



Designation: D5617 – 23

Standard Test Method for Multi-Axial Elongation of Geomembranes¹

This standard is issued under the fixed designation D5617; 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 test method covers the measurement of the out-of-plane response of a geomembrane to a force that is applied perpendicular to the initial plane of the sample.

1.2 When the geomembrane deforms to a prescribed geometric shape (arc of a sphere or ellipsoid), formulations are provided to convert the test data to biaxial tensile stress-strain values. These formulations cannot be used for other geometric shapes. With other geometric shapes, comparative data on deformation versus pressure is obtained.

1.3 This test method requires a large-diameter pressure vessel (610 mm). Information obtained from this test method may be more appropriate for design purposes than many small-scale index tests.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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, health, and environmental 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

[D4439 Terminology for Geosynthetics](#)

¹ This test method is under the jurisdiction of ASTM Committee [D35](#) on Geosynthetics and is the direct responsibility of Subcommittee [D35.10](#) on Geomembranes.

Current edition approved Nov. 1, 2023. Published December 2023. Originally approved in 1994. Last previous edition approved in 2015 as D5617 – 04 (2015). DOI: 10.1520/D5617-23.

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.

[D5199 Test Method for Measuring the Nominal Thickness of Geosynthetics](#)

[D5994/D5994M Test Method for Measuring Core Thickness of Textured Geomembranes](#)

3. Terminology

3.1 *Definitions:*

3.1.1 *multi-axial elongation, n*—average strain along the arch intercepting the centerpoint, generated by the out-of-plane deformation of a geomembrane specimen fixed by a ring and exposed to a fluid pressure.

3.1.2 For definitions of other terms used in this test method, refer to Terminology [D4439](#).

4. Summary of Test Method

4.1 A geomembrane specimen is secured at the edges of a large-diameter pressure vessel. Pressure is applied to the specimen to cause out-of-plane deformation and failure. The deformation at break with pressure information is analyzed to evaluate various materials.

5. Significance and Use

5.1 Installed geomembranes are subjected to forces from more than one direction, including forces perpendicular to the surfaces of the geomembrane. Out-of-plane deformation of a geomembrane may be useful in evaluating materials for caps where subsidence of the subsoil may be problematic.

5.2 Failure mechanisms on this test may be different compared to other relatively small-scale index tests and may be beneficial for design purposes.

5.3 In applications where local subsidence is expected, this test can be considered a performance test.

5.4 For applications where geomembranes cannot be deformed in the fashion this test method prescribes, this test method should be considered an index test.

5.5 Due to the time involved to perform this test, it is not considered practical as a quality control test.

6. Apparatus

6.1 [Fig. 1](#) shows an example of the test apparatus that can be used to perform this test method. The apparatus requires a