thermo scientific

A practical guide to metals gauging systems

Thickness and coating measurement and control systems for the metals production industries.

ThermoFisher SCIENTIFIC

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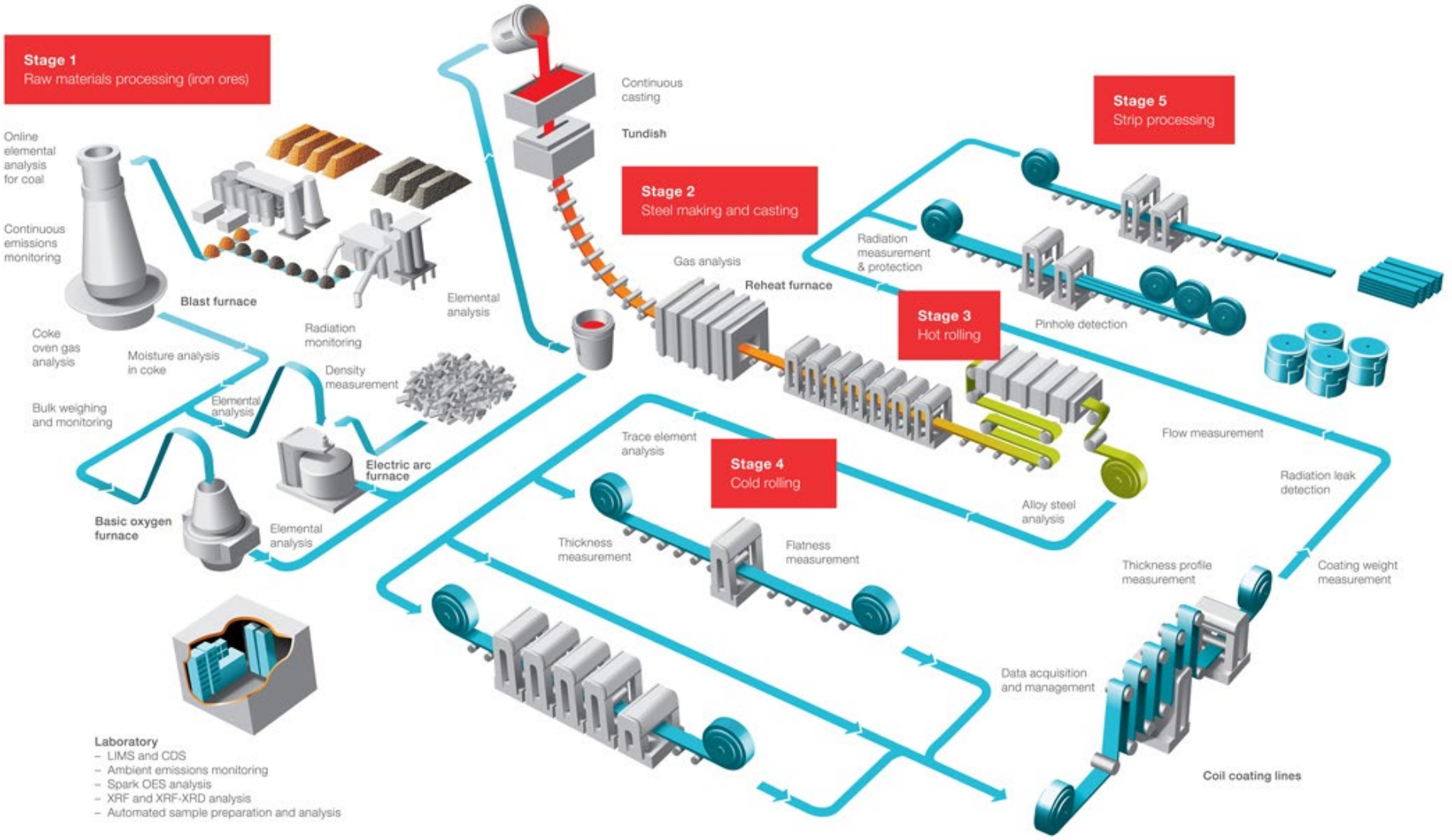
Overview

The metal making process

Metals production is a 24-hour-a-day, 365-day-a-year process, dependent on a consistent supply of raw materials and huge amounts of energy. High demand for iron ore, coke and scrap steel, increasing energy costs and industry consolidation have prompted steel producers to develop new methods for gaining efficiency to remain competitive.

