Strip Tension Systems
Pressductor® PillowBlock load cells
PillowBlock
Quality tension measurement for quality tension control

Introduction
ABB’s Pressductor PillowBlock load cells are sensitive and accurate yet rugged, reliable and compact. The performance of the Pressductor PillowBlock load cells is unsurpassed for rolling mills and process lines characterized by heavy rolls, high speeds and severe conditions – in some instances they are the only viable option. They can withstand high overloads and vibrations, and operate over a wide range of tensions.

The well-proven Pressductor load cells combined with the tension electronics, offer an easy-to-use strip tension measurement system with superior long term performance leading to higher productivity and product quality and higher profit for the strip producer.

Increased process uptime
In a strip process running continuously, every minute of production time is precious. Even so, no production line runs without downtime. With Pressductor PillowBlock load cells the risk of strip breaks can be reduced to a minimum, thus leaving as much time as possible for real production.

Thanks to a strong and stable signal deriving from the PillowBlock load cells, the upcoming strip breaks are kept to an absolute minimum level.

Tighter product tolerances
The ability to produce strip to tighter tolerances minimizes the costs associated with non-conforming strip. It also increases the strip producer’s accessible market to include products with tighter tolerance requirements.

Minimize maintenance
Share the experience, of virtually maintenance-free load cells, with thousands of other PillowBlock users. A robust load cell design with no fragile or ageing components makes this possible. Thanks to its robust design, the PillowBlock load cells work consistently for many years without any need for maintenance, also in the toughest rolling mills and process lines.

Reliable Tension Measurement
• from Sheet to Foil
• from Hot to Cold
Fast access to support and service
ABB provides customers with superior distinctive After Sales Service that really differentiates from the competition. You obtain advanced solutions to problems, service and professional consultation through our After Sales Service program. Expert engineers with extensive experience of all types of Force Measurement products are available to assist you through our world-wide network.

There is a ABB PillowBlock load cell suitable for every strip process
The PillowBlock load cells are designed for reliable and longterm stable strip tension measurement in processes like hot rolling, cold rolling, pickling, annealing and galvanizing lines.

The Pressductor based load cells have for more than 50 years proven their superior performance in a large number of demanding applications.

The Pressductor difference
Like ABB’s other load cells based on Pressductor Technology, PillowBlock Load Cells rely on electromagnetic changes in the transducer, not on physical movement, to sense fluctuations in strip tension. The Pressductor Technology operating principle provides exceptional improvements in load cell performance characteristics, including reliability (notably absence of drift), durability, repeatability, and wider measurement range.

Machined from a solid block of steel, the load cells are rugged and stiff, affording high overload protection as well as an extended measurement range above the nominal load. And they do not contribute to machine vibration, even at high speeds.

Since the transducer action – the magnetic flux – takes place inside a steel core, environmental factors like dirt or fluids can’t degrade performance and reliability. These stainless steel load cells don’t require any physical seals.

Furthermore, low transducer impedance – less than a couple of ohms – helps eliminate susceptibility to radio-frequency and electromagnetic interference.
Performance for any application in any environment

Designers appreciate...
- Remarkably high spring constant
- Wide measurement range
- High reliability
- Performance for any application in any environment

Operators value a load cell with...
- No drift
- No recalibration
- No failures
- High reliability

Measurement essentials
Keeping the tension constant in strip processes is essential for high product quality and productivity. Continuously measuring the tension is an obvious prerequisite for tension control. Drives and operator instruments need quick and accurate input to regulate tension levels and monitor machine performance.

Most strip processing customers put a premium on long-term reliability, in addition to accuracy and overall performance. The measurement system, after all, is the front line of machine control, exposed to all the rigors of the operating environment. The costs associated with downtime and poor product bring out the true value of its components.

Quality measurement technology for superior tension control that will keep your processing lines productive and producing top-notch output... that's what you can expect from us. We are entirely devoted to providing process measurement systems and services, and we have 60 years of experience in the field. We are the experts in web and strip tension as well as force measurement for virtually any purpose.

Selecting and sizing load cells
The two types of ABB PillowBlock load cells are designed for either conventional vertical force measurement or for sensing the horizontal force component that may arise as the processed material partially wraps around a measurement roll.

Using the horizontal load cells can be quite advantageous. By design, they can be made exceptionally sturdy, rugged, and stiff. So, requirements for recalibration, other maintenance, or replacement are negligible, and they do not contribute to machine vibration. Since they don’t measure the tare weight, but just the horizontal force component of the strip tension, they can be sized smaller than otherwise possible, measuring tension with greater accuracy.
Application requirements may dictate the selection of a vertical load cell. But whenever an adequate horizontal force component is present (or can be developed), the horizontal load cell should be considered.

