



Future Proofed
Sensor Solutions



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HYDRO

KME

posco

SMS  **group****TATA STEEL**

thyssenkrupp

Wieland

references (selection)

Sensor systems for strip processing lines and rolling plants

With more than 25 years of practical experience in sensor systems, TB Sensor GmbH is a competent and reliable partner for the industry when it comes to high-precision measuring technology for quality monitoring and the automation of technical processes. Our particular focus is the use of optical sensors in the metals producing and processing industries, in order to keep production operations efficient. The application range of the measurement systems extends from the rolling sector right up to the end product.

TB Sensor GmbH designs, manufactures and installs measurement technology for the measurement of thickness, width, profile or flatness – and most particularly, the measurement of length and speed in dynamic processes. As components, the systems are often indispensable constituents in the products of many machinery and plant manufacturers as well as of electrical equipment suppliers all over the world.

We are also known for unconventional solutions, for meeting the strictest requirements in the processing line sector.

Dr. Klaus Christofori
Managing Director TB Sensor GmbH

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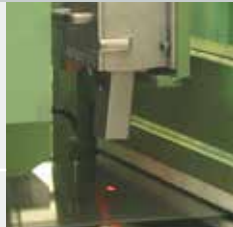


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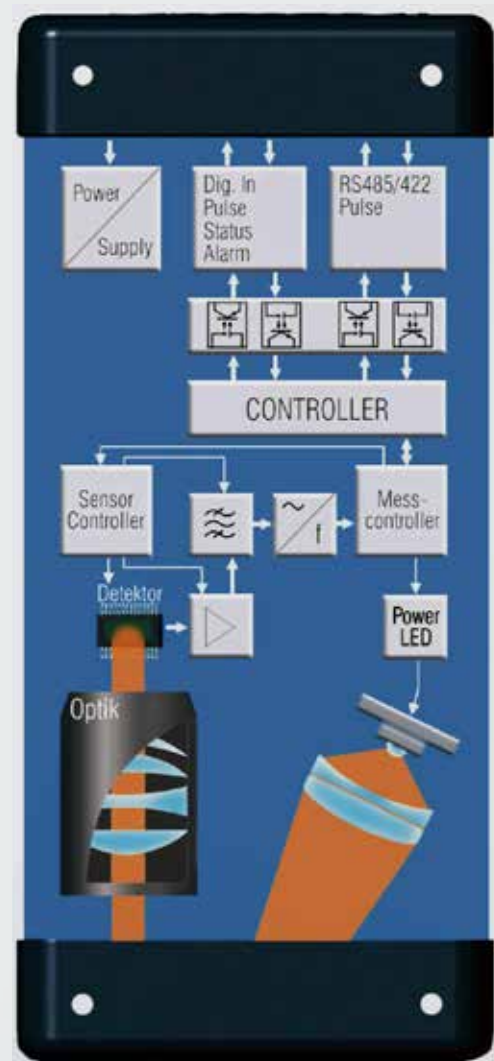
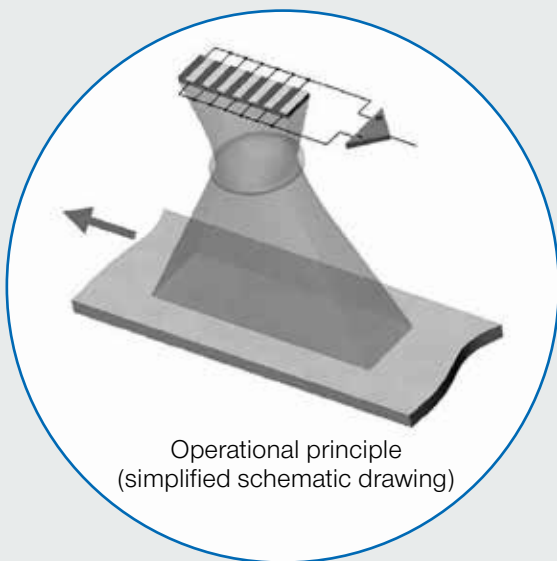
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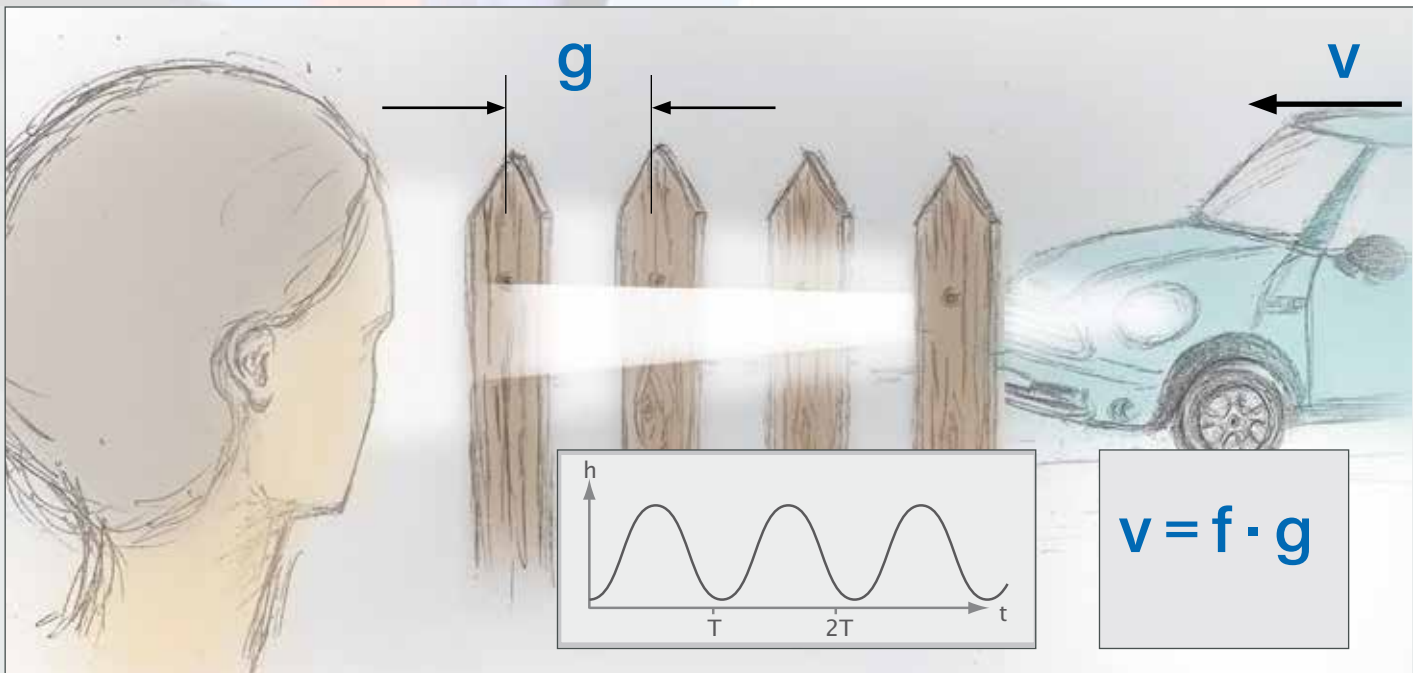
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Technical Specification

Measuring distance	300 ±15 mm
Measuring range	up to max. 3000 m/min
Linearity	± 0.05 %
Repeatability	± 0.03%
Protection standard IP65	0 to 50 °C
LED Class	1

