

## MODEL 4200 SERIES



Model 4202 (front), Model 4200 (center) and Model 4210 (rear) Concrete Embedment Strain Gauges.

### APPLICATIONS

The Model 4200, 4202 and 4210 are designed to measure strains in or on:

- Foundations
- Piles
- Bridges
- Dams
- Containment vessels
- Tunnel liners
- Mass concrete with coarse aggregates
- Laboratories and/or where space limitations exist (Model 4202)

### OPERATING PRINCIPLE

The Model 4200 Series Vibrating Wire Embedment Strain Gauges are designed for direct embedment in concrete. The Model 4200 (standard model) has a 153 mm gauge length and is commonly used for strain measurements in foundations, piles, bridges, dams, containment vessels, tunnel liners, etc. The Model 4210 has a 250 mm gauge length and is designed for use in mass concrete

with coarse aggregates. It is extra rugged to resist bending and has large flanges to provide greater engagement area. The 4202 and 4204 (51 mm and 102 mm gauge lengths, respectively) are designed for laboratory use and/or where there are space limitations.

Strains are measured using the vibrating wire principle: a length of

steel wire is tensioned between two end blocks that are embedded directly in concrete. Deformations (i.e. strain changes) of the concrete mass, will cause the two end blocks to move relative to one another, thus altering the tension in the steel wire. The tension is measured by plucking the wire and measuring its resonant frequency of vibration using an electromagnetic coil.

### ADVANTAGES AND LIMITATIONS

The Model 4200 Series Strain Gauges enjoy all the advantages of vibrating wire sensors, which includes excellent long term stability, maximum resistance to the effects of water, and a frequency output suitable for transmission over very long cables.

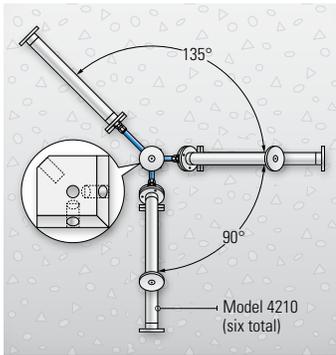
All components are made from stainless steel for corrosion protection and the gauges are fully waterproof. The Model 4210 is very rugged and

designed to withstand the rigors of concrete placement.

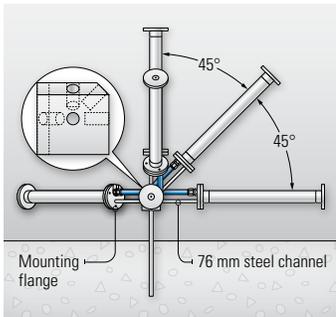
Each gauge incorporates a thermistor so that the temperature can be read and displayed by the readout.

Extended range, low modulus and high temperature versions are also available. The Model 4200-6 and 4200-7 are designed for measuring large strains, 5,000 and 10,000

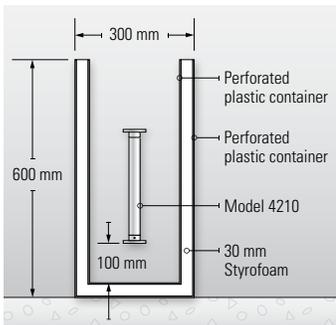
microstrain respectively. The Model 4200L (low modulus version) is particularly suitable for measuring curing strains in concrete. The Model 4200HT is designed for short-term use at temperatures up to 200 °C while the Model 4200HT-T is designed for long-term use at temperatures up to 220 °C, making it particularly suitable for installation in steam-cured spun concrete piles.



Top view of a Model 4210 Strain Gauge rosette configuration. Inset shows rosette fixture (enlarged for detail).



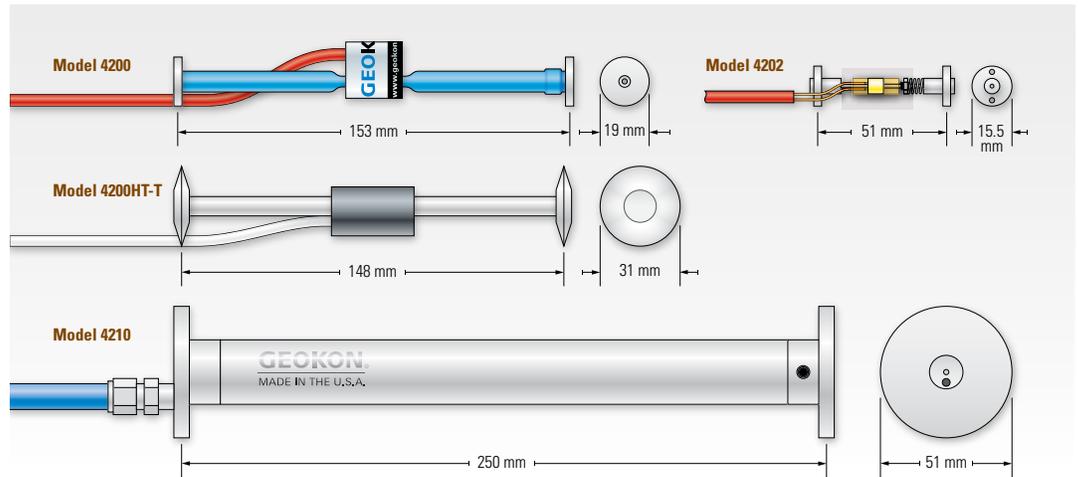
Front view of a Model 4210 Strain Gauge rosette configuration. Inset shows rosette fixture (enlarged for detail).



