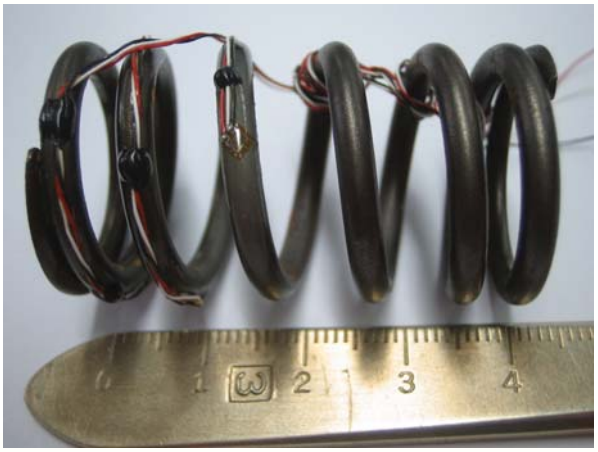
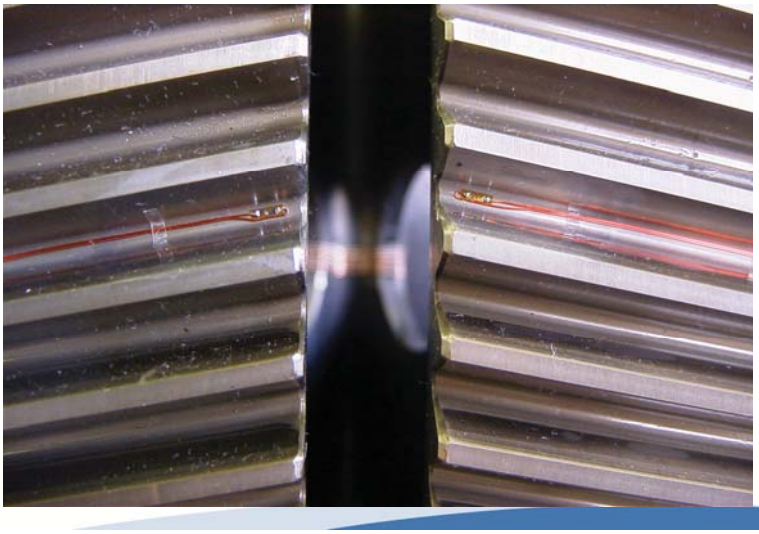
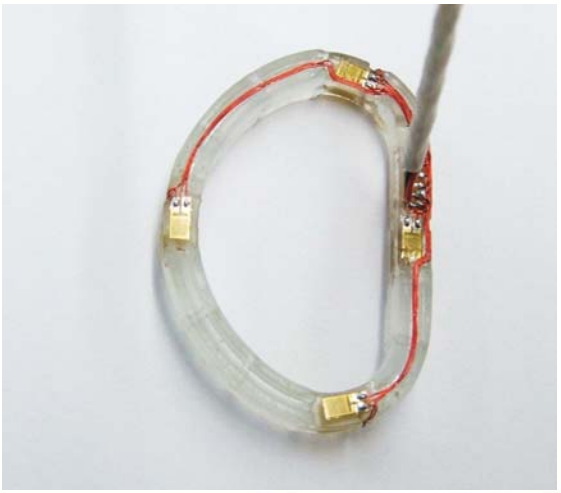
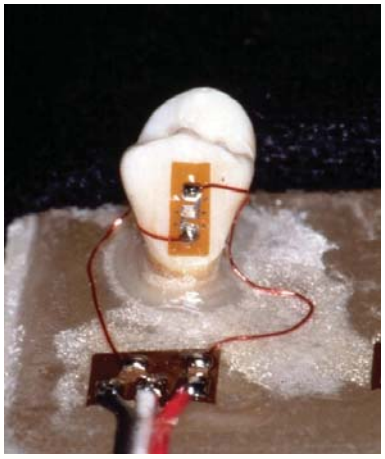
Vishay Measurements Group UK Limited

Experimental Mechanics 2018









Strain Definition

Strain is defined as the ratio of the change in length to the original length

$$Strain, \varepsilon = \frac{change\ in\ length}{original\ length} = \frac{\Delta L}{L}$$

Strain Definition

Micro Strain, με = 0.000001 Metres/ Metre, inches/inch

1 micron in a metre = 6nm on a 6mm gauge!

