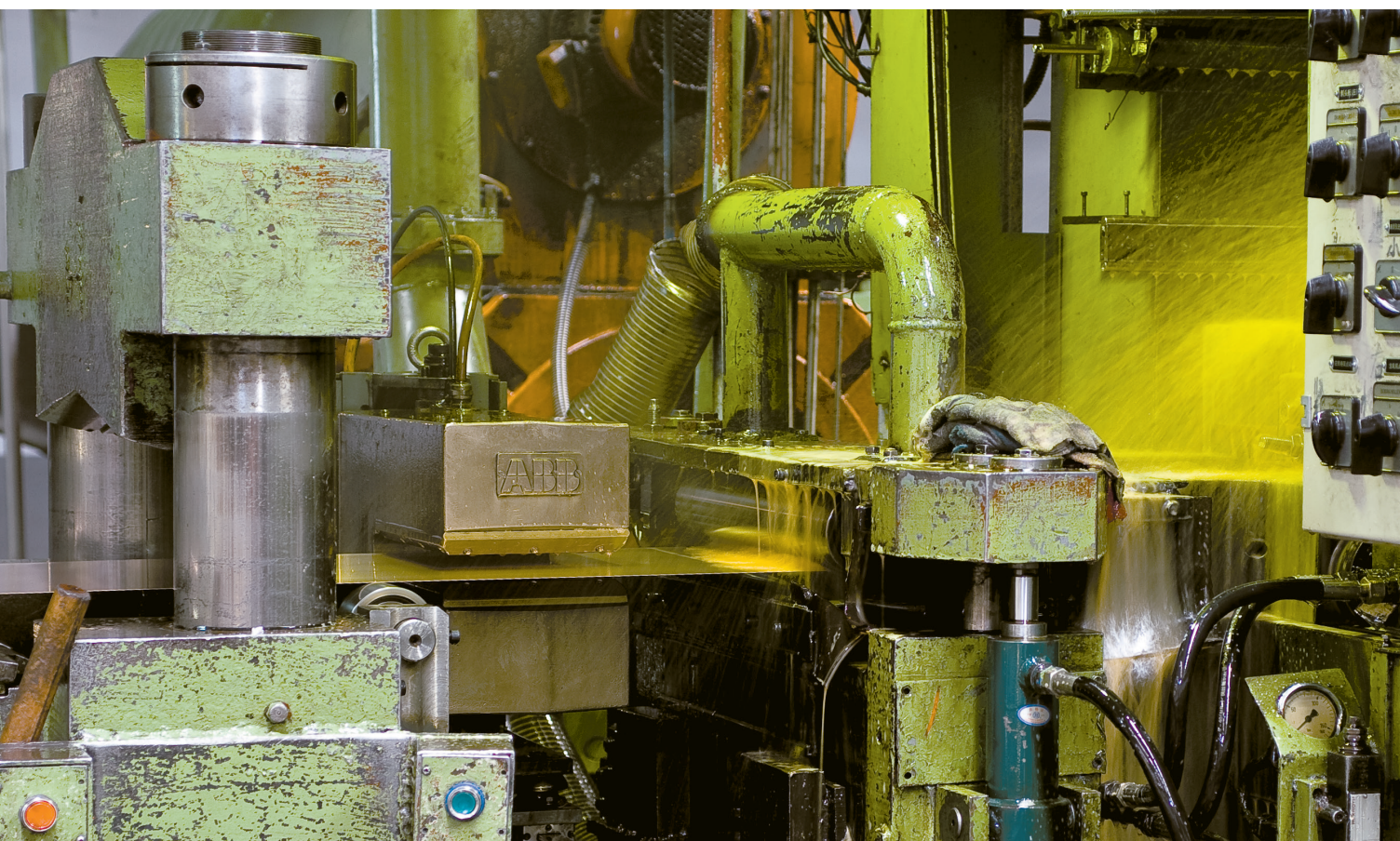


ABB MEASUREMENT & ANALYTICS

# Millmate Thickness Gauging systems

## Gauging for non-ferrous foil & strip



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# Millmate Thickness Gauging Systems

## A gauge with outstanding dependability

Strip producers around the world have replaced their X-ray and contact gauges with the Millmate Thickness Gauging systems (MTG) from ABB and have experiences that this gauging system opens up new opportunities to improve their competitiveness.

### Gauge control is crucial in mill production

MTG systems are used in both aluminium and copper alloy plants for producing a large variety of strip and foil materials, including aluminium-clad material. In rolling mills, the MTG systems are connected to AGC systems for feedback, feedforward and massflow control. The MTG systems are also used for thickness monitoring in tension leveling lines and slitting lines.

### System overview

The MTG system, based on the Pulsed Eddy Current (PEC) technology, opens up new dimensions in metal strip and foil gauging. Weak magnetic fields are used for the measurement and the gauge is completely safe to use. The technology is completely insensitive to anything in the measuring zone, except the metal strip. The gauge will, therefore, measure true strip thickness, unaffected by coolant, dirt, steam, air temperature variations, etc. Since the MTG is material-independent, there is no need for alloy compensation and calibration.

