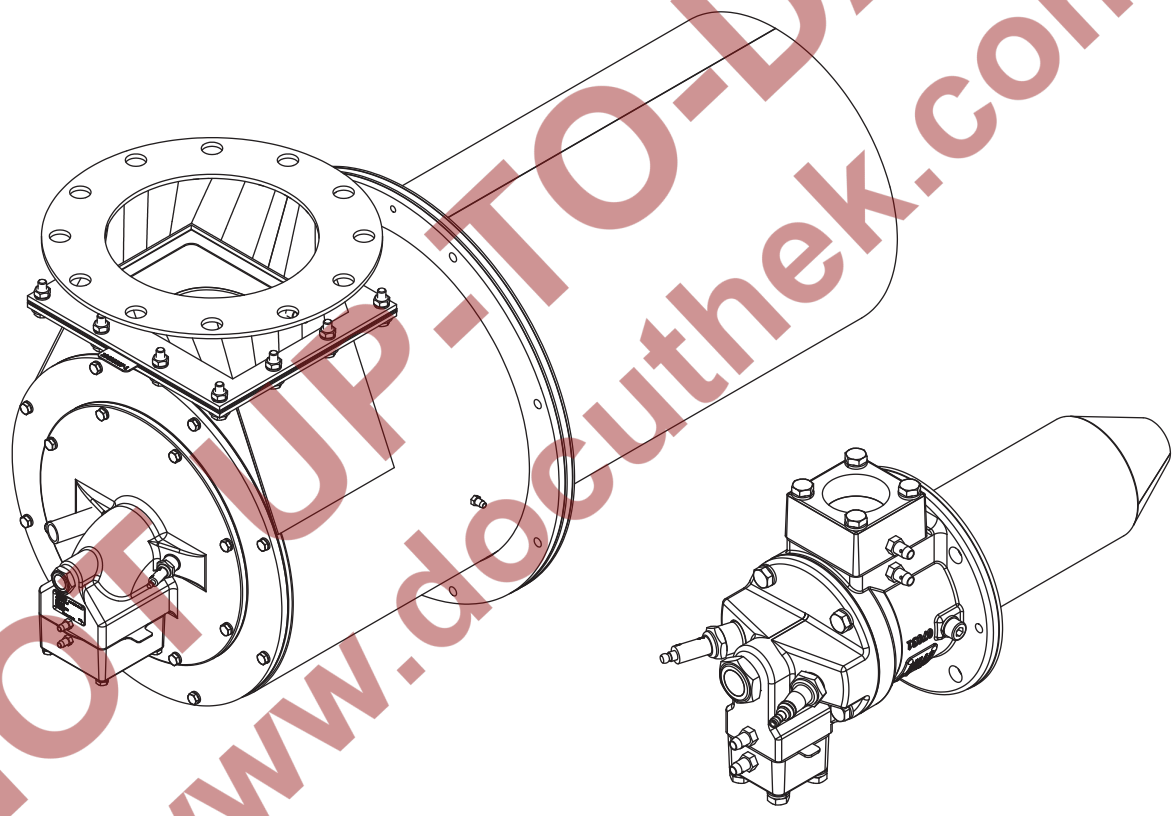
Eclipse ThermJet Burners

Model TJ0015 - 2000

Operating Instructions Edition 9.14

Version 2

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Thermal Solutions

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Document Conventions

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

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

How To Get Help

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

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

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

ECLIPSE® Innovative Thermal Solutions www.eclipsenet.com
Product Name
Item #
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This is the safety alert symbol. It is used to alert you to potential personal injurt hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

WARNING Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE Is used to address practices not related to personal injury.

NOTE Indicates an important part of text. Read thoroughly.

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Introduction 1

Product Description

The ThermJet is a nozzle-mix burner that is designed to fire an intense stream of hot gases through a combustor using ambient combustion air.

The high velocity of the gases improves temperature uniformity, product quality and system efficiency.

The ThermJet burner comes in two types:

- High Velocity (HV)
- Medium Velocity (MV)

Flame velocity information is available in Datasheets 205-1 through 205-13.

The gas velocity can be as high as 500 ft/s for the High Velocity burner, and 250 ft/s for the Medium Velocity burner.

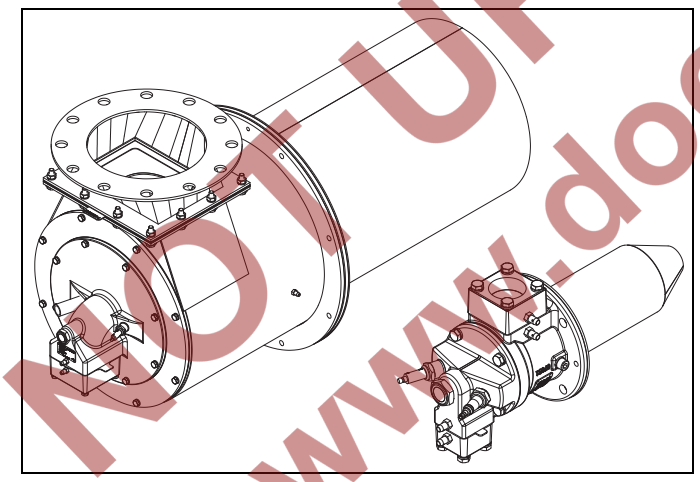


Figure 1.1. ThermJet Burner

Audience

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

These aspects are:

- Installation
- Use
- Maintenance

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

ThermJet Documents

Installation Guide No. 205

- This document

Datasheet, Series No. 205-1 through 205-13

- Available for individual ThermJet models
- Required to complete installation

Design Guide No. 205

- Used with Datasheet to complete installation

Related Documents

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

Purpose

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

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Safety

2

Important notices which help provide safe burner operation will be found in this section. To avoid personal injury and damage to the property or facility, the following warnings must be observed. All involved personnel should read this entire manual carefully before attempting to start or operate this system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

Safety Warnings

⚠ DANGER

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

⚠ WARNING

- **The burner and duct sections are likely to have HOT surfaces. Always wear the appropriate protective equipment when approaching the burner.**
- **Eclipse products are designed to minimize the use of materials that contain crystalline silica. Examples of these chemicals are: respirable crystalline silica from bricks, cement or other masonry products and respirable refractory ceramic fibers from insulating blankets, boards, or gaskets. Despite these efforts, dust created by sanding, sawing, grinding, cutting and other construction activities could release crystalline silica. Crystalline silica is known to cause cancer, and health risks from the exposure to these chemicals vary depending on the frequency and length of exposure to these chemicals. To reduce the risk, limit exposure to these chemicals, work in a well-ventilated area and wear approved personal protective safety equipment for these chemicals.**

NOTICE

- **This manual provides information regarding the use of these burners for their specific design purpose. Do not deviate from any instructions or application limits described herein without written approval from Eclipse.**

Capabilities

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

Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment and its operation. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency. Contact Eclipse for any needed site-specific training.

