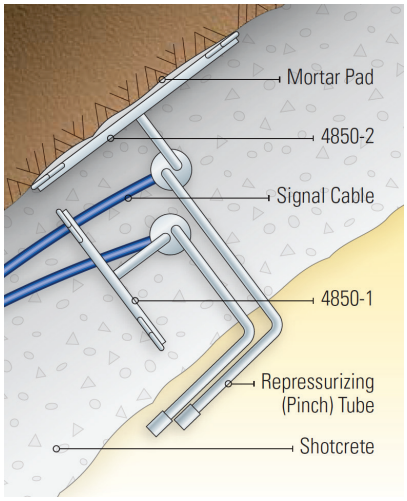
NATM Style Shotcrete Stress Cell

APPLICATIONS

The Model 4850 NATM Style Shotcrete Stress Cells are designed for the measurement of ...

- Tangential (Model 4850-1) and radial (Model 4850-2) stresses in a shotcrete tunnel linings
- Stress in mass concrete



- NATM Shotcrete Stress Cell orientation in a typical tunnel lining installation.

OPERATING PRINCIPLE

Each cell consists of two rectangular stainless steel plates welded together around the periphery, with a de-aired fluid occupying the space between the plates. Increasing concrete stresses cause a corresponding rise in the de-aired fluid pressure as the steel plates are squeezed together. The fluid in the cell is connected via a short tube to a vibrating wire pressure transducer that converts the pressure to an electrical signal that is transmitted, as a frequency, to the readout location. A thermistor inside the transducer housing allows the temperature to be measured at the cell.

Stress cells installed in a concrete or shotcrete will expand if the temperature rises as the concrete cures. On cooling, the cell will contact and leave a gap between it and the surrounding concrete, preventing the concrete stresses from reaching the cell. To correct this situation, a repressurizing tube (pinch tube) is provided to fully expand the cell after the concrete has cured. This ensures an immediate and accurate response to the onset of increasing concrete stresses.

ADVANTAGES AND LIMITATIONS

The GEOKON® NATM Stress Cells offer superior stiffness without the use of mercury. As a result, maximum cell response to changing concrete stresses is achieved and environmental protection is provided. An advantage of the vibrating wire pressure transducer over more conventional electrical resistance (or semi-conductor) types lies mainly in the use of a frequency rather than a voltage, as the output signal from the strain gauge. Frequencies may be transmitted over long lengths of electrical cable without appreciable degradation caused by variations in cable resistance or leakage to ground. This allows for a readout location that may be over a thousand meters from the cell. NATM Stress Cells, like all closed hydraulic systems, are sensitive to temperature changes. Temperature compensation factors can be calculated from close observation of in-situ stress cell performance.

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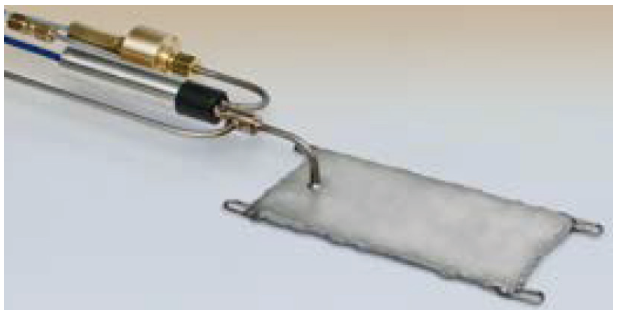
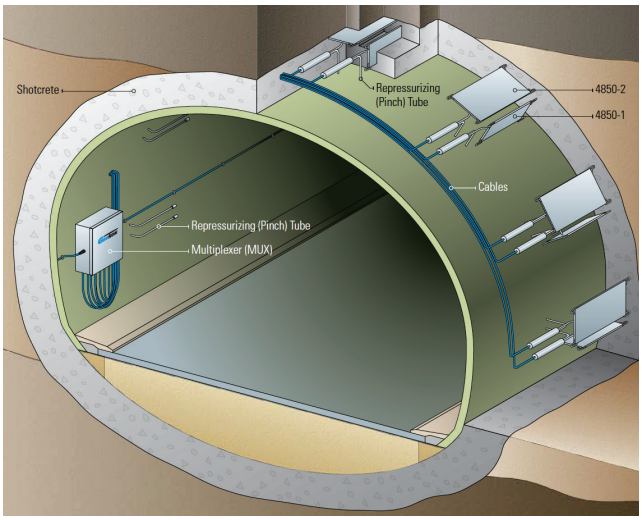
- Model 4850 NATM Shotcrete Stress Cell with remote re-pressurization option.



- Model 4850 NATM Shotcrete Stress Cell with electro-hydraulic pressure switch (for confirmation of measured pressure).

- Model GK-405 Vibrating Wire Readout for manual data acquisition.



- Illustration shows typical installation in tunnel lining.

SYSTEM COMPONENTS

Stress cells are usually installed in pairs as shown above. Attachment of the cells to the tunnel walls prior to shotcreting is facilitated by the provision of lugs welded to the corners of the cell. Cells to measure radial pressures have mortar pads between the cells and the tunnel wall. Cells to measure tangential stresses are either attached to short pieces of rebar protruding from the wall, or to the rebar cage (if one is used). Pinch tubes are bent so that they will protrude from the finished lining, and be accessible for pinching. Cables are routed to the readout location which may include a terminal box or switch box embedded in the lining.

Pinching pliers are available to crush the repressurizing tube (pinch tube) which expands the cell. Repressurizing tubes have an extended length of 762mm. Other lengths are available on request.

The shotcrete stress cells are often used in conjunction with the Model 1600 Tape Extensometer and the Model A-3 or A-6 Borehole Extensometers to measure the performance of a tunnel lining and to determine whether the lining is thick enough. This procedure is an integral part of what is sometimes called the New Austrian Tunnelling Method (NATM).

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TECHNICAL SPECIFICATIONS

	4850-1	4850-2
Standard Ranges[1]	7.5, 20, 35 MPa	2, 3, 5 MPa
Over Range	150% F.S.	150% F.S.
Resolution	0.025% F.S.	0.025% F.S.
Accuracy[2]	±0.1% F.S.	±0.1% F.S.
Aspect Ratio	> 20 to 1	> 20 to 1
Output	2000-3000 Hz	2000-3000 Hz
Temperature Range[1]	–20 °C to +80 °C	–20 °C to +80 °C
L × W × H (Cell)[3]	200 × 100 × 6 mm	250 × 150 × 6 mm
Weight	1 Kg	2 Kg

[1]Other ranges available on request.
[2]Accuracy established under laboratory conditions.
[3]Other sizes available on request.

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