Eclipse Tube Firing Burners
ThermThief Series (version 1.0)
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Disclaimer Notice

We reserve the right to change the construction and/or configuration of our products at any time without being obliged to adjust earlier supplies accordingly.

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About this manual

AUDIENCE

This manual has been written for those persons who are already familiar with all the aspects of a nozzle-mix burner and its add-on components, also referred to as "the burner system". These aspects are:
• design/selection
• installation
• use
• maintenance.

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

SCOPE

Contents

This manual contains essential information that you need to deal with all the above mentioned aspects of the burner system.

Purpose

The purpose of this manual is to make sure that you carry out design, installation, use and maintenance in a safe, effective and trouble-free way.

IMPORTANT NOTICES

• Read this manual carefully. Make sure that you understand the structure and contents of this manual.
• Obey all the safety instructions.
• Do not deviate from any instructions or application limits in this manual without written advice from Eclipse Combustion, Inc.
• If you do not understand any part of the information in this manual, then do not continue. Contact your Eclipse representative or Eclipse Combustion, Inc.
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.

**Danger:**
Indicates hazards or unsafe practices which WILL result in severe personal injury or even death. Only Qualified and Well Trained Personnel are allowed to carry out these instructions or procedures. Act with great care and follow the instructions.

**Warning:**
Indicates hazards or unsafe practices which could result in severe personal injury or damage. Act with great care and follow the instructions.

**Caution:**
Indicates hazards or unsafe practices which could result in damage to the machine or minor personal injury. Act carefully.

**Note:**
Indicates an important part of the text. Read the text thoroughly.

**RELATED DOCUMENTS**

- EFE 825 (Combustion Engineering Guide)
- Eclipse bulletins and Info Guides: 610, 710, 720, 730, 742, 744, 760, 930, 1-354.

**HOW TO GET HELP**

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

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Fax: +1 815 877 3120
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RO. box 37
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Fax: +31 182 533269
E-mail: eclipse@eclipsenet.com
http://www.eclipsenet.com
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The ThermThief is a nozzle-mix tube-firing burner that is designed to fire into radiant tubes or immersion tubes.

**Flame guidance**

An alloy air tube maintains the proper air velocity past the nozzle, regardless of the heater tube diameter. The flame heats the heater tube uniformly without hot spots that might reduce the life of the tube or overheat the process fluid.

**Heat exchanger**

The ThermThief can be used with or without an exhaust leg recuperator. An exhaust leg recuperator is a heat exchanger that transfers heat from the exhaust air to the combustion air. Preheating the combustion air can increase the fuel efficiency by as much as 20%. The ThermThief can handle combustion air temperatures up to 800°F. The recommended recuperator for the ThermThief is the Eclipse Bayonet Ultra (refer to Bulletin 318).
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In this section you will find important notices about safe operation of a burner system.

**Danger:**

The burners covered in this manual are designed to mix fuel with air and burn the resulting mixture. All fuel burning devices are capable of producing fires and explosions when improperly applied, installed, adjusted, controlled, or maintained.

Do not bypass any safety feature.
You can cause fires and explosions.

Never try to light the burner if the burner shows signs of damage or malfunctioning.
You can cause fires and explosions.

**Warning:**

The burner is likely to have HOT surfaces. Always wear protective clothing when approaching the burner.

**Note:**

This manual gives information for the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits in this manual without written advice from Eclipse Combustion.

**Note:**

Read this entire manual before you attempt to start the system. If you do not understand any part of the information in this manual, then contact your local Eclipse representative or Eclipse Combustion before you continue.

Adjustment, maintenance and troubleshooting of the mechanical and the electrical parts of this system should be done by qualified personnel with good mechanical aptitude and experience with combustion equipment.
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.

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.
INTRODUCTION

In this section you will find the information and instructions that you need to install the burner and the recommended accessories.

Note:
Most of the illustrations in this chapter are based on a 30 TFB, but are typical for all ThermThief burners. Where necessary, customized illustrations are used to describe specific details.

HANDLING AND STORAGE

Handling
1. Make sure that the area is clean.
2. Protect the components from the weather, damage, dirt and moisture.
3. Protect the components from excessive temperatures and humidity.

Storage
1. Make sure that the components are clean and free of damage.
2. Store the components in a cool, clean, dry room.
3. 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 the amount of components are determined by the kind of control method that you choose. All the control methods can be found in chapter 4 "System design" on page 4-1. Use the schematics in that chapter to build your system.
## Approval of Components

### Limit controls and safety equipment

All limit controls and safety equipment must comply with the current standards that follow:

- NFPA Standard 86
- NFPA Standard 86C
- UL
- FM
- CGA
- EN 746-2
- all applicable local codes and/or standards.