Replacement Parts

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

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Installation

3

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

Handling

- Make sure that the area is clean.
- Protect the components from the weather, damage, dirt and moisture.
- Protect the components from excessive temperatures and humidity.
- Take care not to drop or damage components.

Storage

- Make sure that the components are clean and free of damage.
- Store the components in a cool, clean, dry room.
- After you have made sure that everything is present and in good condition, keep the components in the original package as long as possible.

NOTICE

■ **When the refractory combustion block is supplied with the burner, it is critical that the instructions for handling and storage are followed. The refractory should be considered fragile; improper handling and storage will cause premature failure.**

Position of Components

The position and amount of components are determined by the kind of control method chosen. All the control methods can be found in Design Guide 205. Follow one of the schematics in the System Design chapter to build your system.

Approval of Components

Limit Controls & Safety Equipment

All limit controls and safety equipment must comply with all applicable local codes and/or standards and must be listed for combustion safety by an independent testing agency. Typical application examples include:

- American: NFPA 86 with listing marks from UL, FM, CSA
- European: EN 746-2 with CE mark from TuV, Gastec, Advantica

Electrical Wiring

All the electrical wiring must comply with all applicable local codes and/or standards such as:

- NFPA Standard 70
- IEC60364
- CSA C22
- BS7671

Gas Piping

All the gas piping must comply with all applicable local codes and/or standards such as:

- NFPA Standard 54
- ANSI Z223
- EN 746-2

Where to Get the Standards:

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

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

The UL Standards are available from:
333 Pfingsten Road
Northbrook, IL 60062
www.ul.com

The FM Standards are available from:
1151 Boston-Providence Turnpike
PO Box 9102
Norwood, MA 02062
www.fmglobal.com/approvals

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

Comité Européen de Normalisation Electronique
Stassartstraat 36
B-1050 Brussels
Phone: +32-25196871
Fax: +32-25196919
www.cenelec.org

Checklist Before Installation

Intake

To admit fresh combustion air from outdoors, provide an opening in the room of at least one square inch per 4,000 Btu/h. If there are corrosive fumes or materials in the air, then supply the burner with clean air from an uncontaminated area, or provide a sufficient air filtering system.

Exhaust

Do not allow exhaust 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 burner in such a way that you can get easy access for inspection and maintenance.

Environment

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

- Voltage, frequency and stability of the electrical power
- Type and supply pressure of the fuel
- Availability of enough fresh, clean combustion air
- Humidity, altitude and temperature of air
- Presence of damaging corrosive gases in the air

Prepare the Burner

Several components must be installed on a burner before it can operate. Installation instructions follow.

It is possible to change the relative position of the gas inlet with respect to the air inlet. This can be convenient for the routing of the piping.

Rotate the Rear Cover (Optional)

To rotate the rear cover, do the following (see Figure 3.1):

1. Disconnect the piping at a union in the piping or the inlet flanges ❶ provided on the burner.

NOTE: Be careful not to lose or damage the orifice plate or the o-rings.

2. Remove the four bolts ❷.
3. Remove the rear cover ❸ from the burner housing ❹.
4. Rotate the rear cover ❸ to the position that you want.
5. Put the rear cover ❸ in position against the burner housing ❹.
6. Install the four bolts ❷.
7. Reconnect the piping. Make sure that the o-rings show no signs of damage.

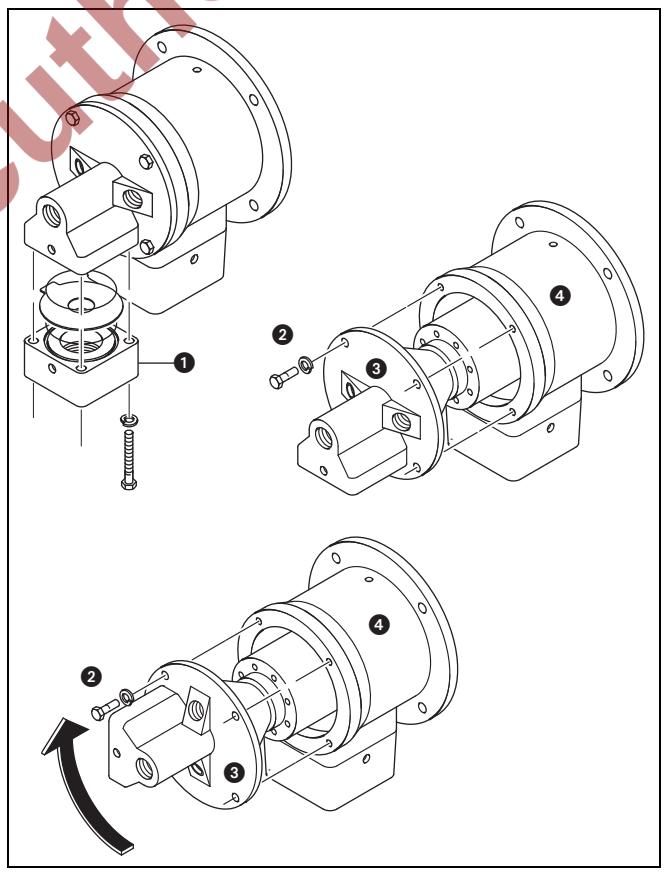


Figure 3.1. Rotate the Rear Cover

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Installing the Flame Sensor

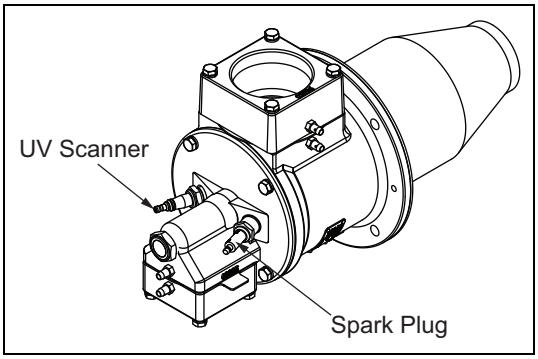


Figure 3.2. Installing the Flame Sensor

1. Install the flame sensor into the NPT opening in the rear cover (1/2" NPT for TJ0015 through TJ0500 and 3/4" NPT for TJ0750 through TJ2000).