"No stress-strain" enclosure using the Model 4210.



Model 4200 Strain Gauge mounted to reinforcing bar using Model 4200-SPACER brackets.



Dimensions of the 4200 Series Strain Gauges.

### SYSTEM COMPONENTS

The strain gauges are shipped ready for installation with the correct amount of cable attached. Installation is accomplished by attaching the strain gauge onto, or suspending it between, reinforcing bar. In mass concrete, rosette fixtures are used to hold multiple strain gauges in different orientations, allowing the measurement of strain in multiple directions.

Also available are no stress-strain enclosures (double-wall plastic containers lined with Styrofoam) designed for use in concrete dams. These enclosures isolate one strain gauge from the stress field in the concrete, thereby allowing the effects of moisture, temperature, autogenous growth, etc., to be estimated and corrected.

All models are equipped with integral thermistors for the simultaneous measurement of temperature.

Model GK-404 and GK-406 Readouts can display the strain measured by Model 4200 Strain Gauges in microstrain. Other compatible readouts and dataloggers are shown in the ordering information below.

### TECHNICAL SPECIFICATIONS

	4200	4200-6/4200-7	4200L	4200HT	4200HT-T	4202	4204	4210
Range <sup>1</sup>	3000 $\mu\epsilon$	4200-6: 5000 $\mu\epsilon$ 4200-7: 10000 $\mu\epsilon$	3000 $\mu\epsilon$	3000 $\mu\epsilon$	3000 $\mu\epsilon$	3000 $\mu\epsilon$	3000 $\mu\epsilon$	3000 $\mu\epsilon$
Resolution	1.0 $\mu\epsilon$	2.0 to 5.0 $\mu\epsilon$	1.0 $\mu\epsilon$	1.0 $\mu\epsilon$	1.0 $\mu\epsilon$	0.4 $\mu\epsilon$	1.0 $\mu\epsilon$	0.4 $\mu\epsilon$
Accuracy <sup>2</sup>	$\pm 0.5\%$ F.S. <sup>3</sup>	$\pm 0.5\%$ F.S.	$\pm 0.5\%$ F.S. <sup>3</sup>	$\pm 0.5\%$ F.S. <sup>3</sup>	$\pm 0.5\%$ F.S.	$\pm 0.5\%$ F.S. <sup>3</sup>	$\pm 0.5\%$ F.S. <sup>3</sup>	$\pm 0.5\%$ F.S. <sup>3</sup>
Nonlinearity	< 0.5% F.S.	$\pm 2.5$ -4.0% F.S.	< 0.5% F.S.	< 0.5% F.S.	< 0.5% F.S.	< 0.5% F.S.	< 0.5% F.S.	< 0.5% F.S.
Coil Resistance	180 $\Omega$	180 $\Omega$	180 $\Omega$	120 $\Omega$	50 $\Omega$	50 $\Omega$	180 $\Omega$	180 $\Omega$
Frequency Datum <sup>4</sup>	800 Hz	800 Hz	800 Hz	800 Hz	800 Hz	2600 Hz	1250 Hz	2600 Hz
Thermal Coefficient of Expansion	12.2 ppm/ $^{\circ}$ C	variable	12.2 ppm/ $^{\circ}$ C	12.2 ppm/ $^{\circ}$ C	12.2 ppm/ $^{\circ}$ C	12.2 ppm/ $^{\circ}$ C	12.2 ppm/ $^{\circ}$ C	12.2 ppm/ $^{\circ}$ C
Temperature Range	-20 $^{\circ}$ C to +80 $^{\circ}$ C <sup>1</sup>	-20 $^{\circ}$ C to +80 $^{\circ}$ C <sup>1</sup>	-20 $^{\circ}$ C to +80 $^{\circ}$ C <sup>1</sup>	-20 $^{\circ}$ C to +200 $^{\circ}$ C	-20 $^{\circ}$ C to +220 $^{\circ}$ C	-20 $^{\circ}$ C to +80 $^{\circ}$ C <sup>1</sup>	-20 $^{\circ}$ C to +80 $^{\circ}$ C <sup>1</sup>	-20 $^{\circ}$ C to +80 $^{\circ}$ C <sup>1</sup>
Cable Type	4-conductor, 2 twisted pairs, 22 AWG (for all models)							
Cable Jacket	Red PVC, 4.75 mm $\varnothing$	Red PVC, 4.75 mm $\varnothing$	Red PVC, 4.75 mm $\varnothing$	White Teflon <sup>®</sup> , 5.20 mm $\varnothing$	White Teflon, 5.20 mm $\varnothing$	Red PVC, 4.75 mm $\varnothing$	Red PVC, 4.75 mm $\varnothing$	Blue PVC, 6.35 mm $\varnothing$
Active Gauge Length	153 mm (6.025")	153 mm (6.025")	153 mm (6.025")	153 mm (6.025")jin.)	148 mm (1.9")	51 mm (2")	102 mm (4.016")	250 mm (9.843")

<sup>1</sup>Other ranges available on request. | <sup>2</sup>Transducer accuracy established under laboratory conditions:  $\pm 0.5\%$  F.S. with standard batch calibration.

