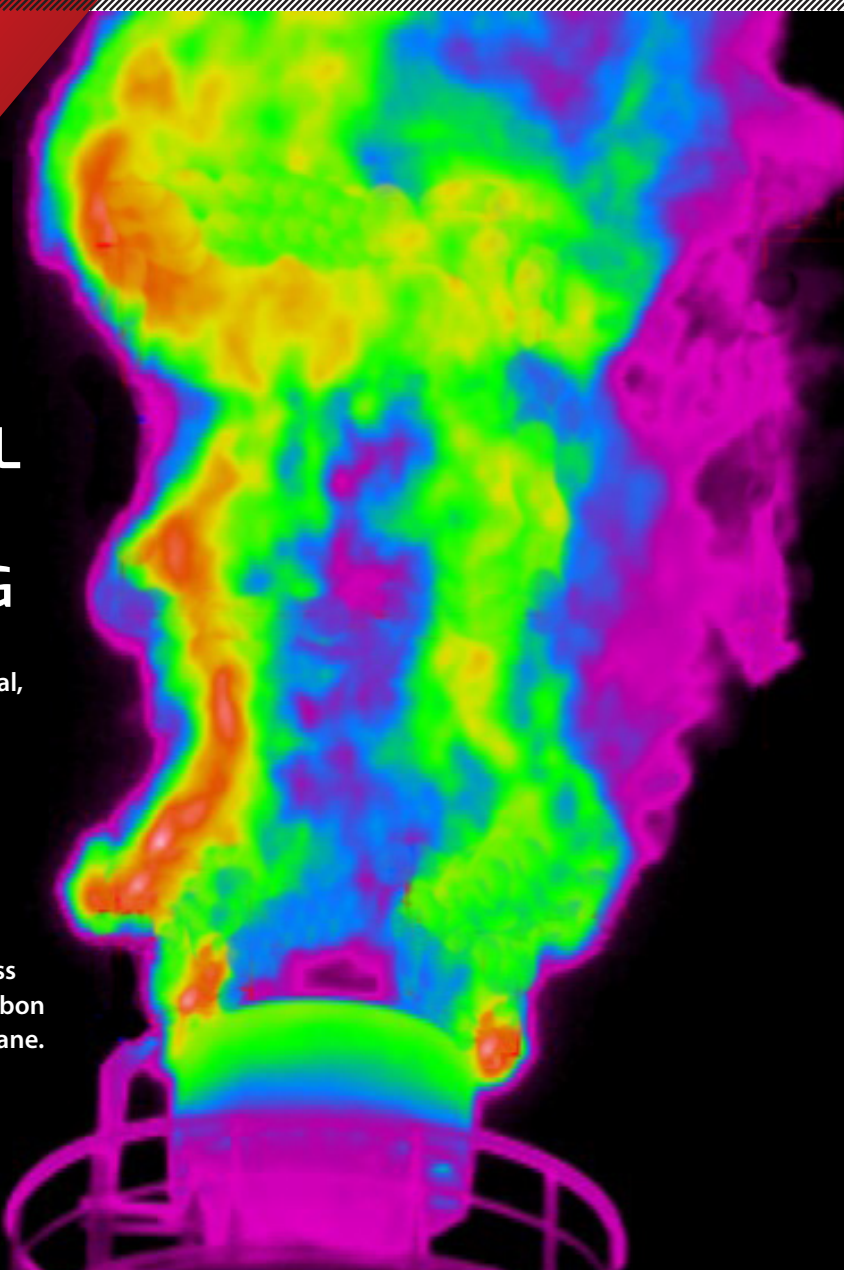
LAND

AMETEK®

FLARE STACK MONITORING

APPLICATION NOTE



ADVANTAGES OF THERMAL IMAGING FOR EFFECTIVE FLARE STACK MONITORING

Flare stacks are widely used in industries especially chemical, petrochemical and steel to safely dispose of excess gasses through combustion.

These may be unwanted waste gases, or flammable gases released to prevent unplanned over-pressurising of plant equipment.