### Electrical wiring

All the electrical wiring must comply with one of these standards:

- NFPA Standard 70
- ANSI-C11981
- EN 746-2
- the electrical wiring must be acceptable to the local authority having jurisdiction.

### Gas piping

All the gas piping must comply with one of these standards:

- NFPA Standard 54
- ANSI Z223
- EN 746-2
- the gas piping must be acceptable to the local authority having jurisdiction.

### Where to get the standards

The NFPA Standards are available from:
National Fire Protection Agency
Batterymarch Park
Quincy, MA 02269

The ANSI Standards are available from:
American National Standard Institute
1430 Broadway
New York, NY 10018

The UL Standards are available from:
333 Pfingsten Road
Northbrook, IL 60062

The FM Standards are available from:
1151 Boston-Providence Turnpike
P.O. Box 9102
Norwood, MA 02062
CHECKLIST BEFORE INSTALLATION

The CGA Standards are available from:
55 Scarsdale Road
Toronto, Ontario
Canada M3B 2R3

Information on the EN standards, and where to get the standards is available from:
Comité Européen de Normalisation
Stassartstraat 36
B-1050 Brussels
Belgium
Phone: +32-25196811
Fax: +32-25196819

Comité Européen de Normalisation Electronique
Stassartstraat 36
B-1050 Brussels
Belgium
Phone: +32-25196871
Fax: +32-25196919

Intake
To admit fresh combustion air from outdoors, provide an opening in the room of at least 1 in² per 4000 Btu/hr.

If there are corrosive fumes or materials in the air, then supply the burner with clean air from an uncontaminated area.

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

Access
Make sure that you install the system in such a way that you can get easy access to the burner for inspection and maintenance.

Environment
Make sure that the local environment matches the original operating specifications (see Chapter 3 "Specifications").

Check the following items:
• voltage, frequency and stability of the electrical power
• type and supply pressure of the fuel
• availability of enough fresh, clean combustion air
• humidity, altitude and temperature of air
• presence of damaging corrosive gases in the air.
Burners are calibrated at the factory. However, you may need to make adjustments for your application. Instructions to do that follow below.

General information

The distance between the end of the firing tube and the end of the nozzle, dimension A, is very important. If dimension A is not correct, then you may have to adjust it later and cause substantial downtime of the system. The instructions to adjust the nozzle follow below.

Find dimension A

Dimension A is different for each fuel type, tube diameter and burner size.

- For the 30 TFB and 75 TFB; use Table 5.1.
- For the 200 TFB; use Table 5.2.

**Table 5.1** Dimension A (in) for 30 TFB and 75 TFB

<table>
<thead>
<tr>
<th>FUEL TYPE</th>
<th>MAXIMUM BURNER INPUT (1000'S BTU/HR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50-150</td>
</tr>
<tr>
<td>Natural gas</td>
<td>¼</td>
</tr>
<tr>
<td>Propane</td>
<td>¼</td>
</tr>
<tr>
<td>Butane</td>
<td>¼</td>
</tr>
</tbody>
</table>

**Table 5.2** Dimension A (in) for 200 TFB

<table>
<thead>
<tr>
<th>FUEL TYPE</th>
<th>MAXIMUM BURNER INPUT (1000'S BTU/HR)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500-1000</td>
</tr>
<tr>
<td>Natural gas</td>
<td>½</td>
</tr>
<tr>
<td>Propane</td>
<td>½</td>
</tr>
<tr>
<td>Butane</td>
<td>½</td>
</tr>
</tbody>
</table>
**Adjust the nozzle**

**Figure 5.1** Disassemble the burner

1. Remove the ignition rod 9.
2. Remove the four bolts 9.
3. Pull the rear cover 9 far enough away from the housing 9 to get access to the lock nut 9.
4. Loosen the lock nut 9.
5. Push the assembly back together.
6. Hold the rear cover 9 in position and screw the nozzle in or out to adjust dimension A.
7. Carefully pull the rear cover 9 and nozzle assembly out of the housing 9.

