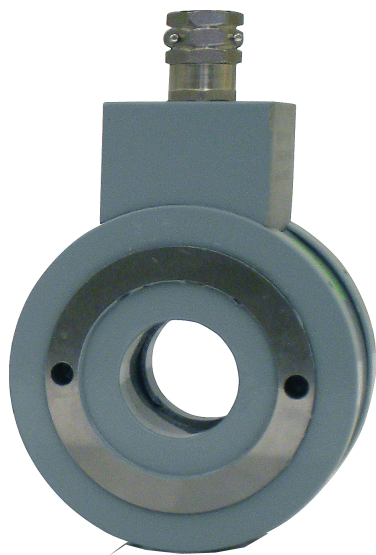


ABB MEASUREMENT & ANALYTICS

Pressductor QGPR Load Cells

User Manual



3BSE014163R0101 en Rev B

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

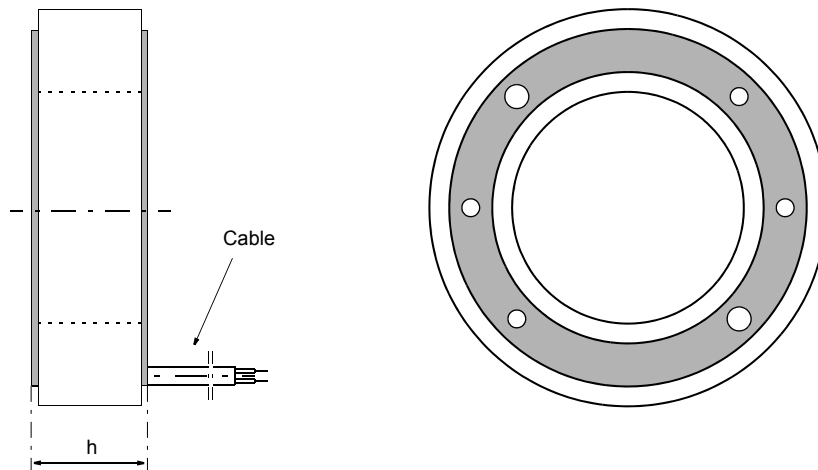
This manual describes the general function and design of the Pressductor® load cells QGPR 102 and QGPR 104. The purpose is also to be a guidance for installation, commissioning, maintenance and fault tracing.

Normally, a complete measuring system consists of two load cells with their attached matching devices, one junction box and one control unit.

The difference between QGPR 102 and QGPR 104 is the installation height (core thickness) of the load cell:

$h = \text{QGPR 102 installation height} = 74 \pm 0.1 \text{ mm}$

$h = \text{QGPR 104 installation height} = 57 \pm 0.1 \text{ mm}$



1.2 Cyber Security Disclaimer

This product has been designed to be connected and communicate data and information via a network interface which should be connected to a secure network. It is the sole responsibility of the person or entity responsible for network administration to ensure a secure connection to the network and to take the necessary measures (such as, but not limited to, installation of firewalls, application of authentication measures, encryption of data, installation of antivirus programs, etc.) to protect the product and the network, its system and interface included, against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB is not liable for any such damages and/or losses.

1.3 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.

<p>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.</p>	
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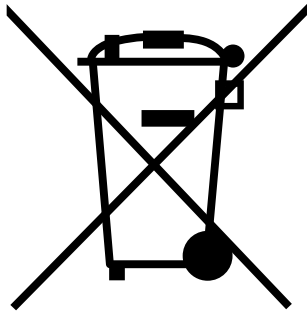
1.4 Disposal and Recycling

1.4.1 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.

1.4.2 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.

1.4.3 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.

1.4.4 Disposal of the Product

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

1.4.4.1 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.

2 Technical Description

2.1 General

The standard electrical equipment, including the load cells, constitutes a force measuring system for nominal forces from 0.1 up to 1.6 MN.

QGPR 102/104 load cells constitute the force sensing units of the equipment. These are annular in shape and are therefore suitable for installation on shafts where the axial forces are to be measured, e.g., in rolling mills where they are installed between the millscrew nuts and the mill stand. In this case, two load cells are used, one at each end of the rolls. Due to their location, the load cells sense the main forces acting on the mill stand. See figure Load cell location in a mill stand.

Typical application area of QGPR 102/104 load cells are in pipe and tube mills particularly for installation in (metallic) pipe extrusion and pipe straightening machines.

QGPR 102/104 load cells can also be used in flat rolling mills where the magnitude of the roll forces is smaller than the force magnitudes that can be measured with other smallest available ABB Roll Force load cell types (i.e. when rolling hot or cold strips of smaller dimensions).

Due to the smaller installation height of QGPR 104 load cells, they are particularly suitable for installations where the available space in the measuring direction of the load cell is too small for using QGPR 102 load cells.

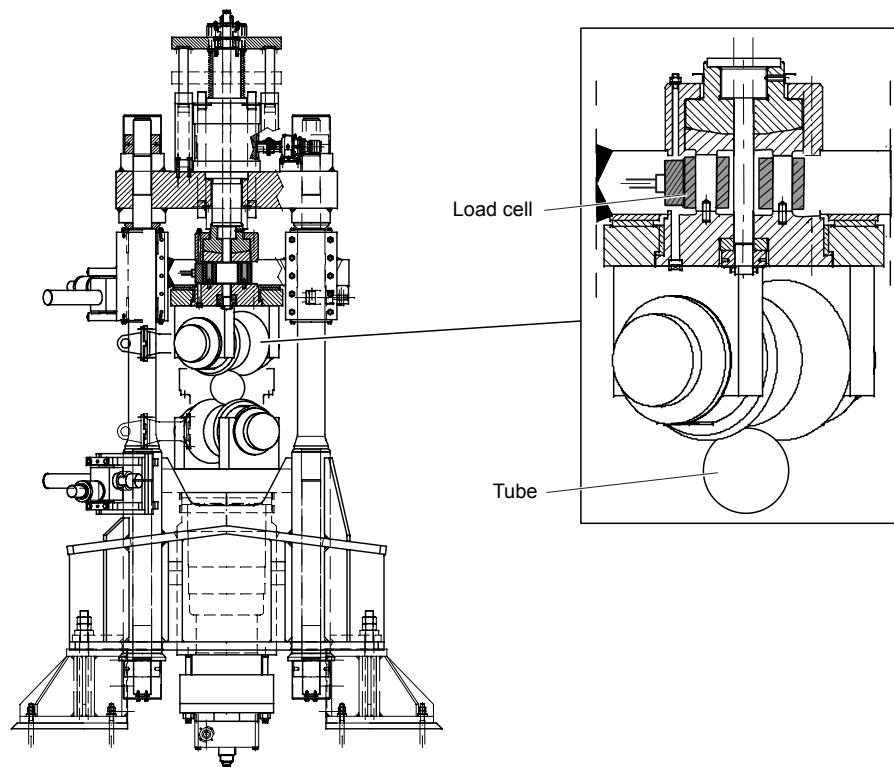


Figure 1. Example of application: Pipe straightening machine

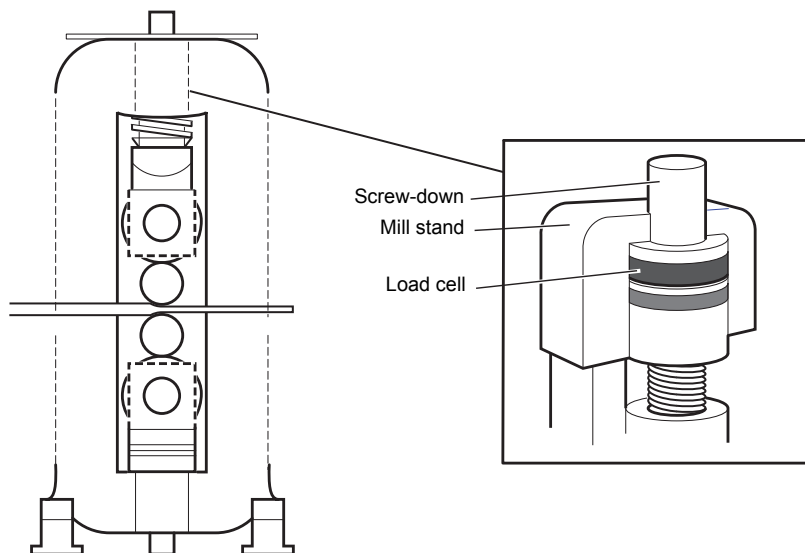


Figure 2. Example of application: Strip mill..

The signals from the load cells are processed in a control unit which also includes supply equipment for the load cells.

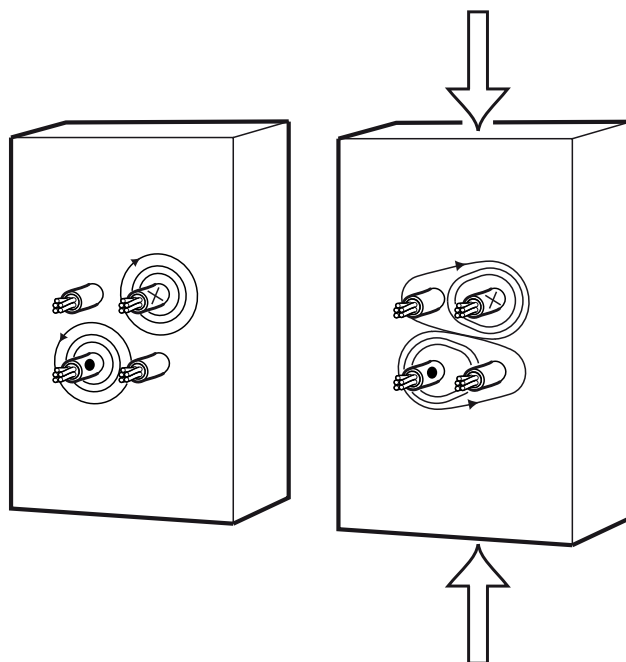
Four signals can be received from the equipment: one which is proportional to the total roll force, i.e. the sum of the output signals from both loads, one which is proportional to the difference between the forces acting on both load cells, and two which are proportional to the forces acting on each individual load cell.

2.2 Measurement Principle

Pressductor® technology is based on the change of the magneto-elastic properties in the material which the load cell core is made of. The load-dependent change of the magnetic properties of the material is in this way used for inducing a voltage over a secondary measurement winding in the load cell core.

The core of a load cell consists of a large number of turns. The turns are made of magneto-elastic plate wound around an inner ring. One single measuring zone will consist of the four holes in a turn plate with associated excitation and measurement signal windings.

The primary excitation winding is supplied with a special alternating current, creating a magnetic flux in the adjacent steel. As long as no load is applied to the transducer element, no net magnetic flux will occur around the secondary, signal, winding at the standard excitation. When the transducer is exposed to a force in the measurement direction, the magneto-elastic change in the steel will allow the magnetic flux to incorporate the secondary winding, inducing an AC voltage proportional to the applied force.



2.3 Load Cell Design

The load cell is built up around a laminated and epoxy-impregnated annular core of magneto-elastic steel. The core has several measuring zones where each steel laminate constitutes a force transducer. Excitation and sensing windings penetrate through the entire core.

The core is provided with an outer and an inner steel ring and cover plates which protect the windings.

The load-bearing surfaces are ground flat and parallel.

The load cell is provided with a permanently fixed cable, of which the free end is connected to an enclosed matching device.