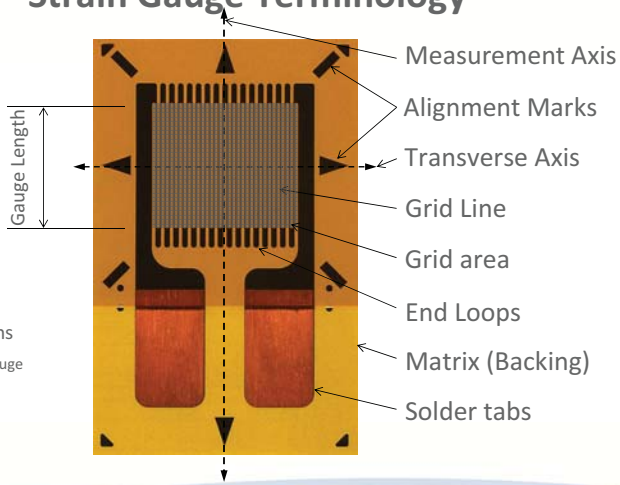
Visible light is 400-700nm

1% Elongation = 10,000 με

0.1% Elongation = 1,000 με

1,000με - 1,200με = Yield point of Mild Steel

Strain Gauge Terminology



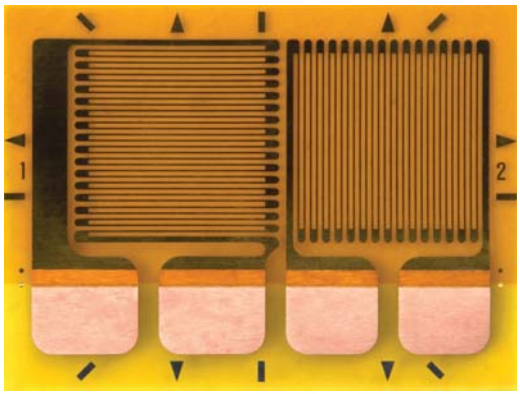
Foil = 5 microns

Matrix = 25 microns

(typical – varies with gauge type)

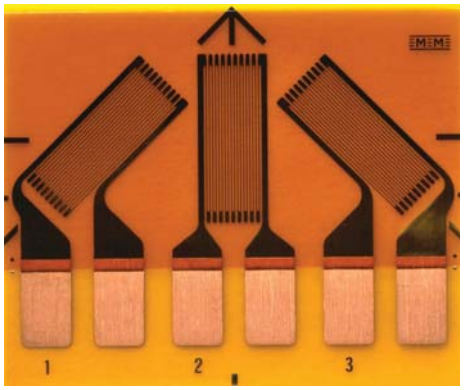
Strain Gauge Patterns

'T' Rosette



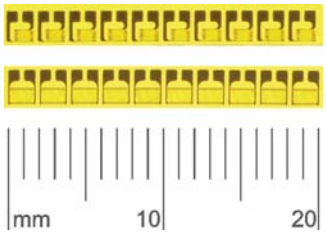
Strain Gauge Patterns

3 Element 45 degree Rosette



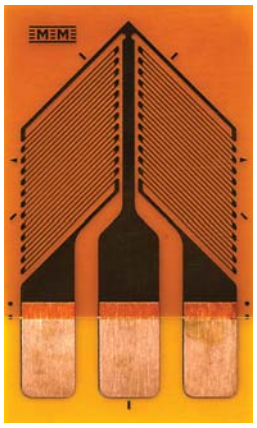
Strain Gauge Patterns

Strip Gauge



Strain Gauge Patterns

Shear or Torsional Gauge 1/2 Bridge



Strain Gauge Patterns

Common Resistances

120 Ohms
350 Ohms (most common)
1,000 Ohms
5,000 Ohms

Gauge Factor
(sensitivity/calibration factor)

$$K = \frac{\Delta R/R}{\Delta L/L}$$

Where: L = Initial Length of Installed Gauge
R = Initial Resistance of Installed Gauge
ΔL = Change in Length
ΔR = Change in Resistance

