

LAND

AMETEK®

*MOLTEN METAL ESCAPES
AND BREAKOUTS*

APPLICATION NOTE

TEMPERATURE MEASUREMENTS TO PREVENT MOLTEN METAL ESCAPES AND BREAKOUTS

The escape or breakout of molten metal is a highly important safety consideration in all metal manufacturing industries, particularly steelmaking.

The extremely high temperatures involved make any breakout of molten metal extremely hazardous. However, if the metal mixes with water, it can instantly vaporise the water, causing a potentially explosive reaction.

Temperature measurement systems can provide a warning of when breakouts are likely to occur. Hotspots on the outside of ladles indicate the early stages of a damaged or thinning refractory lining. By detecting these hotspots on the surface of vessels and torpedo cars, they can identify points where the refractory lining is at its weakest.

Temperature measurement systems can also warn when overfilling is likely to occur, helping to avoid metal escaping over the top of a vessel or ladle.

TORPEDO CARS

Typically, integrated steel mills use torpedo cars on rails to transport molten metal from the blast furnace to the steelworks. Each car has a torpedo-shaped ladle that can carry up to 250 tonnes of liquid metal.

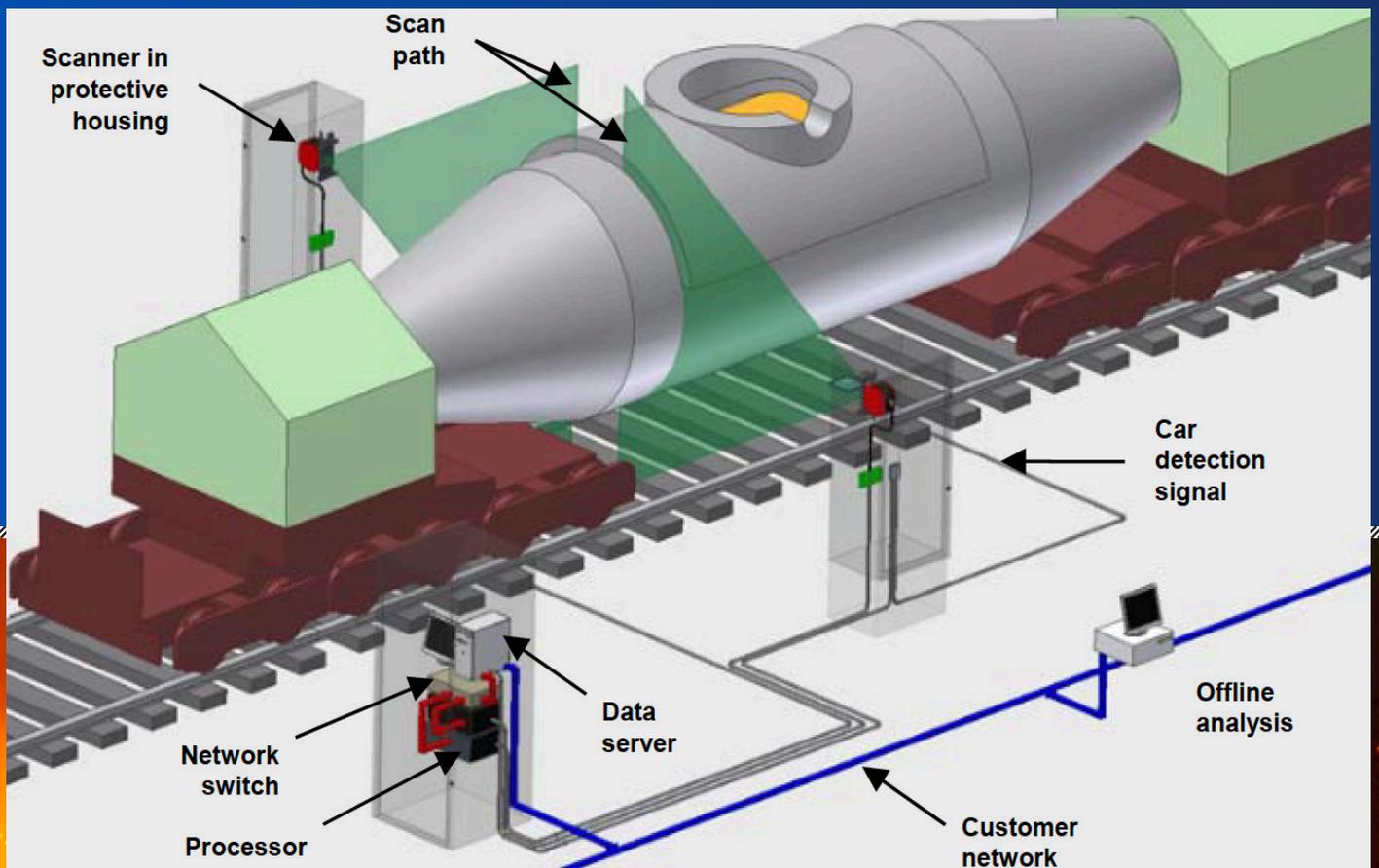
The ladle is lined with refractory brick to keep the contents in a liquid state