**Figure 5.2** Adjust the nozzle

8. Turn the nozzle 9 over the shortest distance until the opening 9 in the nozzle for the ignition rod 9 aligns with the appropriate opening 9 in the rear cover 9.
9. Make sure that the nozzle 9 does not move and tighten the lock nut 9.
Step 2: Set high fire air

1. Make sure that the system is at high fire.
2. Set high fire air:

   The following steps apply to an ambient air system with orifice plates installed:

   Use the air curves in "Orifice curves" on page 6-8 to find the air pressure-differential that you need at high fire. This is now your target value for high fire.

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

   a. Make sure that pressure tap A and pressure tap B of the burner are open (Open the internal screw ½ turn, min.).
   b. Connect the manometer to tap A and tap B of the burner (across the air orifice). Make sure that the hose completely covers the side vents on pressure tap.
   c. Adjust the manual zone air butterfly valve until the high-fire air pressure-differential is at the target value. Make sure that the manual butterfly valves are fully open.
   d. Repeat for the other burners (if any).
   e. If all the measured differential pressures are within 0.3" w.c. of each other, then proceed to the next section. If the variation is greater than 0.3" w.c., then it will be necessary to adjust the manual air butterfly valve at each burner to improve the balance.
   f. Make sure that all the pressure taps are closed.

   Caution:
   Verify the required input levels to ensure that over firing does not occur. Over firing will destroy the radiant tubes.

   The following steps apply to a preheated air system with recuperator, and with no orifice plates installed:

   Use ambient "Static air pressures" on page 6-14 to find the air pressure that you need at high fire. This is now your target value for high fire.

   a. Make sure that pressure tap A of the first burner is open.
   b. Adjust the zone air manual butterfly valve until the high-fire air pressure is at the target value.
   c. Measure and note the air pressure-differential across the next burner in the zone.
Step 2: Install the U.V. scanner (if required)

Figure 5.5  Position of the U.V. scanner

1. Look through the peepsight Φ and make sure that it aligns with the U.V. port in the nozzle.

2. Remove the peepsight Φ.

Caution:
If you use preheated air, then you must protect the U.V. scanner from high temperatures. Install the U.V. scanner with a heat block seal and cooling air.

Note:
When using the U.V. scanner, it is necessary to use mounting adaptor part #109750 to ensure that the U.V. scanner will not detect the ignition spark.

3. Install the U.V. scanner, and if necessary the heat block seal, in opening Φ.

4. Make sure that the center peepsight Φ is installed.

Danger:
Gas will leak if the center peepsight is not installed.

Danger:
Connecting the flame sensor of a burner to the electrical circuit of the wrong burner can cause fires and explosions.
**INSTALLATION**

*Step 1: Install the Burner*

**Dimensions**

For full information on the burner dimensions, refer to Figure 3.6 "Burner dimensions - 30 TFB/75 TFB" on page 3-8.

The burner will bolt to the tube flange. Align the air and gas to accommodate accepted piping practices.

**Straight run of pipe before a metering orifice**

It is recommended that there is a straight run of pipe with a length (L) of at least 10 pipe diameters between the burner balancing valve and the metering orifice. If you do not do this, the pressure readings may be inaccurate.

**Pipe connections**

- Install a pipe union in the line to each burner. This simplifies removal of the burner.
- The use of flexible pipe nipples in the air and gas lines to the burner is optional. Flexible nipples can absorb stresses due to heat expansion.
- Flexible pipe nipples may cause higher pressure drops than equivalent standard pipes. Consider that when you size the air lines.

**Avoid large pressure drops**

*Note:*

*The pressure drop of the gas and the air in the piping is a critical parameter. Make sure that the size of all the piping is large enough to prevent excessive pressure losses.*

If using a recuperator, pressure drops increase with the air temperature. For the effects of the temperature on the pressure drop, refer to the Combustion Engineering Guide.

**Install the recuperator**

In radiant tube applications, the ThermThief burners can be used in conjunction with an exhaust leg recuperator such as the Eclipse Bayonet-Ultra, Bulletin 318. By transferring heat from the exhaust to the combustion air supply, recuperators can increase fuel efficiency by as much as an additional 20%. The ThermThief can be used with combustion air temperatures up to 800° F.
**Step 2: Install the Valves**

(Refer to the Appendix for function descriptions of the valves.)

**Valve orientation**

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

**Note:**

If there is no arrow on the valve body, then there is no mandatory direction of flow through the valve.

**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. If you do not do that, somebody may think that the gas cock is in the closed position, while it is actually in the open position.

