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Designation: D 5031 – 01

Standard Practice for Enclosed Carbon-Arc Exposure Tests of Paint and Related Coatings[1]

This standard is issued under the fixed designation D 5031; 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 practice covers the selection of test conditions for accelerated exposure testing of coatings and related products in enclosed carbon arc devices operated according to Practices G 151 and G 153. This practice also covers the preparation of test specimens, the test conditions suited for coatings, and the evaluation of test results. Table 1 describes commonly used test conditions.

NOTE 1—Previous versions of this practice referenced carbon arc devices described by Practice G 23, which described very specific equipment designs. Practice G 23 has been withdrawn and replaced by Practice G 151, which describes performance criteria for all exposure devices that use laboratory light sources, and by Practice G 153, which gives requirements for exposing nonmetallic materials in enclosed carbon-arc devices.

1.2 This practice does not cover filtered open-flame carbon-arc exposures of paints and related coatings, which is described in Practice D 822. Another procedure for exposing these products is covered by Practice D 3361, in which the specimens are subjected to radiation from an unfiltered open-flame carbon arc that produces shorter wavelengths and higher levels of short wavelength radiation than filtered open flame or enclosed carbon arcs.

NOTE 2—Practice D 3361 requires use of open-flame carbon-arc apparatus with automatic humidity control.

1.3 *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:*

D 358 Specification for Wood to Be Used as Panels in Weathering Tests of Coatings[2]

D 523 Test Method for Specular Gloss[3]

D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products[3]

D 610 Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces[2]

D 659 Method of Evaluating Degree of Chalking of Exterior Paints[4]

D 660 Test Method for Evaluating Degree of Checking of Exterior Paints[3]

D 662 Test Method for Evaluating Degree of Erosion of Exterior Paints[3]

D 714 Test Method for Evaluating Degree of Blistering of Paints[3]

D 772 Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints[3]

D 822 Practice for Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus[3]

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels[3]

D 1005 Test Methods for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers[3]

D 1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base[3]

D 1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base[3]

D 1729 Practice for Visual Evaluation of Colors and Color Differences of Diffusely Illuminated Opaque Materials[3]

D 1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting[5]

D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates[3]

D 2616 Test Method for Evaluation of Visual Color Difference with a Gray Scale[3]

D 3361 Practice for Operating Light- and Water-Exposure

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

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[2] *Annual Book of ASTM Standards*, Vol 06.02.

[3] *Annual Book of ASTM Standards*, Vol 06.01.

[4] Discontinued 1989; see *1990 Annual Book of ASTM Standards*, Vol 06.01.

[5] *Annual Book of ASTM Standards*, Vol 02.05.

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TABLE 1 Test Cycles Commonly Used for Enclosed Carbon-Arc Exposure Testing of Paints and Related Coatings[A]

Cycle Number	Cycle Description	Uninsulated Black Panel Temperature[B] (°C)	(°F)	Typical Uses[C]
1	Continuous light 102 min light only at 50 ± 5 % RH 18 min light and water spray[D] Repeated continuously	63 ± 2.5	145 ± 5	General coatings and historical convention[E]
2	18 h continuous light using: 102 min light only at 50 ± 5 % RH 18 min light and water spray	63 ± 2.5	145 ± 5	General coatings
	6 h dark using: 95 % relative humidity (no water spray) Repeated continuously	24 ± 1.5	75 ± 3	
3	48 min light at 50 ± 5 % RH 12 min light and water spray Repeated continuously	63 ± 2.5	145 ± 5	Coatings used in original equipment manufacturing
4	4 h light at 50 ± 5 % RH 4 h dark with water spray Repeated continuously	63 ± 2.5	145 ± 5	Exterior pigmented stains
5	12 h light at 50 ± 5 % RH 12 h dark water spray Repeated continuously	63 ± 2.5	145 ± 5	Exterior wood stains and clears
6	8 h light at 50 ± 5 % RH 10 h light and water spray 6 h dark with water spray Repeated continuously	63 ± 2.5	145 ± 5	Marine enamels

[A] The cycles described are not listed in any order indicating importance, and are not necessarily recommended for the applications listed.
[B] Unless otherwise indicated, black panel temperatures apply during the light-only portion of the cycle. The equilibrium black panel temperature is obtained without a spray period. For light intervals less than 30 min, the black panel temperature might not reach equilibrium.
[C] Typical uses do not imply that results from exposures of these materials according to the cycle described will correlate to those from actual use conditions.
[D] Unless otherwise specified, water spray refers to water sprayed on the exposed surfaces of the test specimens.
[E] Historical convention has established this as a very commonly used test cycle. This cycle may not adequately simulate the effects of outdoor exposure.

Apparatus (Unfiltered Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products Using the Dew Cycle[3]

D 3980 Practice for Interlaboratory Testing of Paint and Related Materials[6]

D 4214 Test Methods for Evaluating Degree of Chalking of Exterior Paint Films[3]

D 5870 Practice for Calculating Property Retention Index of Plastics[7]

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[8]

E 1347 Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry[3]

G 23 Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials[9]

G 113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials[10]

G 141 Guide for Addressing Variability in Exposure Testing on Nonmetallic Materials[10]

G 147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests[10]

G 151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices That Use Laboratory Light Sources[10]

G 152 Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials[10]

G 153 Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials[10]

G 169 Guide for Application of Basic Statistical Methods to Weathering Tests[10]

3. Terminology

3.1 The definitions given in Terminology G 113 are applicable to this practice.

4. Significance and Use

4.1 The ability of a paint or coating to resist deterioration of its physical and optical properties caused by exposure to light, heat, and water can be very significant for many applications. This practice is intended to induce property changes associated with end-use conditions, including the effects of sunlight, moisture, and heat. The exposure used in this practice is not intended to simulate the deterioration caused by localized weather phenomena such as atmospheric pollution, biological attack, and saltwater exposure.

4.2 *Cautions*—Variation in results may be expected when different operating conditions are used. Therefore, no reference to the use of this practice shall be made unless accompanied by a report prepared according to Section 10 that describes the specific operating conditions used. Refer to Practice G 151 for detailed information on the caveats applicable to use of results obtained according to this practice.

NOTE 3—Additional information on sources of variability and on strategies for addressing variability in the design, execution, and data analysis of laboratory accelerated exposure tests is [illegible]

[6] Discontinued 1998; see *1997 Annual Book of ASTM Standards*, Vol 06.01.
[7] *Annual Book of ASTM Standards*, Vol 08.03.
[8] *Annual Book of ASTM Standards*, Vol 14.02.
[9] Discontinued 2000; see *1999 Annual Book of ASTM Standards*, Vol 14.04.
[10] *Annual Book of ASTM Standards*, Vol 14.04.

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