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Standard Guide for Corrosion Test Panel Preparation, Testing, and Rating of Coil-Coated Building Products[1]

This standard is issued under the fixed designation D7893; 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 guide has been written specifically for coil-coated metal building products.

1.2 This guide applies to preparation, testing, and rating of line-coated and laboratory-coated test panels for the purpose of comparing and ranking the panels for corrosion resistance and other related properties.

1.3 Testing may include accelerated laboratory corrosion tests and outdoor exposure tests.

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:*[2]

B117 Practice for Operating Salt Spray (Fog) Apparatus
D610 Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
D714 Test Method for Evaluating Degree of Blistering of Paints
D870 Practice for Testing Water Resistance of Coatings Using Water Immersion
D1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
D1735 Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus
D2247 Practice for Testing Water Resistance of Coatings in 100 % Relative Humidity
D2803 Guide for Testing Filiform Corrosion Resistance of Organic Coatings on Metal
D3359 Test Methods for Measuring Adhesion by Tape Test
D4138 Practices for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive, Cross-Sectioning Means
D4585 Practice for Testing Water Resistance of Coatings Using Controlled Condensation
D5796 Test Method for Measurement of Dry Film Thickness of Thin-Film Coil-Coated Systems by Destructive Means Using a Boring Device
D5894 Practice for Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
D7091 Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals
G7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials
G85 Practice for Modified Salt Spray (Fog) Testing
G87 Practice for Conducting Moist SO_2 Tests
G169 Guide for Application of Basic Statistical Methods to Weathering Tests

2.2 *SAE Standards:*[3]

J2334 Laboratory Cyclic Corrosion Test

3. Terminology

3.1 *Definitions:*

3.1.1 *test panel, n*—a representative specimen of metal substrate, coated with a coating system for evaluation, and prepared in a way that allows measurement of environmental degradation, especially corrosion, for system performance comparisons and ranking.

4. Summary of Guide

4.1 Test panels may be collected from coil line clips and formed building panels, or may be laboratory-prepared.

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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 15096-0001, http://www.sae.org.

4.2 Test panels are prepared for testing in a specific configuration that simulates conditions on buildings.

4.3 Test panels are exposed to specific conditions in accordance with standard practices and methods.

4.4 After testing, corrosion is measured in a way that relates to building performance and allows performance ranking among samples, for example, by the corrosion creep distance from test panel edges.

5. Significance and Use

5.1 Coil-coated metals are subjected to a wide range of environmental stresses. Corrosion at cut edges, damage points, and fabricated areas can occur and lead to premature failure. Proper preparation and rating of test panels produces meaningful test results that allows comparisons between metal substrates and their pretreatments as well as between coating systems.

5.2 Laboratory-prepared test panels give a relative comparison of the substrates and coating systems under test, but may not duplicate all of the stresses imposed on manufactured components. Validation of results on a manufactured product is recommended.

5.3 Laboratory accelerated corrosion testing is useful in evaluating relative performance of new and existing metal coatings, pretreatments, and paints. It is up to the participating parties to agree on the significance of these tests to actual use.

6. Test Panel Preparation

6.1 An experiment is planned to evaluate the effects of specific variables in the coated metal system on corrosion performance. These variables typically include metal substrate, cleaning, pretreatment, primer, topcoat, forming, and other appropriate stresses.

6.2 The number of replicates in a test is determined by availability of substrate, time, resource constraints, and statistical methods for data analysis. Statistical methods require a number of replicates which is dependent upon the variability of the system under test and the measurement system itself. Although not specific to corrosion testing, Guide G169 can serve as a reference for using statistical methods. Because of test variations, a thorough experimental plan includes controls to rank results. Positive (known good performance) and negative (known poor performance) controls may be included for more effective data interpretation.

6.3 The test panel size, configuration, and features (shape, bends, scribe lines, etc.) are factors in any corrosion test and should be determined during planning in order to ensure enough coated metal is available. A typical flat exposure test panel might be 10 by 20 cm, but could vary to accommodate other configurations. The anticipated corrosion creep distance would also influence test panel size.

6.4 The test panel configuration and features are chosen to simulate real building panels. These might include cut edges, lap edges, scribe lines (to simulate damage), holes with or without fasteners, tension bends, impact dimples, and other forming operations (see Fig. A1.1).

6.5 In addition to test panel configuration, the laboratory accelerated corrosion tests, exposure sites, and panel orientations should be considered. Exposure sites represent unique environments that cyclically expose the test panels to many conditions such as temperature variation, moisture, salt concentrations, industrial pollutants, and solar radiation. Exposure angles such as 1°, 5°, and 45° from horizontal might be chosen for roof simulation, while vertical exposures would be used for side walls. Exposure directions, north, south, east, or west, can be chosen as can the degree of shade or shelter. A sheltered exposure may offer increased time of wetness for test panels.

