



Standard Practice for Conducting Tests on Paint and Related Coatings and Materials Using Enclosed Carbon-Arc Exposure Apparatus¹

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 Practice G 23. Both types are manufactured with or without automatic humidity control.² Table 1 describes commonly used test conditions. Interlaboratory comparisons *must* only be made using the same device type and test conditions.

1.2 The procedures described in this practice were previously included in Practice D 822, which covered the use of both filtered open flame and enclosed carbon arcs for testing paints, varnishes, lacquers, and related products. Practice D 822 describes exposures in filtered open-flame carbon-arc devices only.

NOTE 1—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 much higher levels of short wavelength radiation than filtered open-flame or enclosed carbon arcs. Only automatic humidity controlled open-flame carbon-arc apparatus (Type EH) is applicable to Practice D 3361.

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.* For specific hazard statements, see Section 4.

2. Referenced Documents

2.1 ASTM Standards:

- D 358 Specification for Wood to Be Used as Panels in Weathering Tests of Coatings³
- D 523 Test Method for Specular Gloss⁴
- D 609 Practice for Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and

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

Cycle Description	Black Panel Temp, ^B °F (°C)	Typical Uses ^C
102 min light 18 min light and water spray ^{D,E}	145 ± 5 (63 ± 2.5)	general coatings ^B
18 h using: 102 min light 18 min light and water spray 6 h at 95 ± 4 % relative humidity with no water spray	145 ± 5 (63 ± 2.5) 75 ± 3	general coatings
48 min light 12 min light and water spray	145 ± 5 (63 ± 2.5)	original equipment manu- factured coatings
4 h light 4 h water spray	145 ± 5 (63 ± 2.5)	exterior pigmented paints
12 h light 12 h water spray	145 ± 5 (63 ± 2.5)	exterior wood stains and clears
8 h light 10 h light and water spray 6 h water spray	145 ± 5 (63 ± 2.5)	marine enamels

^AThe cycles described are not listed in any order indicating importance, and are not necessarily recommended.

^BUnless otherwise indicated, black panel temperature during light only portion of the cycle.

^CTypical uses does not imply that results from exposures of these materials according to the cycle described will correlate to those from actual use conditions.

^DUnless otherwise specified, water spray refers to water sprayed on the exposed surface of the test specimens.

^EHistorical convention has established this as a very commonly used test cycle.

Related Coating Products⁴

- D 610 Test Methods for Evaluating Degree of Rusting on Painted Steel Surfaces³
- D 659 Method of Evaluating Degree of Chalking of Exterior Paints⁴
- D 660 Test Method for Evaluating Degree of Checking of Exterior Paints⁴
- D 662 Test Method for Evaluating Degree of Erosion of Exterior Paints⁴
- D 714 Test Method for Evaluating Degree of Blistering of Paints⁴
- D 772 Test Method for Evaluating Degree of Flaking (Scaling) of Exterior Paints⁴

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.

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² Apparatus and carbon arcs manufactured by Atlas Electric Devices Company, 4114 N. Ravenswood Avenue, Chicago, IL 60613, and by Suga Test Instruments Co., Ltd, 4-14 Shinjuku 5-chome, Shinjuku-ku, Tokyo, 160, Japan, have been found satisfactory for this purpose.

³ Annual Book of ASTM Standards, Vol 06.02.

⁴ Annual Book of ASTM Standards, Vol 06.01.

D 822 Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus⁴

D 823 Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products on Test Panels⁴

D 1005 Test Methods for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers⁴

D 1186 Test Methods for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to a Ferrous Base⁴

D 1400 Test Method for Nondestructive Measurement of Dry Film Thickness of Nonconductive Coatings Applied to a Nonferrous Metal Base⁴

D 1729 Practice for Visual Evaluation of Color Differences of Opaque Materials⁴

D 1730 Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting⁵

D 2244 Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates⁴

D 2616 Test Method for Evaluation of Visual Color Difference with a Gray Scale⁴

D 3361 Practice for Operating Light- and Water-Exposure Apparatus (Unfiltered Open-Flame Carbon-Arc Type) for Testing Paint, Varnish, Lacquer, and Related Products Using the Dew Cycle⁴

D 3980 Practice for Interlaboratory Testing of Paint and Related Materials⁴

D 4214 Test Methods for Evaluating Degree of Chalking of Exterior Paint Films⁴

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of Test Methods⁶

E 1347 Test Method for Color and Color Difference Measured by Tristimulus (filter) Colorimetry⁴

G 23 Practice for Operating Light- and Water-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials⁶

