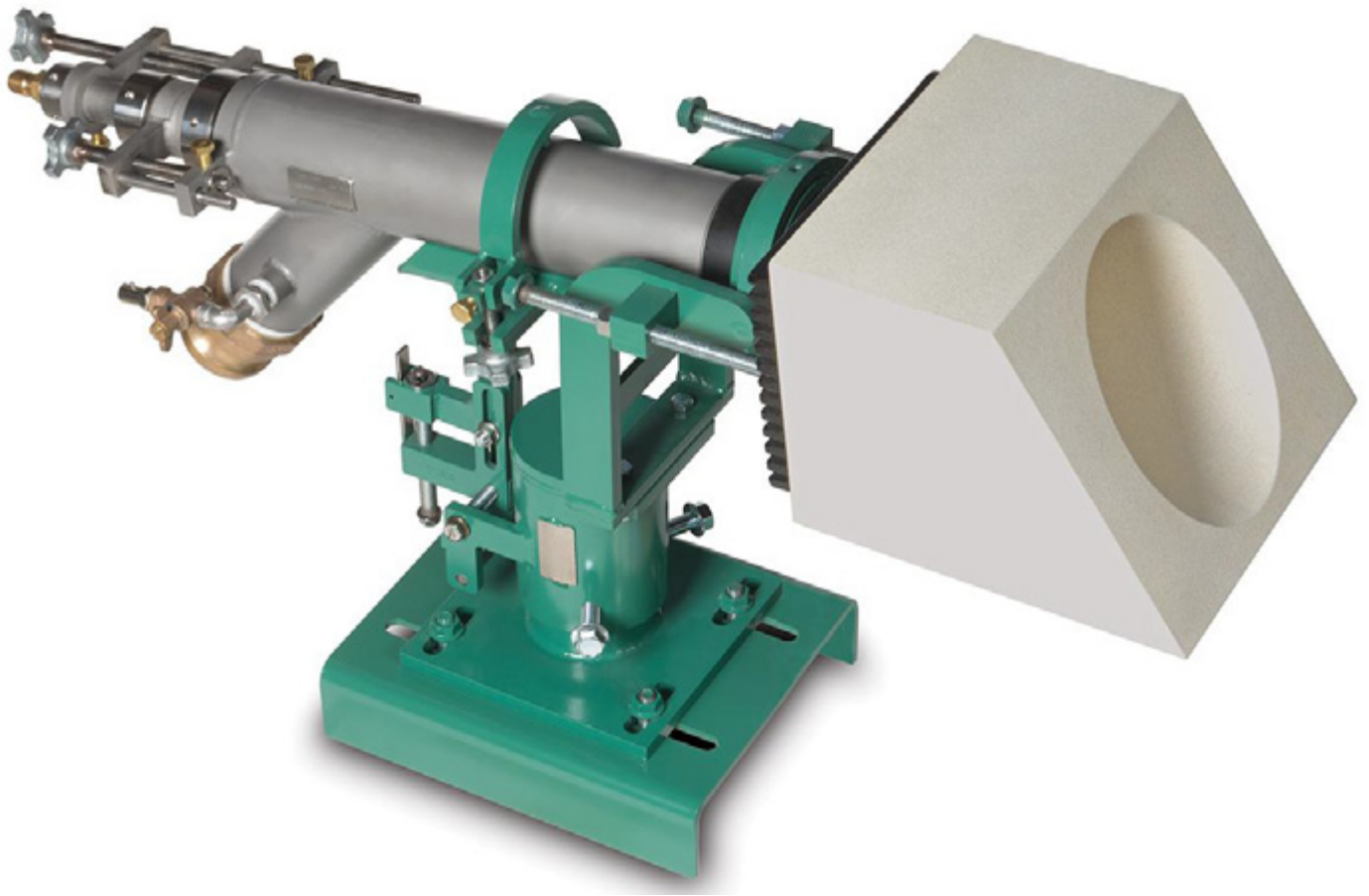


Eclipse BrightFire 200 Burners

*BRT Size G, M, and B
Operating Instructions Edition 09.15*

Version 1



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

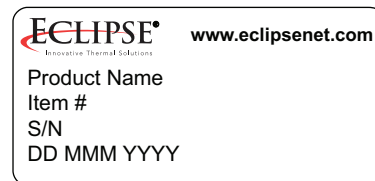
The explanation of these symbols follows below. Please read it thoroughly.

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 injunt 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.



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Introduction

1

Product Description

The BrightFire® 200 burner is an adjustable, low NO_x, air-fuel burner for installation in regenerative type glass furnaces. It can be installed in either end-fired or cross-fired furnaces, as well as in under port or side-of-port configurations. It is designed to work with the Eclipse Gimbal Mounting Bracket to provide excellent adjustability of the flame position within the furnace. Additionally the socket plate provides for a positive seal against the burner block ensuring air is not infiltrated into the furnace. Cooling air is provided through the inner gas tube during off-firing cycles to prevent nozzle burnout.

