

# Fiber Optic Strain Gage

## Applications

The Model FP4000 Fiber Optic Strain Gage is designed to measure strain in or on...

- Tunnel linings
- Bracing
- Struts
- Bridges
- Containment vessels
- Reinforcing bars



• Model FP4000 Fiber Optic Strain Gage.

## Operating Principle

Geokon's fiber optic strain gages are designed for use in environments where it may be difficult to use conventional types of strain gages because of space considerations, high levels of electrical interference or where intrinsic safety is an issue. Measurements of dynamic events are also possible with these gages and the requisite dataloggers. The strain gages have a very low coefficient of thermal expansion and can be used to measure both mechanical and thermo-mechanical strains in a variety of different materials.

## Construction

The gage comprises a Fiber optic cable with a miniature Fabry-Perot strain sensor which is embedded into a composite carbon fiber laminate made of uniaxial fibers to form a highly stable sensor.

The version for bonding to steel has a roughened surface (on the adhesive side) while the version for embedding into concrete has roughened surfaces on both faces and scalloped edges for optimum keying into the concrete mix.

The adhesive used for bonding is a two-component, room temperature curing, methacrylate, especially formulated for bonding to metals.

## Advantages and Limitations

The FP4000 Strain Gage is immune to EMI, RFI and voltage surges (lightning). It is insensitive to transverse strains, capable of signal transmission over long distances and suitable for both static and dynamic measurements.

For optimum accuracy it is recommended that the Model FP4700 Fiber Optic Temperature Sensor, of similar construction, be installed alongside the Strain Gage to provide for precise temperature measurements (and compensation).

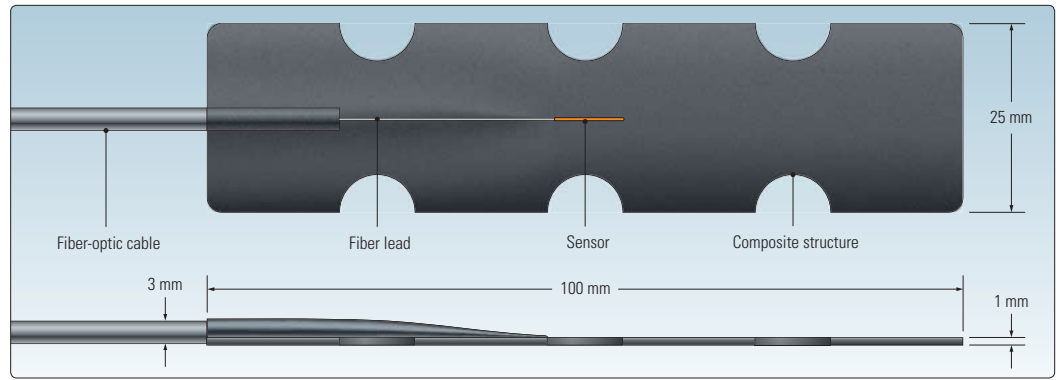
The FP4000 Strain Gage can also be used for measuring strains on "older," dry and intact concrete surfaces. However, it may not be suitable for measurements on fresh or wet concrete surfaces, mainly due to the uncertainties of the epoxy bonding technique.

## Readout

The readout device recommended for basic field measurements is the Pico Sens single channel battery operated handheld signal conditioner.

Where multiple gages are to be monitored the Field Sens Multi-channel, signal conditioner is recommended.

Readouts capable of dynamic measurements up to 1000 Hz are also available.



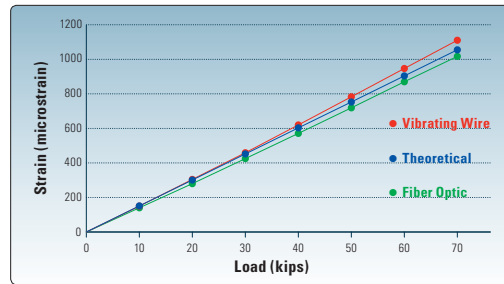
• The Model FP4000 components and dimensions.

## Test Results

The following tests were conducted to verify the performance of the Model FP4000.

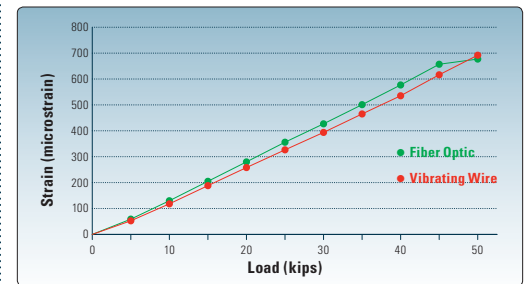
### Steel Bar Tension Load Test

Two FP4000 Strain Gages were mounted onto opposite faces of a 1.5" x 1.5" steel bar, and two Model 4000 VW Strain Gages onto the two remaining faces. The bar was then subjected to incremental loads and the strain values recorded at each increment.



### Concrete Cylinder Compression Load Test

Tests were carried out on a FP4000 Strain Gage embedded inside a concrete cylinder (6" diameter x 12" length) alongside a Model 4202 VW Strain Gage. The cylinder was loaded in 5000 lb. increments and the strain values recorded at each increment.



## Technical Specifications

	FP4000-1.0	FP4000-2.5	FP4000-5.0
Standard Ranges	-1000 to +1000 $\mu\epsilon$	-2500 to +2500 $\mu\epsilon$	-5000 to +5000 $\mu\epsilon$
Resolution	0.15 $\mu\epsilon$	0.30 $\mu\epsilon$	0.50 $\mu\epsilon$
Gage Factor Accuracy <sup>1</sup>	$\pm 3\%$ F.S.	$\pm 3\%$ F.S.	$\pm 10\%$ F.S.
Temperature Sensitivity	0.85 - 1.22 $\mu\epsilon/^\circ\text{C}$		
Transverse Strain Sensitivity	transverse strain insensitive		
Temperature Operating Range <sup>2</sup>	-40°C to +250°C		
EMI/RFI Susceptibility	complete immunity		
Cable Length <sup>2</sup>	1.5 m (standard)		
Optical Connector	SC (standard)		
Signal Conditioner Compatibility	all Opsens WLPI signal conditioners		
L x W x H	100 x 25 x 1 mm		

<sup>1</sup>The accuracy of the DSP sensors is determined by sample testing of controlled batches at the factory. The manufacturing technique results in the spans shown above and is confirmed by actual strain tests performed on samples from batch lots.

<sup>2</sup>Other ranges and cable lengths available on request.



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