is perpendicular to the centerline of the opening.
3. Rotate the mounting extension such that it is square with respect to the vertical centerline of the clearance hole in the furnace.
4. Bolt mounting extension to the furnace casing. See Figure 3.5.1

### **Step 2.2 Retrofit Burner Installation (V1/V3 to V5)**

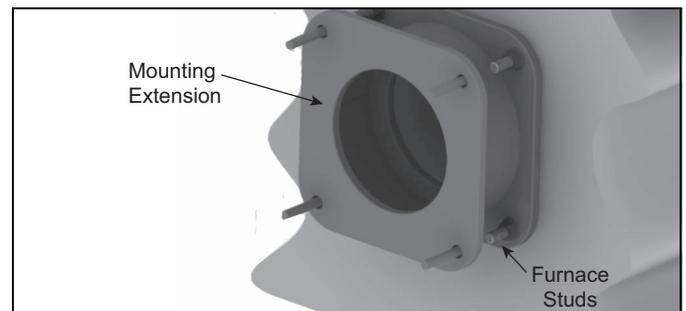
The Eclipse SER V1 and SER V3 burners can easily be replaced with new SER V5 burners by installing the V1/V3 to V5 Adapter Flange before replacing your burner. The V1/V3 to V5 Adapter Flange must be bolted to the existing mounting extension to ensure proper alignment.

**NOTE:** In order to ensure proper alignment of the burner:

1. Ensure the mounting extension is centered on the opening in the furnace wall.
2. Ensure the face of the mounting extension is perpendicular to the centerline of the opening.
3. Bolt the V1/V3 adapter flange to the existing mounting extension. (See Figures 3.5.1 and 3.5.2.)



**Figure 3.4 Mounting Extension Installation**



**Figure 3.5.1**

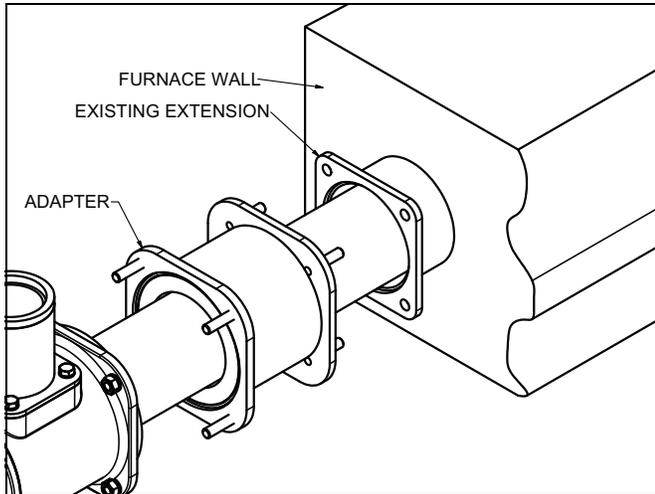


Figure 3.5.2

### Step 3: Exhaust Housing Installation

If mounting extension is not used, four studs must be provided on the furnace casing to mate with the exhaust housing (see the respective datasheet for bolt pattern dimensions. See Figure 3.6)

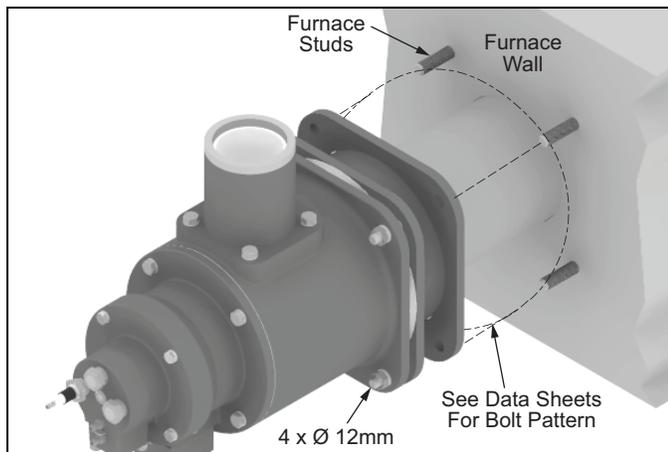


Figure 3.6 Exhaust Housing Installation

### Step 4: Provide Outer Tube Support (Metallic Tube Only)

SER burner outer tubes must be supported if their effective length is longer than 36 inches (900 mm). There are a variety of means for providing support:

1. Provide a simple support for the tube from the furnace hearth.
2. Cantilever a simple support from the opposite furnace wall.
3. Provide an opening in the opposite furnace wall to support an outer tube equipped with a mounting stub.



■ Call your Eclipse sales representative to review.

**NOTE:** For vertical applications, contact Eclipse.

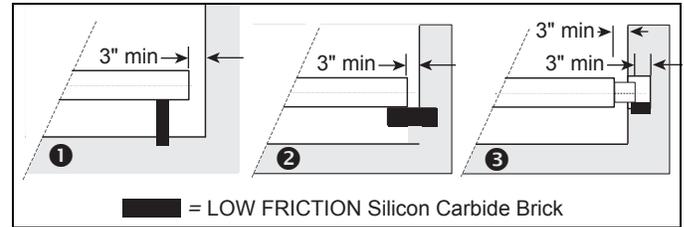


Figure 3.7 Outer Tube Support

Once the tube support has been provided, the outer tube can be installed.

### Step 5: Outer Tube Installation



■ Version 5 outer tubes have a larger diameter flange than previous versions. Previous version outer tubes cannot be used with the version 5 burners.

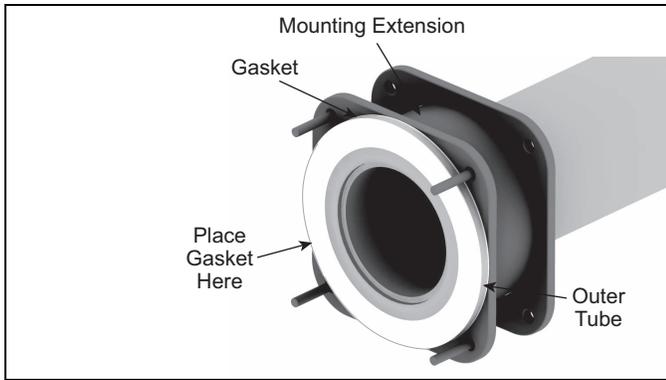
This step is broken into 4 sections. Please select the correct section for your installation.

