

# ECLIPSE INFORMATION GUIDE

## Silicon Carbide Radiant Auto-Recupes



### WARNING

Handle silicon carbide tubes carefully. Do not drop them or hammer on them. Although they feature excellent mechanical and thermal properties in their intended application, sharp impacts may break them.

## 1.0 Introduction

The Eclipse Silicon Carbide Auto-Recupe contains a nozzle mixing burner and recuperator mounted inside of a single-ended radiant tube (SER). It features high strength silicon carbide inner and radiant tubes, allowing higher heat dis-

sipation rates and tube temperatures than those attainable with metallic tubes. In most cases, the silicon carbide radiant tubes also withstand corrosive environments better than metallic tubes.

## 2.0 Burner Operating Parameters and Requirements

### 2.1 Sizing

The length of a silicon carbide Auto-Recupe is determined by the size and heat requirements of the furnace. Once the maximum heat output is known, sizing is simply a matter of choosing the tube length that will release the required heat while operating within its capacity range.

### 2.2 Combustion Air Data

See Figure 1 for air pressure requirements.

### 2.3 Burner Rating

To prevent overheating, burner damage, and a possible reduction in tube life, do not exceed the maximum dissipation rates shown in Figure 1 without first consulting Eclipse.



**Eclipse Combustion**

ISO 9001 Registered

# Figure 1—Specifications

## Firing Rates & Efficiencies

Tube O.D.	High Fire Btu/Hr. In 1000's <sup>1</sup>		High Fire Efficiency <sup>2</sup> For Various Net Outputs, Btu/Hr. in 1000's				
	Min.	Max.	40	60	80	100	120
3-1/4"	18	120	.65	.63	.62	.60	.58

<sup>1</sup> Auto-Recupes burn cleanly with 10% excess air in this range.

<sup>2</sup> Approximate, based on 2000°F. furnace temperature and a burner length of 19".

## Maximum Heat Transfer Rates\*

Furnace Temp, °F.	1500	1700	1900	2100	2300
Max. Heat Transfer, Btu/Hr./Sq. In.	120	120	120	120	120

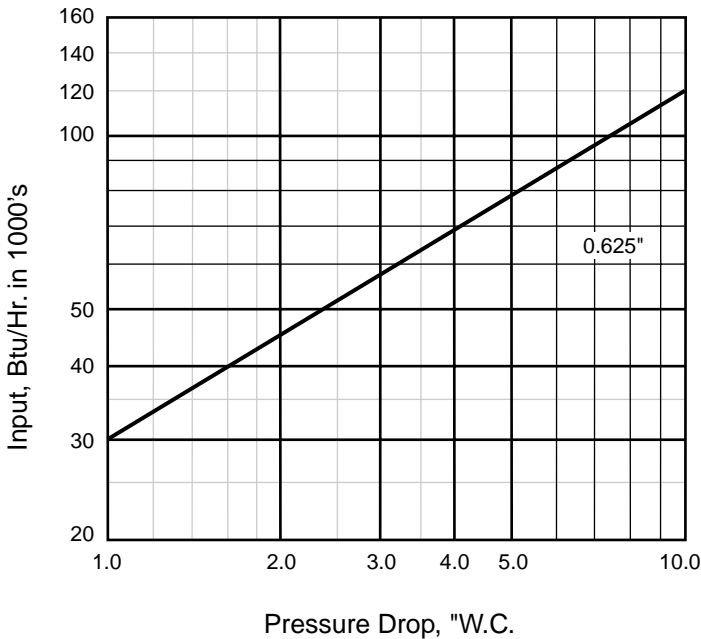
\* For higher temperature or input contact Eclipse.

