| Installation Guide 158 |
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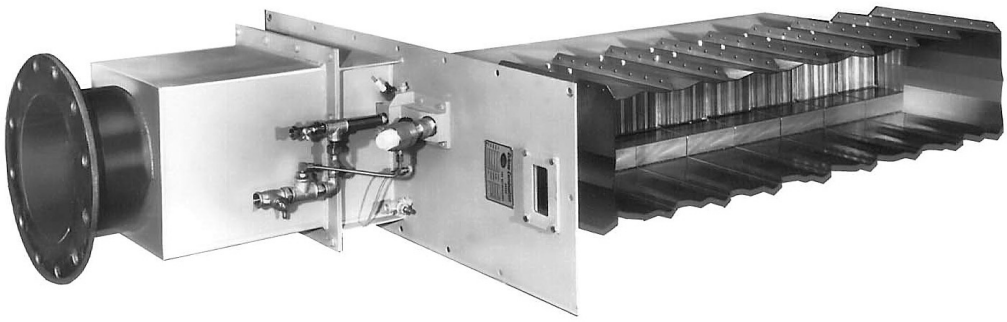
| 3/11/2015 |

# Eclipse Minnox Burners

*Version 1*



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Innovative Thermal Solutions

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The material in this manual is believed adequate for the intended use of the product. If the product is used for purposes other than those specified herein, confirmation of validity and suitability must be obtained. Eclipse warrants that the product itself does not infringe upon any United States patents. No further warranty is expressed or implied.

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Any operation expressly prohibited in this manual, any adjustment, or assembly procedures not recommended or authorized in these instructions shall void the warranty.

## Document Conventions

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

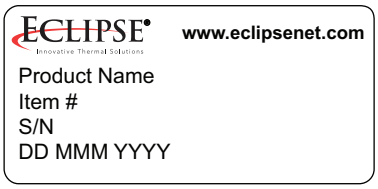
The explanation of these symbols follows below. Please read it thoroughly.

## 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.




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

# Table of Contents

# Introduction 1

## Product Description

The Minnox burner system is designed for direct fired heating where negligible amounts of NOx and CO are required to fulfill legislative and process requirements. Emissions are less than 20 ppm NOx and less than 50 ppm CO (corrected to 3% O2), making the Minnox burner the ideal heat source for industrial drying processes, the food industry, and make-up air systems. Minnox burners are typically supplied as packaged units with the burner, mixer, and supply manifold mounted in a duct section, or as a side-plate for insertion into the process ductwork.

**Burner -** The Minnox design includes a whirl-flame stabilizer for high excess air rates, up to 80%. The flame stabilizer also functions as a flame trap in order to prevent flash back situations. The pre-mixed gas/air mixture with the excess air results in a low flame temperature of about 2192°F (1200°C). This provides an extremely low NOx discharge from the burner head.

**Gas-Air Ratio Control -** This is provided by a proportionator valve in the gas valve train.

**Combustion Air Blower -** The combustion air blower is selected for each individual application by Eclipse, and is supplied as a loose item for installation by the customer.

**Valve Train -** Valve trains are available in compliance with local codes.

**Capacity Control -** An automatic air control valve is mounted between the combustion air blower and the gas/air mixer.

**Control Panels -** Control panels are supplied in compliance with local codes.

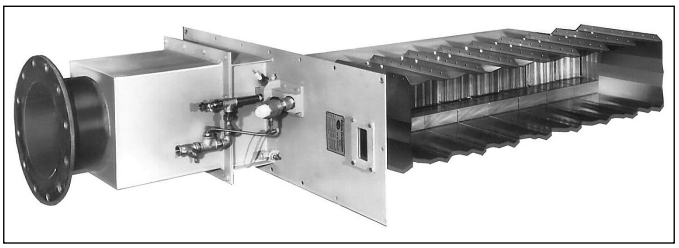


**Figure 1.1 Minnox Burner**

## 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:

- Design / Selection
- Use
- Maintenance

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

## Minnox Documents

**Installation Guide 158**

- This document

**Datasheet 158**

- Available for individual WX models
- Required to complete design and selection

**Related Documents**

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides: 684, 710, 732, 756, 760, 902, 930

# 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.

# Burner Operation and Controls

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## Gas Valve Train

Gas should be supplied to the burner inlet through a valve train which complies with all applicable local codes and standards.

## Control Principle

Minnox burners are designed to operate with modulating temperature control systems. Gas/air ratio control is achieved by a ratio controller as shown in Figure 3.1 below.