2. Make sure that you connect the flame sensor of a burner to the electrical circuit of that burner.

⚠ DANGER

- **If you connect the flame sensor of a burner to the electrical circuit of the wrong burner, then you can cause fires and explosions.**

There are two different types of flame sensors; UV scanner and flamerod.

NOTICE

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

UV Scanner

For detailed information on how to install and connect a UV scanner, refer to scanner information guide.

Flame Rod

NOTE: Only specific burner sizes with alloy or silicon carbide combustors can use a flamerod (see specific burner datasheets).

For detailed information on how to install and connect a flamerod, refer to Bulletin/Info guide 832.

Installing the Spark Plug

Install the spark plug into the opening in the rear cover.

NOTE: Do ***not*** apply any grease to the threads of the spark plug. You can cause bad grounding of the spark plug if you apply grease to it. Bad grounding of the spark plug results in a weak spark.

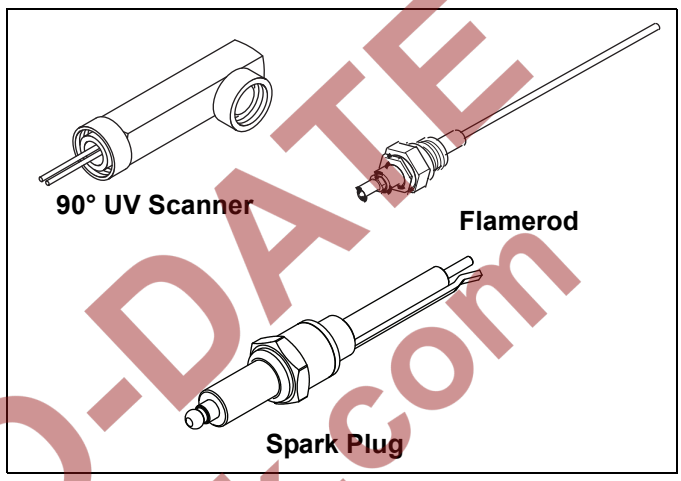


Figure 3.3. Flame Sensor Components

Burner Installation

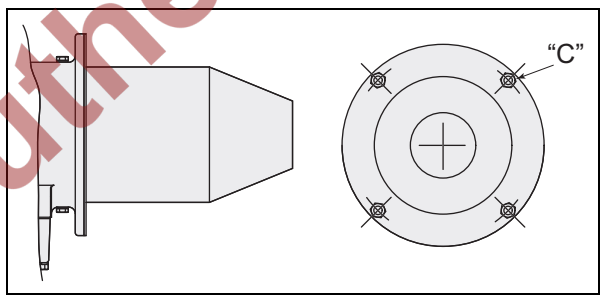


Figure 3.4. Burner Attachment

Dimensions

The burner attaches to the wall of the chamber with bolts through holes "C". For full information on the burner dimensions, refer to specific datasheets.

Chamber Wall

Make sure that the wall of the chamber is strong enough to support the weight of the burner. If necessary, reinforce the area where you plan to install the burner to support the weight of the burner.

Refractory furnace walls must allow for thermal expansion as recommended by the refractory supplier – the wall should apply no stress on the burner block or refractory layer surrounding the burner block. Expansion joints built into the furnace wall should permit the furnace shell, burner block holder, combustor or burner block and surrounding refractory to move as a unit in the event of unequal expansion of the refractory wall and furnace shell.

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The combustor or combustion block must not extend beyond the inside of the furnace wall more than 1". Beyond this length it is necessary to add a spacer on the outside of the furnace to keep the end of the combustor or combustion block within 1/2" of the end of the wall.

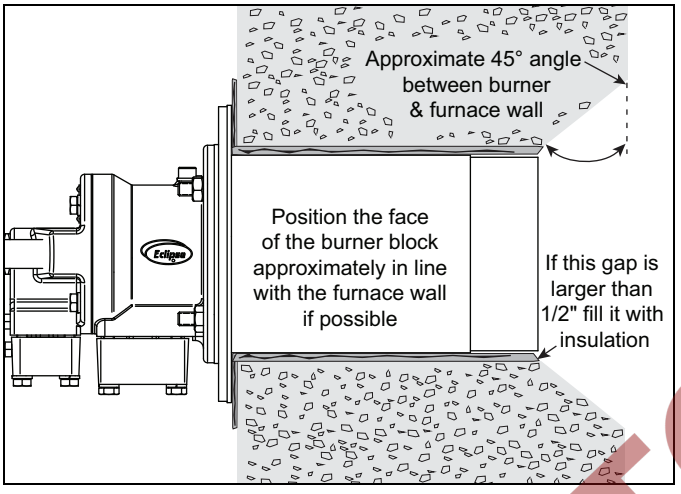


Figure 3.5. ThermJet Combustor Position

If the combustor or burner block is shorter than the furnace wall thickness the block or combustor should be recessed into the wall. To prevent refractory overheating, a 45° chamfer should be applied.

Avoid Losses

To make sure that heat does not go back to the casing of the chamber, it is important that the radial clearance around the firing tube is filled with ceramic fiber.

Alloy Combustor (Figure 3.6)

1. Make sure the gasket ❶ is installed between the burner and the chamber wall ❷.
2. Make sure that gasket ❶ does not leak.
3. Check the size of the clearance. If the gap ❸ around the firing tube is larger than 1/2", then pack the gap with ceramic fiber ❹.

NOTE: Do not insulate the end of the combustion tube "tip". Do not recess the combustion tube into the furnace wall.

