Measurement Products

Web Tension Systems
Pressductor® Radial Load Cells

Power and productivity
for a better world™

ABB

Pressductor® Radial Load Cells

A quality load cell system for dependable tension measurement

Introduction

ABB's Pressductor® load cells are sensitive and accurate yet rugged, reliable and compact. They can withstand high overloads and vibrations, and operate over a wide range of tensions: ideal for any web converting application such as coating, laminating, printing, slitting winding/unwinding and many others.

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

Increased process uptime

In a web process running continuously, every minute of production time is precious. Even so, no production line runs without downtime. With Pressductor® Radial load cells (PRT load cells) the risk of web 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 PRT load cells, the upcoming web breaks are kept to an absolute minimum level.

Tighter product tolerances

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

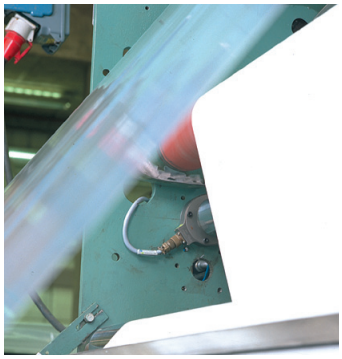
A Pressductor® transducer produces its measurement signal without requiring any physical movement in the transducer measurement element. And it generates a strong signal at comparatively low stress levels. So there is no possibility of fatigue leading to drift and deteriorating measurement performance.

Minimize maintenance

Share the experience, of virtually maintenance-free load cells, with thousands of other Pressductor® load cell users. A robust load cell design with no fragile or ageing components makes this possible. Thanks to its robust and compact design, the PRT load cells work consistently for many years without any need for maintenance.

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 shaft-mounted PRT tension measurement load cell suitable for most web processing machinery used in the converting, printing, plastic film, textiles, and other industries.

In the converting industry, the PRT load cells are ideal on machinery for coating, laminating, embossing, and many other processes.

PRT load cells are used on a wide range of printing presses – in both converting and commercial printing as well as newspaper and magazine production.

In the plastics industry, PRT load cells are used to optimize the production and processing of blown and cast film.

And in the textiles industries, machinery applications include nonwovens production as well as finishing operations like bleaching, desizing, dyeing, and printing.

In all web processing areas, PRT load cells are used on the full range of winding machinery, from unwinds to slitter-rewinders.

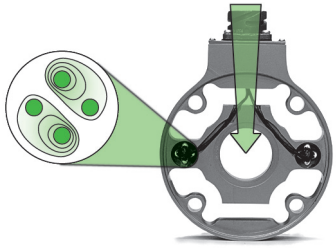
The Pressductor® difference

Like ABB's other load cells based on Pressductor® Technology, PRT load cells rely on electromagnetic changes in the transducer, not on physical movement, to sense fluctuations in web 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, PRT 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.



Pressductor® Technology: Mechanical force alters magnetic field.

Simple to size and easy to apply

Designers appreciate remarkably high spring constant and very narrow profile
Operators value a load cell with high reliability

Application Hint

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

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

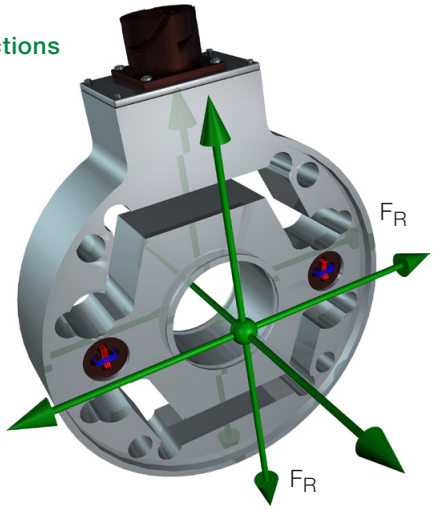
2. During normal operation, the sensed force should not be less than 10 percent of the load cell's capacity.

