MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

ABB DRIVES

3BSX657820-108 PFCL 201CE

PRESSDUCTOR PILLOWBLOCK LOAD CELLS

Applicable product family: ABB Drives

OFFICIAL SOURCE

3BSX657820-108 PFCL 201CE.pdf

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ABB MEASUREMENT & ANALYTICS

Pressductor Pillowblock Load Cells Vertical Measuring PFCL 201

User manual

3BSE023881R0101 en Rev I

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.

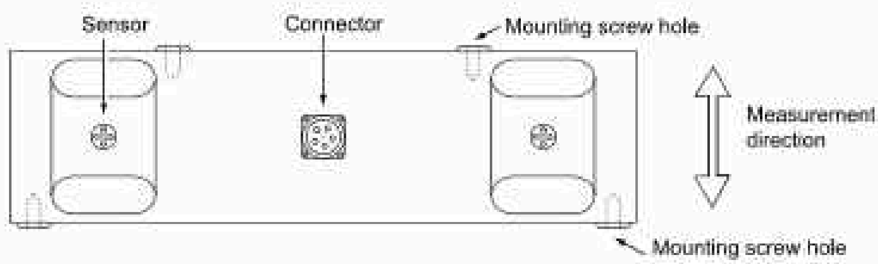


Figure 3. Load Cell PFCL 201C

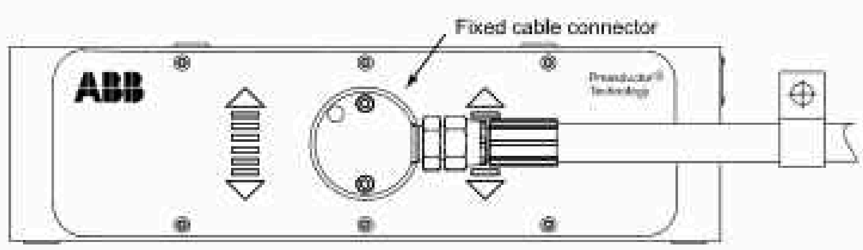


Figure 4. Load Cell PFCL 201CE with protective hose for cable

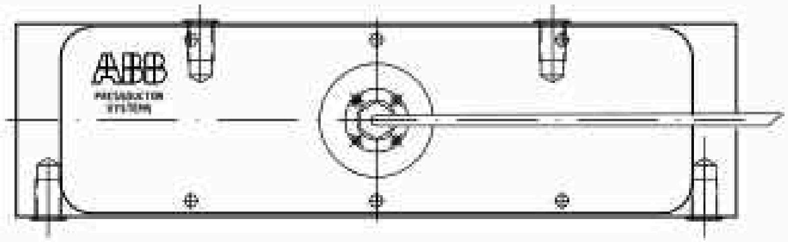


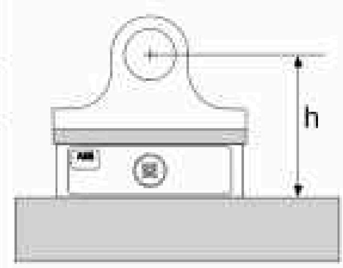
Figure 5. Load Cell PFCL 201CD with insulated cable connection

2.2 Technical Data

Table 1 Technical Data Load Cell PFCL 201

PFCL 201	Type	Data				Unit
Nominal Loads [1]						
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 ±1%, F_{ext}		7,5	15	30	75	
Max permitted load						
In the direction of measurement without permanent change of data, F_{max} [2]	C/CD/CE	50	100	200	500 [3]	kN
In the transverse direction without permanent change of data, F_{Vmax} [2]) (for h = 300 mm)		12,5	25	50	125	
Spring constant	C/CD/CE	250	500	1000	2500	kN/mm
Mechanical data						
Length	C/CD/CE	450				mm
Width	C	110				
	CD	138				
	CE	156				
Height	C/CD/CE	124,6				
Weight		37				kg

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

1) Definitions of directions designations "$_V$"and "$_A$" in F_V and F_A are given in Section 2.5.1 Coordinate System.	
2) F_{max} and F_{Vmax} are allowed at the same time.	
3) Max. permitted load for the load cell is 10 × 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.

