



## Standard Practice for Tests to Evaluate the Chemical Resistance of Geomembranes to Liquids<sup>1</sup>

This standard is issued under the fixed designation D 5747; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This practice covers procedures for the testing of geomembranes for chemical resistance with liquid wastes, prepared chemical solutions, and leachates derived from solid wastes.

1.2 This practice covers procedures for testing semi-crystalline, amorphous, elastomeric, and fabric-reinforced geomembranes.

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

1.4 Evaluation and interpretation of test data are 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.* Specific precautionary statements are given in Section 7.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- C 717 Terminology of Building Seals and Sealants<sup>2</sup>
- D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers-Tension<sup>3</sup>
- D 413 Test Method for Rubber Property-Adhesion to Flexible Substrate<sup>3</sup>
- D 624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer<sup>3</sup>
- D 638 Test Method for Tensile Properties of Plastics<sup>4</sup>
- D 751 Method of Testing Coated Fabrics<sup>5</sup>

- D 882 Test Methods for Tensile Properties of Thin Plastic Sheeting<sup>6</sup>
- D 883 Terminology Relating to Plastics<sup>6</sup>
- D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting<sup>6</sup>
- D 1505 Test Method for Density of Plastics by Density-Gradient Technique<sup>6</sup>
- D 2240 Test Method of Rubber Property-Durometer Hardness<sup>3</sup>
- D 3417 Test Method for Heats of Fusion and Crystallization of Polymers by Thermal Analysis<sup>7</sup>
- D 3418 Test Method for Transition Temperatures of Polymers by Thermal Analysis<sup>7</sup>
- D 3895 Test Method for Oxidative Induction Time of Polyolefins by Thermal Analysis<sup>7</sup>
- D 4437 Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes<sup>8</sup>
- D 4439 Terminology for Geotextiles<sup>8</sup>
- D 4545 Practice for Determining the Integrity of Factory Seams Used in Joining Manufactured Flexible Sheet Geomembranes<sup>8</sup>
- D 4833 Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products<sup>8</sup>
- D 5199 Test Method for Measuring Nominal Thickness of Geotextiles and Geomembranes<sup>8</sup>
- D 5322 Practice for Immersion Procedures for Evaluating the Chemical Resistance of Geosynthetics to Liquids<sup>8</sup>
- D 5323 Practice for Determination of 2 % Secant Modulus of Polyethylene Geomembranes<sup>8</sup>
- D 5397 Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test<sup>8</sup>
- D 5496 Practice for In-Situ Immersion Testing of Geosynthetics<sup>8</sup>
- E 793 Test Method for Heats of Fusion and Crystallinity by Differential Scanning Calorimetry<sup>9</sup>

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.02 on Endurance Properties.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.07.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 09.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 08.01.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 09.02.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 08.01.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 08.02.

<sup>8</sup> *Annual Book of ASTM Standards*, Vol 04.13.

<sup>9</sup> *Annual Book of ASTM Standards*, Vol 14.02.

E 794 Test Method for Melting and Crystallization by Thermal Analysis<sup>9</sup>

F 1251 Terminology Relating to Polymeric Biomaterials in Medical and Surgical Devices<sup>10</sup>

2.2 *Government Standard:*

EPA/600/2-88/052, Lining of Waste Containment and Other Impoundment Facilities<sup>11</sup>

2.3 *NSF Standard:*

NSF Standard 54, Flexible Membrane Liners<sup>12</sup>

2.4 *FTMS Standard:*

FTMS 101C, Method 2031 Test Method for Preservation, Packaging, and Package Materials: Test Procedures<sup>13</sup>

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *chemical resistance, n*—for geosynthetics, the extent to which a material or product retains its as-manufactured physical and chemical characteristics when subjected to immersion or contact with a foreign substance.

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

NOTE 1—See Fig. 1 for the relationship between sample, coupon, and specimen.

3.1.2.1 *Discussion*—See Fig. 1 for the relationship between sample, coupon, and specimen.