**Step 3: Install the Flame safeguard system**

Refer to the System Schematic in chapter 4 for the control methodology you are using. There you will find the recommended components, which are explained in further detail in the Appendix. Use the appropriate flame safeguard if you chose this option.
Step 2: Set high fire air

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

1. Make sure that the system is at high fire.
2. Set high fire air.

The following steps apply to an ambient air system with orifice plates installed:

Use the air curves in "Orifice curves" on page 6-8 to find the air pressure-differential that you need at high fire. This is now your target value for high fire.

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

a. Make sure that pressure tap A and pressure tap B of the burner are open (Open the internal screw ½ turn, min.).
b. Connect the manometer to tap A and tap B of the burner (across the air orifice). Make sure that the hose completely covers the side vents on pressure tap.
c. Adjust the manual zone air butterfly valve until the high-fire air pressure-differential is at the target value. Make sure that the manual butterfly valves are fully open.
d. Repeat for the other burners (if any).
e. If all the measured differential pressures are within 0.3” w.c. of each other, then proceed to the next section. If the variation is greater than 0.3” w.c., then it will be necessary to adjust the manual air butterfly valve at each burner to improve the balance.
f. Make sure that all the pressure taps are closed.

Caution:
Verify the required input levels to ensure that over firing does not occur. Over firing will destroy the radiant tubes.

The following steps apply to a preheated air system with recuperator, and with no orifice plates installed:

Use ambient "Static air pressures" on page 6-14 to find the air pressure that you need at high fire. This is now your target value for high fire.

a. Make sure that pressure tap A of the first burner is open.
b. Adjust the zone air manual butterfly valve until the high-fire air pressure is at the target value.
c. Measure and note the air pressure-differential across the next burner in the zone.
Step 3: Set low fire air

Step 4: Verify the air settings

Step 5: Ignite the burners

The following steps apply to an ambient air system with orifice plates installed:

1. Set the system to low fire.
2. Choose one burner in the zone. Connect the manometer to tap A and tap B of the burner (across the air orifice).
3. Adjust the automatic zone air control valve until the low-fire air-pressure differential is 0.2" w.c. This is your initial setting only. Further adjustment may be required.
4. Repeat steps 2. and 3. for the other zones (if any).

The following steps apply to a preheated air system with recuperator, and with no orifice plates installed:

1. Set the system to low fire.
2. Choose one burner in the zone. Connect the manometer to tap A.
3. Adjust the automatic zone air control valve until the low-fire static air-pressure is:
   - 0.05" w.c for the 30 TFB
   - 0.2" w.c for the 75 TFB and 200 TFB.
4. This is your initial setting only. Further adjustment may be required.
5. Repeat steps 2. and 3. for the other zones (if any).

Make sure that all the settings are still the same after you cycle the system several times between high fire and low fire.

Manual Ignition Steps:

1. Drive the zone air automatic control valve to low fire.
2. Make sure the combustion air blower is running.
3. Set the manual gas butterfly valve at each burner to 50% open.
4. Set the adjusting screw on the ratio regulator 7 full rotations of 360° down from the top (initial setting).
5. Open the zone manual gas cock.

**Danger:**

Do not touch the ignition plug or the ignition wire when the ignition is on. You will get a shock.

7. While viewing down the peep sight, open the manual gas cock at burner. Burner should ignite.
8. If burner does not light within 20 seconds, close gas cock. Add 180° rotation down on ratio regulator.
9. Repeat step 7.
10. Terminate ignition transformer.
11. Repeat from step 6 on for all other burners in the zone.

**Automatic Ignition Steps:**

1. Drive the zone air automatic control valve to low fire.
2. Make sure the combustion air blower is running.
3. Set the manual gas butterfly valve at each burner to 50% open.
4. Set the adjusting screw on the ratio regulator 7 full rotations of 360° down from the top (initial setting).
5. Open the zone manual gas cock.
6. Open the manual gas cock at each burner.
7. Initiate the ignition sequence through the flame safety.
8. Check that all the burners in the zone have ignited.
   - If a gas shut off solenoid valve is fitted at each burner, then repeat 7. for all burners in the zone.
   - If burners do not light, then add a 180° rotation down on the ratio regulator. Repeat step 7.

**Note:**

Initially it may be necessary to repeat step 7. two or three times to purge all the air out of the gas pipework.

9. If all the burners have ignited, then drive the zone air butterfly valve to high fire. Make sure that the burners stay ignited.
Adjustment procedure

1. Use the gas curves in "Orifice curves" on page 6-8 to find the gas pressure differential that you need at high fire. This is now your target value for high fire.

