ABB MEASUREMENT & ANALYTICS

Millmate looper tensiometer systems

Reliable, long-term solutions
for your looper tension measurement

Millmate looper tensiometer systems Introduction

A measurement technology offering high accuracy is a prerequisite today for modern rolling mills.

The constant striving to achieve optimum process quality and the highest possible productivity is the essential goal of modern production units.

One of the crucial parameters in achieving correct strip thickness and width during hot rolling is the strip tension. In order to reach the highest possible accuracy, a looper tensiometer is the best and most reliable alternative.

Loopers are often introduced in hot finishing mills between the mill stands to control strip tension deviations caused by variations in incoming material and mill settings. Tension deviations cause thickness and width variations in the finished strip. Most looper systems estimate the strip tension based on looper actuator force and looper arm position.

Using load cells to measure the force directly is a faster and more accurate way to determine strip tension and thus yield far better results in thickness control.

The Millmate Looper Tensiometer System consists of a Millmate Controller 400, a junction box and two load cells matched to the desired measuring range. The load cells are available in two nominal loads.

The ABB equipment is easy to install and operate. We offer installation support as well as after sales supply and support for the long-term.

Due to ABB's long experience in the field of hot rolling, we can offer outstanding application know-how in this particular field.

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01 System overview ABB's Millmate looper tensiometer system in rolling mills.

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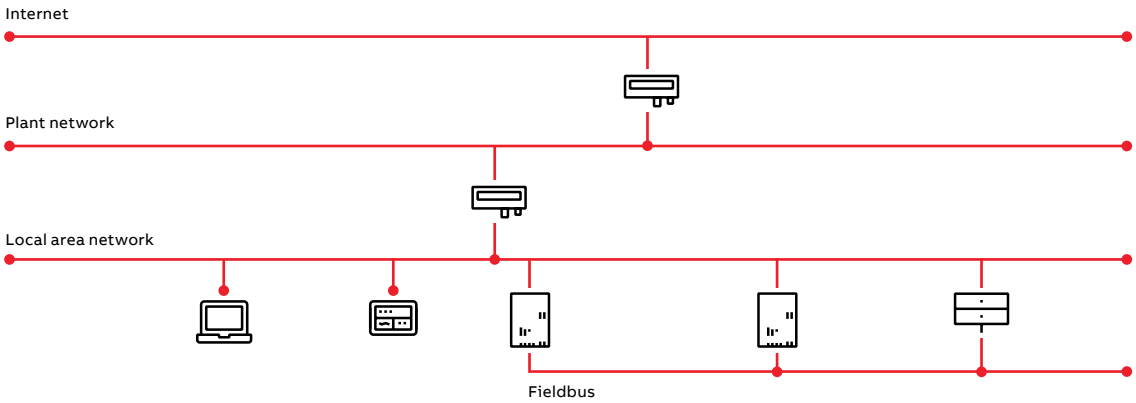

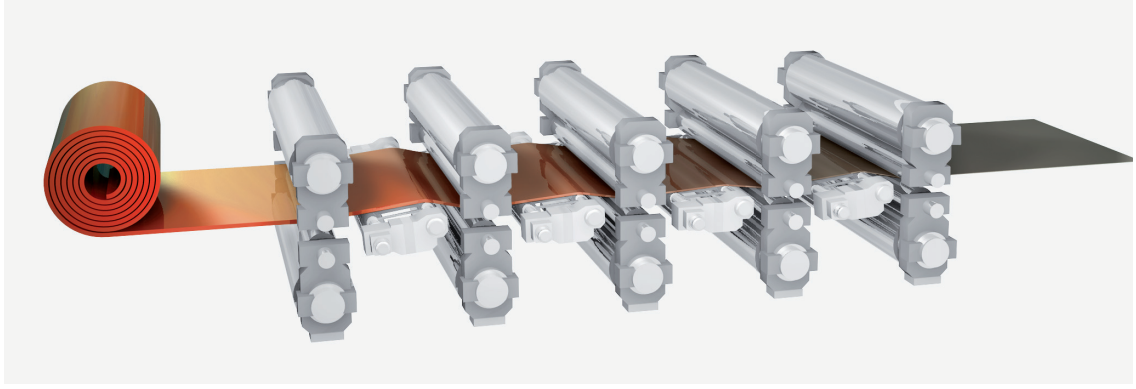

Pressductor® Technology
Measurement principle

ABB's Millmate looper tensiometer load cells are based on the well-known Pressductor® principle patented in 1954, utilizing the magneto-elastic effect, according to which the magnetic properties of steel are influenced by mechanical forces acting on it.