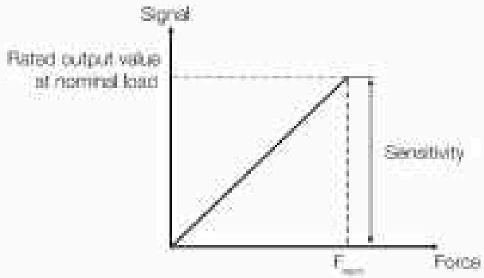


Figure 6. Sensitivity

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.

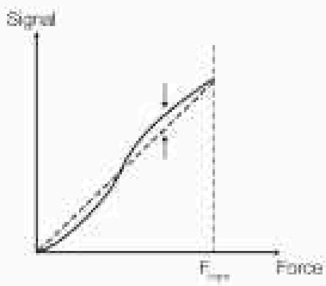


Figure 7. Linearity Deviation

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.

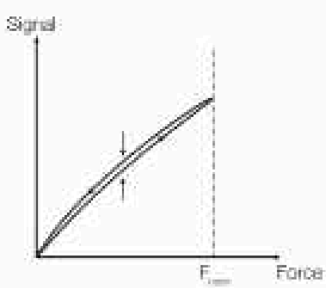


Figure 8. Hysteresis

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.

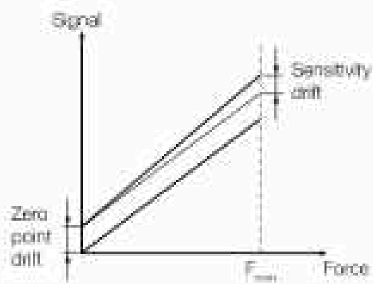


Figure 9. Sensitivity drift with temperature

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.

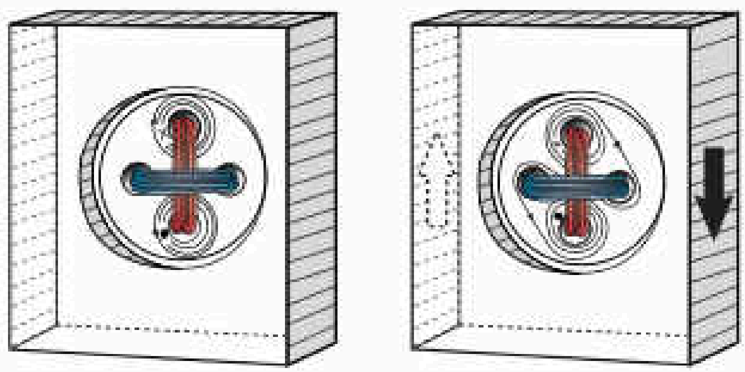


Figure 10. Propagation of magnetic field around secondary winding due to mechanical force on sensor

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.

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 2, page 19 and Table 3, 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 2, page 19 or Table 3, 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 2, page 19 or Table 3, 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 2 Galvanized MoS2 lubricated Screws according to ISO 898/1

Strength class	Dimension	Tightening torque
8.8 [1] (12.9)	M16	170 (286) Nm

Table 3 Waxed Screws of Stainless Steel According to ISO 3506

Strength class	Dimension	Tightening torque
A2-80 [1]	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.		