The size, or nominal load, of a load cell is contingent on the anticipated force it will measure. When a vertical load cell is mounted horizontally (the most common arrangement), the measurement force (FR) is a function of the tension in the strip (T), the deflection angles (α and β), and the tare weight of the roll and bearings (Tare).

The horizontal load cell senses the strip tension’s (T) horizontal component (FR); not the vertical force (FV).

In this scenario, the measurement force (FR) is a function of only the tension in the strip (T) and the strip angles (α and β). Since the tare force – the weight of the deflector roll and bearings – will not be measured, it can be very large compared to the strip tension without affecting the accuracy of the tension measurement.

**Specifying the load cell**

Since load cells are typically used at both ends of a roll, rating the individual cell is usually based on half of the resultant force. The ideal load cell size is usually the smallest nominal capacity rating accommodating that force level, so long as the force exceeds 10 percent of the nominal load. Before choosing a larger size, however, consider using the “extended range” feature of ABB load cells. And always verify that overload specifications will not be exceeded in any direction.

**Application Hint**

Two “10 percent” application guidelines are useful in selecting load cell sizes:

1. The proportion of strip tension that is actually sensed by the load cell should be at least 10 percent of total strip tension. For operational conditions producing values below 10 percent, consult ABB.

2. During normal operation, the sensed force should not be less than 10 percent of the load cell’s capacity.

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**Extended-Range Operation**

An extended range of measurement beyond the nominal load allows the PillowBlock to be sized for normal, as opposed to maximum tension levels. As a result, they permit greater application flexibility in the strip processing line.

**Vertical measuring load cells**

\[
F_R \text{tot} = F_R + T \text{are} = T \sin(\alpha + \sin(\beta) + \text{Tare})
\]

\[
F_V \text{tot} = F_V = T \cos(\beta - \cos(\alpha))
\]

**Horizontal measuring load cells**

\[
F_R \text{tot} = F_R = T \cos(\beta - \cos(\alpha))
\]

\[
F_V \text{tot} = F_V + \text{Tare} = T \sin(\beta + \sin(\alpha) + \text{Tare})
\]

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**Symbols**

- **F_R** = Force component of Tension in the measuring direction
- **F_Rtot** = Total force in the measuring direction
- **F_V** = Force component of Tension transverse to the measuring direction
- **F_Vtot** = Total force in the transverse direction
- **T** = Tension in web
- **Tare** = Weight of roll and bearings
- **α, β** = Deflection angles
Furnace section
Design solutions

Installations in furnace sections
Furnace sections in process lines are very demanding and it is crucial to control strip tension in a correct and accurate way.

The strip tension range is often large; the temperature in the furnace can reach 1000 °C and at the load cell position it can be as high as 90 °C. The elongation of the deflector rolls, from furnace start to process temperature, can be as large as 50 mm. In order to accommodate the large elongation, with a minimum of influence on measurement performance, the deflector roll installation has to be designed with care.

In order to keep up with the competition many mills are continuously working on improvements of the strip quality towards the end-users. To guarantee a high constant strip quality as well as eliminating the risk of strip breaks the mills want accurate control of strip tension in furnace sections. A prerequisite is then reliable strip tension measurement, independent of furnace temperature changes.

ABB offers following design solutions:
- Conventional design
  - With ABB standard load cells:
    This solution is recommended when there are low axial expansion forces. The ABB standard load cell have proven outstanding dependability in a number of furnace sections in galvanizing and annealing lines around the world.
  - Linear bearing design
    This solution is recommended when high axial forces can occur. In order to eliminate these axial forces ABB has a proven solution with a linear bearing unit on the floating bearing side of the roll.

Following benefits can potentially be achieved when using the ABB solution with linear bearing in furnace installations:
- The combination of ABB Large PillowBlock load cells and Linear Bearing is proven to be very reliable with long-term stable tension measurement.
- The Linear Bearing solution is insensitive to and unaffected by temperature variations.
- The ABB load cells are virtually maintenance-free and the Linear Bearings require a minimum of service.

ABB recommends considering the following issues in order to achieve best possible measurement performance in the furnace sections:
- Protection bellows around deflector roll shafts between furnace and bearing housings must be flexible to avoid axial forces caused by thermal expansions
- In order to reduce the load cell temperature variations, heat radiation shields may be fitted between load cells and furnace
- Deflector roll elongation must be accommodated by the free side bearing. The measurement influence can be minimized in two ways.
  1. Clearance between roll bearings and bearing housings on the free side bearing, as well as lubrication must be designed for actual operating conditions.
  2. ABB’s proven solution with linear bearing on the free side of the roll can be utilized to accommodate the roll elongation.

