

ABB MEASUREMENT & ANALYTICS

# Pressductor Pillowblock Load Cells Vertical Measuring PFCL 201

## User manual



3BSE023881R0101 en Rev K

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## USE OF SYMBOLS

This publication includes the following symbols with information regarding safety or other important information:



### CAUTION

**Caution icon** indicates important information. Risk of damage to equipment, property or software.



### DANGER

**Danger icon** indicates a hazard which could result in personal injury or even death.



### ELECTRICAL

**Electrical warning icon** indicates the presence of a hazard which could result in electrical shock.



### ESD

**ESD icon** indicates that electrostatic discharge precautions are needed.



### Information

**Information icon** alerts the reader to relevant facts and conditions.



### Tip

**Tip icon** advise how to design your product or how to use a certain function.

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## CE and UK regulations marking

Provided that the installation is carried out in accordance with the installation instructions given in this manual this product meets the requirements for CE-marking specified in: the RoHS directive 2011/65/EU + AD 2015/863/EU, EMC directive 2014/30/EU and the Low Voltage Directive 2014/35/EU and Conformity to UK regulations: The Electrical Equipment (Safety) Regulations 2016, S.I.2016:1101, The Electromagnetic Compatibility Regulations 2016, S.I.2016:1091 and The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012, S.I. 2012:3032.

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# 1 Introduction

## 1.1 About this Manual

This manual describes the load cells PFCL 201C/201CE/201CD in a Pressductor® Strip Tension Measuring System.

The purpose of this manual is to describe the general function and design of the load cells and also to be a guidance at installation, commissioning, preventive maintenance and fault tracing.

## 1.2 China RoHS Marking en-zh

Table 1 有害物质 Hazardous Substances

产品名称 Product name	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Hexavalent Chromium (Cr (VI))	多溴联苯 Polybrominated biphenyls (PBB)	多溴二苯醚 Polybrominated diphenyl ethers (PBDE)
金属部件 Metal Parts	O	O	O	O	O	O
电路板组件 Printed Circuit Board Assemblies	X	O	O	O	O	O
电缆 Cables	O	O	O	O	O	O

本表格依据 SJ/T 11364 标准的规定编制。

This table is prepared in accordance with the provisions of SJ/T 11364.

O: 表示该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 标准规定的限量要求以下。

O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.

X: 表示该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 标准规定的限量要求。

X: Indicates that said hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.

电子电器产品的环保使用期限依据 SJ/T 11388 标准的规定确定。

The EPUP value of EEP is defined according to SJ/T 11388 standard.

环保使用期限仅在产品使用说明书规定的条件下才有效。The Environment Protection Use Period is valid only when the product is operated under the conditions defined in the product manual.



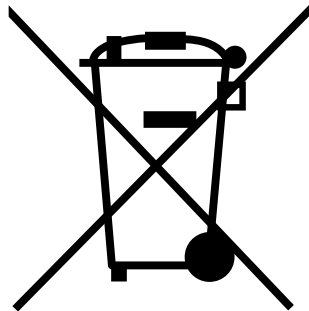
## 1.3 Disposal and Recycling

### 1.3.1 Environmental Policy

ABB is committed to its environmental policy. We strive continuously to make our products environmentally more sound by applying results obtained in recyclability and life cycle analyses. Products, manufacturing process as well as logistics have been designed taking into account the environmental aspects.

Our environmental management system, certified to ISO 14001, is the tool for carrying out our environmental policy. However it is on the customer's responsibility to ensure that local legislation is followed.

### 1.3.2 Recycling Electrical and Electronic Equipment, WEEE



The crossed – out wheeled bin symbol on the product(s) and / or accompanying documents means that used electrical and electronic equipment (WEEE) should not be mixed with general household waste.

If you wish to discard electrical and electronic equipment (EEE), in the European Union, please contact your dealer or supplier for further information.

Outside of the European Union, contact your local authorities or dealer and ask for the correct method of disposal.

Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.

### 1.3.3 Recycling the Transport Material

ABB designs all transport material to be recyclable where practical. The recycling of the transport material depends on the material type and availability of local recycling programs.

After receiving the system into the site, the package and the transportation locking have to be removed. Recycle the transport material according to local regulations.

### 1.3.4 Disposal of the Product

When the product is to be disposed, it should be dismantled and the components recycled according to local regulations.

#### 1.3.4.1 Dismantling and Recycling of the Product

Dismantle and recycle the components of the product according to local regulations.

**CAUTION**  
 Some of the components are heavy! The person who performs the dismantling of the system must have the necessary knowledge and skills to handle heavy components to avoid the risk of accidents and injury from occurring.

- Load cell: These parts are made of structural steel, which can be recycled according to local instructions. All the auxiliary equipment, such as cabling or hoses must be removed before recycling the material.

## 1.4 Function and Design

### 1.4.1 General

A complete measuring system normally consists of two load cells, a junction box, one control unit with two measurement channels and cabling.

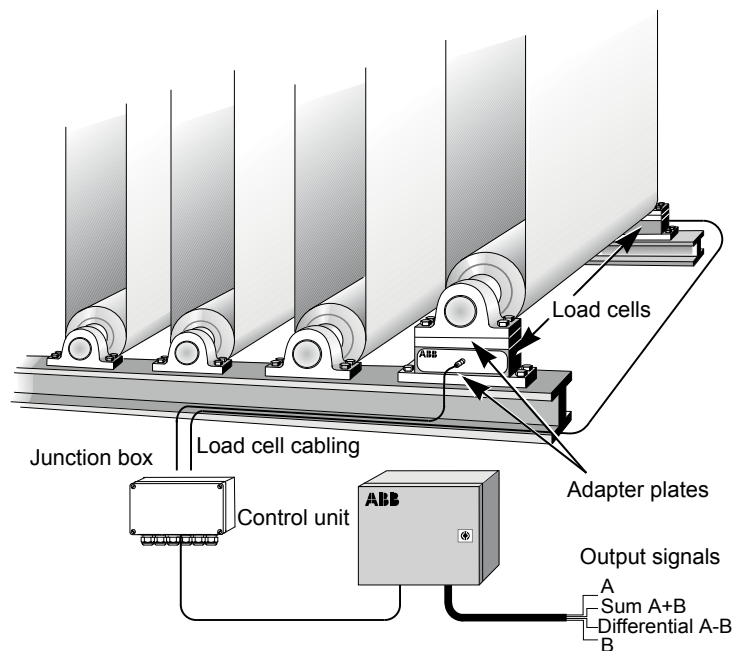


Figure 1. Complete Measuring System

## 1.4.2 Load Cells PFCL 201

The load cells are installed under the roll bearings, where they measure forces at right angles to the mounting surface.

The reactive force from the strip, which is proportional to the strip tension, is transferred to the load cells via the roll and the bearings.

The load cells are connected to the control unit via a junction box. The control unit converts the load cell signals to DC voltages that are proportional to the reaction force. Depending on which control unit is chosen, it is possible to have the analog signals for the two individual load cells (**A** and **B**), the sum of the load cell signals (**A+B**), and/or the difference between the load cell signals (**A-B**).

## 1.4.3 Principle of Measurement

The load cell only measures force in the direction  $F_R$ . The measurement force may be positive or negative. The load cell is normally installed under the roll bearings. When there is a strip in tension over the roll, the tension ( $T$ ) gives rise to two force components, one in the direction of measurement of the load cell ( $F_R$ ) and one at right angles ( $F_V$ ).

The measuring force depends on the relationship between the tension ( $T$ ) and the wrap angle formed by the strip around the measuring roll.