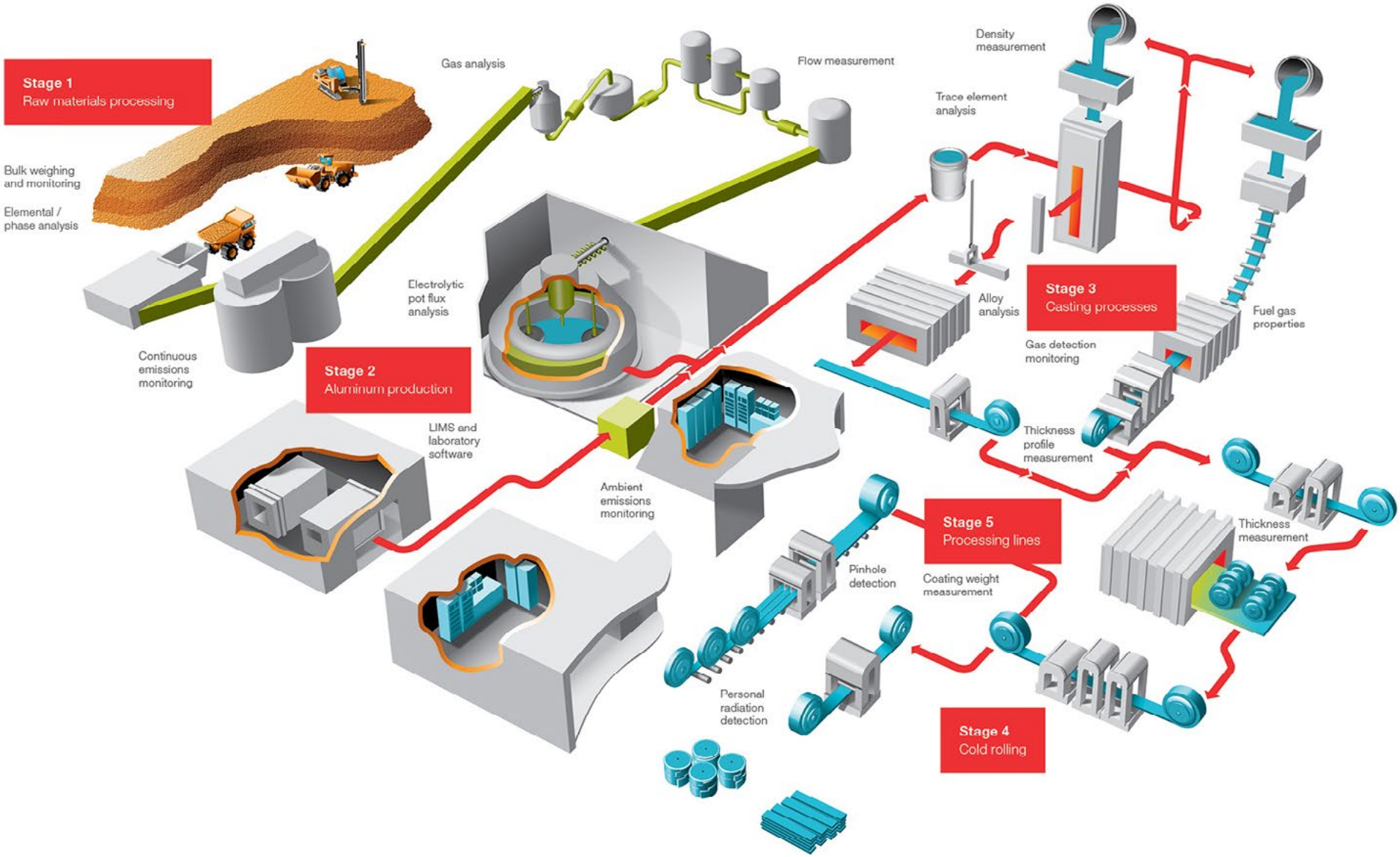
The metals making process

Steel process map



The metals making process

Aluminum process map



Cold rolling mills

Cold rolling is accomplished by processing steel strip through a series of tandem rolling mill stands. Each stand has vertically stacked rolls that are powered by huge motors to impart high compressive stresses into the strip. Hot-rolled, pickled coils are fed into the cold rolling mill from an entry-end reel and progressively reduced in thickness in each stand to achieve the final desired thickness as the strip exits the last stand. After the last stand, the strip is recoiled. At this point, the strip is highly cold-worked and not very useful for most applications. It needs to be annealed to soften the steel, and make it more formable.

Source: United States Steel Corporation

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Click here to download the White Paper: Optimization of a Cold Rolling Mill with a High Speed X-ray Thickness Gauge

Hot strip mills

Hot rolled bands and sheets are produced on a Hot Strip Mill from slabs that have been thoroughly heated to a rolling temperature of approximately 2300°F / 1260°C. Slab heating at this temperature accomplishes several desirable end results, which include, surface scaling for minor surface imperfection removal, softening of the steel so it can be hot rolled, and (where applicable) dissolving carbides or nitrides that are to be precipitated at a later stage of the rolling process.