Simply venting these untreated hydrocarbons into the air creates an environmental hazard. Burning these gases is less harmful – for example, if methane is burned to produce carbon dioxide and steam, it is less damaging than releasing methane.

Environmental regulations require close monitoring of the flare stack to prevent pollutants, particularly unburned hydrocarbons, from entering the atmosphere.

WHY IS FLARE STACK MONITORING IMPORTANT?

There are practical and regulatory requirements to monitor the flare stack for the presence of a flame, and to ensure that proper combustion has taken place. It is also important to monitor the pilot light to make certain it is continuously operating. If flare stack combustion is lost for any reason, the plant operator needs to know as early as possible, so they can get the flame reignited and prevent plant shutdown.

SAFETY

Pollutants escaping into the atmosphere can be hazardous to the health of plant personnel and may damage machinery. Unburned pollutants could also build up and cause an explosion.

REGULATIONS

Flare systems are the last line of defence against pollutant emissions. Methane, for example, is significantly more damaging as a greenhouse gas than the carbon dioxide produced when it is burned. To prevent harmful emissions being released into the atmosphere, environmental regulators demand that the stack's flame or pilot light is monitored at all times.

PILOT LIGHTS

The pilot light exists to light the excess gases as they exit the stack, which causes the flare. It must be 'always on', to ensure that the gas is ignited even if the flare goes out. Monitoring the pilot light is a key part of flare stack control systems, but can be challenging. Remote monitoring must be carried out from at least 300m (984ft), while the pilot flame is typically 30cm (11.8in) in diameter, with the trend towards reducing flame size.

APP NOTE

Continuous operation of the flare stack is a critical requirement under US EPA regulations.

MONITORING METHODS

FOUR MAIN METHODS EXIST FOR MONITORING THE PILOT LIGHT OR FLARE STACK TO ENSURE IGNITION. THESE ARE:

- THERMOCOUPLES
- UV SENSORS
- CCTV
- INFRARED THERMAL IMAGERS

THERMOCOUPLES

Thermocouples are often used very effectively to monitor pilot lights and are mounted at the flame. However, thermocouples are prone to failure because of the hot, corrosive conditions they are used in. Failure is frequent, and it is difficult to replace damaged thermocouples because of the harsh conditions at the installation location. Replacement can usually only be accomplished during a plant shutdown. There is also a potential safety issue in that an engineer has to be sent to the pilot light location, at the top of the stack, to replace the thermocouple.

UV SENSORS

UV sensors detect a flame through its emitted ultra-violet (UV) energy, and are often used to monitor flames inside furnaces. They are less effective for flare stack applications, and need to be installed close to the stack, otherwise they may detect UV energy from other sources, such as reflected sunlight. A change in gas combination, low flow, or smoke can all cause unreliable results and false alarms.

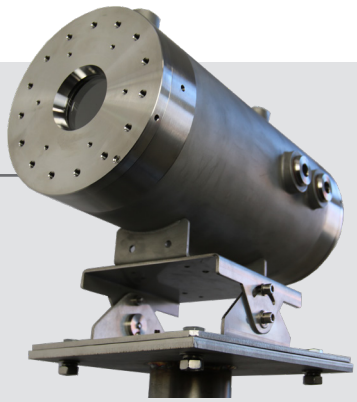
CCTV

Flare stacks can be monitored remotely through a closed-circuit television (CCTV) camera. The major drawback with this system is that it requires an operator to manually monitor the flame at all times. In addition, depending on the gas content, the flame may burn clear and therefore be invisible to the naked eye. This makes it difficult to accurately determine whether or not the flame has gone out and provide a timely response.

ADVANTAGES

THERMAL IMAGERS FOR FLARE STACK MONITORING:

- READINGS UNAFFECTED BY UV REFLECTIONS
- ABLE TO VISUALISE NON-VISIBLE FLAMES
- NO CONSUMABLES REQUIRED AND LOW MAINTENANCE



FLARE STACK MONITORING IMAGER WITH HAZARDOUS AREA CERTIFIED AND WEATHERPROOF ENCLOSURE

FLARE STACK MONITORING PROBLEMS

A NUMBER OF ISSUES MAKE MONITORING THE FLARE STACK LESS THAN STRAIGHTFORWARD.

