Assembly Instructions

PiezoBolt PB...

and

Signal Cable LC...

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The national and regional requirements for the environment protection and the recycling of the force sensor no longer used have to be considered. Please dispose off separately from regular household waste. For further information on waste disposal, please contact your local authorities or the dealer, from whom you have bought the product.

The information contained in this document represents the current state of knowledge. Consenses reserves the right for technical alterations. The liability for consequential damages resulting from the application of ConSenses products is excluded.

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Neglecting safety instructions can result in injury to the operating personnel or damage to the equipment. Therefore, please follow safety instructions before each use.

Should you have any questions regarding this product, please contact the manufacturer:

ConSenses GmbH, Arheilger Weg 11, 63580 Roßdorf
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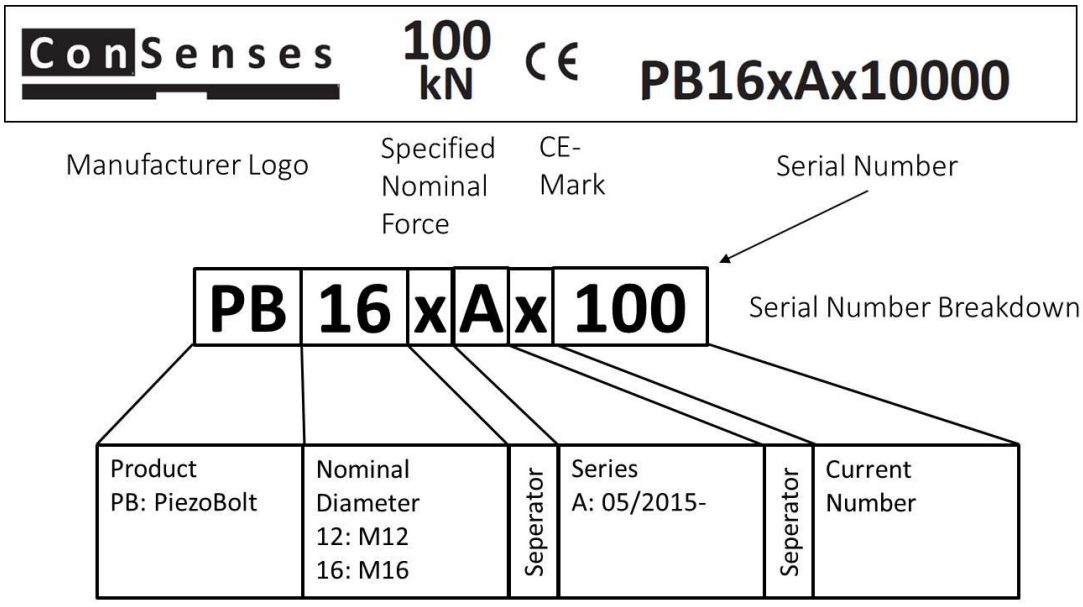
1. PiezoBolt and Cable Set

Label on the bolt head:



The connection to the PiezoBolt is detachable. Force sensors and signals cables are available under the following order numbers:

Order Number	Description
PB12	PiezoBolt Size M12, Nominal Force 55 kN with inspection protocol
PB16	PiezoBolt Size M16, Nominal Force 100 kN with inspection protocol
PB20	PiezoBolt Size M20, Nominal Force 160 kN with inspection protocol

Signal Cable

Order Number	Description
LC12	Piezo Low-Noise Cable for PiezoBolts of size M12 in the length 5m; at the reciever side angle Consenses-Connector M16x1; at the amplifier side BNC Connector
LC16	Piezo Low-Noise Cable for PiezoBolts of size M16 in the length 5m; at the reciever side angle Consenses-Connector M22x1; at the amplifier side BNC Connector
LC20	Piezo Low-Noise Cable for PiezoBolts of size M20 in the length 5m; at the reciever side angle Consenses-Connector M28x1.5; at the amplifier side BNC Connector

On request, an axial cable outlet is also available.