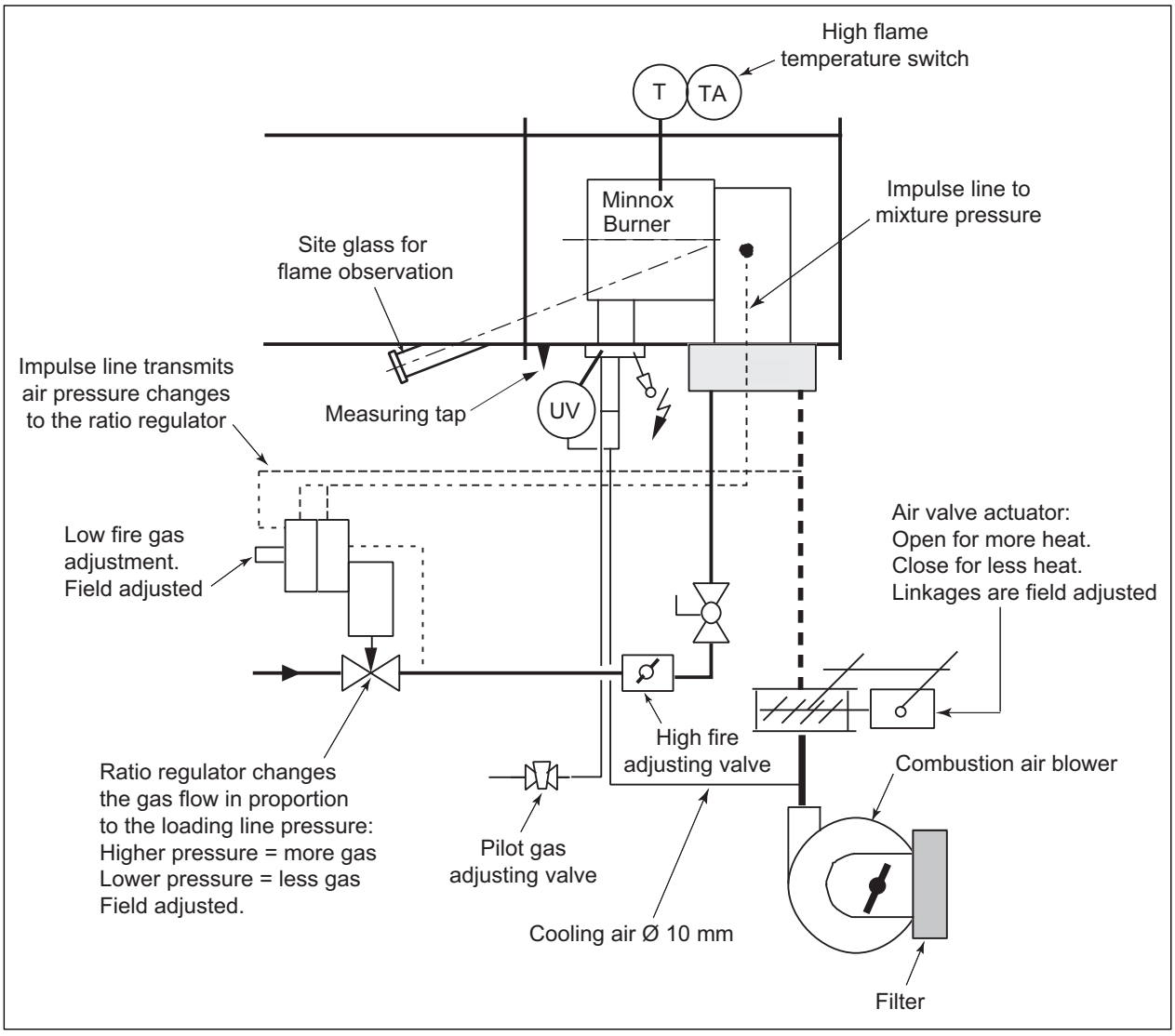


**Figure 3.1. Minnox Operation**

## Control Actuator

The control actuator must have a 90° rotation and a minimum timing of 15 seconds at 90°.

## Pilot Burner

A spark ignited pilot is an integral part of each burner. An adjustable valve is included for pilot adjustment.

The pilot gas valve train should include at least a gas regulator and two solenoid valves.

If the combustion chamber pressure is likely to be more than 1" w.c. (2.5 mbar) or if it is expected to fluctuate during operation, cross connect the regulator vent to the chamber.

## Flame Monitoring

A UV scanner is included with the burner. See pilot options in Figure 3.2 below.

## Combustion Blower Shut-Off

**CAUTION**

- **During shutdown, the combustion air blower must not be turned off until the chamber temperature has dropped below 248°F (120°C). This is to prevent hot gases from flowing back through the burner and blower which will result in damage.**