and to protect the outer steel shell of the torpedo car against failure.

It is important to monitor the shell temperatures using the same method each time the car passes the monitoring location. In this way, a history of hotspot progression can be developed.

There is a temptation for steel manufacturers to allow the refractory linings to thin, thus increasing the volume of iron that can be carried. However, this increases the risk of failure.

Constant and repeatable thermal mapping of the shell allows early detection of areas that need repair.



A TYPICAL TORPEDO CAR SCANNING SYSTEM

A MONITORING SOLUTION FOR TORPEDO CARS

The AMETEK Land Torpedo Car Monitoring System uses LSP-HD scanners installed on each side of the track, producing highly detailed thermal images of each side of the car from a short distance, which usual thermal imagers cannot deliver. This enables the safety system to view very small surface details.

The scanners are housed in climate-controlled enclosures with air purges and electrical interfaces. Industry-standard fast ethernet provides rapid communication to the control room.

As each car passes a measurement station, ID tags on the car provide a

unique car number and temperature data to the monitoring software. The direction of movement is also detected.

The wide 80° vertical scan angle of the scanners and the 1,000 temperature points in each scan produce extremely high-resolution thermal images, providing comprehensive monitoring of the torpedo car.

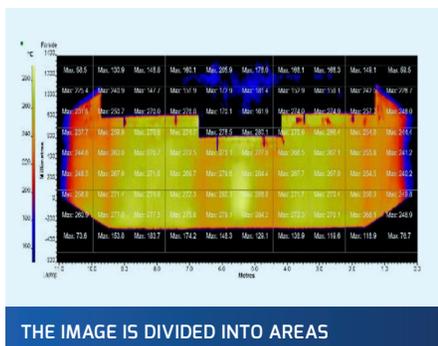
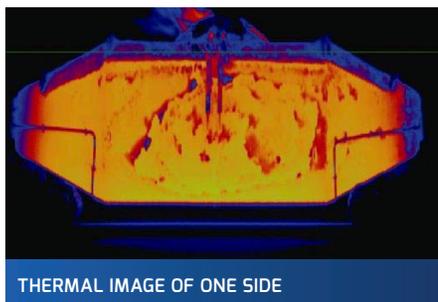
An image file is automatically saved for each side of every car. The complete view is then divided into a number of areas (50, for example).

For each area, the maximum and average temperature is transferred to

a historical database, which provides long-term trending of individual areas on the torpedo car.

The database and stored images are accessible via PCs on the company network. Data can also be transferred to the plant network for further analysis and storage.

Data obtained from a torpedo car can be presented in the form of a complete thermal image. Temperatures above the target region are indicated in red, and indicate an issue with the refractory lining.



MAIN FEATURES AND BENEFITS

Early detection of cracks in refractory helps avoid metal breakouts

Early detection of changes in temperature profile

Hot spot detection, analysis and tracking

Increased plant safety

- Reduce and prevent break-outs
- Less risk to operators as manual field work is reduced by automatic inspection

Easy-to-use, fully automated solution

Historical thermal image database

Analysis of long-term trends

Improved confidence in refractory condition

Planned refractory relining maintenance schedule

Automatic ladle/torpedo car detection and recognition

TORPEDO CAR TAGGING

A SOFIS surface acoustic wave identification system is used for non-contact identification of ID tags located on mobile objects.

The SOFIS reading device has a computer-controlled, high-frequency transmitter and receiver unit. It reads the tag number and direction of

travel in the IDF tag and conveys this to the Landscan WCA software.

The reading device is comprised of an evaluation unit and an integrated antenna designed for railway applications, and is accommodated in a robust housing.

