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Standard Practice for Determining Degradation End Point in Degradable Polyethylene and Polypropylene Using a Tensile Test[1]

This standard is issued under the fixed designation D 3826; 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. ~~ε[1] NOTE—The title was changed editorially in August 1991.~~

1. Scope

~~1.1This practice covers the determination of a degradation-end point (*a brittle point*) for degradable polyethylene/polypropylene films and sheeting less than 1.0 mm (0.04 in.) thick. This practice is not intended for determination of the rate of degree of degradation of a polyethylene/polypropylene film or sheet, but rather, to assess when in the course of its degradation under some condition, a brittle point is reached. If one wishes to monitor tensile elongation during the degradation process (such as when the tensile elongation is significantly greater than 5%), Test Method D882 is recommended. This practice should not be considered the only way of determining a degradation-end point. Other degradation-end-point procedures are currently being evaluated and developed by Subcommittee D20.96 for polyolefins and other plastics such as polystyrene. For example, Test Method D1922 is being considered as a test for determining a degradation-end point in polyethylene/polypropylene films. Practice D1435 may be used for determining outdoor weathering of polyethylene/polypropylene films and sheeting.~~

~~1.2Tensile properties of plastics 1.0 mm (0.04 in.) or greater in thickness shall be determined in accordance with Test Method D638~~

1.1 This practice covers the determination of a degradation-end point *(a brittle point)* for degradable polyethylene/polypropylene films and sheeting less than 1.0 mm (0.04 in.) thick. This practice is not intended for determination of the rate of degree of degradation of a polyethylene/polypropylene film or sheet, but rather, to assess when in the course of its degradation under some condition, a brittle point is reached. If one wishes to monitor tensile elongation during the degradation process (such as when the tensile elongation is significantly greater than 5 %), Test Method D 882 is recommended. This practice should not be considered the only way of determining a degradation-end point.

1.2 Tensile properties of plastics 1.0 mm (0.04 in.) or greater in thickness shall be determined in accordance with Test Method D 638.

~~1.3Use~~1.3 Use a static weighing-constant rate of grip separation test. This procedure employs a constant rate of separation of the grips holding the sample and a static load cell.

NOTE 1—This procedure is based on the use of grip separation as a measure of extension; however, the desirability of using extension indicators accurate to ±1.0 % or better as specified in Test Method D 638 is recognized, and a provision for the use of such instrumentation is incorporated in the procedure.

~~1.4This procedure has been successful for determining the degradation end point of ethylene-carbon-monoxide copolymers, but its utility for other polymers is yet to be determined by round-robin testing.~~

1.4 This procedure has been successful for determining the degradation end point of ethylene-carbon-monoxide copolymers and has screened successfully two other additive-type polyethylenes in a round robin test.

1.5 The values stated in SI units are to be regarded as the standard. The values in parentheses are for information only.

1.6 *This standard does not purport to address all of the safety ~~problems,~~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.*

1.7 There is no equivalent ISO standard.

~~[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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[1] This practice is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.96 on Environmentally Degradable Plastics and Biobased Products.

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2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 374 Test Methods for Thickness of Solid Electrical Insulation

D 618~~Practice for Conditioning Plastics and Electric Insulating Materials for Testing~~ Practice for Conditioning Plastics for Testing

D ~~638Test Method for Tensile Properties of Plastics[4]~~ 638M Standard Test Method for Tensile Properties of Plastics (Metric)[3]

D 882 Test ~~Methods~~Method for Tensile Properties of Thin Plastic Sheeting

D~~1435Practice for Outdoor Weathering of Plastics[4]~~

5208 Practice for Fluorescent Ultraviolet (UV) Exposure of Photodegradable Plastics

D~~1922Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Methods[4]~~

E~~691Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method~~ 691 Discontinued 1981; Specification for Compound Powdered Soap (Granulated, with Rosin)

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions of terms and symbols relating to tension testing of plastics appear in the Annex to Test Method ~~D638~~D 638.~~.~~

~~3.1.2*line grips*, *n*—in~~3.1.2 line grips, n—in tensile testing machines, grips having faces designed to concentrate the entire gripping force along a single line perpendicular to the direction of testing stress.

~~3.1.3*tear failure*, *n*—in~~3.1.3 tear failure, n—in tensile testing of films, a failure characterized by fracture initiating at one edge of the specimen and progressing across the specimen at a rate slow enough to produce an anomalous load-deformation curve.

3.2 ~~Definitions~~*Description of Terms Specific to This Standard:*

3.2.1 *film*, *n*—for the purpose of this practice, a piece of material not exceeding 0.250 mm (0.01 in.) in thickness.

3.2.2 *brittle point*, *n*—in degradable polyethylene/polypropylene film, that point in the history of a material when 75 % of the specimens tested have a tensile elongation at break of 5 % or less.

4. Significance and Use

4.1 The tensile elongation property determined by this practice is of value for the characterization of degradable materials. The tensile elongation property may vary with specimen thickness, method of preparation, speed of testing, type of grips used, and manner of measuring test extension. Consequently, where precise comparative results are desired, these factors must be carefully controlled.

4.2 The tensile elongation property may be utilized to provide data for research and development and engineering design as well as quality control specifications. However, data from such tests cannot be considered significant for applications differing widely from the load-time scale of the test employed.

4.3 Materials that fail by tearing give anomalous data that cannot be compared with those from normal failure.

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

5. Apparatus

5.1 *Testing Machines:*

5.1.1 Use a testing machine of the constant rate-of-jaw-separation type. The machine shall be equipped with a weighing system that moves a maximum distance of 2 % of the specimen extension within the range being measured. Also, there should be a device for recording the tensile load and the amount of separation of the grips; both of these measuring systems shall be accurate to ±2 %. The rate of separation of the grips shall be uniform and capable of adjustment from approximately 1.3 to 500 mm/min (0.05 to 20 in./min) in increments necessary to produce the strain rates specified in 9.2.

5.2 *Grips*—Use a gripping system that minimizes both slippage and uneven stress distribution with the test specimen.

NOTE 2—Grips lined with thin rubber, crocus-cloth, or pressure-sensitive tape as well as file-faced or serrated grips have been successfully used for many materials. The choice of grip surface depends on the material tested and thickness. More recently, line grips padded on the round face with 1.0 mm (40 mil) blotting paper have been found superior. Air-actuated grips have been found advantageous, particularly in the case of materials that tend to *neck* into the grips, since pressure is maintained at all times. In cases where samples frequently fail at the edge of the grips, it may be advantageous to increase slightly the radius of curvature of the edges where the grips come in contact with the test area of the specimen.

~~[3] Accelerated exposure practices to appropriately degrade polyethylene/polypropylene films and sheeting are also being developed by Subcommittee D20.96. When these practices are approved, they will be referenced in this document.~~

[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] Withdrawn.