LAND

AMETEK®

THE GLASS MAGAZINE

AMETEK Land is the world's leading designer and manufacturer of monitors and analysers for industrial infrared non-contact temperature measurement, combustion efficiency and environmental pollutant emissions.

We offer a trusted range of leading-edge technologies, supported by unrivalled applications knowledge, delivering highly accurate measurement solutions that meet every customer's precise process needs.

FIND WHAT YOU NEED ONLINE

The AMETEK Land website is your online guide to our products and services. Visit us to find:

- Details of our extensive product range
- Application-specific solutions
- Industry information
- Downloadable brochures, manuals and application notes
- Free software downloads
- Your nearest AMETEK Land office

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Our comprehensive range of after-sales services ensures you get the highest performance from your AMETEK Land instruments and systems. Dedicated service centres and on-site personnel across the world deliver:

- Technical support
- Maintenance
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WELCOME

YOUR GUIDE TO GLASS INDUSTRY SOLUTIONS

Welcome to the first issue of AMETEK Land's new magazine for professionals working in the glass production industry.

As the world leader in temperature measurement, we've been supplying the glass industry with essential equipment for more than 70 years, providing a combination of flexible devices and application-specific instruments that deliver accurate results at key locations throughout the process.

We know how critical precision temperature measurements are to your glass-making processes; that's why our advanced solutions meet the highest standards of quality and reliability.

Our measurement systems provide the accuracy you need to support applications within all glass manufacturing operations, including flat glass, containers, tempered glass, and fibre-optic communications.

In this issue, you can discover more about AMETEK Land's products, the technology behind them, and how they can improve process efficiency – raising quality and lowering costs.

I hope you find it an enjoyable and enlightening read!

Glass Industry Lead, AMETEK Land
Philippe Kerbois

DISCOVER THE FULL RANGE OF OUR SOLUTIONS FOR THE GLASS INDUSTRY *PRODUCT GUIDE STARTS ON P20*

THE CASE STUDY

AN AWARD-WINNING THERMAL IMAGING SOLUTION FOR CONTAINER GLASS FURNACES

THE COMPANY

NAME: Encirc

BASED IN: Elton, Cheshire, UK and Derrylin, Ireland

INDUSTRY: Container glass manufacture, filling facilities, warehousing and logistics

THE CHALLENGE

The primary goal when melting glass is to maintain the correct temperature profile for high quality glass. This can be achieved by using materials which are easier to melt, optimising furnace wall heat losses through insulation, and increasing pull to reduce heat losses.

To reduce fuel consumption, increase safety and minimise unwanted emissions, it is important to maintain combustion efficiency. This depends on the reaction between fuel and air (providing oxygen) to produce high temperatures in the furnace.

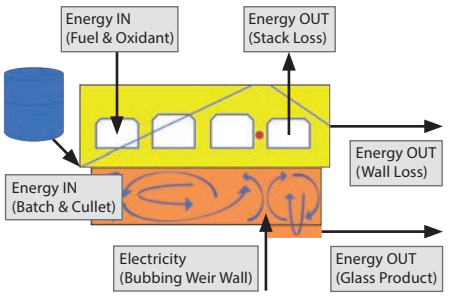
Well-controlled combustion requires the best possible air-to-fuel ratio to maximise the heat capture of the furnace. Too much oxygen creates cooler burning conditions and combines with nitrogen and sulphur to produce unwanted emissions.

However, if there is insufficient oxygen to convert all the hydrocarbon from the fuel, the combustion is incomplete, leaving unburned combustibles in the exhaust gas. High-fuel, low-oxygen conditions also create a risk of dangerous explosions.

The flames within the furnace make accurate temperature profiling challenging, as the energy they radiate creates an unstable background reflection which cannot be corrected for with any degree of accuracy.

A thermal imaging system offers a real-time solution that meets many of these challenges, delivering an accurate (I'm not sure if this is misleading – maybe useable or comparative) temperature profile even when flames are present. This provides important information about the furnace wall, revealing any heat losses, and monitors the glass to ensure uniform melting.

PRIMARY GOALS OF MELTING



- **Maintain temperature profile for good glass**
- **Use materials that are easier to melt**
- **Optimise wall losses (insulate) or increase pull to reduce %**
- **Reduce stack losses through heat recovery**
- **Optimise combustion and heat transfer**

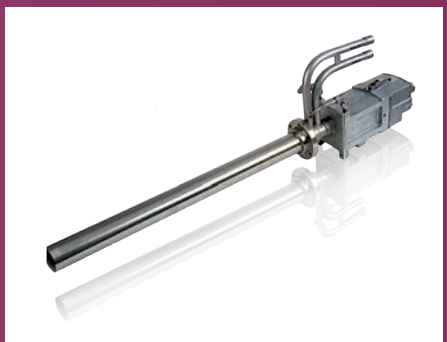
THE SOLUTION

Encirc installed AMETEK Land's NIR-B Glass thermal imaging system on both furnaces at Elton.

The NIR-B continuously takes more than 300,000 optical pyrometer temperature measurements, using them to generate an extremely high-definition image. This allows critical point temperatures in the crown and breastwalls to be measured, providing high-quality temperature data to operators.

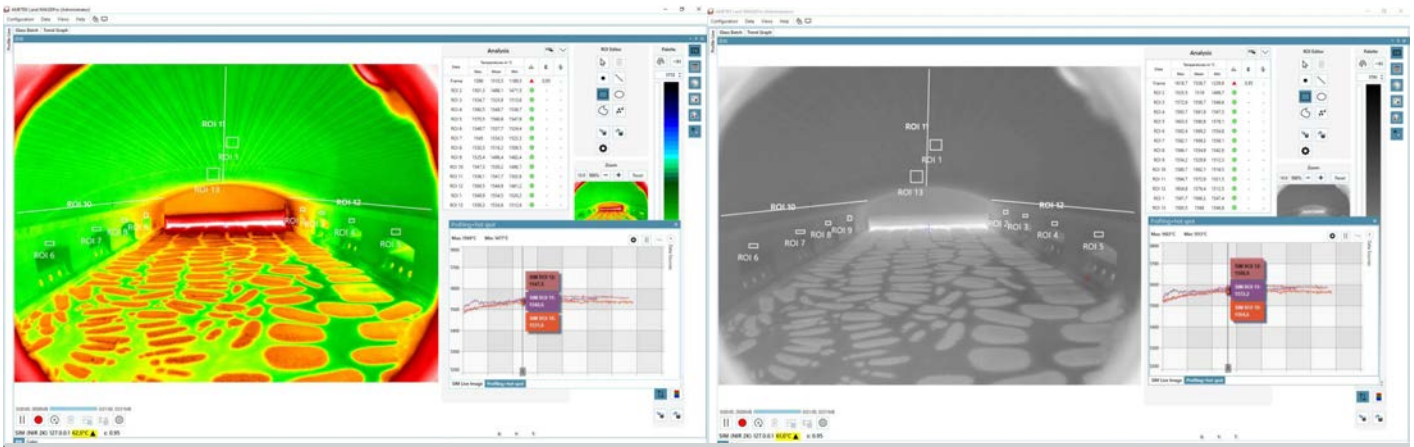
The NIR-B system offers the ability to measure optical profiles continuously, and to specifically obtain all points at the end of the firing cycle.

This provides the opportunity to assess the temperature profile at the next reversal (and the following one), identifying points of concern and allowing any problem to be addressed within an hour. Previously it took at least four hours – and more realistically 24 – before a manual thermal profile was initiated.



AMETEK LAND NIR-B-2K GLASS THERMAL IMAGING SYSTEM

THE RESULT



BATCH COVERAGE AND CROWN TEMPERATURE MONITORING

Two years after installation, AMETEK Land began working with consulting firm Simpson Combustion and Energy to study the impact of effective temperature measurement on optimising Encirc's furnace operations.

The study involved Simpson Combustion and Energy taking port flue gas measurements using AMETEK Land's Lancom analysers. That data was then analysed simultaneously with in-furnace thermal images generated by the NIR-B Glass.

By comparing the information with data recorded two years previously, it was discovered that specific regenerators now had restrictions (cold temperatures), with overheating in clear ports indicating port volume flow at a level higher than design.

In addition, port fuel distribution was now governed by where there was available air for combustion.

The NIR-B showed that the hot spot had moved significantly from its original, ideal position, and there appeared to be excessive metal-line cooling. The metal cooling line was turned down slowly to reduce energy consumption and refractory wear, as part of an asset protection programme.

When the Encirc team reviewed the thermal imaging data, there was a clear indication of a significant restriction in one of the ports, with most of the flue gases going to other ports. Encirc addressed regenerator flow with an external cleaning, then gave the team the flexibility to start moving fuel to get the hot spot closer to where it needed to be.

This resulted in a record pull rate with lower specific energy, on an asset that was then approaching a major repair.

Images generated by the NIR-B have provided Encirc with a valuable tool for supporting customer visits, clearly demonstrating how product quality is optimised, and how emission reductions may be achieved in the future.

- IMPROVED RESPONSE TIMES
- FURNACE TROUBLESHOOTING
- IMPROVED YIELDS
- RECORD PULL RATE
- LOWER SPECIFIC ENERGY
- INCREASED ASSET LIFE

THE AWARD

AMETEK Land's pioneering use of real-time, in-furnace imaging technology at Encirc scooped the Innovative Solution award at the Glass Focus Awards, held by industry body British Glass last June.