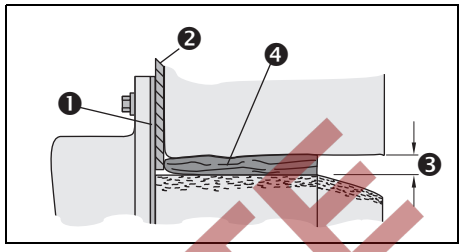


Figure 3.6. Alloy Combustor

Silicon Carbide (SiC) Combustor Only (Figure 3.7)

1. Make sure the gasket ❶ is installed between the burner flange ❻ and chamber wall ❷.
2. Make sure gasket ❺ is installed between SiC tube and flange ❻.
3. Make sure neither gasket ❶ or ❺ leaks.
4. Check the size of the clearance. If the gap ❸ around the firing tube is larger than 1/2", then pack the gap with ceramic fiber ❹.

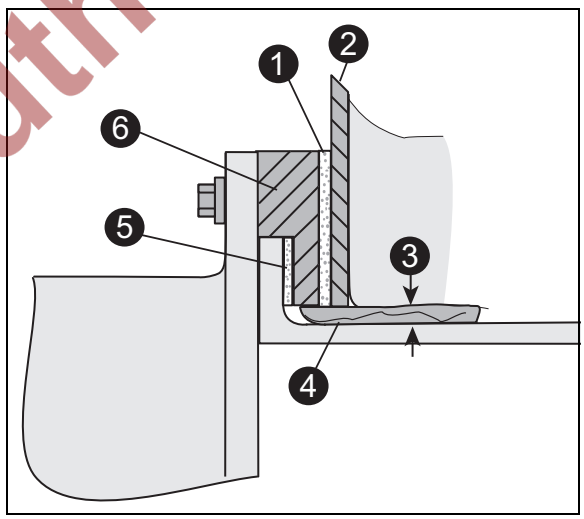


Figure 3.7. Silicon Carbide

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Refractory Block (Figure 3.8)

1. Make sure gasket ❶ is installed between burner ❷ and block holder ❸.

2. Make sure gasket ❹ is installed between block holder ❸ and chamber wall ❺.

3. Support the weight of refractory block ❻ with hard brick work anchored to the furnace shell ❼. Fill the 1/2" space between block ❻ and the three unsupported sides with soft gasket material ❽.

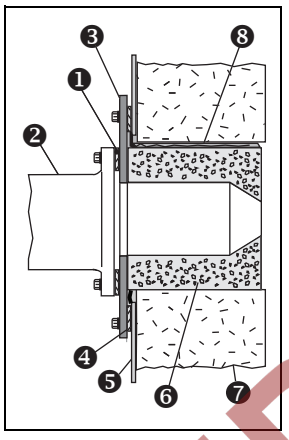


Figure 3.8. Refractory Block

Large Refractory Blocks

On sizes TJ0500 thru TJ2000; the block must be surrounded by a collar made of brick, plastic refractory, or a castable refractory of at least 4" (10 cm) minimum thickness on all sides of the block. If the collar is cast around the block, a thin plastic film (i.e. Saran Wrap® or Glad Wrap®) should be wrapped around the block to keep moisture from leaching into it. The collar should be anchored to the furnace shell with suitable anchors and must be constructed to rest on a surface capable of supporting its weight, such as a hearth or a solid refractory or brick wall. For furnaces that are unable to support the weight of the refractory block, a stainless steel shelf can be welded to the shell to support the collar.

Refractory Block Curing Schedule

The refractory block was cured at the factory up to a temperature of at least 550°F (288°C). Final curing should be done after installation. The recommended curing schedule is:

- Ambient to 600°F (315°C) at 100°F (55°C) per hour.
- 600°F (315°C) to 1000°F (540°C) at 25°F (14°C) per hour. Hold the refractory block at 1000°F (540°C) for 12 hours.
- Cool or raise the operating temperature at a rate of 100°F (55°C) per hour.

Please contact Eclipse with any questions regarding block curing.

After initial curing, blocks are to be heated or cooled at a rate no faster than 200°F (93°C) per hour.

NOTE: The correct insulation of burner combustion blocks in furnaces results in longer block life and adds value by reducing downtime and maintenance.

Block Holder Temperature

Excessive block holder temperatures can cause problems. Overheating can be reduced by carefully sealing the burner blocks in the wall to prevent the leakage of hot gases back to the furnace shell.

In high temperature (>1,400°F, 760°C) fiber-wall furnace installations, the length of the metallic wrapper should extend no farther than the point in the wall where the interface temperature is higher than 1800°F (760°C).

Vertical Down Firing Blocks (Figure 3.9)

1. Down firing blocks may be suspended by customer supplied hangers ❷ attached to the burner body mounting bolts.

2. Hangers should be attached to structural support ❶.

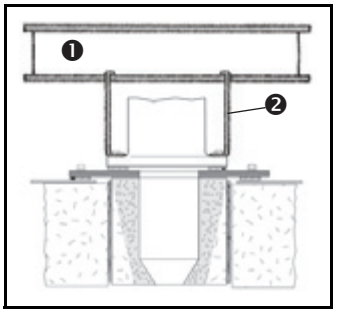


Figure 3.9. Vertical Down Firing Block

NOTE: Burner housings should not be insulated without contacting Eclipse.

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Piping Installation

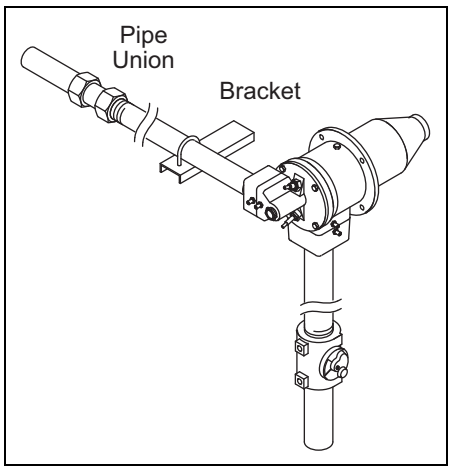


Figure 3.10. Piping Installation

Layout

Install the piping as shown in the schematics. Refer to Chapter 3 of the ThermJet Design Guide No. 205.

Support the Piping

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

Straight Run of Pipe Before a Metering Orifice

NOTE: There must be a run of pipe with a straight length of at least 10 pipe diameters before the burner metering orifice. If you do not do this, the pressure readings ***will*** be inaccurate.