CONDITIONS

The environment at the flare stack is extremely hot and often corrosive. This makes close-contact measurements very difficult. It also makes maintenance and replacement of measurement devices highly hazardous.

WEATHER

Monitors usually focus on a narrow, distinct area of the flare stack. If wind conditions push the flame away from this area, it can produce a false reading.

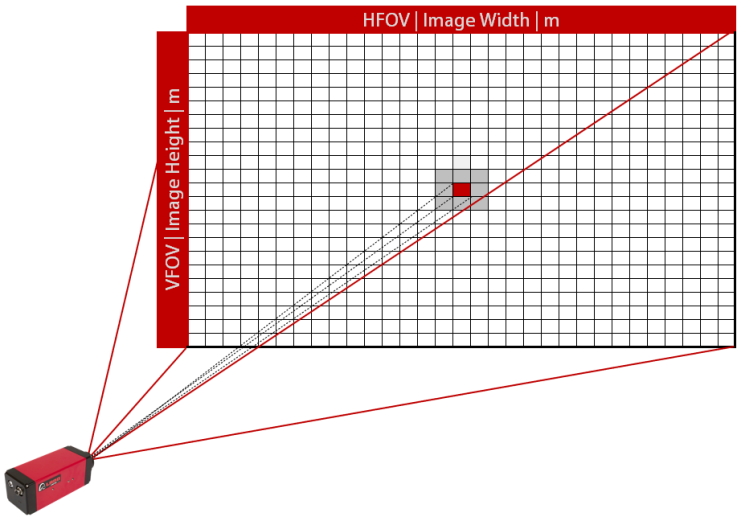
FLAME VISIBILITY

Sometimes the gases burned off by the flare stack will combust without producing any colour. This produces a transparent flame which will not be detectable by visual means and may be incorrectly taken as an indicator that the flare stack flame has gone out.

IMAGER FIELD OF VIEW (FOV)

Because the flare stack flame is exposed to the elements, it is subject to the weather. This means it can be blown out of position by the wind, and so non-contact measurement devices can lose their view of it.

The flare stack monitoring imager's wide field of view provides a solution to this problem. It is customisable with a 6° horizontal field of view (HFOV), providing good coverage around the flare stack and safely monitoring the flare and the pilot flames presence. In addition, the advanced IMAGEPro V2 thermal imaging software allows the operator to set up customised regions of interest (ROI) coupled with alarm threshold levels to monitor and control status of the flare and pilot flames 24/7. This means it can continue to monitor the flame even if it is moved by the weather, providing high-low temperature alarms for each region.



Distance	100 m			150 m		
HFOV x IFOV	Width	Height	IFOV*	Width	Height	IFOV*
6° x 4°	10.48 m	6.98 m	27.3 mm	15.7 m	10.5 m	40.9 mm

200 m			250 m			300 m		
Width	Height	IFOV*	Width	Height	IFOV*	Width	Height	IFOV*
21.0 m	14.0 m	54.5 mm	26.2 m	17.5 m	68.2 mm	31.4 m	21.0 m	81.8 mm

* Centre IFOV

THERMAL IMAGING

Infrared (IR) thermal imaging provides the most accurate and reliable way to monitor the flare stack.

An IR camera such as AMETEK Land's flare stack monitoring imager produces high-resolution thermal images of any target, from any distance. This allows the flame to be monitored from a safe distance, ensuring the camera is not damaged by stack conditions. It also makes maintenance much safer and easier.

IR cameras produce a visual image, but also detect the infrared radiation emitted from the flame. This means the camera sees the flame whether it is coloured or clear, and whatever the weather.

The LWIR-640 offers a wide detection range from 100 °C to 1000 °C (212 °F to 1832 °F), so, if the gas composition changes and affects the temperature of the flame, the LWIR-640 continues to supply an accurate measurement.

The range is high enough to ensure that background heat is ignored.

