



Designation: F3440 – 21

Standard Test Method for Corrosion of Low-Embrittling Zinc-Nickel Plate by Aircraft Maintenance Chemicals¹

This standard is issued under the fixed designation F3440; 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 is intended as a means of determining the corrosive effects of aircraft maintenance chemicals on low-embrittling zinc-nickel plating used on aircraft high-strength steel, under conditions of total immersion by quantitative measurements of weight change. Aircraft maintenance chemicals requiring this test method shall be determined by the cognizant engineering authority.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific hazard statements, see Section 6 and 4.1.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[D329 Specification for Acetone](#)

[D1193 Specification for Reagent Water](#)

2.2 *SAE Standards:*³

[SAE-AMS-6345 Steel Sheet, Strip and Plate \(SAE 4130\)](#)

[Normalized or Otherwise Heat Treated](#)

[SAE-AMS-6350 Steel Sheet, Strip and Plate \(SAE 4130\)](#)

[SAE-AMS 2417 Plating, Zinc-Nickel Alloy](#)

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 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.

³ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.

[SAE-AMS 2750 Pyrometry](#)

3. Significance and Use

3.1 The data generated by this test method shall be used to determine whether low embrittling zinc-nickel 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. (**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.

4.3 *Oven*, capable of maintaining temperature in accordance with SAE-AMS 2750, Furnace Class 1.

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 [D1193](#).

5.2 *Acetone*, in accordance with Specification [D329](#).

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 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 in accordance with SAE-AMS-6345, Condition N, or SAE-AMS-6350, measuring 25.4 by 50.8 by 1.22 mm (1 by 2 by 0.048 in.) and zinc-nickel plated in accordance with SAE-AMS 2417, Type 1, Composition 12-16 % Ni (Nickel), with a thickness of 10 to 20 microns (0.0004 to 0.0008 in.). The plating process used on the test specimens shall be qualified, in accordance with SAE-AMS 2417, to not cause hydrogen embrittlement in steel parts 51 HRC and over, and are embrittlement relief baked after plating.

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 Immerse the test specimens in a beaker of acetone 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 acetone.

8.3 Shake off excess acetone and dry in an oven at $110 \pm 3 \text{ }^\circ\text{C}$ ($230 \pm 5 \text{ }^\circ\text{F}$) 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 $35 \pm 1 \text{ }^\circ\text{C}$ ($95 \pm 2 \text{ }^\circ\text{F}$).

9.4 *Test Duration*—Unless otherwise specified, the test period shall be 24 h.

10. Procedure

10.1 Dry the precleaned specimens at $110 \pm 3 \text{ }^\circ\text{C}$ ($230 \pm 5 \text{ }^\circ\text{F}$) 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 $110 \pm 3 \text{ }^\circ\text{C}$ ($230 \pm 5 \text{ }^\circ\text{F}$) 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 zinc-nickel plate; weight loss

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