

LAND

AMETEK®

APPLICATION NOTE

TEMPERATURE MEASUREMENTS FOR BIOMASS BOILER OPTIMISATION

Biomass boilers are designed to generate heat or electricity by burning organic materials such as wood, agricultural residues, or organic waste. They serve as a renewable energy source, utilising biomass as fuel instead of fossil fuels.

AMETEK Land's solutions use radiometric thermal imaging and non-contact temperature measurement to give you valuable information required to maximise performance, minimise maintenance costs and deliver regulatory compliance.

WHY IS BOILER OPTIMISATION IMPORTANT?

Biomass boiler optimisation is essential for improving efficiency, reducing emissions, ensuring reliability, and maximising the environmental and economic benefits of biomass energy.

Solid-fuel boilers are susceptible to slagging, where ash from the fuel builds up on the heat transfer surfaces. Biomass boilers are especially prone to slagging because of the nature of the residues from the fuels. Ash and slag deposits on boiler tubes lead to reduced heat transfer. In extreme cases, additional weight of these deposits can lead to issues with structural integrity.

Fuel flow can also affect the efficiency of heating. With thermal imaging, boiler tube conditions can be assessed, tube temperatures can be measured, and slag build-up can be detected. This allows boiler operators to achieve ideal combustion conditions and optimise ash and slag removal operations.





BIOMASS BOILER COMBUSTION PROBLEMS

Biomass boiler combustion problems can arise due to various factors, leading to inefficiency, increased emissions, and potential damage to the boiler system. Some common combustion problems include:

Incomplete Combustion: Biomass fuels often contain a variety of components such as cellulose, lignin, and other organic matter. When combustion isn't optimized, these components may not fully burn, leading to the formation of ash and slag.

Moisture Content: Biomass fuels may contain moisture, which can interfere with combustion efficiency. Incomplete combustion due to high moisture content can result in the formation of more ash and slag.

Mineral Content: Biomass fuels also contain minerals such as silica, potassium, calcium, and magnesium. These minerals can form ash and slag when burned, especially if the

combustion temperature is higher than the ash fusion temperature.

Insufficient Air Supply: Adequate oxygen supply is necessary for complete combustion of biomass fuels. If there's insufficient air supply to the combustion chamber, it can result in incomplete combustion and the formation of ash and slag.

Clustering and Bridging: Certain biomass fuels, such as wood chips or pellets, can form clusters or bridges within the fuel storage and feeding systems, leading to uneven fuel distribution and combustion. This can result in inefficient combustion and uneven temperature distribution within the boiler.

High Emissions: Combustion problems can lead to increased emissions of pollutants such as nitrogen oxides (NOx), sulfur dioxide (SO₂), and volatile organic compounds (VOCs). High emissions can result from poor

combustion conditions, improper fuel handling, or inadequate emission control technologies.

Corrosion: Corrosion of boiler components can occur due to interactions between combustion byproducts, such as sulfur or chlorine, and boiler materials. Corrosion reduces the lifespan of the boiler and can lead to leaks or failures if not addressed.

Operating Temperature: Biomass boilers need to operate at temperatures high enough to ensure complete combustion and minimize the formation of ash and slag. If the temperature is too low, incomplete combustion occurs, leading to increased buildup.

THE CHALLENGE OF TEMPERATURE MEASUREMENT

Thermal imaging and temperature measurement in a biomass boiler present several challenges due to the harsh operating conditions and the characteristics of biomass combustion. Some of these challenges include:

High Temperatures: Biomass boilers operate at high temperatures, especially in the combustion chamber and heat exchange surfaces. Traditional temperature sensors may not withstand such high temperatures or be able to capture extreme variations in temperature brought on by startup, shutdown, load changes, or disturbances in fuel supply.