2. Working Principle and Application Instructions

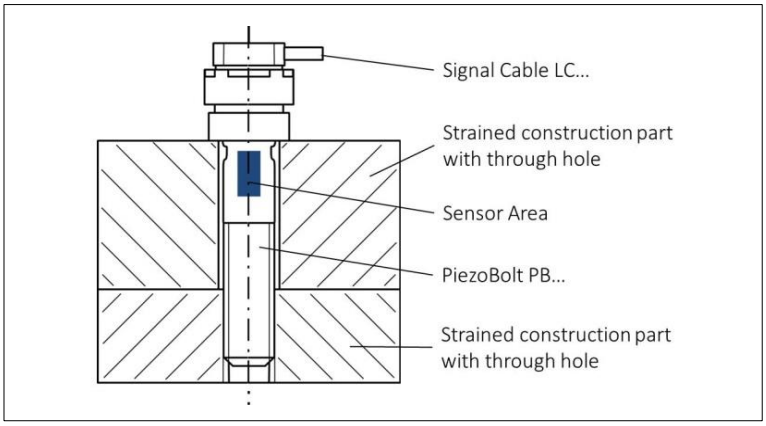


Figure 1: Assembly of a Connection with PiezoBolt

PiezoBolts are modified screws which fulfill DIN ISO 4762. The following features are achieved through modification:

- Piezo sensors are placed inside a concentric hole in the screw shaft.
- The elementary sensors are embedded by joining by forming.
- The inserted sensor is characterized under axial prestress.
- This process eliminates the need for polymers in the load transfer stage (i.e no adhesive).
- The sensor is protected and placed securely in the interior of the screw.

Loads that act axially at the junction can in tension and compression be transmitted and measured, provided the load remains within the maximum load limits of the PiezoBolts.

PiezoBolts substitute existing screws of strength class 8.8 in accordance with DIN ISO 4762. Compliance of the following conditions should be ensured prior to the use of PiezoBolts:

- Maximum load capacity
- Safety factors regarding special safety regulations (for example explosion risk areas, regulations for personnel and facility protection).
- Environmental conditions.

Please observe the following safety instructions and installation guidelines.

3. Safety Instructions

3.1. Intended Use

PiezoBolts are force sensors in the form of a standard connecting element. These are designed to be used in connection sites for the measurement of quasi-static and dynamic forces within the range specified by the technical data of the respective nominal load capacity. The use as a machine element also requires compliance with safety factors.

Any other use is not intended.

In order to mandate a safe operation, the product may only be used in accordance with the assembly instructions and in compliance with the following safety regulations along with the provided technical data. When in use for a particular application, the legal and safety regulations must also be observed. This applies similarly when the use of accessories is intended.

The use of PiezoBolts as a safety component is not intended. Proper transport, appropriate storage and professional installation along with careful operation and maintenance are absolutely essential for correct and safe operation of PiezoBolts.

3.2. Operating Staff

This product is to be mounted and operated exclusively by the qualified personnel in accordance with the technical data in context with the undermentioned safety rules and regulations.

Qualified personnel are considered those who have been trained as operators of the facility and instructed with the safety concept and are familiar with the operation of product as described in the documentation. The operator must have carefully read and understood the installation instructions and safety precautions.

When using PiezoBolts for the specific application, safety regulations for that particular application must also be observed. The same applies as well when using accessories.

Pay attention to safety conscious work and compliance of relevant accident prevention regulations of the staff association.

3.3. Safety Regulations and Load Capacity

For a safe operation of the PiezoBolts, installation instructions and load capacity are to be absolutely observed. Maximum load specified in the technical datasheets must not be exceeded. This concerns:

- Maximum total force
- Temperature limits

When connecting several force sensors together, it should be noted that the force distribution is not necessarily equal.

Signal cables of the sensors must be installed so that the electromagnetic emissions do not cause interference to the sensor functionality.

Before each application, project planning and risk analysis should be carried out that takes into consideration all safety aspects of the surrounding technology. This applies particularly to the protection of personnel

and equipment. In order to avoid defects or errors in systems that have a personnel, equipment damage or loss of data, additional safety precautions must be taken into consideration.

3.4. Supplementary Notes on Safety Instructions

PiezoBolts as passive force sensor cannot assume any safety related feature by itself. For this reason additional components and equipment required for the safety of the installer and operator should be equally taken care of. Electronics handles the measurement signal such that in case of a failure of measurement signal, no subsequent damages can occur.

In the event of a failure through breakage or malfunctioning of PiezoBolts that can cause harm to persons or equipment, the user must arrange to reach a securer operating state. Such measures can, for example, be achieved by joining or disjoining the safety devices or something similar and must at least satisfy the applicable accident prevention regulations.

3.5. General Rules for Neglecting Safety Instructions

PiezoBolts conform to the state of the art technology and are reliable to operate. Hoiwever an element of risk exists when operated improperly. For this reason, any person entrusted with installing, operating and dismantling of the sensors should read and understand the operating manual, especially the safety instructions.

