

# The SPOT GS pyrometer for non-contact temperature measurement in continuous hot dip galvanizing lines

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Continuous galvanizing lines coat steel strip in zinc to make it corrosion resistant by passing through a molten zinc pot under tightly controlled temperature conditions. The strip is heated before contacting the zinc, then cooled before further processing. Galvannealed steel also adds a second process, where the strip is heated after zinc coating, causing iron to diffuse into the zinc forming a harder more scratch resistant corrosion resistant iron zinc alloy coating more suitable for forming and spot welding operations.

Accurate strip temperature must be maintained to produce high-quality products, and in this controlled and varied environment, production engineers and technicians have two broad choices for feedback: thermocouples, which measure conditions via contact temperature measurement and heat conduction, and non-contact sensors, which measure temperature indirectly through radiated heat energy, primarily in the form of infrared radiation.



Figure 1: A galvanizing line.

Source: Gregor Schlaeger/Worldsteel via Getty Images

It is important to note that handheld non-contact thermal measurement instruments do not measure temperature directly. Instead, they measure the amount of heat radiation being emitted from a body. It is a subtle, yet important distinction, and the material type — steel in this case — coating type, ambient temperature and even the angle at which measurement takes place affects these readings.

Simple un-calibrated devices can be useful for getting a general idea of temperature fluctuations, but for carefully controlled steel production processes, non-contact sensing methods normally need much further refinement to ensure that measurements are spot-on.

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This sensor builds upon AMETEK Land's extensive measurement experience, as the world's leading manufacturer of monitors and analyzers for infrared non-contact temperature measurement, combustion efficiency and environmental pollutant emissions.

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## Black bodies, emissivity and highly reflective metallic surfaces

These challenges are illustrated nicely in Manfred Hayk's webinar, [Advances in Non-Contact Temperature Measurement for Continuous Annealing and Galvanizing Lines](#).

Hayk shows a cube at a uniform temperature, which exhibits distinct infrared radiation on its three visible sides. He elaborates that the coated surface has a higher emissivity — ratio of the thermal radiation from a given surface compared to that of an ideal black body at the same temperature — than the uncoated surface, while its shiny metal face actually reflects the heat radiating from a hand next to it. Such differences in emissivity must be well accounted for in a manufacturing process.

Hayk continues to note that Kirchhoff's radiation law states that the sum of all radiation at a certain time is absorption, plus reflection, plus transmission. Metals, however, normally transmit little in the way of infrared radiation, meaning that the sum of infrared radiation in this case is emission plus reflection. While this generally valid assumption perhaps simplifies the measurement process, another factor that must be accounted for, per the Stefan-Boltzmann law, is that while radiation of a black body is directly proportional to the surface area measured, it is proportional to the difference between the body and environmental temperature to the fourth power. It is therefore critical that non-contact measurement equipment take ambient temperatures into account for accurate readings.

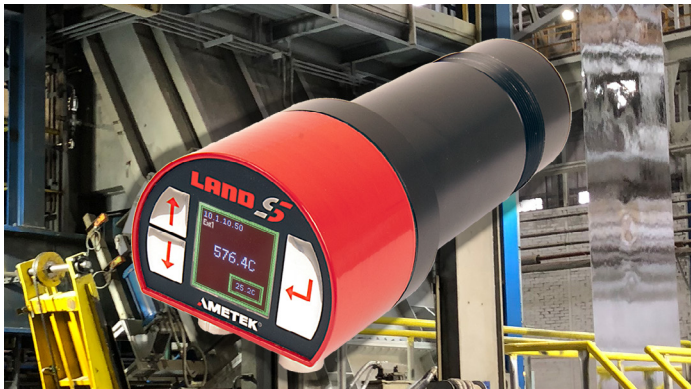


Figure 2: The SPOT GS instrument can be used in both vertical and horizontal furnace arrangements.  
Source: AMETEK Land

## SPOT non-contact solution

The SPOT GS instrument is designed specifically for galvanized and galvanized steel process lines and can be used in both vertical and horizontal furnace arrangements. Not only can this device measure temperature via emitted radiation from steel strip as it travels between rolls, but with the GS+ algorithm, it can even measure the temperature of liquid zinc at the exit to the process's zinc pot, giving engineers yet another option for controlling the process.

