A Perfect Profile

Optical Laser Sensors Measures Metal Strips' Thickness Profile

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Metal strip is used as a raw material in the manufacture of numerous products and so is directly linked to the final quality of the end product. Therefore, metal strips need to be examined for compliance with quality criteria before further processing. In addition to its physical properties, the thickness profile of the metal strip is an important feature. There are many different approaches for measuring the thickness profile. This profile is captured over the length and the width by optical laser sensors regardless of alloy type.

During production, metal strips are rolled hot and cold whereby deviations from the target thickness may occur. Therefore, an exactly constant thickness of metal strips is difficult to reach. In order to optimise thickness profile, various methods are adopted such as roll cambering or support rollers. Important quality criteria of a metal strip are the thickness profile over the length and width, the geometry and documentation of measured values. Measuring systems that check the data and that provide correction variables for regulation are necessary to ensure the compliance with the quality criteria.

Thickness Measurement Methods

Conventional mechanical thickness measurement systems determine the thickness of the metal sheet via contact by a calliper-type arrangement at set measurement points. The values are then interpolated to provide what is only an approximate thickness measurement. This method is much too slow to yield an in-process detailed thickness profile across or down the length of the strip. Furthermore, such measurement methods are often affected by wear and are normally not automated and so are likely to interfere with the flow of production.

Alternatively, the thickness of metal sheets can be determined by using radiometric techniques. The radiation from an isotope source is dampened by the sheet metal. The remaining radiation is measured on the opposite side. The difference between the transmitted and the measured radiation is then converted to an area-weighted value and afterwards to a thickness measurement. However, this method very much depends on the alloy and condition of the metal sheet. Although such a thickness measurement provides sufficient information about the thickness profile for a known alloy, it requires complex, costly safety provisions due to the intensity of the radiation. Across three shifts, the cost of radiation protection, supervisors and continuous safety monitoring systems means that high variable costs are associated with these methods.

However, a solution is the use of the capacitive sensor technology. But one drawback of systems that use this technology is their relatively large spot size. The sensors measure over the complete face surface and so can only provide averaged thickness profile information around the frontal areas of the sensors. Better local resolution is required for the edges of the products.

The Alternative: Optical Laser Sensors

The use of optical laser sensors with radiometric and capacitive measuring techniques is a significant advancement in thickness inspection. Micro-Epsilon provides different variants for this. A simple C-clamp measuring device detects the thickness on a selectable track in the direction of production by using laser sensors and two-sided thickness measurement. Another variant operates using a closed O-frame. With this version, a sensor is placed on each side of the metal strip in an identical position to the other, which then move continuously at right angles to the production flow. The thickness profile over the complete width of the product can therefore be measured.

Robust Innovation

In the new high-end solution ScanControl, the sensor system also traverses

ScanControl Functionality

During a measurement, the reflected light of the laser line is recorded by a highly sensitive CMOS matrix which produces a precise image of the surface profile. Each change of the profile changes the displayed line and so forms a changed image on the matrix.

As the measurement object or scanner is usually moving, a 3D image of the object is produced by apposing the individual line profiles. In this way, a so-called point cloud is generated because the image is composed of many thousands of individual measurement points.

Coils are the raw material for many other products; an important quality criterion of the metal strip is the preferably constant thickness

Laser scanners provide very precise data, particularly for metals

along the measuring gap over the complete width of the strip. However, in contrast to conventional solutions, two laser line scanners are used. The new O-frame innovation from Micro-Epsilon Messtechnik uses specially adapted laser line scanners. In the case of a larger distance to the target and therefore a larger measuring gap, these scanners provide higher precision thickness measurements compared to laser point sensors. With a measuring gap of 200 mm, the system is able to handle large fluctuations in strip guidance and is extremely robust. An open structure at the bottom protects the system. So, scale and dirt simply drop through the system. Vibration of the metal strip or curved/bent strip ends are always a risk for the installed sensor system and so additional mechanical protection is provided to completely safeguard the measuring system.

Laser Line instead of Laser Point Sensors

The use of profile sensors instead of point sensors increases the density of profile information, enabling much better measurements on many different strip materials, regardless of alloy type. The measurement accuracy is also significantly improved by using laser line scanners rather than point lasers; an accuracy of 0.01 mm for a maximum strip width of 4 m is achieved with laser line scanners. High-tech light barriers support the profile sensors. They take over the task of width measurement and if necessary the edge detection of individual strips after splitting. All measured data can be used for documentation of the metal strip. The “thickness” and “profile” measured data are assigned online to a precise position on the strip. The system is used in service centres for flat metal strips and after the separation of the coils into individual metal strips.

The system is considered to be a high-end solution for the measurement of metal strip geometry. Popular conventional measurement systems have been effectively substituted with this system. The return on investment associated with laser scanner measurement comes from the more detailed knowledge of real strip tolerances, including the fact that each individual strip is documented and traceable for the end customer.

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