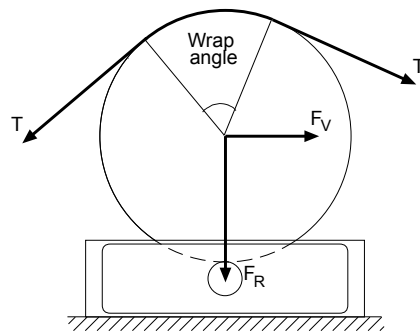


Figure 2. Measuring Roll with Force Vectors



# 2 Description

## 2.1 General

The load cell is machined from a single piece of stainless steel. The sensors are machined directly in the piece of steel and are positioned so that they are sensitive to force in the direction of measurement and insensitive in other directions.

The load cell is mounted on a base with four screws, and the bearing housing is mounted on top of the load cell with four screws.

Every load cell comes calibrated and temperature compensated.

The load cells PFCL 201C/201CE/201CD are available in four measurement ranges, all variants have the same external dimensions.

The load cell PFCL 201C is equipped with a connector for the pluggable connection cable.

The load cell PFCL 201CE has a fixed connection cable with protective hose.

The load cell PFCL 201CD is provided with an acid-proof cable gland with a fixed PTFE- insulated connection cable.

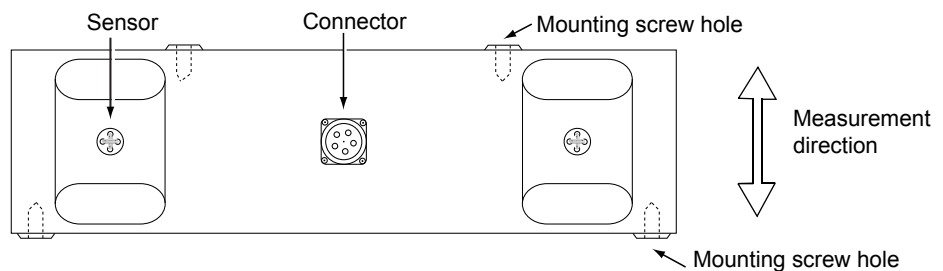


Figure 3. Load Cell PFCL 201C

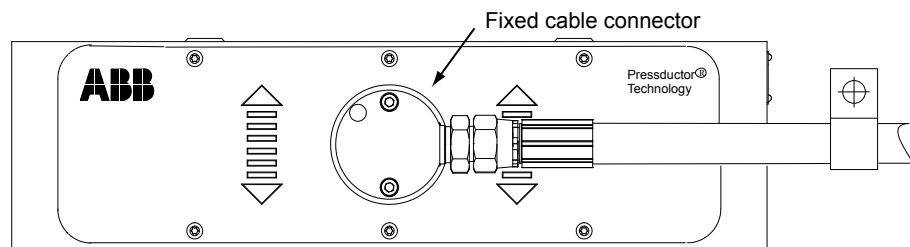


Figure 4. Load Cell PFCL 201CE with protective hose for cable

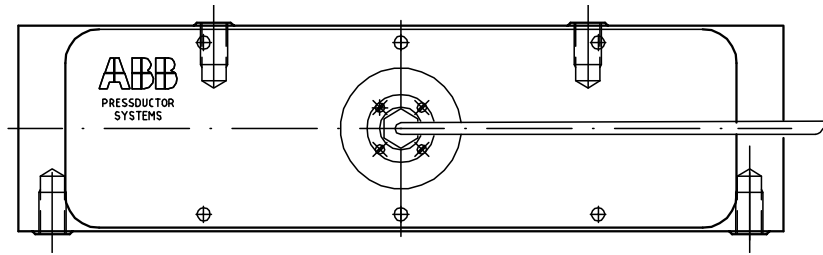


Figure 5. Load Cell PFCL 201CD with insulated cable connection

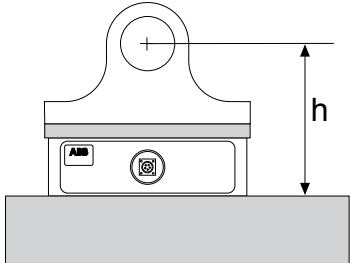
## 2.2 Technical Data

Table 2 Technical Data Load Cell PFCL 201

PFCL 201	Type	Data				Unit
<b>Nominal Loads <sup>1)</sup></b>						
Nominal load in measuring direction, $F_{nom}$	C/CD/CE	5	10	20	50	kN
Permitted transverse force within the accuracy, $F_{Vnom}$ (for $h = 300$ mm)		2,5	5	10	25	
Permitted axial load within the accuracy, $F_{Anom}$ (for $h = 300$ mm)		1,25	2,5	5	12.5	
Extended load in measuring direction with accuracy class $\pm 1\%$ , $F_{ext}$		7,5	15	30	75	
<b>Max permitted load</b>						
In the direction of measurement without permanent change of data, $F_{max}^{2)}$	C/CD/CE	50	100	200	500 <sup>3)</sup>	kN
In the transverse direction without permanent change of data, $F_{Vmax}^{2)}$ (for $h = 300$ mm)		12,5	25	50	125	
<b>Spring constant</b>	C/CD/CE	250	500	1000	2500	kN/mm
<b>Mechanical data</b>						
Length	C/CD/CE	450				mm
Width	C	110				
	CD	138				
	CE	156				
Height	C/CD/CE	124,6				
Weight		37				kg

2 Description

<b>Material</b>	C/CD/CE	Stainless steel SIS 2387 DIN X4CrNiMo 165	
<b>Accuracy</b>			
Accuracy class	C/CD/CE	± 0,5	%
Linearity deviation		< ± 0,3	
Repeatability error		< ± 0,05	
Hysteresis		<0,2	
<b>Compensated temperature range</b>		+20 - +80	°C
Zero point drift	50	100	ppm/K
Sensitivity drift			
<b>Working temperature range</b>	-10 - +90	100	°C
Zero point drift			
Sensitivity drift			
<b>Storage temperature range</b>	-40 - +90	200	ppm/K
Zero point drift			
			°C

1) Definitions of directions designations “V” and “A” in $F_V$ and $F_A$ are given in Section 2.5.1 <a href="#">Coordinate System</a> .	
2) $F_{max}$ and $F_{Vmax}$ are allowed at the same time.	
3) Max. permitted load for the load cell is $10 \times F_{nom}$ . The overload capacity for the total installation may be limited by the screws.	
	h= Building Height

## 2.3 Definitions

### Nominal load

Nominal load,  $F_{nom}$ , is the maximum load in the measurement direction for which the load cell is dimensioned to measure within the specified accuracy class. The load cell is calibrated up to  $F_{nom}$ .

### Sensitivity

Sensitivity is defined as the difference in output values between nominal load and zero load.

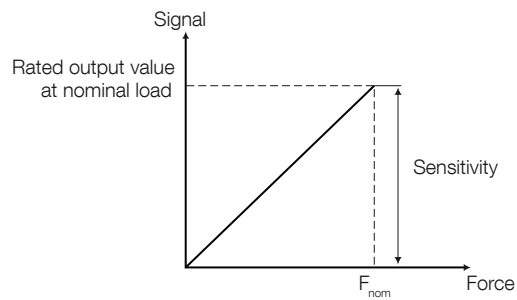


Figure 6. Sensitivity

### Accuracy and Accuracy Class

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

### Linearity Deviation

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

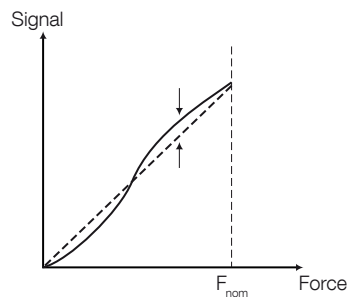


Figure 7. Linearity Deviation

### Hysteresis

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

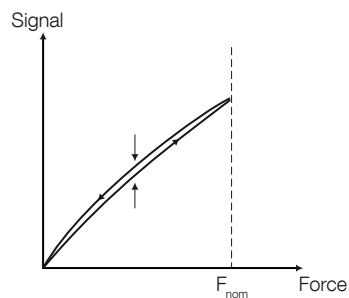


Figure 8. Hysteresis

### Repeatability error

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

### Compensated temperature range

The temperature drifts of the load cell have been compensated for in certain temperature ranges. That is the temperature range within which the specified permitted temperature drifts (i.e. zero point and sensitivity drifts) of the load cell are maintained.