Calculating the forces exerted on load cells in a specific application allows you to determine the ideal load cell size specification. Force calculations and load cell sizing are typically conducted in collaboration with ABB; this page provides an overview of the considerations that play a role in this stage of the specification process.

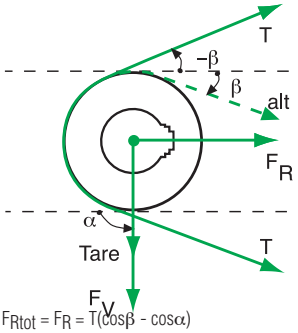
The orientation of PRT load cells on the end of the roll shaft can be adjusted to perform measurements in the most advantageous direction for each application.

In sizing PRT load cells, both the web tension and the weight of the roll and bearings (tare weight) should be considered. If the load cell is oriented vertically or diagonally with respect to the force of gravity, the tare force will contribute to the total force level sensed by the PRT load cell system. If the load cell is oriented horizontally, the tare force will be perpendicular to the measurement axis, and so will not be sensed.

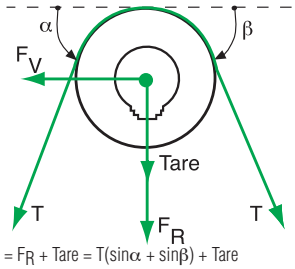
Force directions



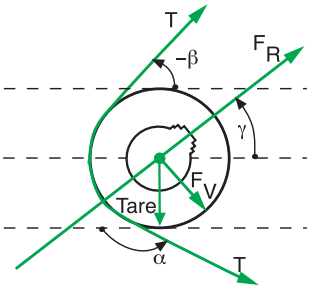
F_R= Force component of Tension in the measuring direction
F_{Rtot}= Total force in the measuring direction
F_V= Force component of Tension transverse to the measuring direction
F_{Vtot}= Total force in the transverse direction
T= Tension in web
Tare= Weight of roll and bearings
α,β= Deflection angles
γ= Angle for load cell mounting



$F_{Rtot} = F_R = T(\cos\beta - \cos\alpha)$
$F_{Vtot} = F_V + Tare = T(\sin\beta + \sin\alpha) + Tare$



$F_{Rtot} = F_R + Tare = T(\sin\alpha + \sin\beta) + Tare$
$F_{Vtot} = F_V = T(\cos\alpha - \cos\beta)$



$F_{Rtot} = T(\cos(\beta + \gamma) - \cos(\alpha - \gamma)) - Tare \times \sin\gamma$
$F_{Vtot} = T(\sin(\alpha - \gamma) + \sin(\beta + \gamma)) + Tare \times \cos\gamma$

Calculating the Forces

The PRT load cell measures bidirectionally along its measurement axis (see illustration). Once the load cell is oriented and the measurement axis determined, the force components exerted on the load cells of a roll are easily calculated as functions of the web tension, tare force, and deflection angles. Since most systems involve two load cells, the calculated forces are divided by 2 to obtain the forces exerted on each individual load cell. The diagrams on this page illustrate three scenarios, involving horizontal, vertical and diagonal measurement axes.

When horizontal, the measurement force (F_{Rtot}) is a function of just the tension in the web (T) and the deflection angles (α and β). Since the weight of the roll and bearings (Tare) is not sensed, the load cells can be sized to measure low tension levels even on a comparatively heavy roll. However, the perpendicular force (F_{Vtot}) – which does include Tare – should not exceed the overload rating.

When the measurement force (F_{Rtot}) is vertical, it includes the weight of the roll and bearings (Tare), and the load cell must be sized accordingly. In effect, the weight of the roll and bearings are using up some of the measurement range of the load cell.

A diagonal load force orientation requires a more complex calculation. Here, the forces sensed in both the measurement direction and the perpendicular direction include a portion of the tare as well as the web tension, and the angle formed by the measurement axis and the horizontal axis (γ) enters into the calculation.

