



Designation: F 1110 – 02

Standard Test Method for Sandwich Corrosion Test¹

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

1. Scope

1.1 This test method defines the procedure for evaluating the corrosivity of aircraft maintenance chemicals, when present between faying surfaces (sandwich) of aluminum alloys commonly used for aircraft structures. This test method is intended to be used in the qualification and approval of compounds employed in aircraft maintenance operations.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information.

1.3 *This standard may involve hazardous materials, operations, and equipment. 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 hazard statements appear in Section 9.

2. Referenced Documents

2.1 ASTM Standards:

D 1193 Specification for Reagent Water²

D 1748 Test Method for Rust Protection by Metal Preservatives in the Humidity Cabinet³

G 46 Guide for Examination and Evaluation of Pitting Corrosion⁴

2.2 Industry Standards:⁵

SAE-AMS-QQ-A-250/4 Al Alloy 2024, Plate and Sheet

SAE-AMS-QQ-A-250/5 Al Alloy Alclad 2024, Plate and Sheet

SAE-AMS-QQ-A-250/12 Al Alloy 7075, Plate and Sheet

SAE-AMS-QQ-A-250/13 Al Alloy Alclad 7075, Plate and Sheet

2.3 Military Specification:

MIL-A-8625 Anodic Coatings for Aluminum and Al Alloys⁶

3. Terminology

3.1 Definition of Term Specific to This Standard:

3.1.1 *sandwich corrosion test*—a comparative accelerated environmental test of the corrosivity of liquid or solid materials present between faying surfaces of structural aluminum alloys commonly used in aerospace construction.

4. Summary of Test Method

4.1 Aluminum coupons having clad or anodized nonclad surfaces are sandwiched together with a filter paper saturated with the test material between the coupons. The sandwiched coupons are cycled between warm ambient air and warm humid air for 7 days. The coupons are then inspected to determine whether corrosion more severe than that caused by reagent water has occurred on the surfaces exposed to the test material. This test method is used for solutions of dry granular material or for liquid materials.

5. Significance and Use

5.1 The data generated by this test method shall be used to determine whether aircraft structural aluminum alloys are liable to be corroded or damaged by application of the test material during routine maintenance operations.

5.2 Interpretation of the sandwich corrosion test results is based on a comparison of the appearance of faying surfaces of three sets of coupons. One set of test coupons is exposed with reagent water only in the faying surfaces, to establish the baseline (controls) against which the panels exposed to the test material are compared. Disregard corrosion at cut edges of the test coupons.

5.3 The relative corrosion severity rating system is provided in order to allow a numerical classification of the test results and to eliminate the necessity for elaborate weight loss measurements. Pitting corrosion, which is rated 4—extensive (severe) corrosion, may involve only a negligible weight loss.

¹ This test method is under the jurisdiction of ASTM Committee F07 on Aerospace and Aircraft and is the direct responsibility of Subcommittee F07.07 on Qualification Testing of Aircraft Cleaning Materials.

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

³ *Annual Book of ASTM Standards*, Vol 05.01.

⁴ *Annual Book of ASTM Standards*, Vol 03.02.

⁵ Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

⁶ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, Attn: NPODS.

5.4 Relative corrosion severity rating system:

Appearance/Corrosion:

- 0—No visible corrosion and no discoloration present
- 1—Very slight corrosion or discoloration, and/or up to 5 % of area^A corroded
- 2—Discoloration and/or up to 10 % of area^A corroded
- 3—Discoloration and/or up to 25 % of area^A corroded
- 4—Discoloration and/or more than 25 % of area^A corroded, and/or pitting present

^A "Area" refers to area under the filter paper, or if no filter paper is used, the area where the test material was applied.

6. Interferences

6.1 It is possible that tap water containing large amounts of dissolved solids, especially chlorides, will cause relative severe corrosion of the aluminum control panels. For this reason, reagent water is specified. For comparative purposes, a set of aluminum test panels, with the locally available tap water applied to the filter paper, is sometimes run along with the reagent water panels.

6.2 Filter paper made from glass fibers is not recommended since, in practice, corrosion of the control panels has often been found.

