

INTERFELS
RADIAL AND TANGENTIAL
TOTAL PRESSURE CELLS

USER'S MANUAL

331.0000

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1. Stress Cell Design and Construction

The basic cell is comprised of two stainless steel plates which are laser-welded together around the periphery, leaving a thin space between the plates which is filled with a special de-aired oil. For environmental reasons INTERFELS is avoiding the use of mercury as a TPC fluid. This approach is made possible by particular design features of the INTERFELS TPC such as:

- The steel plates are always rounded thus minimizing errors from stiff boundary sections of the TPC to the stress readings.
- The two steel plates which make up the TPC are of unequal thickness. There is a thicker base plate which gives the TPC a solid shape and which also provides the connections for the pressure tube and the pinch tubes; and there is a significantly thinner cover plate which is bent at its periphery to minimize the stiffness of the TPC in its outer section. This thinner side is the most sensitive side of the TPC.
- The height to width ratio of the INTERFELS TPC is very small, actually smaller than any other commercially available TPC. This gives superior TPC performance even in stiff media such as concrete.

The oil-filled space of the TPC is connected via a pressure tube to a vibrating wire pressure sensor. Stresses applied normal to the plates of the TPC which shall be monitored are balanced by a corresponding built-up of internal fluid pressure which is then measured by the electrical pressure sensor.

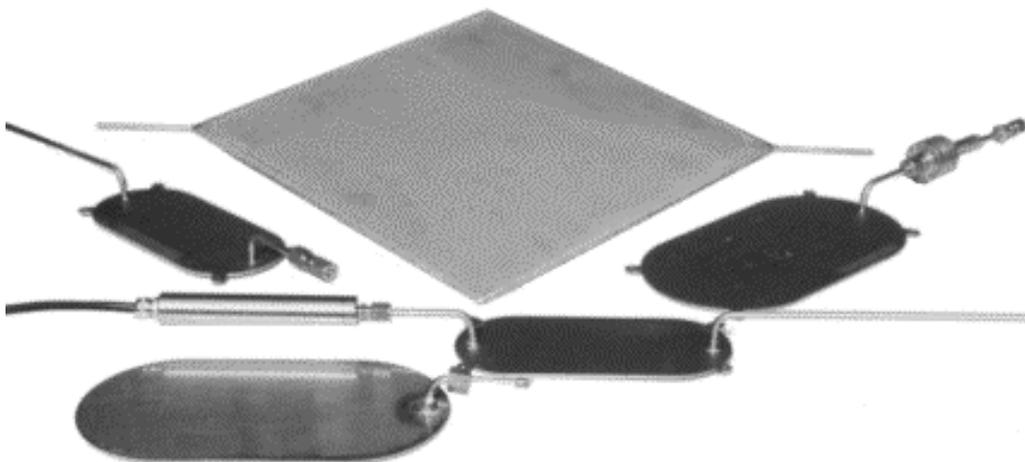


Fig. 1 INTERFELS Total Pressure Cells

2. Specifications

2.1 Radial Total Pressure Cell

INTERFELS Model 331.6520 with Vibrating Wire Pressure Transducer Model 331.8035

TPC Body:

Length:	283 mm
Width:	151 mm
Height:	3,5 mm
Effective area:	375 cm ²
Material:	stainless steel (1.4571)
Type of welding:	Laser
Pressure fluid:	deaired oil

VW Pressure Transducer:

Range:	0 to 50 bar (0 to 500 psi)
Resolution:	0.025% FS with DataMate MP
Accuracy:	± 0.5% FS
Max. Pressure:	2 x measurement range
RTD Range:	-45° to 100° C. Thermistor can be substituted for RTD

