HVT TESTING IS STILL IMPORTANT!

High Velocity Thermocouple (HVT) testing is a relevant and significant testing method used to assess the performance and efficiency of utility and industrial boilers. Despite advancements in technology and newer testing methods, HVT testing remains an essential tool for ensuring the safe and efficient operation of boilers. Plant operators must still rely on excess oxygen indications at the economizer outlet to determine if the furnace has enough oxygen for combustion. Due to the age of the boilers in the USA and the increase in cycling over the years, many times these indications do not represent actual furnace oxygen levels accurately and can often be misleading, indicating higher than actual furnace oxygen levels. HVT testing provides accurate and reliable measurements of key performance indicators, such as in-furnace excess oxygen levels and Furnace Exit Gas Temperatures (FEGTs); which allow for adjustments to be made to optimize the boiler's performance. In this newsletter, we will explore the importance of HVT testing, its benefits, and its role in maintaining regulatory compliance and ensuring the longevity of your boilers.

In This Issue:

Next Issue:

- The Importance of Balanced Fuel to the Boiler

Storm Technologies, Inc.
PO Box 429
Albemarle, NC 28002

Phone: (704) 983-2040
Fax: (704) 982-9657
www.stormeng.com

The High Velocity Thermocouple traverse is, without a doubt, the single most important test in diagnosing combustion-related problems. The HVT probe is intended to accurately measure gas temperatures within the furnace, but its greatest asset is the ability to measure excess oxygen. The water-cooled HVT probe, which is constructed from 304 and 316 stainless steel, is typically inserted into the furnace at the furnace exit; preferably around the nose arch apex. Most boilers are equipped with observation doors along the front and side walls of the boiler at this elevation and these ports are utilized so that flue gas constituents can be measured.

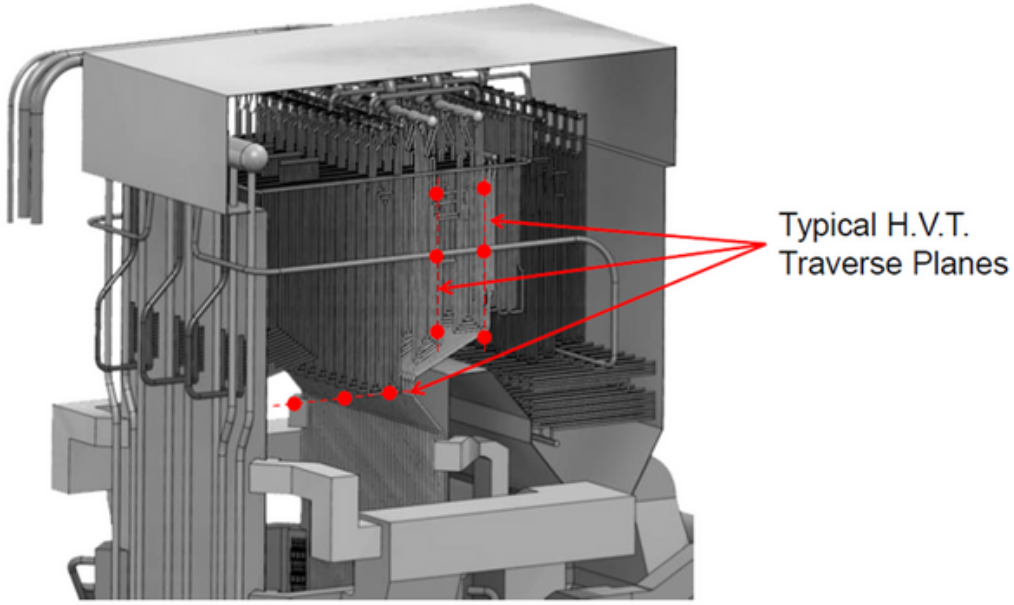


Figure 1: Typical HVT Testing locations

Why is HVT testing not often completed by others providing testing services or by plant staff? The process of setting up the equipment and conducting the test often requires a significant amount of time. Additionally, completing a full HVT traverse of a boiler requires physical exertion and constant control of a heavy probe at each test port and while moving around from port to port. Once a traverse of the furnace has been completed, the data can be utilized to construct a map of the gas constituents within the furnace as shown in the following figure.