6.6 Use of coil line-coated test panels (line clips) is preferred to best represent the commercial product's performance. Often, however, where a number of variables are tested in a screening experiment, it is not practical or economical to test line clips. In such cases, laboratory test panels may be prepared. For laboratory-prepared test panels, heating rate and peak metal temperature should be as close as possible to coil line conditions.

6.7 Pretreatments are applied to a cleaned surface by immersion, spray, drawdown, or rollcoater as appropriate in accordance with manufacturer specification.

6.8 For laboratory-prepared test panels, coil primers and topcoats are typically applied to test panels by wire wound rod. The wire number selected is critical for dry film thickness (DFT) accuracy. DFT must be established for each coating/rod number combination because the same rod can produce different DFTs with different coatings. Typical methods for measuring the dry film thickness of coil coatings include Practices D4138, D7091, and Test Method D5796.

6.9 For laboratory-prepared test panels, when the backside has not been line-primed or backed, a backer coating should be applied to test panels. This may be accomplished with room temperature-cured coatings or tape.

6.10 The metal shear selection is important for consistent results and should be used consistently for all corrosion test panels to be compared in an experiment if edge corrosion is to be measured. The shear type and blade sharpness may influence corrosion results.

6.11 For tests requiring cut edge corrosion measurement, care should be taken to ensure that edges are free of excess coating from the front or backside and to shear the edges with the burrs in a predetermined direction. For example, the right edge may be sheared burr-up and the left edge burr-down. Test panels for a given experiment must be sheared on the same shear to ensure consistent results. Shear sharpness and gap may influence results.

6.12 Holes, drilled or punched, and fasteners may be used if agreed upon between producer and user. For tests requiring a punched hole, the hole is typically punched with the burr down. Punch sharpness may also influence results.

6.13 Test panels requiring a scribe may be scribed consistently using a carbide steel tip pencil-type scribe and metal ruler to give a straight scribe line of equal length on all test panels. Other scribing tools may also be used as agreed upon

between producer and user. Scribing may be done manually or by machine for improved consistency. A preferred scribe direction is lengthwise or vertically with respect to the exposure orientation to allow droplets to run along the length of the scribe line. Care should be exercised to use uniform pressure and to produce scribe cuts that are free of coating and metal debris. Consistent force should be applied to expose a consistent width of metal. For multi-layer substrates (for example, galvanized steel) producer and user should agree on the depth of scribe penetration (for example, if it is to penetrate through the galvanizing layer to the base steel).

6.14 Tension bends may be made in test panels using laboratory roll formers. Other types of forming may include reverse impact dimples, T-bends, and bends using a bending brake.

6.15 A testing request document with vital information is recommended for each individual test. Accelerated testing request document records might indicate which specific test, with cycle and temperature when needed, is to be performed, how long the exposure time is to be, time intervals when checks are to be performed, which checks (photographs or measurements), how test panels are to be handled upon test completion, and identification of the test panels.

6.16 Individual test panels should be identified in a way that does not interfere with the test, and that maintains its integrity throughout the test duration. Different methods may be selected depending on the test. Permanent marker on a coated surface may work well for laboratory accelerated corrosion testing. Outdoor exposures or laboratory testing that exposes the test panel to UV radiation may require scribed or stamped identification.

7. Exposure of Test Panels to Corrosive Conditions

7.1 Test panels are subjected to a laboratory accelerated corrosion test or outdoor exposure test. The test selection and duration of the test are based on a number of factors including historical, customer, or vendor specifications, known correlations with field performance, experience, and relationships between test conditions and product exposure conditions. Typical laboratory accelerated corrosion tests used for coil-coated building products include Practices B117, D870, D1735, D2247, D4585, D5894, G85, G87, Guide D2803 and others such as automotive cyclic test, SAE J2334. Outdoor exposure tests are conducted in accordance with Practice G7.

8. Test Panel Rating

8.1 Test panels should be rated as soon as possible after removal from the test cabinet and outdoor exposure, or a recovery time can be agreed upon between producer and user. Care must be taken to avoid damage. Loose paint may be removed by air blow-off, scraping, or taping. Specific guidance is provided in Test Method D1654.

8.2 Cut edge creep ratings are normally measured in millimetres perpendicular from the test panel cut edge to the leading edge of the paint delamination front. Ratings may be made at an agreed upon number of equally spaced points along the edge and averages taken. A template is helpful to maintain spacing and consistency from test panel to test panel. The bottom and top 10 mm of the test panel should be excluded from the measurements.

