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Standard Practice for Xenon-Arc Exposures of Paint and Related Coatings[1]

This standard is issued under the fixed designation D 6695; 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 xenon arc devices conducted according to Practices G 151 and G 155. 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—ISO 11341:1994 also describes xenon-arc exposures of paints and coatings. However, the exposure conditions described in ISO 11341 are different than those listed in Table 1.

1.2 *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]

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

Cycle Number	Cycle Description[B]	Uninsulated Black Panel, Temperature[C]	Typical Irradiance[D]	Typical Uses[E]
1	Continuous light	63 ± 2°C	0.35 ± 0.02 W/(m^2·nm) at 340 nm	General coatings and
	102 min light only at 50 % ± 5 % RH	145 ± 4°F	41.5 ± 2.5 W/m^2 from 300-400 nm	historical convention[G]
	18 min light and water spray[F]			
	Repeat continuously			
2	18 h continuous light using:	63 ± 2°C	0.35 ± 0.02 W/(m^2·nm) at 340 nm	General coatings
	102 min light only at 50 % ± 5 % RH	145 ± 4°F	41.5 ± 2.5 W/m^2 from 300-400 nm	
	18 min light and water spray	24 ± 1.5°C		
	6 h dark using:	43 ± 3°F		
	95 % relative humidity (no water spray)			
	Repeat continuously			
3	4 h light at 50 % ± 5 % RH	63 ± 2°C	0.35 ± 0.02 W/(m^2·nm) at 340 nm	Exterior pigmented stains
		145 ± 4°F	41.5 ± 2.5 W/m^2 from 300-400 nm	
	4 h dark with water spray			
	Repeat continuously			
4	12 h light at 50 % ± 5 % RH	63 ± 2°C	0.35 ± 0.02 W/(m^2·nm) at 340 nm	Exterior wood stains
		145 ± 4°F	41.5 ± 2.5 W/m^2 from 300-400 nm	and clears
	12 h dark with water spray			
	Repeat continuously			
5	8 h light at 50 % ± 5 % RH	63 ± 2°C	0.35 ± 0.02 W/(m^2·nm) at 340 nm	Marine enamels
		145 ± 4°F	41.5 ± 2.5 W/m^2 from 300-400 nm	
	10 h light and water spray			
	6 h dark with water spray			
	Repeat continuously			
6	40 min light at 50 % ± 5 % RH	70 ± 2 °C (158 ± 4 °F)	0.55 ± 0.02 W/(m^2·nm) at 340 nm	Automotive exterior[H]
	20 min light and water spray	70 ± 2 °C (158 ± 4 °F)	65.5 ± 2.5 W/m^2 from 300-400 nm	
	60 min light at 50 % ± 5 % RH	38 ± 2 °C (100 ± 4 °F)		
	60 min dark at 95 % ± 5 % RH			
	(water spray on front and back of specimens)			
	Repeat continuously			
7	3.8 h light at 50 % ± 5 % RH	89 ± 3 °C (192 ± 5 °F)	0.55 ± 0.02 W/(m^2·nm) at 340 nm	Automotive interior[H]
	1.0 h dark at 95 % ± 5 % RH	38 ± 2 °C (100 ± 4 °F)	65.5 ± 2.5 W/m^2 from 300-400 nm	
	Repeat continuously			

