Important Notices About Safe Burner Operation

Introduction
The burners covered in this Guide are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing explosions and fires when improperly applied, installed, adjusted, controlled, or maintained. This Guide will provide information for using these burners for their limited design purpose. Do not deviate from any instructions or application limits in this Guide without written advice from the Eclipse Combustion Division in Rockford, Illinois. Read this entire Guide before attempting to light burners. If you do not understand any part of the information in this Guide, contact your local Eclipse representative or Eclipse Combustion before proceeding further.

Storage
Store the burner inside. Exposure to the elements can damage the burner.

Qualifications
Adjustment, maintenance, and troubleshooting of the mechanical parts of this unit should be done by people with good mechanical aptitude and experience with combustion equipment.

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

Operator Training
The best safety precaution is an alert and competent operator. Thoroughly instruct new operators so they demonstrate an adequate understanding of the equipment and its operation. Regular retraining must be scheduled to maintain a high degree of proficiency. The operator must have easy access to this Information Guide at all times.
### 1.0 Burner Operating Parameters & Requirements

<table>
<thead>
<tr>
<th>Applications</th>
<th>The 63 TFB burner is designed to operate in radiant or immersion tubes at inputs up to 750,000 Btu/hr (220 kW).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacities &amp; Supply Pressures</td>
<td><strong>Maximum Input:</strong> 750,000 Btu/hr. (220 kW) with ambient combustion air; 600,000 Btu/hr. (175 kW) with preheated combustion air.</td>
</tr>
<tr>
<td></td>
<td><strong>Fuels:</strong> Natural gas or 100% propane vapor. Eclipse has information on using other fuels.</td>
</tr>
<tr>
<td></td>
<td><strong>Minimum Input:</strong> 15,000 Btu/hr. (4.5 kW) with U.V. scanner; 5,000 Btu/hr. (1.5 kW) w/o U.V. scanner.</td>
</tr>
<tr>
<td></td>
<td><strong>Inlet Pressures:</strong> See Table 1.</td>
</tr>
<tr>
<td></td>
<td><strong>Maximum Combustion Air Temperature:</strong> 800°F (430°C).</td>
</tr>
<tr>
<td></td>
<td><strong>Ignition:</strong> Direct spark ignition of low fire gas; ignition rod included. Use 6000V single wave ignition transformers only.</td>
</tr>
<tr>
<td></td>
<td><strong>Flame Monitoring:</strong> UV scanner only.</td>
</tr>
<tr>
<td></td>
<td><strong>Emissions:</strong> With ambient combustion air, NOx levels less than 30 ppm at 3% O₂ and CO levels less than 50 ppm at 3% O₂ can be achieved. Emissions depend not only on the burner, but also other factors such as tube design, combustion air temperature, and heat loading. For estimates of emissions performance in your application, call Eclipse.</td>
</tr>
<tr>
<td></td>
<td><strong>Components:</strong> Assembly includes burner body and mounting gasket, gas tube &amp; nozzle, alloy air tube, ignition rod, two peep sights, three gas metering orifice plates, two air metering orifice plates, copper clad orifice gaskets, and four hose fittings for metering orifices.</td>
</tr>
<tr>
<td></td>
<td>Install the gas and air orifice plates which best match the available supply pressures, as shown below. To avoid excessive air pressure drops, do not install an air orifice plate in preheated air systems.</td>
</tr>
</tbody>
</table>

| Burner Environment | **Ambient Temperature Limits:** This is determined by the limitations of the monitoring and control equipment such as U.V. scanners, automatic fuel shut-off valves, and electrical wiring. Refer to the operating manuals of the control equipment. |
| | **Weather Protection:** Protect burners from the weather. |
| | **Combustion Air:** Must be free of contaminants. Eclipse strongly recommends use of a combustion air filter to remove airborne particles. If corrosive fumes or materials are present in the air, supply the blower with fresh, clean air from an uncontaminated area of the plant or from outside sources. |
| | **Room Openings:** To admit fresh combustion air from outdoors, provide at least one square inch of opening in the room for every 4000 Btu/hr (1.2 kW) of burner firing rate. |
| | **Access:** Provide access to the burner for inspection and maintenance. |
| | **Exhaust:** Do not allow flue gases from the radiant tubes to accumulate in the work area. Provide some positive means for exhausting them from the furnace and building. |

