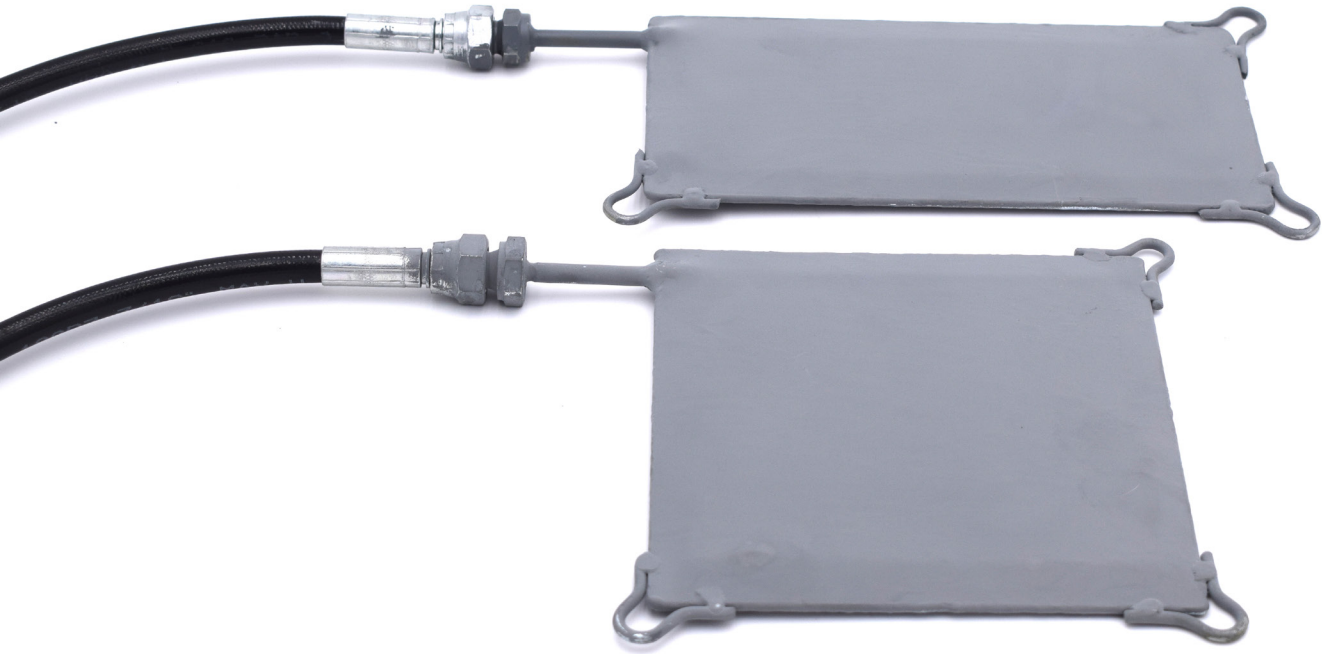

Tunnel pressure cell

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STRUMENTI E MISURE GEOTECNICHE
E STRUTTURALI

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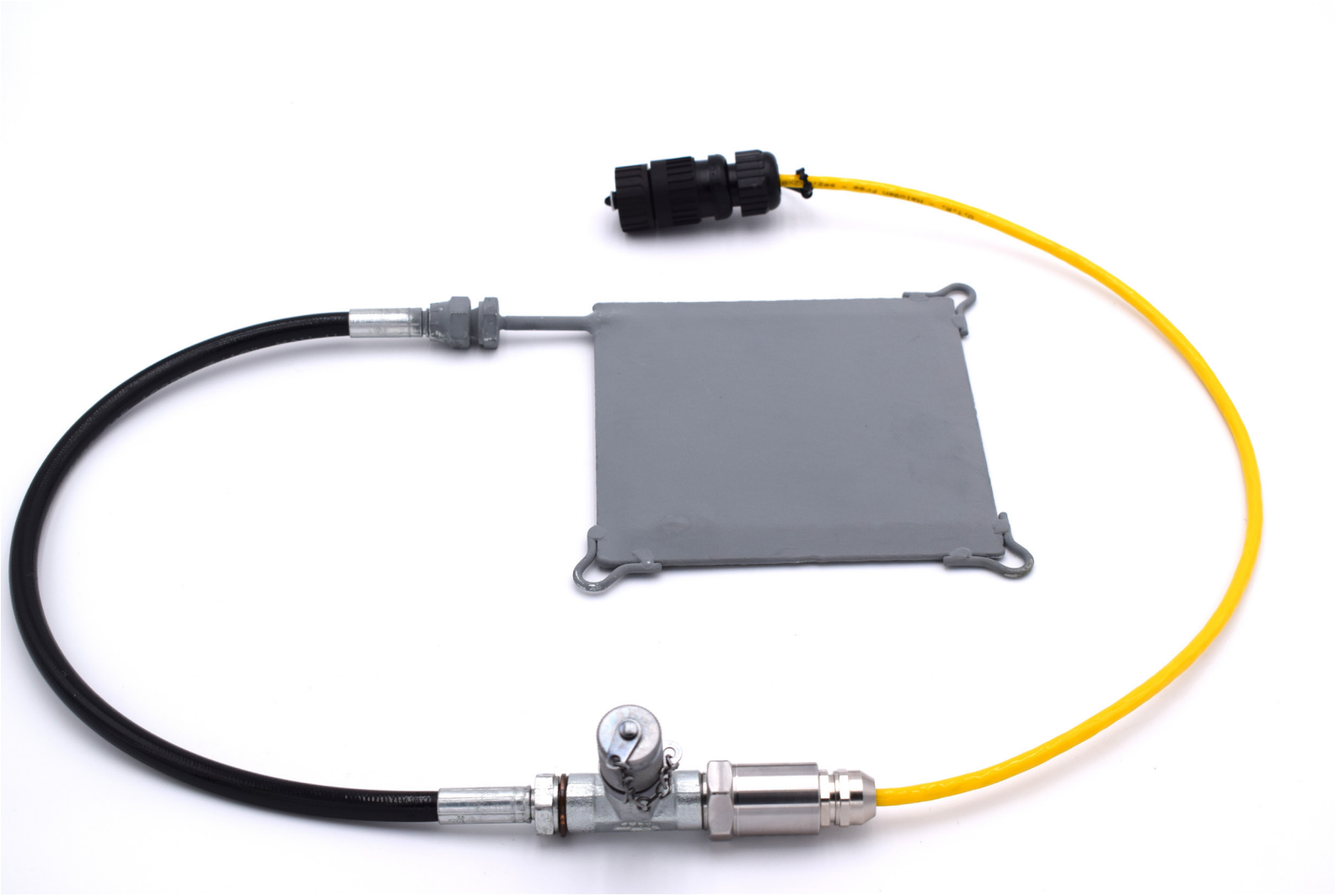

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WARNINGS

This instrument must be utilized only for the application it has been designed for, OTR declines all responsability for any improper use;

Do not charge the cell with not orthogonal or tangential load.

Do not use intrument near potentially explosive gases;
Do not overload the cell;

Do not use the instrument in water where an electric dissipation is in progress;

Use protective gloves;

