Applied measurement technology at MEFOS

MEFOS – Metallurgical Research Institute AB
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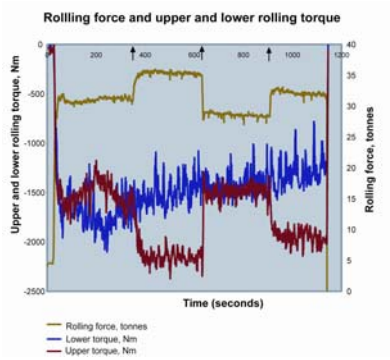
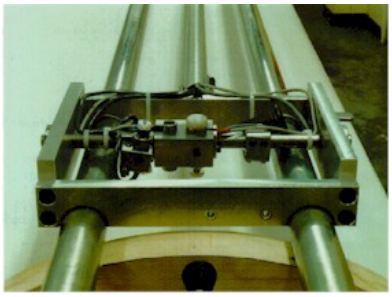
Applied measurement technology

MEFOS offers custom-designed measurement applications for the metal-producing industry, the energy sector and the recycling industry. We have gained a profound experience and knowledge in areas such as:

- Gas analysis 3
- Inspection technology in hot environment 7
- Gauge and position measurements 9
- Image and signal processing 11
- Load determination 14
- Vibration sampling and analysis 15
- Speed determination 16
- Dust sampling and analysis 17
- Temperature determination 18
- Liquid metal sampling 19
- Straightness measurement 20
- Strip flatness and strip/roll profile measurement 21
- Cold rolling friction tests/measurements 24
- Geometrical shape measurement 26
- Portable data acquisition equipment 28





The environment for applying measurement technology often consists of dust, extreme heat, water and steam, 24 hour operation and the demand for fast response to the process. The precision needed for the measurements varies with the process and usually it has to be high.

Based on experience from many research and development projects MEFOS's skill in this field has grown and this expertise is now offered to the industry.

Evaluation of measured values is sometimes directly coupled to the measurement equipment but MEFOS can always offer in-depth analysis or modeling based on the measurements or together with other processes related data in accordance with the customer demand.

Gas analysis

At present MEFOS uses mass spectrometers as well as infrared and paramagnetic principles for continuous gas analysis, as well as tunable laser technology. A very important part for durable gas measurement systems is the design of the gas measurement probes where MEFOS has a great deal of experience of designing, manufacturing and installation. Below is an example of a probe mounted in a gas channel for hot gas.

To be able to serve as mobile measuring units, cabinets with analysis of CO_2, CO, O_2, H_2 and cooler have been developed. A system controlled by a PLC purges the tubes from the sensors for the purpose of cleaning.

Mobile cabinet with conventional gas analyzers, gas cooler and PLC controlled purge system

Example of measurement probe mounted in a waste gas channel

Technical specification

Type	H&B URAS 3G	H&B Magnos	H&B Caldos 4 T
Principle	Infrared analyser	Paramagnetic analyser	Thermal conductivity
Gas	CO, CO_2	O_2	H_2
Number of analyzers	4	2	1
Measuring range	0-30 %	0-30 %	0-10 %
Suitable application	Flue gas	Flue gas	Flue gas

Mass spectrometry

With mass spectrometers virtually all gaseous molecules can be identified. This measuring technique is thus well suited for a number of applications with special emphasis on environmental issues like for example “Sniffing” of waste water gives direct information of the content of dangerous elements. Continuous measurement of gas analysis during process operation gives immediate information of the waste gas composition. This information is fed back for the optimal operation of different processes. A preheated probe is used for measurement of gases which has high condensation temperature. It is also possible to measure at four different positions at the same time.

Measurement setup with the mass spectrometer

Mounting of a probe on a waste-gas channel

Water-cooled probes

- On-line analysis of gas components.
- Two mass spectrometers in one: EI-MS* and SI-MS**.
- Measurement range from 100 % down to ppb levels.
- Gas sampling with a probe developed for extremely harsh conditions.
- Direct analysis at high temperatures and low pressure

***EI-MS: Electron Impact Process**, sampling gas is ionized with 70 eV
****SI-MS: Soft Ionising** by primary ions with different energy levels

Technical specification

Type	V&F Airsense EI-MS	V&F Airsense SI-MS
Mass range	0-100 amu	0-500 amu
Measurement range	0-100 %	0-100 %
Detection limit	< 0.002 % hydrogen	< 10 ppb benzene
Zero noise	<10 ppm	< 5 ppb
Accuracy	< ± 2 %	< ± 2 %
Heated measurement probe	< 300 °C	< 300 °C

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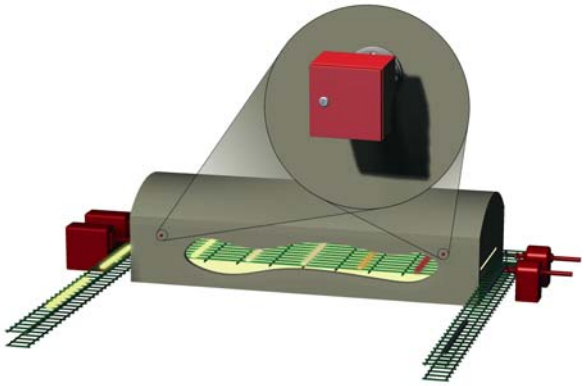
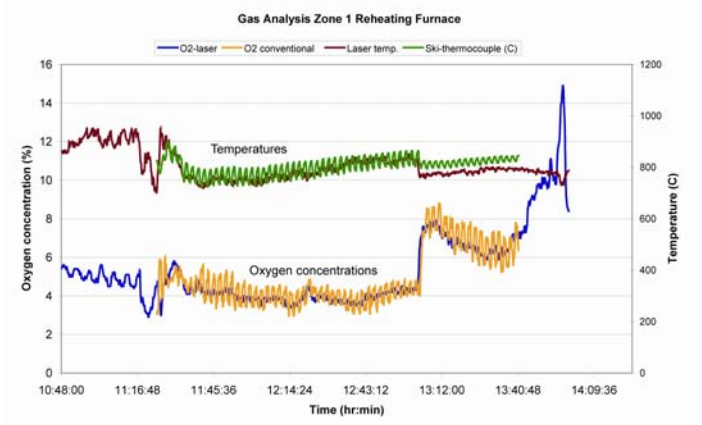
TDLAS

TDLAS (tunable diode laser absorption spectroscopy) is an excellent technology for gas and temperature analysis in metallurgical production units such as reheating furnaces. Especially the scale formation on stock can be affected by controlling the furnace atmosphere.

Cross duct measurement set-up with transmitter and receiver.



Reheating furnace with TDLAS in two positions simultaneously measuring oxygen and temperature.