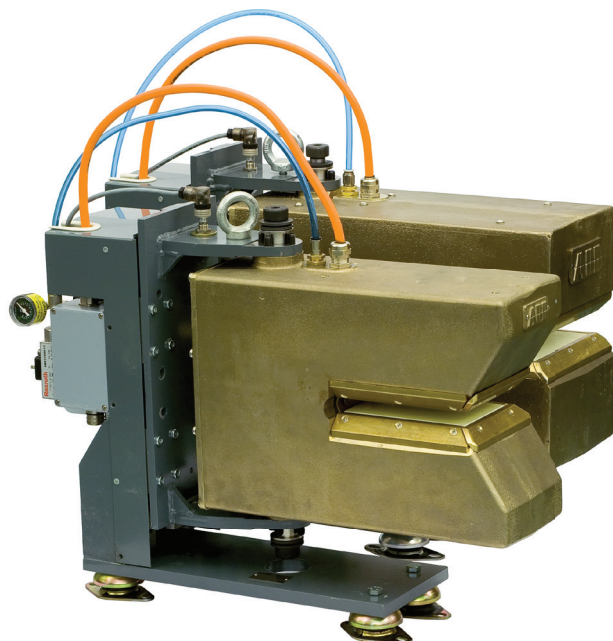
The C-Frame type gauge comes in two sizes – MTG Standard and MTG Foil, and cover a thickness range of 15 mm to 0.010 mm for low alloyed copper and aluminium.

### Increased mill uptime

In a production process running 24 hours a day, every minute of production time is precious. The MTG system makes it possible to increase the available production time. Thanks to its alloy independence, the MTG works consistently without frequent stopping for standardization and calibration.

### Tighter strip tolerances

The ability to produce strip to tighter tolerance maximizes productivity and minimizes the costs associated with non-conforming strip. It also increases the strip producer's accessible market to include product with tighter tolerance requirements. Normal process variations in alloy chemistry affecting the accuracy of X-ray gauges will not influence the alloy independent MTG gauge. Neither will the harshest environmental conditions.



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The high accuracy and contact-free measurement makes the Millmate Thickness Gauge very well suited for rolling mills process lines and final quality inspection.



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01 MTG installed in  
Profilglass, Italy

**No radiation security costs**

Switching over to the MTG from X-ray or isotope gauges eliminates health and environmental concerns as well as the inconvenience of restricted areas. This makes your plant a safer and more efficient place to work in. It also means: no costs for training and certification of your employees and no costs for taking care of radioactive waste material.

**Negligible costs for maintenance**

Share the experience of a virtually maintenance-free gauge with a large number of MTG users. Our robust gauge design, with no fragile or aging components, makes this possible. The MTG has no X-ray source and detector, no high voltage transformer, and no delicate precision mechanics.

**Short payback time**

Each process application has potential for improvement. Replacement of existing X-ray, isotope or contact gauges with the MTG will lead to cost reductions and increased earnings.

Add up your existing gauging costs for mill downtime, non-conforming material, maintenance, spare parts, calibration and security. Calculate the earnings you will get with the MTG. You will find that MTG offers you a short and competitive payback time.

**Customer feedback**

In a mill at Profilglass in Italy, two MTG gauges replaced previously installed X-ray gauges. With no need to compensate for alloy variations and no influence from mill coolant, installation of the MTG has led to significant productivity improvements. Another advantage, according to Profilglass, is the elimination of the personal risks that are associated with X-ray radiation measurement.

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# Unlike other gauges

## Heavy-duty design

Due to the heavy-duty design of the gauge and the stability of the measuring principle, the gauge can be used in positions that are impossible for other gauging technologies.

Measurement can be done close to the rollgap, without removal of emulsion. The gauge can also measure clad material accurately.

ABB offers two C-Frame gauges – MTG Standard Gauge and MTG Foil Gauge – that cover a thickness range for low alloyed copper and aluminum from 15 mm down to 0.010 mm. The Millmate Thickness Gauge offers substantial savings for non-ferrous strip production.

### Main benefits

- Unlike contact gauges
  - Not influenced by strip speed. The accuracy of contact gauges is often affected by increased strip speed and temperature
- Unlike X-ray gauges
  - No material dependence. All non-ferrous materials can be measured without using alloy compensation factors
- Unlike X-ray gauges
  - No need for security measures. The MTG uses a safe and environmentally friendly technology

These benefits contribute to a higher material yield, a higher uptime in the mill, and a minimum need of maintenance.

### Function

The Millmate Thickness Gauge is based on PEC technology, which uses magnetic fields for measurement of the strip thickness. The interaction between an applied magnetic field and the electrically conductive strip indicates the thickness – without influence from the material composition or conditions in the measuring gap.

The pulsed magnetic field is generated and measured by sturdy electric coils placed on both sides of the measuring gap. Since the magnetic field penetrates everything except metal, the coils can be protected by heavy-duty plates. This, together with an aluminium-bronze housing of superior mechanical and chemical characteristics, provides robust protection for the gauge, making it optimal for rolling mill environments.

The gauge is mounted on a vertically moving frame, with the system automatically adjusting vertical positions of the gauge to keep the strip in the center of the measuring gap. This is done with an electric actuator mounted on the gauge frame. The frame is designed so that if there is a strip break the gauge can rotate and turn away in the strip direction, thus reducing impact and potential damage.

### Calibration plates

Only a few certified plates (included in delivery) are needed to calibrate the system to cover the complete measuring range. After calibration at commissioning, the system measures any non-ferrous material or alloys without additional calibration.

### Sledge installation

The gauge holder is mounted on a sledge that enables the gauge to move horizontally into the measuring position. Strip width (min./max.) determines the size of the sledge for each specific application.