The award was presented jointly to AMETEK Land, Simpson Combustion and Energy, and Encirc.

Judging panel chair Dave Fordham, of Glass Worldwide, said:
"We were impressed by how this project had advanced the ability to better control furnaces in the future – and by its potential to reduce emissions, which is a priority for many industries."

Glass Focus Awards 2017 Award Winner Innovative Solution

Daniel Capon (Principal Technologist - Analytical, Glass Technology Services), Dave Fordham (Glass Worldwide), Mark Bennett (Glass Industry Lead, AMETEK Land), Robert Rose (Operations Director, Encirc Glass), Dr. Peter Drögmöller (Technical Director, AMETEK Land) and Neil Simpson (Consultant, Simpson Combustion and Energy).

THE GLASS MELTING

NIR-B-2K THERMAL IMAGING

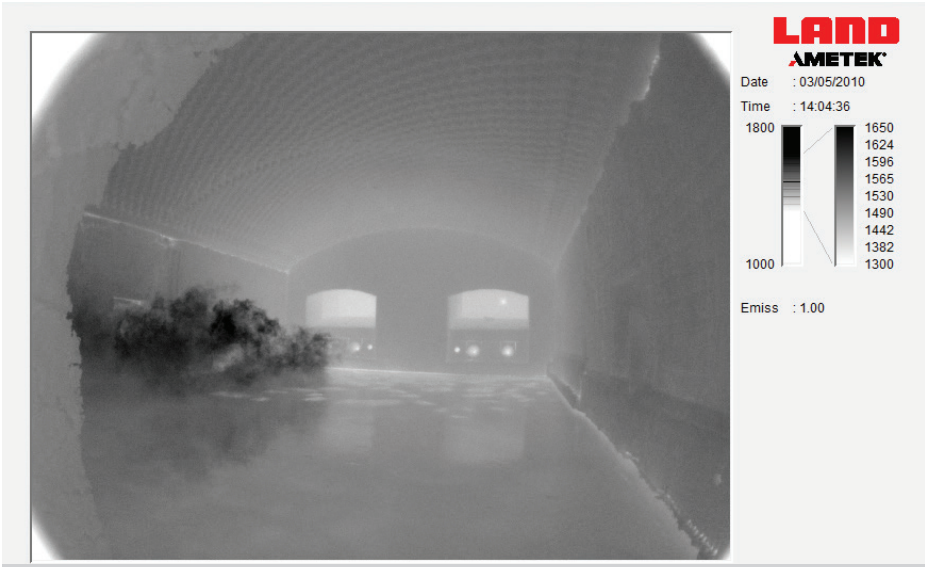
The AMETEK Land NIR-B Glass delivers the innovative approach required by both emissions regulations and industry advances. This short-wavelength, radiometric infrared borescope imaging camera produces high-definition thermal images, enabling accurate temperature measurements from any point in the image.

This thermal imaging technique offers many advantages over visual imaging and point temperature measurements.

A permanently installed thermal imager can actively record all necessary and useful data after a reversal, then replay up to the point of a reversal start. Each of the furnace areas can be viewed, the video can be stopped at any desired frame, and measurements can be taken of all the ports at the exact same point in the process, allowing reversals to be tuned more accurately.

In addition, the beginning of any structural damage caused by high temperatures can be detected rapidly. For example, if a crack is developing, it shows up as a cold area where air is being pulled in, enabling repair before the condition worsens.

The NIR-B allows accurate profiling of the temperature of the entire furnace, with only a small opening in the wall, providing the operator with access to data which would previously have been either time-consuming or impossible to collect.



THE NIR-B DETECTS AN AIR LEAK WHILE THIS END-FIRED FURNACE IS FIRING FROM THE RIGHT PORT

This leaves the operator free to focus on specific areas of interest, measure live data points, and store the information for future analysis.

By monitoring the live video, the operator can begin to increase melt-tank efficiency, improving product quality and reducing process costs.

The NIR-B Glass offers a view of 90 x 67.5 degrees, providing 324,000 data points and 24/7 monitoring. The high-quality images produced allow real-time data to be streamed in time-lapse modes, letting process engineers visualise the flow of the glass melt batch during processing.

This enables statistical levels and alarms to be set in the control equipment on optimum glass quality production. Alarms can be set, for example, to detect air and glass leaks, seen by the imager as 'cold' spots.

By using a high-accuracy thermal imaging device to measure, monitor and record refractory temperature trends, instantaneous information to trigger key alarms and long-term analysis is available in real-time.

THE BENEFITS FOR FURNACE OPERATIONS

The NIR-B Glass delivers access to data that, in the past, was too time-consuming or even impossible to collect. Now the operator has the tools to increase furnace efficiency and product quality, and also reduce process costs.

It does this by allowing the operator to set points and areas of interest, measure live data points, and store and trend data for future analysis. By monitoring live video, the operator can configure the most efficient firing pattern and achieve optimum performance from the burners.This saves significant costs by reducing fuel usage and providing improved performance and life of the furnace or melt tank.

Any air or glass leaks detrimental to the efficiency of the furnace are clearly visible and simple to detect. All positions are monitored from the safety of a control room, from where an operator can respond in real time before catastrophic events can occur.

The addition of accurate thermal imaging improves the quality of the yield, ensures damage within the tank can be discovered before major repairs are required, adds unprecedented data analysis, and reduces the total cost of operations.

This imaging capability is especially important within the settings of emission legislation and emission control requirements affecting furnace structure.

PROCESS

REINFORCING CYCLOPS C100L USES WITH NIR-B-2K

PROCESS IMAGING

The Cyclops C100L, one of the most widely used and respected portable pyrometers in the world, is used to measure the crown temperature during the reversal cycle when the flame is not present.

It is also used to make a once per shift measurement across or between the port arches (depending on the furnace type).

The target wall on the regenerator is also seen as being a good indicator of gas temperature, so Cyclops is also used to measure here.

Rugged and reliable, it can be fitted with a heat-resistant cover and measures between 550-3000°C (1022-5432°F).

KEY BENEFITS

- MEASURES FROM A CLEARLY DEFINED AREA
- MEASURES A SMALL AREA FROM ACROSS THE GLASS MELT TANK
- WAVELENGTH OF OPERATION IS FILTERED TO 'SEE THROUGH' FURNACE COMBUSTION GAS
- FULLY SERVICEABLE
- MAINTAINS CALIBRATION AND STABILITY IN HOSTILE ENVIRONMENTS

OTHER MEASUREMENT SOLUTIONS

MODEL FG

FOR

MEASURING CHEQUERWORK INSIDE REGENERATORS

On many tanks there is a need for a fixed thermometer to measure the chequerwork inside the regenerator. This is a critical measurement – if the regenerator brickwork gets too hot, it will deteriorate and melt.

LANCOM 4

FOR

PORTABLE FLUE GAS ANALYSIS

This portable nine-gas analyser can be used to measure at the top of the regenerators and at the flue to the chimney. It monitors all major flue gases including CO, O_2, NO, NO_2, NOx, CO_2, H_2S, SO_2 and hydrocarbons.

4500 MKIII

FOR

OPACITY MONITORING AT THE FLUE CHIMNEY

This accurate, reliable opacity monitor can be used at the flue chimney to ensure compliance with dust emissions and stack opacity.

DISCOVER THE FULL RANGE OF OUR SOLUTIONS FOR THE GLASS INDUSTRY PRODUCT GUIDE STARTS ON P20

THE PRODUCT

NIR-B GLASS – INNOVATIVE THERMAL IMAGING

PAR CONTROL BOX

The Near Infrared Borescope (NIR-B) is AMETEK Land's cutting-edge, short-wavelength radiometric imaging camera designed to measure temperature profiles in furnace interiors.

An application-specific version, the NIR-B Glass has been created for glass melt furnaces, delivering the same 324,064-pixel real-time image across high temperatures between 1,000-1,800°C (1832-3272°F).

This makes it ideal for glass melt furnace monitoring, including float, container, borosilicate and fibre glass applications.

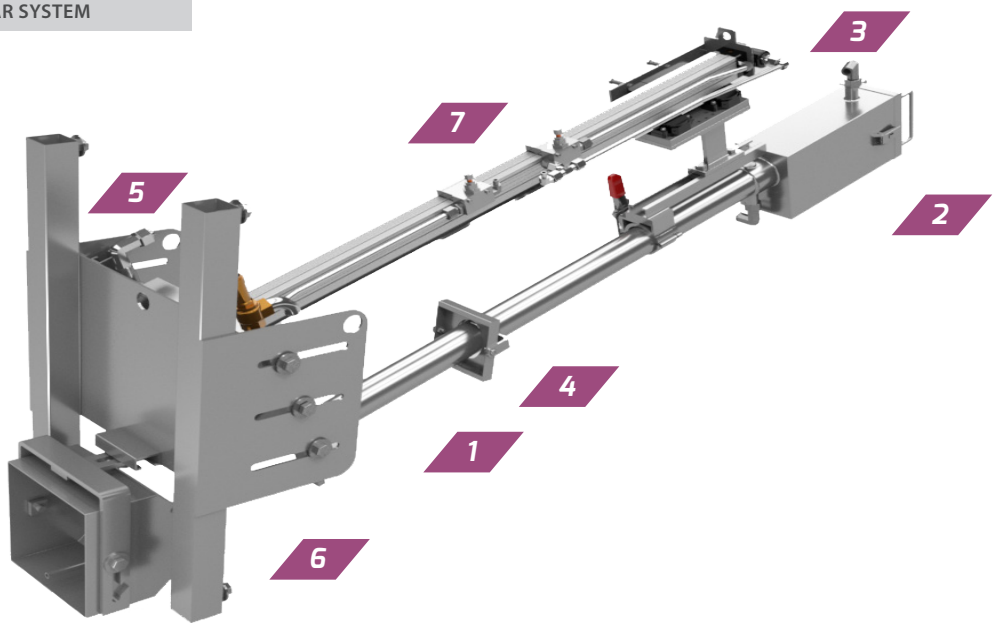
Real-time monitoring ensures high product quality, helps detect furnace structural damage, and improves melt tank efficiency.

