

## Support to Glass Industry Grows with Innovative Technologies

This paper will cover the following:

1. Overview of the new company.
  - a. Company profile
2. How we can better support the Glass Industry with our Combustion Solutions
  - a. Local manufacturing, service and sales thought-out Asia
3. Review of Kromschröder / Eclipse Premix Forehearth Zone Controls.
  - a. The Kromschröder gas controls offer a unique method of safely and accurately mixing air and gas for forehearth combustion control systems used in the Glass Industry. The details of this equipment will be reviewed.
4. Brief introduction to our new BrightFire 200 underport and side of port Natural Gas burner for regenerative furnaces.
  - a. Eclipse has now installed our new BrightFire 200 burner in several float, container and tableware furnaces. The burner has shown significant reductions in NOx as well as improvements in energy use compared to other burners in the market.

In November, 2014, Eclipse joined with the Elster Gas group of companies. In doing so, the two companies believe the joining will enhance the sales, marketing, and operational capabilities of the combined organization. The objective through this transformation is to have the complementary strengths and assets of each organization establish a clear position of excellence in the industry.

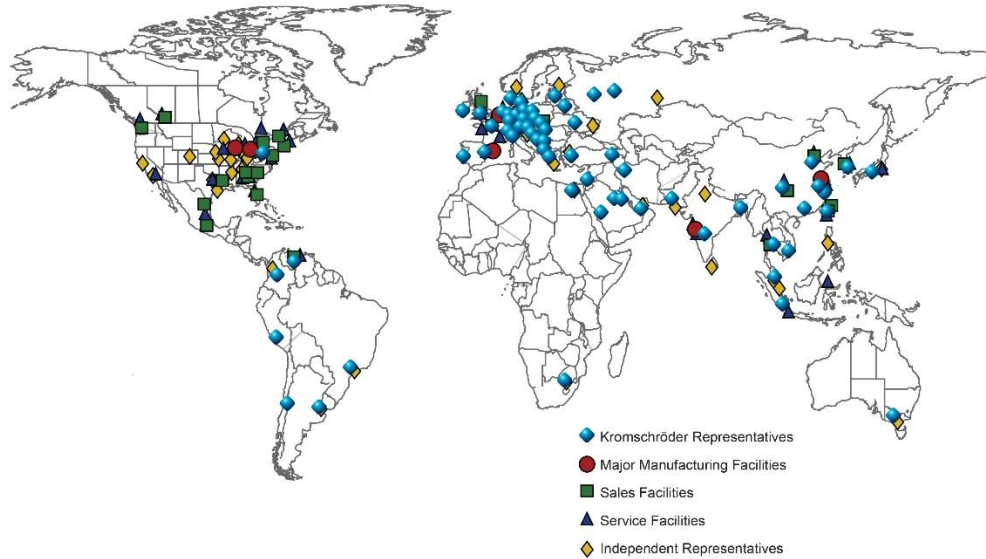
Elster Gas is a German-based group of companies supplying controls and equipment to industry. The group includes respected names like American Meter, Kromschröder, and Hauck. Eclipse is a key piece in achieving excellence in the broader gas and combustion industry.

Eclipse has a long established expertise in industrial gas combustion and heating solutions, global service capabilities, and a dominant position in Glass Melting. All of this complements Elster's expertise in high-temperature industrial gas combustion applications in Europe. In combination, the two businesses will form a worldwide leader in combustion products and solutions.

At Elster Thermal Solutions, we will be able to service combustion requirements in the Glass Plant from the Melter, Forehearth, Working End all the way thru the Lehr, Drying Ovens and basically any combustion requirement in your facility.

The new company is strategically aligned in the three "Mega Regions", Americas, Europe and Asia. We supply through our global network with major manufacturing facilities in Osnabruck, Germany; Rockford, IL USA; Suzhou, China and offices throughout the world. The maps in Figure 1 show that the combined presence of the new company more than doubles our local support. In Asia, our primary support for Glass will still come from Suzhou, China with offices and support throughout the region.