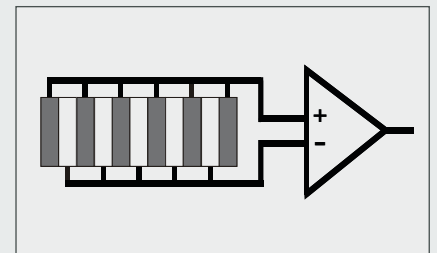




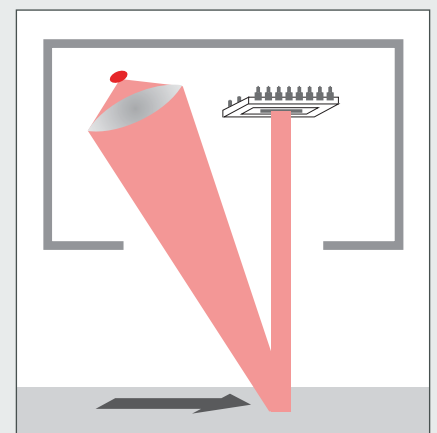
Working principle – explained simply

The spatial frequency filter technology has been known for more than 50 years. Referred to as a “fence-post effect”, the flashing frequency of a light source moving behind the “fence posts” is proportional to the speed (see diagram). Everyone will certainly be familiar with that effect, for example in vehicles driving in the dark. The repeated light flashes shining through the fence posts appear to the observer like a light flashing at a certain frequency. The flashing frequency is a measure of the speed. The distance between the fence posts is the reference or standard value. The smaller the distance between the posts, the higher the flashing frequency is at a given speed. However, the post separation also affects the accuracy. Should the separation vary, the flashing frequency would be affected. In this case, a constant object speed would appear to vary. To apply this measurement effect for use in a measuring instrument, a technical lattice (grating) is used instead of the fence with posts. Transmission lattices in front of a photodetector or projection lattices, as used in laser-Doppler instruments, have

long been the state of the art. Using a light sensitive silicon grating as “fence posts” is the particular innovation that ultimately resulted in this true standard sensor. Conceived as sensor chips by the semiconductor industry, gratings with absolutely identical geometries and properties are mass produced already. Furthermore the most varied functions can be integrated in these chips. When designed as differential gratings, lattices (see diagram of the differential principle) further technical advantages are obtained, particularly effective stray light suppression which makes it impossible for ambient light to influence the sensor. Similarly, surface effects like colour, shininess and other surface properties are compensated to zero because adjacent sensor elements are affected in the same way, but only differences between the + and - gratings are output as signals by the differential amplifier. This intensifies the measurement effect considerably. Hence, especially shiny metallic surfaces such as stainless steel, aluminium or copper are advantageous and provide excellent measurement result).



differential principle



ASCOSpeed – Technological advantages

Eye-safe LED illumination

- + neither protection glasses nor laser safety officer required
- + no safety provisions or restrictions by OSHA

Reliable measurements, even with shiny and reflective surfaces

- + thanks to specially designed lighting compartments and even illumination of the detector
- + no need for special orientation (oblique positioning etc.) on reflective surfaces
- + automatic control of exposure time and illumination brightness when surfaces are changing
- + high dynamic range allows measuring even when colours and structures are changing rapidly (e.g. textured sheets, radiator sheets, stranded cables, etc.) by virtue of the difference principle

Tough in rough environments

- + no influence of interfering particles outside the working distance, thanks to telecentric optics
- + large measurement spot, much less sensitive to interfering particles than fine-focussed laser beams
- + internal plausibility checks filter out interfering signals, instead of averaging them within the raw measurement values
- + effective stray light suppression by virtue of the differential principle, instead of having to record the combined light signal with avalanche or pin diodes as in the case of a laser
- + electronic temperature monitoring (ASCOSpeed only)



photo: ThyssenKrupp

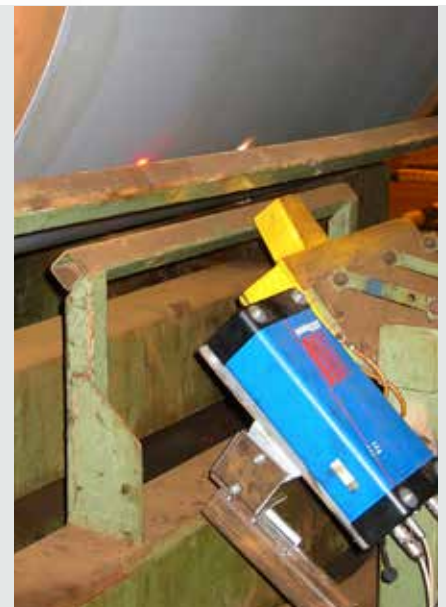


photo: Ruuki

Long life and long-term stability

- precision based on a high-stability silicon grating sensor with structural accuracy in the nanometer range
- extremely high long-term stability of the silicon grating structure, temperature and wavelength-independent (in contrast to the wave length changes of ageing laser diodes)

Robust instrument design

- extruded housing design featuring dual encapsulation
- increased EMV resistance for safe operation close to large drive systems or strong magnetic fields
- compact optical system and silicon-chip-based measurement reference
- components bonded and screwed on, for vibration- and shock-resistant operation

Simple parameterization

- rapid commissioning by means of included software for adjustment, display and recording of measurement results
- simulation mode by way of terminal communication for testing all the activated interfaces, even when the strip is not moving
- optional synchronization of multiple sensors (synchronized clock cycles)

