LAND

AMETEK®

COAL-FIRED POWER PLANTS

APPLICATION NOTE

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.

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.

COAL TRANSPORT

RECOMMENDED TECH:

THERMAL IMAGER

COAL CONVEYING

RECOMMENDED TECH:

INFRARED LINESCANNER

COAL PREPARATION

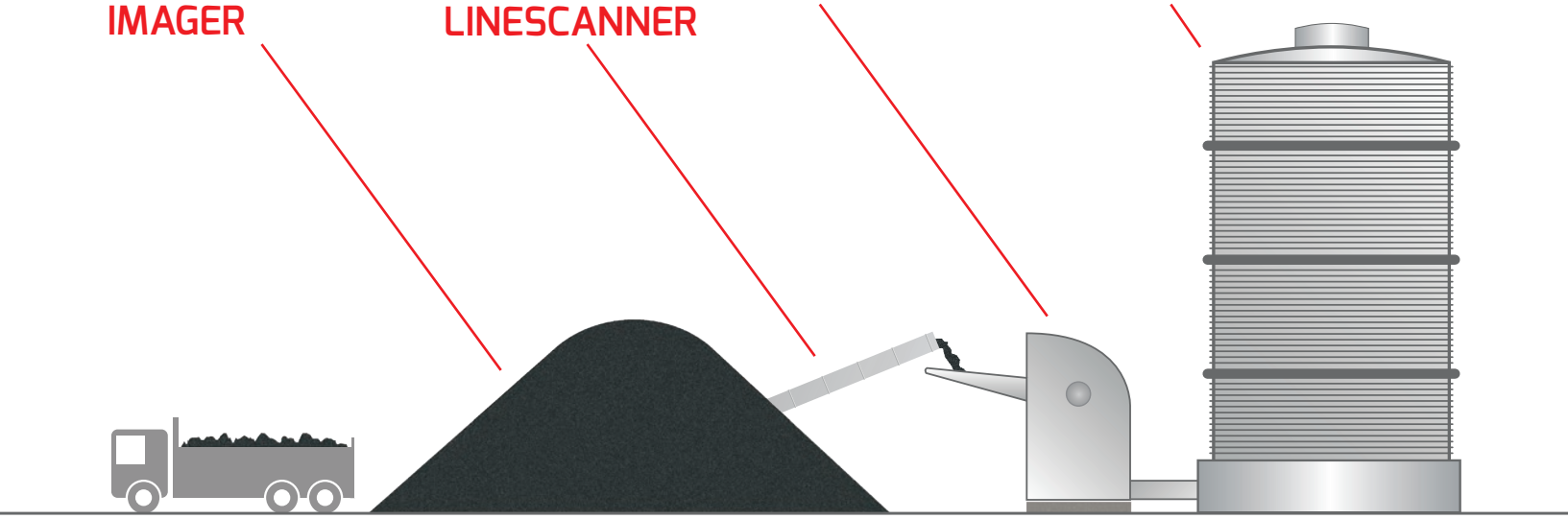
RECOMMENDED TECH:

CO MONITOR

COAL CLOSED STORAGE

RECOMMENDED TECH:

CO MONITOR



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.

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.

COAL TRANSPORT | AMETEK LAND SOLUTION - THERMAL IMAGER

LWIR-640

IDEAL FOR MONITORING COAL STORAGE PILES TO DETECT HOT SPOTS.

A low-temperature, rugged process thermal imager, the LWIR-640 long-wavelength thermal imager is ideal for monitoring coal storage piles to detect hot spots.

It is a radiometric thermal process imager, offering high accuracy across a wide range of applications.

Using a high-resolution sensor, the flexible, option-rich LWIR-640 delivers detailed thermal images with excellent stability.

The LWIR-640 lens options allow a clear view of a target at any distance with outstanding clarity, providing early hotspot detection.
Data processing is performed within the imager without the need for a separate signal processor, allowing continuous and fully automated monitoring of remote storage areas.

An alarm output alerts operators when hotspots are detected, allowing preventative action by plant personnel. Variable warning levels and smart false alarm prevention ensure that action is only taken when needed.

The LWIR-640 is designed specifically for outdoor industrial environments and can be supplied with housing accessories to match even the most arduous environments, delivering the ultimate in reliability and measurement availability.

The LWIR-640 is ideal for monitoring storage piles for any signs of early stage combustion and spontaneous heating.

