AMETEK Land offers multiple solutions for the complex temperature measurement of aluminium. Our products meet the highest standards of quality and reliability to ensure accurate performance under plant operating conditions.

Our advanced, dedicated solutions make us the preferred choice of the world’s leading operators in the aluminium producing and processing industry, providing the accurate, reproducible temperature measurements required. Using our decades of experience and expertise working in the aluminium industry, we have developed market-leading products that monitor temperature and provide essential measurements across a wide range of aluminium applications.

Land application thermometers for aluminium were first launched in the early 1990s. In the late 1990s a second generation of Land application pyrometers was introduced.

Now the SPOT AL EQS smart application pyrometer family improves and extends previous capabilities and is ready for Industry 4.0 integration/operation.
AMETEK Land has extensive experience in providing temperature measurement solutions for the aluminium industry, including special applications.

In this application note, we outline the range of aluminium applications covered by these solutions, highlighting the recommended product and special measuring mode for each one.

These highly accurate solutions address the challenges faced by key applications, supporting higher quality and productivity, and reducing costs for the operator.
The SPOT AL EQS is an advanced, non-contact infrared application pyrometer specifically designed to provide a single-sensor solution for aluminium temperature measurement applications.

It blends AMETEK Land’s smart SPOT technology with unique data-processing algorithms to offer a range of measurement modes in a single device.

These pre-set algorithms are specifically designed for measurements including: at the extruder press exit (E), quench and billets (Q), strip mill (S), hot forge (F) and forging with high-magnesium content alloys (F Mg).

The algorithms are not limited to these specific applications, and provide an effective temperature measurement solution for a range of alloys and surfaces – for example the F and F Mg modes are also well suited to billet temperature measurements at the entry to the extrusion press or during the pre-heating process.

They provide the most accurate digital temperature readings of low and variable emissivity aluminium, to ensure optimised process speed, process efficiency, and high-quality products with minimal scrap.

The SPOT AL EQS offers measurements ranging from 200 to 700 °C (392 to 1292 °F), and integrates with control systems to optimise throughput at the process, press or mill.

Data is made immediately available via the integrated rear display, web server and multiple interfacing options, and the SPOTViewer/SPOTPro advanced pyrometer software for monitoring, analysing, capturing and controlling temperatures in the process. A real-time video camera within the pyrometer, and remote access to all features, enables the user to view, configure and focus the pyrometer locally or remotely.

The SPOT AL EQS also combines Modbus TCP digital and analogue inputs and outputs in a single device.

<table>
<thead>
<tr>
<th>ALGORITHM</th>
<th>MODE DESCRIPTION</th>
<th>EMISSIVITY</th>
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<tbody>
<tr>
<td>E</td>
<td>Extrusion</td>
<td>Low</td>
</tr>
<tr>
<td>Q</td>
<td>Quench</td>
<td>Medium</td>
</tr>
<tr>
<td>S</td>
<td>Strip</td>
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</tr>
<tr>
<td>F</td>
<td>Forming/Forging</td>
<td>Lower to Medium</td>
</tr>
<tr>
<td>F Mg</td>
<td>Higher magnesium alloy</td>
<td>Lower</td>
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Additional measuring modes will be added on request.
THE SPOT AL EQS ACTUATOR

Specifically designed for aluminium applications using the SPOT Pyrometers, the SPOT Actuator is a smart motorised unit which provides remotely controlled target and hot spot alignment, profile tracking and a billet/profile scan for all SPOT pyrometers.

Compact, quick and easily configured via the integrated webserver, or by using the SPOTViewer/SPOTPro software, it can be operated in automatic or operator-controlled modes to suit the needs of an individual aluminium plant.

SPOT AL EQS AND ACTUATOR

Scanning a profile along the billet as it arrives at the press

SPOT with Actuator unit and cooling enclosure

Profile measurement made along the billet

Aluminium billet

Screenshot from the embedded webserver
EXAMPLES OF ALUMINIUM PLANT REQUIREMENTS

Aluminium billets are preheated with a temperature profile to ensure best press operating temperature. Before passing the billets into the press, the temperature profile needs to be checked.

In aluminium extrusion processes, different shapes of profiles are produced and multi-cavity dies are often used to extrude several profiles at once. Every time the die is changed or the profile is moving, the actuator will automatically realign press-exit and quench-exit SPOTs with the hottest profile or the hottest area of a profile.