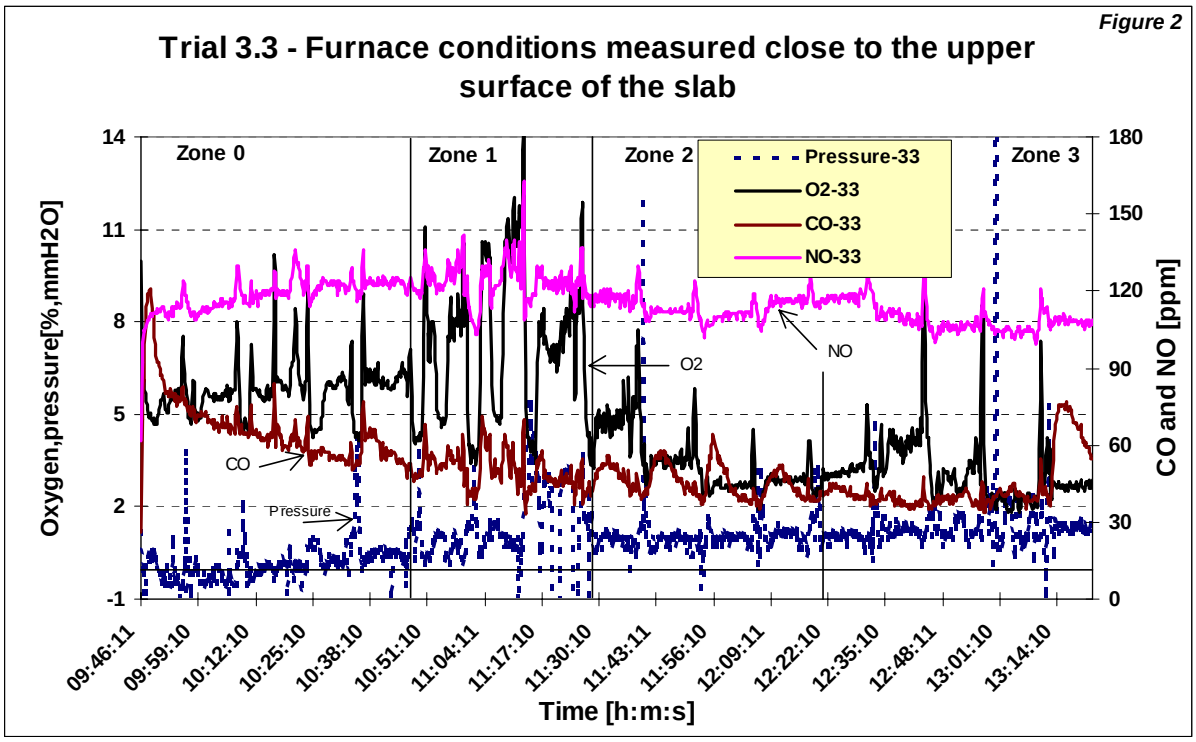


Technical specification

Type	Siemens LDS 3000+ (oxygen)				
Number	1				
Measuring range	0-10 vol %				
Path length	1 m				
Accuracy	**100 °C** ±0.07 %	**300 °C** ±0.10 %	**600 °C** ±0.10 %	**1 000 °C** ±0.14 %	**1 500 °C** ±0.20

Combustion gas analysis in reheat furnaces

Extractive gas analysis is possible along the length of steel reheating furnaces. MEFOS has a KM 9006 Quintox electrochemical gas analyser from Kane May. This analyser can measure four gas components, oxygen, carbon monoxide, nitric oxide and sulphur dioxide. The furnace gas pressure can also be measured using a HM28 differential pressure analyser. This data can be valuable for better understanding and controlling the combustion process and scale formation on the steel. The figure below shows measurements made in MEFOS WBF in an earlier ECSC project.



Technical specifications

Type	KM 9006 Quintox			
Gases	O_2	CO	NO	SO_2
Range	0-25%	0-4000 ppm	0-1500 ppm	0-500 ppm
Accuracy	±0.2% in readout	±5% for 400-2000 ppm	±5% for >100 ppm	±5% for >100 ppm

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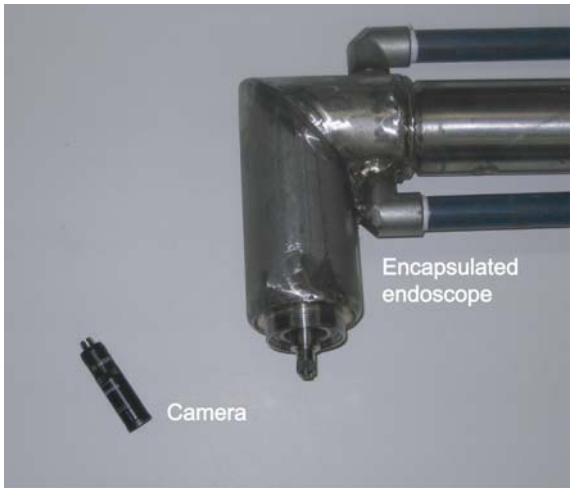
Inspection technology in hot environment

Endoscope technology

MEFOS have developed endoscope technology which can be used in hot area locations which otherwise cannot be inspected without stopping continuous operating processes.



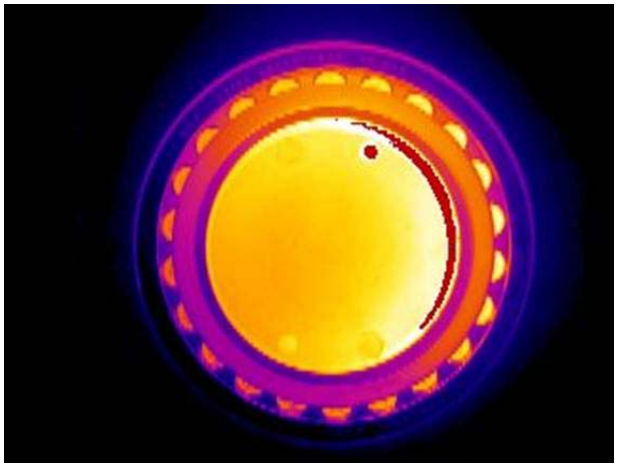
End piece 90 degree angled for the endoscope

Technical specification

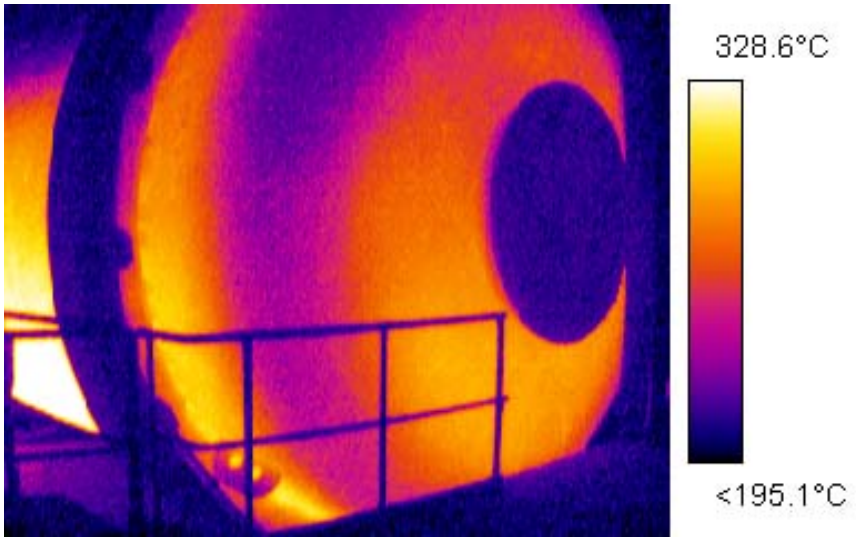
Type	MEFOS
Number	1
Measuring sensor	½" IT-CCD
Lens	48.2° (H) x 36.4° (W) 7.5 mm lens
Shutter speed	> 1/10 000 s
Temperature range	< 1 700 °C
Suitable application	High temperature processes
Air consumption	150 l/h
Water consumption	150 l/h

Infrared camera

MEFOS uses infrared camera for analysis of different process applications. The IR-camera can be used for different types of analysis. Two examples are shown below.



Mounting of a preheated bearing on a shaft. As can be seen there is a temperature asymmetry which leads to an oval bearing that is difficult to mount on the shaft.



A metallurgical reactor with temperature gradients dependent on process situation and abrasion of the lining.

