



Sensor systems for process optimisation in rolling mills and strip finishing lines

References (extract)



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EINEN SCHRITT VORAUS.



Wieland

For more than 40 years, Micro-Epsilon has been a reliable industrial partner in precision measurement technology for inspection, monitoring and automation. Systems and components from Micro-Epsilon are used in metalworking and the metal processing industry in order to develop more efficient production methods. Applications for these measurement systems cover rolled metal products right through to final product. Micro-Epsilon is a medium sized company that employs around 500 people throughout the world and provides Europe's most comprehensive range of measuring technology for measuring thickness, width, profile and surface - as well as temperature, length and speed - for measuring vibration, impact, gap and many other characteristics. As components, these sensors are often essential integral components applied in many machines, production lines and electrical automation worldwide. But the company is also known for developing custom measurement solutions for process manufacturing lines where end user requirements are often very strict. Solutions are devised in the shortest possible time and customised onsite.

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(Picture: MICRO-EPSILON head office in Ortenburg)



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Measurement technology for non-contact speed measurement





Figure: Operational principle (simplified schematic drawing)

Specifications

Measuring range max. Least averaging time Linearity Operational temperature Protection standard LED $\begin{array}{l} 3,000 \text{ m/min} \\ 0.5 \text{ ms min.} \\ \pm \ 0.05 \ \% \\ 0 \text{ to } 50 \ ^\circ\text{C} \\ \text{IP65} \\ \text{Class 1} \end{array}$

Functional principle



The spatial frequency filter method has been used for more than 40 years or more. Commonly known as the "picket fence effect", the flashing frequency is proportional to the speed of a moving light source behind the "pickets" (see figure). At one time or another, we've all experienced this effect e.g. a passing car in the dark. The recurring light between the fence posts appears as a view frequency for the observer. The frequency of the flickering is a measure of speed. The displacement of the single fence elements defined the frequency scaling. The smaller the displacement of the fence posts, the higher the view frequency if the speed remains constant. The "picket spacing" as a reference determines the accuracy of this measuring physical effect. Only if the displacement is constant, is a harmonic frequency created. If the displacement varies, the view frequency changes too. A constant moving object is obtained with speed variation.In order to copy this physical effect into a measurement unit, a technical grid is required to replace the picket fence. Technologically, these grids can be produced in different ways.

Transmission grids in front of a photo detector or projection grid, for example, in Laser-Doppler units, have been the standard so far. The creation of the "picket fences" as a sensible grid in silicium is the most innovative solution, which is used in sensor batch manufacturing. Mask technology in semiconductor production enables the production of thousands of uniform chips. Many functions can be integrated in this chip simultaneously. The connection of the elements to a differential grid version (picture differential principle) offers further technical advantages. This includes an extremely effective suppression of external light, which avoids affecting the sensor by interfering light. The same applies for surface effects such as colour, gloss and other surface properties, which are compensated to zero due to the fact that neighbouring elements are driven the same way. The connected differential amplifier only outputs the changes that influence the signal. The measuring effect is amplified. Therefore, special benefits are provided on glossy metal surfaces such as stainless steel, aluminium and copper.



Differential principle



ASCOspeed Technical details and applications



Picture: Voestalpine

Processes: rolling, coating, stretching and cutting



The ASCOspeed 5500 is a powerful speed sensor that has been developed specifically for applications in the metal processing industry. The system operates according to the phasing groups method and is therefore a further development of the proven spatial frequency filter technology. Moving material surfaces are measured using the detector's precise grid structure and converted into an electrical frequency, which is proportional to the speed of the object.

The realisation of the "pickets" as a sensitive silicon grid, combined with more than 15 years of practical experience, provide the outstanding features of this new, powerful generation of speed and length measurement systems.

A high-performance LED is used as the light source. The back-scattered light from the passing object surface strikes the detector via a lens, which generates the measurement signal. LEDs are on a par with semiconductor lasers with regard to service life. However, with the Class 1 LED, they clearly represent a reduced potential hazard compared with Laser Doppler Velocimeters (LDV).

