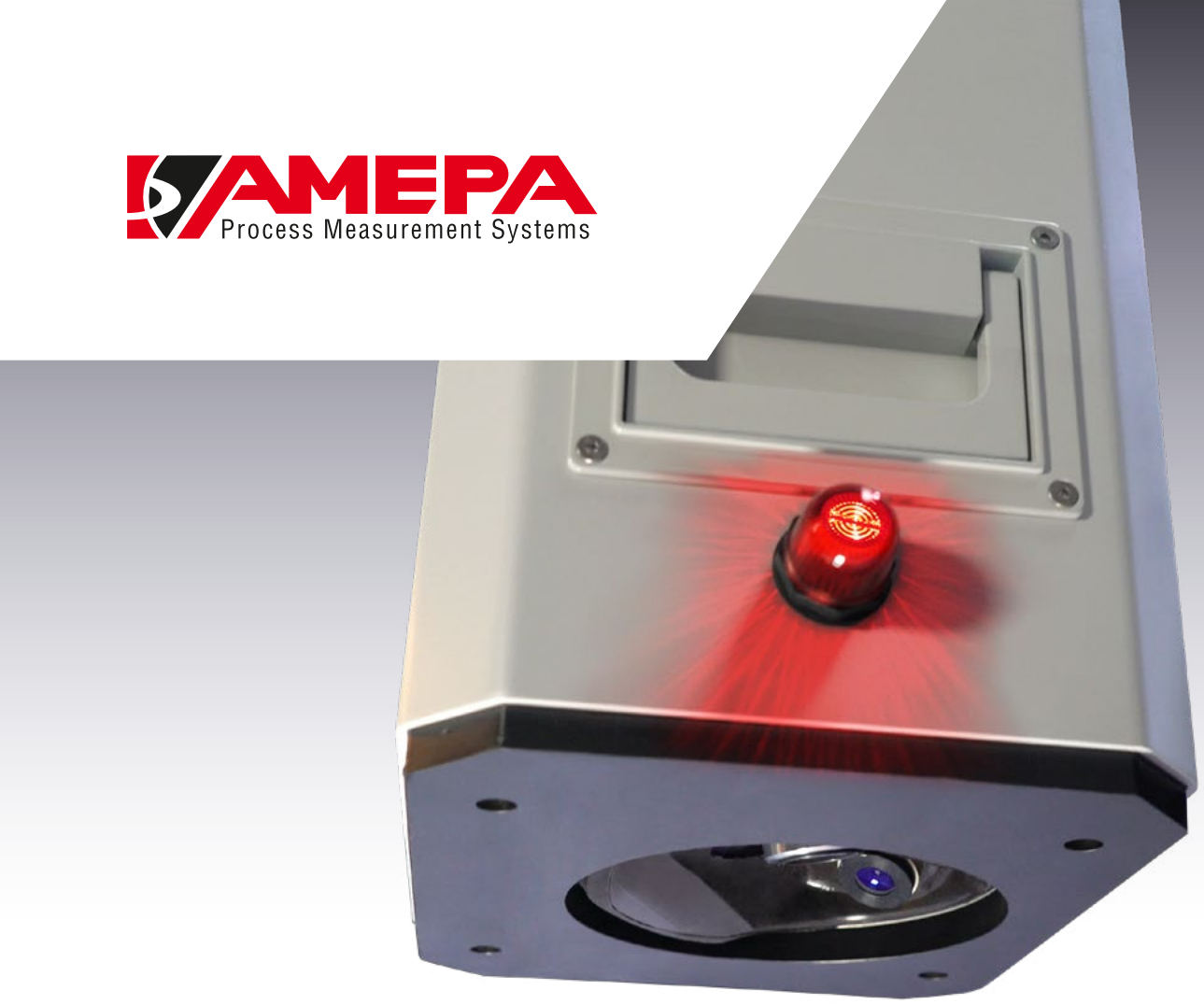
AMEPA
Process Measurement Systems



Perfect Surface with Online Roughness Measurement

SRM 100

Measure it. Control it.

