MICRO-EPSILON

Measuring and inspection systems for the metallurgical industry

Measuring and inspection systems for the metallurgical industry

Micro-Epsilon measurement technology in use (extract)

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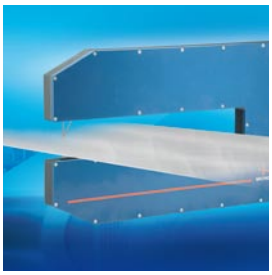
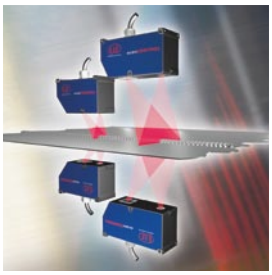
Micro-Epsilon sensors for flatness measurement in rolling mills (photo: Siemens)

Micro-Epsilon has been a reliable industrial partner for more than 40 years for precision measurement technology for inspection, monitoring and automation. Systems and components from Micro-Epsilon are used in the metallurgical industry and metal-working in order to develop efficient production. The application range of the measurement systems covers rolled products up to the final product.

The medium size company employs approx. 500 people throughout the world and provides Europe's most comprehensive range of measuring technology for measuring thickness, width, profile and surface – however also temperature, length and speed, for measuring vibration, impact, gap and many other factors. As components, they are often indispensable integral parts in the products of many machine and line constructors and electrical equipment suppliers world wide.

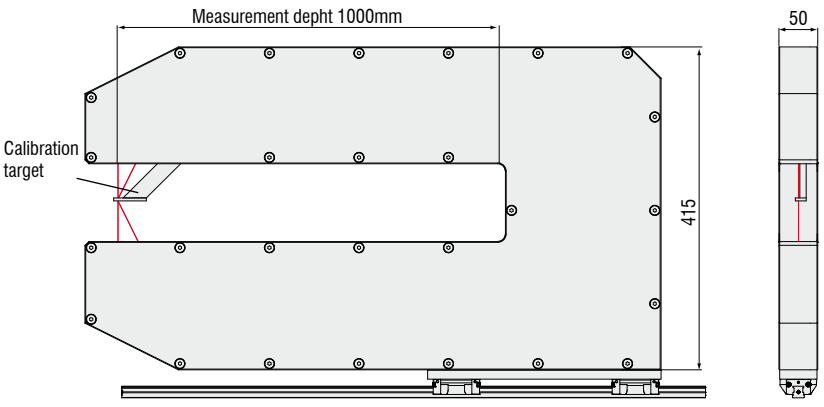
But the company, specialising as it does in measurement technology, is also known for unconventional solutions where requirements are strict in the area of process lines. Solutions are devised in the shortest time and matched onsite.





Flexible strip thickness and profile measurement

Photo: Micro-Epsilon



Technical Data

Measurement depth	max. 1000mm
Measuring rate	max. 20kHz
Clamp width	50mm

Strip thickness and profile of sheet strips

The C-clamp system has been specially developed for the thickness measurement of sheet strips in the metalworking sector. With a width of only 50mm, the clamp can be well integrated into existing production lines.

Two new types of laser sensors are mounted opposite each other on one axis on the micrometer which measure the distance to the strip surface from two sides. The exact sheet thickness is calculated from the two distance signals. This non-contact and wear-free process provides long-term reliable measured data. The acquired data are included for regulation of the production process or for quality control. A master part moves in the measuring gap automatically during the coil change and thus compensates the system for new measurements for the calibration of the C-clamp. The time-consuming manual calibration procedure as is the case for conventional systems is thus not required.

Special features

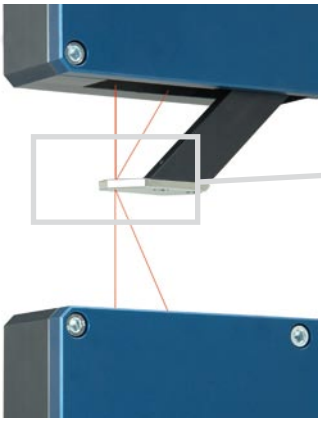
The particularly stable design makes possible a measurement depth of max. 1000mm to the sheet edge. If a variable measuring track should be measured, the system can be easily mounted on a mechanical carriage and thus be positioned at the required place. Due to the difference method for the thickness measurement, the sheet can also move vertically within the measuring gap without falsifying the measurement results. Several C-clamps can be operated with only one terminal for multiple track measurements.

optoNCDT series laser sensors specially developed by Micro-Epsilon provide reliable and stable measurements on the metal strip. In contrast to conventional laser sensors, these sensors operate with one small laser line which optically compensates for the irregularities of the surface and therefore provide extremely precise results. A version with a measuring rate of 20kHz is available for particularly fast processes.

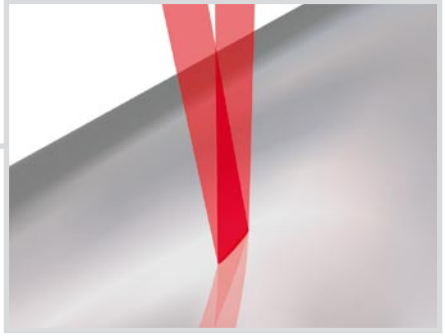
Data acquisition, display and archiving of one or several measuring tracks with only one compact industrial PC

SYSTEM BENEFITS

- Clamp width only 50mm
- Compensation for different surface reflections
- Horizontal positioning of the C-clamp
- Automatic calibration < 3 seconds provides long-term stability
- Control of several measuring points with only one terminal
- Industrial PC for the data acquisition, display and archiving



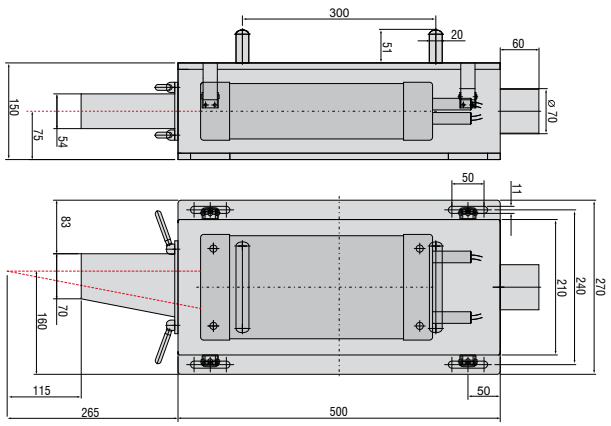
The calibration target moves out automatically during the coil change and thus facilitates practically uninterrupted operation: the automatic calibration only needs 3 seconds.



The small laser line compensates for irregularities of the surface quality and therefore provides extremely precise measurement results.

Speed measurement in rolling mills for thickness control

Photo: SMS Demag AG



ASCOspeed in stainless steel protective case

Technical Data

ASCOspeed synchronised version
2 devices ASP5500-300-A-I-S-D-E

Measurement distance	300 ± 15mm
Measuring range	up to max. 3000m/min
Linearity	± 0.05 %
Reproducibility	± 0,03%
Use	IP 67 in stainless steel protective case
LED	Class 1

ASCOspeed as speed sensor for technical controls in rolling mills

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

The increase in raw material prices in recent years has initiated a strong trend for costs optimisation and resulted in maximum possible material utilisation.

Strict thickness tolerances are the highest importance for this because in this way the strip can be rolled down as close as possible to the minimum thickness.

The task of the regulation of rolling strips is to track the rolling gap to the infeed thickness in order to achieve a reduced, constant output strip thickness in the product. Thereby, the transport time of the strip from the strip thickness measurement to the rolling gap must be measured and taken into account.