It also operates in ambient temperatures from -20 °C to 60 °C (-4 °F to 140 °F), making it suitable for installation in almost any location.

The pilot light emits more IR radiation than UV, so IR cameras are also very well suited to this application, particularly given their ability to provide continuous, remote monitoring and a fast-response alarm.

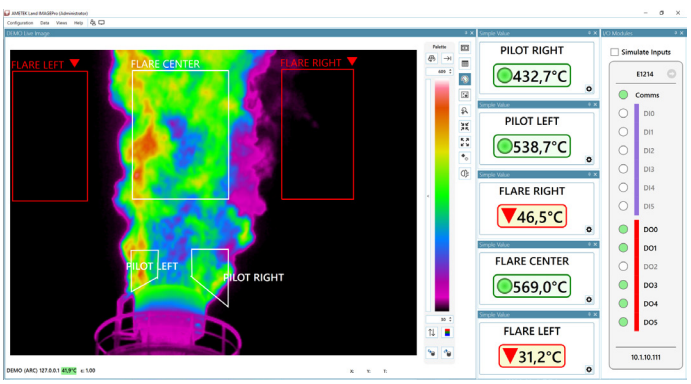
IMPORTANCE OF TEMPERATURE MONITORING

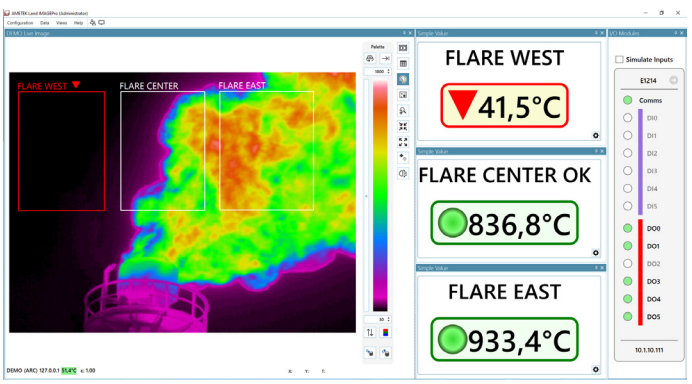
Waste gas components will burn at different temperatures, so ensuring the flare stack does not drop below an effective temperature is critical to delivering complete combustion of the gas.

For example, toluene typically burns at around 554 °C (1029 °F) in flare stack conditions, while benzene usually doesn't burn until the temperature reaches about 565 °C (1049 °F). If the flare stack flame falls to 560 °C (1040 °F), the toluene will be burned off, but the benzene will not.

To complicate matters further, these temperatures are not exact, but are affected by other conditions such as pressure and the mixture of gases being burned. It is therefore extremely important to keep the flame temperature high.

However, most flare stack systems rely on the injection of steam to increase the flame temperature, by inducing air into the flame. Monitoring the upper temperature level of the flame ensures that the flame is not 'over-steamed', and so controls efficiency. This reduces the fuel costs of steam production, and can provide significant savings.





IMAGEPRO V2

IMAGEPro V2 is our innovative, advanced image processing software utility developed to control, monitor, analyse and capture data from thermal imaging cameras.

A Windows PC-based software system, it enables the configuration of an imager, display properties and advanced temperature analysis options.

IMAGEPro V2 can support up to 16 thermal imagers simultaneously, providing real-time analysis and exceptional functionality, delivering detailed user control over thermal imaging measurements.

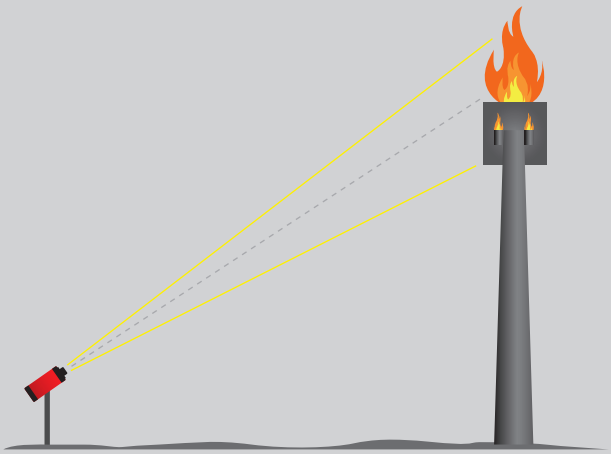
Up to 100 regions of interest are available per camera, using points, rectangle, ellipse free-drawn or profile lines. Profile line, histogram, trend and gauge graphs are generated for analysis.

