

TEMPERATURE MEASUREMENT FOR PETROCHEMICAL

Non-contact temperature monitoring for petrochemical applications including gas plants, oil refineries, and chemical plants



INNOVATIVE SOLUTIONS

Advanced Energy delivers innovative temperature and gas sensing solutions for petrochemical applications including gas plants, oil refineries, and chemical plants.

With a 60-year history of improving process control and safety with optical sensors, Advanced Energy delivers innovative temperature and gas sensing instruments for the Petrochemical market. While estimates put overall refinery efficiency at approximately 90%, many of the processes such as distillation and reforming require high temperatures that are very energy intensive. Small efficiency improvements in these processes can improve yields and provide immediate return on investment.

To realize these efficiency improvements, operators need to implement gas and temperature sensing solutions to understand how their equipment is performing and detect

developing failures. Our temperature solutions provide highly accurate data to help operators realize condition-based maintenance with continuous and remote monitoring.

Our unrivaled passion for excellence is why we have become one of the world's most trusted sensing solution providers. Beyond providing precision engineered instruments, our customers turn to us knowing our commitment to their success comes first. With expert application understanding and a growing portfolio of products, Advanced Energy can combine several technologies together into novel solutions even for the most complex environments.



Thermal Imaging Systems for Monitoring Critical Assets

Advanced Energy's Mikron thermal imaging cameras and systems accurately measure temperature and operate by using reliable infrared technology. These high-tech instruments can operate remotely and can precisely determine the object temperature and temperature distributions, even on small objects. These systems are fully turn-key so you get the most out of your investment. By delivering high-quality, reliable products combined with world-class service and support, our goal is to ensure peace of mind and the highest level of customer satisfaction.

Pyrometer Systems for Monitoring Critical Assets

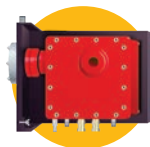
In-plant tests show infrared pyrometers are the most precise way to measure temperatures. Over 550 refineries, gas plants, and petrochemical companies with over 1,700 installations worldwide have looked to Advanced Energy's E²T product line for accurate infrared temperature data. When you install our Infrared Detection Systems, you are investing in proven experience, superior performance, and cost savings.

OUR SOLUTIONS

Flare Monitoring



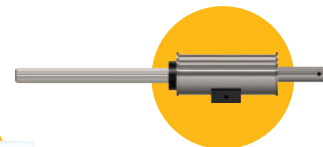
Sulfur Recovery Unit (SRU) Monitoring



Critical Vessel Monitoring



Reformer and Cracker Furnace Monitoring



FLARE STACK MONITORING

Quasar 2 Flare Monitor

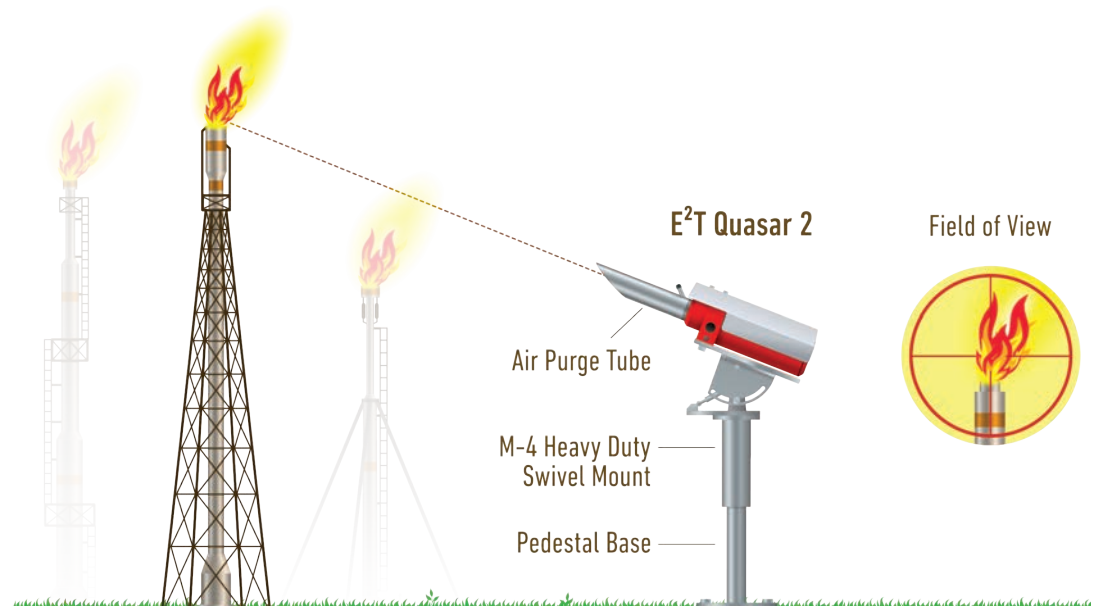
Pyrometer-Based System for Continuous Monitoring of Flared Gases from Remote Locations

Flare systems require pilot flame confirmation for safe operation to confirm there is an ignition source for flared gases. Furthermore, flares that do not ignite will release hazardous gases into the atmosphere, leading to safety risks to infrastructure, personnel, and non-compliance with environmental regulations.

Pilot flame detection must be monitored to assure ignition of flared gases during flare operation. Thermocouple failure due to thermal shock leaves operators without pilot monitoring capability until the next scheduled flare tip maintenance.

Thermocouple failure, flame movement, varying luminosity, and adverse climatic conditions are just a few of the obstacles which have to be overcome to gain long-term monitoring reliability without false alarms.

