ZEECO BURNER DIVISION

Enhanced Jet Flat Flame Burners
GLSF Series

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INTRODUCTION:

This document discusses the advantages of the GLSF design and compares its performance with conventional and low-NO_x emissions burner designs.

Zeeco® offers the proven GLSF Enhanced Jet Flat Flame technology for ethylene cracking, coking, reforming and process heater-type applications that require a flat flame profile and low emissions.

GLSF Enhanced Jet Flat Flame Technology Advantages

The GLSF Enhanced Jet Flat Flame burner design offers the following advantages:

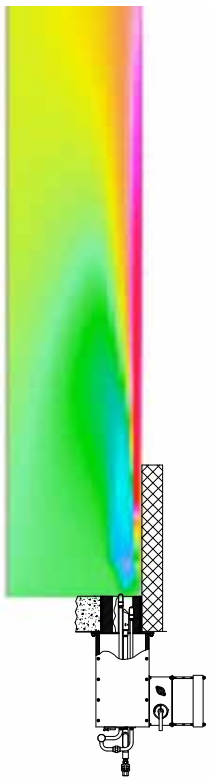
- *No flame rollover*
- *Better turndown*
- *Superior heat flux profile*
- *Superior low NO_x emissions*
- *Compact design that may be retrofit into existing furnaces*
- *Low initial cost*
- *Low maintenance costs*

Customer Support

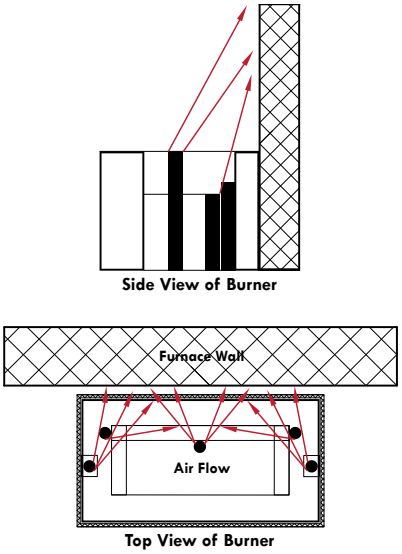
Zeeco's highly-trained staff is available before, during and after the sale to answer questions and to provide engineering support.

ZEECO GLSF DESIGN

The photo above shows that there is no flame rollover.



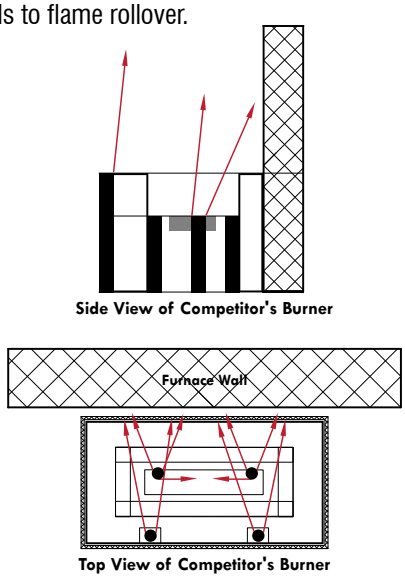
The CFD model/illustration above shows a Zeeco GLSF Enhanced Jet Flat Flame burner. This burner is designed so that when furnace currents pull air toward the tubes, the gas and flame stay next to the furnace wall with no flame rollover.



In the illustration of the Zeeco GLSF Enhanced Jet Flat Flame burner above, all of the gas is burned between the wall and the combustion air stream. Therefore, when the momentum of the air exiting the burner throat becomes less than the momentum of the flue gas flowing downward close to the tubes, the flame is not pulled toward the tubes.

COMPETITORS' DESIGN

In burners designed by our competitors, approximately 70% of the gas burned must cross the combustion air stream before hitting the wall. The gas is burned via staged gas tips, which eject the gas over the combustion air stream. In many cases, this design leads to flame rollover.



The illustration above shows a burner that uses staged gas to cross the combustion air stream.

In general, with this design, as the angle of the gas ejected is rotated toward the furnace wall, the flame becomes shorter and the probability of flame rollover decreases while NO_x emissions increases. To reduce NO_x emissions, the angle of the staged gas tip is rotated upward, which results in lower NO_x emissions but increases the probability of flame rollover. Thus, this design must incorporate a compromise between flame rollover and NO_x emissions; even so, many times customers experience problems with both NO_x and flame rollover.

