Designation: D 5071 – 99

Standard Practice for Exposure of Photodegradable Plastics in a Xenon Arc Apparatus[1]

This standard is issued under the fixed designation D 5071; 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 xenon arc exposure of photodegradable plastics conducted according to Practices G 151 and G 155. This practice also covers the preparation of test specimens, the test conditions best suited for photodegradable plastics, and the evaluation of test results.

NOTE 1—The previous version of this standard referenced xenon arc devices described by Practice G 26, which described very specific equipment designs. Practice G 26 has been replaced by Practice G 151, which describes performance criteria for all exposure devices that use laboratory light sources and by Practice G 155, which gives requirements for exposing nonmetallic materials in xenon arc devices.

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 is technically equivalent to ISO 4892-2 and Practice D 2565 which cover xenon arc exposures of plastics intended for long term use in outdoor applications.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 882 Test Methods for Tensile Properties of Thin Plastic Sheeting

D 883 Terminology Relating to Plastics

D 1293 Test Methods for pH of Water

D 2565 Practice for Exposure of Plastics Intended for Outdoor Applications in a Xenon Arc Apparatus

D 3593 Test Method for Molecular Weight Averages and Molecular Weight Distribution of Certain Polymers by Liquid Size-Exclusion Chromatography (Gel Permeation Chromatography (GPC) Using Universal Calibration

D 3826 Practice for Determining Degradation End Point in Degradable Polyolefins Using a Tensile Test

D 3890 Practice for Interlaboratory Testing of Pain and Related Materials

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 Xenon Arc-Type Light Exposure Apparatus 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

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

2.2 *Other Standards:*

ISO 4892-2 Plastics—Method of Exposure to Laboratory Light Sources—Part 2, Xenon Arc Sources[3]

Publication C.I.E No. 85 (1989)[4]

DIN 53384 Testing of Plastics: Artificial Weathering or Exposure in Laboratory Exposure Weathering or Exposure in Laboratory Exposure Apparatus to UV Radiation[3]

3. Terminology

3.1 *Definitions*—The definitions given in Terminologies D 883 and G 113 are applicable to this practice.

4. Significance and Use

4.1 Materials made from photodegradable plastics are intended to deteriorate rapidly when exposed to solar radiation, oxygen, heat, moisture and other degrading elements of the

[1] This practice is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.96 on Environmentally Degradable 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] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

[4] *Publication No. CIE 85, 1st Ed., 1989 Technical Report*, "Solar Spectral Irradiance," available from U.S. National Committee CIE, Mr. Thomas M. Lemons, TLA-Lighting Consultants, Inc., 72 Loring Ave., Salem, MA 01970.

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

weather. This practice is used for evaluating the photodegradability of plastics when exposed in an apparatus that produces simulated daylight (**1,2**)[5] and controlled temperature and moisture. 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. There may be no positive correlation of exposure results between this and other laboratory weathering devices.

4.2 Variations in results may be expected when operating conditions are varied within the accepted limits of this practice. Therefore, all test results using this practice must be accompanied by the specific operating conditions required in Section 9. Refer to Practice G 151 for detailed information on the caveats applicable to use of results obtained according to this practice.

4.3 The results of laboratory exposure cannot be directly extrapolated to estimate absolute rate of deterioration by the environment because the acceleration factor is material dependent and can be significantly different for each material and for different formulations of the same material. However, exposure of a similar material of known outdoor performance, a control, at the same time as the test specimens allows comparison of the durability relative to that of the control under the test conditions. Evaluation in terms of relative durabilities also greatly improves the agreement in test results among different laboratories (**3**).

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

NOTE 3—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.

4.5 Before proceeding with this practice, reference should be made to the specifications of the material being tested. Any test specimen preparation, conditioning, dimensions, or testing parameters, or combination thereof, covered in the material specification shall take precedence over those mentioned in this practice. If there are no material specifications, then the default conditions apply.

5. Apparatus

5.1 The exposure apparatus employed shall use as the source of radiation a xenon arc lamp and apparatus which conforms to the requirements defined in Practices G 151 and G 155.

5.1.1 Unless otherwise specified, the spectral power distribution (SPD) of the xenon lamp shall conform to the requirements of Table 1 in Practice G 155 for a xenon lamp with daylight filters.

6. Test Specimens

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 is covered. This unexposed surface must not be used as part of the test area. 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, prepare at least three replicate specimens of each test and control material to be exposed. When destructive tests are used for property measurements, a separate set of each test and control material must be prepared for each exposure increment that will be used.

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

6.3.1 When destructive tests are used, it is recommended that a sufficient number of file specimens be retained so that the property of interest can be determined on the file specimens each time the 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 type of interruption may alter results. When specimens are removed from the apparatus exposure for 24 h or more then returned for additional exposure, report the elapsed time in accordance with Section 10.

NOTE 4—Since the stability of the file specimen may also be time-dependent, users are cautioned that over prolonged exposure periods, or when 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 G 147 for identification and conditioning and handling of specimens of test, control, 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 since the marked 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 ±10 % of the nominal dimensions.

NOTE 5—Thickness of a specimen is especially important when mechanical properties are being investigated.

7. Procedure

7.1 It is recommended that a control material be exposed simultaneously with experimental materials for determination of relative performance.

7.2 Mount the test specimens in the specimen racks with the test surfaces facing the lamp. When the test specimens do not completely fill the racks, 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

[5] The boldface numbers in parentheses refer to a list of references at the end of this standard.