Designation: F 1111 – 88 (Reapproved 1998)

Designation: F 1111 – 02

Standard Test Method for Corrosion of Low-Embrittling Cadmium Plate by Aircraft Maintenance Chemicals[1]

This standard is issued under the fixed designation F 1111; 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] This test method is under the jurisdiction of ASTM Committee ~~F-7~~ F07 on Aerospace and Aircraft and is the direct responsibility of Subcommittee F07.07 on Qualification Testing of Aircraft Cleaning Materials.

Current edition approved ~~Nov. 17, 1988.~~ May 10, 2002. Published ~~February 1989.~~ June 2002. Originally published as F 1111 – 88. Last previous edition F 1111 – 88 (1998).

1. Scope

1.1 This test method is intended as a means of determining the corrosive effects of aircraft maintenance chemicals on low-embrittling cadmium plating used on aircraft high-strength steel, under conditions of total immersion by quantitative measurements of weight change.

1.2 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.* For specific hazard statements see Section 6, 4.1, and ~~Note 1 and Note X1.1.~~ X1.3.

2. Referenced Documents

2.1 *ASTM Standards:*

D 329 Specification for Acetone[2]

D 740 Specification for Methyl Ethyl Ketone[2]

D 1193 Specification for Reagent Water[3]

~~2.2 *Military Specification:*~~

~~MIL-S-18729 Steel Plate, Sheet~~

D 4080 Specification for Trichloroethylene, Technical and ~~Strip, Alloy 4130~~ Vapor Degreasing Grade[4]

2.3~~2~~ ~~*Federal Specification:*~~

~~O.T. 620 Specification for 1,1,1-Trichloroethane, Technical Inhibited (Methyl) Chloroform~~[4] *Industry Standards:*

SAE-AMS-6345 Steel Sheet, Strip and Plate (SAE 4130) Normalized or Otherwise Heat Treated[5]

3. Significance and Use

3.1 The data generated by this test method shall be used to determine whether low embrittling cadmium plated parts are liable to be corroded or damaged by application of the test material during routine maintenance operations.

4. Apparatus

4.1 *Wide Mouth Sealable Glass Jar or Stoppered Flask*, having a capacity so chosen that specimens will remain fully immersed in a vertical position and not in contact with other specimens during the test and the ratio of area of immersed metal to the volume of solution will be as prescribed in ~~9.1.~~

~~NOTE 1—~~**~~Caution:~~** ~~Some~~ 9.1. (**Warning**—Some aircraft maintenance chemicals when heated have high vapor pressures or may produce gases during testing. Suitable precautions should be taken to prevent the containing vessel from exploding or the vessel should be so chosen as to withstand the resulting pressures.)

4.2 *Constant Temperature Device*—Any suitable regulated heating device may be employed for maintaining the solution at the required temperature.

[2] *Annual Book of ASTM Standards*, Vol 06.04.

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

~~[4] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.~~

[4] *Annual Book of ASTM Standards*, Vol 15.05.

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

4.3 *Sandblaster*.
4.4 *Ampere Meter*, capable of measuring 60 ± 5 A.
4.5 *Oven*, capable of maintaining temperature of 110 ± 2°C (230 ± 4°F).
4.6 *Plating Bath*, containing the solution specified in X1.2.

5. Reagents

5.1 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean reagent water as defined by Type III of Specification D 1193.
5.2 *Trichloroethaylene*, ~~conforming to Federal~~ in accordance with Specification ~~O.T. 620.~~ D 4080.
5.3 *Methyl Ethyl Ketone*, ~~conforming to~~ in accordance with Specification D 740.
5.4 *Acetone*, ~~conforming to~~ in accordance with Specification D 329.
5.5 *Aluminum Oxide*, 180 grit.

6. Safety Precautions

6.1 The solvents used in cleaning test specimens are flammable or harmful if inhaled, or both. Keep away from sparks and open flames. Avoid breathing vapors and prolonged or repeated contact with skin. Use adequate ventilation.
6.2 Cyanides and cadmium oxide are very toxic and corrosive to skin. Take suitable precautions in the handling of them to avoid personal injury. Use adequate ventilation and keep away from acids.
6.3 Some materials used for aircraft maintenance may contain flammable solvents, acids or alkalis, or other toxic compounds. Take suitable precautions to prevent personal injury.

7. Test Specimens

7.1 The test specimens shall be made of 4130 steel Condition N in accordance with ~~MIL-S-18729 Condition N,~~ SAE-AMS-6345, measuring 25.4 by 50.8 by 1.22 mm (1 by 2 by 0.048 in.) and cadmium plated in accordance with Appendix X1. The electrodeposited plating shall have a minimum thickness of 0.13 mm (0.0005 in.).
7.2 Three replicates should be tested in each concentration of maintenance chemicals solution as prescribed in 9.2.