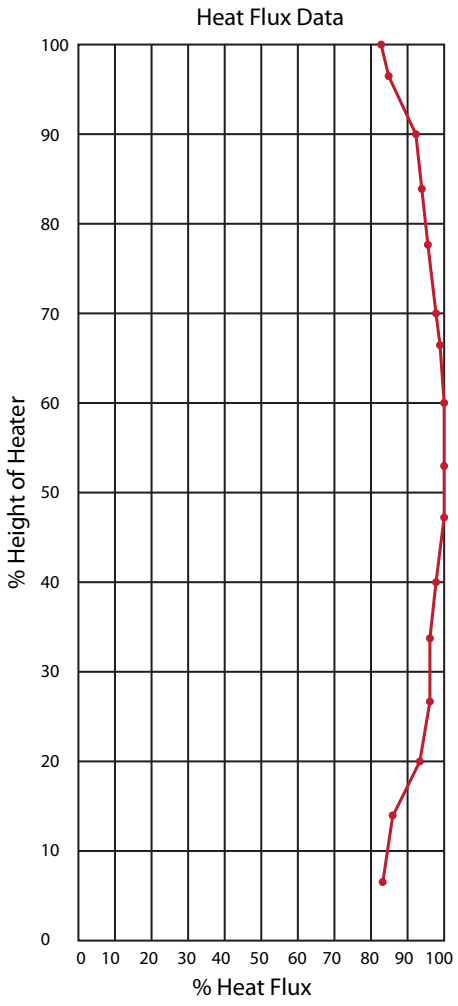
BETTER TURNDOWN

The picture above shows a GLSF Enhanced Jet Flat Flame burner operating in a turndown condition. This burner design enables high turndown to be achieved without separating the primary and secondary fuel gas and shutting off the primary gas. Since fuel does not cross over the air stream and the gas ejected from the secondary tips is close to the adjacent primary tips, the achievable turndown is normally more than 12:1.

SUPERIOR HEAT FLUX PROFILE

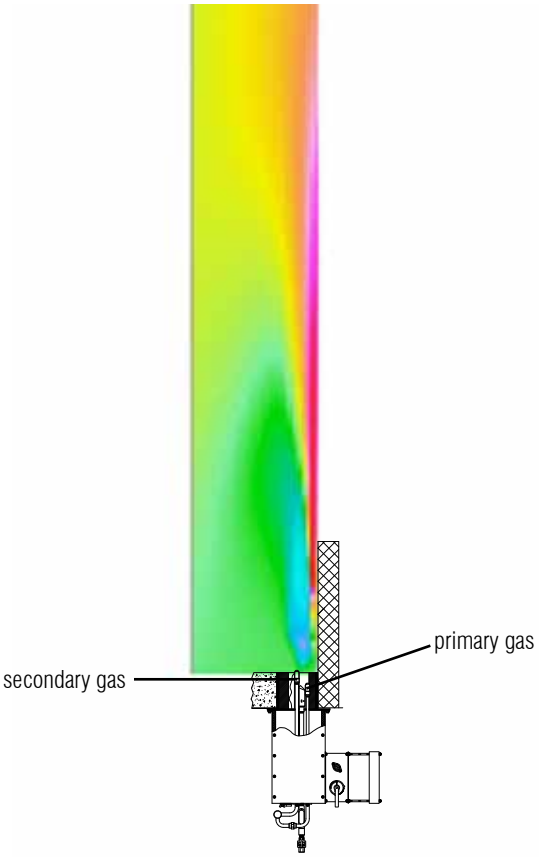
Heat flux is an important factor in ethylene cracking furnace designs. In the GLSF Enhanced Jet Flat Flame burner design, since the fuel ejected from the gas tips is located on the inside of the air stream, the tip drillings may be changed to optimize heat flux requirements. At the same time, low-NO_x emissions are achieved since the gas does not pass directly over the combustion air stream.

This burner design allows for an optimized heat flux curve for a specific furnace design without the typical compromises in burner performance. The heat flux curve below shows that the heat flux profile is flat. Additionally, if the heat flux requirement is to provide more heat at lower elevations, a heat flux lance may be added to the burner to provide more gas on the inside of the air stream.



SUPERIOR NOx EMISSIONS

The Zeeco GLSF Enhanced Jet Flat Flame burner uses internal flue gas recirculation to lower NO_x emissions. As the primary gas burns, inert products of combustion are generated ***(see figure below)***. The secondary gas passes through the primary gas' product of combustion, forming a diluted fuel composition that is burned next to the furnace wall. The secondary gas burns over the region in which the primary gas is burning—resulting in combustion at a reduced peak flame temperature and thermal NO_x production.



In the GLSF burner, the primary fuel gas is directed through channels in the burner tile. The momentum of the primary gas induces inert flue gas products into the combustion zone. Secondary or flame-shaping gas tips are located on the side of the combustion air stream. The momentum of the gas exiting the flame-shaping tips passes through and entrains inert flue gas. This mixing of inert flue gases with fuel gas results in a lower peak flame temperature in the combustion zone. The lower flame temperature produces less thermal NO_x. The more inert flue gas that may be mixed with fuel gas prior to combustion, the lower flame temperature and NO_x emissions are.

