Designation: D6360 – 07

StandardPractice for Enclosed Carbon-Arc Exposures of Plastics[1]

This standard is issued under the fixed designation D6360; 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 enclosed carbon-arc devices conducted in accordance with Practices G151 and G153. This practice also covers the preparation of test specimens, the test conditions suited for plastics, and the evaluation of test results.

1.2 This practice does not cover filtered open-flame carbon-arc exposures of plastics, which are covered in Practice D1499. Practice D5031 describes enclosed carbon-arc exposures of paints and related coatings.

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.*

NOTE 1—There is no known ISO equivalent to this practice.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1499 Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics

D3980 Practice for Interlaboratory Testing of Paint and Related Materials (Withdrawn 1998)[3]

D5031 Practice for Enclosed Carbon-Arc Exposure Tests of Paint and Related Coatings

D5870 Practice for Calculating Property Retention Index of Plastics

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

G113 Terminology Relating to Natural and Artificial Weathering Tests of Nonmetallic Materials

G141 Guide for Addressing Variability in Exposure Testing of Nonmetallic Materials

G147 Practice for Conditioning and Handling of Nonmetallic Materials for Natural and Artificial Weathering Tests

G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G153 Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials

G169 Guide for Application of Basic Statistical Methods to Weathering Tests

3. Terminology

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

4. Significance and Use

4.1 The ability of a plastic material to resist deterioration of its electrical, mechanical, 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. (**Warning—**Variation in results may be expected when operating conditions are varied within the accepted limits of this practice; therefore, no reference to the use of this practice shall be made unless accompanied by a report prepared in accordance with Section 9 that describes the specific operating conditions used. Refer to Practice G151 for detailed information on the caveats applicable to use of results obtained in accordance with 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 G141.

4.2 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; therefore, exposure of a similar material of known performance (a control) at the same time as

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

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

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

the test materials is strongly recommended.[4,5] It is recommended that at least three replicates of each material be exposed to allow for statistical evaluation of results.

4.3 Test results will depend upon the care that is taken to operate the equipment in accordance with Practice G153. Significant factors include regulation of line voltage, freedom from salt or other deposits from water, temperature and humidity control, and conditions of the electrodes.

5. Apparatus

5.1 The enclosed carbon-arc apparatus used shall conform to the requirements defined in Practices G151 and G153.

5.2 Unless otherwise specified, the spectral power distribution of the enclosed carbon-arc shall conform to the requirements in Practice G153 for enclosed carbon-arc with borosilicate glass globes.

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; therefore, 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, exposure at least three replicate specimens of each test and control material.

6.3 Follow the procedures described in Practice G147 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 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.

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

NOTE 3—This is especially important when 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 G153 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. When destructive tests are run, ensure that 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, and then returned for additional exposure, report the elapsed time in accordance with Section 9.

NOTE 4—Since the stability of the file specimen also may 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. Instrumental measurements are recommended whenever possible.

7. Procedure

7.1 Practice G153 lists several exposure cycles that are used for enclosed carbon-arc exposures of nonmetallic materials. Obtain mutual agreement between all concerned parties for the specific exposure cycle used. Additional intervals and methods of wetting, by spray or condensation, or both, may be substituted upon mutual agreement among the concerned parties.

7.1.1 By historical convention, the following exposure cycle has been commonly used for plastics:

7.1.2 Continuous light with equilibrium uninsulated black panel temperature controlled to 63 ± 3°C (145 ± 9°F), consisting of the following alternating intervals:

7.1.2.1 102 minutes light only followed by 18 minutes of light with water sprayed on the test specimens.

7.1.3 Unless otherwise specified, in devices which allow for control of relative humidity, maintain relative humidity at a 50 ± 5 % equilibrium during the light-only interval.

NOTE 5—The equilibrium black panel temperature is obtained without a spray period. For light intervals less than 30 min the maximum black panel temperature may not reach equilibrium.

NOTE 6—The test cycle described in 7.1.1 (also referred to as the 102/18 cycle) may not provide adequate simulation of the effects of outdoor exposure.

7.2 It is recommended that all unused spaces in the specimen exposure area be filled with blank metal panels.

7.3 *Water Purity:*

7.3.1 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.

7.3.2 Follow the requirements for water purity described in Practice G151.

7.3.3 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 7.3.2. On some occasions, exposed specimens can be contaminated by deposits from bacteria that can grow in the purified water used for

[4] Fischer, R., "Results of Round Robin Studies of Light- and Water-Exposure Standard Practices," *Symposium on Accelerated and Outdoor Durability Testing of Organic Materials, ASTM STP 1202*, ASTM, 1993, p.

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