

Non-contact Measurement
in Metals Industry



Non-contact Measurement in Metals Industry

The production of steel and aluminium is done in a harsh environment with a lot of dirt, high temperatures and steam or dust. Despite the challenging environment, the demand on product quality often remains on a very high



level calling for the best control technology solutions. This is especially true for the biggest user base, the automotive industry which demands total quality inspection.

The metals industry must therefore provide top quality process management with precise measurements throughout the different production stages.

Once steel or aluminium has been cast, the next forming process is typically hot rolling where slabs are rolled down to a thickness of roughly 5 mm. The material can then be cold rolled down to its final thickness depending on its final use - down to just a few microns in some cases.

Non-contact measurement with Lasers

Optical instruments make ideal process management tools. Based on "non-contact" technology they are both reliable and accurate compared to mechanical tools which rely on physical contact and can stress the material

One of the most important process and automation parameters is the precise measurement of the speed difference of a rolling mill, i.e. the speed change between entry and exit. As no material is lost during rolling, a change in thickness will lead to a change in speed and this speed difference is typically measured by Laser speed gauges using the Doppler principle.

The Doppler Effect

Inside the measuring head - which is typically mounted above the material to be measured - the Laser light source is located. By use of a beam splitter the laser beam is split into two beams with the same intensity. These two beams are adjusted by using optical components in a way that the two beams overlap at the measurement distance.

The Doppler Signal

Whenever two laser beams cross at an angle, optical interference creates a pattern of light and dark stripes ("fringes") in the measuring area. Operation of an LDV is easy to understand if we assume first that a single small particle moves through the stripes. By doing this it alternately reflects light in the illuminated fringes only. The detector picks up this blinking of the particle as it passes through the light fringes and supplies this frequency to the electronic unit.



LDV Velemeter® for Speed and Length Measurement

The current range of standard systems are

Velemeter Series 500 Model A

Velemeter 500 series model A is the standard system used for speed measurement starting from 12 m/min. It is the most economical version of the system and is already ideal for many standard applications.

Velemeter Series 500 Model B

Model B has a built in Bragg Cell option and can be used if there are additional requirements for zero speed or exact length measurement in reversing applications.



Velemeter C

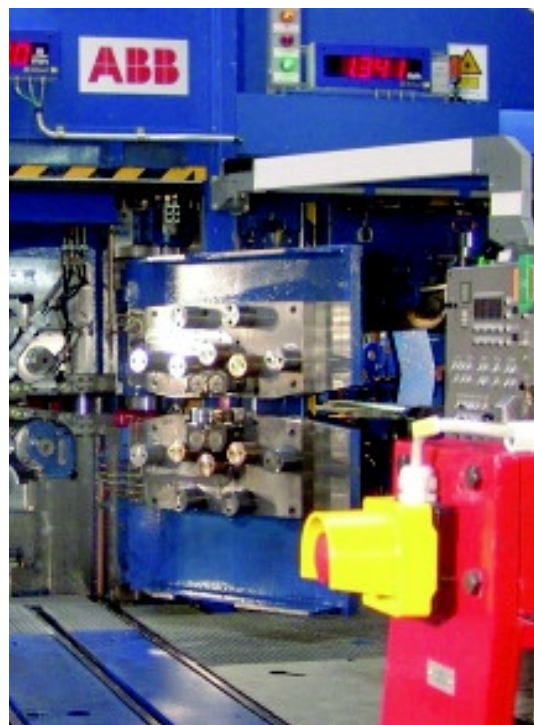
Speed differences in rolling mill application can also be measured by high precision Velemeter® systems. The measurement results are used for mass flow application as well as for elongation ratio measurement in cold mill environment. Additionally to the well established Velemeter 500 series a compact new sensor, Velemeter C is also now available - it is designed for use in or attached to C-frames of thickness gauges and has an integrated angle optic.