Source: United States Steel Corporation

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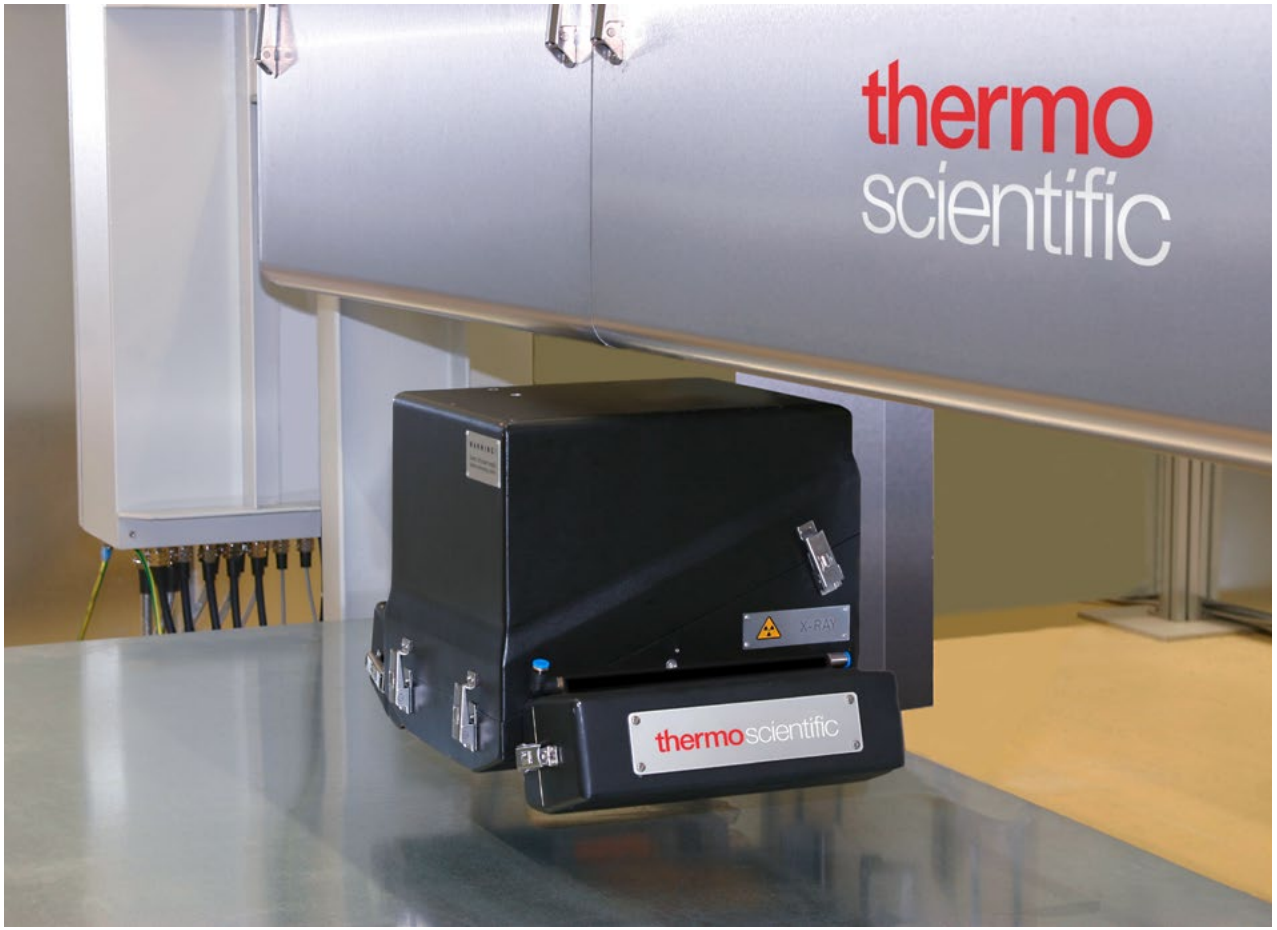
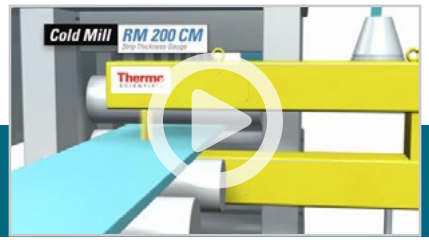
Click here to download Spec Sheet: High-speed Archiving of Thickness and Profile Data in the Hot Strip Mill

Steel and aluminum mills

What is a metal gauging system?

Metal gauging systems – used in hot strip mills, cold rolling mills and process lines – provide fast, accurate, non-contact and non-destructive thickness and coating weight measurements needed to achieve high product quality and maximum productivity.





Click here to watch the video:
Steel Process Products

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Applications

Steel
Non-contact thickness gauging systems for hot strip mills, cold rolling mills and process lines, provide precise, real-time measurements during high-speed production of steel plate and sheet, to help produce quality products and meet the tightest tolerances, while maintaining output and efficiency.

Aluminum
Non-contact thickness gauging systems for hot and cold aluminum rolling mills and process lines provide accurate, robust and repeatable measurements during high-speed production of aluminum plate, sheet and foil, regardless of alloy.

Non-ferrous
Non-contact thickness gauging systems for hot and cold rolling mills provide accurate and repeatable measurements during the production of copper (titanium and others) plate and sheet, helping to produce high quality products while maximizing raw material use.

Coating weight measurement
Non-contact coating weight gauging systems provide accurate measurement of metal coatings on flat sheet products, helping to ensure coating uniformity, product quality and raw materials savings.

Pin hole detection
Non-contact pin hole detection systems inspect flat-sheet as it is being rolled and monitor for defects that could compromise the barrier between perishable goods and the outside environment, helping to assure product integrity, width and edge quality.