### 2.0 Burner Operation and Controls

| Turndown Method | 63 TFB burners are designed to operate with two-position (high-low or high-off) control. If high-off control is used, the ignition transformers must be energized each time the control instrument calls for heat to ensure re-ignition. Time proportional control may be used. However, position proportioning temperature control should not be used, as sustained operation at some intermediate firing rates may produce undesirable radiant tube temperature profiles. |
| | **Fuel-Air Ratio Control** Use an Eclipse Adjustable Bias Proportionator (ABP) or comparable biasable ratio regulator, cross connected to the combustion line; see Figure 5 on page 10. Gas pressure at the ratio regulator inlet must be equal to or greater than the maximum air loading pressure on the regulator plus the maximum gas pressure drop across the regulator itself. Because 63 TFB burners are capable of turning down to exceptionally low gas flows, the ratio regulator model and size must be chosen carefully to provide repeatable low fire performance. |
| | **Air Balancing Valves** On multiple burner control zones, use a manual butterfly valve in the combustion air line to each burner (ambient air systems) or each recuperator (preheated air systems). This will permit balancing burners within the zone.
### Table 1—Required Supply Pressures

Pressures shown are for system sizing only. Do not use for set-up or adjustment!

<table>
<thead>
<tr>
<th>Input (Btu/hr)</th>
<th>Gas Inlet Pressure* vs. Orifice Diameter</th>
<th>Air Inlet Pressure** vs. Orifice Diameter</th>
<th>Hot Air Inlet Press.*** No Air Orifice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>.203&quot; .300&quot; .500&quot; .953&quot; 1.328&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100,000</td>
<td>6  1  —  2  —</td>
<td></td>
<td>—</td>
</tr>
<tr>
<td>200,000</td>
<td>16 5  1  8  2</td>
<td>1  —</td>
<td>1  2</td>
</tr>
<tr>
<td>300,000</td>
<td>— 12  3  16  4</td>
<td>7  3</td>
<td>5  6</td>
</tr>
<tr>
<td>400,000</td>
<td>— 15  4  —  —</td>
<td>11  4</td>
<td>7  10</td>
</tr>
<tr>
<td>500,000</td>
<td>— —  6  —  —</td>
<td>16  6</td>
<td>10 14</td>
</tr>
<tr>
<td>600,000</td>
<td>— —  9  —  —</td>
<td>22  8</td>
<td>— —</td>
</tr>
<tr>
<td>700,000</td>
<td>— — 12  —  —</td>
<td>—  9</td>
<td>— —</td>
</tr>
<tr>
<td>750,000</td>
<td>— — 14  —  —</td>
<td>— —</td>
<td>— —</td>
</tr>
</tbody>
</table>

* Natural gas pressure measured at the inlet to the gas orifice. For propane, multiply pressures in table by 0.41.

** Measured at the inlet to the air orifice, except for "No Orifice" column, which is measured at the air pressure hose fitting on the burner body.

*** Measured at the air pressure hose fitting on the burner body.

### 2.0 Burner Operation and Controls (continued)

- **Gas Balancing Valves**: Install an adjustable orifice gas cock in the gas line to each burner.
- **Metering Orifices**: The 63 TFB includes integral air and gas metering orifices with three gas metering orifice plates and two air metering orifice plates. Install the gas and air orifice plates which best match the available supply pressures; see Table 1. To avoid excessive air pressure drops, do not install an air orifice plate in preheated air systems.
- **Limit Controls/Safety Equipment**: Limit controls and safety equipment should comply with current NFPA Standards 86 and 86C, and all applicable local codes and/or standards. NFPA Standards are available from:
  - National Fire Protection Association
  - Battery March Park
  - Quincy, MA 02269
  - American National Standard Institute
  - 1430 Broadway
  - New York, New York 10018
- **Ignition**: These burners are ignited by direct spark at low fire. Ignition supply should be from individual 6000 VAC transformers. Distributor type ignitors, 10,000 VAC transformers, twin outlet transformers and half wave spark generators are not recommended.
- **Flame Monitoring**: UV scanner only. For preheated air systems, use a scanner cooler with heat block seal to protect the scanner from high ambient temperatures.

> **Caution**: Failure to use suitable flame sensing devices and automatic fuel shut-off valves can cause explosions and fires. The owner/user and/or his insurance underwriter must assume responsibility for the acceptance, use and proper maintenance of the limit controls, other safety devices included with this burner, the flame supervision provided in the control panel, and the interfacing of all electrical equipment and sequencing of burner operation between the control panel and the burner.
Figure 1

Sizing & Selection for Radiant Tubes

Maximum Radiant Tube Heat Transfer Rates

Exceeding these rates will shorten tube life.

