LAND

AMETEK®

APPLICATION NOTE

PLATINUM AND NICKEL ORE EXTRACTION

Metals are sourced from ore deposits in the Earth's crust. Once the metal ore has been mined, it needs to be processed to isolate the desired metal. The properties of the metal dictate the best way of removing it from the ore. Platinum and nickel are extracted from their ore in a furnace in a process called smelting.

AMETEK Land provides advanced solutions tailored to the demands of ore extraction applications. These solutions are dedicated to precise furnace temperature measurement, effective process control, and superior product quality. In this document, we focus on solutions designed for platinum and nickel applications.

TEMPERATURE SOLUTIONS FOR METAL EXTRACTION

AMETEK Land's thermal imagers are used to safely monitor the process of extracting platinum and nickel from its ore, using non-contact infra-red temperature measurement. Our solutions provide critical temperature data used to produce consistent, high quality products and inspect the condition and integrity of high-value assets, without putting any member of the workforce in harms way.

AMETEK Land's thermal imagers can be used inside the furnace as a borescope, or mounted externally to measure the temperature of the main flow during tapping, slag removal and granulation. Mounted camera systems are better than other hand-held portable temperature measuring solutions as they provide consistent continuous data and don't require a worker to go near the molten metal.

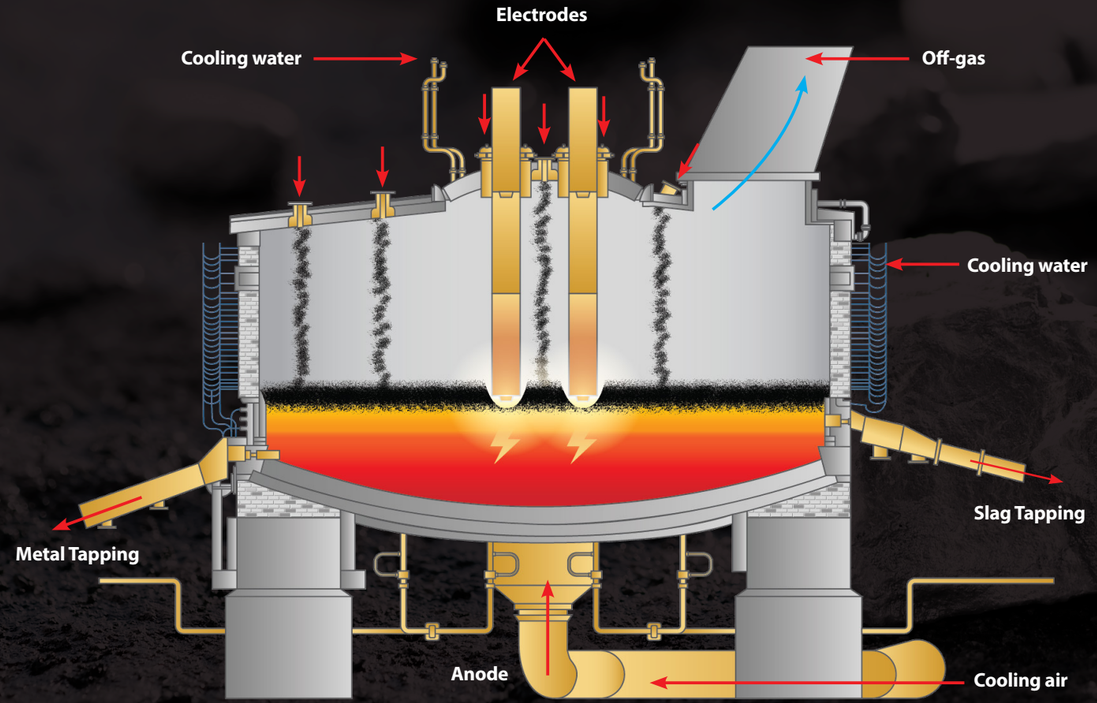
Temperature monitoring across the metal extraction process is essential to support safety, process efficiency, and product quality. It can also help to prolong the life of the equipment through early detection of refractory issues, and by monitoring the time hot material has been in contact with surfaces to plan for maintenance or swap out of equipment.

