SMS group

X-Shape

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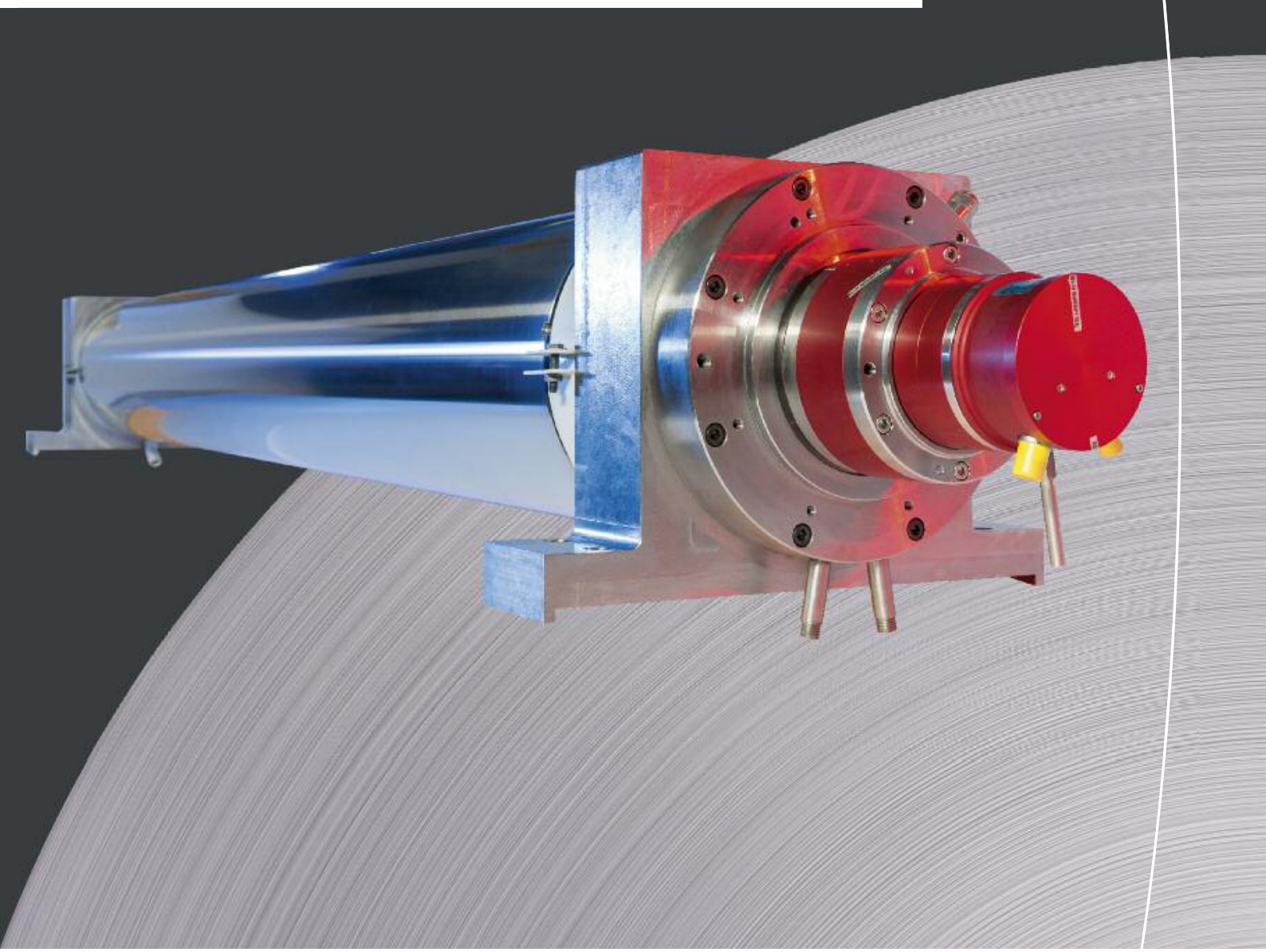
Precise flatness measurement and control



Precise X-Shape flatness measuring system with measuring rollers of the latest generation.

Challenge

In addition to constant strip thickness, the flatness of cold- and hot-rolled strip is the most important quality feature. For quality inspection and as an input variable for the flatness control system, a measuring system is required which determines the current flatness, taking into account strip tension and rolling speed.

Our solution

Reliable and precise flatness measurement is of such great importance for production equipment with high quality requirements that over 10 years ago, we at SMS group decided to develop and manufacture the most modern flatness measuring rollers ourselves. The flatness measuring rollers and the control system carry the brand name X-Shape and are part of the X-Pact® electrical and automation systems product family. Our technological control systems are designed to ensure strip flatness even under the most adverse conditions and at high rolling speeds of up to 3,000 m/min within narrow tolerances and across the entire strip width.