Technical specification

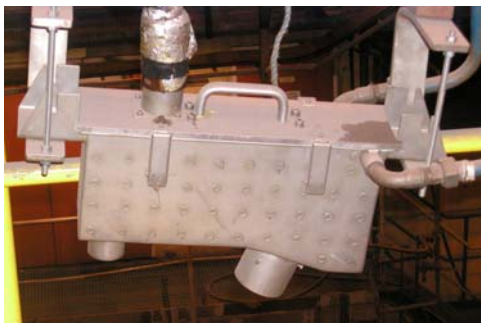
Type	Agema Thermovision 550
Number	1
Measuring range	3.6–5 μm, -20–1500 °C
Lens	10, 20, 40°
Signal	5.5 pictures/s
Temperature range	15–50 °C
Suitable application	Analysis of objects emitting IR radiation

Gauge and position measurements

MEFOS uses both contact and non contact measurement technology for position measurements. Linear variable differential transformers (LVDT) are used as well as laser triangulation technology. The lasers are protected by a cooling box and can be mounted 150 mm from the liquid steel for measurement of the bath level without being overheated. Another example of non contact measurement is shown in the picture below.

Laser

Laser sensor measuring slab position



Encapsulated and water-cooled laser triangulation sensor

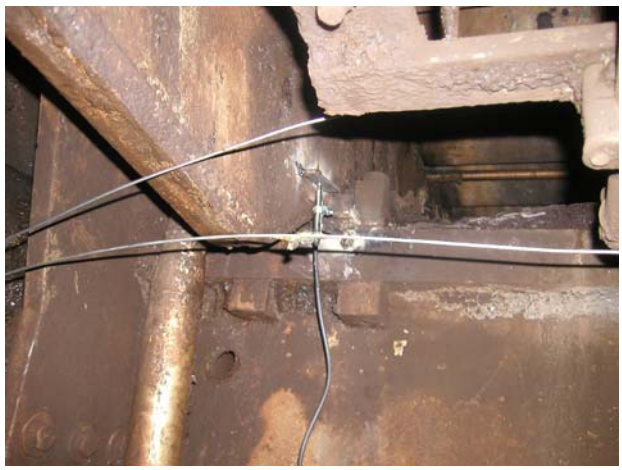
Technical specification

Type	Selcom optokator 2203	Selcom SLS6000-375/1000 mm
Number	1	1
Measuring range	200 mm	375 mm
Stand off	325 mm	1000 mm
Temperature range	Water and air cooled	Water and air cooled
Suitable application	Non contact liquid metal levels	Non contact position measurements of hot objects

LVDT (Linear Variable Differential transformers)

Position measurement in harsh environment needs very robust sensors which can handle heat, water and dust. One of the most difficult environments for measurement is the cooling chamber in a continuous casting machine. MEFOS uses position sensors which can handle this tough environment for measurement campaigns.

Example of position sensor used



Example of measurement application for a position sensor

Technical specification

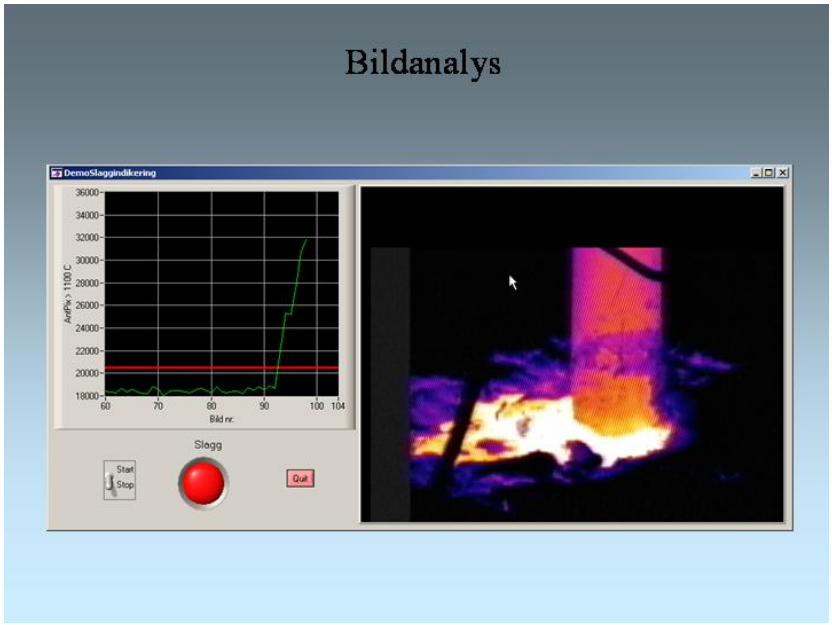
Type	D5/100W LVDT with spring action	D5/200W LVDT with spring action
Number	4	6
Measuring range	±2.5 mm	±5.0 mm
Temperature range	-20–125 °C	-20 – 125 °C
Suitable application	Stability and position measurements in harsh environment	Stability and position measurements in harsh environment

Image and signal processing

Image processing can be made both with IR-camera and Video cameras.

One example of an application is shown below. A signal processing system is illustrated for indication of slag carryover from the ladle to the tundish in continuous casting. The system reacts on the increased light and changed emissivity from the slag floating up around the shrouding tube. In the diagram to the left, a green line passes the red line which is the allowed limit, and at the same time the operators attention is activated by an alarm.

Other applications are indication of slag carryover from converter to ladle.



Viewing screen for slag indication by image processing

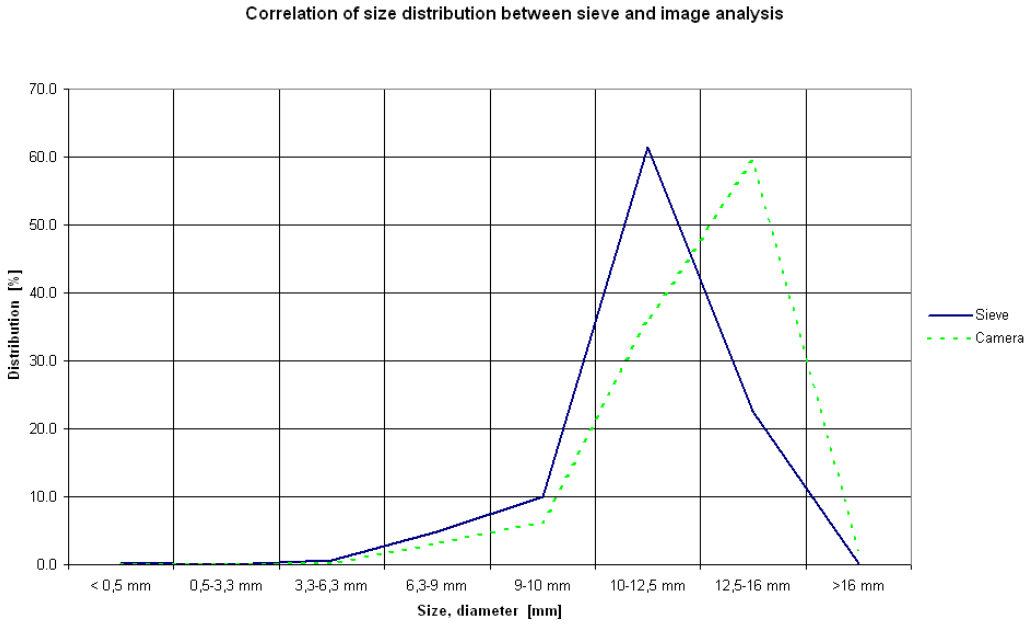
Technical specification

Type	Agema Thermovision 550
Number	1
Measuring range	3.6-5 μm, -20–1500 °C
Lens	10, 20, 40°
Signal	5.5 pictures/s
Temperature range	15–50 °C
Suitable application	Analysis of objects emitting IR radiation

Online analysis of the fraction of material transported into a process is carried out by process imaging of material falling at the end of a conveyor belt. One example of an application is shown together with the size distribution of the material.

A set of lights mounted together with the video camera

Example of measurement situation at the end of a conveyor with material falling over. The image processing system counts the size and amount of pieces falling down for further analysis.