ABB is working very close with the customer and together we always find the best solution. Thanks to the fact that standard load cells are used, the same type of load cells can be fitted both in the hot and cold sections of galvanizing and/or annealing lines. Another advantage is that the standard pedestal bearing houses can be used.

Consult ABB for advice how to design an optimal load cell installation in your furnace section.
In order to drastically reduce the expansion friction on the floating bearing side, the standard ABB large PillowBlock load cell and bearing housing are fitted on a linear bearing unit. The axial expansion friction coefficient drops from typically 0.2 inside a bearing housing in good condition, to <0.01 in a linear bearing unit.
Pressductor PillowBlock load cells
PFTL 101 Horizontal force measurement, 0.5 to 20 kN

Application hint
- Horizontally measuring load cells are ideal in applications with high tare loads and relatively small tensions, such as metal processing lines.
- In applications where high overloads can occur in any direction, the high overload tolerance in all directions of ABB’s horizontal PillowBlock load cell adds reliability.
- If no horizontal resultant force is present, mounting the load cell on a slant will give rise to one.

ABB PillowBlock horizontal load cells are ideal in applications characterized by low tension levels, heavy rolls and high operating speeds – a scenario often encountered in the metals industry.

Using the horizontal force component to measure strip tension can be highly advantageous. The load cell can be sized to measure just the strip tension, excluding the tare weight of the roll, which, on a big metal processing machine, for example, can be far greater than the tension in the strip. The result is optimized measurement accuracy.

Solid stainless steel construction combines sensitivity and accuracy with exceptional ruggedness and high spring constant. The units tolerate overloads up to five times their nominal capacity, and combined with the electronics are designed to provide stable output even when subjected to intense vibration.

The PillowBlock comes in three versions
The standard Version, PFTL 101A/B, is often used for accurate measurement in basic metal processing applications. Load cells are designed for demanding applications with, for instance, heavy rolls, wide tension range and high speed.

For lighter strip tension measurement applications in cold rolling mills, annealing and galvanizing lines, the mill-duty version, PFTL 101AE/BE, is recommended. This version has a fixed connection cable and a degree of protection of IP 66/1), which provides accurate and reliable measurement with long service life.

All load cells are delivered standard calibrated.

The acid resistant version, PFTL 101AER/BER, is designed for pickling lines and has a degree of protection of IP 66/671).

1 According to IEC 529, EN 60-529
<table>
<thead>
<tr>
<th>Technical data</th>
<th>PFTL 101A/AE/AER</th>
<th>PFTL 101B/BE/BER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal load (rated capacity)</td>
<td>kN</td>
<td>0.5 1.0 2.0 5.0 10.0 20.0</td>
</tr>
<tr>
<td></td>
<td>lb.</td>
<td>112 225 450 1125 2250 4500</td>
</tr>
<tr>
<td>Permitted load</td>
<td>kN</td>
<td>5.0 10.0 30.0 30.0 5.0 10.0 30.0 40.0</td>
</tr>
<tr>
<td></td>
<td>lb.</td>
<td>1125 2250 6750 6750 11250 22500 67500</td>
</tr>
<tr>
<td>Overload capacity *</td>
<td>kN</td>
<td>2.5 5.0 10.0 10.0 25.0 50.0 80.0</td>
</tr>
<tr>
<td>Measurement direction (horizontal)</td>
<td>lb.</td>
<td>563 1125 2250 2250 5625 11250 18000</td>
</tr>
<tr>
<td>Deflection *</td>
<td>mm</td>
<td>0.015 0.015 0.015 0.015 0.015 0.015 0.015</td>
</tr>
<tr>
<td></td>
<td>1/1000 in.</td>
<td>0.6 0.6 0.6 0.6 0.6 0.6 0.6</td>
</tr>
<tr>
<td>Spring constant</td>
<td>kN/mm</td>
<td>32 65 130 130 325 650 1300</td>
</tr>
<tr>
<td></td>
<td>1000 lb./in.</td>
<td>183 371 743 743 1857 3715 7430</td>
</tr>
</tbody>
</table>