In addition, the NIR-B Glass connects to a Windows-based PC running dedicated LIPS NIR processing software, providing accurate data analysis, automated alarms and control for 24/7 monitoring.

Traditional optical profiles can take hours to complete, are not continuous and are unreliable due to user error, while visual cameras cannot provide temperature readings. The continuous monitoring of the NIR-B Glass enables effective furnace optimisation and alarms to be set for air and glass leaks.

The NIR-B Glass uses a 90° field-of-view wide angle lens tip, mounted on the borescope. Unlike regular thermal imagers, this requires only a small diameter hole in the refractory wall to enable viewing of the critical area, minimising process disruption.

THE NIR-B GLASS WITH PAR SYSTEM



1. VIEWING ANGLE
90°x67.5° view gives clear, unparalleled internal tank thermal view.

2. HIGH RESOLUTION 656x494 IMAGE
Accurate real-time temperature measurements from any point within the 324,064-pixel image.

3. INTEGRATED AIR PURGE
Unique design maintains a clean lens in harsh process environments.

4. PROBE LENGTHS
915mm (3ft) borescope as standard, other lengths available on request.

5. MOUNTING
Easily and securely mounted with 'camera block' cover to seal process when NIR-B is withdrawn.

6. THERMOCOUPLE AT NIR-B TIP
Provides alarm to remove imager if maximum temperatures exceeded.

7. AUTO-RETRACT SYSTEM
Protects the thermal imager from damage by overheating.

OPTIMISATION FOR GLASS FURNACES

Glass production environments can be extremely harsh, leaving measurement instruments prone to damage if protective systems fail.

In melt furnace monitoring using the NIR-B Glass, the borescope tube containing the wide-angle lens tip is exposed to the furnace conditions through a small-diameter hole in the furnace wall.

The NIR-B Glass is designed to withstand the high ambient temperatures of the glass-melt furnace. An integrated air purge ensures the lens is kept clean at all times, and a high-performance water-cooling system is built in as standard.

However, should either of these fail, or if there is a power loss, the NIR-B Glass is protected against heat damage by a new housing and pneumatic auto-retraction (PAR) system.

The PAR system consists of an innovative, rapid-response mechanism which instantly retracts the instrument from the furnace wall.

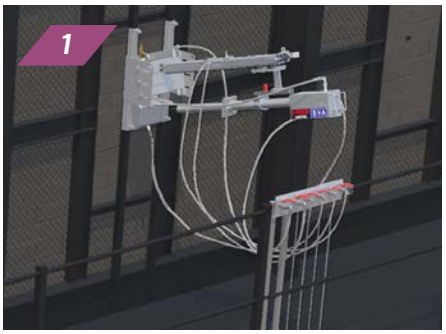
The retraction is triggered by interruption of air, water or electrical supply, and if there is an over-temperature condition detected at the borescope tip. An air reserve ensures full retraction even if the air supply is lost.

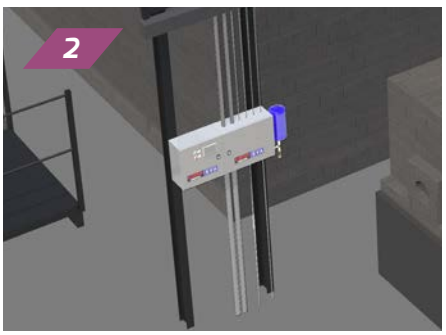
As the system is fully pneumatic, it means there are no exposed electrical components operating in the extreme temperatures of the melt tank. An IP66-rated control box can be located up to 20m away.

"Based on the company's expertise in pneumatic technology, the PAR (pneumatic) autoextract combined with the NIRB2K is the best option for glass apllication in furnces for high-temperature environments. This latest innovation offers major benefits to glass producers in terms of better asset protection and enhanced lifespan for their NIR-B Glass equipment."

Glass Industry Lead, AMETEK Land
Philippe Kerbois

THE NIR-B MONITOR ON THE TANK WALL (1) WITH THE CONTROL BOX SITUATED FURTHER AWAY (2)





DOWNLOAD THE BROCHURE AT AMETEK-LAND.COM/NIR-B

THE GLASS MELTING

Nearly all glass production processes begin with melting the raw material for the glass in a furnace or tank. This process is extremely energy intensive.

According to statistics from the US Department of Energy, around 40% of the energy used involves heating the batch and homogenising batch constituents, while 30% can be lost through the furnace structure, and the remaining 30% can be lost through the exhaust gases.

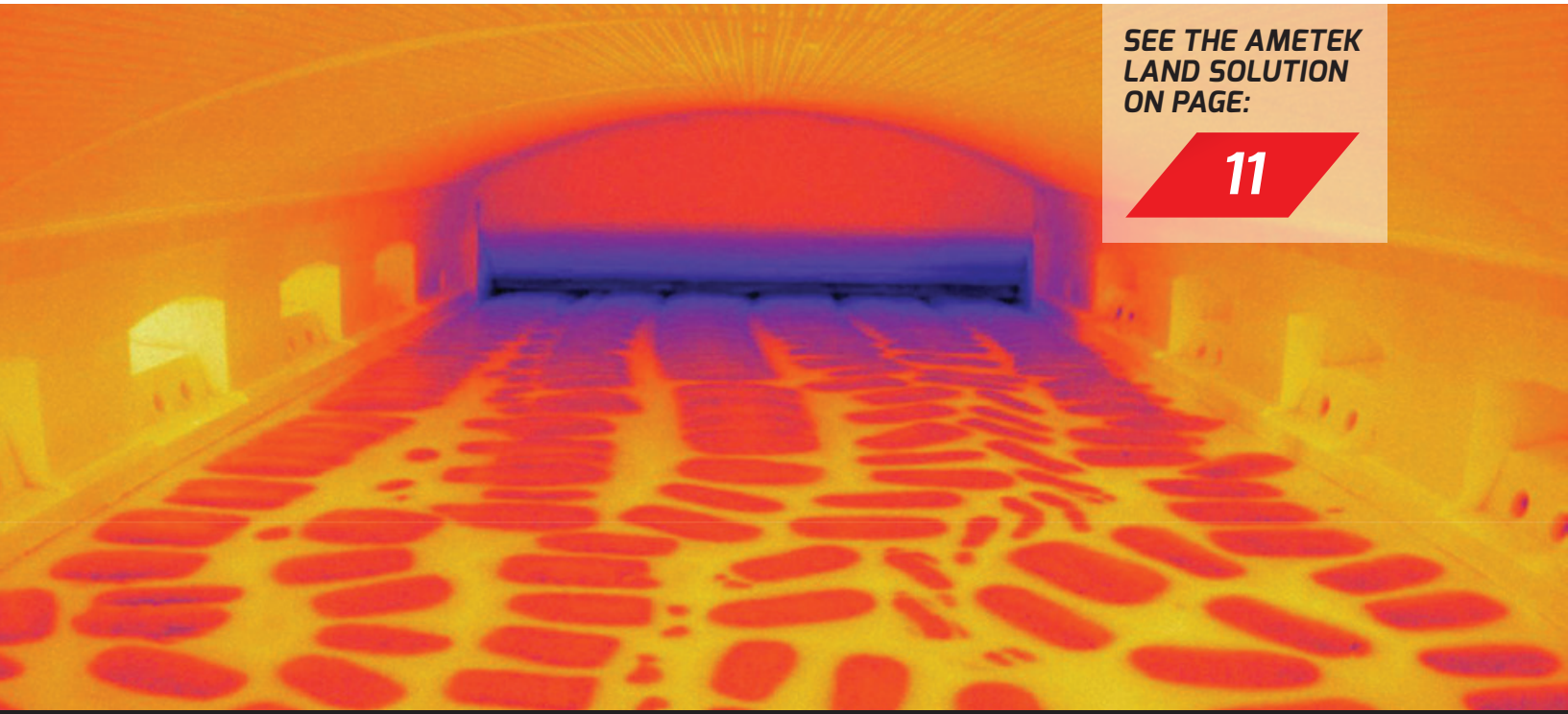
Glass melting takes place in continuously operated tanks where cold ingredients including silica sand, limestone, soda ash, dolomite and cullet are melted at 1600°C (2900°F) in a batch between two feet (0.6m) and three feet (1m) deep.

This process can take more than 24 hours; typically, the quality of the glass produced depends on the length of time allowed for the glass melt process, to ensure complete homogenisation.