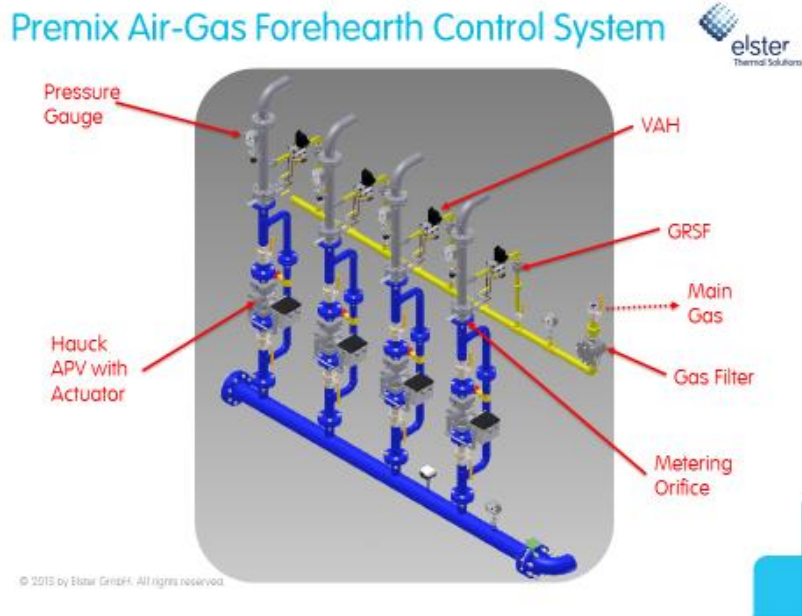
**Figure 1: The new Elster Thermal Solutions Global Presence**



One example of our combined efforts and how we can better support the Glass Industry is with our forehearth combustion systems. Our Forehearth Combustion Controls experience includes over 30 Oxy-Fired Forehearth systems using over 13,000 of Eclipse PrimeFire Oxy-Forehearth burners. Oxy fired forehearths have typically been used in E-Glass with fuel reductions over 50% compared to air gas systems. Air Gas Forehearth controls are used typically in container forehearths which are traditionally pre-mix systems.

Our Air Gas Forehearth control system is designed to meet the forehearth sizing and gas flow requirements. Elster Thermal Solutions does not design the forehearth itself, but we can design and supply the combustion control system for the Glass Company directly or thru an engineering / design company. The system in Figure 2 displays the major components utilized.

**Figure 2: Premix Gas Forehearth Controls**



First we see the “Hauck” Adjustable Port Valve with Actuator for combustion air control to the zone. The valve is manufactured at our facilities in Rockford, IL USA. This type of valve allows the operator / engineer to set the maximum desired flow or pressure drop to achieve very linear flow control from 0 to 100% open. There are many options for the actuator that can be paired with the valve depending upon the plant’s requirements.

Air flow is measured with an Orifice Plate metering system. The differential pressure is tied to the VAH control valve for gas flow control. Many designs and systems are available depending upon local needs and costs, using standard Eclipse systems, Kromschroder or the Hauck design.

Finally, the key to the system is the Kromschroder VAH control valve. This valve also can include a Safety Shutoff which could be tied to a “blowout” valve or other signal for a single zone shutoff. Typical Premix systems use a Zero Governor with a Mixer. The VAH has the following advantages. Gas flow rate is controlled proportionally to a measured air flow, not via the entrainment of gas via a venturi, for more accurate control. The valve has a very simple and measurable scale to set the air / gas adjustment. There is no need for mixing rods with linear control of the mixture setting.

In any forehearth or other gas system, there are requirements for Gas Filters, Regulators, Safety Valves and system and Flow Meters. All of these can be included in the system and supplied by the new company from our Suzhou, China Asia supply base.

The last subject of our discussion today is our new BrightFire 200 Regenerative Gas Burner. Eclipse has a long, successful history with regenerative natural gas burners. In the 1970’s and 80’s the first Seal-in-Burner was developed and it transformed the industry. It was the first easily adjustable Regenerative Natural Gas Burner allowing on-the-fly flame length control, reducing energy use and improving flame control. Then in the mid 1990’s the BrightFire