Advanced Energy's E²T Quasar 2 instruments provide continuous monitoring and detection of pilot flame and flared gases from flares. Two models are available: Quasar 2 M8100-EXP and Quasar 2 M8100-EXP Advanced. The base system provides basic flare pilot monitoring capabilities. The advanced system includes an intensity mA output, which allows the programming of multiple setpoints to indicate pilot flame detection and flaring status signals from the same unit.



The E²T Quasar 2 M8100-EXP Flare Stack Flare Monitors provide continuous monitoring of flared gases from remote locations up to ¼ mile (400 m) away in nearly any climate condition. This solution is ideal for confirming compliance with government-set pilot monitoring requirements.

High quality optics:

5 different optics are available to ensure a positive pilot flame detection.

Heavy duty accessories:

For easy mounting, alignment and focusing on the target, a heavy duty swivel mount with locking and adjusting capability is required. The optional M-4 Heavy Duty Swivel Mount offers secure and stable mounting when combined with the M-8 pedestal mount, a steel pipe assembly with a bolt down plate to secure the M-8 to a foundation. All mounting hardware is sold separately.

Easy maintenance or replacement:

The heart of the system is the Quasar 2 M8100-EXP, a non-contact infrared electro-optical package which can be removed from the explosion-proof housing for repairs or replacement, leaving intact all wiring and alignment of the system.

TYPICAL APPLICATIONS

Elevated Flares

- Steam Assisted
- Air Assisted
- Gas Assisted

Off-Shore Flares**Ground Flares**

- Burn Pit Flares
- Ground Flare Arrays

Staged Flares

Quasar 2

FLARE STACK MONITORING

FlareSpection™

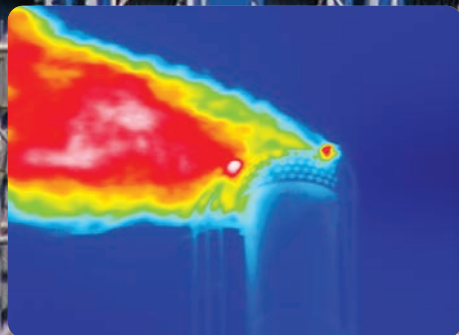
Thermal imaging system designed for continuous monitoring of pilot flames and flaring operations

Flare tips in close proximity cause interference from adjacent flare tip interposing flames. The Advanced Energy FlareSpection system is designed to provide the clearest flare image and pilot flame monitoring for applications with multiple flare tips in close proximity. In addition, the FlareSpection's unmatched spatial resolution enables discrete detection of individual pilots of a flare.

The thermal imaging-based flare monitoring system enables users to confirm flare operation remotely and automatically, detecting differences in heat signatures of the flare stack. Designed with special spectral ranges, calibrations, and optics, this system is able to focus clearly through moisture, heavy rain, and fog from very long distances.

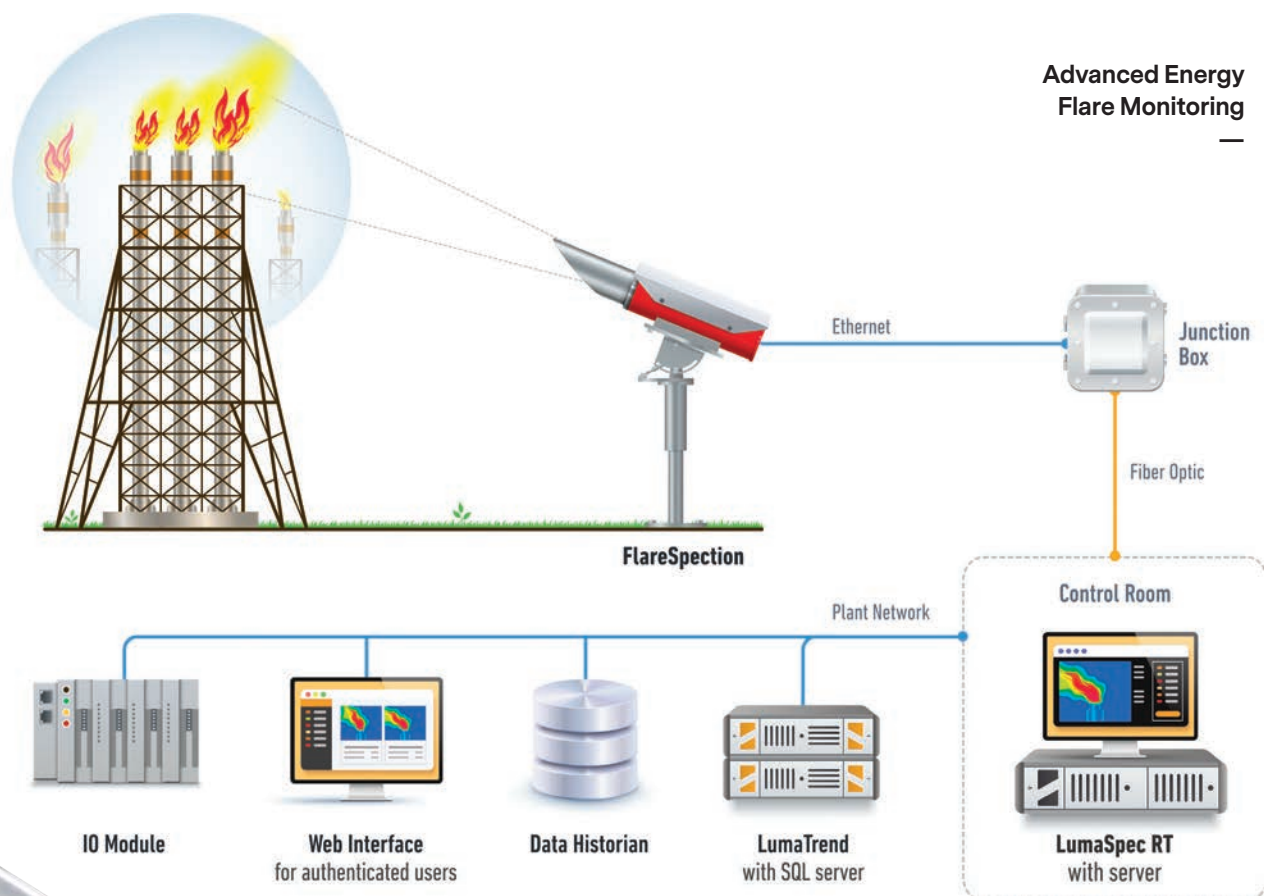
With an adjustable mount and base, the powerful lens and high-resolution camera offer a clear view of flare details from a convenient ground mounting location. The camera is protected in a stainless steel enclosure with an integrated site tube to prevent dust and dirt on the window, enabling long-term use with minimal maintenance.