AMEPA
Online Roughness Measurement

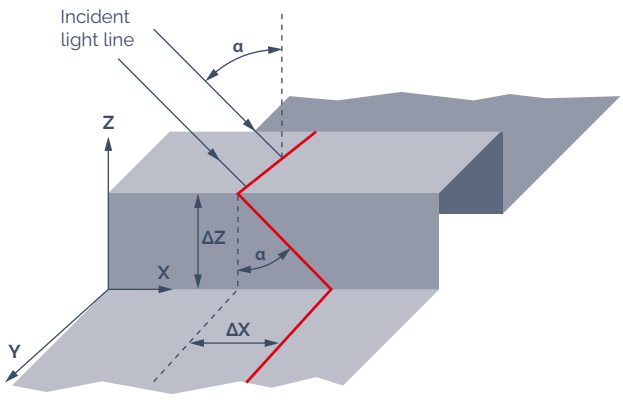
Complex sheet metal forming in connection with design and lightweight construction, motivated by the necessary CO2 savings, leads to increasingly strict criteria regarding the automotive industry's mechanical requirements. The need to increase productivity challenges manufacturers and processors of quality coils to the same extent as the need to guarantee their products' high-quality surface structures. The continuous control of the surface roughness provides an effective approach for improving process reliability.

When integrated into the production line, an online measuring system is capable of measuring with high dynamics over the entire length of the strip without contact. This leads to a better understanding of the influence of the various production parameters.

Profile measurements of smaller surface areas determine roughness parameters. For roughness values of Ra between 0.3 and 3 µm, this is usually done in the range of a cut-off of 0.8 or 2.5 mm.

The fundamental objective of an online roughness measurement of the surface profile is

- **Visualize and document the roughness over the entire length of the coil or strip**
- **Efficiently detect roughness values beyond predefined tolerances, e. g. caused by**
  - **roughness of the raw material**
  - **wear of work rolls**
  - **impermissible process parameters**
- **Provide online data to determine the optimal time to change the work rolls**
- **Provide the roughness value of Ra as an input for the process control**
- **Reduce the number of offline measurements with stylus instruments**



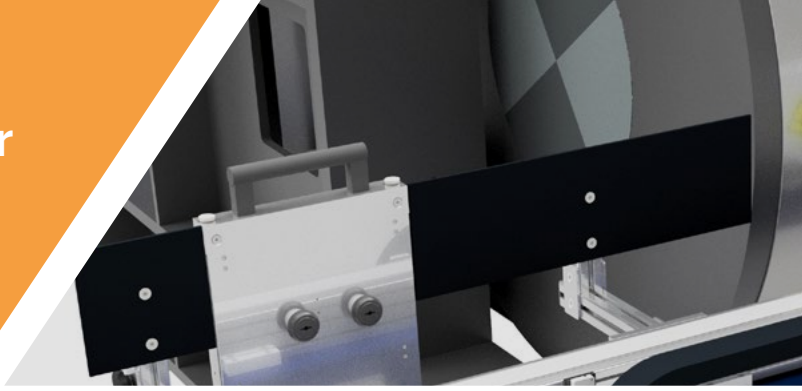
α: Angle of incidence
Z: Height axis
ΔZ: Height variation (to be calculated)
ΔX: Line position variation (measured)
ΔZ = ΔX • cot α