- 5.1 Metallic Horizontal Outer Tube Installation
- 5.2 Metallic Vertical Outer Tube Installation
- 5.3 Ceramic Vertical Outer Tube Installation
- 5.4 Ceramic Horizontal Outer Tube Installation

#### Step 5.1: Metallic Horizontal Outer Tube Installation

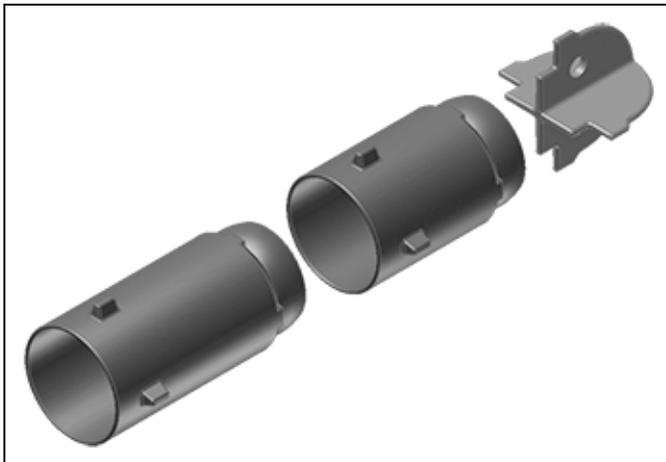
The following instructions apply to burners with metallic outer tubes.

1. Place gasket over outer tube.
2. Slide outer tube through mounting extension flange (if applicable) and prepared hole in the furnace.
3. Place gasket against outer tube flange. Use adhesive spray to hold gaskets in place. See Figure 3.88.



**Figure 3.8**

4. Install inner ceramic sections. Refer to Table 3.1 for the appropriate quantities of short (185 mm) and long (235 mm) inner tube sections. Starting with the end section, add the inner tube sections one into the other and push them to the end of the outer tube. Make sure the inner tube sections are fully inserted in the outer tube. If they are not fully inserted the burner will not operate properly and may become damaged. See Figure 3.9.



**Figure 3.9**

**NOTE:** Use anti-seize compound on all bolts when assembling.

**NOTE:** Outer tube may require centering to assemble. Nuts and bolts should be torqued to 15-20 ft-lbs (20-27 Nm) cold and re-torqued at operating temperature and after 100 hours of operation. Position housing so exhaust is orientated correctly for application.

### Step 5.2: Metallic Vertical Outer Tube Installation

The following instructions apply to burners with metallic outer tubes.

1. With the outer tube horizontally oriented, install inner ceramic sections. Refer to Table 3.1 for the appropriate quantities of shot (185 mm) and long (235 mm) inner tube sections. Starting with the end section, add the inner tube sections one into the other and push them to the end of the outer tube. Make sure the inner tube sections are bottomed in the outer tube. If they are not fully inserted the burner will not operate properly and may become damaged. See Figure 3.9.
2. Place gasket over outer tube.
3. Lift the outer tube to vertical orientation and then lower the outer tube through the mounting extension flange (if applicable) and prepared hole in the furnace.
4. Place gasket against outer tube flange. See Figure 3.88.

**NOTE:** Use anti-seize compound on all bolts when assembling.

**NOTE:** Outer tube may require centering to assemble. Nuts and bolts should be torqued to 15-20 ft-lbs (20-27 Nm) cold and re-torqued at operating temperature and after 100 hours of operation. Position housing so exhaust is orientated correctly for application.

### Step 5.3: Ceramic Vertical Outer Tube Installation

The following instructions apply to burners with ceramic outer tubes.

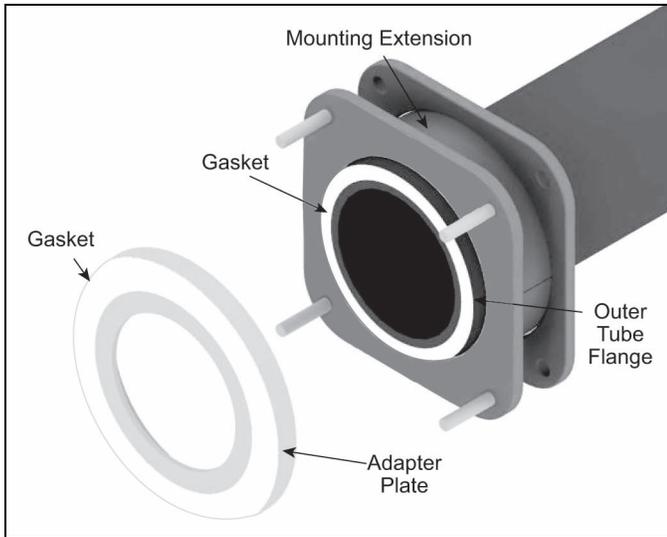
1. With the outer tube horizontally oriented, install inner ceramic sections. Refer to Table 3.1 for the appropriate quantities of shot (185 mm) and long (235 mm) inner tube sections. Starting with the end section, add the inner tube sections one into the other and push them to the end of the outer tube. Make sure the inner tube sections are bottomed in the outer tube. If they are not fully inserted the burner will not operate properly and may become damaged. See Figure 3.9.
2. Place gasket over outer tube.
3. Lift the outer tube to vertical orientation and then lower the outer tube through the mounting extension flange and prepared hole in the furnace.
4. Place gasket against outer tube flange.
5. Place adapter plate over gasket and outer tube flange.



### CAUTION

- Ceramic outer tube must be secure between mounting extension and adapter plate. If not, outer tube may break.

- Place gasket against adapter plate. See figure 3.10.



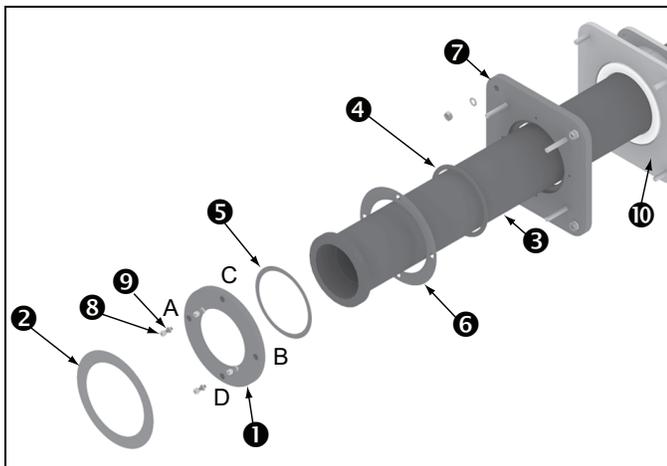
**Figure 3.10**

**NOTE:** Use anti-seize compound on all bolts when assembling.

**NOTE:** Outer tube may require centering to assemble. Nuts and bolts should be torqued to 15-20 ft-lbs (20-27 Nm) cold and re-torqued at operating temperature and after 100 hours of operation. Position housing so exhaust is orientated correctly for application.

