Special Installation Notice!

Before installing these burners, check the Cone-to-Air Tube distance as described in Figure 4.

Failure to check this may cost you substantial down-time if you must pull the burners to correct this setting!
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Important Notices About Safe Burner Operation

1. Store the burner inside. Exposure to the elements can damage the burner.
2. 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.
3. Order replacement parts from Eclipse only. Any customer-supplied valves or switches should carry UL, FM, CSA, and/or CGA approval where applicable.
4. 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.

WARNING

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.
1.0 Burner Operating Parameters & Requirements

Applications

The 63-TFB-L-PCA burners are natural gas burners designed for firing "U" and Trident type radiant tubes. They may be used with ambient or preheated combustion air at gross inputs up to 600,000 Btu/hr. per burner. For higher inputs or for "W" type radiant tubes, the Eclipse 63-TFB-H-PCA burner should be used.

Capacities & Air Pressure

See Figure 1.

Gas Pressure

2" w.c. @ 600,000 Btu/Hr. measured at burner inlet.

High Fire Flame Length

High fire flame should just reach the return bend (fingers of flame just visible in the return leg) with free oxygen in the exhaust of 2 to 3.5%. If necessary, the flame length can be adjusted by varying the position of the burner cone relative to the air tube. See Figure 1.

Burner Environment

Ambient Temperature Limits: As determined by monitoring and control equipment such as UV scanners, automatic fuel shut-off valves, and electrical wiring.

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.

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 or building.

Figure 1 - Capacities & Air Pressures

<table>
<thead>
<tr>
<th>High Fire Input Btu/Hr.</th>
<th>Combustion Air Pressure, &quot;w.c.&quot;</th>
<th>Low Fire Inputs &amp; Exhaust Oxygen Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>60(^\circ)F.</td>
<td>400(^\circ)F.</td>
</tr>
<tr>
<td>50,000</td>
<td>0.05</td>
<td>0.08</td>
</tr>
<tr>
<td>100,000</td>
<td>0.15</td>
<td>0.24</td>
</tr>
<tr>
<td>150,000</td>
<td>0.35</td>
<td>0.57</td>
</tr>
<tr>
<td>200,000</td>
<td>0.63</td>
<td>1.02</td>
</tr>
<tr>
<td>300,000</td>
<td>1.40</td>
<td>2.30</td>
</tr>
<tr>
<td>400,000</td>
<td>2.50</td>
<td>4.10</td>
</tr>
<tr>
<td>500,000</td>
<td>4.00</td>
<td>6.40</td>
</tr>
<tr>
<td>600,000</td>
<td>5.76</td>
<td>9.20</td>
</tr>
</tbody>
</table>

Combustion Air pressure is measured at the pressure tap shown in Figure 3.

Use these pressures for blower sizing only.

Do not use them to measure air flow!
Figure 2—Maximum Radiant Tube Heat Transfer Rates

CAUTION: Exceeding these rates will shorten tube life!

<table>
<thead>
<tr>
<th>Furnace Temp., °F</th>
<th>Maximum Radiant Tube Heat Transfer Btu/Hr./Sq. In.</th>
<th>Heat Transfer Efficiency²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1550</td>
<td>70</td>
<td>65%</td>
</tr>
<tr>
<td>1650</td>
<td>60</td>
<td>64%</td>
</tr>
<tr>
<td>1750</td>
<td>50</td>
<td>63%</td>
</tr>
<tr>
<td>1850</td>
<td>45</td>
<td>62%</td>
</tr>
</tbody>
</table>

¹For tube free to radiate on three sides. For tubes closely enclosed by brickwork, i.e. lower tubes on continuous furnaces, reduce the figure shown by 15 Btu/Hr./Sq. In.
²Using burner and recuperator.

Burner Input Calculation

Max. Burner Input = \( \frac{\text{Max. Radiant Tube Heat Transfer x Radiant Tube Surface Area}}{\text{Heat Transfer Efficiency}} \)

Example: The "U" tubes shown are to be retrofitted with 63 TFB-L burners and Eclipse Bayonet-Ultra recuperators. Chamber temperature is 1650° F.

Max. Radiant Tube Heat Transfer (from chart above):
Upper Tubes = 60 Btu/Hr./Sq. In.
Lower Tubes = 45 Btu/Hr./Sq. In.

Surface Area = O.D. x \( \pi \times (\text{Effective Length} \times 2) \)
= 4.5\( \times \) 3.14 \times 100" = 1413 Sq. In.