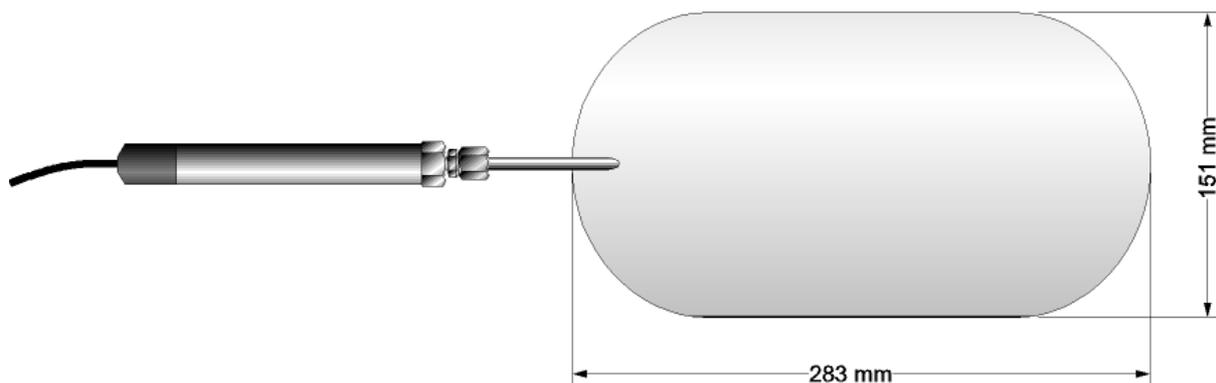


Fig. 2 INTERFELS Radial Total Pressure Cell, 375 mm²

The vibrating wire pressure transducer supplied with the INTERFELS TPC is a standard transducer mounted inside an all-welded housing. The sensor is hermetically sealed and is connected via waterproof connectors to an electrical cable leading to the readout location. The sensor housing also incorporates a thermistor which permits measurement of temperature at the location of the transducer. The VW pressure transducer can be read by Slope Indicator VWP Indicator readouts such as Model 52611900.

2.2 Tangential Total Pressure Cell

INTERFELS Model 331.6510 with Vibrating Wire Pressure Transducer Model 331.8210

TPC Body:

Length:	222.5 mm
Width:	101 mm
Height:	3,5 mm
Effective area:	200 cm ²
Material:	stainless steel (1.4571)
Type of welding:	Laser
Pressure fluid:	deaired oil

VW Pressure Transducer:

Range:	0 to 210 bar (0 to 3000 psi)
Resolution:	0.025% FS with DataMate MP
Accuracy:	± 0.5% FS
Max. Pressure:	2 x measurement range
RTD Range:	-45° to 100° C. Thermistor can be substituted for RTD

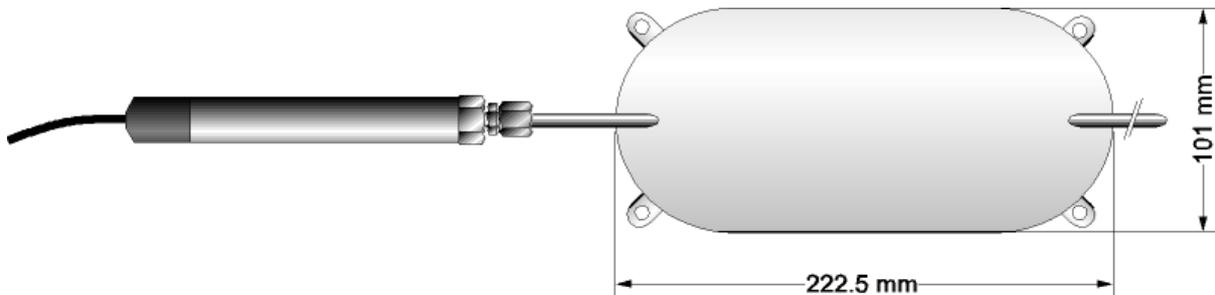


Fig. 3 INTERFELS Tangential Total Pressure Cell, 200 cm²

Mounting eyes are provided at the edges of the Tangential TPC to allow for easy positioning of the cell prior to embedment in the shotcrete or concrete.

One design aspect of the Tangential TPC should be particularly noted to secure proper TPC functioning in stiff media: This is the pinch tube which, like the TPC body, is completely filled with de-aired oil. The tube is connected at one end to the fluid-filled space between the TPC plates whilst the other end is entirely squeezed (blind tube). The purpose of this pinch tube is to slightly inflate the cell when the concrete around it has fully cured and has cooled off to the ambient temperature. During concrete curing, temperatures rise and will cause the cell fluid to expand. After curing the cell fluid shrinks thus leaving a small gap between the pressure cell plates and the now hardened concrete. For reliable measurements the pressure cell plates have to

be brought back into direct contact with the surrounding concrete. This is done by squeezing of the pinch tube by heavy-duty pliers thus injecting some additional fluid into the body of the TPC. Very often only a very small amount of pinching, typically by some 10 to 20 mm, will do to reestablish the full contact between TPC plates. This is typically indicated by a significant increase of the cell pressure.

The vibrating wire pressure transducer supplied with the INTERFELS TPC is a standard transducer mounted inside an all-welded housing. The sensor is hermetically sealed and is connected via waterproof connectors to an electrical cable leading to the readout location. The sensor housing also incorporates a thermistor which permits measurement of temperature at the location of the transducer. The VW pressure transducer can be read by Slope Indicator VWP Indicator readouts such as Model 52611900.