The system includes the capability to log performance for audits, record video for reviewing historical events, and set up automated alerts. The software also easily connects to the plant DCS via protocols such as Modbus and OPC, enabling closed-loop integration.



- Archive of flare with date and timestamp
- See H₂ (clear) flares
- Provide video image to control room of flare
- Easy to integrate data into existing DCS via protocols, analog outputs, and relays

Advanced Energy Flare Monitoring



FLARESPECTION SYSTEM COMPONENTS



Infrared Thermometry for Sulfur Reactors

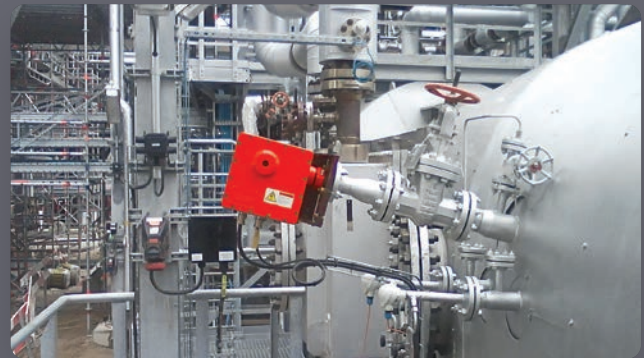
Continuous measurement of Refractory Temperature (RT), Gas Temperature (GT), and Integrated Temperature (FF)

Optimal operation of Sulfur Recovery Unit (SRU), Sulfur Burner, and Thermal Oxidizer furnaces require accurate process Gas (Flame) measurement and accurate Refractory measurement for operational safety (high temperature alarms).

Of particular importance, is control of the furnace process temperatures to prevent damage to the furnace refractory and assurance that reaction or destruction temperatures are reached and maintained.

Thermocouple measurement of acid processes either fail prematurely or are protected by multiple thermo wells and sweep air systems that make thermal transmission to the actual thermocouple inaccurate or slow and only provides a refractory measurement not useful for process control.

Typical single channel infrared pyrometers do not compensate for changing flame transparencies and only provide one wavelength measurement. Operators must settle for either a Gas (Flame) or Refractory measurement or make multiple installations requiring multiple ports and hardware installations.