The modern signal processing architecture ensures to have an exact monitoring of each speed variation of the material. This is provided by extremely fast hardware that registers, checks and compresses current speed values in microseconds up to maximum material speeds of 3,000 m/min. Only in this way can maximum precision be achieved in acceleration processes.



Block diagram



The sensor also provides a reliable speed signal for minimal averaging and output time of 0.5ms. Conventional mechanical systems can be replaced easily with the ASCOspeed 5500. This unit provides up to 4 scalable impulse output channels that offer the 4 squares signal (A,B. / A,/B; max 500kHz). Therefore the ASCOspeed can be applied as a plug in alternative to rotary shaft encoders. Alarm outputs and switching inputs, as well as optional analogue outputs, complement the periphery for the unit. The synchronised operation provides significant benefits when measuring differential speeds such as for regulating mass flow or skin pass levelling. Using a trigger pulse from the controller, several hardware-controlled measuring process devices can operate in absolute synchronisation and in this way provide precise results in acceleration phases. The Master / Slave operation of two autonomous AS-COspeed 5500 devices now enables the output of the differential speed without using additional PLCs but by using internal calculations in the Master device. The interconnection of several devices in inspection lines simplifies the transmission of speed information. The compact de-

sign combines sensor and electronics in a single robust housing, therefore guaranteeing its use in a diverse range of applications. The device operates autonomously, has low power consumption and so only requires a 24V DC power supply. Internal temperature monitoring enables the integration in the controller of harsh climate applications, which increases operational reliability. Standard interfaces ensure connectivity with automation systems in process lines.



ADVANTAGES

- Easy to use due to non-hazardous LED light source
- Maximum dynamics due to fast adapting hardware
- Flexibility and compactness due to integrated design
- Simple sensor exchange

Speed measurement in rolling mills for thickness control



Picture: Wieland Werke AG



Technical Data

ASCOspeed synchronised version		
2 devices ASP5500-300-A-I-S-D-E		
Measuring distance	300 ±15mm	
Measuring range	up to max. 3000m/min	
Linearity	± 0.05 %	
Repeatability	± 0.03%	
Protection standard	IP67 in stainless steel	
	protective housing	
	with air-purging	
LED	Class 1	

The rolling of flat products is a complex process where compliance with the thickness tolerance is a decisive factor in the quality of the final product.

The increase in raw material prices in recent years has initiated a growing trend for cost optimisation and has also resulted in a drive towards maximising material utilisation. Minimum thickness tolerance limits are critical for this because it means that the strip can be rolled down as close as possible to the minimum thickness.

The task of control rolling strips includes tracking the rolling gap to the infeed thickness in order to achieve a reduced, constant thickness of the output strip in the finished product. There is the transport time of the strip from the strip thickness measurement to the rolling gap must



Picture: Mendritzki



Picture: Wieland Werke AG

ADVANTAGES

- Non-contact and slippage free with no enertia of mass
- Safe light source (Class 1), easy handling
- Robust and not prone to error due to plausibility test
- Hardware synchronized function in connection of 2 or more gauges for mass-flow

be measured and taken into account.

Depending on the manufacturer, rolling mill and customer requirements, different thickness control strategies are used. However, for new installations or upgrades, technical controls according to the mass flow principle are increasingly being used.

According to the law of constant volume in forming, the emerging strip thickness from the incoming strip thickness at the moment of rolling and the infeed and discharge speed can be calculated and therefore suitable correction values for the actuators can be determined. High precision thickness measurement and reliable speed measurement without slippage are prerequisites for achieving this modern control concept.

The ASCOspeed 5500 is a compact device for non-contact speed measurement up to maximum material speeds of 3,000m/min. In the Heavy Duty version, the unit has a solid stainless steel housing and is robust enough to withstand cold rolling mill environments. ASCOspeed synchronisation version is recommended for the detection of target speed in technological control processes for rolling mills.