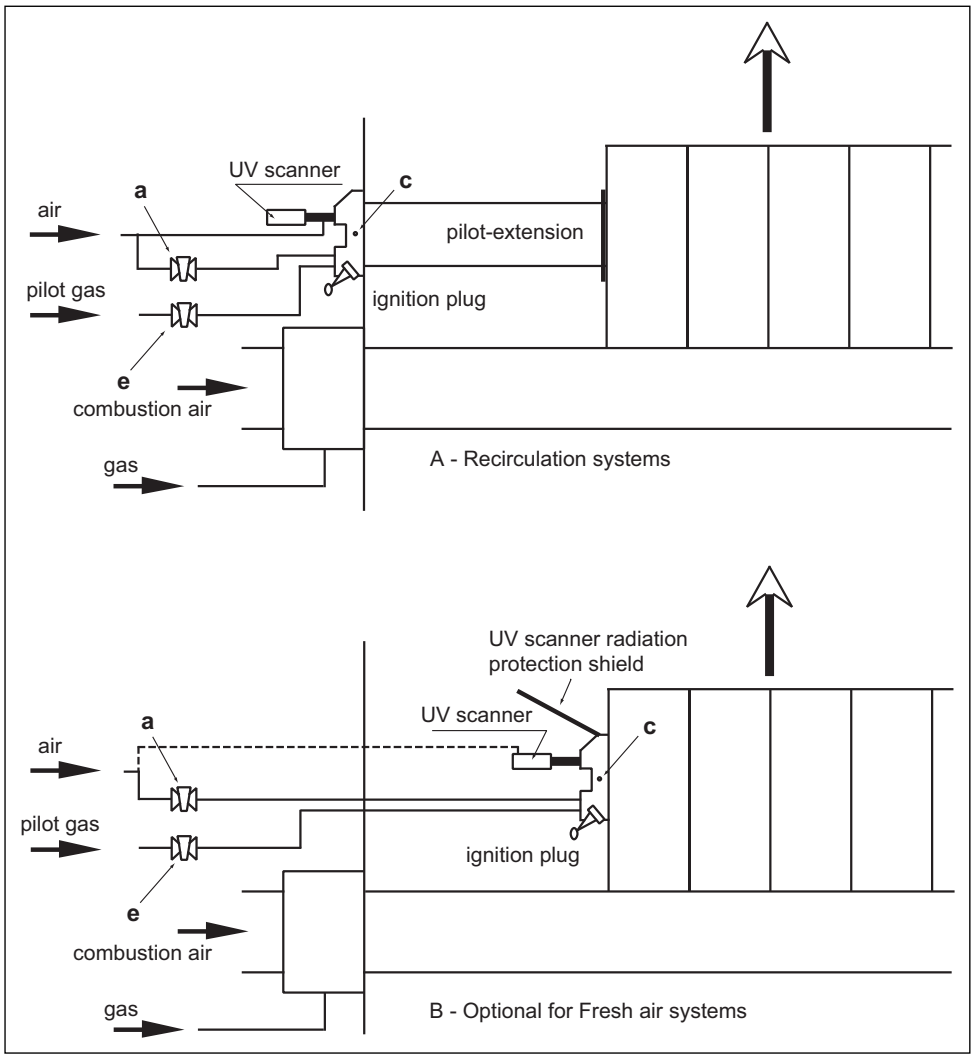


**Figure 3.2. Pilot Options**

# Installation 4

## Introduction

In this chapter you will find information and instructions needed to install the burner and system components.

## Handling & Storage

### 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.

## 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

**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 (1.2 kW). 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 fumes to accumulate in the work area. Provide some positive means for exhausting from the furnace and the building.

### Access

Make sure that you install the burner in such a way that you can gain 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 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
- Prevent direct exposure to water

## Installation

### Duct Configuration

See Figure 4.1 below.

### Combustion Air Blower

Blowers ordered from Eclipse are shipped loose for installation at the job site. Locate the blower as close as possible to the burner and connect it with a pipe/duct sized on a velocity of 33 fps (10 m/s).

Be certain that piping losses between the blower and the burner are low enough to provide the required air supply pressures. See Datasheet 158.

### Blower Wiring

Check that the motor is wired to rotate in the correct direction.

### Combustion Air Pressure Switch

Shipped loose for remote mounting.

### Combustion Air Control Valve

The air flow at the burner air connection flange should be evenly distributed. Never install the air valve closer than 10 pipe diameters from the burner without making special provisions.

### Pilot Gas Valve Train

The start gas valve train should be installed as close as possible to the burner mounted adjusting cock.

### UV Scanner

Use short pipe nipples to allow the best possible view of the flame.

### Purge / Cooling Air for Pilot and UV Scanner

A purge / cooling air supply is required. Minimum inside diameter is 0.4 inches (10 mm).

### Pressure Taps

Install a pressure test point in the chamber wall for system pressure.

### Sight Glass

Install a sight glass to observe the flame pattern during burner operation. A major part of the flame must be visible. See Figure 3.1 for recommended position.