**All load cells**

**Operating principle**
- Electromagnetic Pressductor technology

**Accuracy class**
- % 0.5

**Repeatability error**
- % <±0.05

**Operating range**
- 30:1

**Standard/Mill-duty version**
- Stainless steel SIS 2383
- DIN X4CrNiMo165

**Degree of protection**
- IP65 *1 (standard version)
- IP66 *1 (mill-duty version)

**Acid resistant version**
- Stainless steel SIS 2348
- DIN 17440X2CrNiMo17 13 2

**Degree of protection**
- IP67

**Working temperature range**
- –10 to 105 °C
- 14 to 221 °F

**Zero point drift**
- °C/°C <±0.005
- °F/°F <±0.003

**Sensitivity drift**
- °C/°C <±0.010
- °F/°F <±0.006

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*1 Maximum permitted loads without affecting load cell calibration.
*2 At nominal load.
*3 Accuracy class is defined as the maximum deviation, and is expressed as a percentage of the sensitivity at nominal load.
*4 This includes linearity deviation, hysteresis and repeatability error.
*5 Corrosion resistance properties similar to AISI 430F
*6 According to IEC 529, EN 60-529
*7 Corrosion resistance properties similar to AISI 316L
*8 Applies for 20 to 80 °C/68 to 176 °F

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Note: For more information, please refer to the provided documentation or contact the manufacturer.
Pressductor PillowBlock load cells
PFTL 201 Horizontal force measurement, 10 to 100 kN

ABB’s horizontal Pressductor® load cells are specifically designed for horizontal force measurement.

Key advantages
- Smaller load cell sizes can be specified since the tare weight won’t be a factor
- Inherently sturdier designs are virtually maintenance-free
- No contribution to machine vibration

In many strip processes, the strip tension inherently produces a horizontal force component on a roll or by design it can be made to do so.

Using this horizontal force component to measure strip tension can be highly advantageous. The load cell can be sized to measure just the strip tension, excluding the tare weight of the roll, which, on a big metal processing machine, for example, can be far greater than the tension in the strip. The result is optimized measurement accuracy.

Another advantage is that ABB’s unique horizontal load cell – specifically designed to measure this force component – provides stiffness levels and overload tolerances in all force directions that are significantly greater than what can be achieved with vertical load cells.

Solid stainless steel construction combines sensitivity and accuracy with exceptional ruggedness and high spring constant. The units tolerate overloads up to ten times their nominal capacity, and combined with the electronics are designed to provide stable output even when subjected to intense vibration.

Two versions of the PFTL 201 are available
- The standard version PFTL 201C/D equippe with Cannon connector for the connection cable.
- The mill-duty version PFTL 201CE/DE with fixed connection cable in protective hose, best suited for positions with severe environments like interstand.

The protective hose comes in three version
1. Standard mill-duty version suitable for most applications.
2. Kerosene resistant version for aluminium applications.
3. Acid resistant version primarily for pickling lines and/or TCM’s coupled with pickling lines.
### Technical data

<table>
<thead>
<tr>
<th></th>
<th>PFTL 201C/CE</th>
<th>PFTL 201D/DE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nominal load (rated capacity)</strong></td>
<td>10.0 kN</td>
<td>20.0 kN</td>
</tr>
<tr>
<td></td>
<td>2250 lb.</td>
<td>4500 lb.</td>
</tr>
<tr>
<td><strong>Extended load</strong>&lt;sup&gt;1&lt;/sup&gt;</td>
<td>15.0 kN</td>
<td>30.0 kN</td>
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<td>3375 lb.</td>
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<td><strong>Permitted load</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
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<td>200.0 kN</td>
</tr>
<tr>
<td><strong>(vertical) h=300 mm</strong></td>
<td>22500 lb.</td>
<td>45000 lb.</td>
</tr>
<tr>
<td><strong>Overload capacity</strong>&lt;sup&gt;2&lt;/sup&gt;</td>
<td>100.0 kN</td>
<td>200.0 kN</td>
</tr>
<tr>
<td><strong>Measurement direction (horizontal)</strong></td>
<td>22500 lb.</td>
<td>45000 lb.</td>
</tr>
<tr>
<td><strong>Transverse direction</strong></td>
<td>100.0 kN</td>
<td>200.0 kN</td>
</tr>
<tr>
<td><strong>(vertical) h=300 mm</strong></td>
<td>22500 lb.</td>
<td>45000 lb.</td>
</tr>
<tr>
<td><strong>Deflection</strong>&lt;sup&gt;3&lt;/sup&gt;</td>
<td>0.010 mm</td>
<td>0.020 mm</td>
</tr>
<tr>
<td></td>
<td>0.4 1/1000 in.</td>
<td>0.8 1/1000 in.</td>
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<tr>
<td><strong>Spring constant</strong></td>
<td>1000 kN/mm</td>
<td>1000 kN/mm</td>
</tr>
<tr>
<td></td>
<td>5720 lb./in.</td>
<td>5720 lb./in.</td>
</tr>
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</table>

### All load cells

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

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<sup>1</sup> 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.