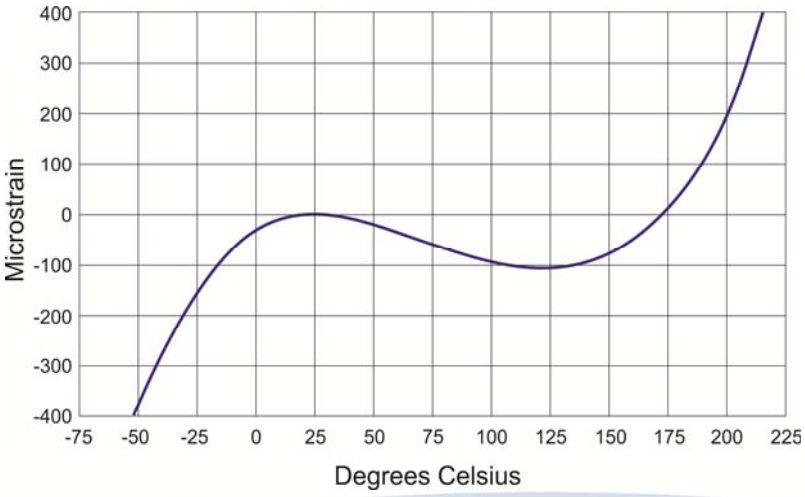
Resistance Change per microstrain

$$\Delta R = K\varepsilon R$$

$$\Delta R = 2.1E^{-6}.350$$

$$= 0.0007\Omega$$

Thermal Output



Surface Preparation

- Chemical compatibility
- Minimum material removal
  - Avoid broken fibres
- Smooth or textured

Common Adhesives

(more than 20 available)

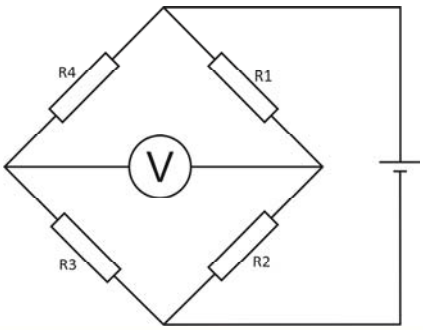
- Instant
  - M-Bond-200 (Cyanoacrylate)
    - Short term (up to 1 year)
- Cold Cure
  - M-Bond-AE10 (100% Solids Epoxy)
    - Long term (20+ years), moisture resistant, gap filling
- Heat Cure
  - M-Bond-610 (Solvent-thinned Epoxy Phenolic)
    - Long term (30+ years), wide temperature range, ideal for transducers

Common Protective Coatings

(more than 20 available)

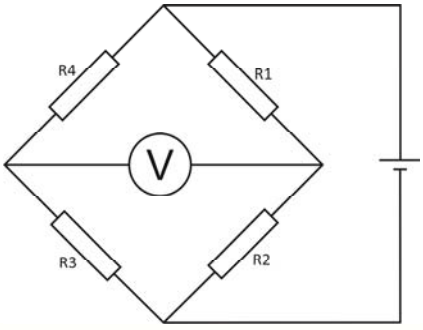
- Laboratory
  - Polyurethane, Acrylic
    - M-Coat A, D
- Field Applications
  - Butyl, Polysulphide, Silicone
    - M-Coat F, J, 3145

The Wheatstone Bridge



Sir Charles Wheatstone
1802-1875

The Wheatstone Bridge

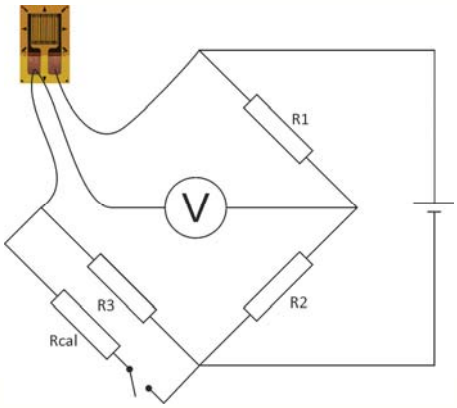


$$Vout = \frac{KV\varepsilon N}{4}$$

K = gauge factor
V = excitation voltage
ε = strain
N = number of active arms

Shunt Calibration

$$\mu\varepsilon_{cal}=\frac{R3}{K(R_{cal}+R3)}x10^{6}$$



Instrumentation

- Variable Bridge Excitation
  - Minimise grid power density
    - 2V maximum
- Should Accept Common Resistances
  - 350 ohms
  - 1000 ohm
- Easy to use

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