3. TPC Installation Procedures

3.1 Radial Total Pressure Cell

The Radial TPC is installed with its sensitive side towards the rock. It measures the pressure of the rock acting on the tunnel lining. If the rock surface is very rough a small concrete pad should be applied to form a smooth surface at which the cell can be attached to. Since the cell touches the cool rock face with its sensitive side and is therefore not completely embedded in shotcrete, temperature influences are not as critical as with the tangential cell. For this reason a pinching tube is not required.

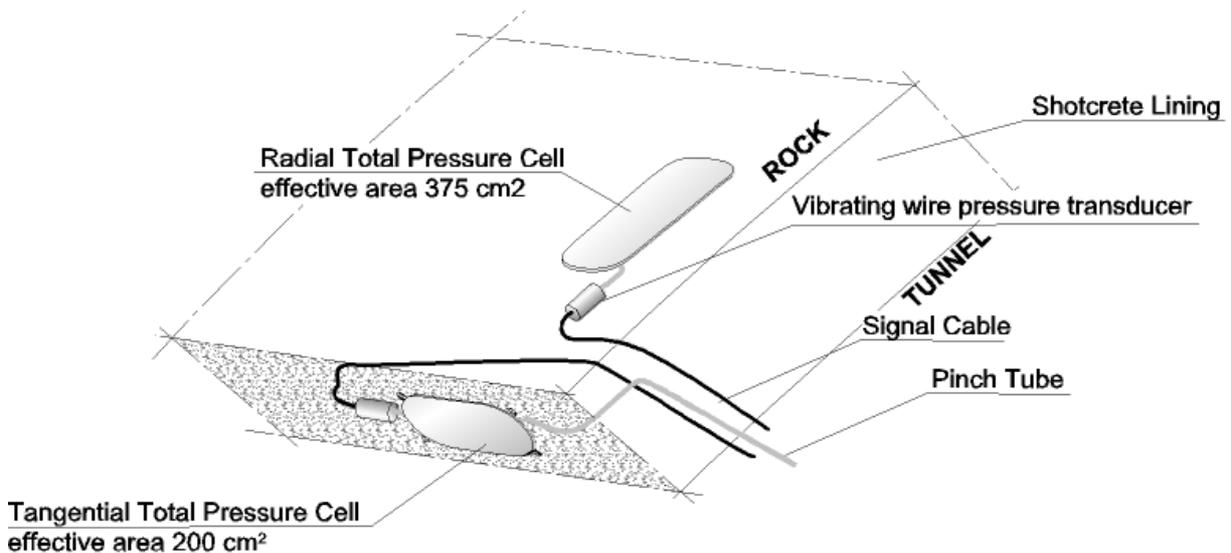


Fig. 4 Installation of Total Pressure Cells

3.2 Tangential Total Pressure Cell

The tangential TPC is installed with its sensitive side perpendicular to the rock surface. It measures the pressure within the tunnel lining. It is therefore completely embedded in shotcrete. It is advisable to attach the cell to the reinforcement in order to position the cell properly. For this purpose the cell has mounting eyes around the edge, where soft wires can be used for binding. Make sure that the pinching tube will protrude out of the shotcrete into the tunnel void. The pinching tube can be carefully bent by hand to adjust for the right direction of the tube.

When the shotcrete starts curing it will heat up, the cell will expand. When cooling down the shotcrete as well as the cell will shrink, leaving a small gap between. To establish full contact again, the cell has to be inflated. This is done by using our special repressurization pliers. Start pinching from the end of the tube and work your way towards the cell. When pinching one should carefully monitor the pressure using a readout unit attached to the cell. Full contact is established when a significant increase in pressure can be noticed. Usually pinching of 10 to 20 mm is adequate.

4. Taking Readings

The vibrating wire pressure transducer supplied with the INTERFELS TPC is a standard transducer mounted inside an all-welded housing. The sensor is hermetically sealed and is connected via waterproof connectors to an electrical cable leading to the readout location. The sensor housing also incorporates a thermistor which permits measurement of temperature at the location of the transducer. The VW pressure transducer can be read by Slope Indicator VWP Indicator readouts such as Model 52611900.

Cable Colour	Function	Bare Wire Adapter
Blue	Temperature	5
Orange	Vibrating Wire	6
Blue/White	Temperature	7
Orange/White	Vibrating Wire	8
Shield	Shield	10

The first reading should be taken when the cell is installed to the reinforcement cage prior to casting. This is for checking the proper function.

After the concrete is poured allow for sufficient setting time. Depending on the size of the segment this might last up to several weeks.

After setting of the concrete the repressurization can be conducted according to the chapter above.

It is advisable to record all prior readings as well to get an idea of the load change and stress distribution in the segment under all load conditions.