

# Balancing Combustion Reduces Emissions

TECHNICAL NOTE

## Problem

Modern boilers are complex machines that are difficult to operate at optimum performance over long periods of time. Operators need good information and performance feedback to help them succeed in this endeavor. The one area of the furnace where, historically, the least information has been available is the combustion zone. Combustion imbalances and off-center firing result in reliability problems and increased emissions, but without information about the combustion zone, it is difficult to identify and eliminate these issues.

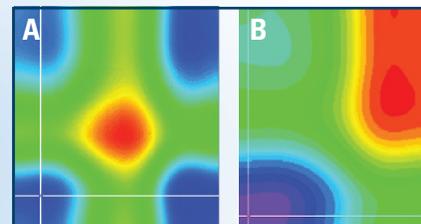
## Solution – Center the Fireball

The ZoloBOSS™ is the industry's first instrument that can measure and map combustion characteristics directly in the furnace allowing the operator to manipulate operating variables to center the fireball and achieve optimum combustion. In a T-Fired boiler it is essential to have a well centered fireball as shown in the tomographic image A to the right. An off-center fireball, as shown in tomographic image B, can result in flame impingement on the water wall and local areas of low oxygen that can accelerate corrosion.

With real time combustion zone information from the ZoloBOSS, operators can manipulate mill configurations, burner tilts and air dampers to move the fireball back to the center of the furnace.

## Solution – Balance the Furnace

Once the fireball is well centered in the boiler, the operator can use the ZoloBOSS information to make the temperatures more uniform across the furnace. Localized high temperature areas are a primary cause of NO<sub>x</sub> creation and can increase furnace slagging if the temperatures exceed the ash fusion point. Image C shows a well-centered fireball, but the temperature variation across the furnace is 230 °F with a high peak in the center of the furnace. The results in image D, operators have adjusted airflows to balance the temperatures across the furnace resulting in only a 130 °F variation in the temperatures across the furnace and eliminating the peak temperature areas.

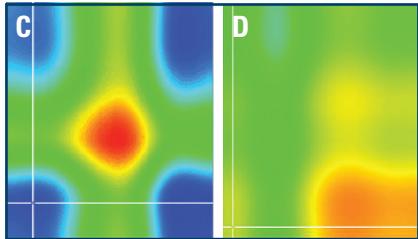


### Centered Combustion

ZoloBOSS temperature displays show a centered fireball (left) compared to an off-center one (right) for a T-fired boiler.

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## Benefits



### Balanced Combustion

Here balanced combustion, which reduces the range of temperatures in the combustion zone, leads to reduced  $\text{NO}_x$  emission. Both displays are shown at the same scale, but the example on the right shows significantly less temperature range and performs with lower emissions.

The ZoloBOSS uses laser-based absorption measurements to provide temperature, water, oxygen and carbon monoxide readings in real-time in the fireball. The ZoloBOSS measures combustion on multiple paths and provides operators with two-dimensional maps or tomographs of combustion constituents. These tomographs provide information to operators regarding fireball position and temperature deviation.

A fireball that is centered, balanced and has less total temperature variation improves unit performance through:

- ▶ Lower  $\text{NO}_x$  due to fewer extreme high temperatures
- ▶ Improved heat transfer
- ▶ Reduced LOI due to more complete combustion
- ▶ Reduced water-wall wastage due to local reducing environments
- ▶ Reduced slagging or fouling
- ▶ Reduced soot blowing
- ▶ Reduced unplanned outages
- ▶ Less temperature stress on super-heat and re-heat tubes

ZoloBOSS data provides the feedback required to change boiler controls to improve combustion. Operators can best use the information if it is available to them in the control room. Alternatively, the ZoloBOSS data can be sent to a neural network that delivers improved results against an optimization goal defined by the plant. Either way, the plant benefits from a better positioned fireball and more evenly distributed combustion.

*“Seeing inside the combustion zone enables operators or combustion optimization software to balance combustion and improve performance”*