[A] The cycles described are not listed in any order indicating importance, and are not necessarily recommended for the applications shown.
[B] As stated in 5.2, the spectral power distribution (SPD) of the xenon lamp shall conform to the requirements of Practice G 155 for a xenon lamp with daylight filters.
[C] Unless otherwise indicated, black panel temperatures apply during light-only portion of the cycle. The equilibrium black panel temperature is obtained without a spray period. For light intervals shorter than 30 min, the black panel temperature might not reach equilibrium. Unless otherwise specified, add 6°C (11°F) to the temperature given for the uninsulated black panel when an insulated black panel is used. Practice G 151 provides more information on the temperatures indicated by insulated and uninsulated black panels, which can depend on irradiance level, and the type of xenon-arc filter used.
[D] The irradiance values given are those that have historically been used. In devices capable of producing higher irradiance, the actual irradiance used may be higher than the stated values. For example, Japanese auto industry specifications allow use of exposures according to Cycle 1 with 300 to 400 nm irradiance of up to 180 W/m^2.
[E] Typical uses does not imply that results from exposures of these materials according to the cycle described will correlate to those from actual use conditions.
[F] Unless otherwise specified, water spray refers to water sprayed on the exposed surface of the test specimens.
[G] This cycle has been used for coatings by historical convention and may not adequately simulate the effects of outdoor exposure.
[H] The SPD of the xenon lamp with the filters required in SAE standards J1960 and J1885 does not meet the requirements of Practice G 155 for a xenon lamp with daylight filters.

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 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]

[2] *Annual Book of ASTM Standards*, Vol 06.02.
[3] *Annual Book of ASTM Standards*, Vol 06.01.
[4] Discontinued; see *1990 Annual Book of ASTM Standards*, Vol 06.01.

D 1729 Practice for Visual Appraisal 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 Practice for Calculation of Color Tolerances and Color Differences From Instrumentally Measured Color Coordinates[3]
D 2616 Test Method for Evaluation of Visual Color Difference with a Gray Scale[3]
D 3359 Test Methods for Measuring Adhesion by Tape Test[3]
D 3980 Practice for Interlaboratory Testing of Paint and Related Materials[3]
D 4214 Test Methods for Evaluating Degree of Chalking of Exterior Paint Films[3]
D 5870 Practice for Calculating Property Retention Index of Plastics[6]
E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method[7]
E 1347 Test Method for Color and Color Difference Measured by Tristimulus (Filter) Colorimetry[3]
G 113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials[8]
G 141 Guide for Addressing Variability in Exposure Testing on Nonmetallic Materials[8]
G 147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests[8]
G 151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices That Use Laboratory Light Sources[8]
G 155 Practice for Operating Xenon-Arc Light Apparatus for Exposure of Nonmetallic Materials[8]
G 169 Guide for Application of Basic Statistical Methods to Weathering Tests[8]

2.2 *ISO Standards:*

ISO 11341:1994 Paints and Varnishes—Artificial Weathering and Exposure to Artificial_Radiation—Exposure to Filtered Xenon-Arc Radiation[9]

2.3 *Society of Automotive Engineers' Standards:*

SAE J1885, Accelerated Exposure of Automotive Interior Trim Components Using a Controlled Irradiance Water Cooled Xenon Arc Apparatus[10]

SAE J1960, Accelerated Exposure of Automotive Exterior Materials Using a Controlled Irradiance Water Cooled Xenon Arc Apparatus[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 salt water exposure.

4.2 *Caution*—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 2—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 found in Guide G 141.

4.2.1 The spectral power distribution of light from a xenon-arc is significantly different from that produced in light and water exposure devices using carbon-arc or other light sources. The type and rate of degradation and the performance rankings produced by exposures to xenon-arcs can be much different from those produced by exposures to other types of laboratory light sources.

4.2.2 Interlaboratory comparisons are valid only when all laboratories use the same light source, filter type, and exposure conditions.

4.3 Reproducibility of test results between laboratories has been shown to be good when the stability of materials is evaluated in terms of performance ranking compared to other materials or to a control.[11,12] Therefore, exposure of a similar material of known performance (a control) at the same time as the test materials is strongly recommended. It is recommended that at least three replicates of each material be exposed to allow for statistical evaluation of results.

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[5] *Annual Book of ASTM Standards*, Vol 02.05.
[6] *Annual Book of ASTM Standards*, Vol 08.03.
[7] *Annual Book of ASTM Standards*, Vol 14.02.
[8] *Annual Book of ASTM Standards*, Vol 14.04.
[9] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.
[10] Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.
[11] 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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[12] Ketola, W., and Fischer, R. "Characterization and Use of Reference Materials in Accelerated Durability Tests," *VAMAS Technical Report No. 30*, available from NIST, June 1997.

