

Measuring FEGT In Industrial Furnaces

Abstract

Measuring furnace exit gas temperature (FEGT) is an essential task in industrial furnaces (Figure 1) to ensure proper operation and safety. FEGT is a key parameter that indicates the efficiency of the combustion process and helps identify potential issues such as overheating or underheating.



Figure 1: Furnance

In this white paper, we will discuss the importance of measuring FEGT in industrial furnaces, the methods used to measure it, and the factors that can affect the accuracy of the measurements. We will also discuss a reliable solution to FEGT measurement – the Infra-View® Infrared Thermometers and discuss its benefits.

The Opportunity

Furnace Exit-Gas Temperature (FEGT): A Crucial Parameter

Industrial furnaces are used in a wide range of applications, including metal production, chemical processing, and heat treatment. They are designed to reach high temperatures to achieve the desired results (Figure 2). The combustion process in these furnaces involves the mixing of fuel and air,

which generates heat that is transferred to the material being processed. Measuring the FEGT is essential in ensuring the efficient and safe operation of the furnace. The FEGT is a critical parameter that indicates the performance of the combustion process and can help identify potential issues such as overheating or underheating.

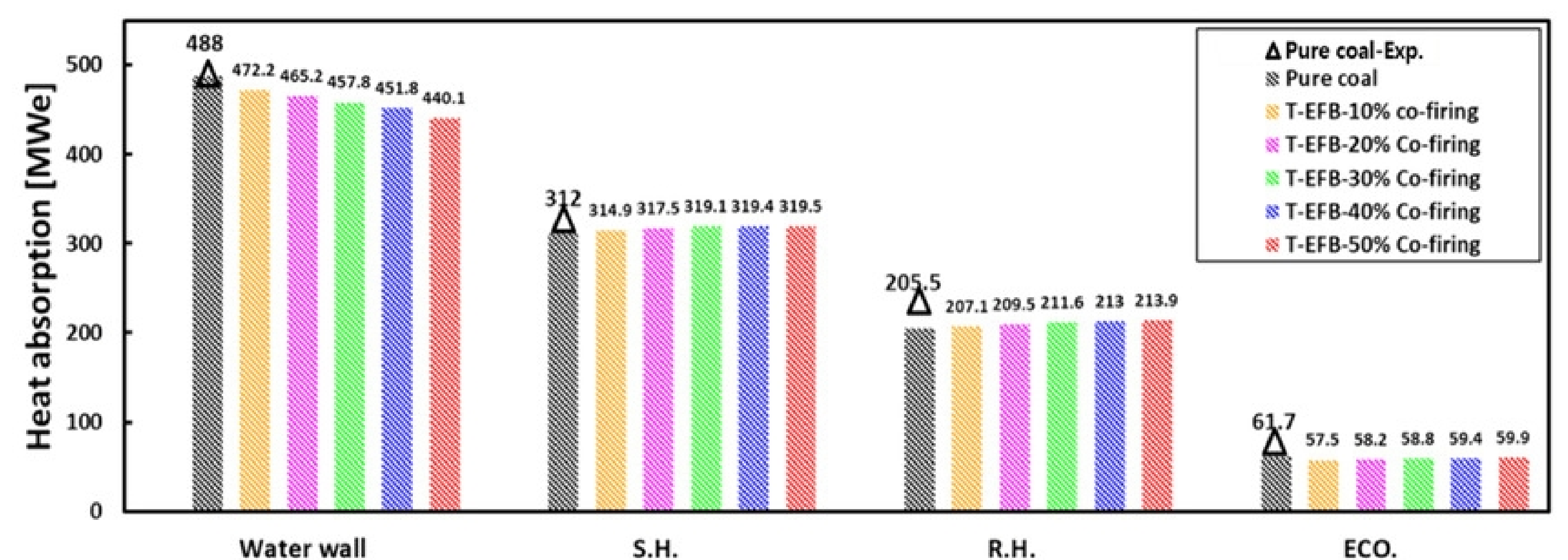


Figure 2: Heat Absorption Chart

The FEGT measurement (Figure 3) offers a precise measure of the heat transfer to the water walls of the furnace under a given load condition and establishes the anticipated performance of the superheat and reheat procedures. When FEGT is high, it can cause fly ash to stick to the tubes and pendants, creating slag and decreasing heat exchange efficiency with the tube walls. This can result in frequent soot-blowing, tube corrosion, lower load operation, and potential safety hazards.