Strip quality begins in the meltshop

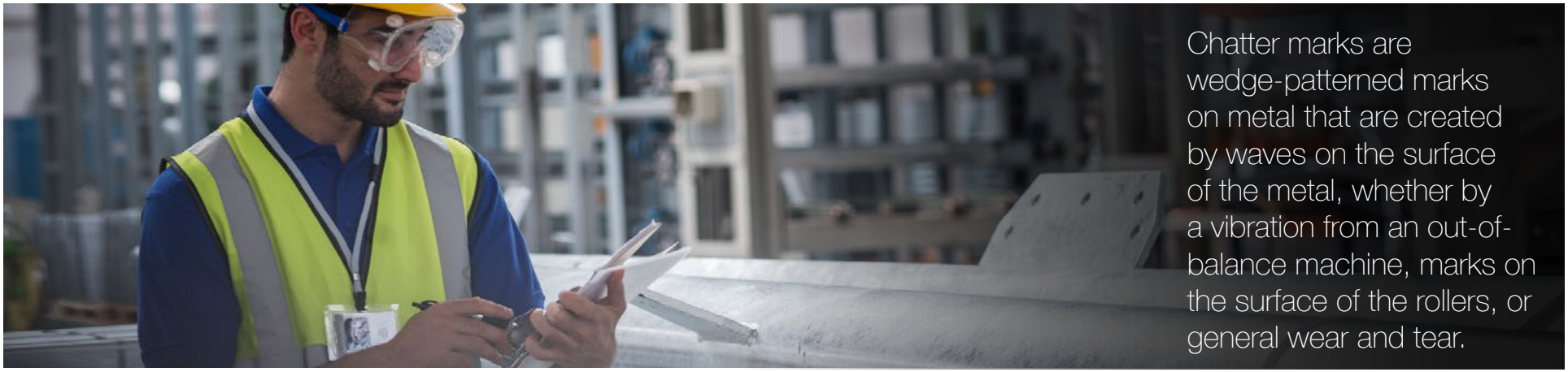
Controlling the chemistry and thermal history of the steel not only assures the grade produced will meet the mechanical properties desired of the final product, but that the strip will handle the tons of pressure and tensions of the high speed rolling process. The table below summarizes the typical thickness and rolling speeds for each mill type.

	Hot roughing mill	Hot finish mill	Cold rolling mill
Maximum thickness	> 400 mm	20-50 mm	3-20 mm
Minimum thickness	6 mm	1 mm	0.100 mm
Rolling speeds (meters per min)	~ 100	~ 1000	~ 2000

As the material gets thinner, the speeds increase dramatically.

Benefits of gauging system for flat metal production

To achieve the maximum ROI and shortest payback time, the mill needs to produce high quality sheet at the fastest possible mill speeds.



Chatter marks are wedge-patterned marks on metal that are created by waves on the surface of the metal, whether by a vibration from an out-of-balance machine, marks on the surface of the rollers, or general wear and tear.

Meet customer specs and standards. Steel sheet producers and their customers have agreed upon standards to describe various physical parameters for the material traded, with thickness, width, hardness, and strength among the key variables defined in a simple product code.

Maintain uniformity of thickness. Detect and correct deviations in thickness in real-time.

Reduce chatter marks. Identify and avoid blemishes in the finished product.

Keep an electronic trail. Each coil completed and shipped by the mill can have a record of thickness that provides quality assurance further on in the supply chain.

Save raw materials, time, and money: Correct issues in real time, reduce scrap, and keep commitments to customers.

Benefits of hot coating weight measurements to coating control

Minimize zinc consumption and provide uniform coating coverage, which helps you profitably produce world-class steel for your customers.

Online measurement of hot dipped zinc-coated steel after the cooling tower provides essential quality control data for your galvanized coil customers. However, when that measurement is made right above the air knives in the 'hot' location, production managers and process engineers are provided with valuable near real-time data that can save hundreds of thousands of dollars in raw zinc per year.

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Click here to download the white paper:
The Benefits of Hot Coating Weight Measurements to Coating Control

Benefits of simultaneous measurements

Simultaneous measurement of centerline and transverse thickness, temperature, profile, width, edge drop and shape of a steel strip at the exit of a hot rolling mill helps improve operating practices. With this wealth of process control data, mill throughput and yield can be increased.

Raw materials savings

Off-gauge and off-tolerance product results in the downgrading or even scrapping of coils. High-speed, accurate dimensional measurements allow for in-bar correction of off-gauge product, resulting in raw materials savings and mill optimization.

The importance of uptime

Production demands require permanent uptime, and scheduled outages are limited to just a few days each year. Reliable sensors and the built-in redundancy of SIPRO simultaneous profile gauge ensure measurement values are there when needed.

Protection in harsh environment

Designed to last, SIPRO simultaneous profile gauge is built with a robust stainless steel frame. Water-cooled jackets on all strip-facing surfaces protects sensor components from heat, steam and other challenges that exist in the hot rolling environment.

Flatness measurement

SIPRO simultaneous profile gauge provides the highest cross-strip measurement resolution of any on-line hot mill profile gauge. This granularity allows proprietary algorithms to calculate strip flatness, head to tail and strip edge to strip edge.

In bar control

By providing stereoscopic, full profile measurements every 5 milliseconds, the advanced profile control software can make corrections within the same bar. This increases mill yield, product quality and overall profitability.

World class quality = high profits

Accuracy and reliability conceals the impressive technology behind the measurements. With the highest speed and resolution available, SIPRO simultaneous profile gauge assures the quality of your products and the quality of your products assures your profitability.