#### Step 5.4: Ceramic Horizontal Outer Tube Installation

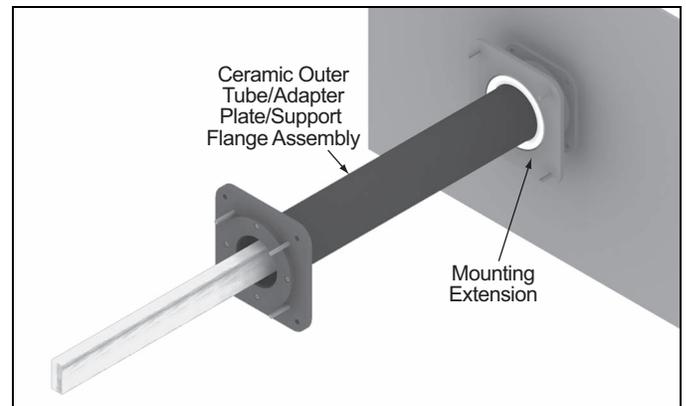
The horizontal ceramic tube should be mounted as follows, please refer to Figure 3.11 for all Item numbers:



**Figure 3.11**

- Use an adhesive spray (ex. 3M Super 77) to adhere gasket (Item 4) into the counter bore of the Support Flange (Item 7) and to adhere gasket (Item 2) into the counter bore of the Adapter Plate (Item 1).

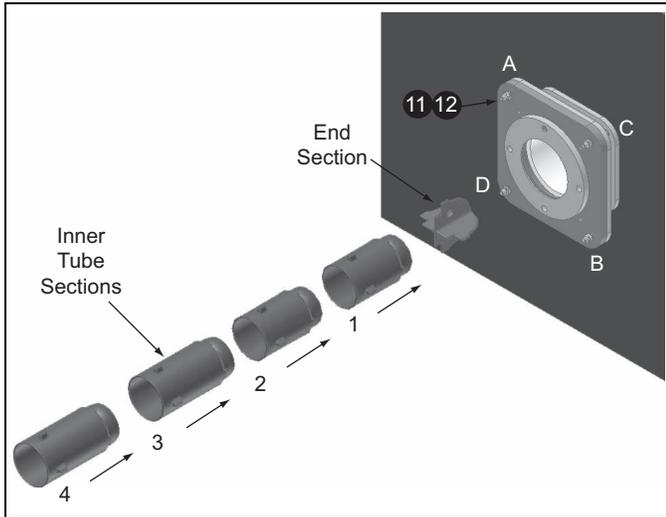
- Slide Support Flange (Item 7) over the ceramic tube (Item 3) until it reaches the ceramic tube flange.
- Mount Adapter Plate (Item 1) to the Support Flange (Item 7) with gasket (Item 6) in between the two. Care should be taken to ensure the ceramic tube flange is centered. Use M8 Cap Screws and Washers (Items 8 and 9) to mount the two parts together. The bolts should be tightened as follows:
  - Apply high temperature anti-seize that is good up to 2400°F to bolts (such as Bostik Never Seez).
  - Lightly tighten all bolts around the circle
  - Using a hand wrench snug all bolts in the following order - A,B,C,D (see Figure 3.11)
  - Using a torque wrench, tighten the bolts to 15-20 ft-lbs (20-27 Nm) in the following order - A,B,C,D
  - Bolts should be re-torqued after 100 hours of operation.
- Slide the Ceramic Outer Tube/Adapter Plate/Support Flange assembly through the mounting extension (Item 10) into the furnace. Special care should be taken during this step to prevent damaging the fragile Ceramic Tube. It may be helpful to lift the assembly with a crane or hoist by rigging to the Adapter Plate. In many cases a cantilever will be necessary to keep the tube horizontal while inserting it into the furnace. If this is the case Eclipse recommends using a long piece of wood as shown in Figure 3.12.



**Figure 3.12**

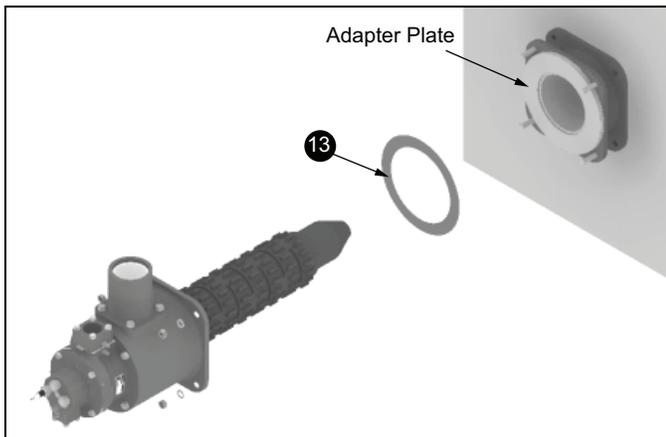
- Secure the Support Flange to the Mounting Extension using M12 nuts and washers (see Figure 3.13) (Items 11 and 12) as follows:
  - Apply High Temperature Anti-Seize to bolts
  - Lightly tighten all bolts around the circle
  - Using a hand wrench snug all bolts on the following order - A,B,C,D (see Figure 3.13)
  - Using a torque wrench, tighten the bolts to 15-20 ft-lbs (20-27 Nm) in the following order - A,B,C,D
  - Bolts should be re-torqued after 100 hours of operation.

- Install inner ceramic sections. Refer to Table 3.1 for the appropriate quantities of short (185 mm) and long (235 mm) inner tube sections. Starting with the end section, add the inner tube sections one into the other and push them to the end of the outer tube. Make sure the inner tube sections are bottomed in the outer tube. If they are not fully inserted, the burner will not operate properly and may become damaged. See Figure 3.13.



**Figure 3.13**

- Adhere gasket (item 13) to the Adapter Plate using a spray adhesive. See Figure 3.14.



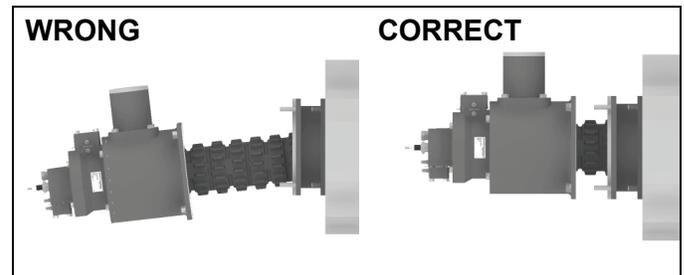
**Figure 3.14**

### Step 6: Burner Installation

Mount burner in outer tube (see Figure 3.15) by aligning holes in exhaust housing with studs on mounting extension (or studs on furnace if no mounting extension is used).

