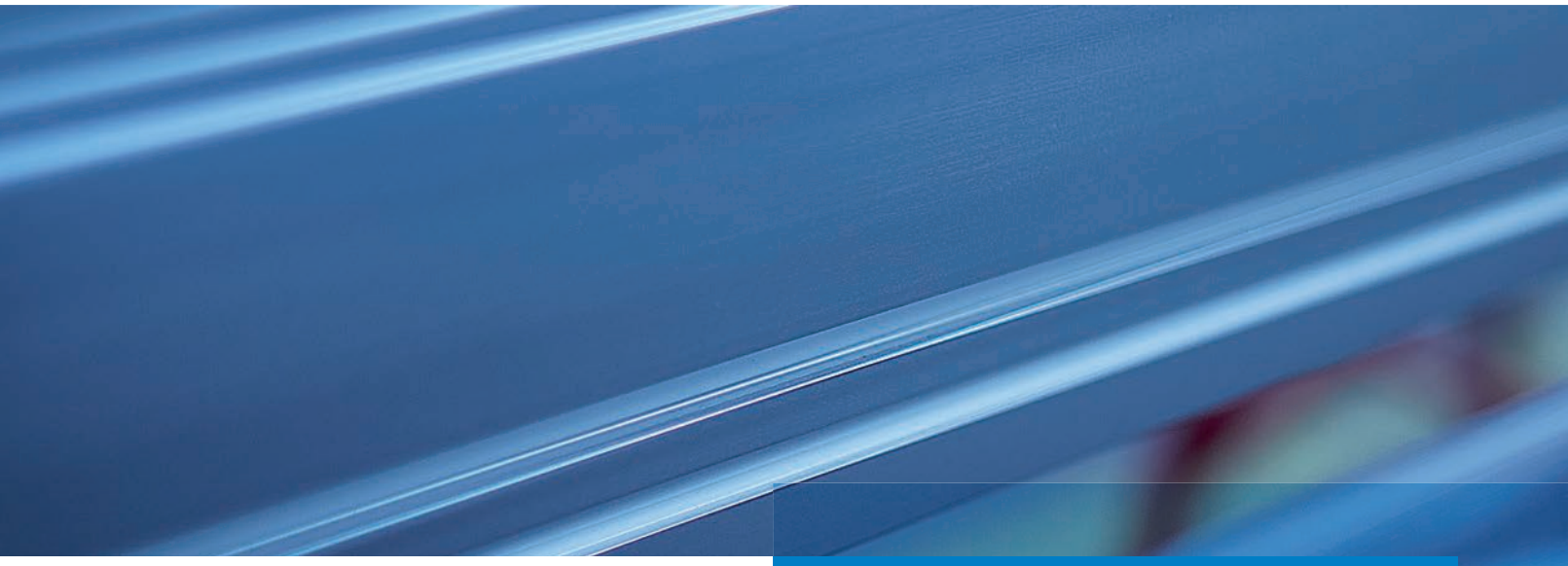


ELTENS

Web tension measuring/control systems

Continuous detection and control of the web tension

Contents

ELTENS – Web tension measuring and control systems

Increased quality and productivity

Increased quality and productivity due to web tension control

Today, the manufacturers and users of machines for processing web-type materials are confronted with ever increasing demands: production processes should be even faster, while at the same time performed with greater precision, the quality of the finished product further improved while personnel, waste and, above all, downtimes, should be reduced to a minimum. A decisive contribution to the fulfillment of these prerequisites is made by web tension control systems. Typically, web-type materials are fed from a roll to the machine, finished and then rewound. At each stage, web tension errors may occur that may lead to malfunctions and quality impairments. The elimination of these sources of error and ensuring a constant web tension during the production process is the task of E+L web tension control systems. Depending on the material type, application and task, Erhardt+Leimer offers a variety of systems with the latest technology: For decisively more quality and productivity that pays off.

Typical web tension errors

Web tension after the unwinder

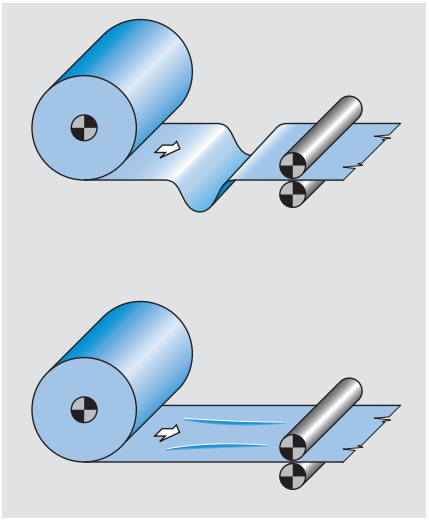
+ Insufficient web tension causes slack in front of the transport drive
+ If the web tension is too high, longitudinal creasing and textile web deformation may be caused

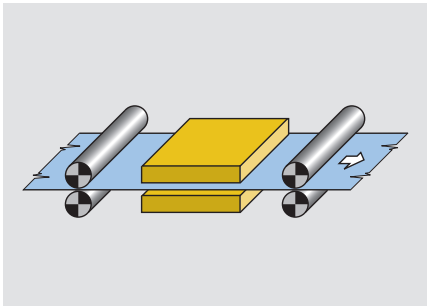
Web tension between the clamping points

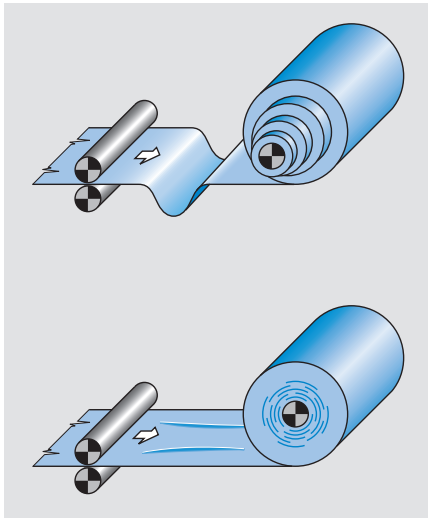
+ Crucial to the quality of the process is a constant web tension between clamping points

Web tension on the rewinder

+ If web tension on rewinding is insufficient, roll telescoping may occur
+ Excessively high tensile forces damage the inner windings



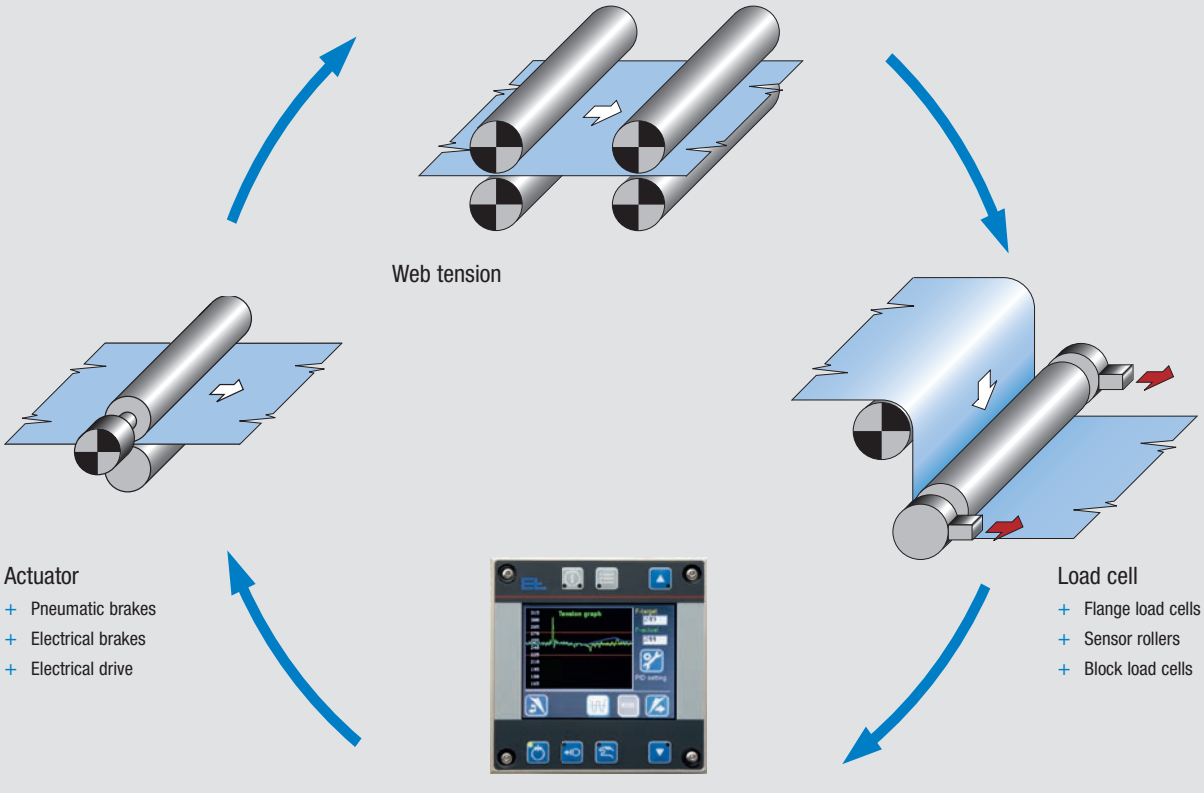




Control loop

Any automation of a controller is based on the principle of a simple control loop. Even the most complex of tasks may be reduced to this control loop.

+ The starting point is the actual tensile force of the web
+ Load cells continuously and precisely detect the tensile force on the web
+ The controller compares the actual web tension value with the specified target value and transmits the relevant corrective signal to the actuator
+ The actuator converts the correction signal into the braking torque or the target speed value and, in this way, generates the web tension



Web tension controller DC 62

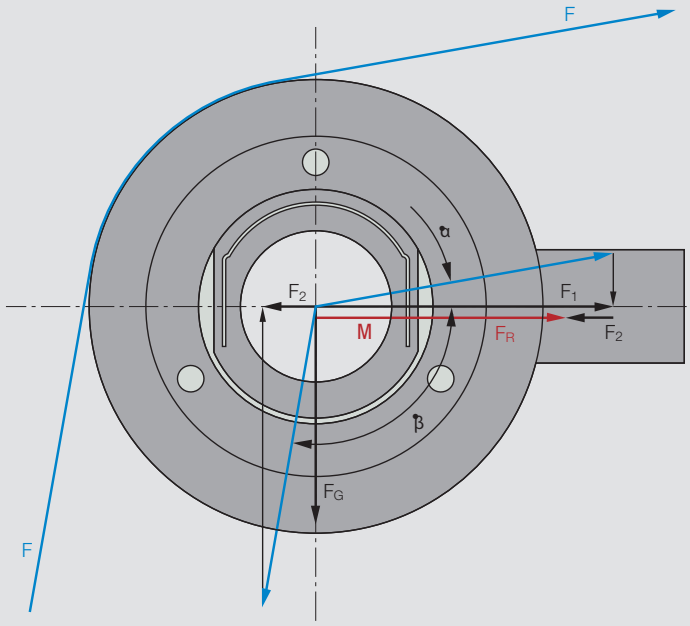
Flange load cells

Function

The load cell comprises a stable outer ring with flange cover and centering collar for precision assembly. The inner ring in the form of a double bending beam ensures centered mounting of the ball bearing. The radial forces created by the web unbalance the strain gauges linked together to form a measuring bridge on the inner ring. This leads to an analog output signal proportional to the web tension.