Pipe Connections

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

The use of flexible pipe nipples in the gas line to the burner is optional. Flexible nipples can absorb stress due to heat expansion and slight misalignment.

NOTE: Flexible pipe nipples will cause inaccurate metering orifice readings and may cause higher pressure drops than equivalent standard pipe. Consider this when you size the gas lines.

Avoid Large Pressure Drops

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

Valve Installation

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.

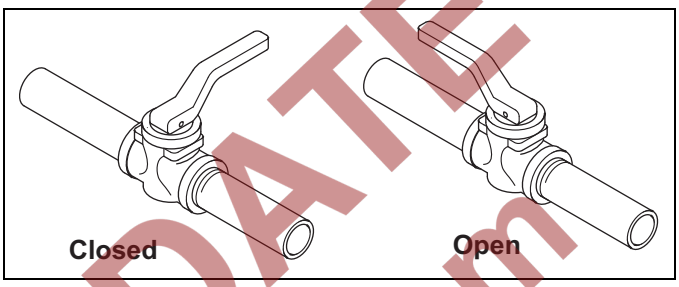


Figure 3.11. Valve Orientation

Gas Cocks

Make sure that the handle of a gas cock is at a right angle to the valve body when the valve is in the closed position. This is an important position indicator. If you do not do this, someone may think that the gas cock is in the closed position, while it is actually in the open position.

Gas Balancing Valves

A gas balancing valve is typically the same as a manual butterfly valve. For more information, refer to "Manual Butterfly Valves" below.

Manual Butterfly Valves

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

2. Install manual butterfly valves in the gas line to the burner (optional).

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

Automatic Butterfly Valve

An automatic butterfly is driven by an actuator. Install the control valve in accordance with Bulletin/Info Guide 720.

Ratio Regulator

- Connect an impulse line to the ratio regulator and air supply line.
- Install the ratio regulator in accordance with Bulletin/ Information Guide 742.

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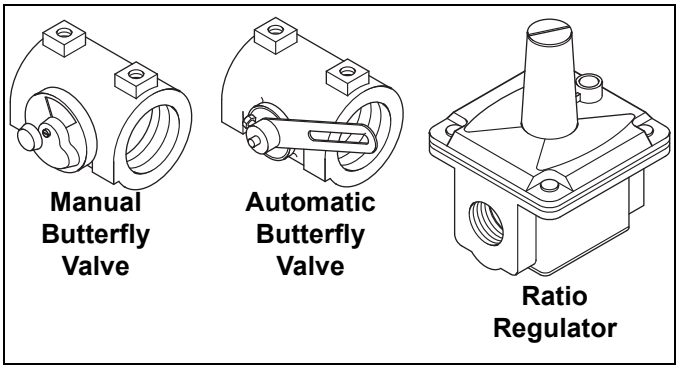


Figure 3.12. Valves

Checklist After Installation

To verify proper system installation, do the following:

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

Prepare for Adjustment

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

1. Set the air pressure switch so that it drops out at 4" w.c. (10 mbar) below the pressure rating of the blower.
2. Set the low gas pressure switch at 4" w.c. (10 mbar) below the gas pressure measured at the inlet to the main gas valve train.
3. Set the high gas pressure switch so that it comes on at 4" w.c. (10 mbar) above the gas pressure measured at the inlet to the main gas valve train.
4. Close all the burner gas cocks.
5. Try to light a burner before the purge and other timers have finished their cycles. Make sure that the flame monitoring system indicates a flame failure.
6. Trip out pressure switches and other limit interlocks. Make sure that the main gas valve train closes.

⚠ DANGER

- **If simulated limits or simulated flame failures do not shut down the fuel system within the required failure response time, immediately correct the problem before proceeding.**

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Adjustment, Start and Stop

4

In this chapter you will find instructions on how to adjust a system, and how to start and stop a system.

⚠ DANGER

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

Adjustment

There are two adjustment procedures. To adjust a modulating gas and air ratio system, refer to “Modulating Gas & Air Ratio System”. For a fixed-air system, refer to “Fixed-Air System”.

Modulating Gas & Air Ratio System

If you adjust an on-ratio system for the first time, you must follow these steps: (Refer to Figures in the ThermJet Design Guide No. 205)

Step 1: Reset the System

1. Close the automatic gas valves and gas cocks.
2. Fully open the manual air butterfly valve at each burner.
   a. Drive the automatic zone air control valve to high fire.
   b. Adjust the automatic zone air control valve so that it is fully open.
3. Start the blower.

NOTICE

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

Step 2: Set High Fire Air

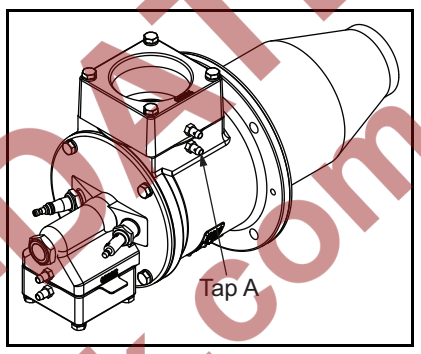


Figure 4.1. Set High Fire Air

1. Set the system to high fire, but **DO NOT** ignite the burner(s).
2. Use the air curves from the appropriate ThermJet datasheet to find the differential air pressure needed at high fire. This is the target value for high fire.
3. Set high fire air using the instructions for either a single burner system or multiple burner system below. (See Figure 4.2)

To set high fire air on a single burner system:

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

a. Make sure that pressure taps A and C are open.
b. Connect the manometer to taps A and C (across the air orifice).
c. Adjust the manual butterfly valve until the high fire differential air pressure is at the target value.
d. Remove the manometer.
e. Close the pressure taps.

To set high fire air on a multiple burner system:

a. Make sure that pressure taps A and C of the first burner are open.
b. Connect the manometer to taps A and C of the first burner (across the air orifice).
c. Adjust the zone air manual butterfly valve to achieve the target value for the first burner.

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d. Measure and note the differential air pressure across the next burner in the zone.

e. Repeat step d for all the burners in the zone.

f. If all the measured differential pressures are within 0.3" w.c. (0.75 mbar) of each other, then proceed to the next section. If the variation is greater than 0.3" w.c. (0.75 mbar) it will be necessary to adjust the manual air butterfly valve at each burner to improve the balance.

g. Make sure that all the pressure taps are closed.