## Burner Air & Gas Pressures Required

Btu/hr. Input in 1000's	20	30	40	50	60	70	80	100	120
Air Pressure, "W.C.	1.2	1.7	2.5	3.7	5.2	6.8	8.4	12.5	17.8
Gas Pressure, "W.C.	0.8	1.2	1.8	2.7	4.0	5.2	6.5	9.5	13.5

## High Fire Air Pressure Drop Across Metering Orifice

15% Excess Air



## Low Fire Air Pressure Drop Across Metering Orifice

**0.625" Orifice:** 0.4" w.c. with 14% O<sub>2</sub>.

Low fire input is 5000 Btu/hr.

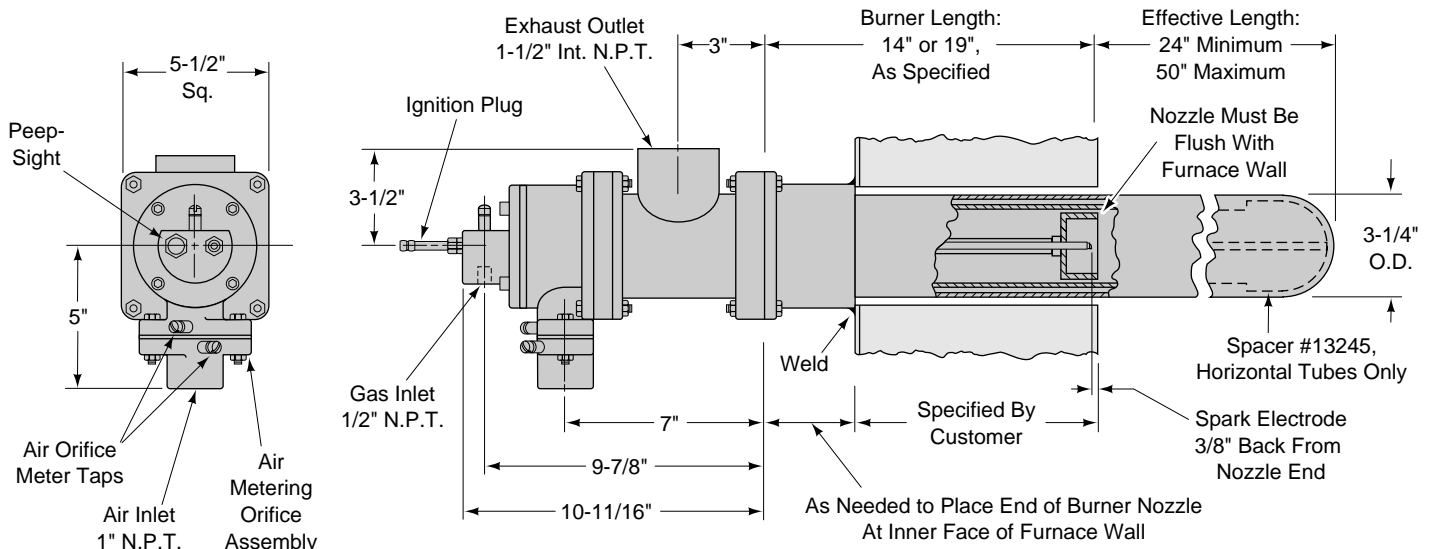
## 3.0 Control Methods

Although high/low firing is preferred, on/off firing may be used when chamber temperatures are above 1550° F.

Time proportional control is acceptable.