The QGPR 102/104 load cells utilise a unique method to compensate for the undesired tensile forces which are generated when a cylindrical tube is subjected to load.

When loaded, the body is deformed as shown in the figure below. Note that the amount of deformation is considerably exaggerated.

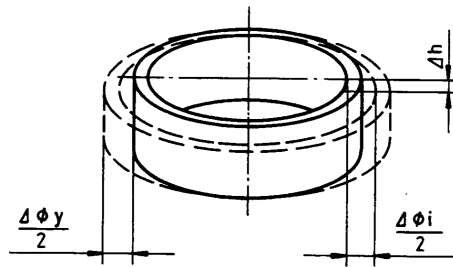


Figure 3. Load cell subjected to a load

At the same time as the tube is compressed vertically (approx. 50 μm at rated load), the inner and outer circumferences of the tube increase. When subject to a load, the transducer in the load cell will be exposed to a compressive force in the vertical direction and a tensile force in the horizontal direction. To eliminate this undesired tensile force, which is caused partly by the load and partly by the disturbing forces in the core, each measuring zone has vertical slots on both sides. The measuring zones are not influenced by tensile forces caused by deformation, disturbing forces, non-uniform application of forces, bending, torsion, etc., but sense only the vertical component of the force.

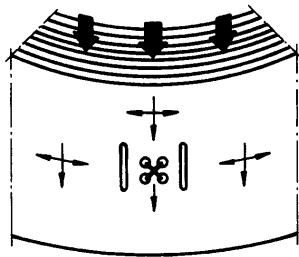


Figure 4. Components of force when a vertical force is applied to an annular shaped core

Despite the vertical slots, at the radially located transducer elements in a measuring zone cooperate, as do the different measuring zones around the periphery of the load cell, to form a force integrating load cell due to the rigid mechanical joints between both the transducer elements and the measuring zones.

2.3.1 Technical Data for Load Cell QGPR 102/104

The measuring range of QGPR 102/104 load cells is specified on the designation plate mounted on the load cell, in the calibration certificate and in the order forms. In certain cases, the order forms may specify the total measuring range of the two load cells used together. This applies especially to rolling mill applications where a pair of load cells is included in a common measuring system.

Mechanical data, such as weight, width etc. and nominal load for the individual load cells are given in the order documents.

QGPR 102/104 Load Cell		Unit
Nominal Load*	0.1 to 1.6	MN
Nominal Surface Load (σ)	See information below	N/mm ² (MPa)
Overload Capacity		
Max. load without change in calibration data	200	N/mm ² (MPa)
Max. load without influencing load cell sensitivity, only the zero signal is changed in calibration data	300	
Max. load without permanent mechanical damage	400	
Accuracy		
Repeatability	< \pm 0.05 (of nominal load)	%
Accuracy Class	\pm 1.0 (of nominal load)	
Linearity Deviation	\leq \pm 1.0 (of nominal load)	
Hysteresis	\leq \pm 0.2 (of nominal load)	
Temperature Dependency		
Zero point drift	\leq \pm 0,005	% / K
Sensitivity drift	\leq \pm 0,01	
Working Temperature Range	-10 to +80	°C
Max. Permissible Operating Temperature	+110	

* See order documents for the actual nominal load



Information

The nominal surface load σ of the load cell is 100 N/mm², i.e. $\sigma_0 = F_{nom} / A$
 where F_{nom} = nominal load (N) and A = load carrying area, core area (mm²)

2.3.2 Load Cell Signal Characteristics

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.

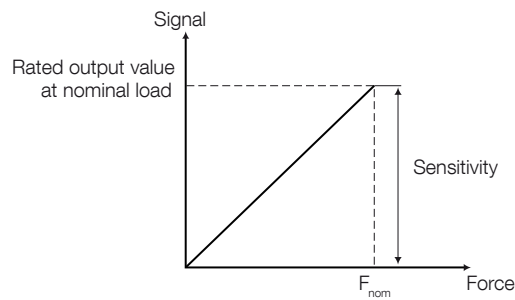


Figure 5. Sensitivity

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.

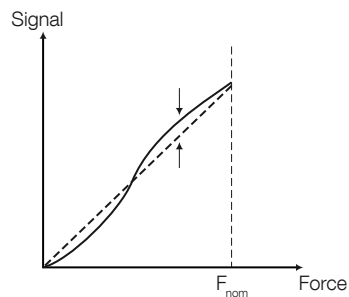


Figure 6. Linearity Deviation

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.

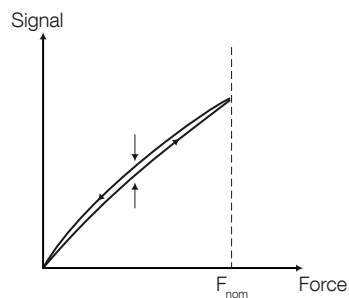


Figure 7. Hysteresis

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.

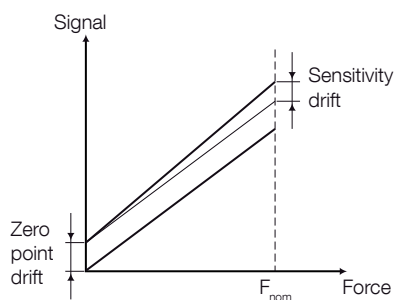


Figure 8. Sensitivity drift with temperature

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 QIPZ 127 Matching Device



Figure 9. Matching device

The matching device incorporates a double-winding transformer which galvanically isolates the transducer from the electrical equipment. The output signal from the transducer is adjusted to its correct level by means of R1-R5. The linearity of the transducer is adjusted with R7-R12. Circuit diagram and dimension drawing are given in [A Drawings](#).



Information

The matching device and the load cell have been jointly trimmed and are an inseparable pair. If the matching device is opened and the connection cable is disconnected, it is therefore important that the device is afterwards connected to the correct load cell.

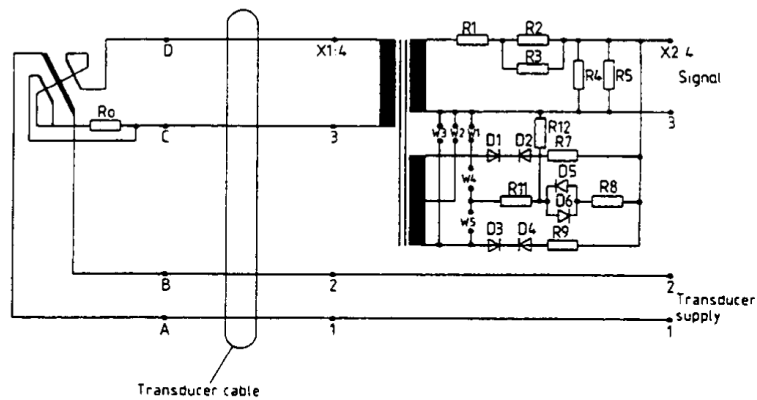


Figure 10. Circuit diagram for QIPZ 127 matching device

2.5 Electrical Circuit

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

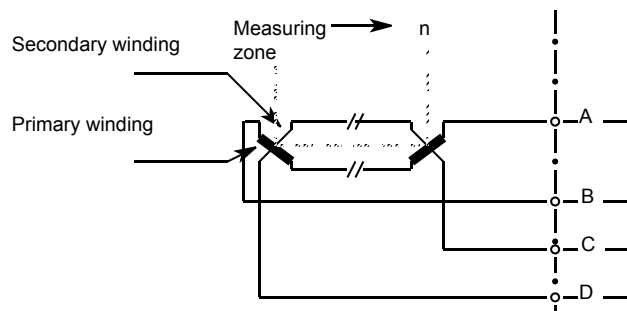


Figure 11. Electric circuit of the QGPR 102/104 load cell

The load cell is supplied with a highly stabilized current of 2 A at 330 Hz.

3

Installation

3.1 Transport and Handling

Although the QGPR 102/104 load cells are a precision measuring system which is intended for severe operating conditions in a harsh industrial environment, they must be handled with care while unpacking, in storage and during installation



CAUTION

Do not place the load cells or load cell packages close to high current conductors and make sure that no magnetic lifting devices are used when relocating the load cells or when mounting them in their installations.

3.2 Package and Delivery

To prevent delays in the installation work, make sure that the equipment is complete at delivery. Check against the order receipt or dispatch note and report any uncertainties to ABB immediately.

3.3 Installation

3.3.1 General

To achieve high accuracy, reliability and long-term stability, the load cells must be installed in accordance to the instructions below. It is important that the pressure surfaces of the load cell package are protected from damage and corrosion.



CAUTION

Never weld, drill or make any other alteration to the load cell. Do not use the load cell as a working surface or table in any way.



CAUTION

When mounting, be careful so that the pressure surfaces don't become grimy.

See also section [Tolerance Requirements and Check Lists for Installations](#) in Application Design Guide 3BSE072259 for reference.

3.3.2 Installation Drawings

The load cell package, consisting of load cell and pressure plates, is usually designed specifically for the roll stand in question, and a special installation drawing is prepared. This drawing, which must be followed during installation work, normally provides all the information needed.

The following design demands must be considered together with the installation drawings:

- The load cell package must be compact and form an integral part of the mill stand.
- The load cell package must be designed and mounted in such a way that force shunting does not occur.
- The roll force must be well distributed over the load cell pressure surface.
- The load cell must be well protected against lateral forces.
- The clearance between the load cell and other parts must be correct.
- Avoid sharp corners and edges close to the cabling.

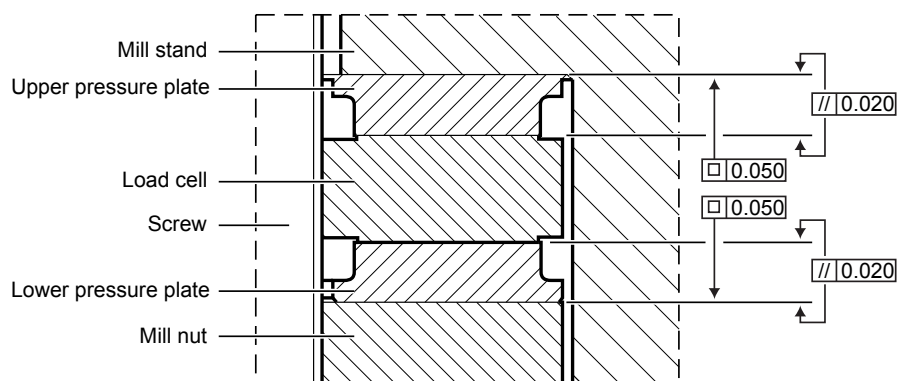


Figure 12. Preferred tolerances for the pressure surfaces in an annular load cell package

3.3.3 Dimensions of Pressure Plates

The pressure plate material should have an elastic limit (i.e Yield Strength) of at least 500 N/mm² or 500 MPa, and be uniformly hardened to a hardness of at least 350 Brinell.

The dimensions for the pressure plates must conform to the installation constraints and the type and size of the load cell chosen.

For annular load cells, it is possible to exclude the lower pressure plate located between the mill nut and the load cell, when the available space is insufficient.

3.3.4 Preparation before Installation

Prepare for the installation thoroughly by checking that the necessary documents and material are available, as follows:

- This manual, installation drawings, and inspection and test records.
- Standard tools, torque wrench and test instrument for measurement of resistance and insulation (measuring range 0.01 Ω - 100 Ω and 1 M Ω max. 250 V).
- Rust protection, if additional protection is to be given to machined surfaces. Choose e.g. TECTYL 511 (Valvoline) or FERRYL (401) or equivalent.
- Locking fluid (medium strength), e.g. Loctite 242 or equivalent, to lock bolts.
- Solvent, e.g. ligroin or isopropanol to clean the load pressure surfaces. Other solvents may be used for other surfaces.
- Load cells, pressure plates, etc.