This original Doppler frequency is transferred via our pulse output without any modification for evaluation by the user. The Velemeter a measurement device which has no wear and tear, it works with non-contact and is very precise. The advantage is the high repeatability of better than 0.01 %.

Laser Tubes with constant wave length

Doppler measurement is based on frequency measurement. Therefore it is essential to have a Laser light source which is absolute stable over its life time. Only HeNe Laser Tubes guarantee a stable Laser frequency as they produce coherent and mono-mode waves.

Laser diodes are not recommended for precise Doppler measurement because of there multi-mode light.





Non-contact Speed and Length Measurement with Velemeter Series 500

During the last years, the use of non-contact laser-technology in cold rolling mills has become well accepted by both line-builders and end users. The introduction of laser technology resulted in a significant breakthrough for mass flow control. It is possible to control the mill



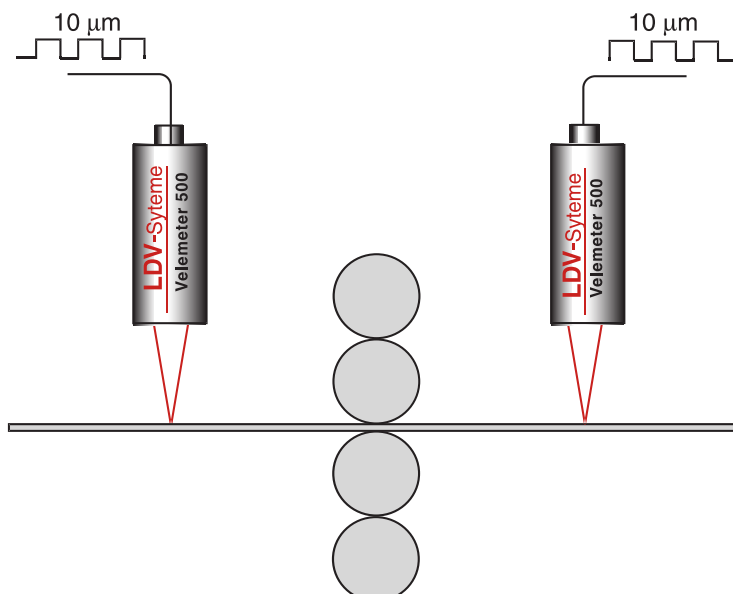
gauge in a way that variations in the thickness of the material at the entry side are eliminated in the mill by using the material speed and the measured thickness for mass flow control. New material demands and ever increasing requirements on process control mean the old mechanical detectors type systems are no longer state-of-the-art.

The main applications for mass flow control are in the aluminium and stainless steel industries. The VELEMETER LV 500 is well adapted for both material types.

Mounting and Cooling of Velemeter 500

The gauge head is typically integrated in the extractor hood at the entry and exit side where the thickness gauges are also installed. In some applications, the gauge head is equipped with an angle optic, so that it is possible to mount the gauge head at the same c-frame as the thickness gauge. In order to keep an optical instrument running under rolling mill conditions, it is absolutely essential to take care of the environment. For cooling purposes the gauge head is equipped with a liquid-cooled housing which can be supplied from existing cooling facilities or with its own temperature control device or chiller. The VELEMETER LV 500 is also able to use the emulsion which is used at the mill for cooling. The laser itself must also be able to see the material under all rolling conditions and an air purging device is also therefore included.