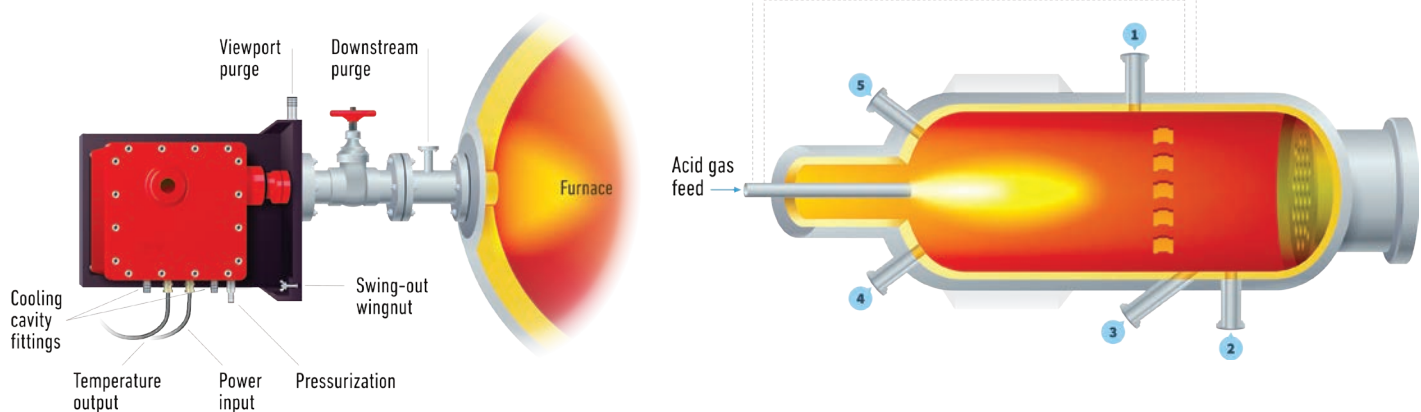


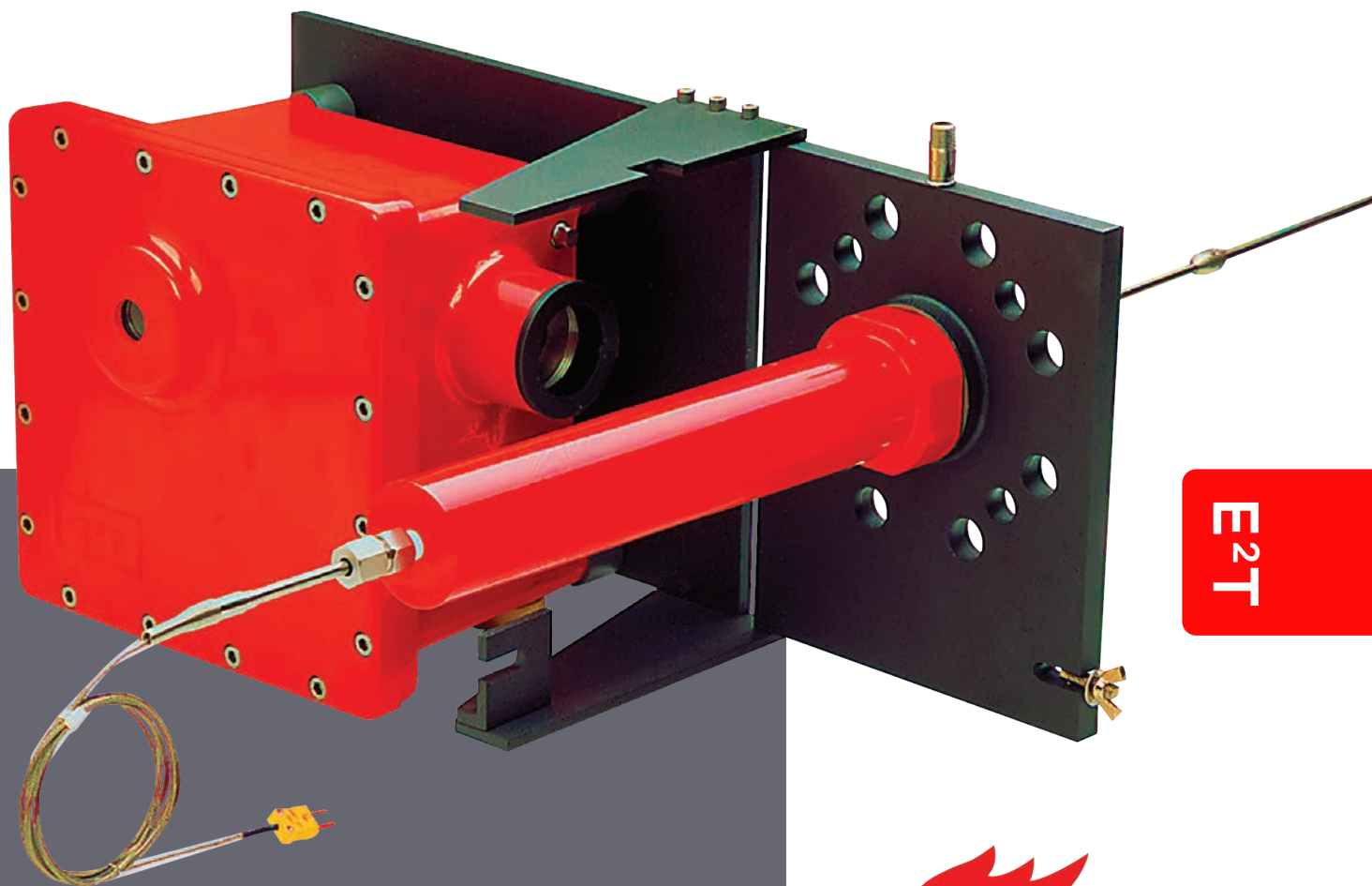
The Advanced Energy Solution

A single system installation with two independent IR filtered detectors that provides both Gas (Flame) and Refractory measurements simultaneously.

The innovative Advanced Energy Smart FMA™ Flame Measurement Algorithm allows for accurate real-time flame transparency compensation and correction.

Applying flame transparency calculation with FMA removes the flame transparency errors that typical IR pyrometers experience to the Gas (Flame) and Refractory temperatures, providing the highest accuracy in process temperatures.





E2T

Pulsar 4

Advanced Energy's new generation E²T Pulsar 4 combines continuous measurement of gas and refractory temperatures, reporting both readings simultaneously in one instrument.

The Pulsar 4 is a single channel option for direct replacement of our older Pulsar II products. The Pulsar 4 Advanced features include two analog outputs, Smart FMA capability, and HART protocol.

TRUSTED PROVIDER

Over 550 refineries, gas plants and petrochemical companies with over 1,700 installations worldwide have looked to us for accurate infrared temperature data. When you install E²T Pulsar 4 infrared thermometers, you are investing in proven experience, superior performance, and ultimate cost savings.



Higher Area Class
IIB+H2



High Ambient
No Cooling



Flexible Power
24VDC/120/230VAC



SMART FMA™

Pulsar 4 Advanced Only

Advanced Energy has developed a unique method called Smart Flame Measurement Algorithm (Smart FMA) to compensate for varying gas transparency and their effects on gas and refractory IR temperature measurements. In a normal situation, a dirty flame can increase the signal emitted from the refractory depending on the quality, quantity, and absorption of the flame.

In a similar manner, some transparency of the flame or hot gas can cause refractory radiance to decrease the flame temperature. The Smart FMA algorithm virtually removes these unwanted 'crosstalk' artifacts and solves for more meaningful refractory and flame/hot gas temperatures in real time.

Real-Time Fault Detection and Monitoring

Continuous, non-contact measurement solution for monitoring critical vessels such as gasifier skin temperature

Critical vessels in the chemical, refining, and power industries operate at high temperature and pressure and are at risk of failure as joints and refractory degrade. The consequences of undetected failures can be very serious.