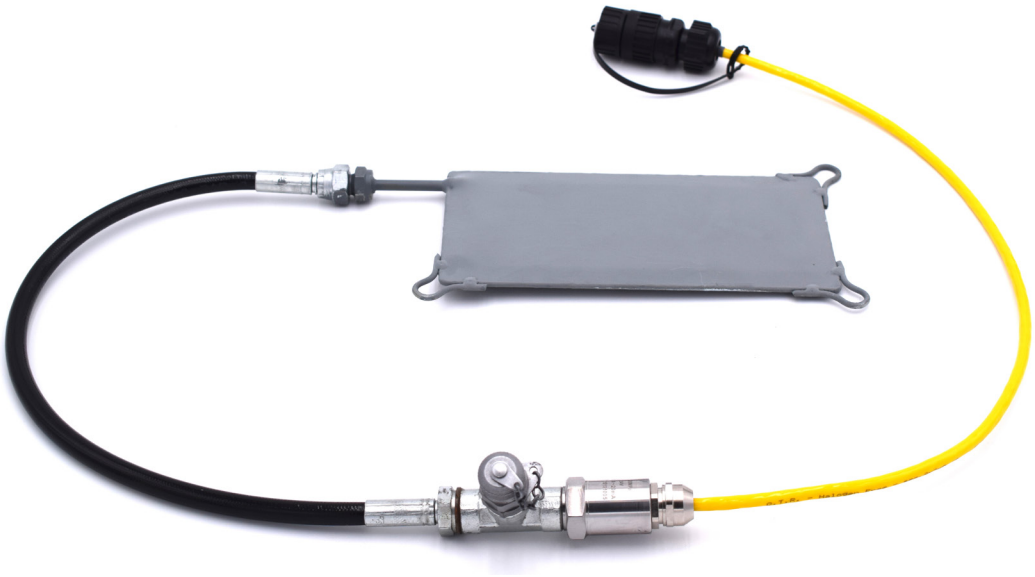
Furthermore

- Do not open the instrument, contact the manufacturer for checks and repairs;
- Keep out of reach of children;
- Do not connect the instrument to the readout unit with wet hands;
- Clean the instrument and its cable with alcohol or water, do not use acetone or aggressive liquids for plastics or labels;
- Use surge arresters for installations with unprotected cables longer than 30 meters;
- During the installation phase, disconnect the instrument from measuring devices or from any device connected to the AC power supply;

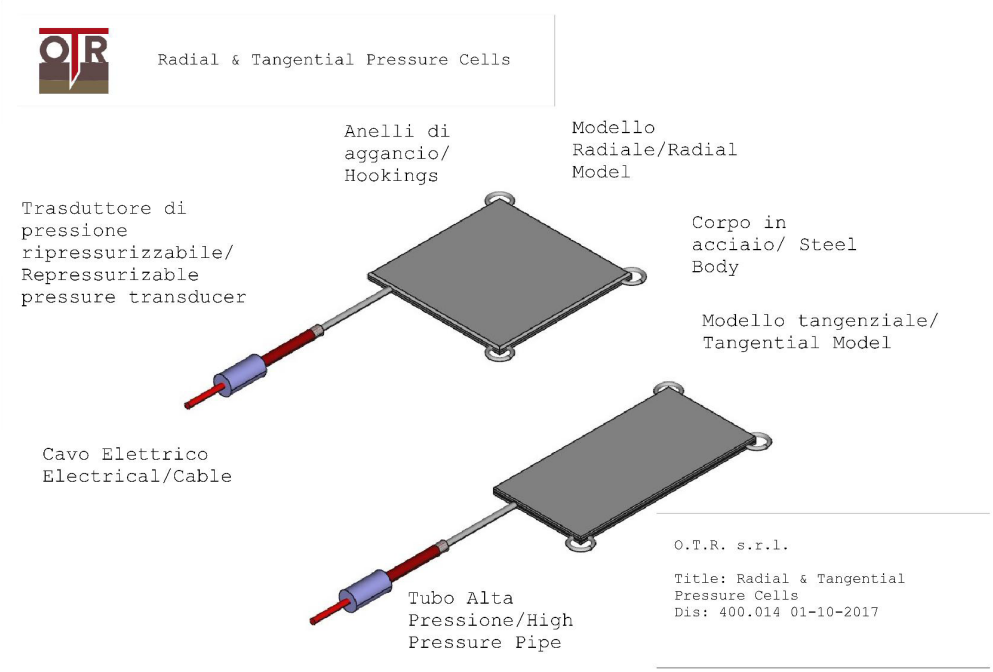
Applications

The NATM pressure cells are designed to detect the state of stress of the concrete lining of tunnels in a radial or tangential position. They are used for monitoring:

- Radial and tangential stresses in the lining of tunnels and underground excavations
- Stress in rock masses
- Pressures under foundations
- Contact pressures on the surface of diaphragm and retaining walls, piers and abutments of viaducts.



Description



Cells are made of 2 steel plates welded together and are filled up with de-aired oil. The transducer is covered by a thick and resistant external steel protection and is directly connected to the pressure cell. As the shotcrete hardens, a rise of the concrete temperature may cause a dilatation of oil in the cell. The following temperature drop will therefore result in a detachment of the cell plate from the surrounding concrete.

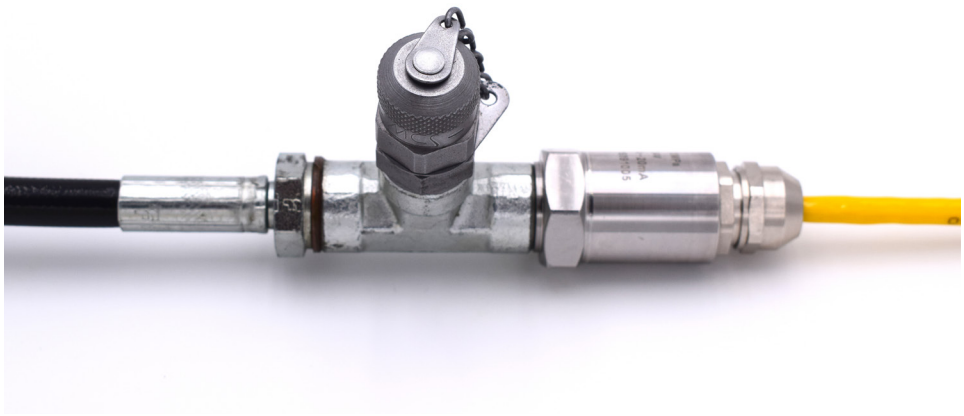
Identification

Every pressure cell is identified by:

- Serial Number with a calibration report;
- Model ;
- Full scale;
- Input / Ouput

Technical Specification

Material	Galvanized Steel
Full scale	20-50-100-200 Kg/cm2
Ouput	4-20 mA
Thikness	5 mm
Active Area	150x150 (radial) 100x200 (tangential)



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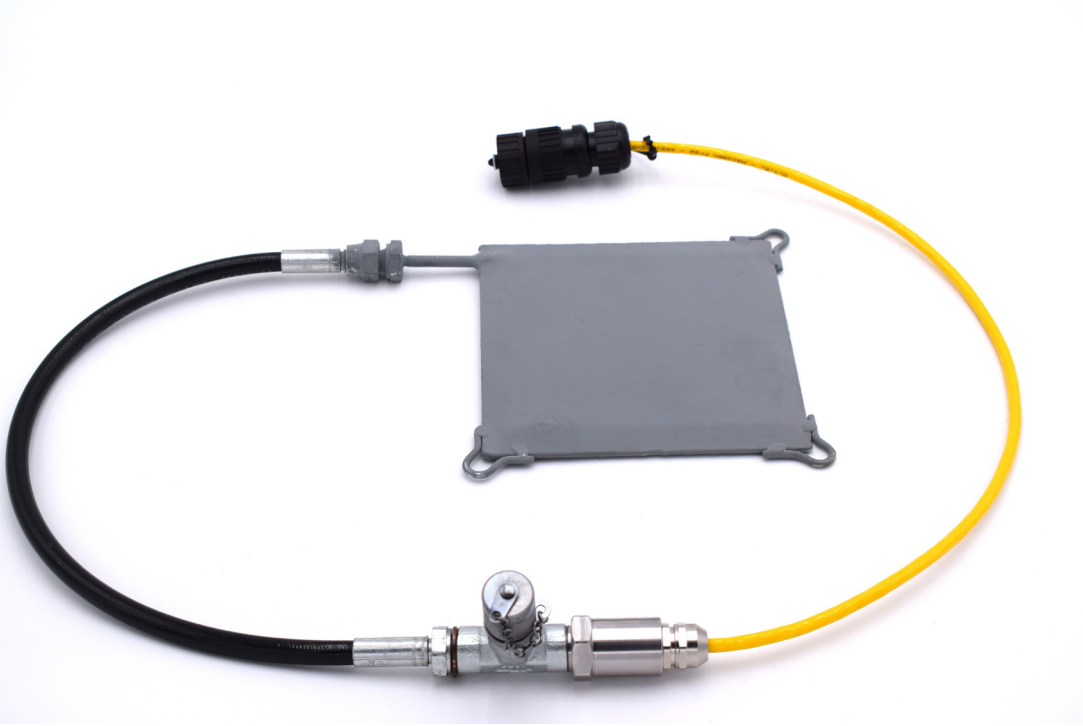
Installation

Radial Model

The radial pressure cell is installed towards the rock, the sensitive surface is placed perpendicular to the load and in direction of the radius of the arc. It measures the pressure that rock applies to the tunnel lining.
The rock surface is often rough and not planar, so :