The ASCOspeed 5500 operates autonomously and only requires a 24V DC power supply. A temperature data logger monitors the thermal load and registers inadmissible deviations even when switched off.

The modern sensor concept facilitates the precise measurement of each change in the material speed. Special signal processing structures register, check and compress current speed values in microseconds. Only in this way can maximum precision be realised for acceleration processes. The sensor also provides a high precision speed signal for minimal averaging and output time of 500μ s and is therefore ideally suited to the control of complex cold rolling lines.

The hardware-driven synchronised operation provides significant benefits when measuring



Picture: SMS Siemag AG

differential speeds such as for regulating mass flow or skin pass levelling. Using a trigger pulse from the controller, several hardware-controlled measuring process devices can operate in absolute synchronisation and in this way provide precise results in acceleration phases.

Due to the use of a new type of LED illumination, the potential risk associated with radiation exposure of popular lasers is minimised.

This exact, non-contact speed measurement meets the requirements for achieving high thickness tolerances and to achieve the required thickness specifications at the beginning of the strip.

Non-contact elongation measurement



Picture: Hydro



Measuring principle: Stretch coefficient measurement with ASCOspeed

Technical Data

ASCOspeed Master-Slave Version		
ASP 5500-300-A-I-M-D-0		
Measurement distance	300 ±15mm	
Linearity	± 0.05%	
Repeatability	± 0.03%	
Protection standard	IP65	
Operational temperature	0 to 50°C	
LED	Class 1	

Today, the production of strips and foils is characterised by increasingly large track widths and line speeds. Applications in the areas of print media, pharmaceuticals, food processing and the aerospace industry place stringent demands on the characteristics of the end product. Therefore, precise and reliable elongation measurement is a critical requirement for compliance with uniform, high precision flatness.

In many technological processes stretching of foils and strips is the only method of achieving exact flatness. What may sound very simple is actually very challenging technology, partly due to the multitude of materials and alloys.

Thickness removal during rolling results in an increase in strip length over the largest part of the width of the strip. The convex shape of the rollers or not completely rolled out thickness tolerances result in different tensions in the strip, which then affect the flatness. These tensions are removed by overstretching the strip from the 'elastic' to the 'plastic' range and an exact flatness is then achieved. Depending on material and alloy, the elongation to be applied are in the 0.1% to 3% range. The stretch coefficient must be measured and regulated in order to guarantee strip quality. Non-contact measurement based on strip speeds is available for this.

The strips are stretched in order to obtain strips and sheets with a high degree of flatness. This continuous stretching is performed according to the input flatness of the cold rolled strips in either one, two or three zones. The stretching is carried out between two large stretching drums that can be regulated for their torque and speed. Strips with slight differences in stretch limit must be regulated in terms of strip tension in order to



Picture: Novelis



Picture: Novelis

precisely maintain the range of the plastic elongation and therefore the stretch limits. On the infeed side, an ASCOspeed 5500 slave unit determines the current strip speed before the stretch zone. The stretched strip is measured for speed by a second ASCOspeed working as a master unit. Due to the slight stretching, the strip is now longer and so runs slightly faster. The speed difference is a measure of the stretching of the strip and therefore also for the elongation ratio. Due to its specific capabilities, the ASCOspeed is available in a Master-Slave Version for measuring stretch coefficients. More than 15 years of practical experience and the use of state-ofthe-art semiconductor technologies mark the outstanding features of the ASCOspeed technology and provide a basis for powerful generation of speed and length measuring devices.