### Working temperature range

Working temperature range is the temperature range within which the load cell can operate within a specified accuracy. The maximum permitted temperature drifts (i.e. zero point and sensitivity drifts) of the load cell are not necessarily maintained in the whole working temperature range.

### Storage temperature range

Storage temperature range is the temperature range within which the load cell can be stored.

### Zero point drift with temperature

Zero point drift is defined as the signal change with temperature, related to the sensitivity, when there is zero load on the load cell.

### Sensitivity drift with temperature

Sensitivity drift is defined as the signal change with temperature at nominal load, related to the sensitivity, excluding the zero point drift.

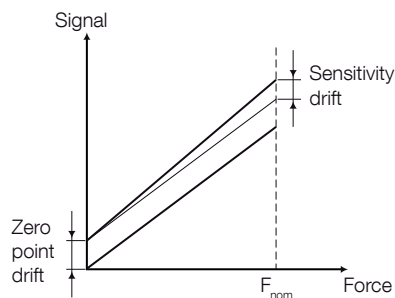


Figure 9. Sensitivity drift with temperature

### Compression

Compression is the total reduction in the height of the load cell when the load is increased from zero to the nominal value.

## 2.4 Measuring principle of the sensor

The measuring principle of the sensor is based on the Pressductor® technology and the fact that the permeability of a magnetic material changes under mechanical stress.

The sensor is a membrane machined in the load cell. Primary and secondary windings are wound through four holes in the load cell so that they cross at right angles.

The primary winding is supplied with an alternating current which creates a magnetic field around the primary winding. Since the two windings are at right angles to each other, there will be no magnetic field around the secondary winding, as long as there is no load on the sensor.

When the sensor is subjected to a mechanical force in the direction of measurement, the propagation of the magnetic field changes so that it surrounds the secondary winding, inducing an alternating voltage in that winding.

The control unit converts this alternating voltage into a DC voltage proportional to the applied force. If the measurement force changes direction, the sensor signal changes also polarity.

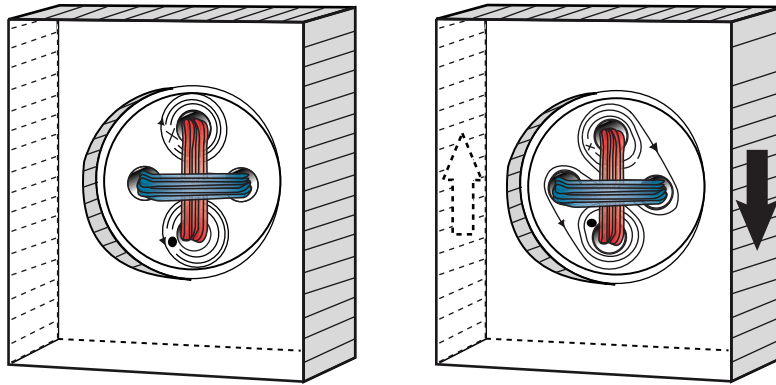


Figure 10. Propagation of magnetic field around secondary winding due to mechanical force on sensor

## 2.5 Mounting Arrangement

When choosing a mounting arrangement it is important to remember to position the load cell in a direction that gives sufficient measuring force ( $F_R$ ) to achieve the highest possible accuracy.

The load cell has no particular correct orientation; it is positioned in the orientation best suited for the application, bearing in mind the positions of the screw holes. The load cell can also be installed with the roll suspended under the load cell.

The load cell has the same sensitivity in both tension and compression, so the load cell can be installed in the easiest manner.

Typical mounting arrangements are horizontal and inclined mounting.

### 2.5.1 Coordinate System

A coordinate system is defined for the load cell. This is used in force calculations to derive force components in the load cell principal directions.

## 2 Description

Where direction designations R, V and A are recognized as suffixes for force components, F, this represents the force component in the respective direction. The suffix R may be omitted, when measuring direction is implied by the context.

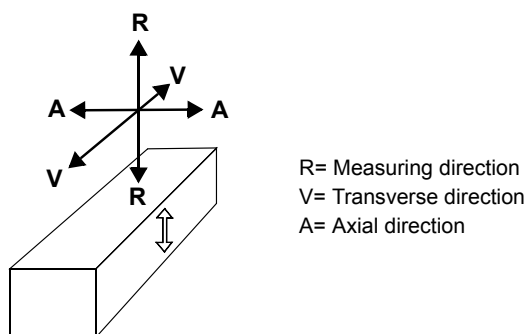


Figure 11. Coordinate system defining directions used in force calculations

### 2.5.2 Horizontal Mounting

In the majority of cases horizontal mounting is the most obvious and simplest solution. Stand, mounting surface and shims (if required) are simple and cheap to make.

When calculating the force, the equations below must be used:

$$F_R = T \times (\sin \alpha + \sin \beta)$$

$$F_{RT} = T \text{are}$$

$$F_{Rtot} = F_R + F_{RT} = T \times (\sin \alpha + \sin \beta) + T \text{are}$$

$$F_V = T \times (\cos \beta - \cos \alpha)$$

$$F_{VT} = 0$$

$$F_{Vtot} = F_V + F_{VT} = T \times (\cos \beta - \cos \alpha) + 0 = T \times (\cos \beta - \cos \alpha)$$

where:

T = Strip tension

$F_R$  = Force component from strip tension in measurement direction, R

$F_{RT}$  = Force component from Tare in measurement direction, R

$F_{Rtot}$  = Total force in measurement direction, R

$F_V$  = Force component from strip tension in transverse direction, V

$F_{VT}$  = Force component from Tare in transverse direction, V

$F_{Vtot}$  = Total force in transverse direction, V

Tare = Force due to tare weight

$\alpha$  = Deflection angle on one side of the roll relative the horizontal plane

$\beta$  = Deflection angle on the other side of the roll relative the horizontal plane

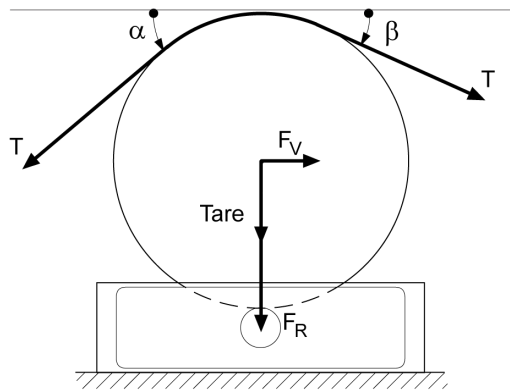


Figure 12. Horizontal mounting

### 2.5.3 Inclined Mounting

Inclined mounting means arrangements in which the load cell is inclined relative to the horizontal plane. In some cases this is the only option.