Area of use

Flange load cells are used in practically all processing plants where web-type materials are processed or finished. In front of processing stations, in particular, it is of fundamental importance that the web is transported with a continuous web tension.



Legend

F	Web tension (N)
F_1	Force component 1 measuring direction (N)
F_2	Force component 2 measuring direction (N)
F_G	Weight force (N)
F_R	Resulting force in measuring direction (N)
$F_{R/K}$	Resulting force/load cell (N)
α	Angle between outgoing web and measuring direction
β	Angle between incoming web and measuring direction
M	Measuring direction

Calculation, flange load cells

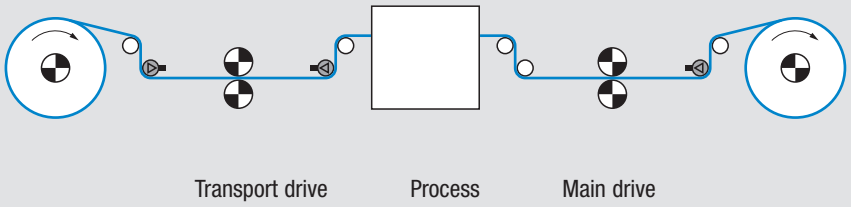
$F_1 = F \cdot \cos \alpha$
$F_2 = F \cdot \cos \beta$
$F_{R/K} = (F_1 + F_2)/2$

Calculation, sensor rollers

$F_1 = F \cdot \cos \alpha$
$F_2 = F \cdot \cos \beta$
$F_R = (F1 + F_2)$

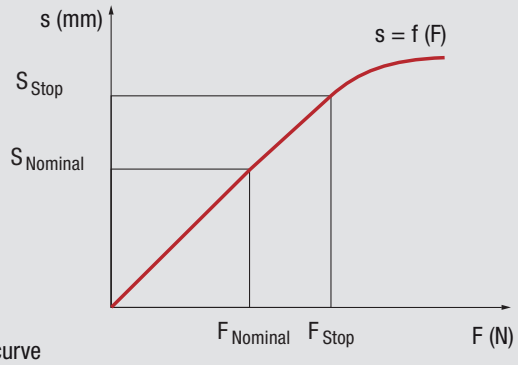
Application

With a 90° horizontal-vertical wrapping angle on the measuring roller and a horizontal measuring direction, optimum web tension detection is assured. Only detection of the bearing forces on both sides can prevent incorrect measurements caused by the web moving sideways and asymmetrical web tension distribution. Load cells incorporated into a control loop should be mounted as near to the actuator as possible.



Calibration

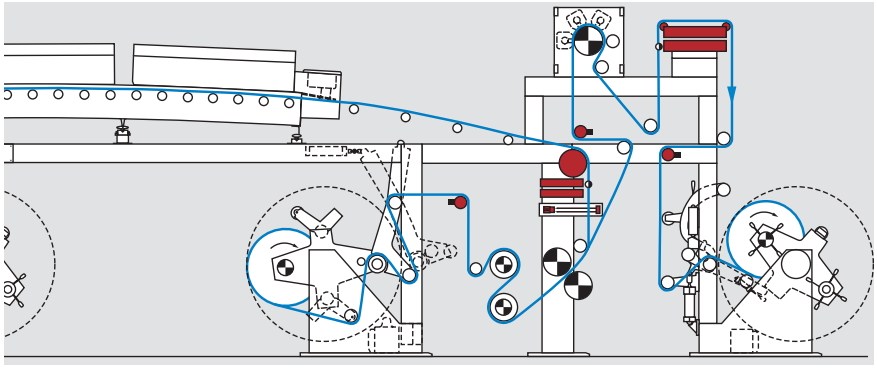
The tensile force–path characteristic curve forms a straight line to the mechanical stop. All the load cells with the exception of the PD 25 series are calibrated to the nominal measuring force. Between the nominal measuring force and mechanical stop, a safety factor of 50 to 100 % is taken into account to compensate for asymmetrical web tension distribution.



Characteristic curve

Flange load cell PD 21/22

- Position-independent installation due to various mounting options such as flange bearings, pedestal bearings, inner or outer fastening
- Maximum operational reliability due to overload protection up to 20 times the nominal measuring force
- Different shaft diameters from 12 to 65 mm and nominal measuring forces from 0.05 to 10 kN ensure a high degree of flexibility
- With a horizontal measuring direction, the weight of the roller does not affect the measured result
- Good temperature behavior and a high degree of linearity of the measuring elements due to strain gauge application on a flat surface
- High permissible operating speed of the measuring roller due to high web load cell spring constant
- Best surface protection due to chemical nickel plating



Flange load cell PD 21 on laminating line

Selection table

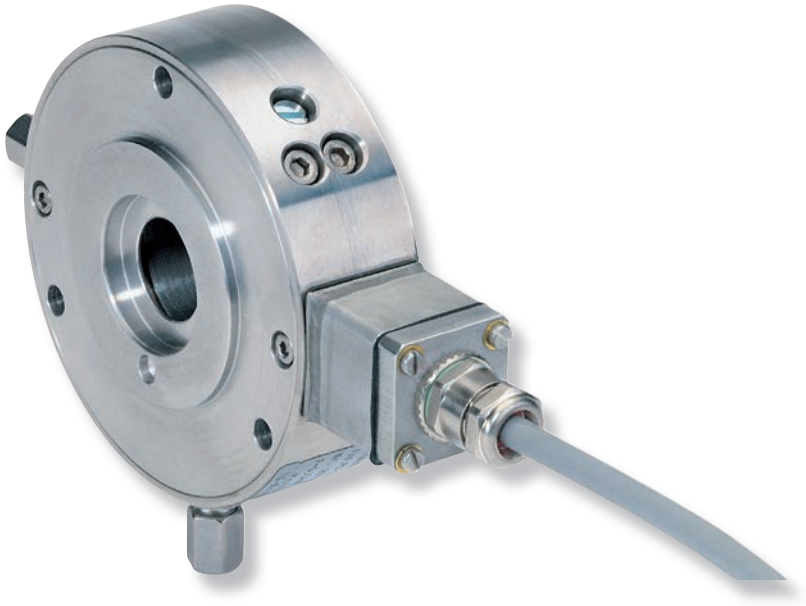
Flange load cell PD 21/22							
Type, bore on one side	Type, bore on both sides	D3 (mm)	Nominal measuring force (kN)				
PD 2112	PD 2212	12	0.05	0.1	0.2	0.5	1
PD 2115	PD 2215	15	0.05	0.1	0.2	0.5	1
PD 2117	PD 2217	17	0.05	0.1*	0.2	0.5*	1
PD 2120	PD 2220	20		0.15	0.3	0.75	1.5
PD 2125	PD 2225	25		0.15*	0.3	0.75*	1.5
PD 2130	PD 2230	30		0.3	0.6	1.5	3
PD 2135	PD 2235	35		0.3*	0.6	1.5*	3
PD 2140	PD 2240	40		0.6	1.2	3	6
PD 2145	PD 2245	45		0.6	1.2	3	6
PD 2150	PD 2250	50		0.6*	1.2	3*	6
PD 2155	PD 2255	55		1	2	5	10
PD 2160	PD 2260	60		1	2	5	10
PD 2165	PD 2265	65		1	2	5	10
*Preferred sizes							

Technical data

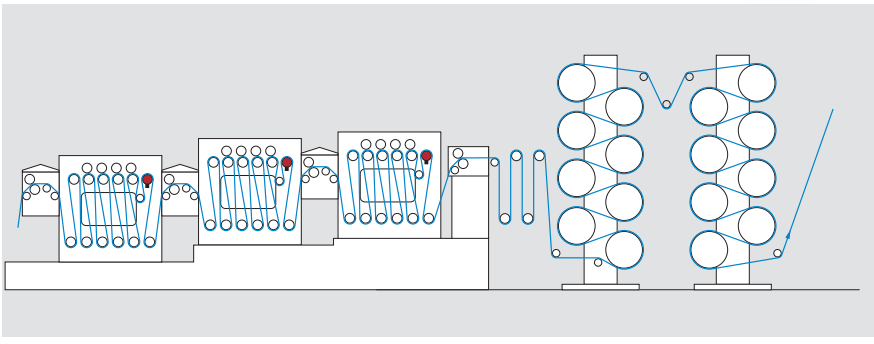
Flange load cell PD 21/22	
Accuracy class	0.5
Nominal characteristic value (sensitivity)	1 mV/V
Combined error	< 0.5 %
Characteristic value tolerance	0.2 %
Measuring principle	Full bridge strain gauge
Nominal resistance of the strain gauge bridge	700 Ohm
Bridge supply voltage, nominal value	10 V
Max. permissible value	14 V
Mechanical stop	1.8 to 2.4 x F_N dep. on type
Operating load	1.8 to 2.4 x F_N
Limit load	20 x F_N
Nominal measuring deflection	0.1 to 0.2 mm depending on type
Nominal temperature range	-10 to +60 °C
Operating temperature range	-10 to +90 °C
Temperature coefficient	±0.3 %/10 K (characteristic value), ±0.3 %/10 K (zero signal)
Protection class	IP 50
Max. permissible axial lateral force	1 x F_N
Weight	2.3 kg (D3 = 17 mm), 3.6 kg (D3 = 25 mm), 8.5 kg (D3 = 35 mm)

Flange load cell PD 23/24

- + Flange load cell in stainless steel for difficult ambient conditions, e.g. washing machines and etching units
- + Multi-position, easy installation due to various mounting options, e.g. flange bearings, pedestal bearings, inner or outer fastening
- + Maximum operational reliability due to overload protection up to 20 times the nominal measuring force
- + With a horizontal measuring direction, the weight of the roller does not affect the measured result
- + Good temperature behavior and a high degree of linearity of the measuring elements due to strain gauge application on a flat surface
- + High permissible operating speed of the measuring roller due to high web load cell spring constant