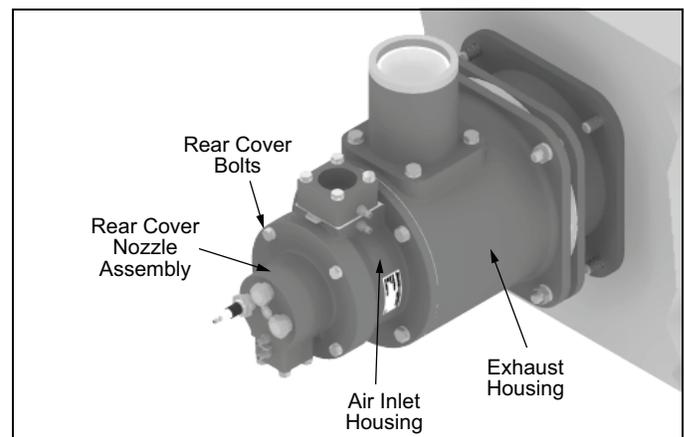


- Do not allow the ceramic combustor to carry the weight of the burner or the combustor will break.



**Figure 3.15**

**NOTE:** The burner may require centering to assemble. Nuts and bolts should be torqued to 15-20 ft-lbs (20-27 Nm) cold and re-torqued at operating temperature and after 100 hours of operation. Position housing so air inlet is oriented to align with the air manifold piping.



**Figure 3.16**

### Step 7: Igniter Installation:

1. Remove rear cover assembly by removing rear cover bolts. See Figure 3.16.
2. Thread igniter through rear cover and through hole in nozzle. See Figure 3.17a.
3. Confirm the position of the igniter. See Figure 3.17b.
4. Slide the rear cover nozzle assembly through the air inlet housing and into the combustor assembly. See Figure 3.18.
5. Assemble the rear cover to the air inlet housing using cap screws. Torque to 5 ft-lbs (7 Nm). Position cover so gas inlet is aligned with gas manifold piping.

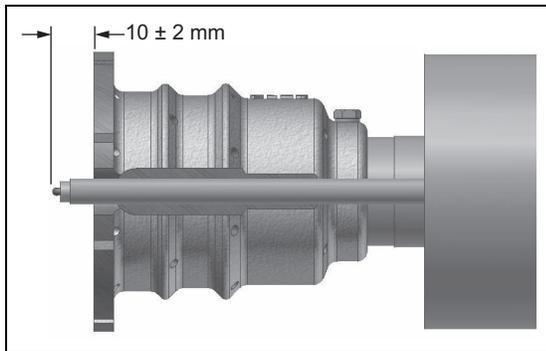


Figure 3.17a

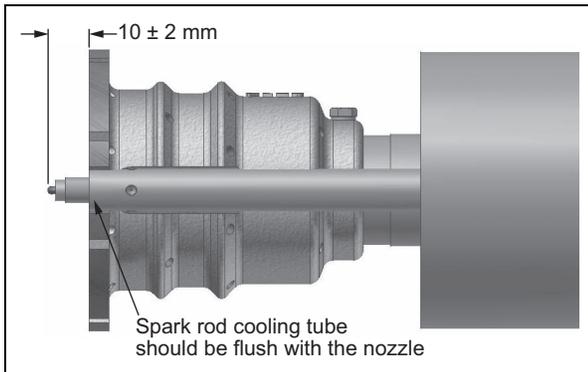


Figure 3.17b

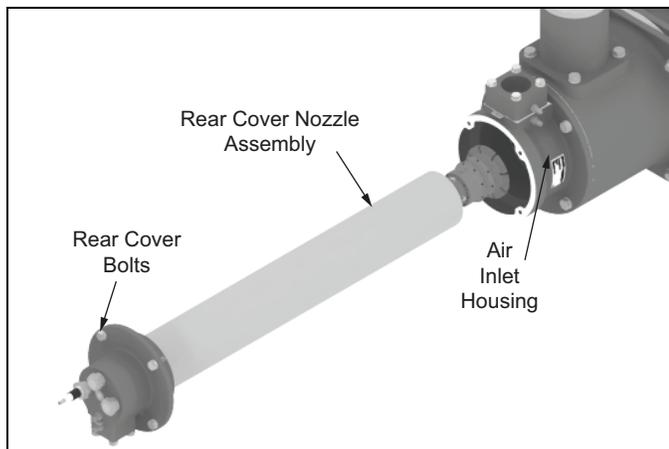


Figure 3.18

### Step 8: UV Flame Sensing (if used):

1. Install the flame sensor into the designated opening in the rear cover. See corresponding Datasheet 325 for proper location.
2. Make sure that the UV scanner is connected to the electrical circuit of that burner.



- Connecting the UV scanner of a burner to the electrical circuit of a different burner can cause fires and explosions.

The UV scanner must be compatible to the flame monitoring control that is used. Refer to the manual of your selected control for proper selection of the scanner.

### NOTICE

- Adjustments may vary from Eclipse published values if the flame controls other than those recommended in the Design Guide are used. Consult with the engineer who specified the alternate control for limitations.

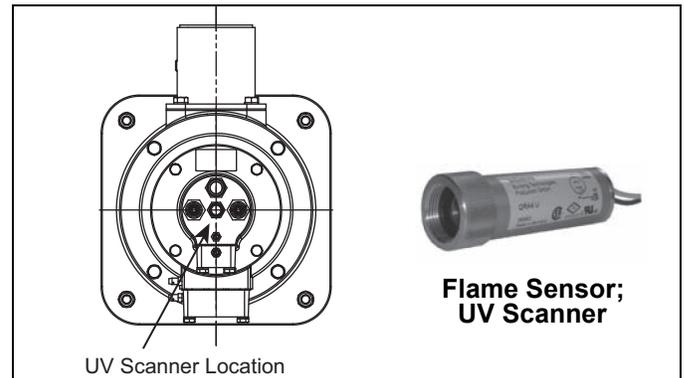


Figure 3.19 Flame Sensor Installation

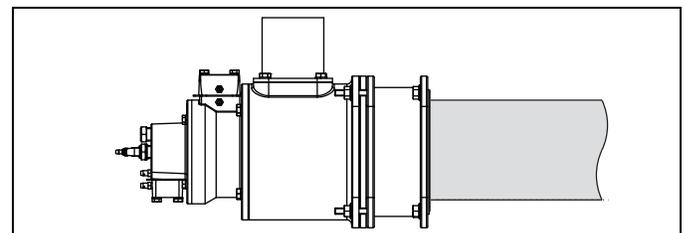


Figure 3.20 Completed Burner Assembly

## Step 9: Cooling Option (if used):

### SER450

If applicable, connect flex hose to air cooling connections, Points A and B shown in Figure 3.21.