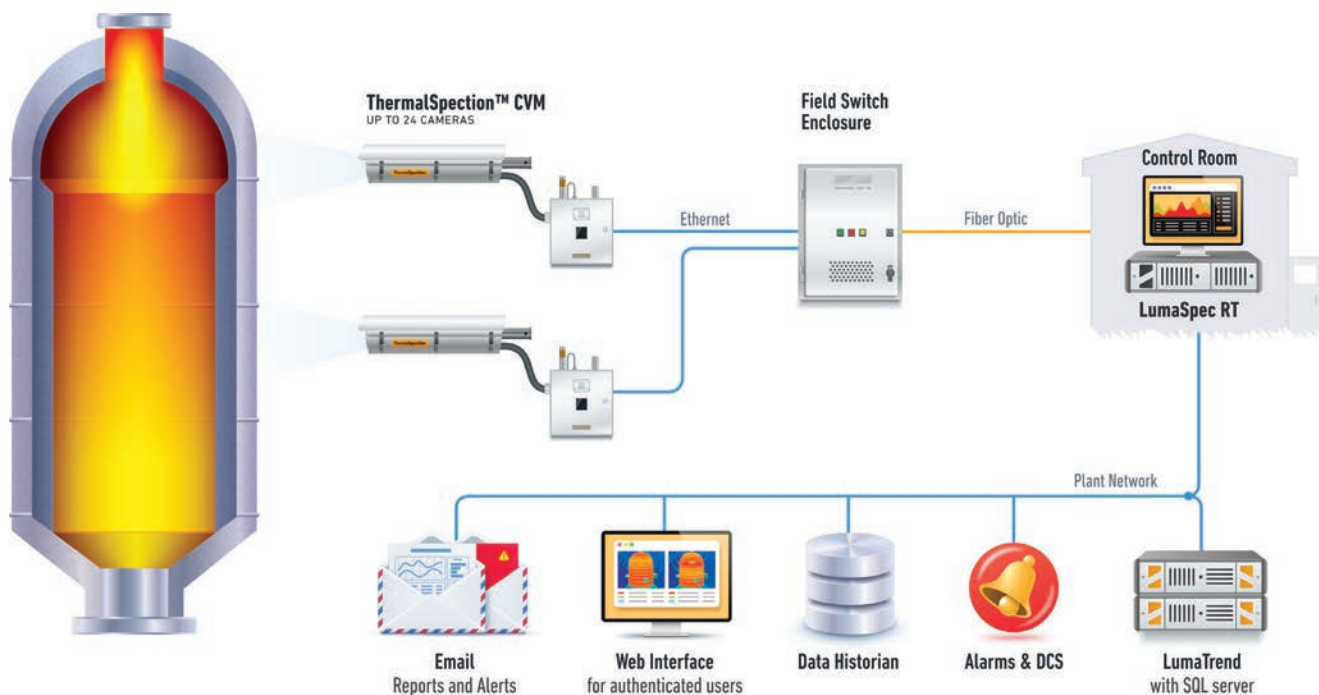
For many years, thermocouple systems and fiber optic sensors have been viewed as the traditional solution for temperature measurement in critical vessel monitoring applications. Yet, these sensors can be both unreliable and cost prohibitive to install and operate. They typically utilize wired or fiber optic networks and employ point sensors that only monitor the temperature of discrete points on the outside of a vessel.

In addition, failures of thermocouples leave dangerous holes in overall monitoring schemes until replacement or repair can be made. Of course, missing points in the monitoring scheme put the critical vessel, plant, and staff at risk when unexpected hot spots arise.

Thermal imaging cameras allow operators of high temperature and high pressure vessels to see, in color, real-time thermal behaviors of equipment. This insight is unavailable with fiber optic systems, giving infrared thermal imaging an edge when it comes to early detection of possible failures.

Thermal imaging systems go further by providing a more complete look at the temperature profile of the vessel; highlighting where potential dangers lie. With a system of infrared cameras constantly monitoring the environment as a whole, it is far less likely that a potential problem will be missed.

The ThermalSpection CVM system uses non-contact thermal imaging to provide real-time, continuous, automated fault detection and monitoring for your most critical assets.

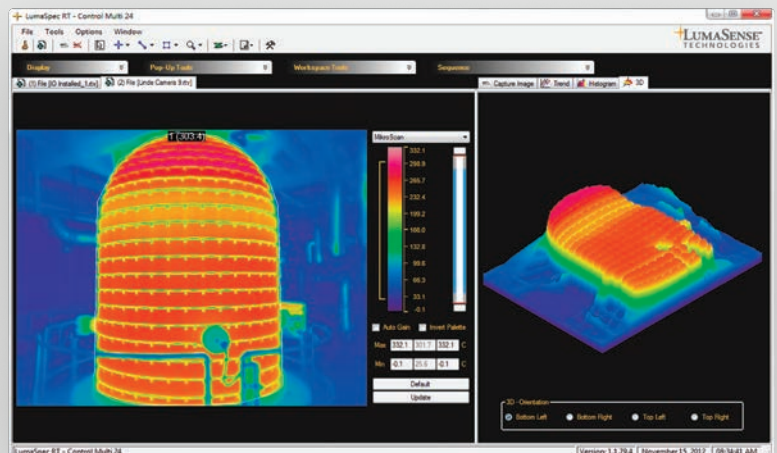




ThermalSpec™ CVM

The ThermalSpec™ Critical Vessel Monitoring system is a turn-key solution for monitoring critical vessels, such as gasifier skin temperature.

