



Standard Practice for Tests to Evaluate the Chemical Resistance of Geonets to Liquids¹

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1. Scope

1.1 This practice describes procedures for testing geonet products for chemical resistance with liquid wastes, prepared chemical solutions, or leachates, or both, derived from solid wastes.

1.2 This practice describes test methods for measuring changes in mass, dimensions, tensile and hydraulic properties and other optional physical and mechanical properties caused by immersion in test solutions, which may be representative of anticipated end use conditions. This practice may be used to assess the extent to which a product's as-manufactured properties are affected by such immersion.

1.3 This practice is intended to be used in conjunction with Practices D 5322 or D 5496. The scope of this practice is limited to testing and reporting procedures for unexposed and exposed geonet samples.

1.4 Evaluation or interpretation of test data is beyond the scope of this practice.

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 and health practices and determine the applicability of regulatory limitations prior to use.* See Section 7 for specific hazards statements.

2. Referenced Documents

2.1 ASTM Standards:

- D 123 Terminology Relating to Textiles²
- D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement²
- D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer³
- D 1621 Test Method for Compressive Properties of Rigid Cellular Plastics³
- D 4439 Terminology for Geotextiles⁴
- D 4595 Test Method for Tensile Properties of Geotextiles by Wide Width Strip Method⁴

¹ This practice is under the jurisdiction of ASTM Committee D-35 on Geosynthetics and is the direct responsibility of Subcommittee D35.02 on Endurance Properties.

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² *Annual Book of ASTM Standards*, Vol 07.01.

³ *Annual Book of ASTM Standards*, Vol 08.01.

⁴ *Annual Book of ASTM Standards*, Vol 04.09.

D 4716 Test Method for Determining the (In-Plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head⁴

D 5035 Test Method for Breaking Strength and Elongation of Textile Fabrics (Strip Test)⁵

D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes⁴

D 5322 Practice for Immersion Procedures for Evaluating the Chemical Resistance of Geosynthetics to Liquids⁴

D 5496 Practice for In-Field Immersion Testing of Geosynthetics⁴

D 5747 Practice for Tests to Evaluate the Chemical Resistance of Geomembranes to Liquids⁴

2.2 EPA Standards:

EPA/600/2-88/052 Lining of Waste Containment and Other Impoundment Facilities⁶

EPA 9090 Compatibility Test for Wastes and Membrane Liners⁷

3. Terminology

3.1 Definitions:

3.1.1 *chemical resistance, n*—for geosynthetics, the extent to which a material or product retains its original physical and chemical characteristics as a function of immersion in, or contact with, a foreign substance (see Practice D 5747).

3.1.2 *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 (see Terminology D 4439).

3.1.3 *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 manmade project, structure, or system (see Terminology D 4439).

3.1.4 *specimen, n*—a specific portion of a material or laboratory sample upon which a test is performed or which is taken for that purpose (see Terminology D 4439).

3.1.5 For definitions of terms used in this practice, refer to Terminologies D 123 and D 4439.

⁵ *Annual Book of ASTM Standards*, Vol 07.02.

⁶ Available from the *National Technical Information Service*, PB-89-129670.

⁷ Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

4. Summary of Practice

4.1 This practice defines test methods and procedures for evaluating the resistance of geonet to liquid exposure by monitoring physical and chemical properties of geonet specimens immersed in a test liquid. The physical condition of the geonet is monitored as a function of cumulative exposure time by means of dimensional measurements and physical and chemical property tests.

5. Significance and Use

5.1 This practice is intended to provide a list of standard procedures for test programs for investigating the chemical resistance of a geonet with a liquid waste, leachate, or chemical. This practice should be used in the absence of other specifications required for the particular situation being addressed.

5.2 Chemical resistance, as used in this practice, is not a quantifiable term. This practice is intended to provide a basis of standardization for those wishing to compare or investigate the chemical resistance of a geonet. It should be recognized that chemical resistance is a user judgment evaluation and that this practice does not offer procedures for interpreting the results obtained from test procedures contained herein. As a practice, a test result is not produced.

5.3 This practice is for the chemical resistance assessment of geonets and is written in parallel to similar practices for geomembranes, geogrids, geotextiles, and geopipes. Each practice is to be considered individually for the geosynthetic under investigation and collectively for all geosynthetics exposed to the potentially harsh chemical environment under consideration.

6. Apparatus

6.1 *Analytical Balance*, capable of weighing to an accuracy of 0.001 g.

6.2 *Measuring Equipment*, such as scales or calipers, suitable for determining dimensions of geonet specimens.

6.3 All other required equipment is specified in the referenced test methods. Refer to the appropriate standards for a description of the apparatus necessary to perform those tests.