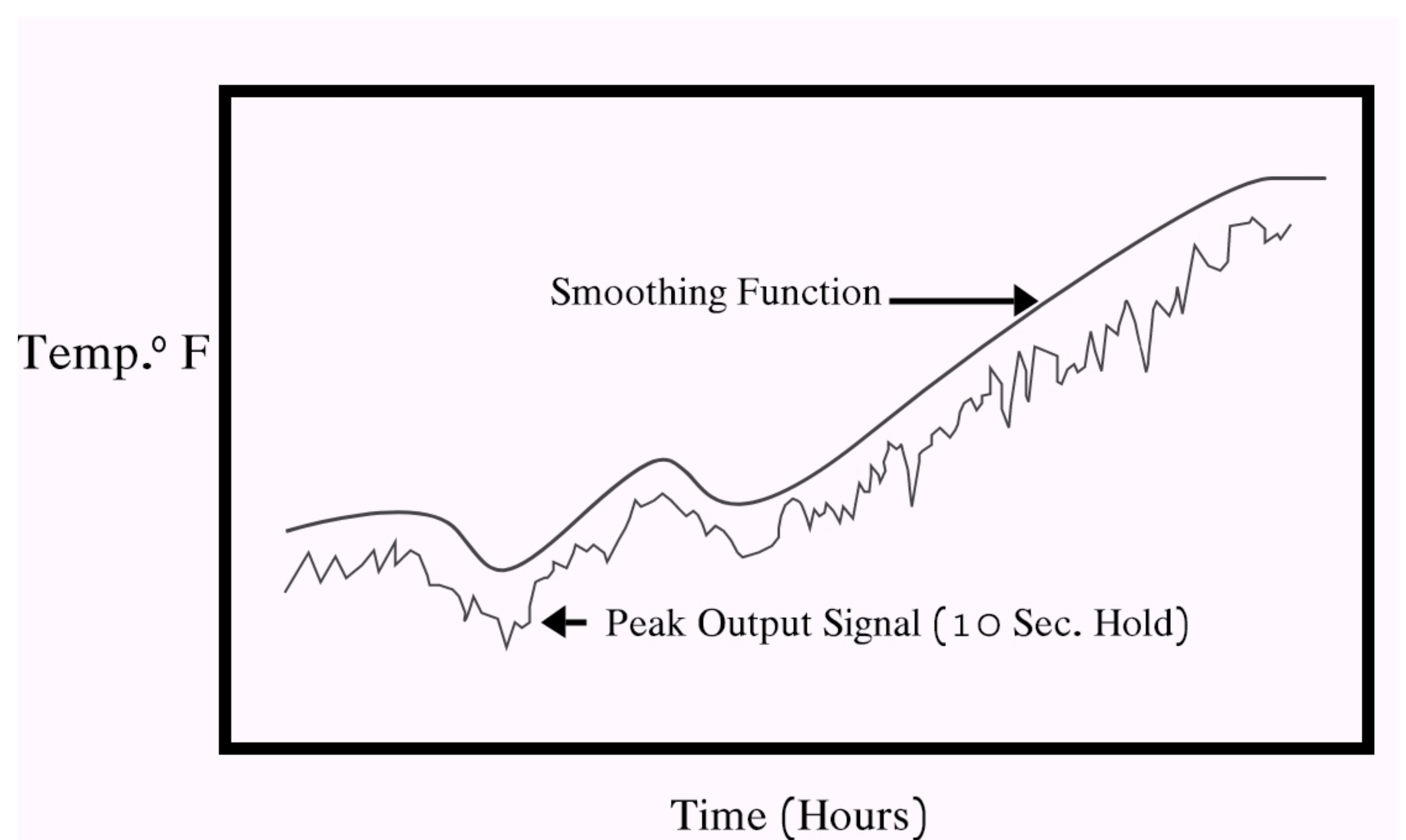


Figure 3: FEGT Measurement Chart

Conversely, a low FEGT value may indicate excessive radiative losses to the water walls or an incomplete combustion process resulting in lost efficiency. Fuel quality, excess air, burner selection and tilt, low NOx operation, and heat transfer issues all affect the exit-gas temperature.

Monitoring the FEGT allows operators to balance and optimize their combustion process and safeguard the boiler furnace.

The Solution

Methods for Measuring FEGT

There are several methods for measuring FEGT in industrial furnaces, including contact and non-contact methods. Contact methods involve the use of a thermocouple or other temperature sensor that is placed directly into the exhaust gas stream. Non-contact methods involve the use of infrared (IR) radiation to measure the temperature of the exhaust gas.

Contact Methods for Measuring FEGT

Thermocouples are commonly used to measure FEGT in industrial furnaces. They are small, durable, and can be inserted directly into the exhaust gas stream. They can measure temperatures up to **2,500°C (4,532°F)** and are highly accurate.

It is recommended that these thermocouples are calibrated annually to maintain functionality and accuracy.