3.1.3 *elastomer, n*—a macromolecular material that returns rapidly to approximately the initial dimensions and shape after substantial deformation by a weak stress and release of the stress. (C 717, C-24)

3.1.4 *elastomeric, adj*—having the characteristics of an elastomer. (C 717, C-24)

3.1.5 *fabric-reinforced, adj*—structurally reinforced material made by incorporating geotextile.

3.1.6 *flood coating, n*—the process of placing a layer(s) of adhesive or polymer on the edges of cut, fabric-reinforced geomembranes in order to prevent exposure of the fabric to an environment.

3.1.7 *geomembrane, n*—an essentially impermeable geosynthetic composed of one or more synthetic sheets. (D 4439)

3.1.8 *plasticized, adj*—having had a plasticizer added.

3.1.9 *plasticizer, n*—a substance incorporated into a material to increase its workability, flexibility, or distensibility. (D 883, D-20)

3.1.10 *semi-crystalline, n*—a solid that contains a mixture of both crystalline and amorphous regions.

3.1.11 *tensile set, n*—represents residual deformation which is partly permanent and partly recoverable after stretching and retraction. (D 412, D-11)

3.1.12 *thermoplastic, n*—a plastic that repeatedly can be softened by heating and hardened by cooling through a

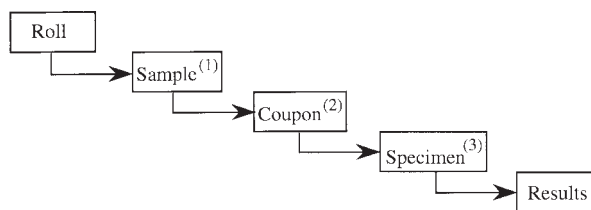
temperature range characteristic of the plastic, and that in the softened state can be shaped by flow into articles by molding or extrusion. (F 1251, F-4)

3.2 For definitions of other terms related to geomembranes, refer to Terminology D 4439.

3.3 For definition of other terms related to plastics, refer to Terminology D 883.

4. Summary of Practice

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



- (1) sent to lab from manufacturer (for laboratory immersion) or taken directly in field (for field immersion)
- (2) cut from sample and immersed in container (for laboratory) or sump (for field)
- (3) cut from the immersed coupon on a periodic basis for testing

FIG. 1 Chemical Resistance of Geomembranes

5. Significance and Use

5.1 This practice is intended to provide a list of standard procedures for test programs investigating the chemical resistance of a geomembrane 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 geomembrane. It should be recognized that chemical resistance is a user judgement evaluation and that this practice does not offer procedures for interpreting the results obtained from test procedures contained in this practice. As a practice, this does not produce a test result.

NOTE 2—This practice is for the chemical resistance assessment of geomembranes and is written in parallel to similar standard practices for geotextiles, geonets, geogrids, geopipes, and geosynthetic clay liners. Each standard is to be considered individually for the geosynthetic under

<sup>10</sup> Annual Book of ASTM Standards, Vol 13.01.

<sup>11</sup> National Technical Information Service, PB-89-129670.

<sup>12</sup> Copies can be obtained from National Sanitation Foundation International, 3475 Plymouth Road, PO Box 1468, Ann Arbor, MI 48106.

<sup>13</sup> Copies can be obtained from Global Engineering Documents, 2805 McDermit Ave., Irvine, CA 92714.

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 *Dead Weight Micrometer(s)*, meeting the requirements of Test Methods D 638, D 751, or D 5199, or combination thereof, capable of measuring thicknesses to an accuracy of 0.0025 mm (0.0001 in.).

6.3 *Air Circulating Oven*, capable of maintaining a temperature of  $105 \pm 2^\circ\text{C}$ .

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

## 7. Hazards

**NOTE 3—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 must also be taken to prevent the spilling of hazardous materials and provisions must be made to clean up any accidental spills which do occur.

## 8. Sampling

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

8.2 Sample in accordance with the respective test methods selected.

8.3 Cut the geomembrane coupons so that they are representative of the geomembrane being evaluated. Discard coupons that contain scratches or other imperfections that might affect the test results.

