Conversion equations for current to mass loss rate

Free Corrosion $MR_c = 17.7059\, I_{rms}\ (g/(m^2 \cdot a))$

Galvanic Corrosion $MR_g = 21.661\, I_g\ (g/m^2 \cdot a)$

Free Corrosion Conversion

The Acuity LS monitoring system reports free corrosion current (µA) as a response to a sinewave excitation of 20 mVpp at a frequency of 0.5 Hz. This allows for output of a corrosion current measurement that is independent of the electrode area and alloys used as the sensing elements.

Conversion of the measurements to units used within ISO 9223 "Corrosivity of atmospheres — Classification, determination and estimation" requires post processing of the current measurements. Luna can provide an executable file to accomplish this conversion automatically for specific sensor geometries fabricated from engineering alloys with known corrosion properties.

For Acuity LS AA7075 free corrosion sensors

Free corrosion current – I_{rms} (µA); data output from Acuity LS

Free corrosion rate – i_{corr} (µA/cm^2); calculated using alloy corrosion properties and electrode area

$$i_{corr} = \frac{\beta I_{rms}}{0{,}5\, V_{rms} A}$$

$$i_{corr} = 0.5655\, I_{rms}\ (\mu A/cm^2)$$

Free corrosion mass rate (MR_c) is calculated using Faraday's Law according to ASTM G102 with a conversion from days (d) to years (a)

$$MR_c = K_2\, i_{corr} EW$$

$$MR_c = 31.31\, i_{corr}\ (g/m^2 \cdot a)$$

Free corrosion mass rate (MR_c) is calculated using Faraday's Law according to ASTM G102 with a conversion from days (d) to years (a)

$$MR_c = 17.7059\, I_{rms}\ (g/(m^2 \cdot a))$$

The free corrosion mass rate of AA7075 can be used to estimate the ISO 9223 corrosivity categories for aluminum. Note that ISO 9223 corrosivity categories are based on one year average corrosion from mass loss coupons. The Acuity LS sensors will produce instantaneous corrosion rates that may be much higher than the one year average rates, and comparisons between Acuity LS data and ISO 9223 should utilize longer term averages on the order of weeks to months.

Galvanic Corrosion Conversion

For Acuity LS AA7075 galvanic corrosion sensors

Galvanic corrosion current – I_g (µA); data output from Acuity LS

Galvanic corrosion rate – i_g (µA/cm^2); calculated using galvanic current and electrode area

$$i_g = \frac{I_g}{A}\ (\mu A/cm^2)$$

$$i_g = 0.6918\, I_g\ (\mu A/cm^2)$$

Galvanic corrosion mass rate (MR_g) is calculated using Faraday's Law according to ASTM G102 with a conversion from days (d) to years (a).

$$MR_g = K_2\, i_g EW$$

$$MR_g = 31.33\, i_g\ (g/m^2 \cdot a)$$

Free corrosion mass rate (MR_c) is calculated using Faraday's Law according to ASTM G102 with a conversion from days (d) to years (a)

$$MR_g = 21.661\, I_g\ (g/m^2 \cdot a)$$

The galvanic corrosion mass rates of AA7075 will be higher than the ISO 9223 corrosivity categories for free corrosion of aluminum. The Acuity LS sensors will produce instantaneous galvanic corrosion rates that may be much higher than long term average mass loss rates. Comparisons between Acuity LS data and ISO 9223 should utilize longer term averages on the order of weeks to months.