



Designation: G 34 – 99

## Standard Test Method for Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)<sup>1</sup>

This standard is issued under the fixed designation G 34; 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.

*This standard has been approved for use by agencies of the Department of Defense.*

### 1. Scope

1.1 This test method describes a procedure for constant immersion exfoliation corrosion (EXCO) testing of high-strength 2XXX and 7XXX series aluminum alloys.

NOTE 1—This test method is useful for research and development purposes and should not be construed as a quality assurance test.

1.2 This test method applies to all wrought products such as sheet, plate, extrusions, and forgings produced from conventional ingot metallurgy process.

1.3 This test method can be used with any form of specimen or part that can be immersed in the test solution.

1.4 *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>

E 3 Methods of Preparation of Metallographic Specimens<sup>3</sup>

G 15 Terminology Relating to Corrosion and Corrosion Testing<sup>4</sup>

G 112 Guide for Conducting Exfoliation Corrosion Tests in Aluminum Alloys<sup>4</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *exfoliation*—corrosion that proceeds laterally from the sites of initiation along planes parallel to the surface, generally at grain boundaries, forming corrosion products that force metal away from the body of the material giving rise to a layered appearance (Terminology G 15).

### 4. Summary of Test Method

4.1 This test method provides an accelerated exfoliation corrosion test for 2XXX and 7XXX series aluminum alloys that involves the continuous immersion of test materials in a solution containing 4 M sodium chloride, 0.5 M potassium nitrate, and 0.1 M nitric acid at  $25 \pm 3^\circ\text{C}$  ( $77 \pm 5^\circ\text{F}$ ). The susceptibility to exfoliation is determined by visual examination, with performance ratings established by reference to standard photographs.

### 5. Significance and Use

5.1 This test method is primarily used for research and development and should not be construed as a method for quality acceptance.

5.2 Use of this test method provides a useful prediction of the exfoliation corrosion behavior of these alloys in various types of outdoor service, especially in marine and industrial environments.<sup>5</sup> The test solution is very corrosive and represents the more severe types of environmental service, excluding, of course, unusual chemicals not likely to be encountered in natural environments.

5.3 The exfoliation ratings were arbitrarily chosen to illustrate a wide range in resistance to exfoliation in this test. However, it remains to be determined whether correlations can be established between EXCO test ratings and realistic service conditions for a given alloy. It is an ongoing activity of the Task Group on Exfoliation Corrosion of Aluminum Alloys (G01.05.02.08) to maintain outdoor exposure tests for this purpose. For example, it has been reported<sup>6</sup> that samples of Al-Zn-Mg-Cu alloys rated EA or P in a 48-h EXCO test did not develop more than a slight amount of incipient exfoliation

<sup>5</sup> Ketcham, S. J., and Jeffrey, P. W., "Exfoliation Corrosion Testing of 7178 and 7075 Aluminum Alloys" (Report of ASTM G01.05 Interlaboratory Testing Program in Cooperation with the Aluminum Association); and Sprowls, D. O., Walsh, J. D., and Shumaker, M. B., "Simplified Exfoliation Testing of Aluminum Alloys," *Localized Corrosion—Cause of Metal Failure*, ASTM STP 516, ASTM, 1972.

<sup>6</sup> Sprowls, D. O., Summerson, T. J., and Loftin, F. E., "Exfoliation Corrosion Testing of 7075 and 7178 Aluminum Alloys—Interim Report on Atmospheric Exposure Tests" (Report of ASTM G01.05.02 Interlaboratory Testing Program in Cooperation with the Aluminum Association); and Lifka, B. W. and Sprowls, D. O., "Relationship of Accelerated Test Methods for Exfoliation Resistance in 7XXX Series Aluminum Alloys With Exposure to a Seacoast Atmosphere," *Corrosion in Natural Environments*, ASTM STP 558, ASTM, 1974.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee G01 on Corrosion of Metals and is the direct responsibility of Subcommittee G01.05 on Laboratory Corrosion Tests.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 11.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 03.02.