When calculating the force, the equations below must be used:

$$F_R = T \times [\sin(\alpha - \gamma) + \sin(\beta + \gamma)]$$

$$F_{RT} = Tare \times \cos \gamma$$

$$F_{Rtot} = F_R + F_{RT} = T \times [\sin(\alpha - \gamma) + \sin(\beta + \gamma)] + Tare \times \cos \gamma$$

$$F_V = T \times [\cos(\beta + \gamma) - \cos(\alpha - \gamma)]$$

$$F_{VT} = -Tare \times \sin \gamma$$

$$F_{Vtot} = F_V + F_{VT} = T \times [\cos(\beta + \gamma) - \cos(\alpha - \gamma)] - Tare \times \sin \gamma$$

$$\gamma = 90^\circ - \varphi$$

where:

T = Strip tension

$F_R$  = Force component from strip tension in measurement direction, R

$F_{RT}$  = Force component from Tare in measurement direction, R

$F_{Rtot}$  = Total force in measurement direction, R

$F_V$  = Force component from strip tension in transverse direction, V

$F_{VT}$  = Force component from Tare in transverse direction, V

$F_{Vtot}$  = Total force in transverse direction, V

Tare = Force due to tare weight

$\alpha$  = Deflection angle on one side of the roll relative the horizontal plane

$\beta$  = Deflection angle on the other side of the roll relative the horizontal plane

$\varphi$  = Angle for measurement direction relative the horizontal plane

$\gamma$  = Angle for load cell mounting surface relative the horizontal plane



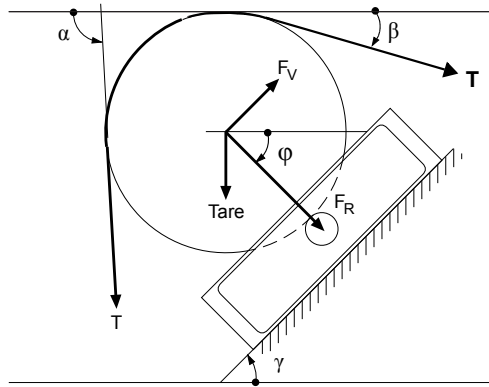


Figure 13. Inclined mounting

## 2.6 The Electrical Circuit

The electrical circuit of the load cell is shown in the diagram below.

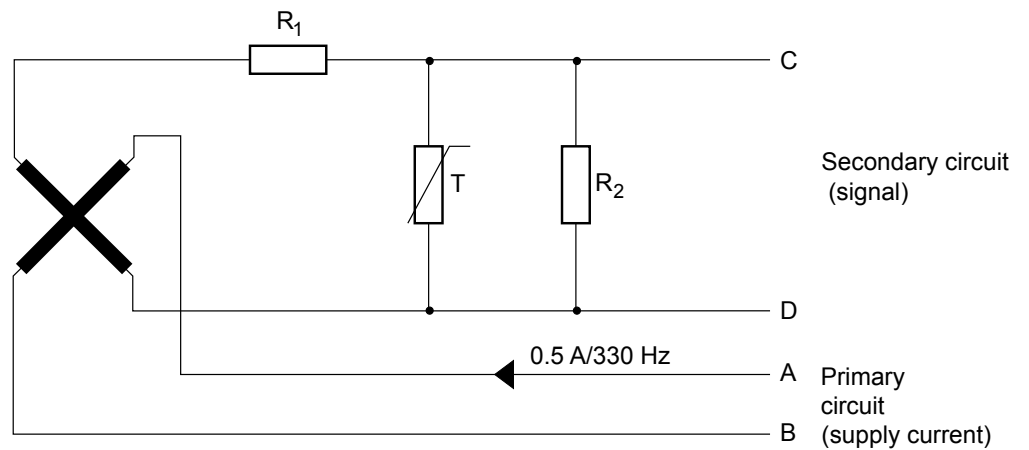


Figure 14. Load cell circuit diagram

The load cell is supplied with a 0.5 A, 330 Hz alternating current. The secondary signal is calibrated for the correct sensitivity with a voltage divider  $R_1 - R_2$ , and temperature compensation is provided by thermistors T.

All impedances on the secondary side are relatively low. The output impedance is typically 9-12  $\Omega$ , which helps to suppress interference.

# 3

## Installation

---

### 3.1 General

The equipment is a precision instrument which, although intended for severe operating conditions, must be handled with care. The load cells should not be unpacked until it is time for installation.

To achieve the specified accuracy, the best possible reliability and long-term stability, the load cells must be installed in accordance with the instructions below. See also [6.4 Fault Tracing in the Mechanical Installation](#).

- The foundation for the load cell must be made as stable as possible. A resilient stand lowers the critical frequency of the measuring roll and bearing arrangement.
- The surfaces closest to the load cell, and other surfaces that affect the fit, must be machined flat to within 0.05 mm.
- There must not be any shims immediately above or below the load cell, as this may adversely affect the flatness. Instead, shims may be placed between the adapter plate and the foundation or between the adapter plate and the bearing housing.
- The screws that secure the load cell must be tightened with a torque wrench.
- The bearing arrangement for the measuring roll must be designed to allow axial expansion of the roll with changes in temperature.
- Any drive to the roll must be applied in such a way that interfering forces from the drive are kept to a minimum.
- The measuring roll must be dynamically balanced.
- The mounting surfaces of the load cells must be on the same height and parallel with the measuring roll.
- In a corrosive environment, galvanic corrosion may occur between the load cell, galvanized screws and adapter plates. This makes it necessary to use stainless steel screws and adapter plates of stainless steel or equivalent. See adapter plates in [A Drawings](#).

### 3.2 Unpacking

When the equipment arrives, check against the delivery document. Inform ABB of any complaint, so that errors can be corrected immediately and delays avoided.

### 3.3 Preparations

Prepare the installation in good time by checking that the necessary documents and material are available, as follows:

- Installation drawings and this manual.
- Standard tools, torque wrench and instruments.
- Rust protection, if additional protection is to be given to machined surfaces. Choose TEC-TYL 511 (Valvoline) or FERRYL (104), for example.
- Load cells, adapter plates, bearing housings, etc.

- Locking fluid (medium strength) to lock mounting screws.
- Screws as listed in [Table 3, page 19](#) and [Table 4, page 19](#) to secure the load cell, and other screws for bearing housings etc.

## 3.4 Mounting

The instructions below apply to a typical mounting arrangement. Variations may be allowed, provided that the requirements of [3.1 General](#) are complied with.

1. Clean the foundation and other mounting surfaces.
2. Fit the lower adapter plate to the load cell. Tighten the screws to the torque stated in [Table 3, page 19](#) or [Table 4, page 19](#).
3. Fit the load cell and the lower adapter plate to the foundation, but do not fully tighten the screws.
4. Fit the upper adapter plate to the load cell, tighten to the torque stated in [Table 3, page 19](#) or [Table 4, page 19](#).
5. Fit the bearing housing and the roll to the upper adapter plate, but do not fully tighten the screws.
6. Adjust the load cells so that they are in parallel with each other and in line with the axial direction of the roll. Torque tighten the foundation screws.
7. Adjust the roll so that it is at right angles to the longitudinal direction of the load cells. Torque tighten the screws in the upper adapter plate.
8. Apply rust protection to any machined surfaces that are not rust proof.

Table 3 Galvanized MoS2 lubricated Screws according to ISO 898/1

Strength class	Dimension	Tightening torque
8.8 <sup>(1)</sup> (12.9)	M16	170 (286) Nm

Table 4 Waxed Screws of Stainless Steel According to ISO 3506

Strength class	Dimension	Tightening torque
A2-80 <sup>(1)</sup>	M16	187 Nm
(1) Strength class 12.9 is recommended for 50 kN load cells, when large overloads are expected, especially if the mounting screws are subjected to tension.		