Pressductor® Radial Load Cells

Designed to measure web tension on most types of web processing machinery used in the converting, plastic film, printing, textiles, and other industries

Four standard sizes measure web tension from 0.1 to 100 kN. With its extended-capacity feature, the PRT load cell is capable of measuring tension reliably over a 30:1 range. Superior overload characteristics in all force directions (up to 500%) eliminate overload failures for all practical purposes. Exceptionally high spring constant virtually precludes load cell contributions to machine vibration, even at very high machinery speeds. The performance of the load cells is unaffected by environmental factors like dust, corrosion, and radio or electromagnetic interference.

Extended-Range Operation

Beyond their nominal capacity, PRT load cells have an extended range of measurement – so they can be sized for normal, as opposed to maximum, tension levels. As a result, they can process a wider variety of materials.

Properties		PFRL 101A	PFRL 101B	PFRL 101C			PFRL 101D
Nominal load (rated capacity)	kN	0.5	1.0	0.5	1.0	2.0	5.0
	Lbs.	112	225	112	225	450	1125
Extended load[1]	kN	0.75	1.5	0.75	1.5	3.0	7.5
	Lbs.	169	337	169	337	675	1687
Overload[2] Measurement direction	kN	2.5	5.0	2.5	5.0	10.0	25.0
	Lbs.	562	1125	562	1125	2250	5625
Transverse to measurement direction	kN	2.5	3.0	1.25	2.5	5.0	10.0
	Lbs.	562	674	281	562	1125	2250
Axial	kN	2.5	5.0	2.5	5.0	10.0	25.0
	Lbs.	562	1125	562	1125	2250	5625
Spring constant	kN	50	100	50	100	200	500
	1000 Lbs./inch	286	572	286	572	1143	2858
Deflection[3]	mm	0.01	0.01	0.01	0.01	0.01	0.01
	1/1000 inch	0.4	0.4	0.4	0.4	0.4	0.4

All Load Cells

Operating Principle		Electromagnetic Pressductor® Technology
Accuracy class[4]	%	±0.5
Repeatability error	%	<±0.1
Operating range		30:1
Stainless steel	SIS	2387[5]
	DIN	X4CrNiMo165
Working temp. range		-10 to +80°C 14 to 176°F
Zero point drift[6]	%/°C	<±0.015
	%/°F	<±0.008
Sensitivity drift[6]	%/°C	<±0.015
	%/°F	<±0.008

[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 small decline in measurement accuracy may be experienced.

[2] Maximum permitted loads without affecting load cell calibration.

[3] At nominal load.

[4] 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.

[5] Corrosion resistance properties similar to AISI 304

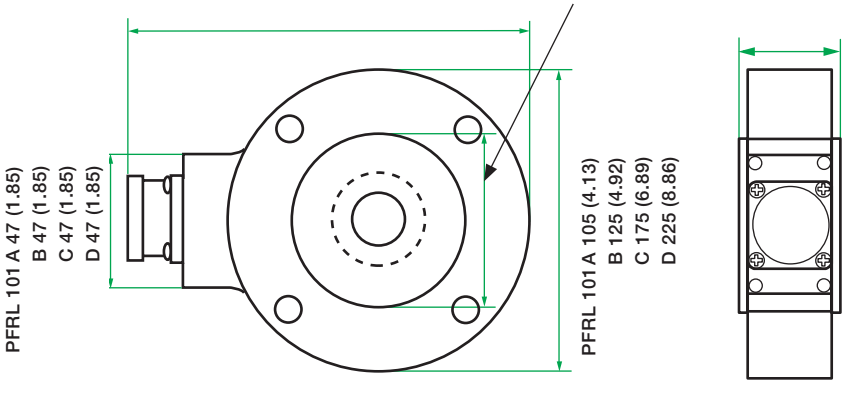
[6] Applies for +20 – 80°C
+68 – 176°F

PRT dimensions

PFRL 101 A 143 (5.63)
B 163 (6.42)
C 213 (8.39)
D 263 (10.35)

PFRL 101 A 60 (2.26)
B 60 (2.26)
C 100 (3.94)
D 130 (5.12)

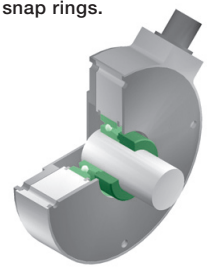
PFRL 101 A 37 (1.46)
B 37 (1.46)
C 50 (1.97)
D 56 (2.20)



mm (inch)

Shaft sizes and bearing recommendations

The bearing is press fit to the roll shaft, and the assembly is slip fit to the load cell and secured with snap rings.