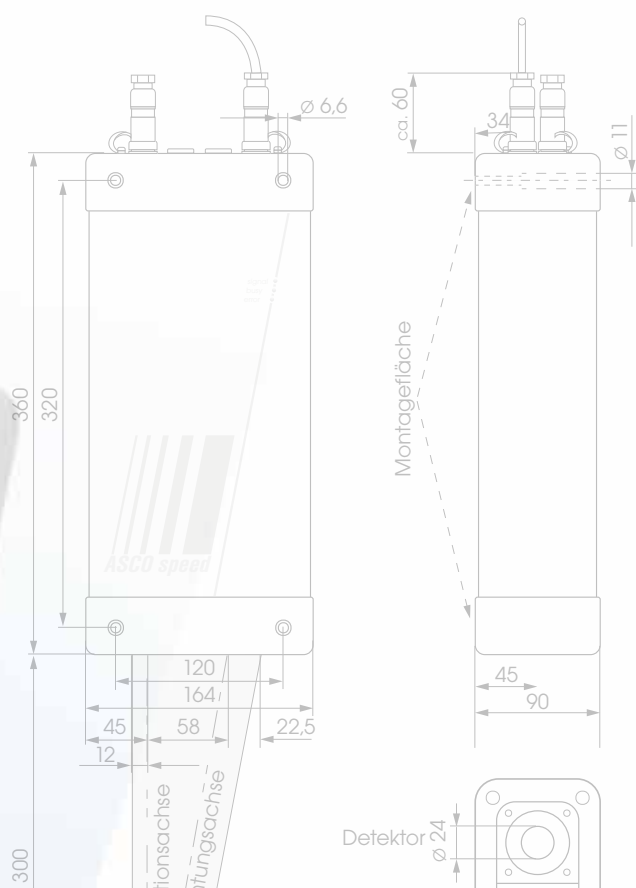


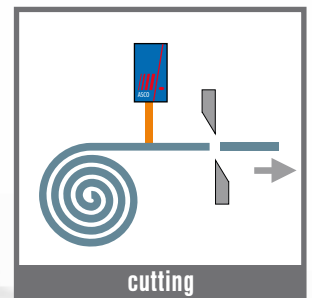
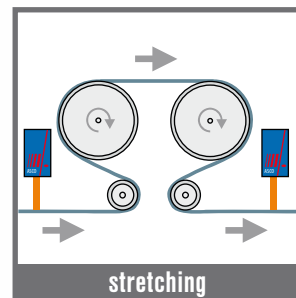
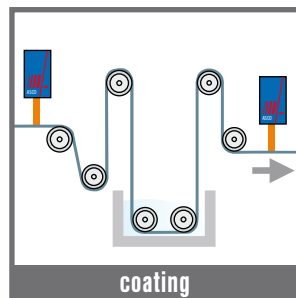
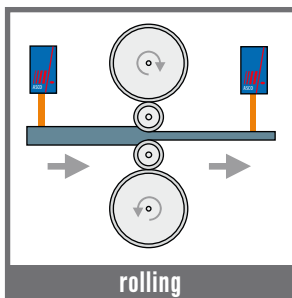
photo: Danieli Fröhling

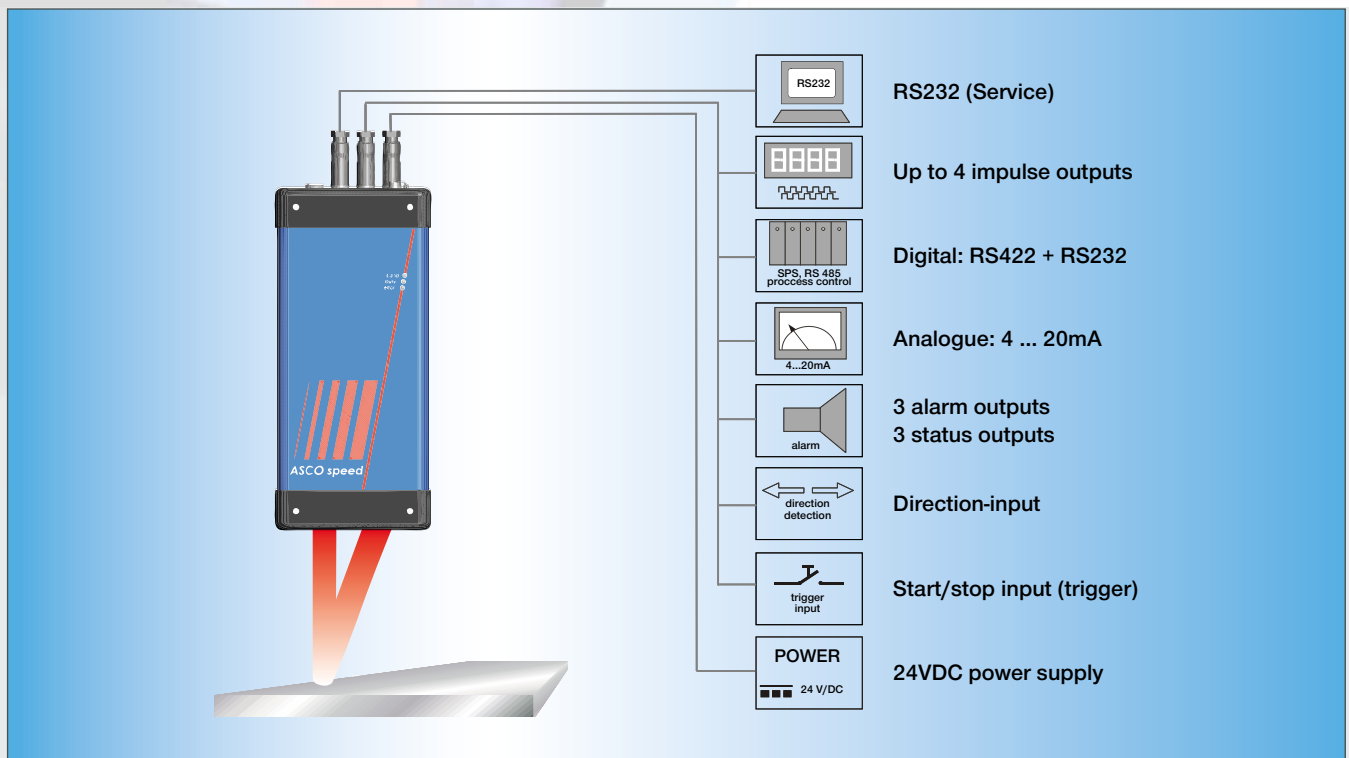


photo: Novelis

ASCOspeed - technique that convinced

Application: rolling, coating, stretching, cutting





The **ASCOSpeed 5500** is a high-performance speed sensor, developed for applications in the metal industries. It works according to the phase group method, a further development within well known and proven spatial frequency filter techniques. Minute contrasts within moving material surfaces are converted by the precise lattice structure of the detector into an electrical signal with a frequency proportional to the speed of the object only.

Eye-safe LED illumination

More than 25 years of experience with silicon lattice sensors form the basis for the outstanding properties of this new generation of speed sensors. As the light source, a high-power LED is used. The light back-scattered from the surface of the moving object is directed on the detector via an optical system, generating the measurement signal. With the use of LEDs a longer life time is achieved than with semiconductor lasers. As the LED is falling into class 1, there is no potential risk compared with Laser Class 3B devices.

A novel type of signal processing realized in hardware ensures that even speed changes of the material are measured precisely. A super-rapid hardware system registers, checks and consolidates the instantaneous speed values in the microsecond range up to a maximum material speed of 3000 m/min. Thus the highest precision is achieved regardless of acceleration or braking in processes.

Easily incorporated

Even at the minimal averaging and output time of 0.5 ms, the sensor gives a reliable speed signal. Conventional mechanical systems can be replaced by the ASCOSpeed 5500 without problems. The instrument has up to 4 scalable pulse output channels which, respectively, deliver the 4 quadrature signals (A, B, /A, /B). Thus, ASCOSpeed can easily be used to directly replace rotary encoders. Inputs and alarm outputs, as well as an optional analog output complete the sensor interface.

Multi-sensor capable for speed difference measurements

The Master-Slave operation of two autonomous ASCOSpeed 5500 units, with internal computation in the Master unit, can output the speed difference of the sensors, without any additional external unit like a PLC or alike. In this mode, synchronous operation has distinct advantages for the measu-

rement of speed differences, as required for mass flow control or control of elongation in skin passes. Triggered by pulses from the control system several instruments in a measurement sequence will work exactly synchronously under hardware control and thereby deliver precise results regardless of acceleration phases. In material testing lines multiple sensors can be daisy-chained, thus simplifying the transfer of speed information.

The compact structure combines the sensor and the electronic system in a robust housing, ensuring problem-free use in the most varied plants. The instrument works autonomously, uses little power, requiring only a 24 VDC voltage supply. An internal temperature monitoring system enables external temperature control in order to keep the sensor cool, further increasing operating reliability. Several standard interfaces provide the user with several options for the automation of process lines.