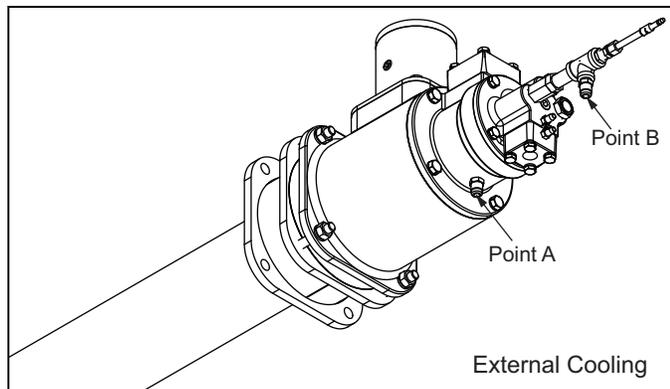


Figure 3.21

### SER600 and SER800

If applicable, burners will have a cooling tube installed and extra ports plugged, as shown. No further assembly is required for this internally-cooled design.

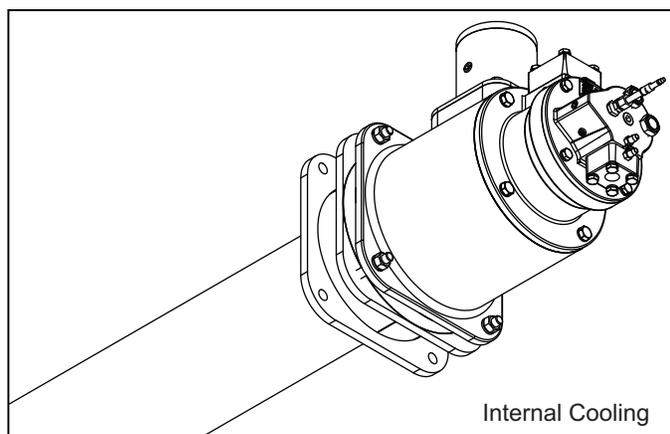


Figure 3.22

## Step 10: Piping

Install the piping as shown in the schematics. Refer to Chapter 3 of the SER Design Guide No. 325.

### Support the Piping

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

## Straight Run of Pipe Before a Metering Orifice

There must be a run of pipe with a straight length of at least 10 pipe diameters before the burner metering orifice. Failure to provide this length will result in inaccurate pressure readings, and poor burner operation.

## Pipe Connections

Install a pipe union in the gas line to the burner. This simplifies removal of the burner.

**NOTE:** Flexible pipe nipples will cause inaccurate metering orifice readings if installed in the burner inlet and may cause higher pressure drops than equivalent standard pipe. Consider this when sizing the gas lines.

## Avoid Large Pressure Drops

Pressure drop 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 valves in such a way that the arrow (if present) on the valve body points in the direction of flow.

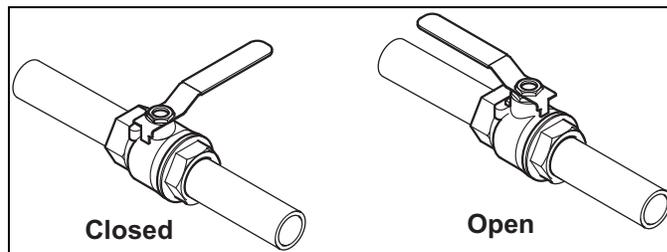


Figure 3.23 Valve Orientation

## 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.

## Balancing Valves

A gas balancing valve is either an adjustable limiting orifice valve or a manual butterfly valve. An air balancing valve is typically a manual butterfly valve. For more information, refer to the following sections.

### Manual Butterfly Valves

- Install manual butterfly valves in accordance with Bulletin / Info Guide 720.

### Adjustable Limiting Orifice Valves

- Install adjustable limiting orifice valves in accordance with Bulletin 728/730.

**NOTE:** It is recommended that there is a run of pipe with a length of at least 10 pipe diameters between any flow altering device and the metering orifice on the burner.

### Automatic Butterfly Valve

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

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

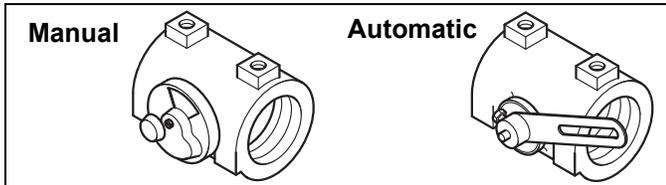


Figure 3.24 Butterfly Valves

### Ratio Regulator

Connect an impulse line to the ratio regulator and to the air supply line.

**NOTE:** The inlet gas pressure to the ratio regulator must be higher than the impulse line pressure at high fire condition.

### Checklist After Installation

To verify proper system installation, do the following:

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

### Prepare for Adjustment

After installation of the burner system components is complete, the following steps should be followed in order to prepare for adjustment:

1. Set the air pressure switches.
2. Close all the burner gas cocks.

3. Try to light a burner before the purge and other timers have finished their cycles. Make sure that the flame monitoring system indicates a flame failure.
4. Trip out pressure switches and other limit interlocks. Make sure that the main gas valve train closes.



**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.

## Inner Tube Sections for Effective Lengths

Effective Lengths (mm)	SER 450		SER 600		SER 800	
	Short (185mm)	Long (235mm)	Short (185mm)	Long (235mm)	Short (185mm)	Long (235mm)
800	3	1	-	-	-	-
850	2	2	-	-	-	-
900	1	3	1	3	2	2
950	0	4	0	4	1	3
1000	3	2	3	2	0	4
1050	2	3	2	3	3	2
1100	1	4	1	4	2	3
1150	0	5	0	5	1	4
1200	3	3	3	3	0	5
1250	2	4	2	4	3	3
1300	1	5	1	5	2	4
1350	0	6	0	6	1	5
1400	3	4	3	4	0	6
1450	2	5	2	5	3	4
1500	1	6	1	6	2	5
1550	0	7	0	7	1	6
1600	3	5	3	5	0	7
1650	2	6	2	6	3	5
1700	1	7	1	7	2	6
1750	0	8	0	8	1	7
1800	3	6	3	6	0	8
1850	2	7	2	7	3	6
1900	1	8	1	8	2	7
1950	-	-	0	9	1	8
2000	-	-	3	7	0	9
2050	-	-	2	8	3	7
2100	-	-	1	9	2	8
2150	-	-	0	10	1	9
2200	-	-	3	8	0	10
2250	-	-	2	9	3	8
2300	-	-	1	10	2	9
2350	-	-	0	11	1	10
2400	-	-	3	9	0	11
2450	-	-	2	10	3	9

# Adjustment, Start and Stop

# 4

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. Read all of this chapter before starting the system.

