



Designation: D 930 – 89 (Reapproved 1996)^{ε1}

Standard Test Method of Total Immersion Corrosion Test of Water-Soluble Aluminum Cleaners¹

This standard is issued under the fixed designation D 930; 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.

^{ε1} NOTE—Keywords were added editorially in February 1996.

1. Scope

1.1 This test method² covers determination of the corrosive effects of water-soluble aluminum cleaners (nonetching type) on aluminum or aluminum alloys, under conditions of total immersion, by quantitative measurement of weight change or by qualitative visual determination of change. The test is designed for the determination of corrosion characteristics of the cleaner and not for determination of the life of the cleaner.

1.2 *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.* Material Safety Data Sheets are available for reagents and materials. Review them for hazards prior to usage.

2. Significance and Use

2.1 This test method is used to distinguish water-soluble aluminum cleaners that are excessively corrosive to aluminum or aluminum alloys. The users will define the degree of corrosion considered excessive in terms of weight loss per unit of surface area or in terms of changes in appearance, or both.

3. Apparatus

3.1 *Test Tubes*—Chemical- and heat-resistant glass³ test tubes 38 mm in diameter by 300 mm in length, having a capacity of about 300 mL. The tubes shall be chosen so that the specimens will remain fully immersed during the test, the ratio of area of immersed metal to the volume of solution will be as prescribed in 6.1, and sufficient space will be provided for foam formation if foam is formed by the cleaner.

3.2 *Condensers*—Allihn or other type condensers having jackets not less than 200 mm in length.

3.3 *Stoppers*—The connection between test tube and con-

denser optionally may be either standard-taper joints or rubber stoppers preboiled in aqueous caustic soda to remove free sulfur and boiled in a sufficient number of changes of distilled water until neutral.

3.4 *Constant-Temperature Device*—Any suitable means may be employed for maintaining the solutions actively at the boiling point, for tests conducted at that temperature. In the event that the tests are to be made at temperatures $20 \pm 2^\circ\text{F}$ above and $20 \pm 2^\circ\text{F}$ below the average temperature recommended by the manufacturer, as prescribed in 6.4, a suitable constant-temperature bath shall be provided to maintain the cleaner temperature at the required point.

4. Test Specimens

4.1 Aluminum or aluminum alloys, protectively coated or bare, may be used as required. The test specimens shall be 18 by 75 by 1 mm in size (see 6.1). At least two, and preferably four, replicates shall be tested in each concentration of cleaner solution prescribed in 6.2. The number of replicates under test shall be reported.

5. Preparation of Test Specimens

5.1 *Selection of Samples*—The samples selected for corrosion testing shall be identical in composition, metallurgy, and surface finishing with the conditions of the metal at the stage where cleaning will be applied in practice. Burred edges or other surface imperfections not normally present on the sample either shall be removed, or, where removal would change surface finish characteristics, another sample, if available, shall be chosen.

5.2 *Protection of Cut Edges*—The surfaces of clad (or metal-clad) aluminum alloy or other surface-treated metal shall be left bare if the metal is to be placed in service under these conditions. If metal edges are to be protected in service, they shall be carefully coated 2 to 4 mm back from the edges with an alkali- and temperature-resistant stop-off lacquer.⁴ The area of metal surface exposed shall be measured, and only the bare metal surface shall be used in the calculation of the ratio of area immersed to volume of test solution (6.1).

⁴ A suitable lacquer for this purpose is available from Mass and Waldstein Co., 433 Riverside Ave., Newark, NJ, or other suitable lacquer may be used as agreed upon.

¹ This test method is under the jurisdiction of ASTM Committee D-12 on Soaps and Other Detergents and is the direct responsibility of Subcommittee D12.16 on Hand Surface Cleaning.

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² For information relating to the development of this method, reference may be made to the paper by Harris, Jay C., "Corrosion Testing of Water-Soluble Aluminum Cleaners," *ASTM Bulletin*, No. 129, August, 1944, p. 21.

³ Borosilicate glass has been found satisfactory for this purpose.

5.3 *Precleaning Materials*—The following cleaning materials shall be made ready for removal of soil present on the metal surface prior to immersion corrosion testing:

5.3.1 A 250-mL beaker containing 200 mL of trichloroethylene at room temperature,

5.3.2 A 1-L beaker containing 150 to 200 mL of hot trichloroethylene, the degree of vaporization being controlled to permit vapor degreasing of the specimens when held in the beaker, or, alternatively, a wash bottle containing either of these solvents at 25 to 30°C,

5.3.3 A 250-mL beaker of either anhydrous methanol or isopropanol at 50°C,

5.3.4 A 250-mL beaker of distilled water at 50°C,

5.3.5 A 250-mL beaker of acetone at room temperature, and

5.3.6 A small swab of fresh absorbent cotton placed in each of the beakers.

5.4 *Precleaning Technique*—The test specimens shall be cleaned as follows immediately prior to use in the test (Section 7 or 8):

5.4.1 Immerse the test specimens in the beaker of trichloroethylene (5.3) and immediately swab the surfaces of the individual specimens thoroughly, using clean forceps to hold both the cotton swab and the test specimen.