FEATURES

- High-resolution radiometric thermal images
- Range of lens options
- Wide ambient temperature range
- Configurable areas of interest
- IMAGEViewer and IMAGEPro advanced thermal imaging software

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.

There are three key locations for scanner placement:

1. **Above the coal conveyor belt to detect hot inclusions on or close to the surface**
2. **Looking at the curtain of coal as it falls from one section of belt to another. This allows a scanner to see deeper into the coal and detect hot inclusions**
3. **Under a belt just after a transfer point. The freshly uncovered belt will have a thermal fingerprint of any hot items that have been in contact with the surface**

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.

COAL CONVEYING | AMETEK LAND SOLUTION - INFRARED LINESCANNER

HotSpotIR 9000

HIGH-SPEED SCANNING SYSTEM FOR DETECTING HOT INCLUSIONS

HotSpotIR 9000 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 9000 can detect hot spots as small as 25 mm (1 in) in diameter.

Easy to install, it uses non-contact infrared scanning to measure from 20 to 250 °C (68 to 482 °F).

HotSpotIR 9000 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.

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

FEATURES

- Wide scan angle of 80°
- 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

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 need to be designed to continuously monitor the atmosphere inside silos to quickly respond to any significant increase in CO levels. This is crucial to allow time for preventative action to avoid damage to plant or injury to personnel.

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 (O_2) measurement is also an option for oxygen-limited silos which need to continuously monitor O_2 levels.

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.

FEATURES

- Specifically designed for storage silos
- Sensitive, 2 ppm detection limit
- Automatic calibration verification
- Optional O_2 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

MONITORING COAL MILLS

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.

A higher alarm setting is generally needed where mills use recycled combustion gases for coal feed heating.

COAL STORAGE | 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 50 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)

MAXIMISING EFFICIENCY OF COAL-FIRED BOILERS

Maintaining safe and efficient combustion from a boiler relies on the accurate monitoring of many parameters. The dynamic nature of the process means that the key products of combustion require monitoring and control on a real-time basis. Parameters include furnace exit gas temperature, oxygen and combustibles (CO, hydrocarbons) boiler efficiency, slagging rates and nitrogen oxide (NOx) production.

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 O_2, CO, CO_2, NO, NO_2 SO_2, 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 allow 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 AMETEK LAND SOLUTION

WDG 1200/1210

STACK-MOUNTED O_2 PROBE FOR COMBUSTION OPTIMISATION

A stack-mounted, in-situ O_2 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.

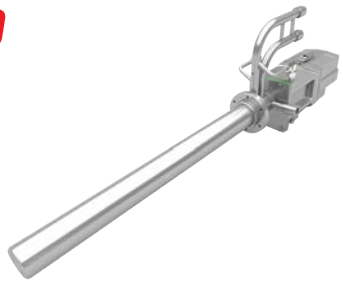
- SIMPLE USER INTERFACE FOR EASY, FLEXIBLE OPERATION
- FULLY FIELD-SERVICEABLE, WITH REMOVABLE INNER TUBE STRUCTURE
- VERSATILE PROBE AND MOUNTING
- RUGGED, RELIABLE DESIGN
- PROVIDES ESSENTIAL COMBUSTION EFFICIENCY MEASUREMENTS

the 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.

MWIR-Borescope-640

MEASURES TEMPERATURE PROFILES INSIDE BOILERS AND FURNACES



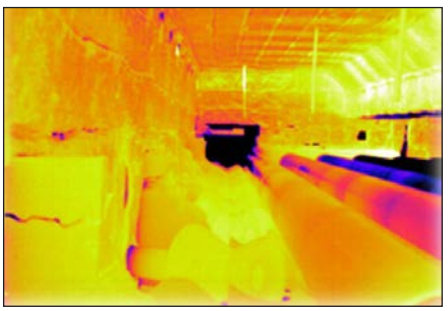
The MWIR-B-640 enables a continuous and clear view, even through heavy smoke and hot gases inside the boiler, which is not possible with visual or short-wavelength infrared furnace camera systems.

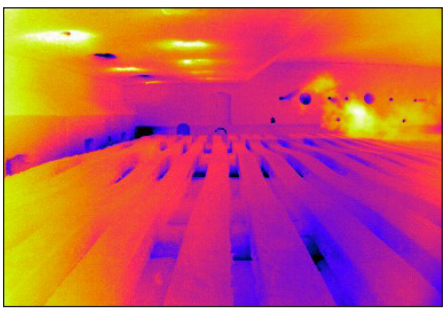
Requiring only a small opening in the boiler wall, the MWIR-B-640 allows highly accurate and fully radiometric temperature measurement data to be taken, stored, and trended over the lifetime of the boiler. Accurate tube wall temperatures provide key data for intelligent sootblowing and enable problems such as flame impingement to be identified and corrected.