2. Verify settings when the furnace is at operating temperature.

3. Connect the manometer to tap C and tap D of the burner (across the gas orifice).

4. Measure the high fire gas pressure drop for the first burner.

5. Adjust the manual gas butterfly valve at the burner until the gas flow is at the target value.

6. Repeat 4. and 5. for the other burners in the zone (if any).

7. Check the gas pressure at the inlet to the zone ratio regulator. This should be at least 5"w.c. higher than the loading line pressure. It should not exceed the maximum pressure rating of the ratio regulator.

8. Measure the oxygen level in the exhaust, using an oxygen analyzer.

9. If the O₂ level is between 2½ and 4%, the level is correct. If not, adjust the manual gas butterfly valve until you have the appropriate level.

10. Repeat steps 2. thru 9. for the other burners.

11. For each burner, connect the manometer across pressure taps C and D and measure the pressure drop.
   - If all pressure drops are at or below the target value, then the settings are correct.
   - If necessary, adjust the manual zone air butterfly valve to obtain the target value.
Step 7: Verify the gas settings

1. Make sure that all the settings are still the same after you cycle the system several times between high fire and low fire.

2. When all settings have been completed, mark the position of the position indicator on each butterfly valve to indicate valve position. This will save time later.

Danger:
Make sure that you close all the pressure taps after you remove the manometer. Gas that leaks from the pressure taps can cause fires and explosions.

Step 8: Adjust low fire

1. Drive the system to low fire.

2. If a burner goes out, close gas cocks. Go to Step 5: "Ignite the burners" on page 6-3, and follow steps.

3. Adjust the ratio regulator until the O₂-level is between 10% and 14%.

If the oxygen levels are between 10% and 14%, but the temperature continues to rise above the desired level:

4. Reduce low fire air flow by adjusting the zone air control valve linkage. Recheck oxygen levels at low and high fire.

5. If necessary, repeat step 3.
Start Procedure

I. Start the blower.

2. Open all the gas cocks.

3. Use the manual steps or start the automatic ignition sequence.

Danger:

If a burner does not light, and the system does not shut down automatically, then you must close the main gas cock. An uncontrolled flow of gas can cause fires and explosions.

Do not touch the ignition plug or the ignition wire when the ignition is on. You will get a shock.

4. Look through the peepsights of the burners to make sure that you see a flame in all the burners.

If a burner does not light and:

• the system does not shut down automatically:
  Close the main gas cock manually. Do NOT operate the system. Go to "Checklist After Installation" on page 5-10. After that, repeat the start procedure.

• the system shuts down automatically:
  See "Trouble-shooting" on page 7-3.

Stop Procedure

I. Close these valves:

• the manual gas cock for each burner or zone
• the manual gas cock at the main control valve
• all the manual shut-off valves in the gas line upstream of the burner gas cock.
ORIFICE CURVES

Figure 6.1  Orifice curves for the 30 TFB

Air @ 3% oxygen (30 TFB)

Natural Gas (20 TFB)
Figure 6.1   Orifice curves for the 30 TFB (Continued)
Figure 6.2  Orifice curves for the 75 TFB

Air @ 3% oxygen
(75 TFB)

Natural Gas
(75 TFB)
Figure 6.2  Orifice curves for the 75 TFB (Continued)
Figure 6.3  Orifice curves for the 200 TFB

Air @ 3% oxygen
(200 TFB)

Natural Gas
(200 TFB)
Figure 6.3  Orifice curves for the 200 TFB (Continued)
When a burner uses preheated combustion air, there are no air orifices installed. In that case, the static air pressure is used to set the initial air flow of a burner. From there on the burner is further adjusted.

**Table 6.1 Static pressure at the air inlet**

**Burner: 30 TFB**

<table>
<thead>
<tr>
<th>INPUT (1000's BTU/HR)</th>
<th>STATIC PRESSURE (&quot;W.C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AT 70 °F</td>
</tr>
<tr>
<td>50-100</td>
<td>0.1-0.4</td>
</tr>
<tr>
<td>101-150</td>
<td>0.4-0.7</td>
</tr>
<tr>
<td>151-200</td>
<td>0.7-0.9</td>
</tr>
<tr>
<td>201-300</td>
<td>0.9-2.0</td>
</tr>
</tbody>
</table>

**Table 6.2 Static pressure at the air inlet**

**Burner: 75 TFB**

<table>
<thead>
<tr>
<th>INPUT (1000's BTU/HR)</th>
<th>STATIC PRESSURE (&quot;W.C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AT 70 °F</td>
</tr>
<tr>
<td>301-350</td>
<td>2.0-2.5</td>
</tr>
<tr>
<td>351-400</td>
<td>2.5-3.0</td>
</tr>
<tr>
<td>401-500</td>
<td>3.0-5.0</td>
</tr>
<tr>
<td>501-600</td>
<td>5.0-7.0</td>
</tr>
<tr>
<td>601-750</td>
<td>7.0-10</td>
</tr>
</tbody>
</table>