When used to measure strip temperature inside a furnace, accounting for background temperature traditionally meant using a water-cooled sighting tube to prevent most of the hot reflections, or using a thermocouple to give background temperature readings. However, AMETEK Land's SPOT GS pyrometer is capable of taking these readings independently in most cases, without a water-

cooling device or external thermocouple, and adjusting to emissivity changes in the processed steel as needed within a few milliseconds. When there is an extreme difference in background temperature, however, the SPOT GS is capable of using an external thermocouple to compensate for the temperature as needed. While this functionality is available with the correct parameters set up, the instrument is able to work without external input about 90% of the time.

## Specifications

The SPOT GS pyrometer features two signal processors, which allow it to process information with a 10 ms response time, or 100 readings per second, and can account for changing emissivity within a few milliseconds as noted earlier. Steel processing measurement range is 200° C to 1,000° C, and accuracy is specified at 5° C at 200° C, and  $\pm 2^\circ$  C at 300° C and above. It is capable of 0.1° C resolution, and measurement repeatability is  $\pm 3^\circ$  C or less at <200° C and above. These numbers are obviously smaller than the stated tolerance of the instrument, but higher precision readings could still be advantageous for spotting trends on a micro or even macro level. Processing functions offered by the instrument include: peak/valley picking, average, mode master, CMD in sampling or LED control, CMD out alarms and emissivity output or actuator control.

The SPOT GS implements 0 to 20 mA and 4 to 20 mA output formats and 24 V DC inputs. It also features CMD in and out functionality, and is Industry 4.0 ready with a wide range of Ethernet input/output protocols: Transmission Control Protocol/Internet Protocol (TCP-IP), Modbus TCP, Dynamic Host Configuration Protocol (DHCP), http, User Datagram Protocol (UDP) and Internet Control Message Protocol (ICMP). SPOTViewer and SPOTPro software support is available for configuration and analysis, where operators can see an instrument overview and track trends.

## Easy installation and setup

Setup of the SPOT GS is facilitated with an aiming light that indicates precisely where the device is pointed. It also features a rear display on the unit that allows for single-person installation at the device's location, without needing to verify readings with a control room.

The high-visibility LED sighting system places a bright mark on the part to indicate sensing size and location, without any laser eye-safety issues. The device senses the proper focus distance and spot size, pulsing its LED red or green to indicate whether it is set up correctly. An integrated video camera with both local display and remote image capture is available to assist, and the focus can be tuned from 300 mm (11.8 in) to infinity and controlled locally or remotely.

## Robust industrial construction

The SPOT GS is designed for industrial use with an IP65 rating, and has a full range of mounting options and accessories available. It features high-quality optics, protected by a sapphire window, allowing infrared and visible light to be transmitted whilst sealing against ingress from contaminants. It is able to operate in a range of ambient temperatures as wide as 0° C to 70° C before cooling is required.

### Ready to process

With the tight control afforded by the SPOT GS, it is possible to optimize furnace temperature controls for potential savings in heating costs, while still providing quality steel products demanded by customers in advanced manufacturing sectors. This instrument builds upon AMETEK Land's extensive experience, as the world's leading manufacturer of monitors and analyzers for infrared non-contact temperature measurement, combustion efficiency and environmental pollutant emissions.

AMETEK Land provides on-site engineering support at customer facilities to help determine where their products would fit best. With this expertise built into the Spot GS, customers can be confident they are getting the accurate data needed to keep their processes running perfectly.

For more information on sensors and other products, go to AMETEK Land's [website](#).

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#### AMETEK LAND

Stubley Lane  
Dronfield, S18 1DJ United Kingdom  
Tel: +44 1246-417691

#### IEEE GLOBALSPEC

201 Fuller Road, Suite 202  
Albany, NY 12203-3621  
Tel: +1 518 880 0200

#### ABOUT AMETEK LAND

Founded in the UK in 1947, AMETEK Land (Land Instruments International Limited) developed a reputation for producing innovative, resilient measurement technologies designed to operate in the most challenging conditions. Acquired by the Process & Analytical Instruments Division of AMETEK, Inc in 2006, today AMETEK Land is the premium supplier of product application solutions to world industries including steelmaking, glass making, minerals processing, hydrocarbon processing and thermal power generation.

Our success rests on award-winning technologies that push the limits demanded by the ever-increasing technical demands of global industry. Aligned with our expert knowledge, we meet the challenges of a wide range of applications, delivering process safety, process control and product quality our customers depend on.