3.3.5 Cleaning

Clean all pressure surfaces in the load cell package thoroughly with recommended solvent.

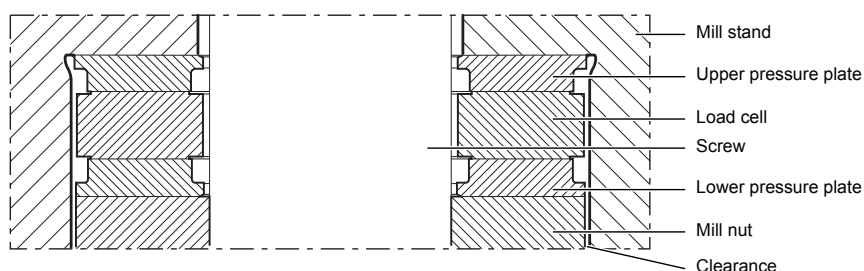
3.3.6 Anti-Corrosion Protection

All surfaces of the load cell package must be given anti-corrosion treatment before assembly. Spray or brush on a thin coating of the recommended anti-corrosion compound.

3.3.7 Installation of Annular Load Cells QGPR 102/104

3.3.7.1 General

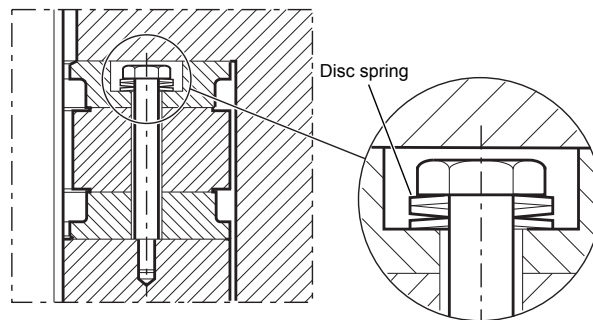
A load cell package for installation of a circular load cell is shown in the figure below:



When installing an annular load cell the following points must be considered:

- The pressure surfaces in the load cell package must be pressed against each other and they should be pre-loaded, to prevent water and dirt entering between the pressure plates and the load cell.

Pre-loading of the load cell package can be accomplished with disc springs. See the installation drawing.



- Bolts holding the load cell package together must be secured to prevent them from working loose. This can be done with different methods, for example with locking fluid, tab washers, locking wire or similar techniques.

Tighten the bolts to the prescribed torque and lock them in the manner specified on the installation drawing.

3.3.7.2 Anti-Rotation Arrangement

The parts in the load cell package must be locked to ensure that they do not rotate relative to each other. The load cell and the pressure plates must be fixed relative to the mill nut, with screws and dowel pins.

Check that all rotation-locking devices are correctly installed in accordance to the installation drawing.

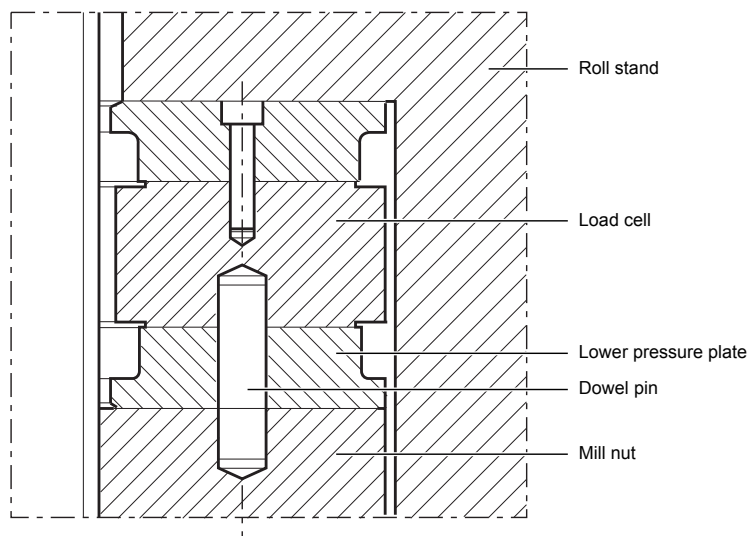


Figure 13. Rotation Locking of a Load Cell Package with an Annular Load Cell

3.3.7.3 Mounting

The load cell is delivered with the connection cable connected to the load cell, see figure below. The cable must be routed through the lower pressure plate and the mill nut, and further on to the matching device.

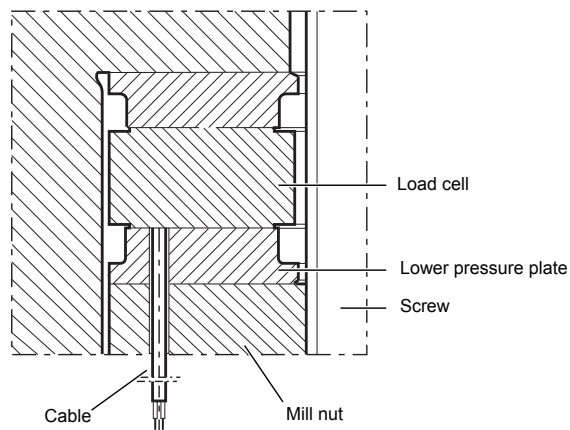


Figure 14. Routing of the connection cable

Assembly of an annular load cell with fixed cable:

1. Assemble the parts in the load cell package according to the installation drawing.
2. Make sure that there is sufficient clearance between the load cell and the mill stand. See the figure above and the installation drawing.
3. Make sure that the parts are fixed and locked against rotation according to the installation drawing.
4. Make sure, whenever applicable, that the pre-loading of the load cell package is correct.
5. Make sure that all bolts are tightened to the prescribed torque specified in the installation drawing and are locked using an appropriate locking method.
6. Place the load cell package in position and pull out the connection cable through the hole in the mill nut.
7. Place the load cell package in position.



CAUTION

Make sure that the cable is not damaged during assembly.

3.3.8

Installation of Matching Device QIPZ 127

The matching devices shall be placed as close to the load cells as possible, and well protected against mechanical damage and heat radiation.

The matching device is to be installed in a dry place having a maximum ambient temperature of +60 °C.



Information

The matching device and the load cell have been jointly trimmed and are an inseparable pair. If the matching device is opened and the connection cable is disconnected, it is therefore important that the device is afterwards connected to the correct load cell.

Different types of cable may be used between the load cell and the matching device. The cable is to be connected in accordance with the instructions given on the label inside the cover of the unit. The colours of the cores which are to be connected to the X1-terminals, in QIPZ 127, are also given on this label.

Space requirements and cut-out dimensions for the matching devices are given in [A Drawings](#).

3.4 Connections

Make sure that all connections are performed correctly.

After connecting the load cell cable, check the connections at the terminals in the matching device and control unit and make sure that there is no poor connection at any terminal in the matching device or anywhere else in the primary circuit. If there would be any problem with the electrical connections at the terminals in the named units, the control/operator unit would indicate the error message “too high input impedance” when the power supply is switched on. Find out about the location of the problem and correct it before proceeding. Make sure that the power supply is switched on properly and run a self test afterwards.

4

Commissioning

The procedure for commissioning the load cells is simple, provided that the load cells and the cables have been properly installed. This procedure is carried out in parallel with the commissioning of the control unit. However, this procedure is described in a separate 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
- That resistance and zero signal of the load cells are correct according to the inspection and test record
- That the insulation of the load cells is higher than 1 M Ω at 250 V
- That all terminals in matching device have been retightened, especially 11 and 12.

5

Inspection and Maintenance

The Pressductor® QGPR 102/104 Load Cells are designed for continuous operation in harsh environmental conditions, which reduces the need for maintenance and service to a minimum. A system which has been designed, dimensioned and installed correctly can work for very long periods of time with only periodic maintenance.

Periodic inspection should be performed on the components that are subjected to vibration. These are mainly the matching devices and the cables. Inspection of the integrity of the force path parts, such as rocker, pressure plates as well as the underlying support structure should preferably be carried out every 6th month, or at least once every year.

To avoid any unnecessary, unplanned shutdowns, it is recommended that a complete load cell package is kept as spare.

The system components are factory calibrated and can be replaced directly with another component of the same type, geometry and load rating etc.

5.1 Inspection and Maintenance of Load Cell Package

5.1.1 General

Maintenance of the load cell package involves measures to prevent corrosion on the mating surfaces of both the load cells and the pressure plates, and to keep the installation free from dirt and particles. Poor maintenance can cause poor load distribution, resulting in poor measurement performance and eventually partial overloads.

- Any damage indicating design, dimensioning or installation faults must be corrected and documented with reference, for future maintenance.
- When dismantling for maintenance, the mating surfaces of the load cell and the pressure plates must be inspected. The surface flatness and uniform thickness should be measured and compared to the installation requirements.
- In order to check if an overload has mechanically damaged the load cells, a test program should be executed. See the control unit manual, chapter "Fault tracing".
- After any installation, or re-installation, the first check should be done after six to twelve months. The following maintenance interval are decided on the basis of the experience then gained:
 - If the surfaces of the load cell package is near fault-free, this indicates that the design is correctly dimensioned. In this case a longer maintenance interval can be set.
 - If the surfaces are damaged, the cause must be determined and the damage corrected. A new check should be done within 6 months.



Information

Even minor surface flaws or thickness deviations on load carrying plates in the installation, must be corrected during maintenance since it is impossible to refit all parts in exactly the same position they had before the load cell package was dismantled.

5.1.2 Preparation before Maintenance

Prepare for the maintenance by checking that the necessary documents and material are available:

- Installation drawings, inspection and test records
- Standard tools, torque wrench and test instruments for measurement of resistance and insulation (measuring range 0.01 Ω - 100 Ω and 1 M Ω max. 250 V)
- A straight-edge and feeler gauge for inspection of flatness
- Micrometer for inspection of uniform thickness
- Solvents. e. g. white spirit or isopropanol, to clean the load pressure surfaces.
- Rust protection, if additional protection is to be given to machined surfaces. For example TECTYL 511 (Valvoline) or FERRYL (104)
- Locking fluid (medium strength), for example Loctite 242, to lock fixing screws
- Load cells, pressure plates, etc.

5.2 Inspection of the Mechanical Installation

5.2.1 Annular Load Cells

Recommended workflow:

1. Disconnect the connection cable from the matching device. Then carefully dismantle the load cell package and the mill nut from the mill stand. Bring the package to a workshop or some other suitable place for dismantling.
2. Thoroughly clean all parts and take particular care of the pressure surfaces.
3. Check that the connection cable is undamaged.
4. Inspect all rotation locks in the load cell package. Look for every sign of incorrect clearance. Report all such signs.
 - Too little clearance can result in uneven force distribution, which can cause damage to the load cells.
 - Too much clearance can result in the pressure plates and the load cell having moved relative to each other, which also can cause damage to the load cells.
5. Check that all the pressure surfaces are within recommended surface tolerances. If not, the surfaces must be re-ground.



Information

The connection cable may be stuck due to dirt and grease in the mill nut hole.

Check the following for annular load cells:

- Flatness of the mill stand.
- Parallelism / flatness of the upper pressure plate.
- Parallelism of the load cell.
- Parallelism / flatness of the lower pressure plate.
- Flatness of the mill nut.