The key features of an effective melt tank are:

- **Adequate insulation**
- **Good sealing to minimise air in-leakage**
- **Excellent heat recovery from efficient regenerators**
- **A well-designed doghouse and charging system**
- **Accurate control system**

In the past, thermal imaging inside refractory-lined furnaces and glass-melt tanks required large openings in the refractory wall to view critical areas. This resulted in lost heat and wasted energy.



SEE THE AMETEK LAND SOLUTION ON PAGE: 11

CROSS-FIRED FURNACES

The process in a cross-fired furnace involves a series of ports on one side of the furnace, where hot air and gas are injected, producing flames that lick across the top of the glass.

At the opposite side of the furnace, there are an equal number of ports that pull the exhaust outwards. This exhaust is not released into the atmosphere, instead entering a regenerator – an area produced from refractory bricks constructed with gaps between the bricks, called chequerwork.

Hot gas flows through the gaps between the bricks, heating them to more than 1500°C.

After 20 minutes, the firing ceases on one side, and after a few seconds (known as null time), firing begins on the other side. In this way, air is preheated by the energy from the bricks in the regenerator.

If the process runs for too long, the refractory insulation brickwork at the port arches will begin to melt, a process called glazing. When brickwork glazes, it loses its insulation properties and fails to emit energy properly.

If the regenerator brickwork is overheated it can slump, restricting airflow to the port and causing the chequerwork to crumble. These factors can shorten the life of the furnace from an expected 15 years to as little as 10 years.

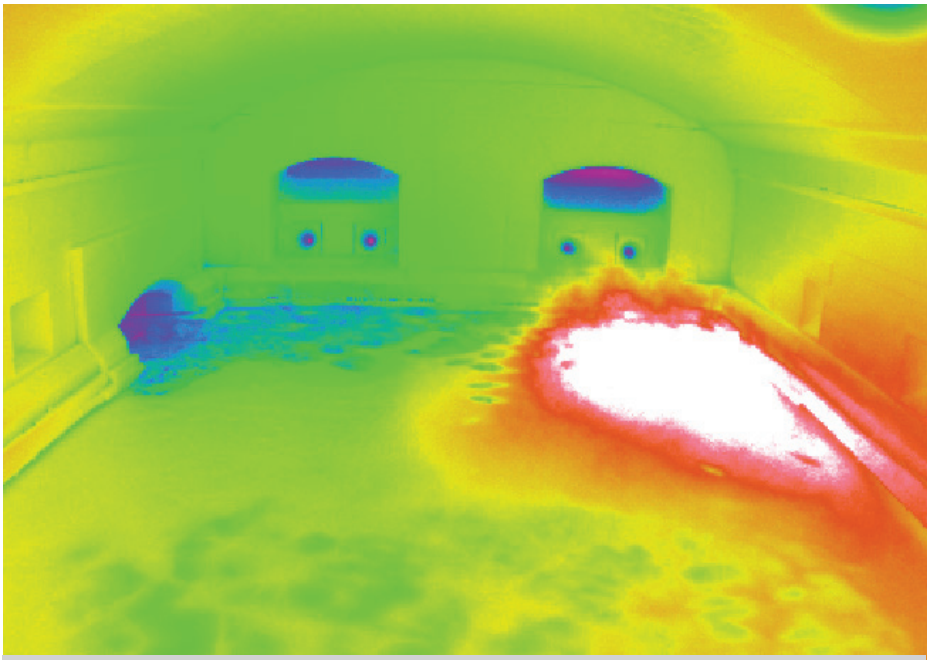
PROCESS

MONITORING THE THERMAL PROFILE

Throughout this process, the accurate monitoring of key refractory-lined areas is challenging. For example, within the furnace there are a variety of temperature measurements to be taken in different locations. The trends established by temperature measurements throughout the furnace are also important.

It remains common to use a portable infrared thermometer, to take measurements inside the glass furnace to gauge the time of reversal intervals and ascertain if they are too long or too short. To carry this out, the operator flips open a viewing port on the side of the furnace, waits for a reversal when there is no flame, and then measures the temperature of the port arch on the opposite side of the tank.

However, during a reversal, the refractory surface temperature drops rapidly, by many degrees per second, from the moment the flame stops. This makes the timeliness, accuracy and repeatability of the measurements highly questionable.



MONITORING FLAME INTENSITY

CONTROLLING EMISSIONS

Globally, there is an increased focus on emission control. Legislation has established provisions covering the emission of pollutants and furnace specifications. While glass manufacturing involves emissions to air, waste water and solid waste, the main emission sources for nitrogen oxides (NOx) are:

- **Fuel NOx – from nitrogen elements in fuel**
- **Prompt NOx – relatively low temperature reaction**
- **Feed NOx – from raw ingredients such as Niter in the past**
- **Thermal NOx - at temperatures more than 1600°C**

In glass manufacture, because of modern batch materials, typically the greatest source of NOx is believed to be thermal NOx. At temperatures more than 1600°C (2900°F) the oxygen molecules in air start to dissociate into elemental atoms. The higher the process or flame temperature, the higher the dissociation and therefore the greater formation of NOx. In the hottest zone of the flame a super equilibrium level of oxygen atoms exists.

The higher the process or flame temperature, the greater the dissociation and, therefore, the greater the formation of NOx. Studies have shown that reducing the rate of mixing and staging fuel and/or excess air to lower the flame temperature will lower the formation of NOx. Accurate monitoring of the flame temperature is therefore key to controlling NOx emissions.

Using the unique filters and "NOx colour pallet" of the NIR B and by adjusting the range limits to increase contrast, it is possible to determine what parts of the flame have the highest heat intensity and thereby assess and minimise the generation of thermal NOx.

LEGISLATION HAS LED TO CHANGE IN GLASS-MELT FURNACES

There has been a transition to the use of Oxy-fuelled furnaces, which use pure oxygen. There is no nitrogen content in the fuel and so NOx emissions are significantly reduced. However, using this system presents its own challenges. The fuels burn hotter, requiring thermal imagers which can keep pace and provide accuracy, since even a slight temperature increase can adversely affect the refractory insulation within the furnace.

LEAK DETECTION

GLASS FURNACE LEAK MONITORING FOR SAFETY

The condition of glass furnace refractories is vitally important to safety and process efficiency, especially towards the end of the life of the tank. Monitoring the exterior of the melt tank with a thermal imager, especially at the tank bottom, can indicate any hot areas which may indicate refractory damage. It also gives an early warning of potential glass break-outs.

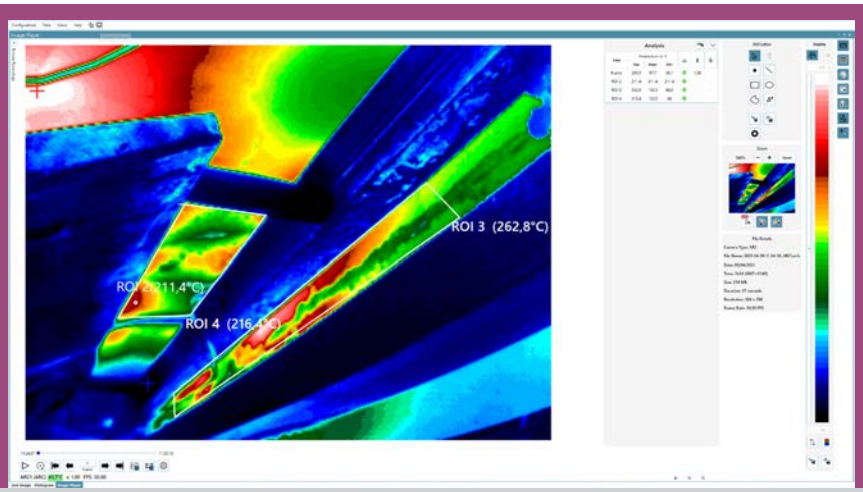
Early detection is essential when a glass break-out occurs since if the leak is not detected and stopped (using water and compressed air) in the first 20 minutes, it is unlikely it can be stopped. In addition to the risks to personnel, this also has considerable cost implications since the batch is lost, the energy used for the melt is wasted, the tank will require repair or replacement, and clean-up of the plant will be necessary.

Our solution for this application is the LWIR-640 monitoring system, which combines cutting-edge, high-resolution radiometric camera technology with sophisticated data processing and powerful software support. This delivers detailed thermal images with unrivalled precision and thermal data necessary to detect damage or wear to the refractory lining at an early stage for corrective maintenance to be scheduled at the least disruptive times.