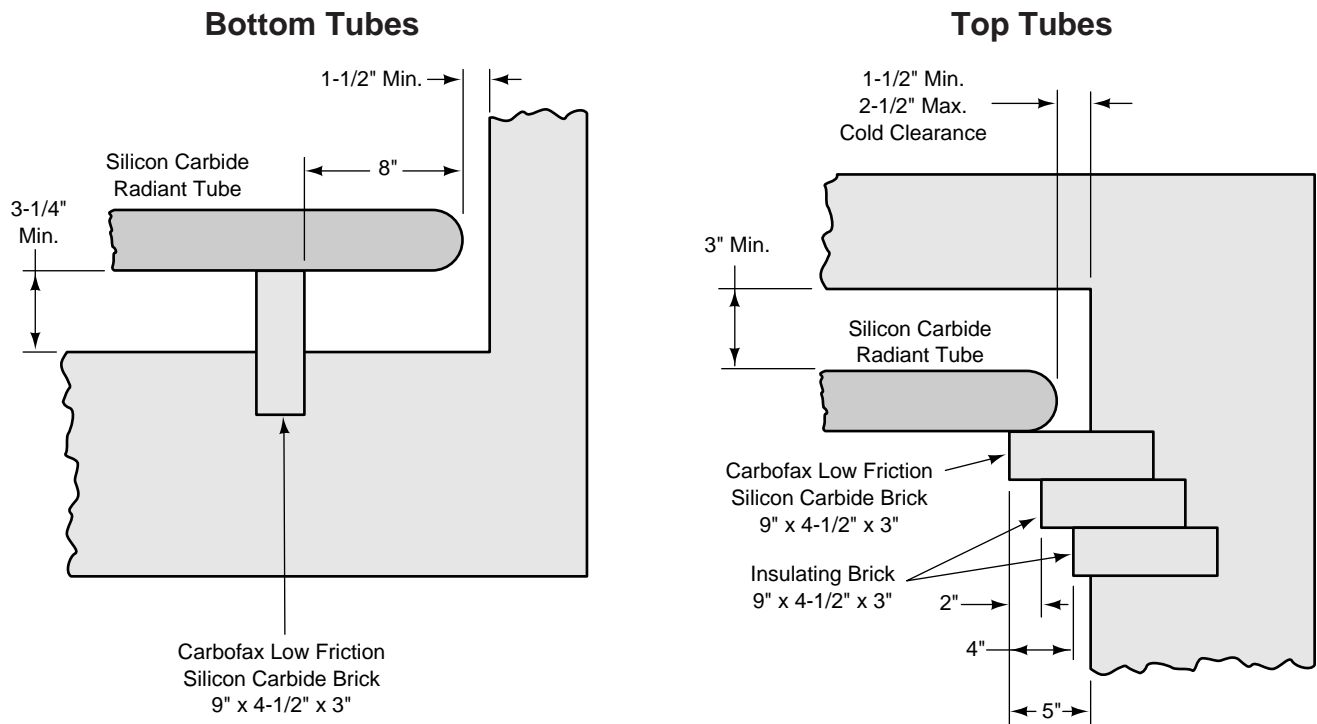
Modulating control may be used only with special provisions and prior approval from Eclipse.

## Figure 2—Dimensions



Tubes may be mounted vertically or horizontally. For horizontal installation, internal tube spacer #13245 must be ordered with the burner and installed as shown in Figure 4. Horizontal installation will also require external tube support as shown in Figure 3.

## Figure 3—Horizontal Tube Support



## 4.0 System Installation

### 4.1 Safeguards

Before beginning any modification to the furnace:

1. Turn off the gas supply at the main valve.
2. Turn off the electric supply at the main fuse or breaker box and make sure it can't be turned on accidentally.
3. If it is necessary to enter the furnace, completely purge all gas. Provide ventilation, lock the doors open, and use the "buddy" system to prevent the furnace from being started with somebody inside.
4. Spark rods are fragile and break easily. Keep them in a safe place during equipment installation. Install as shown in Figure 4.

### 4.2 General Piping Suggestions

To insure against potential leaks, use a quality grade sealing compound on all joints in gas pipework.

Gas piping must comply with American National Standard "National Fuel Gas Code"\* (NFPA No. 54) or ANSI Z223.1, or must be acceptable to the authority having jurisdiction.

### 4.3 General Wiring Suggestions

Electrical wiring must comply with the "National Electric Code"\* (NFPA Std. 70 or ANSI-CI 1981) or must be acceptable to the authority having jurisdiction.