4. Repeat step 3 for other zones (if any).

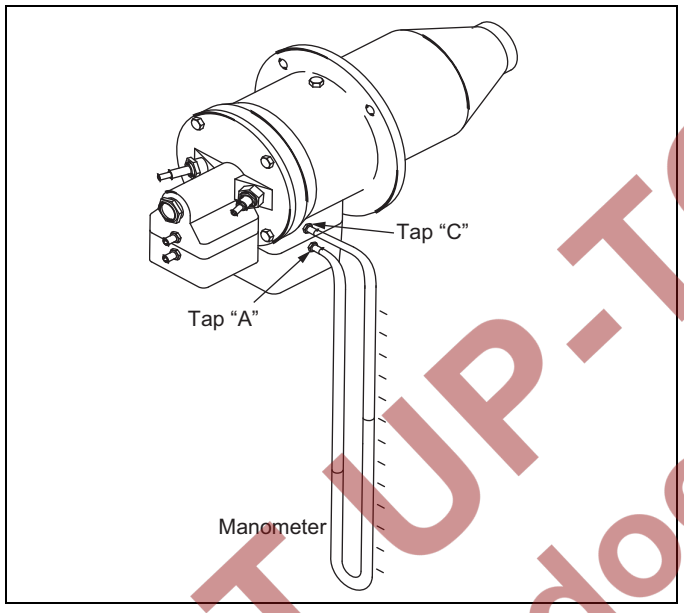


Figure 4.2. Set High Fire Air

Step 3: Set Low Fire Air

1. Set the system to low fire.
2. Connect the manometer to tap A (air inlet pressure tap).
3. Adjust the automatic zone air control valve until the low fire static air pressure is 0.2" w.c. This is the initial setting only. Further adjustment may be required.
4. Repeat 2 and 3 for the other zones (if any).

Step 4: Verify the Air Settings

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

Step 5: Ignite the Burners

⚠ WARNING

- **This procedure assumes that a flame monitoring control system is installed and is serviceable. It also assumes that normal low fire start is being used. If low fire gas is too low to be used for ignition, refer to options in "Set the Bypass Pilot Gas (Optional)" on page 17.**

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 six full (360°) turns down from the top (initial setting).

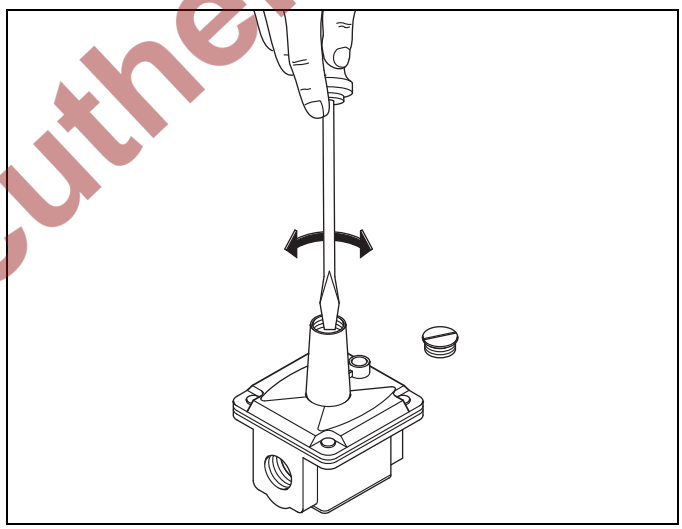


Figure 4.3. Adjusting Ratio Regulator Screw

5. Open zone manual gas cock.
6. Open manual gas cock at each burner.
7. Initiate the ignition sequence through the flame monitoring control system.
   a. Check that all the burners in the zone have ignited.
   b. If safety shut-off solenoid valves are installed at each burner, then repeat 6 and 7 for all the burners in the zone.

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8. If all the burners have ignited, drive the zone air butterfly valve to high fire. Verify flame is present at each burner. If burners do not light, add a 1/2 turndown on the proportionator, and repeat steps 7 and 8.

9. Verify that air pressure drops have remained the same.

10. If air pressure drop is too high, close down the zone manual air butterfly valve.

11. If air pressure drop is too low, open the zone manual air butterfly valve.

Step 6: Set High Fire Gas

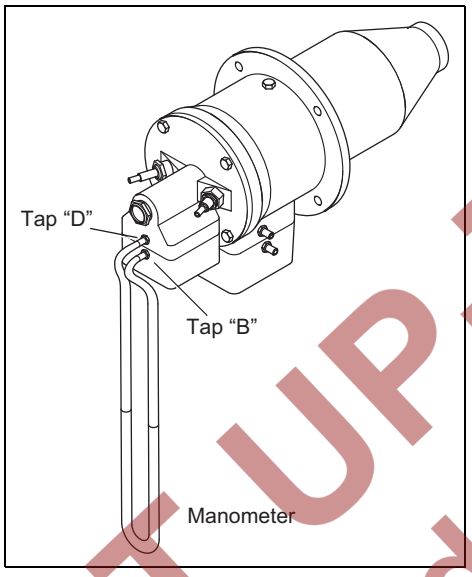


Figure 4.4. Set High Fire Gas

1. Use the gas curve from the appropriate ThermJet datasheet for the gas being used to find the differential gas pressure needed at high fire. This is the target value for high fire.
2. Connect the manometer to taps B and D (across the gas orifice, see Figure 4.4).
3. Measure the high fire differential gas pressure for the first burner.
4. Adjust the gas butterfly valve at the burner until the gas flow is at the target value.
5. Repeat 3 thru 4 for the other burners in the zone.
6. Check the gas pressure at the inlet to the zone ratio regulator. This should be at least 5" w.c. (12.5 mbar) higher than the loading line pressure. It should not exceed the maximum pressure rating of the ratio regulator.

⚠ WARNING

- **Insufficient gas inlet pressure may cause the proportionator to remain fully open as the burner system turns down from high fire, causing excess fuel operation and possible accumulation of unburned fuel in the chamber. In extreme cases, this may cause explosions or fires.**

Step 7: Set Low Fire Gas

1. Drive the system to low fire.
2. Use the gas curve from the appropriate ThermJet datasheet for the gas being used to determine the differential gas pressure required for low fire. This is your target value for low fire.
3. Measure the gas pressure at the first burner.
4. Adjust the ratio regulator until the gas flow is on the target value. (Refer to Bulletin 742 for adjustment.)