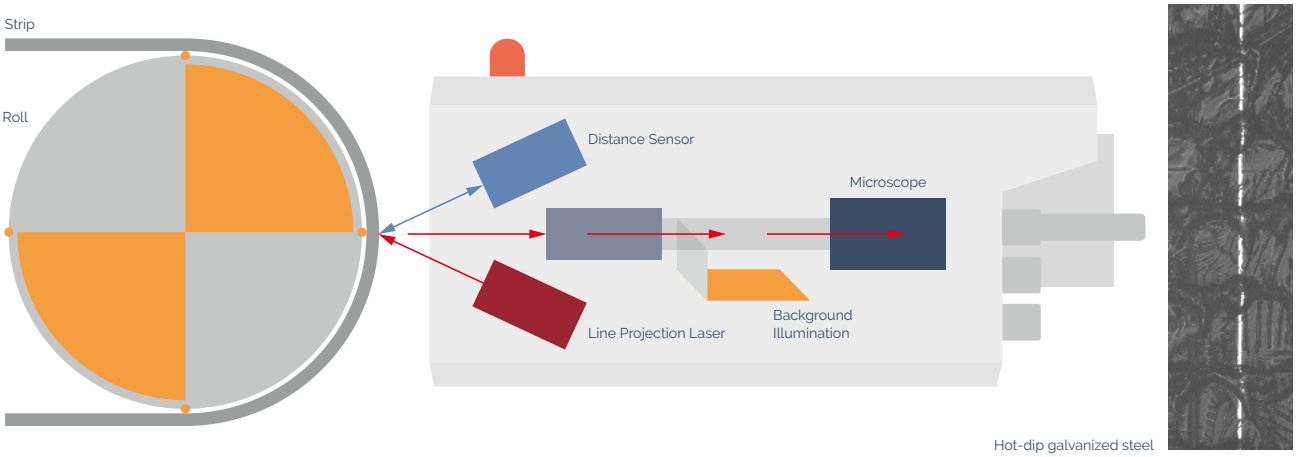
Measurement of Change in Altitude

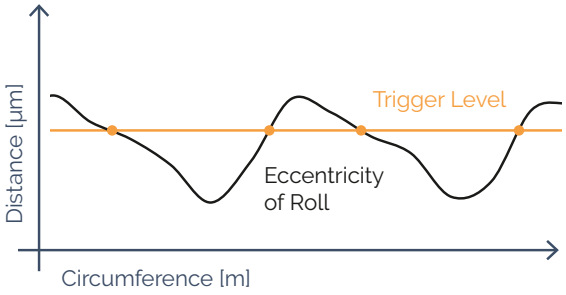
Measuring Principle of Online Roughness Measurement

Based on the light section measurement, a two-dimensional laser triangulation patented by the Centre for Metallurgical Research (CRM Center de Recherches Métallurgiques, Liège) for the online roughness measurement and implemented industrially by AMEPA GmbH, an optical measurement is carried out on metal strips. With this non-contact measuring method, an extremely fine laser line is projected at a defined angle onto the surface that is entitled to be monitored. An image of the line is taken with a high-resolution industrial microscope. The surface profile of the strip can be determined directly from the distortion of the laser line.

Reliable industrial design for high accuracy in inline measurement







Positioned in the middle of the distance variations, the distance sensor triggers the measurement and image acquisition. This means that the focus for the optics is always at the correct distance. Aligned by an integrated, motorized movement, the sensor automatically adjusts to varying strip thicknesses.

/01

Precise

- Measuring range: Ra 0.3 to 3 µm, RPc 30 to 120 cm^{-1}, Resolution for Ra: 0.01 µm
- Measuring frequency: up to 100 Hz, short response times, high dynamics
- Ra measurements with a selectable cut-off of 0.8 or 2.5 mm
- Field of view: 1.2 x 0.4 mm, Measuring line: 1200 x 3.5 µm (≈ spatial resolution like stylus tip)