Due to the improper use of PiezoBolts or by the nonobservance of safety instructions, damage, malfunction, failure or breakage of PiezoBolts can occur. Especially by the failure of force sensors, equipment or persons in the vicinity can be harmed. A malfunction or failure of the force sensor can have the consequence that the items or personnel in the vicinity of the force sensor can be brought into danger.

The services and items delivered as the product covers from the force sensor to the BNC connector and is only a part of the measuring chain. Additional safety related checks of the measurement chain are to be planned, realized and implemented by the equipment designer/installer/operator to minimize residual hazards. Existing regulations are to be observed.

3.6. Alteration and Modifications

The product must not be modified without the explicit consent of the manufacturer. Any modification shall exclude any liability of the manufacturer for resulting damage.

4. Preparations and Conditions at Installation Site

Make sure that the PiezoBolts are protected from harsh conditions like salt water, snow, rain or ice.

Protect the contact points against any contamination and do not touch the terminals.

False signals occur if there is a decrease in the insulation resistance of the electrical measurement system consisting of PiezoBolts, signal cable and charge amplifier. Symptom of such a decrease in insulation resistance is positive or negative signal drift of the nominal output span without any force applied.

This can be avoided by maintaining the terminals clean. If necessary, clean the PiezoBolt contacts and signal cable with a lint-free fabric. As detergent, the use of pure isopropanol is recommended.

A steadily maintained temperature within the operating range affects the sensitivity of PiezoBolts only to a negligible extent. However in an uneven temperature distribution, thermal stresses can arise and have an undesired impact on the output. This can be counteracted, by bringing the PiezoBolt to its operating temperature before prior to measuring Force. For example, through residing at a later measurement site. Additionally, shortly before measurement no heat through physical contact should be introduced into the PiezoBolts.

The use of PiezoBolts in extremely humid conditions (>80% rel. humidity) should be avoided. PiezoBolts with the attached signal cable LC… possess the protection class IP65 in accordance with DIN EN 60529. This protection is ensured as long as the connector is mounted properly on the PiezoBolts.

The force sensor is surrounded by a protective coated layer of zinc. Make sure that the force sensor does not come into contact with chemicals that may damage this zinc layer. Protect the signal cable from harsh chemicals. Acids and other chemicals that have corrosive effects set ions free that can cause a failure of the force sensor. In such a scenario, please ensure appropriate safety measures.

Sediments such as dust, dirt and other foreign materials can produce a shunt force with the measuring point and thus distort force measurements. Make sure that shunt forces are avoided.

Note: Contaminated, painted or damaged screw connection points prevent the presence of a sustained prestress of the screw connection.

5. Mechanical Installation

5.1. General Installation Guidelines

Handle the force sensor carefully. This is to prevent any damage which can impair the mounting of force sensor or signal cable and any consequent distortion in measuring signal.

Please make sure that the force sensor is not overloaded. In case of an overload there exists a danger of sensor failure, which poses a risk to the safety of the operating staff and the resulting system. Make measures to protect against overload or take appropriate measures to handle the consequences of sensor failure.

The forces to be measured must be directed axially to the force sensor. Transverse forces and/or torques can produce measurement errors and lead to exceeding the load limits. This implies that a PiezoBolt which is loaded with its nominal force must not be subjected to additional transverse forces and/or toques.

In order to measure the intended loads axially, the PiezoBolts must be mounted pre-stressed. In individual cases where the PiezoBolts lie in direct force flow, the pre-stressing can be eliminated. The rule however is that the PiezoBolts are in addition to the force flow and replace or supplement existing screws, as the case may be.

5.2. Installation

PiezoBolts can be screwed with torque wrench with hexagon socket ISO 2936. For this purpose, the signal cable is removed, that consequently exposes the inner parts of the screw. It is structurally ensured that the signal contact in the screw head cannot be damaged from a standard screw tool.

Please make sure that the force sensors are not overloaded during its assembly.

6. Connection

Appropriate connecting cables for piezo-based force sensors are typically characterized by a very high Internal resistance (>1*10^{13} Ω) and a special construction of cable to minimize triboelectric effects. Furthermore, the capacitance of the cable must be low.

The signal cable LC... meets these requirements and also features appropriate terminals at the sensor as well as the amplifier side. These cables must not be reduced or modified subsequently. Handle the signal cable carefully, as any damage can directly deteriorate the signal quality. It is strongly recommended to replace damaged cables.

In order to prevent signal interference due to triboelectric effects, care should be taken when laying the signal cable that the cable is moved as little as possible and at best remains in rest. The minimum cable bending radius of 26 mm must not be underrun, so that any damage to the cable construction is avoided.

