



Standard Practice for Conducting Exterior Exposure Tests of Paints on Steel¹

This standard is issued under the fixed designation D 1014; 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 the determination of the relative service of exterior paints and other materials of similar purpose when applied on steel surfaces exposed out-of-doors.

1.2 Experience indicates that the steel used as a test surface has a marked bearing upon the weathering results. It is the purpose of this test method to minimize the influence of variation in steel surfaces on any series of tests by providing for uniformity in the selection of the steel surface, particularly in cooperative work. This practice also outlines uniform procedures for conducting the exposure tests and for evaluating and recording results.

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses 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:

A 36 Specification for Carbon Structural Steel²

A 283/A283M Specification for Low and Intermediate Tensile Strength Carbon Steel Plates²

D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products³

D 610 Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces⁴

D 659 Methods of Evaluating Degree of Chalking of Exterior Paints⁵

D 660 Test Method for Evaluating Degree of Checking of Exterior Paints³

D 661 Test Method for Evaluating Degree of Cracking of Exterior Paints³

D 714 Test Method for Evaluating Degree of Blistering of Paints³

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels³

D 1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base³

D 1212 Test Methods for Measurement of Wet Film Thickness of Organic Coatings⁴

D 2200 Pictorial Surface Preparation Standards for Painting Steel Surfaces⁴

D 4141 Practice for Conducting Accelerated Outdoor Exposure Tests of Coatings³

G 7 Practice for Atmospheric Environmental Exposure Testing of Nonmetallic Materials⁶

3. Significance and Use

3.1 The procedures described in this test method are intended to aid in evaluating performance of coatings on either new or previously rusted steel.

3.2 Since the natural environment varies with respect to season and geographic location, test results may not correlate with in-service performance.

4. Base Materials for Test Specimens

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

4.2 The surface preparation for the test panels should be that expected to be done in the field or in-service. 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 must be essentially identical for all test panels, as the thoroughness of preparation may directly determine the performance life of the applied coating system.

4.3 The test panels should be fabricated from the same material over which the coating is expected to perform in-service. Any of the following surfaces may be used:

4.3.1 *Abrasive Blasted Steel Plate*—The steel plate shall conform to Specification A 36 or Specification A 283/A 283M. The minimum thickness shall be 1/16 in. (1.6 mm). The

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

Current edition approved Feb. 15, 1995. Published April 1995. Originally published as D 1014 – 49 T. Last previous edition D 1014 – 83 (1988)ε¹.

² Annual Book of ASTM Standards, Vol 01.04.

³ Annual Book of ASTM Standards, Vol 06.01.

⁴ Annual Book of ASTM Standards, Vol 06.02.

⁵ Discontinued; see 1989 Annual Book of ASTM Standards, Vol 06.01.

⁶ Annual Book of ASTM Standards, Vol 14.02.

minimum size shall be 4 by 6 in. (100 by 150 mm). 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 D 609. The surface shall be blasted to meet the requirements of Standard D 2200, *Sa* 2½, if another degree of surface preparation has not been agreed upon.

4.3.2 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 A 283/A 283M. The steel angles shall be at least 4 by 4 by ⅝ in. (100 by 100 by 3.2 mm) in cross section and 12 in. (300 mm) in length. The minimum size of the steel plate shall be 4 by 6 in. (100 by 150 mm) with a minimum thickness of ⅛ in. (1.6 mm). 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 D 609. Those persons desiring to test coatings over rusty or slightly rusted surfaces (Note 1) should refer to Standard D 2200, 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.

NOTE 1—When testing over rusty surfaces, the test specimens should preferably be pre-corroded (weathered) in the same environment in which they ultimately will be exposed. The environment in which the steel is rusted prior to painting has considerable influence on the performance of paint applied to such steel. Artificial rusting, however, is permitted but conditions must be stated in the test report.

4.3.3 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 D 609. The panels shall be not less than 4 by 6 in. (100 by 150 mm) in size and 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 D 609.

4.4 After surface preparation, the panels shall be prime coated as soon as possible to prevent flash rusting or deposit of any foreign contaminant on the cleaned surface. After surface preparation, if the panels are stored prior to coating, precautions must be taken to preserve the clean surface.