7. Apparatus

7.1 *Humidity Test Cabinet*, as specified in Test Method **D 1748** or equal, capable of maintaining 95 to 100 % relative humidity at $37.7 \pm 1^\circ\text{C}$ ($100 \pm 2^\circ\text{F}$).

7.2 *Oven*, forced air circulation, capable of maintaining $37.7 \pm 1^\circ\text{C}$ ($100 \pm 2^\circ\text{F}$).

7.3 *Microscope*, binocular, 10× to 40×.

8. Reagents and Materials

8.1 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Specification **D 1193**, Type IV.

8.2 *Aluminum Alloy Coupons*:

8.2.1 Aluminum alloy coupons shall conform to the following industry standards:

SAE-AMS-QQ-A-250/4, 2024-T3 nonclad

SAE-AMS-QQ-A-250/5, 2024-T3 Alclad

SAE-AMS-QQ-A-250/12, 7075-T6 nonclad

SAE-AMS-QQ-A-250/13, 7075-T6 Alclad

8.2.2 *Coupon Size*—The recommended coupon size 50 by 100 by 1.0 to 1.5 mm (2 by 4 by 0.04 to 0.06 in.) has been found to provide suitable results for comparative tests. Smaller sizes are not recommended, because of the increased variations due to edge effects. Larger coupons are acceptable, but the space requirements for testing and storage shall be taken in consideration.

8.3 Anodize the nonclad coupons in accordance with Military Specification **MIL-A-8625**, Type 1 (Chromic Acid).

8.4 *Filter Paper*—Use Whatman No. 5 or equal filter paper made from cellulose, 11 or 13 cm. Filter paper is not required when the material being tested is a solid. In case no filter paper is used, the area covered by the test material shall also be approximately 25 by 75 mm (1 by 3 in.).

9. Hazards

9.1 The materials used for aircraft maintenance sometimes contain flammable solvents, strong acids or alkalis, or other

toxic compounds. Take suitable precautions to prevent personal injury from these hazards. When the composition of the test material is not known, consult the manufacturer to determine whether any hazards exist.

9.2 Exercise special care in handling the chromic acid solution, specified in **8.3**, for its etching properties.

10. Sampling

10.1 Agitate or thoroughly mix the test material to assure uniformity. Where dilution of the material is required, use reagent water or the solvent specified by the product manufacturer. Apply sufficient test material to saturate the area between the metal coupons.

11. Test Specimen

11.1 Prepare three sets of test panels. A test panel set shall consist of eight individual test coupons, sandwiched together in pairs of coupons of the same alloy and the same surface treatment, to provide four test coupon sandwiches for each test condition. Identify each coupon by impression stamping or other suitable permanent method.

11.2 Clean the panels by solvent wiping, or vapor degreasing. Do not use acid or caustic cleaners. Remove ink stamped markings from the panels. Do not use abrasive materials to clean the panels.

11.3 Prepare the test panel sets as follows for each alloy:

11.3.1 One set for the compound to be tested at use dilution,

11.3.2 One set for the compound to be tested in concentrated form and

11.3.3 One set for controls using reagent water.

12. Preparation of Apparatus

12.1 Verify that the humidity cabinet is operating at the specified temperature and humidity.

12.2 Verify that the oven is operating at the specified temperature, with air circulation.

13. Calibration and Standardization

13.1 Since the test coupons include controls for comparative purposes, no special calibration or standardization procedures are required.

14. Conditioning

14.1 Conditioning of the test materials or the sets of prepared test coupons is not required. Thoroughly agitate the test sample before application to the test coupons.

14.2 Allow the anodized panels to age for a period of at least 48 h prior to exposure.

15. Procedure

15.1 Assemble the cleaned panels into three identical groups each having four different sets of panels suitably identified by permanent marking. Each panel set shall consist of two individual coupons of the same alloy and the same surface treatment.

15.2 Cut a piece of cellulose filter paper to approximate 25 by 75 mm (1 by 3 in.). Fit this piece over one of the coupons. Add the test solution at the use concentration to the paper until saturated. Cover the wet paper with the second coupon of the