



Standard Practice for Conducting Wire-on-Bolt Test for Atmospheric Galvanic Corrosion¹

This standard is issued under the fixed designation G116; 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 practice covers the evaluation of atmospheric galvanic corrosion of any anodic material that can be made into a wire when in contact with a cathodic material that can be made into a threaded rod.

1.2 When certain materials are used for the anode and cathode, this practice has been used to rate the corrosivity of atmospheres.

1.3 The wire-on-bolt test was first described in 1955 (1),² and has since been used extensively with standard materials to determine corrosivity of atmospheres under the names CLIMAT Test (C**L**assify I**N**dustrial and M**A**rine A**T**mospheres) (2-5) and ATCORR (A**T**mospheric C**O**RRosivity) (6-9).

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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:*³

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

G3 Practice for Conventions Applicable to Electrochemical Measurements in Corrosion Testing

¹ This practice is under the jurisdiction of ASTM Committee G01 on Corrosion of Metals and is the direct responsibility of Subcommittee G01.04 on Atmospheric Corrosion.

Current edition approved Nov. 1, 2015. Published December 2015. Originally approved in 1993. Last previous edition approved in 2010 as G116-99 (2010). DOI: 10.1520/G0116-99R15.

² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ 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.

G15 Terminology Relating to Corrosion and Corrosion Testing (Withdrawn 2010)⁴

G16 Guide for Applying Statistics to Analysis of Corrosion Data

G50 Practice for Conducting Atmospheric Corrosion Tests on Metals

G82 Guide for Development and Use of a Galvanic Series for Predicting Galvanic Corrosion Performance

G84 Practice for Measurement of Time-of-Wetness on Surfaces Exposed to Wetting Conditions as in Atmospheric Corrosion Testing

G91 Practice for Monitoring Atmospheric SO₂ Deposition Rate for Atmospheric Corrosivity Evaluation

G92 Practice for Characterization of Atmospheric Test Sites

G104 Test Method for Assessing Galvanic Corrosion Caused by the Atmosphere (Withdrawn 1998)⁴

3. Terminology

3.1 For definitions of terms used in this practice, refer to Terminology G15. For conventions related to this method, refer to Practice G3.

4. Summary of Practice

4.1 The practice consists of wrapping a wire of the anode material around the threads of a bolt or threaded rod of the cathode material, exposing the assembly to atmosphere, and determining mass loss of the anode wire after exposure. Reference specimens of the anode wire on a threaded, non-conductive, non-porous rod are used to separate general and crevice corrosion effects from galvanic corrosion effects.

5. Significance and Use

5.1 The small size of the wire compared to the short galvanic interaction distance in atmospheric exposures gives a large cathode-to-anode area ratio which accelerates the galvanic attack. The area between the wire and the threads creates a long, tight crevice, also accelerating the corrosion. For these reasons, this practice, with a typical exposure period of 90 days, is the most rapid atmospheric galvanic corrosion test,

⁴ The last approved version of this historical standard is referenced on www.astm.org.

particularly compared to Test Method G104. The short duration of this test means that seasonal atmospheric variability can be evaluated. (If average performance over a 1-year period is desired, several staggered exposures are required with this technique.) Reproducibility of this practice is somewhat better than other atmospheric galvanic corrosion tests.

5.2 The major disadvantage of this test is that the anode material must be available in wire form and the cathodic material must be available in the form of a threaded rod. This should be compared to Test Method G104 where plate or sheet material is used exclusively.

5.3 An additional limitation is that the more anodic material of the pair must be known beforehand (from information such as in Guide G82) or assemblies must be made with the material combinations reversed.

5.4 The morphology of the corrosion attack or its effect on mechanical properties of the base materials cannot be assessed by this practice. Test Method G104 is preferable for this purpose.

5.5 This test has been used under the names CLIMAT and ATCORR to determine atmospheric corrosivity by exposing identical specimens made from 1100 aluminum (UNS A91100) wire wrapped around threaded rods of nylon, 1010 mild steel (UNS G10100 or G10080), and CA110 copper (UNS C11000). Atmospheric corrosivity is a function of the material that is corroding, however. The relative corrosivity of atmospheres could be quite different if a different combination of materials is chosen.