8.3 Scribe creep can be measured in various ways, so producer and user should agree upon a method to maintain consistency. Scribe creep is often measured perpendicular to the scribe on both sides at the predetermined number of spots and averaged. A template is helpful to maintain consistency. The number of readings should be agreed upon between producer and user and be kept consistent within a test series.

8.4 Face blistering can be rated in accordance with Test Method D714.

8.5 Adhesion by tape test can be rated using Test Method D3359.

8.6 Other ratings may also be used depending upon test panel configuration. Corrosion at bends, punched holes, and impact dimples are examples. Red rust may be rated using Test Method D610.

8.7 Statistical analysis of data can be applied to differentiate system performance from measurement variability, for example, the Students t-test. Guide G169 can be used as a reference for statistical analysis. Information developed from such analysis can be used to properly rank system performance in each test. Weighting of results from various tests might be based on historical or customer specifications, known correlations with field performance, experience, and relationships between test conditions and product exposure conditions.

9. Report

9.1 A report of results should include the test series number, substrate identification, coating mass for galvanized products, thickness, pretreatment identification, pretreatment weight, primer, primer thickness, topcoat, topcoat thickness, corrosion test with standard method number, duration of the test and any irregularities. Where applicable, the report should include edge creep for burr-up and burr-down edges, lap edges, scribe creep, face blistering, and other measures that relate to the effect of stresses applied to the test panel such as bend or impact dimple corrosion.

10. Keywords

10.1 coil coating; corrosion

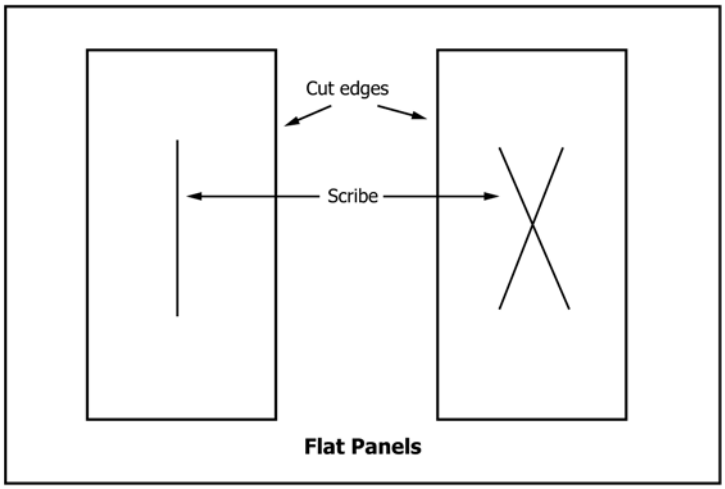
ANNEX

(Mandatory Information)

A1. TEST PANEL CONFIGURATIONS

A1.1 Test Panel Configurations

A1.1.1 See Fig. A1.1.



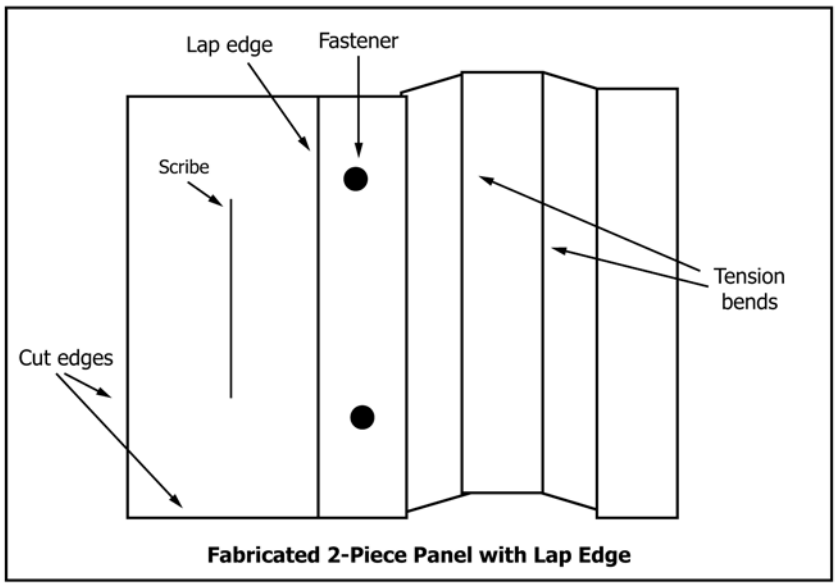


FIG. A1.1 Test Panel Configurations