The safety and efficiency of modern thermal power plants relies on accurate measurement and careful control of operating conditions. Employing many decades of experience and expertise, AMETEK Land provides instrumentation and monitoring systems that are ideal for:

- Monitoring coal transport, storage and preparation
- Maximising efficiency of coal-fired furnaces and boilers
- Ensuring emissions compliance

This application note aims to provide an overview of the many technologies available for monitoring essential operations in coal-fired power generation and their respective limitations and advantages.
A 600 MW baseload power station requires several thousand tons of coal per day. From coal stockpile through to boiler, there are many transfer points and storage areas that must be monitored for the onset of spontaneous combustion.

If these areas are not properly monitored, the plant could risk unexpected physical and financial losses, along with possible shutdown. Sub-bituminous coals have been increasingly used in recent years because of their wide availability, low sulphur content and low cost. These coal types have a lower heating value and exhibit a tendency to react with oxygen in the air. The oxidation makes them self-heating and so such coals have a reputation for spontaneous combustion, which has resulted in fires at facilities that previously had excellent safety records. Many facilities that have switched to sub-bituminous coal are discovering that increased monitoring is required to assure safe and continuous operations.

Fortunately, several technologies are available to give an early warning of spontaneous heating before a hazardous condition is reached.

**OXIDISING FUEL**

Oxidising fuel has two tell-tale characteristics which can be used to give an early indicator that spontaneous heating is occurring:

1. **CARBON MONOXIDE**

   As oxidation occurs, carbon in the fuel is converted to carbon monoxide. Even in an industrial environment, ambient air contains very little CO, so an increased concentration is a sure sign that oxidation is occurring. CO monitoring is only effective in an enclosed space because air movements in open areas will disperse the gas before a measurable concentration can build up.

2. **TEMPERATURE INCREASE**

   Although it takes longer to give an unambiguous indication of spontaneous heating, an increase in the temperature of the stored coal indicates that spontaneous heating has taken place.

**RECOMMENDED TECH:**

- **THERMAL IMAGER**
- **INFRARED LINE SCANNER**
- **CO MONITOR**
COAL STORAGE PILES

Coal storage piles can be monitored by infrared imagers that are typically mounted above and to the sides of the pile, frequently supported with pan and tilt motorised mounts. This enables the equipment to be programmed to ‘patrol’ the pile’s surface and detect developing hot areas before they become a problem.

In order to prevent false alarms these systems typically require embedded logic to ignore non-target sources such as hot vehicles that are operating in the areas of pile monitoring.

ARC Imager

**IDEAL FOR MONITORING COAL STORAGE PILES TO DETECT HOT SPOTS.**

A low-temperature, rugged process thermal imager, the ARC Imager is ideal for monitoring coal storage piles to detect hot spots.

**FEATURES**
- High-resolution radiometric thermal images
- Four lens options
- Wide ambient temperature range
- Four configurable areas of interest
- Viewer software as standard

**BENEFITS**
- Excellent temperature accuracy
- View any target, at any distance, with outstanding clarity
- Suitable for installation in just about any climate
- Rangeable target settings always keep the target in view
- User-friendly software control

CONVEYOR SYSTEMS

Hot inclusions on coal or coke conveyors can go undetected before causing substantial damage. Traditional methods such as visual inspections or single-point pyrometers often have difficulty detecting these hot spots on a moving conveyor. A high-speed infrared scanning system provides the most reliable and accurate solution for continuous monitoring of emerging hot spots. This can reduce downtime and help eliminate costly conveyor belt repairs.

**FEATURES**
- Fast, 100 Hz scanning speed
- Robust high ambient temperature performance
- Direct control system integration

**BENEFITS**
- Continuous automatic monitoring
- Rapid-response alarm system
- Helps reduce insurance costs
- Prevents damage and downtime

The systems need to be small enough to be positioned under a belt just beyond the point where the material has been transferred. They need to measure the entire belt surface and alarm if any areas are above a designated temperature. Alarms can trigger water sprays or suppression systems. Alternatively, hot material can be diverted to a safe area so that it does not pass to the next stage of the process.