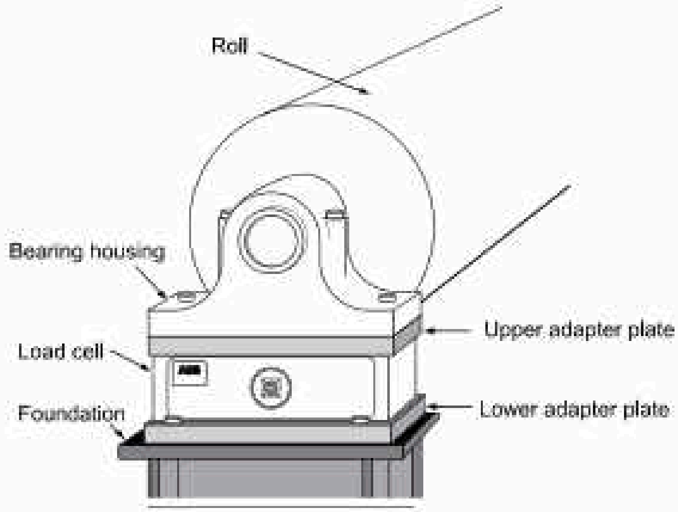


Figure 15. Typical installation

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.

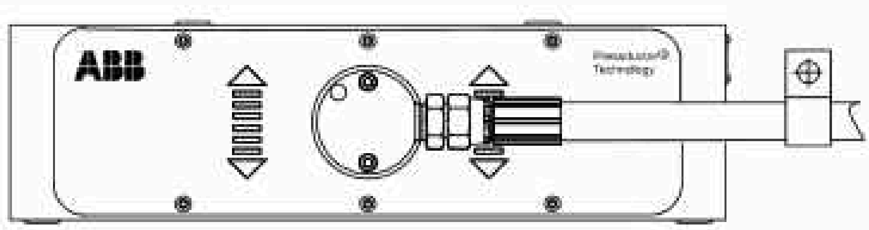


Figure 16. Position of cable from factory

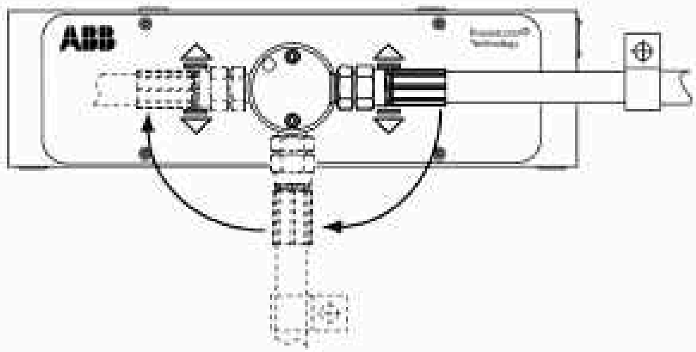


Figure 17. Possible directions of cable for PFCL 201CE

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

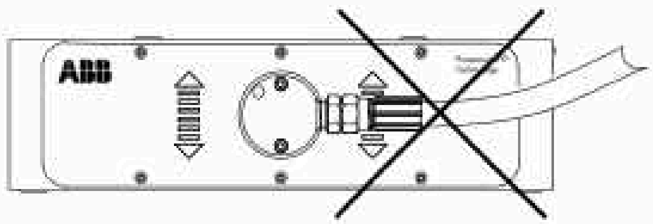


Figure 18. Cable bending, wrong installation

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 $\mathbf{F_R/2}$ at maximum tension **T** must be calculated. Each load cell is subjected to half the total measurement force $\mathbf{F_R}$. This calculation must be done before commissioning can begin. Calculation of $\mathbf{F_R}$ is described in 2.5 Mounting Arrangement.

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.