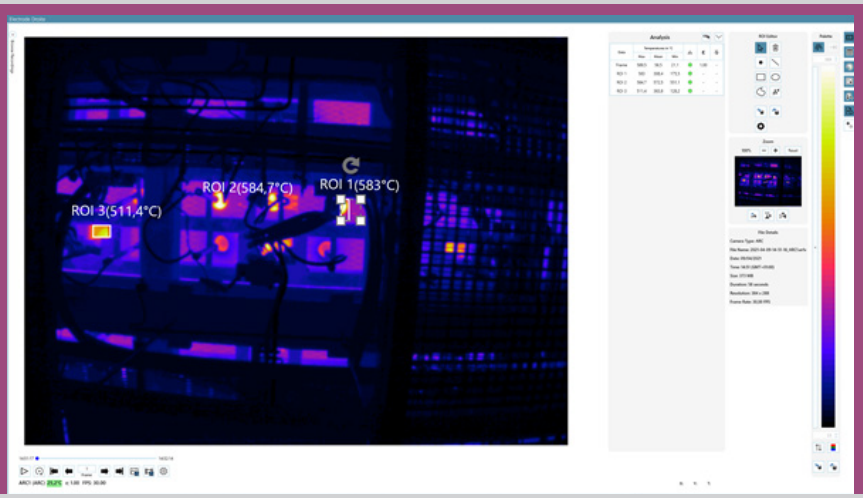
The thermal imaging provided by the LWIR-640 camera allows a continuous view of the entire target at any distance. Thermal data generated by the camera is presented in real-time, making it faster and easier to detect anomalous hot spots, alerting plant staff to take immediate action.

LWIR-640 can be combined within our advanced thermal imaging software, IMAGEPro, to show a view into the furnace for thermal distribution and batch coverage functions and to monitor the outside of the furnace for hot spots.

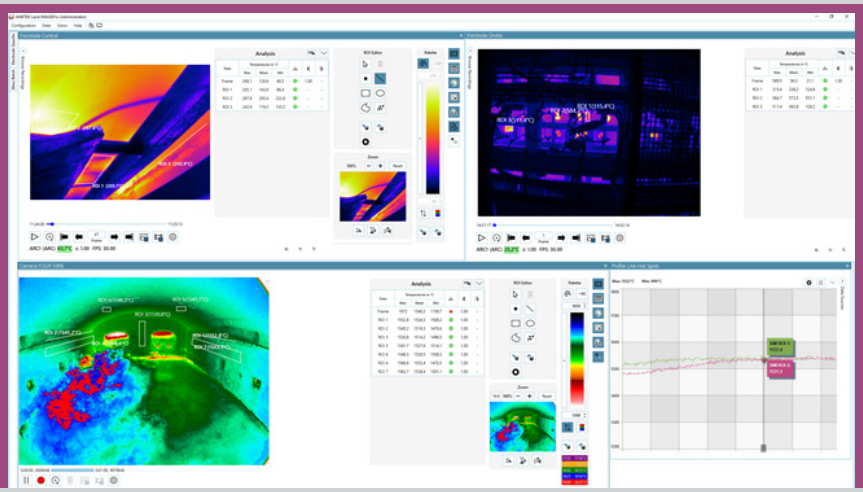
Detection of damage to the tank allows early maintenance and extends the tank's lifespan. Around 70% of container glass production costs come from energy, so preventing cracks and lost heat produces significant savings. Early detection of glass break-outs enhances plant safety.



BOTTOM OF GLASS FURNACE TEMPERATURE MONITORING USING LWIR-640 THERMAL IMAGER.



ELECTRODES TEMPERATURE MONITORING WITH ALARMS.



MULTIPLE DISPLAYS SHOWING BOTH LWIR-640 AND NIR-B-2K THERMAL IMAGES.

THE PRODUCTS

THE FLT5B – DEDICATED TO FLOAT LINE APPLICATIONS

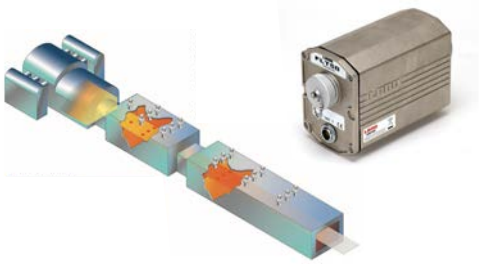
The FLT5B is designed specifically to provide precise non-contact measurements of the surface temperature of glass float lines, supporting consistently high product quality throughout the process.

In order to achieve this consistency, it is vital to keep the temperature as uniform as possible across the width of the glass. This applies throughout the process, from the initial floating and forming in the bath, to the cooling and annealing sections in the tin bath and annealing lehr.

A standalone thermometer, the FLT5B removes the need to use a range of temperature monitoring instruments on the float line, simplifying system integration and operation.

This is because the FLT5B provides a spectral response from 4.8-5.2µm and measures from 250-1100°C (482-2012°F), so it can be used at more points on the float lines, reducing the need for different types of measurement device.

Using 50:1 optics and a fixed 1m focus, the thermometer has low penetration into the glass, ensuring 98% energy is read from the 20mm target spot. It is unaffected by atmospheric humidity.



TYPICAL MEASUREMENT POINTS ON THE FLOAT LINE

Suitable for use in the most hostile glass production environments, the FLT5B is easily demountable from a cooling jacket and can be used with AMETEK Land's extensive range of mountings and accessories, including the System 4 series.

Operating on a two-wire, 4-20mA current loop, the FLT5B is fully compatible with industry-standard indicators and recorders.

LSP-HD

LINESCANNING

The cooling rate and homogeneous thermal distribution across the width and length of the glass ribbon within the annealing lehr and forced air cooling zones are essential to float glass quality.

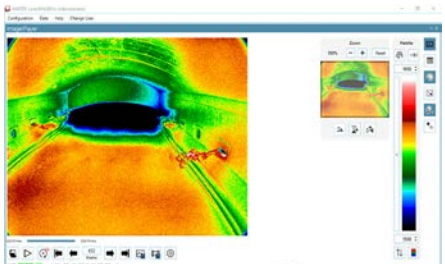
Frequent, accurate measurements of the temperature profile are necessary to reduce stresses in the glass and to optimise the cooling rate over the entire process length. With the development of the LSPHD linescanner, AMETEK Land provides a non-contact infrared solution for accurate temperature-crossprofile measurements that optimise the annealing process and minimise thermal variations across the width of the glass, making production of thinner or thicker glasses possible.

LWIR-640–A FLEXIBLE IMAGING SOLUTION

PROCESS IMAGING

With four lens options and two temperature ranges, the LWIR-640 provides versatile high-resolution radiometric thermal imaging for a range of glass production applications.

It is particularly suited for the manufacture of container glass, fibre glass, flat glass, specialty glass and tableware, making key measurements at the melt tank exterior, batch inlet, and the annealing lehr.



DETAILED THERMAL IMAGING

Outstanding adaptability ensures the LWIR-640 can be customised to the precise needs of your application:

- Batch inlet temperature – provides thermal monitoring of the raw materials for quality control
- Melt tank exterior – provides continuous monitoring of tank condition, warning of possible break-out or refractory failure

LWIR-640 HOUSING

- Annealing lehr entry and exit – monitors the cooling product at each end of the annealing process to detect problems

Offering a detailed 384x288 thermal image, the LWIR-640 does not require a separate signal processor, using our IMAGEPro software for real-time visualisation of the thermal data.

TEMPERATURE MEASUREMENTS FOR TEMPERED GLASS

Tempered glass – sometimes called toughened or safety glass – is glass which has been heat-treated and then rapidly cooled, in a controlled manner, in an air quench section. This process makes the glass much more resilient than plain flat glass – typically four times stronger.

Plain glass, in addition to being more easily broken that tempered glass, breaks into sharp shards which can cause serious injury. If tempered glass is broken, it produces small, harmless dice-shaped pieces.

This makes tempered glass ideally suited to applications where human safety is an issue.

TEMPERED GLASS IS COMMONLY USED IN:

- VEHICLE WINDOWS
- ARCHITECTURAL GLASS FOR BUILDINGS
- APPLIANCES SUCH AS OVEN DOORS AND REFRIGERATOR SHELVES
- GLASS DOORS AND SHOWER DOORS
- GLASS COOKWARE
- MOBILE PHONE AND TABLET SCREENS

Before tempering, the glass must be cut to the desired size, as operations such as etching or edging after the heat treatment can result in strength reductions or product failure.

The glass is examined for imperfections, then the sharp edges are removed by an abrasive such as sandpaper, and the glass is washed.

Next, the glass is heated in a tempering oven to more than 600°C (the industry standard is 620°C). It then undergoes rapid, high-pressure cooling through blasts from air nozzles.

This process, called quenching, lasts just seconds and cools the outer surface of the glass much more quickly than the centre. As the centre cools, it tries to pull back from the outer surfaces.

The result is that the centre remains in tension, while the outer surfaces go into compression, providing the tempered glass with its strength.

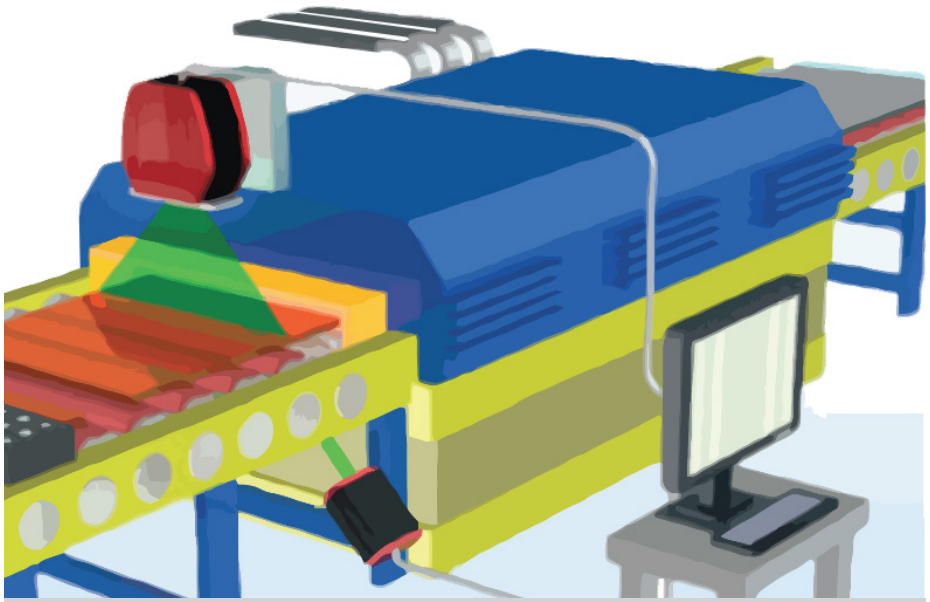
The tempered glass must also be free of visual distortions, which is achieved by maintaining the same, uniform temperature over the entire surface of each lite.