\*Available from:

National Fire Protection Association  
Batterymarch Park  
Quincy, MA 02269

American National Standards Institute  
1430 Broadway  
New York, NY 10018

### 4.4 Removing Existing Radiant Tubes (if applicable)

Remove existing burners and radiant tubes.

If expansion glands or bellows were fitted to the casing for the old radiant tubes, these should be removed to leave a clear area for welding the new mounting flange at the inlet end.

If the Auto-Recupe tubes are replacing straight-through radiant tubes or heating elements, fill the unused hole with ceramicfiber or insulation block. Seal the hole in the casing by welding or bolting on (with gasket) a blank plate. For furnaces requiring protective atmospheres, this should be a gas tight seal.

### 4.5 Auto-Recupe Mounting

Units may be mounted vertically or horizontally. See Figure 3 for horizontal tube support requirements and minimum clearances between the radiant tube and furnace walls. Check insulation thickness and burner length to make sure that the nozzle will be flush with the inner face of the furnace wall as shown in Figure 2. If there are any questions, contact the nearest Eclipse office before proceeding further.

See Figure 4 for sequence of assembly. Before welding or bolting the mounting flange to the casing, make sure the inlets and outlets will be square with mainfolds. Check that the Auto-Recupe assembly is perfectly horizontal or vertical. If necessary, reposition the inlet connection after assembly by removing the bolts on the inlet casing and rotating the casting to correct position.

To aid in burner and recuperator servicing, use anti-seize compound on all Auto-Recupe bolts.

### 4.6 Exhaust Connection

Extend the exhaust using standard black iron pipe to clear the immediate area, or to connect to existing exhaust ducting.

If an exhaust fan is used, be sure that there is an adequate break between the exhaust hood and the Auto-Recupe exhaust outlet. Any negative pressure on the exhaust outlet will reduce burner performance.

Certain combinations of input and tube length may cause excessive exhaust noise. This noise can be eliminated by fitting exhaust mufflers available from Eclipse.

### 4.7 Air and Gas Manifolds

If existing air and gas manifolds are used, be sure their diameters are large enough for the new system.

If new air and gas manifolds are required, size them for minimum pressure drop. Eclipse recommends pressure drops no greater than 0.05" w.c. per foot of manifold. Under-sized manifolds will cause poor distribution of air and gas flows. Holes in the manifold for outlet connections should be drilled larger than the I.D. of the couplings to be welded on.

Fit pressure test cocks on all gas and air manifolds.

### 4.8 Air and Gas Pipework at Burner

Locate the air and gas manifolds alongside the burners using temporary supports. Pipe the first and last burner to the manifold. Be sure to include the valves indicated on the system drawing supplied. Position the valves so that adjusting screws and handles can be operated conveniently. Connect the remaining burners to the manifold using permanent manifold supports.

#### 4.9 Main Gas and Air Pipework

Run the gas and air manifolds back to the main air and gas lines.

If metering orifice plates are installed, allow at least ten pipe diameters of straight pipe on the inlet side and five pipe diameters on the outlet side to ensure accurate measurement.

Position all valves so they are accessible from ground level. There must be sufficient clearance under the ratio regulator, Figure 5, to adjust the valve spring.

#### 4.10 Ratio Regulator Connections

Connect the ratio regulator as shown in Figure 5. The loading line should be at least 1/4" I.D., as short as possible, with as few bends as possible. The connection on the air manifold should be at least two pipe diameters upstream and five pipe diameters downstream of any valves or fittings.

Fit an 1/8" test cock and hose fitting to the outlet pressure connection on the ratio regulator.