**Table 6.3 Static pressure at the air inlet**

**Burner: 200 TFB**

<table>
<thead>
<tr>
<th>INPUT (1000's BTU/HR)</th>
<th>STATIC PRESSURE (&quot;W.C.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>AT 70 °F</td>
</tr>
<tr>
<td>700-800</td>
<td>1.3-1.7</td>
</tr>
<tr>
<td>801-900</td>
<td>1.7-2.0</td>
</tr>
<tr>
<td>901-1000</td>
<td>2.0-2.3</td>
</tr>
<tr>
<td>1001-1100</td>
<td>2.3-2.7</td>
</tr>
<tr>
<td>1101-1200</td>
<td>2.7-3.3</td>
</tr>
<tr>
<td>1201-1300</td>
<td>3.3-3.7</td>
</tr>
<tr>
<td>1301-1400</td>
<td>3.7-4.3</td>
</tr>
<tr>
<td>1401-1500</td>
<td>4.3-4.8</td>
</tr>
<tr>
<td>1501-1600</td>
<td>4.8-5.4</td>
</tr>
<tr>
<td>1601-1700</td>
<td>5.4-6.0</td>
</tr>
<tr>
<td>1701-1800</td>
<td>6.0-6.5</td>
</tr>
<tr>
<td>1801-1900</td>
<td>6.5-7.0</td>
</tr>
<tr>
<td>1901-2000</td>
<td>7.0-7.5</td>
</tr>
</tbody>
</table>
INTRODUCTION

Introduction
This section is divided into two parts:
• The first part describes the maintenance procedures.
• The second part helps you to identify problems that may occur, and gives advice on how to solve these problems.

MAINTENANCE

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

In the paragraphs that follow are suggestions for a monthly list and a yearly list.

Caution:
The monthly list and the yearly list are an average interval. If your environment is dirty, then the intervals should be shorter.

Monthly Checklist:

1. Inspect U.V. scanners for good condition, and cleanliness.
2. Check for proper inlet air/gas ratios.
3. Test all the alarm systems, or both, for proper signals.
4. Check ignition rod.
5. Check valve motors and control valves for free, smooth action and adjustment.
6. Measure and record the high fire oxygen levels in the exhaust every month. If there is any change, find the cause and correct it.
7. View down the peepsights 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.
Yearly Checklist

1. Test interlock sequence of all safety equipment. Manually make each interlock fail, noting that related equipment closes or stops as specified by the manufacturer. Test flame safeguard by manually shutting off gas to burner.

2. Test (leak test) safety shut-off valves for tightness of closure.

3. Test main fuel hand-valves for operation.

4. Test pressure switch settings by checking switch movements against pressure settings and comparing with actual impulse pressure.

5. Visually check ignition cable and connectors.

6. Inspect impulse piping for leaks.

7. Remove and inspect all the burners. Clean off any carbon build up.

8. Make sure that the following components are not damaged or distorted:
   - the burner nozzle
   - the ignition rods
   - the flame tube.