Flange load cell PD 23 on washing machine



Flange load cell PD 23 on dyeing system

Selection table

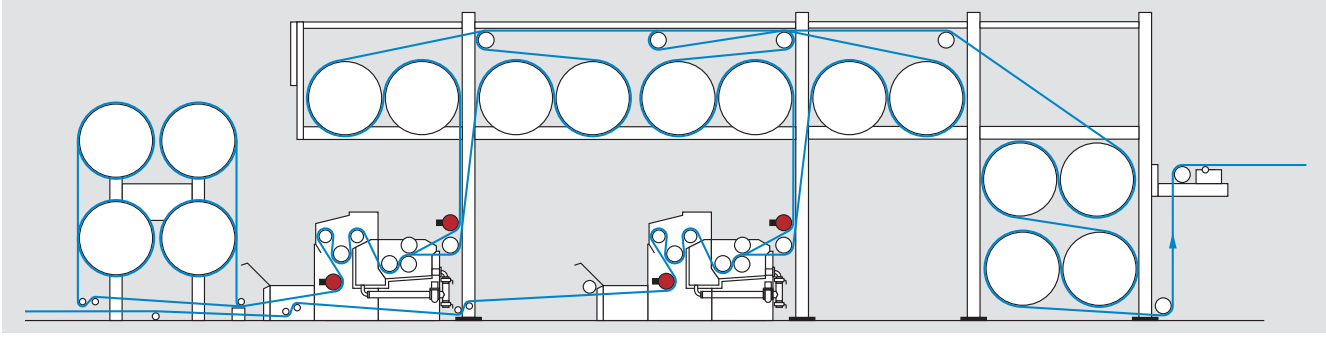
Flange load cell PD 23/24						
Type, bore on one side	Type, bore on both sides	D3 (mm)	Nominal measuring force (kN)			
PD 2317	PD 2417	17	0.1	0.2	0.5	1
PD 2325	PD 2425	25	0.15	0.3	0.75	1.5
PD 2335	PD 2435	35	0.3	0.6	1.5	3

Technical data

Flange load cell PD 23/24	
Accuracy class	0.5
Nominal characteristic value (sensitivity)	1 mV/V
Combined error	< 0.5 %
Characteristic value tolerance	0.2 %
Measuring principle	Full bridge strain gauge
Nominal resistance of the strain gauge bridge	700 Ohm
Bridge supply voltage, nominal value	10 V
Max. permissible value	14 V
Mechanical stop	1.8 to 2.4 x F_N dep. on type
Operating load	1.8 to 2.4 x F_N
Limit load	20 x F_N
Nominal measuring deflection	0.1 to 0.2 mm depending on type
Nominal temperature range	-10 to +60 °C
Operating temperature range	-10 to +90 °C
Temperature coefficient	±0.3 %/10 K (characteristic value), ±0.3 %/10 K (zero signal)
Protection class	IP 65
Max. permissible axial lateral force	1 x F_N
Weight	2.3 kg (D3 = 17 mm), 3.6 kg (D3 = 25 mm), 8.5 kg (D3 = 35 mm)

Flange load cell PD 25

+ Cost-effective aluminum flange load cell
+ Compatible with the PD 21/22 standard series
+ Multi-position, easy installation due to various mounting options, e.g. flange bearings, pedestal bearings, inner or outer fastening
+ High reliability due to overload protection up to 10 times the nominal measuring force
+ With a horizontal measuring direction, the weight of the roller does not affect the measured result
+ Good temperature behavior and a high degree of linearity of the measuring elements due to strain gauge application on a flat surface
+ High permissible operating speed of the measuring roller due to high web load cell spring constant



Flange load cell PD 25 on sizing machine

Selection table

Flange load cell PD 25				
Type, bore on one side	D3 (mm)	Nominal measuring force (kN)		
PD 2517	17	0.1	0.2	0.5
PD 2525	25	0.15	0.3	0.75
PD 2535	35	0.3	0.6	1.5

Flange load cell PD 25 on the infeed to a sizing bath

Technical data

Flange load cell PD 25	
Accuracy class	1
Nominal characteristic value (sensitivity)	1 mV/V
Combined error	< 1 %
Characteristic value tolerance	0.2 %
Measuring principle	Full bridge strain gauge
Nominal resistance of the strain gauge bridge	700 Ohm
Bridge supply voltage, nominal value	10 V
Max. permissible value	14 V
Mechanical stop	1.8 to 2.4 x F_N dep. on type
Operating load	1.8 to 2.4 x F_N
Limit load	10 x F_N
Nominal measuring deflection	0.1 to 0.25 mm depending on type
Nominal temperature range	-10 to +60 °C
Operating temperature range	-10 to +90 °C
Temperature coefficient	±0.5 %/10 K (characteristic value), ±0.5 %/10 K (zero signal)
Protection class	IP 54
Max. permissible axial lateral force	1 x F_N
Weight	0.8 kg (D3 = 17 mm), 1.25 kg (D3 = 25 mm), 2.94 kg (D3 = 35 mm)

Accessories for load cells

Measuring roller BA 6

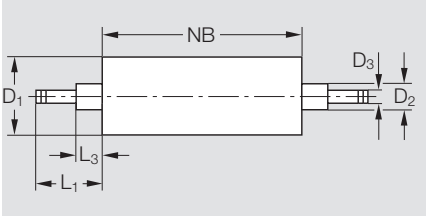
+ Aluminum rollers mounted on outer bearings for PD 21/25 flange load cell assembly
+ Minimum concentricity tolerances and high balance quality
+ Roller diameter from 80 to 200 mm
+ Various surfaces for a wide range of implementation areas

Selection table

Measuring roller BA 6				
Type	Roller diameter D1 (mm)	Nominal width NW, min. (mm)	Nominal width, max. (mm)	Shaft diameter D3 (mm)
BA 6080	80	200	1200	17/25
BA 6100	100	200	1800	17/25
BA 6120	120	400	2700	25/35
BA 6160	160	600	2700	25/35
BA 6200	200	600	2700	35/45

Selection table

Measuring roller BA 6 surface	
Index	Surface
01	Bare RA 3.2 (standard)
02	Wound with rubber cork
03	Fine blasted with glass corundum RA 6.3, hard anodized, layer thickness 30 µm 450 HV
04	Hard anodized, layer thickness 30 µm 450 HV

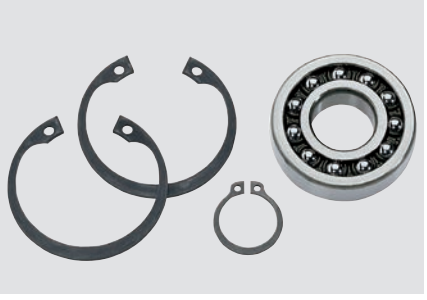


Technical data

Measuring roller BA 6 surface	
Roller tube basic material	ENAW-6060T66 (AlMgSi 0.5)
Balance quality	Dynamic precision balancing to VDI 2060
Quality grade	2.5 (80 mm); 6.3 (100/120/160/200 mm)
Concentricity	< 50 µm for NW ≤ 1000 mm; < 150 µm for NW ≥ 1000 mm
Cylinder form	< 50 µm for NW ≤ 1000 mm; < 150 µm for NW ≥ 1000 mm

Accessory kits for flange load cells

+ Accessory kits with self-aligning ball bearing, securing ring and compensating sleeves for the different assembly variants



Selection table

Accessory kits for flange load cells				
Roller version	Shaft/axle version	for load cell	Moving bearing side accessory kit	Fixed bearing side accessory kit
	Stepped axle	PD 21, PD 25	1	3
	Continuous axle	PD 21, PD 25	2	4
	Stepped shaft	PD 21/23, PD 25	1	1
	Continuous shaft	PD 21, PD 25	2	2
	Stepped shaft	PD 22	5	5
	Continuous shaft	PD 22	6	6

Selection table

Bearing blocks for flange load cells													
Material number	Shaft diameter (mm)												
	12	15	17	20	25	30	35	40	45	50	55	60	65
042594	■	■	■										
042595				■	■								
042596						■	■						
042597								■	■	■			
042598											■	■	■

Bearing blocks for flange load cells

+ Bearing block for precise assembly of flange load cells on machine frames

Cable for load cell PD 21/22

Material number	Designation	Length (m)
045449	PDV0200 – 60	5
220397		10
045450		15
058131		20
058641		25
053769		30

Cable for load cell PD 25

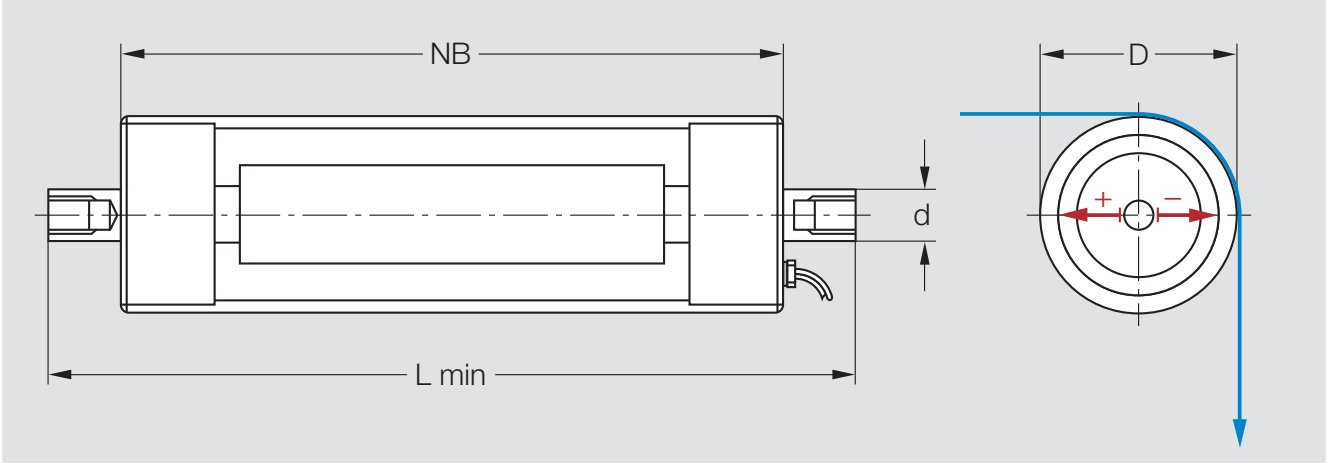
Material number	Designation	Length (m)
208534	PD_2517 – 99	5
208533		10
211310		15
211309		20
211308		25
325971		30

Cable for load cell PD 30/40/50

Material number	Designation	Length (m)
306962	PD_3000 – 96	5
311536		10
383595		15
316491		20
325522		25
325523		30

Sensor roller PD 30

+ Aluminum roller with fixed axle and two integrated load cells
+ For easy installation between side walls. Optionally with fastening kit for precision shoulder screws
+ High reliability due to overload protection up to 10 times the nominal measuring force
+ Different roller diameters from 80 to 200 mm ensure maximum flexibility
+ With a horizontal measuring direction, the weight of the roller does not affect the measured result
+ Good temperature behavior and a high degree of linearity of the measuring elements due to strain gauge application on a flat surface
+ High permissible operating speed of the measuring roller due to high web load cell spring constant



Selection table

Roller surface PD 30	
Surface index	Surface
01	Bare Ra 3.2 (standard)
02	Wound with rubber cork
03	Fine blasted with glass corundum Ra 6.3, hard anodized, layer thickness 30 µm 450 HV
04	Hard anodized, Ra 3.2, layer thickness 30 µm 450 HV
05	Spiral groove left + right, pitch 40 mm, groove radius 6 mm, groove depth 0.25 mm
13	Rough blasted with glass corundum Ra 12.5, hard anodized, layer thickness 30 µm 450 HV