4.4 Test results will depend upon the care that is taken to operate the equipment according to Practice G 155. Significant factors include regulation of line voltage, freedom from salts or other deposits from water, temperature and humidity control, and condition and age of the burner and filters.

4.5 *All references to exposures in accordance with this practice must include a complete description of the test cycle used.*

5. Safety Hazards

5.1 **Warning:** Never look directly at the xenon-arc because UV radiation can damage the eye. Most xenon-arc machines are equipped with door safety switches, but users of old equipment must be certain to turn the power to the lamp off before opening the test-chamber door.

5.2 Xenon-arc lamps should be at or near room temperature before handling.

6. Apparatus

6.1 Use xenon-arc apparatus that conforms to the requirements defined in Practices G 151 and G 155.

6.2 Unless otherwise specified, the spectral power distribution of the xenon-arc shall conform to the requirements in Practice G 155 for xenon-arc with daylight filters.

7. Test Specimens

7.1 Apply the coating to flat (plane) panels with the substrate, method of preparation, method of application, coating system, film thickness, and method of drying consistent with the anticipated end use, or as mutually agreed upon between the producer and user.

7.2 Panel specifications and methods of preparation include but are not limited to Practices D 609, D 1730, or Specification D 358. Select panel sizes suitable for use with the exposure apparatus.

7.3 Coat test panels in accordance with Practices D 823 and then measure the film thickness in accordance with an appropriate procedure selected from Test Methods D 1005, D 1186, or D 1400. Nondestructive methods are preferred because panels so measured need not be repaired.

7.4 Prior to exposing coated panels in the apparatus, condition them at 23 ± 2°C (73 ± 3°F) and 50 ± 5 % relative humidity for one of the following periods in accordance with the type of coating:

Baked coatings	24 h
Radiation-cured coatings	24 h
All other coatings	7 days min

7.4.1 Other procedures for preparation of test specimens may be used if agreed upon between all interested parties.

7.5 Mount specimens in holders so that only the minimum specimen area required for support by the holder is covered. Do not use this covered area of the specimen as part of the test area.

7.6 Unless otherwise specified, expose at least three replicate specimens of each test and control material.

7.7 Follow the procedures described in Practice G 147 for identification and conditioning and handling of specimens of test, control, and reference materials prior to, during, and after exposure.

7.8 Do not mask the face of a specimen for the purpose of showing on one panel the effects of various exposure times. Misleading results may be obtained by this method, since the masked portion of the specimen is still exposed to temperature and humidity cycles that in many cases will affect results.

7.9 Retain a supply of unexposed file specimens of all materials evaluated.

7.9.1 When destructive tests are run, it is recommended that a sufficient number of file specimens be retained so that the property of interest can be determined on unexposed file specimens each time exposed materials are evaluated.

NOTE 3—Since the stability of the file specimen may also be time-dependent, users are cautioned that over prolonged exposure periods, or where small differences in the order of acceptable limits are anticipated, comparison of exposed specimens with the file specimen may not be valid. Nondestructive instrumental measurements are recommended whenever possible.

7.10 Specimens should not ordinarily be removed from the exposure apparatus for more than 24 h then returned for additional tests, since this may not produce the same results on all materials as tests run without this type of interruption. When specimens are removed from the exposure apparatus for 24 h or more then returned for additional exposure, report the elapsed time as noted under Section 10.

8. Procedure

8.1 Table 1 lists several exposure cycles that are used for xenon-arc exposures of paints and coatings. Obtain agreement between all concerned parties for the specific exposure cycle used. Additional intervals and methods of wetting, by spray, condensation, immersion, or combination of these, may be substituted upon agreement among the concerned parties.