## DANGER

- The SER 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. Close the automatic gas valves and gas cocks.
2. Fully open the manual air butterfly valve at each burner.
3. Set the zone air control valve to maximum air flow.
4. Start the blower.

## NOTICE

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

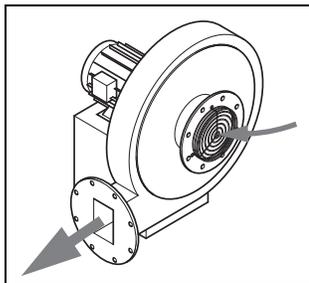


Figure 4.1. Correct Blower Rotation

#### Step 2: Set High Fire Air

1. With gas cocks remaining closed and the system at maximum airflow, use the air curves from the appropriate SER datasheet to find the differential air pressure needed at high fire. This is now the target value for high-fire.
2. Set high-fire air.

**NOTE:** The pressure tap is in the open position when the screw inside the tap is unscrewed approximately 1/2 turn. Do not remove screw.

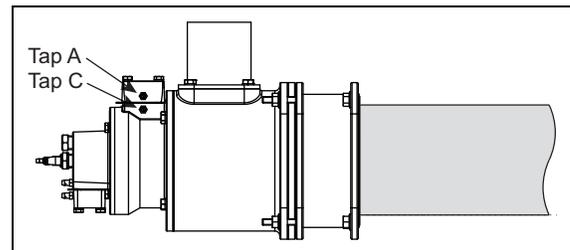


Figure 4.2. Air Taps

#### **Burner System:**

- a. Adjust the zone air control valve to achieve the target differential air pressure between taps A and C for the first burner. (See Figure 4.2.)
- b. Measure and note the differential air pressure across the remaining burners in the zone.
- c. If all the measured differential pressures are within 0.3" w.c. (0.75 mbar) of each other, proceed to the next section. If the variation is greater than 0.3" w.c. (0.75 mbar) it will be necessary to adjust the manual control valve at each burner to improve balance.

**NOTE:** Be sure to tighten pressure tap screw clockwise to the closed position after pressure measurements have been taken.

3. Repeat step 2 for other zones (if applicable).

### **Step 3: Set Low-Fire Air** **(For High/Low Pulse Only)**

1. Set the system to low-fire by closing the burner main air valve and adjusting the low fire air bypass control valve. Set the low fire air  $\Delta P$  to 0.3" - 0.4" w.c. (0.75 - 1.0 mbar). This is the initial setting only. Further adjustment may be necessary.
2. Repeat step 2 for all burners (if applicable).

### **Step 4: Verify the Air Settings**

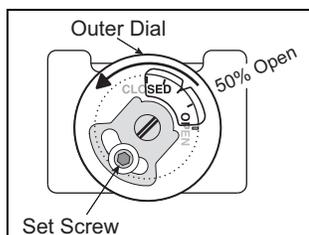
Cycle the system between low and high-fire several times, verifying that all settings remain the same.

### **Step 5: Ignite the Burners**

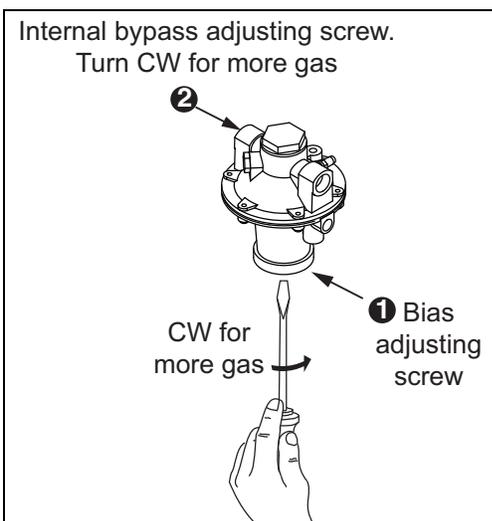
#### **Manual Ignition Steps:**

**NOTE:** Manual ignition is the recommended start procedure for cold start-up.

1. Set the zone air control valve to maximum air flow.
2. Verify burner air valves are open. (Closed with only bypass open for high/low pulse.)
3. Make sure the combustion air blower is running.
4. Set the manual gas valve at each burner to 50% open. See Figure 4.3. If using an adjustable limiting orifice valve, set it at 5 full 360° rotations up from the bottom.



**Figure 4.3. Manual Gas Butterfly 50% Open**



**Figure 4.4. Adjusting Set Screw**

5. Open the zone manual gas cock.
6. Start ignition transformer.



### **DANGER**

- **To avoid the risk of electrical shock, do not touch the ignition plug or the ignition wire when the igniter is energized.**
7. Open burner manual gas cock. Burner should ignite.
  8. If burner does not ignite in 3 seconds, close gas cock.
  9. Wait at least 30 seconds for purge and repeat Step 6.
  10. If the burner fails to light after the second attempt, adjust ratio regulator clockwise 1-2 turns and repeat Step 6.
  11. Terminate ignition transformer.
  12. Open main air valve for high/low pulse only.
  13. Repeat steps 5 through 10 for all burners in the zone.



### **WARNING**

- **These procedures are written with the assumption that each burner is connected to a flame monitoring control system that is installed and operating. A proper purge cycle must be part of the system and purge timing should not be bypassed.**

#### **Automatic Ignition Steps:**

1. Set the zone air control valve to maximum air flow.
2. Make sure the combustion air blower is running.
3. Set the manual gas butterfly valve at each burner to 50% open. See Figure 4.3. If using an adjustable limiting orifice valve, set it at 5 full 360° rotation up from the bottom.
4. Open the zone manual gas cock.
5. Open the manual gas cock at each burner.
6. Initiate the ignition sequence through the flame monitoring system (check for flame, initiate spark, open gas solenoid, trial time, check for flame).
7. Check that all the burners in the zone have ignited.
8. If the burner fails to light after repeated attempts, adjust ratio regulator clockwise 1-2 turns and repeat Step 6.
9. If a gas solenoid valve is fitted at each burner, repeat Step 6 for each burner in the zone.

### **Step 6: Set High Fire Gas**

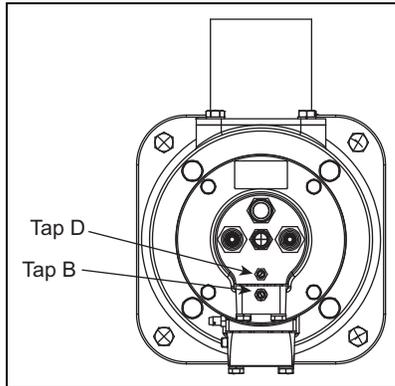
1. With the burners lit, open main air valve.
2. Check the gas pressure at the inlet to the zone ratio regulator. This should be at least 5" w.c. (12.5 mbar) higher than the loading line pressure. It should not

exceed the maximum pressure rating of the ratio regulator.