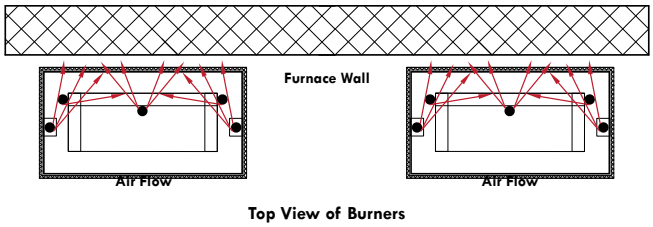
COMPACT DESIGN

Since the GLSF design does not have a metal flame stabilization device in the burner's throat, the burner size is relatively small. The advantages of smaller burner external dimensions are:

- Easy retrofit - Since the external dimensions of the burner are smaller, it can normally replace conventional NO_x and staged-fuel NO_x burners with only minor furnace modifications.
- Reduced cost - Since the burner is smaller than other ultra-low NO_x designs, the cost of material and labor is lower. Zeeco passes these savings on to our customers.

Because the flame is over the top of the burner tile, the burners may be mounted close together without problem.

The picture above shows burners successfully mounted close together. As shown, there is no flame interaction and flame rollover.



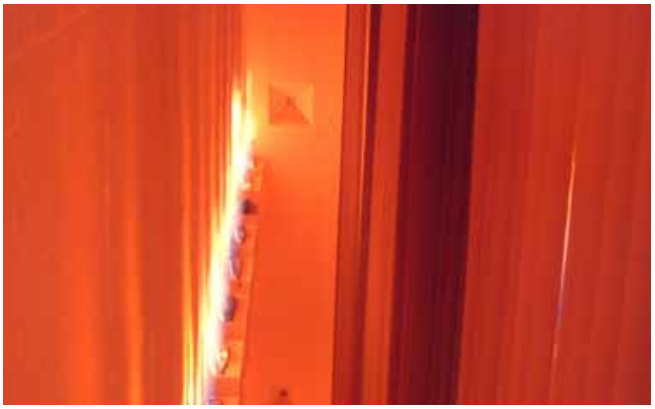
In the GLSF design, the fuel gas is placed between the furnace wall and the air stream. Consequently, flame interaction between the burners is minimized due to the location of the burner tip.

GLSF ENHANCED JET FLAT FLAME DESCRIPTION

The GLSF design incorporates internal flue gas recirculation to lower NOx emissions and to provide improved heat flux characteristics. In addition, the GLSF Enhanced Jet Flat Flame burner has small external dimensions, making it easy to retrofit into existing furnaces. Each GLSF Enhanced Jet Flat Flame burner is supplied with the following:

- One tile assembly constructed of nominal 60% Al2O3 material. Provided as standard pre-dried to 260°C and optionally may be pre-fired to a ceramic bond.
- One burner tile mounting plate. This plate is mounted to the furnace floor so that the burner tile may be removed from underneath the furnace.
- One manually-operated damper assembly complete with a self-locking handle.
- One 0.14" (3.54 mm) thick carbon steel plenum assembly complete with 1" (25 mm) thick 8# density mineral wool insulation held in place with a mesh liner and weld cup pins.
- Two type 310 SS primary gas tips mounted on carbon steel risers and installed in the plenum assembly prior to shipment.
- Two type 310 SS secondary gas tips mounted on carbon steel risers and installed in the plenum assembly prior to shipment.
- One 2" lighting port and one 2" sight port. Both complete with a pivoting swing-type port cover.
- One PT-1S manual ignition, pre-mixed pilot complete with a carbon steel riser and a 310 SS pilot tip.
- One type 310 SS gas lance tip mounted on a carbon steel riser and installed in the plenum assembly prior to shipment (optional). Note: This tip is used for applications requiring the heat flux profile to be hot at the bottom of the profile.

Zeeco's GLSF Enhanced Jet Flat Flame burner firing a natural gas/ hydrogen fuel mixture. For this particular application, turbine exhaust gas is being mixed with the combustion air stream. Note that there is no flame interaction and flame rollover in the furnace.



Zeeco's GLSF Enhanced Jet Flat Flame burner operates at a reduced capacity. Note that the burner shown is stable without flame interaction and flame rollover. The GLSF Enhanced Jet Flat Flame burner is capable of a more than 12:1 turndown without the need to separate the primary and secondary gas tips with separate manifold—as are required for other burners. Also shown is how the gas stays along the wall and is not influenced by the currents within the furnace.

The next two pictures are of the GLSF Enhanced Jet Flat Flame burner operating in a horizontally-mounted position but fired vertically up the furnace wall. Note that there is no flame rollover and interaction. The GLSF design produces low emissions without compromising flame quality and turndown.

SUMMARY

Zeeco equipment provides the best performance for the best value for your applications. To learn more about Zeeco products and services, contact the following locations:

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