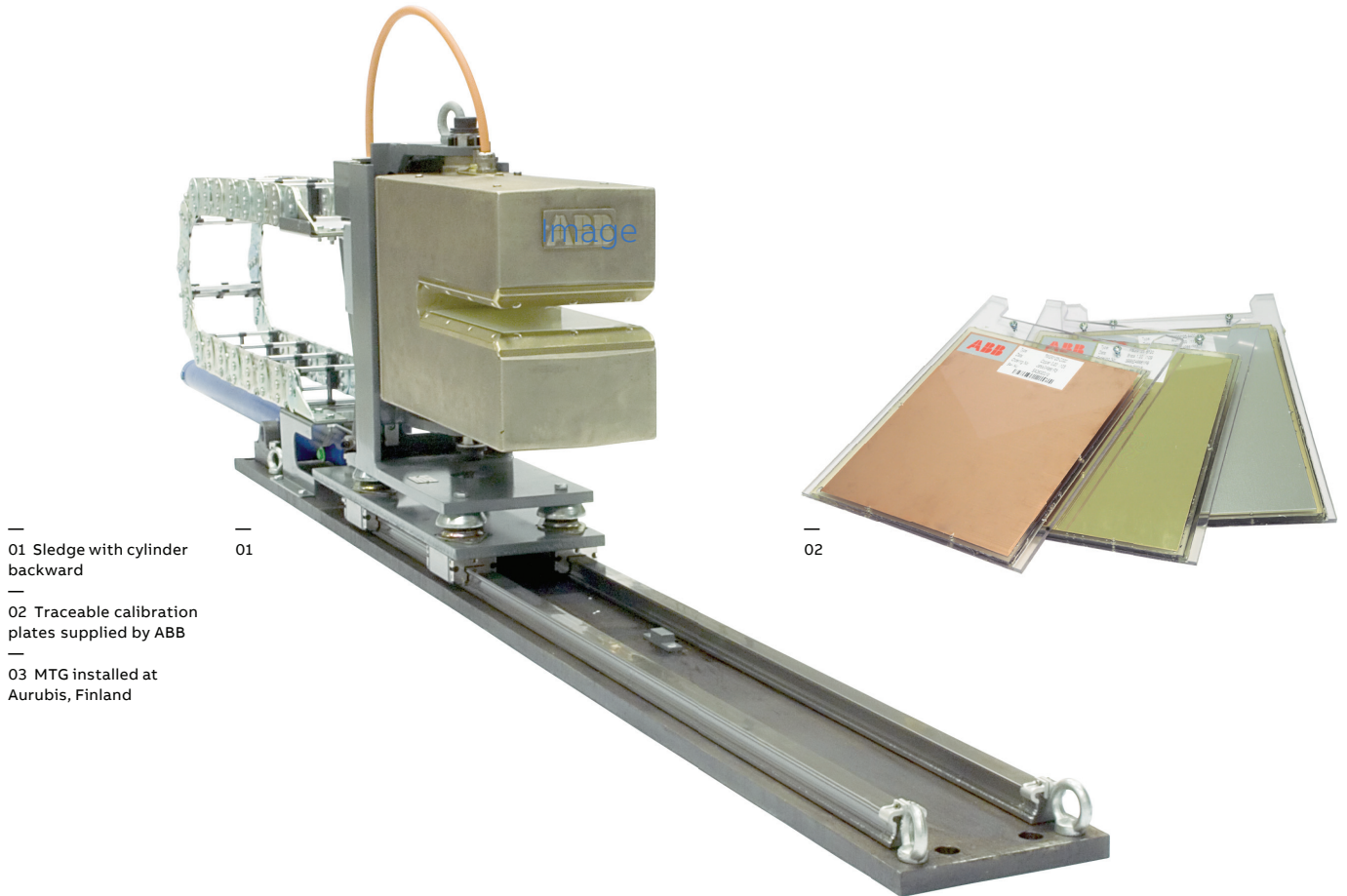
### Material

The MTG is designed for dependable gauge measurement on a wide range of non-ferrous materials with different alloy compensations and resistivities, i.e. aluminium, copper, zinc, tin, lead and magnesium.

### Customer feedback

MTG installed in a copper rolling mill at Aurubis Finland Oy, Pori, Finland. This mill uses one double MTG system with one gauge on the entry side and one gauge on the exit side. The strip width is 750 mm and the exit gauge is 0.15 mm. The gauge deviation signal is used for feedforward, feedback and massflow AGC. Aurubis has achieved considerably improved thickness tolerances.





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# System concept

## With opportunities you didn't know existed

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01 System overview  
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02 Touchscreen  
monitor  
—  
03 MTG installed in  
Taiwanese mill

ABB offers a gauging system with outstanding dependability, opening up new opportunities to improve your competitiveness.

### Lab accuracy in the mill

The Millmate Thickness Gauging system is an intelligent measurement system that measures as accurately in a production environment as it does in the laboratory.

### Control unit

The control unit is used for integration with superior systems to enable automatic operation with a choice of integration interfaces.

- Profibus-DP fieldbus communication
- Network communication via OPC
- Discrete I/O-signals

The Control unit also handles communication with the gauge. It communicates measurement data, state control and error handling as well as implements vertical and horizontal automatic position control functions.

There are Control unit versions for one or two gauges and they are supplied in either wall or floor cabinets.

### Operator unit

The application software is installed in an Industrial computer. It can be combined either with a touchscreen for panel installation or with a separate monitor. Computer and monitor can be separated by using a KVM Extender which enables a safe environment for the computer even though the monitor is placed close to the process.

The HMI has a number of features including multiple unit handling, different user access levels and several selectable languages.