The results are safer employees, reduced risk of damage and downtime, and lower insurance costs.

**HotSpotIR**

**HIGH-SPEED SCANNING SYSTEM FOR DETECTING HOT INCLUSIONS**

HotSpotIR is a compact, fixed-focus, high-speed scanning system specifically developed to detect hot inclusions at an early stage. Designed for industrial environments, it rapidly identifies hot material on a moving conveyor, preventing damage and avoiding costly shutdowns. With high-resolution monitoring across 1000 temperature spots, user-adjustable scanning speeds up to 100 Hz, and repeatability of ±0.5°C (±0.9°F), HotSpotIR can detect hot spots as small as 25 mm (1 in) in diameter.

**FEATURES**
- Wide scan angle of 80°
- Adjustable scanning speeds up to 100 Hz
- Repeatability of ±0.5°C (±0.9°F)

**BENEFITS**
- Prevents damage and downtime
- Helps reduce insurance costs
- Rapid-response alarm system
- Easy to install, uses non-contact infrared scanning to measure from 20 to 250°C (68 to 482°F)

HotSpotIR utilises a dedicated processor to monitor the entire belt surface, activating an alarm which can be linked to fire suppression systems. The continuous monitoring means hot spots can be detected and the alarm triggered in a hundredth of a second, allowing the operator to respond quickly.

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MONITORING COAL STORAGE SILOS

Carbon monoxide (CO) monitoring is a fast and unambiguous indication of spontaneous combustion in an enclosed space such as a storage silo. Ambient air has a very low concentration of CO, but a large amount of CO is produced as spontaneous combustion begins. A rapid rise in CO concentration is therefore a clear sign that preventative action is required.

Detection systems typically extract sample gases from the silo headspace. Alarm threshold levels can be set to best suit the plant’s individual operating conditions. Oxygen (O₂) measurement is also an option for oxygen-limited silos which need to continuously monitor O₂ levels.

Carbon monoxide (CO) monitoring also provides an excellent early warning of a possible mill fire. A fast response to an increase in CO concentration is especially important in pulverisers, where there is a risk that burning material may be introduced, and a hazardous condition can develop in less than a minute. The risk is highest during mill start-up and shut down as the concentration of combustible dust passes through the explosion range. If burning material is present at this time, ignition is highly likely.

Typically, these types of systems extract a sample from the classifier outlet. If the CO level reaches a user-set limit, the instrument alarms to enable preventative action to be taken before a fire starts or an explosion occurs, increasing plant safety and reducing downtime.

FEATURES
- Specifically designed for storage silos
- Sensitive, 2 ppm detection limit
- Automatic calibration verification
- Optional O₂ measurement
- Simple sample probe with dust filter and blowback
- Z-purge available for hazardous areas

BENEFITS
- Rapid indication of onset of spontaneous heating
- Protects expensive equipment and prevents downtime
- Integrates with plant operating system
- Dual-stream option continuously monitors one or two locations
- Highly reliable in aggressive environments

COAL PREPARATION | AMETEK LAND SOLUTION - CO MONITOR

Silowatch

PROVIDES A CONTINUOUS INDICATION OF THE CO CONCENTRATION

AMETEK Land’s Silowatch rapidly detects the build-up of carbon monoxide (CO) in storage silos, providing a continuous indication of the CO concentration. If the CO level reaches a user-set limit, the instrument alarms to allow preventative action to be taken before a fire starts or an explosion occurs, increasing plant safety and reducing downtime.

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STANDARD START UP

MILLWATCH OFFERS INDEPENDENT ALARM POINTS

COAL MILLING | AMETEK LAND SOLUTION - CO MONITOR

Millwatch

RAPID DETECTION OF THE BUILD-UP OF CO IN A HORIZONTAL OR VERTICAL-AXIS MILL

Millwatch detects the rapid build-up of CO in a horizontal or vertical-axis mill, giving a continuous indication of the CO concentration.