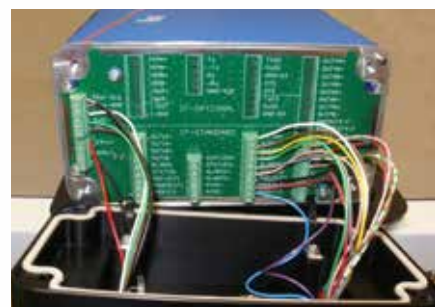




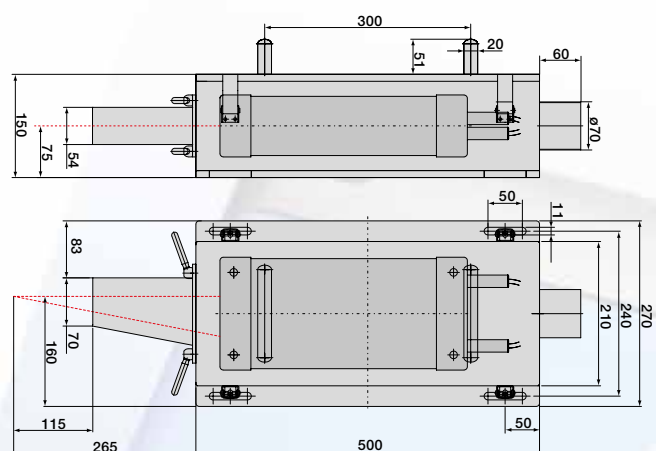
photo: Wieland Werke AG

Speed measurement in rolling mills

Technical Specification

ASCOSpeed synchronised version
2 devices ASP 5500-300-A-I-S-D-E

Measuring distance	300 ±15 mm
Measuring range	up to max. 3000 m/min
Linearity	± 0.05 %
Repeatability	± 0.03%
Protection	IP67 in stainless steel housing with air-purging
Light source	LED Class 1



ASCOSpeed within stainless steel protection housing



Foto: TB Sensor



photo: Mendritzki

Rolling of flat products is a complex process, where maintaining the thickness tolerance of the final product is a decisive quality parameter. To control the roll gap it is necessary to determine the transport time of the strip from the strip thickness measurement unit to the rolling gap, and also the increase of the strip speed as its thickness is reduced. Thanks to its non-contact working principle and its internal hardware synchronization function the ASCOSpeed is exceptionally suitable for detecting the actual speeds in technological control units (AGC) for rolling mills. Without any wear, ASCOSpeed measures material speeds up to 3000 m/min and in its Heavy-Duty version, with its strong stainless steel protective housing, is robust enough to be used in cold-rolling mills. A temperature data-logger monitors the thermal load and records unacceptable excesses even in the switched-off condition. By the use of LED illumination the

potential risks as related to laser emission are eliminated.

ASCOSpeed uses special signal-processing hardware to detect, check and consolidate instantaneous speed values in microseconds. With its freely scalable averaging and output time (minimum 500 μ s) the sensor outputs a high-precision speed signal. For the measurement of speed differences, as for the mass flow control or skin-pass ratio, the hardware-triggered, synchronous operation has important advantages. By virtue of a control pulse from the control unit several instruments can work absolutely synchronously in their measurement sequence under hardware control and thereby deliver results of unmatched precision during acceleration phases, which is a prerequisite for the control unit to meet strict thickness tolerance requirements from the leading end of the strip already.

System advantages

- ✚ contactless and non-inertial function
- ✚ safe LED light source (Light Class 1)
- ✚ robust and fault-tolerant measurement thanks to plausibility testing
- ✚ function of multiple sensors synchronisable by hardware means



photo: ThyssenKrupp

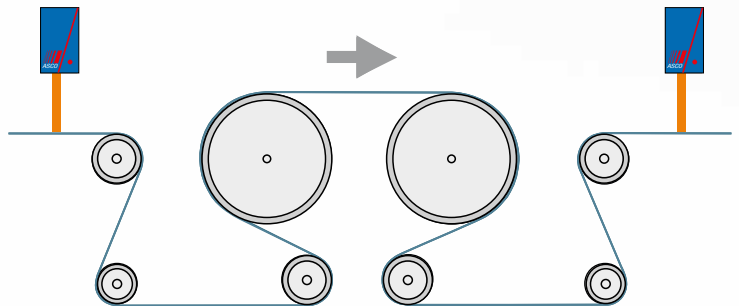


Non-contact tension leveling measurement

Technical Specification

ASCOSpeed master-slave version
2 devices ASP 5500-300-A-I-M-D-O

Measuring distance	300 ±15 mm
Measuring range	up to max. 3000m/min
Linearity	± 0.05 %
Repeatability	± 0.03%
Protection	IP65; 0 bis 50 °C
LED Class	1



Measuring principle: Stretching coefficient measurement with ASCOSpeed



photo: Hydro Aluminium

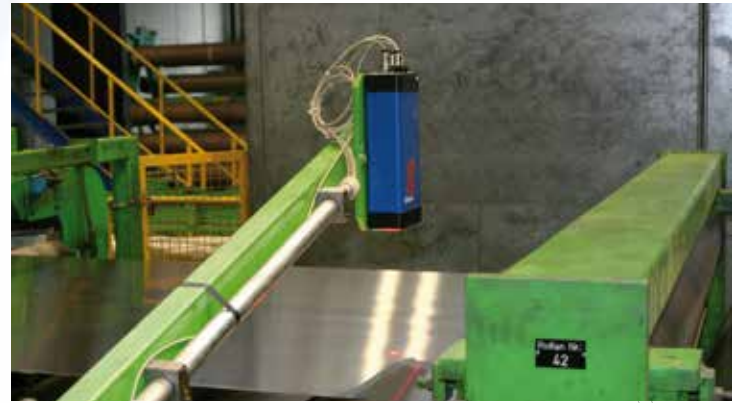


photo: Novelis

The stretch-leveling of strips is a demanding technology owing to the variety of materials and alloys. Overstretching the strip beyond the elastic into the plastic range removes stresses produced during the rolling process and results in exact flatness. Depending on the material and alloy, the stretching degrees range from 1 to 3 percent and have to be measured and controlled. Strips with small yield-point differences are controlled by way of the strip tensions. Greater stretching is achieved with special stretching drums, whose torque and rotation speed are controlled in order to conform exactly to the range of plastic deformation and hence the yield points. Corresponding straightening cassettes (levellers) also influence this process. For technologists the elongation in individual zones and the total degree of elongation are decisive. For this, a non-contact measurement method of the strip speeds is ideal. On the run-in side an ASCO speed 5500, the Slave unit, determines the instantaneous strip speed ahead of the stretching zone. The speed of the

stretched strip is then measured by a second ASCO speed, the Master unit. Owing to the stretching the strip is now longer and therefore moves faster in the same proportion. The speed difference is a measure for the elongation of the strip and thus also for the degree of stretching. For this measurement method it is essential that the involved sensors operate synchronously. A control pulse from the Master unit initiates the measurement sequences of both units by hardware control means exactly synchronously, so that more precise results are obtained during acceleration phases. By means of internal calculations in the Master unit the determination of the stretching degree takes place autonomously. No need for a control unit or additional SPS functions in the plant control system!

ASCO speed technology, within its microscopically small silicon detector grating combined with the LED illumination, enables measurement on virtually any metal surface, regardless if bright, reflective or oiled.