Your benefits at a glance

- Application in hot and cold rolling mills as well in strip processing lines
- Mark-free measurement thanks to closed shell
- Selectable roll surface finish (hardended / coated)
- Measurement up to 3,000 mm strip width, max. 96 sensors, variable measuring zone width
- Reliable and wear-free signal transmission
- Re-calibration not required
- Model-based signal evaluation: one system for all products
- Robust flatness control, scalable for all plant types and available control elements
- Increased productivity thanks to high-dynamic control
- Independent system which can be used in new plants or retrofitted to existing installations

X-Shape flatness control

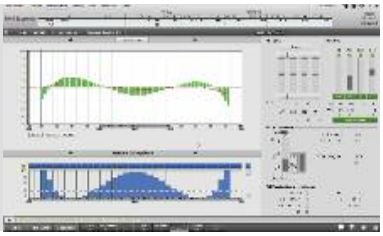
Flatness measurement and the downstream X-Shape flatness control system are the result of continuous further development of the high-precision, robust, low-maintenance and cost-efficient X-Shape system. A flexible and integrated flatness control concept provides various technological solutions to minimize the flatness deviation (so-called orthogonal functions, actuator functions).
The standardized communication concept enables simple integration even with an existing automation solution.

The SMS group flatness control system uses the following flatness actuators – depending on their availability – in a closed-loop control circuit:

- Swiveling of the hydraulic adjustment system
- Work roll and, if applicable, intermediate roll bending systems
- Work roll or intermediate roll shifting systems with CVC®plus contour on the respective rolls
- Multi-zone cooling of the work rolls
- Work roll heating at the strip edges by means of induction heaters or heating nozzles (optionally for aluminum rolling mills)

The flatness result can be obtained in a targeted manner thanks to optimized and cross-linked application of all mechanical and thermal actuators. In this way, the setting for the strip edges can be adapted individually to the customer requirements by combining the existing actuators and weighting of the measured results. As a result, also mechanical actuators such as bending systems can respond to edge defects to an adjustable extent. For multi-zone cooling, an optimized pulse width algorithm is used to improve the flatness results while simultaneously increasing the nozzle service life. Furthermore, smart cross-linking with the control strategies of the existing automation system, such as harmonized controlling of inclinations, is an integral part of the X-Shape flatness control concept.

Additional features such as de-coupling and separating of actuators, pilot-control solutions as well as smart reference curve strategies can be activated optionally depending on the application, and be combined with an existing automation system. The optimal utilization of all adjustment systems ensures the best possible production result.



Control room of an aluminum cold rolling mill.

Measuring principle

Measurement using X-Shape rollers is based on the BFI technology, which is implemented by introducing force sensors into a measuring roller body through axial bores and securing them in their position. The position of the sensors and the width of the measuring zones can be freely selected depending on the minimum and maximum strip widths. The highly sensitive sensors detect even minimum variations in strip tension across the strip width by measuring the vertical force components of the strip tension. The strip tension distribution is the measure for the product flatness.
The axial bores have the advantage that the roller shells remain fully intact during manufacturing so that later, during operation, no marks occur on the strip surface.
The roller surfaces can be standard-hardened or provided with various coatings, such as chrome or tungsten-carbide. In this way, the rollers' service life is extended, making them more wear-resistant.

Measuring sensor with tapered sleeve (l); installation of the measuring sensor (m); signal transmitter (r).