Selection table

Sensor roller PD 30									
Type	ø D (mm)	NW min. (mm)	NW max. (mm)	L min. (mm)	ø D (mm)	Thread	Nominal measuring force F_N per roller (kN)		
PD 3008	80	300	1200	NW +10	20	M 12	0.2	0.4	1
PD 3010	100	300	1800	NW +10	20	M 12	0.3	0.6	1.5
PD 3012	120	400	2500	NW +10	20	M 12	0.3	0.6	1.5
PD 3016	160	600	3000	NW +10	40	M 16	0.6	1.2	3
PD 3020	200	600	3000	NW +10	40	M 16	0.6	1.2	3

Technical data

Sensor roller PD 30	
Roller tube basic material	AlMgSi 0.5
Bearing	Self-aligning ball bearings with fixed and moveable bearing, including labyrinth seal and lubrication for life
Balance quality	Dynamic precision balancing to VDI 2060 PD 3008, PD 3010, PD 3012 Quality grade Q = 2.5 PD 3016, PD 3020 Quality grade Q = 6.3
Concentricity	< 50 µm for NW ≤ 1000 mm, < 100 µm for NW ≥ 1000 mm
Cylinder form	< 50 µm for NW ≤ 1000 mm, < 100 µm for NW ≥ 1000 mm
Max. speed	PD 3008 3600 revs/min, PD 3010 3000 revs/min, PD 3012 2400 revs/min, PD 3016 1800 revs/min, PD 3020 1500 revs/min
Roller weight	PD 3008 with NW 600 mm 7.5 kg per 100 mm step 0.85 kg PD 3010 with NW 600 mm 10.0 kg per 100 mm step 1.05 kg PD 3012 with NW 1100 mm 21.3 kg per 100 mm step 1.15 kg PD 3016 with NW 1100 mm 25 kg per 100 mm step 1.30 kg

Sensor roller PD 30 on web offset printing press

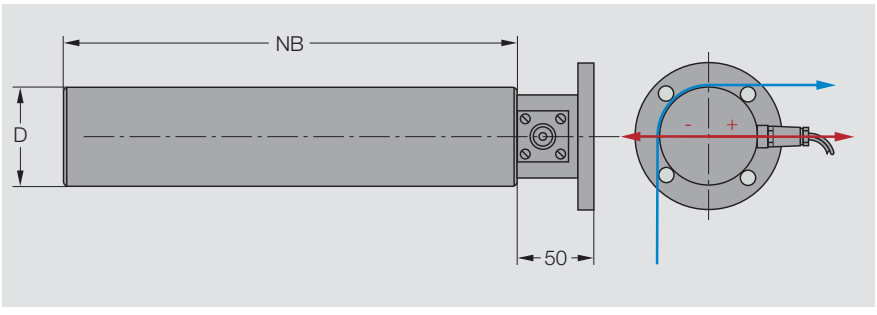
Technical data

Sensor roller PD 30	
Accuracy class	0.5
Nominal characteristic value (sensitivity)	1 mV/V
Combined error	< 0.5 %
Characteristic value tolerance	0.2 %
Measuring principle	Full bridge strain gauge
Nominal resistance of the strain gauge bridge	700 Ohm
Bridge supply voltage	
Nominal value	10 V
Max. permissible value	14 V
Output voltage	
Nominal range	0 to 10 mV (for nominal force and bridge infeed 10 V)
Max. range	0 to 18 mV (at 1.8 x nominal force and bridge infeed 10 V)
Mechanical stop	1.2 to 1.8 x F_N dep. on type
Operating load	1.2 to 1.8 x F_N
Limit load	10 x F_N
Nominal measuring deflection	0.15 to 0.25 mm depending on type
Nominal temperature range	-10 to +60 °C
Operating temperature range	-10 to +70 °C
Temperature coefficient	
of characteristic value	±0.3 %/10 K
of the zero signal	±0.3 %/10 K
Protection class	IP 50
Max. permissible axial lateral force	1 x F_N
Connection cable	6 x 0.14 mm², 5 m/10 m long

Sensor roller PD 40

+ Aluminum roller with fixed axle and two integrated load cells
+ Assembly flange at one end for cantilever mounting
+ High reliability due to overload protection up to 10 times the nominal measuring force
+ Different roller diameters from 60 to 120 mm ensure maximum flexibility
+ With a horizontal measuring direction, the weight of the roller does not affect the measured result
+ Good temperature behavior and a high degree of linearity of the measuring elements due to strain gauge application on a flat surface

Sensor roller PD 40 in baby diaper machine



Selection table

Roller surface PD 40	
Surface index	Surface
01	Bare Ra 3.2 (standard)
02	Wound with rubber cork
03	Fine blasted with glass corundum RA 6.3, hard anodized, Layer thickness 30 µm 450 HV
04	Hard anodized, Ra 3.2, layer thickness 30 µm 450 HV

Sensor roller PD 40						
Type	ø D (mm)	NW min. (mm)	NW max. (mm)	Nominal measuring force F_N per roller (N)		
PD 4006	60	150	300	50	100	200
PD 4008	80	200	400	100	200	400
PD 4010	100	250	500	100	200	400
PD 4012	120	400	600	200	400	600

Technical data

Sensor roller PD 40			
Roller tube basic material	ENAW-6060T66 (AlMgSi 0.5)		
Bearing	Self-aligning ball bearings with fixed and moveable bearing including labyrinth seal and lubrication for life		
Balance quality (dynamic precision balancing to VDI 2060)	Quality grade Q = 2.5 (standard) Quality grade Q = 1 (option)		
Concentricity	< 50 µm		
Cylinder form	< 50 µm		
Max. web speed at balance quality Q 2.5	450 m/min		
Max. web speed with balance quality Q 1	600 m/min (900 m/min on PD 4012)		
Max. bending		At max. nominal measuring force	Per 100 mm nominal width
	PD 4006	200 N	0.16 mm
	PD 4008	400 N	0.21 mm
	PD 4010	400 N	0.11 mm
	PD 4012	600 N	0.08 mm
Roller weight	PD 4006	With NW 150 mm 1.43 kg	Per 50 mm step 0.23 kg
	PD 4008	With NW 200 mm 3.80 kg	Per 50 mm step 0.40 kg
	PD 4010	With NW 250 mm 6.60 kg	Per 50 mm step 0.72 kg
	PD 4012	With NW 400 mm 17.30 kg	Per 50 mm step 2.21 kg
Mounting flange fixture (features centering collar)	With centric thread With 4 bores		

Sensor roller PD 40	
Accuracy class	1
Nominal characteristic value (sensitivity)	1 mV/V
Combined error	< 1 %
Characteristic value tolerance	0.2 %
Measuring principle	Full bridge strain gauge
Nominal resistance of the strain gauge bridge	700 Ohm
Bridge supply voltage	
Nominal value	10 V
Max. permissible value	14 V
Output voltage	
Nominal range	0 to 10 mV (at nominal force and bridge infeed 10 V)
Max. range	0 to 18 mV (at 1.8 x nominal force and bridge infeed 10 V)
Mechanical stop	1.2 to 1.8 x F_N dep. on type
Operating load	1.2 to 1.8 x F_N
Limit load	10 x F_N
Nominal measuring deflection	0.15 to 0.25 mm depending on type
Nominal temperature range	-10 to +60 °C
Operating temperature range	-10 to +70 °C
Temperature coefficient	
of characteristic value	±0.3 %/10 K
of the zero signal	±0.3 %/10 K
Protection class	IP 50
Max. permissible axial lateral force	1 x F_N
Connection cable	6 x 0.14 mm², 5 m/10 m long

Flange load cells for open-frame machines

Function

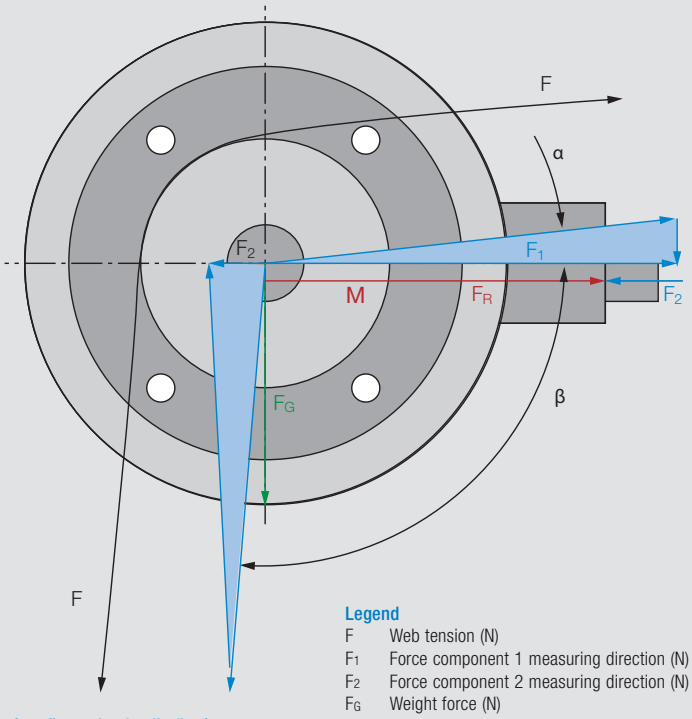
The flange load cell consists of a mounting flange, inner ring and an adapter for accepting the roller axis. The inner ring is in the form of a double bending beam to which two strain gauges are applied. An axis of a roller with internal bearing can be mounted in the adapter. The flange load cell always measures the total web tension. A web offset or an asymmetrical web tension distribution has no effect on the measured result.

Area of use

Flange load cells for rollers with a bearing on one side are used in all open-frame machines. The main area of use is the hygiene and battery industry.

Application

With a 90° horizontal-vertical wrapping angle on the measuring roller and a horizontal measuring direction, optimum web tension detection is assured.