In the transducer body there are four holes. Two coils at right angle to each other are winded through these holes. One winding (the primary) is supplied with an alternating current; the other winding (the secondary) acts as a measurement winding. Since the two windings are at right angle to each other, there is no magnetic coupling between them as long as there is no load acting on the transducer body.

If the transducer body is loaded (as shown in figure 01), the field pattern changes. The permeability of the steel is reduced in the direction of the force and increase in the direction at right angles. The result is a change in the symmetry of the magnetic flux, so that some of the flux induces a voltage in the secondary winding. The induced voltage is proportional to the load.

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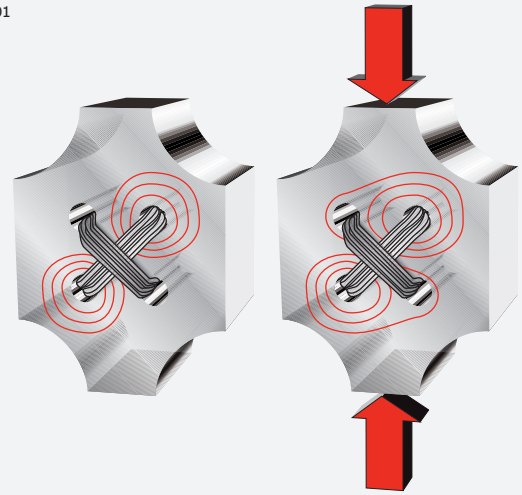

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01 The measurement principle is based on the magneto- elastic effect, according to which the magnetic properties of the material are influenced by mechanical stress. The transducer is magnetized via the primary coil. An electrical voltage proportional to the applied force is induced in the secondary coil.

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02 Load cell mounted in the looper arm.

ABB's Looper Tensiometer load cells are available in two sizes that cover the typical measuring ranges in the hot rolling mill and give an output signal proportional to the measurement force FR. The housing, containing the Pressductor force transducer, is well protected against harsh mill conditions such as dirt, dust, liquids, steam and corrosive environments.

The magnetoelastic operating principle enables a design of the load cell that does not require physical movement in the transducer to produce a measurement signal.

Mechanically, the load cell is virtually a solid block of stainless steel. Its consequent overall strength and rigidity with a high spring constant are important contributions to applications that put a premium on overload protection or are sensitive to vibrations.

Total solution
In order to achieve true accurate measurement also in very severe conditions, it is not enough to buy only high-quality products. The surroundings and the total installation, too, have to be designed in a correct way.

With ABB's long experience we can support installation proposals for your specific needs and mill geometry. We also offer total solutions including mechanical accessories, such as adapter plates and looper arms.

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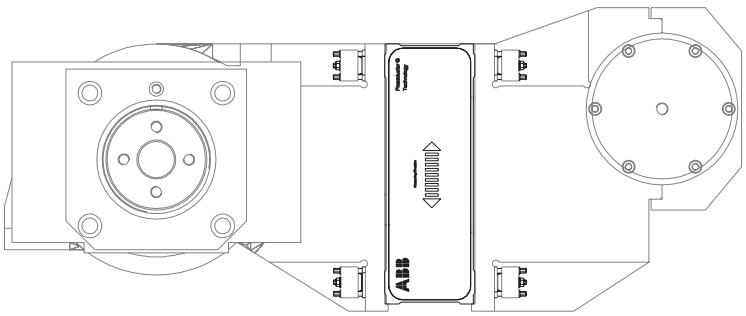


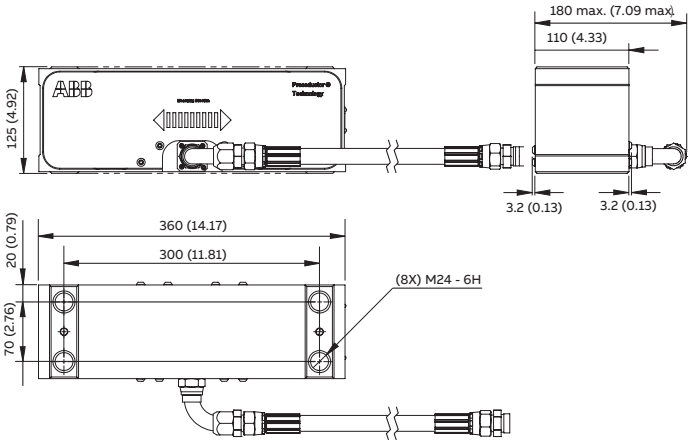
Pressductor PillowBlock load cells

PFTL 211 Horizontal force measurement, 20 and 50 kN

The Looper Tensiometer load cell is used for strip tension measurement in hot rolling mills.