<table>
<thead>
<tr>
<th>Furnace Temp.</th>
<th>Maximum Heat Transfer Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tube Open*</td>
</tr>
<tr>
<td>°F</td>
<td>°C</td>
</tr>
<tr>
<td>1000</td>
<td>540</td>
</tr>
<tr>
<td>1300</td>
<td>700</td>
</tr>
<tr>
<td>1550</td>
<td>940</td>
</tr>
<tr>
<td>1650</td>
<td>900</td>
</tr>
<tr>
<td>1750</td>
<td>550</td>
</tr>
<tr>
<td>1850</td>
<td>1000</td>
</tr>
</tbody>
</table>

* Tube free to radiate on three sides; see upper tubes example at right.
** Tube closely enclosed by brickwork; see lower tubes example at right.

Sizing Example:
The "U" tubes shown are to be retrofitted with 63 TFB burners and Bayonet-Ultra recuperators.

Application Parameters:
1650°F (900°C) operating temperature
4-1/2" (11.4 cm) tube OD

Tube Surface Area:
= OD x 3.14 x total effective length
= 4.5" x 3.14 x (50" x 2) = 1413 in²
= 11.4 cm x 3.14 x 254 cm = 9092 cm²

Max. Heat Transfer Rate (from table above):
Upper Tubes: 60 Btu/hr/in²
2.7 W/cm²
Lower Tubes: 45 Btu/hr/in²
2.0 W/cm²

Efficiency (from table above): 64% or .64

Recommended Burner Input, Upper Tubes:
= Max. Heat Transfer x Area + Efficiency
= 60 Btu/hr/in² x 1413 in² + .64 = 132,500 Btu/hr.
= 2.7 W/cm² x 9092 cm² + .64 = 38.4 kW

Recommended Burner Input, Lower Tubes:
= Max. Heat Transfer x Area + Efficiency
= 45 Btu/hr/in² x 1413 in² + .64 = 99,400 Btu/hr.
= 2.0 W/cm² x 9092 cm² + .64 = 28.4 kW

Tables 2 & 3—NOx & CO Emissions

NOTE: Based on inputs at 200,000 Btu/hr. (60kW) with preheated burner air at 700°F (371°C)
Sizing & Selection
1. Determine the net output required from the immersion tube and the desired fuel efficiency of the system.
2. Use the chart at right to determine the effective tube length. Effective length equals the total length of straight tube covered by liquid, plus 18" (46 cm) for each 90° bend.
3. Divide the net output by the efficiency to find the burner input required.
4. Using the "Maximum Tube Input" ratings above, determine the smallest immersion tube diameter that will accept the required burner input. For heating cooking oil, limit burner input so that heat transfer greater than 50 Btu/hr/in² of tube surface area (2.3 W/cm²) is not exceeded. This will avoid burning the oil.

### Tube Design
1. We recommend using standard and sweep elbows only.
2. The first elbow should be at least eight tube diameters from the burner face.
3. Use a draft breaking hood (shown below) so burner operation is less susceptible to atmospheric conditions and flue gas temperatures are lowered as they pass through the roof. Allow access between the hood and tube in case a damper plate must be installed to prevent rumbling.
4. When multiple exhausts are manifolded together into a common stack, always use draft hoods and size the stack to handle the total exhaust flow from all the burners, plus dilution air. This prevents cross-feeding of pressure between tubes which can cause pilot difficulties, burner instability, rumbling, and popping.

### 3.0 Installation

#### Warning
Before installing these burners, check the cone-to-air tube distance as described in Figure 6. Failure to do so may cost you substantial downtime if you must pull the burners to correct this setting!

**Burner Mounting**
See Figure 3 on page 6 for burner mounting. The seal between the burner and the radiant tube must be airtight.

**Metering Orifice Plates**
Orifice plates are included and sized in accordance with Eclipse SP-418. To accurately determine air and gas flows, refer to Table 6 for English units on page 10, and Table 7 for metric units on page 11. To avoid excessive air pressure drops, do not install an air orifice plate in preheated air systems.

**Metering Orifice Piping**
Provide a straight run of pipe at least ten pipe diameters upstream of each metering orifice. Failure to do this will cause inaccurate pressure readings.

**Burner Gas Connection**
To simplify ignition rod replacement and burner removal, install a pipe union in the gas line to each burner at least ten pipe diameters upstream of the gas orifices.