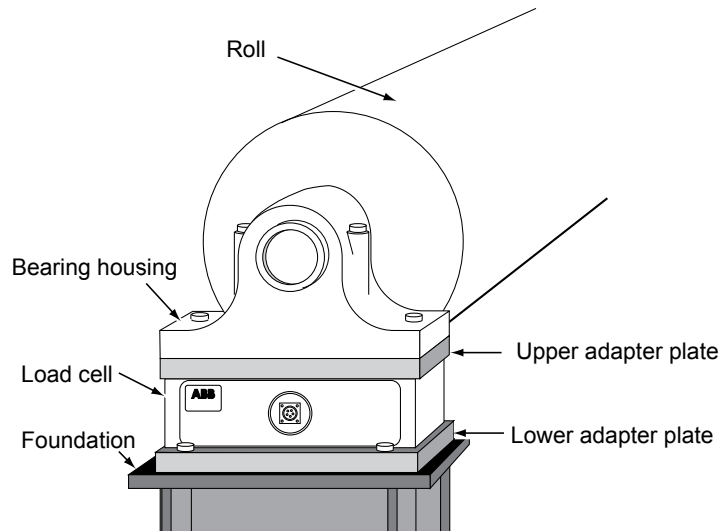


Figure 15. Typical installation

## 3.5 Cabling for Load Cell PFCL 201CE

Cabling with protective hose shall be mounted so that the forces related to the weight of the cable/hose do not act in the measuring direction of the load cell. A cable clamp is therefore necessary. If the load cell is prevented from movement in the measuring direction- it will shunt force, and the measured force will differ from the actual.

The favourable direction of the cable/hose is the horizontal direction to the left or right as indicated in [Figure 16. Position of cable from factory page 20](#). This as possible forces in the longitudinal direction of the cable/hose due to temperature, will act perpendicular to the measuring direction of the load cell (the direction in which the load cell is insensitive to loads).

For achievable cable directions, see [Figure 17. Possible directions of cable for PFCL 201CE page 21](#).

The direction of the cable and protective hose can be changed by unscrewing the two screws in the connection box and turning the cable to a suitable direction. Make sure to re-install the screws in the connection box.

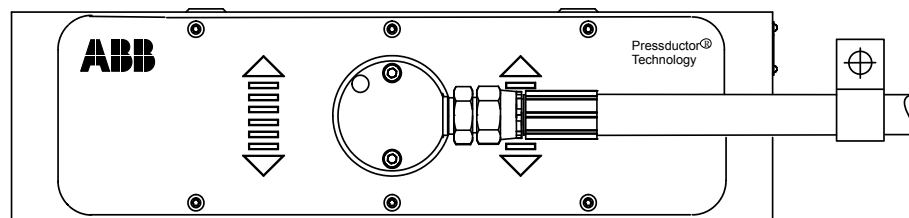


Figure 16. Position of cable from factory

3 Installation

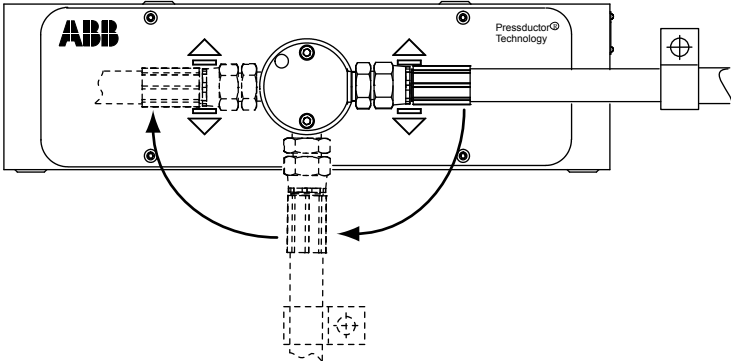



Figure 17. Possible directions of cable for PFCL 201CE

 **CAUTION**  
Cable bending is not allowed in the connection

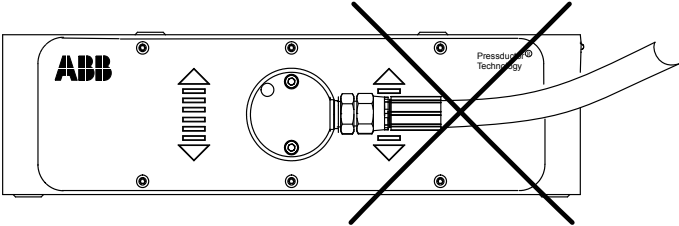


Figure 18. Cable bending, wrong installation

# 4

## Commissioning

---

### 4.1 General

The actual procedure for commissioning a load cell is simple, provided that the load cells and cables have been properly installed. Commissioning of the control unit is described in the relevant chapter of the control unit manual.

Check the following:

- that the load cells have been correctly installed and aligned
- that all screws have been tightened to the correct torque
- that all cables are correctly installed and connected
- that all connectors are plugged in

### 4.2 Preparatory Calculations

To be able to set the correct measuring range, the measurement force per load cell  $F_R/2$  at maximum tension  $T$  must be calculated. Each load cell is subjected to half the total measurement force  $F_R$ . This calculation must be done before commissioning can begin. Calculation of  $F_R$  is described in [2.5 Mounting Arrangement](#).

# 5

## Maintenance

### 5.1 General

Strip Tensiometer Systems with Pressductor® load cells are extremely reliable and do not require daily servicing. As a preventive measure, checks should be done periodically on all parts subject to mechanical wear.

### 5.2 Preventive Maintenance

Check mounting screws and tighten if necessary.

The gaps between load cell and plates should be checked to ensure that they do not get clogged with dirt, causing shunt force past the load cell. Clean the gaps with compressed air if necessary.

The cable between the load cell and the junction box is subjected to possible damage and should be checked and replaced if necessary.

### 5.3 Spare Parts

Users are recommended to keep the following spare parts in stock:

- One load cell of correct type and size.
- One connector complete with cable (for PFCL 201C)

Table 5 Ordering numbers for Load Cell PFCL 201

Description	Type	Nominal load (kN)	Ordering numbers
Load cell	Load cell PFCL 201C	5,0	3BSE027070R5
Load cell	Load cell PFCL 201C	10,0	3BSE027070R10
Load cell	Load cell PFCL 201C	20,0	3BSE027070R20
Load cell	Load cell PFCL 201C	50,0	3BSE027070R50
Load cell	Load cell PFCL 201CE	5,0	3BSE027062R5
Load cell	Load cell PFCL 201CE	10,0	3BSE027062R10
Load cell	Load cell PFCL 201CE	20,0	3BSE027062R20
Load cell	Load cell PFCL 201CE	50,0	3BSE027062R50
Load cell	Load cell PFCL 201CD	5,0	3BSE029774R5

Load cell	Load cell PFCL 201CD	10,0	3BSE029774R10
Load cell	Load cell PFCL 201CD	20,0	3BSE029774R20
Load cell	Load cell PFCL 201CD	50,0	3BSE029774R50



# 6 Fault Tracing

---

## 6.1 General

It is important to be thoroughly familiar with the description of operation in [2 Description](#) before starting fault tracing.

## 6.2 Interchangeability

The load cells are factory calibrated and can be replaced directly with another load cell of the same type. The only adjustment required after load cell replacement is zero adjustment in the control unit.

## 6.3 Fault Tracing Procedure

The measuring equipment can be divided into four parts:

- The mechanical installation.
- The load cell.
- The junction boxes and the cabling.
- The control unit (see the control unit manual).

The fault symptoms indicate in which part the fault lies.

- Faults in the mechanical installation often result in an unstable zero point or incorrect sensitivity.  
If a fault follows something else in the process, such as temperature, or can be linked to a particular operation, it probably originates from something in the mechanical installation.
- Load cells are extremely robust and can withstand ten times their nominal load in the measuring direction. If a load cell has nevertheless been so overloaded that its data have been altered, this is probably due to an event in the mill, such as strip breakage. On excessive overload the first thing that happens is that the zero point shifts.
- Problems such as interference or unstable zero point may be caused by wiring faults. Some malfunctions may be due to the proximity of cables that cause interference. Incorrect installation, such as imbalance in a cable or screens earthed at more than one end may cause the zero point to become unstable. Cables are subject to mechanical wear, and should be checked regularly. The junction box should also be checked, especially if it is subject to vibration.
- A fault in the control unit usually causes intermittent loss of a function. It is unusual for the control unit to cause stability problems. Faults in connected units may affect the operation of the control unit. For further details see the control unit manual.