Figure 4: RTD – Thermocouple – Thermistor

Other contact methods include resistance temperature detectors (RTDs) and thermistors. RTDs are highly accurate and have a stable output over a wide temperature range.

They are suitable for use in harsh environments and can measure temperatures up to 1,000°C (1,832°F). Thermistors are less expensive than RTDs and thermocouples but have a limited temperature range.

Non-Contact Methods for Measuring FEGT

Infrared thermometers and thermal imaging cameras are commonly used non-contact methods for measuring FEGT in industrial furnaces. Infrared thermometers measure the temperature of a small area of the exhaust gas stream using IR radiation. They are simple to use and can measure temperatures up to **1,600°C (2,912°F)**. However, they require a clear line of sight of the exhaust gas and are affected by the emissivity of the material being measured.



Figure 5: Infra-View IR Pyrometer

Thermal imaging cameras use IR radiation to create an image of the exhaust gas stream. They can measure temperatures up to **3,000°C (5,432°F)** and provide a visual representation of the temperature distribution across the exhaust gas stream. However, they are more expensive than other methods.

Factors Affecting Furnace Exit-Gas Temperature Measurements

Several factors can affect the accuracy of FEGT measurements, including:

- **The Placement Of The Temperature Sensor:** The position of the temperature sensor in the exhaust gas stream can affect the accuracy of the measurements. The sensor should be placed in a location that is representative of the temperature of the exhaust gas stream.
- **The Type And Size Of The Temperature Sensor:** The type and size of the temperature sensor can affect the accuracy of the measurements. The sensor should be selected based on the temperature range of the exhaust gas stream and the accuracy required.

- **The Emissivity Of The Material Being Measured:** The emissivity of the material being measured can affect the accuracy of the measurements. IR radiation is absorbed differently by different materials, which can affect the readings of infrared thermometers.
- **The Presence Of Contaminants In The Exhaust Gas Stream:** The presence of contaminants such as soot or ash in the exhaust gas stream can affect the accuracy of the measurements. Contaminants can block the view of the temperature sensor or affect the emissivity of the material being measured.

A Safe and Reliable Solution: Infra-View® Infrared Thermometers for FEGT Measurement



Figure 6: Infrared Thermometers

Infra-View® Infrared Thermometer (Figure 6) is a state-of-the-art infrared system that offers a reliable and secure solution for measuring flue gas temperature. The device is equipped with an Infra-View® sensor that can detect heated CO₂ gas generated during combustion processes in boilers or furnaces using fossil fuels. The sensor is designed with a thin film thermopile and a spectra filter that blocks out other infrared emissions, allowing it to detect CO₂ infrared energy with high sensitivity. This makes it possible to directly measure the temperature of the CO₂ gas within its field of view.

Infra-View® Infrared Thermometers are remotely-sensed infrared detectors that can become a permanent fixture that is installed on any door, port, or into the boiler or furnace (Figure 7). The device is lightweight and can also be used as a portable system for testing purposes. It comes with a patented design that includes a protective-cooling

jacket, air cooler, purging and filtering system, making it suitable for use in harsh environments.