These burners are of a welded, stainless steel body construction, produce a highly adjustable flame, and provide superior heat transfer to the glass melt. Multiple burners may be used in each port. Port design must be compatible with the burner.

Benefits

- Additional adjustments for increased flame control and burner flexibility.
- Lower NO_x emissions.
- Compatible with current mounting bracket for easy installation.
- Compatible with current BrightFire™ gas and cooling air connections for easy conversion.
- Nozzle combinations allow firing to be tailored to furnace requirements.
- Durable construction.
- Low Maintenance.
- Improved glass quality.
- Reduced fuel usage due to improved heat transfer into the glass.

Audience

This manual has been written for people who are already familiar with all aspects of a glass 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.

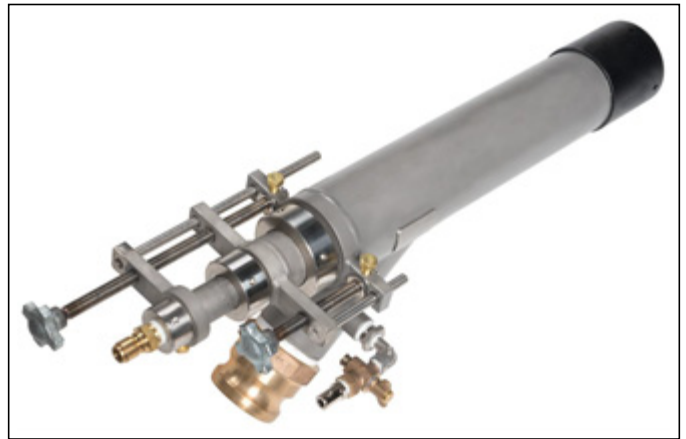


Figure 1.1. BrightFire® 200 Burner

BrightFire® Documents

Information Guide

- This document

Datasheet, Series 1112-1 through 1112-3

- Available for individual BrightFire 200 models.

Spare Parts List

- Recommended replacement part information

Related Documents

- EFE 825 (Combustion Engineering Guide)
- Gimbal Mounting Bracket Information Guide 1113

Purpose

The purpose of this manual is to ensure the installation and adjustment of a safe, effective and trouble-free combustion system.

Safety

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.



WARNING

- **DO NOT** disassemble any component **WITHOUT** first reading the manufacturer's instructions. Several components contain parts under compression or pressure and could injure personnel if not disassembled properly.
- Control panels contain voltages which can severely injure personnel. These panels are normally double fed from the emergency supply. **NO** engineer/maintenance technician who is not fully conversant with the equipment should be allowed access to the panel internals.
- Control circuits **MUST** not be altered at any time unless Eclipse has been consulted and has approved the modifications.
- **No naked lights** are to be used in the area of gas pipeline components.
- Any gas leaks should always be isolated and rectified immediately. Any piece of pipeline equipment and its surrounding area should be properly vented and/or purged as appropriate after isolation and before the start of any maintenance.
- Extreme care should be taken when working on burner equipment installed under the furnace port.
- Eclipse recommends installing a safety guard around moving parts.
- Eclipse recommends considering any area with moving mechanical parts a restricted area.

- **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.**
- **The burner and duct sections are likely to have HOT surfaces. Always wear the appropriate protective equipment when approaching the burner.**

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.

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.

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.



Installation

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

Handling & Storage

Handling

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

Storage

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

BrightFire® 200 Adjustable Burners

The BrightFire® 200 is available in three body sizes, G, M and B, with diameters of 73.0 mm (2.88”), 88.9 mm (3.50”) and 101.6 mm (4.00”), respectively. All three sizes consist of an outer tube with a separate inner tube to provide two separate gas jets.

Each burner includes two adjustments (see Figure 2.1). The first adjustment (the longer adjusting screw) changes the annulus area between the inner and outer nozzle tips, providing changes to the annular gas jet velocity at the burner tip to control flame length. The second adjustment (the shorter adjusting screw) is incorporated into the middle tube and is used to open and close an orifice within the annular gas jet which changes the gas flow distribution between the inner and outer gas jets. This unique inner flow adjustment allows the heat release from the flame to be adjusted independent of the flame length. See BrightFire®200 Flame Adjustment section for more information.

Nozzles can be supplied with the burners for a variety of inputs (2 to 10 MM Btu/h gross (528 to 2638 kW net) for G-size; 5 to 17 MM Btu/h gross (1319 to 4484 kW net) for M-size; and 10 to 31 MM Btu/h gross (2638 to 8177 kW net) for B-size). Two types of nozzles are available to provide flame length, heat release, and emissions tailored to specific furnace requirements.