System advantages

- contactless measurement prevents any scratches and traces
- Master-Slave function determines the elongation degree directly and autonomously
- motion length based synchronous mode of operation

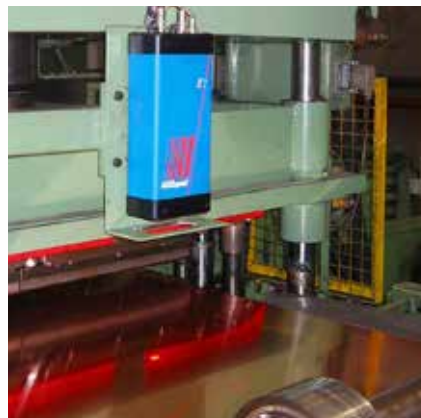
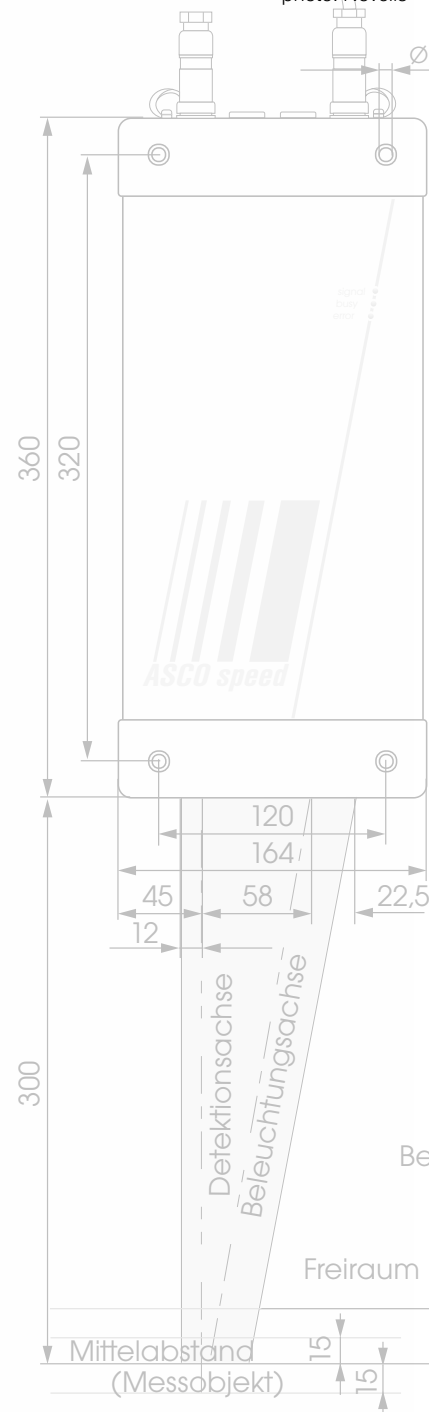


photo: KME

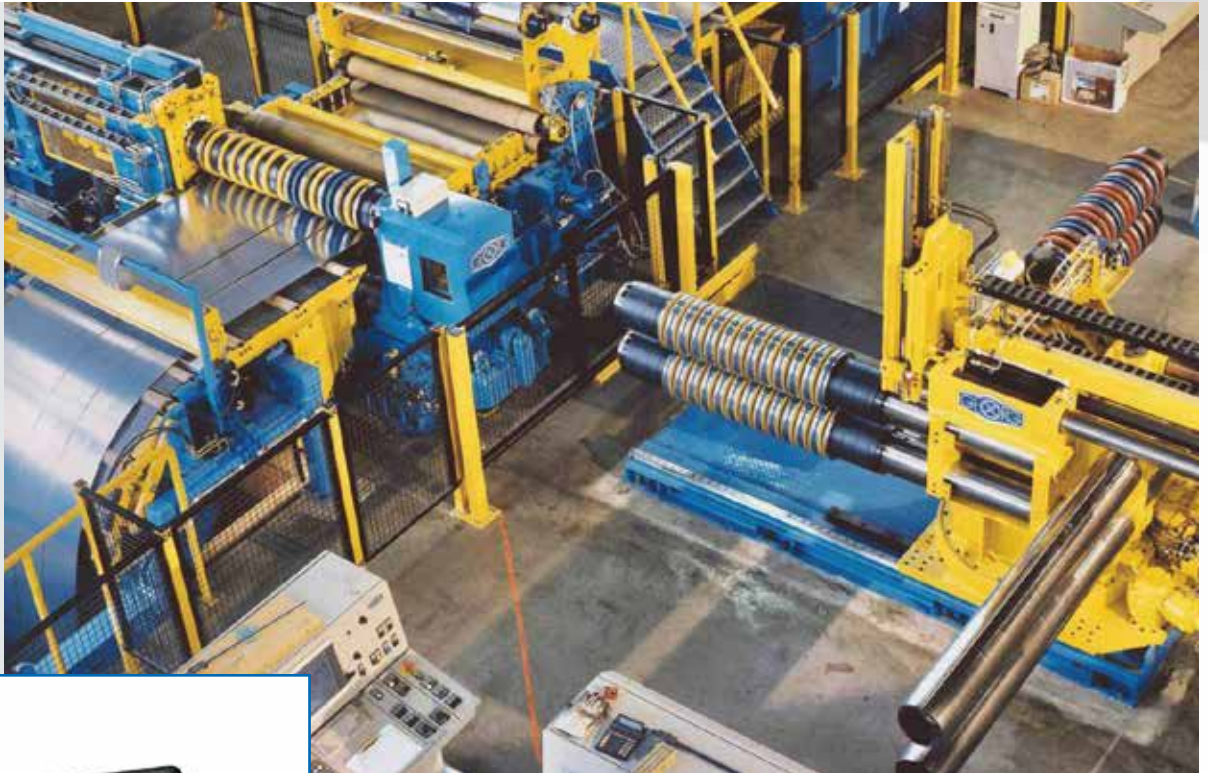
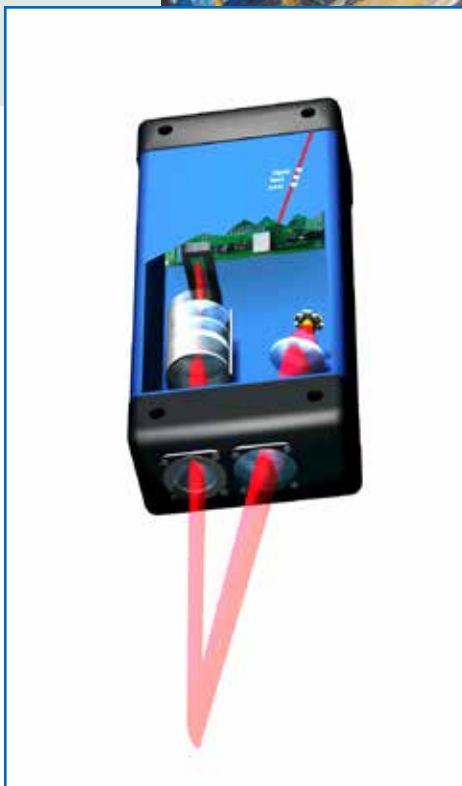


photo: Heinrich Georg Maschinenfabrik GmbH



Strip speed measurement for cutting lines

Technical Specification

ASCOSpeed interface version
2 devices ASP 5500-300-A-I-O-O-O

Measuring distance	300 ±15 mm
Measuring range	up to max. 3000m/min
Linearity	± 0.05 %
Repeatability	± 0.03%
Protection	IP65; 0 to 50 °C
LED Class	1