Flatness is measured with straight-edge and feeler gauges. Use a felt-tip pen to draw a grid of measurement points on the surfaces to be checked. Make the measurements with the straight-edge positioned both straight and diagonally over the measurement points. Note the values in a report.

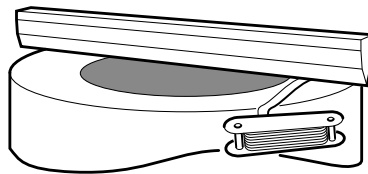


Figure 15. Annular flatness measurement

- For smaller local deviations in the flatness of the surface, the largest permissible diameter of cavities and holes is less than 10 mm.
- The total area covered by indents must not exceed 5 % of the total pressure surface.
- Raised areas on the surface are unacceptable.

Uniform thickness is measured with a micrometer or suitably supported in a coordinate machine, with about 10mm separation between measurement points. Measure and note the values in a report.

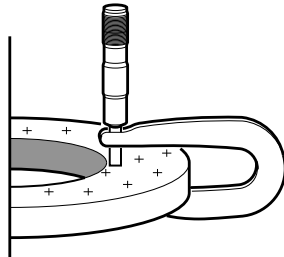


Figure 16. Uniform thickness measurement

5.3 Mechanical Maintenance and Recommendations

Mechanical maintenance should be carried out thoroughly and any shortcomings found should be corrected before remounting the parts in the installation. The general recommendation is to follow the four basic rules discussed in the Application Design Guide, making sure that these rules are fulfilled before remounting the parts.

General recommendations:

- Make sure that the 4 basic rules are fulfilled
- Use as few plates as possible
- Make sure that the mechanical properties of all involved parts meet ABB requirements

The mechanical properties of all involved parts should be according to ABB requirements. This includes e.g. material thickness, surface flatness and roughness, surface parallelism, material hardness and material strength. Refer to the tables in Appendix [Tolerance Requirements and Check Lists for Installations](#) in Application Design Guide 3BSE072259 for different installation types and the required properties of the mechanical parts involved in the installation. For each installation type in specified there is also a separate check list which can be used to ensure that the maintenance work is carried out properly.

5.4 Inspection of the Electrical Installation

Inspection of the electrical installation is carried out by visual inspection of the cabling as well as checking the terminals inside the junction box, the matching device and the cabinet / enclosure.

Matching devices and junction boxes are often exposed to vibrations, heat and cooling liquids.

- Check that screw terminals are properly tightened.

5.5 Electrical Maintenance and Recommendations

Periodic maintenance should be carried out for the different electrical equipment of the Millmate Roll Force system. A summary of recommended maintenance interval for these equipments is given in table below.

Equipment	Action	Maintenance Interval		
		3 Months	6 Months	1 Year
Enclosures and Cabinets	Cleaning		X	
	Checking cables		X	
Operator Unit	Cleaning			X
Cabling	Visual inspection		X	
Junction Box	Check terminals		X	
Matching Device	Check terminals		X	

5.6 Other Units

5.6.1 Control Unit

Apart from checking the terminals and cable connections, the control unit does not require any additional periodic maintenance.

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.

5.6.2 Junction Box

The only periodic maintenance required for the junction box PFXC 141 is checking the screw terminals to make sure that they are properly tightened.

5.6.3 Operator Unit

The operator unit contains no parts requiring maintenance by the user. Apart from cleaning the enclosure and the keyboard, no routine maintenance is required for the operator unit.



CAUTION

Use only a damp cloth, no solvents, when cleaning the operator unit.

5.6.4 Cabinets

Check that:

- All screw terminals are well tightened
- All units are securely fastened
- No cables or conductors are damaged

5.6.5 System Test

Maintenance of the Roll Force System and associated electronics should also include a system test.

The Millmate® Controller 400 contains a system test which checks the measuring object and its connected units. The system test cannot be started when measurement is in progress. It must also be started manually. This is because any ongoing measurement is interrupted when the cabling and load cells are checked.

The system test consists of 64 part tests. These can be run one at a time or in sequence.

See MC400 User Manual for a complete description of the system test and the system error list. See also the control unit user manual for further details on system tests.

5.7 Interchangeability

5.7.1 Load Cells

The load cells are interchangeable with load cells of the same type and measuring range. A system test must be performed and new reference values must be stored.

The load cells are factory calibrated and can be replaced directly with another load cell of the same type, geometry and load rating. After load cell replacement, adjust the zero setting and storage of reference data in control unit. See separate manual for MC400 control unit.

Matching device QIPZ 127 is not exchangeable.

5.7.2 Junction Box

Junction boxes are interchangeable with units of the same type. The old type PFBC 161 can be replaced by PFXC 141, but the connection is different, see MC 400 manual.

5.7.3 Millmate Controller 400

The control unit MC 400 is interchangeable with control units of the same type. Replacement can also be done according to the table below. All settings must be reentered, a system test must be performed and new reference values must be stored.

The table below shows the different types of control units and how they are replaceable with each other.

Installed control unit, MC 400 type	Replacement control unit, MC 400 type			
	PFXA 401	PFXA 401F	PFXA 401S	PFXA 401SF
PFXA 401	X	X	X	X
PFXA 401F		X		X
PFXA 401S			X	X
PFXA 401SF				X

5.8 Spare Parts

It is recommended that the following spare parts are kept in stock:

- load cell of correct size and type with it's matching device
- junction box
- pressure plates

6

Fault Tracing and Troubleshooting

6.1 Introduction

The measuring system can be divided into four parts:

- Mechanical installation
- Load cell
- Matching devices and cabling
- Control unit (see MC 400 manual)

There are a number of typical fault symptoms, for example:

- No signal
- Intermittent signal
- Changed zero signal
- Unstable zero point
- Incorrect sensitivity
- Start up problem
- Intermittent loss of function

It is important to be thoroughly familiar with the measuring system as described in the manuals, before starting any fault tracing.

6.2 Necessary Equipment

The following equipment is required to perform fault tracing and repairs:

- Cable diagram for the actual installation
- Inspection and test records
- Servicing tools (screwdriver, pliers, etc.)
- Instruments for resistance and insulation measurements

6.2.1 Measuring Insulation Resistances

Normally a voltage value of 250V is used and the resistance to the current flow is expressed in units of $k\Omega$ or $M\Omega$. The device used for introducing the voltage and measuring the insulation resistance is called the "Insulation Tester" or the "Mega-Ohm tester" or "Megger". The procedure of measuring and testing the insulation resistance is therefore sometimes also referred to as "megging".

Five different resistance values can be measured at the wire terminals of a Roll Force load cell:

- Resistance: Primary circuit
- Resistance: Secondary circuit
- Insulation resistance: Primary to Ground
- Insulation resistance: Secondary to Ground
- Insulation resistance: Primary to Secondary

Insulation resistances in Roll Force load cells are high at room temperature at calibration. Values larger than 500MΩ are common.

When measuring the insulation resistance between secondary and ground, the results can vary depending on the actual temperature or surface moisture condition of the parts involved. This is due to change of dielectric constant of the wire insulators (wire protections) and epoxy adhesive to the calibration circuit. To avoid these changes in results, always measure the resistances under as similar conditions as possible. The terminals shall always be dry and held at sufficient long distance from each other when measuring the insulation resistance between wire terminals and/or ground.

- The terminals shall always be dry and held at sufficient long distance from each other when measuring the insulation resistance between wire terminals and/or ground.
- These changes in insulation resistances will not affect the load cell signal as long as the insulation resistance is larger than 10kΩ. Insulation resistance below 10kΩ can affect the load cell signal and load cell performance under certain environmental conditions.

Table 2 Causes of low insulation resistance ($\leq 10k\Omega$)

Test point A	Test point B	Cause
Primary	Ground	Defective or damaged insulation cover of the primary wire
Primary	Secondary	Defective or damaged insulation cover of both the primary and secondary wires
Secondary	Ground	Damaged connector or damaged insulation cover of secondary wires

Damaged insulation covers of wires or damaged calibration circuit can be caused by either mechanical deformation, damage of load cell cores, or similar, or by a chemical impact.

6.3 Fault Symptoms and Actions

Millmate Controller 400 has a continuous monitoring function for the control unit function and the load cell excitation circuit. Fault messages can be read and acknowledged from the control unit service menu.

The control unit contains a system test which checks the system and its connected units. The system test must not be started when measurement is in progress. It has to be started manually. This is because the measurement is interrupted when cabling and load cells are checked.

See MC 400 User Manual for a complete description of the system test, the system error list and suggested measures for eliminating the possible errors. See the user manual for the MC 400 control unit for more information.

6.3.1 No Signal

Perform the "Major System Test" if the signal is missing.

6.3.2 Intermittent Signal

Any poor electrical connection in the matching devices may cause intermittent faults. Both sensitivity and zero point might vary. Check all screw terminals. Do not use pins crimped to the connecting wires, as these often can work themselves loose after a while.

Jammed cables subjected to small movements can cause intermittent faults. The cable between the matching device and the load cell is the most exposed part. Incorrect installation, such as screens grounded at more than one end, might cause an unstable zero point. Check that the connections (if any) at the load cell is mounted correctly and tightened.

Fault symptoms that appear for a single load cell is often caused by poor connection to affected load cell. If a fault is indicated for both load cells, the probable cause can be addressed to the control unit, its connections, or excitation current.

Some malfunctions may be due to placing the load cell cabling too close to existing cables in the mill, which will cause interference. Cables are subject to mechanical wear, and should be checked regularly. The matching device should also be checked, especially if it is subject to vibration.

6.3.3 Changed Zero Signal

The data of a Pressductor load cell changes in steps, usually caused by an event in the mill. Excessive overloading results in a permanent shifting of the zero point.