The two available nozzle types are a straight body nozzle and a profiled nozzle. The profiled nozzle provides greater heat and flame control when compared to the similarly sized straight body nozzle. However, the same size straight body nozzle will provide a reduction in NO_x emissions compared to the profiled nozzle.

Oil lances are also available in a variety of inputs from 2 to 28 MM Btu/h (528 to 7388 kW). Oil lances are easy to install in place of the inner gas tube for a flexible back-up option in the event of natural gas interruptions.

The burner length and diameter must be determined from the furnace and port information.

Gimbal Mounting Bracket Installation

NOTE: For additional info on the Gimbal Mounting Bracket, refer to Info Guide 1113.

1. Set all bracket adjustments to zero using the scales and pointers.
2. Place the socket plate in the recess of the burner block
3. Loosely attach bracket to furnace steel and roughly align with the centerline of the burner block opening.

4. Install the alignment tube in the bracket, ensuring that the alignment tube pin is in contact with the gimbal ring of the bracket to simulate burner position and allow for proper working distance from the socket plate to the face of the burner nozzle.
5. With the alignment tube in place, push the bracket assembly forward to hold the socket plate in place.
6. Sight down the alignment tube and adjust the bracket to match the centerline of the tube to the centerline of the burner block opening.
7. Tighten the mounting bolts of the bracket and secure the socket plate to the block using the jack bolts on the bracket. Slight adjustments may be required after heat-up due to thermal expansion.
8. Tighten the bracket mounting bolts after final adjustment and remove the alignment tube.
9. Seal the block opening with refractory fiber blanket for heat up.

Pre-Start Considerations

- Ensure all components are on site: burners, brackets, socket plates, etc.
- All threaded components should have anti-seize applied.
- Ensure burner tool kit matches burner size. Kits include: ratchet, spanner wrenches, burner alignment tube, and anti-seize.
- Confirm cooling air has local flow control and pressure gauge (0-15 PSI (0 – 1 bar)) for each burner.
- Confirm gas has local flow control and measurement provisions.
- Test the fit of the gas and cooling air flex hoses.
- Mount the burner and ensure supply lines can easily be attached.
- Confirm cooling air and natural gas check valves are fitted and within 2.5 m (8 ft) of the burner.
- Confirm that the check valves have been properly installed in the gas and cooling air lines.
- Preset the manual gas flow control valve for each burner to 50% open to allow for adjustment in both directions and to establish a rough gas flow balance across the burners.

- Ensure local gas and cooling air valves are closed. The main gas and cooling air supplies should remain closed until the main burners are to be brought on line.
- Confirm that the burner blocks are plugged prior to, and during, heat-up.
- Confirm that the external cooling wind ducts are in place and directed at the socket plates.

BrightFire® 200 Installation and Start-Up During Initial Heat-up of Furnace

NOTE: Once the furnace temperature is above the auto-ignition temperature of the gas, the main burners can be gradually brought on line.



- To ensure ignition of gas, allow the furnace to reach a minimum of 1400° F (760° C) before starting gas flow to the burners.

NOTE: as the gas flow to the main burners is increased, the heat-up burner input is decreased to maintain the heat-up schedule until the heat-up burner can be removed.

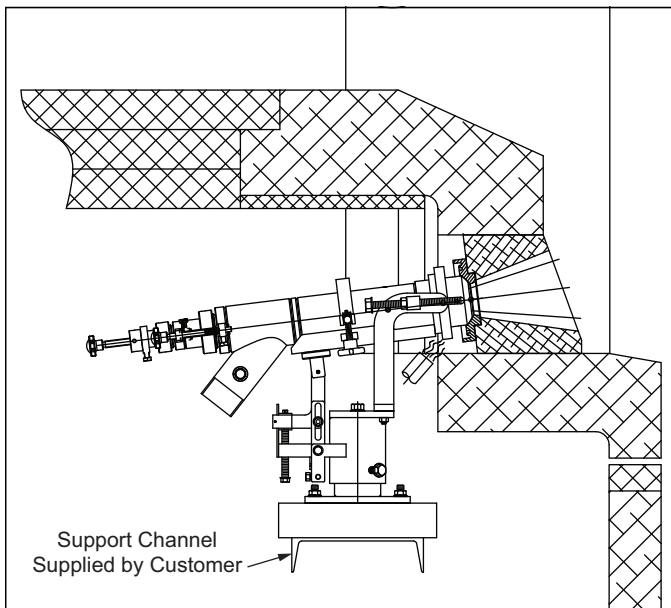


Figure 3.1. Typical Installation (Under port)