Ideally, each sheet of glass should have minimal temperature variation. This provides the same even stress across the glass, ensuring distortion-free viewing.

Generally, customers reject distorted glass, which inflicts replacement costs on suppliers and affects their reputation for a quality product.

DISTORTION-FREE TEMPERED GLASS – UNIFORM GLASS TEMPERATURE VERSUS DISTORTED GLASS – NON-UNIFORM GLASS TEMPERATURE

NITOR



LSP-HD 50 MOUNTED ABOVE THE GAP BETWEEN THE FURNACE EXIT AND BEFORE THE QUENCH

A thermal image of each lite as it enters the quench allows adjustment of the heating profile to maintain a uniform glass temperature.

The gap between the furnace exit and the air quench entrance can be very narrow, often as small as 10cm, so a linescanner is the ideal instrument to use at this point.

Glass lites entering the tempering furnace are often a mixture of sizes and are randomly placed. A linescanner such as the AMETEK Land LSP-HD 50 can easily monitor the glass as it passes through the narrow gap, scanning continuously across all the glass lites, typically at 100 scans per second.

Single-spot thermometers are not suited to this measurement, as they may miss the glass lites and cannot monitor for a uniform temperature across the width of the glass.

Two or three temperature bias sensors may be installed on the underside of the process to provide a compensating measurement for any surface coating on the glass.

For example, in recent years, Low Emissivity (Low E) glass has been increasingly used for windows. Low E glass prevents much of the sun's non-visible radiation from entering the building. It also retains existing heat inside the building, reducing energy costs for the end user.

Measuring the surface temperature of Low E glass is difficult. Low E glass does not emit much of its energy, and there are hundreds of different grades, all with different emissivity values, so a single compensation value cannot be used for all glass types.

In addition, Low E glass is run through the same furnaces as uncoated glass.

AMETEK Land's solution compensates for each batch of glass and the emissivity value of that specific batch. First, a contact closure signal is taken from the furnace controls, signalling the start of the batch exiting the furnace, and the end of the batch.

Then, the underside temperature correction – as measured by one, two or three underside sensors – is applied. Only one of the sensors needs to have seen the glass lite for this to work correctly.

Operators typically mark the input roller with stripes to ensure a lite will pass over at least one of the sensors.

This 'true temperature' system is a big advantage to users of the LSP-HD 50, enabling the manufacturer to produce better quality tempered glass with fewer visual distortions, reducing waste product, increasing profit, and enhancing reputation.

LSP-HD 50

LINESCANNING

A compact infrared linescanner, the LSP-HD 50 is able to provide highly accurate temperature measurements even when the gap between the furnace and air quench is a narrow one.

Scanning 1000 data points at 150 scans per second, it enables detection of the smallest temperature variations, and is plug-and-play

compatible with LANDSCAN WCA software for advanced analysis.

The LSP-HD 50 operates accurately without cooling in ambient conditions up to 60oC and will continue to operate outside its specifications up to 70°C. A mounting/cooling assembly is available.

When viewing Low E glass, an innovative reflector plate prevents LSP-HD 50 seeing its own reflection, ensuring accurate measurements.

In addition to glass tempering, the LSP-HD 50 is ideal for measurements on glass float lines, forming and bending processes, glass coating and solar panel manufacture.

KEY BENEFITS

- DISPLAYS CAN BE USED TO IDENTIFY AND ANALYSE PROBLEMS
- PROCESS MODELLING TO IMPROVE PROCESS CONTROL
- ACCURATE THERMAL RECORDS ARE A CRITICAL ASPECT OF PRODUCT QUALITY CONTROL
- REAL TIME THERMAL DISPLAYS OF THE PRODUCT IN A VARIETY OF DIFFERENT DISPLAY FORMATS

TEMPERATURE ACCURACY FOR LOW EMISSIVITY GLASS

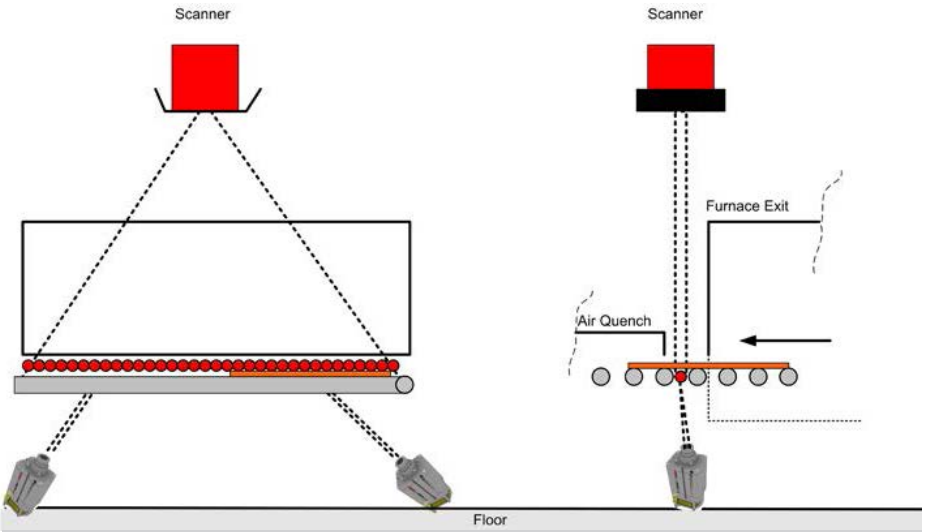
THE CHALLENGE

To create visually perfect tempered glass lites, the stress across the entire lite must be kept even during processing. This requires precise temperature control.

Infrared measurement technology generates a thermal map of the product which allows for better process control. However, mapping Low Emissivity (Low E) glass can be a challenge.

Infrared thermometers are non-contact instruments that sense emitted radiation and convert the received signals into an accurate temperature measurement. Low emissivity means there is very little emitted radiation for the infrared instrument to measure.

When emissivity is low, reflectivity is high, so background sources of radiation can easily add extraneous signals to the measurement. An incorrect estimate of emissivity may lead to very large errors in temperature reading, so active emissivity compensation is required.



INFRARED MEASUREMENT TECHNOLOGY

There are hundreds of different grades of Low E glass, all with different emissivity values, which means a single compensation value cannot be used for all glass types.

In addition, Low E glass is produced in the same furnaces as uncoated glass, so there is a huge variation in emissivity for any temperature measurement system to cope with.

THE SOLUTION

AMETEK Land's solution for thermal tempering measurements uses a 5µm linescanner – the LSP-HD 50 – to measure the Low E surface through the narrow gap between furnace and air blowers, and temperature bias sensors on the underside of the glass.

Coated glass is invariably processed with the coated side upwards, to avoid contact with the rollers. In order to view the full width of the process line, the scanner must be positioned above the line, so the scanner is always viewing a surface of unknown emissivity.

Two or three small temperature bias sensors – typically the AMETEK Land SoloNET SN5 – measure the temperature of the uncoated underside of the glass. This temperature reading is used to automatically correct the emissivity of the film.

The result is that the whole scanner image displays the correct temperature without needing to recalibrate for different coating constituents or uncoated glass.

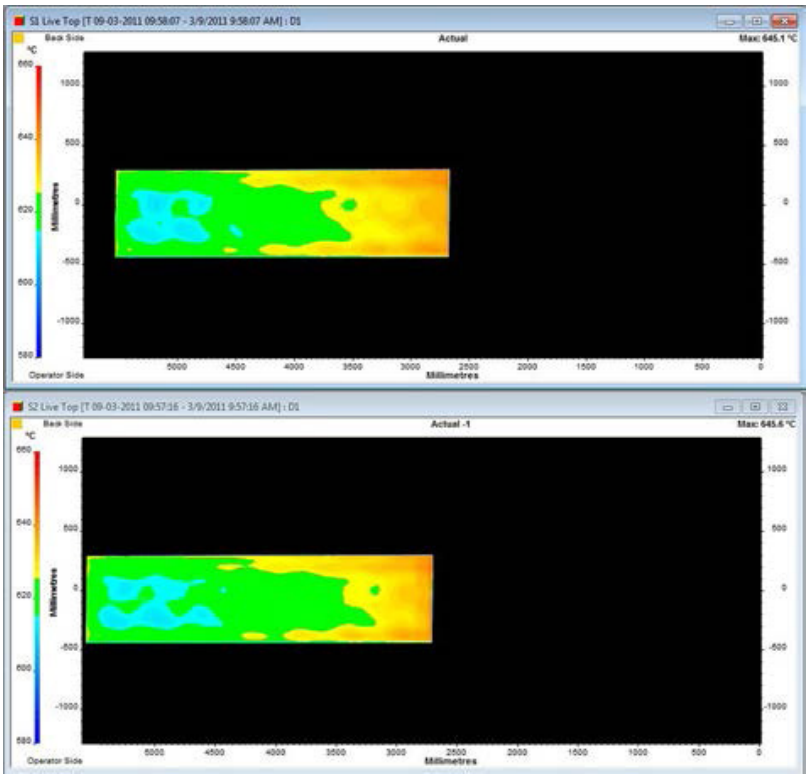
AMETEK Land's process imaging software is able to use this information to calculate true temperature for an entire batch of lites, even if they are not positioned to be measured by the bias sensors.

