

## Applications

For the measurement of strain in concrete.  
Primarily designed to be installed prior to concrete pour, in:

- Piles.
- Beams.
- Bridges.
- Foundation slabs.
- Tunnel Segments.

### Operating Principle

Internal deformations (strain) of a concrete mass are measured using a vibrating strain wire element, sealed within a gauge tube and tensioned between two end flanges.

With the gauge embedded within concrete, deformation of the concrete mass causes the two gauge flanges to move relative to one another, thus altering the tension in the steel wire.

As the wire tension changes, its natural frequency of vibration changes.

An externally mounted, housed electromagnetic excitation coil, within a sealed PVC housing at the mid-point of the gauge tube, is used to excite the strain wire.

Connected by tough 4-core, screened cable, the coil is activated by an electrical pulse from a vibrating wire readout, which then measures the resulting frequency of vibration. Using a gauge factor, the measured frequency may be converted directly into units of strain.

Of stainless steel construction, the 150mm active length gauges may be pre-attached to rebar or tensioning cables either by tie wire wrapped around the heat shrink sleeved gauge tube or by attachment to a 2,3 or 4 directional rosette, thereby measuring strain in several directions.

Alternatively, the gauge may be pre-cast into a concrete brickette, for subsequent casting into the structure, or grouting into holes drilled into existing structures.

# Vibrating Wire Embedment Strain Gauge

Frequency readings may be taken manually with a portable Soil Instruments Model 1030 vibrating wire logger or automatically and remotely, with a Campbell Scientific data logger.

Additionally, recorded data may be imported automatically into I-Site software for tabular and graphical data presentation.

Long cable lengths may be used without significant deterioration of signal quality.

Attached cable lengths are user specified.

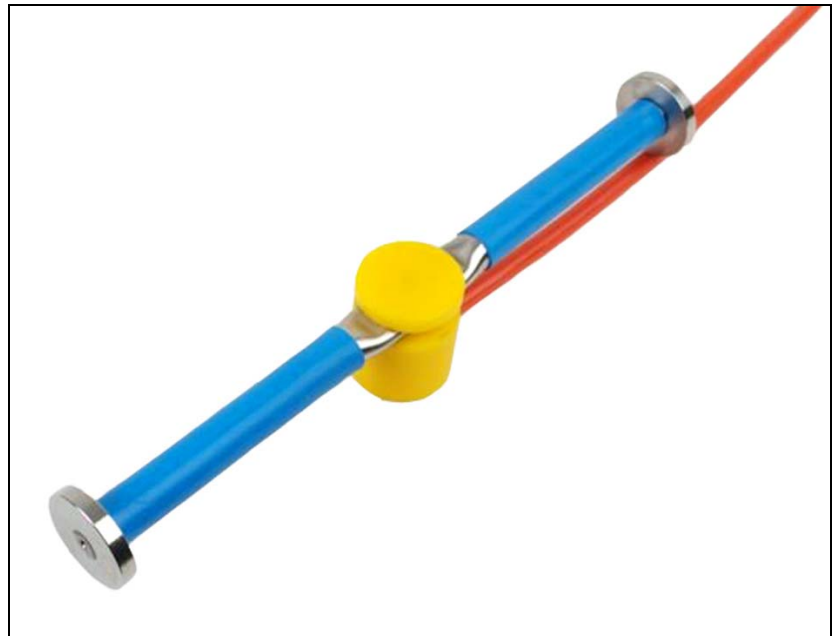
The gauge combines accuracy, sensitivity and long-term stability with a rugged and waterproof construction.

Pressure testing is to 15 bar. Over-voltage protection is provided at the gauge coil by a gas tube arrestor.

The gauge may be supplied set for mid-range, providing either extension or compression measurements or set for compression only.

### Advantages and Limitations

- Simple in principle.
- Accurate and sensitive.
- Waterproof.
- Suitable for long cable lengths.
- Long-term stability.
- Degree of care required to avoid mechanical damage during embedment.
- Integral Thermistor.



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**DATA SHEET  
ST4**

# Specification

## 1. Embedment Strain Gauge

### Strain Gauge

Stainless steel gauge tube and gauge flanges.

Carbon steel strain wire.

PVC, resin-potted coil housing.

Heat shrink sleeved gauge tube.

153mm active length.

19mm diameter gauge flanges.

Set mid-range or for compression.

### Rosettes

PVC adapter blocks machined to receive up to 4 strain gauges at 45° to each other in one plane.

Push-fit ensures gauges are firmly located.

### Portable VW Loggers

See Datasheet RO1-VW.

### Terminal Boxes

See Datasheet RO-TB.

### Dataloggers

See Datasheet D1.

### Software

See Datasheet D2.

### Cable

See Datasheet CA1.

## 2. System Performance

### Active Gauge Length

153mm

### Range

Max strain range: 3000µS

### Sensitivity

1.0µS

### Accuracy

±0.1% FS

### Thermal coefficient of expansion

12 ppm/°C

### Temperature Range

PWLS: -20 to +80°C

### Gauge Equation

$$\partial\epsilon = k \times (f_1^2 - f_2^2) \times 10^{-3}$$

where:

$\partial\epsilon$  is strain change

k is calibration factor

f1 is datum frequency in Hz

f2 is loaded frequency in Hz

Note: Positive sign indicates compressive strain.

## 3. Ordering Information

### ST4-1 Embedment Strain Gauge

ST4-1.1 ESG set for Mid-Range

ST4-1.2 ESG set for Compression

### ST4-2 Rosettes

ST4-2.1 Rosette 2 direction

ST4-2.2 Rosette 3 direction

ST4-2.3 Rosette 4 direction

### CA1 Cable and Fittings

CA-3.1-4-IC 4 core screened

CA1-4.1 Joint sealing kit



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