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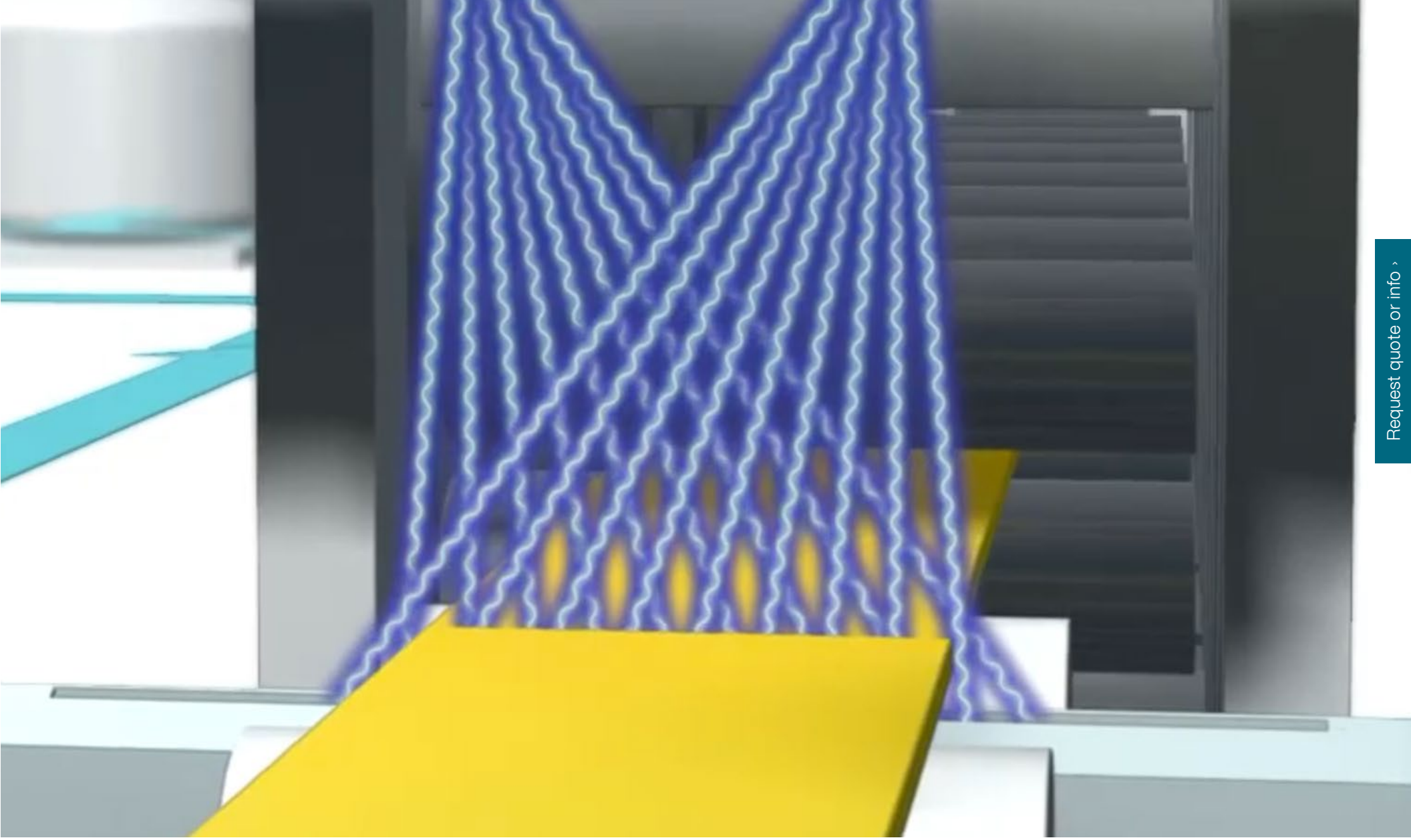