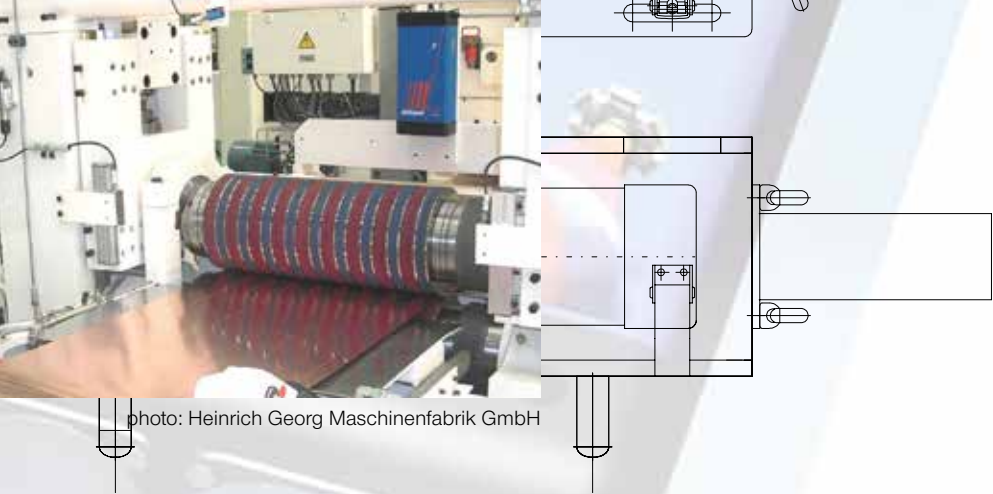


photo: Heinrich Georg Maschinenfabrik GmbH

Slitters for longitudinal cutting of strip material are used in the finishing shop for a wide variety of almost all materials. The most important criteria are the edge quality after cutting and the exact winding, with an accurate winding pattern and finished coil diameters as large as possible. This demands exact determination of the current strip speed.

The exact advance of the blade shaft relative to the strip movement is responsible for cut-edge quality and blade life. Soft strips are wound with as little tension as possible, which is achieved with appropriate braking stands. For the control of this process a decisive prerequisite is precise and direct measurement of the strip speed. Contactless also means unaffected by inertia – this already being a major advantage compared with mechanical measurement by means of deflector rolls, which suffer from varying slippage depending on mass or grip quality. Thanks to its contactless working principle and efficient interface options ASCOSpeed is beneficial as the speed master in strip plants. A safe working distance of 300 mm provides for best service life and easy maintenance.

In typical slitting lines, the ASCOSpeed can replace up to 4 rotary encoders. As the speed master, the instrument provides the signals for the cutting process and for tracking the material, as well as providing the required pulse counts for control of ink-jet printers for the material-characterising data. The pulse count in the typical four channels (A, B, /A, /B) is freely scalable up to a maximum frequency of 500 KHz. If HTL signals are required, galvanically isolated line drivers enable interference-free operation. Thus, the ASCOSpeed can supply a separate coil computer with the necessary pulses as required.

Another interesting solution is the operation of two instruments for the control of a slack-pit. The difference between entry and exit strip lengths, precisely measured by ASCO speed sensors, determines the current length of the loop in the pit. This type of measurement often has advantages over direct loop measurement by means of laser distance sensors, because laser distance measurements often become problematic due to oscillations of the strip loop.

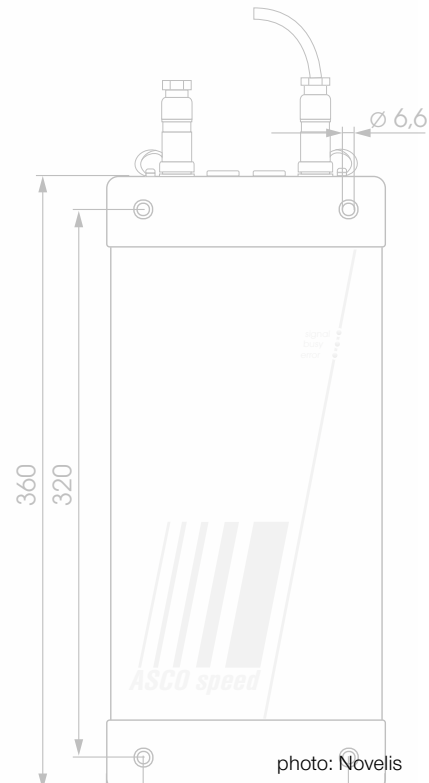


photo: Novelis

System advantages

- ⊕ non-contact measurement = no scratches or traces
- ⊕ very small visible measurement spot, suitable for any type of slit strip
- ⊕ great flexibility through freely scalable pulse output



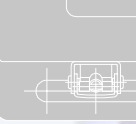
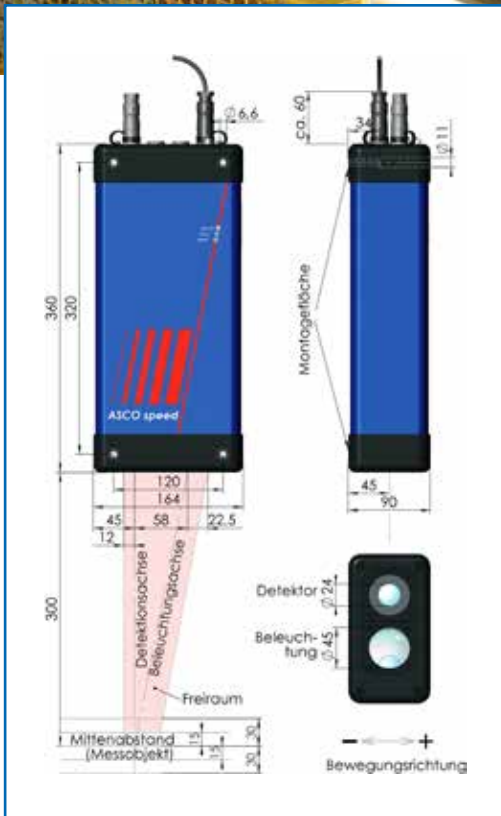


photo: Hydro Aluminium



Length measurement for surface inspection

Technical Specification

ASCOSpeed interface version
2 devices ASP 5500-300-A-I-O-O-O

Measuring distance	300 ± 15 mm
Measuring range	up to max. 3000m/min
Linearity	± 0.05 %
Repeatability	± 0.03%
Protection	IP65 , 0 bis 50 °C
LED Class	1

Surface inspection systems assist producers in their quest to produce larger quantities by monitoring and control of their production output. To achieve the best possible results, continuous inspection of the surface and control of the production process are indispensable. ASCOSpeed technology is a valuable supplement to all surface inspection systems available on the market and realises continuous allocation of the inspection results to the respective strip length position. ASCOSpeed is much more than just a non-contact, optically operating length measuring system. From a safe distance of 300 mm the instrument makes its measurements without any contact. Contactless also means not affected by inertia – providing advantages compared with an incremental mechanical measurement by way of deflection rolls or running wheels, suffering slippage depending on the mass, grip quality or contact pressure. An optimised beam characteristic of ASCOSpeed technology, in combination with multi-channel plausibility analysis, enables robust and fault-resistant measurement of

speed and thus smooth operation regardless of any surface defects, and on surfaces of the most varied qualities, from painted to reflective strips. This length measurement system is substantially more reliable and is noted for being largely maintenance-free. ASCOSpeed has technical advantages: the speed is digitally recorded in the unit and can also be output for process control by appropriate digital outputs and inputs which, for example, can generate alarm signals.