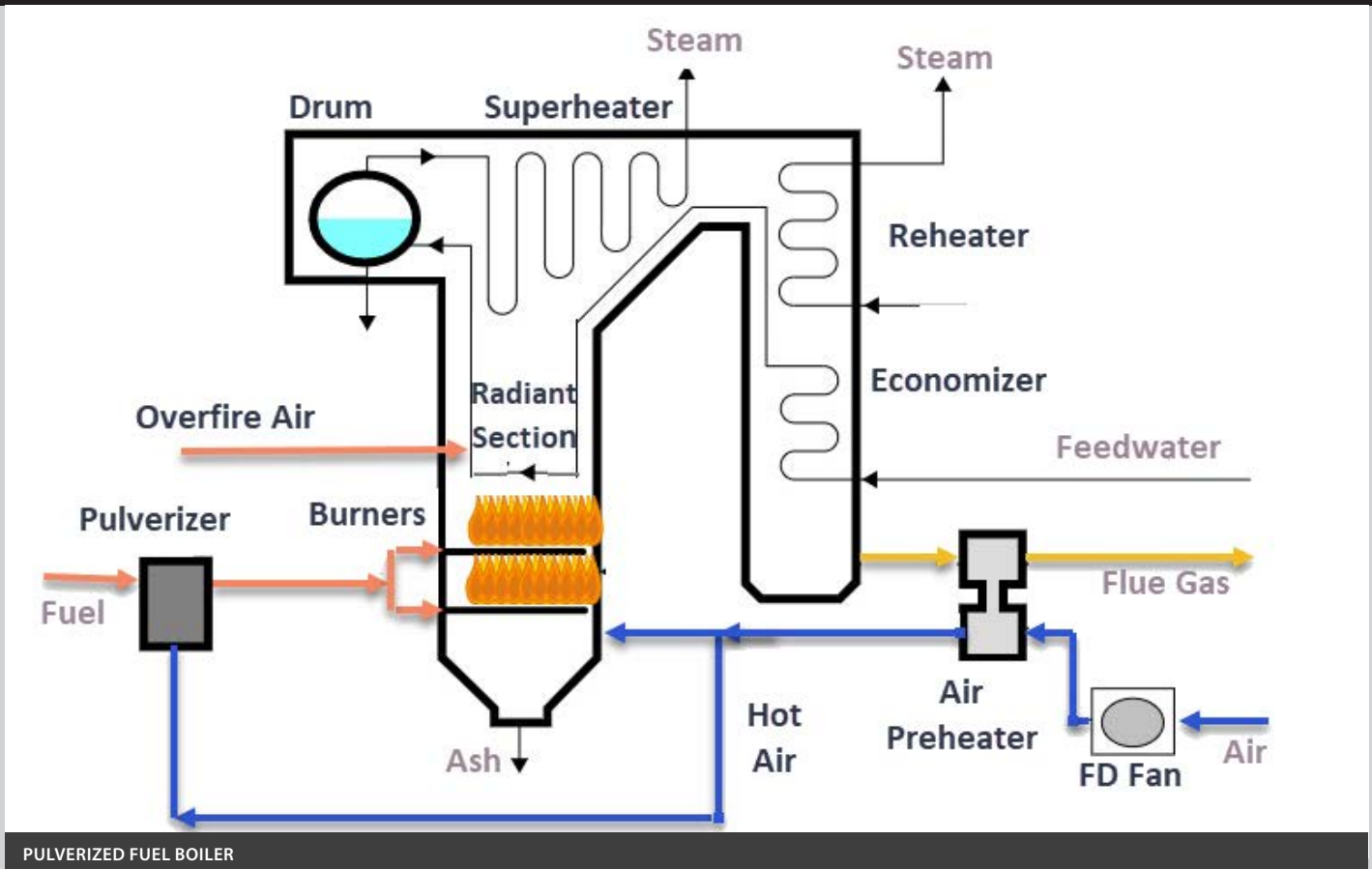
Corrosive Environment: Biomass combustion produces corrosive by-products such as sulphur compounds and chlorides, which can degrade sensor materials and lead to measurement inaccuracies or sensor failure. Specialised materials and coatings may be necessary to protect temperature sensors from corrosion.

Ash and Particulate Build-up: Ash and particulate matter generated during biomass combustion can accumulate on temperature sensors, affecting their accuracy and response time. Regular cleaning and maintenance of sensors may be required to prevent build-up and ensure reliable temperature measurement.

Variability in Fuel Composition: Biomass fuels can vary widely in composition, moisture content, and heating value, leading to fluctuations in combustion temperature and thermal performance. Temperature sensors must accurately measure temperature under varying fuel conditions to optimise combustion efficiency.

Uneven Temperature Distribution: Biomass boilers may experience uneven temperature distribution within the combustion chamber or heat exchange surfaces due to fuel bridging, uneven fuel distribution, or combustion inefficiencies. Temperature sensors must be strategically placed to capture representative temperature readings and identify temperature gradients.

Addressing these challenges requires careful selection of temperature measurement devices, proper sensor placement and installation, regular maintenance and calibration, and integration with advanced control and monitoring systems. Collaborating with experienced engineers and suppliers familiar with biomass boiler applications can help overcome these challenges and ensure accurate and reliable temperature measurement for optimal boiler performance.