#### 4.11 Ignition Circuit

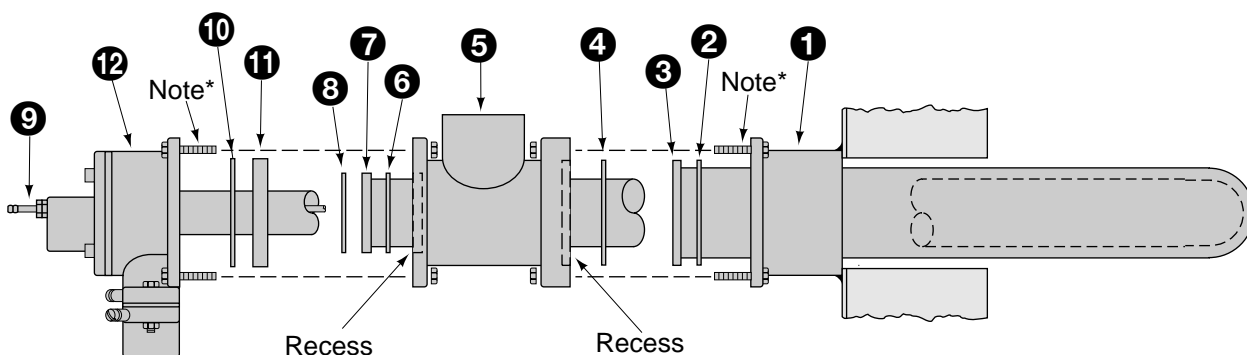
The Eclipse Auto-Recupe is designed for spark ignition with a 6000 volt transformer at each burner. Mount the transformers as close to the burners as possible, but do not mount them too close to the exhaust housings, burner bodies, or furnace casing, as overheating may occur. The transformers must be grounded.

#### 4.12 Air Metering Orifice Plates

Each Auto-Recupe is supplied with two orifice plates in the air metering orifice assembly, Figure 2. The size of each orifice is stamped on the tang. When both plates are fitted, the smaller sized plate measures the flow. If you discover during start-up that insufficient air pressure is available, loosen the flange bolts and slide the smaller orifice plate out. The larger remaining plate then measures the flow. Flow curves for the orifice plates are shown in Figure 1.

**Figure 4—Tube Assembly Sequence**

For routine spark wand maintenance, see Figure 6.



1. Fasten **mounting flange** to furnace wall.
2. Slide **gasket** over radiant **OUTER tube**.
3. Insert radiant **OUTER tube**.
4. Place **gasket** in recess in exhaust housing.
5. Bolt **exhaust housing** to mounting flange. Be sure tube flange fits into recess in exhaust housing.
6. Slide **gasket** over **INNER tube**.
7. Insert **INNER tube**. Be sure tube flange fits into recess in exhaust housing.
8. Place **gasket** against **INNER tube** flange.
9. Install spark igniter with compression fitting and set according to specific igniter requirements. Tighten compression fitting, **but do not over-tighten or ceramic may break**.
10. Slide **gasket** over nozzle/air shroud.
11. Slide **steel ring** over nozzle/air shroud.
12. Insert nozzle/air shroud, align gaskets & ring, and bolt **inlet housing** to exhaust housing.

**Note\*** To complete assembly, tighten all flange bolts to 15 to 20 ft/lb cold. Re-check at operating temperature and again after 100 hours of operation.

## 5.0 Initial Start-Up—See Figure 5

Initial start-up should be performed by Eclipse combustion engineers. Incorrect setting of the burners may reduce burner efficiency, damage the burners and tubes, and invalidate equipment guarantees.

Supplied with your system is an Application Data Sheet, *Data 322*, specifying high fire and low fire inputs for your Auto Recupe. Refer to this sheet during set-up and adjustment.

### 5.1 Initial Settings

Fully open all zone and burner air butterfly valves.

Turn the center adjusting screw on all burner gas adjusting valves fully closed, then open them five turns.

Close all manual gas cocks.

Cycle the zone air control valve to ensure that when heat is called for, the valve is fully open, and when cooling is required, the valve is approximately 5° from fully closed. Adjust the valve linkage as required.

### 5.2 Start Blower

Start the combustion air blower. Check the rotation to make sure it is correct. If not, have a qualified electrician re-wire the blower for proper rotation.