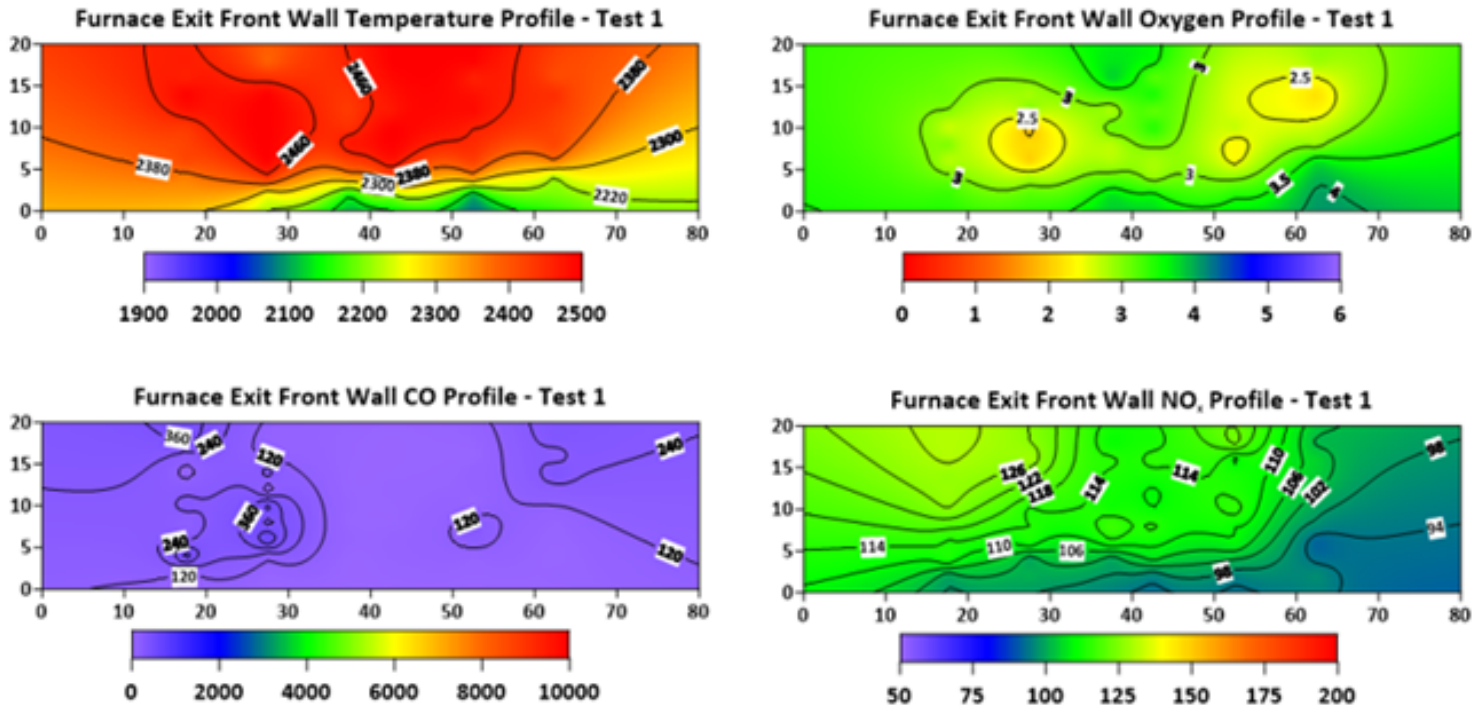


Figure 2: HVT Flue Gas Profiles of the Upper Furnace

Over the years, the common challenges that plants face have transformed due to fuel changes, new firing equipment/practices as well as the need to cycle the boiler to follow load demand. HVT testing has been used in these situations to allow Storm to diagnose combustion-related challenges for many years that would not easily be determined by just measuring flue gas constituents at the economizer outlet; which is a standard location for combustion testing. With that said, the following combustion-related challenges are some of the most recent that Storm has been able to help diagnose:

- Elevated furnace exit gas temperatures
- Upper furnace slagging
- Oxygen, CO, and NOX imbalances
- Factors leading to elevated tube metal temperatures
- Factors behind elevated spray flows