Each thermal imaging camera is mounted in a sealed housing that includes internal cooling and a positive pressure purge to prevent dirt or flammable gases from entering the enclosure. Advanced Energy's LumaSpec™ software provides advanced features in a user-friendly interface. From a single computer, the software can send commands to and gather data from up to 24 cameras mounted in the field.



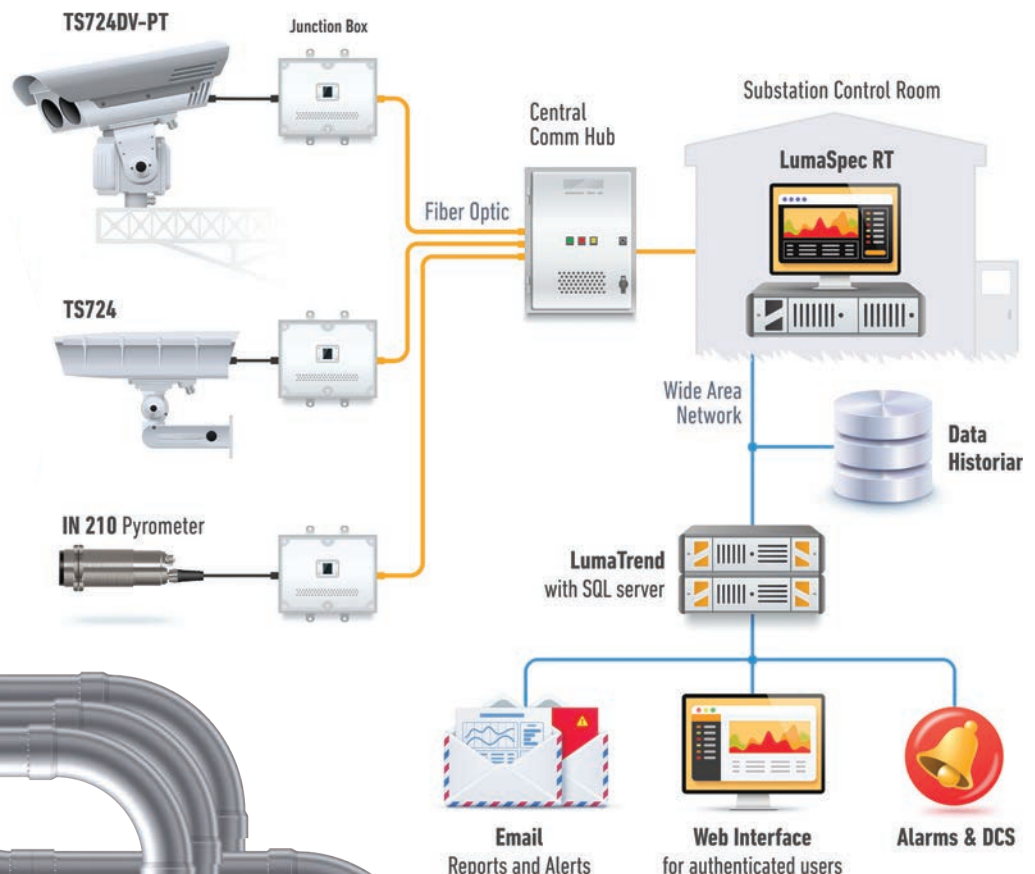
THERMAL IMAGING FOR ASSET MONITORING

Automated, continuous thermal and visual imaging to identify thermal abnormalities within industrial and petrochemical pipelines.

The ThermalSpection 724 Remote Thermal Monitoring solution represents another milestone in innovative infrared thermometry. With its multiple camera system functionality, it is the first system to allow remote monitoring of temperatures in real time via image data obtained from one or more cameras and sent to a single central controller.

Designed with advanced maintenance-free electronics and industrial protective packaging, the ThermalSpection 724 solution offers a high degree of accuracy for demanding industrial settings, while quickly measuring temperature without contact in even the most adverse environments.

Monitor industrial and petrochemical pipelines for leaks and fuel storage facilities for hot spots.





TS724DV-PT: Pan-Tilt Thermal Imager

**Real-Time, Remote Monitoring/
Control with Full Range Pan-and-Tilt
Capability.**

- High resolution readings of 0.08°C at up to 60 measurements per second
- Temperature measurement between -40°C and 500°C
- Alarm communication via OPC/Modbus or standard alarm feedback (relay, 4-20mA, 0-10V, etc.)
- Multi-Spot temperature measurement with independent emissivity settings at each "Tour" location



TS724: Fixed Mount Thermal Imager

**High Performance Infrared Camera
for Demanding Real-Time Imaging
Applications.**

- High performance, cost-effective complete monitoring solution
- Advanced maintenance-free electronics and industrial protective packaging
- Serves the industry's broadest range of process monitoring applications
- Superior images and temperature measurement for long- and mid-wave applications

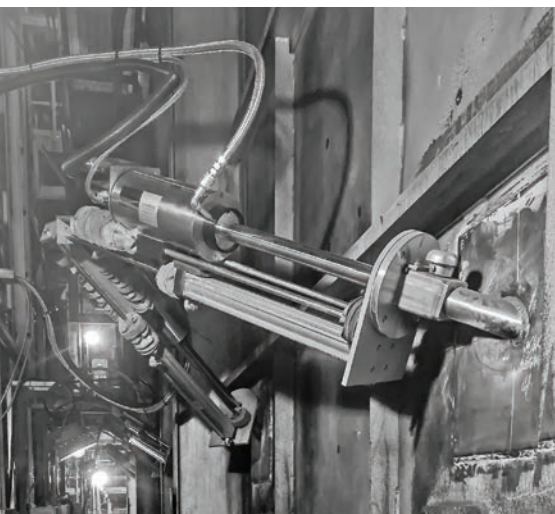


IN 210: Compact pyrometer for non- metallic surfaces

**Small, stationary infrared thermom-
eter for non-contact temperature
measurement of coated metal and
non-metallic surfaces.**