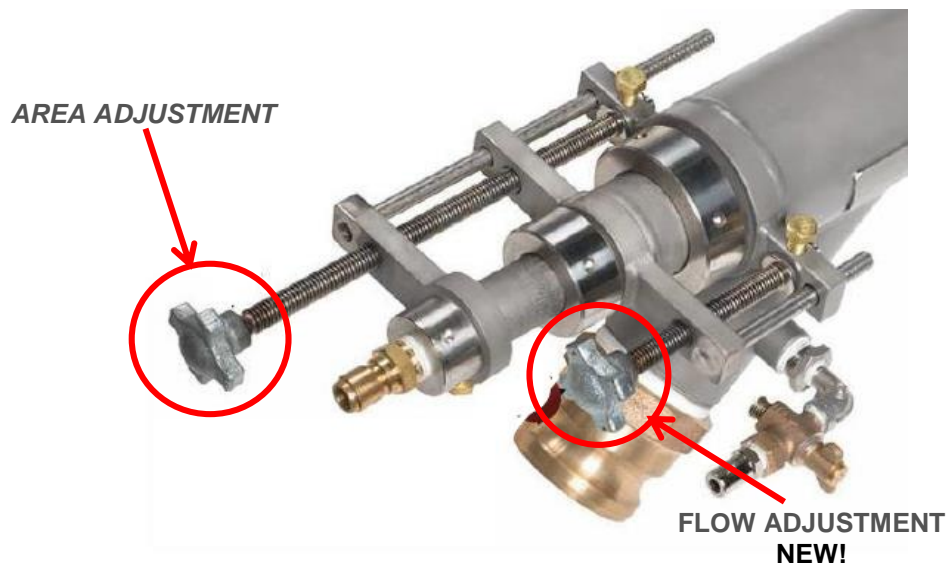
Burner was developed which continued to use the sealed-in burner principles. Dual Gas Injection was developed which improved flame control and lowered NOx. Today many burners in the market use the same technique in various fashions.

Over the years the Glass Industry has pushed for continued improvements in flame control with the goals for reduced NOx, ease of use and improved flexibility of the flame. Of course improvements in heat transfer with lower energy use are always in demand.

With those goals in mind the BrightFire 200 was developed and has demonstrated superior flame control. With the two separate adjustment mechanisms on the burner the operator can firstly control the location of the heat release within the length of the flame. Secondly and independently, the flame length can be adjusted.

Referencing the burner details in Figure 3, two separate control adjustments can be observed. First is an Area Adjustment, which increases the opening between the Outer and Inner Nozzles. This controls the overall flame length.

**Figure 3: Brightfire Burner Controls**



The second new adjustment mechanism, called the Flow Adjustment, moves the gas flow between the inner and outer nozzles. Altering the gas flow between the two tips can affect NOx and move the heat release of the flame forward or back without affecting flame length. Basically, more gas through center jet, increases the center jet momentum, moving heat release away from firing port. Less gas through the center jet, decreases the center gas momentum, moving heat release closer to the firing port and reducing NOx.

Only one gas inlet to the burner is required, reducing piping and control piping compared to other burners on the market. Finally, it is a direct replacement to our original BrightFire and most other burners on the market today.

The burner is now in use throughout the globe and results have been favorable in all installations. A large End Port Container Furnace demonstrated a significant improvement in heat transfer as bottom power was reduced by 15% on Amber Glass. Most importantly NO<sub>x</sub> was reduced 15%, bringing the furnace below local requirements and eliminating the need for additional NO<sub>x</sub> abatement equipment. A small side port Tableware furnace showed improvements in melting as the batch line pulled back and seed counts reduced. Energy use remained stable as the customer was more concerned with the glass quality improvement.

In Asia, two float furnaces have shown the burner's flexibility. In Vietnam, we demonstrated the flame could be adjusted from 30% to 80% of the furnace width on a large furnace. We also showed the flexibility of the burner with the ability to change to Oil Firing using the Oil Lance option for the burner. An Ultra-thin glass mini-float in China showed improvements in heat transfer and the customer is now moving to replace all burners on the furnace.

In Europe, a large Float furnace showed improvements in flame adjustability. The customer is now planning to update the burners on other furnaces. Also in Europe a Specialty Glass End Port Furnace was able to reduce NO<sub>x</sub> by 20% bringing the level below the critical 550 mg/m<sup>3</sup> target.

There are other examples, but most importantly is the fact we are moving on additional installations in Vietnam, Thailand, China and thru-out Asia. The burner continues to demonstrate improvements in flame control, NO<sub>x</sub> reduction and elusive energy reductions. Unlike competitive burners, BrightFire 200 provides easy to use controls and is installed with just one gas inlet.

In this paper, we have introduced the new company which combines, Elster, Hauck, Kromschröder and Eclipse and have shown how we can better serve the industry globally. The Kromschröder gas controls for Air Gas Forehearth systems were discussed and with our base in Asia we can easily support these systems locally now. Finally, the new BrightFire 200 Regenerative Gas Burner was briefly introduced showing the benefits and success of the new design.