Changing fuels may seem easy but it's not always straightforward, especially when switching types of coal such as from the CAPP to ILB or from bituminous to sub-bituminous. Storm has been involved with these switches over the years and one that stands out is a plant that switched from 100% CAPP to 100% ILB. The first attempt by the plant resulted in the superheater becoming 100% plugged during a single shift. After experiencing this aggressive slagging during multiple firing attempts, Storm was brought in to determine if burning the ILB was feasible. The major issue when switching from CAPP to ILB lies with the significant drop in ash fusion temperatures. The ash fusion temperatures of the new ILB coal in a reducing atmosphere were less than 2,000°F. By inserting an HVT probe in the upper furnace while the plant was still operating on CAPP coal it was determined that there was 5% - 8% leakage between the furnace exit and the oxygen probes; leaving areas within the furnace in a reducing environment. In addition, fuel fineness levels were low and several secondary air dampers were not operating properly.

By incorporating the HVT probe into the testing process, we were able to enhance the furnace conditions and create an oxidizing environment. This improvement allowed the power plant to operate the boiler without encountering slagging issues, even after eliminating the fuel additives previously utilized to help keep the boiler clean. The following figure illustrates pre and post photos from the superheater. Keep in mind, the photo on the left is after a single shift with ILB coal before Storm's visit. After implementing our improvements, the boiler was operated with ILB coal throughout the entire summer, as shown in the photo on the right.

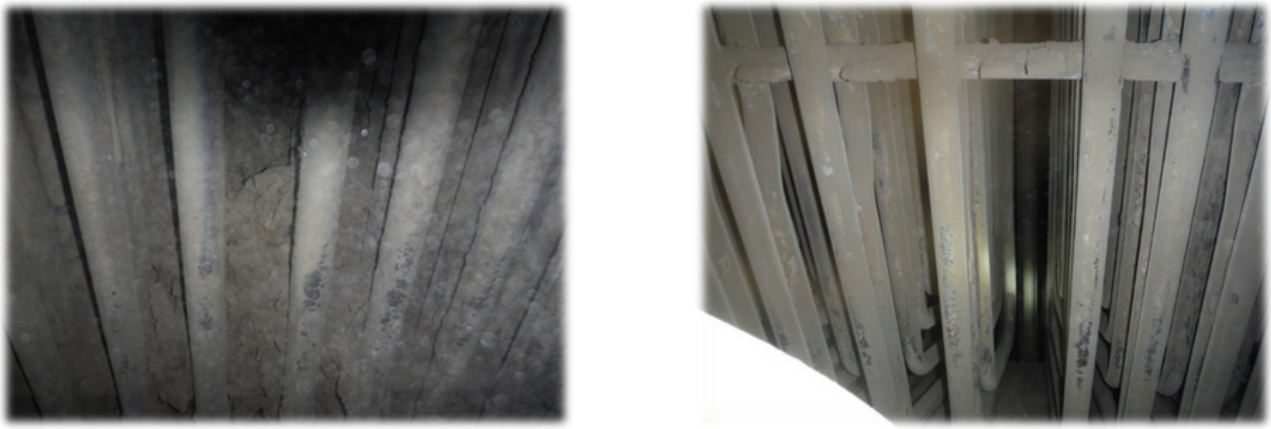
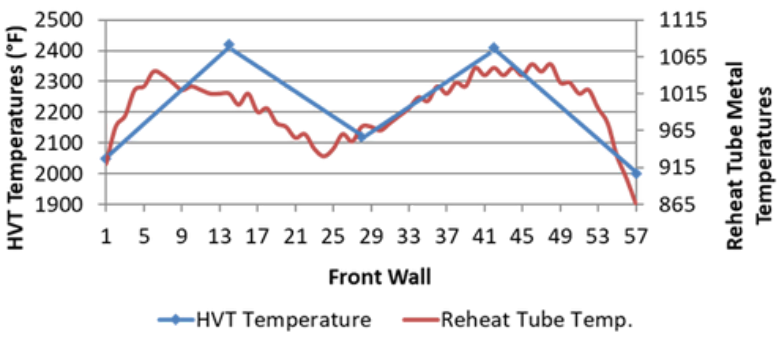


Figure 3: Pre and Post Comprehensive Tuning utilizing an HVT Probe

Another great example of using the HVT test to address slagging involved one of Storm's customers testing and tuning solely from the economizer. From that location, everything appeared to be in good order. However, the plant still had major issues with slagging. Subsequent utilization of the HVT test revealed that the FEGTs were exceeding the fluid temperature of the coal ash by 300 degrees. After this, Storm and plant personnel worked to address the flue gas imbalances and elevated temperatures by HVT testing along with economizer testing.