The load cell can be installed as an integrated part of the looper arm and senses the force from strip tension in both directions.

The load cell comes in one version, PFTL211-CE, a mill-duty version with fixed connection cable in a protective hose and mounted at different angular positions.



Technical data		PFTL 211CE	
Nominal load (rated capacity)	kN	20.0	50.0
	lb.	4500	11250
Extended load [1]	kN	30.0	75.0
	lb.	6750	16875
Permitted load			
Transverse direction	kN	100.0	250.0
(vertical) h=300 mm	lb.	22500	56250
Overload capacity [2]	kN	200.0	500.0
Measurement direction (horizontal)	lb.	45000	112500
Transverse direction	kN	200.0	250.0
(vertical) h=300 mm	lb.	45000	56250
Deflection [3]	mm	0.02	0.05
	1/1000 in.	0.8	2.0
Spring constant	kN/mm	1000	1000
	1000 lb./in.	5720	5720

All load cells		
Operating principle		Electromagnetic Pressductor Technology
Accuracy class [4]	%	0.5
Repeatability error	%	<±0.05
Operating range		30:1
Stainless steel	SIS	2387 [5]
	DIN	X4CrNiMo165
Working temperature range		–10 to 90 °C 14 to 194 °F
Zero point drift [6]	%/°C	<±0.005
	%/°F	<±0.003
Sensitivity drift [6]	%/°C	<±0.010
	%/°F	<±0.006

[1] Values indicate the total capacity of the load cells when taking into account their permissible "extended capacity". In the extended range, above the nominal load, some decline in measurement accuracy may be experienced.
[2] Maximum permitted loads without affecting load cell calibration.
[3] At nominal load.
[4] Accuracy class i+s defined as the maximum deviation, and is expressed as a percentage of the sensitivity at nominal load. This includes linearity deviation, hysteresis and repeatability error.
[5] Corrosion resistance properties similar to AISI 304
[6] Applies for 20 to 80 °C/68 to 176 °F

Nominal load (F_{nom}) is the load for which the load cell is dimensioned and calibrated, i.e. the sum of the stationary load and the maximum measured load in the measuring direction.

Permitted load (F_{nom}) in a specific direction is the maximum load in that direction up to which the measurement can be performed within the specified accuracy.

Extended load (Fext) is the maximum load in the measuring direction for which measurement can be performed with a specified accuracy class.

Overload capacity in a specific direction is the maximum permitted load in that direction without change of data.

Deflection is the maximum displacement in the measuring direction of the load cell when the load is increased from zero to nominal load.

Accuracy class is defined as the maximum deviation and is expressed as a percentage of the sensitivity at nominal load. This includes linearity deviation, hysteresis and repeatability error.

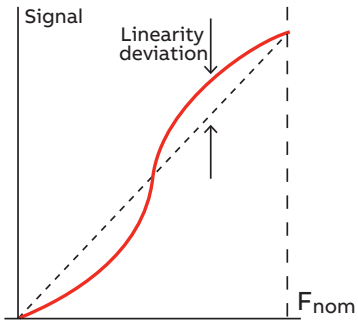
Linearity deviation is the maximum deviation from a straight line drawn between the output values of zero and nominal load, related to the nominal load.

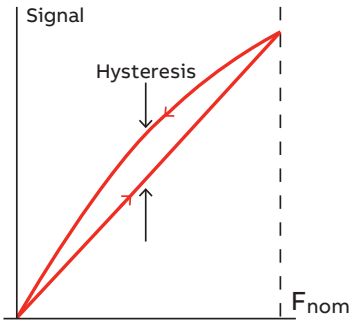
Hysteresis is the maximum deviation of the output signal at the same load during a cycle from zero to nominal load and back to zero, related to the sensitivity at nominal load. The hysteresis is proportional to the cycle.

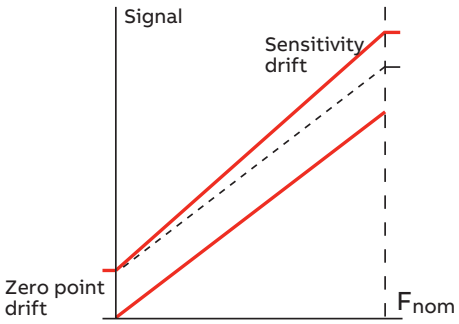
Repeatability error is defined as the maximum deviation between repeated readings under identical conditions. It is expressed as a percentage of the sensitivity at a nominal load.