NOTE: It is very difficult to measure the very low pressures experienced at low fire, and it may be necessary to rely on visual inspection. This is especially true when gas turndowns in excess of 10:1 are being used. The main intent is to provide a clean stable flame with a good flame signal that will not cause the furnace temperature to overshoot.

If the pressure required is too low to be measured, adjust the ratio regulator until a gas flow is obtained that will provide a clean stable flame with a strong flame signal.

Step 8: Verify the Gas Settings

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

NOTE: When all the settings have been completed, mark the position of the indicator on the butterfly valves to indicate valve position.

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Fixed Air System

When you adjust a fixed-air system for the first time, you must follow these steps:

Step 1: Reset the System

1. Close the automatic gas valves and gas cocks.
2. Fully open the manual air butterfly valve at each burner.
   a. Drive the automatic zone air control valve to high fire.
   b. Adjust the automatic zone air control valve so that it is fully open.
3. Set the manual gas butterfly valve at each burner to 50% open.
4. Start the blower.

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

Step 2: Set High Fire Air (Figure 4.2)

1. Set the system to high fire, but **DO NOT** ignite the burner(s).
2. Use the air curves in "Orifice Curves" from the appropriate ThermJet datasheet to find the differential air pressure needed at high fire. This is now the target value for high fire.
3. Set high fire air using the instructions for either a single burner system or multiple burner system below.

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

Single Burner System:

a. Make sure that pressure taps A and C of the burner are open.
b. Connect the manometer to taps A and C (across the air orifice).
c. Adjust the manual butterfly valve until the high fire differential air pressure is at the target value.
d. Remove the manometer.
e. Close the pressure taps.

Multiple Burner System:

a. Make sure that pressure taps A and C of the first burner are open.
b. Connect the manometer to taps A and C of the first burner (across the air orifice).
c. Adjust the manual butterfly valve for the zone, until the high-fire differential air pressure is at the target value for the first burner.
d. Measure the differential air pressure across the next burner in the zone.
e. Repeat step **d** for all the burners in the zone.
f. If all the measured differential pressures are within 0.3" w.c (0.75 mbar) of each other, then proceed to the next section. If the variation is greater than 0.3" w.c. (0.75 mbar) it is necessary to adjust the manual air butterfly valve at each burner to improve the balance.
g. Make sure that all the pressure taps are closed.

4. Repeat 3 for other zones (if any).

Step 3: Ignite the Burners

⚠ WARNING

- **This procedure assumes that a flame monitoring control system is installed and is serviceable. It also assumes that normal low fire start is being used. If low fire gas is too low to be used for ignition, refer to options in "Set the Bypass Pilot Gas (Optional)" on page 17.**

1. Drive the zone gas automatic butterfly valve to low fire.
2. Make sure the combustion air blower is running.
3. Set the burner manual gas butterfly valve to low fire.
4. Set the adjusting screw on the ratio regulator six full (360°) turns down from the top (initial setting).
5. Select the valve according to the control method:
   a. **With high/low control:**
      Set the gas bypass butterfly valve 25% open.
   b. **With modulating gas control:**
      Set the zone gas automatic butterfly value to approximately 10% open. Stroke the valve to the open position to ensure 100% open. Readjust if necessary.

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6. Open the zone gas manual gas cock.

7. Open the manual gas cock at each burner.

8. Initiate the ignition sequence through the flame monitoring control system.

9. Check that all the burners in the zone have ignited.

10. If shut-off solenoid valves are installed at each burner, then repeat 6 and 7 for all the burners in the zone.

11. If all the burners have ignited, drive the zone to high fire. Verify flame is present at each burner.

Step 4: Set High Fire Gas (Figure 4.1)

1. Use the gas curves from the appropriate ThermJet datasheet for the gas being used to find the differential gas pressure needed at high fire. This is the target value for high fire.

2. Connect the manometer to taps B and D (across the gas orifice, see Figure 4.4).

3. Measure the high fire differential gas pressure for the first burner.

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

5. Repeat 3 and 4 for the other burners in the zone.

6. Check the gas pressure at the inlet to the zone ratio regulator. This should be at least 5" w.c. (12.5 mbar) higher than the loading line pressure. It should not exceed the maximum pressure rating of the ratio regulator (optional).

⚠ WARNING

- **Insufficient gas inlet pressure may cause the proportionator to remain fully open as the burner system turns down from high fire, causing excess fuel operation and possible accumulation of unburned fuel in the chamber. In extreme cases, this may cause explosions or fires.**

Step 5: Set Low Fire Gas

1. Drive the system to low fire.

2. Measure the gas pressure drop at the first burner.

3. Select the valve according to the control method:

   a. **With high/low control:**
   Adjust the gas bypass butterfly valve (see ThermJet Design Guide No. 205) until the minimum fire that will still maintain a strong flame signal is obtained.

   b. **With modulating gas control:**
   Adjust the zone gas automatic butterfly valve (see ThermJet Design Guide No. 205) until the minimum fire that will still maintain a strong flame signal is obtained.

NOTE: It is very difficult to measure the very low pressures experienced at low fire, and it may be necessary to rely on visual inspection. This is especially true when gas turndowns in excess of 10:1 are being used. The main intent is to provide a clean stable flame with a good flame signal that will not cause the furnace temperature to overshoot.

Step 6: Verify the Gas Settings

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

NOTE: When all the settings have been completed, mark the position of the indicator on the butterfly valves to indicate valve position.

Set the Bypass Pilot Gas (Optional)

1. Set the system to low fire.
2. Make sure that the blower is on.

⚠ WARNING

- **Before you perform this procedure, make sure the flame monitoring control system is working.**

3. Use the flame monitoring control system to start the ignition and the bypass pilot gas for all the burners in the zone.

4. Adjust the manual butterfly valve in the bypass line until you obtain reliable ignition within the required trial for ignition time limit.

5. Repeat 4 for all the other burners and zones (if any).

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Start Procedure

1. Start the blower.
2. Open all the gas cocks.
3. Start the ignition sequence.
4. Verify that flame is present at each burner.