Tube Metal Thermocouples & HVT Testing

As mentioned earlier, HVT testing can be extremely time-consuming and labor-intensive; which is why many do not want to complete this type of testing. However, most plant operators and engineers have a tool that can be utilized between HVT tests to determine the balance within the furnace. Tube metal thermocouples installed on SH and RH tubes within the penthouse can provide a temperature grid that many times mimic the HVT furnace exit gas temperature and oxygen profiles. By analyzing the association between tube metal temperatures and HVT testing results, operators gain a reliable and insightful resource that enhances their ability to optimize furnace operations. It is often found that when a plant has a large imbalance between tube metal temperatures, it almost always coincides with high FEGTs or low areas of oxygen unless it's a steam side problem (i.e. circulation). The following figure illustrates just one example of the correlation between HVT test temperatures and actual reheat tube temperatures.



Tube metal thermocouples play a vital role in modern-day boilers, offering significant importance in terms of safety, efficiency, and performance optimization. These thermocouples are strategically placed within the boiler's tubes to measure the temperature of the metal surfaces directly. Here are key reasons why tube metal thermocouples are essential:

Safety: Monitoring tube metal temperatures is crucial for ensuring the safe operation of boilers. Excessive temperatures can lead to overheating, material degradation, or even tube failures. By continuously monitoring the tube metal temperatures, operators can detect any anomalies or deviations that could indicate potential safety risks, allowing them to take preventive measures promptly.

Efficiency: Efficient boiler operation is closely tied to maintaining optimal tube metal temperatures. Monitoring these temperatures helps operators identify any heat imbalances or inefficiencies within the boiler system. By optimizing tube metal temperatures, operators can achieve better heat transfer, reduce fuel consumption, and improve overall energy efficiency.

Performance Optimization: Tube metal thermocouples provide valuable insights into the boiler's performance characteristics. By tracking and analyzing the temperature data, operators can identify areas of the boiler system that may require adjustments or maintenance. This information enables operators to fine-tune operational parameters, such as fuel-air mixture, combustion settings, or tube cleaning schedules, to optimize performance, reduce emissions, and extend the boiler's lifespan.

Early Fault Detection: Tube metal thermocouples act as early warning systems for potential equipment failures or malfunctions. Sudden or abnormal temperature changes in the tube metal can indicate issues such as scaling, fouling, corrosion, or inadequate water flow. Detecting these problems at an early stage allows operators to take corrective actions promptly; preventing costly downtime, repairs, and potential accidents.

Data-Driven Decision Making: Tube metal thermocouples provide real-time and historical temperature data that can be used for comprehensive analysis and trend monitoring. By leveraging this data, operators can identify patterns, assess long-term performance trends, and make informed decisions regarding maintenance, repairs, or upgrades to the boiler system.

In summary, tube metal thermocouples are integral to the safe, efficient, and optimized operation of modern boilers. While HVT testing plays a vital role in diagnosing combustion-related issues, it cannot be performed 24 hours a day. However, by using the HVT probe to correlate the flue gas constituents to the tube metal temperatures, the plant can have a better understanding of the conditions within the furnace between HVT testing visits.

In conclusion, HVT boiler testing is a critical process for maintaining the efficiency, safety, and regulatory compliance of a boiler system. Regular testing allows for the identification and correction of issues before they become major problems; ensuring that the system operates at peak performance and minimizing the risk of downtime. By allowing STORM to assist your team's needs for combustion improvements and tuning, HVT boiler testing opens up opportunities to improve and identify potential leakage and overall boiler efficiency.

Respectfully,

Kenneth Iacona

Kenneth Iacona
Field Service Engineer
Storm Technologies, Inc.