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

Photo: Wieland Werke AG

SYSTEM BENEFITS

- Non-contact and no delay function
- Safe LED light source (Light Class 1)
- Robust and not prone to errors due to plausibility test
- Hardware synchronisation function of several devices

According to the law of constant volume in the 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 thus suitable correction values for the actuators can be determined.

High precision thickness measurement and reliable speed measurement without slippage are the prerequisites for the realisation of this modern control concept.

The synchronised version of the ASCOspeed 5500 speed sensor is ideally suitable for the measurement of the actual speed in technical rolling mill controls. The ASCOspeed 5500 is a compact device for non-contact speed measurement up to maximum material speeds of 3000 m/min. In the Heavy Duty version, the unit has a solid stainless steel case, robust enough to withstand use in cold rolling mills.

The ASCOspeed 5500 operates autonomously and only needs a 24 VDC 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 the current speed values in the microseconds range. It is only in this way that maximum precision can be realised for acceleration processes. The sensor also provides a high precision speed signal for the minimal averaging and output time of 500μs and is thus ideally suitable for use in the control of complex cold rolling lines.

The hardware-driven synchronised operation provides significant benefits for the measurement of differential speeds such as for regulating mass flow or skin pass level. Using a trigger pulse from the controller, several hardware-controlled measuring process devices can operate absolutely synchronised and in this way provide precise results in acceleration phases.

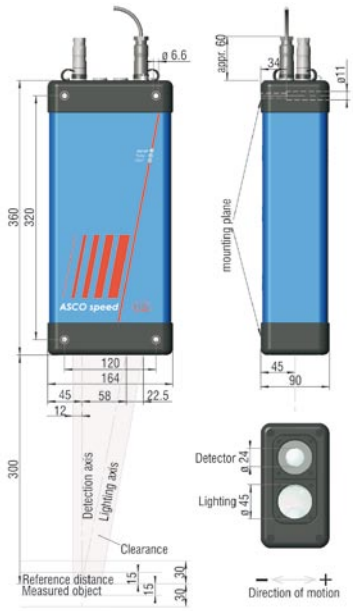
Photo: SMS Demag AG

Due to the use of a new type of LED illumination, the potential danger with respect to radiation exposure of well known lasers has been clearly minimised.

The exact and non-contact speed measurement provides the requirements for the regulation to achieve the high thickness tolerance requirements and the requirement to already achieve the thickness specifications at the start of the strip.

Exact strip speed measurement for cutting lines

Photo: Heinrich Georg Maschinenfabrik



Dimensions ASCOspeed

Technical Data

ASCOspeed Interface version
2 devices ASP5500-300-A-I-O-O-O

Measurement distance	300 ± 15mm
Linearity	± 0,05 %
Reproducibility	± 0,03%
Use	IP 65, 0 to 50°C
LED	Class 1

Cut to length shears for splitting strip material are used in the adjustment for practically all materials. The most important criteria are the edge quality after the cutting and the winding result with an accurate winding pattern for as large as possible finished coil diameters. This requires exact measurement of the current strip speed.
The focus for the splitting of strips is the requirement for stricter and stricter tolerances of the final product with respect to width and cut angle. The processing of thin strips or soft alloys is particularly challenging. Modern cutting lines achieve operating speeds in the thin strip range of 1000m/min and more. However, this is only possible with modern drive regulation and measuring technology.
Due to its non-contacting way of working and powerful interface option, the ASCOspeed is preferred for use as speed master in strip lines. The device measures without contact from a distance of 300mm and is thus not too close to the belt. This is very important for service life and service. It is also not too far away so that a suitable mounting point in the line can be found and a time-consuming measuring traverse is not necessary. The device can thus easily be protected against belt rears by the surrounding mechanics.
Non-contact also means without delay – thus the advantage as compared with an incremental, mechanical measurement using deflection rollers which always slip depending on mass or wrapping round is already catered for. This is particularly evident for so-called driven rollers which have their own drive as is also the case for flatness measuring rollers.

Photo: Micro-Epsilon

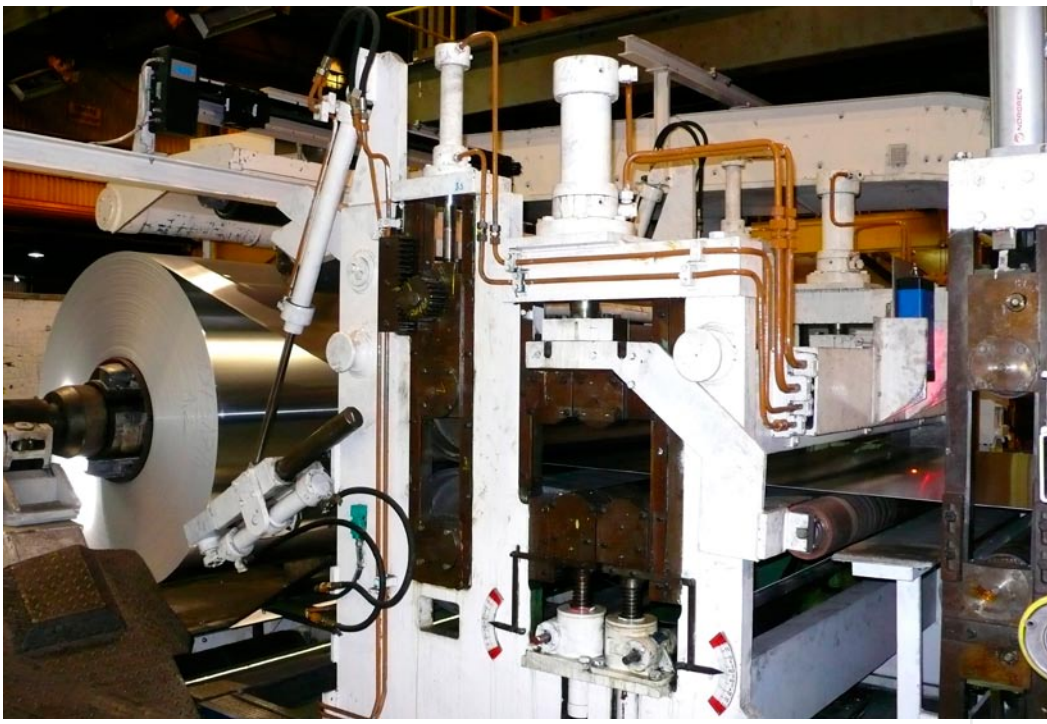


Photo: Hydro

It is also beneficial that strip thickness or height fluctuations of up to 30mm are tolerated and remain without influence in the context of the specified measurement accuracy.
In conventional use, the ASCOspeed can replace up to 4 speed sensors. As speed master, the device can thus equally provide the signals for the cutting line and those for the material tracking and at the same time control an inkjet printer for printing the material characteristics with the required pulse rate. The typical 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 make possible galvanically isolated and thus interference-free operation. If necessary, the ASCOspeed can therefore also provide a separate winding calculator with the necessary pulses. The exact advancement of the cutter spindle is responsible for cut edge quality and knife service lives. Precise and direct measurement of the strip speed are the requirements for this.

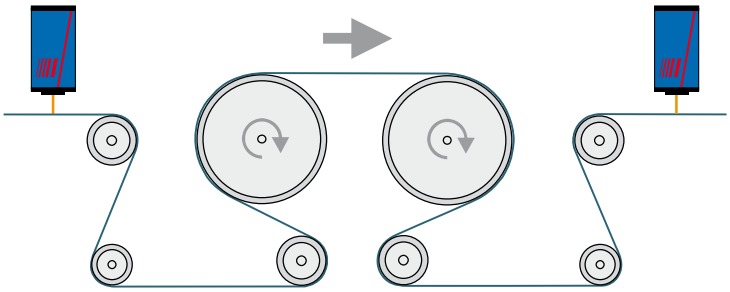
An interesting solution is the operation of 2 devices for gully control. The current length of the loop in the gully is produced from the difference between infeeding and discharging strip length. This type of measurement often has the advantage over direct loop measurement using laser distance sensors because the laser measurements quickly become a problem due to the 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 realised by corresponding brake modules. ASCOspeed provides the exact strip speed for this.