Avoid stray field of motors, transformers and switches. Also avoid immediate vicinity of power supply lines or hot parts for laying signal cables.

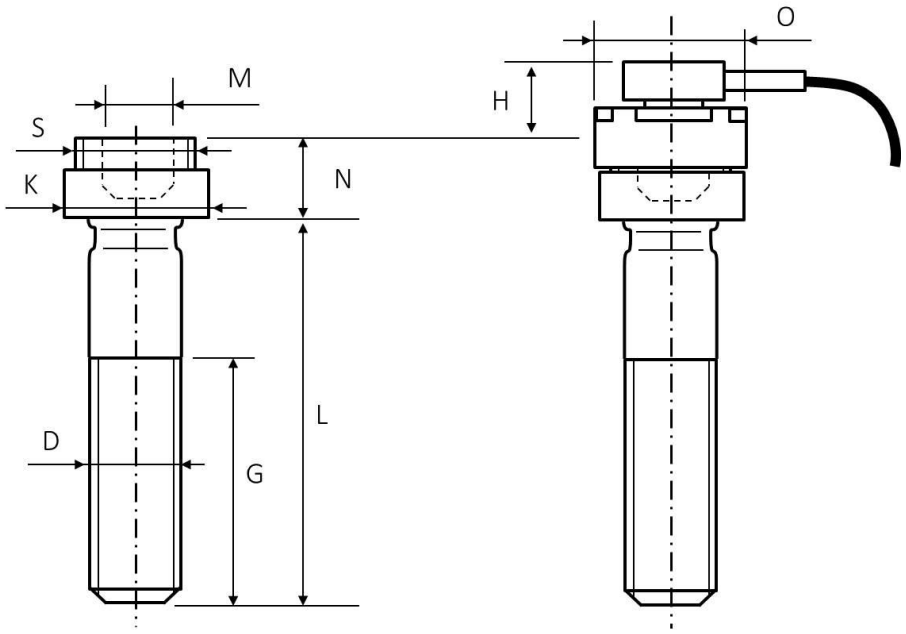
In order to avoid damage to the charge amplifier, take care to be sure that the amplifier is in reset mode when the signal cable is connected to it.

Tighten the connection cable to the PiezoBolt manually and avoid the use of a tool. The maximum tightening torque is 7 Nm. Pay attention to have good accessibility to the connecting site.

Figure 2: Measurement Chain with Analysis System DeveloperSenses

7. Technical Data

7.1. Dimensions



Without Signal Cable

With Signal Cable LC...

Tolerance according to DIN ISO 4762		PB12	PB16	PB20
Nominal Diameter D	mm	M12	M16	M20
Thread Pitch	mm	1.75 or selectable	2 or selectable	2,5 or selectable
Thread Length G	mm	38	44	52
Length L	mm	65 or selectable	75 or selectable	90 or selectable
Inner Hexagon M	mm	10	14	17
Head Height N	mm	12	16	20
Head Diameter K	mm	18	24	30
Additional Connector Height H	mm	14	11	11
Connector Mounting S	mm	M16x1	M22x1	M28x1,5
Connector Diamter O	mm	20; SW 18	25,5; SW 23	31,5; SW 27

7.2. Specific Data

		PB12	PB16	PB20
Nominal Force	kN	55	100	160
Maximum Load	kN	60	110	175
Typical Sensitivity	pC/N	2.2	1.3	0,7

7.3. General Data

Operating Temperature Range	°C	-20 … 70
Degree of Protection DIN EN 60529 (with connected cable)		IP65

8. Declaration of Conformity

CE

We,

ConSenses GmbH, Arheilger Weg 11, D-64380 Roßdorf, Germany

Declare under our sole responsibility that the product

Piezo Bolt

In the design

PB...

Meets the following regulations of the European Union:

Directive 2014/30/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to electromagnetic compatibility

Consequently, the underlying relevant standards or normative documents are listed herein:

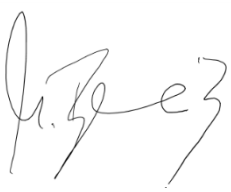
EN 61326-1: 2013 Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 1: General requirements

EN 61326-2-3:2013 Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 2-3 Particular requirements – Test configuration, operational conditions and performance criteria for transducers with integrated or remote signal conditioning

Signed for and on behalf of:

ConSenses GmbH

Roßdorf, 21.10.2016



Dr. Matthias Brenneis, Director