SMELTING FURNACES

Furnaces are used to heat and melt metal ore concentrates along with powdered collectors, fluxes, and other reagents. Fluid slag and metallic layers are created and then separated, producing a molten metal product ready for refining. This process is called smelting.

Smelting furnaces can reach temperatures up to 1800°C. Precise temperature control during smelting is important for on-site safety, product quality and equipment management.

Temperature monitoring in this harsh environment is critical and requires specialist knowledge and equipment.



FURNACE MONITORING

A borescope is used for real-time temperature measurement and imaging inside a furnace, allowing you to:

- **Understand the process**
- **Increase process control**
- **Reduce energy consumption and emissions**
- **Inspect electrodes and refractory material and**
- **Identify damage quickly**

AMETEK Land's borescopes are specially designed to perform in hot furnaces and produce reliable readings you can trust. Two borescopes are installed per furnace to provide a clear view of both sides of the electrodes.

Cracked electrodes can be quickly and automatically identified with thermal imaging, preventing costly furnace shutdowns.

Maintaining electrodes in peak condition is critical to avoid explosions during ore material addition. Neglecting their upkeep risks sudden, violent reactions, temperature fluctuations, and potential hazards.

Arcing electrodes in furnaces perform the following tasks:

- **Initiating the melting process:** The arcs between the electrodes and the material being added generate intense heat, which is essential for initiating the melting process. Arcs can reach extremely high temperatures, providing the energy required to raise the material's temperature to its melting point.
- **Heat transfer:** The electric arcs not only create high temperatures but also ensure efficient heat transfer to the material. This helps to melt the product more quickly and evenly.
- **Stirring and homogenising:** The arcing action can also create stirring and agitation in the molten material, promoting a more homogenous melt. This is important when alloying or mixing different materials to ensure consistent composition.
- **Maintaining the molten state:** In some furnaces, especially those used for continuous processes, the arcs help maintain the material in a molten state. As the product is added and melts, the arcs ensure that it doesn't solidify prematurely.
- **Control and regulation:** The intensity and behaviour of the arcs can be controlled to manage the temperature and other properties of the molten material. This control is vital for achieving the desired quality of the final product.
- **Electromagnetic effects:** In some cases, the arcs generate electromagnetic fields that can have beneficial effects on the melting and refining processes, such as reducing impurities or promoting the separation of slag from the molten metal.

When an electrode starts to crack, a white line forms which is easy to spot with a thermal imager but difficult if you are relying on looking through a viewing window.

If a crack is detected, operators can pull the electrode out and repair it quickly, rather than run the risk of having a damaged electrode breaking off inside the furnace.

If an electrode does break off inside the furnace, then either the furnace must be emptied, which would be extremely costly, or it can continue to operate while running the risk of a new electrode touching the broken-off piece within the furnace.

Electrodes are the main cause of delays or significant shutdowns.

RECOMMENDED THERMAL BORESCOPE SOLUTIONS

AMETEK Land borescopes can help to monitor refractory wall damage at tap holes as well as monitor electrodes, seeing clearly through dusty and smoky atmospheres.

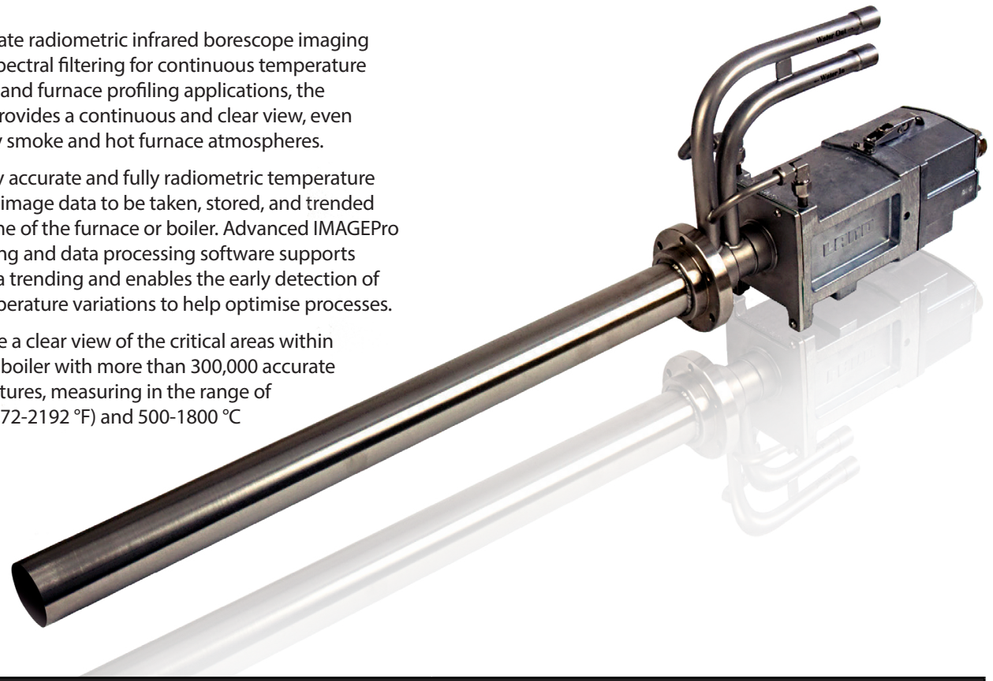
Tap holes should be monitored as this is where the first signs of refractory wall damage will appear.