SYSTEM BENEFITS

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

Non-contact stretch coefficient measurement

Photo: Hydro



Principle: Stretch coefficient measurement with ASCOspeed

Technical Data

ASCOspeed Master-Slave Version
ASP 5500-300-A-I-M-D-O

Measurement distance	300 ±15mm
Linearity:	± 0,05 %
Reproducibility	± 0,03%
Use	IP 65, 0 to 50°C
LED	Class 1

ASCOspeed solves stretch coefficient tasks

The production of strips and foils today is marked by larger and larger track widths and line speeds. Applications in the areas of print media, pharmaceuticals and foodstuffs industry to aerospace make exacting demands on the characteristics of the end product. Therefore, precise and reliable stretch coefficient measurement is an indispensable requirement for compliance with a uniform, exact flatness.

Stretching foils and strips is the only possibility in many technological processes to achieve an exact flatness. What sounds so simple is a challenging technology due to the multitude of materials and alloys.

The thickness removal during rolling results in a length increase of the strip over the largest part of the width of the strip. The convexity 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 into the plastic range and an exact flatness is achieved. Depending on material and alloy, the stretch coefficients to be complied with are in the range from 0.1 to 3 percent. The stretch coefficient must be measured and regulated in order to guarantee the 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 high flatness. The continuous stretching is performed according to the input flatness of the cold rolled strips optionally in one, two or three zones. The stretching is performed between 2 large stretching drums which can be regulated for their torque and speed. Strips with slight stretch limit differences must be regulated in the strip tensions in order to exactly maintain the range of the plastic elongation and thus the stretch limits. On the infeed side, an ASCOspeed 5500 as slave determines the current strip speed before the stretch zone. The stretched strip is measured for speed by a second ASCOspeed, the master. Due to the slight stretching, the strip is now longer and thus also runs slightly faster. The speed difference is a measure for the stretching of the strip and thus also for the stretch coefficient.

Due to its particular capability, the ASCOspeed is available in the Master-Slave Version for the stretch coefficient measurement. More than 15 years of practical experience and the use of state-of-the-art semiconductor technologies mark the outstanding features of the ASCOspeed technology and are the basis for a powerful generation of speed and length measuring devices.

The ASCOspeed 5500 is a powerful speed sensor which has been specially developed for the applications in the metal sector. It operates according to the phasing groups method and is therefore a further development within the proven spatial frequency filter technology. The moved material surfaces are measured by means of the precise grid structure of the detector and converted into an electrical frequency which is proportional to the speed of the object. The design of this grid as a microscopically small structure and the use of an LED as illumination form the basis for universal applicability and also on very high glossy or shiny metal surfaces.

The ASCOspeed Master-Slave is a pair of 2 speed measurement systems which interact to determine the speed difference between 2 measuring points. The Master unit fetches the measured value from the slave and evaluates it with its own into a speed difference. This can then already be transmitted as finished stretch coefficient to the controller of the line.

The sensors operate synchronously for the measurement and thus provide significant benefits. Using a trigger pulse from the Master, both hardware-controlled devices operate exactly synchronised in their measuring process and in this way provide more precise results in acceleration phases.

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

If it is taken into account that modern lines can achieve process speeds of up to 400m/min here for strip widths up to 2100 mm and strip thicknesses from 0.1 to 0.5mm, then non-contact measurement is very beneficial.

SYSTEM BENEFITS

- Non-contact measurement prevents any scratches and marks
- Master-Slave function determines stretch coefficient directly and autonomously
- Strip length synchronised functionality

Thickness and width measurement for strip lines and Service Centre

Photo: Heinrich Georg Maschinenfabrik

The calibration target moves out automatically during the coil change and facilitates practically uninterrupted operation. The completely automatic calibration is performed within a few seconds.

Technical Data

Steel strip width	up to 4000mm
Number of strips	any
Strip width	any
Traversing width	up to 4200mm
Traversing time	approx. 4s (one way)
Strip thickness	up to 15mm

Mechanics dimensions:

Length	approx. 2000 to 5000mm
Width	approx. 600mm
Height	approx. 1200mm

Thickness and width of steel strips

The measuring system for strip lines and Service Centre has been developed in order to document the strip thickness and width. The particular challenge is in the application area directly after the cut to length shear. Thereby, the thickness trend over the length and the thickness across the track width are measured without contact and in one measurement pass. The system can be expanded with a speed and length sensor for exact speed and length measurement.

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 with each other. Specially developed laser sensors which measure the metal strip are mounted on both flanges. The upper sensor has a tracking function and is positioned accordingly for different material thicknesses.

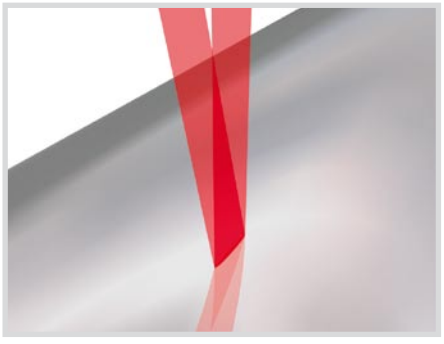
The traversing sensors are installed opposite each other and determine the thickness profile using the difference method. The exact strip thickness can be determined from the known distance of both sensors from one another and the measured distances to the strip surface.

The non-contact measurement is performed from a safe distance to the strip and is absolutely wear-free. The special feature of the sensors used is the small laser line which compensates for possible irregularities in the reflection behaviour of the metal strip. The system thus provides extremely stable data.

Temperature fluctuations in the process line present a further challenge for the precise measuring system and require regular calibrations. The system is able to perform the recalibration completely automatically. Thereby, a master target moves in during the coil change and initiates the automatic calibration routine.

The system can be expanded by an ASCOspeed speed and length sensor for the exact determination of the strip length. The non-contact sensor is used for the exact logging of the strip length and achieves extremely precise measurement results in contrast to a roller sensor. Furthermore, the ASCOspeed can be used as Master for the synchronisation of the strip speed with the cutter spindles on the cut to length shears.

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



The small laser line compensates for irregularities of the surface quality and therefore provides extremely precise measurement results.

SYSTEM BENEFITS

- Measurement of the thickness and width profiles
- Length and speed measurement as master signal for the synchronisation of the strip speed with the cutter spindle on the cut to length shear
- Completely non-contacting and wear-free measurement (emission-free)
- Automatic calibration for recalibration without shutdown