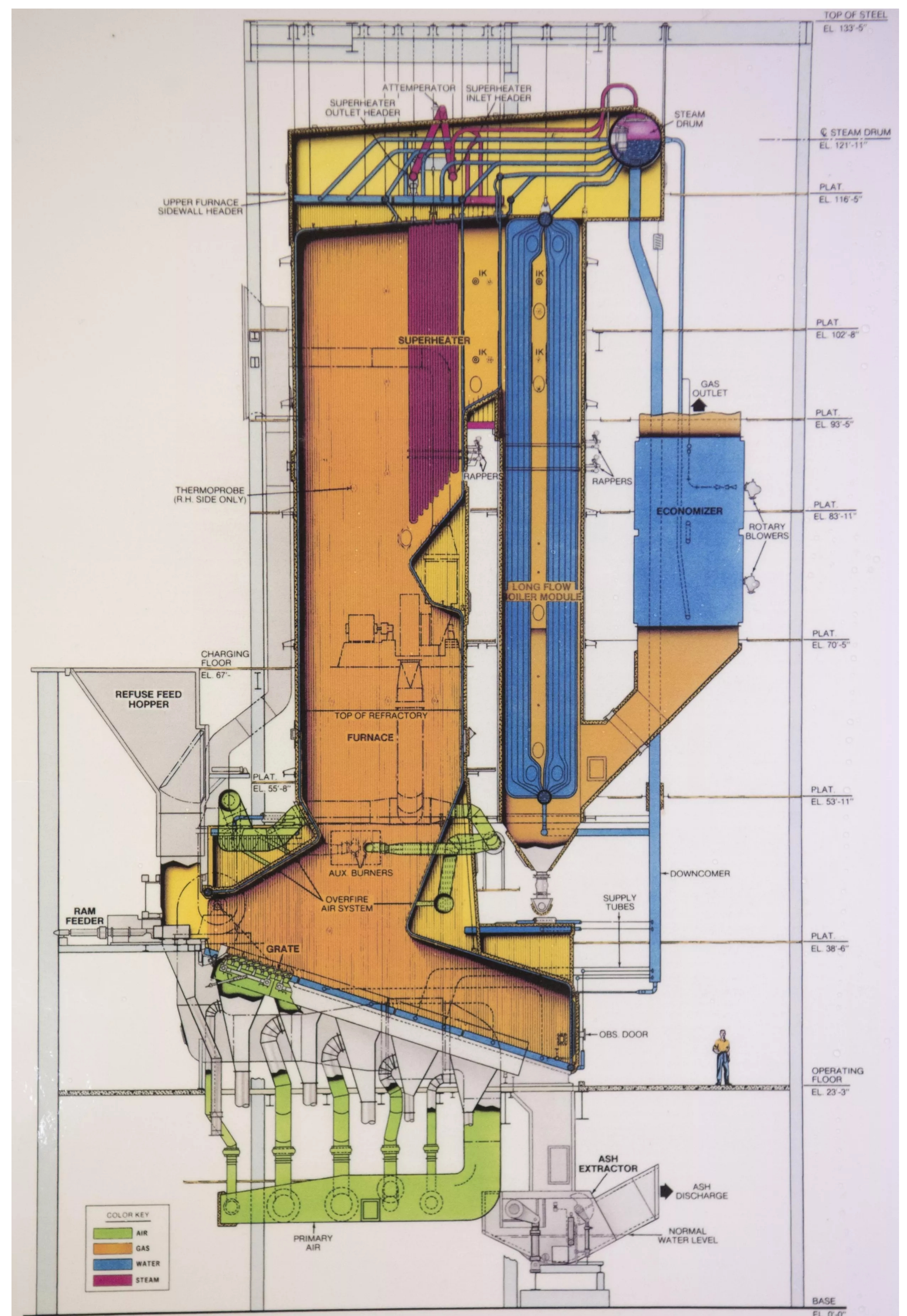


Figure 7: Installation Location Diagram

The Infra-View® infrared "non-contact" sensors can monitor flue gas temperatures in the boiler or furnace within the range of **250°F (120°C) to 3,000°F (1,650°C)**, with even higher temperature measurements also available.

Other Notable Features of Infra-View® Infrared Thermometers include:

- Operators can set adjustable alarms that sound off in the presence of FEGT changes (e.g., deviations from the set-point).
- Detect the occurrence of fouling and slagging.
- Digitally adjust the alarm set-point to suit different run and fuel conditions.
- Pyrometers can continuously measure temperatures between **250°F (120°C) to 3,000°F (1,650°C)**, with an accuracy of better than 1% (Max. Error + 30°F).

- Data Output: Digital 4–20 mA Loop Powered.
- A NIST Calibration Certificate can be requested.
- Response Time: 100 msec(600 readings/min.)
- The analog output is linear 0 to 20 mA OR 4 to 20 mA, and can be fully sub-scaled.
- Offers a Field of View that is 30:1 (i.e., 3 ft spot @ 90 ft).

Why Depend on Infra-View® Infrared Thermometers for FEGT Measurement?

Infra-View® offers a range of monitoring services to help you optimize your boiler's performance. These services include monitoring flue gas temperatures for soot blower, startup, slag control, low NOx, fireball centering, and FEGT monitoring.

The Infra-view system is a cost-effective instrument for measuring FEGT online and provides a wide range of flue gas temperature measurements. It has been successfully implemented on over 400 sites to offer real-time information for improving boiler operation, performance, and reliability. The system is easy to use, cost-effective and requires minimal maintenance.

Conclusion

Measuring FEGT is a crucial task in industrial furnaces to ensure efficient and safe operation. There are several methods for measuring FEGT, including contact and non-contact methods. The selection of the appropriate method depends on factors such as the temperature range of the exhaust gas stream, the accuracy required, and the presence of contaminants.

It is essential to consider the factors that can affect the accuracy of FEGT measurements, such as the placement of the temperature sensor, the type and size of the temperature sensor, the emissivity of the material being measured, and the presence of contaminants in the exhaust gas stream. By ensuring accurate and reliable FEGT measurements, industrial furnace operators can optimize the combustion process, improve energy efficiency, and maintain safe operating conditions.

Sources

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<https://www.infra-view.com/infrared-pyrometers/infrared-boiler-furnace-thermometer/technical-paper/>

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