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Standard Practice for Fluorescent UV Exposure of Plastics[1]

This standard is issued under the fixed designation D 4329; 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 fluorescent UV exposure of plastics conducted in accordance with Practices G 151 and G 154. This practice also covers the preparation of test specimens, the test conditions best suited for plastics, and the evaluation of test results.

NOTE 1—Previous versions of this practice referenced fluorescent UV devices described by Practice G 53, which described very specific equipment designs. Practice G 53 is being replaced by Practice G 151, which describes performance criteria for all exposure devices that use laboratory light sources and by Practice G 154, which gives requirements for exposing nonmetallic materials in fluorescent UV devices. Practice G 53 will be balloted for withdrawal before December 2000.

1.2 The values stated in SI units are be regarded as standard. The values given in parentheses are for information only.

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 2—This practice is technically equivalent to ISO 4892-3.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 3980 Practice for Interlaboratory Testing of Paint 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 53 Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) 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 154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

2.2 *ISO Standard:*[3]

ISO 4892-3 Plastics—Methods of Exposure to Laboratory Light Sources — Part 3, Fluorescent UV Lamps

3. Terminology

3.1 The definitions in Terminology G 113 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.

4.2 **Caution**—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 should be made unless accompanied by a report prepared in accordance with Section 8 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 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.

4.3 Reproducibility of test results between laboratories has been shown to be good when the stability of materials is

[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.

[3] 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.**

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evaluated in terms of performance ranking compared to other materials or to a control.[4,5] 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.

4.4 Test results will depend upon the care that is taken to operate the equipment in accordance with Practice G 154. Significant factors include regulation of line voltage, temperature of the room in which the device operates, temperature control, and condition and age of the lamp.

5. Apparatus

5.1 Use of fluorescent UV apparatus that conforms to the requirements defined in Practices G 151 and G 154 is required to conform to this practice.

5.2 Unless otherwise specified, the spectral power distribution of the fluorescent UV lamp shall conform to the requirements in Practice G 154 for a UVA 340 lamp.

5.3 *Test Chamber Location*:

5.3.1 Locate the apparatus in an area maintained between 18 and 27°C (65 and 80°F). Measure ambient temperature at a maximum distance of 150 mm (6 in.) from the plane door of the apparatus. Control of ambient temperature is particularly critical when one apparatus is stacked above another, because the heat generated from the lower unit can interfere with the operation of the units above.

5.3.2 Place the apparatus at least 300 mm from walls or other apparatus. Do not place the apparatus near a heat source such as an oven.

5.3.3 Ventilate the room in which the apparatus is located to remove heat and moisture.

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 For specimens of insulating materials, such as foams, maximum specimen thickness is 20 mm in order to allow for adequate heat transfer for condensation.

6.3 To provide rigidity, attach flexible specimens to a backing panel made of aluminum, 0.635 mm (0.025 in.) thick. Suggested aluminum alloys are 5052, 6061, or 3003.

6.4 Seal any holes in specimens larger than 2 mm and any openings larger than 1 mm around irregularly shaped specimens to prevent loss of water vapor. Attach porous specimens to a solid backing such as aluminum that can act as a vapor barrier.

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

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

6.7 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.

6.8 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 4—This is especially important when mechanical properties are being investigated.

6.9 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 154 to ensure either equal radiant exposure or compensation for differences in radiant exposure.

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

6.10.1 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.

6.11 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 as noted in accordance with Section 9.

NOTE 5—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.

7. Procedure

7.1 When the test and control specimens do not completely fill the specimen racks, fill all empty spaces with blank panels to maintain the test conditions within the chamber.

7.2 Unless otherwise specified, program the device to one of the following test cycles. Operate the device continuously.

7.2.1 *Cycle A*:

8 h UV with uninsulated black panel temperature controlled at 60 ± 3°C
4 h condensation with uninsulated black panel temperature controlled at 50± 3°C
(Used for most general applications)

[4] 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.

[5] 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.

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