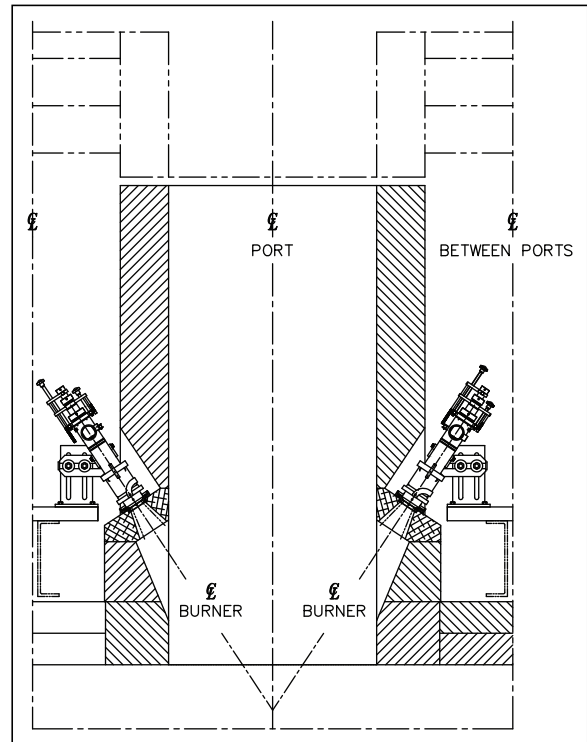


Figure 3.2. Typical Installation (Side of Port)

1. Ensure everyone involved is aware of, and ready for, the main burner lite-off.
2. Ensure there is sufficient air flow for combustion.
3. Set the main gas flow control to manual and open to 10-15%.
4. Establish gas and cooling air supply up to the local shut off valves.
5. Prior to installing the burner in the bracket, set the area adjustment (refer to figure 2.1 for burner adjustment identification) so that the tip of the inner nozzle is about even with the beginning of the taper of the outer nozzle (see figure 1.3).
6. Set the flow adjustment to position 6 (refer to figure 2.3).
7. Attach the cooling air and gas hoses to the burner prior to placing the burner in the bracket.

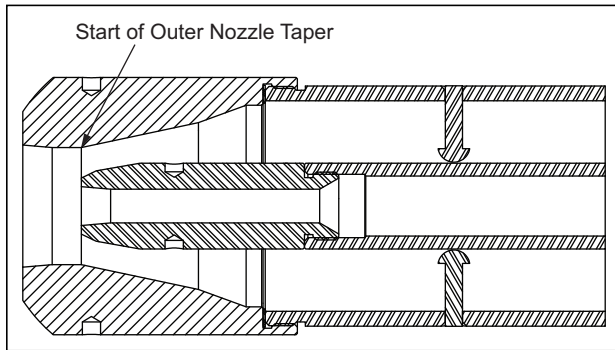


Figure 3.3. Inner nozzle initial position for installation

8. Place one burner onto bracket on “off side” and push forward until burner is tight against the socket plate.
 9. Secure the burner in place by tightening the t-bolt or split ring clamp, depending on which bracket style has been supplied.
 10. Ensure sufficient combustion air flow is present in all ports.
 11. Open the local cooling air valve and set the pressure to 3 – 4 psi (207 – 276 mbar).
- NOTE:** To prevent damage to the burners in the event the cooling air is lost for more than 20 minutes, the burner should be removed and the block openings plugged with refractory fiber.
12. After reversal, open the local gas valve at the installed burner.
 13. Visually confirm ignition and adjust the main gas flow control to achieve the desired gas flow, ensuring the flow is above the minimum input rating of the burner.
 14. Repeat steps 1 through 13 on the opposite side of the furnace (Ex: Complete port 1 left side and then complete port 1 right side.)
 15. Working closely with the heat-up crew, gradually increase the main burner input.
 16. Check for flame impingement and stability.
 17. When enough gas flow is achieved, with the first installed burner in each side, to support the minimum input of two burners, a second burner per side may be installed, following steps 1 through 16.
 18. Repeat steps 1 through 17 until all burners are installed and operational.

NOTE: As burners are added, cooling air pressures should be monitored and adjusted as necessary.

19. With all of the main burners in operation, a preliminary gas flow balance may now be achieved and will vary based on furnace design and/or the desired input or temperature profile of the furnace. This should be done with the gas control in manual.

The side of port firing arrangement incorporates two burners per port. Both burners of any given port should have equal gas flow and be adjusted in pairs when balancing gas flow.

On a typical under port fired furnace, either side port or end port, balancing the burners is usually a visual task and can be checked with either gas inlet pressure or differential pressure at an orifice plate.

In most conditions final burner balancing will not take place until after the furnace is full and the regenerators have heated to normal operating temperatures, thus combustion air velocity at the port is at normal levels.

Air/fuel ratio to this point has been primarily controlled visually with aid from instrumentation. Once the thermal expansion of the furnace is complete, any cracks or gaps will be sealed. Port flue gas readings should then be taken and the air/fuel ratio should be adjusted and balanced to achieve 0.5 - 2.0% excess oxygen in the exhaust stream.

NOTE: For lower NO_x applications, the air fuel ratio should be adjusted to be between 0.5 – 1.0% excess oxygen in the exhaust stream.