MWIR-BORESCOPE-640

A highly accurate radiometric infrared borescope imaging camera with spectral filtering for continuous temperature measurement and furnace profiling applications, the MWIR-B-640 provides a continuous and clear view, even through heavy smoke and hot furnace atmospheres.

It allows highly accurate and fully radiometric temperature measurement image data to be taken, stored, and trended over the lifetime of the furnace or boiler. Advanced IMAGEPro thermal imaging and data processing software supports long-term data trending and enables the early detection of leaks and temperature variations to help optimise processes.

Operators have a clear view of the critical areas within the furnace or boiler with more than 300,000 accurate point temperatures, measuring in the range of 300-1200 °C (572-2192 °F) and 500-1800 °C (932-3272 °F).



SPECIFICATION HIGHLIGHTS	
MID-TEMPERATURE:	300 to 1800 °C / 572 to 3272 °F
MID-WAVELENGTH:	MWIR 3.9 µm
TEMPERATURE RANGE:	300 - 1200 °C / 572 - 2192 °F | 500 - 1800 °C / 932 - 3272 °F
Spectral Response:	3.9 µm
Pixel Resolution:	640 x 480 pixels
Frame Rate:	60 Hz / 9 Hz
Optics (FOV):	90° x 67.5°
Interfacing:	Gbit - Ethernet /PoE
I/O Options:	I/O-modules and digital interfacing via IMAGEPro V2
Smart Functions:	Integrated Webserver

NIR-BORESCOPE-656

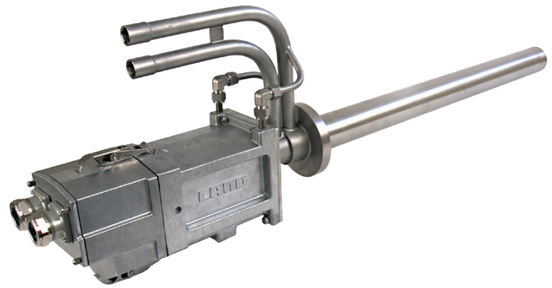
The NIR-Borescope-656 (NIR-B-656) is a high-resolution short wavelength full radiometric infrared borescope imaging camera designed to produce continuous live high-definition thermal images.

It can measure temperatures in the range of 600 to 1800 °C (1112 to 3272 °F) and is suitable for a wide range of continuous process monitoring and control applications, providing high-resolution images and temperature readings in large furnaces.

By providing a cutting-edge clear thermal image unaffected by the furnace's hot atmosphere/gases, the NIR-B-656 allows operators to measure from any of the 322,752 pixels, and optimise furnace temperature to save energy, increase efficiency and reduce emissions.

With 24/7 coverage via a Gigabit Ethernet connection, automated alarm outputs instantly alert the user to any problems or structural issues to ensure furnace efficiency and provide complete operational control. Thermal anomalies are easy to detect through continuous monitoring of all positions from the safety of the control room.

The camera requires only a narrow opening to accommodate a wide field-of-view angle lens tip. A choice of optics (FOVs) are available and provide an extensive measurement area throughout for wide furnace coverage.