## Duct Configuration

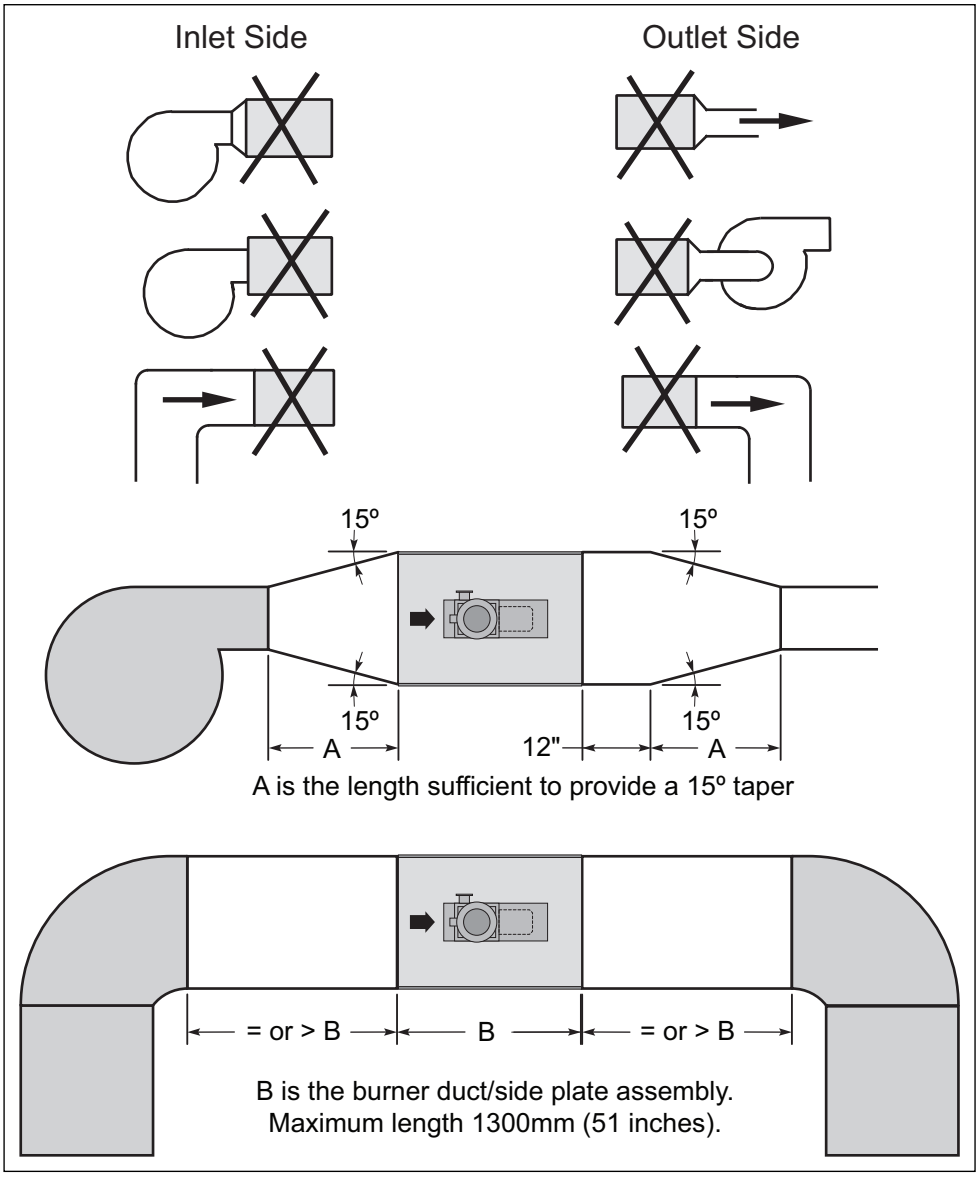


**Figure 4.1. Good Duct Design**

**NOTE:** The Minnox duct / side plate unit has to be included in the process air duct system such that the velocity of the process air past the burner is as uniform as possible. The diagrams below indicate good design practice. The shaded areas represent the Minnox burner assembly.

**⚠ CAUTION**

- **Incorrect duct design can produce poor distribution both on and off the burner which in turn can create noise, vibration, temperature uniformity problems and possibly reduced burner life. The above diagrams are intended as a guide only. Inlet and outlet duct design is the responsibility of the customer. Eclipse can accept no responsibility for problems which may result from poorly designed ductwork.**

# Adjustment, Start & Stop

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In this chapter, you will find instructions on how to adjust, start, and stop the burner system. Become familiar with burner control methods before attempting to make adjustments.

**⚠ DANGER**

- **The Minnox burners 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.**

## Step 1: Initial Settings

### Gas Valves

Close all manual and automatic gas valves, including the main gas butterfly valve and the pilot gas valve.

### Combustion Air Blower

Start the blower and check the impeller for correct rotation. If it's running backward, have a qualified electrician change the motor wiring.

### Combustion Air Pressure Switch

Adjust the pressure switch 20% lower than the measured pressure in high fire position of the air damper. Start and stop the blower and check if the switch actuates according to the electrical diagram.

### Gas Pressure Switches

Adjust the LOW gas pressure switch 20% lower than the pressure at the valve train inlet.

Adjust the HIGH gas pressure switch 20% higher than the burner design pressure at high fire.

### Cooling Air UV Scanners

Open the air adjusting tee one turn. See Figure 3.2.

### Circulating Fan

Start the fan to produce full process air flow past the burner.

### Circulating (differential) Air Pressure Switch

Adjust the pressure switch 20% lower than the measured differential pressure. Start and stop the blower, and check if the switch actuates according to the electrical diagram. Check the burner interlock system at too low air flows.

## Step 2: Adjust Air Settings

During burner adjustment, you will need to run the control actuator on the air control valve to high and low fire several times. You may do this with the process temperature control, setting to a higher temperature for high fire or a lower temperature for low fire. It is also possible to use the manual override of the control actuator. Before attempting to adjust the burner, determine how you will control the actuator position and become familiar with the method.

### Air Differential Pressure at Low Fire

1. Run the control actuator to its low fire position.
2. Preset the low fire position at a differential air pressure of 4" w.c. (1 mbar) between points A and D. See Figure 5.1. Final adjustment can only be made during burner operation.