Profile and thickness measurement on aluminium plates

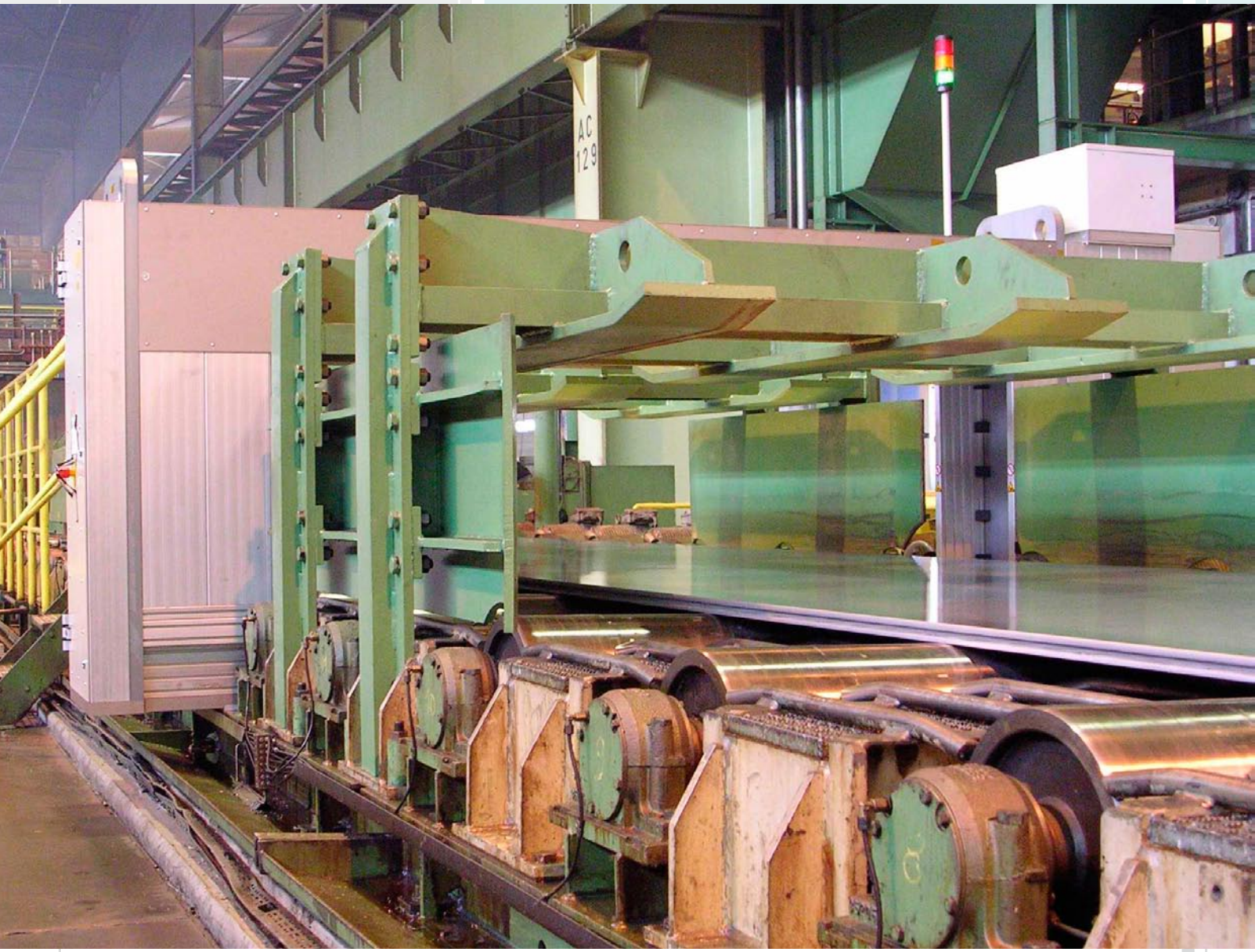
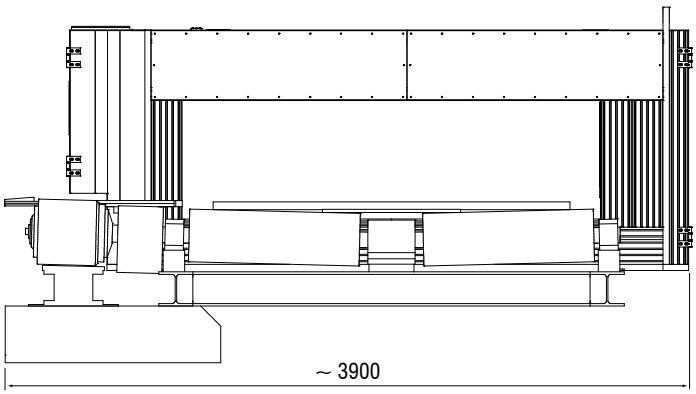


Photo: AluNorf



Technical Data

Max. measuring object size	4m x 50mm
Max. plate temperature	530°C
Resolution	Width: ±50µm
	Thickness: ±3µm
Max. height clearance	700mm
Measuring cycle	< 4sec

Profile measurement of metal tracks

The track thickness and the thickness profile are decisive measured values for the deviation control in the rolling mill for metal production and machining. Thereby, the measurement of profile and thickness is 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 550°C, temperature fluctuations, dirt, vibrations and fast processing speeds impose the highest requirements on measurement units and systems.

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

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

Above and below the plate, one capacitive sensor in each case traverses perpendicularly to the plate and 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, which determines the width of the plate during motion.

The acquired data are also used for controlling upstream or downstream processes.

If the system is integrated in the hot rolling area, a special temperature compensation unit provides constant and exactly repeatable measurement results. In doing so, material elongations which are produced due to temperature fluctuations are reliably compensated for.

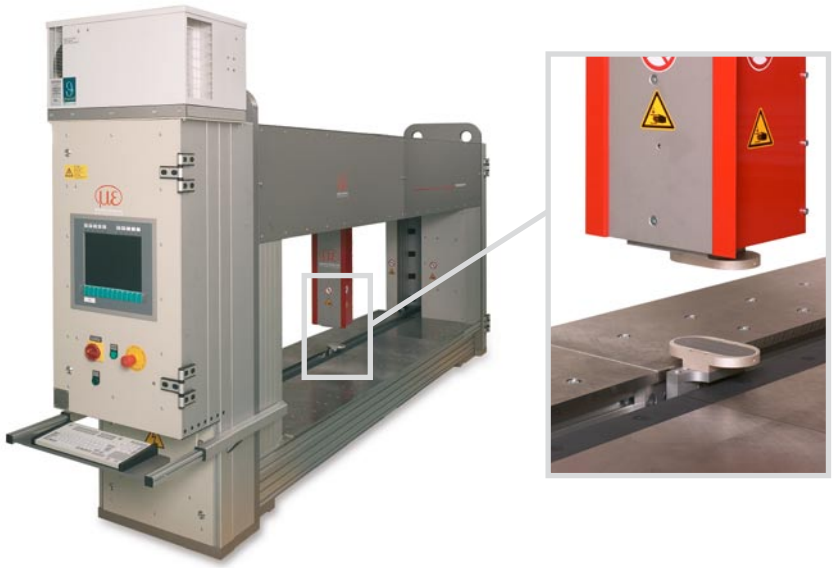
The system must be adapted in a simple way to the different requirements of the steel or aluminium industry.