The ID tag consists of a surface acoustic wave chip and antenna in a protective housing.

Both the tag and reader are highly resistant to vibration and shock, and are suitable for use in the track ballast or for installation on the vehicle body.



LSP-HD 61

LSP-HD 61

A compact, high-accuracy infrared linescanner, the LSP-HD is designed to provide advanced thermal images of moving processes.

Output from the linescanner heads is converted into a data string of 1000 readings per scan line, at a maximum frequency of 150 scanlines per second. Landscan WCA software provides all calculations required from each scan line.

The LSP-HD 61 is the model recommended for torpedo car monitoring, and operates in a temperature range from 50 to 400 °C (120 to 750 °F), with a wavelength between 3 and 5 μm , which excludes sun and weather influences on the measurement.

FEATURES

High-resolution optical system, providing a highly homogenous thermal image

Industry-leading 150 Hz scan speed

Designed to operate in harsh industrial environments

Plug-and-play installation via a single Ethernet cable

BENEFITS

Full-width measurement identifies smallest temperature variations

Accurate thermal records

Real-time thermal display

Easy connection to control systems

Complete, integrated system from a single supplier

MOLTEN METAL LEVEL INDICATION IN LADLES

The use of refractory-lined vessels (ladles) to transport molten iron and steel is commonplace in steel plants worldwide. Over time, the refractory condition degrades until it must be re-lined.

Traditionally, the timing of this re-lining has been based on previous experience and best-practice information from the plant's Refractory Manager. However, this mechanism can be unreliable and breakouts occur, causing severe damage to plant, injuries to personnel and losses of revenue due to production delays.

The maintenance of these refractory linings contributes significantly to steel production costs. By monitoring the external temperature pattern of ladles, the extent and distribution of wear can be assessed, determining the re-lining strategy to prevent excessive lining damage and breakouts.

Visual cameras are unreliable for filling applications, because smoke and gas present in the application environment often obscure the view of the measurement zone. These cameras also rely on the operator's skill and level of attention, which can be inconsistent and unreliable.

The level of molten steel in the ladle can also be determined by weighing the ladle before and after filling. However, oxide scale can build up on the ladle over time, affecting the measurement, so the result is not entirely reliable or preventative.

Since the temperature of molten steel is much higher than that reached by the ladle refractory bricks, temperature measurements can be taken at key points on the freeboard to determine the depth of the steel. This measurement however proves difficult due to the hostility of the steel mill environment around the ladle during steel tapping, making most instrumentations unreliable.

THE AMETEK LAND SOLUTION

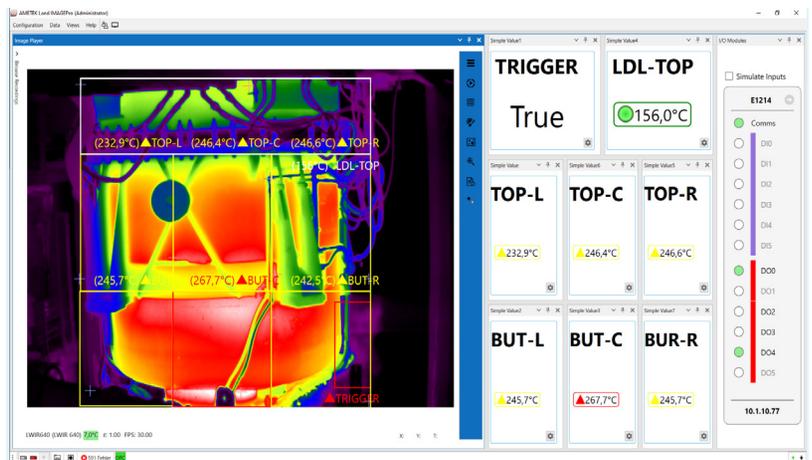
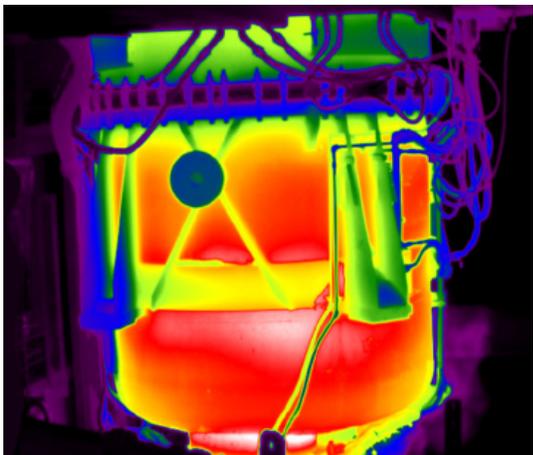
AMETEK Land provides the advanced LWIR-640 thermal imagers to monitor the external shell temperature of passing ladles as they move through the inspection field of view, transferring steel to the next production stage.