Low E coating processes are sufficiently controlled that the emissivity value will be consistent for every lite of the same grade. Lites from the same batch are always tempered together. This is partly for logistical reasons, and partly because different grades of Low E glass would quickly cause a temperature imbalance in the furnace by pulling varying levels of heat.

LSP-HD 50 FOR THERMAL TEMPERING MEASUREMENTS

SOLONET SN5 MEASURES GLASS TEMPERATURE

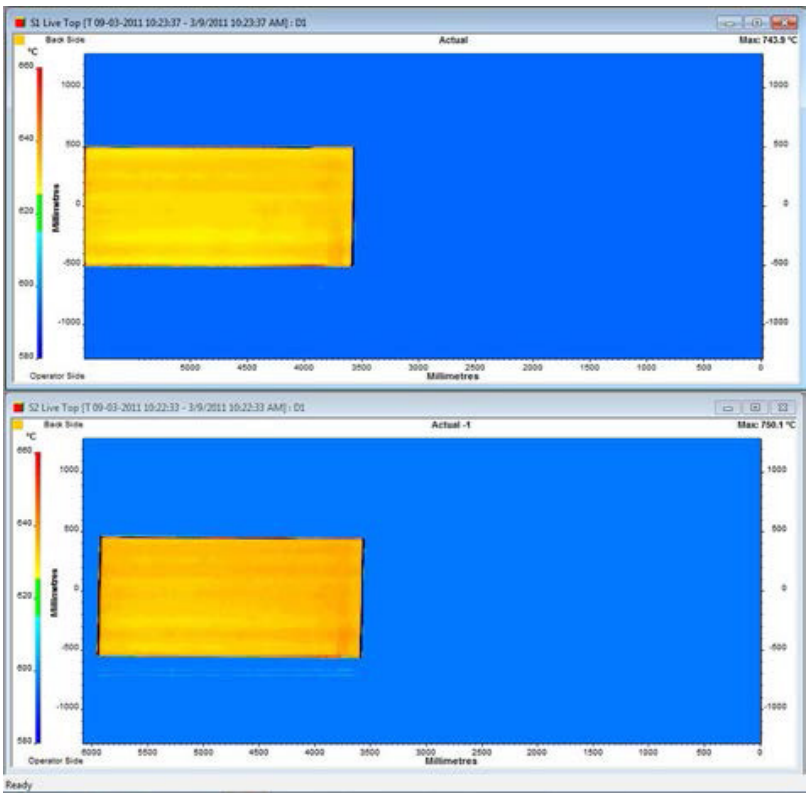
THE RESULT



These thermal images show Low E glass lites using the AMETEK Land measurement system, with a temperature scale set to 620°C, ±5°C. Measurements within this range are shown in green. Hotter areas are yellow or red, while colder areas are blue.

The lites were travelling from left to right. Most of the glass is close to 620°C and appears green, but the leading edge is yellow, closer to 640°C. Towards the tail in the middle there is a colder blue area at around 610°C. This is sufficient variation to cause concern for a tempered glass manufacturer.

LOW EMISSIVITY GLASS THERMAL IMAGES



In this set of images, a much more even temperature profile has been achieved, though as the yellow colour indicates, it is around 15°C higher. This may also cause concern.

Thermal images produced for each batch of lites effectively provide a temperature profile of the furnace. Trends from batch to batch can reveal if one side of the furnace is running cooler than the other.

Changing the distribution of lites is often the simplest way to adjust the furnace temperature profile – placing larger lites on the hotter side of the furnace will draw heat away from this area, evening out the temperature.

Batch timing and other thermal controls can also be adjusted to reliably produce lites with a uniform thermal profile within the required temperature range.

By measuring the true temperature of Low E glass, the thermal profile of the furnace can thus be controlled in an informed way, ensuring the consistent production of high-quality, distortion-free glass.

THE PRODUCTS

CYCLOPS C100L – PORTABLE MEASUREMENTS

LOGGER SOFTWARE

MANAGE THE UNIQUE ROUTE CONFIGURATIONS TO COVER YOUR PROCESS

ACCESSORIES

HEAT RESISTANT JACKET

WATERPROOF CARRY CASE

LONG EYE RELIEF EYEPIECE ADAPTOR

CLOSE-UP LENSES

Easy to handle and simple to operate, the Cyclops C100L non-contact pyrometer provides precise temperature measurements across the glass production process.

With an extensive measurement range from 550-3000°C (1022-5432°F), it is widely used for melt tank measurements at the crown and port arches, and to determine the regenerator wall temperature as an indicator of gas temperature.

It can also support process efficiency by measuring bulk glass temperature in the tank, reducing melt time and lowering energy costs.

Camera quality through-the-lens sighting ensures that what you see is what you measure. This make the Cyclops ideal for on-the-spot molten glass temperature measurements, such as at the distributor, feeders and forehearth, as well as measurement of the gob.

In fibreglass production, it also provides a precise measurement of the fibre as it leaves the bushing outlet.

Providing fast, simple data-logging with on-board storage of up to 9,999 measurements, the Cyclops can be used one-handed, making it easy to hold onto a hand rail and still take safe, accurate temperature readings.

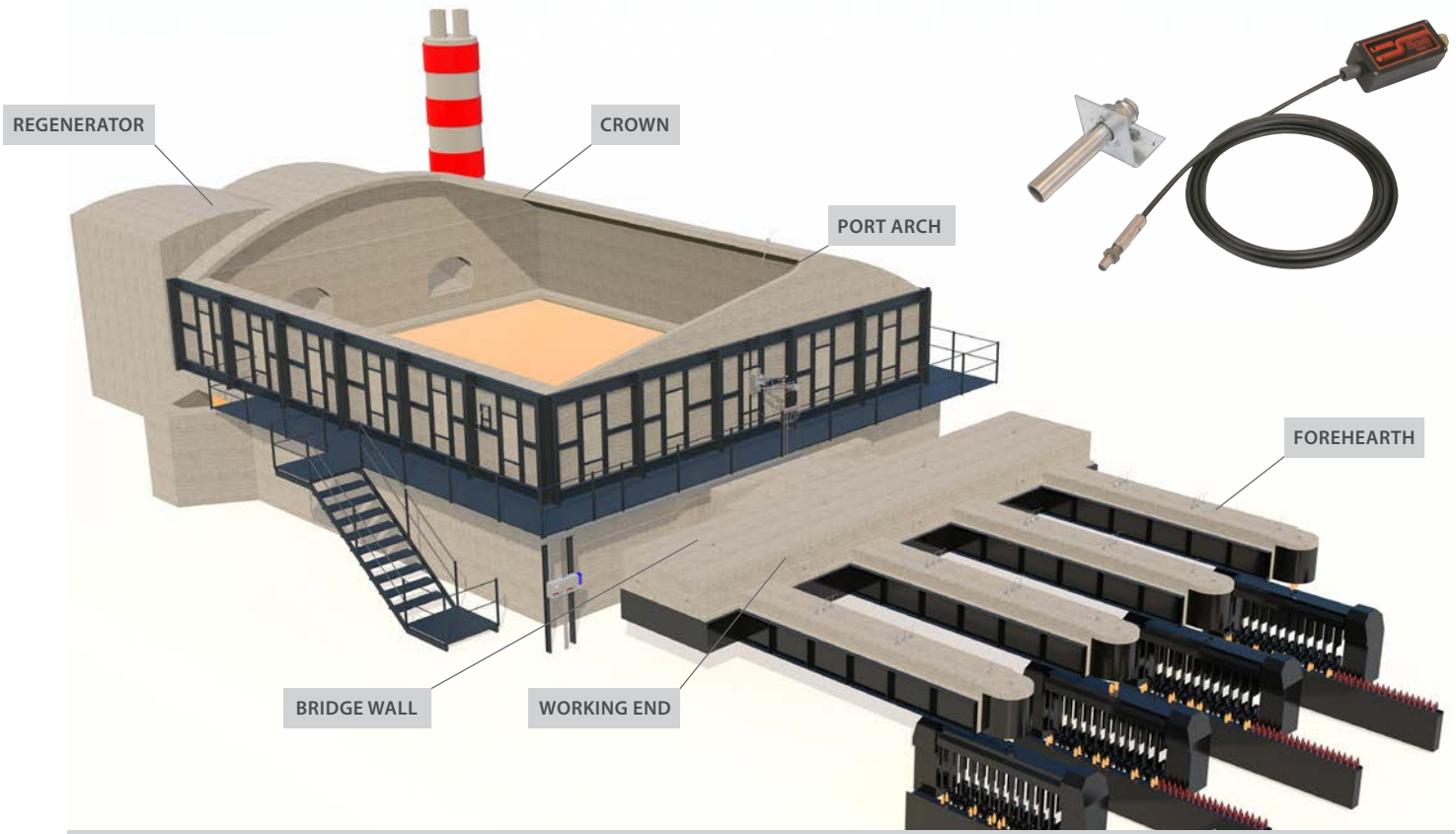
The four data-logging modes are trigger-controlled, and recorded data can be transferred to a PC running the free Cyclops Logger software to analyse the results.