6. Interferences

6.1 The manufacturing process used to make the wire and rod may affect their corrosion potentials and polarization behavior. Material in these forms may not behave galvanically the same as material in the form of interest, such as fasteners in sheet roofing for example. Although unlikely, this may even lead to a situation where reversing the materials may also reverse their anode-cathode relationship, resulting in attack during service of a material which was resistant during testing as a wire.

7. Procedure

7.1 Components:

7.1.1 The components used to construct the specimen assemblies for this test are shown in Fig. 1.

7.1.2 Prepare a 1-m length of 0.875 ± 0.002 -mm diameter wire of the anode material for each assembly. Other diameters may be used, however, the diameter of the wire may affect the test results, so that tests may only be compared if they use wire of similar diameters. In selecting material for the wire, consider the cold work and heat treatment of a wire may be significantly different than for the component that the exposure is modeling.

7.1.3 Make the cathode material into M12 \times 1.75 (1/2-13-UNC) threaded rods or bolts, 100-mm long. Either metric or English threads may be used, but results may only be compared between assemblies with similar thread types.

7.2 Making the Assemblies:

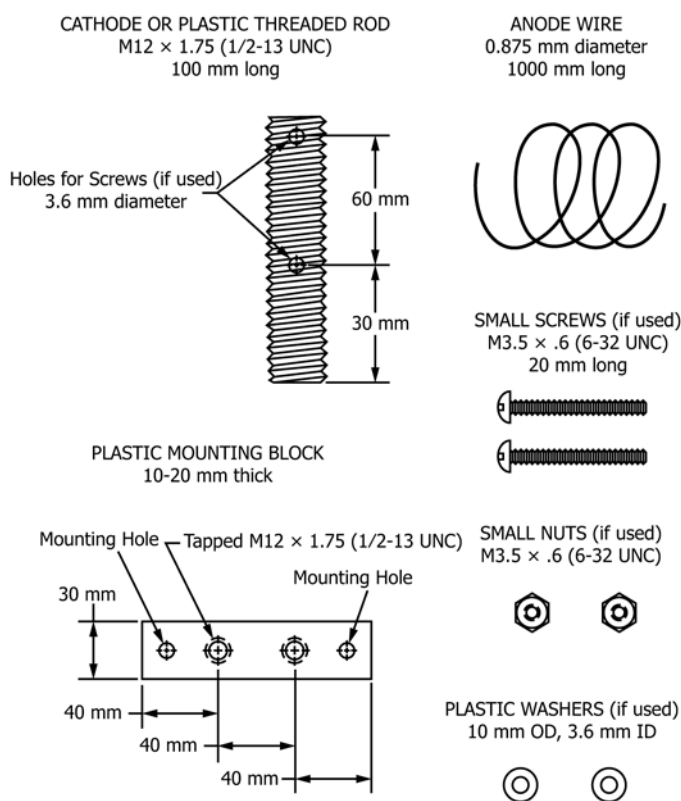


FIG. 1 Components for Making Wire-on-Bolt Exposure Assemblies

7.2.1 Thoroughly clean and degrease all parts before assembly in accordance with Practice G1.

7.2.2 Determine the mass of the wire to the nearest 0.0001 g.

7.2.3 Secure one end of the wire to a threaded rod using small screws and nuts of the rod material, if possible, or of nylon, stainless steel insulated with nylon, acetal resin, or TFE-fluorocarbon. Plastic washers are usually used under the heads of the screws. The wire may instead be secured to the rod by means of a tight O-ring wrapped around the threaded rod and the wire together.

7.2.4 Wrap the wire tightly around the rod so that it lies inside the threads using a jig such as that shown in Fig. 2. This jig is used to keep constant tension on the wire while it is being wound. While using this jig, wear clean cotton gloves to prevent contamination of the surfaces of the wire or rod. If it is felt that the wire tension is not critical for the particular application being tested, replace the use of the jig with hand-winding.

7.2.5 Wind the wire until it is in contact with roughly an axial distance of 50 mm of threaded rod.

7.2.6 Secure the free wire end to the rod by means of small screws and nuts made of the rod material, if possible, or of nylon, stainless steel insulated with nylon, acetal resin, or TFE-fluorocarbon. Plastic washers are usually used under the heads of screws. The wire may instead be secured to the rod by means of a tight O-ring wrapped around the threaded rod and the wire together.