### 5.3 Adjust Burner High Fire Air

Drive the zone air control valve to high fire.

Attach a manometer across the air metering orifice on the first burner. Referring to Figure 1 and Step 4.12, adjust the zone air butterfly valve to achieve the correct pressure drop for the high fire input specified for your installation.

If an orifice plate is changed or removed from one Auto-Recupe, **the same must be done** to all Auto-Recupes in that zone.

With the control valve still at high fire, attach a manometer to each burner in turn and check that the same pressure drop is obtained. If the pressure drops are significantly different, adjust the burner air butterfly valve at each burner to achieve a balance.

### 5.4 Adjust Zone Low Fire Air

Set the temperature controller to low fire and check the pressure drop at each air metering orifice. Adjust the zone air control valve to produce a 0.4" w.c. drop across the air metering orifices. **Do not adjust the zone air butterfly valve.**

### 5.5 Check Air Settings

Cycle the furnace to high fire and re-check air pressure drop at one of the air orifice plates.

### 5.6 Start Spark

Energize the ignition spark. **Do not touch the spark rod, ignition wire, or transformer while the spark is energized, or you will get a shock.**

### 5.7 Light Each Burner and Adjust High Fire Gas

Open the main gas valve and safety shut-off valve.

Open the zone gas cock.

Open the gas shut-off valve at the first burner. View down the peepsight to see if the burner has ignited. If not, turn the burner gas adjusting screw to find the position that will ignite the burner.

Using the oxygen analyzer, measure the oxygen level in the exhaust. Turn the gas adjusting screw as needed to produce an O<sub>2</sub> level between 3% and 6%.

Repeat these steps for each Auto-Recupe.

### 5.8 Wait 30 to 60 Minutes, then Stop Spark

Allow the burners to stabilize for 30 to 60 minutes, then terminate the ignition spark.

### 5.9 Check Oxygen Levels

Recheck oxygen levels and adjust burner gas valves as described in Step 5.7. This is only an initial setting. Final adjustments will be made when the furnace is at operating temperature.

### 5.10 Adjust Zone High Fire Gas

Attach a manometer across the zone gas metering orifice plate and compare the reading with the pressure drop on the flow chart supplied with the orifice. If necessary, adjust it using the zone air butterfly valve, **NOT** the burner gas adjusting valves.