NOTE 4—Each setpoint and its tolerances found in Table 1 represent an operational control point for equilibrium conditions at a single location in the cabinet that may not necessarily represent the uniformity of those conditions throughout the cabinet. ASTM Committee G03.03 is working to refine these tolerances and address the uniformity issue.

NOTE 5—Spray, condensation, and immersion are different kinds of moisture exposures and frequently produce different results.

8.1.1 Unless otherwise specified, maintain relative humidity at 50 ± 5 % equilibrium during the light-only interval.

8.2 If no other cycle is specified, use Cycle No. 1.

8.3 Mount test specimens in the device following the placement and specimen repositioning procedures described in Practice G 155. It is recommended that all unused spaces in the specimen exposure area be filled with blank metal panels that are not highly reflective. The blanks used shall be resistant to corrosion and shall not contaminate the specimens being exposed.

8.4 RIf the irradiance uniformity does not meet the requirements of Practice G 151, reposition specimens in devices preferably using the procedure described or, at a minimum, one of the procedures described in Practice G 155 unl.

Repositioning of specimens throughout the exposure period can be shown minimize variations in test results for materials that are especially sensitive to small variations in temperature, humidity, or irradiance. As such, respositioning is always a good idea and is recommended even if a device meets the irradiance uniformity meets the requirements of in Practice G 151 f.

It is also recommended to randomly position multiple specimens of each material throughout the specimen rack or tray. By randomly positioning multiple replicate specimens of one material, the effects of uniformity variations can be reduced.

8.4.1 If specimen repositioning is used, and no other repositioning schedule is specified, use the following procedure for specimen repositioning is recommended:

8.4.1.1 Once per week move all holders in the top half of the specimen exposure area to the bottom half, and move all holders in the bottom half of the exposure area to the top half. Do not reposition the specimens within the holder.

NOTE 56—In older devices, incident energy at the top and bottom of the specimen rack is often only 70 % of that at the center. This condition requires that the procedures described in 8.4 be followed to ensure uniformity of radiant exposure.

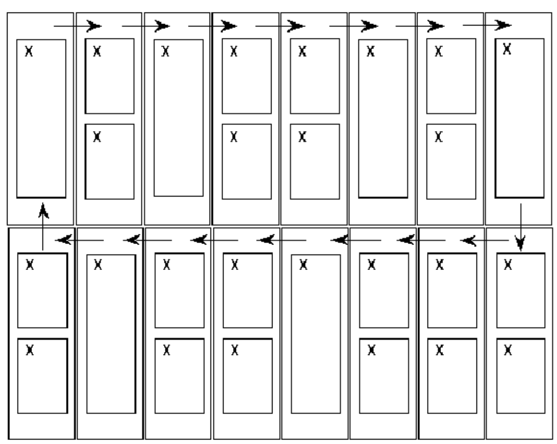
8.4.1.2 For devices with a planar exposure area, reposition specimens by moving specimens or holders in the half of the exposure area farthest from the door, one position to the right. The rightmost specimen or holder in this area is moved to the rightmost position in the half of the area closest to the door. Other specimens in this area are moved one position left with the leftmost specimen or holder moved to the leftmost position in the half farthest from the door. This repositioning schedule is illustrated in Fig. 1.

8.5 *Water Purity*:

8.5.1 The purity of water used for specimen spray is very important. Without proper treatment to remove cations, anions, organics, and particularly silica, exposed panels will develop spots or stains that may not occur in exterior exposures.

8.5.2 Follow the requirements for water purity described in Practice G 151.

8.5.3 If specimens are found to have deposits or stains after exposure in the apparatus, the water purity must be checked to determine if it meets the requirements of 8.5.2. On some occasions, exposed specimens can be contaminated by deposits from



NOTE 1—"X" denotes specimen orientation. If multiple specimens are in a single holder, they do not need to be repositioned within the holder.