5. Painting Test Specimens

5.1 Apply all coatings in strict accordance with the coating manufacturer's written recommendations. The method of application expected for the production work on the job should also be used for test panel application.

5.2 If the method of application is unknown select one of the following (Note 2):

- Automatic Spray Machine
- Automatic Dip Coater
- Manual Spray Application
- Motor Driven Blade Applicator
- Brush Application
- Roller Coating
- Curtain Coating

NOTE 2—Details for the application of paint are given in Practices D 823.

5.3 Measure and record the film thickness of each coat in accordance with the methods recommended in Test Methods D 1186. If the test panel is covered by rust and mill scale, these methods will be less accurate, as they are influenced by the surface characteristics of this base metal. In such cases, approximations can be made by wet film thickness measurements in accordance with Test Methods D 1212, or the amount of paint applied to a known area can be weighed and the average dry film thickness computed. It should be noted that even though dry film thickness measurements in accordance with Test Methods D 1186 are less accurate on surfaces with rust and mill scale than on smooth steel surfaces, they are still more accurate than those obtained by Test Methods D 1212 or weighing.

5.4 Allow the proper drying time between coats for multiple paint systems and before exposure as required by the coatings manufacturer and include in the test record.

5.5 Paint the back and edges of all test specimens with the same systems as that being tested on the front of each panel. This painting provides considerable information on the behavior of the paint system on the reverse side.

5.6 The test specimens may be scribed to base metal prior to exposure. Rate any corrosion from this point of damage in accordance with Methods D 610.

6. Exposure

6.1 The type of exposure and the position of the painted specimens may be selected from the following:

5°, facing south

45°, facing south

45°, facing north

Vertical, facing south

Vertical, facing north

Insulated (backed or black box) in accordance with Practice G 7 and Practice D 4141.

6.2 Mount the specimens so they do not cast shadows on each other, or contact each other or any metallic material, or any material capable of acting as a wick. Also, mount the specimens so that the products of weathering and rain water drippings do not flow from one to another.

6.3 The test period shall be sufficient to evaluate the characteristics of the system under consideration.

NOTE 3—A suitable material for the construction of racks and supports is painted wood. Metal, such as aluminum, is also suitable if the test specimens are properly insulated as by the use of porcelain or suitably selected plastic.

7. Inspections and Records

7.1 After panels have been exposed to the weather, inspections should be made after not more than 1 month, at 3 months, and at intervals of 3 months during the first 2 years, and every 6 months thereafter. Midwinter inspections, however, may be omitted in northern latitudes. Inspections may be made more frequently if desired. Usually the exposures should be continued for a considerable length of time after deterioration has reached the point which best practice calls for repainting.

7.2 Evaluate (resistance to or) degree of rusting, chalking,

checking, cracking, and blistering using the following ASTM photographic reference standards: Test Methods D 610, D 659, D 660, D 661, and D 714.

7.3 Records should be kept on report forms agreed upon between the purchaser and seller.

8. Report Section

8.1 Complete the inspection report covering the various failure modes agreed upon between the purchaser and the seller. The report shall clearly show a record of the type and identification of the product tested, the rating of the various criteria, reference standard(s) used, and other pertinent information.

8.2 The pertinent information covering outdoor weathering tests shall include the following:

- 8.2.1 Date of inspection,
- 8.2.2 Date of exposure start,
- 8.2.3 Reporting testing facility's order number,
- 8.2.4 Client's (purchaser's) name, address,

8.2.5 Name of principal contact,

8.2.6 Duration expressed in time,

8.2.7 Radiation data to date in terms of MJ/m² of UV, radiation (295nm to 385nm), total solar radiation expressed in MJ/m²

8.2.8 Type of exposure,

8.2.9 Notation as to ASTM Test Method used,

8.2.10 Orientation of the samples,

8.2.11 Site location comments section to more completely describe the failures noted on panels,

8.2.12 Remarks about unusual weather,

8.2.13 Other information agreed upon between the purchaser and the seller, and

8.2.14 Name of the person and signature of the person making the inspection.

9. Keywords

9.1 durability; paints; exposure tests; exterior; organic coatings; panels; steel

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