(Section 3.0 continues onto page 7)
Figure 3—Burner Mounting & Assembly

Table 4—Dimension “A”: English Units

<table>
<thead>
<tr>
<th>Inches</th>
<th>Radiant Tube Diameter</th>
<th>Up to 4</th>
<th>5</th>
<th>5 or more</th>
<th>High Fire Input, Btu/hr. in 1000's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>1/8</td>
<td>1/4</td>
<td>3/8</td>
<td>1/2</td>
</tr>
<tr>
<td>0100200300400500600</td>
<td>0306090120150180210240</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Radiant</td>
<td>1 1/8</td>
<td>1 1/4</td>
<td>3/8</td>
<td>1/2</td>
</tr>
<tr>
<td></td>
<td>Tube Diameter</td>
<td>0.953&quot;</td>
<td>0.875&quot;</td>
<td>0.500&quot;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orifice Type*</td>
<td>#14191-1</td>
<td>#14191-2</td>
<td>#14191-2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air</td>
<td>0.203&quot; Dia.</td>
<td>0.300&quot; Dia.</td>
<td>0.500&quot; Dia.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gas</td>
<td>#14191-1</td>
<td>#14191-2</td>
<td>#14191-2</td>
<td></td>
</tr>
</tbody>
</table>

* Except for orifice #14191-2, all of the orifices have a ΔP of 8"w.c. (20 mbar) at the high end of their respective input ranges. For example, #14188-1 will have a ΔP of 8"w.c. at 219,000 Btu/hr (20 mbar at 747 kW).

** For the 63 TFB-A burner model only.

Table 5—Dimension “A”: Metric Units

<table>
<thead>
<tr>
<th>Millimeters</th>
<th>Radiant Tube Diameter</th>
<th>Up to 102</th>
<th>102 or more</th>
<th>High Fire Input, kW</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>127</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24mm Dia.</td>
<td>34mm Dia.</td>
<td>13</td>
</tr>
<tr>
<td>Orifice Type*</td>
<td>#14188-1</td>
<td>#14188-2</td>
<td>#14188-2</td>
<td>#14188-2</td>
</tr>
<tr>
<td>Air</td>
<td>#14191-1</td>
<td>#14191-2</td>
<td>#14191-2</td>
<td>#14191-2</td>
</tr>
<tr>
<td>Gas</td>
<td>5mm Dia.</td>
<td>8mm Dia.</td>
<td>13mm Dia.</td>
<td></td>
</tr>
</tbody>
</table>

Standard Installation

63 TFB Burners are shipped from Eclipse fully assembled. Before mounting the burner on the flange, check two things:

1. Measure the "A" dimension shown above. If the measurement corresponds to the application's high fire input as shown in the table, no adjustments are required. If dimension "A" is not correct, follow the procedures described under "Burner Adjustments."

2. With U.V. scanners, check to see that the hole in the cone aligns with one of the two peep sight ports. If not, follow the procedures described under "Burner Adjustments."

If the "A" dimension and scanner alignment are correct as shipped, bolt the burner to the tube or adaptor flange. Be sure the air inlet is properly aligned with respect to the air manifold.

Check to see that the gas inlet aligns properly with the gas manifold. If not, unbolt the gas inlet casting from the air inlet casting, rotate the gas inlet, and reassemble.

Burner Nozzle Adjustments

1. Unbolt the gas inlet casting from the air inlet casting, and withdraw the gas tube and nozzle from the burner.

2. Remove the ignition rod. Loosen the gas tube locknut and screw the gas tube in or out to achieve the required "A" dimension shown above.

3. With U.V. scanners, determine which peep sight the scanner will replace and align the hole in the cone with that port as shown above. Tighten the gas tube locknut.

4. Bolt the air inlet housing with gasket to the adaptor flange or radiant tube flange. Be sure the air inlet is positioned properly with respect to the air manifold.

5. Bolt the gas inlet housing to the air inlet housing. Be sure the gas inlet is positioned properly with respect to the gas manifold.

6. If a U.V. scanner will be used, unscrew the peep sight that aligns with the hole in the cone (step 3) and install the scanner in its place.

7. Insert the ignition rod into the burner, thread into the hole in the cone. Verify alignment with grounding lug, then tighten compression fitting. Do not use pipe sealant on ignition rod threads.
3.0 Installation (continued from page 5)

**Pipe Sizing**

Size all piping to prevent excessive pressure losses. In preheated air systems, the pressure drop in the air piping between the burner and recuperator increases with the air temperature. Multiply the calculated cold air pressure drop by the appropriate factor below to arrive at the preheated air drop.