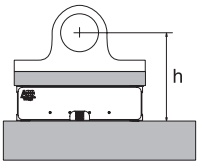
Zero point drift is defined as the drift in the output signal when there is no load on the load cell.

Sensitivity drift is defined as the drift in the output signal at nominal load, excluding the zero point drift.









Height (h) from load cell's bottom surface to roll center line

Control unit
Millmate Controller 400

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01 Millmate Controller with Operator unit.

The control unit supplies the load cells with power, processes the signals from the load cells and communicates the result to other systems. Communication can take place via digital inputs/outputs, analog inputs/outputs, TCP/IP-communication, RS-232 and as an option, via high-speed fieldbus.

The control unit can be manually operated using the Millmate Operator Unit 410 and by external units via a serial interface or digital/analog inputs. Setup and commissioning are easy following step-by-step menus.

Measured values are displayed on the operator unit, connected to analog outputs or transmitted via a serial interface to an external display or to other external units.

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Features
The Millmate Controller 400 has been designed to offer a lot of functionalities and at the same time very easy to use.

The control unit covers most mechanical arrangements. This means the user only has to follow the step-by-step menus in order to set up the control unit and to obtain correct strip tension calculated.

Some examples of the built-in functionalities:
- Easy to install
  - Industrial grade electronics, operating temperature up to 70°C
  - Fulfills EMC legislation without additional enclosoures
  - Detachable screw terminals located at the bottom of the Control unit for easy access
  - Built in Earth point for cable screens
  - Supply voltage 100–240 V AC
- Easy to commission
  - Step-by-step instructions to set up the control unit
  - Predefined standard measurement modes
  - Easy configurable analog/digital inputs/outputs
  - Level detectors
  - Unit selection (N, kN, MN, kp, t, lb, T)
  - Simulation mode for easy check of system integration
- Easy maintenance/monitoring
  - Self-diagnostics test system including transducer test
  - Load and dump set-up to connected PC
  - Network connection for remote access

External connections:

- Excitation current to the load cells
- 2 or 4 analog inputs for load cell signals
- 4 analog outputs, voltage or current
- 8 digital inputs for control signals
- 8 digital outputs
- +24 V supply for external units, max 0.5 A
- Ethernet for connection to:
  - other Millmate control and operator unit
  - other control systems with VIP protocol
- 2 serial interfaces of type RS-232 for external displays, control, etc.
- High-speed Profibus (optional)

Analog/digital inputs and outputs are galvanically insulated as groups.

Vendor Internet Protocol (VIP)

Other control systems can send control data and monitor measurement data with TCP/IP-communication. The Ethernet connection together with the Vendor Internet Protocol (VIP) is used for communication. The protocol uses configurable predefined data telegrams and the Millmate Controller 400 acts as a server. The sending procedure is cyclic and thereceiving procedure reacts on incoming messages.

The PROFIBUS option

As an option the control unit can be equipped with PROFIBUS. The Profibus interface in the Millmate Controller 400 is updated with a new complete set of measuring values every 1.5 milliseconds.

Millmate Controller 400		**PFXA 401**	**PFCA 401**
Dimensions (H x W xD)		380 x 235 x 90 mm	
Weight		5 kg	
Protection class [1)]		IP 20	
Main voltage		85 to 264 V, 100 (–15 %) to 240 V (+10 %)	
Power consumption		140 VA	
Wrap angle compensation		Yes	No
Excitation current		2 A, 0.5 A	0.5 A
Operating temperature		0 to +70 °C	
Storage temperature		–40 to +70 °C	
Analog intputs		0 to 10 V, ±10 V differential inputs	
Analog outputs	Voltage	0 to ±10 V	
	Current	0 to ±20 mA, 4 to 20 mA (insulated as group)	
	Step response	5 ms (0 to 90 %)	
Digital inputs		0/+24 V insulated 4 + 4	
Digital outputs		0/+24 V insulated 4 + 4	

1) According to IEC 529, EN 60-529

VIP	
Network	10 Mbit/s Ethernet
Communication rate	10 messages/s
Error handling	Automatic retransmission

Profibus-DP	
Station type	Slave
Maximum speed	12 Mbit/s
Configuration	Printable GSD-file in control unit

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