



Designation: D1499 – 05

## Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics<sup>1</sup>

This standard is issued under the fixed designation D1499; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the Department of Defense.*

### 1. Scope\*

1.1 This practice covers specific procedures and test conditions that are applicable for exposure of plastics in filtered open-flame carbon-arc devices conducted in accordance with Practices [G151](#) and [G152](#). This practice also covers the preparation of test specimens, the test condition suited for plastics, and the evaluation of test results.

1.2 This practice does not cover enclosed carbon-arc exposures of plastics, which had been allowed in Practice D1499. Enclosed carbon-arc exposures of plastics are described in Practice [D6360](#), and in [G153](#), which gives requirements for exposing nonmetallic materials in enclosed carbon-arc devices.

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—This practice is technically equivalent to [ISO 4892-4](#).

### 2. Referenced Documents

#### 2.1 ASTM Standards:<sup>2</sup>

[D3980 Practice for Interlaboratory Testing of Paint and Related Materials](#) (Withdrawn 1998)<sup>3</sup>

[D5870 Practice for Calculating Property Retention Index of Plastics](#)

[D6360 Practice for Enclosed Carbon-Arc Exposures 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](#)

<sup>1</sup> 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.

Current edition approved July 1, 2005. Published July 2005. Originally approved in 1950. Last previous edition approved in 1999 as D1499 - 99. DOI: 10.1520/D1499-05.

<sup>2</sup> 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.

<sup>3</sup> The last approved version of this historical standard is referenced on www.astm.org.

[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](#)

[G152 Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials](#)

[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](#)

#### 2.2 ISO Standard:<sup>4</sup>

[ISO 4892-4 Plastics—Methods of Exposure to Laboratory Light Sources—Part 4, Open-Flame Carbon Arc Lamp](#)

### 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.)

<sup>4</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

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

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.<sup>5,6</sup> 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.

4.3 Test results will depend upon the care that is taken to operate the equipment in accordance with Practice G152. 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 Use filtered open-flame carbon-arc apparatus that conforms to the requirements defined in Practices G151 and G152.

5.2 Unless otherwise specified, the spectral power distribution of the filtered open-flame carbon-arc shall conform to the requirements in Practice G152 for carbon-arc with daylight filters.

## 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. When necessary, to provide rigidity, flexible specimens should be attached to, or backed by, a panel made of aluminum, 0.025-in [0.64-mm] thick.

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

6.3 Retain a supply of unexposed file specimens of all material evaluated.

6.3.1 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.

6.4 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 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. Instrumental measurements are recommended whenever possible.

6.5 Follow the procedures described in Practice G147 for identification and conditioning and handling of test specimens, and reference materials prior to, during, and after exposure.

6.6 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.

6.7 Since the thickness of a specimen may markedly affect the results, thickness of test and control specimens shall be within  $\pm 10\%$  of the nominal dimensions.

NOTE 4—This is especially important when mechanical properties are being investigated.

6.8 Incident energy at the extremes of the specimen exposure area in older equipment may be only 60 to 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 G152 to ensure either equal radiant exposure or compensation for differences in radiant exposure.

## 7. Procedure

7.1 It is recommended that a control material be exposed simultaneously with experimental materials for determination of relative performance, if performance comparisons are not being made between the test materials themselves. All concerned parties must agree on the control material used.

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

7.2 Mount the test specimens in the specimen exposure area with the test surfaces facing the lamp. When the test specimens do not completely fill the exposure area, fill the empty spaces with blank metal panels to maintain the test conditions within the chamber.

7.3 Confine specimens to an exposure area where the irradiance is at least 90 % of that measured at the center of the exposure area. In areas where the irradiance is between 70 and 90 % of maximum irradiance, follow one of the procedures outlined in Practice G152 to ensure either equal radiant exposure or compensation for differences in radiant exposure. Determine irradiance uniformity in accordance with Practice G151.

7.4 Practice G152 lists several exposure cycles that are used for filtered open-flame 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, condensation, or

<sup>5</sup> 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.

<sup>6</sup> 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.