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Standard Terminology for Geosynthetics¹

This standard is issued under the fixed designation D4439; 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. Referenced Documents

1.1 ASTM Standards:²

- C125 Terminology Relating to Concrete and Concrete Aggregates
- D1987 Test Method for Biological Clogging of Geotextile, Drainage Geocomposites, or Soil/Geotextile Filters
- D4354 Practice for Sampling of Geosynthetics and Rolled Erosion Control Products (RECPs) for Testing
- D4491/D4491M Test Methods for Water Permeability of Geotextiles by Permittivity
- D4533/D4533M Test Method for Trapezoid Tearing Strength of Geotextiles
- D4594/D4594M Test Method for Effects of Temperature on Stability of Geotextiles
- D4595 Test Method for Tensile Properties of Geotextiles by the Wide-Width Method
- D4632/D4632M Test Method for Grab Breaking Load and Elongation of Geotextiles
- D4716/D4716M Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
- D4751 Test Methods for Determining Apparent Opening Size of a Geotextile
- D4759 Practice for Determining the Specification Conformance of Geosynthetics
- D4833/D4833M Test Method for Index Puncture Resistance of Geomembranes and Related Products
- D4873/D4873M Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
- D4884/D4884M Test Method for Strength of Sewn or Bonded Seams of Geotextiles
- D4885 Test Method for Determining Performance Strength of Geomembranes by the Wide Strip Tensile Method
- D5101 Test Method for Measuring the Filtration Compatibility of Soil-Geotextile Systems
- D5141 Test Method for Determining Filtering Efficiency and Flow Rate of the Filtration Component of a Sediment Retention Device
- D5262 Test Method for Determining the Unconfined Tension Creep and Creep Rupture Behavior of Planar Geosynthetics Used for Reinforcement Purposes
- D5322 Practice for Laboratory Immersion Procedures for Evaluating the Chemical Resistance of Geosynthetics to Liquids
- D5323 Practice for Determination of 2 % Secant Modulus for Polyethylene Geomembranes
- D5397 Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test
- D5494 Test Method for the Determination of Pyramid Puncture Resistance of Unprotected and Protected Geomembranes
- D5496 Practice for In-Field Immersion Testing of Geosynthetics
- D5514/D5514M Test Method for Large-Scale Hydrostatic Puncture Testing of Geosynthetics
- D5567 Test Method for Hydraulic Conductivity Ratio (HCR) Testing of Soil/Geotextile Systems
- D5594 Test Method for Determination of the Vinyl Acetate Content of Ethylene-Vinyl Acetate (EVA) Copolymers by Fourier Transform Infrared Spectroscopy (FT-IR)
- D5617 Test Method for Multi-Axial Elongation of Geomembranes

¹ This terminology is under the jurisdiction of D35 on Geosynthetics and is the direct responsibility of D35.93 on Editorial and Terminology. Current edition approved July 15, 2023; Feb. 1, 2024. Published July 2023; March 2024. Originally approved in 1984. Last previous edition approved in 2023 as D4439 – 23a; D4439 – 23b. DOI: 10.1520/D4439-23B; 10.1520/D4439-24.

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.

D5641/D5641M Practice for Geomembrane Seam Evaluation by Vacuum Chamber
 D5747/D5747M Practice for Tests to Evaluate the Chemical Resistance of Geomembranes to Liquids
 D5818 Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics
 D5820 Practice for Pressurized Air Channel Evaluation of Dual-Seamed Geomembranes
 D5994/D5994M Test Method for Measuring Core Thickness of Textured Geomembranes

1.2 *Federal Standard*.³

Federal Standard 751a Stitches, Seams, and Stitchings

2. Terminology

absorption, *n*—the process by which a liquid is drawn into and tends to fill permeable pores in a porous solid body, also, the increase in mass of a porous solid body resulting from penetration of a liquid into its permeable pores. **C125**

aerobic, *n*—a condition in which a measurable volume of air is present in the incubation chamber or system. **D1987**

anaerobic, *n*—a condition in which no measurable volume of air is present in the incubation chamber or system. **D1987**

apparent opening size (AOS), O_{95} , *n*—for a geotextile, a property which indicates the approximate largest particle that would effectively pass through the geotextile. **D4751**

atmosphere for testing geosynthetics, *n*—air maintained at a relative humidity between 50 to 70 % and a temperature of 21 ± 2 °C (70 ± 4 °F). **D4439, D4751, D5494**

back flushing, *n*—a process by which liquid is forced in the reverse direction to the flow direction. **D1987**

barrier—the ability of a geosynthetic to prevent or reduce flow, mass transfer, or both.