5.4.2 After the swabbing of each specimen is completed, shake off excess solvent and either transfer the specimen to the vapor degreasing bath long enough to observe the vapor completely covering and condensing on the specimen, or thoroughly wash the specimen with a stream of fresh solvent from the wash bottle.

5.4.3 Swab the specimens separately in the beaker of alcohol and shake free from excess alcohol.

5.4.4 Transfer the specimens to the beaker of distilled water. Swab carefully and shake free from excess water.

5.4.5 Immerse the specimens separately several times in the beaker of acetone, shake free from acetone, and place them in a beaker, spacing the specimens for maximum exposure of surface area (do not stack or pile the specimens in the beaker).

5.4.6 Transfer the specimens immediately to an oven (Note 1) at 105°C.

NOTE 1—Warning: When the directions given in 5.4 are followed, the specimens will be free from acetone, but precaution should be taken to prevent ignition of acetone vapors in the oven which might result in an explosion.

6. Test Conditions

6.1 *Ratio of Area of Immersed Metal to Volume of Solution*—The ratio of the area of the immersed metal to the volume of solution shall be maintained at 1.5 dm²/L with an 18 by 75 by 1-mm corrosion specimen in 190 ± 5 mL of cleaner solution in the test tubes specified in 3.1. If necessary to use another ratio, it shall be indicated and recorded.

NOTE 2—If a stop-off lacquer has been used to protect freshly cut edges, the ratio of the area exposed to the volume of solution shall be calculated on the basis of actual metal exposed, exclusive of the lacquer-protected area.

6.2 Solution Concentration:

6.2.1 In the absence of the manufacturer's recommendations, the specimens shall be tested in a cleaner solution of the volume prescribed in 6.1 and at solution concentrations of

0.25, 0.5, 1.0, 4.0, and 8.0 weight % from stock solutions which shall be freshly prepared in 2000-g quantities. If the cleaner is not soluble to the extent noted in the stock solutions indicated, a weighed quantity of the cleaner shall be transferred to a graduate and made up to volume. The undissolved portion of the cleaner shall be transferred to the test tubes by rinsing with the supernatant liquid. A blank test of either two or four replicates shall be made in freshly boiled distilled water.

6.2.2 In case the manufacturer's recommendations are available, the test shall be made at the following relative concentrations (based on the average concentrations suggested), recording the percentages these represent: (1) One half the concentration recommended, (2) At the concentration recommended, and (3) Twice the concentration recommended. A blank test of either two or four replicates shall be made in freshly boiled distilled water, submitting them otherwise to exactly the same procedure followed for the specimens immersed in cleaner solution.

6.3 *Water*—The water used in preparing the cleaner solutions shall be freshly boiled distilled water.

6.4 *Temperature*—In the absence of manufacturer's recommendations, the test shall be made at the boiling point. With available recommendations, the test shall be made at 20 ± 2°F above and 20 ± 2°F below the average recommended temperature, the test temperature being recorded in any case. In any case the top temperature will not exceed the boiling point.

7. Procedure for Quantitative Weight Loss Test

7.1 Dry the cleaned specimens (5.4) in an oven at 105°C for 30 min. Remove, cool in a desiccator, and weigh to the nearest 0.001 g.

7.2 Transfer the corrosion specimens individually to test tubes containing the preheated cleaner solutions in the volumes and concentrations prescribed in 6.1 and 6.2, using only one specimen per tube. Attach the tube containing the specimen to a reflux condenser and maintain the solution at the required temperature, adding a small piece of unglazed porcelain to prevent bumping.

7.3 Expose for a period of 2 h. Other exposure periods may optionally be observed but shall be stated in the report (Section 9).

7.4 Remove the strips at the end of the exposure period and proceed as follows:

7.4.1 Hold the specimens in forceps and rinse thoroughly in a 1-L beaker into which tap water is flowing actively.

7.4.2 Rinse thoroughly in distilled water at room temperature (25 to 30°C).

7.4.3 Follow with a wash-bottle rinse with neutral acetone (free from residue). Shake free from acetone droplets and transfer to a clean, dry beaker.

7.4.4 Examine for and record any of the following visible changes in comparison with the original cleaned, untreated specimen: (1) Discoloration, (2) Dulling, (3) Etching, (4) Presence of accretions and relative amounts, (5) Types of pitting—wide, medium, or narrow, and (6) Presence of selective or localized attack.

7.4.5 Immerse the strips, including blanks, in a beaker of nitric acid (sp gr 1.42), heating, if necessary, to remove accretions.