Correlation between sieve analyse of samples and measured size of gravitational flow with image analysis

Technical specification

Type	Digital CMOS area scan monochrome 1.3 Mpixel
Signal	500 frames/s
Temperature range	0-50 °C
Suitable application	Dynamic motion inspection

MEFOS uses inclinometers for the measurement of the inclination angels for different subjects. One example of application is the analysis of the movements of the narrow and wide faces in a continuous casting mould.

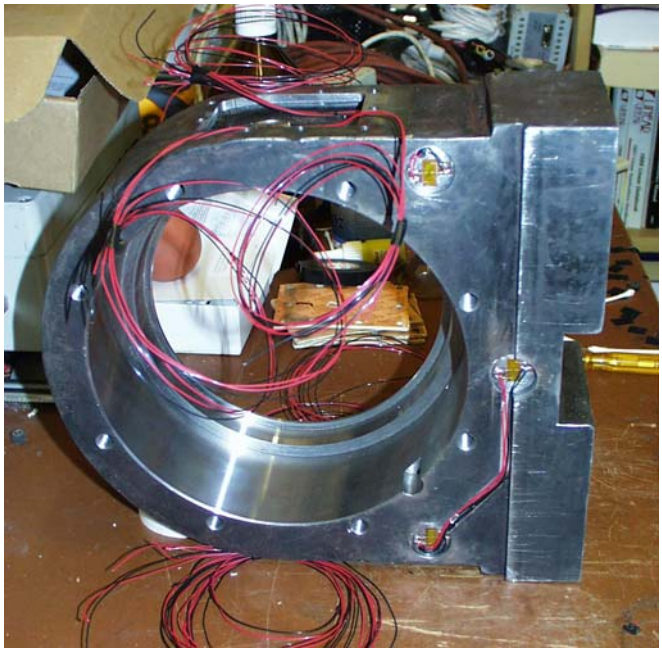
Inclinometers fixed to mounting brackets for easy handling

Technical specification

Type	Inclinometer Schaevitz LSRP 3	Inclinometer Schaevitz LSOC 1
Number	5	2
Measuring range	±3 degrees	±1 degree
Temperature range	-20–50 °C	-20–50 °C
Suitable application	Stability measurements	Stability measurements

Load determination

Strain measurements are used to determine load on different machine elements where it is difficult and costly to mount load cells. If necessary, FEM analysis is provided to indicate the most suitable location for the mounting of the strain gauges. Calibration is carried out with hydraulic jackets to get the absolute load.



Bearing housing with strain gauges mounted

Roller apron with hydraulic jacket set-up for calibration of strain gauges

Technical specification

Type	Strain gauges from HBM
Number	Defined for the …… application
Measurement range	“
Temperature range	“
Suitable application	Strain and load analysis

Vibration sampling and analysis

MEFOS has sensors both for contact and non contact measurements of vibrations.

The analysis of measurements is carried out with software package from National Instruments, Lab-View and Lab-Windows.

Accelerometers mounted by magnetic force

Technical specification

Type	Accelerometer ICP 625B02
Number	2
Measuring range	±10 g, approx. 98.2 m/s^2
Temperature range	−65−250 °C
Suitable application	Analysis of dynamic process

Example of an application for contact-free vibration measurement.

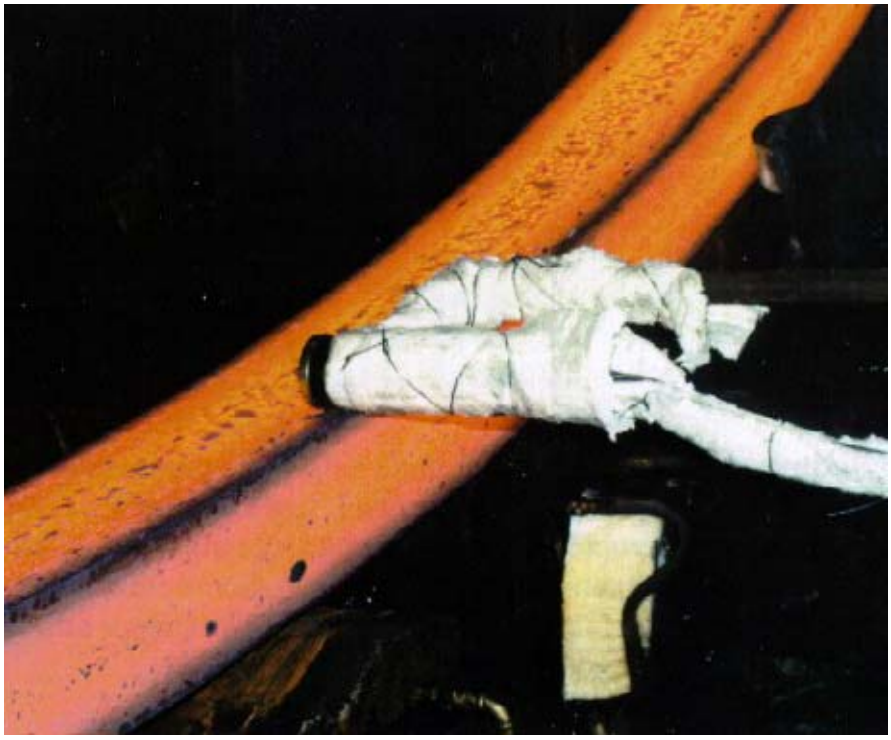
Technical specification

Type	Polytec laser vibrometer CLV700−V25, CLV800-V25 and CLV1000-CLV050
Number	1
Max velocity 0-peak	0-500 min/g
Temperature range	0-40 °C
Frequency range	0-50 kHz
Suitable application	Non contact measurement of dynamic process

Speed determination

Accurate speed measurement is of vital importance for many processes which need an accurate mass flow for the next process step. Pulse transducer is the most common way to measure speed. For non-contact measurement laser doppler technology is the most common technology.

To analyse continuous casting a set of speedometers has been developed with a very high resolution.



Speedometer mounted for measurement analysis of bloom speed at CC

Technical specification

Type	MEFOS design, 20 000 pulses/rev
Measuring range	±10 m/min
Number	3
Temperature range	water and air cooled for CC application
Suitable application	Continuous casting (CC)

Dust sampling and analysis

Measurement of the emission of particles from different processes is often an important parameter for the optimization besides the environmental aspect of minimizing dust emission. The dust concentration in a gas flow is determined by a sample from a probe inserted in the off gas channel. The gas sample is filtered and its gas volume measured. The concentration of dust is determined by the increase of the weight of the filter. The filter can also be analyzed on its content of different elements.

Dust sampler

Technical specification

Type	METLAB, Isokinetic dust sampler. Modified by MEFOS.
Number	1
Measuring range	5.6 m^3/h at 20 °C
Temperature range	Water cooled probe for hot gas sampling
Suitable application	Both cold and hot flue gas sampling

Temperature determination

Temperature measurement are made using either contact measurements with thermocouples or indirect by measuring emission of infrared light.

For continuous casting pyrometers are specially developed for measurement in a cooling chamber of a continuous caster. The visibility tube which has a cleaning gas for protection of water and damp is close to the measurement object.

Four pyrometers developed for temperature measurements in continuous casting machines

Measurements with thermocouples have many applications, some which need very high accuracy for example when collecting temperature data for calculation of heat flows. The mounting of the thermocouples is often very important in order to get useful information for the appropriate analysis of the results. This is especially the case for temperature measurements in gas streams.