DISCUSSION—

The boundaries for the function are usually defined by a single or multiple engineering or regulatory thresholds.

basis weight—deprecated term (do not use in the sense of mass per unit area). **D4439**

<https://standards.iteh.ai/catalog/standards/astm/780bd1f5-e5fd-4c84-9a9a-4523f71392fb/astm-d4439-24>

bend, *vt*—in mechanics, to force an object from its natural or manufactured shape into a curve or into increased curvature. **D4439**

biocide, *n*—a chemical used to kill bacteria and other microorganisms. **D1987**

bituminous geosynthetic barrier (GBR-B), *n*—factory-produced structure of geosynthetic materials in the form of a sheet in which the barrier function is fulfilled by bitumen.

blinding, *n*—for geotextiles, the condition where soil particles block the surface openings of the fabric, thereby reducing the hydraulic conductivity of the system. **D4439**

breaking force, (*F*), *J*, *n*—the force at failure. **D4885**

breaking load, *n*—the maximum force applied to a specimen in a tensile test carried to rupture. **D4632/D4632M**

breaking toughness, *T*, (FL^{-1}), Jm^{-2} , *n*—for geotextiles, the actual work-to-break per unit surface area of material. **D4595, D4885**

chemical resistance, *n*—the ability to resist chemical attack. **D5322**

³ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

clogging, *n*—*for geotextiles*, the condition where soil particles move into and are retained in the openings of the fabric, thereby reducing the hydraulic conductivity. **D4439**

clogging potential, *n*—*in geotextiles*, the tendency for a given geotextile to decrease permeability due to soil particles that have either lodged in the geotextile openings or have built up a restrictive layer on the surface of the geotextile. **D5101**

compressed thickness (*t*, (*L*), mm), *n*—thickness under a specified stress applied normal to the material. **D4439**

constant-rate-of-load tensile testing machine (CRL), *n*—a testing machine in which the rate of increase of the load being applied to the specimen is uniform with time after the first 3 s. **D4439**

corresponding force, *n*—synonym for force at specified elongation. **D4885**

coupon, *n*—a portion of a material or laboratory sample from which multiple specimens can be taken for testing. **D5747/D5747M**

creep, *n*—the time-dependent increase in accumulative strain in a material resulting from an applied constant force. **D5262**

critical height (*ch*), *n*—the maximum exposed height of a cone or pyramid that will not cause a puncture failure of a geosynthetic at a specified hydrostatic pressure for a given period of time. **D5514/D5514M**

cross-machine direction, *n*—the direction in the plane of the fabric perpendicular to the direction of manufacture. **D4632/D4632M**

density (ρ , (ML⁻³), kg/m³), *n*—mass per unit volume. **D4439**

design load—the load at which the geosynthetic is required to operate in order to perform its intended function. **D5262**

drainage, *n*—the ability of a geosynthetic to collect and transport fluids along its plane.

elastic limit, *n*—*in mechanics*, the stress intensity at which stress and deformation of a material subjected to an increasing force cease to be proportional; the limit of stress within which a material will return to its original size and shape when the force is removed, and hence, not a permanent set. **D4885**

elongation at break, *n*—the elongation corresponding to the breaking load, that is, the maximum load. **D4632/D4632M**

failure, *n*—an arbitrary point beyond which a material ceases to be functionally capable of its intended use. **D4885, D5262**

failure, *n*—*in testing geosynthetics*, water or air pressure in the test vessel at failure of the geosynthetic. **D5514/D5514M**

field testing, *n*—testing performed in the field under actual conditions of temperature and exposure to the fluids for which the immersion testing is being performed. **D5496**

fill—deprecated term, see **filling**.