<sup>2</sup> Maximum permitted loads without affecting load cell calibration.

<sup>3</sup> Permitted load in the transverse direction.

<sup>4</sup> 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.

<sup>5</sup> Stainless steel properties similar to AISI 304

<sup>6</sup> Applies for 20 to 80 °C/68 to 176 °F

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Height (h) from load cell's bottom surface to roll center line.
Pressductor PillowBlock load cells

PFCL 201 Vertical force measurement, 5 to 50 kN

Application hint
Vertically measuring load cells are ideal for applications with high speed gradients during acceleration and deceleration in cold rolling.

These units are designed for strip tension measurement in applications where it is essential or advantageous to determine the vertical force component.

Machined from a single block of stainless steel, they have exceptionally high tolerance for overloads, shock and impact, in addition to high immunity to dust and corrosion.

The standard construction is of highly resistant stainless steel with potted internal components. Mill-duty versions are available for exceptionally hostile environments in e.g. cold rolling mills, galvanizing lines and pickling lines.

The family of vertical load cells comprises units in four operating ranges offering measurement capacities from 5 kN (1,125 lbs.) to more than 50 kN (11,250 lbs.), covering applications with tensions levels in excess of 1,000 kN (225,000 lbs.).

ABB’s vertical load cells, like their counterparts for horizontal measurement, feature an extended operating load range. Up to 50 percent more measurement capacity is available in this range with fully retained performance characteristics, except some decline in measurement accuracy. As a result, in most applications, the load cells can safely be specified for the strip’s normal tension range, but still will accommodate substantial peak loads.

In fact, both types of ABB PillowBlock load cells feature an exceptionally wide measurement range.

Installation in existing equipment can be simplified by use of top and bottom adapter plates, which can be supplied by ABB.

Three versions of the PFCL 201 are available
- The standard version PFCL 201C equipped with Cannon connector for the connection cable.
- PFCL 201CD equipped with a tight cable gland and 20 m TEFLO® insulated connection cable
- The mill-duty version PFCL 201CE with fixed connection cable in protective hose, best suited for cold rolling mill applications. The cable connection is adjustable for left or right routing.

The protective hose comes in three versions
1. Standard mill-duty version suitable for most applications.
2. Kerosene resistant version for aluminium applications.
3. Acid resistant version primarily for pickling lines and/or TCM’s coupled with pickling lines.

1 TEFLO® is a registered trademark of DuPont
All load cells

<table>
<thead>
<tr>
<th>Operating principle</th>
<th>Electromagnetic Pressductor Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy class</td>
<td>%</td>
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<td></td>
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<tr>
<td>Repeatability error</td>
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<td></td>
<td>≤±0.05</td>
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<tr>
<td>Operating range</td>
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<td>Stainless steel</td>
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<td>2387 SIS</td>
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<td>X4CrNiMo165</td>
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<tr>
<td>Working temperature range</td>
<td>-10 to 90 °C</td>
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<td></td>
<td>14 to 194 °F</td>
</tr>
<tr>
<td>Zero point drift</td>
<td>%/°C</td>
</tr>
<tr>
<td></td>
<td>≤±0.005</td>
</tr>
<tr>
<td></td>
<td>%/°F</td>
</tr>
<tr>
<td></td>
<td>≤±0.003</td>
</tr>
<tr>
<td>Sensitivity drift</td>
<td>%/°C</td>
</tr>
<tr>
<td></td>
<td>≤±0.010</td>
</tr>
<tr>
<td></td>
<td>%/°F</td>
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<tr>
<td></td>
<td>≤±0.006</td>
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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
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

<table>
<thead>
<tr>
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<tr>
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<td>Extended load 1</td>
<td>kN</td>
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<tr>
<td></td>
<td>lb.</td>
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<tr>
<td>Permitted load</td>
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<tr>
<td>Transverse direction  kN</td>
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<tr>
<td>(vertical) h=300 mm</td>
<td>lb.</td>
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<tr>
<td>Overload capacity 2</td>
<td>kN</td>
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<tr>
<td>Measurement direction</td>
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<tr>
<td>(horizontal)</td>
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</tr>
<tr>
<td>Transverse direction  kN</td>
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<tr>
<td>(vertical) h=300 mm</td>
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<tr>
<td>Deflection 3</td>
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<td>Spring constant</td>
<td>kN/mm</td>
</tr>
<tr>
<td></td>
<td>1000 lb./in.</td>
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</table>