**NOTE 4—**Since rate of leachate absorption is a function of thickness and can have an impact on the test results, the geomembrane coupons should be as close in thickness as possible.

8.4 Mix the selected coupons in a random fashion and then re-select coupons for the immersion and baseline testing.

8.5 Cut individual test specimens for thickness, weight, and volatile loss measurements. Specimens may be of any size for which accurate and repeatable measurements can be made. Cut specimens from sheet stock using a die to ensure consistency of dimensions.

**NOTE 5—**Circular specimens  $7.98\text{ cm}^2$  ( $3.14\text{ in.}^2$ ) have been found to be satisfactory for thickness, weight, and volatile loss measurements. The same individual specimen may be used for thickness, weight, and volatile loss measurements if desired.

## 9. Conditioning

9.1 *Conditioning*—Condition samples at  $21 \pm 2^\circ\text{C}$  ( $70 \pm 4^\circ\text{F}$ ) and a relative humidity between 50 and 70 % for not less than 40 h prior to weighing or baseline testing and immersion,

or combination thereof.

## 10. Procedure

10.1 Immerse the geomembrane in the test solution as specified in Practice D 5322 or Practice D 5496, or both.

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

10.3 Immerse additional pieces of geomembrane for weight changes, thickness 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 coupons at the prescribed test period for the required testing. Rinse each coupon with deionized water and blot dry with water-absorbent, lint-free paper towels to remove any visible liquid or solid residue on the coupon surface. Allow elevated temperature coupons to cool to room temperature in a sample of immersion fluid. Store coupons 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. Keep cut specimens in an airtight container between tests.

10.5 The tests to be performed on the geomembrane are listed in Sections 11 through 20 for each of the four types of geomembranes addressed by this practice. The tests consist of required testing to be done on the geomembrane and recommended testing to be performed at the discretion of the user. Conduct recommended tests whenever possible as this data will aid in the interpretation of the final test results. All the tests should be completed on the unexposed geomembrane as well as on the exposed material after each test period. Test twice as many specimens as listed below on the unexposed material in order to increase precision of baseline data.

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

## 11. Required Testing, All Geomembranes

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

**NOTE 6—**Extra care should be taken to completely dry textured surfaces to avoid an apparent increase in weight caused by residual surface moisture.

11.2 *Dimension Changes*—Measure thickness as directed in Test Methods D 751, D 638, or D 5199 to the nearest 0.0025 mm (0.0001 in.) at three locations near the center of the pieces of geomembrane used for weight changes before and after immersion. Measure length and width (machine and transverse directions) at two locations on the sheets of geomembrane used for the physical testing before and after immersion. Calculate percent changes to the nearest 0.1 %.

11.3 *Volatile Loss*—Dry the pieces of geomembrane from the weight changes at  $105 \pm 2^\circ\text{C}$  for 24 h and then weigh to the

nearest 0.001 g. Calculate the percent volatiles to the nearest 0.1 %.

11.4 *Visual Observations*—Describe the samples before and after immersion. Visual appearance can help in the interpretation of the data and may explain anomalous test results. Appearance items to be considered may include change from original color, including any mottling; change in surface gloss; change in surface roughness; curling, swelling, or other change at the edges of the specimen; scratch, scoring, fracture initiation, or splitting of specimen into separate parts; and gross specimen changes such as wrinkling, ovalization, or noticeable curling.

## 12. Required Testing, Group 1, Geomembranes (NonReinforced)

12.1 Group 1 geomembranes include, but are not necessarily limited to: polypropylene, high-density polyethylene, very low-density polyethylene, and linear low-density polyethylene.

12.2 *Tensile Properties*—Use Test Method D 638, Type IV specimens and a rate of grip separation of 50 mm (2 in.)/min. Highly extendable geomembranes such as VLDPE should use a rate of grip separation of 500 mm (20 in.)/min. Test five specimens in each of the machine and transverse directions. Determine strain at yield, strain at break, stress at yield, and stress at break. For materials without a pronounced yield point determine stress at 100 % elongation and stress at 200 % elongation.