- For 400°F (204°C) air, multiply 60°F (16°C) drop by 1.65
- For 600°F (316°C) air, multiply 60°F (16°C) drop by 2.04
- For 800°F (427°C) air, multiply 60°F (16°C) drop by 2.42
- For 1,000°F (538°C) air, multiply 60°F (16°C) drop by 2.81

**Flexible Connectors**

Use flexible pipe nipples in the air and gas lines to each burner. These will absorb stresses due to heat expansion. On preheated air systems, the air nipple must be suitable for the design air temperatures. Flexible pipes may cause higher pressure drops than equivalent standard pipes; consider these drops when sizing combustion air lines.

**Pipe Support**

Do not use the burner or recuperator to support piping. Provide suitable brackets or hangers. If in doubt, consult your local gas company.

**Valve Orientation**

Install all valves so that the arrow on the side of the valve body points in the direction of gas or air flow through the valve. If the handle of a plug type gas cock is removable, be sure that the handle is properly installed. When the valve is in the "off" position, the handle must be 90° or at a right angle to the valve body.

**Gas Piping Standards**

Gas piping must comply with American National Standard entitled "National Fuel Gas Code" (NFPA No. 54 or ANSI Z223.1), or must be acceptable to the authority having jurisdiction. A copy of the Gas Code is available by writing the NFPA or ANSI organizations at the addresses listed under Section 2.0 on page 3.

**Wiring Standards**

Electrical wiring must comply with the National Electric Code (NFPA Std. 70 or ANSI-Cl 1981), or must be acceptable to the authority having jurisdiction. It should comply with current NFPA Standards 86 and 86C, and all applicable local codes and/or standards. Either electrical code is available by writing the NFPA or ANSI organizations at the addresses listed under Section 2.0 on page 3.

**Flame Monitoring**

The UV scanner must be mounted in place of one of the two peepsights. The hole in the nozzle cone must be aligned with the scanner; see Figure 3 on page 6.

4.0 Start-Up And Adjustment

NOTE: Refer to Figure 5 on page 8 for identification and location of any components described in the following steps.

**Initial Settings**

1) Fully open all zone and burner air butterfly valves.
2) Turn the adjusting screw on all burner gas adjusting valves fully closed, then open them five turns.
3) Close all manual gas cocks.
4) Adjust the linkage of the zone air control valve so that when heat is called for, the valve is 10° from fully open, and when cooling is required, the valve is about 5° from fully closed.

**Start Blower**

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

**Set Burner High Fire Air**

1) Drive the zone air control valve to high fire.
2) If air metering orifice plates were installed, connect a manometer across the air metering orifice for the first burner. Adjust the burner air butterfly to produce the required air pressure drop across the orifice as shown in Tables 6 or 7 on pages 10 or 11. Repeat this adjustment for each burner, then recheck all air orifice measurements.
3) If air metering orifice plates were NOT installed, measure the air pressure at tap "A" on one burner. Adjust the zone air butterfly valve to achieve the correct pressure as listed in Table 1 on page 3. Then check the air pressure at each of the other burners, and if necessary adjust each burner air butterfly valve to achieve the same pressure.

(Section 4.0 continues onto page 9)
### Figure 4—Dimensions

<table>
<thead>
<tr>
<th>Burners</th>
<th>Spark Rod</th>
</tr>
</thead>
<tbody>
<tr>
<td>63 TFB-A</td>
<td>63 TFB-PCA</td>
</tr>
<tr>
<td>Assay. No.</td>
<td></td>
</tr>
<tr>
<td>102924-30</td>
<td>102923-30</td>
</tr>
<tr>
<td>102924-31</td>
<td>102923-31</td>
</tr>
<tr>
<td>102924-32</td>
<td>102923-32</td>
</tr>
<tr>
<td>102924-33</td>
<td>102923-33</td>
</tr>
<tr>
<td>102924-34</td>
<td>102923-34</td>
</tr>
<tr>
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<td>102924-36</td>
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<td>102924-3</td>
<td>102923-3</td>
</tr>
<tr>
<td>102924-4</td>
<td>102923-4</td>
</tr>
</tbody>
</table>

### Figure 5—Typical System

**System Less Air Orifice**
- Exhast<br>“B” Flex Hose<br>Hi-Temp Flex Hose<br>Bayonet Recuperator<br>Tap “B” Gas Press.<br>Gas Press.<br>Gas Metering Orifice<br>Flex Hose<br>Union<br>1. Exhaust<br>2. System With Air Orifice
4.0 Start-Up And Adjustment (continued from page 7)

NOTE: Refer to Figure 5 on page 8 for identification and location of any components described in the following steps.