filling, *n*—yarn running from selvage to selvage at right angles to the warp in a woven fabric. **D4439**

flexible polypropylene, *n*—a material having a 2 % secant modulus of less than 300 MPa (40 000 psi) as determined by Practice **D5323**, produced by polymerization of propylene with or without other alpha olefin monomers.

force at specific elongation, FASE, *n*—the force associated with a specific elongation on the force-elongation curve. **D4439**

force-elongation curve, *n*—*in a tensile test*, a graphical representation of the relationship between the magnitude of an externally applied force and the change in length of the specimen in the direction of the applied force. (*Synonym* for stress-strain curve.) **D4885**

geocell, *n*—a factory-produced, three-dimensional, compartmentalized, polymeric structure having discrete cells formed by expanding the structure, which are subsequently filled.

geocomposite, *n*—a product composed of two or more materials, at least one of which is a geosynthetic.

geofoam, *n*—block or planar rigid cellular foamed polymeric material used in geotechnical engineering applications.

geogrid, *n*—a geosynthetic formed by a regular network of integrally connected elements with apertures greater than 6.35 mm (¼ in.) to allow interlocking with surrounding soil, rock, earth, and other surrounding materials to function primarily as reinforcement. **D5262**

geomembrane, *n*—an essentially impermeable geosynthetic composed of one or more synthetic sheets. **D4439, D4873/D4873M, D4885, D5994/D5994M, D5820**

geonet, *n*—a geosynthetic consisting of integrally connected parallel sets of ribs overlying similar sets at various angles for planar drainage of liquids or gases. **D4439**

geostrip—polymeric material in the form of a strip of width not more than 200 mm (7.87 in.), used in contact with soil or other materials in geotechnical and civil engineering applications, or both.

geosynthetic, *n*—a planar product manufactured from polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project, structure, or system. **D4354, D4759, D4873/D4873M, D5617, D5818**

geosynthetic barrier—low-permeability geosynthetic material, used in geotechnical and civil engineering applications with the purpose of reducing or preventing the flow of fluid through the construction.

geosynthetic barrier clay (GBR-C), *n*—factory-produced structure of geosynthetic materials in the form of a sheet, in which the barrier function is fulfilled by clay.

geosynthetic barrier polymeric (GBR-P), *n*—factory-produced structure of geosynthetic materials in the form of a sheet, in which the barrier function is fulfilled by polymers.

geosynthetic cementitious composite mat (GCCM), *n*—a factory-assembled geosynthetic composite consisting of a cementitious material contained within layer or layers of geosynthetic materials that becomes hardened when hydrated.

geosynthetic clay liner, *n*—a manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetic materials.

geotechnical engineering, *n*—the engineering application of geotechnics. **D4439, D4595**

geotechnics, *n*—the application of scientific methods and engineering principles to the acquisition, interpretation, and use of knowledge of materials of the earth’s crust to the solution of engineering problems. **D4439, D4491/D4491M, D4595, D4716/D4716M, D4751**

geotextile, *n*—a permeable geosynthetic comprised solely of textiles.

DISCUSSION—

Geotextiles perform several functions in geotechnical engineering applications, including: separation, filtration, drainage, reinforcement, and protection. **D1987, D4439, D5594**

grab test, *n*—*in fabric testing*, a tension test in which only a part of the width of the specimen is gripped in the clamps. **D4632/D4632M**

gradient ratio, *n*—*in geotextiles*, the ratio of the hydraulic gradient through a soil-geotextile system to the hydraulic gradient through the soil alone. **D5101**

gravity flow, *n*—flow in a direction parallel to the plane of a geotextile or related product driven predominately by a difference in elevation between the inlet and outflow points of a specimen. **D4716/D4716M**

head, *n*—pressure at a point in a liquid, expressed in terms of the vertical distance of the point below the surface of the liquid. **D4716/D4716M**

hydraulic conductivity (*k*), *n*—the rate of discharge of water under laminar flow conditions through a unit cross-sectional area of a porous medium under a unit hydraulic gradient and standard temperature conditions (20 °C). **D5567**

hydraulic conductivity ratio (HCR), *n*—the ratio of the hydraulic conductivity of the soil/geotextile system, k_{sg} , at any time during the test, to the initial hydraulic conductivity, k_{sg0} , measured at the beginning of the test (NEW).