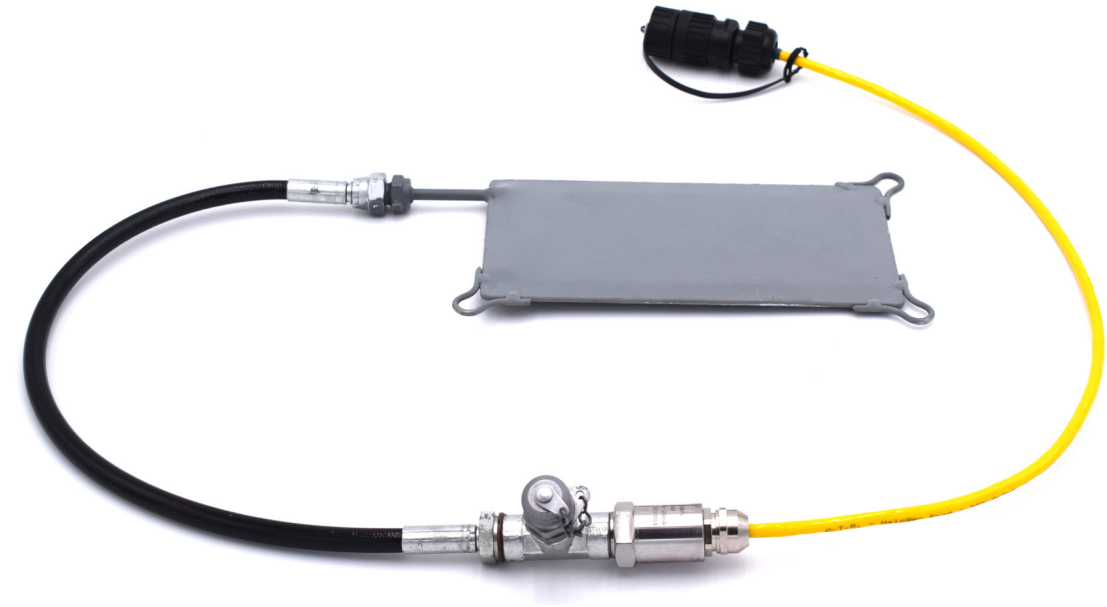
- Prepare concrete to make the surface planar. Take care not to leave edges ;
- Position the cell in the concrete fixing it using the mounting eyes.

As the cell is in contact with the rock it will not be exposed to relevant temperature cahnges-
For this reason re-pressurizstion system is not always required.



Tangential Model

The tangential pressure cell is installed with the sensitive plate perpendicular to the surface of the rock. It measures the pressure in concrete of the tunnel and it is completly embedded in it. During installation the mounting eyes must be used to position it in the right way using the reinforment. The hydraulic pipe must be long enough to allow the sensor and the valve to be outside the concrete.



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Re-Pressurization of the cell

As accessory can be used the pressure pump in this cases:

- After installation it is possible that the cell is not yet prefectly in contact with the surface to monitor;
- After installation the increase of temperature due to concrete has created a separation between the instrument and the surface to monitor (oil expansion)

For these reasons can be recommended to re-pressurize the cell after installation.
Pump Features:

- Manual operation;
- Screw movement;

The pump is composed by steel cylinder by a piston moved by a screw that puts in pressure the oil.
The oil is pressed inside the cell by a valve. The pump must be filled with oil before operating.
Proceed as follow:

1. Prepare the pump filled with oil;
2. Take readings with mA readout unit to verify that pressure is about 0 (4 mA)
3. Connect the pump to the cell;
4. Turn the screw of the pump clockwise checking continously the value of pressure on readout unit.;
5. Reach a value that ensure the contact between cell and concrete (e.g. 5-10% FS);
6. Do not exceed 10-15 Kg/cm2 values
7. Disconnect the pump from the instrument.

Readouts

In order to take a reading, connect the cable to the readout unit, following the indications on the instruction manual of the readout unit being used: Instrument signals can be different depending on the type of sensor, pressure sensor 4-20 mA, or Hz vibrating wire being used.

Taking Measurements

Here follow the colors and functions of the electrical cables connected to the pressure sensor with a 4-20 mA output signal:

4-20 mA Output signal:
Red cable = + 15 volts
Black cable = Loop
Shield = Earth of Datalogger

Hz Output signal:
Red cable = + signal
Black cable = - signal
Green cable = Temp
White cable = Temp
Shield = Earth of Datalogger

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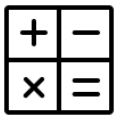
Data processing

Depending on the instrument and measurement unit, the electrical reading can be expressed in mA or in Hz to be converted into bar or Kpa using the sensitivity factor shown on the calibration sheet provided by the manufacturer of each instrument:

Calculations & Formulas

The pressure sensor reading is the measurement of the output current (mA) or of the frequency (Hz) taken by the electrical pressure transducer.

P = Pressure expressed in engineering units (bar and/or Kpa)
E = Electrical reading (mA or Hz)
K = Sensitivity factor (shown on the calibration sheet)



P (bar or Kpa) = ExK (Pressure expressed in engineering units (bar and/or Kpa)