High-strength extrusions need to be cooled rapidly after extrusion to ensure the required internal structure and mechanical properties are achieved. However, thinner profiles can move transversely to the direction of extrusion if they are only loosely constrained over a long quench section, so repeated realignment of a post-quench thermometer is required. The actuator can be set to automatically detect a drifting profile, and realign.

"With the addition of the SPOT Actuator, this pyrometer ensures that our customers receive the highest quality aluminium products"

László Domokos
Process Reliability Team Leader,
Hydro Extrusions Hungary
Heated billets of different aluminium alloy are pressed through a preheated die to create the required profile shape and dimensions. Quenching is vital to ensure the finished product has the correct material/mechanical properties and tolerances.

The process requires accurate temperature monitoring of the billet, press exit temperature and die, to control the process speed and efficiency and to prevent damage to the profile or press to increase/ensure quality. Quench and extrusion monitoring also ensures consistent product quality.

With decades of experience and a global reputation for excellence working closely with leading aluminium producers, AMETEK Land provides dedicated solutions for each stage of the process. Our products offer the precision and rapid response your operation requires.

A billet, or solid block, of aluminium is the raw material used in the extrusion process. It must be heated before it is pressed through the die and extruded to the correct shape. In thermal extruding processes, it needs to have a certain temperature profile (taper), to compensate for heat produced from the forming energy during the pressing process.

Under-heated billets can damage the die or block the entire process and affect the product quality.

Traditionally, thermocouples are used for temperature measurement, but these are sporadic, slow, maintenance-intensive, and become inaccurate as metal build-up occurs.

Thermocouples measure the furnace atmosphere, and can only be used for sporadic point measurements on billets. They are also expensive to replace.

Non-contact accurate billet temperature monitoring enables process optimisation and control. This maximises process uptime, prevents wasted billets and avoids costly repairs to damage caused by falsely, or under-heated billets solidifying during the extrusion process. Additionally, it controls the heating process and the requested temperature profile.

The hot, soft, preheated aluminium billet is extruded through the die, which produces the desired product shape. It is essential that the die is sufficiently heated so that it does not cool the aluminium, which will block or affect the process.

The die is preheated in a die oven to ensure it is sufficiently hot enough – typically around 450 to 500 °C (842 to 932 °F) – to guard against the aluminium solidifying. It is important that the die is not removed from the oven prematurely, and that it does not cool too much between the oven and the die press.

As the die is pre-heated, it is important to measure the temperature rapidly so that it does not have time to cool before being loaded into the press. A sufficiently heated die does not run the risk of blocking the process by causing the aluminium to harden.
The aluminium which exits the die press is known as the extrusion profile. This will have been shaped into the desired form, but the metal will still be hot and soft – typically 500 to 550 °C (932 to 1022 °F). To control the optimum product temperature and press speed to achieve the required mechanical properties, accurate temperature measurement of the extruded profiles is needed.

These measurements allow optimisation and control of press speed and quality of extrusion. This makes sure the aluminium product has the required physical properties, surface finish, and precise dimension tolerances by the time it leaves the process step.

To monitor the cooling rate through the quench process, it is necessary to precisely measure the aluminium temperature at each end of the process, beginning with the extrusion as it exits the press. This ensures that the aluminium product has the required physical properties and precise dimension tolerances by the time it leaves the quench process step.

After exiting the press, the hot extrusion is quenched to cool it. The rate and target cooling temperature affects the mechanical properties of the finished product, such as the hardness and resilience of the metal. It is also important to ensure that complex internal structures of aluminium profiles are cooled down below a critical temperature.

Quenching brings the temperature of the extrusion down to lower levels. It can be accomplished by forced air convection or industrial water (emulsion). Water cools at a faster rate, producing a harder product, but cooling too rapidly can affect or distort the aluminium profile.

By monitoring the cooling rate of the extrusions moving through the quench, a finished product with the required properties is consistently achieved. Any structural damage to the profile from cooling it too quickly is avoided.
The strip mill takes aluminium from the smelters or recycled product formed and solidified to a slab or billet and converts it into a usable industrial form, reducing thick slabs into thin sheets that are light, durable and strong.

Accurate temperature measurements support process control throughout the strip mill, detecting problems before product damage breakdown occurs. The quality of the finished product can be verified by thermal monitoring at key points, typically on both sides of a traversing mill.

AMETEK Land products provide dedicated temperature solutions for the aluminium strip mill. The SPOT AL EQS pyrometer delivers high accuracy with a fast response time, while our ASPS system with coil detection software tracks the coil measurement position throughout the coiling process at the end of the rolling process.

