



Designation: **D4355/D4355M – 14** ~~D4355/D4355M – 14~~ (Reapproved 2018)

Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type ~~Arc-Type~~ Apparatus¹

This standard is issued under the fixed designation D4355/D4355M; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This test method covers the determination of the deterioration in tensile strength of geotextiles by exposure to xenon arc radiation, moisture, and heat.

1.2 The light and water exposure apparatus employs a ~~xenon arc~~ xenon arc light source.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in ~~non-conformance~~ nonconformance with the 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~~ safety, health, and ~~health~~ 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

D123 Terminology Relating to Textiles

D1898 Practice for Sampling of Plastics (Withdrawn 1998)³

D4439 Terminology for Geosynthetics

D5035 Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

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

G141 Guide for Addressing Variability in Exposure Testing of Nonmetallic Materials

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

G155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *geotextile*—any permeable textile material used with foundation, soil, rock, earth, or any other geotechnical ~~engineering~~ related ~~engineering-related~~ material that is an integral part of a ~~man-made~~ manmade product, structure, or system.

3.2 *Definitions:*

3.2.1 For definitions of other textile terms used in this test method, refer to Terminology D123; for geotextile terms, refer to Terminology D4439.

3.2.2 The definitions given in Terminology G113 are applicable to this standard.

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. Current edition approved July 15, 2014 June 1, 2018. Published September 2014 June 2018. Originally approved in 1984. Last previous edition approved in 2007 2014 as D4355 – 07-D4355/D4355M – 14. DOI: 10.1520/D4355_D4355M-14.10.1520/D4355_D4355M-14R18.

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. Summary of Test Method

4.1 Five specimens of a geotextile for the machine direction and for the ~~cross-machine-cross-machine~~ direction are exposed in a xenon arc device for each of the following times: 0 (control specimens), ~~for~~ 150, 300, and 500 h. The exposure consists of 120-min cycles as follows: 90 min of light only at $65 \pm 3^{\circ}\text{C}$ 3°C $^{\circ}\text{C}$ uninsulated black panel temperature and $50 \pm 10\%$ relative humidity, followed by 30 min of light plus water spray. (See [Note 8](#).)

4.2 After each exposure period, the specimens are subjected to a cut or ravel strip tensile test. The average breaking strength in each direction is compared with the average breaking strength in each direction of the control specimens. The percent strength retained is plotted versus exposure period to produce a degradation curve for the specimens from each direction.

5. Significance and Use

5.1 This method is intended to induce property changes associated with ~~end-use-end-use~~ conditions, including the effects of solar radiation, moisture, and heat. The exposure used is not intended to simulate the deterioration caused by localized weather phenomena such as atmospheric pollution, biological attack, and salt water exposure.

5.2 The relation between time to failure in an exposure conducted in accordance with this test ~~method-method~~ and service life in a specific outdoor environment requires determination of an acceleration factor, as defined in Terminology [G113](#). The acceleration factor is ~~material-dependent-material dependent~~ and is only valid if it is based on data from a sufficient number of separate exterior and laboratory-accelerated exposures so that the results used to relate times to failure in each exposure can be analyzed using statistical methods.

NOTE 1—An example of a statistical analysis using multiple laboratory and exterior exposures to calculate an acceleration factor is described by J. A. Simms.⁴ See Practice [G151](#) for more information and additional cautions about the use of acceleration factors.

5.2.1 The deterioration curve obtained from the results of this test method enables the user to determine the tendency of a geotextile to deteriorate when exposed to xenon arc radiation, water, and heat.

5.3 Variation in results may be expected when operating conditions are varied within the accepted limits of this test method. Its intended use is as a qualitative assessment of the presence of ultraviolet inhibitors, and comparison of that influence between products. However, no inference to the time of stability should be implied by the test results to the relation between time duration and outdoor exposure.

NOTE 2—Information on sources of variability and on strategies for addressing variability in the design, execution, and data analysis of ~~laboratory aaccelerated-laboratory-accelerated~~ exposure tests is found in Guide [G141](#).

5.3.1 If it becomes necessary for the purchaser and seller to use this test method for acceptance testing, the statistical bias, if any, between the purchaser's and seller's laboratories should be determined. Such comparison is based on specimens randomly drawn from the sample of geotextile being evaluated.

5.3.2 In such cases, as at a minimum, the two parties should take a group of test specimens which are as homogeneous as possible, and which are from a lot of material of the type in question. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using Student's *t*-test for unpaired data and an acceptable probability level chosen by the two parties before the testing started. If a bias is found, either its cause must be found and corrected, or the purchaser and the supplier must agree to interpret future test results in the light of the known bias.

6. Apparatus

6.1 ~~Xenon-Arc~~ Xenon Arc Apparatus, with daylight filters conforming to Practices [G151](#) and [G155](#).

NOTE 3—Previous versions of this standard referenced ~~in~~ Practice [G26](#), which describes specific equipment designs of xenon arc devices. Practice [G26](#) has been replaced by Practice [G151](#), which gives performance criteria for all devices that use laboratory light sources, plus Practice [G155](#), which gives requirements for exposure of nonmetallic materials in xenon arc devices.

6.1.1 The apparatus must be capable of exposing the specimens to cycles of light only, followed by light and moisture as water spray.

