Designation: G 67 – 99

Standard Test Method for Determining the Susceptibility to Intergranular Corrosion of 5XXX Series Aluminum Alloys by Mass Loss After Exposure to Nitric Acid (NAMLT Test)[1]

This standard is issued under the fixed designation G 67; 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 describes a procedure for constant immersion intergranular corrosion testing of 5XXX series aluminum alloys.

1.2 This test method is applicable only to wrought products.

1.3 This test method covers type of specimen, specimen preparation, test environment, and method of exposure.

1.4 The values stated in SI units are to be regarded as the standard.

1.5 *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[2]

G 1 Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens[3]

3. Summary of Test Method

3.1 This test method consists of immersing test specimens in concentrated nitric acid at 30°C (86°F) for 24 h and determining the mass loss per unit area as a measure of susceptibility to intergranular corrosion.

4. Significance and Use

4.1 This test method provides a quantitative measure of the susceptibility to intergranular corrosion of Al-Mg and Al-Mg-Mn alloys. The nitric acid dissolves a second phase, an aluminum-magnesium intermetallic compound (βAl-Mg), in preference to the solid solution of magnesium in the aluminum matrix. When this compound is precipitated in a relatively continuous network along grain boundaries, the effect of the preferential attack is to corrode around the grains, causing them to fall away from the specimens. Such dropping out of the grains causes relatively large mass losses of the order of 25 to 75 mg/cm^2 (160 to 480 mg/in^2), whereas, samples of intergranular-resistant materials lose only about 1 to 15 mg/cm^2 (10 to 100 mg/in^2). When the βAl-Mg compound is randomly distributed, the preferential attack can result in intermediate mass losses. Metallographic examination is required in such cases to establish whether or not the loss in mass is the result of intergranular attack.

4.2 The precipitation of the second phase in the grain boundaries also gives rise to intergranular corrosion when the material is exposed to chloride-containing natural environments, such as seacoast atmospheres or sea water. The extent to which the alloy will be susceptible to intergranular corrosion depends upon the degree of precipitate continuity in the grain boundaries. Visible manifestations of the attack may be in various forms such as pitting, exfoliation, or stress-corrosion cracking, depending upon the morphology of the grain structure and the presence of sustained tensile stress.[4]

5. Interferences

5.1 If all loose particles are not removed during cleaning after exposure, the mass loss will be low relative to the amount of corrosion that actually occurred.

6. Apparatus

6.1 *Nonmetallic Container*—A suitable inert, nonmetallic container should be used to contain the nitric acid and specimens during the period of the test. The use of individual beakers for each specimen is recommended; however, the immersion of multiple specimens in the same container is acceptable.

6.1.1 The specimens should be situated in the container so that none of the major surfaces is in total contact with the walls of the container. Also, specimens should be isolated electrically from one another. A recommended method of positioning the

[1] This test method is under the jurisdiction of ASTM Committee G-1 on Corrosion of Metals and is the direct responsibility of Subcommittee G01.05 on Laboratory Corrosion Tests. This method was developed by a joint task group with The Aluminum Association, Inc.

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

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

[4] Craig, H. L. Jr., "Nitric Acid Weight Loss Test for the H116 and H117 Tempers of 5086 and 5456 Aluminum Alloys," *Localized Corrosion—Cause of Metal Failure, ASTM STP 516*, ASTM, pp. 17–37, 1972.