### All load cells

- **Operating principle**: Electromagnetic Pressductor Technology
- **Accuracy class 4**: %
- **Repeatability error**: %
- **Operating range**: 30:1
- **Stainless steel**: SIS 2387
- **DIN**: X4CrNiMo165
- **Working temperature range**: –10 to 90 °C
  14 to 194 °F
- **Zero point drift 4**: %/°C
  %/°F
- **Sensitivity drift 4**: %/°C
  %/°F

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 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.
5. Corrosion resistance properties similar to AISI 304
6. Applies for 20 to 80 °C/68 to 176 °F
Pressductor PillowBlock load cells
PFCL 241 Vertical force measurement, 200 kN

Load cell PFCL241-SE is an excellent choice in Cluster rolling mills and other mill applications where strip tensions are high. It can also be used in high tension application in process lines.

The load cell is a solid tensiometer made from stainless steel with exceptional ruggedness and high spring constant in line with other Pressductor PillowBlock load cells. It can be installed under the bearing housing and senses the vertical force, measuring in both directions. PFCL241-SE is available as mill-duty version with fixed connection cable in protective hose. The protective hose/cable can be mounted at desired angular position.

The protective hose comes in three versions:
1. Standard mill-duty version suitable for most applications.
2. Kerosene resistant version for aluminium applications.
3. Acid resistant version primarily for pickling lines and/or TCM’s coupled with pickling lines.

### PFCL 241-SE

Dimensions in mm (in.)

<table>
<thead>
<tr>
<th>Technical data</th>
<th>PFCL 241-SE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal load (rated capacity)</td>
<td>200.0 kN</td>
</tr>
<tr>
<td>Extended load</td>
<td>300.0 kN</td>
</tr>
<tr>
<td>Permitted load</td>
<td></td>
</tr>
<tr>
<td>Transverse direction</td>
<td>100.0 kN</td>
</tr>
<tr>
<td>(horizontal) h=300 mm</td>
<td>1000.0 kN</td>
</tr>
<tr>
<td>Overload capacity</td>
<td>2000.0 kN</td>
</tr>
<tr>
<td>(vertical)</td>
<td>500.0 kN</td>
</tr>
<tr>
<td>Deflection</td>
<td>0.02 mm</td>
</tr>
<tr>
<td>Spring constant</td>
<td>1000 kN/mm</td>
</tr>
</tbody>
</table>

### All load cells

<table>
<thead>
<tr>
<th>Operating principle</th>
<th>Electromagnetic Pressductor Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy class</td>
<td>%</td>
</tr>
<tr>
<td>Repeatability error</td>
<td>%</td>
</tr>
<tr>
<td>Operating range</td>
<td>30:1</td>
</tr>
<tr>
<td>Stainless steel</td>
<td>SIS</td>
</tr>
<tr>
<td></td>
<td>DIN</td>
</tr>
<tr>
<td>Working temperature range</td>
<td>-10 to 90 °C</td>
</tr>
<tr>
<td>Zero point drift</td>
<td>%/°C</td>
</tr>
<tr>
<td>Sensitivity drift</td>
<td>%/°C</td>
</tr>
</tbody>
</table>

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.
Tension electronics

PFEA – the compact solution

Covering a wide range of applications the tension electronics comes in three versions, with different levels of performance and functionality.

All three versions have multi-language digital display and configuration keys. The configuration keys being used for setting different parameters and to check the status of the tension system. The 2 x 16 character display can present sum, difference or individual load cell signals. All three versions are available in both DIN-rail version and enclosed IP65 version for mounting in more severe environments.

**PFEA 111**

A cost effective, compact and user-friendly tension electronics providing an accurate and reliable fast analog SUM signal from two load cells for control and/or monitoring. The display can show the SUM, individual A & B and difference signal. The small size and DIN-rail mount make this unit very easy to integrate into many types of electrical cabinets.

**PFEA 112**

This unit provides the same functionality and user friendliness as the PFEA 111 with the addition of fieldbus communication via Profibus-DP.

**PFEA 113**

This advanced tension electronics can supply up to four load cells and has six configurable analog out-puts for control and/or monitoring of strip tension. The output signals are also available on Profibus-DP.

Another useful feature is the possibility to, via the digital input or Profibus, switch the gain for two different web paths. Alternatively, the digital input could be used for remote gain scheduling or zero set. This unit also includes a self-diagnostic function and four configurable digital outputs for alarms and level detection. Status of self-diagnostic functions are also available on Profibus-DP.