## WARNING

- Insufficient gas inlet pressure may cause the ratio regulator to remain fully open as the burner system turns down from high fire, causing excess fuel operation and the possible accumulation of unburned fuel in the chamber. In extreme cases, this may cause explosions or fires.
3. Use the gas curve from the appropriate SER datasheet for the gas and orifice plate being used to find the differential gas pressure needed at high fire. This is the target value for high fire.
  4. Adjust the high fire gas flow by adjusting the manual gas balancing valve until the pressure differential across the gas orifice between tap B and tap D is at the target value. (See Figure 4.5.)



**Figure 4.5. Set High Fire Gas**

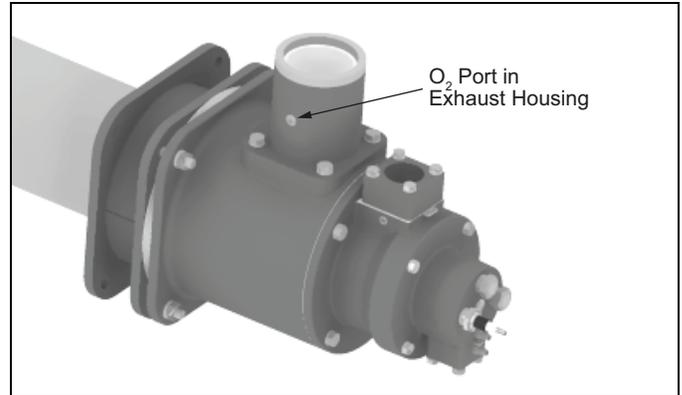
**NOTE:** Be sure to tighten pressure tap screw clockwise to the closed position after pressure measurements have been taken.

5. Repeat step 3 for the other burners in the zone.
6. Bring furnace temperature to operational level.
7. Verify high-fire air pressure differential (Step 2a page 16). Adjust zone manual air valves if necessary to obtain correct levels or manual valves to restore balance between burners.
8. Fine adjust the gas balancing valves to obtain 3% to 5% O<sub>2</sub> in the exhaust gas.

**NOTE:** Lower than recommended O<sub>2</sub> levels may result in premature wear of burner components. Higher than recommended O<sub>2</sub> levels will result in reduced efficiency.

9. Repeat Steps 7 & 8 for other burners in the zone.

### **Step 7: Set Low Fire Gas** **(High/Low Pulse Only)**



**Figure 4.6. Set Low Fire Gas**

1. Leave the air bypass valve open and close the main air valves.
2. Adjust the ratio-regulator to achieve 12% to 15% O<sub>2</sub> in the exhaust gases. Turning the adjusting screw counter-clockwise lowers gas flow and increases O<sub>2</sub> reading.
3. As the initial air  $\Delta P$  setting may provide a wide range of air flows depending on burner model and orifice size, it may be necessary to lower the air flow from the initial setting if additional turn-down is required (while maintaining 12% - 15% O<sub>2</sub> in the exhaust gas).

**NOTE:** The main objective of setting low fire is to provide a clean stable flame with a reliable flame signal. For tubes < 60 inches (1500 mm) in length, slightly higher O<sub>2</sub> levels are recommended. Lower than recommended O<sub>2</sub> levels may result in over-heating of internal burner components.

# Maintenance and Troubleshooting

# 5

This chapter is divided into two sections:

- Maintenance procedures
- Troubleshooting guide

## **Maintenance**

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

**NOTE:** These are guidelines only. The customer should make the final determination on maintenance intervals and tasks to be performed while considering the working environment.

## **Monthly Checklist**

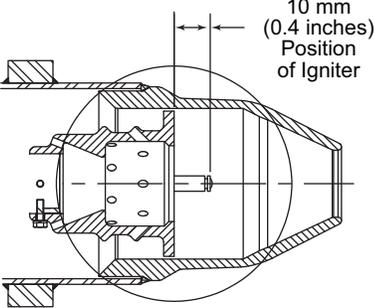
1. Inspect flame sensing devices for good conditions, and cleanliness.
2. Check for proper inlet air/gas ratios (refer to the SER datasheets, series 325).
3. Test all the alarm systems for proper response signals.
4. Check and clean igniter electrodes.
5. Check the air control valve for smooth, trouble free operation and adjustment.
6. Check for the proper operation of ventilating equipment.
7. Test the interlock sequence on all safety equipment. Manually force each interlock to intentionally fail while at the same time noting if related equipment closes or stops as specified by the manufacturer. Test the flame safeguard by manually shutting off the gas to the burner.
8. Test the manual gas shut off cocks for proper operation.
9. Clean and/or replace the combustion air blower filter.
10. Inspect and clean the combustion air blower rotor.

## **Yearly Checklist**

1. Leak test the safety shut-off valves for tightness of closure.
2. Test the pressure switch settings by checking the switch movements against pressure settings and comparing these with the actual impulse pressure.
3. Visually check igniter cable and connectors.
4. Inspect impulse line for leaks.
5. Be sure the following components are not damaged or excessively dirty:
  - the burner nozzle
  - the igniter
  - the flame sensors
  - the inner and outer tubes
6. Rotate metallic outer tubes 180°.

**NOTE:** Burner nozzle can be inspected by removing the rear cover assembly shown on page 11. Inspection of the inner tube sections and outer tube can be done by removing the burner assembly from the mounting extension or furnace. This can be done by reversing the steps on page 8.

## Troubleshooting Procedures

Problem	Possible Cause	Solution
Start-up sequence runs but does not light, no ignition  	There is no power to the ignition transformer.	Restore the power to the ignition transformer.
	Open circuit between the ignition transformer and the ignition rod.	Repair or replace the wiring to the ignition rod.
	The igniter needs cleaning.	Clean the igniter.
	The igniter is not correctly grounded to the burner.	Clean the threads on the igniter and the burner. Do not use grease on the threads on the igniter.
	Igniter insulator is broke. Igniter is grounding out.	Inspect the igniter. Replace if broken.
	Igniter in wrong position.	Check that the igniter extends the proper distance beyond the nozzle face. See illustration on the left.
Start-up sequence runs but does not light, not enough gas	The gas pressure going into the ratio regulator is too low.	Check the gas pressure out of the main gas regulator and adjust if necessary.
	The impulse line to the ratio regulator is leaking.	Repair any leaks.
	Start gas solenoid valve does not open.	Check the solenoid valve coil for proper operation. Replace if necessary.
	Gas valve does not open.	Check the wiring to the automatic gas shut-off valve. Check the output from the flame safeguard. Open manual gas cock.
	Air in the gas line.	Repeat the start attempt several times to purge air from the gas line.
Start-up sequence runs but does not light, too much gas	Gas pressure out of ratio regulator is too high.	Check the gas pressure out of the main gas regulator and adjust if necessary.
	Improper component piping sequence.	Make sure solenoid valve is down stream of ratio regulator.
	Gas BV too far open (high fire).	Check for proper setting.
	Ratio regulator adjustment (low fire).	Check for proper setting.
Start-up sequence runs but does not light, no flame signal	Dirty UV scanner lens.	Inspect and clean sensor. Replace if necessary.
	The low fire flame is weak or unstable	Not enough gas flowing to the burner. Adjust the ratio regulator. Not enough air. Adjust the air control valve to increase low fire air flow.