FIG. 1 Specimen or Specimen Holder Repositioning for a Xenon-Arc Device With a Planar Exposure Area

bacteria that can grow in the purified water used for specimen spray. If bacterial contamination is detected, the entire system used for specimen water spray must be flushed with chlorine and thoroughly rinsed prior to resuming exposures.

8.5.4 The typical temperature of water used for specimen spray is 21 ± 5°C (70 ± 9°F). However, if ambient water temperature is low and a holding tank is not used to store purified water, the temperature of water used for specimen spray may be below the typical range given.

8.5.5 When the water purity requirements are met and there is disagreement between parties on the extent of problems caused by stain or deposit, run referee tests in at least one other laboratory that can meet the water quality requirements described in 8.4.

8.5.6 For devices with humidity control, it is recommended that deionized water be used when generating water vapor to control humidity.

8.6 Some tests for lightfastness are run without any specimen wetting. When this type of test is required, omit the period where water is sprayed on specimens.

8.7 Identification of any control specimen used shall accompany the report.

9. Periods of Exposure and Evaluation of Test Results

9.1 In most cases, periodic evaluation of test and control materials is necessary to determine the variation in magnitude and direction of property change as a function of exposure time or radiant exposure.

9.2 The time or radiant exposure necessary to produce a defined change in a material property can be used to evaluate or rank the stability of materials. This method is preferred over evaluating materials after an arbitrary exposure time or radiant exposure.

9.2.1 Exposure to an arbitrary time or radiant exposure may be used for the purpose of a specific test if agreed upon between the parties concerned or if required for conformance to a particular specification. When a single exposure period is used, select a time or radiant exposure that will produce the largest performance differences between the test materials or between the test material and the control material.

9.2.2 The minimum exposure time used shall be that necessary to produce a substantial change in the property of interest for the least stable material being evaluated. An exposure time that produces a significant change in one type of material cannot be assumed to be applicable to other types of materials.

9.2.3 The relation between time to failure in an exposure conducted according to this practice and service life in an outdoor environment requires determination of a valid acceleration factor. Do not use arbitrary acceleration factors relating time in an exposure conducted according to this practice and time in an outdoor environment because they can give erroneous information. The acceleration factor is material dependent and is only valid if it is based on data from a sufficient number of separate exterior and laboratory accelerated exposures so that results used to relate times to failure in each exposure can be analyzed using statistical methods.

NOTE 67—An example of a statistical analysis using multiple laboratory and exterior exposures to calculate an acceleration factor is described by J.A. Simms[13]. See Practice G 151 for more information and additional cautions about the use of acceleration factors.

9.3 After each exposure increment, determine the changes in exposed specimens. Test Methods D 523, D 610, D 659, D 660, D 662, D 714, D 772, D 2244, D 2616, D 3359, D 4214, E 1347 or Practice D 1729 may be used. Consider product use requirements when selecting appropriate methods.

9.3.1 Other methods for evaluating test specimens may be used if agreed upon between all interested parties.

NOTE 78—For some materials, changes may continue after the specimen has been removed from the exposure apparatus. Measurements (visual or instrumental) should be made within a standardized time period or as agreed upon between interested parties. The standardized time period needs to consider conditioning prior to testing.

9.4 It is recommended that the following procedure be followed when results from exposures conducted according to this practice are used in specifications.

9.4.1 If a standard or specification for *general use* requires a defined property level after a specific time or radiant exposure in an exposure test conducted according to this practice, base the specified property level on results from round-robin experiments run to determine the test reproducibility for the exposure and property measurement procedures. Conduct these round-robins according to Practice E 691 or Practice D 3980 and include a statistically representative sample of all laboratories or organizations who would normally conduct the exposure and property measurement.

9.4.2 If a standard or specification for *use between two or three parties* requires a defined property level after a specific time or radiant exposure in an exposure test conducted according to this practice, base the specified property level on at least two independent experiments run in each laboratory to determine the reproducibility for the exposure and property measurement process. The reproducibility of the exposure/property measurement process is then used to determine the maximum or minimum level of property after the exposure that is mutually agreeable to all parties.