BrightFire® 200 Installation to Convert Existing Burners

NOTE: Prior to conversion, it should be verified that the burner block is compatible with BrightFire200.

To install the BrightFire® 200 in an existing furnace mid-campaign with the furnace at operational temperatures, use the following procedures for either conversion from existing gas burners or existing oil burners:

Conversion from Existing Gas Burner to BrightFire® 200 Gas Burner

1. To minimize furnace disruptions and maintain glass quality, start with one burner during the off-firing cycle
2. Prior to installing the burner in the bracket, set the area adjustment (refer to figure 2.1 for burner adjustment identification) so that the tip of the inner nozzle is about even with the beginning of the taper of the outer nozzle (see figure 1.3).
3. Set the flow adjustment to position 6.
4. Close the local gas and cooling air supply shut off valves.
5. Disconnect gas and cooling air hoses.

6. Remove the existing burner from the burner bracket.
7. Follow the Gimbal Mounting Bracket installation steps if necessary.
8. Install the BrightFire® 200 burner into the burner bracket, ensuring a tight seal against the socket plate.
9. Connect gas and cooling air hoses to the burner.
10. Ensure sufficient combustion air flow is present in all ports.
11. Open the local gas and cooling air shut-off valves for the burner and set the pressure to 3 -4 psi (207-276 mbar).

NOTE: To prevent damage to the burners in the event the cooling air is lost for more than 20 minutes, the burner should be removed and the block openings plugged with refractory fiber.

12. Once firing cycle reverses and gas is flowing to the installed BrightFire® 200, visually inspect flame and make changes to the burner adjustments per the “BrightFire® 200 Flame Adjustments” section below.
13. Repeat steps 1 through 12 until all burners are converted to BrightFire® 200's.

Conversion from Existing Oil Burner to BrightFire® 200 Gas Burner

1. Ensure all gas and cooling air systems are in place prior to BrightFire® 200 install.
2. Ensure all local gas and cooling air valves at the burners are shut off prior to installation.
3. Prior to installing the burner in the bracket, set the area adjustment (refer to figure 2.1 for burner adjustment identification) so that the tip of the inner nozzle is about even with the beginning of the taper of the outer nozzle (see figure 1.3).
4. Set the flow adjustment to position 6 (refer to figure 2.3).
5. Follow Gimbal Mounting Bracket Installation guide.
6. Set the main gas flow control to manual and open to 10-15%.
7. Establish gas and cooling air supply up to the local shut off valves.
8. Beginning with one burner on the off-firing side of the furnace, disconnect oil and atomizing air hoses and remove oil burner.

9. Secure the burner in place by tightening the t-bolt or split ring clamp, depending on which bracket style has been supplied.
10. Connect the cooling air and gas hoses to the burner.
11. Ensure sufficient combustion air flow is present in all ports.
12. Open the local cooling air valve and set the pressure to 3 – 4 psi (207 – 276 mbar).

NOTE: To prevent damage to the burners in the event the cooling air is lost for more than 20 minutes, burner should be removed and the block openings plugged with refractory fiber.

13. After reversal, open the local gas valve at the installed burner.
 14. Visually confirm ignition and adjust the main gas flow control to achieve the minimum input rating of the burner.
 15. Repeat steps 1 through 14 on the opposite side of the furnace (Ex: Complete port 1 on the left side and then complete port 1 on the right side.)
 16. Gradually increase the main burner input.
 17. Check for flame impingement and stability.
 18. When enough gas flow is achieved, with the first installed burner in each side, to support the minimum input of two burners, a second burner per side may be installed, following steps 1 through 17.
 19. Repeat steps 1 through 18 until all burners are installed and operational.
- NOTE:** As burners are added, cooling air pressures should be monitored and adjusted as necessary.
20. With all of the main burners in operation, a preliminary gas flow balance may now be achieved and will vary based on furnace design and/or the desired input or temperature profile of the furnace. This should be done with the gas control in manual.