6.3.3.1 Connecting QGPR 102/104 load cells

6.3.3.1.1 Connecting two QGPR 102/104 load cells with PFXC 141

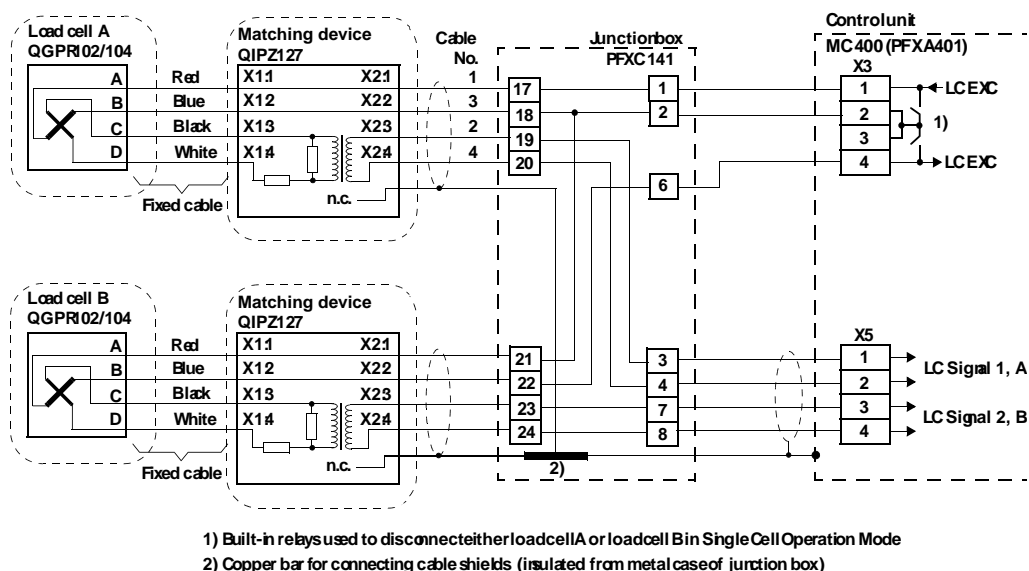


Figure 17. Connecting two QGPR 102/104 load cells with PFXC 141

6.3.3.1.2 Connecting four QGPR 102/104 load cells with two PFXC 141

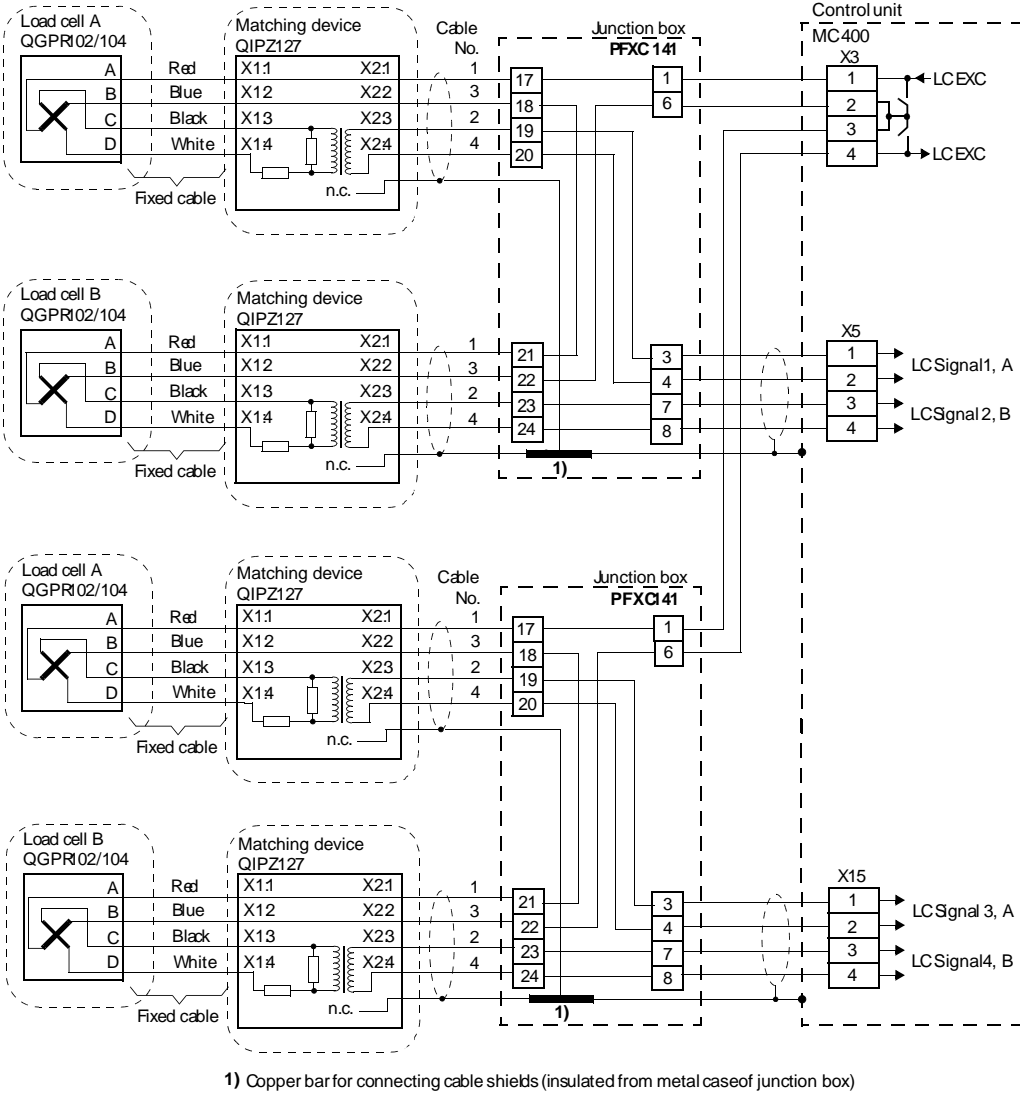
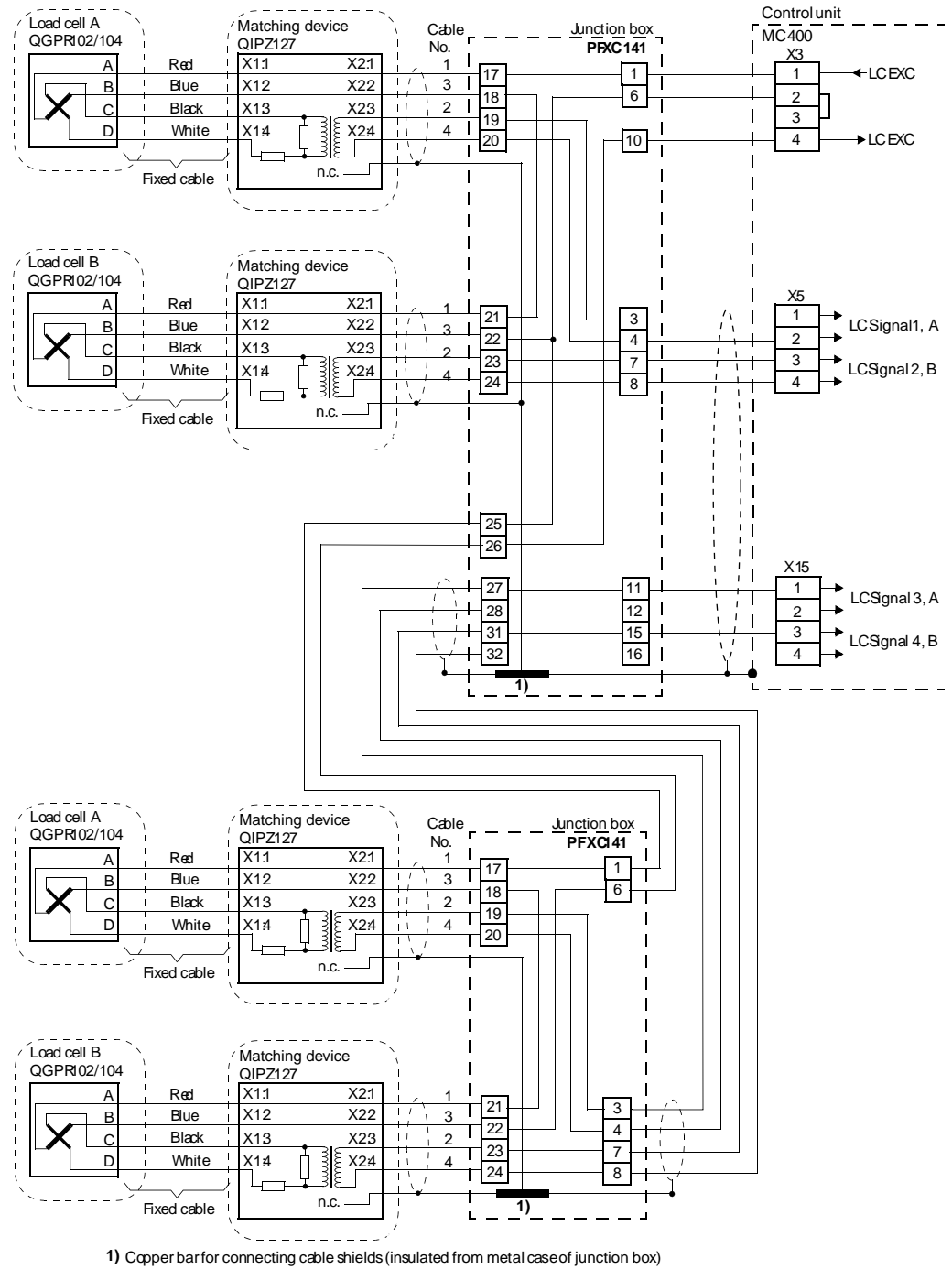


Figure 18. Connecting four QGPR 102/104 load cells with two PFXC 141

6.3.3.1.3 Connecting four QGPR 102/104 load cells with two PFXC 141, connected in series



1) Copper bar for connecting cable shields (insulated from metal case of junction box)
 Figure 19. Connecting four QGPR 102/104 load cells with two PFXC 141, connected in series