User-selectable alarm relays give an additional warning that a hazardous condition is developing.

FEATURES
- Specifically designed for coal mills
- Sensitive 2 ppm detection limit
- Automatic calibration verification
- Rugged sample probe with abrasion shield, large-area filter and blowback
- Freeze-protected sample line

BENEFITS
- Fast response – T90 less than 30 s.
- Minimised false alarms
- Dual-stream option continuously monitors one or two locations
- Uninterrupted on-line maintenance with external sample filter
- Suitable for installations down to -20 °C (-4 °F)

STANDARD START UP

NORMAL OPERATION
MAXIMISING EFFICIENCY OF COAL-FIRED BOILERS

Gas analysis systems can be installed from the furnace exit to the stack exit. Analysers that utilise various technologies can be used to measure a wide range of emissions including O₂, CO, CO₂, NO, NO₂, SO₂, and sulphuric acid dew point.

Infrared technology provides a proven non-contact method for furnace exit gas temperature measurement. This can be used as a tool in reducing NOx emissions and indicating possible boiler slagging conditions. Thermal imaging inside the boiler provides important information on the boiler tube conditions. Measuring tube temperatures and detecting slag build-up allows operators to optimise combustion conditions and soot-blowing operations. An infrared borescope employing a wide-angle lens allows the operator to see a large portion of the boiler wall with only a small penetration, and allows the sensitive imager to be located outside the boiler. A water-cooled, air-purged lens permits continuous operation even in such an aggressive environment. Portable sulphuric acid dewpoint monitors have been developed by AMETEK Land specifically for coal-fired systems that require periodic monitoring. This measurement helps maintain boiler efficiency, prevent corrosion and evaluate the effectiveness of fuel additives and changes in combustion conditions.

These lightweight, easy-to-use instruments capture and store thousands of readings and require only simple field maintenance. They assure coal boiler operators that the optimum operating temperature is maintained – just above the sulphuric acid dewpoint – where no sulphuric acid is being formed and combustion efficiency is maximised.

THE AMETEK LAND SOLUTION

The Lancom 200 is a portable multi-gas analyser, the Lancom 4 is able to measure up to eight flue gases in a range of combustion and emissions processes. It supports combustion efficiency with simultaneous measurements for O₂ and CO. These can be combined with a true NOx measurement and SO₂ monitoring for emissions reduction and a hydrocarbons measurement to support safety.

- MONITORS UP TO 17 COMBUSTION PARAMETERS
- ONE INSTRUMENT FOR ALL MEASUREMENT NEEDS
- EASY TO CARRY AROUND AND OPERATE
- HIGH-SPEED DIGITAL COMMUNICATIONS
- CONFIGURABLE TO MATCH APPLICATION NEEDS

THE WDG 1200/1210
STACK-MOUNTED O₂ PROBE FOR COMBUSTION OPTIMISATION

A stack-mounted, in-situ O₂ probe for combustion optimisation, the WDG 1200/1210 range features integrated control and display electronics for a standalone flue gas analysis solution. Using AMETEK Land’s industry-proven zirconium oxide sensor, the analyser has a unique design for easy field maintenance.

- SIMPLE USER INTERFACE FOR EASY, FLEXIBLE OPERATION
- FULLY FIELD-SERVICEABLE, WITH REMOVABLE INNER TUBE STRUCTURE
- VERSATILE PROBE AND MOUNTING
- RUGGED, RELIABLE DESIGN
- PROVIDES ESSENTIAL COMBUSTION EFFICIENCY MEASUREMENTS

THE LANCOM 200
MEASURES SULPHURIC ACID DEWPOINT TEMPERATURE

The Lancom 200 is a portable Acid Dewpoint Monitor that uses conductive cell technology to deliver accurate, periodic measurements of the sulphuric acid dewpoint temperature (ADT) in combustion processes. Easy to use ADT monitoring enables operators to balance acid emissions with efficiency. This reduces the risk of corrosion while increasing combustion efficiency.