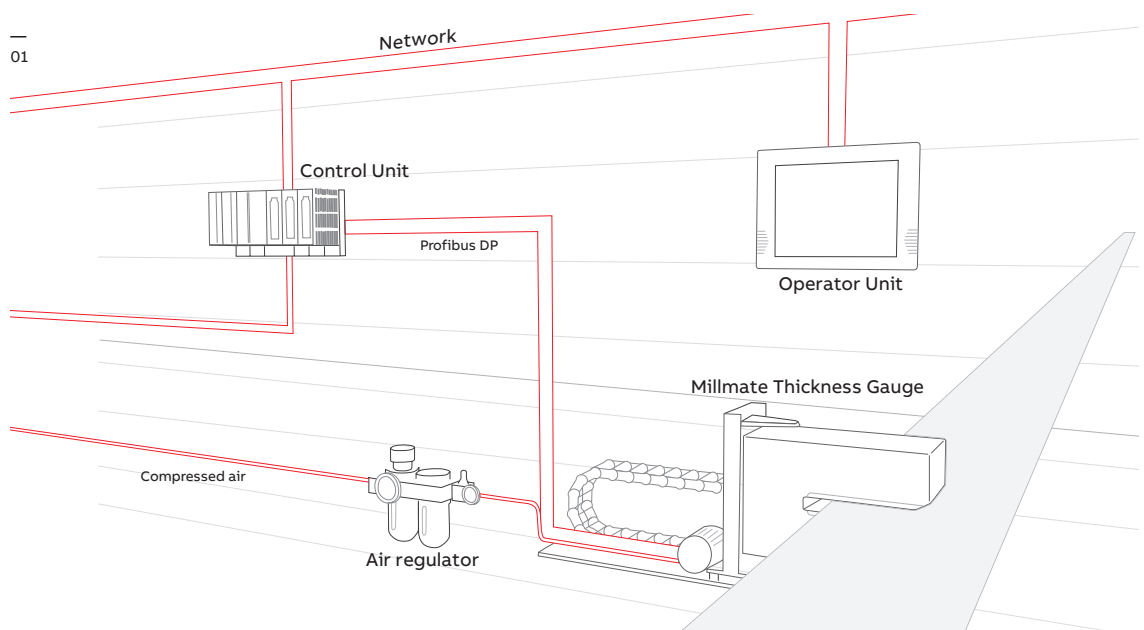
### Air regulator

The air regulator filters the air and controls the air pressure in the gauge. The air is used for internal temperature control and provides over-pressure to prevent coolant etc. from entering the gauge. A gauge cooling kit, based on a Vortex tube, is used for extra cooling of the inlet air.

### System functions

All system functions can be performed through the Operator unit. The Operator unit uses touchscreens for an efficient and user-friendly operator interface.

The main functions are divided into three menu groups – Operation, Maintenance and Service.







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### Operation

In the Operation menu the operator can read and adjust current set-ups, thickness value and status information. The thickness value is presented as a real-time value as well as in a trend graph. Status information from the control unit is available. The positions of the gauge and strip are also displayed.

With automatic sledge control, the gauge is automatically moved to the measurement position.

### Service

In the Service menu the operator has functions for fault tracing and diagnostics. There are also other menus for commissioning and advanced fault tracing that allow manual operation of the gauge, handling of I/O-signals, presentation of the strip position and slope at the gauge.

### Maintenance

The Maintenance menu includes Calibration, Manual Control, System Diagnostics and Gauge Diagnostics. Gauge calibration is performed in the Calibration menu. A few calibration plates are used to calibrate the system to cover the complete measuring range (thickness and material). At calibration, gauge adjustments can be done automatically and the system will measure any non-ferrous material or alloy without additional calibration. Manual sledge control can be used for moving the gauge to a convenient calibration or service position. It is also possible to define two different pass lines to adapt to different operation conditions of the mill.

Diagnostics is present for system, gauge and measurement status.

### Coil report

The MTG system can provide a simple coil report for the last rolled coil. The report displays a trend graph of the part of the strip that has been measured and a histogram showing deviations.

If the resistivity measurement option is included in your thickness gauge, a resistivity deviation report can be generated.

### Unit handling

There is the possibility to select different measurement units, i.e. Standard Metric units, Standard US units or Customer defined units.

### User access levels

The Operator unit provides the means to protect the system settings with passwords. This function offers the possibility to set different access levels for different users.

### Pressure monitoring

In order to provide a thickness gauge system with a high level of reliability in operation, the control unit has a built-in function for air and oil pressure monitoring.

### Customer feedback

An MTG system is installed in a Taiwanese aluminium mill. Strip width 1270 mm and minimum thickness 0.2 mm. The replacement of existing contact gauge has led to significantly improved productivity.



# System interface

## Different solutions for system integration

The MTG system can easily be connected to AGC systems, based on feedback, feedforward and massflow control.

— 01 MTG installed in a aluminium mill in Gränges, Sweden

— 02 Control Unit for two gauges

— 03 Double gauge operation with two trend graphs

The Millmate Thickness Gauge can easily be integrated with a mill control system or other superior systems. The MTG system offers different solutions for system integration both with discrete I/O signals and communication via a network. The Operator's unit, with color graphic touch-screen, is a user-friendly interface for manual operation and maintenance.

### I/O-signals

I/O-signals are used for communication with mill control and HMI. Status signals, nominal thickness and gauge position control can be handled via the I/O-signals. In addition to input for nominal thickness, the MTG system also needs input "EnableMovement" to allow any sledge movement and "AllowedOnStrip" to allow the sledge to move the gauge to the measurement position.