SYSTEM BENEFITS

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

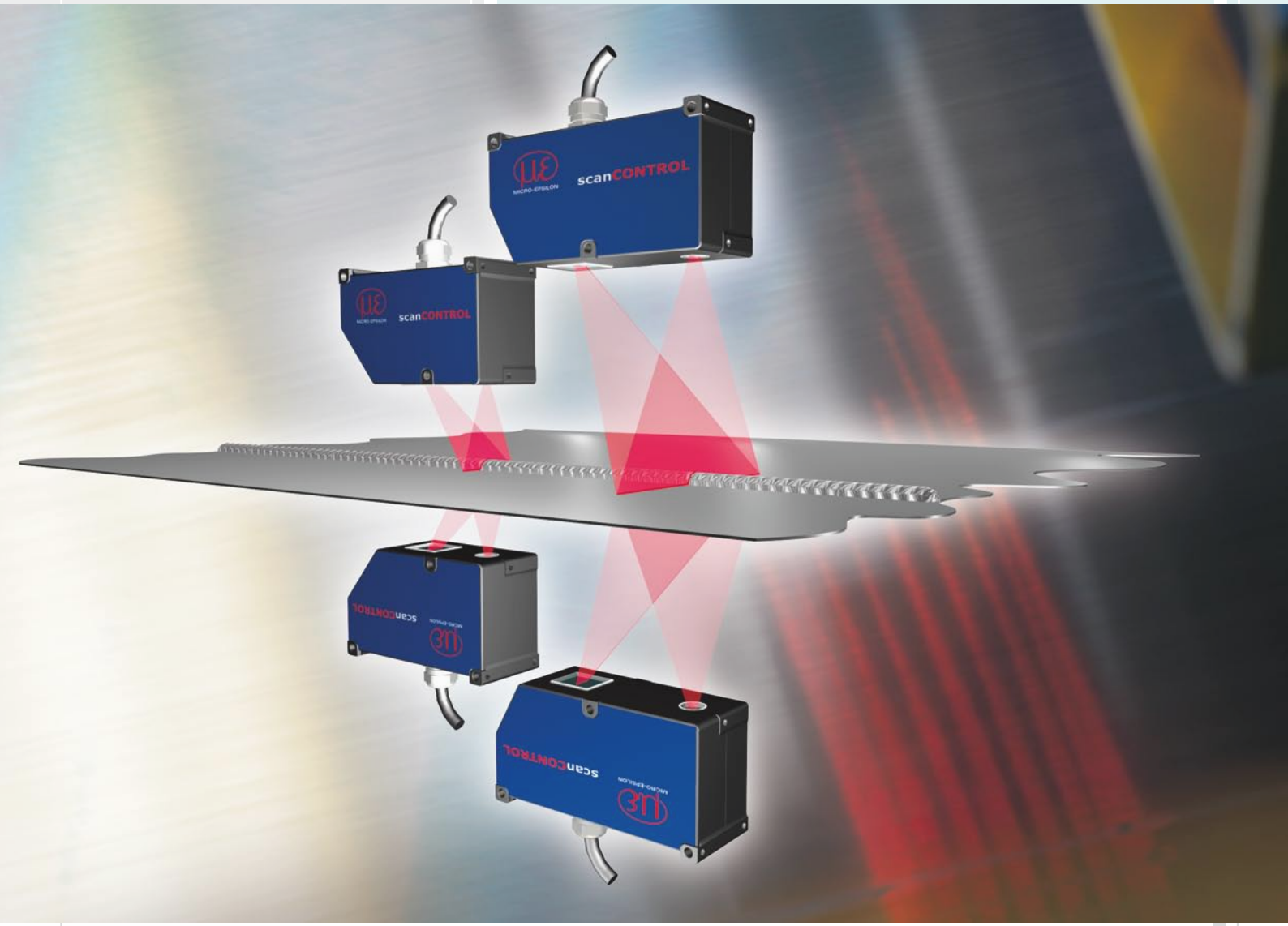
AVAILABLE VERSIONS

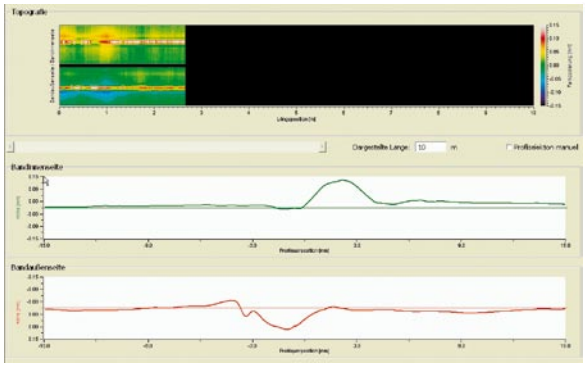
- Profile monitoring of aluminium plates
- Thickness and profile monitoring of steel tracks
- Thickness and profile monitoring of special metals



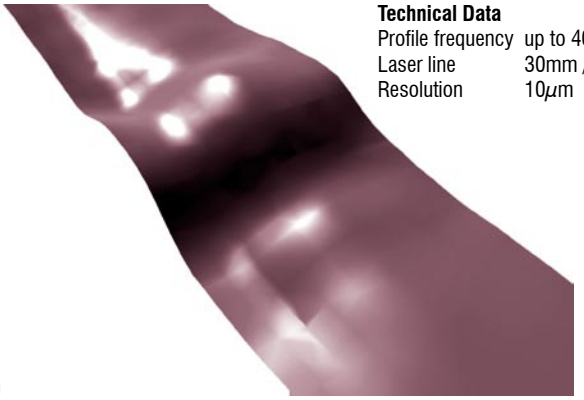
The thickness measurement is performed using capacitive sensors: the traversing measurement arm moves over the measuring section and provides constantly stable measured values without contacting the measuring object. A further decisive benefit: no emission protection regulations such as for isotopic methods have to be complied with.

Weld seam inspection and profile measurement





Visualisation of a weld seam



Technical Data

Profile frequency	up to 4000Hz
Laser line	30mm / 100mm
Resolution	10µm

Weld seam inspection on steel strips

Steel strips with geometry defects in the area of the weld seam are not suitable for further processing to process strips; even the smallest deviations must be removed with a lot of effort. The weld seam quality thus has a decisive influence on the further processing steps and is therefore an important factor in the added value chain.

System design

The inspection system for weld seam inspection is used for non-contact in-line measurement of weld seam profiles on steel strips.

In the production of steel strips, one wider strip is manufactured by longitudinal welding two separate steel strips. The strips are welded in a Stop&Go process while the two parts of the strip are aligned and fixed on a level table. Once the strip section has been welded, the strip moves further so that the next section can be welded.

Another process variant is the welding of the strips in continuous operation where the strips are guided through a stationary welding unit using rollers.

Laser profile sensors form the core of the measuring system. These sensors facilitate a continuing measurement of the weld profiles during the passage of the strips. Two sensors on each side – each with a laser line of 30 and 100mm – inspect the weld seam parameters for defects such as, for example, undercuts and movements or the angle between the two strips. If deviations are detected, a corresponding signal is transmitted to the controller. The sensors measure 3D profiles all round the weld seam at high speed.

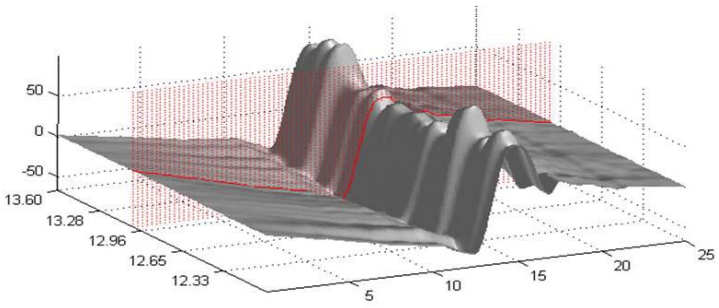
Afterwards, these profiles are evaluated, displayed graphically and stored in a database. A seamless integration with existing interfaces makes the system an integrated part of the complete line.

Measuring principle

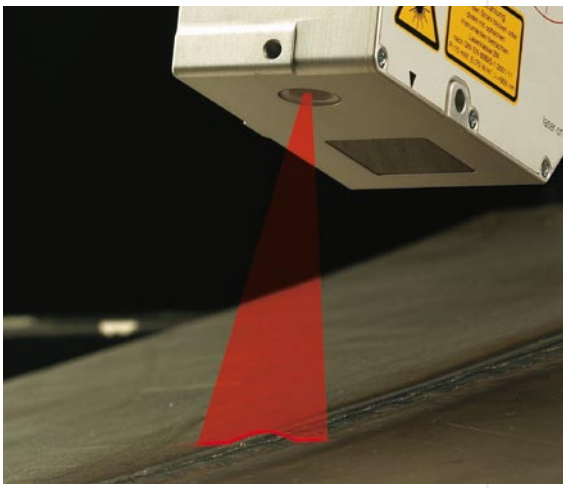
The scanCONTROL sensors used operate according to the optical triangulation principle (light section method) Thereby, a laser beam is projected on to the measurement object surface using an optical system. The diffusely reflected light from the laser line is replicated on a CMOS matrix by a high quality optical system and evaluated in two dimensions.