- OPTIMISE THE ACID DEWTEMPERATURE TO IMPROVE EFFICIENCY
- AVOID COLD-END CORROSION
- FULLY PORTABLE – JUST REQUIRES A COMPRESSED AIR SUPPLY
- EASY TO MAINTAIN
- STORES READINGS FOR LATER ANALYSIS

THE LANCOM 4
PORTABLE MEASUREMENT OF UP TO EIGHT FLUE GASES

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THE MWIR-BORESCOPE-640
MEASURES TEMPERATURE PROFILES INSIDE BOILERS AND FURNACES

The MWIR-B-640 enables a continuous and clear view, even through heavy smoke and hot gases inside the boiler, which is not possible with visual or short-wavelength infrared furnace camera systems.

- THE MWIR-R-640 MEASURES TEMPERATURE PROFILES INSIDE BOILERS AND FURNACES
- MONITORS UP TO 17 COMBUSTION PARAMETERS
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- HIGH-SPEED DIGITAL COMMUNICATIONS
- CONFIGURABLE TO MATCH APPLICATION NEEDS

These lightweight, easy-to-use instruments capture and store thousands of readings and require only simple field maintenance. They assure coal boiler operators that the optimum operating temperature is maintained – just above the sulphuric acid dewpoint – where no sulphuric acid is being formed and combustion efficiency is maximised.

THE IMAGEPro thermal imaging and data processing software supports long term data trending, to enable the early detection of leaks and temperature variations and achieve process optimisation. Operators have a clear view of the critical boiler areas with more than 300,000 accurate point temperatures, measuring in the range of 300-1200 °C (572-2192 °F) or 500-1800 °C (932-3272 °F). Providing advanced digital communications via the IMAGEPro software, the performance of the furnace can be monitored to easily identify hot and cold areas and any uneven heating can be visualised with corrections viewed in real-time.

- SOPHISTICATED SPECTRAL FILTERING
- HIGH-TEMPERATURE MEASUREMENT ACCURACY
- REAL-TIME THERMAL DATA COMBINED WITH HIGH RESOLUTION, LOW NOISE IMAGE
- SAFE 24 HOUR, 7 DAY MONITORING
EMISSIONS MEASUREMENTS

Emissions of gases and dust from power plants and other industrial sources are regulated to protect public health and the environment. Plant operators worldwide must monitor and report these emissions to demonstrate compliance with regulations.

Continuous emissions monitors provide essential feedback for optimising the process and for demonstrating compliance with relevant emissions rules. Within the European Union, compliance monitors must be certified as meeting the QAL1 standard according to EN 15267, and this has become de facto requirement in many other countries. In the United States, analysers must meet Performance Specifications defined by the US EPA.

Highly accurate and reliable non-contact opacity and dust monitors are required to measure emissions of dust and particulate matter (PM). Opacity is ideal for moderate and high PM concentrations where their ruggedness and simplicity make them well-suited to emissions measurements. For the lowest PM concentrations found in modern power plants, laser light scattering allows greater sensitivity. Forward-scattering gives the best performance, with lower detection limit and reduced sensitivity to changes in particle size. Back-scattering PM-CEMs offer a cost-effective solution for less demanding applications.

THE AMETEK LAND SOLUTION

4500 MkIII
ACCURATE AND RELIABLE CONTINUOUS OPACITY MONITOR

A high-sensitivity opacity monitor meeting US and European standards for monitoring combustion processes, the 4500 MkIII is the most accurate and reliable continuous opacity monitor available.

Using a highly homogenous LED light source to minimise sensitivity to optical misalignment, the monitor ensures compliance limits are met with confidence, avoiding the risk of regulator fines and lowering costs through operational efficiencies.