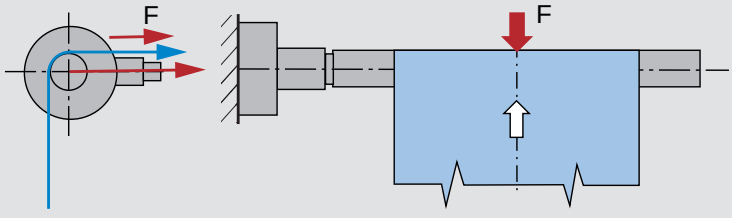
Calculation, flange load cells (horizontal measuring direction)

$F_1 = F \cdot \cos \alpha$
$F_2 = F \cdot \cos \beta$
$F_R = F_1 + F_2$

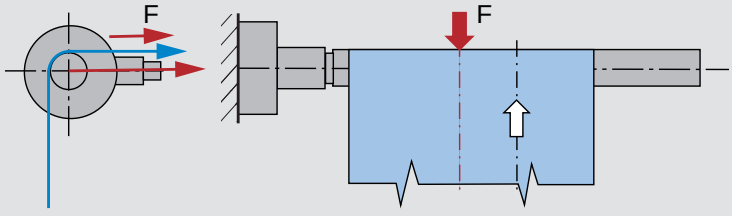
Legend

F	Web tension (N)
F_1	Force component 1 measuring direction (N)
F_2	Force component 2 measuring direction (N)
F_G	Weight force (N)
F_R	Resulting force in measuring direction (N)
α	Angle between outgoing web and measuring direction
β	Angle between incoming web and measuring direction
M	Measuring direction

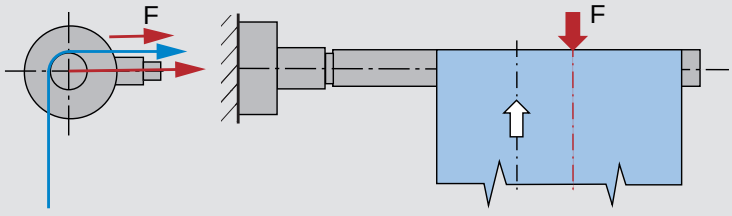
Flange load cell with web centered in relation to the center of the machine



Flange load cell with web displaced to the left in relation to the center of the machine

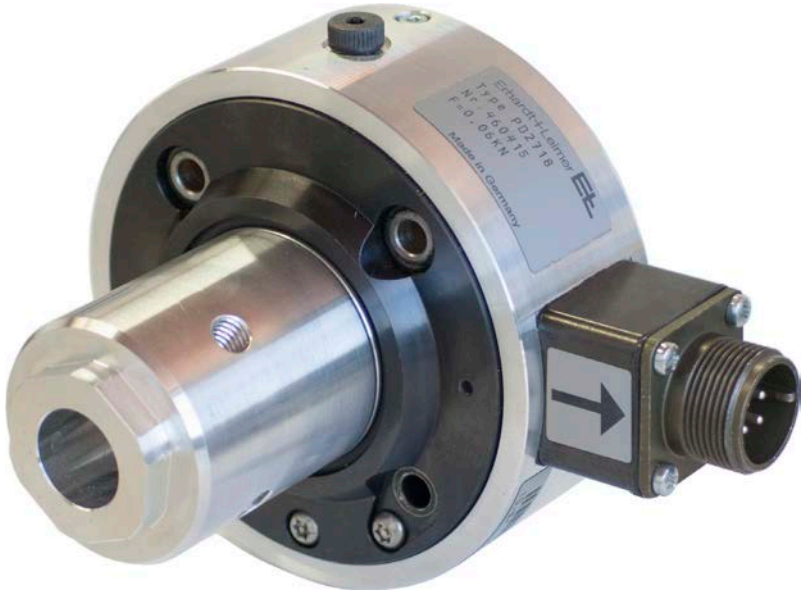


Flange load cell with web displaced to the right in relation to the center of the machine



Flange load cell PD 2718

- Flange load cell with a nominal measuring force of 60 N for mounting on rollers with bearings on one end
- Precise web tension measurement independent of the force applied to the roller
- High reliability due to overload protection up to 10 times the nominal measuring force
- With horizontal measuring direction, the weight of the roller does not affect the measured result
- Nominal characteristic value calibrated in the factory to 1 mV/V



Technical data

Flange load cell PD 2718	
Nominal measuring force	60 N
Accuracy class	0.5
Nominal characteristic value (sensitivity)	1 mV/V
Combined error	±0.5 %
Characteristic value tolerance	±0.2 %
Measuring principle	Full bridge strain gauge
Nominal resistance of the strain gauge bridge	700 Ohm
Bridge supply voltage	
Nominal value	10 V
Max. permissible value	14 V
Output voltage Nominal range Maximum range	 0 to 10 mV (at nominal measuring force) 0 to 15 mV (at 1.5 x nominal measuring force)
Mechanical stop	1.5 x F_N
Operating load	1.0 to 1.4 x F_N
Limit load	10 x F_N
Nominal measuring deflection	0.3 to 0.4 mm
Nominal temperature range	-10 to +60 °C
Operating temperature range	-10 to +90 °C
Temperature coefficient	
of characteristic value	±0.3 %/10 K
of the zero signal	±0.3 %/10 K
Ambient conditions	Usage in dry and dusty environment
Protection class	IP 50
Axial transverse force	0.5 x F_N
Roller nominal width, max.	400 mm
Roller weight, max.	1 kg
Weight	3.3 kg

Block load cells

Function

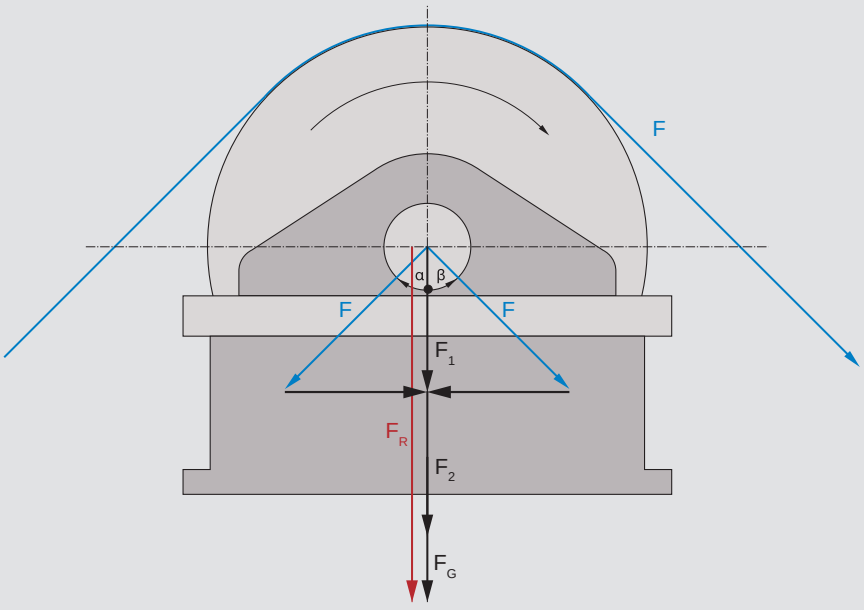
Block load cells comprise a cast housing for adaptation to the customer's machine and a mounting plate to accommodate the pedestal bearing. The measuring force is acquired via a double bending beam to which the strain gauges are applied and, in this way, an analog measured signal proportional to the web tension output.

Area of use

Block load cells are used in practically all processing plants where web-type materials are processed or finished. Particularly in the converting sector they offer significant advantages, as the rollers can always be replaced easily thanks to the very good accessibility of the pedestal bearings.

Application

A horizontal mounting position is preferred with symmetrical wrapping between 60 - 180° to the vertical measuring direction. Measurement of the web tension on both sides prevents incorrect measurements caused by the web moving sideways and asymmetrical web tension distribution. Load cells incorporated into a control loop should be positioned as near to the actuator as possible.



Legend

F	Web tension (N)
F_1	Force component 1 in measuring direction
F_2	Force component 2 in measuring direction
F_G	Weight force
α	Angle between outgoing web and measuring direction
β	Angle between incoming web and measuring direction
$F_{R/K}$	Resulting force on a block load cell

Calculation, block load cell (horizontal mounting position)

$F_1 = F \cdot \cos \alpha$

$F_2 = F \cdot \cos \beta$

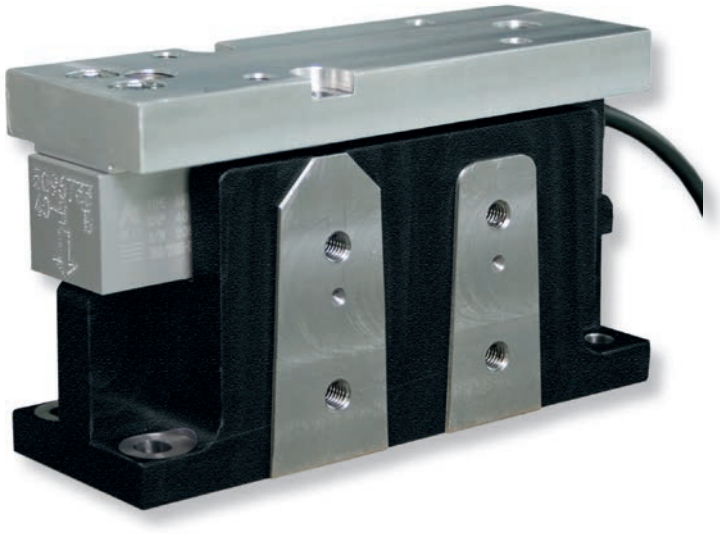
$F_G = F_G$ Roller/2 + F_G Pedestal bearing

$F_{1/2} = (F_1 + F_2)/2$

$F_{R/K} = F_G + F_{1/2}$

Block load cell PD 50

+ Can be mounted on almost all common pedestal bearings in conjunction with standard guide rollers
+ High reliability due to overload protection up to 10 times the nominal measuring force
+ Large measuring range due to 1:25 resolution
+ Double bending beam with strain gauges in full bridge configuration
+ Straightforward guide roller replacement due to good pedestal bearing access
+ Can be mounted both on and against the machine wall



Selection table

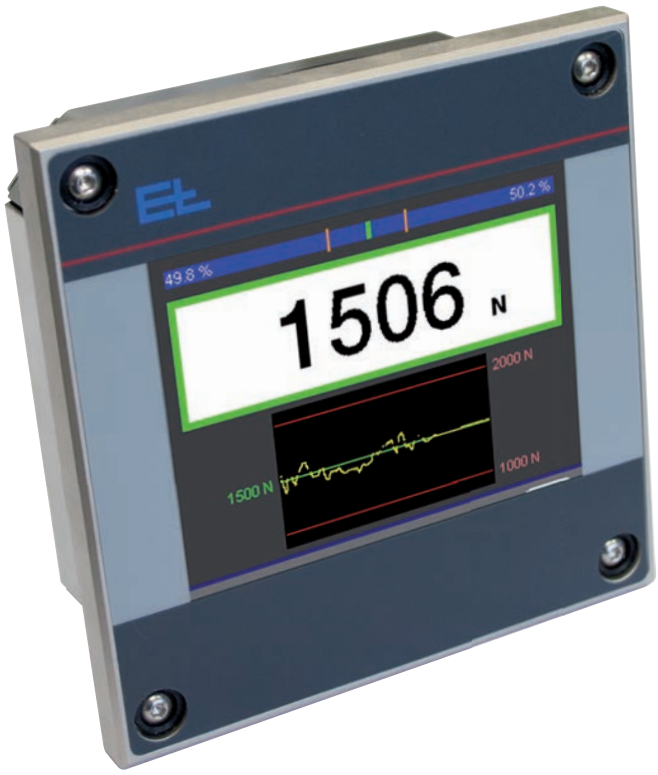
Block load cell PD 50						
Type	Size L x W x H (mm)	Through hole	Hole spacing for mounting (mm)	Nominal measuring force F_N per block load cell (kN)		
PD 5010	134 x 48 x 78	Ø 7	118 x 28	0.08	0.2	0.4
PD 5020	150 x 68 x 78	Ø 9	135 x 51	0.5	1.0	2.0