- Measure temperature of objects between -32°C and 900°C hidden from view of imagers
- Small, stainless steel housing dimensions suitable for use in confined spaces
- Easy electrical and mechanical installation
- Ambient temperature up to 70°C without cooling

IMPROVING FURNACE EFFICIENCY AND SAFETY



Reformer and Cracker furnaces are critical equipment in petrochemical refineries. Common concerns include proper tuning of the burner firing efficiency and maintaining the furnace tubes at the correct temperatures to prolong the life of the tubes. The objective is to minimize variation in tube wall temperature (TWT) and operate at a higher outlet temperature (ROT) without violating maximum allowable TWT.

Conventional methods of monitoring include portable pyrometers, portable thermal imagers, and shielded Type-K thermocouples. However, these methods have been proven to be unreliable, expensive to implement, prone to operator variation, and do not provide comprehensive ability to detect hot spots.

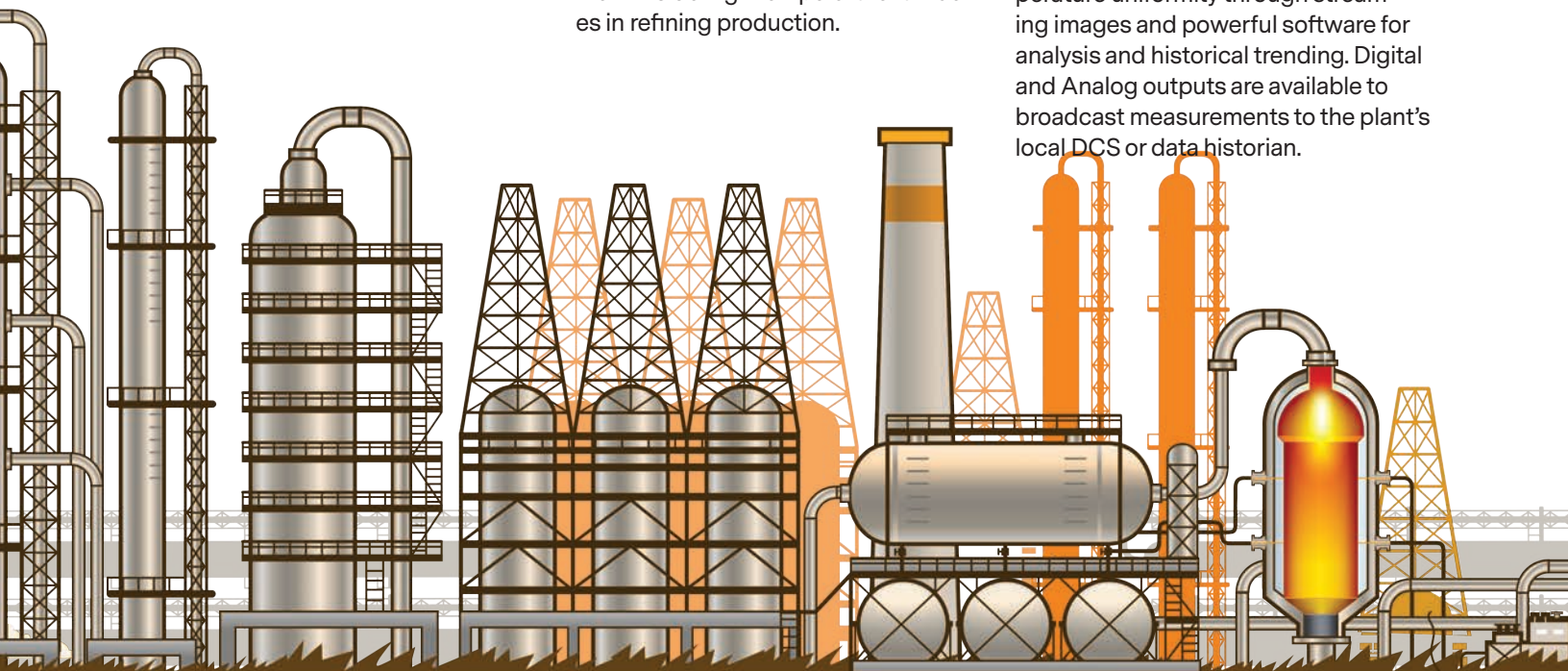
FurnaceSpection thermal imaging systems are designed and developed for continuous temperature measurement inside high temperature furnaces in refining production.

