Designation: D 4459 – 99

Standard Practice for Xenon-Arc Exposure of Plastics Intended for Indoor Applications[1]

This standard is issued under the fixed designation D 4459; 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 specific procedures and test conditions that are applicable for exposure of plastics in window glass-filtered xenon-arc devices in accordance with Practices G 151 and G 155 for evaluating the stability of plastics intended for use in indoor applications.

NOTE 1—Previous versions of this practice referenced xenon-arc devices described by Practice G 26. This practice described very specific equipment designs and is being replaced by Practices G 151 and G 155, which describe performance criteria for all xenon-arc devices. Practice G 26 will be balloted for withdrawal before December 2000.

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.*

NOTE 2—This practice has no ISO equivalent.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

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

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

D 3980 Practice for Interlaboratory Testing of Paint and Related Materials

D 4674 Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight

D 5870 Practice for Calculating Property Retention Index of Plastics

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

G 26 Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

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

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

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

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

G 155 Practice for Operating Xenon-Arc Light Apparatus for Exposure of Nonmetallic Materials

3. Terminology

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

4. Significance and Use

4.1 This practice is intended to simulate the effects produced by exposure to solar radiation through glass. This practice uses exposure in a xenon-arc device equipped with window glass filters and operated in accordance with Practices G 151 and G 155.

NOTE 3—Practice D 4674 describes exposures in a device that uses a combination of fluorescent "cool white" and ultraviolet (UV) lamps to simulate the effects of exposures to indoor fluorescent light and window glass filtered daylight.

[1] This practice is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.50 on Permanence Properties.

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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.

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

4.2 *Caution*—Variation in results may be expected when operating conditions are varied within the accepted limits of this practice. Therefore, all references to the use of this practice must be accompanied by a report prepared in accordance with Section 9 that describes the specific operating conditions used. Refer to Practice G 151 for detailed information on the caveats applicable to use of results obtained in accordance with this practice.

NOTE 4—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.

4.3 Test results will depend upon the care that is taken to operate the equipment in accordance with Practice G 155. Significant factors include regulation of line voltage, temperature and humidity control, and condition and age of the burner and filters.

4.4 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.[3,4] 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.

5. Apparatus

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

5.2 The spectral power distribution of the xenon-arc lamp shall conform to the requirements described in Practice G 155 for a xenon-arc lamp with window glass filters.

5.3 Unless otherwise specified, use a xenon-arc device equipped with a radiometer capable of monitoring either narrow-band or broad-band irradiance incident on test specimens.

6. Test Specimen

6.1 The size and shape of specimens to be exposed will be determined by the specifications of the particular test method used to evaluate the effects of the exposure on the specimens; the test method shall be determined by the parties concerned. Where practical, it is recommended that specimens be sized to fit specimen holders and racks supplied with the exposure apparatus. Unless supplied with a specific backing as an integral part of the test, specimens shall be mounted so that only the minimum specimen area required for support by the holder shall be covered. This unexposed surface must not be used as part of the test area.

6.2 Unless otherwise specified, expose at least three replicate specimens of each test material and of the control material, if used.

6.3 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.

6.4 Do not mask the face of 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.

6.5 Since the thickness of a specimen may affect markedly the results, thickness of test and control specimens shall be within ±10 % of the nominal dimensions.

NOTE 5—This is especially important if changes in mechanical properties are being investigated.

6.6 Incident energy at the extremes of the specimen exposure area in older equipment may be only 70 % of that at the center. If the irradiance at any position within the exposure area is less than 90 % of the peak irradiance, follow one of the procedures outlined in Practice G 155 to ensure either equal radiant exposure or compensation for differences in radiant exposure.

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

6.7.1 When destructive tests are run, ensure than sufficient file specimens are retained so that the property of interest can be determined on unexposed file specimens each time exposed materials are evaluated.

6.8 Specimens should not be removed from the exposure apparatus for more than 24 h and then returned for additional tests, since this does 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 in accordance with Section 9.

NOTE 6—Since the stability of the file specimens is also 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. Instrumental measurements are recommended whenever possible.

7. Procedure

7.1 Operate the xenon-arc device in continuous light mode without any water spray.

7.2 Unless otherwise specified, control the irradiance at one of the following levels:

7.2.1 0.3 ± 0.02 W/m^2 at 340 nm.

7.2.2 0.8 ± 0.05 W/m^2 at 420 nm.

7.2.3 36.5 ± 2.5 W/m^2 between 300 and 400 nm.

7.2.4 If the exposure device is not equipped with irradiance control, follow the manufacturer's recommendations to produce the specified irradiance levels.

7.3 Unless otherwise specified, control the temperature of an insulated black panel at 55 ± 2°C (131 ± 4°F).

7.4 Unless otherwise specified, control relative humidity at 55 ± 5 %.

7.5 It is recommended that a control material be exposed at the same time as the test specimens for comparison purposes, if performance comparisons are not being made between the

[3] Fischer, R., "Results of Round Robin Studies of Light- and Water-Exposure Standard Practices," *Accelerated and Outdoor Durability Testing of Organic Materials, ASTM STP 1202*, Warren D. Ketola and Douglas Grossman, eds., American Society for Testing and Materials, Philadelphia, 1993.

[4] Ketola, W., and Fischer, R., "Characterization and Use of Reference Materials in Accelerated Durability Tests," *VAMAS Technical Report No. 30*, available from NIST, Gaithersburg, MD.