By combining up to three PFEA 113 the system can handle segmented roll applications, i.e. winders, with up to 12 load cells.

The high level of functionality and user-friendliness make the PFEA 113 one of the most complete tension electronics on the market.

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**01** PFEA tension electronics.

**02** IP20 version for control room cubicle.

**03** Interactive display.

**04** IP65 version for mounting on machine.

---

According to IEC 529, EN 60-529
Features and benefits

Interactive menu
The tension electronics has a unique interactive menu which guides the commissioning step by step, eliminating the potential for making mistakes and significantly reducing startup time – a very helpful tool.

Built-in self diagnostics
The electronics continuously supervise a number of important parameters and provides error messages if something goes wrong.

Multi-language display
The multi-language display is a great feature that helps to eliminate mistakes, during start-up and/or operation of the tension system.

Load memory
The resetable load memory stores max. load values. A useful tool for maintenance.

Analog outputs
Individual scaling and filtering of all analog outputs. Fieldbus communication Versions PFEA 112 and PFEA 113 have Fieldbus communication via Profibus-DP as standard. In contradiction to many other tension systems the PFEA 112 and PFEA 113 provide a scaled and zeroed tension output ready for use in control or monitoring.

Filter function
All units come with a selectable filter function for removal of roll unbalance, machine vibrations and other disturbances.

Commissioning without calibration weights
All Pressductor load cells are standard calibrated to the same sensitivity before delivery from ABB factory. This means that the fastest and most accurate way to commission a tension system is to use a calculated value instead of using calibration weights.

Mounting
To provide flexibility of mounting, all three versions of the tension electronics are available in two mounting alternatives. For mounting on a standard DIN-rail the IP 20 and for wall mounting the IP 65.

Floor cubicle
Floor cubicle type MNS Select is available for housing of up to 24 pcs. of PFEA 111/112 or 12 pcs. of PFEA 113 when mounted on 19 inch plates. Exact numbers depend on the combination of different tension electronics and the number of optional units used.
Options and dimensions

Options
To meet certain special application requirements the following options are available:

Insulation amplifier PXUB 201
The insulation amplifier can be used when galvanic insulation is required for analog output signals. The insulation amplifier can be connected to all versions and PFEA 113 – IP 65 can hold up to four PXUB 201.

<table>
<thead>
<tr>
<th>Supply voltage</th>
<th>24 V (20 to 253 V AC/DC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current consumption</td>
<td>10 mA + external load</td>
</tr>
<tr>
<td>Signal range</td>
<td>Input</td>
</tr>
<tr>
<td></td>
<td>0 to ±10 V</td>
</tr>
<tr>
<td></td>
<td>0 to ±10 V</td>
</tr>
<tr>
<td></td>
<td>0 to 10 V</td>
</tr>
<tr>
<td>Rated insulation voltage</td>
<td>600 V (basic)</td>
</tr>
</tbody>
</table>

Relay board PXKB 201
PXKB 201 is DIN-rail mounted and can be mounted in the IP 65 versions of the tension electronics together with the insulation amplifier. PFEA 113–65 can hold up to four PXKB 201.

<table>
<thead>
<tr>
<th>Supply voltage</th>
<th>24 V DC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power consumption</td>
<td>18 mA</td>
</tr>
<tr>
<td>Contact data</td>
<td>AC</td>
</tr>
<tr>
<td></td>
<td>6 A at 250 V</td>
</tr>
</tbody>
</table>

Power supply unit
When using the DIN-rail IP 20 version of the electronics and 24 V main supply is not available, ABB offers optional power supply units.

The compact units transform main supply from 110 to 120 V/207 to 240 V AC to 24 V DC for supply of the PFEA 111, 112 and 113.

Three power supply units with different power ratings are available. The table below indicates max. number of electronics per power supply unit.