The ASCOspeed 5500 is a powerful speed sensor that is specifically developed for metal processing applications. The system operates according to the phasing groups method and is an advanced development within the proven spatial frequency filter technology. The moving material surfaces are measured by using the precise grid structure of the detector and converted into an electrical frequency, which is proportional to the speed of the target object. The design of this microscopically small grid structure and the use of LED illumination form the basis for universal use on very high gloss or shiny metal surfaces. The ASCOspeed Master-Slave is a pair of two speed measurement systems that interact in order to determine the speed difference between two measuring points. The Master unit obtains the measured value from the slave and evaluates this with its own measurement value in order to determine the speed difference. This can then be transmitted as a finished elongation ratio to the line controller. The sensors operate synchronously for measurements and therefore provide significant benefits. Using a trigger pulse from the Master, both hardware-controlled devices operate in exact synchronisation in their measuring process, providing more precise results in acceleration phases.

Using internal calculations in the Master device, stretch coefficient measurements can be performed completely autonomously and do not require any kind of control unit or additional PLC functions in the line controller.

Taking into account the fact that modern process lines can operate at speeds of up to 400m/ min, for strip widths up to 2,100mm and strip thicknesses from 0.1 to 0.5mm, non-contact measurement offers significant benefits.

ADVANTAGES

- Non-contact measurement prevents any scratches or marks
- Master-Slave function determines stretch coefficient directly and autonomously
- Time or length synchronized computing and monitoring of elongation

Accurate strip speed measurement for slitting lines



Picture: Heinrich Georg Maschinenfabrik



Technical Data

ASCOspeed Interface version		
2 devices ASP5500-300-A-I-O-O-0		
Measurement distance	300 ±15mm	
Linearity	± 0.05%	
Repeatability	± 0.03%	
Protection standard	IP65	
Operational temperature	0 to 50°C	
LED	Class 1	

Slitting lines for splitting strip material are used in the adjustment of almost all materials. The most important criteria are edge quality after the cutting and the winding result, with the objective being an accurate winding pattern for as large as possible finished coil diameters. This requires exact measurement of the current strip speed. The focus now for the splitting of strips is on the increasingly strict tolerance requirements of the final product with respect to width and angle of the cut. The processing of thin strips or soft alloys is particularly challenging. Modern slitting lines of thin tickness strips achieve operating line speeds in excess of 1800 m/min. However, this is only possible by using modern drive regulation and measuring technology.

Due to its non-contact operational method and powerful interface options, the ASCOspeed is the preferred choice as the speed master unit in continuous strip production. This device measures without contact from a distance of up to 300mm and is therefore not too close to the strip surface. This is very important in terms of service life and maintenance. It is also not too far away so that a suitable mounting point in the line can be easily found and so a time-consuming measuring path or traverse is not necessary. The device can easily be protected against strip cracks rears by the surrounding mechanics.

Non-contact also means without delay – therefore the advantages compared with an incremental, mechanical measurement using deflection rollers, which always slip depending on the mass or wrapping round, is already catered for.



Picture: Micro-Epsilon



Picture: Hydro

This is particularly evident in driven rollers, which have their own drive, as is also the case with flatness measuring rolls.

It is also beneficial that strip thickness or height fluctuations of up to 30mm are tolerated and do not influence the specified measurement accuracy.

In conventional use, the ASCOspeed can replace up to four various rotary encoder wheels. As a speed master unit, the device can equally provide signals for the cutting line and those for material tracking, and at the same time can also control an inkjet printer for printing the material characteristics with the required pulse rate. Typically, signals are provided on four channels (A, B, /A, /B) for this. The pulse rate can be freely scaled up to a maximum pulse frequency of 500kHz. Corresponding line drivers can provide HTL signals with an external power supply and enable galvanic isolation and therefore disturbance-free operation. If necessary, the AS- COspeed can also provide a separate winding calculator with the required pulses. The exact advancement of the rotating knife is responsible for cut edge quality and the life time of the knife. Precise, direct measurements of strip speed are required for this.

An interesting solution is the operation of two devices for gully control. The current length of the loop in the gully is deduced from the difference between infeeding and discharging strip length. This type of measurement often has advantages over direct loop measurement using laser distance sensors, because the laser measurements quickly become a problem due to vibrations of the coil loops.