Large companies in particular appreciate the advantages of ASCOSpeed as a universal system that can be used throughout the process chain, from the rolling plant, through the coating process and up to the finishing stage. All ASCOSpeed units are equipped with a multi-level setup memory, allowing units to be exchanged with one another or replaced by a unit from stock for servicing purposes as quickly as possible. The plant electrician only has to input the number for the setup page allocated to the unit and then activate this specific setup.



photo: Hydro Aluminium

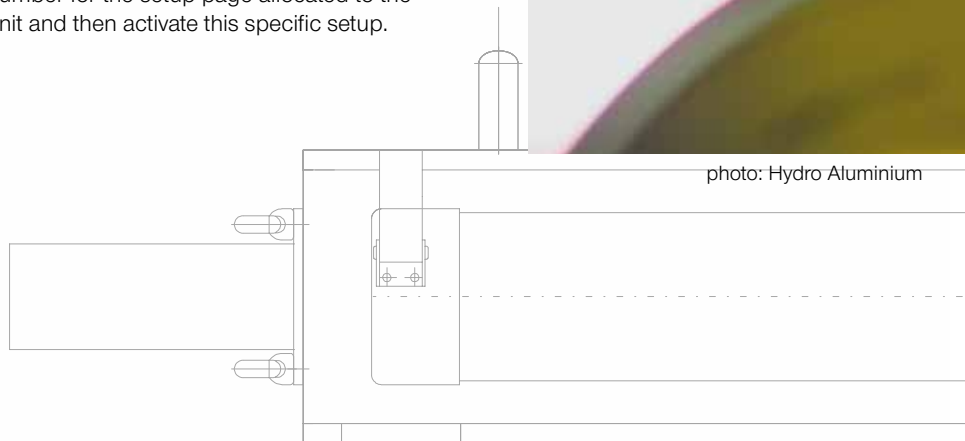
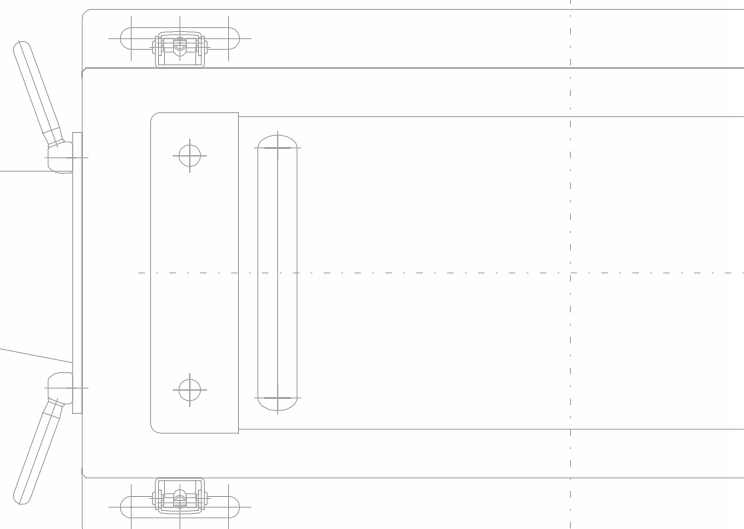


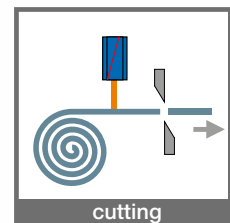
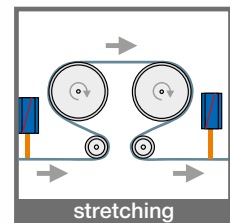
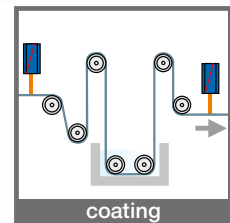
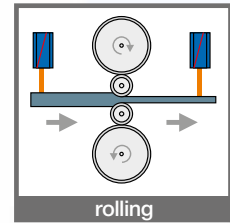
photo: Hydro Aluminium



ASCOSpeed 5500-300 Technical Specification

Measuring range	1-3000 m/min
Reference distance	300 ±15 mm 300 ±30 mm ¹⁾
Linearity	± 0.05 % ^{2) 4)}
Repeatability	± 0.03 % ^{3) 4)}
Resolution	0.1 mm / 0.001 m/min
Update-time (least averaging-time)	0.5 ms
Light source	Power-LED (safety class 1)
Signal conditioning	compact housing with integral electronics
Protection class	IP65 (suitable for cold-rolling-mill application by using the stainless steel protective housing with air-purging and viton-seams)
Vibration (DIN EN 60068-2-6)	2g / 20 ... 500Hz, sinoidal
Shock (DIN EN 60068-2-29)	15g / 6ms, half sinoidal
Operating temperature	0°C to 50°C (without external cooling)
Storage temperature	-20°C to 70°C
Output	Standard: 2 encoder outputs (A, B, /A, /B), 3 status Optional: 2 further encoder outputs (A, B, /A, /B), synchronisation output; analogue output (4 - 20mA) All outputs opto-insulated
Digital Data-Interfaces	Standard: 1x RS232 (Service or parameterization interface) Optional: 1x RS232, 1x RS232 o. RS422 (switchable) Optional: EtherCAT-ready (compatible with Beckhoff EL6021/KL6041) All serial interfaces are optically isolated
Input	Standard: Direction- and trigger inputs Optional: 3 further control- or pulse inputs All inputs optically coupled with current delimiter resistors
Signal-LEDs	1. Signal (LED green/red) 2. Busy (yellow) 3. Error (red)
Power supply	24 VDC ± 15% / P < 50 W
Weight	5,6 kg

- ¹⁾ Extended measuring distance with restricted measurement uncertainty of 0.1%
- ²⁾ Deviation of the sensor characteristic for speed respectively length from a straight line, bigger than 15 m/s extended area with 0,1 %
- ³⁾ Statistical probability 2 sigma, distribution measured at 5 m/s
- ⁴⁾ Testing condition: metal surface, 10 m reference length, basic measuring distance 300 mm, temperature = 20 °C (constant), tilting less than 0,1 degree



Product key

ASP-5500-300-X-X-X-X

X	0 - Standard (without protection housing) E - Heavy Duty Version, (Stainless steel protection housing)
X	0 - without direction detection D - with direction detection
X	0 - Standard S - Synchron Version M - Master-Slave Version (with Interface)
X	0 - without Interface I - with interface
	A - Standard Distance Range (300±15mm) R - Long Distance Range (300±30mm)

Most requested system configuration

ASP-5500-300-A-0-0-0-0	Standard Version
ASP-5500-300-A-I-0-0-0	Interface Version
ASP-5500-300-A-I-S-D-0	Synchronous Version with interface extensions and automatic direction detection
ASP-5500-300-A-I-S-D-E	Synchronous Version, Heavy Duty (Stainless steel protection housing)
ASP-5500-300-A-I-M-D-0	Master-Slave-Version with interface extensions and automatic direction detection