PULVERIZED FUEL BOILER

THE SOLUTION: RADIOMETRIC THERMAL IMAGING

Radiometric thermal imaging can deliver clear, live images of the boiler interior, even through smoke and hot furnace atmospheres which would obscure visual furnace camera systems, whilst taking accurate temperature measurements, showing the temperature distribution across the boiler.

AMETEK Land's solution for this application is the MWIR-B-640, a mid-wavelength infrared thermal imager using a borescope design which builds upon more than 20 years of experience with this type of technology.

MWIR-BORESCOPE-640

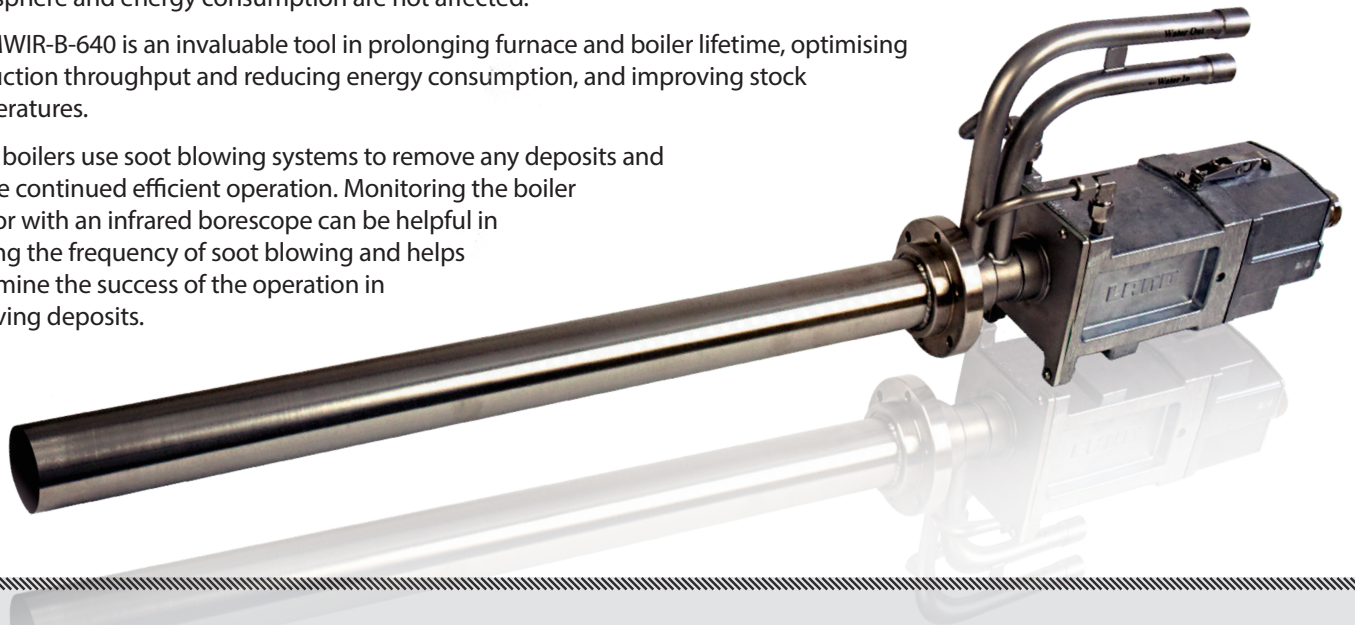
The MWIR-B-640 allows highly accurate and fully radiometric temperature measurements to be taken, stored, and trended over the lifetime of the boiler. It utilises advanced IMAGEPro thermal imaging-processing software for long term data trending and analysis, enabling the early detection of leaks and temperature variations, and achieving effective process optimisation.

Operators are provided with a clear view of the critical boiler areas, with more than 300,000 accurate point temperatures, measuring in the range of 500-1800 °C (932-3272 °F). IMAGEPro software also facilitates advanced digital communications, allowing easy monitoring of the boiler to identify hot and cold areas and visualise any uneven heating in real-time.

The MWIR-B-640's high-resolution image, combined with its wide-angle field of view (90°), allows multiple areas to be imaged and measured simultaneously, with the live image data viewed from the safety of the control room. Only a small opening in the wall is required for the MWIR-B-640 to accurately profile the temperature of the entire furnace wall, so the furnace atmosphere and energy consumption are not affected.