6.3.3.1.4 Connecting four QGPR 102/104 load cells with one PFXC 141

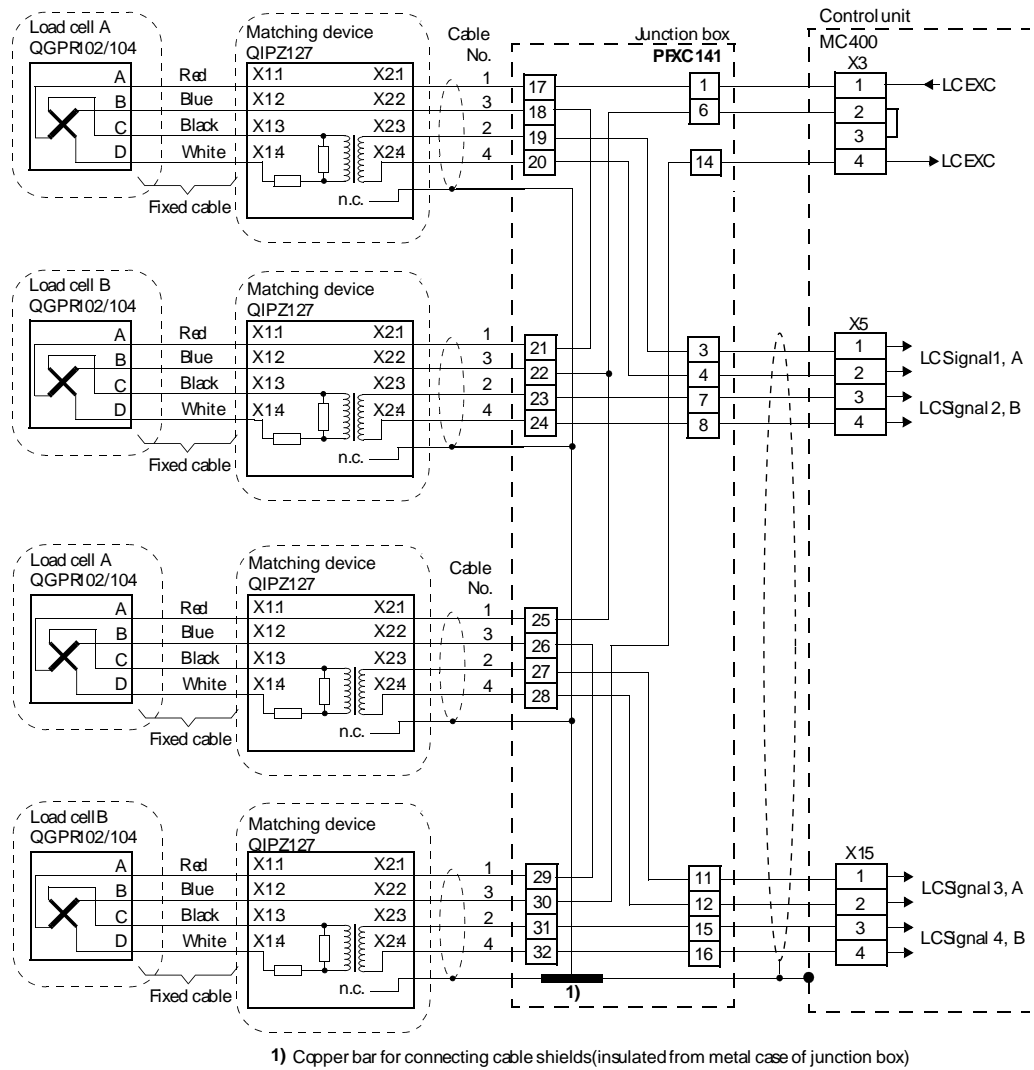


Figure 20. Connecting four QGPR 102/104 load cells with one PFXC 141

6.3.3.1.5 Connecting two large QGPR 102/104 load cells and matching board PFBK 401 with one PFXC 141

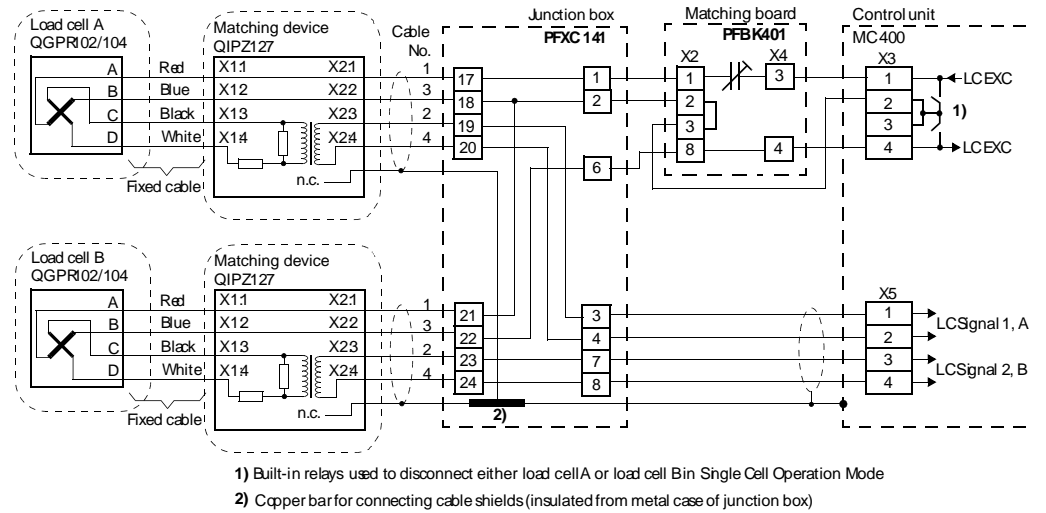
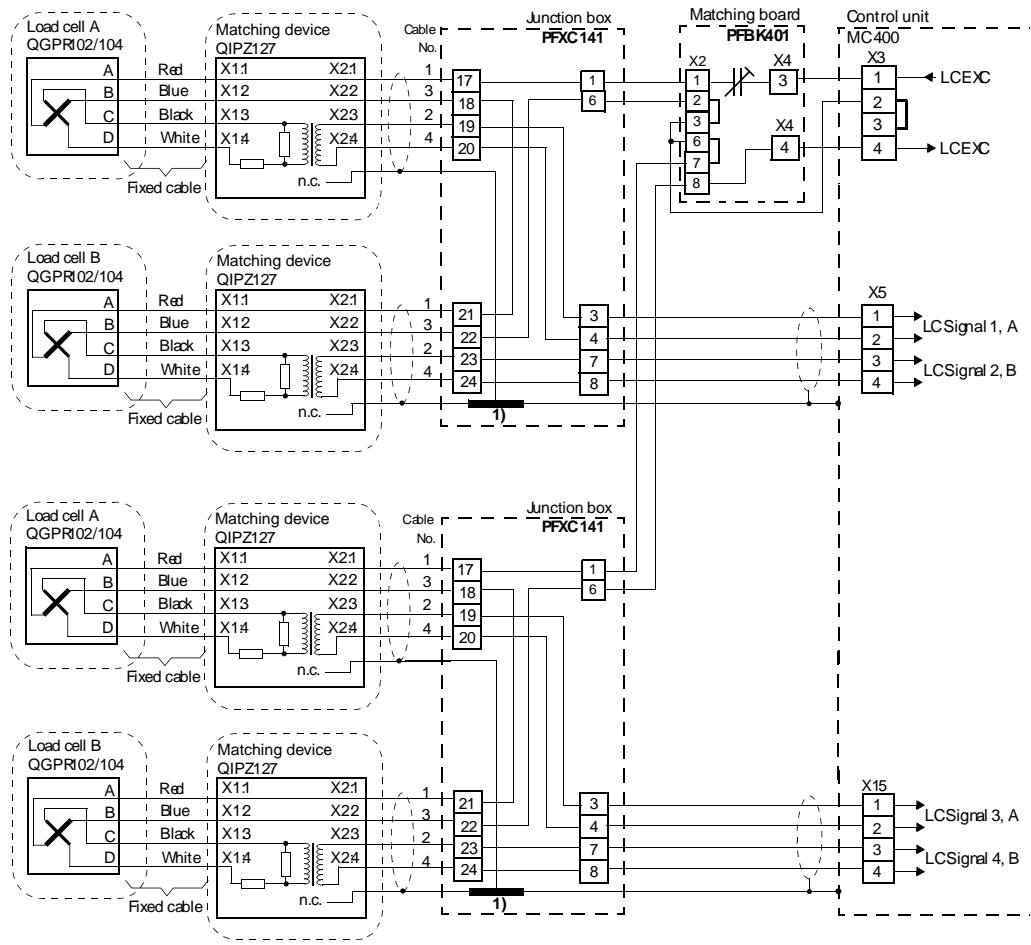


Figure 21. Connecting two large QGPR 102/104 load cells and matching board PFBK 401 with one PFXC 141

6.3.3.1.6 Connecting four large QGPR 102/104 load cells and matching board PFBK 401 with two PFXC 141



1) Copper bar for connecting cable shields(insulated from metal case of junction box)

Figure 22. Connecting four large QGPR 102/104 load cells and matching board PFBK 401 with two PFXC 141

6.3.3.1.7 Connecting four large QGPR 102/104 load cells and matching board PFBK 401 with one PFXC 141

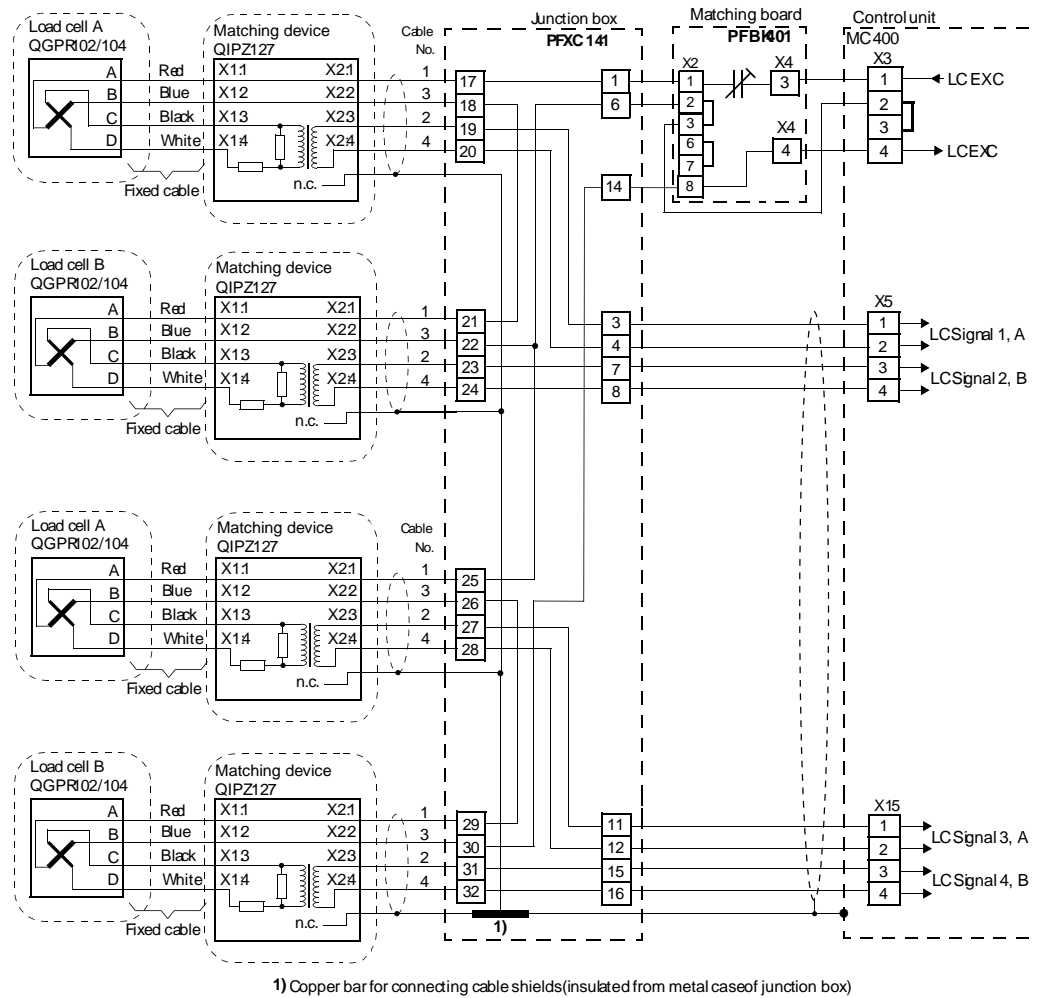


Figure 23. Connecting four large QGPR 102/104 load cells and matching board PFBK 401 with one PFXC 141

6.3.3.1.8 Measurements

Start by performing the "Major system test".

Measure the resistance and insulation in both the primary and secondary circuits. If no deviations are detected, check if the mill stand has been subjected to overload and if the load cell has been overloaded. If the load cell has been overloaded, send it back to the supplier for checking, recalibration and any necessary repairs.

Overload can be caused by poorly machined mounting surfaces or dirt deposits between load cell and pressure plates.

6.3.3.2 Fault Tracing of the Load Cell Primary circuit

The resistance of the load cell primary windings is very low. The load cell and cabling can be checked from the control unit, junction box or matching device.

1. Switch off the control unit and pull out connector X3 on the control unit PFXA 401
2. Measure the resistance between terminals X3:1 and X3:4 on the plug connector, normal value is 1 - 6 Ω . If matching board PFBK 401 is mounted measure instead on it's terminals X2 :1 and X2 :8 on PFSK 401
3. If the resistance is too high pinpoint the fault by
 - a. Measuring in the junction box PFXC 141 terminals:
 - 17 to 18 for load cell A
 - 21 to 22 for load cell B
 - 25 to 26 for load cell C
 - 29 to 30 for load cell D
 - b. Measuring in the matching device QIPZ 127, terminals X2:1 and X2:2. Normal value is < 1 Ω .
4. Measure the insulation of the primary circuit between terminal X3:1 in the plugs and ground. The insulation must be greater than 10 k Ω .

6.3.3.3 Fault Tracing of the Load Cell Secondary Circuit

The secondary circuit in QGPR 102/104 is insulated by the transformer in matching device QIPZ 127. Resistance and insulation check at the loadcell have to be made from the matching device. Resistance and insulation check of the cabling can be made from control unit.



CAUTION

Short-circuit the secondary winding at the terminal blocks to prevent the load cell trim resistors from being destroyed.