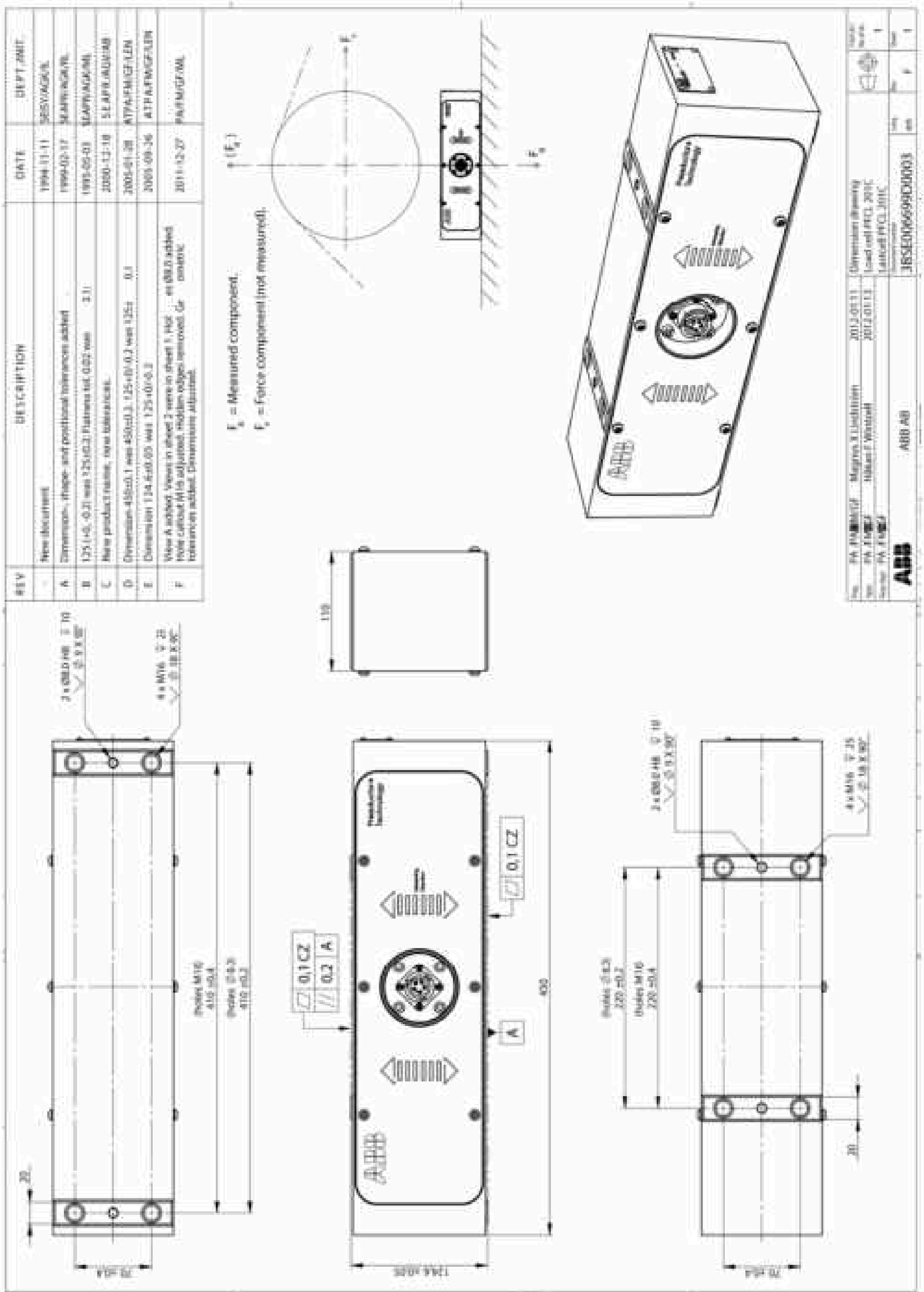
- Faults in the mechanical installation often result in an unstable zero point or incorrect sensitivity.
  If a fault follows something else in the process, such as temperature, or can be linked to a particular operation, it probably originates from something in the mechanical installation.

- 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.