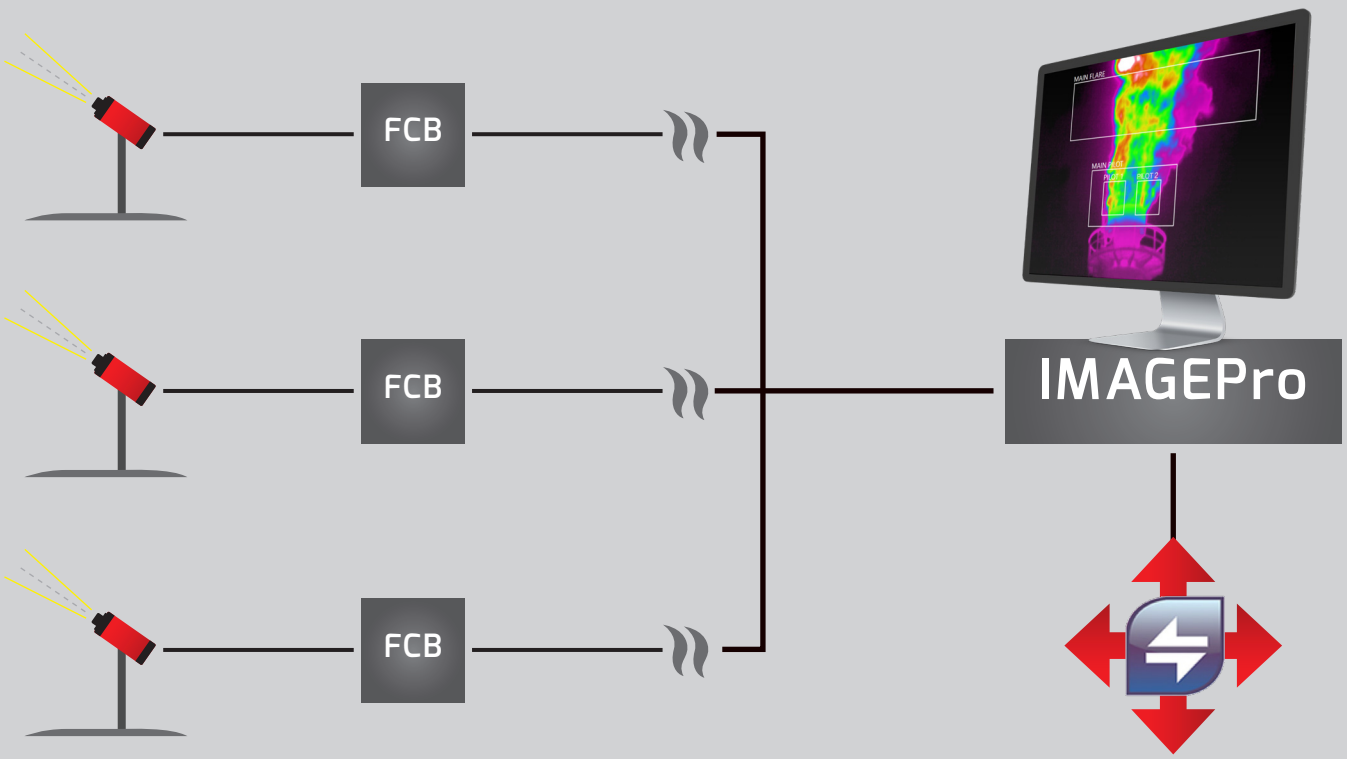
Flexible communications enable the exchange of information using a simple cross-platform Modbus TCP protocol, analogue signals or alarm output via I/O modules, while password protection ensures that only users with the correct access can change system configurations.