6.3.3.3.1 Measurement from Control unit

1. Switch off the control unit and pull out the connectors X5 and X15 on PFXA 401. The secondary circuit is then completely free.
2. Measure load cell resistance on X5 and X15 plug connectors.

terminal 1 and 2 for load cell A respectively C
terminal 3 and 4 for load cell B respectively D
Normal values are 7-35 Ω .
3. Measure the insulation resistance between terminal 1 and ground, respectively terminal 3 and ground. The insulation should be greater than 10 k Ω
4. If insulation is unsatisfactory, check cables and matching device.

6.3.3.3.2 Measurement from Matching device QIPZ 127

1. Switch off control unit.
2. Disconnect terminal X1:3 and X1:4 in matching device.
3. Measure the resistance between the black (terminal 3) and the white (terminal 4) wire.

Normal value <1 Ω
4. Measure the insulation between the black wire (terminal 3) and ground. The insulation must be greater than 10 k Ω .
5. If insulation value is unsatisfactory, the load cell should be replaced.

6.3.4 Unstable Zero Point Signal

Mechanical wear or dirt deposits causes uneven mounting surfaces. An uneven mounting surface causes bending or twisting of the load cell and results in an unstable zero point. See figures for pressure surfaces requirements.

If a fault correlates to something else in the process, such as temperature, or can be linked to a particular operation, it is usually caused by some shortcoming in the mechanical installation.

6.3.5 Incorrect Sensitivity

With incorrect sensitivity, either the sensitivity of both load cells or of one single load cell has been changed.

Incorrect sensitivity on both load cells can be caused by a fault in the control unit. Perform the "Major System Test".

Incorrect sensitivity on a single load cell can be caused by force shunting, a mechanical fault, or a fault in the load cell secondary unit. Check resistance and insulation of the load cell secondary circuit.

In case of mechanical fault:

1. Check if friction has occurred in and around the load cell assembly. Friction is caused by dirt, mechanical wear or too little clearance. Presence of friction is shown as increased hysteresis at the mill modules set up. For example: A reduced, or too low height of the pressure plates will cause a concentration of the load to the central part of the load cell core, causing measurement errors and partial overload.
2. Check if the pressure plates have the correct measurement. A reduced height is usually caused by mechanical wear or machining. A reduced height of the pressure plates can cause the indicated force to be lower than the actual force, and the load cycle hysteresis increases.

6.3.6 Start Up Problem

If the measuring system acts unexpectedly during the load cell excitation start up, check that the mains supply is stable enough.

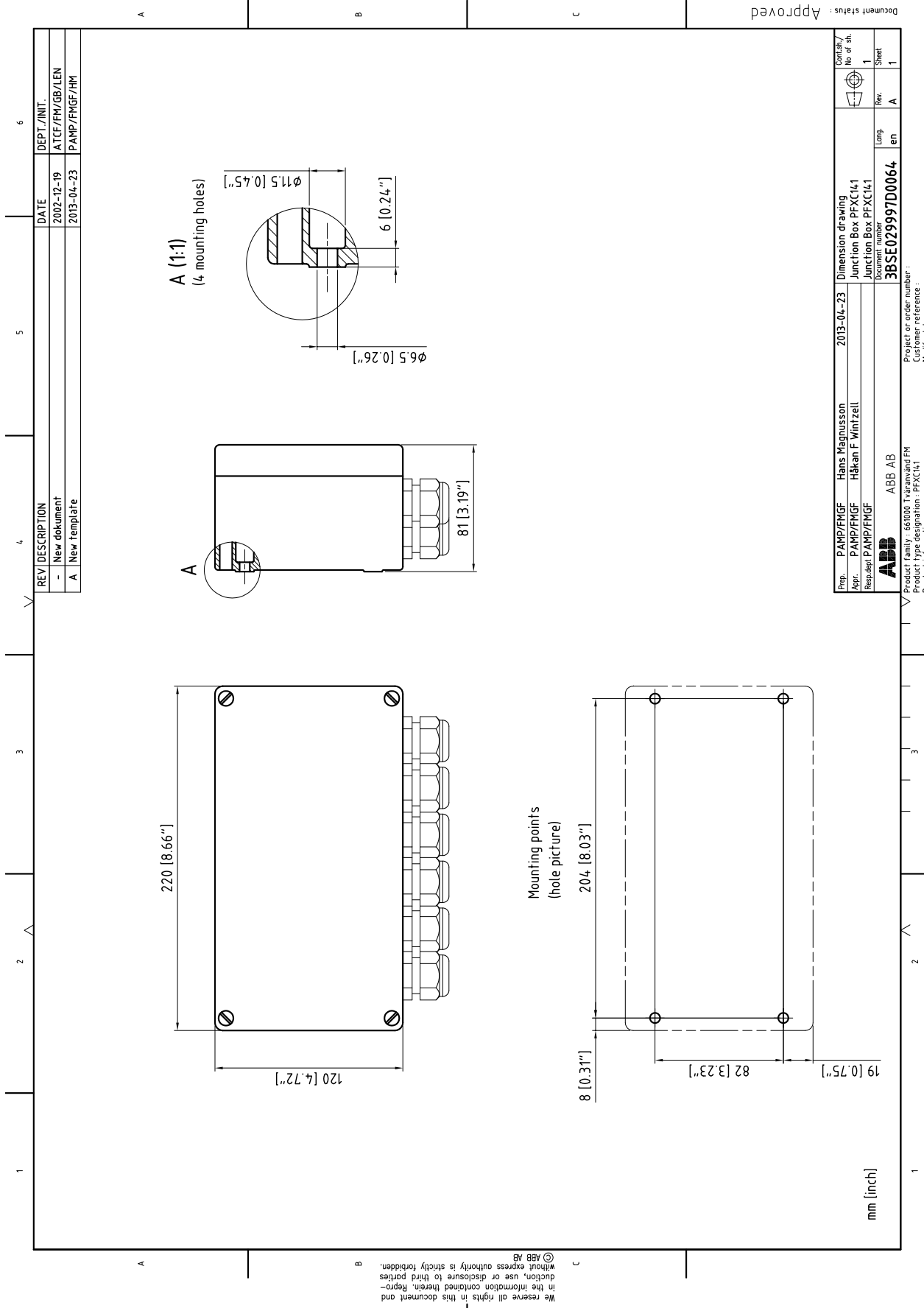
6.3.7 Intermittent Loss of Function

Faults in the control unit can cause the intermittent loss of a function. Poor contact at the terminals can cause intermittent faults. It is unusual for the control unit to cause stability problems. Faults in connected units may affect the operation of the control unit. See separate manual for the control unit for more information.

A

Drawings

A.1 Dimension Drawing: Junction Box PFXC 141



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-	New document	2002-12-19	ATCF/FM/GB/LEN
A	New Template	2013-04-23	PAMP/FM/GF/HM

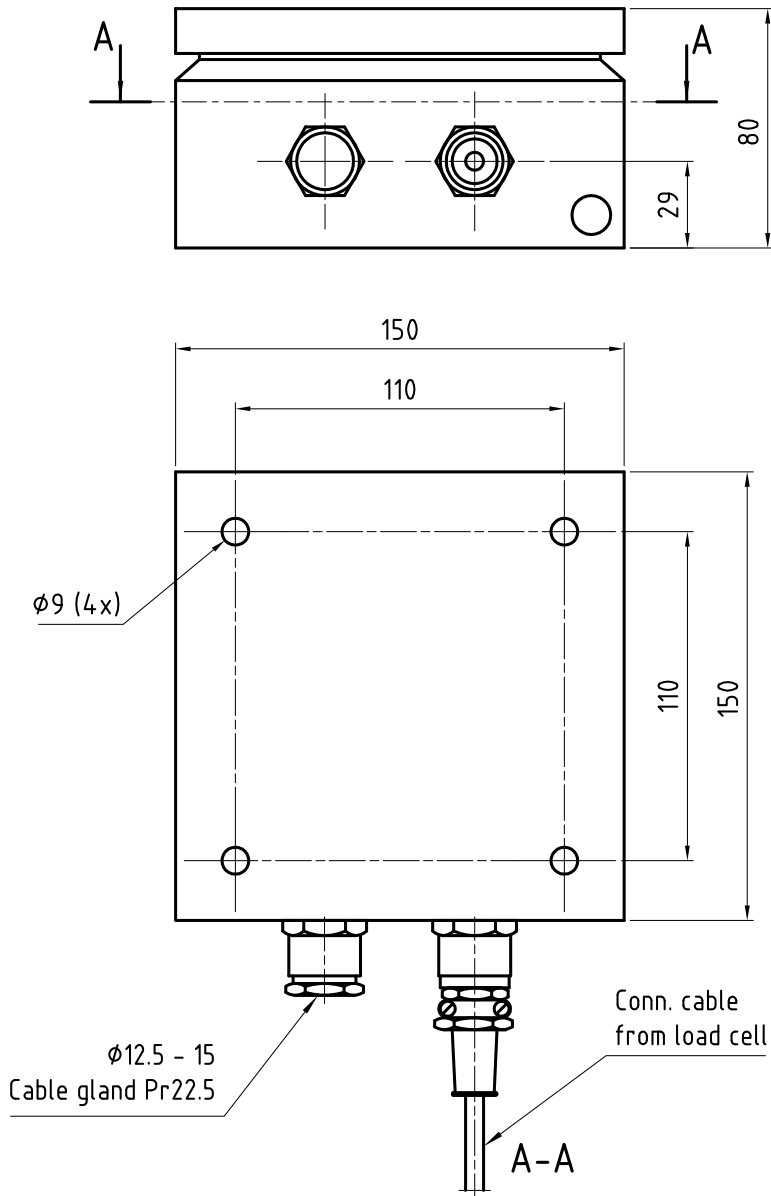
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Appr.	PAMP/FM/GF	Håkan F. Wintzell		Junction Box PFXC141	No of sh.	1
Resp. dept.	PAMP/FM/GF			Junction Box PFXC141	Rev.	A
				Document number	Long.	len
					Sheet	1
					Rev.	A
					Len	1

Product family: 651001 v4-arv and FM
 Product type designation: PFXC141
 Project or order number: 3BSE029997D0064
 Customer reference:
 Modify date:

Document status: Approved

A.3 Dimension Drawing: Matching device QIPZ 127

REV	DESCRIPTION	DATE	DEPT./INIT.
-	Nytt dokument	79.25	TL/U.Olsson
2	Omrit. Låda utbytt.	88.18	RL
3	Spansk text inf.	88.51	
A	Ny ritningsmall	2013-04-22	PAMP/FMGF/HM