Adjustment, Start and Stop

BrightFire 200 Flame Adjustments

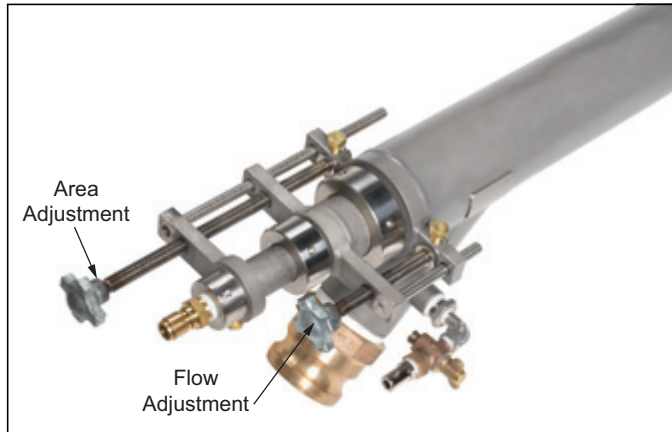


Figure 2.1. BrightFire 200 Adjustments

The BrightFire® 200 has two adjustment valves, an area adjustment (see Figure 2.1) and a flow adjustment. The area adjustment (see Figure 2.2) changes the annulus area between the inner and outer nozzles and is used to control flame length. The flow adjustment (see Figure 2.3) opens and closes an internal valve that changes the distribution of gas flow between the outer and inner gas tubes and is used to control where the heat from the flame is released in the furnace. This can be changed independently of the flame length. In addition, the firing angle of the burner can be adjusted using the gimbal mounting bracket adjustments to optimize gas flow into the air stream. (Refer to Gimbal Bracket Info Guide 1113.)

NOTE: Mounting bracket adjustments should only be done on the off-firing side to prevent natural gas from deflecting back into the port area if the seal between the socket plate and burner nozzle is lost.

To adjust the burners once the furnace is at, or near, normal operating conditions, begin by adjusting the area adjustment to set the flame to the desired length. Increasing the annulus area by moving the adjustment back (counter-clockwise rotation of the adjustment knob) will lengthen the flame while moving the adjustment forward (clockwise rotation of the adjustment knob) will shorten the flame.

To read the indicator rod positions for the area and flow adjustments, the first ring starting from the back of the burner indicates position '1'. The position is indicated by the ring that is flush with the back face of the adjusting lug. Position 1 on the area adjustment rod indicates the inner nozzle is all the way forward within the outer gas annulus, flush with the face of the outer nozzle. Position 1 on the flow adjustment rod indicates the inner flow valve is closed with the maximum amount of gas flow through the center jet. Refer to figures 2.2 and 2.3 which show an area adjustment at position 1 and a flow adjustment at position 10.

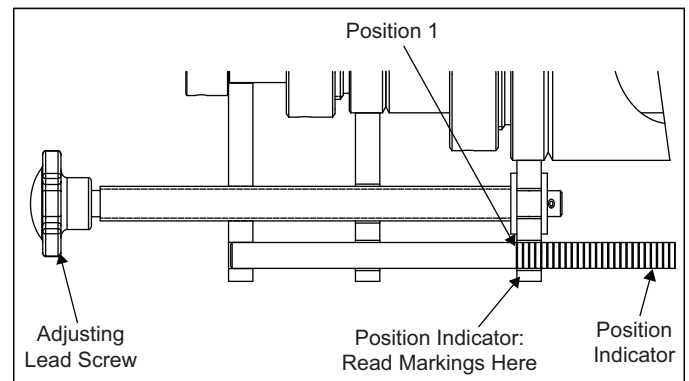


Figure 2.2. Area Adjustment Mechanism

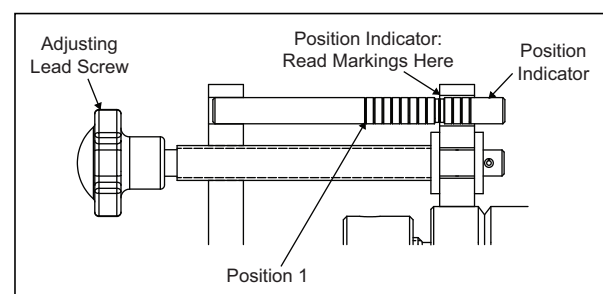


Figure 2.3. Flow Adjustment Mechanism

The flame is typically set about 2/3 of the width of the furnace (length for end fired furnaces). The flame should not impinge on the far wall or fire into the opposite side port. Excessive lofting of the flame should also be avoided to prevent damage to the furnace crown. Flames should be above the glass or batch pile surface, and should not be too low to prevent dust kick-up and batch carry-over into the opposite port.

Once acceptable flame length has been achieved, the heat release into the furnace should be adjusted to provide the desired heat profile using the flow adjustment. In general, opening the inner valve (counter-clockwise rotation of adjustment knob) will move the heat release closer to the burner block opening while closing the valve (clockwise rotation of the adjustment knob) will move the heat further away from the burner block opening. Furnace temperatures should be monitored during flow adjustment to determine the correct flow adjustment setting. The optimal flow adjustment setting will vary depending on furnace type and design.

NOTE: The flame length will be affected when reaching the extreme positions on the flow adjustment. A setting of 1 will shorten the flame due to increased velocity through the center jet while a setting of 10 will lengthen the flame.

To achieve low NO_x, the flow adjustment should be set to the higher (6 and higher) settings. This will reduce the velocity in the center gas jet, moving the heat distribution closer to the port and lowering NO_x emissions.

NOTE: After adjusting the area or flow valves, check the packing nuts to verify they are tight to prevent gas leaks.