Processing soft strips is particularly challenging as the strips must be wound with as little tension as possible, which is achieved by using corresponding brake mill. For this, ASCOspeed provides exact strip speed measurements.

ADVANTAGES

- Non-contact measurement prevents any scratches or marks
- Extremely narrow measuring track suitable for every type of split strip
- Great flexibility due to freely scalable pulse output

High precision length detection for surface inspection



Picture: Hydro

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Technical Data

AASCOspeed Interface version		
1 unit ASP 5500-300-A-I-O-O-O		
Measurement distance	300 ±15mm	
Linearity	± 0.05%	
Repeatability	± 0.03%	
Protection standard	IP65	
Operational temperature	0 to 50°C	
LED	Class 1	

Dimensions ASCOspeed

Surface inspection in strip processing

Solutions for surface inspection support manufacturers in the monitoring and control of the production process, larger strip quantities and the company's success. During the production process the surface quality of strip material is determined by using numerous parameters. In order to achieve the best possible result, it is vital to enable permanent monitoring and control of the production process. The information obtained can be used in three different ways: to optimise a process stage; for feedback to the supplier (if necessary an internal process); and for the transmission of information for subsequent downstream processes. Examples of process control include warning signals for edge cracks or holes on the tension leveller, cutting optimisation or process analysis. Due to early defect detection and analysis, material scrap or waste disposal can be avoided in later processing stages. As a result, production time and material costs are reduced.

Exact length material tracking

ASCOspeed technology complements surface inspection systems currently available on the market. The technology continuously detects length and allocates each meter to the surface inspection results.

ASCOspeed is far beyond a normal noncontact optical length detector. The device measures without contact from a distance of 300mm and is therefore not too close to the strip. Non-contact also means without delay – therefore providing advantages compared with incremental, mechanical measurement methods, which use guiding rolls with encoders or measurement encoder wheels that slip depending on the mass or wrap round.

Applied to surface detection, ASCOspeed supplies length information via signal impulses. The pulse rate can be freely scaled up to a maximum pulse frequency of 500kHz, simplifying integration to surface inspection systems. Due to the narrow-banded light source of the ASCOspeed, any effects on the optical surface inspection system are avoided. Furthermore, the optimised beam characteristics of ASCOspeed, combined with a mulitchannel plausibility analysis, enables a robust, error-free speed measurement.

ADVANTAGES

- Non-contact and non-contact function
- Safe LED light source (Class 1)
- Low maintenance function that is independent of the system
- Surface independent and not prone to errors due to plausibility test

Therefore, a smooth operation of the system that is not prone to surface errors in the case of different surfaces such as painted or reflecting strips.

Due to the ASCOspeed 5500, surface inspection is independent from system signals. Strip length can be detected reliably and is characterised by a virtually maintenance-free service.

ASCOspeed offers technological benefits

Speed is recorded in digital form within the unit and can also be used for process control. Therefore, the device provides corresponding inputs and outputs that can, for example, provide an alarm output. Similar to surface inspection systems, ASCOspeed can be universally applied in the overall process procedure such as in rolling mills, coating or finishing lines. However, the ASCOspeed series is an overall solution that only differs in its function but not in its metrological characteristics. Consequently, all units of the ASCOspeed 5500 series are designed for maximum line speeds of 3,000m/min.

The units are factory calibrated and so can be installed quickly and easily. In particular, large companies such as Hydro Aluminium, which has subsidiaries all over the world, appreciate the advantages of the ASCOspeed technology. The company applies the technology on very different lines. Micro-Epsilon has equipped all ASCOspeed units with multi-level memory that enables units to be replaced quickly and easily. The operator simply enters the number that is allocated to the setup page of the unit. Subsequently, the setup can be activated.