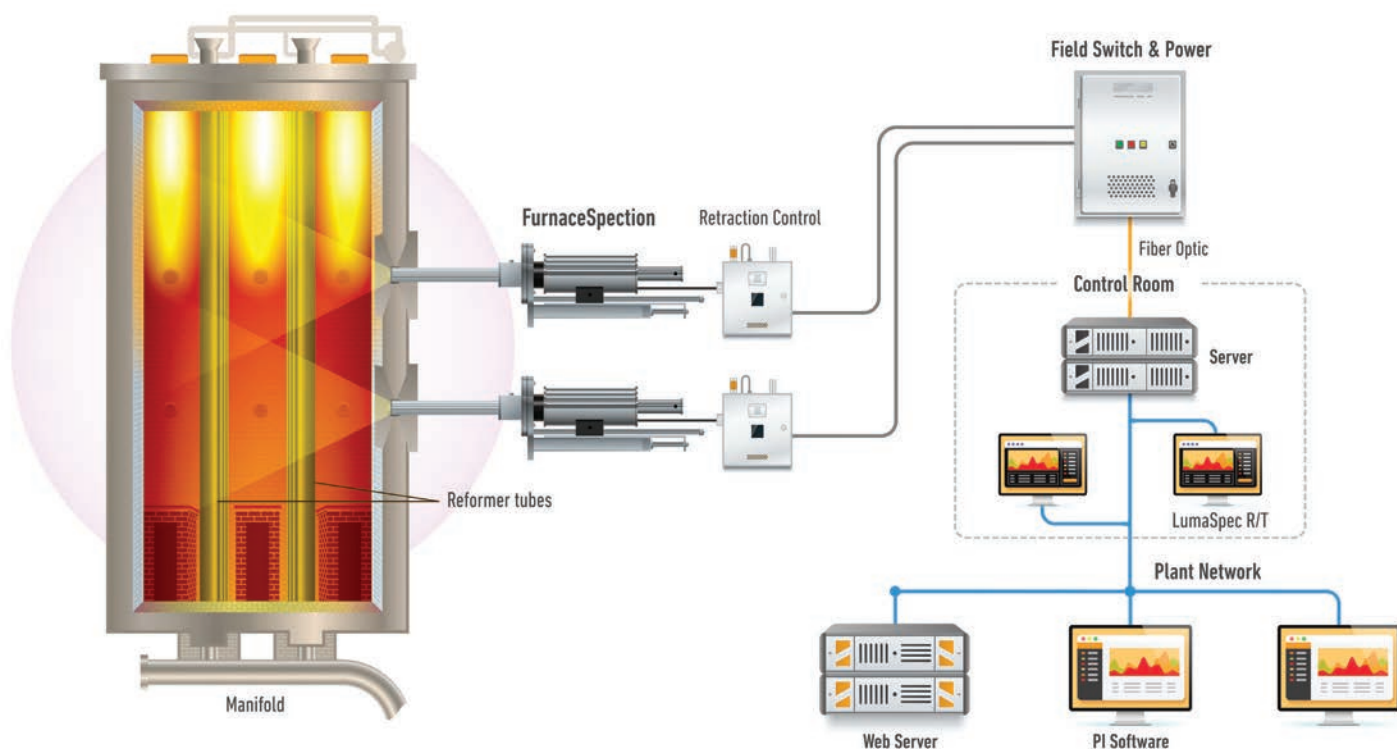
FurnaceSpection's proven technology provides critical insight for failure prevention and asset management.

The FurnaceSpection™ system provides users with a real-time tool for quickly and accurately identifying process abnormalities before they develop into problems that can lead to unplanned outages. This radiometrically calibrated imager accurately measures the temperature of product, refractory, and heat transfer surfaces inside natural gas fired furnaces.

For petrochemical reformers, this is a critical tool to ensure tubes perform optimally for their longest possible life cycle. At a cost of several thousands of dollars per tube and a re-tubing costs in the millions, a significant amount of capital can be lost if tube failure goes unnoticed or tubes are retired too early or too late.

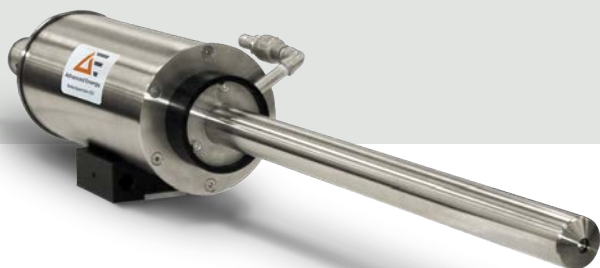
FurnaceSpection™ helps operators monitor and control process temperature uniformity through streaming images and powerful software for analysis and historical trending. Digital and Analog outputs are available to broadcast measurements to the plant's local DCS or data historian.





FurnaceSpection™

- Network of specialized thermal imagers designed for continuously viewing inside tube furnaces.
- Accurate 640×480 focal-plane array thermal imaging camera with sensitivity of 0.06°
- Rugged IP66, air cooled, protective enclosure
- Boroscope optics filtered at $0.85 \mu\text{m}$ wavelength to view through combustion gas and flames
- Ethernet interface for long distance reliable communication
- Auto-retraction system to remove cameras from furnace in the event of cooling system failure
- Class 1 DIV 2 compliant
- Complete system integration with installation support



LumaSpec RT Software

- Real-time thermal imaging software
- Real-time analysis and display of temperature data (e.g. HotSpots, Isotherms).
- Software collects streaming thermal data from cameras and continuously calculates TWT for display to operator and output directly to DCS.
- Systematic monitoring of user-defined regions with automatic alarming mode.
- Integration into an existing company network via Ethernet and output directly to plant DCS via standard protocols.





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ABOUT ADVANCED ENERGY

Advanced Energy (AE) has devoted more than three decades to perfecting power for its global customers. AE designs and manufactures highly engineered, precision power conversion, measurement and control solutions for mission-critical applications and processes.

AE's power solutions enable customer innovation in complex semiconductor and industrial thin film plasma manufacturing processes, demanding high and low voltage applications, and temperature-critical thermal processes.

With deep applications know-how and responsive service and support across the globe, AE builds collaborative partnerships to meet rapid technological developments, propel growth for its customers and power the future of technology.

PRECISION | POWER | PERFORMANCE

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