Technical specification

Type	Impac, IS2 SP/SG Infratherm. IR-camera
Number	5
Measuring range	650-1300 °C
Temperature range	max 65 °C
Suitable application	Surface temperature measurement at CC

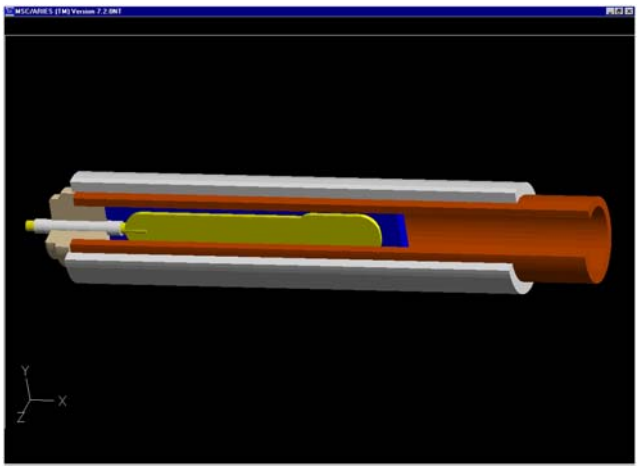
Liquid metal sampling

MEFOS has developed the TIC sampler and the LSHR sampler for the assessment of inclusions in steel, both of them to be found on the market. The LSHR method comprises not just the sampler but also a complete system including sampler, sampling equipment and sample post treatment. The inclusion assessment is best achieved with conventional ultrasonic technique even though SEM and light optical microscopy are possible techniques to use. The sampler is a well suited tool for the assessment of semi-macro and macro inclusions in clean steels. Furthermore, the so-called inlet pin of the LSHR sampler has shown to be an excellent sample for total oxygen analysis, a sample with an extremely low variation in total oxygen along the pin. The sampler is designed for sampling in ladles, tundishes as well as casting moulds. The development of the LSHR method introduced the use of argon and the exclusion of the sampler slag cover, which is now becoming a standard procedure in the steel business.

Furthermore, samplers for sampling of samples for direct analysis with Laser ablation technique have also been developed. The use of Laser-OES sets new demands on the sample in terms of design, homogeneity and surface quality. The LSHR method has been further developed to meet the new set of demands, resulting in a method to sample steel with high sample quality. The steel samples can be used as production control samples and together with a fast sample preparation method, shorten the overall delay time for the analysis.

For optimization purposes MEFOS has done practical tests with different sampling techniques as well as theoretical analyses including CFD modeling of the sampling process.

In addition MEFOS has also participated in projects regarding sampling of glassy slag samples. The use of laser together with the OES-Technology gives the opportunity to analyze slag, which was impossible before.



Cutaway view of a LSHR sample probe, showing sample (yellow), sample mould (blue), silicon glass tube and the anti-splash cover (grey), sintered sand (beige) and inally the cardboard tube is in red.

Straightness measurement

Bar and tube straightness meter

MEFOS has developed a fast, reliable inexpensive straightness meter for bars and tubes. The apparatus is available for measurements of dimensions between 80 and 130 mm. The product has been tested in a production line at a rolling mill for a period of time and is now commercially available. During production measurements it was shown that one man needed only 30 minutes to measure the same number of bars as it took two men four hours to manually measure the bar pitch by the use of two rulers.

The equipment is manually operated and can easily be adjusted to different round diameters. It has a built-on electronic device for data acquisition and data processing, which can store measurements from several bars/tubes. The apparatus measures straightness deviations in all directions as well as spiral twist of the bar/tube. The measurement accuracy is far more precise than any known customer demand for this group of products today. All the data can be transferred to a PC and the evaluation can be performed directly on the screen.

The communication is handled by an enclosed software package available for Windows operating systems. Programs for evaluation and plotting of the measurement results are included.

The straightness meter is equipped with special differential transformers measuring the bar curvature in two directions. Properly calibrated the maximum error is a curvature of 16 μm per meter bar length. If the error is systematic this gives a straightness accuracy of 2.5 mm over a bar length of 10 m.

The bar and tube straightness meter

Technical specification

Moving unit	
Weight	23 kg
Length	800 mm
Width	150 mm
2 transformers	±3 mm, acc. ±10 μm
	(optional ±1 mm, acc. ±1 μm)
Electronic device	
Dimensions	200 x 145 x 50 mm
Measuring capacity	100 bars of max 20 m length
Communication interface	RS232
Overall measuring accuracy	
16 μm/m	
maximum 2.5 mm/10 m	

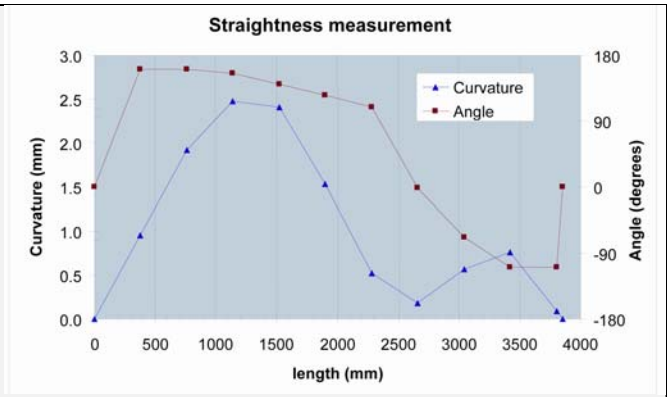


Chart showing the straightness of a measured bar

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Strip flatness and strip/roll profile measurement

Profile/position measurement equipment – Rollprof

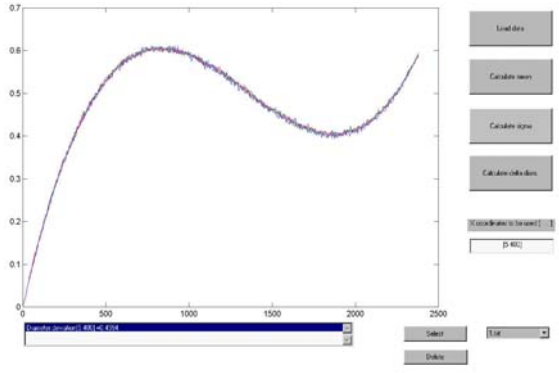
Rollprof is a system for the measurement of profile and length in a workshop environment. Two linear sensors of LDT* type measure the distance, and a pulse wheel measures the length position. The accuracy is high and the system is easy to use.

Rollprof is used when it is desired to measure variations in profiles in a high accurate manner and relate these variations to the position. The instrument can measure diameter variations axially on rolls.

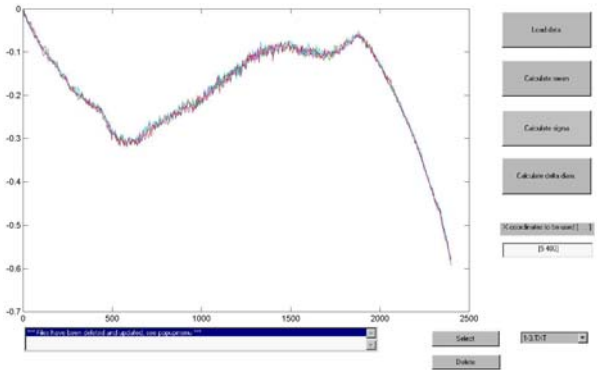
The Rollprof instrument can be connected to a PC. The profile program for the PC can be used to store measured data, to study graphs in detail and to perform calculations. The graphs and measured values can be transferred to word processing and calculation programs (for incorporation in written reports or further calculations).

