



Standard Guide for On-Line Monitoring of Corrosion in Plant Equipment (Electrical and Electrochemical Methods)¹

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^{ε1} NOTE—The Appendix section was editorially corrected in October 2001.

1. Scope

1.1 This guide outlines the procedure for conducting on-line corrosion monitoring of metals in plant equipment under operating conditions by the use of electrical or electrochemical methods. Within the limitations described, these test methods can be used to determine cumulative metal loss or instantaneous corrosion rate, intermittently or on a continuous basis, without removal of the monitoring probes from the plant.

1.2 The following test methods are included: Test Method A for electrical resistance, and Test Method B for polarization resistance.

1.2.1 Test Method A provides information on cumulative metal loss, and corrosion rate is inferred. This test method responds to the remaining metal thickness except as described in Section 5.

1.2.2 Method B is based on electrochemical measurements for determination of instantaneous corrosion rate but may require calibration with other techniques to obtain true corrosion rates. Its primary value is the rapid detection of changes in the corrosion rate that may be indicative of undesirable changes in the process environment.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* Specific precautionary statements are given in 5.6.

2. Referenced Documents

2.1 ASTM Standards:

D 1125 Test Methods for Electrical Conductivity and Resistivity of Water²

G 1 Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens³

G 3 Practice for Conventions Applicable to Electrochemical

Measurements in Corrosion Testing³

G 4 Guide for Conducting Corrosion Tests in Field Applications³

G 15 Terminology Relating to Corrosion and Corrosion Testing³

G 59 Test Method for Conducting Potentiodynamic Polarization Resistance Measurements³

G 102 Practice for Calculation of Corrosion Rates and Related Information from Electrochemical Measurements³

3. Terminology

3.1 *Definitions*—See Terminology G 15 for definitions of terms used in this guide.

4. Summary of Guide

4.1 *Test Method A—Electrical Resistance*—The electrical resistance test method operates on the principle that the electrical resistance of a measuring element (wire, strip, or tube of metal) increases as its cross-sectional area decreases:

$$R = \sigma \frac{l}{A} \quad (1)$$

where:

R = resistance,

σ = resistivity of metal (temperature dependent),

l = length, and

A = cross-section area.

In practice, the resistance ratio between the measuring element exposed to corrosion and the resistance of a similar reference element protected from corrosion is measured, to compensate for resistivity changes due to temperature. Based on the initial cross-sectional area of the measurement element, the cumulative metal loss at the time of reading is determined. Metal loss measurements are taken periodically and manually or automatically recorded against a time base. The slope of the curve of metal loss against time at any point is the correction rate at that point. The more frequently measurements are taken, the better is the resolution of the curve from which the corrosion rate is derived.

4.1.1 The electrical resistance of the metal elements being measured is very low (typically 2 to 10 mΩ). Consequently, special measurement techniques and cables are required to

¹ This guide is under the jurisdiction of ASTM Committee G01 on Corrosion of Metals and is the direct responsibility of ASTM Subcommittee G01.12 on In-Plant Corrosion Tests.

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² *Annual Book of ASTM Standards*, Vol 11.01.

³ *Annual Book of ASTM Standards*, Vol 03.02.