<https://standards.iteh.ai/catalog/standards/astm/780bd1f5-e5fd-4c84-9a9a-4523f71392fb/astm-d4439-24>
hydraulic gradient, *i*, *s* (*D*)—the loss of hydraulic head per unit distance of flow, dH/dL . **D5101**

hydraulic transmissivity, $\theta(L^2 T^{-1})$, *n*—*for a geotextile or related product*, the volumetric flow rate of water per unit width of specimen per unit gradient in a direction parallel to the plane of the specimen. **D4716/D4716M**

hydrostatic pressure, *n*—a state of stress in which all the principal stresses are equal (and there is no shear stress), as in a liquid at rest; induced artificially by means of a gaged pressure system; the product of the unit weight of the liquid and the difference in elevation between the given point and the free water elevation. **D5514/D5514M**

index test, *n*—a test procedure which may contain a known bias but which may be used to establish an order for a set of specimens with respect to the property of interest. **D4833/D4833M, D4885**

inflection point, *n*—the first point of the force-elongation curve at which the second derivative equals zero. **D4885**

initial tensile modulus, $J_p (FL^{-1})$, Nm^{-1} , *n*—*for geosynthetics*, the ratio of the change in force per unit width to the change in elongation of the initial portion of a force-elongation curve. **D4885**

in-plane flow, *n*—fluid flow confined to a direction parallel to the plane of a geotextile or related product. **D4716/D4716M**

integral, *adj*—*in geosynthetics*, forming a necessary part of the whole; constituent. **D4439**

laboratory sample, *n*—a portion of material taken to represent the lot sample, or the original material, and used in the laboratory as a source of test specimens. **D4354**

laminar flow, *n*—flow in which the head loss is proportional to the first power of the velocity. **D4716/D4716M**

linear density, *n*—mass per unit length; the quotient obtained by dividing the mass of a fiber or yarn by its length.

lot, *n*—a unit of production, or a group of other units or packages, taken for sampling or statistical examination, having one or more common properties and being readily separable from other similar units. **D4354**

lot sample, *n*—one or more shipping units taken at random to represent an acceptance sampling lot and used as a source of laboratory samples. **D4354**

machine direction, *n*—the direction in the plane of the fabric parallel to the direction of manufacture. **D4632/D4632M**

minimum average roll value (MARV), *n*—for geosynthetics, a manufacturing quality control tool used to allow manufacturers to establish published values such that the user/purchaser will have a 97.7 % confidence that the property in question will meet published values. For normally distributed data, “MARV” is calculated as the typical value minus two (2) standard deviations from documented quality control test results for a defined population from one specific test method associated with one specific property.

DISCUSSION—

MARV is applicable to a geosynthetic’s intrinsic physical properties such as weight, thickness, and strength. MARV may not be appropriate for some hydraulic, performance, or durability properties.

minimum test value, *n*—for geosynthetics, the lowest sample value from documented manufacturing quality control test results for a defined population from one test method associated with one specific property.

modulus of elasticity, *MPa (FL⁻²)*, *n*—the ratio of stress (nominal) to corresponding strain below the proportional limit of a material, expressed in force per unit area, such as megapascals (pounds-force per square inch). **D5323**

multi-axial tension, *n*—stress in more than one direction. **D5617**

multi-linear drainage geocomposite, *n*—a manufactured product composed of a series of parallel single drainage conduits regularly spaced across its width sandwiched between two or more geosynthetics.

nominal, *n*—representative value of a measurable property determined under a set of conditions, by which a product may be described.

nominal value, *n*—representative value of a measurable property by which a product may be described **D4439**

normal direction, *n*—for geotextiles, the direction perpendicular to the plane of a geotextile. **D4439**

normal stress, (FL⁻²), *n*—the component of applied stress that is perpendicular to the surface on which the force acts. **D4439**

offset modulus, *J_o*, (FL⁻¹), Nm⁻¹, *n*—for geosynthetics, the ratio of the change in force per unit width to the change in elongation below an arbitrary offset point at which there is a proportional relationship between force and elongation, and above the inflection point on the force-elongation curve. **D4885**

performance property, *n*—a result obtained by conducting a performance test. **D5141**