*Linear distance transducer

Rollprof measurement rig



Measured roll profile of a new grinded work roll

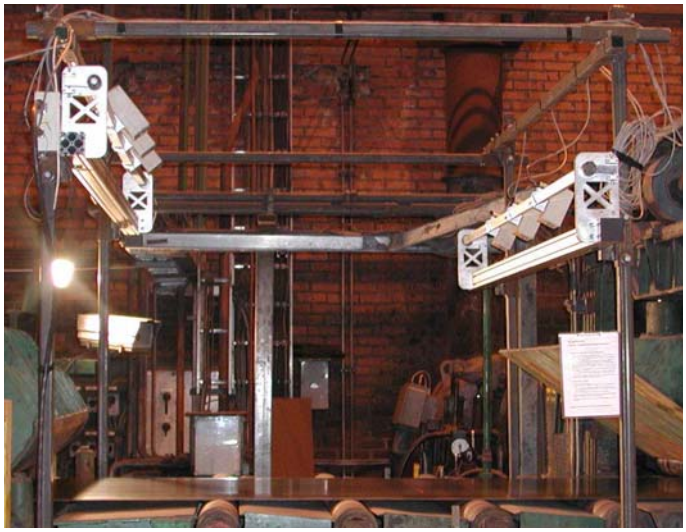


Measured roll profile after a campaign, before grinding

Technical specification

Type	U-Teknik Rollprof
Number	1
Roll diameters	200 – 1600 mm
Distance measuring range	±3 mm (low), ±1.2 mm (high)
Distance reading accuracy	±10 microns (low), ±1 microns (high)
Distance resolution	0.5 mm
Operating temperature	0–50 °C
Position range (resolution)	0–5000 mm (±1 mm)

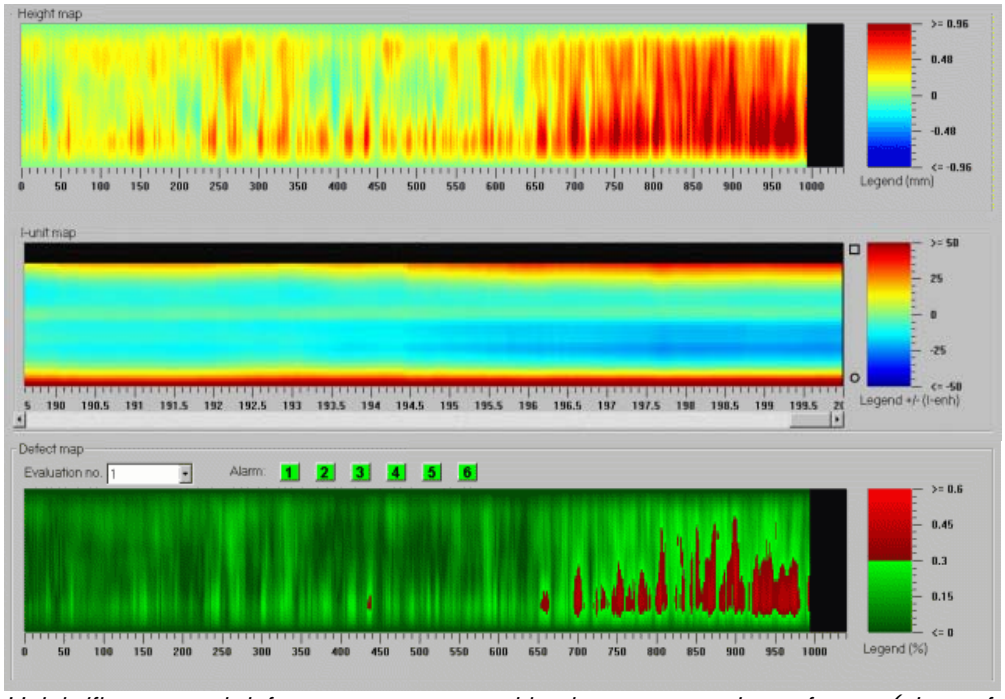
Flatness measurement device



The flatness measuring system at a temporary installation in Rautaruukki's pickling line. MEFOS's demo system has three line lasers (to the right) and three cameras (to the left).

To be able to measure flatness and crossbow in a production line MEFOS hs a "portable" flatness measurement device delivered by Shapeline. The device is frequently used for industrial flatness measurements.

The technology is a further development of the laser triangulation principle. A line laser system projects a continuous line across the material. The laser line is registered with a camera system. A flatness defect is detected as a deviation from a straight line. The out of flatness is calculated and presented with a special software package.



Height/flatness and defect map as presented by the accompanying software. (picture from www.shapeline.se)

The system is flexible and provides a high point density in the width as well as in the length direction for normal line speeds. The device can detect the strip edge. The accuracy of the system is very high but the accuracy depends on the geometry and the conditions at the installation site. The same kind of system is used commercially in industry for tuning of hardening and quenching, quality assurance and tuning of roll and tension levellers.

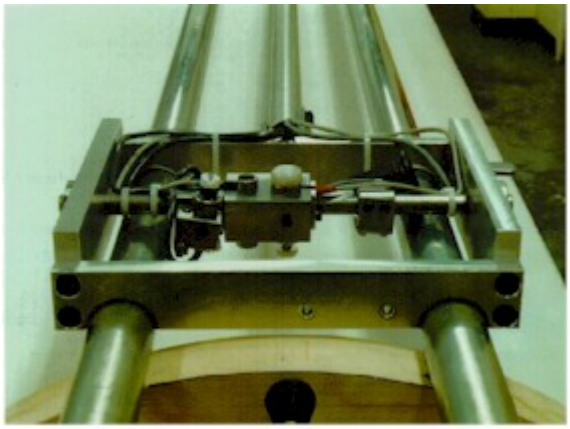
Technical specification

Type	Shapeline Flex demo system
Accuracy	down to a few microns
Width	Up to 3 m, ca 1800 points in width direction
Sampling frequency	Up to 120 profiles/s

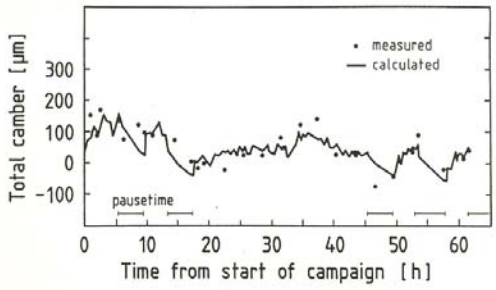
Roll-gap profiler

In order to calibrate on-line models for pass schedules in plate and strip rolling the device Roll-gap profiler for measuring the roll gap has been developed. The instrument measures thermal expansion, wear and surface temperature of the work rolls.

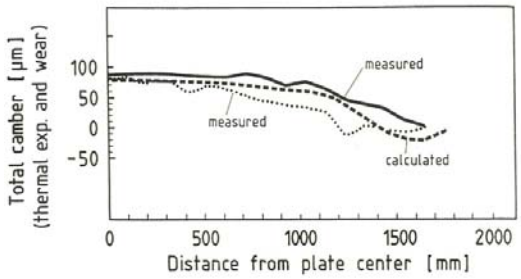
The Roll-gap profiler consists of a measurement rig of two aluminium bars, a contact inductive distance transducers for measuring the roll gap and two thermocouples for roll surface temperature measurements. A measuring wagon slides along the aluminium bars, which ensures good tracking of the equipment during measuring. On the wagon there is also a measuring wheel which gives the position along the work roll face length. All measurements are stored in a measuring interface which can be connected to a personal computer for later analysis.