   If applicable, remove and clean all the orifice plates.
**Trouble-Shooting**

<table>
<thead>
<tr>
<th><strong>Problem</strong></th>
<th><strong>Possible Cause</strong></th>
<th><strong>Solution</strong></th>
</tr>
</thead>
</table>
| Burner does not light. (See also next page). | Not enough gas:  
  * Air in the gas line. | Repeat the start attempt several times. |
| | No ignition:  
  * There is no power to the ignition transformer. | Restore the power to the ignition transformer. |
| | No ignition:  
  * Open circuit between the ignition transformer and the ignition rod. | Repair or replace the wiring to the ignition rod. |
| | No ignition:  
  * The ignition rod needs cleaning. | Clean the ignition rod. |
| | No ignition:  
  * The ignition rod is not correctly grounded to the burner. | Clean the threads of the ignition rod and the burner.  
  Do not use pipe sealant on ignition plug threads. |
| | No ignition:  
  * The ignition rod is grounded to the nozzle or the air shroud. | Check the ignition rod position. |
| | Not enough gas:  
  * The gas pressure into the ratio regulator is too low. | Measure the gas pressure into the ratio regulator and adjust gas pressure if necessary.  
  (See Chapter 6 "Adjustment, Start & Stop" on page 6-1) |
| | Not enough gas:  
| |  
  * Improper air/gas settings. | Check pressures and settings against start-up report and adjust as necessary. |
| | Too much gas:  
  * Gas pressure out of ratio regulator is too high. | Check adjustments.  
  If necessary, remove regulator and investigate. |
| | Not enough gas:  
  * The impulse line to the ratio regulator is leaking. | Repair any leaks. |
| | Not enough gas:  
  * Start gas solenoid valve does not open (if fitted). | Check solenoid valve coil for proper operation. Replace if necessary.  
  Check wiring to the valve.  
  Check output from the flame safeguard. |
<table>
<thead>
<tr>
<th><strong>PROBLEM</strong></th>
<th><strong>POSSIBLE CAUSE</strong></th>
<th><strong>SOLUTION</strong></th>
</tr>
</thead>
</table>
| Burner does not light. (Continued) | Not enough gas:  
|  | Improper air/gas ratio:  
- Air in the gas line. | Repeat start-up several times. |
|  | Improper air/gas ratio:  
- Ratio regulator incorrectly set. | Adjust to proper setting. |
| The low fire flame is weak or unstable | Not enough gas. | Readjust gas flow at ratio regulator. |
|  | Not enough air. | Open automatic valve slightly. |
| The burner does not light or goes off when it cycles to high fire. | Burner set too lean, becoming unstable as air increases. | Adjust the settings to provide more gas. |
|  | Insufficient pressure into regulator. | Adjust the pressure settings. |
|  | Main gas adjustable valve not open enough. | Adjust the main gas adjustable valve. |
|  | Marginal air pressure switch setting. | Adjust the air pressure switch setting. |
| The burner is erratic and does not respond to adjustment | Internal damage to the burner:  
- Some parts inside the burner are loose, dirty or burned out. | Contact your Eclipse representative or the Eclipse factory. |
| The burner is unstable or produces soot, smoke or excessive carbon monoxide. | The air/gas ratio is out of adjustment. | Reset the burner controls.  
(See Chapter 6 “Adjustment, Start & Stop” on page 6-1) |
|  | Combustion air filter is dirty, causing air starvation. | Clean or replace filter. Check burner nozzle, ignition rod and U.V. scanner for soot accumulation and clean as necessary. |
|  | Bleed fitting (if used) is dirty. | Clean filter and reset burner controls. |
|  | After this step it is important that you clean the ignition rod and the U.V. scanner, and make sure that there is no excessive soot on the nozzle. Clean where necessary. | |
### Table 7.1  Trouble-shooting (Continued)