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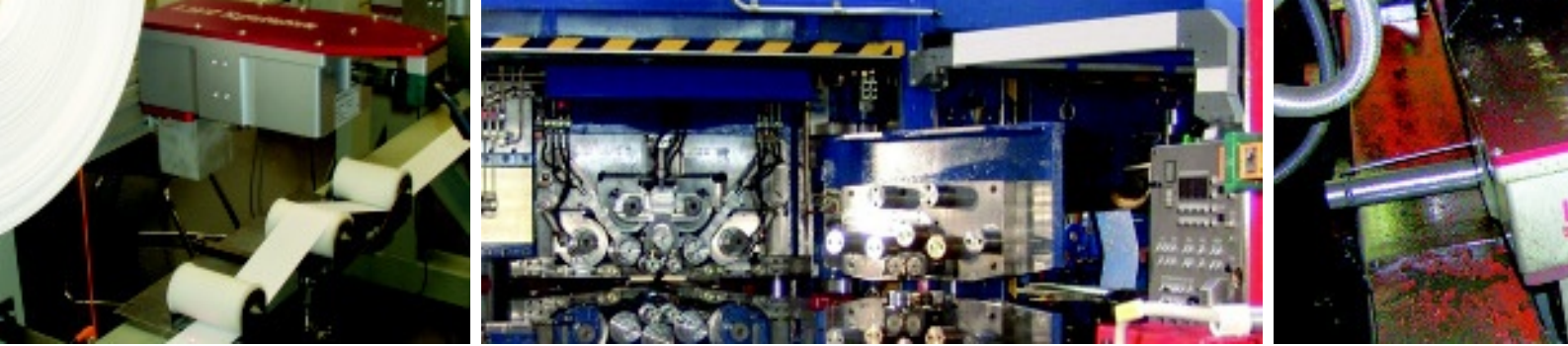
Velemeter 500 – in New Mills or for Revamp

As the mass flow control itself is typically supplied by the contractors for the electrical part of the mill, it is necessary to connect the VELEMETER Model 500 to a host computer. For this reason, the system has a standard pulse output with a resolution of 10 μm .

Since nearly all new rolling mills nowadays have built-in lasers, many users of older mills are looking to re-equip their existing equipment with new measuring and control technology to maintain competitiveness. Laser measurement is a vital factor for survival in today's fierce competition. With the 500 Series two systems with different features are available to make retrofits and upgrades as easy as possible.

Technical Data Velemeter 500 Series

Measuring range	12 – 3000 m/min, optional 0 – 3000 m/min
Length measurement range	unlimited, min. resolution 10 μm
Stand-off distance	1000 mm standard 500 mm – 2000 mm optional
Depth of field	± 50 mm at 1000 mm stand-off
Accuracy	$\pm 0,05$ %
Repeatability	$\pm 0,01$ %
He / Ne-Laser	632.8 nm, red, visible
Guaranteed lifetime	5 years
Voltage supply	110 / 230 VAC, 50/60 Hz
Ambient temperature	5 – 40°C without cooling
Cooling at t >40°C	3 l/min with t of cooling liquid < 30°C
Protection	IP 67, resistant against kerosene
Air supply for air wipe	10 m ³ /h free of oil and water
Output of length	ca. 10 μm pulses as a standard output
Additional outputs	optional via RS232 converter or optional via PC with all standard PC-outputs



Velemeter® C – the Compact Solution for Speed and Length Measurement

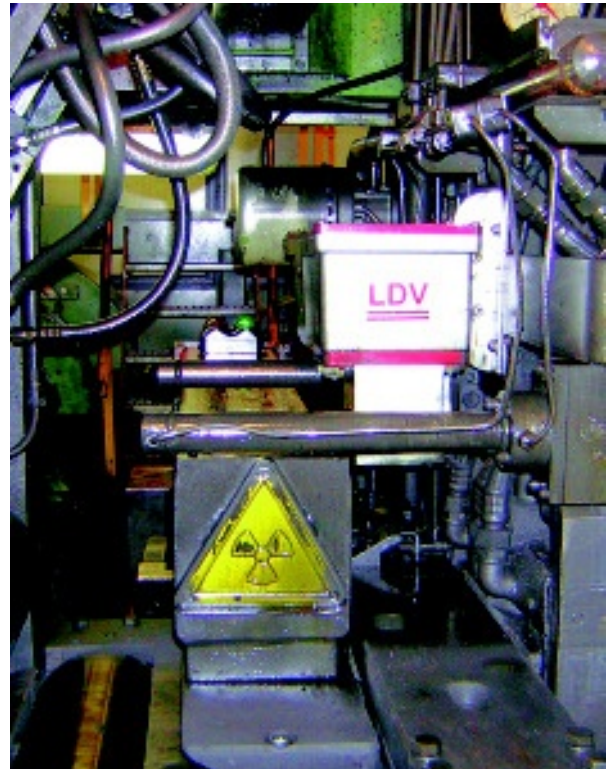
The Velemeter® C provides highly accurate speed and length measurements with all the advantages of non-contact laser based measuring equipment. The sensors are used in mass flow application as well as for elongation measurement.



