ESA MESSTECHNIK GMBH

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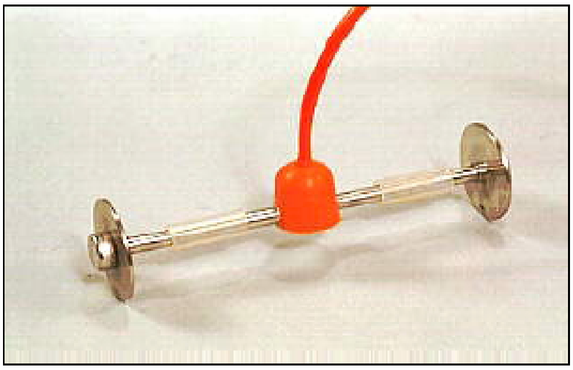
VIBRATING WIRE STRAIN GAUGE

TECHNICAL DATA SHEET



TES/5.5/T

The type TES/5.5/T embedment vibrating wire strain gauge for concrete is based on a design by the Road Research Laboratory in the UK. Gauges of this type have been used successfully, worldwide, for the past 40 years, in major Civil Engineering projects such as the Channel Tunnel UK, & Storæbelt Crossing Denmark.
Typical applications include pre-cast tunnel linings, concrete bridge sections, dams and concrete creep tests.
The gauges are suitable for long term use, the oldest working examples are currently over 30 years old.

TECHNICAL SPECIFICATION

Gauge Type:	TES/5.5/T embedment strain gauge.	
Gauge Length:	5.5 inches.	
Gauge factor:	3.025 x 10^{-3} microstrain per frequency squared.	
Measurement range:	Greater than 3000 microstrain.	
Resolution:	Better than 1 microstrain.	
Coil Resistance:	Approximately 100 or 150 ohms.	
Operating temperature range:	From -20^{0}C to 80^{0}C.	
Thermal coefficient of vibrating wire:	11 ppm per ^{0}C.	
Thermistor temperature sensor:	Optional (type TES/5.5/T).	
Cable diameter:	4.5 millimetres.	
Cable colour code:	Brown	Coil +ve.
	Blue	Coil -ve.
	Yellow	Thermistor (optional).
	Green	Thermistor (optional).

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The Vibrating Wire Equation

The change in engineering units, microstrain (με), is given by the following expression:

$$\mu\varepsilon = (F_1^2 - F_2^2) \times GF$$

where, F_1 = the initial or Datum frequency reading
F_2 = a subsequent measured frequency
GF = the appropriate Gauge Factor for the gauge.

This equation may be expressed in terms of period reading (T), as displayed by the GT1174 Miniature Strain Meter:

$$\mu\varepsilon = \left(\frac{10^{14}}{T_1^2} - \frac{10^{14}}{T_2^2}\right) \times GF$$

where, T_1 = the initial or Datum period reading
T_2 = a subsequent measured period reading.

Note: A positive change in microstrain indicates a compressive strain change.

Measurement Range and Resolution

The following table gives typical upper limit, lower limit, mid range values to 5 significant figures, and resolutions in microstrain, for all strain gauges of the same gauge length:

TES/5.5/T
Gauge Length (GL), 5.5 inches
Gauge Factor (GF), $3.025e^{-3}$ Microstrain per Frequency squared

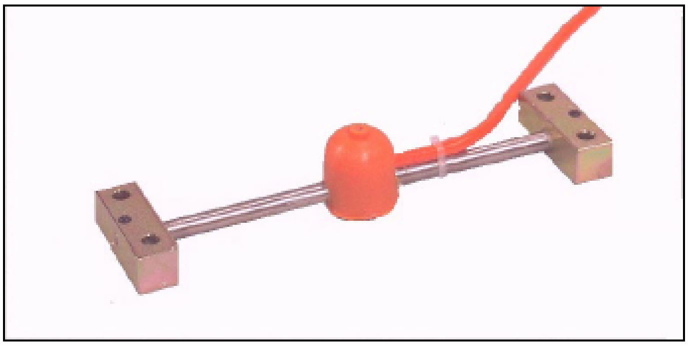
	T	F	Lin.	Change με	Resolution GT1174	Resolution GT1192
Upper limit	08500	1176.5	1384.1	-1489.5	0.98	0.71
Mid range	10590	944.29	891.68	0.0	0.51	0.06
Lower limit	16000	625.00	390.63	1515.7	0.15	0.04

Notes.