Depending on the integration, several different interface options are available, with up to 32 I/O-signals.

- Digital inputs for system operations
- Digital outputs to indicate system status
- Analog output for thickness deviation signal
- Analog input for temperature, strip speed and height

### Network communication

OPC ([www.opcfoundation.org](http://www.opcfoundation.org)) can be used as an alternative to I/O-signals for integration. The system supports OPC 5.0 Data Access over an optional Ethernet local network. To gain access to measurement data and system set-up, a superior computer with OPC-client functionality can communicate with the Control unit via an optional OPC-server.





### Profibus-DP

As an option, the MTG system can be equipped with a Profibus-DP slave interface for communicating with the rolling mill control system. The Profibus-DP interface provides fast transfer of measurement data. It can also be used for setting up nominal thickness and for remote control of system settings and gauge movement.

### Single or double gauge system

In reversing mills it is very common to use thickness gauges on both sides of the mill. The MTG system offers two different control units, one for handling a single gauge and the other for handling two gauges. The user-friendly operator unit has a display function for double gauge configuration. The operator can see the thickness gauge deviation graphs, one for each gauge, on the same menu page. Double gauge systems can also be valuable in applications like tandem mills or slitting lines.

### Dual pass line

The MTG system can handle two nominal pass line settings, via Profibus and/or via the Operator unit.

### Customer feedback

An MTG system is in operation at a wide aluminium mill at Gränges in Sweden. Strip width 1650 mm and min. exit gauge 0.05 mm. The gauge is installed on the entry side of the mill. The thickness signal is used for feedforward and massflow. Gränges also has seven MTG systems installed in cold rolling mills and processing lines at their subsidiary, Gränges Shanghai in China.

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MTG confirms by experience that it offers a very short and competitive payback time.

# Data

## MTG Standard Gauge

Type	PMGG 123-S
<b>Minimum thickness</b>	
for low alloyed copper and aluminium	0.010 mm (foil mode)
	0.025 mm (normal mode)
for high resistivity material (450 nΩm)	0.040 mm (foil mode)
	0.100 mm (normal mode)
<b>Maximum thickness</b>	15 mm
<b>Resistivity range</b>	16 to 450 nΩm
<b>Repeatability</b>	±0.03 % (not better than 0.3 μm)
<b>Accuracy<sup>1</sup></b>	±0.05 % (not better than 0.5 μm)
<b>Total accuracy<sup>2</sup></b>	
Standard mode (relative permeability = 1.0)	
0.025 to 2 mm thickness	±(1.0 μm + 0.1 % of actual thickness)
2 to 15 mm thickness	±(2.0 μm + 0.05 % of actual thickness)
Foil mode (relative permeability = 1.0)	
0.010 to 0.025 mm thickness	±(1.0 μm + 0.1 % of actual thickness) <sup>3</sup>
Weak magnetic mode (relative permeability < 1.3)	(Accuracy non-ferrous material) + 1.0 μm
<b>Oil on strip</b>	No influence
<b>Minimum strip width</b>	250 mm
<b>Allowed edge position</b>	±10 mm from normal edge position
<b>Strip position</b>	
for changes faster than 1 mm/s	±5 mm
for changes slower than 1 mm/s	±10 mm
<b>Strip slope</b>	±3°
<b>Step response</b>	15 ms
<b>Operation temperature</b>	+5 to 55° C
<b>Degree of protection</b>	IP 65
<b>Power supply (from control unit)</b>	24 V DC, max 3 A
<b>Weight</b>	
Gauge	50 kg
Gauge holder	30 kg

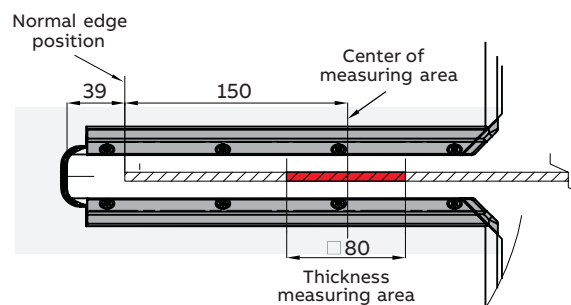
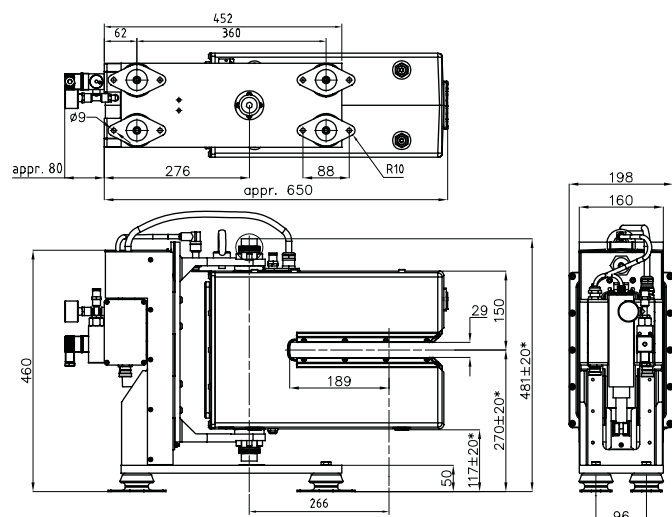
### Data for Hydraulic Valve Assembly for for sledge control

