Epsilon technology corp

Guide

Extensometer “Gage Factors”

Using extensometers with data acquisition systems designed for use with strain gages

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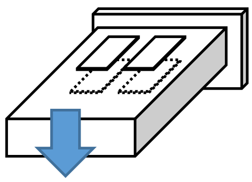
Typical use of strain gage Gage Factor

Gage Factor (GF) for strain gages is a measure of gage sensitivity, relating electrical output to indicated strain; typically in the range of 2.0-3.0. The relationship also depends on the physical configuration of the gaged elements. For a full-bridge type I configuration, the corresponding conversion relationships is:

Full-bridge type I configuration



$$\varepsilon_{gage} = \frac{v_{ratio}}{GF} \quad \text{, where } v_{ratio} = \frac{V_{indicated}}{V_{excitation}}.$$

However, these equations relate to the indicated superficial strain on the *bending element*, not the strain indicated by the *extensometer*. The gage factor of the strain gages is not a directly useful metric *once the sensing element is built into a completed extensometer*; additional scaling must be applied. Three methods are described below. Available / preferred methods may depend on the Data Acquisition System (DAQ).

Method 1 – Direct conversions to strain

If the DAQ reports ratiometric bridge output (v_{ratio}) directly, the transducer has a fixed gage length, and output units of *strain* are desired, output may be converted to strain without using a gage factor as follows:

$$\varepsilon(mm/mm) = \frac{v_{ratio}\,(mV/V)}{k\,(mV/V/mm) * GL(mm)}$$

ⓘ *Best-fit slope **k** may be found on the Epsilon Test Certificate provided with the transducer.*

Method 2 – Direct conversions to elongation

If the DAQ reports ratiometric bridge output (v_{ratio}) directly, it may also be converted to *elongation* without using a gage factor as follows:

$$\Delta L(mm) = \frac{v_{ratio}\,(mV/V)}{k\,(mV/V/mm)}$$

This method is useful where the transducer does not have a fixed gauge length, and/or where output units of *elongation / deflection* are preferred.

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Method 3 – Using a simulated gage factor

If the DAQ reports output in units of strain and requires the use of a gage factor, a simulated gage factor may be calculated by combining the equations above, again assuming a full-bridge type I configuration Wheatstone Bridge. Note the conversion of units from mV/V to V/V:

$$GF' = k\ (mV/V/mm) * GL(mm) * 0.001\ V/mV$$

Example:

From Epsilon Test certificate:

Best fit slope ***k*** (mV/V/mm)	0.5093
Gage Length (mm)	25

Calculate GF':

GF'=0.5093*25*.001 = 0.0127 (*unitless*)

Fixed Gage Factor DAQs

Some DAQ assume a fixed GF of 2.0 (a typical value). A post-hoc correction may be made:

$$\varepsilon_{corrected} = \varepsilon_{indicated}\frac{GF_{Nominal}}{GF'} = \varepsilon_{indicated}\frac{2.0}{GF'}$$

Gage Resistance & Excitation Voltage

Typically 350Ω / 175Ω for single- and dual-bridge transducers, but the gage resistance is generally not significant in the strain calculation. 2-12V excitation is typically acceptable, and will typically not affect the strain calculation when ratiometric units are used as above.

Quarter-bridge and half-bridge DAQ

All of Epsilon's strain-gaged transducers are configured as full-bridge or dual-bridge devices in type I configuration. DAQ designed for use with individual strain gages in quarter-bridge or half-bridge configuration may not be suitable for use with extensometers.

Verification

Regardless of the method is used, the calibration should be verified to ensure accuracy. See General Information Manual for Strain-Gaged Extensometers for details regarding spot-check verification using Epsilon Shunt – a simple method for minimal verification – and other verification methods.

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