One application is in the production of beverage cans, which are subsequently processed extensively by the manufacturer. The base material is rolled aluminium strip with thicknesses between 0.18mm and 1.5mm. These rolled aluminium strips are coated on both sides in a state-of-the-art strip painting line. Production speeds of up to 350m/min and paint layer thicknesses of 4μ m to 16μ m, not only require high precision measurements but also extensive, accurate quality assurance. Exact length allocation and tracking are critical for manual follow-up inspection. For this reason, automatic cutting of defective points is also possible.

The more exact the length measurement provided, the more accurate the section/ off-cuts. A non-contact measurement with repeatability of 0.03% reduces the required time for detecting the error compared to 1% for a mechanical solution at a coil length of e.g. 3,000m from 30m to 0.9m.

Automatic surface inspection is vital in order to guarantee and track product quality in strip processing and finishing.



Picture: Hydro

Flexible strip thickness and profile measurement



Picture: BBV



Measurement accuracy from $\pm 10 \mu m$ Gap depthup to 500mmGap widthup to 420mm

MTS 8202.LLT laser line triangulation

thicknessCONTROL MTS 8202

The modular designed C-frame based systems of the MTS8202 family are renowned for their flexibility and high performance in the metalworking industry. Applying these in strip-processing-lines provides reliable, high precision measurements, therefore creating a basis for controlling the production process and eventually the quality achieved.

Precise

The system measures differentially i.e. an application-specific displacement sensor is integrated in the upper and lower flange of the C-frame. The thickness of the target material is calculated from the displacement measurements of the upper- and lower sensor. A combination of high efficiency signal processing algorithms, analyses and visualisation software, ensures sub-micrometre accuracies.

Robust High sp

High speed and fully automatic calibration ensures the measurement is independent of temperature influences, which means the system can be applied in harsh industrial environments, characterised by providing fixed, inline precision. All sensor technologies applied provide noncontact, wear-free measurements without using isotopes or X-rays. This process provides long term, reliable measurements that are independent of alloy type while avoiding unnecessary costs.

Unique

Supported by various physical measurement technologies, thicknessCONTROL MTS8202 offers a unique range of application solutions with regard to profile thickness measurements in the metal processing industry.





Data acquisition is performed via an industrial PC or a compact universal controller (pictured).



SYSTEM INTEGRATION:

In order to ensure complete width measurements of the target, the C-frame can be used as a traversing thickness measurement system on an integrated linear axis. The control and analysis software provides all the required functions to record and evaluate production quality without any process downtime or stoppages. Various interfaces provide excellent integration to the process line, enabling communication with production control systems.

SPECIAL FEATURES:

- No consequential costs due to isotopes or X-rays
- Correct measurement despite material tilting and undulations
- Independent of type of surface and alloys
- Various sensor technologies offer a unique range of application solutions.
 - Laser triangulation point or line
 - Capacitive
 - Confocal
- Integrated system for inspection equipment control
- Detection and communication of measurement interferences due to soiling
- Multiple measurement points available on one industrial PC











MTS 8202.T Laser triangulation

MTS 8202.LLT Laser line triangulation MTS 8202.K Confocal

Due to the diverse range of measurement technologies, the ideal system can be devised for each application. In doing so, large free gaps, various material thicknesses and surfaces can be measured easily.

Capacitive

Thickness and width measurement for strip processing lines

Technical Data Material thickness to 200mm

Outlet opening to 600mm Measurement accuracy better + 5μ m Integrated coil-length measurement Optional: Integrated width measurement



Picture: Flender



The calibration target moves out automatically during the coil change, which enables almost uninterrupted operation. Fully automatic calibration is performed within just a few seconds.

Thickness and width of steel strips

The measuring system for continuous strip processes i.e. in steel-service-centres has been developed in order to document strip thickness, width and length. The particular challenge is in the application area directly after the cutter spindle. Here, the thickness trend over the length and the thickness profile over the strip-width is measured contactless and for every strip.