/02

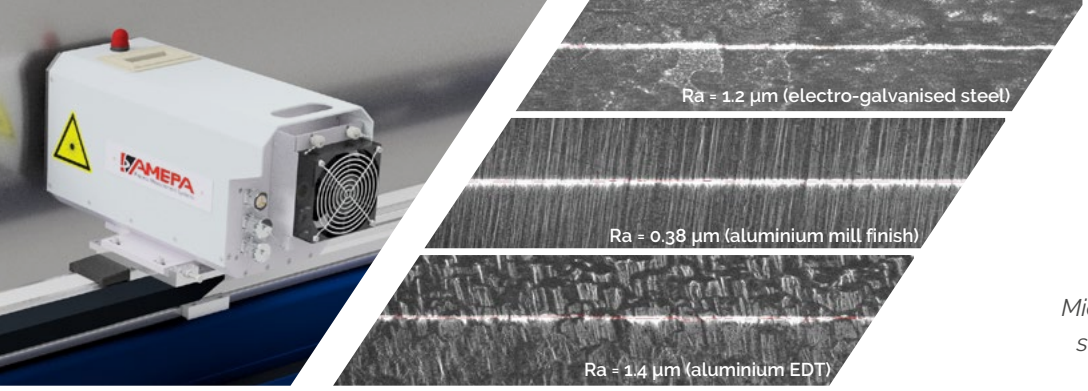
Efficient

- Insensitive to vibrations and strip oscillations, measurement possible at up to 2000 m/min and higher strip speed
- Reduction of time- and sample-consuming measurements with stylus instrument, while maintaining the very high correlation with tactile measurement
- Measurement is possible regardless of lighting conditions and even when the strip of the coil is standing idle

/03

Informative

- Documentation of measurement data of relevant roughness parameters with image proofs from the beginning to the end of the coil
- Microscopic image of the surface structure with approx. 2000 data points
- Validation unit for measurement integrity and measurement equipment capability studies



Microscopic images of different strip surfaces of steel and aluminum for quality documentation

SRM Roughness Visualisation

The laser line is projected onto the metal strip surface up to 100 times per second. The integrated CMOS camera takes a microscopic image of the laser line and the surface structure. The clearly visible laser line is checked for plausibility, filtered, and processed with intelligent image processing to enable the roughness values to be calculated. The measurements are combined appropriately so that the conditions, according to the DIN EN ISO 10049 standard, are approximated. With operation at 60 Hz, for example, and averaging over 25 measured values, a response time of around 0.5 seconds to changing roughness can be achieved.

In addition to the Ra roughness value, RPc, Rz, and other statistical values can also be calculated. The SRM system offers a variety of options for visualizing online data as well as stored data.

Based on the customer's specified threshold values, warnings and alarms are displayed immediately if the roughness is beyond tolerance so that operators can take appropriate countermeasures without delay.

The laser line and the galvanized surface texture (here EDT) are clearly visible. The example of a screenshot shows the online Ra and RPc results over the coil length with the most recent microscopic image. The high dynamic of the system allows the operator to quickly correct the overshoot of the roughness when changing the strip's material (in the middle of the diagram).

/04

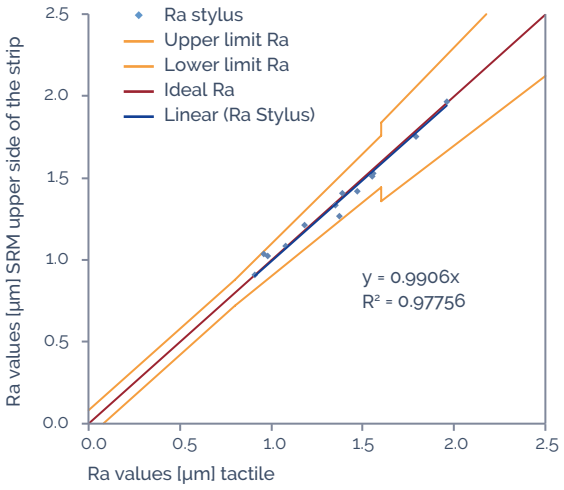
Versatile

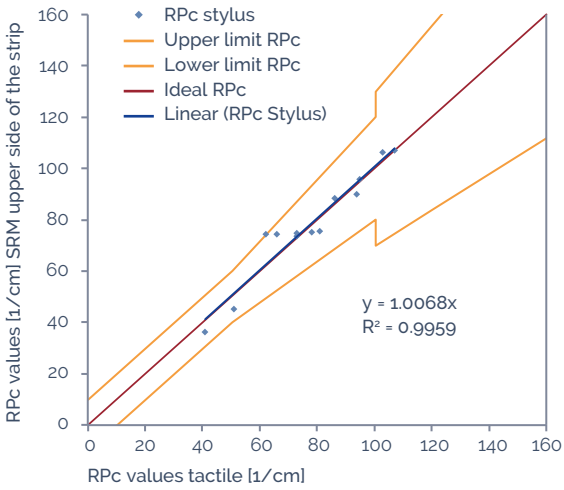
- Non-contact measurement on all quality surfaces made of steel (GI, EG, GA, ZM, each EDT, EBT or PRETEX texturing) and aluminum (mill finish and EDT)
- Acquisition of Ra, RPc and Rz in one measurement recording, adjustable to traversing approachable measurement tracks (e. g. for middle of strip, strip edges)
- Measuring angle 90 degrees to the rolling direction (requirement DIN EN ISO 10049), optionally with 45 degrees

The validation unit can be equipped with reference sheet metal samples from the customer and certified geometry standards and is only opened for the duration of the validation measurement.

