



Standard Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates¹

This standard is issued under the fixed designation D1014; 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.

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

1. Scope*

1.1 This practice covers procedures to be followed for direct exposure of exterior paints and coatings to the environment when applied to metal surfaces. When originators of a weathering test have the actual exposure conducted by a separate agency, the specific conditions for the exposure of test and control specimens should be clearly defined and mutually agreed upon between all parties.

1.2 Experience indicates that the metal used as a test substrate has a significant effect upon weathering results. The purpose of this practice is to define specific steel and other metal surfaces to be used for testing in order to minimize this source of variability.

1.3 The values stated in SI units are to be regarded as the standard. The values given in parenthesis are for information only.

1.4 *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

- A36/A36M Specification for Carbon Structural Steel
- A283/A283M Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
- B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- B449 Specification for Chromates on Aluminum

¹ This practice is under the jurisdiction of ASTM Committee D01 on Paint and Related Coatings, Materials, and Applications and is the direct responsibility of Subcommittee D01.27 on Accelerated Testing.

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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.

- D523 Test Method for Specular Gloss
- D609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
- D610 Practice for Evaluating Degree of Rusting on Painted Steel Surfaces
- D660 Test Method for Evaluating Degree of Checking of Exterior Paints
- D661 Test Method for Evaluating Degree of Cracking of Exterior Paints
- D662 Test Method for Evaluating Degree of Erosion of Exterior Paints
- D714 Test Method for Evaluating Degree of Blistering of Paints
- D772 Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints
- D823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels
- D1212 Test Methods for Measurement of Wet Film Thickness of Organic Coatings
- D1654 Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
- D1729 Practice for Visual Appraisal of Colors and Color Differences of Diffusely-Illuminated Opaque Materials
- D1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
- D2200 Practice for Use of Pictorial Surface Preparation Standards and Guides for Painting Steel Surfaces
- D2201 Practice for Preparation of Zinc-Coated and Zinc-Alloy-Coated Steel Panels for Testing Paint and Related Coating Products
- D2244 Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
- D2616 Test Method for Evaluation of Visual Color Difference With a Gray Scale
- D2803 Guide for Testing Filiform Corrosion Resistance of Organic Coatings on Metal
- D3359 Test Methods for Measuring Adhesion by Tape Test
- D4214 Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films

*A Summary of Changes section appears at the end of this standard

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

E41 Terminology Relating To Conditioning

E1347 Test Method for Color and Color-Difference Measurement by Tristimulus Colorimetry

G7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials

G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

G141 Guide for Addressing Variability in Exposure Testing of Nonmetallic Materials

G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

2.2 *Other Standard:*

SSPC Method 1 Test Panel Preparation Method No 1, Uncontaminated Rusted Steel SSPC³

3. Terminology

3.1 *Definitions*—The definitions given in Terminologies **E41** and **G113** are applicable to this practice.

4. Significance and Use

4.1 The procedures described in this practice are intended to aid in evaluating the performance of coatings on various metal panels including either new or rusted steel.

4.2 The relative durability of paints in outdoor exposures can be very different depending on the location of the exposure because of differences in solar radiation, time of wetness, temperature, pollutants, and other factors. Therefore, it cannot be assumed that results from one exposure in a single location will be useful for determining relative durability in a different location. Exposures in several locations with different climates which represent a broad range of anticipated service conditions are recommended.

4.2.1 Because of year-to-year climatological variations, results from a single exposure test cannot be used to predict the absolute rate at which a material degrades. Several years of repeat exposures are needed to get an “average” test result for a given location.

4.2.2 Solar radiation varies considerably as function of time of year. This can cause large differences in the apparent rate of degradation in many polymers. Comparing results for materials exposed for short periods (less than one year) is not recommended unless materials are exposed at the same time in the same location.

4.3 The Significance and Use in Practice **G7** addresses many variables to be considered in exterior exposure tests. Guide **G141** provides more information on variability in weathering testing.

5. Materials Used for Test Specimens

5.1 A minimum of two and preferably four test specimens shall be used to evaluate the performance of any paint system.

5.2 The surface preparation shall be the same for all test panels in the test program unless surface preparation is one of the variables to be evaluated. Surface preparation shall be essentially identical for all test panels, as the thoroughness of preparation may directly determine the performance life of the applied coating system.

5.3 *Steel Panels*—Unless otherwise specified, fabricate steel test panels from the same material over which the coating is expected to perform in-service, when the exact composition of the substrate is known. Any of the following surfaces may be used.

5.3.1 *Abrasive Blasted Steel Plate*—The steel plate shall conform to Specification **A36/A36M** or Specification **A283/A283M**. The minimum thickness shall be 1.6 mm ($1/16$ in.). The minimum size shall be 75 by 150 mm (3 by 6 in.). Burrs and sharp projections shall be removed from the edges by filing. The test panels shall be freed of oil by suitable grease-removing solvents in accordance with Procedures B, C, or D of Practice **D609**. Unless otherwise specified and agreed upon, the surface shall be blasted to meet the requirements of Standard **D2200**, Sa $2\frac{1}{2}$.

5.3.2 *Rusted Surfaces*—Hot rolled steel angle or plate, or both, are useful for determining the performance of paints applied to structures that cannot be thoroughly cleaned of rust and corrosion products. The steel angle and plate shall conform to Specification **A283/A283M**. The steel angles shall be at least 100 by 100 by 3.2 mm (4 by 4 by $1/8$ in.) in cross section and 300 mm (12 in.) in length. The minimum size of the steel plate shall be 100 by 150 mm (4 by 6 in.) with a minimum thickness of 1.6 mm ($1/16$ in.). Burrs and sharp projections shall be removed from the edges by filing. The test pieces shall be freed from oil by the use of suitable grease-removing solvents in accordance with Procedures B, C, or D of Practice **D609**. Those persons desiring to test coatings over rusty or slightly rusted surfaces (**Note 1**) should refer to Practice **D2200**, select the degree of rusting desired from the rust grades given, and utilize the degree of surface preparation that can be accomplished in the field or on the job.

5.3.2.1 When evaluating performance over rusty surfaces, it is recommended that substrates be pre-corroded (weathered) in the same environment in which they will be ultimately be exposed. SSPC Method 1 describes this pre-aging procedure. Artificial rusting is permitted but conditions used must be stated in the test report.

NOTE 1—The environment in which the steel is rusted prior to painting has considerable influence on the performance of paint applied to such steel.

5.3.3 *Cold-Rolled Steel Strip*—Cold-rolled steel strip has a slightly roughened surface free from mill scale and rust, and is useful for checking the relative performance of paints on a clean, uniform surface. The steel strip shall conform to one of the types described in Practice **D609**. The panels shall be not less than 100 by 150 mm (4 by 6 in.) in size and it is recommended that all edges shall be smooth and uniformly rounded. The metal panels shall be prepared by the agreed upon procedure (A, B, C, or D) in Practice **D609**.

5.3.4 *Galvanized Steel*—When galvanized steel panels are used, prepare test specimens according to Practice **D2201**.

³ Available from Society for Protective Coatings (SSPC), 40 24th St., 6th Floor, Pittsburgh, PA 15222-4656, <http://www.sspc.org>.