<sup>3</sup> $\pm 0.1\%$  F.S. with individual calibration. | <sup>4</sup>Typical. | <sup>5</sup>Other lengths available on request.



Model 4200-6 Extended Range (5,000 µε) Strain Gauge.



Model 4200-7 Extended Range (10,000 µε) Strain Gauge.



Model 4200L Low Modulus Strain Gauge.



Model 4200HT-T High Temp (220° C) Strain Gauge.



4200HT High Temp (200° C) Strain Gauge

## ORDERING INFORMATION<sup>1</sup>

**4200:** Vibrating Wire Strain Gauge, concrete embedment type, 153 mm gauge length. (Strain gauge only.)

**4200A-1:** Model 4200 Strain Gauge, complete with plucking coil, thermistor, hose clamp, and 3 m cable.

**4200A-2:** Model 4200 Strain Gauge, complete with plucking coil, thermistor and hose clamp. Cable sold separately.

**4200L:** Model 4200 Strain Gauge, low modulus version for measuring concrete curing strains, complete with plucking coil, thermistor, and hose clamp. Cable sold separately.

**4200-6:** Model 4200 Strain Gauge, 5,000 microstrain range, complete with plucking coil, thermistor and hose clamp. Includes individual calibration. Cable sold separately.

**4200-7:** Model 4200 Strain Gauge, 10,000 microstrain range, complete with plucking coil, thermistor and hose clamp. Includes individual calibration. Cable sold separately.

**4000-1:** Plucking coil, thermistor and hose clamp. Cable sold separately.

**4000-3:** Plucking coil, thermistor and hose clamp. Includes 3 m cable.

**4200-SPACER:** Pair of mounting brackets for attaching strain gauges to #4 through #11 reinforcing bar. Includes two 254 mm cable ties.

**4200ROS:** Model 4200 Strain Gauge for rosette mount, complete with plucking coil, thermistor and hose clamp. Cable sold separately.

**4200-3:** Rosette Mount for Model 4200ROS. Specify method of attachment to rosette.

**4200-4:** No-stress strain enclosure. Double-wall plastic container lined with Styrofoam. Allows a strain gauge to be isolated from the stress field in the concrete.

**4202:** Vibrating Wire Strain Gauge, concrete embedment type, 51 mm gauge length, complete with integral plucking coil and thermistor. Cable sold separately.

**4204A-1:** Vibrating Wire Strain Gauge, concrete embedment type, 102 mm gauge length, complete with plucking coil, thermistor, hose clamp, and 3 m cable.

**4204A-2:** Vibrating Wire Strain Gauge, concrete embedment type, 102 mm gauge length, complete with plucking coil, thermistor and hose clamp. Cable sold separately.

**4204L:** Vibrating Wire Strain Gauge, low modulus version for measuring concrete curing strains, 102 mm gauge length, complete with plucking coil, thermistor and hose clamp. Cable sold separately.

**02-187V3:** Red PVC Cable, 4.75 mm (±0.25 mm) [0.187"] Ø, 2 twisted pairs, for the above.

**4210:** Vibrating Wire Strain Gauge, concrete embedment type, 250 mm gauge length, complete with integral plucking coil and thermistor. Cable sold separately.

**4210-1:** Rosette Mount for Model 4210. Specify method of attachment to rosette.

**4210-2:** No-stress strain enclosure for 250 mm gauge. Double-wall plastic container lined with Styrofoam. Allows a strain gauge to be isolated from the stress field in the concrete.

**2-250V6-E:** Blue PVC Cable, 6.35 mm (±0.25 mm) [0.250"] Ø, 2 twisted pairs, for the above.

**4200HT:** Vibrating Wire Strain Gauge, High Temperature (200°C), concrete embedment type, 6" gauge length, complete with integral plucking coil, high temperature thermistor. For short-term use.

**4200HT-T:** Vibrating Wire Strain Gauge, High Temperature (220°C), concrete embedment type, 6" gauge length, complete with integral plucking coil, high temperature thermistor. For long-term use.

**02-250T:** White Teflon Cable, 5.20 mm (±0.25 mm) [0.156"] Ø, 2 twisted pairs, for the above.

<sup>1</sup>Unless otherwise specified, strain gauges are batch calibrated. Individual calibrations are available upon request for an additional fee.

## COMPATIBLE READOUTS AND DATALOGGERS

**GK-404:** Handheld Readout

**GK-406:** Vibrating Wire Analyzer

**8600 Series:** Multi-Channel Dataloggers

**8800 and 8900 Series:** GeoNet Wireless Data Acquisition System

**8920 and 8930 Series:** GeoNet Cellular and Wi-Fi Network Loggers

**8940 Series:** GeoNet Dataloggers

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