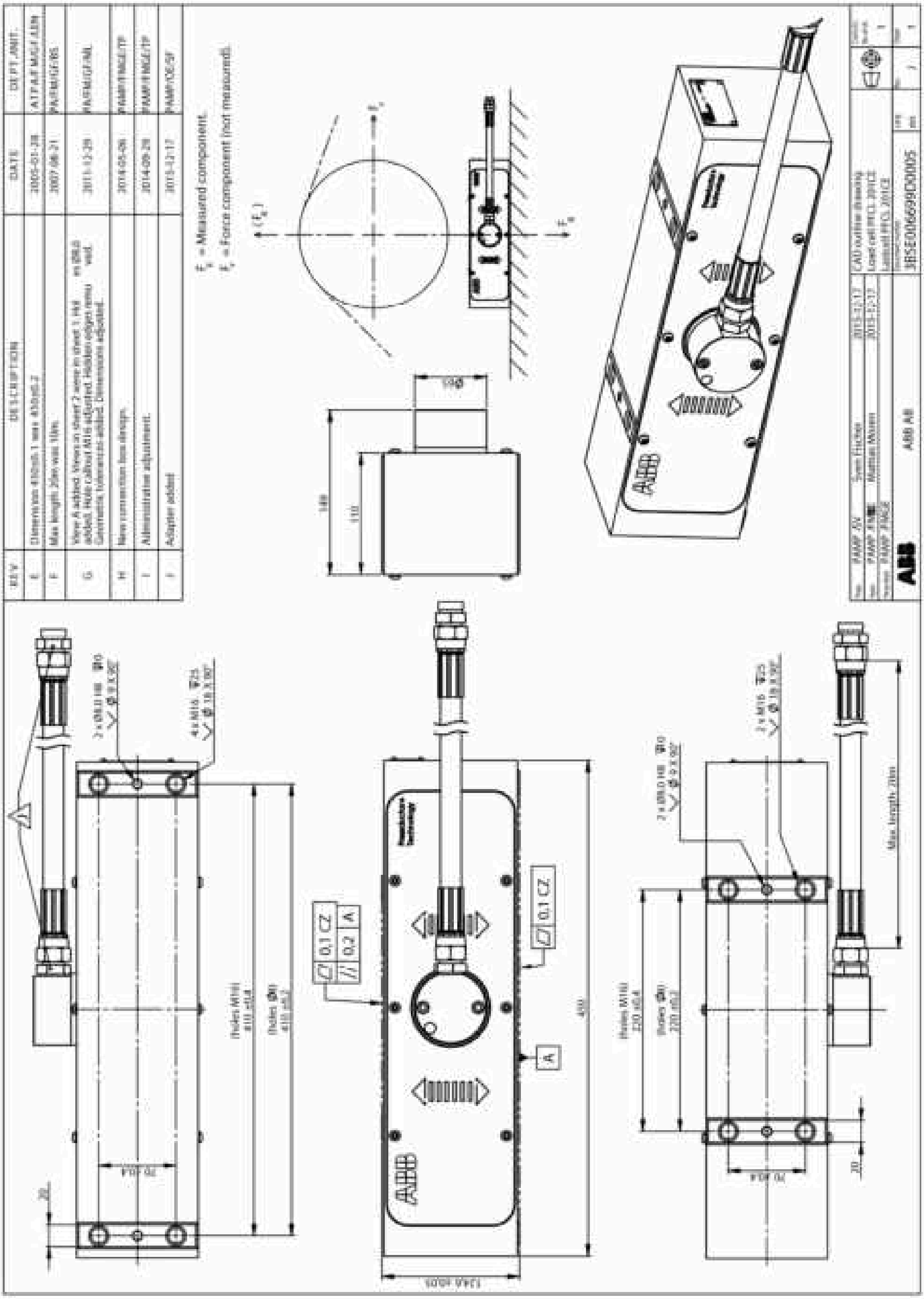
- Problems such as interference or unstable zero point may be caused by wiring faults. Some malfunctions may be due to the proximity of cables that cause interference. Incorrect installation, such as imbalance in a cable or screens earthed at more than one end may cause the zero point to become unstable. 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.

A.1 Load Cell PFCL 201C, Dimension Drawing



A.2 Load Cell PFCL 201CE, Dimension Drawing



A.3 Load Cell PFCL 201CD, Dimension Drawing