6.2 Strength Testing Apparatus, conforming to that described for a 2-in. cut or ravel strip test, as described in Test Method [D5035](#).

7. Sampling

7.1 Lot Sample—As a lot sample for acceptance testing, take at random the number of rolls of fabric directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider rolls of fabric to be the primary sampling units. If the specification requires sampling during manufacture, select the rolls for the lot sample at uniformly spaced time intervals throughout the production period.

⁴ Simms, J. A., *The Journal of Coatings Technology*, Vol 50, 1987, pp. 45-53-45-53.

NOTE 4—An adequate specification, or other agreement between the purchaser and the supplier, requires taking into account the variability between rolls of fabric, and between specimens from a swatch from a roll of fabric, so as to provide a sampling plan with a meaningful producer’s risk, consumer’s risk, acceptable quality level, and limiting quality level.

7.2 *Laboratory Sample*—Take for the laboratory sample a sample extending the full width of the fabric of sufficient length along the selvage from each sample roll such that the requirements of 8.1 are met. The sample shall exclude material from the outer wrap of the roll or the inner wrap around the core, unless the sample is taken at the production site, at which point inner and outer wrap material may be used.

8. Specimen Preparation

8.1 Take ~~two, one-metre~~ two 1-m² square portions from the laboratory sample. Each shall be no closer to the selvage than ~~1/40 one-tenth~~ the sample width. One is to be used for machine direction specimens, the other for ~~cross-machine~~ cross-machine direction specimens.

NOTE 5—Since the thickness of a specimen may markedly affect test results, thickness of the replicate specimens shall be within ±10 % of the nominal dimensions. This is especially important when mechanical properties are being investigated.

8.2 Use the template illustrated in Fig. 1 to identify potential specimens from which the actual specimens are drawn. To select these actual specimens, randomly draw 20 specimens from both the machine and cross directions measuring 50 by 150 mm [2 by 6 in.] from the ~~one-metre~~ 1-m² square portions of each laboratory sample, as directed in Practice D1898.

NOTE 6—In the event that roller grips are used to hold the specimens in the tensile testing machine, specimens must be longer than the ~~150 mm~~ 150-mm length specified. They shall be of sufficient length to ensure proper gripping. The portions of the specimens may be rolled to accommodate placement in the weathering device. See Figs. 2 and 3 for placement of specimens in a weathering device. Please note that the rolled portions of the specimens shall be protected from exposure to the radiation while in a weathering device.

9. Procedure

9.1 Operate the ~~xenon arc~~ xenon arc test apparatus as directed in Practices G151 and G155. Expose test specimens to the following cycle: 90 min of light only at 65 ± 3°C [149 ± 5°F] 3 °C [149 ± 5 °F] uninsulated black panel temperature; temperature and 50 ± 10 % relative humidity, followed by 30 min of light and water spray.

NOTE 7—Immersion in water during exposure to light is one of the methods specified in Practices G151 and G155 for providing moisture to specimens. It can be substituted for water spray if equivalency is demonstrated, or the geotextile will be immersed in water in its final installation.

NOTE 8—The ± values are the maximum allowed operational fluctuations about the set points. If the operational fluctuations are greater than the maximum allowable after the equipment is stabilized, discontinue the test and correct the cause of the problem before ~~continuing~~ continuing.

9.1.1 Unless otherwise specified, set the level of irradiance at the control point to produce 0.35 W/(m²·nm) at 340 nm maintained at 0.02 W/(m²·nm). If the exposure device is not equipped with irradiance control, follow the device ~~manufacturer’s~~ manufacturer’s recommendations to produce this irradiance. ~~for~~ For the equivalent 300 to 400 nm or 300 to 800 nm broad band irradiances and tolerances, consult the manufacturer for the specification.

NOTE 9—Practice G155 does not specify a particular irradiance level. Various options are listed in Table X3.1 of the appendix in Practice G155. However, as the historical records of testing of geotextiles are based on the irradiance of 0.35 W/m²/nm at 340 nm, this shall be the standard for Test Method ~~D4355~~ D4355/D4355M.

9.2 Randomly assign five specimens for each direction from each laboratory sample to each of the following exposure times: 0 (unexposed), 150, 300, and 500 clock hours. Place 15 specimens from each direction from each laboratory sample in the apparatus, such that the side most likely to solar radiation will be exposed to radiation in the apparatus.

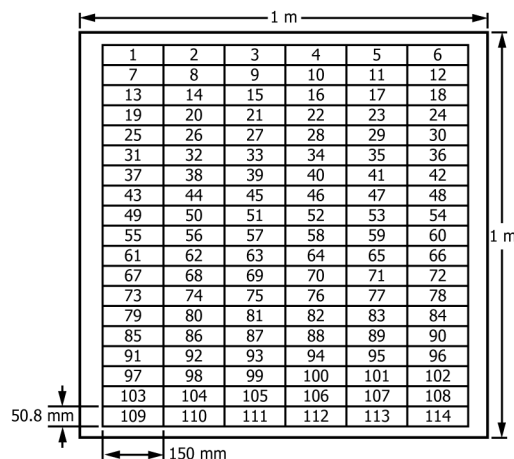


FIG. 1 Specimen Selection Template