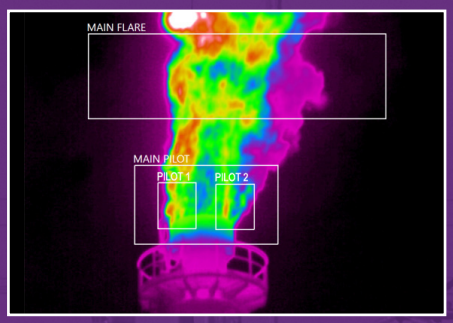
A free 30-day trial version is available for extensive testing.

SYSTEM DIAGRAMS

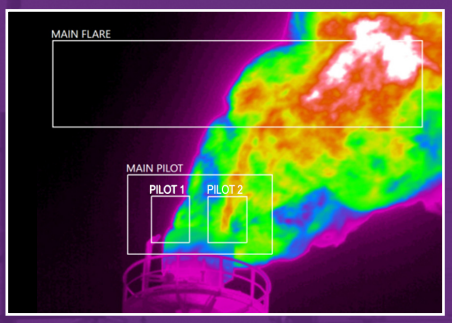
IMAGEPro V2 software can support multiple thermal imagers in an integrated flare stack monitoring system.



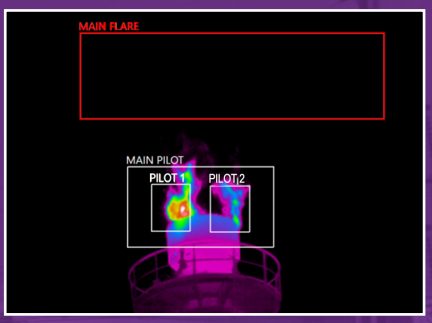




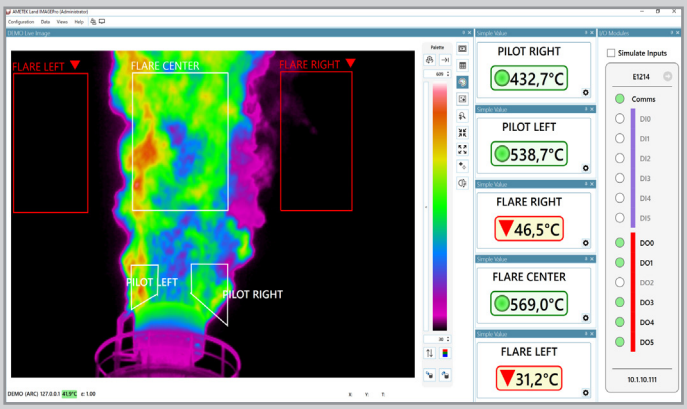
Single Camera View (Full Flare Flame)