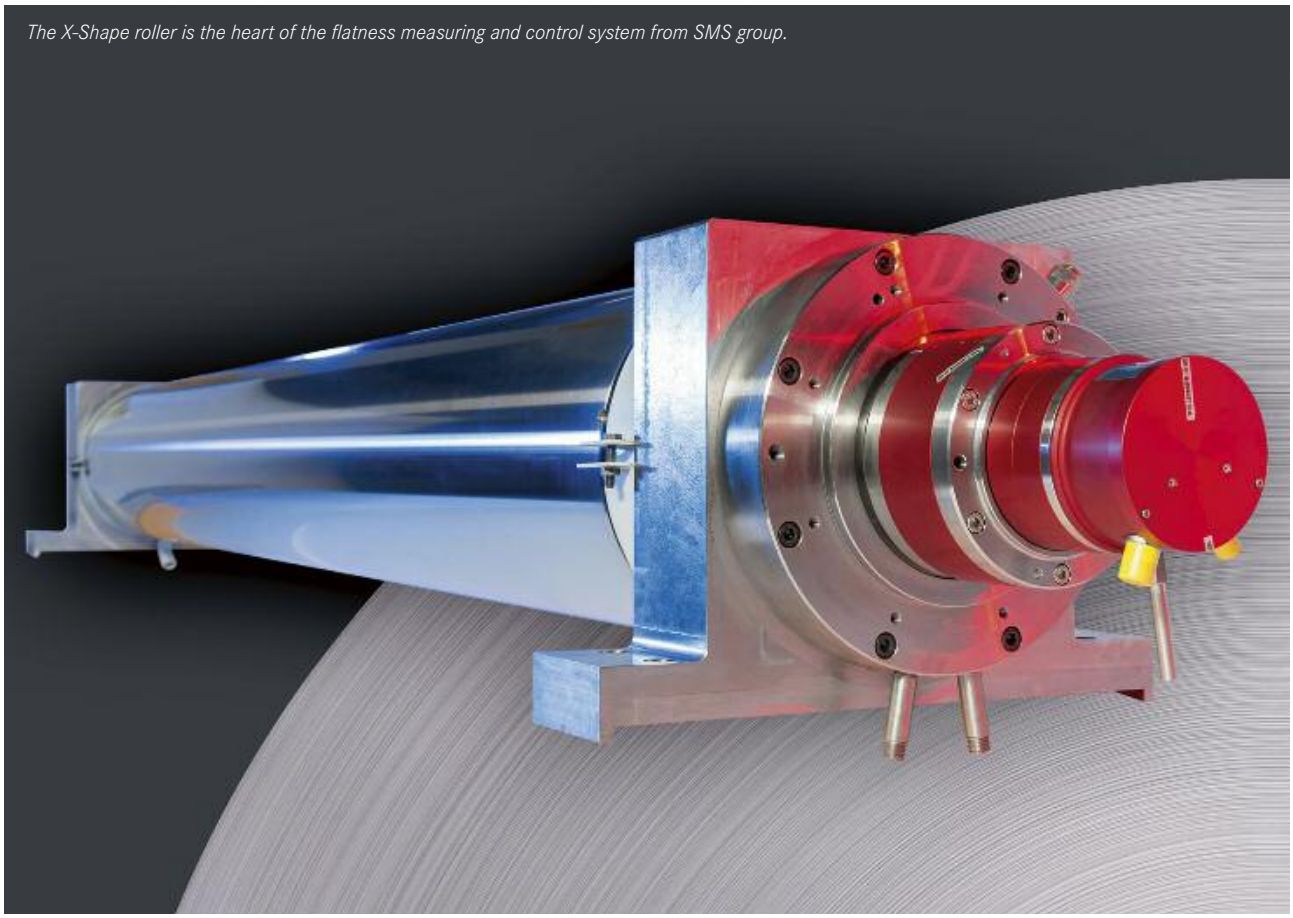
Arrangement of the sensors

Up to 96 sensors can be fitted into the 4 axial bores. In this way, strip widths of up to 3,000 mm can be measured without gaps and in high definition in the area of the strip edges (26 mm zone width). This is of major importance as in modern rolling mills; especially in the field of aluminum rolling, the maximum strip widths continue to increase and thus can no longer be fully covered by conventional measuring rolls.
After the sensors have been positioned and fixed inside the bores by means of tapered sleeves especially developed by SMS group, the signal transmitter is installed on both sides, sealing the axial bores to be dust-proof.

Secure signal transmission

Digital signals are continuously transmitted via optical signal transmission in a maintenance-free manner. In the control cabinet included in the scope of supply, the signals are processed further. The raw signals from the sensors are evaluated using newly developed software. The Analyzer precisely filters the useful fraction from the sensor signals and prepares it for the visualization and control systems.
The signals are then provided to the flatness control system via a defined interface.

The X-Shape roller is the heart of the flatness measuring and control system from SMS group.



Quality inspection of a strip in a pickling line / tandem cold mill.

Permanent calibration

In our workshop, the measuring rollers are calibrated on the test stand developed by SMS group. Calibration of the measuring roller on site following installation into the plant or regularly during maintenance shutdowns, which used to be common practice for measuring rollers in the past, is no longer required. This further emphasizes the system's maintenance-free design.

Operating experience

Our experience gained in various rolling mills and strip processing lines for steel and non-ferrous metals over the past years has continuously contributed to the further development of the X-Shape flatness measuring roller.

In operation, the roller is characterized by its high reliability, low degree of wear and almost maintenance-free design as well as its high temperature resistance. The latter has proven to be essential especially for the rolling of strips at temperatures exceeding 200°C.
X-Shape can of course be installed in new plants or retrofitted in the scope of modernizations or revamps of existing plants.

Together with the X-Shape flatness control system, SMS group offers a complete system perfectly tailored to match the process requirements. This technology sustainably ensures and even improves the productivity and product quality of rolling mills.

Since the market launch of the X-Shape flatness measuring rollers, the number of systems commissioned has increased every year. Alone in 2017, more than 20 measuring systems were supplied.

X-Shape is used in plants producing flat-rolled strip from steel, specialty steel, silicon steel, aluminum and copper.

The SMS group X-Shape flatness measuring systems are being employed successfully at our customer's facilities worldwide in the following plant types:

- Tandem cold rolling mills
- Reversing cold mills
- Skin-pass mills
- Inline mills
- 20-high cluster mills
- Individual stands

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