<b>Work pressure</b>	70 bar
<b>Input pressure</b>	80 to 160 bar
<b>Flow</b>	25 l/min
<b>Pressure switch</b>	40 bar nominal
<b>Pressure fluid</b>	Mineral oils DIN 51524 (HL, HLP) Phosphate ester (HFD-R)

<sup>1</sup> Accuracy = Accuracy after calibration, measured on a calibration plate

<sup>2</sup> Total Accuracy = Accuracy after calibration, measured on an arbitrarily selected plate/strip at normal mill operating conditions, i.e. with mill coolant, temperature variations, pass line variations and alloy composition variations

<sup>3</sup> Provided that correct foil temperature and nominal resistivity is input to the system





# Data

## MTG Foil Gauge

Type	PMGG 123-F
<b>Minimum thickness</b>	
for low alloyed copper and aluminium	0.010 mm (foil mode)
	0.025 mm (normal mode)
for high resistivity material (450 nΩm)	0.040 mm (foil mode)
	0.100 mm (normal mode)
<b>Maximum thickness</b>	6 mm
<b>Resistivity range</b>	16 to 450 nΩm
<b>Repeatability</b>	±0.03 % (not better than 0.3 μm)
<b>Accuracy<sup>1</sup></b>	±0.05 % (not better than 0.5 μm)
<b>Total accuracy<sup>2</sup></b>	
Standard mode (relative permeability = 1.0)	
0.025 to 2 mm thickness	±(1.0 μm + 0.1 % of actual thickness)
2 to 15 mm thickness	±(2.0 μm + 0.05 % of actual thickness)
Foil mode (relative permeability = 1.0)	
0.010 to 0.025 mm thickness	±(1.0 μm + 0.1 % of actual thickness) <sup>3</sup>
Weak magnetic mode (relative permeability < 1.3)	(Accuracy non-ferrous material) + 1.0 μm
<b>Oil on strip</b>	No influence
<b>Minimum strip width</b>	140 mm
<b>Allowed edge position</b>	±10 mm from normal edge position
<b>Strip position</b>	
for changes faster than 1 mm/s	±3 mm
for changes slower than 1 mm/s	±8 mm
<b>Strip slope</b>	±3°
<b>Step response</b>	15 ms
<b>Operation temperature</b>	+5 to 55° C
<b>Degree of protection</b>	IP 65
<b>Power supply (from control unit)</b>	24 V DC, max 3 A
<b>Weight</b>	
Gauge	37 kg
Gauge holder	30 kg

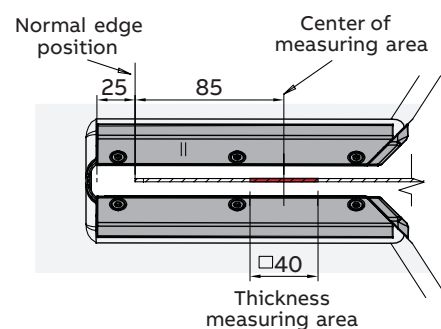
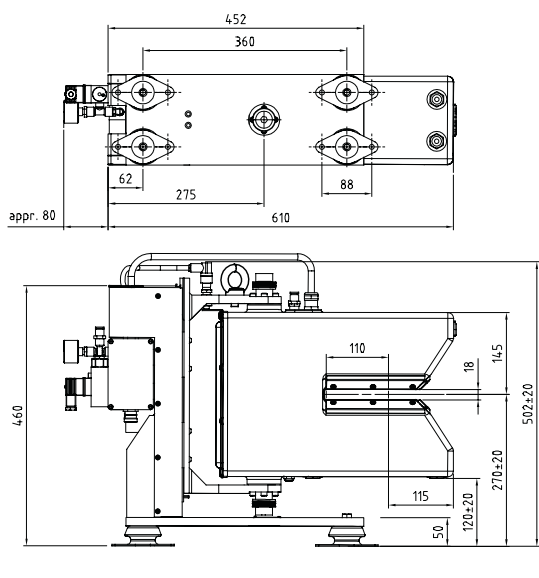
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<sup>1</sup> Accuracy = Accuracy after calibration, measured on a calibration plate

<sup>2</sup> Total Accuracy = Accuracy after calibration, measured on an arbitrarily selected plate/strip at normal mill operating conditions, i.e. with mill coolant, temperature variations, pass line variations and alloy composition variations

<sup>3</sup> Provided that correct foil temperature and nominal resistivity is input to the system



# Data

## Control Unit

### Data for Millmate Control Unit



<b>Single gauge system</b>	PMGA121
<b>Double gauge system</b>	PMGA122
<b>Supply voltage</b>	115/230 V +10/-15 %
<b>Power consumption</b>	300 VA
<b>Thickness output</b>	±10 V
<b>Digital input</b>	24 V nominal, opto insulation
<b>Digital output</b>	24 V/0.5 A, opto insulation
<b>Operation temperature</b>	+5 to 45° C
<b>Dimensions W x D x H</b>	
Elkapsling wall cabinet	800 x 300 x 800 mm
Elkapsling floor cabinet	800 x 400 x 1900 mm
MNS Select floor cabinet	840 x 656 x 2225 mm
<b>Weight</b>	
Elkapsling wall cabinet	75 kg
Elkapsling floor cabinet	250 kg
MNS Select floor cabinet	250 kg
<b>Protection class</b>	
Elkapsling wall/floor cabinet	IP 65
MNS Select floor cabinet	IP 21/IP 54

### Data for Millmate Operator Unit



<b>Industrial computer</b>	
Supply voltage	24 VDC, 120 W via AC power adapter 100 to 240 V
Protection class	IP 21
<b>Monitors</b>	
17" touch-screen	Panel mounted
21,5" or 24" wide screen	LCD