Heat Transfer Efficiency (from chart above): = 64% or .64

Max. Burner Input
Upper Tubes = \( \frac{60 \ \text{Btu/Hr./Sq. In.} \times 1413 \ \text{Sq. In.}}{.64} \)
= 130,000 Btu/Hr.
Lower Tubes = \( \frac{45 \ \text{Btu/Hr./Sq. In.} \times 1413 \ \text{Sq. In.}}{.64} \)
= 99,000 Btu/Hr.

Figure 3—Dimensions
2.0 Burner Operation and Controls

Turndown Method

TFB-L 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, proportional 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. 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-L 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 recuperator. This will permit balancing burners within the zone.

Gas Balancing Valves

Install an adjustable orifice gas cock in the gas line to each burner.

Gas Metering Orifices

Install an orifice meter in the gas line to each burner. Gas static pressures at the burner cannot be used to set gas flows.

Limit Controls and Safety Equipment

Limit controls and safety equipment should comply with current NFPA Standards* 86 and 86C, and all applicable local codes and/or standards.

*Available from:

National Fire Protection Association
1 Batterymarch Park
Quincy, MA 02269

American National Standard Institute
1430 Broadway
New York, New York 10018

Ignition

These burners are ignited by direct spark at high fire. Ignition supply should be from individual 6000 VAC transformers. Distributor type ignitors, 10,000 VAC transformers, and twin outlet transformers are not recommended.

Flame Monitoring

Although flame rods can be used to monitor preheated air burners, Eclipse recommends UV scanners. Use a scanner cooler with heat block seal to protect the scanner from high ambient temperatures.

Test Cocks

Install test cocks at tap "B" on the burner (Figure 3) and the inlet and outlet taps of the ratio regulator.

WARNING

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 and 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.
3.0 Installation

Burner Mounting  See Figure 4 for burner mounting. The seal between the burner and the radiant tube must be air-tight.

Spark Rod Installation  To avoid damage, the spark rods are shipped separately. Install the spark rods after all the burners have been mounted and piped. See Figure 4. Do not use pipe dope on spark plug threads.

Caution: Do not bend or drop the spark rod or overtighten the compression fitting. The ceramic insulator is fragile. If it is broken, the spark rod will not work.

Pipe Sizing  Size all piping to prevent excessive pressure losses. For a given air flow, 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 air: multiply 60° drop by 1.65
- For 600°F air: multiply 60° drop by 2.04
- For 800°F air: multiply 60° drop by 2.42
- For 1,000°F air: multiply 60° 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. The air nipple must be suitable for preheated air. Flexible pipes may cause higher pressure drops than equivalent standard pipes; consider these drops when sizing combustion air lines.

Burner Gas Connection  To simplify spark plug replacement and burner removal, install a pipe union at the gas connection to each burner.

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.

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

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.

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.

*Available from:
- National Fire Protection Association
  Batterymarch Park
  Quincy, MA 02269
- American National Standard Institute
  1430 Broadway
  New York, New York 10018

Flame Monitoring  See Figure 4 for U.V. scanner mounting.
Figure 4—Tube Assembly Sequence
See Figure 6 for Routine Spark Rod Replacement

Assemble Procedure

1. Bolt the **adapter flange** (if needed) and gasket to the radiant tube flange.

2. Loosen the **gas tube locknut** and screw the gas tube in or out to the required "A" dimension shown above. If a UV scanner will be used, determine which peep-sight the scanner will replace and align the groove in the cone with that connection as shown above. Tighten the gas tube locknut.

3. Slide the **spark rod** into the bushing on the gas inlet casting and place the ferrule and locknut over the rod. Position the end of the rod 1/2" past the narrow end of the cone as shown above, then tighten the locknut. **Do not overtighten or you may break the rod!**

4. Bolt the **air inlet housing** with gasket to the adapter 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 is positioned properly with respect to the gas manifold.

6. If a UV scanner will be used, unscrew the peep-sight selected in step 2 and install the scanner in its place. Be sure the scanner aligns with the groove in the cone as shown above.