### High Fire Air Adjustment

1. Run the control actuator to its high fire position. High fire position is obtained at about 85% opening of the air control valve.
2. Adjust the air differential pressure to 19" w.c. (48 mbar) by moving the inlet damper of the combustion air blower.
3. Set the limit switch on the control actuator. See the instructions of the control actuator to adjust the position limit switch.

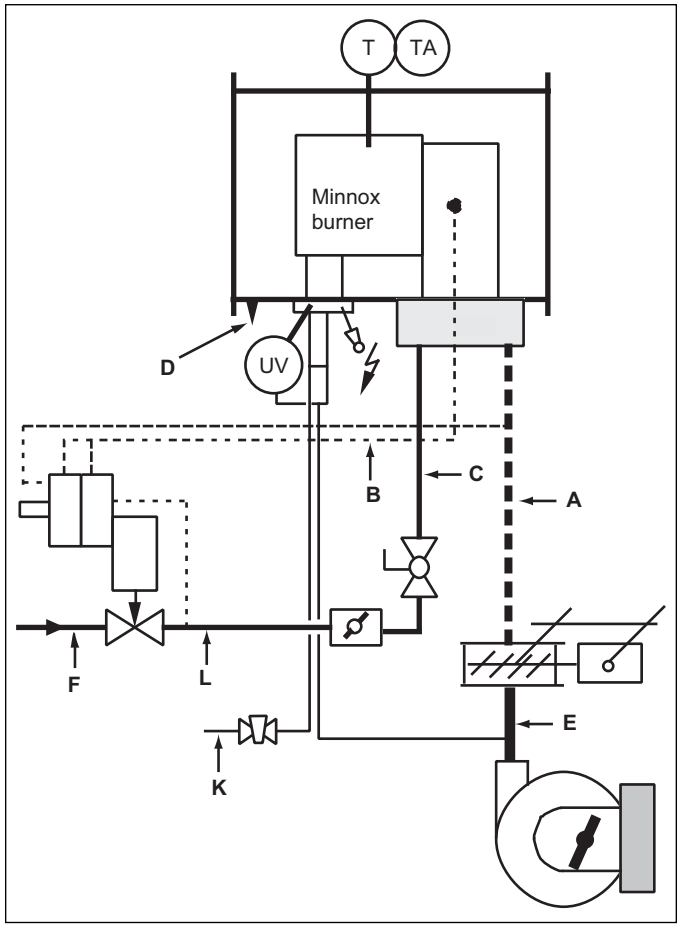


**Figure 5.1. Burner Adjustment and Settings**

### Air Differential Pressure at the Ignition Load Position

1. Run the control actuator to its ignition load position.
2. Set the auxiliary switch on the control actuator to limit the actuator travel until ignition load position is obtained. For adjustment of this auxiliary switch, refer to the instructions of the control actuator. Ignition load position is obtained at a differential air pressure of 1.6" w.c. (4 mbar), measured between taps A and D. See Figure 5.1.

## Step 3: Adjust the Pilot

Some electrical provisions may have to be made to operate only the pilot during pilot adjustment. See the literature included with the flame monitoring programmer and/or control panel for information on operation with pilot only.

1. Adjust the adjusting tee for pilot air and cooling air by fully opening the screw. See Figure 3.2.
2. Adjust the adjusting screw for pilot air by opening the screw one turn from the closed position and lock the screw by fastening the lock nut.
3. Drive the control actuator to ignition load position and set the programmer to operate on pilot only.
4. Adjust the adjusting tee for pilot gas by opening the screw two turns from the closed position. See Figure 3.2.
5. Start the burner programmer.
6. Check for the presence of a spark first.
7. Turn the gas screw inside the pilot gas adjusting tee counterclockwise to increase flow, clockwise to decrease flow, until the pilot gives reliable ignition and a steady flame signal with minimum pilot gas flow.
8. Start the pilot several times to check reliable lighting.

## Step 4: Adjust Ignition Load

1. Open the manual gas butterfly valve.
2. With the pilot lit and the control actuator in ignition load position, open the main automatic shut-off valve. The main flame should light.
3. Check if the flame fills up the entire burner surface.
4. The flame will be too rich. Throttle the manual gas butterfly valve until the UV flame signal starts to decrease (this adjustment is only possible by continuously observing the flame through a proper sight glass). The flame should be clear blue. Check the temperature on the limit controller. See Figure 5.1. This temperature at ignition load should be approximately 480°F (250°C). The thermoelement should be inserted 1.2 inches (30 mm) from the burner plate. Check this dimension by removing the thermoelement and reinstalling 1.2 inches (30 mm) through the insertion opening. See Figure 5.2.

## Step 5: Adjust High Fire

1. Run the control actuator to high fire position while constantly observing the UV flame signal. When the flame signal starts to lower and the flame becomes too long and transparent, increase the gas flow by opening the manual gas butterfly valve.
2. The flame should be clear blue. If the flame is orange and too short the gas flow is too high and the manual gas butterfly valve is opened too far.
3. Measure the gas differential pressure between Taps C and D. Refer to Figure 5.1. Gas differential pressure at high fire (approximately 19.2" w.c. (48 mbar) differential air pressure) is approximately 12" w.c. (30 mbar) on natural gas.
4. Set the burner to low fire.