Application Hint

Thermal expansion of the roll is accommodated by installing snap rings on both sides of the bearing in just one load cell.

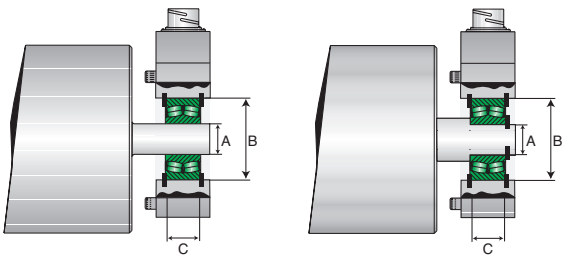
PRT load cells work well with both rotating (live) and non-rotating (dead) shafts. For live shaft applications, many different bearing types and sizes can be used. The load cell and the shaft can be integrated by first press-fitting the selected bearing onto the shaft and then sliding the assembly into the center hole of the PRT load cell. Or, alternatively, the roll shaft may be machined to create a shoulder that one side of the bearing rests against, while the other side is restricted by a snap ring.

In live shaft assemblies, the roll is held securely in place by snap rings installed in grooves on each side of the bearing in the center hole of the load cell. Thermal expansion of the roll is accommodated by installing snap rings on both sides of the bearing in just one load cell.

The table below presents a sampling of bearing specifications for PRT load cells for various shaft diameters and bearing types. Other bearing types and sizes can be accommodated, including both conventional SKF bearings and many self-locking Torrington-type bearings.

The table includes typical examples of bearings for a variety of shaft diameters, based on specific load cell capacities, center hole diameters, and bearing widths (distance between snap rings). Of course, bearing load and rotational speed are also important specification criteria that must be considered when selecting an appropriate bearing. Only the bearings for the largest shaft diameters that fit standard PRT load cells are shown; many other options are available. ABB applications engineers can provide assistance with bearing selection.

Load Cell		PFRL 101A				PFRL 101B			PFRL 101C			PFRL 101D	
Nominal load	kN	0.5	0.5	0.5	0.5	1.0	1.0	1.0	0.5	1.0	2.0	5.0	5.0
	lbs	112	112	112	112	225	225	225	112	225	450	1125	1125
Load cell hole dia.	mm	32	35[1)]	35[1)]	40	40	47	52	80	80	80	110	125
	inch	1.26	1.38	1.38	1.57	1.57	1.85	2.05	3.15	3.15	3.15	4.33	4.92
Dist. between snap rings	mm	14	11	14	16	16	18	18	23	23	23	28	28
	inch	0.55	0.43	0.55	0.63	0.63	0.71	0.71	0.91	0.91	0.91	1.10	1.10
Self-aligned ball bearing SKF#		2201E	1202E	2202E	2203E	2203E	2204E	2205E	2208E	2208E	2208E	2212E	2214E
shaft dia.	mm	12	15	15	17	17	20	25	40	40	40	60	70
	inch	0.47	0.59	0.59	0.67	0.67	0.79	0.98	1.57	1.57	1.57	2.36	2.76
Spherical roller bearing SKF#								22205E	22208E	22208E	22208E	22212E	22214E
shaft dia.	mm							25	40	40	40	60	70
	inch							0.98	1.57	1.57	1.57	2.36	2.76



