Designation: D7238 – 06 (Reapproved 2017)

Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus[1]

This standard is issued under the fixed designation D7238; 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 standard covers the specific procedures and test conditions that are applicable for exposure of unreinforced polyolefin geomembranes to fluorescent UV radiation and condensation.

NOTE 1—Polyolefin geomembranes include high-density polyethylene (HDPE), linear low-density polyethylene (LLDPE), flexible polypropylene (fPP), etc.

1.2 Test specimens are exposed to fluorescent UVA 340 lamps under controlled environmental conditions. UVA 340 lamps are standard for this method.

NOTE 2—Other types of fluorescent UV lamps, such as UVB-313, can also be used based upon discussion between involved parties. However, if the test is run with another type of fluorescent UV lamps, such as UVB-313, this should be considered as a deviation from the standard and clearly stated in the test report. UVB-313 and UVA-340 fluorescent lamps generate different amounts of radiant power in different wavelength ranges; thus, the photochemical effects caused by these different lamps may vary.

1.3 This method covers the conditions under which the exposure is to be performed and the test methods for evaluating the effects of fluorescent UV, heat and moisture in the form of condensation on geomembranes. General guidance is given in Practices G151 and G154.

1.4 The values listed in SI units are to be regarded as the standard.

1.5 *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.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

D5885 Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry

D6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes

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

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

G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials

G156 Practice for Selecting and Characterizing Weathering Reference Materials

3. Terminology

3.1 *Definitions:* (According to Terminology G113.)

3.1.1 *control, n*—a material which is of similar composition and construction to the test material used for comparison, exposed at the same time.

3.1.2 *irradiance, n*—the radiant power per unit area incident on a receiver, typically reported in units of $W/(m^2.nm)$ at specified wavelength of measurement or in W/m^2 in a specified spectral range.

3.1.3 *reference material, n*—a material with known performance.

3.1.4 *ultraviolet regions, n*—the UV region of the spectrum is divided into three regions: UVA, radiation in wavelengths

[1] This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.02 on Endurance 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.

between 315 nm and 400 nm; UVB, radiation in wavelengths between 280 nm and 315 nm; and UVC, radiation in wavelengths shorter than 280 nm (Ref. CIE Publication No. 20 (1972)).

4. Summary of Test Method

4.1 Geomembrane coupons are exposed to repetitive cycles consisting of ultraviolet radiation at a specified temperature followed by moisture in the form of condensation at a specified temperature in the absence of ultraviolet radiation.

4.2 The UV source is provided by fluorescent UVA-340 lamps, with lamp emissions peaking at 343 nm.

4.3 Water vapor shall be generated by heating water and filling the chamber with hot vapor, which then is made to condense on the front of the test coupons. The reverse side of the coupons is exposed to the cooling influence of ambient room air.

4.4 While this standard prescribes a particular set of exposure conditions, such conditions may be varied by agreement between the parties involved in the agreement or contract. Such variation may include the irradiance, the selection of the fluorescent UV lamps, the duration of the UV and condensation exposure periods, the temperature of UV exposure, and the temperature of the condensation exposure.

4.5 The periodically removed coupons are cut into test specimens, appropriately tested, and the results compared to unexposed samples for determination of a percent retained for each property evaluated.

5. Significance and Use

5.1 The use of this apparatus is intended to induce property changes associated with the end-use conditions, including the effects of the UV portion of sunlight, moisture, and heat. Exposures are not intended to simulate the deterioration caused by localized weather phenomena, such as atmospheric pollution, biological attack, and saltwater exposure.

NOTE 3—Refer to Practice G151 for cautionary guidance applicable to laboratory weathering devices.

5.2 Variation in results may be expected when operating conditions are varied within the accepted limits of this method.

5.3 Test data for one thickness of a geomembrane cannot be used as data for other thickness geomembranes made with the same formula (polymer, pigment, and stabilizers) since the degradation is thickness related.

NOTE 4—It is recommended that a similar material of known performance (a control) be exposed simultaneously with the test material to provide a standard for comparative purposes. When control material is used in the test program, it is recommended only one coupon be used for each UV exposure period to allow for OIT testing.

6. Apparatus

6.1 *Fluorescent UV/Condensation Apparatus,* complying with Practices G151 and G154.

6.2 Unless otherwise specified, the spectral power distribution of the fluorescent UV lamp shall conform to the requirements in Practice G154 for a UVA-340 lamp.

6.3 The apparatus must include a feedback loop controller and be capable of controlling the irradiance level within the guidelines set in Practice G154, Table X2.3, Operational Fluctuations On Exposure Conditions.

6.4 *Exposure Chamber Location:*

6.4.1 The apparatus shall be located in an area maintained at temperature range between 18 and 27 °C (64 and 81 °F) measured at a maximum distance of 150 mm (5.9 in.) from the plane door of the apparatus.

6.4.2 It is recommended that the apparatus be located at least 0.3 m (12 in.) from walls or other test devices. Nearby heat sources, such as ovens or heated test devices, shall be avoided or shielded because such sources can influence the results.

6.4.3 The room where the apparatus is located shall be adequately ventilated to remove the heat and moisture produced and to maintain the temperatures specified in 6.4.1.

6.5 *Instrument Calibration:*

6.5.1 To ensure standardization and accuracy, the instruments associated with the exposure apparatus (that is, timers, thermometers, UV sensors, radiometers) require recurrent calibration to ensure repeatability of test results. The calibration frequency recommended by the equipment manufacturer should be used.

NOTE 5—It is recommended that a weathering reference material should be evaluated at least once per year to assess the operation of the device. Practice G156 describes procedures for selecting and characterizing weathering reference materials used to establish consistency of operating conditions in a laboratory accelerated test.

7. Test Coupons

7.1 The number of coupons should be sufficient to produce five Test Method D6693 specimens from the exposure areas for each exposure period.

7.2 Prepare the test coupons so that the longer dimension of the test coupon is the machine direction of the test material.

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

7.4 Retain adequate unexposed material for the determination of unexposed properties (tested one time to form the baseline for comparison of the exposed material properties).

8. Procedure

8.1 Attach the coupons, backed by an aluminum panel, to the coupon holders in the equipment in such a manner that the specimens are not subjected to any applied stress.

NOTE 6—Some UV fluorescent devices have a central stiffening bar on the holder. To ensure that the entire coupon is exposed to ultraviolet radiation, this bar should be removed prior to the start of the exposure cycle.

8.2 Place the coupon holders in the exposure device with the desired surfaces facing the lamps. If the coupons do not completely occupy the racks, fill the empty spaces with blank panels to maintain proper test conditions within the chamber.