The MWIR-B-640 is an invaluable tool in prolonging furnace and boiler lifetime, optimising production throughput and reducing energy consumption, and improving stock temperatures.

Many boilers use soot blowing systems to remove any deposits and ensure continued efficient operation. Monitoring the boiler interior with an infrared borescope can be helpful in guiding the frequency of soot blowing and helps determine the success of the operation in removing deposits.



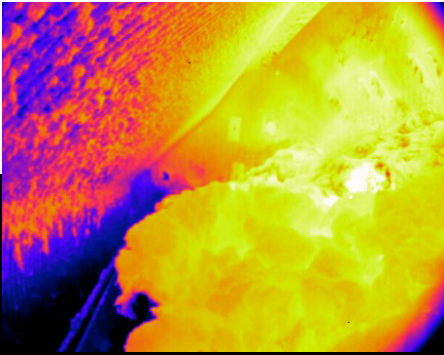
MWIR-B-640 FEATURES

- Advanced spectral filtering
- High-temperature measurement accuracy
- High spatial resolution
- Real-time thermal data
- Advanced image processing software

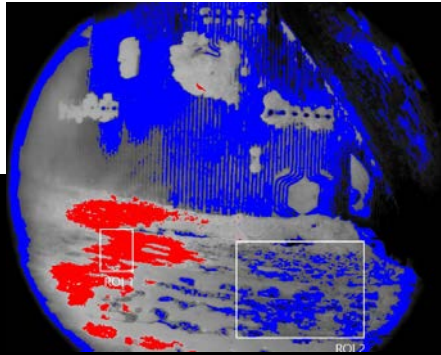
MWIR-B-640 BENEFITS

- Clear views through dusty/smoky/luminous flames/hot conditions
- Allows optimum boiler control in real-time
- Resolves fine details within the boiler
- Improves energy efficiency without degrading boiler lifetime
- Continuous monitoring from a safe operator location

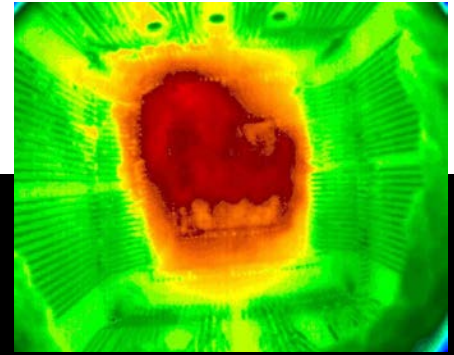
RADIOMETRIC THERMAL IMAGING



Measure Fuel flow and slag buildup in a sloping grate boiler.



Isotherm view makes it easy to identify which areas in the image are the hottest and which are cooler.



Viewed from the top, it is easy to see the temperature and surface conditions in a bubbling fluidised bed boiler.

FURNACE EXIT GAS TEMPERATURE

Furnace Exit Gas Temperature (FEGT) refers to the temperature of the gases leaving a furnace or boiler, and is another opportunity to monitor the combustion efficiency of a boiler.

Achieving the optimal FEGT helps balance energy consumption and production requirements while minimizing environmental impact.

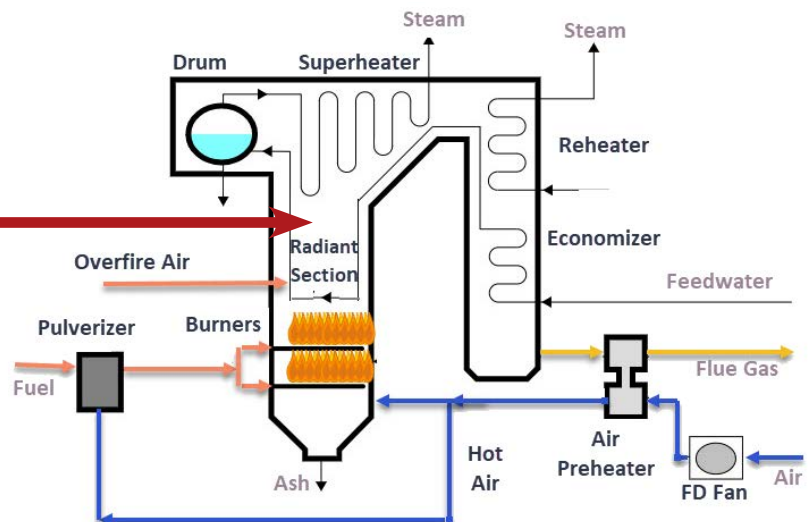
TOO HIGH

- Reduce life of boiler tubes
- Deposit ash on tubes and reduce heat transfer
- Corrosion