As well as the distance information (Z axis), the exact position of each point on the laser line (X axis) is also acquired and output by the system. The form and height of the weld seam in relation to the flat strip next to the weld seam is important for this special measuring task. The position and angle of the welded strips to each other are also determined at high speed.

The weld seam inspection system significantly reduces the downstream machining process, avoids cost-intensive rejection and delivers important results for the optimisation of the welding process.



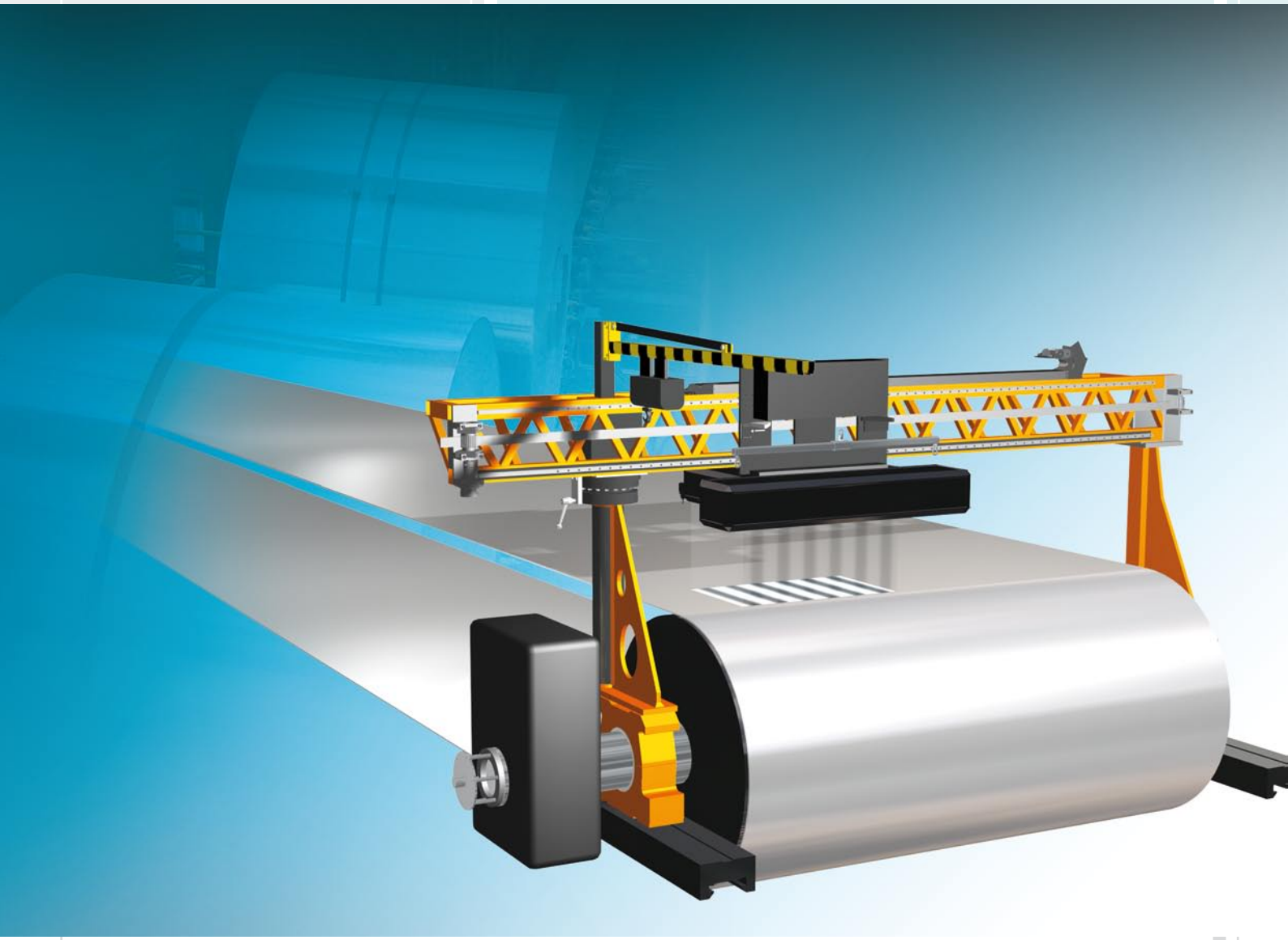
The laser line sensors provide exact profile data about the weld seam profile.

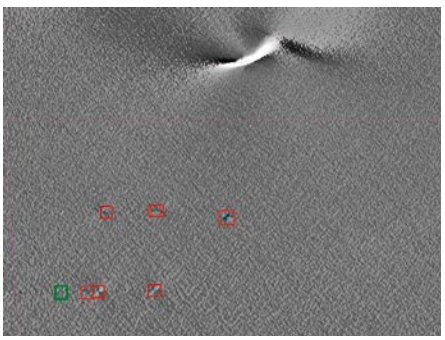


SYSTEM BENEFITS

- Non-contact measurement principle
- High measuring speed for continuous process flow
- Measured values are included for the process optimisation
- Measured data evaluation and logging according to customer specifications

Surface inspection of stainless steel strips





Technical Data

Width	approx. 4500mm
Strip width	500 to 3200mm
Strip thickness	0.5 to 4.0mm
Defect sizes	from 15μm

The smallest defects in the micrometre range are measured on polished surfaces by the measuring system.

Surface inspection on the stainless steel strip

Polished stainless steel strips are produced according to strict specifications and are subject to a continuous quality control. In order to meet the customer requirements, the steel strips must be manually inspected laboriously during the polishing. The production process is interrupted during this time-consuming inspection.

System design

The system based on the deflectometry principle contains several CCD matrix cameras mounted in parallel on a high-precision traversing mechanism and an extra wide LCD screen with high contrast. While alternating horizontal and vertical striped patterns are produced on the screen, each of these high resolution cameras measures the reflected patterns on the strip surface and detects defects in the micrometre range.

The strip is inspected incrementally by moving the camera block in the transverse direction to the machine drive from right to left after each revolution whereby the cameras are mounted on vertical carriages. The actual distances of the camera from the strip surface are also measured by 5 distance measurement sensors and regulated by the carriages for camera focussing according to the target specifications. For each transverse movement, the cameras are returned and then focussed on the strip surface again. Another optical sensor tracks the right-hand edge of the strip and keeps the camera block at a constant distance in relation to the belt edge for a complete strip revolution. This process is repeated until the complete strip surface has been inspected.

SYSTEM BENEFITS

- Non-contact measurement principle
- Microscopic accuracy
- Automatic classification of defects
- Customer-specific evaluations

The data are evaluated for potential defects in the evaluation computer whereby classification, display and archiving are performed in real-time. The numerous display and evaluation options enable the user to precisely localise all recorded defects in running operation and offline.

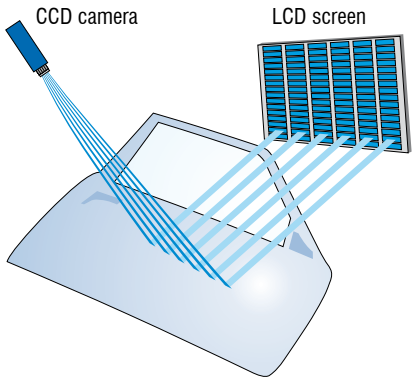
A precision sensor is fixed on the return drum in order to be able to establish the position in the longitudinal direction. The strip edge sensor detects the zero point in the longitudinal direction after each complete revolution; the zero point is defined by a marking on the top side of the strip.

The traversing mechanism is mounted on a corresponding mechanical holder with a bridge design. This consists of horizontal and vertical bars and is provided so that it is possible to install / remove the strip and the strip surface is freely accessible to the operator.