A range of accessories are available, including a heat-resistant jacket to protect against very hot and dusty environments, and an eyepiece adapter to make it easier to operate when the user is wearing protective goggles or a hard hat with face shield.

A close-up lens option, designed for the C100L, allows temperature measurement of small targets at close range.

DOWNLOAD THE BROCHURE AT AMETEK-LAND.COM/C100L

THE FG THERMOMETER – A SIMPLE, COST-EFFECTIVE SOLUTION



TYPICAL MEASURING POINTS FOR LAND FIBRE-OPTIC MODEL FG THERMOMETERS

Designed specifically for the glass industry, the FG delivers accurate, reliable temperature measurements up to 1650°C (3000°F).

A simple fibre-optic thermometer, it provides a cost-effective alternative to thermocouples in some zones measuring bulk glass temperature.

Containing AMETEK Land's market-leading infrared measurement within an advanced optic head, the FG offers highly stable measurements across five ranges for maximum cross-application flexibility.

This versatility allows the FG to monitor and control glass or refractory temperatures in the forehearth, regenerator, tank and refinery, along with other spot measurements in the glass production process.

The FG can be used to safeguard vulnerable refractory materials such as the crown, detect possible firing imbalance at the port arch, and provide improved control over bulk glass temperatures.

Furnace installation is easy, allowing the signal processor unit to be located away from the high temperatures at the optic head, linked via a multi-core, fibre-optic light guide. The signal processor provides high-accuracy linearisation of the detector signal, adjustable emissivity compensation and a self-test function. It also outputs to process computers and control systems.

In addition, the FG offers long-term, drift-free operation with no requirement for online calibration.

The two-wire, 4-20mA loop-powered design makes it easy to set up and maintain – an adjustable mounting assembly, with quick-release adapter and air purge, allows simple removal for inspection purposes.

DOWNLOAD THE BROCHURE AT AMETEK-LAND.COM/FG

THE PRODUCTS

LSP-HD

LINESCANNING

Standalone thermometer offering precision measurement of the surface temperature of glass float lines, ensuring consistently high product quality throughout the process.

Offering excellent precision and long-term stability, the FLT5A's extensive measurement range removes the need to use a variety of temperature monitoring instruments on the float line.

Temperature measurement range: 250-1100°C (482-2012°F)

Sectors: Architectural, Automotive, Flat Glass, Toughening

FLT5B

FIXED SPOT THERMOMETERS

Standalone thermometer offering precision measurement of the surface temperature of glass float lines, ensuring consistently high product quality throughout the process.

Offering excellent precision and long-term stability, the FLT5B's extensive measurement range removes the need to use a variety of temperature monitoring instruments on the float line.

Temperature measurement range: 250-1100°C (482-2012°F)

Sectors: Architectural, Automotive, Flat Glass, Toughening

SOLONET

FIXED SPOT THERMOMETERS

Flexible, web browser-enabled digital infrared thermometer customisable to a wide range of process control applications.

Suitable for stand-alone, single-point or multi-point installations, SOLOnet is easily configured to meet precise measurement and control requirements to help improve product quality, maximise process efficiency and reduce operational costs.

Temperature measurement range: SN51 model: 200-1100°C (392-2012°F)

Sectors: Architectural, Automotive, Fibreglass, Toughening

IQ*

FIXED SPOT THERMOMETERS

For sale in the Americas, China and India only.*

Compact, rugged industrial thermometers designed to meet the needs of high-temperature process control applications.

Easy to install, IQ makes it simple to customise for the perfect measurement in your application, with a range of plug and play options.

Temperature measurement range: IQ5 model: 200-1100°C (392-2012°F)

Sectors: Architectural, Automotive, Fibreglass, Toughening

*Only available in the Americas, China and India.

DOWNLOAD THE BROCHURES AT AMETEK-LAND.COM

LWIR-640

PROCESS IMAGING

Rugged, compact radiometric thermal process imager providing unsurpassed temperature accuracy across a wide range of applications.

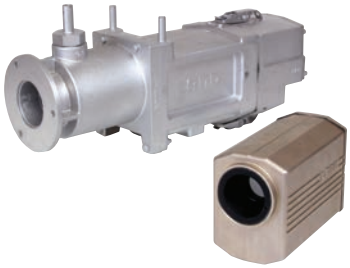
With four lens options, it views any target at any distance, delivering outstanding clarity for reliable process control, product quality verification or safety monitoring.

Temperature measurement range: 0-500°C (32-932°F) and 100-1000°C (212-1832°F)

Sectors: Container, Fibreglass, Flat Glass, Speciality, Tableware

RT8B

FIXED SPOT THERMOMETERS



Non-contact infrared thermometer for use in low temperature applications, helping glass manufacturers meet quality compliance requirements.

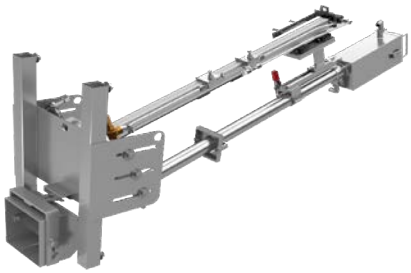
Integrating easily into low-cost recorder and controller systems, the RT8B provides a fast, accurate measurement to support product quality assurance. It is ideal for lehr exit and cooling applications.

Temperature measurement range: 0-250°C (32-482°F) and 0-500°C (32-932°F)

Sectors: Container, Fibreglass, Flat Glass, Speciality, Tableware

NIR-B GLASS

PROCESS IMAGING



Borescope thermal imaging camera specifically developed to return precise temperature measurements in glass furnace applications.

This application-specific device delivers detailed, live radiometric images – allowing continuous temperature measurements that support high product quality, help detect furnace structural damage and improve melt tank efficiency.

Temperature measurement range: 1000-1800°C (1832-32722°F)

Sectors: Container, Fibreglass, Flat Glass, Speciality, Tableware

CYCLOPS C100L

PORTABLES

High-quality, precision-accuracy hand-held pyrometers providing easy point-and-measure temperature readings in a rugged yet lightweight design.

Designed for single-handed use, the ergonomic Cyclops C100L uses trigger control for data-logging, storing up to 9,999 readings internally for later analysis.

Temperature measurement range: 550-3000°C (1022-5432°F)

Sectors: Container, Fibreglass, Flat Glass, Speciality, Tableware

THE PRODUCTS

FG

FIXED SPOT THERMOMETERS

Simple fibre-optic, two-wire, loop-powered thermometer with 4-20mA output, specifically designed to improve process control in the glass industry.

Offering accurate, high-resolution and reliable temperature measurements, the FG's flexible design makes it ideal for spot measurements throughout the glass production process.

Temperature measurement range: 980-1300°C (1796-2372°F), 1000-1400°C (1832-2552°F) and 1200-1650°C (2192-3002°F)

Sectors: Container, Fibreglass, Flat Glass, Speciality, Tableware

SPOT+

FIXED SPOT THERMOMETERS

Family of fully-featured, high-performance pyrometers for fixed non-contact infrared spot temperature measurements, available in a range of operating wavelengths, temperature ranges and process requirements.

Designed for easy single-person installation, SPOT+ pyrometers deliver the accurate measurements to optimise application processes and maintain high product quality.

Temperature measurement range: Model specific, from 50-1800°C (122-3272°F)

Sectors: Container, Fibreglass, Flat Glass, Speciality, Tableware

FLUE GAS ANALYSERS

COMBUSTION & EMISSION MONITORING

The combustion operations often used in glass production produce flue gas emissions which are subject to strict environmental regulations.

To support compliance, AMETEK Land offers a range of instruments for monitoring flue gases. These include the 4500 MkIII, WDG 1200/1210 and Model 9100.

Sectors: Container, Fibreglass, Flat Glass, Speciality, Tableware

DOWNLOAD THE BROCHURES AT AMETEK-LAND.COM

LANCOM 4

COMBUSTION & EMISSION MONITORING

Compact portable multi-gas analyser, capable of measuring several flue gases simultaneously in combustion and emission processes.

Lancom 4 is simple to set up and operate, enabling highly accurate spot and semi-continuous gas testing of all major flue gas emissions, with advanced real-time processing techniques.

Sectors: Container, Fibreglass, Flat Glass, Speciality, Tableware

NIR-B-2K

PROCESS IMAGING

Fixed, focusable infrared thermal imaging camera designed for high temperature measurements, producing high-resolution images for a range of applications.

Versatile, accurate and reliable, the NIR delivers the continuous high-precision measurements that support consistent fibreglass production quality at the hot spinner.

Temperature measurement range: Model specific, from 600-3000°C (1112-5432°F)

Sectors: Fibreglass

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