* The Period (T) is the reading as displayed by the GT1174 Miniature Strain Meter in seconds x 10^{-7}.
* The Frequency (F) is the reading as displayed by the GT1192/615 Geologger in hertz and is equivalent to $10^7/T$.
* The Linear value (Lin.) is $F^2/1000$ and is equivalent to $10^{11}/T^2$.
* The microstrain Change (με) is derived from the Vibrating Wire Equation.
* The Resolution is given in microstrain. It is the resulting change in microstrain for a least significant digit change in the reading as displayed by the GT1174 or GT1192. Resolution varies over the frequency range of the gauge, and is related to the parameter being measured by the readout unit (period, frequency or linear value).

Vibrating Wire Strain Gauge

Surface Mounting Gauge



TSR/5.5/T Surface Mounted Strain Gauge

Gauge Type:	TSR/5.5/T surface mounting strain gauge.
Gauge Length:	5.5 inches.
Gauge factor:	3.025 x 10^{-3} microstrain per frequency squared.
Measurement range:	Greater than 3000 microstrain.
Resolution:	Generally better than 1 microstrain.
Coil Resistance:	Approximately 100 ohms.
Operating temperature range:	From -20^{0}C to 80^{0}C.
Thermal coefficient of vibrating wire:	11 ppm per ^{0}C.
Thermistor temperature sensor:	Optional.
Cable diameter:	4.5 millimetres.

Cable colour code:		
	Brown	Coil +ve.
	Blue	Coil -ve.
	Yellow	Thermistor (optional).
	Green	Thermistor (optional).

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THE VIBRATING WIRE EQUATION

The change in engineering units, microstrain (**με**), is given by the following expression:

$$\mu\varepsilon = (F_1^2 - F_2^2) \times GF$$

where,
F_1 = the initial or Datum frequency reading
F_2 = a subsequent measured frequency
GF = the appropriate Gauge Factor for the gauge.

This equation may be expressed in terms of period reading (T), as displayed by the GT1174 Miniature Strain Meter:

$$\mu\varepsilon = \left(\frac{10^{14}}{T_1^2} - \frac{10^{14}}{T_2^2} \right) \times GF$$

where,
T_1 = the initial or Datum period reading
T_2 = a subsequent measured period reading.

Note: A positive change in microstrain indicates a compressive strain change.

MEASUREMENT RANGE AND RESOLUTION

The following table gives typical upper limit, lower limit, mid range values to 5 significant figures, and resolutions in microstrain, for all strain gauges of the same gauge length:

TSR/5.5/BG/T
Gauge Length (GL), 5.5 inches
Gauge Factor (GF), 3.025e-3 Microstrain per Frequency squared

	T	F	Lin.	Change με	Resolution (με) GT1174	Resolution (με) GT1192
Upper limit	08500	1176.5	1384.1	-1489.5	0.98	0.71
Mid range	10590	944.29	891.68	0.0	0.51	0.06
Lower limit	16000	625.00	390.63	1515.7	0.15	0.04

NOTES.

- The Period (T) is the reading as displayed by the GT1174 Miniature Strain Meter in units of seconds x 10^{-7}.
- The Frequency (F) is the reading as displayed by the GT1192/615 Geologger in hertz and is equivalent to $10^7/T$.
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The Resolution is given in microstrain. It is the resulting change in microstrain for a least significant digit change in the reading as displayed by the GT1174 or GT1192. Resolution varies over the frequency range of the gauge, and is related to the parameter being measured by the readout unit (period, frequency or linear value).