8. Precleaning Test Specimens

8.1 Using a stiff bristle brush, brush off loose cadmium plate. Be careful to brush only as hard as is required to remove the loose cadmium plate. Immerse the test specimens in a beaker of 1,1,1-trichloroethaylene maintained at a temperature of 66 ± 3°C (150 ± 5°F) and swab the surface of the individual specimen thoroughly using clean forceps to hold the test specimen and the cotton swab.
8.2 Shake off excess solvent. Transfer and immerse the test specimens separately several times in a beaker of methyl ethyl ketone.
8.3 Shake off excess methyl ethyl ketone and dry in an oven at 110 ± 2°C (230 ± 4°F) for 1 h.

9. Test Conditions

9.1 *Ratio of Area of Immersed Metal to Volume of Solution*—The ratio of the area of immersed metal to volume of solution shall be 25 mL of solution per 625 mm^2 (1 $in.^2$) of specimen surface.
9.2 *Solution Concentration*—Unless otherwise specified, test the specimens in solutions of the maintenance chemicals in the concentrated as-received condition and at the recommended use dilution, using water to dilute the material under test. (For solid materials concentrated condition shall mean one part solid to five parts by weight of diluent.) In case the material is not soluble at the recommended dilution, record this fact and continue with the test.
9.2.1 If water is not used as the diluent, record the type and specification of diluent used in the test.
9.3 *Temperature*—Unless otherwise specified, the test temperature shall be 35 ± 1°C (95 ± 2°F).
9.4 *Test Duration*—Unless otherwise specified, the test period shall be 24 h.

10. Procedure

10.1 Dry the precleaned specimens at 110°C (230°F) for 1 h, allow to cool to room temperature in a desiccator, then weigh to the nearest 0.1 mg.
10.2 Transfer the specimens to the vessel containing the preheated maintenance chemical solution. Seal the test vessel to prevent loss of vapor. Maintain at the required temperature and expose for a period of 24 h.
10.3 Remove the specimens at the end of the exposure period and proceed as follows:
10.3.1 Hold the specimen in forceps and rinse thoroughly in a 1-L beaker into which tap water is flowing rapidly.
10.3.2 Rinse thoroughly in water at room temperature.
10.3.3 Rinse with a stream of acetone from a wash bottle. Shake free from acetone and dry.
10.3.4 Place the specimens in an oven at 110 ± 2°C (230 ± 4°F) for 1 h and allow to cool to room temperature in a desiccator.
10.3.5 Reweigh the specimens to the nearest 0.1 mg and record.

11. Report

11.1 Report the following data for each test performed:

11.1.1 Name and type of maintenance chemical tested.
11.1.2 Concentrations and diluent used.
11.1.3 Number of specimens tested.
11.1.4 Temperature and duration of test.
11.1.5 Average weight loss in milligrams per 24 h.
11.1.6 Range in weight loss values.
11.1.7 Report any visual change in appearance including staining.

12. Precision and Bias

12.1 No statement is made about either the precision or bias of this test method since the result merely states whether there is conformance to the criteria for success specified in the accompanying material or process specification of the material being tested, or both.

13. Keywords

13.1 aircraft maintenance chemicals; corrosion; low-embrittling cadmium plate; weight loss

APPENDIX

(Nonmandatory Information)

X1. LOW-EMBRITTLING CADMIUM PLATE

X1.1 Degrease and clean the ~~MIL-S-18729~~ SAE-AMS-6345 specimens by abrasive blasting with No. 180 aluminum oxide grit. Rinse specimens free of abrasive with water.

X1.2 Without drying, plate the specimens for approximately 3 to 4 min at a current rating of 18.2 ± 1.5 A/dm^2 (60 ± 5 A/ft^2), to achieve a minimum thickness of 0.013 mm (0.0005 in.), using the following embrittlement cadmium cyanide bath,

Cadmium (as CdO)	33.5 g/L (4.5 oz/gal)
Total sodium cyanide (NaCN)	105 g/L (14 oz/gal)
Sodium carbonate (Na_2CO_3)	15 g/L (2 oz/gal)
Ratio NaCN to CdO	3.1:1
pH	12
Temperature	24 ± 2°C (75 ± 4°F)
Free caustic (NaOH)	18.7 g/L (2.5 oz/gal)

X1.3 Rinse the plated specimen in running cold tap water followed by a stream of hot water and dry at 110 ± 2°C (230 ± 4°F) for 1 h. Ensure that the test specimens are neutral and do not contain caustic or cyanide ~~residues.~~

~~NOTE X1.1—~~**Warning:** ~~Cyanides~~ residues. (**Warning**—Cyanides and cadmium oxide are very toxic and corrosive to skin. Take suitable precautions in the handling of them to avoid personal injury. Use with adequate ventilation and keep away from acids.)