



Standard Practice for Calculation of Corrosion Rates and Related Information from Electrochemical Measurements¹

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^{ε1} NOTE—Editorially corrected the legend below Eq 1 in 4.1 in November 2015.

1. Scope

1.1 This practice covers the providing of guidance in converting the results of electrochemical measurements to rates of uniform corrosion. Calculation methods for converting corrosion current density values to either mass loss rates or average penetration rates are given for most engineering alloys. In addition, some guidelines for converting polarization resistance values to corrosion rates are provided.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 ASTM Standards:²

D2776 Methods of Test for Corrosivity of Water in the Absence of Heat Transfer (Electrical Methods) (Withdrawn 1991)³

G1 Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens

G5 Reference Test Method for Making Potentiodynamic Anodic Polarization Measurements

G59 Test Method for Conducting Potentiodynamic Polarization Resistance Measurements

3. Significance and Use

3.1 Electrochemical corrosion rate measurements often provide results in terms of electrical current. Although the con-

version of these current values into mass loss rates or penetration rates is based on Faraday's Law, the calculations can be complicated for alloys and metals with elements having multiple valence values. This practice is intended to provide guidance in calculating mass loss and penetration rates for such alloys. Some typical values of equivalent weights for a variety of metals and alloys are provided.

3.2 Electrochemical corrosion rate measurements may provide results in terms of electrical resistance. The conversion of these results to either mass loss or penetration rates requires additional electrochemical information. Some approaches for estimating this information are given.

3.3 Use of this practice will aid in producing more consistent corrosion rate data from electrochemical results. This will make results from different studies more comparable and minimize calculation errors that may occur in transforming electrochemical results to corrosion rate values.

4. Corrosion Current Density

4.1 Corrosion current values may be obtained from galvanic cells and polarization measurements, including Tafel extrapolations or polarization resistance measurements. (See Reference Test Method **G5** and Practice **G59** for examples.) The first step is to convert the measured or estimated current value to current density. This is accomplished by dividing the total current by the geometric area of the electrode exposed to the solution. The surface roughness is generally not taken into account when calculating the current density. It is assumed that the current distributes uniformly across the area used in this calculation. In the case of galvanic couples, the exposed area of the anodic specimen should be used. This calculation may be expressed as follows:

$$i_{\text{cor}} = \frac{I_{\text{cor}}}{A} \quad (1)$$

where:

i_{cor} = corrosion current density, $\mu\text{A}/\text{cm}^2$,
 I_{cor} = total anodic current, μA , and

¹ This practice is under the jurisdiction of ASTM Committee **G01** on Corrosion of Metals and is the direct responsibility of Subcommittee **G01.11** on Electrochemical Measurements in Corrosion Testing.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.