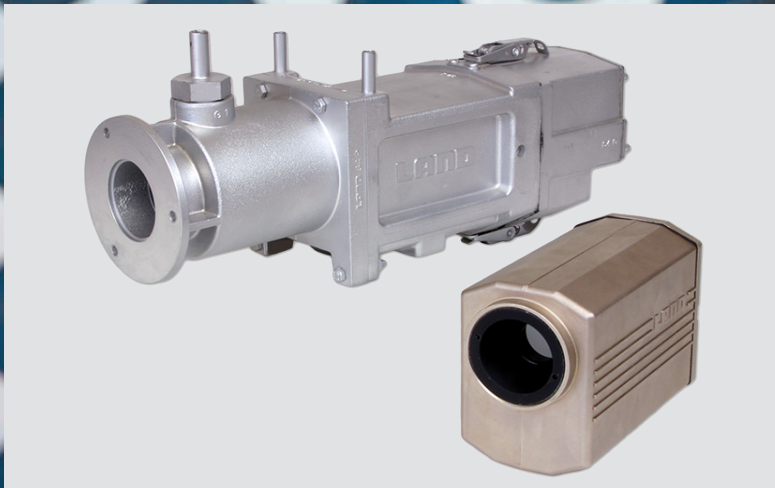
TOO LOW

- Reduced thermodynamic efficiency
- Increased costs
- Increased CO₂ emissions

Furnace Exit Gas Temperature (FEGT)



FURNACE GAS TEMPERATURE - CDB



The CDB thermometer is optimised to accurately measure the true gas temperature in boilers and incinerators using AMETEK Land's unique non-contact infrared technology.

CDB 'sees' through a cold ambient atmosphere to measure the main combustion product, hot carbon dioxide. With advanced spectral filtering of CO₂, CDB provides a true gas temperature for exceptional control - improving both process safety and process efficiency.

Installed at a boiler or incinerator, the thermometer works non-contact, 24/7, with its sight path extending above the furnace bed. With a two-wire loop connection and standard 4-20 mA signal output for easy connectivity, CDB ensures no interference with the process, ensuring an accurate measurement and high reliability.

RESILIENT AND ACCURATE MEASUREMENT

Insensitive to the presence of gases other than hot carbon dioxide, CDB delivers a highly stable, true gas temperature.

COMPATIBLE WITH SYSTEM 4 ACCESSORIES

CDB fits the standard AMETEK Land System 4 mounting accessories, air-cooled or water-cooled protection jackets, and air-purged sighting tube. This means there are no compatibility issues when using these attachments, which provide excellent protection in harsh environments.

