

# Cleanfire® HR<sub>x</sub>™ Oxy-fuel Burner



## Glass melting technology with expanded functionality and flexibility for unmatched performance

Oxy-fuel combustion has proven benefits over air-fuel combustion, including lower capital cost, higher fuel efficiency, and reduced NO<sub>x</sub>. For decades, customers have relied on our line of industry-leading Cleanfire® oxy-fuel burners. With Air Products' patent-pending Cleanfire HR<sub>x</sub> burner you can expect even more... By allowing the user to control both the magnitude and location of oxygen staging up to 95% of the combustion oxygen, this burner harnesses the power of oxygen staging for both higher melting efficiency and foam reduction—resulting in significant energy and emissions reductions and improved product quality.

### Benefits you can count on

The HR<sub>x</sub> burner can safely operate with oxygen staging in excess of 95 percent, enabling benefits such as the following over air-fuel technology:

- Increased flame radiation for high fuel efficiency
- Ultra-low NO<sub>x</sub> emissions
- Foam reduction capability for higher-quality glass production
- Enhanced productivity



Melt mode



Split mode



Foam control mode

Optimization of flame properties to achieve different melting objectives are readily enabled by adjustment to convenient staging valves integrated onto the HR<sub>x</sub> burner body. Pictured from left to right are the HR<sub>x</sub> burner in the Melt (under-staged), Split (dual over/under-staged) and Foam Control (over-staged) operating modes.



### How it works

The Cleanfire HR<sub>x</sub> burner offers you expanded functionality and flexibility with unmatched performance in your glass melting furnace; whether as a boost burner to complement the operation of an air-fuel furnace, or in a full oxy-fuel furnace to increase fuel efficiency, lower NO<sub>x</sub> emissions, or reduce foam.

Key features include:

- On-burner valves for easy adjustment of oxygen staging location and magnitude
- Extremely high flame radiation for highly efficient glass melting
- Flame length adjustability by a factor of up to 2x at a fixed firing rate
- Optional remote performance monitoring

"With Air Products' new HR<sub>x</sub> burner we have observed a significant reduction in crown temperature and fuel consumption, both as a result of the burner's foam reduction capability. It has made a noticeable improvement in our operation."

Young-Min Kim  
Technical Team General Manager  
of Techpack Solutions

## Data monitoring / process control

The HR<sub>X</sub> burner features Air Products Process Intelligence. This technology uses state-of-the-art on-burner diagnostic sensors and wireless communications technology to monitor and control our gases and equipment as well as track key process parameters. The on-board sensors are a valuable tool to help furnace operators optimize the burner setting for maximum flame staging, foam reduction, or NO<sub>X</sub> control. With this technology, your key operating personnel can have instantaneous access to up-to-date burner operating parameters in your control room or remote computers and smart devices for improved process understanding. In addition, each burner has a nozzle tip thermocouple that can alert the plant of potential issues with burner overheating or flame instability due to excessive glass run down on the face of the block or block cracking/deformation. We recommend incorporating the sensor data into your plant's distributed control system and data historian to keep a complete historical record of the burner settings for each production run, making it easier to repeat or exceed previous performance levels.

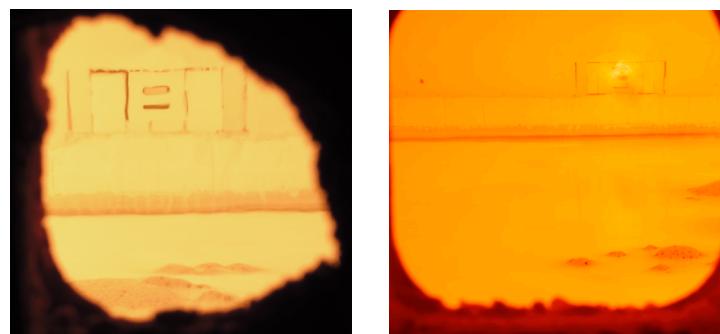
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## Proven benefits

- Reduction of secondary foam in the fining section of the glass melting tank has shown benefits of up to 40% reduction in glass defects, while reducing crown temperature by up to 50 deg C
- Reduction in NO<sub>X</sub> emissions of 40%, relative to previous generation of staged oxy-fuel burner
- Increase in fuel efficiency of up to 3% due to enhanced flame luminosity and reduced foam
- Wide range of independent control of flame length and momentum via staging has enabled operators to increase burner power by over 15%, without risk of damaging the furnace breast walls or crown



Operation of the HR<sub>X</sub> burner in the Foam Control mode (right) generates a reducing environment adjacent to the glass surface that destabilizes surface foam (left), yielding higher flame-to-glass heat transfer rates and improved glass refining.

## The Air Products advantage

Air Products is a global, leading industrial gas supplier. For more than 70 years, primary glass producers have turned to Air Products' continuously evolving portfolio of oxygen solutions to improve combustion and enable additional benefits, including increased glass production, reduced fuel consumption and emissions, and enhanced glass quality. Processed glass producers rely on us for safe and efficient supply and use of nitrogen, oxygen, hydrogen, helium, and argon for a number of applications involved in forming, assembly, and recycling of products.

Let us help optimize your production, as we have done for hundreds of furnaces all over the world. To help you understand if the HR<sub>X</sub> burner is a good fit for your needs, contact us about a demonstration in our pilot-scale Advanced Clean Energy lab.