### Data for Air Regulator

Product name



<b>Air supply</b>	
Pressure	Maximum 16 bar, minimum 4 bar
Temperature	5 to 25° C
Temperature with cooling kit	Maximum 40° C
<b>Air regulator</b>	
First filter	Removes particles > 5 µm
Second filter	Removes particles > 0,01 µm
	Removes oil > 0,01 mg/m <sup>3</sup> (0,01 ppm/weight air)
<b>Output pressure</b>	0,5 bar nominal
<b>Air consumption</b>	Max 4 dm <sup>3</sup> /s



# Millmate Thickness Gauging Systems

## Installation options

- 01 MTG with enhanced protection kit installed in a US mill
- 02 Sledge
- 03 Horizontal positioning for service position as well as operating position at different strip widths

### Sledge

The gauge holder is mounted on a sledge that enables the gauge to move horizontally into the measuring position. ABB offers a standard sledge solution with a number of stroke lengths. Strip width (min./max.) determines what kind of sledge should be used. Consult your local ABB representative for further details.

### Enhanced protection kit

In applications where the gauge may be exposed to severe strip breaks, other high impact forces, or fires, the optional enhanced protection kit is recommended.

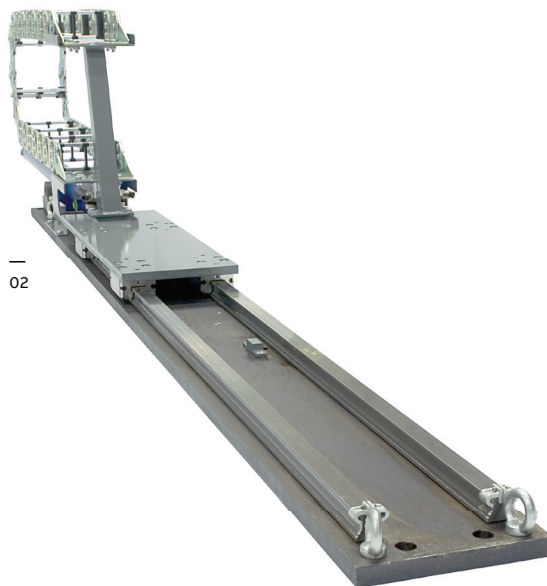
The enhanced protection kit consists of a stainless steel hose and hood for the gauge and the gauge holder. The kit enhances the mechanical, chemical, and fire protection of the gauge.

### Customer feedback

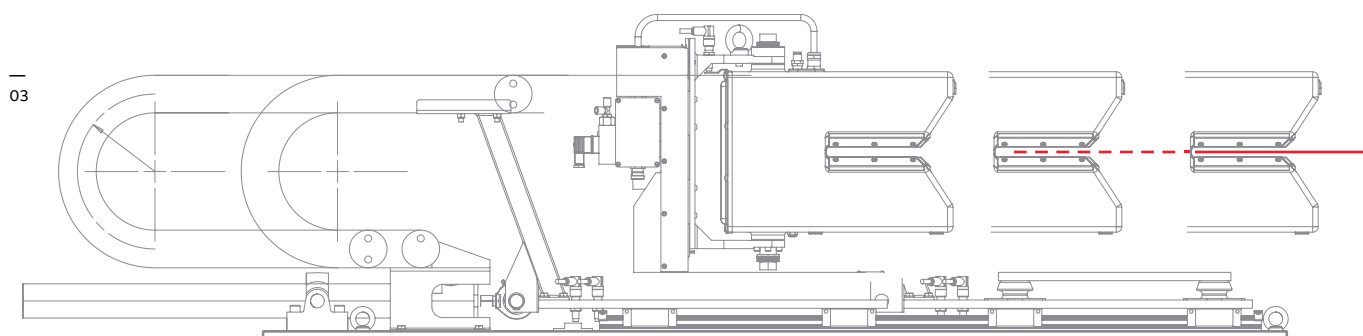
After testing one MTG system in a really harsh environment, a US mill was so convinced by the MTG performance that they decided to invest in five additional gauges to replace all their other gauging systems.



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# System options

## Aluminium clad material

Processing advanced clad materials for heat exchangers and aeroplanes require very accurate and dependable thickness measurement.

The MTG system measures the thickness on clad material with less influence of variations in alloy composition and clad geometry compared to x-ray gauges.

The MTG is well-known for providing material-independent thickness measurement on homogeneous, non-ferrous strip, without the need for any alloy information. With the optional clad measurement function, the MTG measures the thickness of multi-layer aluminium clad strip with superior accuracy.

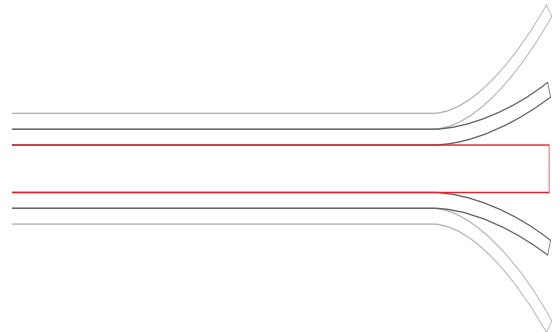
The built-in clad function only requires information about each clad layer's nominal thickness and resistivity. The resistivity can be determined with support functions included in the scope of supply. The start-up and commissioning routines for the clad function are straightforward and easy to use. The need for test plates is limited. New types of clad material can easily be added, without the need for time-consuming tests and calibration procedures.