**APPLICATION**  
**Ingot/slub (re)heat furnace**  
**SOLUTION:** SPOT AL EQS F and F Mg mode

Aluminium slabs or ingots are heated in a reheat furnace to ensure a homogenous temperature prior to rolling. Accurate temperature measurements at the furnace exit help to monitor each slab, supporting consistent temperature and product quality throughout the process.

The reheat furnace typically heats the slab slightly above rolling temperature, to ensure the properties of the aluminium are the same throughout the slab. It is then allowed to cool to the rolling temperature during transport, requiring measurements to ensure it is at the correct level before rolling.

**APPLICATION**  
**Hot rolling**  
**SOLUTION:** SPOT AL EQS S mode

Aluminium is reduced to the required uniform thickness at the rolling mill, ready for coiling before transferring to the cold rolling mill. Temperature monitoring is essential to optimise and control the process closely, increase process efficiency and detect potential mill problems.

Uncontrolled temperatures can cause unexpected thickness variations, while cold metal may cause cracks during rolling, so accurate and continuous measurements play an important role. Since the surface finish may change during the process, affecting emissivity, these can be difficult to achieve.

Precise temperature control enables a reduction in re-anneling and finishing costs, the detection of potential breakdown mill problems, and improved process control and product quality. This in turn reduces operating costs and reduces the likelihood of producing any scrap product.
An application-specific version of our proven ARC thermal imaging system, the ASPS is designed for temperature monitoring of aluminium during strip coiling.

The ASPS uses advanced radiometric imaging to deliver accurate edge-to-edge profile measurement of aluminium temperature at the coiler.

For optimised support, hot and cold mill versions cover two temperature ranges: 100 to 1000°C (212 to 1832°F) or 0 to 500°C (32 to 932°F).
Forging can be used to convert aluminium or aluminium alloy from a workpiece/ingot/billet into a shape for further processes by forming the material between dies, either by press forging or drop forging.

Before forging, a blank is preheated to temperatures typically around 550 °C (932 °F), depending on the alloy used. It is then worked between flat or shaped dies to produce the desired forged product.

Hot forging can imbue aluminium with some mechanical qualities comparable with steel, while the metal remains easy to manipulate and cut into complex shapes. Temperature measurement during this process is important to check the metal is hot enough to forge effectively, to ensure the product quality and material specifications within small tolerances and prevent scrap parts. In addition, metal which is too cool may adversely affect the dies, since it may harden and be more resistant to the die impact.
This is a fast, reliable and efficient application which can be used for many purposes, including forging, mounting, coating, or heat treating. Temperature measurements ensure that the metal reaches the correct temperature for the next stage of processing, without being damaged or having its physical properties changed to an unwanted degree. It also helps to optimise the amount of energy used to heat the aluminium, reducing waste and energy costs.

Mounting/shrinking is commonly used in metals applications to fit a component in or around another. For instance, a metal tube in an engine might be thermally expanded, resulting in a wider internal diameter. A bearing with an external diameter greater than the new width of the tube can then be added. As the tube cools, the inner diameter shrinks, and the bearing is mounted securely within it. Temperature monitoring and fast, online controlling is required for this application to ensure that the part is heated sufficiently to expand, but not to so high a temperature that it is damaged or deformed. As these processes are relatively fast and closely controlled, a fast and reliable measurement is required.

Heat is often used to apply a surface coating to an aluminium part. If the metal is insufficiently heated, the coating may not correctly adhere to the component, or may not bond in a uniform way. However, if it is too hot, the coating may be damaged. So, accurate temperature monitoring is needed to ensure the heating process is controlled.

To make the aluminium easier to bend and shape without breaking, it is often heated first. Temperature measurement ensures that the metal is adequately heated to bend easily, while also safeguarding against heat damage to the aluminium or unexpected material thickness.
SPOT AL EQS
A family of advanced non-contact infrared application pyrometers providing a single sensor solution for a variety of aluminium production and processing applications.

SPOT Actuator
A smart motorised unit specifically designed to work with the SPOT pyrometer range. It provides remotely controlled target alignment and a billet/profile scan.

ASPS Thermal Imaging System
An application-specific version of the proven ARC thermal imaging system, designed for temperature monitoring of aluminium and metal strip rolling and during coiling processes.

LSP-HD
Compact infrared linescanner, designed to produce advanced and high-homogeneous thermal imaging in moving processes.

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.

DOWNLOAD THE BROCHURES AT: WWW.AMETEK-LAND.COM