Technical data

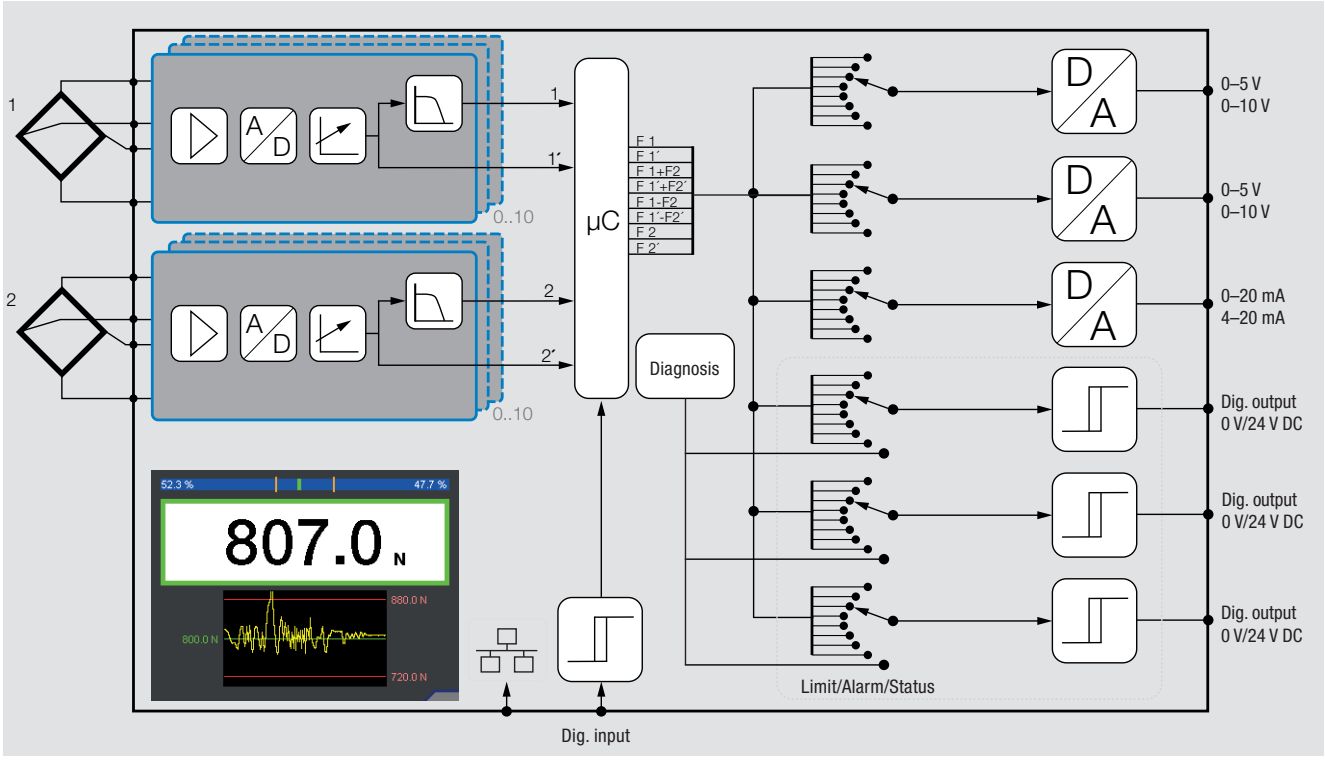
Block load cell PD 50	
Accuracy class	0.5
Nominal characteristic value (sensitivity)	2 mV/V
Combined error	±0.5 %
Characteristic value tolerance	< ±0.2 %
Measuring principle	Full bridge strain gauge
Nominal resistance of the strain gauge bridge	700 Ohm
Bridge supply voltage	
Nominal value	10 V
Max. permissible value	14 V
Mechanical stop	1.2 x F_N
Operating load	1.2 x F_N
Limit load	10 x F_N
Nominal measuring deflection	0.2 to 0.3 mm depending on type
Nominal temperature range	-10 to +60 °C
Operating temperature range	-10 to +90 °C
Temperature coefficient	
of characteristic value	±0.3 %/10 K
of the zero signal	±0.3 %/10 K
Protection class	IP 54
Axial transverse force	1 x F_N
Weight	1.5 kg

Digital measuring amplifier PA 62

+ Digital two-channel measuring amplifier for connection of 2 fabric tension sensors with a strain gauge bridge
+ Menu-based, language-neutral commissioning wizard
+ Online diagnostics on load cells including wiring
+ X-t plotter for long-term display of the web tension
+ Monitoring of the web tension for adjustable limits with digital alarm output
+ Signal output analog or using Ethernet interface



Block diagram

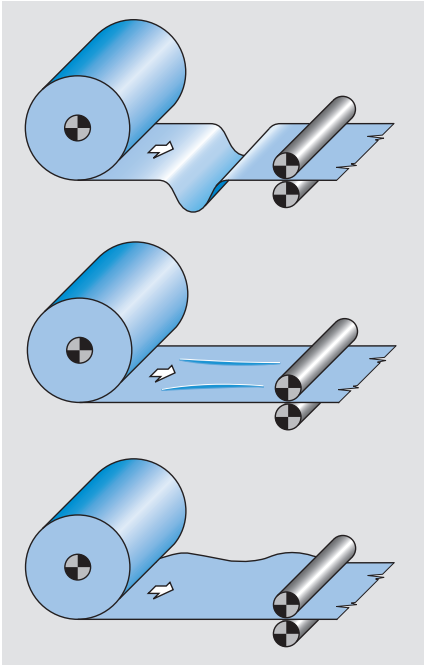


Your benefits

Process monitoring
+ Detection of peaks in web tension
+ Detection of web tension fluctuations
+ Prewarning with large asymmetrical web tension distribution

Load cell monitoring
+ Ground fault
+ Short circuit
+ Cable open-circuit

System integration
+ Prepared for Industry 4.0
+ Fieldbus EtherNet/IP™ or UDP/IP



Selection table

Measuring amplifier PA 62				
Type	Front panel installation	With housing	Top-hat rail mounting	Fieldbus
PA 6200	■			
PA 6210	■			■
PA 6201		■		
PA 6211		■		■
PA 6202			■	
PA 6212			■	■

Technical data

Measuring amplifier PA 62	
Accuracy class	0.1
Operating voltage Current consumption	24 V DC (18 to 30 V DC) 0.2 A
Strain gauge amplifier Input voltage Bridge supply voltage Measuring cycle time	2 channels ± 25 mV, 14 Bit 10 VDC 1 ms
Analog outputs: Actual signal, direct Actual signal, filtered Output signal (configurable)	 1 x 0 to 5/10 V 1 x 0/4 to 20 mA, R_{max} 500 Ω 1 x 0 to 5/10 V, f_g=0.2 to 20 Hz Total signal/channel 1/channel 2/difference signal
Digital outputs Output voltage Output signal (configurable)	3 x floating, short circuit proof 24 V, max. 500 mA Limit/Alarm/Status
Digital input Input voltage Input signal (configurable)	1 x floating 24 V DC Tare/recipe/stop recording
Display and control unit	Color touch display (LCD)
Interfaces EtherNet/IP ODVA	1 x RJ45, 100 MBit: EtherNet/IP™ (ODVA-compliant) or UDP/IP
Nominal operating temperature Relative humidity	+10 to +50 °C 15 to 95 % (non-condensing)
Protection class	IP 20 (plug-in) IP 54 (with housing)
Dimensions (W x H x D)	100 x 100 x 9 (85) mm (plug-in) 130 x 155 x 106 mm (with housing) 90 x 90 x 90 mm (top-hat rail mounting)

Web tension controller DC 62

+ Compact, digital web tension controller for different control structures including color touch-display
  - Unwinder for pneumatic or electrical brakes
  - Rewinder or unwinder with speed-controlled drive
  - Transport unit with speed-controlled drive
  - Dancer position control
  - Braking torque control for pneumatic and electrical brake
+ Menu-based, language-neutral wizard for quick commissioning
+ Integrated measuring amplifier for the evaluation of the load cell signals
+ With output stage for the direct operation of electrical brakes
+ Recipe management with up to 30 recipes

Technical data

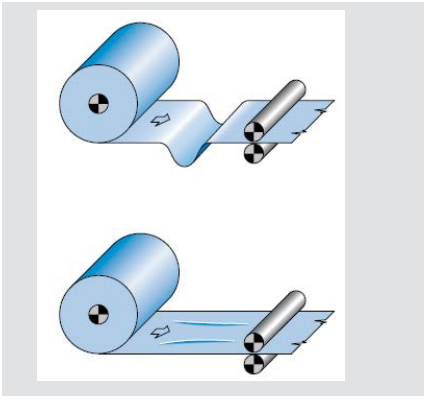
Web tension controller DC 62	
Operating voltage Current consumption (without el. brake) Control cycle time	24 V DC (20 to 30 V DC) 0.3 A/4.3 A (elec. brake) 1 ms
Strain gauge amplifier Input voltage Bridge supply voltage	2 channels ± 30 mV, 14 bits 10 V
Analog inputs Guiding value/target value/dancer position Diameter	 2 x 0 to ±10 V, 14 bits 1 x 0 to 10 V, 12 bits
Analog outputs Electrical brake/coupling Controller actuating signal Monitor output	 PWM current output 0 to 4 A, 24 V 1 x 0 to ±10 V, 14 bits 1 x 0/4 to 20 mA 1 x 0 to 10 V, 12 bits
Digital inputs	3 x floating Signal "0": -5 V to +2 V Signal "1": +8 V to +30 V
Digital outputs Output voltage	2 x floating/short-circuit proof 24 V, max. 0.5 A
Interfaces	2x RJ45, 100 MBit: EtherNet/IP™ oder UDP/IP 2x M16 E+L CAN Bus
Nominal operating temperature Relative humidity	+10 to +50 °C 15 to 95% (non-condensing)
Protection class	IP 20 (plug-in) IP 54 (with housing)
Dimensions (W x H x D)	100 x 100 x 9 (88) mm (plug-in) 130 x 155 x 106 mm (with housing)

Selection table

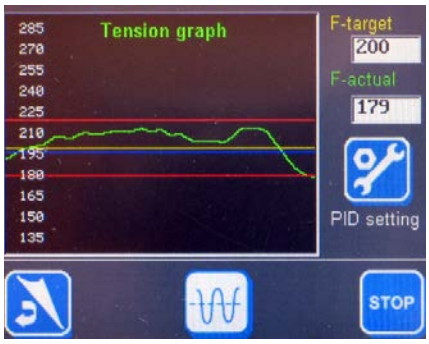
Web tension controller DC 62			
Type	Plug-in	Housing	Ethernet
DC 6200	■		■
DC 6201		■	■
DC 6210	■		
DC 6211		■	

Your benefits

Process control
+ Smoothing of web tension fluctuations
+ Detection of peaks in web tension

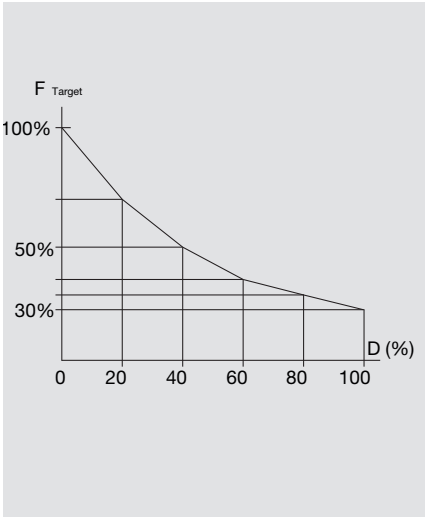


Graphic display
+ Graphic display of the target and actual web tension values, including actuating signal
+ Simple optimization of the control parameters