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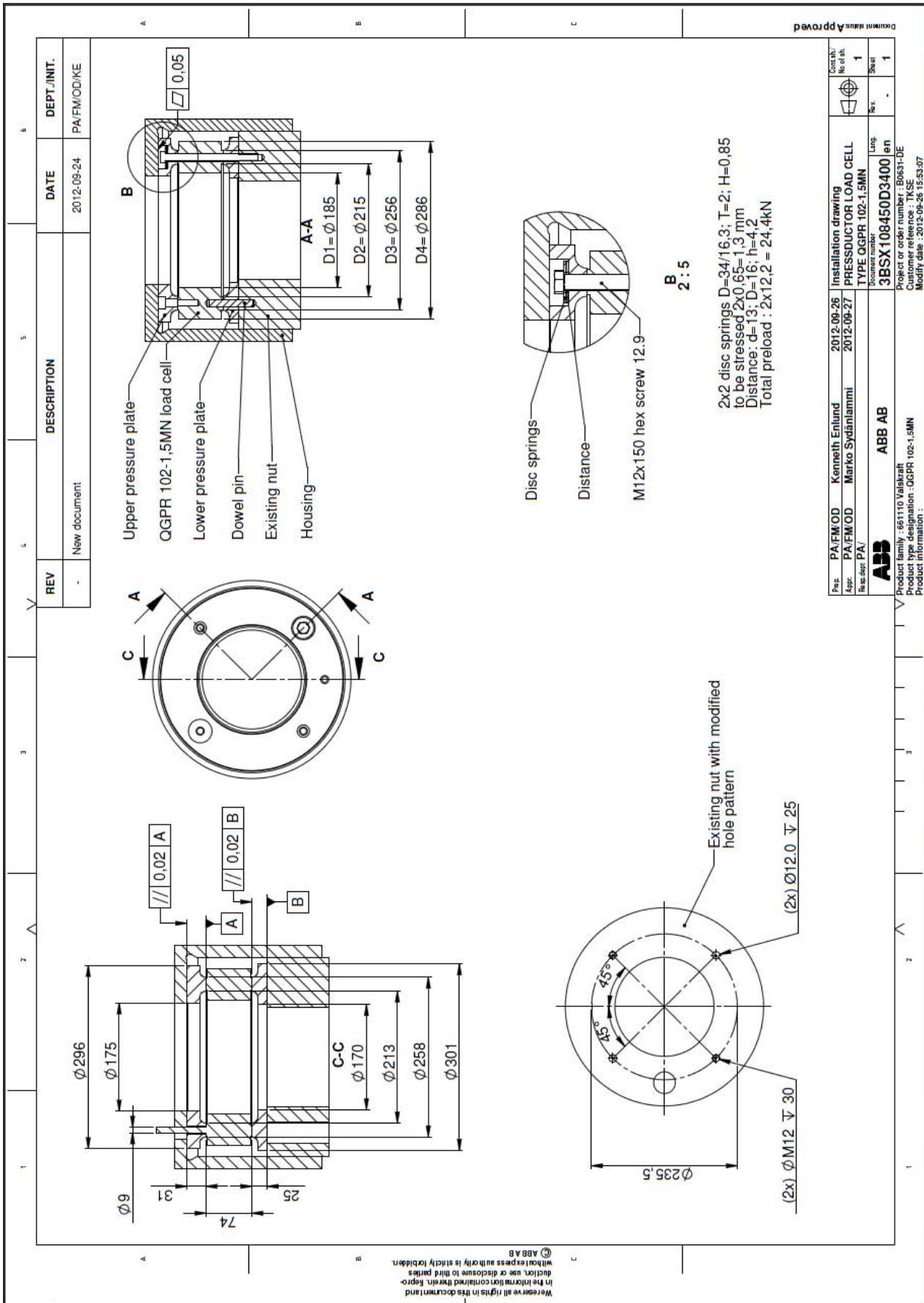
Prep.	PAMP/FMGF	Hans Magnusson	2013-04-22	Dimension drawing		Cont.sh./No of sh.
Appr.	PAMP/FMGF	Håkan F Wintzell	2013-04-22	Matching Device QIPZ 125/127		-
Resp.dept	PAMP/AT Dummy			Anpassningsdon QIPZ 125/127		Sheet
ABB AB				Document number	Lang.	Rev.
				5693380-MFC	82	A
						1

Product family : 661000 Tvärvärend FM
 Product type designation :
 Product information :

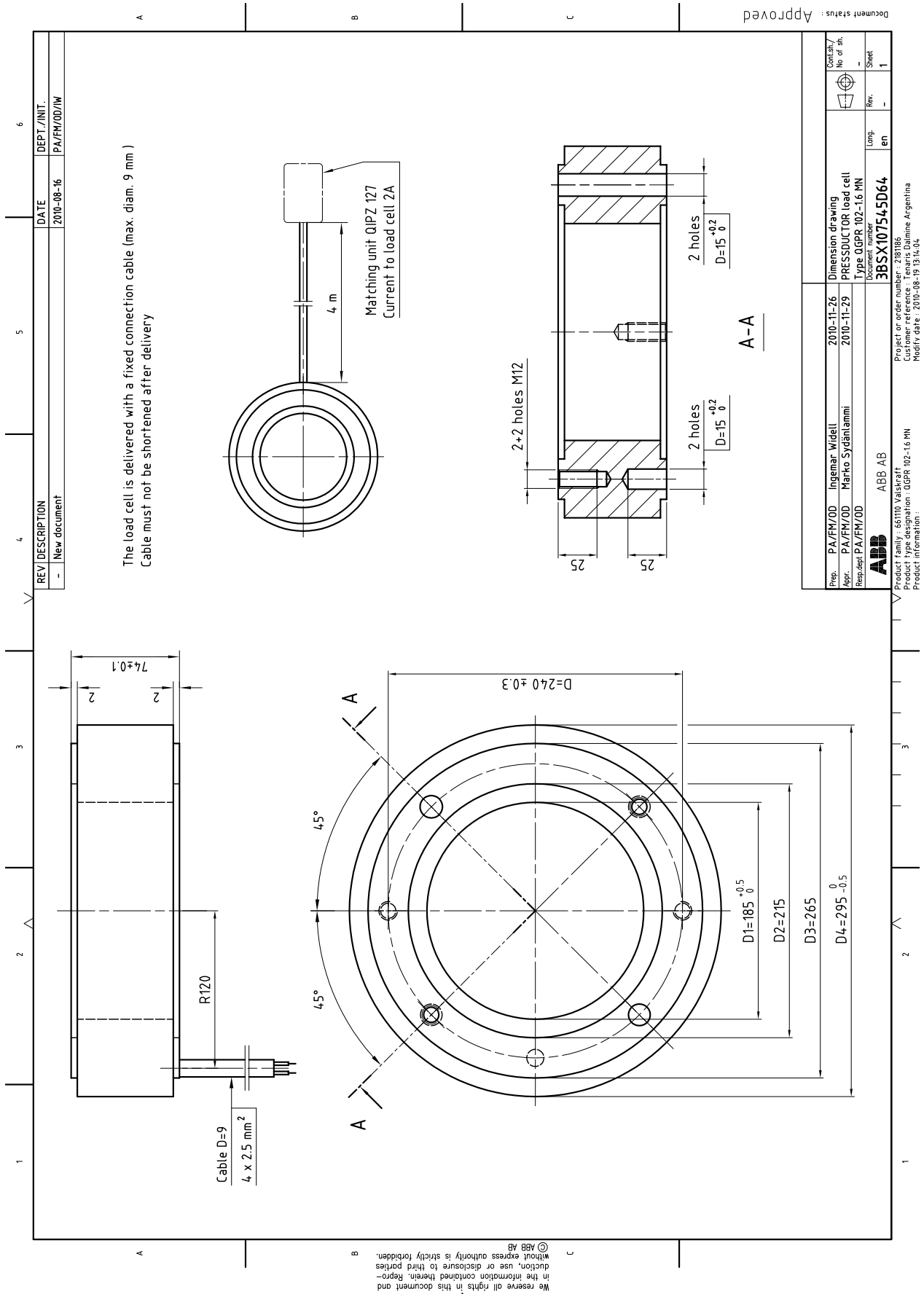
Project or order number :
 Customer reference :
 Modify date :

Document status : Approved

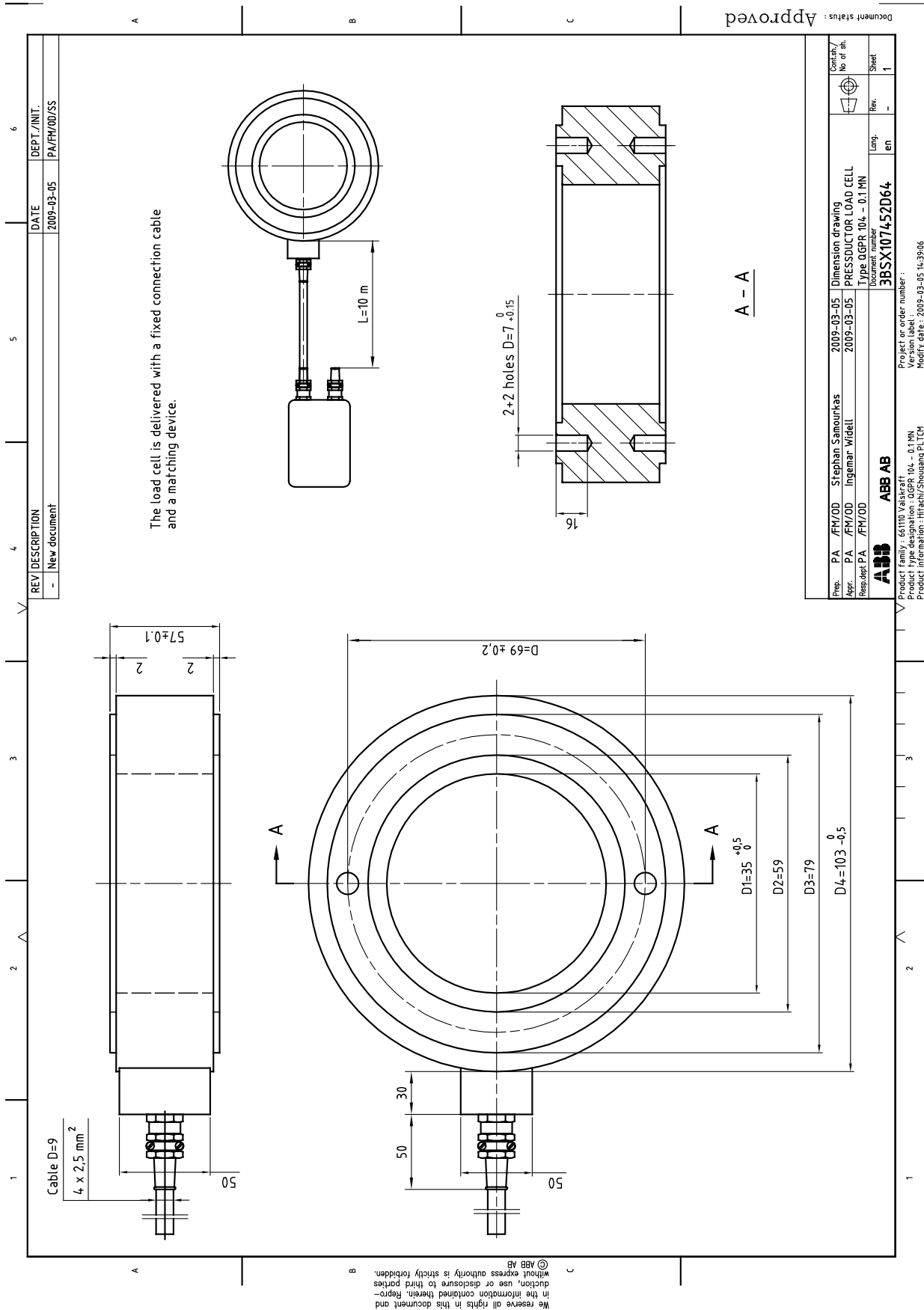
A.4 Example of Installation Drawing: Load cell QGPR 102



A.5 Example of Dimension Drawing: Load cell QGPR 102



A.6 Example of Dimension Drawing: Load cell QGPR 104



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