System design

The inspection system is designed as a stable O-frame structure and has a traversing apparatus with upper and lower flange, which are mechanically coupled to each other. Specially developed laser sensors that measure the metal strip are mounted on both flanges. The upper sensor has a tracking function and is positioned accordingly for different material thicknesses. The traversing sensors are installed opposite one another in order to determine the thickness profile using the differential method. The exact strip thickness can be determined from the known distance between both sensors and the measured distances to the surface of the strip. The non-contact measurements are performed a safe distance away from the strip and measurements are completely wear-free. The special feature of the sensors is the small laser line that

compensates for possible irregularities in the reflection behaviour of the metal strip.

The system therefore provides extremely stable measurements. Temperature fluctuations in the process line present a further challenge for high precision measuring systems and so regular calibration is required. The system is able to recalibrate itself completely automatically. A master target moves in during the coil change, which initiates the automatic calibration routine.

Additional the system uses the ASCOspeed for determining the exact process-speed and the length-allocation of the thickness-measurements. This non-contact sensor achieving a extremely precise measurement without scratches and slipping like a rotary encoder wheel. Furthermore, the ASCOspeed can be used as a Master for synchronising the strip speed with the cutter spindles in slitting- or trimming-lines.



Operation and process visualisation is performed using the extensive software provided.



ASCOspeed speed and length sensor for logging the length and for synchronisation with the cutter spindle.

SYSTEM INTEGRATION:

For different fields of application, corresponding tools for process visualisation and documentation are provided for plant operators. Various interfaces that enable excellent integration to the process line are available to communicate with production control systems.

SPECIAL FEATURES:

- Costs of isotopes or X-rays is eliminated.

- Various physical sensor technologies offer a unique range of application solutions.
 - Laser triangulation point or line
 - Capacitive
 - Confocal



Laser line triangulation

MTS 8201.11T



MTS 8201.T Laser triangulation



MTS 8201.C Capacitive

Hot rolling application of thickness and profile measurement



Picture: AluNorf



Technical Data Material temperature Material width Material thickness

max. 600 deg C max. 6,000mm max. 300mm

Profile measurement of metal tracks

Track thickness and thickness profile are critical measured values for controlling deviation in rolling mills for metal processing and machining. For this, measurements of profile and thickness are required in different process stages, which are distinguished by different general conditions. Harsh requirements in rolling mills require maximum performance from the process measuring technology. Target temperatures of up to 600 deg C, temperature fluctuations, dirt, vibrations and high processing speeds, impose the strictest requirements on measurement systems.

The profile measuring system for aluminium plates measures metal tracks up to 6m wide. The measurement is only performed on the metal surfaces so that different strengths or alloys have no influence on measurement performance. As the measurement of profile data only takes 4 seconds, no process downtime is incurred.

The measurement unit, which operates using non-contact capacitive sensors, is based on a closed O-frame that provides maximum rigidity. This unit can be seamlessly integrated to the existing roller track.

Above and below the plate is a capacitive sensor, one of these moves perpendicular to the plate, the other moves synchronously in the opposite direction to the direction of travel during the measurement. By traversing the sensors, a profile of the complete width of the plate can be calculated from the local thickness signals. In addition, as well as the upper capacitive sensor, a laser sensor can be integrated in the sensor arm in order to determine the width of the plate during motion. Acquired data is also used to control upstream or downstream processes. If the system is integrated in the hot rolling area, for example, a special temperature compensation unit provides constant, highly repeatable measurement results. In doing so, material elongations, which sometimes occur due to temperature fluctuations, can be compensated for. The system must be adapted in a simple way to the different requirements of the steel or aluminium industries.

ADVANTAGES

- Measurement of profile and width
- Can be used on all metals
- Emission-free measuring principle
- No consumable materials
- Low maintenance
- Can also be used in the hot rolling process

AVAILABLE VERSIONS

- Profile monitoring of aluminium plates
- Thickness and profile monitoring of steel tracks
- Thickness and profile monitoring of special metals





Thickness measurements are performed using capacitive sensors: the traversing measurement arm moves over the measuring section, providing constant, stable measurements without touching the target object. Another important benefit: no emission protection regulations need to be complied with, as is the case when using isotopic methods.