Roll gap and roll surface temperature measuring device



Measured and calculated work-roll camber vs. time from start of campaign



Measured and calculated work-roll profile (thermal and wear) during a campaign

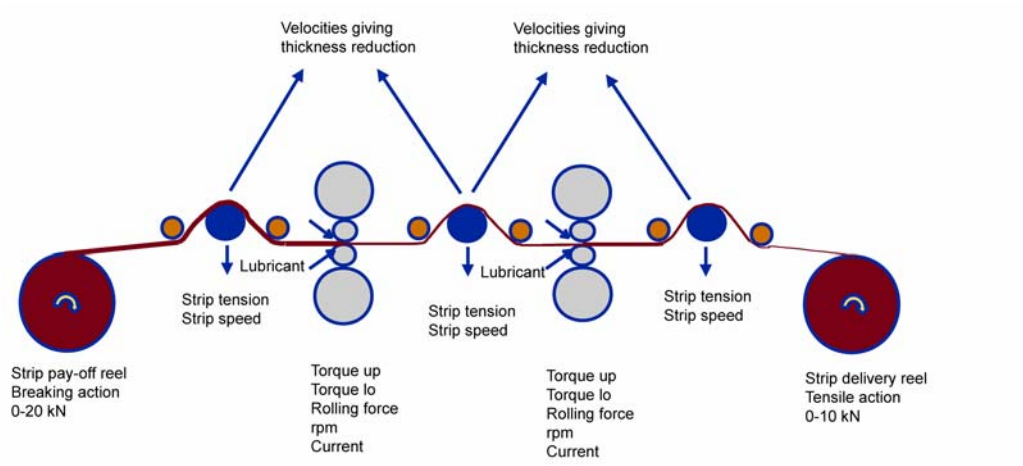
Technical specification

Type	MEFOS design
Number	1
Distance measuring range	±3 mm (low), ±1.2 mm (high)
Distance resolution	±3 microns (low), ±1 microns (high)
Distance accuracy	±10 microns (low), ±3 microns (high)
Temperature range (resolution)	0–100 °C (±1 °C)
Position range (resolution)	0–5000 mm (±1mm)

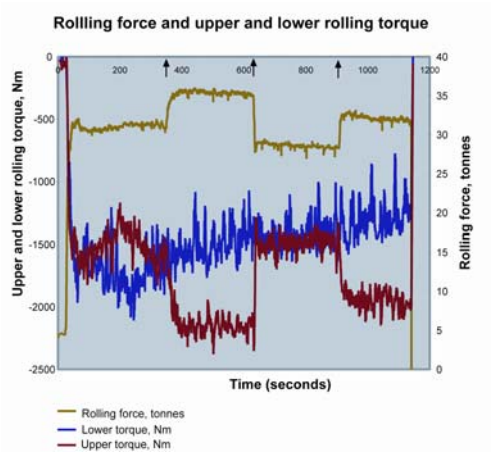
Cold rolling friction tests/measurements

Cold rolling lubricant test method

A full-scale industrial trial can lead to production interruption, and the on-line development of application techniques and evaluation of lubricant performance can lead to high costs. Therefore MEFOS has developed a method for evaluation and testing of cold rolling lubricants in a pilot rolling mill. MEFOS´s three-stand continuous rolling mill with a maximum force of 500 kN per stand is used for the trials. The test programme is based on experimental design, and each lubricant will be subjected to the same test programme. During the pilot mill test, the rolling force, torque, strip speed, strip tension, strip reduction and the strip temperature are logged.



Rolling mill configuration used for lubrication testing



Lubrication test diagram. Four lubricants were applied sequentially and the arrows toward the time axis indicate time of change of lubricant

Nozzle set-up for strip and for roll gap lubrication

Technical specification

Mill Type	2-high and 4-high
Number of stands	3
Force	500 kN
Torque	2 800 Nm (2-high), 875 Nm (4-high)
Roll diameter (work rolls)	150–240 mm (2-high), 40–80 mm (4-high)
Face length	125 mm
Rolling peripheral speed	0–15 m/s
Coiler max. torque	4 000 Nm

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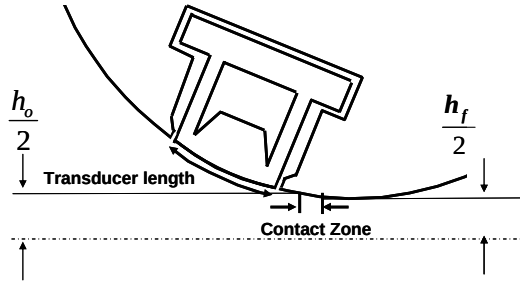
Measurement of normal and friction forces in a rolling process

The transducer before mounting into the roll

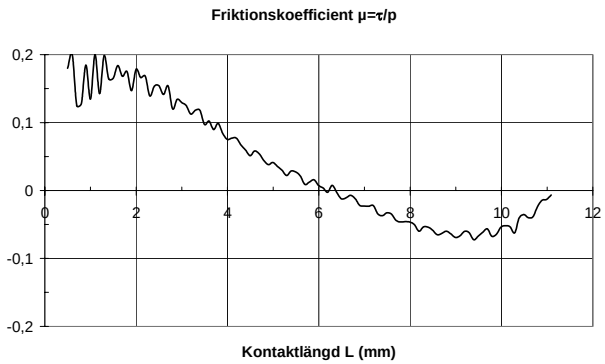


The length of the transducer embedded in the roll exceeds the contact length

To improve the quality of frictional data and to validate the mathematical simulations in rolling, a load transducer for measuring normal and friction stresses in the deformation zone has been developed. MEFOS has participated in the development of a new measuring device for this on-line measurement of normal and friction pressure during rolling. The work has been carried out together with the Technical University in Denmark and Jernkontoret in Sweden. The transducer consists of a strain gauge- equipped insert embedded in the surface of the roll. The length of the insert exceeds the contact length. By analyzing the output from the insert, the friction stress and normal pressure in the contact zone can be determined. The new concept differs from existing pin designs by a lower disturbance of lubricant film and material flow and limited penetration of material between transducer and roll. The transducer is measuring the integrated normal force and friction force at the contact area. A constant situation is expected when the transducer covers the full deformation zone.

The transducer has been tested and calibrated in laboratory scale and mounted into a 230 mm diameter work roll in MEFOS's continuous rolling mill. In one of the figures below the measured normal pressure and friction stress is shown for cold rolling of a stainless steel strip without lubrication.

Work roll with transducer mounted inside. Amplifier and Pocket PC mounted outside the roll. Radio link connection to the Laptop PC



Friction coefficient during cold rolling of 18/8 stainless steel strip from 1.85 till 1.80 mm with a speed of 0.5 m/s. No lubrication.

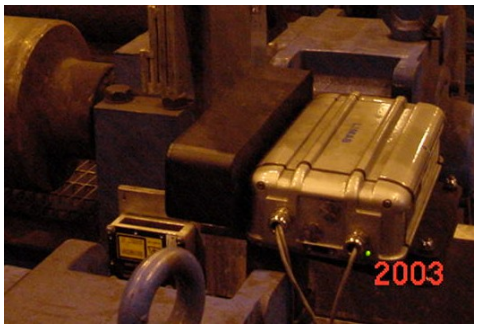
Technical specification

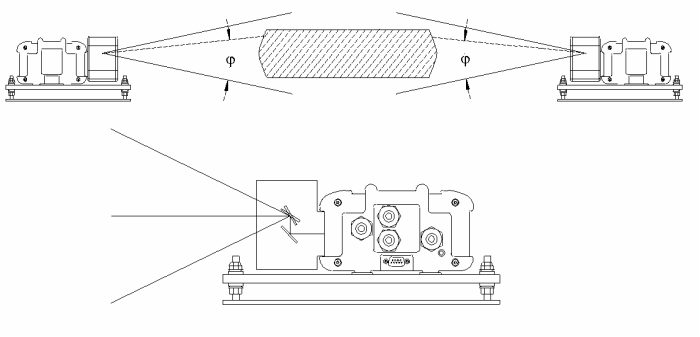
Type	ROLLSURF version 1
Number of stands	1
Force (max.)	500 kN
Torque (max.)	2 800 Nm
Roll diameter	230 mm
Face length	90 mm
Rolling peripheral speed	0-10 m/s
Lubrication	On/Off
Coiler torque (max.)	4 000 Nm

Geometrical shape measurement

Measurement of edge profile, width and thickness

A portable measurement system for measurement of edge profile, width and thickness on slabs, plates, strips or other objects is available at MEFOS. Sensor design and measurement principle is demonstrated below.