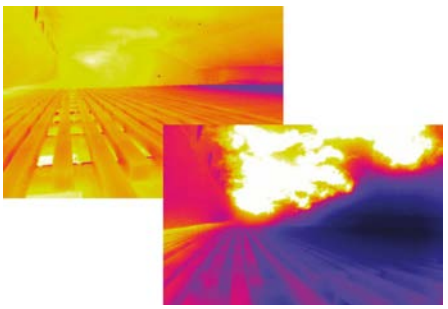
The high-resolution image, combined with the 90° field of view, allows multiple areas to be imaged and measured simultaneously. With the wide-angle view into the furnace, image data can be viewed in real-time from the safety of the control room.

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 a de facto requirement in many other countries. In the United States, analysers must meet Performance Specifications defined by the US EPA.

THE AMETEK LAND SOLUTION

4500 MkIII

ACCURATE AND RELIABLE CONTINUOUS OPACITY MONITOR

A high-specification opacity and dust 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 US EPA PS-1
- EASY OPERATION WITH INTUITIVE BUILT-IN DISPLAY
- MULTI-PRISM RETRO-REFLECTOR REDUCES THERMAL DRIFT
- NO CONTINUOUSLY-MOVING PARTS

4650-PM

STABLE AND ACCURATE LOW-RANGE RESULTS IN STACKS AND DUCTS

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 FOR HIGHEST SENSITIVITY
- NO MOVING PARTS IN THE MEASUREMENT PATH
- COMPREHENSIVE CONTROL OPTIONS

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 stacks and ducts. It can be used 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.

- LARGE AREA COLLECTION OPTICS
- HIGHLY STABLE AND RELIABLE
- NON-INTRUSIVE SENSOR
- WIDE MEASUREMENT RANGE
- EN 15267 APPROVAL THROUGH TUVdotCOM

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.

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.

- LONG LIFETIME LED LIGHT SOURCE
- NO MOVING PARTS
- PATENTED, ALL-GLASS, MULTI-PRISM RETROREFLECTOR
- WIDE OPERATING TEMPERATURE RANGE
- EN 15267 APPROVAL THROUGH TUVdotCOM

CDB

INFRARED THERMOMETER MEASURES FURNACE EXIT GAS TEMPERATURE

A thermometer optimised to accurately measure furnace exit gas temperatures

CDB 'sees' through a cold ambient air to measure the hot carbon dioxide beyond. By filtering out other gas types, CDB provides a true gas temperature for exceptional control - improving both process safety and process efficiency.

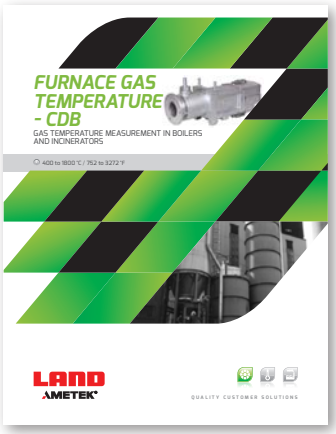
Installed in a boiler, the thermometer works as an 'invisible thermocouple', with its sight path extending above the furnace bed.

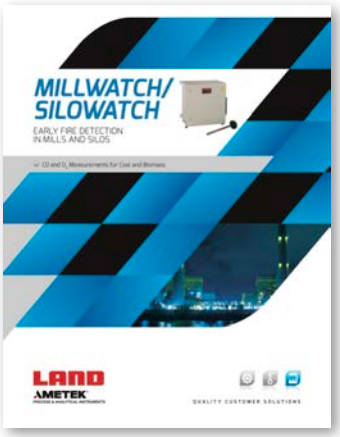
- IGNORES COLD ATMOSPHERES AND GASES OTHER THAN CO_2
- NON-CONTACT MEASUREMENT DOESN'T INTERFERE WITH THE PROCESS
- MEASURES A KEY PROCESS PARAMETER.

AMETEK LAND SOLUTIONS FOR COAL-FIRED POWER PLANTS

AMECARE® PERFORMANCE SERVICES

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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