9.4.3 When reproducibility in results from an exposure test conducted according to this practice has not been established through round-robin testing, specify performance requirements for materials in terms of comparison (ranked) to a control material. All specimens shall be exposed simultaneously in the same device. All concerned parties must agree on the specific control material used.

[13] Simms, J.A., *Journal of Coatings Technology*, Vol 50, 1987, pp. 45-53.

9.4.3.1 Conduct analysis of variance to determine whether the differences between test materials and any control materials used are statistically significant. Expose replicates of the test specimen and the control specimen so that statistically significant performance differences can be determined.

NOTE 89—Fischer illustrates use of rank comparison between test and control materials in specifications[14].
NOTE 910—Guide G 169 includes examples showing use of analysis of variance to compare materials.

10. Report

10.1 Report the following information:
10.1.1 Material description and specimen dimensions.
10.1.2 Specimen mounting procedure.
10.1.3 Type and model of exposure device.
10.1.4 Type of light source.
10.1.5 AvIf the exposed face of a specimen does not fall within the exposure device's specimen plagne, report the distance from specimens to light source. For three-dimensional specimens extending beyond the specimen plane (in front of or behind the specimen plane, or both), report the minimum and maximum distance from the exposed face of the specimen to the light source.
10.1.6 Type and age of filters at the beginning of the exposure, and whether any of the filters were replaced during the period of exposure.
10.1.7 Type of black panel (uninsulated or insulated) used.
10.1.8 If required, report irradiance measured at a single wavelength in W/(m^2·nm) and radiant energy for a single wavelength in J/(m^2·nm). Report irradiance measured in a broad band, such as 300 to 400 nm, in W/m^2 with the spectral region specified. Report radiant energy measured in a broad band as J/m^2 with the spectral region specified.
10.1.8.1 Do not report irradiance or radiant exposure unless direct measurement of irradiance was made during the exposure.
10.1.9 Elapsed exposure time.
10.1.9.1 When required, report any test interruptions greater than 24 h in accordance with 7.10.
10.1.10 Light and dark-water-humidity cycle employed.
10.1.11 Operating black
10.1.11 Black panel temperature.
10.1.12 Operating set point and set point tolerance. If light and dark periods are employed, report the set point and set point tolerance for each period.
10.1.12 If relative humidity is controlled, report relative humidity set point and set point tolerance. If light and dark periods are employed, report the relative humidity set point and set point tolerance for each period.
10.1.13 If controlled, set point and tolerance limits for chamber air temperature. If light and dark periods are employed, report the chamber air temperature set point and tolerance limits for each period.
10.1.14 Type of spray water.
10.1.134.1 Total solids and silica level of water used for specimen spray, (if above limits specified in 8.5).
10.1.145 Type of spray nozzle.
10.1.156 If used, specimen repositioning procedure.
10.1.167 RDate, results of physical property tests, identification of laboratory conducting the exposure and property tests, (if different labs conduct the exposures and property tests, identify both). Where retention of a characteristic property is reported, calculate results according to Practice D 5870 contains examples of these calculations.

NOTE 101—In some cases, exposures are conducted by a contracting agency but property tests are conducted by the contracting party. In these cases, the agency that conducts the exposures cannot report results from property tests.

11. Precision and Bias

11.1 *Precision*—The repeatability and reproducibility of results obtained in exposures conducted according to this practice will vary with the materials being tested, the material property being measured, and the specific test conditions and cycles that are used.
11.2 *Bias*—Bias can not be determined because no acceptable standard weathering reference materials are available.

12. Keywords

12.1 degradation; exposure; light exposure; ultraviolet; weathering; xenon-arc

[14] Fischer, R., Ketola, W., "Impact of Research on Development of ASTM Durability Testing Standards," *Durability Testing of Non-Metallic Materials, ASTM STP 1294*, Robert Herling, Editor, ASTM, Philadelphia, 1995.