Solutions to Problem Set 3

1. The resistance of the strain gauge at zero strain is given as 350Ω. The resistance at other strains may be determined from the definition of the gauge factor

$$R_2 = 350\Omega + \gamma \frac{\Delta L}{L} 350\Omega = 350\Omega\left(1 + 2.12\frac{\Delta L}{L}\right)$$

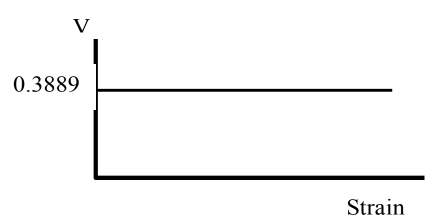
Since this is a linear relationship, if we find one other point we have defined the line on the plot. At the maximum strain of 15 microstrain

$$R_2 = 350\Omega\left(1 + 2.12\left(15x10^{-6}\right)\right) = 350.01113\Omega$$

The voltage out from the circuit is

$$V = \frac{R_2}{R_1 + R_2}E$$

at zero strain this is



$$V = \frac{350\Omega}{1{,}000\Omega + 350\Omega}1.5V = 0.3888889\,V$$

at 15 microstrain this becomes

$$V = \frac{350.011\Omega}{1{,}000\Omega + 350.011\Omega}1.5V = 0.3888981\,V$$

This is not much of a change, but it is typical for foil strain gauges

The sensitivity is the slope of the line

$$m = \frac{0.000009211\,V}{15\ microstrain} = 0.614\frac{V}{microstrain}$$

The intercept is the voltage output at zero strain.

3. The resistance increase of R_2 is so small at 9 microstrain, we will consider it to be 350Ω. The Thevinen voltage will be the no strain voltage from problem 1, and the Thevinen resistance will be the resistance seen at the output terminals when all voltage sources are shorted out. Thus, the Thevinen resistance will be the parallel combination of R_1 and R_2.

$$R_{Th} = \frac{R_1 R_2}{R_1 + R_2} = \frac{1{,}000\Omega(350\Omega)}{1{,}350\Omega} = 259\Omega$$

The Thevinen equivalent circuit is then