⚠ 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.**

Stop Procedure

1. Close the following 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
2. Let the burners cool down. Keep the blower on until the chamber temperature is less than 1000°F (500°C) and then stop the blower.

NOTICE

- **Keeping the blower on after the burner is off protects the burner and the other components from hot gases that flow back through the burner.**

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Maintenance and Troubleshooting

5

This chapter is divided into two sections:

- Maintenance procedures
- Troubleshooting guide

Maintenance

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

The following are suggestions for a monthly list and a yearly list.

NOTE: The monthly list and yearly lists are an average interval. If your environment is dirty, the intervals may be shorter.

Monthly Checklist

1. Test (leak test) safety shut-off valves for tightness of closure.
2. Test air pressure switch settings by checking switch movements against pressure settings and comparing with actual impulse pressure.
3. Visually check ignition cable and connectors.
4. Inspect impulse piping for leaks.
5. Clean and inspect all the burners.
6. Make sure that the following components are not damaged or distorted:
   - burner nozzle
   - spark plugs
   - flame sensors
   - flame tube or combustion block
7. If applicable, remove and clean all the orifice plates.

Yearly Checklist

1. Inspect flame-sensing devices for good condition and cleanliness.
2. Check for proper inlet air/gas ratios.
3. Test all the alarm systems for proper signals.
4. Check ignition spark plugs and proper gap.
5. Check valve motors and control valves for free, smooth action and adjustment.
6. Check for proper operation of the ventilating equipment.
7. Test the interlock sequence of all safety equipment; manually make each interlock fail, noting that related equipment closes or stops as specified by the manufacturer.
8. Test flame monitoring control system by manually shutting off gas to burner.
9. Test main fuel hand-valves for operation.
10. Clean or replace the combustion air blower filter.

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Troubleshooting Procedures

Problem	Possible Cause	Solution
Cannot initiate start sequence	Air pressure switch has not made contact	Check air pressure switch adjustment. Check air filter. Check blower rotation. Check outlet pressure from blower.
	High gas pressure switch has tripped	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	Low gas pressure switch has tripped	Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation.
	Malfunction of flame monitoring control system such as shorted out flame sense or electrical noise in the sensor line	Have a qualified electrician investigate and rectify.
	Purge cycle not completed	Check flame monitoring control system or purge timer.
	Main power is off	Make sure power is on to control system.
	No power to control unit	Call qualified electrician to investigate.
Start-up sequence runs but burner does not light	No ignition: There is no power to the ignition transformer	Restore power to the ignition transformer.
	No ignition: Open circuit between the ignition transformer and the spark plug	Repair or replace the wiring to the spark plug.
	No ignition: The spark plug needs cleaning	Clean the spark plug.
	No ignition: The spark plug is not correctly grounded to the burner	Clean the threads of the spark plug and the burner. Do not apply grease to the thread of the spark plug.
	Too much gas: Improper gas valve train sequence	Verify solenoid valve is down-stream of proportionator.
	Too much gas: Manual gas butterfly valves have been opened too far	Check pressures and settings against start-up report and adjust as necessary.
	Too much gas: Gas pressure out of the main gas pressure regulator is too high	Check start-up setting. If necessary, remove regulator and investigate.
	Not enough gas: The gas pressure out of the main gas pressure regulator is too low	Check start-up setting. Check regulator and adjust if necessary.
	Not enough gas: Start gas solenoid valve does not open.	Check solenoid valve coil for proper orientation. Replace if necessary.
	Not enough gas: Gas valve not open	Check wiring to the automatic gas shut-off valve.
	Not enough gas: Air in the gas line	Check output from the flame safeguard. Open gas cock. Purge gas line.

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Problem	Possible Cause	Solution
The low fire flame is weak or unstable	Low fire adjusted too slow	Increase low fire gas setting.
	Not enough gas	Check start-up settings and adjust to increase low gas flow.
	Not enough air	Check start-up settings. Investigate any change, i.e. blocked filter, loose connections.
The burner goes off when it cycles to high fire	Insufficient air (flame too rich)	Check start-up settings. Check air filter, clean or replace if required.
The burner is erratic and does not respond to adjustment	Flame signal weak	Check condition of flame monitoring device.
	Internal damage to the burner. Some parts inside the burner may be loose or dirty.	Contact Eclipse.
The burner is unstable or produces soot or smoke	The air/gas ratio is out of adjustment	Measure all gas pressures and air pressures. Compare to initial start-up settings, and adjust them where necessary.
Cannot achieve full capacity	Air filter is blocked	Clean or replace the air filter.
	Gas pressure is too low into the main gas pressure regulator	Adjust gas pressure.
	Increase furnace/chamber pressures	Re-check setup pressures.
	Poor piping practices	Contact Eclipse.

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Appendix

Conversion Factors

Metric to English

From	To	Multiply By
actual cubic meter/h (am³/h)	actual cubic foot/h (acfh)	35.31
normal cubic meter/h (Nm³/h)	standard cubic foot /h (scfh)	38.04
degrees Celsius (°C)	degrees Fahrenheit (°F)	(°C x 9/5) + 32
kilogram (kg)	pound (lb)	2.205
kilowatt (kW)	Btu/h	3415
meter (m)	foot (ft)	3.281
millibar (mbar)	inches water column ("w.c.)	0.402
millibar (mbar)	pounds/sq in (psi)	14.5×10^{-3}
millimeter (mm)	inch (in)	3.94×10^{-2}
MJ/Nm³	Btu/ft³ (standard)	26.86

Metric to Metric

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

English to Metric

From	To	Multiply By
actual cubic foot/h (acfh)	actual cubic meter/h (am³/h)	2.832×10^{-2}
standard cubic foot /h (scfh)	normal cubic meter/h (Nm³/h)	2.629×10^{-2}
degrees Fahrenheit (°F)	degrees Celsius (°C)	(°F - 32) x 5/9
pound (lb)	kilogram (kg)	0.454
Btu/h	kilowatt (kW)	0.293×10^{-3}
foot (ft)	meter (m)	0.3048
inches water column ("w.c.)	millibar (mbar)	2.489
pounds/sq in (psi)	millibar (mbar)	68.95
inch (in)	millimeter (mm)	25.4
Btu/ft³ (standard)	MJ/Nm³	37.2×10^{-3}

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Notes

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