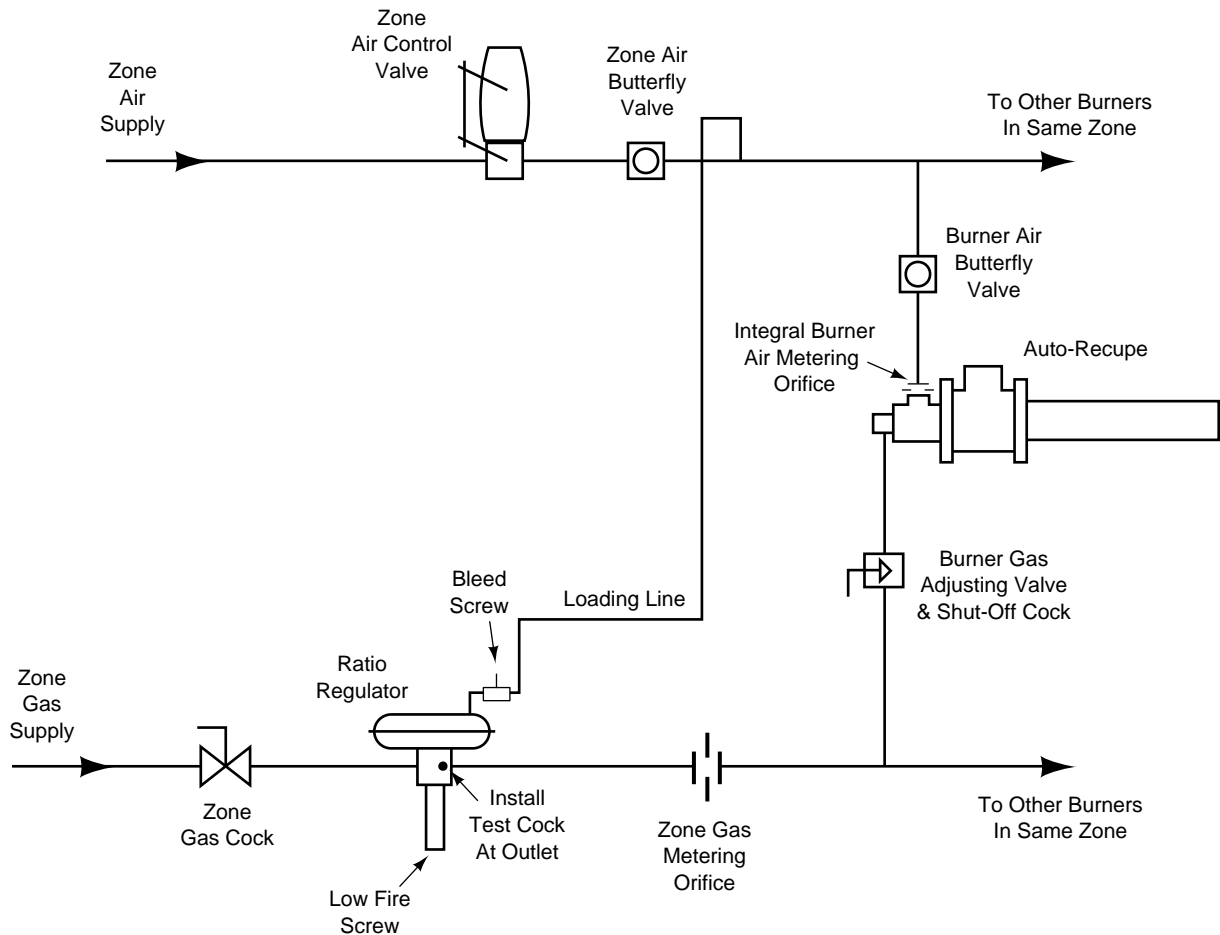
After adjustments have been made, the ratio regulator valve should maintain the correct gas/air ratio. Re-check the oxygen levels at several burners to ensure correct combustion.

### 5.11 Adjust Bleed Screw

With the system at high fire, attach the manometer to the outlet pressure tap on the ratio regulator and note the pressure. Slowly open the bleed screw until the outlet pressure drops. Close the bleed screw slightly until the original pressure is established. This ensures that any reduction in air pressure will reduce the gas flow.

### 5.12 Adjust Zone Low Fire Gas

**Figure 5—Typical System**



Drive the zone air control valve to low fire.

**If the burner goes out:** Re-energize the spark and increase air flow by adjusting the low limits on the zone air control valve until the burner re-ignites. Terminate the spark. Check oxygen levels as described in the next two steps.

**If the burners stay ignited:** Turn the ratio regulator low fire screw as required to produce an oxygen content between 12% and 16%.

**If oxygen levels are between 12% and 16% but temperature continues to rise above the desired level:** Reduce air flow by adjusting the zone air control valve linkage. Re-check oxygen levels.

**5.13 Check High Fire Oxygen at Set Point**

Set the temperature controller at the desired operating temperature. When the furnace is within 200° F of setpoint, use the gas adjusting valve at each burner to achieve 3% to 5% O<sub>2</sub> in the exhaust at high fire.

**5.14 Check High Fire Gas Orifice Pressure at Set Point**

Check the pressure drop at the zone gas metering orifice and adjust as described in step 5.10.

**5.15 Monitor All Settings**

Over the next few days check frequently to make sure that oxygen levels and flows do not change.