As a supplementary sensor to the well established Velemeter® 500 series, the Velemeter® C is the more compact version but also makes use of the advantage of a He/Ne Laser tube.

The Velemeter® C is designed for use in or attached to C-frames of thickness gauges and has an integrated angle optic. The sensor head is mounted perpendicular to the direction of movement of the material, usually at a standard stand-off distance of 450 mm but also provides every stand-off distance between 300 and 1500 mm to allow easy installation at the mill construction.

The digital signal converter box (DAB) has to be mounted in a cubicle by the user. As basic length and speed information we supply a pulse output. The pulse frequency is equal the Doppler frequency and can be supplied with 2 or 4 channels according to the RS422 standard. This output is compatible to mechanical encoders and it is therefore possible to do an upgrade from mechanical encoders to non-contact sensors and still use the same mill control system.



Advantages Velemeter® C

- | high repeatability < 0,01 % (3 Sigma)
- | high accuracy < 0,05 % (3 Sigma)
- | high resolution with ca. 6 µm per pulse:
 - | the pulses can be divided by factor 4 – 255
 - | full quadrature pulse output if required
- | visible Laser light
- | flexible stand-off (between 300 mm and 1500 mm)
- | low laser power for safety reasons (2 mW)



- | additional advantage because of He/Ne Laser tube:
 - | requires no temperature stabilizing (like Laser diodes)
 - | requires no stabilizing for operating range (like Laser diodes)
 - | absolute constant Laser frequency - no mode hopping
 - | coherent light all over whole life time
 - | guaranteed life time 5 years
 - | no change in specification caused by aging (like semi-conductors do)
- | customized solutions and engineering support



Technical Data Velemeter C

Measuring range *	3 – 3000 m/min
Resolution *	ca. 6 µm
Stand off distance, flexible	300 - 1500 mm
Depth of field *	+/- 10 mm - +/- 45 mm
Accuracy	+/- 0.05 % (3 Sigma)
Repeatability	+/- 0.01 % (3 Sigma)
He / Ne Laser	632.8 nm, red, visible,
Guaranteed lifetime	5 years
Pulse output equivalent to the Doppler frequency	RS 422
Analogue output for signal quality	0 - 10 V / 4 - 20 mA
Diagnose link for service	RS 485
Dimension (L x W x D)	470 x 195 x 139 mm

* depends on the stand off



LDV-Systeme GmbH

Non-Contact Measurement

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Company Profile

LDV-Systeme GmbH was founded in 1999 in the technology centre of Kamen. The company develops, produces, sells and supports systems for non-contact speed and length measurement based on Doppler principle. These systems are used for mass-flow control as well as for elongation measurement in all kind of hot and cold rolling mill applications.

The high motivated staff is experienced in industrial measurement techniques and serves our customers as a skilful partner for non-contact measurement applications.

Additionally LDV-Systeme GmbH is a sales and service partner of Mesacon Messelektronik GmbH Dresden for their thickness gauges based on optical, isotope or x-ray principle and for Shapeline AB for their optical flatness measurement systems.

LDV-Systeme GmbH works according to the quality standard DIN EN ISO 9001:2015 and holds also the GOST-R certificate.