- UNMATCHED, CLASS-LEADING OPACITY MONITORING
- EN 15267 AND QAL1 APPROVALS THROUGH MCERTS AND UBA
- CERTIFIED TO ASTM D6216 AND EN 15267 AND QAL1 APPROVALS
- UNMATCHED, CLASS-LEADING through operational efficiencies.
- REGULATOR FINES AND LOWERING COSTS WITH CONFIDENCE, AVOIDING THE RISK OF
- ENSURING COMPLIANCE LIMITS ARE MET
- UNMATCHED, CLASS-LEADING through operational efficiencies.

4650-PM
STABLE AND ACCURATE LOW-RANGE RESULTS IN STACKS AND DUCTS RELIABLY

Providing a high-sensitivity, forward-scatter laser measurement for particulate matter, the 4650-PM delivers stable, accurate low-range results in stacks and ducts where water droplets are not present in the flue gas.

Consisting of a stack-mounted probe and separate control unit, the 4650-PM enables closer emissions control, with a more accurate measurement than similar PM monitoring systems.

- REDUCED SENSITIVITY TO CHANGES IN PARTICLE SIZE
- VERY LOW DETECTION LIMIT
- MEETS US EPA PS-11
- LARGE-AREA COLLECTION OPTICS
- NO MOVING PARTS IN THE MEASUREMENT PATH
- COMPREHENSIVE CONTROL OPTIONS
- NO CONTINUOUSLY-MOVING PARTS

4750-PM
MEASURES PARTICULATE MATTER IN STACKS AND DUCTS RELIABLY

Utilising a back-scatter laser technique, the 4750-PM provides accurate, reliable measurements of particulate matter in all combustion processes where condensed water is not present. With a rugged design suitable for a range of applications, it features a highly stable optical system offering a low detection limit, and can be used as a continuous emissions monitor for compliance or process monitoring.

- REDUCED SENSITIVITY TO CHANGES IN PARTICLE SIZE
- HIGHLY STABLE AND RELIABLE
- NON-INTRUSIVE SENSOR
- WIDE MEASUREMENT RANGE
- EN 15267 APPROVAL THROUGH TUVdotCOM
- LIFETIME LED LIGHT SOURCE

4400
HIGH PERFORMANCE OPACITY AND DUST MEASUREMENT

A robust, accurate opacity monitor, the 4400 combines the unique features of three patented technologies to deliver high performance and reliable operation for opacity or dust measurements.

Complying with EN 15267 Part 3, the monitor is easy to use and has no moving parts, ensuring it will provide many years of trouble-free operation in combustion applications requiring emissions monitoring to a high standard.

- REDUCED SENSITIVITY TO CHANGES IN PARTICLE SIZE
- HIGHLY STABLE AND RELIABLE
- NON-INTRUSIVE SENSOR
- WIDE MEASUREMENT RANGE
- EN 15267 APPROVAL THROUGH TUVdotCOM
- LONG LIFETIME LED LIGHT SOURCE
- NO MOVING PARTS
- PATENTED, ALL-GLASS, MULTI-PRISM RETROREFLECTOR
- WIDE OPERATING TEMPERATURE RANGE
- EN 15267 APPROVAL THROUGH TUVdotCOM
- EASY TO CARRY AROUND AND OPERATE
- HIGH-QUALITY COLOUR DISPLAY AND USB SUPPORT
- CONFIGURABLE TO MATCH IDEAL APPLICATION NEEDS

Lancom 4
PORTABLE MEASUREMENT OF UP TO EIGHT FLUE GASES

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CDA
INFRARED THERMOMETER MEASURES FURNACE EXIT GAS TEMPERATURE

A thermometer optimised to accurately measure furnace exit gas temperatures CDA ‘sees’ through a cold ambient air to measure the hot carbon dioxide beyond. By filtering out other gas types, CDA provides a true gas temperature for exceptional control - improving both process safety and process efficiency.

Installed in a boiler, the thermometer works as an invisible thermocouple, with its sight path extending above the furnace bed.

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Our in-house 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 can also attend your site to cover planned maintenance schedules and repair emergency breakdowns.

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