G 113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials⁶

3. Terminology

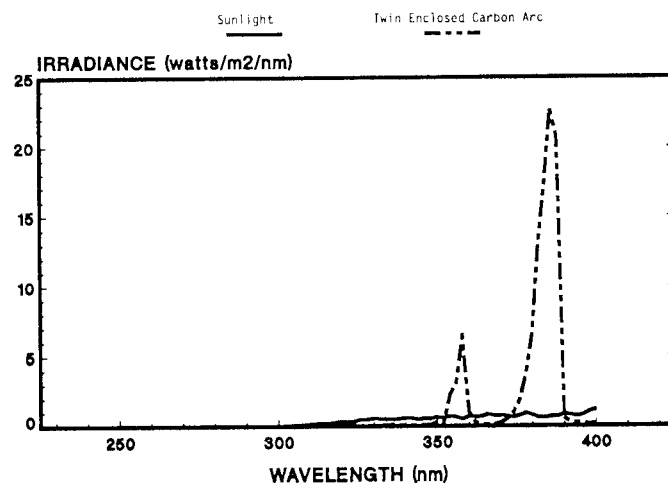
3.1 The definitions given in Terminology standard G113 are applicable to this practice.

4. Significance and Use

4.1 Organic coatings on exterior exposure are subjected to attack by degrading elements of the weather, particularly ultraviolet light, oxygen, and water. This practice is intended to evaluate coating films for their stability in an apparatus that exposes specimens to ultraviolet (UV) light, heat, and moisture. If the spectral power distribution of the light source used for exposure tests does not adequately simulate that of terrestrial solar radiation, it may produce a different type of degradation and distort the ranking of materials obtained in outdoor exposures. Fig. 1 and Fig. 2 compare representative spectral power distributions of the enclosed carbon-arc with that of terrestrial sunlight.

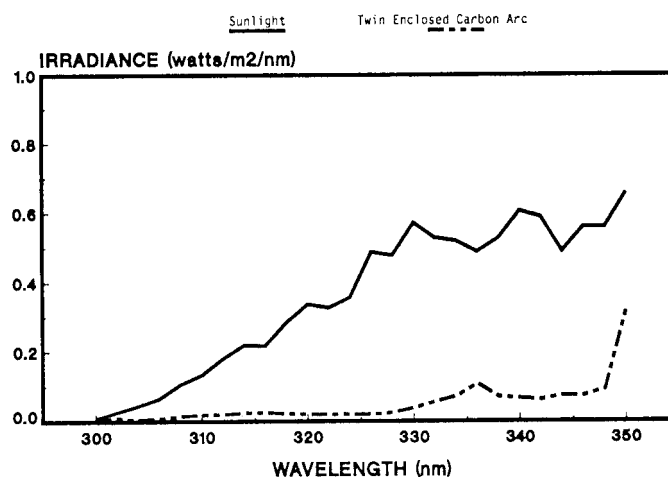
⁵ Annual Book of ASTM Standards, Vol 02.05.

⁶ Annual Book of ASTM Standards, Vol 14.02.



NOTE 1—The enclosed carbon-arc irradiance was measured at the sample plane at a position centered between the two carbon arcs. Sunlight was measured in Phoenix, AZ, at the summer solstice with clear sky at solar noon using a double grating monochromator (1-nm bandpass) with a quartz cosine receptor on an equatorial follow-the-sun mount. Because of momentary fluctuations in intensity due to flickering of the carbon-arc flame, the spectral power distribution shown in this figure is relative and is not to be used to calculate or estimate total radiant exposure for tests in enclosed carbon-arc devices.

FIG. 1 Representative Spectral Power Distributions (250–400 nm) for Twin Enclosed Carbon Arcs and Terrestrial Sunlight



NOTE 1—Measurements were made as described in Fig. 1. Because of momentary fluctuations in intensity due to flickering of the carbon-arc flame, the spectral power distribution shown in this figure is representative and is not meant to be used to calculate or estimate total radiant exposure for tests in enclosed carbon-arc devices.

FIG. 2 Representative Spectral Power Distributions (300–350 nm) for Twin Enclosed Carbon Arcs and Terrestrial Sunlight

4.1.1 Exposures in enclosed carbon-arc devices have been historically used to simulate the effects of terrestrial sunlight. As shown in Fig. 1 and Fig. 2, the UV spectral power distribution of the light from these devices is significantly different from that of terrestrial sunlight. The primary emission of the enclosed carbon-arc produces is in two relatively narrow peaks between 350 and 400 nm. The intensity of the enclosed carbon arc is less than that of terrestrial solar radiation at virtually all other wavelengths.