## Step 6: Adjust Low Fire

1. Make sure the burner operates at low fire, dP air ~ 0.4”w.c. (1 mbar).
2. When the flame is too rich the swirl plates will start to glow and will be overheated. Readjust the spring in the ratio regulator, turning the adjusting screw counterclockwise to decrease the gas flow. A high limit flame temperature is above 1000°F - 1100°F (550°C - 600°C).
3. When the mixture is too lean the flame shows “holes” and the flame signal is unstable. Readjust the spring in the ratio regulator, turning the adjusting screw clockwise to increase the gas flow.
4. Generate a steady flame detector signal of sufficient value.
5. Check the combustion air differential pressure.
6. Adjust the linkage between the control motor and the air control valve in such way that the low fire position of the air control valve corresponds with the closed position of the control actuator.
7. Set the closed position limit switch on the control motor. Refer to the instructions of the control actuator.

After adjusting the low fire flame, return to high fire and observe the flame. Readjustment may be necessary. See Step 5 above.

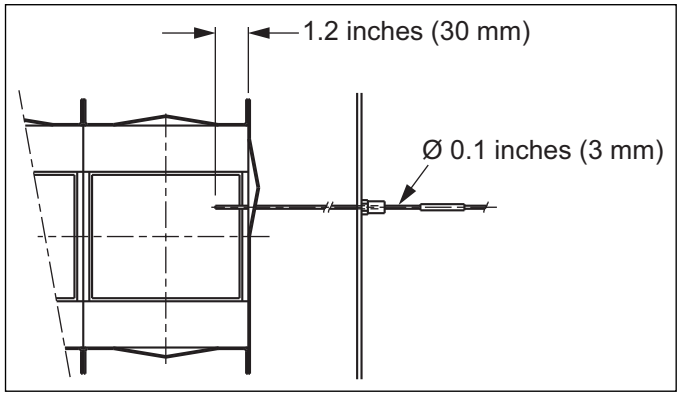


**Figure 5.2. Thermoelement Detail (Dualcore Type K Thermocouple)**

## Step 7: Verify the Settings and Shut Down the Burner

1. Cycle the burner from high to low several times to check repeatability of settings and flame pattern. To make it easier to set up and troubleshoot the burner in the future, record your setup data. See table below.
2. Check the function of flame monitoring. Remove the UV scanner. The main gas valves should shut down within about 1 second, and the system should go into flame failure.

**NOTE:** If simulated limit or flame failures do no shut down the fuel system within an acceptably short period of time, immediately take the equipment out of service and correct the problem.

3. Check the function of the burner temperature limit switch by lowering the set point.
4. Check the high gas pressure switch by lowering the set point.
5. Check the low gas pressure switch by lowering the inlet gas pressure.
6. Check the function of the combustion air pressure switch by stopping the combustion air blower.
7. Check the maximum temperature of the UV scanner. Increase cooling air if temperature exceeds 120°F (50°C).
8. Check the function of the process air pressure switch by stopping the process air blower.
9. Check the function of the process air temperature limit switch by lowering the set point.

**NOTE:** Do not turn the blower off until the chamber temperature is below 250°F (120°C). This will prevent hot gases from flowing back through the burner and blower and damaging them.

10. Stop the burner.

## Adjustment Data

| | Start Position, “w.c. (mbar) | Low Fire, “w.c. (mbar) | High Fire, “w.c. (mbar) |
|---|---|---|---|
| Combustion air pressure Tap E above duct pressure | | | |
| Combustion air pressure drop between Tap A and chamber pressure Tap D | 1.6 (4.0) | 0.4 (1.0) | 19.2 (48) |
| Mixture pressure drop between Tap B and Tap D | | | |
| Gas pressure into mixer Tap C | | | |
| Gas pressure drop between Tap C and chamber pressure Tap D (approximately) | | 0.1 (0.3) | 12 (30) |
| Chamber pressure Tap D | | | |
| Gas pressure before proportionator Tap F | | | |
| Gas pressure out of proportionator Tap L | | | |
| Gas pressure into pilot gas adjusting cock Tap K | | | |
| Flame signal | | | |
| Burner surface temperature limit switch 1000°F - 1100°F (550°C - 600°C) | | | |

# Maintenance & Troubleshooting

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

Preventative maintenance is the key to a reliable, safe and efficient system. The following are suggested guidelines for periodic maintenance. Burners in severe environments or operational conditions should be checked more frequently.

**NOTE:** The monthly and yearly lists are an average interval. If your environment is dirty, then the intervals may be shorter. Check with local authorities having jurisdiction on their recommended maintenance schedules.