## 6.0 Shut Down Procedure

- 6.1 Close the gas cocks at each burner.
- 6.2 Close the zone gas cocks.
- 6.3 Close the main gas valve.

- 6.4 Wait 10 minutes for the gas to purge out of radiant tubes, then turn off the combustion air blower.
- 6.5 Insure that ignition is off.
- 6.6 Shut down procedure is complete.

## 7.0 Normal Start-Up

This assumes that the standard shut down procedure was followed and that no adjustment has been made to the combustion system.

- 7.1 Start the combustion air blower.
- 7.2 Energize spark ignition. **Do not touch spark rod, ignition wire, or transformer, or you will get a shock.**
- 7.3 Open the main gas safety shut-off valve.

- 7.4 Open the main gas cock.
- 7.5 Open the zone gas cock.
- 7.6 Open the first burner gas shut-off valve.
- 7.7 Verify that the burner has ignited by looking down the peepsight.
- 7.8 Repeat 7.6 and 7.7 for all burners.
- 7.9 Start-up procedure is complete.

## 8.0 Maintenance

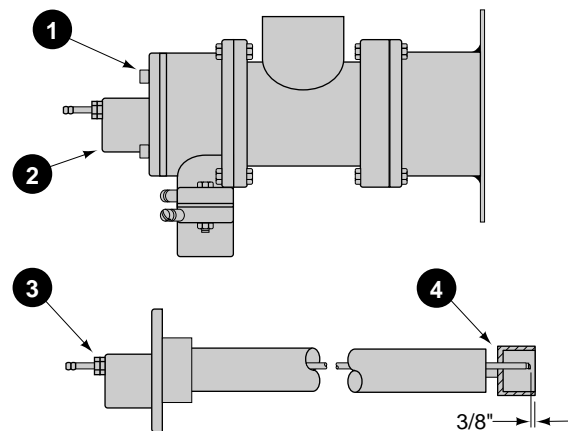
The following maintenance will help insure trouble-free operation of the equipment and will help identify problems before they affect the operation of the equipment.

- 8.1 Once the equipment is installed and operating correctly, measure and record the following. These measurements and notes will be very important if the settings are disturbed for any reason.
  - a. Oxygen levels in the exhaust on high fire.
  - b. Pressure drop at the gas metering orifice. (high and low fire)
  - c. Gas pressure at the ratio regulator outlet.
  - d. Air pressure drop at the burner air metering orifices. (high and low fire).
  - e. Gas pressure at the burner inlet casing.
  - f. Gas manifold pressure.
  - g. Air manifold pressure.
  - h. Air pressure from the combustion blower.
  - j. Scale settings on the zone air adjusting valve and the burner air adjusting valves.
- 8.2 Every month measure and record the high fire oxygen levels in the exhaust. If there is any change, find the cause and correct it.
- 8.3 Every month view down the peepsights on the burners to check for unusual flame or carbon build-up. If necessary remove the burner to investigate.
- 8.4 At least once each year (twice a year if possible) remove all burners and inner tubes. Clean off any carbon build-up and check the condition of burner, inner tube, outer tube and spark rod.
- 8.5 To insure continued operation of the system, keep an appropriate quantity of spare parts in stock for immediate use. See your Eclipse representative for

part numbers and recommended stocking levels.

Ignition rod  
Ignition transformer  
Rajah connector  
Ignition cable  
Ratio Regulator  
Burner head for Auto-Recup  
Burner gas inlet tube for Auto-Recupe  
Inner tube for Auto-Recupe  
Outer tube for Auto-Recupe

**Figure 6—Replacing Spark Wand without disturbing air or exhaust connections**



1. Remove four cap screws.
2. Slide rear casting out of tube.
3. Loosen compression fitting and remove old spark wand.
4. Insert new spark wand through fitting and hole in nozzle. End of wand should be 3/8" back from front of nozzle.
5. Tighten fitting, but do not over-tighten.
6. Re-assemble, using new gasket if necessary.



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