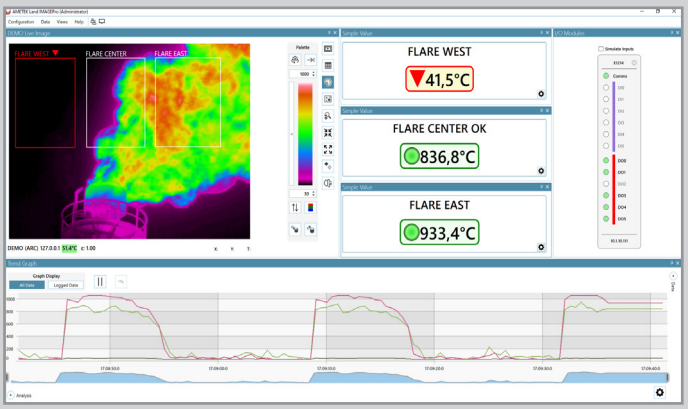


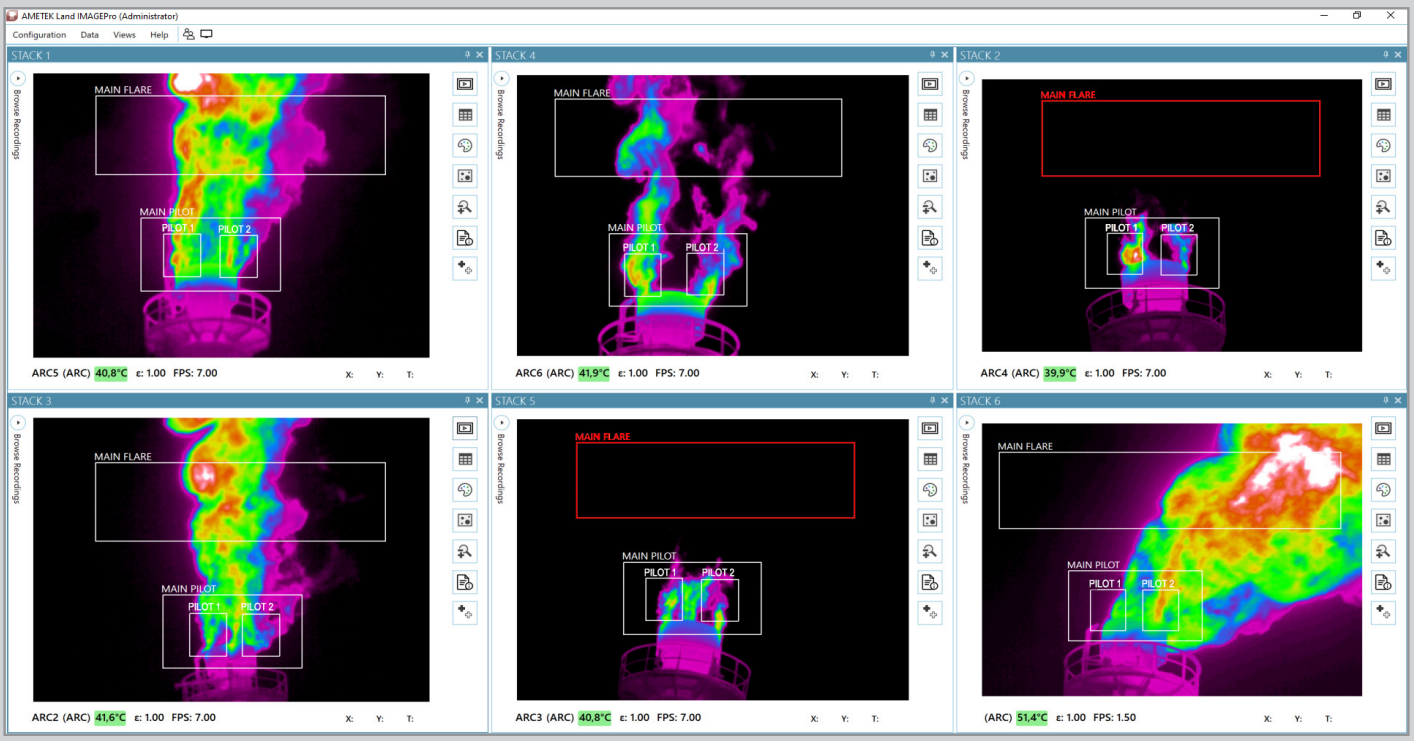
Single Camera View (Full Flare Flame)



Single Camera View (Pilot Flames)







IMAGEPro V2 | Multiple Camera Analysis/Monitoring

AMETEK LAND SOFTWARE ENABLES DETAILED VISUALISATION OF THE THERMAL DATA AND THE ABILITY TO SET ALARMS IF THE TEMPERATURE FALLS TOO LOW (OR, IN SOME CASES, RISES TOO HIGH).

CONCLUSION

Thermal imaging using an IR camera provides the most effective, cost-efficient and safe method of monitoring the flame at the flare stack. These benefits also apply to monitoring of the pilot light.

By viewing the flame from a safe distance, the camera avoids the possibility of damage from the hazardous conditions at the flare stack. Should maintenance become necessary, it is easier and safer for an engineer to attend the installation location.

The thermal imaging technology allows for remote automated viewing, with alarm settings to warn if action needs to be taken. The LWIR-640 camera monitors the flame temperature with unsurpassed accuracy and a wide field of view, viewing the flame even when it is completely clear.