**⚠ CAUTION**

- **Turn off the power to the burner and controls before proceeding with burner inspection.**

## Monthly Checklist

1. Inspect flame-sensing devices for good condition and cleanliness.
2. Check for proper air/gas pressures. Refer to the Minnox datasheet, series 158.
3. Test all alarms for proper signals.
4. Check and clean igniter electrodes.
5. Check the air control valve for smooth, trouble free operation and adjustment.
6. Check for the proper operation of ventilating equipment.
7. Test interlock sequence of all safety equipment and 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.
8. Test all manual fuel valves for operation.
9. Clean and/or replace the combustion air blower filter.
10. Inspect and clean the combustion air blower rotor.

## Yearly Checklist

1. Test (leak test) safety shut-off valves for tightness of closure.
2. Test pressure switch settings by checking switch movements against pressure settings and compare these with the actual impulse pressure.
3. Visually check ignition cable and connectors.
4. Inspect impulse piping for leaks.
5. Check air ducting connections for leaks.
6. Check mixture ducting connections for leaks.
7. Check all bolts and screws for tightness.
8. Check the area around the burner mounting flange for signs of overheating. Gasket or insulation replacement may be necessary.

## Recommended Spare Parts

To make sure that the downtime of the system is as short as possible in case of a failure, you should keep a stock of spare parts. Please refer to the Eclipse Product Information Center (EPIC) for a full listing of spare parts: http://www.eclipsenet.com/products

## Troubleshooting

| Problem | Possible Cause | Solution |
|---|---|---|
| Burner sequence starts but locks out before ignition. | Combustion air fault. Blower failure. | Check blower remedy fault. |
| | Combustion air fault. Blocked blower inlet or filter. | Clean inlet.<br>Clean or replace filter. |
| | Combustion air fault. Pressure switch failure. | Check pressure switch and replace if necessary. |
| | Combustion air fault. 3-way solenoid valve failure (if fitted). | Check solenoid valve.<br>Replace coil if necessary. |
| Burner start-up sequence runs but pilot does not light. | 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 igniter. | Repair or replace the wiring to the igniter. |
| | No ignition. The igniter needs cleaning. | Clean the igniter. |
| | No ignition. The igniter is not correctly grounded to the burner. | Clean the threads on the igniter and the burner. **NOTE:** Do not apply grease to the threads on the igniter. |
| | No ignition.<br>Igniter insulator is broken.<br>Igniter is grounding out. | Inspect the igniter. Replace if broken. |
| | | |
| | Not enough gas. The gas pressure into the ratio regulator is too low. | Check the start-up setting. Measure the gas pressures and adjust where necessary. |
| | Not enough gas. Pilot solenoid valve does not open. | Check wiring. |
| | Not enough gas. The adjustable limiting orifice valve is set too low. | Adjust flow rate. |
| Burner main flame does not light or goes out as control actuator runs to high fire. | Not enough gas. Insufficient pressure into or out of the ratio regulator. | Check for sufficient gas pressure.<br>Check the ratio regulator.<br>Outlet differential pressure should be equal to the loading line pressure. |
| | Not enough gas. Manual gas adjusting valve not open enough. | Open manual gas adjusting valve until a stable flame is achieved. |
| | Not enough gas. Low fire setting too low. | Adjust the low fire setting. |
| Burner lights and then goes to lockout. | No flame signal. Dirty UV scanner lens. | Measure flame signal.<br>Inspect and clean sensor.<br>Replace if necessary. |
| The high fire flame is large and yellow. | Insufficient combustion air pressure.<br>Air damper closed.<br>Blower running in reverse.<br>Inlet or filter blocked. | Set air damper correctly.<br>Check and correct blower wiring.<br>Clean inlet or filter.<br>Replace filter if necessary. |
| | Gas pressure too high. Pressure regulator adjustment set too high | Adjust pressure regulator |
| The low fire flame is weak and unstable. | Not enough gas flowing to the burner. | Adjust the low fire setting on the modulating control actuator. |
| Burner behaves erratically or does not respond to adjustment. | Internal damage to the burner. Some parts inside the burner are loose, dirty or burned out. | Contact Eclipse for further information. |

| Problem | Possible Cause | Solution |
|---|---|---|
| Swirl plates become red in color. | Overheating due to the gas / air mixture being too rich | Adjust the gas / air mixture. |
| Cannot initiate a start-up sequence. | Air pressure switch has not made contact. | Check air pressure switch adjustment.<br>Check air filter.<br>Check blower rotation.<br>Check outlet pressure from blower. |
| | External interlock failure. | Check all external interlocks. |
| | High or low gas pressure switch has activated. | Check incoming gas pressure. Adjust gas pressure if necessary. Check pressure switch setting and operation. |
| | Malfunction of the flame safeguard system (e.g. shorted-out flame sensor or electrical noise in the sensor line). | Have a qualified electrician troubleshoot and correct the problem. |
| | No power to the control unit. | Have a qualified electrician troubleshoot and correct the problem. |

# Appendix

## Conversion Factors

### Metric to English

| From | To | Multiply By |
|---|---|---|
| actual cubic meter/h ($am^3/h$) | actual cubic foot/h (acfh) | 35.31 |
| normal cubic meter/h ($Nm^3/h$) | 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) | $14.5 \times 10^{-3}$ |
| millimeter (mm) | inch (in) | $3.94 \times 10^{-2}$ |
| $MJ/Nm^3$ | $Btu/ft^3$ (standard) | 26.86 |

