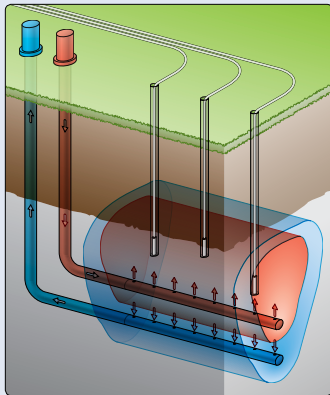


# High Temperature Piezometers and Pressure Transducers

## Applications

For the measurement of downhole pressures and temperatures in oil recovery systems and geothermal applications.



• Model 4500HT used for monitoring pressures and temperatures in oil recovery applications.



• Model 4500HT High Temperature Vibrating Wire Piezometer.

Geokon's 4500HT Series High Temperature Piezometers and Pressure Transducers are designed for monitoring downhole pressures and temperatures in oil recovery systems and geothermal applications.

These sensors are capable of operation under extreme conditions and at temperatures up to 250°C. In thermal recovery applications (steam assisted gravity drainage (SAGD) or cyclic steam stimulation (CSS)), they can provide accurate, real-time, continuous monitoring of pressures in production and injection wells thereby optimizing the recovery rate and reducing the costs of the steam injection process. In geothermal applications, they offer a means for in situ and continuous monitoring of pressures and temperatures over extended periods of time.

## Operating Principle

The sensors use a pressure sensitive diaphragm with a vibrating wire element attached to it. The diaphragm is welded to a capsule, which is evacuated and hermetically sealed. Fluid pressures acting upon the outer face of the diaphragm cause deflections of the diaphragm and changes in tension and frequency of the vibrating wire.

The changing frequency is sensed and transmitted to the readout device by an electrical coil acting through the walls of the capsule.

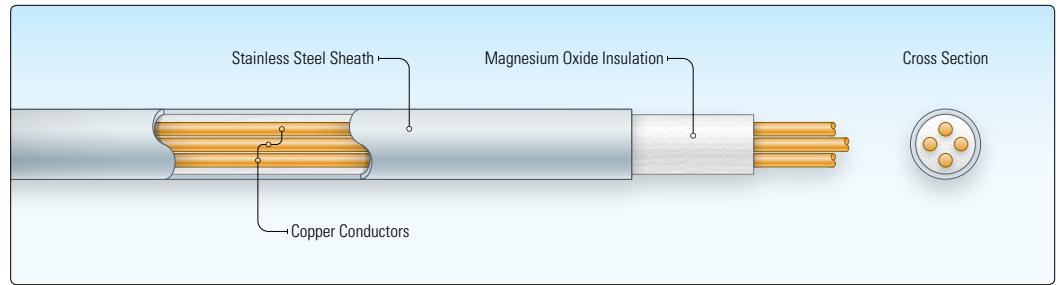
## Advantages and Limitations

Vibrating wire sensors can be modified for use in environments subject to temperature extremes more easily than many other commercially available sensor types because the electromagnetic coil (used to excite the wire) is the only electronic component inside the sensor. In addition, the construction of vibrating wire sensors that are highly corrosion-resistant and capable of long-term use, in very aggressive environments, is possible due to the careful selection of materials and use of proprietary assembly techniques. All exposed components are made of corrosion-resistant stainless steels and internal components (plucking coils, electrical hook-up wire, thermistors, and internal seals) are high-temperature versions.

The 4500HT Series High Temperature Piezometers and Pressure Transducers offer outstanding long-term stability and reliability, and low thermal zero shift.



• Model 4500HT shown with Teflon® cable inside stainless steel tubing (coiled, pre-installed configuration).



• Model 4500HT mineral insulated cable details.

Cable lengths of several kilometers are possible and the frequency output signal is not affected by changing cable resistances (caused by splicing, changes of length, terminal contact resistances, etc.), nor by penetration of moisture into the electronic circuitry. A thermistor (or secondary vibrating wire temperature sensor), located in the same housing, permits the measurement of temperatures at the piezometer location.

Calibrations are performed at six different temperatures throughout the range to determine zero shift and the change in gage factor with temperature.

The 4500HT Series are delivered with mineral insulated cables (4 solid, 22 gage copper conductors in magnesium oxide inside a 316 stainless steel tube), or with Teflon® insulated cables inside stainless steel tubing with couplings. The Tubing can be terminated with a connector, a transition to a regular instrumentation cable, or other as determined by the customer.

These sensors are designed for static measurements only and at least one second is required to excite and read the sensor.

## Technical Specifications

Standard Ranges <sup>1</sup>	-100 to 700 kPa; 1, 2, 3, 5, 7.5, 10, 25, 50, 75, 100, 150 MPa
Over Range	2 × rated pressure
Resolution	0.025% F.S. (minimum)
Accuracy	±0.1% F.S.
Linearity	< 0.5% F.S. (±0.1% F.S. optional)
Temperature Range	0°C to +250°C
Thermal Zero Shift	< 0.05% F.S./°C
Diaphragm Displacement	< 0.001 cm <sup>3</sup> at F.S.

**Note:**  $PSI = kPa \times 0.14503$ , or  $MPa \times 145.03$

<sup>1</sup>Other ranges available on request.

### ▼ 4500SHT Piezometer

Length × Diameter	188 × 19 mm <sup>1</sup> ; 210 × 25 mm <sup>2</sup>
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### ▼ 4500HHT Pressure Transducer

Length × Diameter	210 × 19 mm <sup>3</sup> ; 210 × 25 mm <sup>4</sup>
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<sup>1</sup>Ranges: -100 to 700 kPa; 1, 2, 3, 5 MPa.

<sup>2</sup>Ranges: 7.5, 10, 25, 50, 75, 100, 150 MPa.

<sup>3</sup>Ranges: -100 to 700 kPa; 1, 2, 3, 5, 7.5, 10, 25 MPa.

<sup>4</sup>Ranges: 50, 75, 100, 150 MPa.

## Cable Specifications

### ▼ Mineral Insulated

Conductors	4-conductors, 22 AWG, solid copper
Sheath	316 stainless steel
Sheath Wall	0.76 mm (0.03")
Nominal O.D.	4.76 mm (0.1875")
Coil ID	3 ft.

### ▼ Teflon® (inside 316 stainless steel tubing)

#### Externally Coupled in Nominal 30 m (100 ft) Lengths

Conductors	4-conductors, 2 twisted pairs, 22 AWG, stranded silver plated copper with 24 AWG stranded tinned copper drain wire
Conductor Insulation	Teflon®
Cable Jacket	white Teflon®
Nominal O.D.	8 mm (±0.25 mm) (316 stainless steel tubing)

#### Continuous Lengths up to 2,750 m (9,000 ft)

Conductors	7-conductors, 22 AWG, stranded copper
Conductor Insulation	Teflon®
Nominal O.D.	6.35 mm (±0.25 mm) (316 stainless steel tubing)



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