The BrightFire®200 may be installed with a mechanical gas swirler. To install, remove the outer nozzle (and the inner nozzle if the profiled nozzle is installed) and slide the swirler over the inner gas tube. The inner gas tube alignment pins inside the burner will sit inside the notches in the swirler to prevent spinning. The swirler should be flush with the end of the burner body if seated correctly. Once it is installed, the inner and outer nozzles can be installed.

Installing the swirler into the gas tube of the burners will allow the center jet velocity to be increased without increasing NO_x. The heat distribution from the flame can then be moved further from the port opening while maintaining lower NO_x emissions.

Converting BrightFire® 200 from Gas to Oil Firing

NOTE: If firing heavy fuel oil, the oil must be conditioned to maintain a viscosity of 100 SSU or less at the burner.

NOTE: The following procedure assumes the capability of firing gas and oil at the same time, allowing for individual burners to be converted to oil firing. Fuel and atomizing services should be readily available prior to conversion. Internal off-side cooling air provisions via the atomizing air piping must be provided with a required pressure of 4 to 7 PSIG (0.28 to 0.48 BARG) at the burner for internal tip cooling, depending on conditions.

1. Shut off gas and internal cooling air to one off-side burner.
2. Remove internal cooling air and gas flexible hoses and cap the burner's gas inlet.
3. Loosen the inner gas tube locking nut and packing gland nut and remove the inner gas tube. (Refer to Figure 4.1 in the Maintenance Section.)
4. Install the oil/atomizing assembly and secure the packing gland and inner gas tube locking nut. (Refer to Figure 4.2 in the Maintenance Section.)
5. Set the area adjustment to 1 to align the oil nozzle flush with the outer nozzle face.
6. Connect atomizing and oil flex lines.
7. Introduce internal cooling air through the atomizing air line at around 4 to 7 PSIG (0.28 to 0.48 BARG) at the burner.
8. After reversal, adjust the atomizing air to around 30 - 40 PSIG (2.07 – 2.76 BARG) at the burner.
9. Introduce fuel at a flow rate equal to the burner's minimum capacity.
10. Visually confirm ignition and adjust atomizing pressure as required.
11. Repeat steps 1 through 9 for all burners to be converted from gas to oil firing.

NOTE: Steps 3 and 4 may be done on a spare burner not installed in the furnace. Install the oil-ready burner in place of a gas burner in the furnace and follow steps 5 through 9. The gas burner can then be moved to a workstation to install the oil lance. Repeat until all burners have been converted from gas to oil firing. This will be necessary with the profiled nozzle installed as it cannot be removed through the back of the burner.

Maintenance and Troubleshooting

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 periodic, monthly, and yearly lists are an average interval. If your environment is dirty, the intervals may be shorter. Check with local authorities having jurisdiction regarding their recommended maintenance schedules.

Periodic Checklist

Remove and inspect the burners at least once per month, paying close attention to any build-up/degradation of the burner nozzles.

1. Frequently monitor flame patterns for flames that appear to be deflected, abnormal, or impinging on refractory surfaces. These are signs of dirty nozzles or blocks.
2. Cooling air pressure should be monitored daily to ensure proper tip cooling is maintained.

NOTE: Excessive cooling air pressure may create recirculation in the burner block and cause fouling. If frequent burner block fouling is an issue, reduce the cooling air pressure, making sure to not allow cooling air pressure to go below 2 psi (138 mbar) or damage to the burner nozzles may occur.

3. Burner gas flow and pressure should be monitored daily. Irregularities in flow or pressure may indicate a dirty burner or block.
4. Regular port flue gas readings should be taken to ensure proper air/gas ratios are being maintained. Flue gas irregularities may indicate plugging of the regenerator ports, instrumentation issues, or furnace wear allowing infiltration of ambient air. A side to side bias in the ratios may be required.
5. Check the rear packing nuts to verify tightness to prevent gas leaks. If the packing nuts bottom out, contact the burner body, and cannot be tightened any further, the packing needs to be replaced due to wear from adjusting the area and flow valves or removing the gas tube insert.

Monthly Checklist

1. Clean all burner nozzles on a routine bases once per month and when required by flame appearance, making sure the burner nozzles are not damaged or distorted.
2. Test all the system alarms for proper response signals.
3. Check for the proper operation of ventilating equipment.
4. Test the manual gas shut-off valves for proper operation.

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 comparing these with the actual impulse pressure..
3. Clean and inspect all burners.

Instructions for Cleaning

NOTE: A matching spare burner can be used to replace a burner in need of cleaning to minimize furnace disruption and eliminate the need to plug the burner block during cleaning.

NOTE: Only remove a burner during the off-firing cycle.

1. Shut off local gas and cooling air valve supplying the burner to be cleaned.
2. Disconnect gas and cooling air hoses at the burner.
3. Loosen t-bolt or split ring clamp and remove burner from the bracket.
4. Inspect the socket plate and carefully clean out any debris using a steel rod.