The ability to select up to four regions of interest ensures that measurements continue to be made even when the flame is moved by wind conditions.

By delivering accurate and reliable monitoring, the LWIR-640 helps ensure that plants can meet flare stack emissions requirements in a safe and efficient operation.

LWIR-640 FEATURES AND BENEFITS

FEATURES	BENEFITS
High-resolution radiometric thermal images	Unsurpassed temperature accuracy
Variable lens options	View any target at any distance with outstanding clarity
Wide ambient temperature range	Suitable for installation in just about any climate
Configurable regions of interest	Range of settings always keeps the target in view
Monitoring whatever the weather	User-friendly software control

AMETEK LAND'S EMISSIONS AND OPACITY MONITORS FOR STACK APPLICATIONS

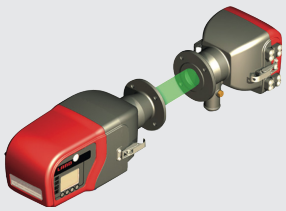
4500 MkIII

Industry-leading opacity monitor for PS-1 and ASTM D6216 compliance measurements. Installed on the stack, or ducts leading to the stack.

COMBUSTION & EMISSION MONITORING

Model 4200 +

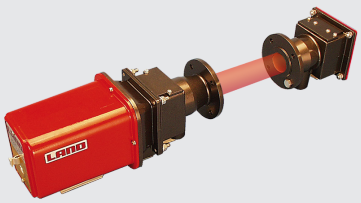
Accurate, stable opacity monitor for non-compliance applications. Designed for measuring dust concentrations in stack gas emissions.



COMBUSTION & EMISSION MONITORING

Model 4200

Compact, effective and lightweight particulate monitor designed to measure dust emissions in industrial processes and non-compliance applications.



COMBUSTION & EMISSION MONITORING

Model 4650

For continuous measurement of the concentration of low-range particulate matter in stacks and ducts. Can be used as a PM-CEMS or PM-CPMS.

COMBUSTION & EMISSION MONITORING

FGA

A simple, rugged and reliable analyser for accurate measurements of carbon monoxide, nitric oxide and oxygen in flue gases.

COMBUSTION & EMISSION MONITORING

Lancom 4

A portable flue gas analyser featuring up to nine sensors for emissions measurement and combustion optimisation, used for stack emission monitoring.

COMBUSTION & EMISSION MONITORING

WDG 1200/1210

In-situ oxygen probe for combustion optimisation, featuring integrated control and display electronics. Mounted on the stack or downstream of particulate control equipment.

COMBUSTION & EMISSION MONITORING

AMETEK LAND SOLUTION

FLARE STACK MONITORING IMAGER (LWIR-640)

RADIOMETRIC THERMAL PROCESS IMAGING

SPECIFICATION & DESIGN

VIEWING ANGLE 6° (HFOV) angle provides thermal view, 384 x 288 resolution

OPTIONAL ATEX AND CLASS/DIVISION ENCLOSURES Suitable for hazardous area applications

IP65/NEMA 4 X SEALING Maintains performance in any environment

REMOTE MOTORISED FOCUS Quicker installation, safe and convenient operation

STANDARD INDUSTRIAL ETHERNET Direct connection to a range of I/O modules for simple, stand-alone operation

MONITORING SOFTWARE IMAGEPro V2 advanced thermal processing software for monitoring, analysing, capturing, including multiple interface options and alarm outputs

TYPICAL APPLICATIONS

- AUTOMATION
- PROCESS CONTROL
- MACHINE VISION
- FLARE STACK MONITORING
- COAL PILE HOT SPOT DETECTION
- MEDICAL
- CRITICAL VESSEL REFRACTORY
- PETROCHEMICAL
- FOOD
- MINERALS

MOUNTING ACCESSORIES

HAZARDOUS AREA (EX) ENCLOSURE AND MOUNTING

AIR PURGED ENCLOSURE

INDUSTRIAL HOUSING

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