Dimensions and Scope of Delivery



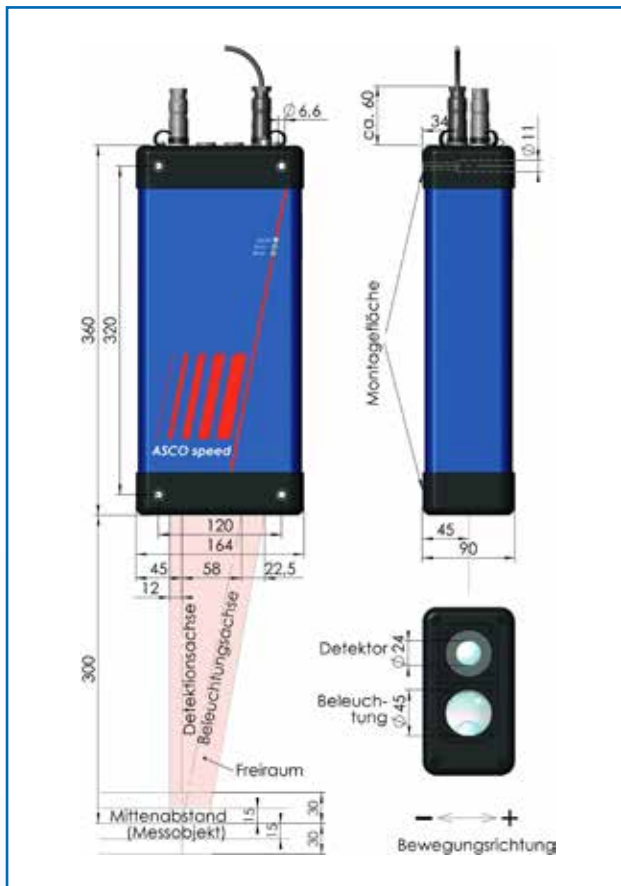
Scope of supply

- ASCOspeed 5500 (various versions)
- Supply cable PC5500-5
- Service cable C5500-5
- cables for interface output IF1 (or IF2, IF3)
- all cables can be ordered with length of 5 m, 10 m, 15 m, 20 m, 25 m or 30 m
- CD with documentation, manual and software ASCOspeed service tool

Accessories

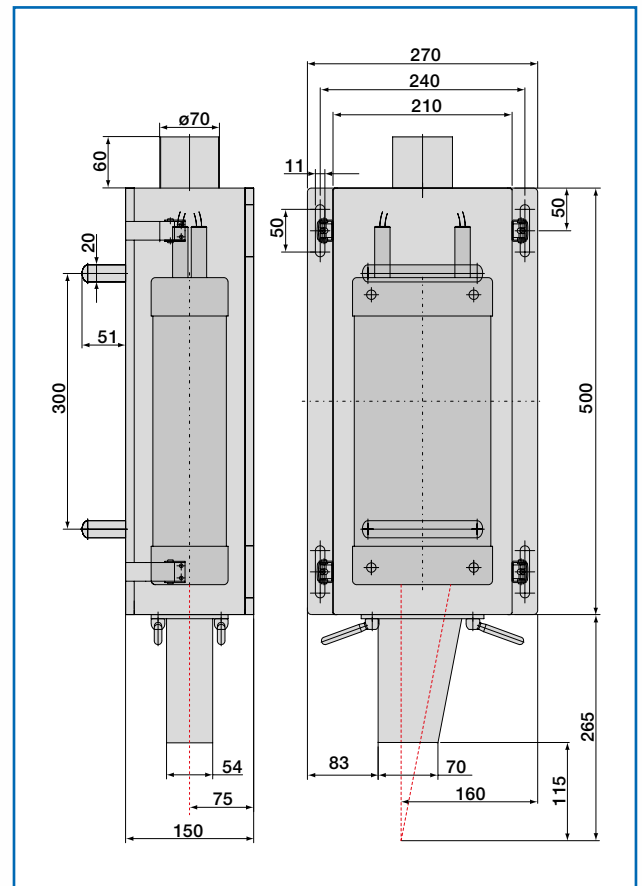
- Interface cable SC5500-nn/IF1(IF2, IF3), with connector and open cable tail
nn - length of 5 m, 10 m, 15 m, 20 m, 25 m or 30 m
Other cable length on request
- Stainless steel protection housing SGH5500 (picture on the left)
Connection for air purging, contains Viton-seals for a usage in rolling mill applications
Reference distance: without tube 265 mm, with tube 115 mm, variable through slots
Weight (with sensor): appr. 33kg

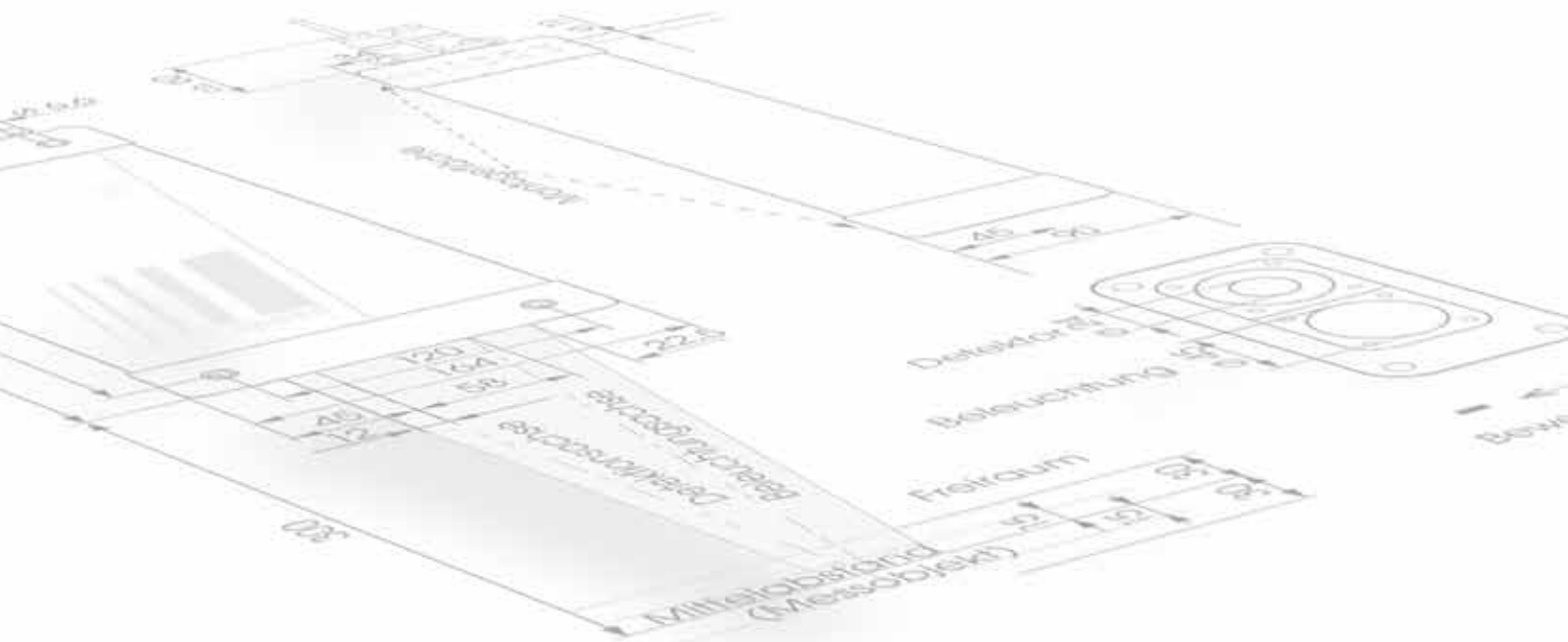
Sensor ASCOspeed 5500-300



Dimensions in mm, not true to scale

Stainless steel protection housing SGH5500





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