The measurement is made in several passes to distinguish between pseudo defects such as dust particles on the inspected surface and actual surface defects. In between the passes, the steel strip is treated using a polishing cycle. The system automatically recognises defects occurring once as contamination and only registers stationary deviations as defects. Seamless integration makes the system an integrated part of the complete line.

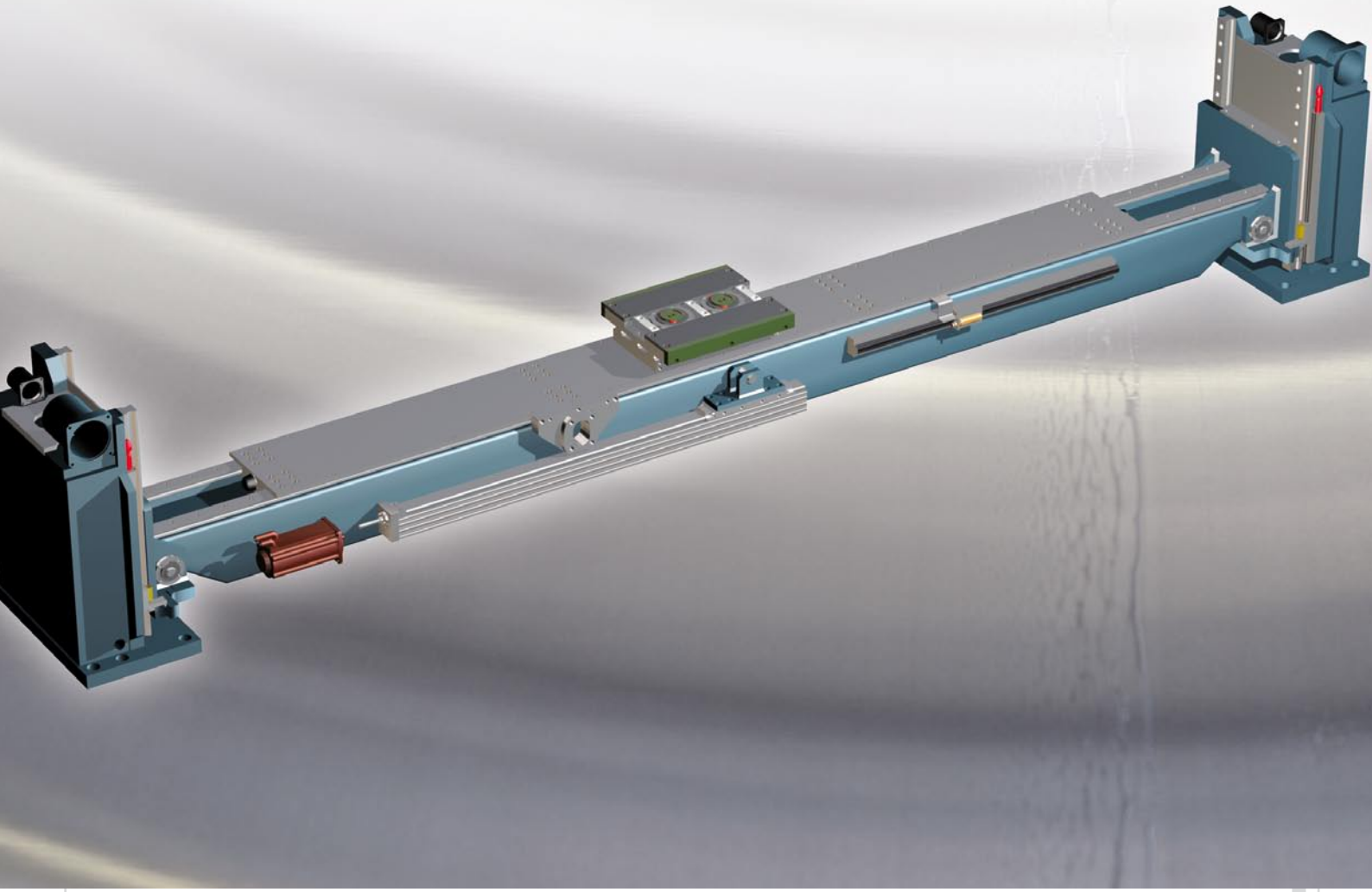
Benefits

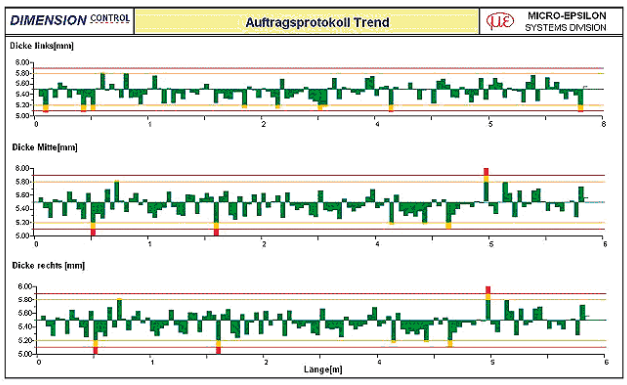
As compared with manual assessment, the surface inspection system reduces the inspection time by a factor of 10 and avoids undiscovered defects by 100% coverage with constant maximum accuracy. Furthermore, defects below the human perception limit are found and in this way preciously unattainable accuracies in the manufacture of polished strips are achieved.



The LCD screen generates a striped pattern on the metal surface which is recorded by high resolution cameras. The smallest deviations from the pattern are detected by the system.

Single-sided thickness measurement for strip lines





Thickness profile

Technical Data

Strip width	500 to 3200mm
Strip thickness	0.5 to 4.0mm

The grinding of steel strips is a time-consuming process which is controlled by a continuous inspection of the metal removal performed. Due to unfavourable operating conditions in the grinding line, thickness measurements using two-sided methods are not always possible and result in interruptions of the production process.

System design

The measuring system has been designed for the non-contact, in-line thickness measurement of stainless steel strips. The steel strips are welded in the transverse direction into a continuous strip which is conveyed between the two large rollers during the double-sided grinding process.

The measuring system itself uses the principle of ultrasonic echo analysis with water as the coupling medium. The ultrasonic sensor passes through the complete strip width crosswise to the material feed. The system can also bring the sensor into a special calibration position outside the maximum strip width so that a reference part can be measured. This makes possible completely automatic calibration during the production.

Two additional proximity or occupancy sensors are used for the automatic detection of the strip edges. The ultrasonic sensor records a mapping of the thickness values over the complete strip. The sensor controller determines the thickness values on the industrial PC which then processes them, displays them, presents them statistically and stores them in a database. Exceeded limit values are indicated onsite at each measuring station by a light signal.

Measuring principle

The thickness of the flat steel strip is determined by measuring the time interval between the two echoes from the ultrasonic pulse signal. In order to obtain absolute thickness values, the calibration target must show the same material characteristics. The production is mainly interested in the relative thickness deviation and less so in the absolute values.

Treated water is used as the coupling medium for the present measuring principle. In order to obtain reliable measurement signals, a uniform water covering must be present. The maximum permitted distance between sensor and strip surface is 3mm.