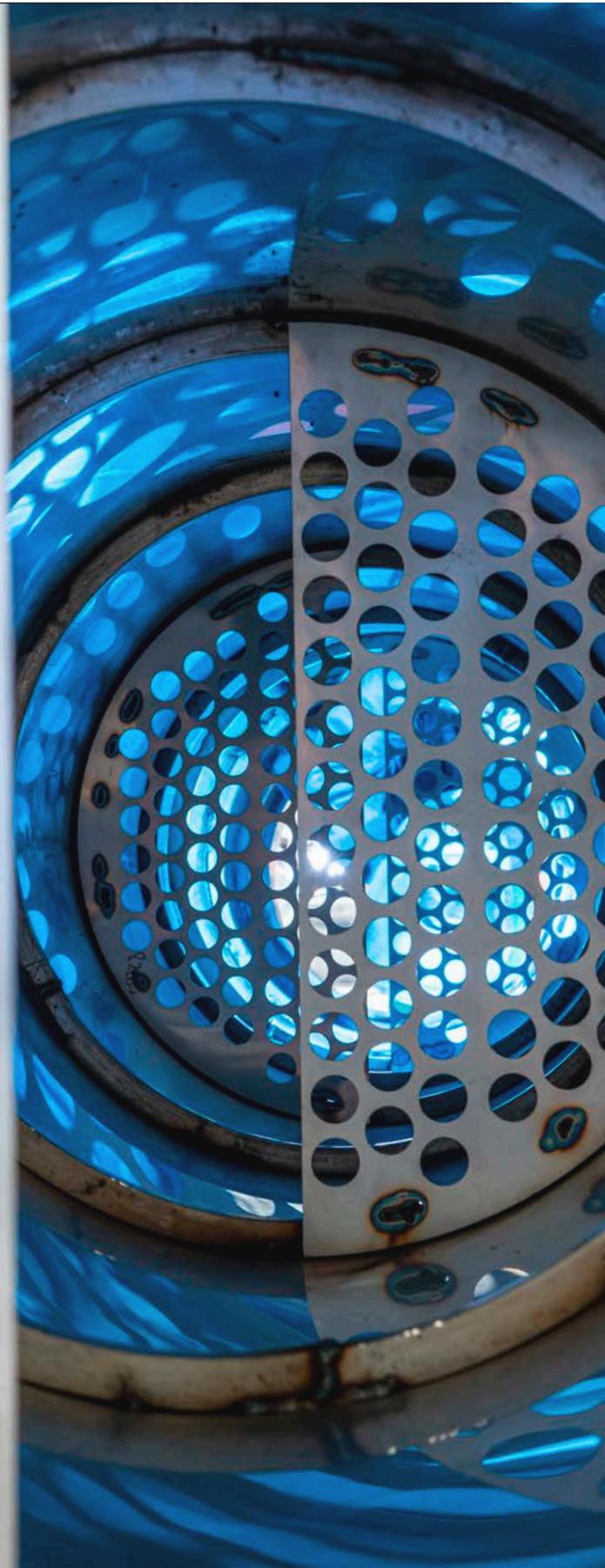
MINIMAL MAINTENANCE REQUIRED

Fitted externally, the thermometer sight path extends into the incinerator atmosphere to a depth which depends on atmospheric conditions. This ensures no interaction with the combustion process and reduces maintenance requirements for the thermometer.

MEASURES FURNACE EXIT GAS TEMPERATURE (FEGT)

This is a key parameter for boiler operation and optimisation.

The CDB thermometer is AMETEK Land's non-contact solution for measuring gas temperature in furnace processes.

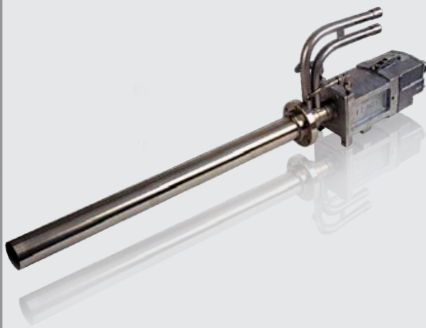


TEMPERATURE MEASUREMENTS FOR BOILER OPTIMISATION



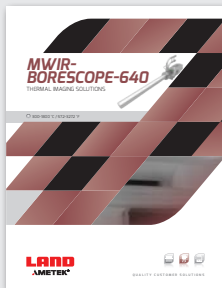
Our global service centres provide after-sales services to ensure you get the best performance from your system. This includes technical support, certification, calibration, commissioning, repairs, servicing, preventative maintenance and training. Our highly trained technicians/engineers can also attend your site to cover planned maintenance schedules and repair emergency breakdowns.

FIXED THERMAL IMAGERS

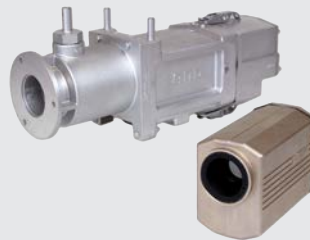


MWIR-B-640

A mid-wavelength radiometric infrared borescope imaging camera, delivering a clear image of the stock and furnaces temperatures even in smoky and dusty furnace atmospheres.

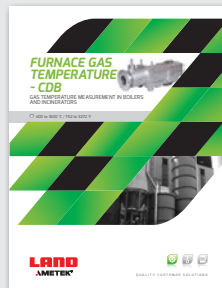


FIXED SPOT THERMOMETERS



FURNACE GAS TEMPERATURE - CDB

Advanced non-contact infrared thermometer designed for measuring the gas temperature in boilers and incinerators.



FIXED THERMAL IMAGERS

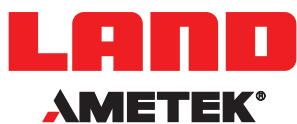


MWIR-640 390

A smart Mid-wavelength thermal imager providing wide temperature measurement range coverage, with a choice of different optics and lenses.



FIND OUT MORE AT: WWW.AMETEK-LAND.COM



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We are fully committed to Quality Assurance. See all our accreditations at AMETEK-LAND.COM/QUALITY