SPECIFICATION HIGHLIGHTS	
HIGH-TEMPERATURE:	600 to 1800 °C / 1112 to 3272 °F
TEMPERATURE RANGE:	600 - 1000 °C / 1112 - 1832 °F | 800 - 1400 °C / 1472 - 2552 °F | 1000 - 1800 °C / 1832 - 3272 °F
Spectral Response:	1 µm
Pixel Resolution:	656 x 492 pixels
Frame Rate:	30 fps
Optics (FOV):	31° x 24° / 95° x 71°
Interfacing:	Gbit - Ethernet
I/O Options:	I/O-modules and digital interfacing via IMAGEPro V2

IMAGEPro SOFTWARE

IMAGEPro V2 is advanced image processing software for process control, monitoring, analysing and capturing temperature measurement data.

Able to monitor and control up to sixteen of AMETEK Land's thermal imagers, IMAGEPro V2 offers real-time analysis and clear visualisation of critical process parameters enabling precise thermal imaging enhanced application control.

- **IMAGEPro Software allows you to treat recorded data as a live feed and change the ROIs and measurement constraints**
- **Calibrations can be performed on-site so you don't need to worry about downtime**
- **An open data interface enables exchange of information using a simple cross-platform Modbus TCP protocol, analogue signals or alarm output via I/O modules.**
- **Continuous and triggered background recording, with a 10 second pre-recording function based on a temperature threshold trigger, gives you a complete process recording.**

SLAG AND MATTE TAPPING

Slag is the stony waste material separated from the matte (molten metal) during smelting. Slag is less dense than matte and so is tapped out of the furnace first. The point where the material transitions from slag to matte can be determined based on the temperature of the main flow.

Launders are used to transport slag and matte slurries when they are tapped. These are trough-like structures made of various materials including steel and concrete, and are lined with specialised coatings to withstand the abrasive and corrosive nature of the materials being transported.

A fixed thermal imager allows the temperature of the flow along the launder to be monitored, facilitating real-time process decisions based on a pre-identified cut-off, without the need for operators to be close to the dangerous furnace.

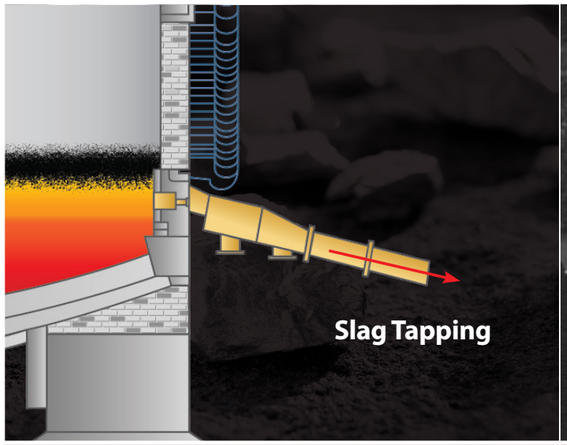
The thermal imager captures the whole process, allowing metallurgists to study the complex details of the process without generating needless information for the operator.

Equipment life span calculations can be made based on the time the molten material was in contact with the equipment – for example, the lifespan of a launder can be calculated.

This facilitates efficient equipment replacement, preventing costly launder failure and removing the waste of replacing a launder when well within operating limits.

Thermal imaging provides continuous temperature monitoring, not just spot temperatures, so the slag to matte transition can be better assessed and a fuller understanding of the quality of the melting process inside can be obtained. Armed with this knowledge, adjustments can be made to improve the output from the furnace.

In platinum smelting, the slag is processed a second time in a slag cleaning furnace to recover any matte that was included with the slag in the first tap.



RECOMMENDED PRODUCT:

NIR-656 fixed thermal imager mounted 30m from furnace for molten metal temperature measurement

ADDITION PRODUCT:

LWIR-640 fixed thermal imager mounted beneath to monitor for hotspots

GRANULATION

Granulation is the formation of granules or pellets from the molten nickel matte through rapid cooling. It is important that slag doesn't contaminate the nickel matte that is being granulated, as this will reduce the product quality.

AMETEK Land's Slag Detection System (SDS) uses a high-resolution thermal imaging camera to detect the transition between nickel matte and slag.