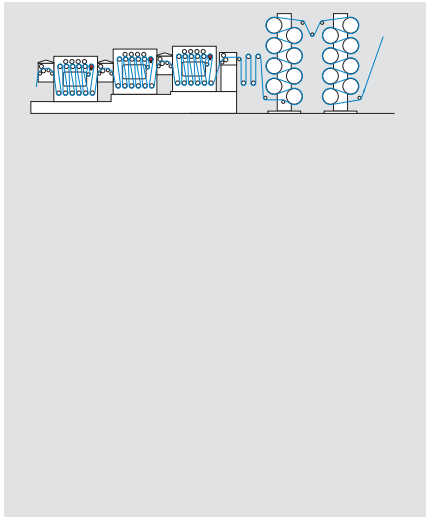


System integration
+ Prepared for Industry 4.0
+ Fieldbus EtherNet/IP™ or UDP/IP

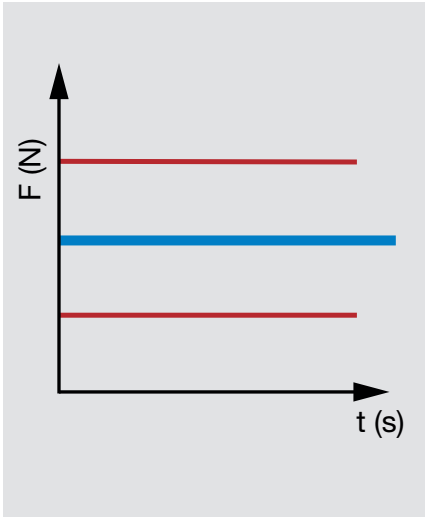
Winding characteristic
+ No roll telescoping
+ 30 recipes possible



Electrical brakes
+ Output stage integrated to up to 4 A output current



Process monitoring
+ F tolerance adjustable
+ F threshold adjustable



Web tension controllers

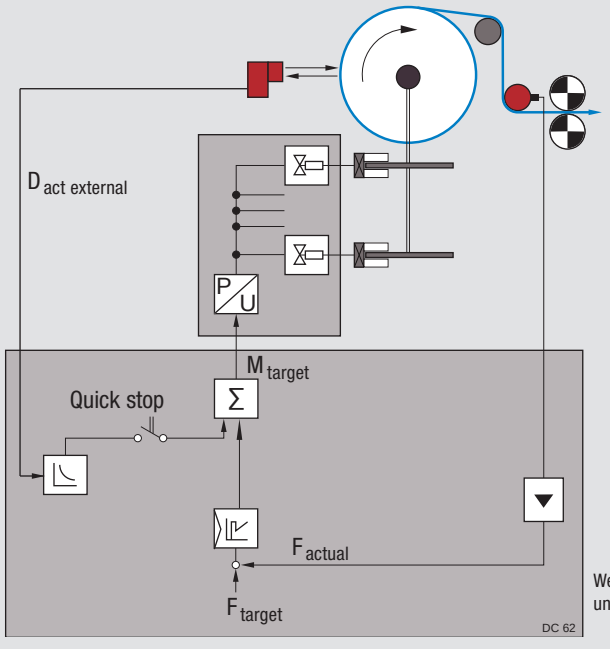
Function: Unwinder with pneumatic brake

Two load cells measure the actual web tension value of the moving web. This value is compared with the target web tension and transferred as a control difference to the PID controller. The PID controller forms the actuating signal for the following U/P converter. At its output, the converter provides a proportional actuating signal for operating a pneumatic brake.

Special features

+ Connection for diameter sensor
+ Mass inertia compensation for quick stop
+ Brake caliper rotation
+ Target torque value for unwinders

Control structure for unwinding with pneumatic brake



Web tension controller DC 6 for unwinding with pneumatic brake

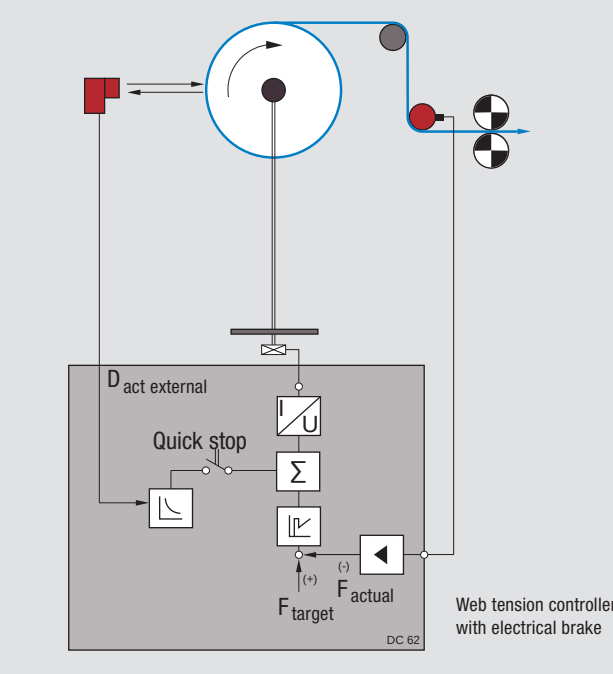
Function: Unwinder with electric brake

Two load cells measure the actual web tension value of the moving web. This value is compared with the target web tension and transferred as a control difference to the PID controller. The PID controller forms the actuating signal for the following U/I converter. The converter provides on its output a proportional actuating signal for operating an electrical brake.

Special features

+ Target torque value for unwinders
+ Integrated output stage for electrical brake
+ Mass inertia compensation for quick stop
+ Optional connection for diameter sensor

Control structure for unwinding with electrical brake



Web tension controller DC 6 for unwinding with electrical brake

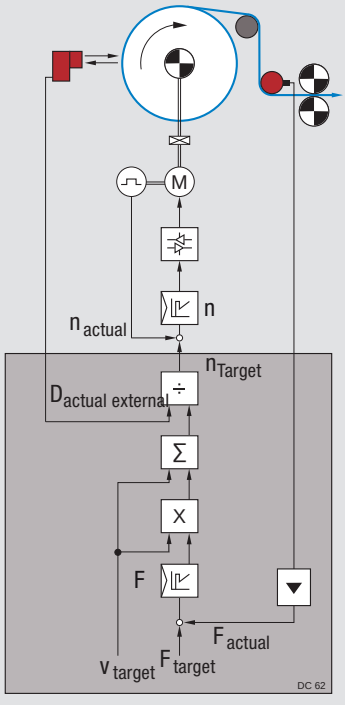
Function of unwinder or rewinder with speed-controlled drive

Two load cells measure the actual web tension value of the moving web. This value is compared with the target web tension and transferred as a control difference to the PID controller. The PID controller forms the speed correction signal ± Δ v which is added to the web speed signal v web target. The v web target corresponds to the v web target from the main drive. For unwinders and rewinders, the superimposed speed target value is divided by the actual coil diameter. The result is a superimposed speed target value for the speed-controlled unwinder and rewinder.

Special features

+ Connection for diameter sensor
+ Speed target value for rewinders and unwinders
+ Winding characteristic F = f (D) can be selected as required

Control structure for rewinder and unwinder



Web tension controller DC 6 for rewinding and unwinding

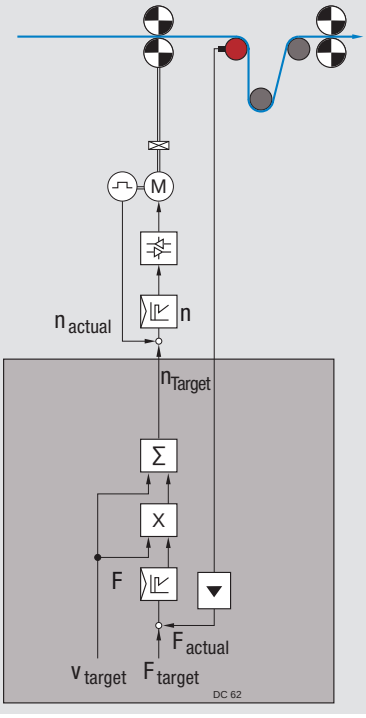
Function of transport drive

Two load cells measure the actual web tension value of the moving web. This value is compared with the target web tension and transferred as a control difference to the PID controller. The PID controller forms the speed correction signal ± Δ v which is added to the web speed signal. This signal is transferred to the next drive.

Special features

+ Speed target value for transport drive

Control structure for transport drive



Web tension controller DC 6 for transport drive

Web tension controllers

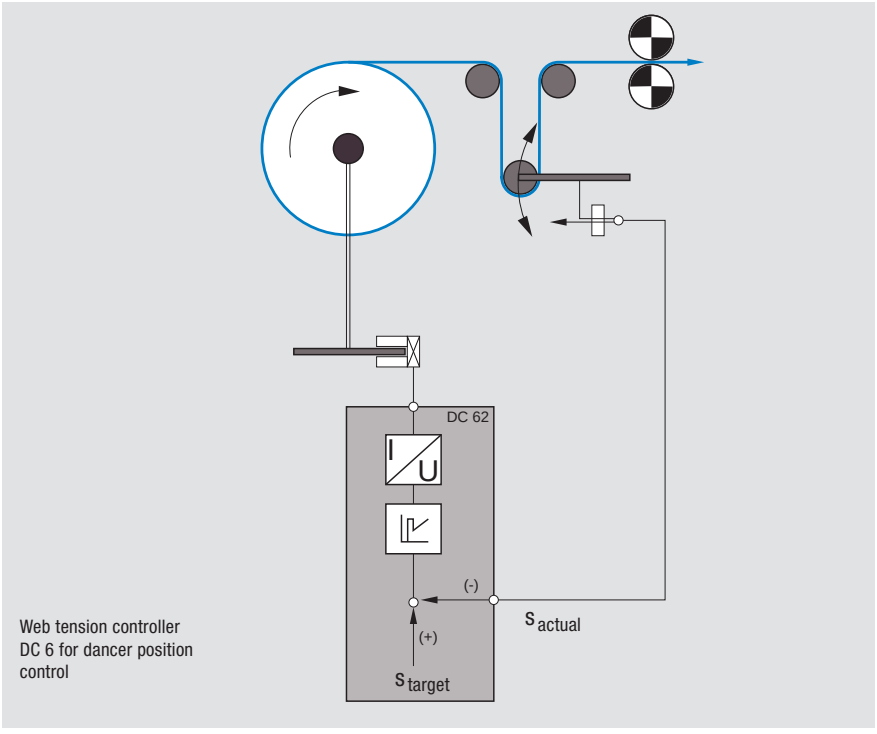
Dancer position controller

Function: Unwinder with pneumatic or electrical brake

The dancer position is measured using an analog signal and compared with the settable target position. The difference is transferred to the PID controller and a corresponding actuating signal is calculated.