Each measurement station can comprise from one to typically five cameras, mounted in industrial protection enclosures, to give full coverage of the exterior of a ladle, the bottom and

outlet, depending on customer needs. The thermal images, temperature data and hot-spot alarms are clearly monitored and stored within the fast response time of the cameras (7.5 or 60 Hz), enabling engineers to identify hot-spot trends and make decisions about the repair and renewal of linings.



LADLE MONITORING



LADLE MONITORING HIGH RESOLUTION THERMAL EXAMPLE IMAGE

LWIR-640

The new LWIR-640 long-wavelength thermal imagers build on more than 20 years of thermal imaging experience, expanding the market-leading range of AMETEK Land temperature measurement solutions.

FEATURES

Unmatched image quality for process visualisation and control

Heavy Industrial colling and ourging enclosures available for reliable 24/7 operation

A range of optics (FOV) available

Designed for 24/7 operation in harsh environmental conditions

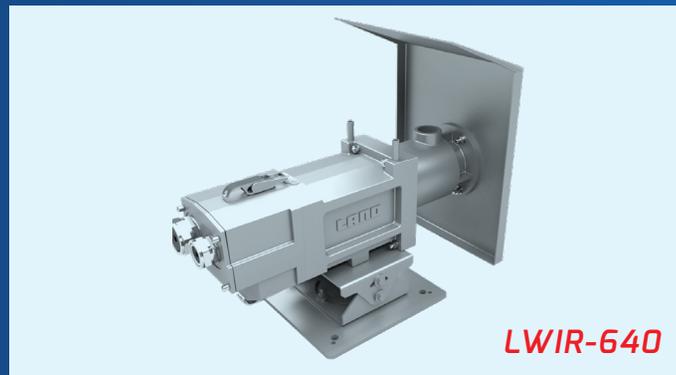
BENEFITS

Easy access for remote configuration

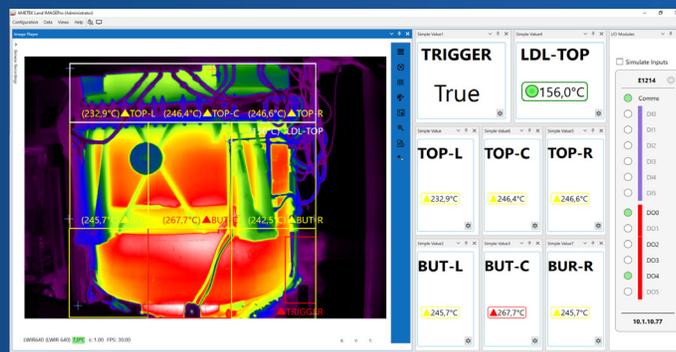
I/O setup and image monitoring setup via web browser

Software-based or fully autonomous operation (integrated webserver)

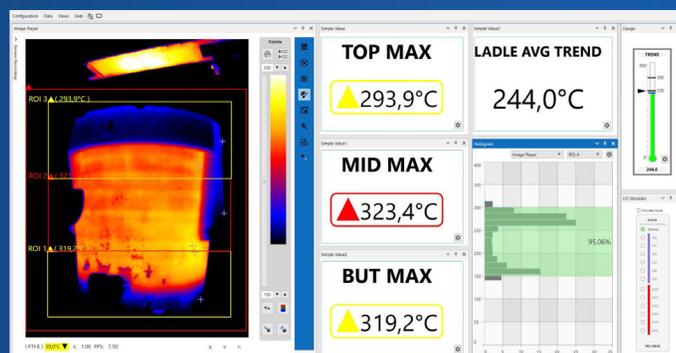
Multiple digital and analog interfacing (I/O modules, Modbus, TCP, OPC UA)