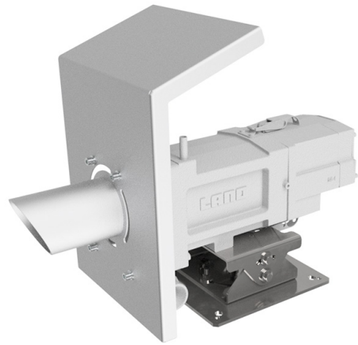
SLAG DETECTION SYSTEM (SDS) V2

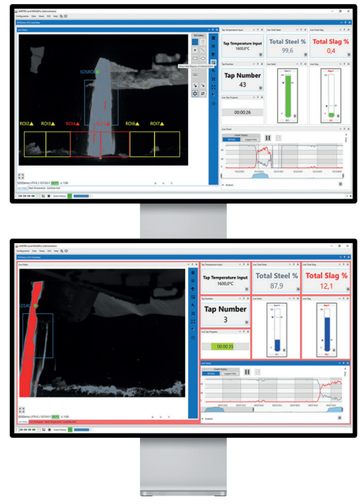
The AMETEK Land Slag Detection System delivers improved yields and higher-quality metals reducing costly downstream processing. There are additional benefits in reduced ladle refractory wear.

At the end of the tap, the proportional levels of slag and the measured metal rapidly reverse. Quick termination of the tap after the alarm has been triggered is necessary to prevent excessive levels of slag in the ladle.

SDS uses a high-resolution thermal imaging camera to detect the transition between product and slag. This camera has been specifically designed to survive in harsh operating conditions and utilises a particular wavelength to reduce obscuration caused by smoke and fume. Data is presented to the operator in real-time, enabling them to make informed decisions about the tapping process. The system also provides clear alarm notifications.

By using additional regions of interest (ROIs) together with a secondary thermal imaging camera integrated into the system, optional features such as stream position or freeboard height can also be integrated, providing advanced process monitoring and control.





SPECIFICATION HIGHLIGHTS	
MID-TEMPERATURE:	**500 - 1800 °C / 932 - 3272 °F**
MID-WAVELENGTH:	3.9 µm camera / MWIR-640 SDS
TEMPERATURE RANGE:	500 - 1800 °C / 932 - 3272 °F
Spectral Response:	3.9 µm
Pixel Resolution:	640 x 480 pixels
Max Frame Rate:	60 fps / 7.5 fps
Optics (FOV):	12° x 9° / 25° x 19°
Interfacing:	Open Data Interface, Modbus TCP, Moxa I/O unit
Softwear:	IMAGEPro SDS

SLAG SKIMMING

Slag skimming can be done using slag skimmers, ladles, or slag rakes. The slag is typically skimmed off the surface of the molten metal and directed into slag pots or slag beds for further processing or disposal. It is important to make sure that as much slag is removed as possible to maintain the purity and quality of the nickel matte.

The camera component of AMETEK Land's Slag Detection System can be used to visually inspect the slurries and make sure all of the slag has been skimmed off.

METAL ORE EXTRACTION AND REFINING

AMECARE® PERFORMANCE SERVICES

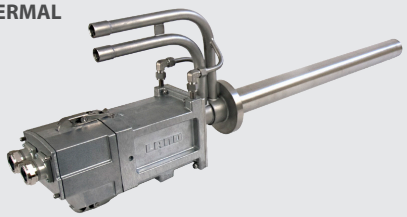
Our global service centres provide after-sales services to ensure you get the best performance from your system. This includes technical support, certification, calibration, commissioning, repairs, servicing, preventative maintenance and training. Our highly trained technicians/engineers can also attend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



NIR-BORESCOPE-656

A short-wavelength radiometric infrared borescope imaging camera designed to produce continuous live thermal images for process monitoring and control applications.

FIXED THERMAL IMAGERS

NIR-656

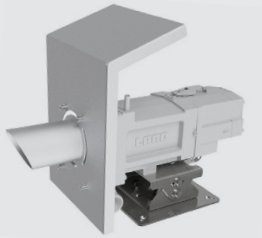
A range of high-precision thermal imagers producing high-temperature measurements in a wide range of applications.

FIXED THERMAL IMAGERS

LWIR-640

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

FIXED THERMAL IMAGERS



SDS V2

The Slag Detection System (SDS) delivers improved yields, higher-quality steel and reduces costly downstream processing.

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