## 6.4 Fault Tracing in the Mechanical Installation

There are a number of parts in the mechanical arrangement that can cause faults. The extent to which these faults are repeatable differs. Possible causes fall into the following groups.

- Defective mounting surface, stand or adapter plates.
- Force shunting.
- Insufficient mounting of load cell and adapter plates.
- Rolls and bearings.
- Driven roll.

### 6.4.1 Defective Mounting Surface, Support or Adapter Plates

An unmachined or poorly machined mounting surface, which is uneven, may cause bending or twisting of the load cell. This may result in instability of the zero point.

### 6.4.2 Force Shunting

Force shunting means that some of the force is diverted past the load cell. This may be caused by some kind of obstruction to the force through the load cell. The connecting cables, for example, have been incorrectly installed and are preventing movement. Another possible cause is that the roll is not free to move in the direction of measurement, possibly because something is mounted too close to a bearing housing, or because an object has worked loose and become trapped between the bearing housing and adjacent parts.

Force shunting causes the strip tension indication to be lower than the actual strip tension.

### 6.4.3 Fastening of Load cell and Adapter Plates

Screw joints that have not been properly tightened or have lost their pre-tightening force, cause sliding at the mating surfaces. Fastening of the load cell is especially critical. If a load cell is not properly secured, the zero point will be unstable. Sliding between other surfaces may cause the same symptoms.

### 6.4.4 Rolls and Bearings

An incorrectly designed bearing arrangement may give rise to high axial forces. The roll should be fixed at one end and free at the other.

If both ends are fixed, there will be a high axial (thrust) force due to expansion of the shaft with rising temperature.

Even a correctly designed bearing arrangement may deteriorate with time; bearings become worn, and so on. This may give similar symptoms, such as slow zero point drift between cold and hot machine, or sudden jumps in the signal.

### 6.4.5 Driven Roll

A source of error that is seldom suspected is the roll itself. The effect is especially critical when measuring forces on the load cell are relatively low. Long drive shafts with their associated universal joints may cause unstable signals if they are not properly maintained. It is important to lubricate universal joints. Longitudinal expansion of the drive shaft should also be taken into account. Since

such expansion is often taken up by splines, these must also be lubricated. The symptoms are instability of the signal, for instance jumps in the signal during slow running.

## 6.5 Fault Tracing of Load Cells, Junction Boxes and wiring

The load cell is very robust and can withstand high overloads. The data of a Pressductor load cell does not change slowly, but in steps, usually in connection with an event in the mill. Excessive overloading usually results in permanent shifting of the zero point.

Poor contact in the junction box causes intermittent faults. Both sensitivity and zero point may vary. Check all screw terminals. Do not use pins crimped to the connecting wires, as these often work loose after a time.

The cabling, especially the cable to the load cell, is the part that is most exposed to damage.

Since the resistance of the load cell windings is low, it is easy to check the load cells and cabling from the control unit.

Typical readings are 2 Ω for the resistance of the primary winding and 9-12 Ω for the output impedance of the secondary winding.

Insulation faults in the cabling or the load cell may cause incorrect sensitivity or unstable zero point. When the load cell circuits have been isolated from earth and from the control unit at the disconnectable terminals, it is easy to measure the insulation from the control unit.

If the cables are not routed correctly, they may pick up interference from other cables.

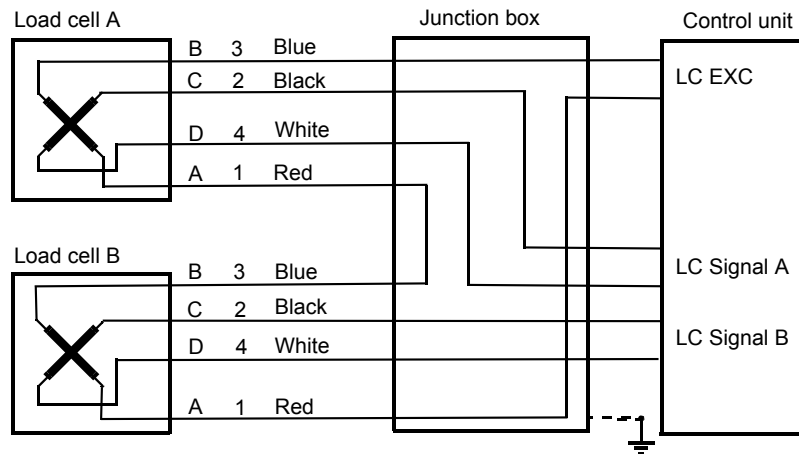


Figure 19. Typical load cell cabling

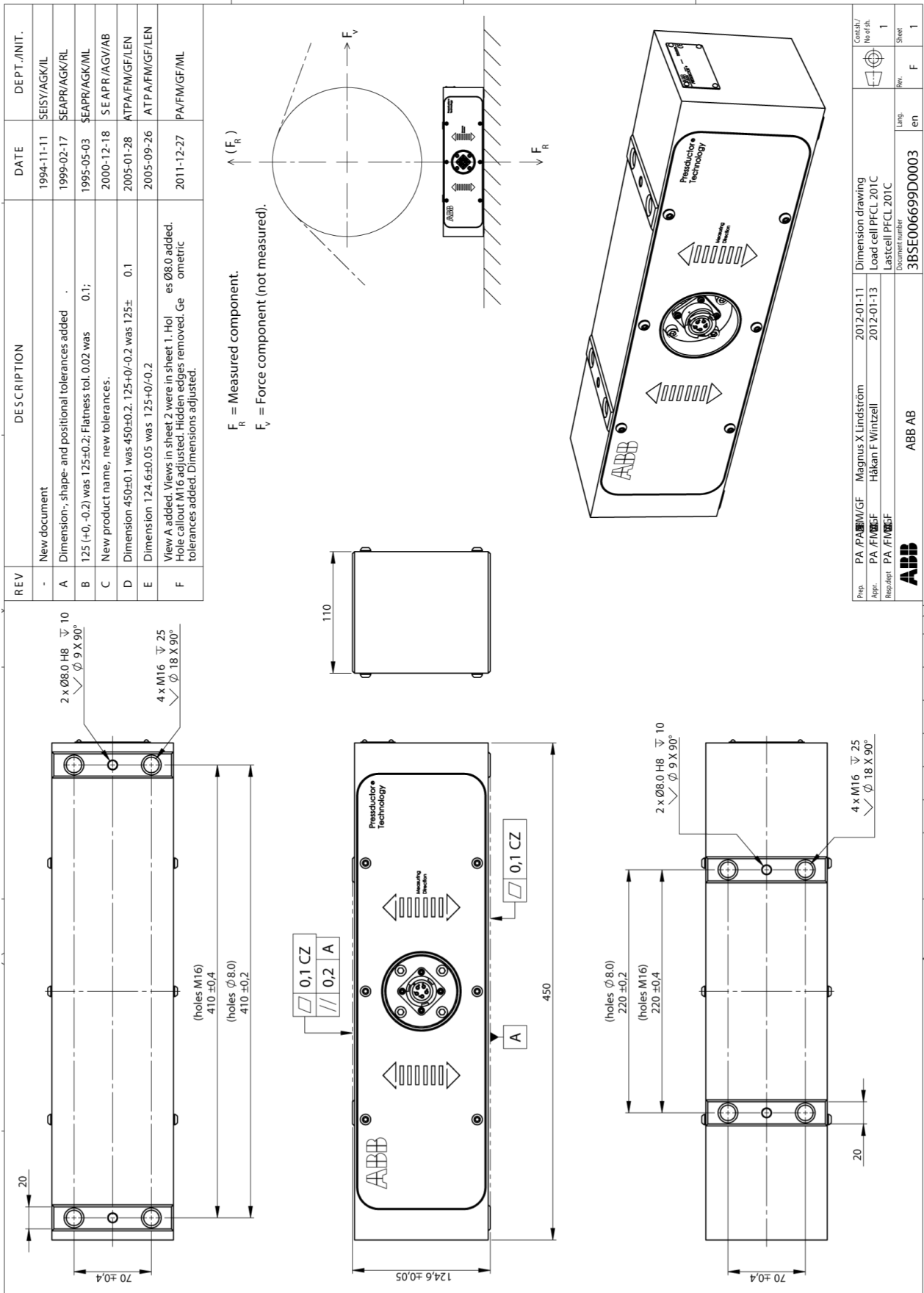
For circuit diagram applications, see the manual for the applicable control unit:  
 Millmate Strip Tension Systems with Millmate Controller 400, 3BSE023139Rxxxx  
 Web Tension Systems with Tension Electronics PFEA 111/112, 3BSE029380Rxxxx  
 Web Tension Systems with Tension Electronics PFEA 113, 3BSE029382Rxxxx