---

**Dimension "A"—Cone-to-Air Tube Setting**

<table>
<thead>
<tr>
<th>Radiant Tube Diameter</th>
<th>High Fire Input, Btu/Hr. in 1000's</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 4&quot;</td>
<td>1/8&quot; 1/4&quot; 3/8&quot; 1/2&quot; 5/8&quot;</td>
</tr>
<tr>
<td>5&quot;</td>
<td>1/8&quot; 1/4&quot; 3/8&quot; 1/2&quot; 5/8&quot;</td>
</tr>
<tr>
<td>6&quot; or More</td>
<td>1/8&quot; 1/4&quot; 3/8&quot; 1/2&quot; 5/8&quot;</td>
</tr>
</tbody>
</table>

---

**Alignment Diagram:**

- **1.** Set Swamp High Fire Air
- **2.** Radiant Tube Is Diameter 9/16" V.P.I.S.P.M.
- **3.** High Fire Input, Btu/Hr. in 1000s
- **4.** Radiant Tube
- **5.** Gas Inlet
- **6.** Air Inlet
- **7.** Gasket
- **8.** Adaptor Flange (If Required)
- **9.** Ferrule
- **10.** Locknut
- **11.** Cap Screws (4)

---

**Dimensions:**

- Dimension "A" See At Left
- 1/2" I.D.
- 3-1/2" L.D.
### 4.0 Start-Up And Adjustment

**Initial Settings**

Fully open all zone and burner air butterfly valves.

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

Close all manual gas cocks.

Adjust the linkage of the zone air control valve so that when heat is called for, the valve is fully open, and when cooling is required, the valve is approximately 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 re-wire the blower for proper rotation.

**Set Burner High Fire Air**

Drive the zone air control valve to high fire.

Measure the air pressure at tap “A” on the one burner. Adjust the zone air butterfly valve to achieve the correct pressure as listed in Figure 1. 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.

**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.**

**Light Burners & Set High Fire Gas**

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

Open the zone gas cock.

Connect a manometer across the gas metering orifice for the first burner. With the temperature controller at high fire, open the gas shut-off valve at the first burner. The burner should light as viewed down the peepsight. Turn the adjusting screw to produce the required gas pressure drop across the metering orifice. After adjustment, turn off the ignition spark.

Repeat these steps for each burner.

**Measure Exhaust O₂**

Using an oxygen analyzer, measure the oxygen level in the exhaust for each burner. Turn each gas adjusting screw as needed to produce an O₂ level of 3% or above for that burner.

**Check O₂ at Set Point**

When the furnace is near temperature, turn the gas adjusting screw for each burner as needed to produce an O₂ 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**

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**

Drive the zone air control valve to low fire.

**If a 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 10% and 14%.

**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. Re-check oxygen levels at low and high fire.
4.0 Start-Up And Adjustment (Continued)

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 make sure that oxygen levels and flows do not change.

Flame Length
At high fire with 2.5 to 4% O₂, 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 4.

Figure 5—Typical System
5.0 Shut Down Procedure

Close Burner Gas Cocks
Close Zone Gas Cocks
Close Main Gas Valve
Purge Tubes
Check that Spark is Off
Shutdown is Complete

Close the gas cocks at each burner.
Close the zone gas cocks.
Close the main gas valve.
Wait 5 minutes for the gas to purge out of radiant tubes, then turn off the combustion air blower.
Insure that ignition is off.
Shutdown procedure is complete.

6.0 Normal Start-Up

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

Start Blower
Turn On Spark
Open Main Gas Valve
Open Zone Gas Cock
Start Burners
Turn Off Spark
Check Burners at Set Point
Start-Up is Complete

Start the combustion air blower.
Energize spark ignition. Do not touch spark rod, ignition wire, or transformer, or you will get a shock.
Open the main gas cock.
Open the zone gas cock.
Open the first burner gas shut-off valve.
Verify that the burner has ignited by looking down the peep sight.
Turn off spark.
After the furnace reaches set point, check that the burners remain lit on low fire.
Start-up procedure is complete.

Figure 6—Spark Rod Replacement

1. Unscrew the locknut and remove the old rod with the compression ferrule in place.
2. Place the new rod next to the old one with the electrodes side-by-side.
3. Mark the ferrule position on the new rod in line with the compression ferrule of the old rod.
4. Place the new ferrule into the spark rod bushing on the burner and slide the new rod through it until the mark reaches the ferrule.
5. Replace the locknut and tighten, but don't overtighten or you may crack the insulator!
7.0 Maintenance

Spark Rod Testing

To check the spark rod for proper operation, loosen the locknut shown in Figure 4 and slide the rod out of the burner. Attach the ignition cable and ground the outer metallic sheath. Energize the ignition transformer, but do not hold onto the rod or you will get a shock. If a strong spark occurs at the electrode, replace the rod in the burner. Otherwise, install a new rod as shown in Figure 6.

Routine Maintenance

The following procedures will help insure 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.

Record O2 Levels Monthly

Every month measure and record the high fire oxygen levels in the exhaust. If there is any change, find the cause and correct it.

Check Flame Monthly

Every month 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.

Clean System Annually

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