7. Hazards

NOTE 1—Warning: The solutions used in this practice may contain hazardous chemicals. Appropriate precautions must be taken when handling hazardous waste, chemicals, and the immersion solutions. Protective equipment suitable for the chemicals being used must be worn by all personnel handling or exposed to the chemicals. Particular care should be taken when opening storage vessels at elevated temperatures due to the increased volatility of organics and the increased activity of acids and bases. Care also must be taken to prevent the spilling of hazardous materials, and provisions must be made to clean up any accidental spills that do occur.

7.1 Before carrying out any test, safety precautions and disposal procedures for hazardous waste, chemicals or immersion solutions, and any contaminated geonet materials, should be identified and implemented to provide full protection to all personnel and to comply with applicable disposal regulations.

8. Sampling

8.1 Determine the number and dimensions of the test

specimens according to the requirements of the dimensional measurements and physical/polymer property tests to be performed, the duration of the immersion, and the number of test intervals.

NOTE 2—In contrast to other related chemical resistance test practices, this practice provides for the preparation of individual test specimens directly from roll materials instead of prepared samples or exposure coupons, or both. These test specimens then are used for subsequent exposure and testing.

8.2 Sample in accordance with respective test methods selected.

8.3 Cut individual test specimens in each the machine and transverse directions from stock roll material.

8.4 Mix or shuffle in a random fashion, and then select pre-cut, randomly mixed specimens for assignment to unexposed (baseline) testing or immersion in test solutions for testing after exposure.

8.5 Cut individual test specimens for dimension and mass measurements. Specimens may be of any size for which accurate and repeatable measurements can be made, compatible with the immersion tank. Cut specimens from sheet stock using a die to assure consistency of dimensions.

NOTE 3—Square specimens 152.4 by 152.4 mm (6 by 6 in.) have been found to be satisfactory for dimensional and mass measurements. The same individual specimens may be used for length, width, thickness, and weight change measurements, if desired. Multiple dimensional measurements may be made on a given specimen and averaged to obtain a representative basis for comparison.

9. Conditioning

9.1 Condition geonet test specimens at a temperature of $21 \pm 2^\circ\text{C}$ ($70 \pm 4^\circ\text{F}$) and relative humidity between 50 and 70 % for a period not less than 40 h prior to weighing, or baseline testing and immersion, or a combination thereof.

10. Procedure

10.1 Immerse the geonet specimens in the test solution as specified in Practices D 5322 or D 5496.

10.2 Immerse a sufficient number of specimens to perform the required testing for each of the immersion periods.

10.3 Immerse additional pieces of geonet for dimensional changes and volatile loss for each immersion period. Record the weight of the specimens to an accuracy of at least 0.1 % of the specimen's weight. Record the thickness of the specimens to an accuracy of 0.0025 mm (0.0001 in.).

10.4 Remove a sufficient number of specimens at the prescribed test period for the required testing. Rinse each specimen with deionized water and blot dry with water-absorbent, lint-free towels to remove any visible liquid residue on the specimen surface. Elevated temperature specimens should be allowed to cool to room temperature in a sample of immersion fluid. Specimens should be stored in an airtight container or bag with as little air as possible when not being used or tested in order to minimize moisture, or volatile loss, or both.

10.5 The tests to be performed on the geonet specimens are listed in Sections 11 and 12. The tests consist of required testing to be done on the geonet and recommended testing to be performed at the discretion of the user. Recommended tests

should be conducted whenever possible as this data will aid in the interpretation of the final test results. All the tests should be completed on the unexposed geonet, as well as the exposed material after each test period. Twice as many specimens as listed below shall be tested on the unexposed material in order to increase precision of baseline data.

10.6 Testing (except the extractables test) of the geonet exposed to the test fluid must be done within 24 h of removal from the test solution.

11. Required Testing, All Geonets

11.1 *Weight Change*—After each period, remove three pre-weighed specimens of geonet from the test fluid, quickly blot dry with water-absorbent, lint-free towels to remove any visible liquid residue on the specimen, and weigh to the nearest 0.001 g. Calculate the percent weight change to the nearest 0.1 %.

11.2 *Dimensional Changes*—Measure thickness as directed in Test Method D 5199, to the nearest 0.0025 mm (0.0001 in.) at three pre-marked locations on the specimens designated for measurement of weight before and after immersion. Measure length and width (in both machine and transverse directions) at two locations on the geonet specimens designated for dimension testing before and after immersion. Calculate percent changes to the nearest 0.1 %.

11.3 *Visual Observations*—Describe the test specimens before and after immersion. Observations of visual appearance can help in the interpretation of data and may explain anomalous test results. Appearance items to be considered may include a change from original color, as well as, curling, swelling, or other gross specimen changes.