# A

# Drawings

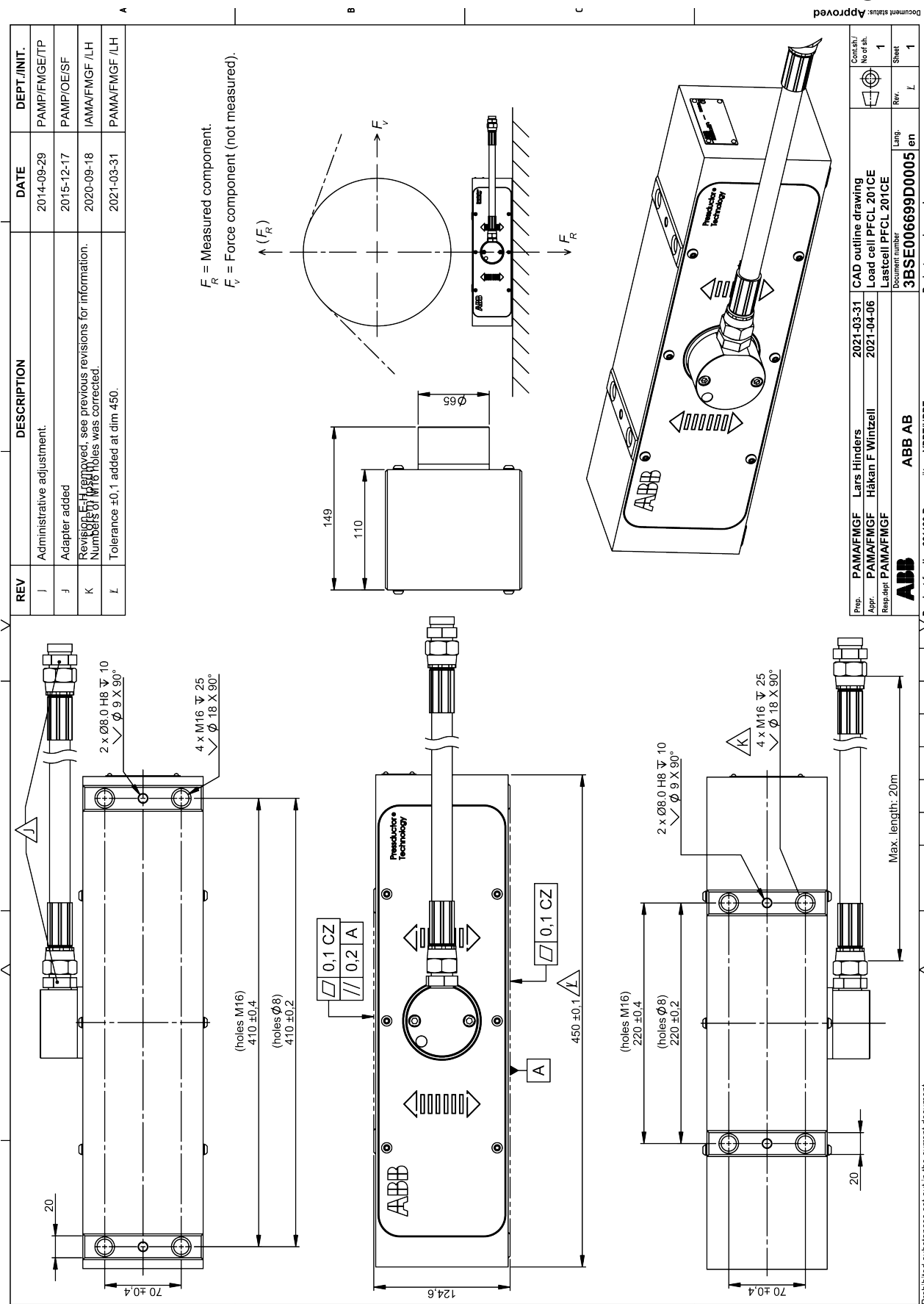
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# A.1 Load Cell PFCL 201C, Dimension Drawing