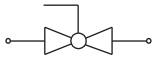
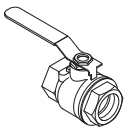
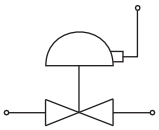
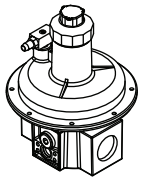
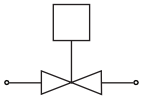
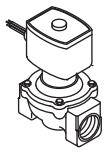
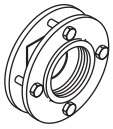
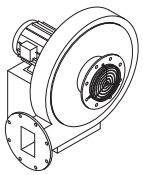
### Metric to Metric

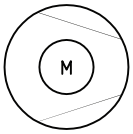
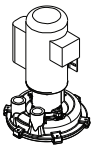
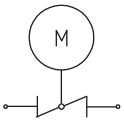
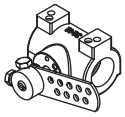
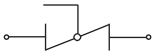
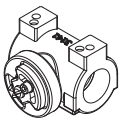
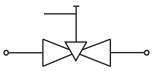
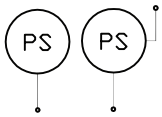
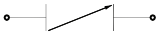
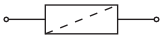
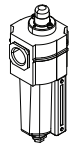
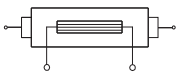
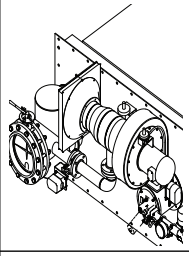
| From | To | Multiply By |
|---|---|---|
| kiloPascals (kPa) | millibar (mbar) | 10 |
| meter (m) | millimeter (mm) | 1000 |
| millibar (mbar) | kiloPascals (kPa) | 0.1 |
| millimeter (mm) | meter (m) | 0.001 |

### English to Metric

| From | To | Multiply By |
|---|---|---|
| actual cubic foot/h (acfh) | actual cubic meter/h ($am^3/h$) | $2.832 \times 10^{-2}$ |
| standard cubic foot /h (scfh) | normal cubic meter/h ($Nm^3/h$) | $2.629 \times 10^{-2}$ |
| degrees Fahrenheit (°F) | degrees Celsius (°C) | (°F - 32) x 5/9 |
| pound (lb) | kilogram (kg) | 0.454 |
| Btu/h | kilowatt (kW) | $0.293 \times 10^{-3}$ |
| 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 |
| $Btu/ft^3$ (standard) | $MJ/Nm^3$ | $37.2 \times 10^{-3}$ |

# System Schematics

| Symbol | Appearance | Name | Remarks | Bulletin/ Info Guide |
|---|---|---|---|---|
|  |  | Gas Cock | Gas cocks are used to manually shut off the gas supply. | 710 |
|  |  | Ratio Regulator | A ratio regulator is used to control the air/gas ratio. The ratio regulator is a sealed unit that adjusts the gas pressure in ratio with the air pressure. To do this, it measures the air pressure with a pressure sensing line, the impulse line. This impulse line is connected between the top of the ratio regulator and the burner body. | 742 |
| Main Gas Shut-Off Valve Train | | Main Gas Shut-Off Valve Train | Eclipse strongly endorses NFPA as a minimum. | 790/791 |
| Pilot Gas Shut-Off Valve Train | | Pilot Gas Valve Train | Eclipse strongly endorses NFPA as a minimum. | 790/791 |
|  |  | Automatic Shut-Off Valve | Shut-off valves are used to automatically shut off the gas supply on a gas system or a burner. | 760 |
|  |  | Orifice Meter | Orifice meters are used to measure flow. | 930 |
|   |  | Combustion Air Blower | The combustion air blower provides the combustion air to the burner(s). | 610 |

| Symbol | Appearance | Name | Remarks | Bulletin/ Info Guide |
|---|---|---|---|---|
|   |  | Hermetic Booster | Booster is used to increase gas pressure. | 620 |
|   |  | Automatic Butterfly Valve | Automatic butterfly valves are typically used to set the output of the system. | 720 |
|  |  | Manual Butterfly Valve | Manual butterfly valves are used to balance the air or gas flow at each burner. | 720 |
|  |  | Adjustable Limiting Orifice | Adjustable limiting orifices are used for fine adjustment of gas flow. | 728/730 |
|   |  | Pressure Switch | A switch activated by rise or fall in pressure. A manual reset version requires pushing a button to transfer the contacts when the pressure set point is satisfied. | 840 |
|   |  | Pressure Gauge | A device to indicate pressure. | 940 |
|  |  | Check Valve | A check valve permits flow only in one direction and is used to prevent back flow of gas. | 780 |
|  |  | Strainer | A strainer traps sediment to prevent blockage of sensitive components downstream. | |
|  |  | Flexible Connector | Flexible connectors isolate components from vibration, mechanical, and thermal stresses. | |
|  |  | Heat Exchanger | Heat exchangers transfer heat from one medium to another. | 500 |
|  | | Pressure Taps | Pressure taps measure static pressure. | |

# Notes

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