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Technology

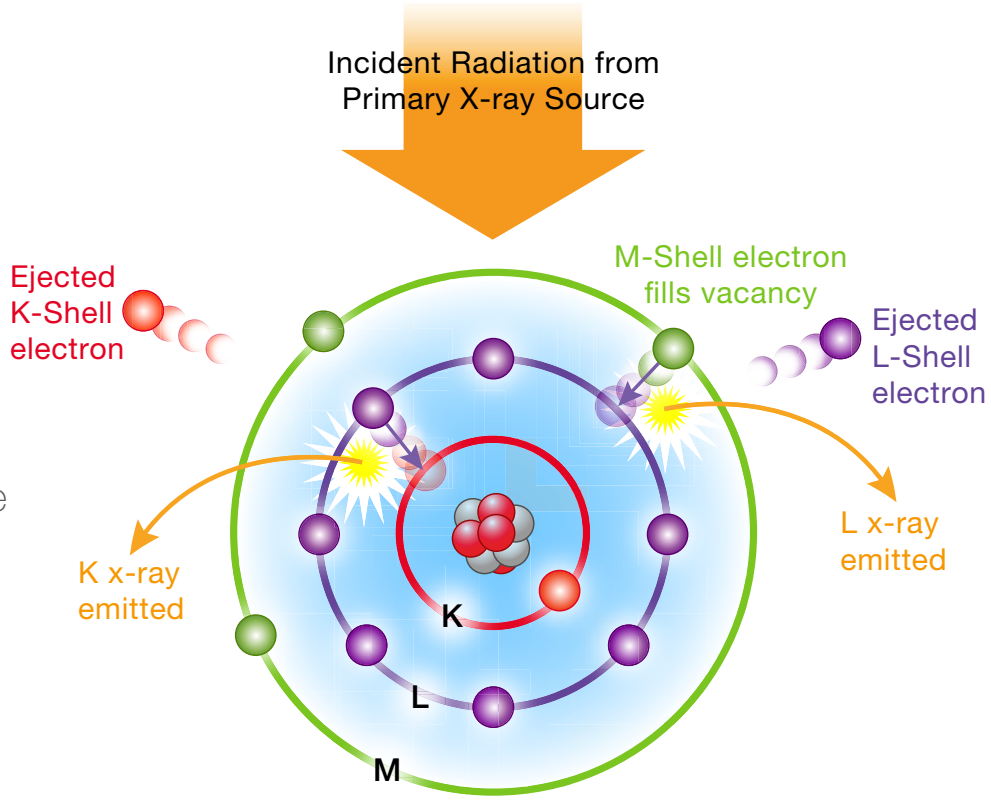
XRF technology

X-ray fluorescence (XRF): a non-destructive analytical technique used to determine the chemical composition of materials.

For measurement of thin metallic coatings applied to steel strips this X-Ray Fluorescence (XRF) principle is used:

The coated steel strip is exposed to a primary beam of photon radiation. This photon radiation can be gamma rays or X-rays, having sufficiently high energy to stimulate excitation and emission (fluorescence) of X-rays.

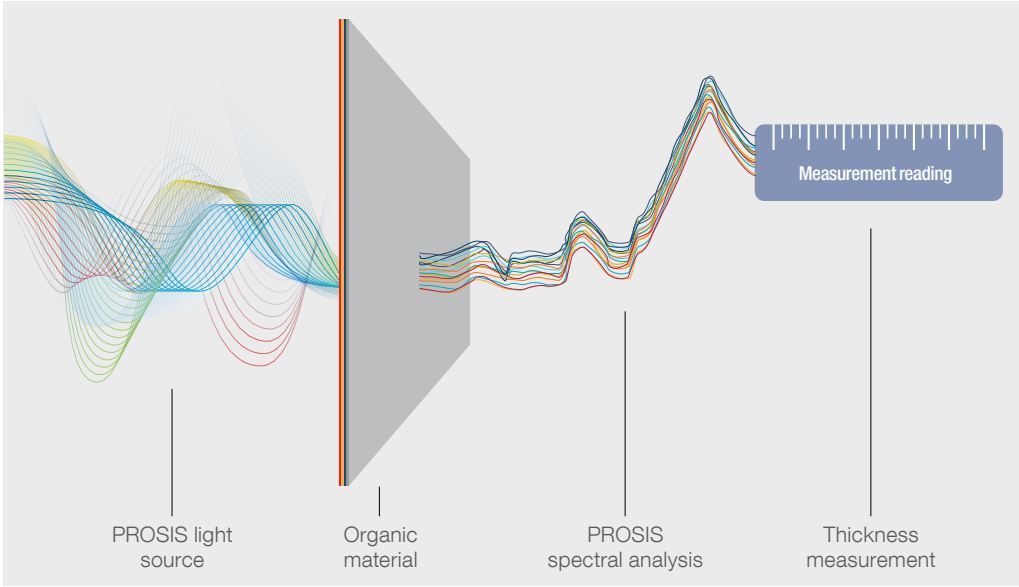
The excitation of iron atoms in a steel strip leads to emission of fluorescence radiation with an energy of 6.4 keV (1 kilo electronvolt = 1.6 * 10^{-16} Joule).



Click here to learn more about XRF Technology

Sensor technology – infrared

Sensors utilizing infrared technology are available in both transmission and reflectance modes. The measurement is based on the absorption of light by the materials to determine the resulting thicknesses. Each material exhibits a unique light absorption characteristic and emits a signature waveform (spectra) as light passes through it. As material thicknesses change, the spectra will change throughout the infrared wavelength spectrum. Because of this, the sensor is uniquely designed to inspect the entire infrared spectrum to accurately measure thicknesses of both single layer and multilayer products. This technique enables the sensor to discriminate between different components even if they exhibit very similar IR absorption characteristics, whereas it is almost impossible for competing filter wheel IR sensors with limited resolution to sense the critical differences.