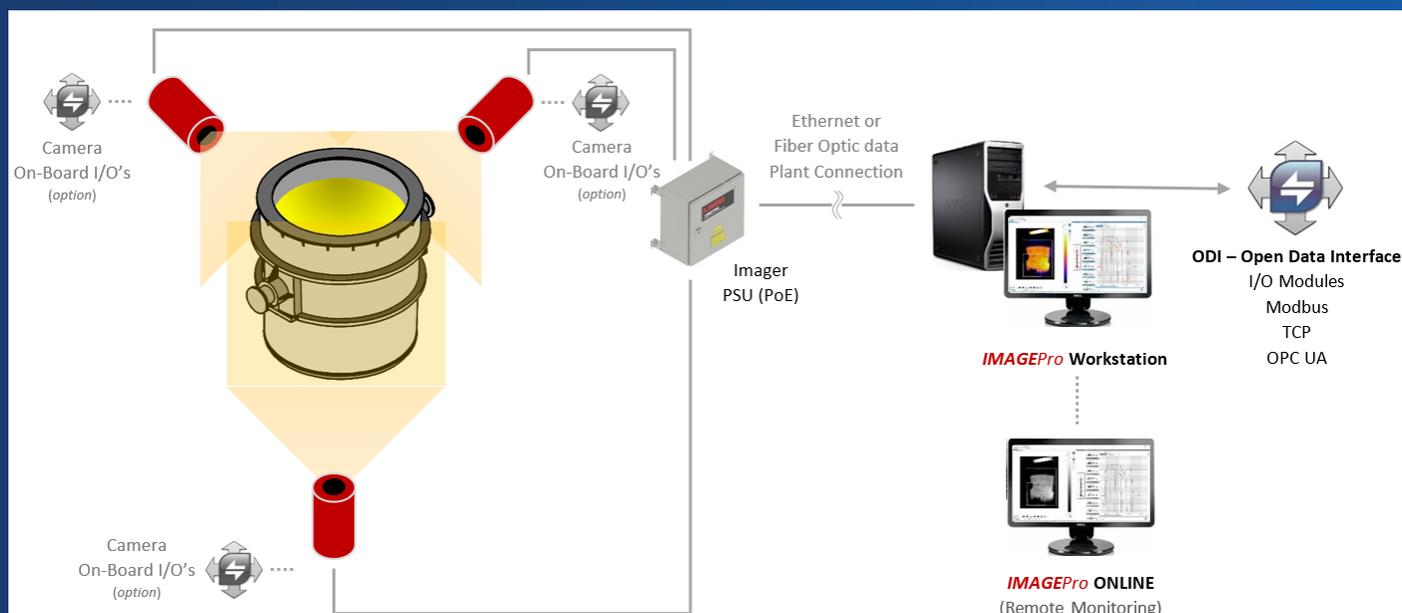
LWIR-640



IMAGEPRO LADLE MONITORING CONFIGURABLE SOFTWARE VIEW



IMAGEPRO LADLE MONITORING CONFIGURABLE SOFTWARE VIEW



LADLE MONITORING SYSTEM – SYSTEM DIAGRAM

AMETEK LAND SOLUTIONS FOR TEMPERATURE MEASUREMENTS TO PREVENT MOLTEN METAL ESCAPES AND BREAKOUTS



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.

LSP-HD 61

A compact and robust infrared linescanner, designed to produce advanced thermal imaging in moving processes.



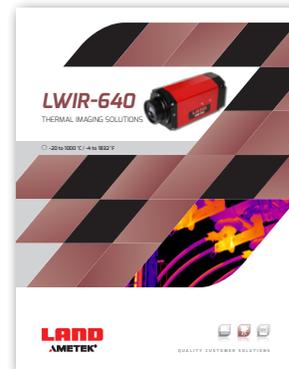
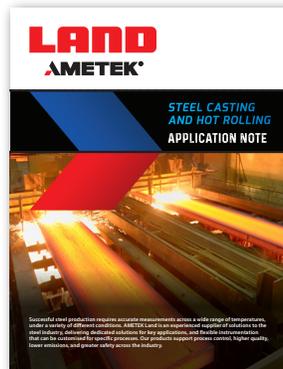
LINESCANNING

LWIR-640

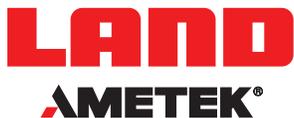
A smart thermal imager providing a full temperature measurement range of -20 to 1000 °C (-4 to 1832 °F) with an integrated webserver and multiple interface options.



PROCESS IMAGING



DOWNLOAD THE BROCHURES 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