<table>
<thead>
<tr>
<th></th>
<th>PFEA 111</th>
<th>PFEA 112</th>
<th>PFEA 113</th>
</tr>
</thead>
<tbody>
<tr>
<td>SD831 3 A</td>
<td>6</td>
<td>6</td>
<td>3*</td>
</tr>
<tr>
<td>SD832 5 A</td>
<td>12</td>
<td>12</td>
<td>6*</td>
</tr>
<tr>
<td>SD832 10 A</td>
<td>24</td>
<td>24</td>
<td>12*</td>
</tr>
</tbody>
</table>

* Supply of digital outputs are not included.
# Technical data

<table>
<thead>
<tr>
<th>Data</th>
<th>PFEA 111</th>
<th>PFEA 112</th>
<th>PFEA 113</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Power supply</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP 20 voltage</td>
<td>24 V DC (18 to 36 V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power requirement</td>
<td>7.5 W</td>
<td>7.5 W</td>
<td>12 W</td>
</tr>
<tr>
<td>IP 65 main voltage</td>
<td>24 V DC (18 to 36 V), 100 (~15 %) to 240 (+10 %) V AC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>45 to 65 Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Number of load cells</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Load cell excitation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current</td>
<td>0.5 A RMS, 330 Hz</td>
<td>0.5 A RMS, 330 Hz</td>
<td>0.5 A RMS, 330 Hz</td>
</tr>
<tr>
<td>Max. load</td>
<td>2 load cells plus 5 Ω cable resistance</td>
<td>2 load cells plus 5 Ω cable resistance</td>
<td>4 load cells plus 10 Ω cable resistance</td>
</tr>
<tr>
<td><strong>Inputs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digital inputs (remote zero or gain scheduling)</td>
<td>—</td>
<td>—</td>
<td>1</td>
</tr>
<tr>
<td>Analog inputs (connection of multiple PFEA 113 units)</td>
<td>—</td>
<td>—</td>
<td>2</td>
</tr>
<tr>
<td><strong>Outputs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog outputs (voltage or current)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>–5 to 11 V (max. load 5 mA)</td>
<td>—</td>
<td>—</td>
<td>6</td>
</tr>
<tr>
<td>0 to 21 mA (max. load 550 Ω)</td>
<td>1</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Selectable filter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Step response (0 to 90 %) can be set for each output</td>
<td>15, 30, 75, 250, 750, 1500 ms</td>
<td>15, 30, 75, 250, 750, 1500 ms</td>
<td>5, 15, 30, 75, 250, 750, 1500 ms</td>
</tr>
<tr>
<td>Scaling function of analog outputs</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Digital outputs (Status OK and/or Level detectors)</td>
<td>—</td>
<td>—</td>
<td>4</td>
</tr>
<tr>
<td>Self diagnostics, Status OK</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LED (green/red)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Alarm on Digital output</td>
<td>—</td>
<td>—</td>
<td>Yes</td>
</tr>
<tr>
<td>Alarm via Profibus</td>
<td>—</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Multi-language interactive display</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Selectable tension units on the display</td>
<td>N, kN, kg and lbs, N/m, kN/m, kg/m, pli</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum load memory</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Zero offset memory</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Communication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ProfiBus DP, baud rate up to 12 Mbit</td>
<td>—</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GSD-file</td>
<td>—</td>
<td>ABB_0716.GSD</td>
<td>ABB_0717.GSD</td>
</tr>
<tr>
<td>Environmental tolerance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical environment</td>
<td>As per EMC Directive 2014/30/EU</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrical safety</td>
<td>As per Low Voltage Directive 2014/35/EU</td>
<td>As per UL508 Industrial control equipment</td>
<td></td>
</tr>
<tr>
<td>Ambient temperature</td>
<td>5 to 55 °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IEC 529 Protection class IP 20 or IP 65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 English, German, Italian, French, Japanese, Portuguese
2 Not PFEA 112-65
Control unit
Millmate Controller 400

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.

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 enclosures
  - 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 therecieving 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.

---

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

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
Control unit accessories

**Millmate Operator Unit 410**
The Millmate Operator Unit 410 provides communication with the control unit and is designed for panel mounting.

The operator unit(s) and control unit(s) are interconnected on a common network. This common network can be a separate network for measuring objects or it can be part of a local area network (LAN).

The communication on the network is in accordance with the IEEE 802.3 standard and uses TCP/IP protocol.

**Relay board PFVK 128**
Fitted with four relays with one changeover function per relay.

**Insulation amplifier PXUB 201**
The insulation amplifier can be used when improved electrical insulation is required. Selected voltage or current output.

**Switch SDI-880**
Connects MC400 control units and operator units in one network.

**Switch with opto SDW-541**
Opto interface and network switch for external communication.

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Installation options

**Wall cabinet**
A control unit can be installed in the dust- and hose-proof wall cabinet. The operator unit can be mounted on the inside of the door or through the door.

**Floor cabinet**
The MNS floor cabinet can contain a combination of control units with Roll Force, Strip Tensiometer and Strip Scanner applications. They can be operated by one operator unit, optionally mounted through the door or inside the cabinet.

**Junction box PFXC141**
A junction box can be used for efficient cable connection of up to four load cells.