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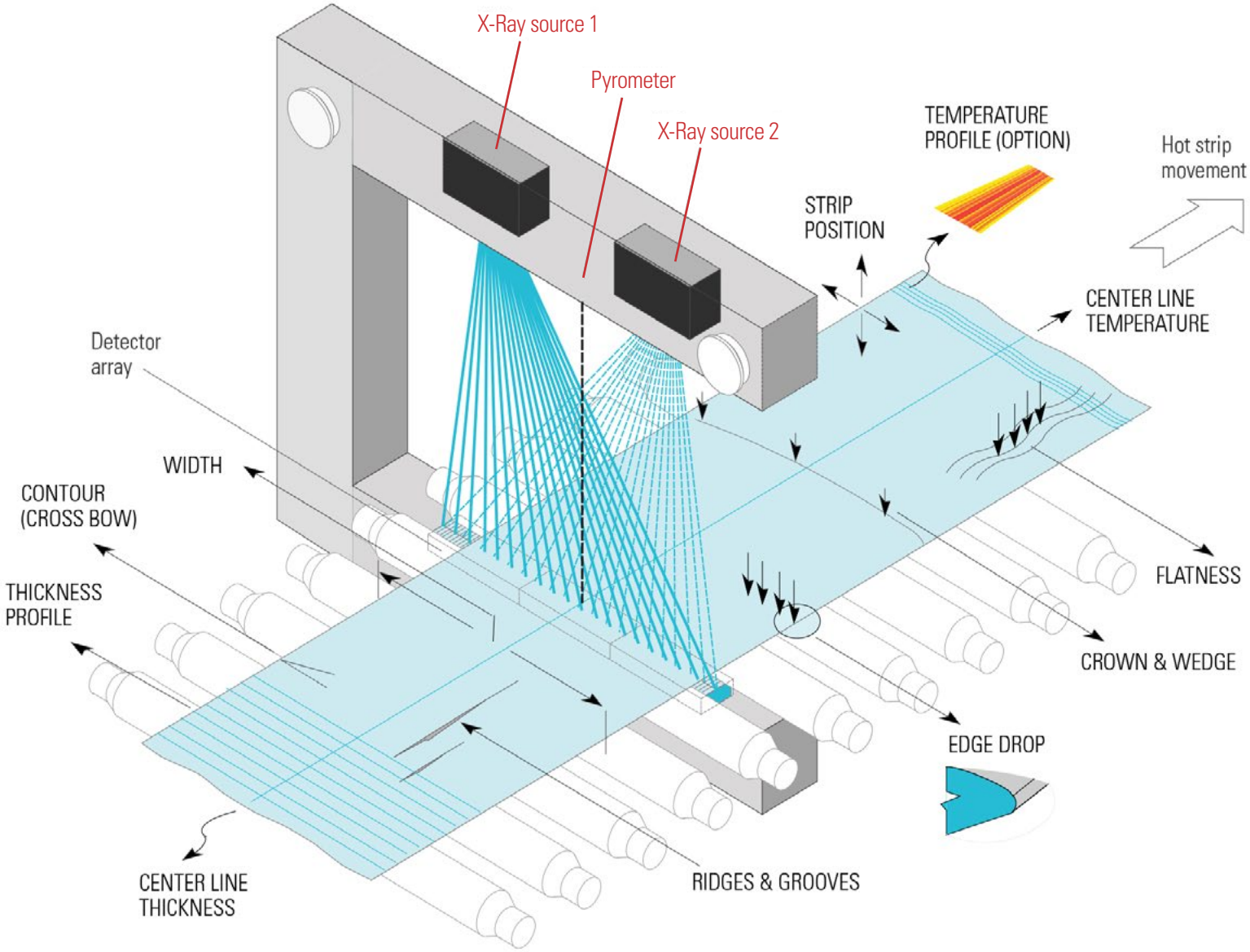
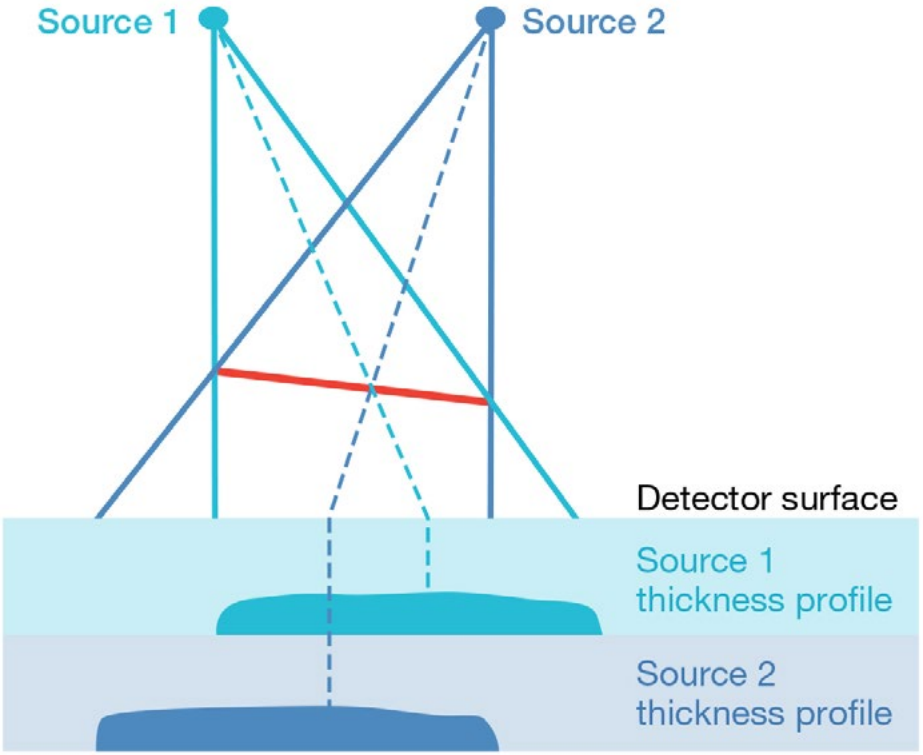
Measurements



Measurement principle - profile gauge

For every 5 ms exposure, the computer calculates an apparent thickness for each detector giving a raw thickness profile. It then analyzes the results of the current and previous scans to locate the edges of the strip in space.