SRM – Tested and Proven

System tests in which the SRM results are compared with tactile measurements (stylus instruments) show the system's high reliability and accuracy. The excellent correlation between the offline, tactile profile results and the online SRM results can be seen in the example below.





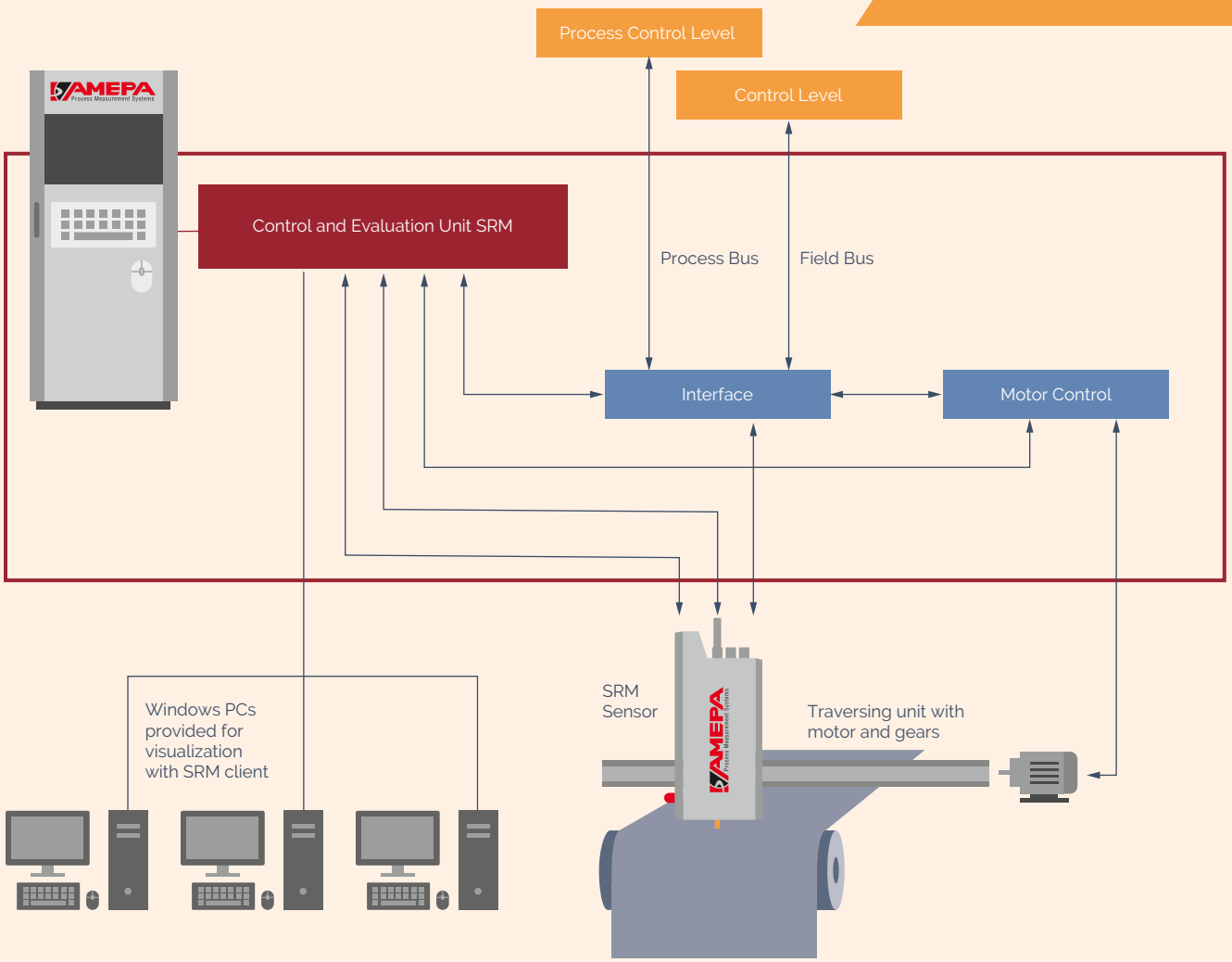
SRM Validation Unit for Checking the Sensor Integrity