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>POSSIBLE CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burner pulsates or produces noise.</td>
<td>• Acoustic feedback from tube. (The exact cause of this problem is unknown.)</td>
<td>Slide a piece of steel plate over the end of the tube until the rumbling disappears. Weld the plate in place. Readjust the burner controls if necessary.</td>
</tr>
<tr>
<td></td>
<td>• Input inconsistent with nozzle settings.</td>
<td>Check if input is consistent with nozzle settings and adjust if necessary.</td>
</tr>
<tr>
<td></td>
<td>• Could be lean.</td>
<td>Check oxygen levels and adjust to 2½ to 4% O₂ (at high fire).</td>
</tr>
<tr>
<td></td>
<td>• Could be over fired.</td>
<td>Check the pressure drops to verify that the inputs are at the correct levels. Reduce the input on the air and gas as required to achieve the specified inputs.</td>
</tr>
<tr>
<td></td>
<td>• Negative pressure in the building.</td>
<td>In some cases, building exhaust systems create a negative pressure that “pulls” on the exhaust outlet of the tube. By placing a washer or restriction plate over the tube outlet, this suction can be equalized by burner pressure.</td>
</tr>
<tr>
<td>Cannot achieve full capacity</td>
<td>• Air filter is blocked.</td>
<td>Clean the filter.</td>
</tr>
<tr>
<td></td>
<td>• Gas pressure too low into the ratio regulator.</td>
<td>Adjust gas pressure.</td>
</tr>
<tr>
<td></td>
<td>• Loading line pressure too low.</td>
<td>Open the zone air control valves to increase the air volume and pressure.</td>
</tr>
<tr>
<td></td>
<td>• Adjusting valve has closed.</td>
<td>Open the valve to previous setting and check the input and flue gas settings to verify proper operations.</td>
</tr>
<tr>
<td></td>
<td>• Blower is wired backwards.</td>
<td>A blower wired to turn backwards will produce approximately 60% of its rated capacity. Check the rotation of the blower impeller. If spinning backwards, have a qualified electrician reverse the electrical wiring.</td>
</tr>
<tr>
<td>Table 7.1</td>
<td>Trouble-shooting (Continued)</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Problem</strong></td>
<td><strong>Possible Cause</strong></td>
<td><strong>Solution</strong></td>
</tr>
<tr>
<td>Cannot initiate start sequence</td>
<td>• Air pressure switch has not made contact.</td>
<td>Check air pressure switch adjustment.  Check air filter.  Check blower rotation.  Check outlet pressure from blower.</td>
</tr>
<tr>
<td></td>
<td>• High gas pressure switch has tripped.</td>
<td>Check incoming gas pressure.  Adjust gas pressure if necessary.  Check pressure switch setting and operation.</td>
</tr>
<tr>
<td></td>
<td>• Low gas pressure switch has tripped.</td>
<td>Check incoming gas pressure.  Adjust gas pressure if necessary.  Check pressure switch setting and operation.</td>
</tr>
<tr>
<td></td>
<td>• Malfunction of flame safeguard system such as shorted out flame sensor or electrical noise in the sensor line.</td>
<td>Have qualified electrician investigate and rectify.</td>
</tr>
<tr>
<td></td>
<td>• Purge cycle not completed.</td>
<td>Check flame safeguard system, or purge timer.</td>
</tr>
<tr>
<td></td>
<td>• Main power is off.</td>
<td>Make sure power is on to control system.</td>
</tr>
<tr>
<td></td>
<td>• No power to control unit.</td>
<td>Call qualified electrician to investigate.</td>
</tr>
<tr>
<td>Pos. No.</td>
<td>Qty.</td>
<td>Part Name</td>
</tr>
<tr>
<td>---------</td>
<td>------</td>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>1</td>
<td>Spark electrode assembly</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Tube, gas</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>P.F. Locknut, ⅜ - 14 NPSM SS</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Cover, rear</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>Washer, ⅜&quot;, medium, split</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>Screw, hex cap, ⅜&quot; - 18 x ⅜&quot;</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>Peepsight ½&quot;</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>P.F. Plug, Test, ⅜ &quot; NPT</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>Peepsight ½&quot;</td>
</tr>
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<td>10</td>
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<td>P.F. Plug, Test, ½ &quot; NPT</td>
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<tr>
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<td>Seal, O-ring, Viton, V747</td>
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<td>13</td>
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<td>Plate, gas orifice</td>
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<td>Seal, O-ring, Viton, V747</td>
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<tr>
<td>16</td>
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<td>P.F. Plug, TEST ⅞ &quot; NPT</td>
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<td>17</td>
<td>4</td>
<td>Washer, ⅜&quot;, medium, split</td>
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<tr>
<td>18</td>
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<td>4</td>
<td>Screw, hex cap, ⅜&quot; - 18 x 2 &quot;</td>
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<tr>
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<td>Inlet, air, machining</td>
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<td>Nozzle, with spark lug</td>
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<td>27</td>
<td>1</td>
<td>Tube air, natural gas</td>
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<tr>
<td>27</td>
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<td>Tube air, propane and butane</td>
</tr>
<tr>
<td>Pos. No.</td>
<td>Qty.</td>
<td>Part Name</td>
</tr>
<tr>
<td>---------</td>
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</tr>
<tr>
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<tr>
<td>2</td>
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<td>Tube, gas</td>
</tr>
<tr>
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<td>P.F. Locknut, 1-11½ NPT</td>
</tr>
<tr>
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<td>Cover, rear</td>
</tr>
<tr>
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<td>Washer, lock, M8</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
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<tr>
<td>7</td>
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<tr>
<td>8</td>
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<td>Peepsight ¾&quot;</td>
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</tr>
<tr>
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</tr>
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<td>4</td>
<td>Washer, lock, M8</td>
</tr>
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<td>Screw, hex head, M8x22</td>
</tr>
<tr>
<td>17</td>
<td>4</td>
<td>Screw, hex head, M8x22</td>
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<tr>
<td>18</td>
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<td>Washer, lock, M8</td>
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<tr>
<td>19</td>
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<td>Housing</td>
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<tr>
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<tr>
<td>27</td>
<td>1</td>
<td>Nozzle</td>
</tr>
<tr>
<td>28</td>
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<td>Air tube</td>
</tr>
</tbody>
</table>
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