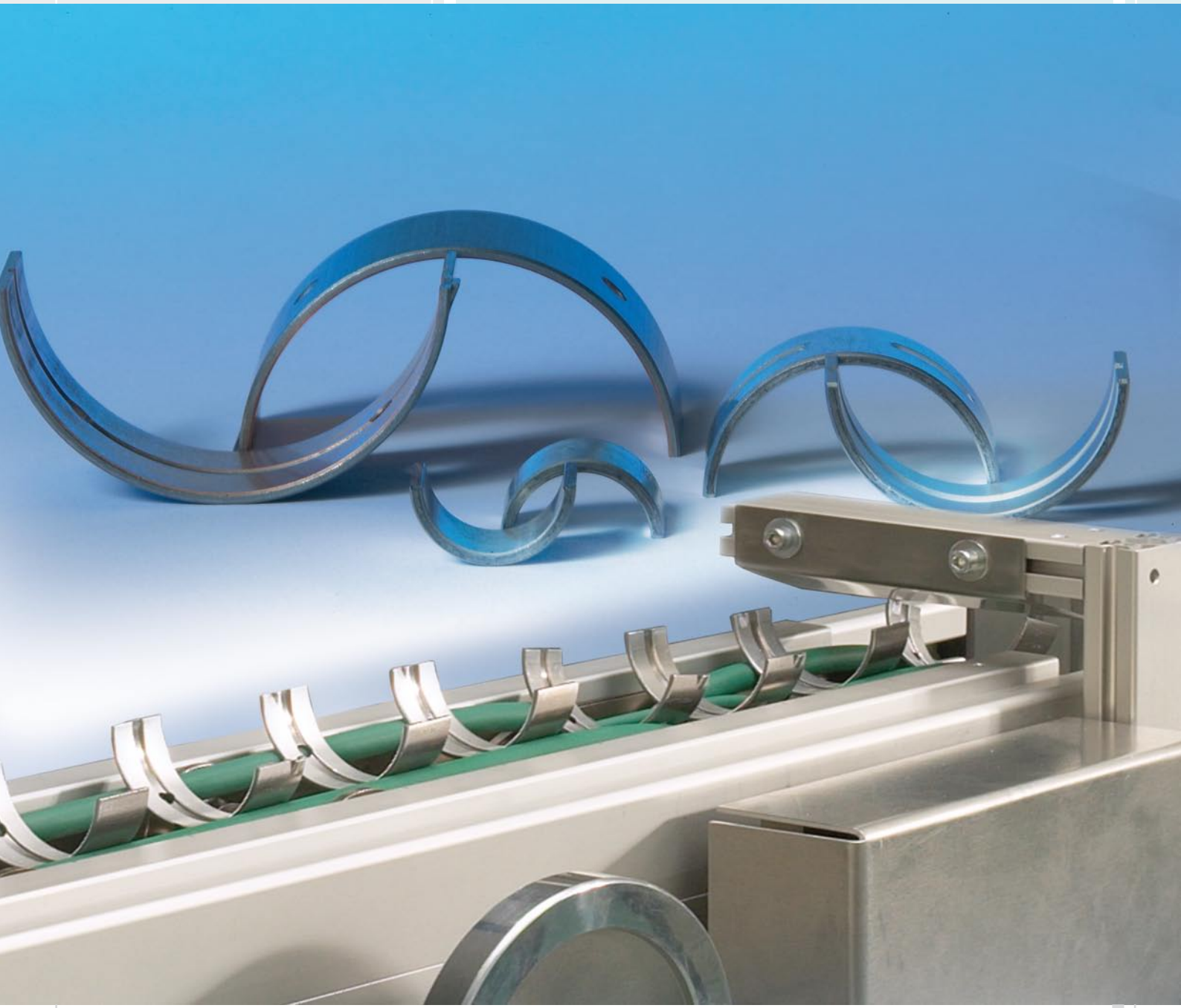
In order to avoid any damage to the strip surface, the sensor must not contact the strip surface. It is also required that the two rollers right and left of the measuring station form a stable and reliable measuring plane for the thickness measurement system. In this way, the sensor can be moved to the measuring point during operation and maintained at a constant distance by means of the integrated regulation.

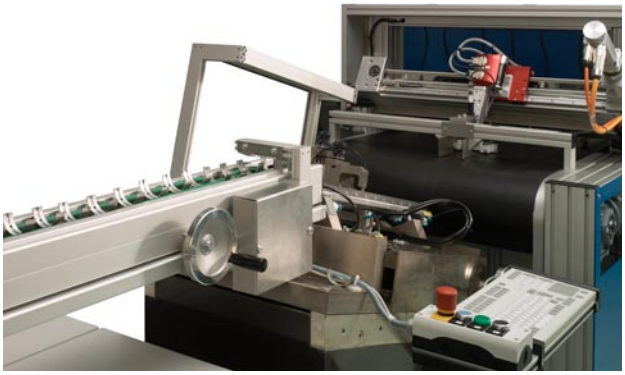
The edges of the strip are determined by the measuring system using two additional proximity and occupancy sensors.

SYSTEM BENEFITS

- Single-sided, non-contact measurement
- Continuous tracking of the grinding process
- Wear-free system

Wall thickness and surface inspection of bearing shells





The measuring systems are available in different versions. The design with an attached sorting unit can be seen in the picture.

Technical Data

Measuring range	up to 100μm thickness change
Shell diameter	30 to 85mm
Repeat accuracy	up to 0.3μm
Measuring rate	up to 60 bearing shells per minute
Dimensions	500x500x1330mm

Quality inspection of bearing shells

The performance requirements for bearing shells are enormous. They take over several equally important tasks in the combustion engine such as lubrication and bearing various shafts. In order to perform the task for a long time, the shells must not show any kind of dimensions or surface defects.

The quality assurance of bearing shells is determined by the extremely precise specification of several characteristics. Dimensional measured values such as thickness and diameter are also included with the surface quality in the quality inspection. Micro-Epsilon provides several systems using different technologies for the determination of the respective quality criteria.

Modular inspection process

The bearing shell inspection systems measure characteristics such as thickness, diameter, dimensions, roundness, wall thickness and also surface quality directly in the production line. The precision of the systems is based on the sensors matched to the application case as well as special mechatronics and elegant algorithms for signal conditioning.

Using sensors and image processing technologies developed in-house coupled with intelligent analysis software, the measurement signals are processed and conditioned for the corresponding production environment. The systems are designed so that the bearing shells are classified in up to five quality classes and can be grouped using an optional downstream sorting unit.

Depending on the requirement, there are systems available for this which inspect many different criteria on bearing shells. Depending on the version, the bearing shell is transported absolutely vibration-free on an air cushion or lifted on to the next conveyor belt using a transport arm with semicircular movement for the measurement.

The bearing shells are recorded for the measurement using an inverse conical mirror with a BV camera for the surface inspection. Other cameras can also perform a dimensions control.

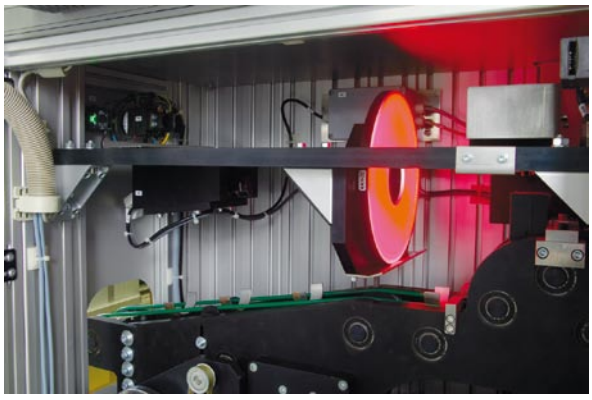
SYSTEM BENEFITS

- Intelligent classification of different defect classes and types
- Short cycle times for in-line process systems or production line applications
- Dynamic measurement with maximum accuracy and resolution
- Wear-free measuring process using transport of the shells on air cushions
- Sorting according to quality classes

AVAILABLE VERSIONS

- Measurement of the bearing shell wall thickness
- Characteristics recognition on bearing shells
- Defect detection on the bearing shell running surface

Bearing shell wall thickness measurement with attached sorting unit



Surface inspection of bearing shells using image processing system

High performance sensors made by Micro-Epsilon

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