### Scope of supply

- License dongle to enable software functionality for clad material and resistivity measurement
- PC-software for calculation of the resistivity based on the alloy compensation – Clad Help Function

Gauge data	Standard / Foil
Accuracy, thickness < 2mm*	$\pm(2.0 \mu\text{m} + 0.1 \%)$
Accuracy, thickness > 2mm*	$\pm(3.0 \mu\text{m} + 0.05 \%)$
Thickness range	0.035 to 15 mm / 0.025 to 6 mm

\*Provided that information about clad layer parameters is correct



### Function overview

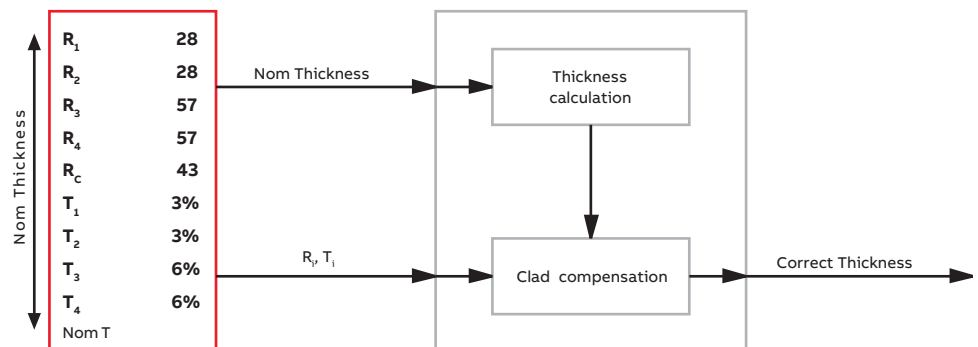
#### Clad parameter

Liner 1 Thickness ( $T_1$ )	Liner 1 Resistivity ( $R_1$ )
Liner 3 Thickness ( $T_3$ )	Liner 3 Resistivity ( $R_3$ )
Core Resistivity ( $R_c$ )	
Liner 4 Thickness ( $T_4$ )	Liner 4 Resistivity ( $R_4$ )
Liner 2 Thickness ( $T_2$ )	Liner 2 Resistivity ( $R_2$ )

#### Customer database

$R_1$	28
$R_2$	28
$R_3$	57
$R_4$	57
$R_c$	43
$T_1$	3%
$T_2$	3%
$T_3$	6%
$T_4$	6%
Nom T	

#### MTG system



# Millmate Thickness Gauging Systems

## On-line resistivity measurement

With the optional resistivity measurement function, the MTG offers the unique ability to continuously monitor material property changes. Material property measurements on metal strip are normally done in the laboratory according to a spot test procedure.

The MTG, with the built-in resistivity function, measures the resistivity on-line with an accuracy equal to the best available lab instruments. The resistivity of the strip is of increasingly importance to producers of electro-technical material. However, in the future electrical resistivity will have greater importance as an indirect measure of different materials properties.

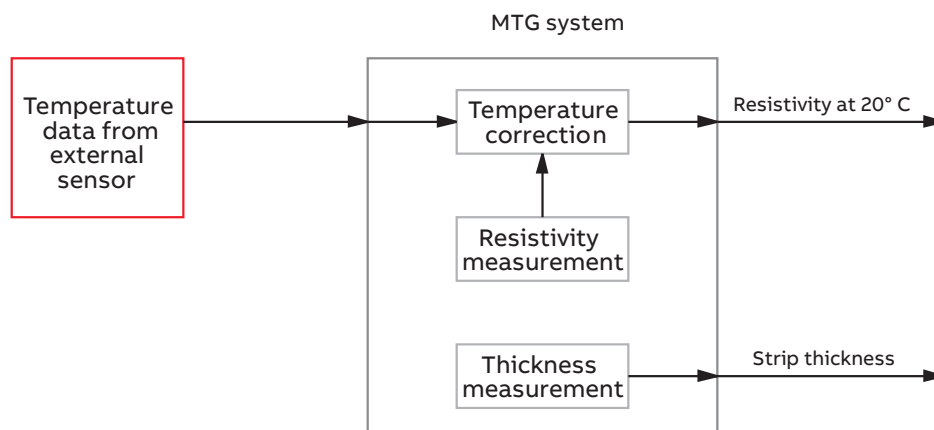
Temperature information from other sources can be fed into the system. The temperature information is used to correct the measured resistivity to a 20 °C value. The resistivity measurement is traceable to national standards.

Data	
<b>Accuracy</b> (at 20° C)	±1.2 % < 0.1 mm
	±1.0 % < 0.1 mm (of resistivity reading for thickness)
<b>Range</b>	16 to 450 nΩm (4 to 110 % IACS)
<b>Output</b>	Resistivity in nΩm
	Conductivity in MS/m or % IACS
<b>Input</b>	Strip temperature
	Analog input, external source
	Serial communication data, external source

### Application

- Resistivity measurement on material for electro-technical applications
- Resistivity measurement on coin material
- Alloy identification and verification
- Detection of material property changes due to changes in alloy composition, work hardening and process temperature
- Verification of correct heat treatment
- Determination of heat conductivity.

### Function overview







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**ABB AB**

**Industrial Automation**

Measurement & Analytics

Force Measurement

S-721 59 Västerås, Sweden

Phone: +46 21 32 50 00

**[www.abb.com/thicknessgauging](http://www.abb.com/thicknessgauging)**

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