A = Shaft diameter

B = Load cell hole diameter

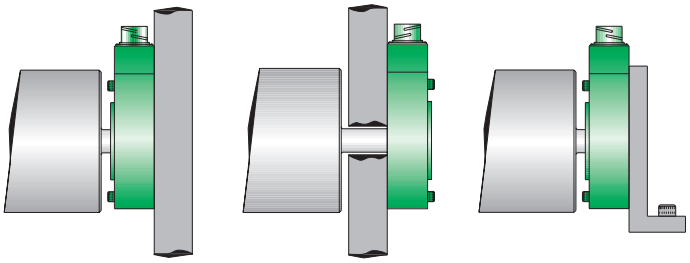
C = Distance between snap rings

[1)] Please specify desired snap ring distance when ordering

Note:

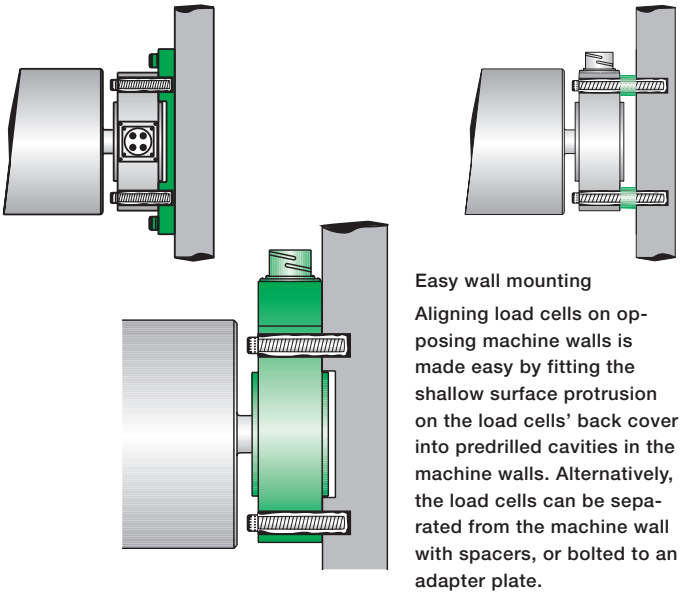
Bearing specifications in table are samples. PRT load cells can accommodate bearings for many other shaft diameters besides those shown.

Mounting options



Three ways to mount

PRT load cells mount with equal ease on the inner and outer side of machine walls. In locations where pedestal mounting is required, a specially designed angle bracket extends the usefulness of the radial load cell.



Easy wall mounting

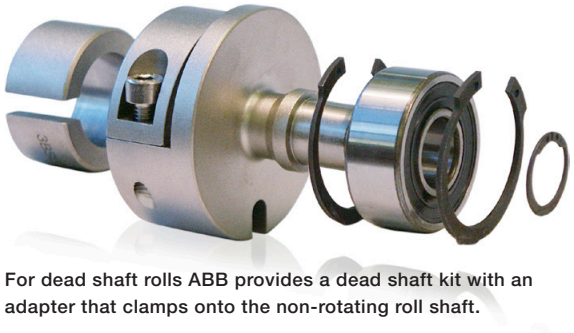
Aligning load cells on opposing machine walls is made easy by fitting the shallow surface protrusion on the load cells' back cover into predrilled cavities in the machine walls. Alternatively, the load cells can be separated from the machine wall with spacers, or bolted to an adapter plate.

Dead shaft adapter kit

For applications with non-rotating shaft ends ABB provides an optional dead shaft adapter kit for PFRL 101A and PFRL 101B. The kit consists of a self-aligning bearing to manage misalignments, adapter for different shaft diameters and an anti-rotation pin.

Dead shaft adapter kit is available for following shaft diameters:

3/4", 1", 1 1/8", 1 1/4", 1 1/2",
20 mm, 25 mm and 30 mm.



For dead shaft rolls ABB provides a dead shaft kit with an adapter that clamps onto the non-rotating roll shaft.

Grease nipple

ABB recommends to use sealed bearings that will meet most demands in web handling machinery without the need for regular greasing operations. However, if greasable bearings must be used, ABB offers, as an option, load cells modified for grease nipples. This option is available for PFRL 101B, PFRL 101C and PFRL 101D.