



## Standard Test Method for Measurement of Corrosion Potentials of Aluminum Alloys<sup>1</sup>

This standard is issued under the fixed designation G 69; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This test method is a procedure for measurement of the corrosion potential (see Note 1) of an aluminum alloy in an aqueous solution of sodium chloride with enough hydrogen peroxide added to provide an ample supply of cathodic reactant.

NOTE 1—The corrosion potential is sometimes referred to as the open-circuit solution or rest potential.

1.2 *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.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

D 1193 Specification for Reagent Water<sup>2</sup>

### 3. Significance and Use

3.1 The corrosion potential of an aluminum alloy depends upon the amounts of certain alloying elements that the alloy contains in solid solution. Copper and zinc, which are two of the major alloying elements for aluminum, have the greatest effect with copper shifting the potential in the noble or positive direction, and zinc in the active or negative direction. For example, commercially unalloyed aluminum (1100 alloy)<sup>3</sup> has a potential of –750 mV when measured in accordance with this practice, 2024–T3 alloy with nearly all of its nominal 4.3 % copper in solid solution, a potential of –600 to –620 mV (Note 2), and 7072 alloy with nearly all of its nominal 1.0 % zinc in solid solution, a potential of –885 mV (SCE) (1-3).<sup>4</sup>

NOTE 2—The potential depends upon the rate of quenching.

3.2 Because it reflects the amount of certain alloying elements in solid solution, the corrosion potential is a useful tool

for characterizing the metallurgical condition of aluminum alloys, especially those of the 2XXX and 7XXX types, which contain copper and zinc as major alloying elements. Its uses include the determination of the effectiveness of solution heat treatment and annealing (1), of the extent of precipitation during artificial aging (4) and welding (5), and of the extent of diffusion of alloying elements from the core into the cladding of alclad products (2).

### 4. Apparatus

4.1 The apparatus consists of an inert container for the test solution, a mechanical support for the test specimens that insulates them electrically from each other and from ground, saturated calomel electrode (SCE) (see Note 3), wires and accessories for electrical connections, and equipment for the measurement of potential.

NOTE 3—Saturated calomel electrodes are available from several manufacturers. It is a good practice to ensure the proper functioning of the reference electrode by measuring its potential against one or more reference electrodes. The potential difference should not exceed 2 or 3 mV.<sup>5</sup>

4.2 A high-impedance ( $>10^{12}\Omega$ ) voltmeter is suitable for measurement of the potential. Measurement of this potential should be carried out to within  $\pm 1$  mV. Automatic data recording systems may be used to permit the simultaneous measurement of many specimens and the continuous recording of corrosion potentials.

### 5. Reagents

5.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.<sup>6</sup> Other grades may be used, provided it is first ascertained that the reagent is of sufficiently high purity to permit its use without lessening the accuracy of the determination.

<sup>1</sup> This practice is under the jurisdiction of 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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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 11.01.

<sup>3</sup> All alloy designations are those of the Aluminum Association.

<sup>4</sup> The boldface numbers in parentheses refer to the references at the end of this standard.

<sup>5</sup> Round-robin test conducted by G01.11 (unpublished results).

<sup>6</sup> *Reagent Chemicals, American Chemical Society Specifications*, American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.