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## **Question 69: What is your experience with using thermal scans or other methods to monitor tube wall temperature furnaces?**

**Chris Claesen** (NALCO Champion)

This is a common practice in furnaces that have severe operation (VBU, Coker, etc.). All VBU's have multiple fixed TMT measurements on all coils. Thermal imaging is used in furnaces that have specific TMT issues, it does require expertise and specialized thermal imaging cameras in order to get useful data. Thermal imaging will not work on tubes that have external fouling.

**Greg Savage** (NALCO Champion)

Thermography can help identify hot spots that will not be detected using fixed temperature measurements, however, there can be greater error in measurement. Additionally, flame height and pattern can be determined using thermography. Consequently, a combination of fixed temperature measurements and thermography is recommended.

**Pat Bernhagen** (Foster Wheeler USA Corporation)

This is a common and if properly performed a quite effective tool in monitoring difficult or sensitive heater services. Some refiners have their own scanning team and put all their heaters on a regular rotation of monitoring. Other refiners outsource to specialized companies. TSTC (tube skin thermocouples) are the other predominate tube wall measuring device. There are a number of advancements in the market for these TSTC over the traditional knife edge design. The advantages are more accurate readings and maintenance if properly installed. The combination of the thermal scan and TSTC is recommended for every heater. A scan should cover the TSTC area to verify both devices are reading true. The frequency of the thermal scan is largely dependent on the severity or sensitivity of the heater operation. Once or twice a year each heater should have a thermal scan but for instance a delayed coker heater should be monitored much more frequently say every week or two if in house people are available. On existing units consider providing additional sight ports and platforms as needed to improve the viewing of the tubes.

This is an important feature to consider in new units - provide adequate number of sight doors, necessary platforms, confirm view angles to ensure all tubes are in view and perhaps even the type of design if in critical service that has an inherently better ability to view all the tubes and full length of the tubes. Foster Wheeler's double fired Terrace Wall units both horizontal and vertical tube variety have full viewing capability as an example of benchmarks to compare against.

Several industry standard methods exist for tube-wall temperature measurement in heaters.

1. Tube skin thermocouples – installed at multiple locations for continuous measurement. These should be shielded type for accuracy and longevity, checked frequently, and replaced when failed.

2. Infrared Thermography – indicates via photograph the tube temperature and surrounding refractory. Temperatures are inferred from color, or contrast of photograph. Requires a large sight-port, special equipment, and is not practical for continuous or even frequent monitoring. Limited to identifying hot tube areas from flame impingement, fouling, and flue gas patterns. Can be used to monitor progress of fouling, checking of skin T/S, and flame condition.

3. Infrared Pyrometer – used with high intensity or high temperature heaters (e.g. ethylene and hydrogen production). Can be used to measure temperatures over the entire length of the tube. Ease of use for operators once per shift.

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