<b>Problem</b>	<b>Possible Cause</b>	<b>Solution</b>
The burner goes out when it cycles to high fire	Insufficient air.	Check start-up settings. Check air filter, clean or replace if required.
	Insufficient pressure into ratio regulator.	Adjust pressure settings on main gas regulator or change spring.
	Main gas adjustable valve not open enough.	Adjust the main gas adjustable valve.
	Marginal air pressure switch setting.	Adjust air pressure switch setting.
	Gas pressure switch set incorrectly.	Adjust switch setting.
The burner is erratic and does not respond to adjustment	Lost impulse line pressure	Check that the impulse air pressure line is clean and clear of moisture or dirt, and is tight on connections.
	Internal damage to the burner. Some parts inside the burner are loose, dirty, or burned out.	Contact your Eclipse representative for further information.
	Flame signal is weak.	Check the condition of the flame monitoring device.
	Damage to ratio regulator	Replace ratio regulator.
The burner is unstable or produces soot, smoke, or excessive carbon monoxide	The air/gas ratio is out of adjustment.	Measure all the gas pressures and air pressures. Compare these pressures to the initial start-up settings and adjust them where necessary.
	Bleed fitting (if used) is dirty.	Clean fitting.
The burner cannot achieve full capacity	Air filter is blocked.	Clean or replace the air filter.
	Gas pressure going into the ratio regulator is too low.	Adjust the gas pressure.
	Loading line pressure too low.	Open the zone air control valve to increase the air volume and pressure. Recheck all burner settings.
	Adjusting valve has closed.	Open the valve to previous setting and check the input and flue gas settings to verify proper operations.
	Blower is wired incorrectly.	A blower wired to turn backwards will produce approximately 60% of its rated capacity. Check the rotation of the blower impeller. If spinning backwards, contact a qualified electrician.
	Poor piping practices.	Contact the factory.

<b>Problem</b>	<b>Possible Cause</b>	<b>Solution</b>
Cannot initiate start sequence	Air pressure switch has not made contact.	Check air pressure switch adjustment, air filter, blower rotation, and outlet pressure from blower.
	Purge cycle not complete.	Check flame monitoring control system or purge timer.
	High gas pressure switch has activated or low gas pressure switch has activated.	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operate.
	Malfunction of flame safeguard system.	Contact a qualified electrician.
	No power to control unit.	Contact a qualified electrician.
	Main power is off.	Ensure main power to the system is switched to the "On" position.
	Interlocks may not have been met.	Check other additional interlocks or safeties.

# 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

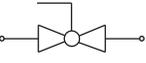
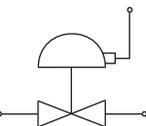
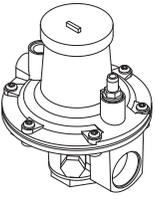
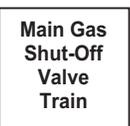
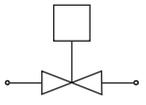
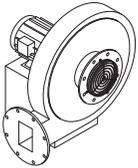
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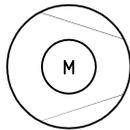
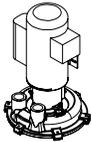
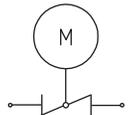
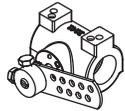
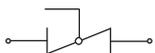
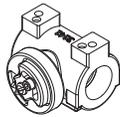
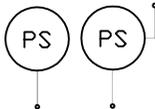
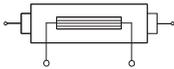
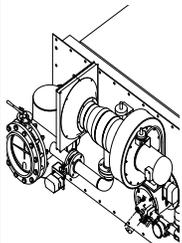
From	To	Multiply By
kiloPascals (kPa)	millibar (mbar)	10
meter (m)	millimeter (mm)	1000
millibar (mbar)	kiloPascals (kPa)	0.1
millimeter (mm)	meter (m)	0.001

### 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>

# System Schematics

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		Gas Cock	Gas cocks are used to manually shut off the gas supply.	710
		Ratio Regulator	A ratio regulator is used to control the air/gas ratio. The ratio regulator is a sealed unit that adjusts the gas pressure in ratio with the air pressure. 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 burner body.	
		Main Gas Shut-Off Valve Train	Eclipse strongly endorses NFPA as a minimum.	790/791
		Pilot Gas Valve Train	Eclipse strongly endorses NFPA as a minimum.	790/791
		Automatic Shut-Off Valve	Shut-off valves are used to automatically shut off the gas supply on a gas system or a burner.	
		Orifice Meter	Orifice meters are used to measure flow.	929
		Combustion Air Blower	The combustion air blower provides the combustion air to the burner(s).	610, 612

Symbol	Appearance	Name	Remarks	Bulletin/ Info Guide
		Hermetic Booster	Booster is used to increase gas pressure.	620
		Automatic Butterfly Valve	Automatic butterfly valves are typically used to set the output of the system.	720
		Manual Butterfly Valve	Manual butterfly valves are used to balance the air or gas flow at each burner.	720
		Adjustable Limiting Orifice	Adjustable limiting orifices are used for fine adjustment of gas flow.	728/730
		Pressure Switch	A switch activated by rise or fall in pressure. A manual reset version requires pushing a button to transfer the contacts when the pressure set point is satisfied.	
		Pressure Gauge	A device to indicate pressure.	
		Check Valve	A check valve permits flow only in one direction and is used to prevent back flow of gas.	780
		Strainer	A strainer traps sediment to prevent blockage of sensitive components downstream.	
		Flexible Connector	Flexible connectors isolate components from vibration, mechanical, and thermal stresses.	
		Heat Exchanger	Heat exchangers transfer heat from one medium to another.	500
		Pressure Taps	Pressure taps measure static pressure.	

# *Notes*

**Automation and Control Solutions**

Honeywell International Inc.

1985 Douglas Drive North

Golden Valley, MN 55422

[customer.honeywell.com](http://customer.honeywell.com)

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