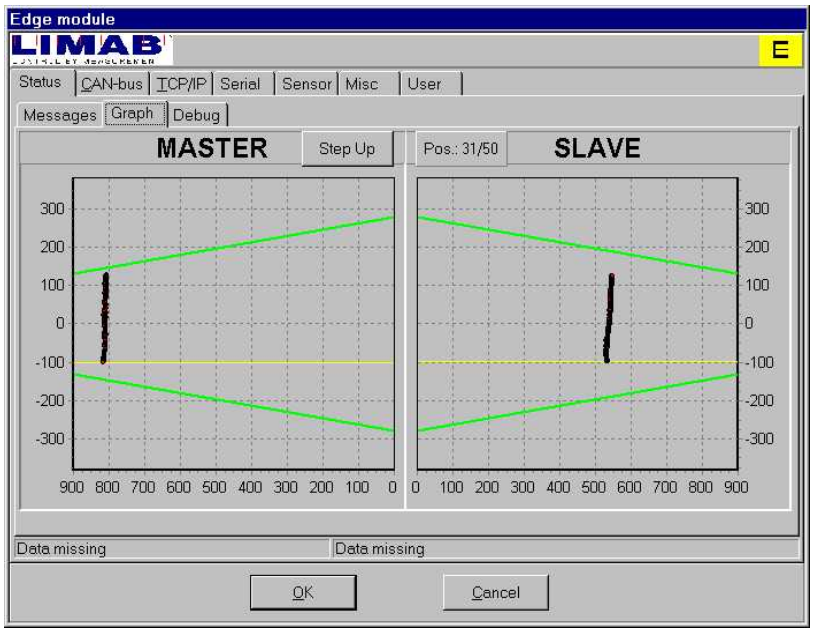


Sensor design and measurement principle

Each sensor measures the distance between the sensor and the measurement object while a laser beam scans the object surface. The measurement result is stored as two vectors containing measurement angle and measured distance. From these values the edge profile, and thickness at the edge can be calculated. If the distance between the sensors is known it is also possible to calculate minimum, maximum and mean width etc.

Technical specification

Type	Sensors: 2 LIMAB Accura 35-2D
Measurement range	750-1 650 mm
Measurement angle	20°
Measurement accuracy, profile	±2 mm



Measurement presentation

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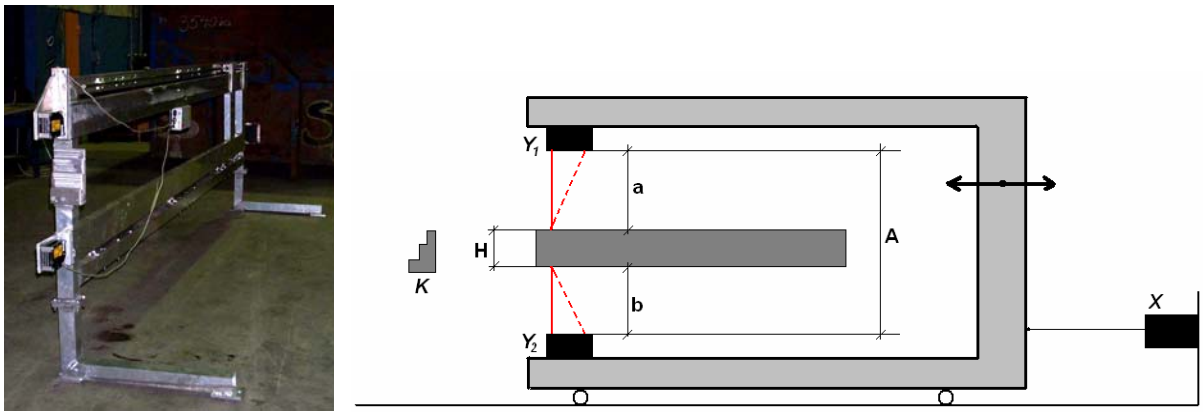
Measurement of thickness and thickness profile

A transportable measurement frame for measurement of thickness and thickness profile on slabs, plates, strips or other objects is available at MEFOS. The design and working principle of the system is presented in Figure 1.



Measurement frame and measurement principle

The height or thickness of the measurement object is given by the following formula

$$H = A - (a + b)$$

where a and b is measured by the sensors Y_1 and Y_2. The distance between the sensors, A, can be measured by positioning the sensors over the calibration piece, K, whose different heights are known. The position of the measurement frame is given by the sensor, X.

The sensors Y_1 and Y_2 are laser triangulation sensors and sensor X is a cable-extension position transducer.

Measurement frame:

Total length	4 100 mm
Total height	1 435 mm
Width including sensor	70 mm
Width range	3 200 mm
Sensor distance	210-600 mm

Sensors Y_1, Y_2: LMI SLS5035/100

Measurement range	82.5-117.5 mm
Measurement accuracy	0.017 mm

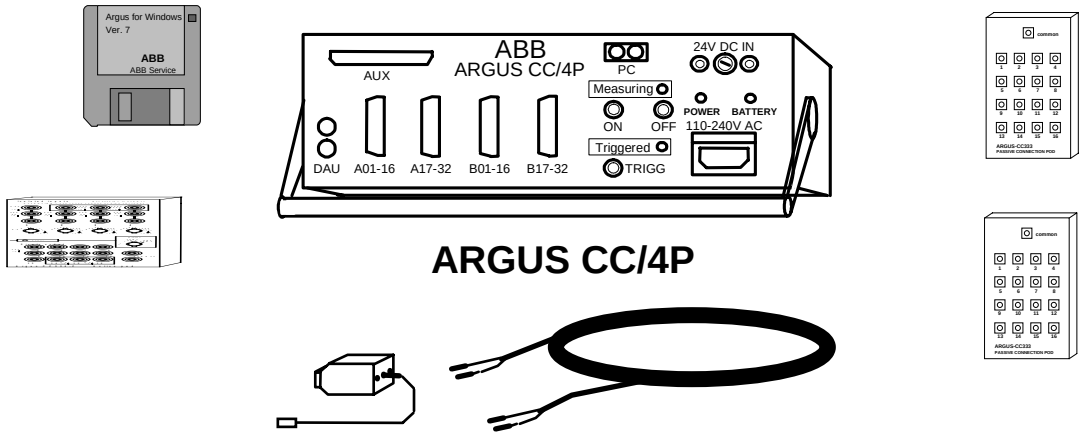
Sensor X: CELESCO PT5DC-25-N34-FR-M0P0-MC4

Measurement range	6 350 mm
Measurement accuracy	6.35 mm

Portable data acquisition equipment

ARGUS

A transportable measurement acquisition system is available at MEFOS. The system is based on ARGUS CC/4 manufactured by ABB.



The components of the ARGUS system

ARGUS CC/4 is a powerful system for collection of data in small or large quantities. The system is complete with hardware and software for connection to any PC with a parallel printer port or a network connection.

The system includes

- one central unit for administration of data acquisition. To the central unit a number of different measurement interfaces, called pods, can be connected. MEFOS's system has the possibility to connect 2 pods with 16 analogue inputs each.
- two active pods with 16 analogue inputs each. Four of the inputs on each active pod are fully isolated and have individual input range selectors for measuring low- or high-voltage signals. For AC a true RMS measurement can be selected. The remaining 12 inputs have fixed gain, but are buffered to increase the input impedance. These pods also have a switch for selection between three different cut-off frequencies (low-pass filter), which is then connected to all the channels.
- two passive pods with 16 analogue inputs each. The inputs on the passive pods have common ground and a voltage range of ±12.5 V.
- one pulse counter card with four double pulse counter inputs for sampling of speed on rotating devices. The pulse counter card is connected to the central unit via a fibre optic cable.

Measurement applications are configured using software running in MS-Windows operating systems. Collected data is transferred to and stored on the PC and displayed during sampling.

A freeware viewer is available for viewing of collected data files and export of data.

Collected data can be exported in different formats for evaluation with standard programs as MS-Excel or MatLab.