Start Spark

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

Light Burners

1) Open the main gas valve and safety shut-off valve.
2) Open the zone gas cock.
3) Connect a manometer across the gas metering orifice for the first burner. Energize spark ignition. With the temperature controller at low fire, open the gas shut-off valve at the first burner. The burner should light as viewed down the peepsight.

Set High Fire Gas

1) With the temperature controller at high fire, turn the adjusting screw to produce the required gas pressure drop across the metering orifice as shown in Figure 5. After adjustment, turn off the ignition spark.
2) Repeat these steps for each burner.

Measure Exhaust $O_2$

Using an oxygen analyzer, measure the oxygen level in the exhaust for each burner. Turn each gas adjusting screw as needed to produce an $O_2$ level of 3% or above for that burner.

Check $O_2$ at Setpoint

When the furnace is near temperature, turn the gas adjusting screw for each burner as needed to produce an $O_2$ level between 2.5% and 4%.

Check Gas Orifice Pressure

Attach a manometer across the gas metering orifice of one burner. If necessary, use the zone air butterfly valve to adjust the pressure drop to the correct value.

Adjust Bleed Screw (if required)

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 gas flow.

Adjust Low Fire

1) Drive the zone air control valve to low fire.
2) If a burner goes out: Reenergize the spark and increase air flow by adjusting the low limits on the zone air control valve until the burner reignites. Terminate the spark. Check oxygen levels as described in the next two steps.
3) If the burners stay ignited: Turn the ratio regulator low fire screw as required to produce an oxygen content between 10% and 14%.
4) If oxygen levels are between 10% and 14% but temperature continues to rise above the desired level: Reduce low fire air flow by adjusting the zone air control valve linkage. Recheck oxygen levels at low and high fire.

Check All Settings

Check low and high fire oxygen levels, and high fire gas metering orifice pressures. Over the next few days, check these frequently to assure that oxygen levels and flows do not change.

Flame Length

At high fire with 2.5 to 4% $O_2$, a "finger" of flame should just be visible turning the bend toward the exhaust leg of "U" and trident type tubes. Flame length can be adjusted by dismantling the burner and adjusting the gas cone setting as shown in Figure 3 on page 6.

5.0 Shutdown Procedure

1) Close the gas cocks at each burner.
2) Close the zone gas cocks.
3) Close the main gas valve.
4) Wait five minutes for the gas to purge out of radiant tubes, then turn off the combustion air blower.
5) Insure that ignition is off.
6) Shutdown procedure is complete.
6.0 Normal Start-Up

The following procedure assumes that the standard shutdown procedure was followed and that no adjustment has been made to the combustion system:

1) Start the combustion air blower.
2) Energize spark ignition. **Do not touch ignition rod, ignition wire, or transformer, or you will get a shock.**
3) Open the main gas cock.
4) Open the zone gas cock.
5) Open the first burner gas shut-off valve.
6) Verify that the burner has ignited by looking down the peep sight.
7) In a multi-burner system, Repeat the previous six steps for each burner.
8) Turn off spark.
9) After the furnace reaches set point, check that the burners remain lit on low fire.
10) Start-up procedure is complete.

7.0 Routine Maintenance

The following procedures will provide trouble-free operation and will help identify problems before they disrupt production.

**Record Set-Up Measurements**
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:

- Oxygen levels in the exhaust on high fire
- Pressure drop at the gas metering orifice (high and low fire)
- Gas pressure at the ratio regulator inlet and outlet
- Gas pressure at the burner inlet casing
- Gas manifold pressure
- Air manifold pressure
- Air pressure from the combustion blower
- Settings on the zone air adjusting valve and the burner air adjusting valves

**Monthly Maintenance**
Perform the following steps every month:

1) Measure and record the high fire oxygen levels in the exhaust every month. If there is any change, find the cause and correct it.
2) View down the peep sights on the burners and down the exhaust legs of the tubes to check for unusual flame or carbon build-up. If necessary remove the burner to investigate.

**Other Maintenance**
At least once each year (twice a year if possible) remove all burners and recuperators. Clean off any carbon build-up and check the condition of burner, radiant tube, and ignition rod.

**Spare Parts List**
To insure continued operation of the system, keep an appropriate quantity of the following spare parts in stock for immediate use. See your Eclipse representative for part numbers and recommended stocking levels.

- Ignition rod
- Rajah connector
- Ignition transformer
- Ratio Regulator
- Ignition cable