Micro-Epsilon customer solutions in metal industry

For more than 40 years, Micro-Epsilon has been a reliable industrial partner in precision measurement technology for inspection, monitoring and automation. Systems and components from Micro-Epsilon are used in metalworking and metal processing in order to develop more efficient production methods. Applications of these measurement systems range from rolled metal products through to finished product. Micro-Epsilon is a medium sized company with around 500 employees throughout the world. The company provides the most comprehensive range of measuring technologies for measuring thickness, width, profile and surface in Europe - as well as temperature, length and speed, for measuring vibration, impact, gaps and many other geometrical features. As components, these measurement sensors are often critical, integral parts of process lines or machines developed and installed by systems integrators and electrical equipment suppliers throughout the world. However, although, Micro-Epsilon specialises in measurement technology, the company is also well regarded for developing unique, custom measurement solutions for process lines, where system requirements are often very strict. Solutions are devised in the shortest possible time and matched onsite.



Flatness measurement in rolling mills

There is a steady increase in the surface quality requirements of rolled blank sheets, whether these are used in the latest stainless steel topped kitchens or aluminium sheets used in automotive interiors. Due to the enormous tensile forces when rolling the sheet, there is a risk that the tensile distribution will vary over the width of the sheet and that the sheet will therefore distort in a wave shape at the edges. Siemens has developed a technology that pneumatically excites the sheet to vibrate. The amplitude of the vibration is acquired using non-contact displacement sensors from Micro-Epsilon Messtechnik and from this, the tensile stress is calculated transversely over the width of the sheet. A significant advantage of this measurement technology is that the surface is not damaged in any way.



High precision measurement of strip diameters in rewinding machines In rewinding machines for metal strips, sing-

le metal rings or complete coils are produced. These metal rings or complete coils are produced. These metal rings are assembled coil by coil in order to supply a coil with a continuous strip coating. In order to detect the end of the ring, optoNCDT ILR laser distance sensors are applied. The model used allows distances of up to 150m to be detected and so is often used for the position measurement of coils, cranes and diameter detection.



Detection of blade position on edge trimmers

In the production of metal strip, trimming of strip edges is often required. If the width of the metal strip needs to be changed, new target data is specified for controlling the machine. The flexible blades used therefore move automatically to the new target width. As errors can often occur, up to now, the actual width has also been inspected manually. As the operator must interrupt the process, this procedure is inaccurate and high risk. The company AIM (American Industrial Metrology) located in Ohio uses laser sensors from Micro-Epsilon in order to detect the width of metal strips. The solution at AIM consists of a target being applied to the drives of the blades to which the laser sensor measures. For this the long range optoNCDT 1700 sensor with 500mm measuring range is used. The distance of the target to the blades, as well as the distance of the two laser sensors, is measured. In the differential method, the current cutting width is measured. The measurement results and the target data are output and displayed. After this, the operator is able to manually re-adjust the

Quality control on pipes

Large jet pipes are used to transport liquid waste, water, oil or gas. Therefore, companies have to ensure that weld seams are absolutely leak tight during the production of these pipes. The raw material is joined into a single pipeline by spiral welding. For this process sheet tracks are positioned manually. Difficulties associated with this method is how to precisely adjust the pipes. The positioning of the pipes can be performed automatically by using a scanCONTROL 2710 laser scanner. The calculated profile measurement data is used directly in positioning the pipes. machine controls or the data can be used for automatic machine control adjustments. The application of optoNCDT 1700 sensors enable fully automatic control of the process. The sensors are positioned at the appropriate distance from the target so as to avoid any risk of collision if an error occurs.







High performance sensors made by Micro-Epsilon



Sensors and systems for displacement and position



Sensors and measurement devices for non-contact temperature measurement



Measurement and inspection systems for quality assurance



Optical micrometers and optical fibers



2D/3D profile sensors (laser scanner)



Color recognition sensors and LED analyzers



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