Designation: D5721 – 08 (Reapproved 2018)

Standard Practice for Air-Oven Aging of Polyolefin Geomembranes[1]

This standard is issued under the fixed designation D5721; 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 a means for estimating the resistance of polyolefin geomembranes to thermal aging in the presence of air. Only the procedure for heat exposure is specified, not the test method or specimen. The effect of heat on any particular property may be determined by selection of the appropriate test method and specimen.

1.2 This practice should be used as a guide to compare thermal aging characteristics of materials as measured by the change in some property of interest. This practice does not predict thermal aging characteristics where interactions between stress, environment, temperature, and time control failure.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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]

D618 Practice for Conditioning Plastics for Testing
D638 Test Method for Tensile Properties of Plastics
D746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
D1505 Test Method for Density of Plastics by the Density-Gradient Technique
D1525 Test Method for Vicat Softening Temperature of Plastics
D1790 Test Method for Brittleness Temperature of Plastic Sheeting by Impact
D1870 Practice for Elevated Temperature Aging Using a Tubular Oven (Withdrawn 1998)[3]
D3045 Practice for Heat Aging of Plastics Without Load
D4439 Terminology for Geosynthetics
E145 Specification for Gravity-Convection and Forced-Ventilation Ovens
F412 Terminology Relating to Plastic Piping Systems

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of general terms used in this standard, refer to Terminology D4439.

3.1.2 *aging, n*—the process of exposing materials to an environment for an interval of time.

3.1.3 *polyolefin, n*—a polymer prepared by the polymerization of an olefin(s) as the sole monomer(s). **(F412)**

3.1.4 *Vicat softening point*—the temperature at which a flat-ended needle of 1-mm^2 circular cross section will penetrate a thermoplastic specimen to a depth of 1 mm under a specified load using a selected uniform rate of temperature rise. **(D1525)**

4. Significance and Use

4.1 Under the severe conditions of this test, the specimens undergo degradation at a rate that is a function of the thermal endurance of the geomembrane under examination.

4.2 The elevated temperature for this practice should represent conditions that are sufficiently severe to induce failure of polyolefin geomembranes within an abbreviated period of time.

[1] This practice 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.

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

4.3 The rate of change of a particular property as a function of temperature may be evaluated using the temperatures and times outlined in Practice D3045.

4.4 Any correlation between this practice and natural life of these materials must be determined for the particular application in which the materials are to be used.

4.5 Air-oven aging can be used to evaluate and compare the performance of various heat stabilizer packages.

5. Apparatus

5.1 *Oven*—A controlled, forced-ventilation oven with substantial fresh air intake is recommended. Oven apparatus shall be in accordance with Type 11B in Specification E145.

NOTE 1—Cross contamination has been known to occur in rubber products. It is not known if it can occur in semi-crystalline thermoplastics. When it is necessary to avoid contamination among specimens or materials, a tubular oven method such as Practice D1870 may be desirable.

5.2 *Temperature Measuring Device*—A thermocouple or thermometer adequate to cover the range being tested and accurate to at least ±0.5 °C.

6. Sampling

6.1 Sampling shall be in accordance with the ASTM test methods for the specific properties to be determined.

7. Conditioning

7.1 Conduct initial tests in the standard laboratory atmosphere as specified in Practice D618, and with specimens conditioned in accordance with the requirements of the ASTM test method for determining the specific property or properties required.

7.2 When required, conditioning of specimens following exposure at elevated temperature and prior to testing, unless otherwise specified, shall be in accordance with Practice D618.

8. Procedure

8.1 Allow the oven to equilibrate at the test temperature. The temperature shall be below the Vicat softening point of the material.

8.2 Suspend the specimens for exposure below an oven shelf in a way to maintain a distance of at least 20 mm between specimens and to allow for the entire shelf with specimens to be removed. Age for the specified time and temperature.

NOTE 2—Certain metals are known to affect the thermal endurance of some polyolefins. Therefore, direct contact of the specimens with metal shall be minimized.

8.3 Inspect the specimens weekly to ensure that the specimens have remained properly mounted. Note any visual changes of the specimens.

8.4 Rotate the shelves from top to bottom and from front to back once a week to ensure even exposure.

8.5 At the end of an aging interval, remove a set of specimens and allow them to cool. Test the specimens for the selected property in accordance with the appropriate test method, including provisions for conditioning.

9. Potential Tests

9.1 The following properties may be appropriate for evaluating the effects of oven exposure:

9.1.1 Tensile properties (see Test Method D638),

9.1.2 Melt flow index (see Test Method D1238),

9.1.3 Density (see Test Method D1505),

9.1.4 Tensile impact (see Test Method D746), and

9.1.5 Brittleness temperature (see Test Method D1790).

10. Calculation

10.1 Express the results of the aging test as a percentage of the change in each physical property, calculated as follows:

$$\text{change, } \% = [(A - O)/O] \times 100 \quad (1)$$

where:

O = original value, and

A = value after aging.

NOTE 3—Since the values of some properties may increase as a function of exposure time, a positive change shows an increase while a negative change shows a decrease in the property value.

10.2 Alternatively, the time to failure can be determined based on a failure criteria such as brittleness, or on a percentage change of a given property.

11. Report

11.1 Report the following information:

11.1.1 Geomembrane type, thickness, and specimen preparation procedure,

11.1.2 Pre-conditioning and post-conditioning procedures followed,

11.1.3 Test methods utilized for evaluation of each property,

11.1.4 Observations of any visible changes in the test specimens,

11.1.5 Type of oven used,

11.1.6 Exposure temperature and times used,

11.1.7 Mean and standard deviation for results calculated according to 10.1, and

11.1.8 Mean time to failure and failure criteria for results generated in 10.2.

12. Keywords

12.1 geomembrane; oven aging; polyolefin