11.4 *Tensile Properties*—Determine tensile properties of unexposed and exposed geonet in accordance with Test Methods D 5035. Use specimens 50.8 mm wide by 152.4 mm long (2 by 6 in.), allowing a 50.2-mm (2-in.) gage length with a 50.8 mm (2 in.) wide span. Test at 127 mm/min (5 in./min). Test five samples in each direction (machine and transverse). Determine maximum strength and percent elongation at maximum strength.

11.5 Determine hydraulic transmissivity for unexposed and exposed geonet in accordance with Test Method D 4716.

NOTE 4—The value of test parameters for the transmissivity determination, including hydraulic gradient(s), normal stress(es), and seating time should be specified by the user of this practice.

11.6 Determine compressive load/deflection properties of unexposed and exposed geonet in accordance with Test Method D 1621, Procedure A. Cut and test three test specimens

150 by 150 mm (6.0 by 6.0 in.). Apply loading at a constant rate of deformation of 1 mm/min (0.04 in./min).

11.7 Determine volatiles content of geonet using the procedure in EPA/600/2-88/052, Appendix E.

11.8 Determine extractables content of geonet using the procedure in EPA/600/2-88/052, Appendix E.

11.9 Determine specific gravity in accordance with Test Methods D 792, Method A.

12. Recommended Testing, All Geonets

12.1 *Wide Width Tensile Properties, modified for testing of geonets*—Test geonets using the same procedure required for geotextiles, that is, same specimen size, strain rate, and strength and elongation determinations (see Test Method D 4595).

12.2 *Melt Index*:

12.2.1 *Polyethylene*—Use Test Method D 1238, Condition 190/2.16.

12.2.2 *Polypropylene*—Use Test Method D 1238 Condition 230/2.16.

13. Report

13.1 State that the immersion was performed as directed in Practices D 5322 or D 5496.

13.2 Describe the material or product tested and the material's condition prior to immersion, such as product manufacturer's type and lot number, surface color and gloss, flatness or degree of curl of specimen, estimate of uniformity of channels in *x*, *y*, and *z* planes, degree of angularity or roundness in channel impressions.

13.3 Describe the method used to sample the product for the immersion procedure.

13.4 Report which test procedures, and any deviations from the procedures, that were used for evaluating the geonet.

13.5 Report all raw data, averages, and standard deviations.

13.6 Report the percent changes from the original unexposed test values for the exposed materials.

NOTE 5—The test results may be plotted as a function of time of immersion if desired. It is suggested that error bars, range indicators, or similar means to illustrate observed experimental variability be used.

13.7 Evaluation or interpretation of test results is beyond the scope of this practice and intended to be done by an appropriate expert.

14. Keywords

14.1 chemical resistance; geonets; geosynthetics; liquid wastes

APPENDIXES
(Nonmandatory Information)
X1. Test Summary

X1.1 Table X1.1 Summarizes the testing program outlined in this practice.

TABLE X1.1 Test Summary

Material Property	Test Method
Specific gravity	D 792, Method A ^A
Thickness	D 5199 ^A
Weight	EPA/600/2-88/052 ^A
Length and width	EPA/600/2-88/052 ^A
Volatile loss	EPA/600/2-88/052, Appendix E ^A
Extractables content	EPA/600/2-88/052, Appendix E ^A
Strip tensile properties	D 5035 ^A
Compressive load deflection	D 1621 ^A
Transmissivity	D 4716 ^A
Wide width tensile properties	D 4595 ^B
Melt index	D 1238 ^B

^ARequired testing.

^BRecommended testing

X2. Rationale

This practice is intended to provide a standardized procedure for conducting chemical resistance tests for geonet. The term “chemical compatibility” also has been used to describe such tests. The need for this practice was established by ASTM Subcommittee D 35.02, with the objective to provide a group of related standards for defining test procedure specifications for chemical resistance studies covering various kinds of geosynthetics. The purpose of such testing is to assess the effects of immersion in liquid waste, leachate, or chemical on geosynthetic materials and products, which will contact the fluids in a waste containment facility. Such testing may be performed as part of the design or regulatory review process.

EPA Method 9090 (SW846) has been used widely as a reference describing procedures for chemical resistance testing

of geomembranes. This practice is intended to extend the concept and rationale behind EPA Method 9090 to address geonets. The practice addresses test methods applicable to geonets, and it should be used together with Practice D 5322, which defines immersion procedures for geosynthetics in waste fluids.

Evaluation or interpretation is beyond the scope of this practice and should be conducted by the owner, or an agent thereof, or an appropriate expert. In general, the facility owner, designer, or geosynthetics user is responsible for defining chemical resistance criteria. Such criteria are generally considered to be site- and application-specific.

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