A validation measurement checks the sensor's optical properties and its perfect operational functionality.

The validation unit consists of a mounting frame that is attached to the traversing unit. A specimen holder is used in this mounting frame, equipped with validation specimens of known roughness.

By inserting the sample holder, the validation unit is closed to the environment to protect the samples from contamination and impairment. The cover is automatically opened towards the sensor only for the time of a validation measurement. The cover on the back is connected to the mounting frame and prevents the laser beam from being dangerous if the specimen holder is missing.

The sensor moves along a specified route during a validation measurement. As soon as the sensor reaches the end of the line, the validation measurement is finished, and the sensor moves back to the standby position. The cover closes automatically when the sensor leaves the validation position. The validation can be started manually or automatically, e. g. per hour or as a daily cycle.

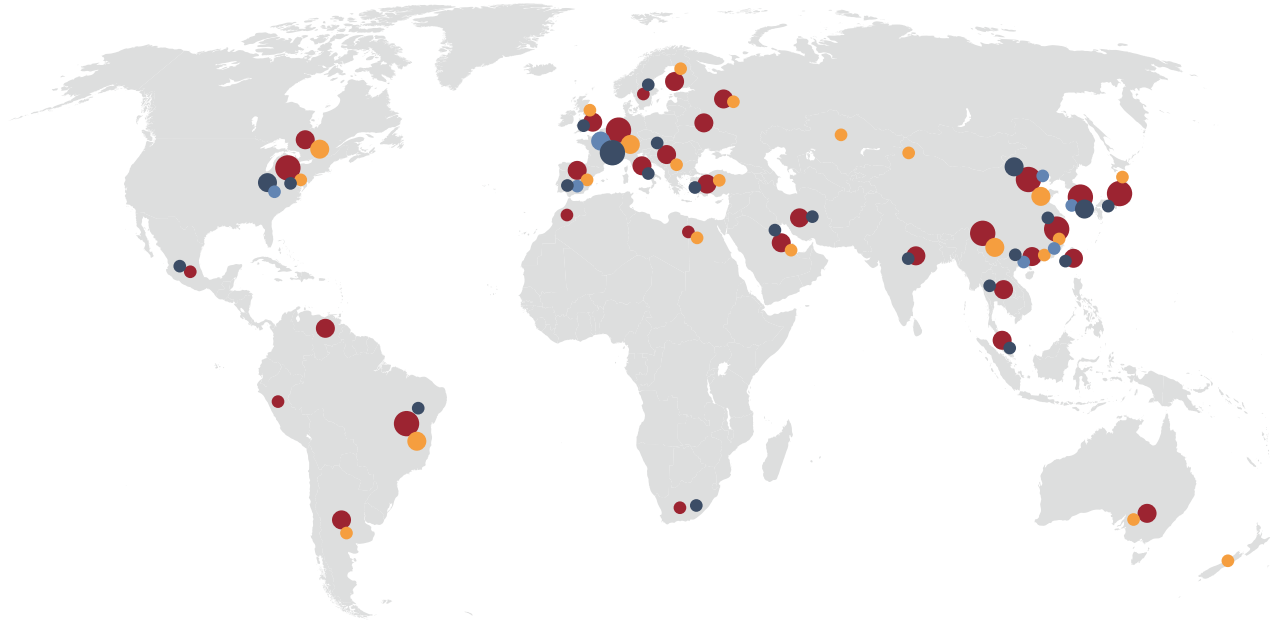


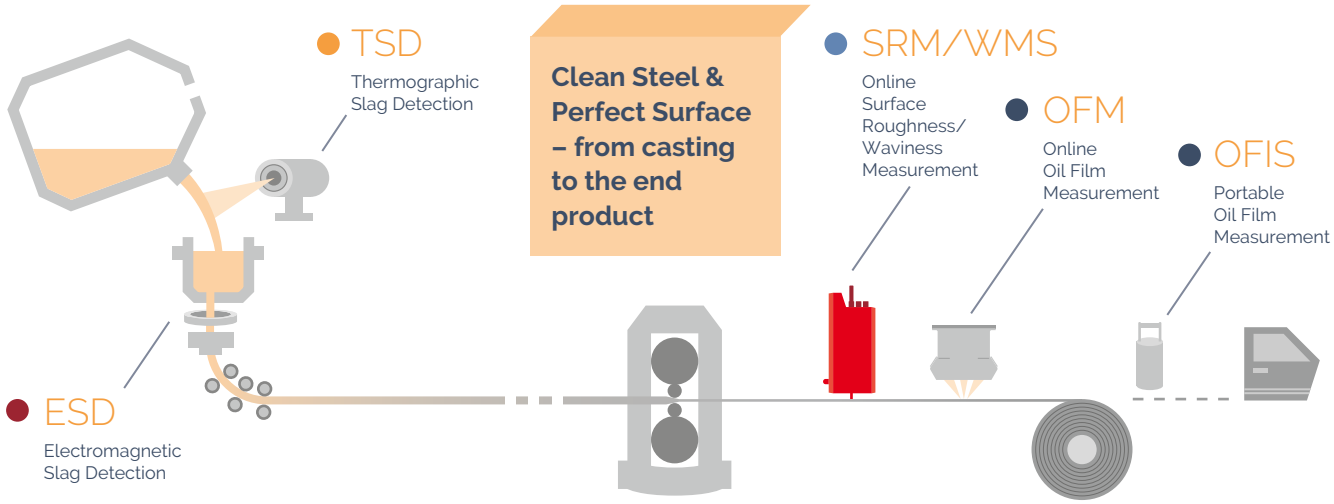
SRM Technical Specifications

- Measuring range Ra: 0.3 to 3 µm
- Measuring range RPc: 30 to 120 cm^{-1}
- Resolution Ra: 0.01 µm