Special features

+ Connection for diameter sensor
+ Integrated output stage for electrical brake



Web tension controller DC 6 for dancer position control

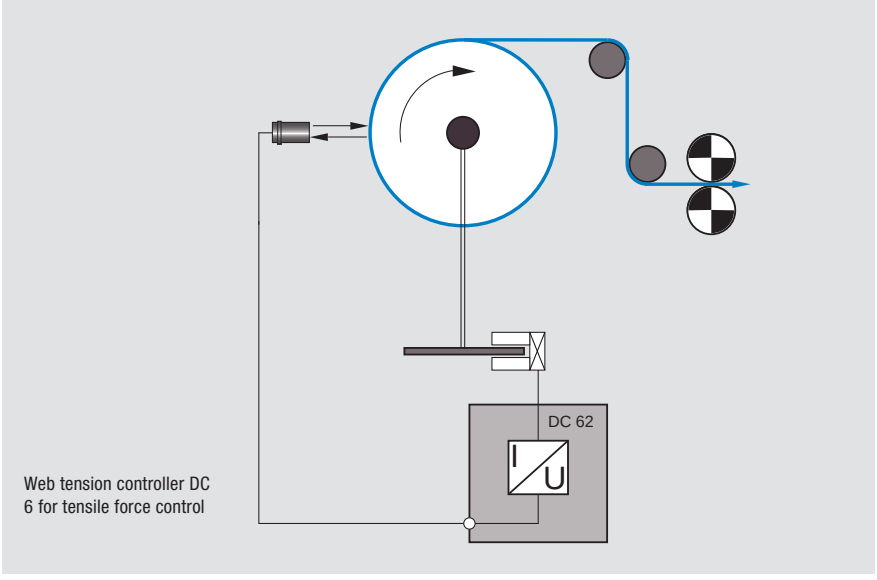
Braking torque control

Function: Unwinder with pneumatic or electric brake

During braking torque control, the torque is adjusted according to the current coil diameter. Overall, the torque can be defined via the target value.

Special features

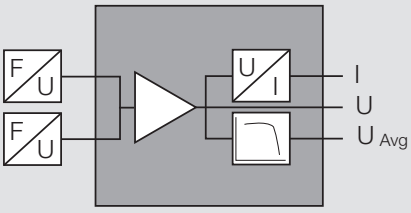
+ Very easy adjustment of the braking torque, depending on the diameter
+ Connection for diameter sensor
+ Integrated output stage for electrical brake



Web tension controller DC 6 for tensile force control

Measuring amplifier CV 22

- Single-channel measuring amplifier for connecting two fabric tension sensors with strain gauge bridge
- Precision instrument amplifier with low temperature drift, high long-term stability and excellent linearity
- With potentiometer for zero point and tare adjustment as well as gain setting
- Internal reference voltage for measuring amplifier calibration without reference weights given exact knowledge of the wrapping angle and mounting position



Block diagram CV 22

Technical data

Measuring amplifier CV 22	
Accuracy class	0.1
Gain range	990 to 3400 V/V 400 to 1250 V/V 600 to 2050 V/V 300 to 1025 V/V
Input voltage	0 to ±20 mV
Output signals	
Voltage	0 to ±10 V (rise time 5 ms)
Voltage filtered	0 to ±10 V (rise time 2 s)
Current	0/4 mA to 20 mA (rise time 5 ms)
Nominal temperature	0 to +60 °C
Temperature coefficient	
of the nominal value	±0.3 %/10 K
of the zero signal	±0.3 %/10 K
of the bridge supply voltage	±0.04 %/10 K
Operating voltage	
Nominal value	24 V DC
Nominal range	20 to 30 V DC
Current consumption	0.2 A
Bridge supply voltage	
Nominal value	10 V DC
Nominal range	9 to 13 V DC
Protection class	
Top-hat rail mounting to DIN EN 50022	IP 00
With housing	IP 54

Questionnaire, web tension control

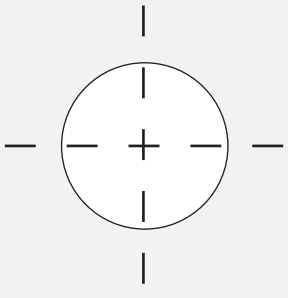
General data

Customer			
Street			
Zip code		**City/ town**	
Country		**Internet**	
Phone		**Fax**	
Contact person			
Phone (direct)		**E-mail**	
Project			

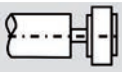
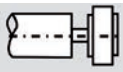
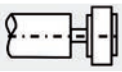
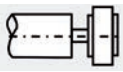
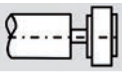
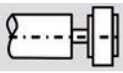
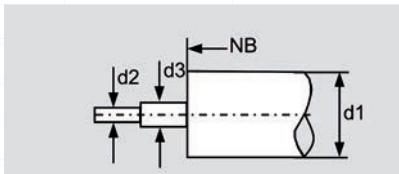
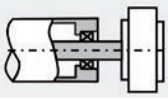
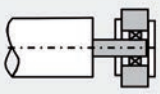
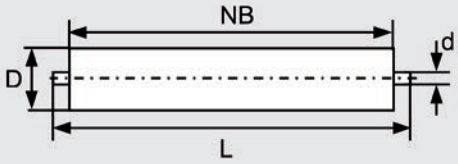
Technical data

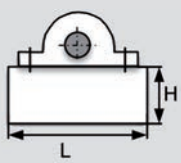
Type of machine					
Make					
Position on the machine					
Web type	❑ Paper	❑ Card	❑ Foil	❑ Metal	❑ Rubber
	❑ Textiles	❑ Carpet	❑ Non-woven fabric		
Web tension	Min. N		Max. N		
Web weight	Min. g/m²		Max. g/m²		
Web width	Min. mm		Max. mm		
Web thickness	Min. mm		Max. mm		
Web speed	Min. m/min		Max. m/min		
Condition in operation	❑ Dry	❑ Moist	❑ Wet	❑	
Ambient temperature	°C				
Ambient conditions	❑ Dry	❑ Dusty	❑ Wet	❑	
Control voltage	❑ 24 V DC		❑ V	Hz	
Operating voltage	❑ 3x V	Hz			

Application



Technical specification

❑ **Flange load cell, steel PD 21/22**	Structure	❑ Open on one side 			❑ Open on both sides 	
❑ **Flange load cell, stainless steel PD 23/24**	Structure	❑ Open on one side 			❑ Open on both sides 	
❑ **Flange load cell, aluminum PD 25**	Structure	❑ Open on one side 			❑ Open on both sides 	
	Mounting	❑ Flange			❑ Pedestal bearing	
	Cable length	❑ 5 m	❑ 10 m	❑ 15 m	❑ 20 m	❑ 25 m
Sensor roller BA 6	❑ Provided by customer			❑ BA 6 provided by E+L		
	Nominal width NW	mm				
	Diameter d1	mm				
	Shaft diameter d2	mm				
	Shaft diameter d3	mm				
	Roller weight	kg				
Bearing position	❑ In sensor roller 			❑ In fabric tension sensor 		
	❑ Ball bearing provided by customer			❑ Ball bearing provided by E+L		
❑ **Flange load cell for mounting on PD 27 rollers with bearings on one end**	❑ Roller provided by customer					
	❑ Roller provided by E+L					
	Diameter	❑ 40 mm		❑ 60 mm		
	Nominal width	❑ 100 mm	❑ 200 mm	❑ 300 mm	❑ 400 mm	❑ ____ mm
	Material	❑ Aluminum		❑ CFK		
	Surface	❑ Bare RA 3.2 (standard)				
		❑ Fine blasted with glass corundum RA 6.3, hard anodized, layer thickness 30 µm, 450 HV				
		❑ Hard anodized, layer thickness 30 µm, 450 HV				
	Cable length	❑ 5 m	❑ 10 m	❑ 15 m	❑ 20 m	❑ 25 m
❑ **Sensor roller PD 30**	Diameter D	❑ 80 mm ❑ 100 mm ❑ 120 mm ❑ 160 mm ❑ 200 mm				
	Nominal width NW	mm				
	Axis length L	mm				
	Surface	❑ Bare RA 3.2 (standard)				
		❑ Wound with rubber cork				
		❑ Fine blasted with glass corundum RA 6.3, hard anodized, layer thickness 30 µm, 450 HV				
		❑ Hard anodized, layer thickness 30 µm, 450 HV				
	Cable length	❑ 5 m	❑ 10 m	❑ 15 m	❑ 20 m	❑ 25 m

❑ **Sensor roller PD 40**	Diameter D	❑ 60 mm ❑ 80 mm ❑ 100 mm ❑ 120 mm				
	Nominal width NW	mm				
	Surface	❑ Bare RA 3.2 (standard)				
		❑ Wound with rubber cork				
		❑ Fine blasted with glass corundum RA 6.3, hard anodized, layer thickness 30 µm, 450 HV				
		❑ Hard anodized, layer thickness 30 µm, 450 HV				
	Cable length	❑ 5 m	❑ 10 m	❑ 15 m	❑ 20 m	❑ 25 m
❑ **Block load cell PD 50**	Size	❑ PD 5010 (L=134 x W=48 x H=78) mm ❑ PD 5020 (L=150 x W=68 x H=78) mm				
	Cable length	❑ 5 m	❑ 10 m	❑ 15 m	❑ 20 m	❑ 25 m

Web tension measurement

❑ **Web tension measuring amplifier CV 22**	Structure	❑ With housing	❑ Top-hat rail mounting	
❑ **Web tension measuring amplifier with display**	Structure	❑ With housing	❑ Top-hat rail mounting	❑ Front panel installation
	Fieldbus	❑ EtherNet/IP™		❑ UDP/IP

Web tension control

❑ **Web tension controller**	Structure	❑ With housing	❑ Front panel installation
	Fieldbus	❑ EtherNet/IP™	❑ UDP/IP

Version, actuator with brake

❑ **Brake available to customer**	❑ Unwinder		❑ Braking roller
	❑ Electrical brake	❑ Friction-free	❑ Liable to friction
	❑ Pneumatic brake		Number of brake calipers
	Brake attachment	❑ One-sided	❑ Double-sided

❑ **Brake provided by E+L**	❑ Unwinder		❑ Braking roller
	❑ Electrical brake		❑ Pneumatic brake
	Brake attachment	❑ One-sided possible	❑ Double-sided possible
	Coil diameter	Min. mm	Max. mm
	Brake roller diameter	mm	
	Hub diameter	mm	
	Emergency stop time	sec	
	Coil weight max.	kg	
	Operating pressure	bar	

Version, actuator with electric brake

❑ **Electrical drive available to customer**	❑ Unwinder	❑ Center winder	❑ Perimeter winder
	❑ Transport roller		
	❑ Rewinder	❑ Center winder	❑ Perimeter winder

❑ **Electrical drive provided by E+L**	❑ Unwinder	❑ Center winder	❑ Perimeter winder
	❑ Transport roller		
	❑ Rewinder	❑ Center winder	❑ Perimeter winder
	Coil diameter	Max. mm	Min. mm
	Transport roller diameter	mm	
	Coil weight max.	kg	
	Start-up time of the system from 0 to max. speed		sec
	Stop time of the system from max. speed to 0		sec
	Stop time of the system from max. speed to 0 in case of emergency stop		sec

Comments

Date		**Issuer**	

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