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 midpoint 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.

Frequency readings maybe 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 maybe imported automatically into I-Site software for tabular and graphical data presentation.

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.
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**
\[ \Delta \varepsilon = k \times (f_1^2 - f_2^2) \times 10^{-3} \]

where:
- \( \Delta \varepsilon \) is strain change
- \( k \) is calibration factor
- \( f_1 \) is datum frequency in Hz
- \( f_2 \) 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