The thickness profile is then calculated by working along a straight line between the two edge positions. For every 5 mm of strip width, the measurements from the two source views are combined, taking into account the known strip angle, to give a strip thickness profile measurement insensitive to position or tilt. For profile control systems that require real-time crown and wedge outputs, the system provides these by further analysis of each 5 ms thickness profile. This analysis is made using configurable sections of profile width to obtain the crown position required (e.g. C40, C50, etc.).



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Equipment

Metals gauging products

Thickness gauges for hot plate mills

Our thickness gauges for hot plate mills optimize the mill process with extremely high measurement accuracy at high speed, low noise, and with excellent cross-profile resolution—making them ideal for applications such as bridges, wind turbine towers, and ships.

Product details ›

Non-contact metals thickness gauges for hot strip mills

Our non-contact thickness gauges for hot strip mills provide reliable, high-speed repeatable process control data to identify operating issues, ensure product uniformity, and increase output.

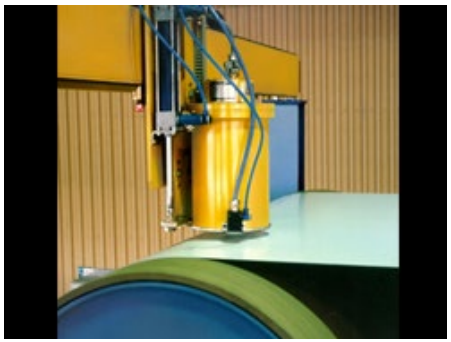
Product details ›

Non-contact thickness gauges for cold rolling and process lines

Thermo Scientific thickness gauges for cold rolling and process lines provide accurate, non-contact thickness measurement of flat sheet steel in every type of processing line.

Product details ›

Non-contact paint coating gauges



Our paint coating gauges provides fast, accurate and reliable profile measurement of multilayer paint and organic coatings, providing essential information to optimize your production process.

Product details ›

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Metals gauging products

Non-contact metallic coating gauges

Our cold coating weight gauges provide the highest level of precise, non-contact coating weight cross-profile measurement of metal coatings applied to steel strip, helping to ensure coating uniformity, product quality and raw materials savings.

Product details ›

Non-contact metallic coating gauges

Our coating weight gauge for hot-dip galvanizing lines significantly improves coating weight control by reducing the dead time between the actuator and measurement, resulting in raw material savings and a reduction in scrap.

Product details ›

Non-contact oil thickness gauge

Our coating weight sensor provides fast, accurate, non-contact coating weight measurement of oil coatings applied to flat sheet products. It is especially suited for thin and ultra-thin coatings.

Product details ›

Pinhole detection

Our pin hole detector provides contactless monitoring of flat sheet for defects that could compromise the barrier between perishable goods and the outside environment. Especially suitable for process lines where sheet integrity is critical.

Product details ›

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Choose the system that's right for you

Metals coating weight gauges

Metals thickness measurement gauges

Products | Sensors

	RM310EC-LE	RM310EC	RM310EH	RM315EC	RM300EL	PROSIS
Applications						
Zinc (below 300 gsm per side or G200) Hot dip galvanization lines Electrolytic galvanization lines	✓	✓	✓			
Galvanized (below 500 gsm per side or G400) Thick coatings for crash barriers		✓		✓		
Zinc alloys (except Galvanneal) Zn/Al, Zn/Ni, Zn/Al/Mg, Al/Si	✓*	✓				
Galvanneal (iron content in %)				✓		
Tin	✓	✓				
Aluminized coatings	✓					

Click here to access the full metals coating weight gauges product comparison table ›

Steel, Copper, Titanium Applications | Aluminum

	RM 100 PL	RM 110 PL	RM 200 PL	RM 210 PL	Laser TX	SIPRO	RM 200 CM	RM 210 CM	RM 215 HM
Sensor	Isotope	X-ray	Isotope	X-ray	Optical	X-ray	Isotope	X-ray	X-ray
Process lines									
Coating lines	✓	✓	✓	✓	✓*				
Slitting lines	✓	✓	✓	✓	✓*				
Inspection lines	✓	✓	✓	✓	✓*				
Cut-to-length lines	✓	✓	✓	✓	✓*				
Pickling	✓	✓	✓	✓	✓*				

Click here to access the full metals thickness measurement gauges product comparison table ›

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Thermo Scientific metals gauging

We offer a complete line of non-contact thickness gauges for hot- and cold-rolling mills that provide precise, real-time measurements that meet the tightest specifications of any application while maximizing raw material use. Whether you're producing steel from iron ore or scrap, or whether your end product is more than several inches or less than a millimeter thick, you can rely on us for accurate thickness or coating weight measurement and the highest quality finished products.

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About Thermo Fisher Scientific

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