CAUTION

- Molten glass is electrically conductive. DO NOT make contact with glass surface when cleaning burner blocks.

5. Install spare burner or plug the block opening with fiber blanket.
6. Remove the outer nozzle using the 2" x 4-3/4" spanner wrench (or equivalent).
7. Remove the gasket from the outer nozzle.
8. Inspect the outer nozzle for damage and clean with a metal brush of medium stiffness.
9. Remove the inner nozzle using the 1-1/4" x 3" spanner wrench (or equivalent).
10. Inspect the inner nozzle for damage and clean with a metal brush of medium stiffness.
11. Remove swirler if installed.
12. Inspect swirler for damage.
13. Remove the cooling air boss from the rear of the inner gas tube and inspect for any blockage. Clean if necessary.
14. Remove the inner gas tube locking nut and packing gland nut and pull the tube straight out from the rear of the burner.
15. Inspect the tube for damage and clean with a metal wire brush, if needed.
16. Inspect the packing in the packing gland nut and replace if necessary.
17. Loosen and remove the packing gland nut for the flow adjustment valve. Inspect the packing and remove if necessary.
18. Reassemble the burner by replacing the packing gland nut on the flow adjustment valve. Inspect the packing and remove if necessary.
19. Install the inner gas tube packing gland nut but do not tighten.
20. Insert the inner gas tube through the rear of the burner until the end is flush with the area adjustment lug.
21. Tighten the inner gas tube locking nut and the packing gland nut.
22. Once the inner gas tube is installed, tighten the flow adjustment valve packing gland nut.
23. If necessary, install the swirler on the inner gas tube so that the inner gas tube alignment pins inside the burner sit in the notches in the swirler.
24. Install and tighten the cooling air boss on the rear of the inner gas tube.

25. If new packing was installed, there may be additional resistance when adjusting the flow and area adjustments initially.

26. Apply anti-seize to the inner nozzle threads and the threads on the burner body for the outer nozzle.

NOTE: Replace the outer nozzle gasket whenever the outer nozzle is removed from the burner.

27. Install inner nozzle and tighten with spanner wrench, then install outer nozzle and tighten with spanner wrench.

28. Re-install the burner into the gimbal bracket and attach gas and cooling air hoses.

29. Open cooling air and gas valves at the burner.

30. Make flow and area adjustments as needed.

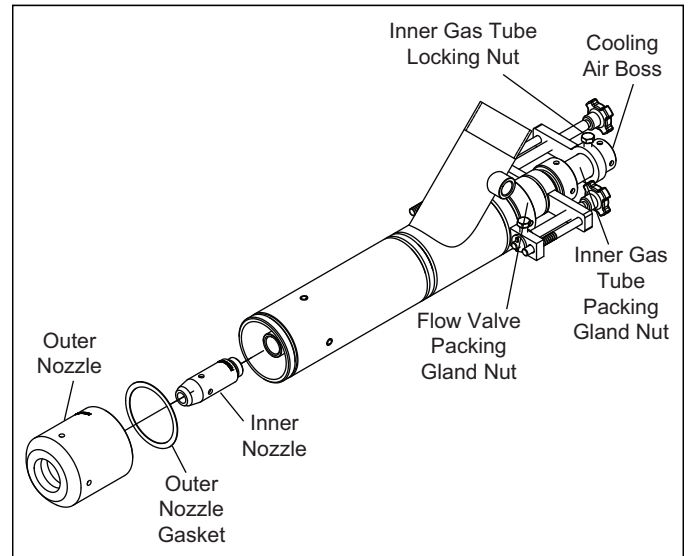


Figure 4.1.

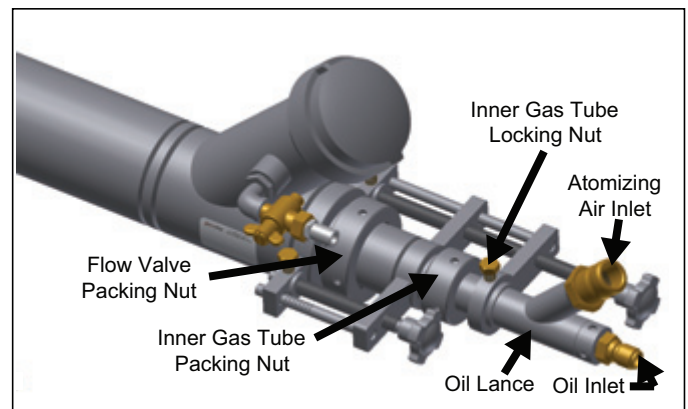


Figure 4.2.



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 x 10 ⁻³
millimeter (mm)	inch (in)	3.94 x 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 x 10 ⁻²
standard cubic foot /h (scfh)	normal cubic meter/h (Nm ³ /h)	2.629 x 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 x 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 x 10 ⁻³