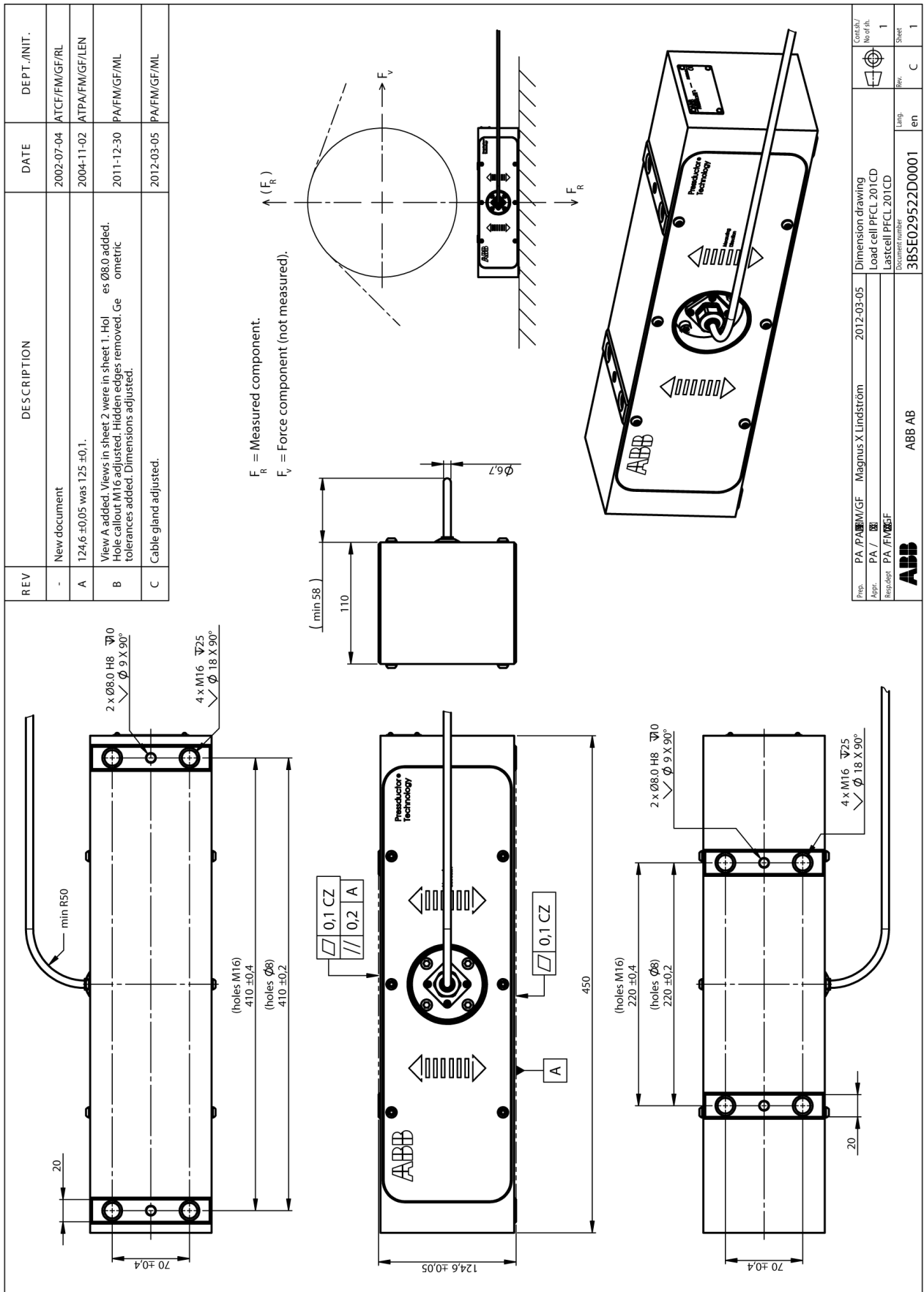


Prop.	PA /PA/M/GF	Magnus X Lindström	2012-01-11	Dimension drawing	Cont./No. of sh.	1
Appl.	PA /FM/GF	Håkan F Wintzell	2012-01-13	Load cell PFCL 201C	Rev.	F
Rep./Appl.	PA /FM/GF			Lastcell PFCL 201C	Lang.	en
				Document number	Rev.	F
				3BSE006699D0003	Sheet	1

# A.2 Load Cell PFCL 201CE, Dimension Drawing

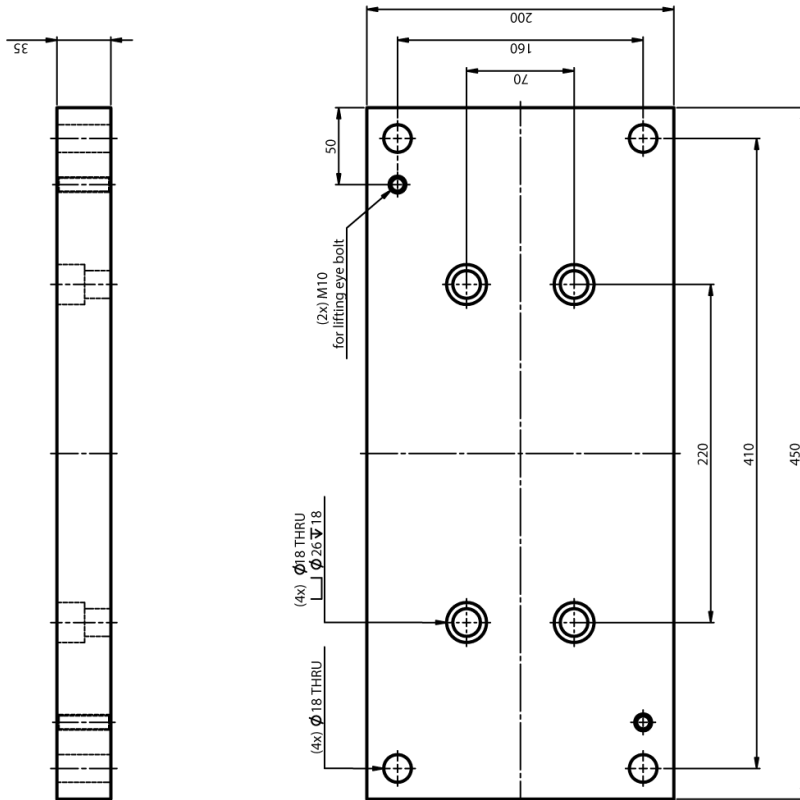


## A.3 Load Cell PFCL 201CD, Dimension Drawing



# A.4 Adapter Plate Upper PFCL 201, Dimension Drawing

REV	DESCRIPTION	DATE	DEPT./INIT.
E	Redrawn: PFCL201D added	2003-09-09	ATCE/FM/GF/RL
F	Redrawn to match standard adapter plate manufacturing drawing	2009-04-22	PA/FM/GF/JK
G	Drawing in S.W. was autocad	2011-04-14	PA/FM/GF/SF
H	Table "Technical material" added	2012-12-18	PA/FM/GF/SF



- Upper adapter plate for:
- PFCL 101 A
  - PFCL 101 AE
  - PFCL 201 C
  - PFCL 201 CD
  - PFCL 201 CE

Manufacturing drawing: 3BSE030638D3000

Technical material	
Material description	Material designation
Steel, through hardened	34CrNiMo6+QT900 Toolox 33; Toolox 44
Martensitic stainless Steel	34CrNiMo6+AT, 1.4021+A
Hardness 300-400 HB	Yield stress > 500MPa (N/mm <sup>2</sup> )
Remanent magnetism of finished detail must be less than 2 Gauss (0-0,2mT)	Permanent magnetism of finished detail must be less than 2 Gauss (0-0,2mT)
Hardness 300-400 HB	CTE 11-13 µm/m°C
Remanent magnetism of finished detail must be less than 2 Gauss (0-0,2mT)	Remanent magnetism of finished detail must be less than 2 Gauss (0-0,2mT)

Rev	PA/FM/GF	Swiss Fischer	2012-12-18	Dimension drawing	Mass (weight): App. 24kg
01	PA/FM/GF <td>Hilbert Winzler <td>2012-12-20 <td>Up-adapter plate PFCL loadcell <td></td> </td></td></td>	Hilbert Winzler <td>2012-12-20 <td>Up-adapter plate PFCL loadcell <td></td> </td></td>	2012-12-20 <td>Up-adapter plate PFCL loadcell <td></td> </td>	Up-adapter plate PFCL loadcell <td></td>	
02	PA/FM/GF <td>Hilbert Winzler <td>2012-12-20 <td>Down-adapter plate PFCL loadcell <td></td> </td></td></td>	Hilbert Winzler <td>2012-12-20 <td>Down-adapter plate PFCL loadcell <td></td> </td></td>	2012-12-20 <td>Down-adapter plate PFCL loadcell <td></td> </td>	Down-adapter plate PFCL loadcell <td></td>	
03	PA/FM/GF <td>ABB AB <td></td> <td>3BSE00669D0004</td> <td></td> </td>	ABB AB <td></td> <td>3BSE00669D0004</td> <td></td>		3BSE00669D0004	



# A.5 Adapter Plate Lower PFCL 201, Dimension Drawing

REV		DATE	DEPT./INIT.
-	DESCRIPTION New document. Replaces 3BSE006699D0004 part 002	2013-01-17	PA/FM/GF/SF

(2x) M10  
for lifting eye bolt

(4x) Ø18 THRU  
(4x) Ø18 THRU  
Ø26 ∇18

Lower adapter plate for:

- PFCL 101 A
- PFCL 101 AE
- PFCL 201 C
- PFCL 201 CD
- PFCL 201 CE

Manufacturing drawing: 3BSE030638D3001

Technical material	
Material description	Material designation
Steel, through hardened	32CrNiMo6+QT900 C10x 33; Toolox 44 S690 Werk. 1.6582+QT900 ASTM 4340 or equivalent
Martensitic stainless Steel	X12CrMoS13+AT X12CrMoS13 Werk. 1.4005+AT; 1.4021+A ASTM 416, 420 or equivalent

Author: DA, F.M.G.F.	2013-01-17	Dimension drawing	Title
Approved: PA, F.M.G.F.	2013-01-17	Low adapter plate PFCL loadcell	Sheet 1
Designer: DA, F.M.G.F.		Need adapterplate PFCL lastcell	Rev. 1
<b>ABB</b>	ABB-AB	3BSE006699D0006	Len 1

Mass (weight): App. 24kg

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