- Strip thicknesses from 0 to 6 mm
- Measurement possible on all surfaces of steel and aluminum
- Working distance between sensor and strip: approx. 25 mm
- Maximum strip speed: up to 2000 m/min and more
- Measuring frequency: up to 100 Hz, depending on the installation
- Measurement for Ra with selectable cut-off of 0.8 or 2.5 mm
- Field of view: 1.2 x 0.4 mm, measuring line 1200 x 3.5 µm (≈ spatial resolution like stylus tip)
- Motor-controlled readjustment of the optical focusing on different strip thicknesses, traversing unit with arbitrary parameterisable measuring tracks
- Measurement regardless of the lighting conditions
- Fast emergency or escape speed; typically 1 m/s (max. approx. 2 m/s)
- Sensor dimensions: ~ 210 x 256 x 500 mm
- Sensor weight: ~ 16 kg

AMEPA
Process Measurement Systems

Worldwide successful





AMEPA GmbH
Karl-Carstens-Str. 12
52146 Wuerselen
Germany
Phone +49 2405 40808-0
Fax +49 2405 40808-44
Email info@amepa.de
www.amepa.de

AMEPA America Inc.
31250 Solon Road, Unit 17
Solon, OH 44139
USA
Phone +1 440 337 0005
Fax +1 440 318 1027
Email info@amepa.com
www.amepa.com

AMEPA Trading (Shanghai) Co., Ltd.
Changshou Rd. 1118, Room 19B
Building A, Putuo District,
200042 Shanghai, P.R. China
Phone +86 21 64478501
Fax +86 21 64478502
Email info@amepa.sh.cn
www.amepa.com