NOTE 7—Stress and strain at break are subject to more variables than the other tensile properties due to the catastrophic nature of the failure. Since the standard deviations are higher for the break values, changes in those values should be considered with less importance than the other tensile values.

12.3 *Tear Resistance*—Use Test Method D 1004, a rate of grip separation of 50 mm (2 in.)/min and test five specimens in each direction. Report tear resistance in N/mm thickness (or pounds per inch thickness).

12.4 *Puncture Resistance*—Use Test Method D 4833 to test ten specimens. Report puncture resistance in N/mm thickness (or pounds per inch thickness).

12.5 *2 % Secant Modulus*—Use Practice D 5323 to test five specimens in each direction.

NOTE 8—Secant modulus is subject to more variables than the other properties due to operator interpretation of the linear portion of the stress/strain curve. Since variability is high, changes in secant modulus should be considered with less importance than the other tensile properties.

12.6 *Hardness*—Use Test Method D 2240, Type D Durometer and test five specimens.

12.7 *Extractables Content*—Use the procedure in Appendix E of EPA/600/2-88/052.

12.8 *Density*—Use Test Method D 1505 and test three specimens.

## 13. Recommended Testing, Group 1 Geomembranes (Non-Reinforced)

13.1 *Seam Peel Adhesion*—Use Practices D 4437 or D 4545 and test five specimens.

13.2 *Bonded Seam Strength*—Use Practices D 4437 or D 4545 and test five specimens.

13.3 *Notched Constant Tensile Load*—Use Test Method D 5397 (single point at 30 % of room temperature stress at yield) and test five transverse direction specimens.

13.4 *Melting Point*—Use Test Method D 3418 or E 794 to obtain melting point.

13.5 *Percent Crystallinity*—Use Test Methods D 3417 or E 793 to derive the percent crystallinity.

13.6 *Oxidative Induction Time*—Use Test Method D 3895, an aluminum pan, and an oxygen environment at one atmosphere of pressure.

13.7 *Hydrostatic Resistance*—Use Method A, Procedure 1 of Test Method D 751 and test five specimens.

## 14. Required Testing, Group 2 Geomembranes (NonReinforced)

14.1 Group 2 geomembranes include, but are not necessarily limited to: polyvinyl chloride (PVC).

14.2 *Tensile Properties*—Use Test Methods D 882 and a rate of grip separation of 500 mm (20 in.)/min. Test five specimens in each of the machine and transverse directions. Report strain at break, stress at 100 % elongation, stress at 200 % elongation, and stress at break.

14.3 *Tear Resistance*—Use Test Method D 1004, a rate of grip separation of 50 mm (2 in.)/min and test five specimens in each direction. Report tear resistance in N/mm thickness (or pounds per inch thickness).

14.4 *Puncture Resistance*—Use Test Method D 4833 to test ten specimens. Report puncture resistance in N/mm thickness (or pounds per inch thickness).

14.5 *Hardness*—Use Test Method D 2240, Type A Durometer and test five specimens.

14.6 *Extractables Content*—Use Appendix E of EPA/600/2-88/052.

## 15. Recommended Testing, Group 2 Geomembranes (Non-Reinforced)

15.1 *Seam Peel Adhesion*—Use Practices D 4437 or D 4545 and test five specimens.

15.2 *Bonded Seam Strength*—Use Practices D 4437 or D 4545 and test five specimens.

15.3 *Hydrostatic Resistance*—Use Method A, Procedure 1 of Test Method D 751 and test five specimens.

## 16. Required Testing, Group 3 Geomembranes (NonReinforced)

16.1 Group 3 geomembranes include but are not necessarily limited to: ethylene propylene diene monomer (EPDM), butyl rubber, and polychloroprene (neoprene).

16.2 *Tensile Properties*—Use Test Methods D 412, Die C specimens and a rate of grip separation of 500 mm (20 in.)/min. Test five specimens in each of the machine and transverse directions. Report strain at break, stress at 100 % elongation, stress at 200 % elongation, stress at break, and tensile set after break.

16.3 *Tear Resistance*—Use Test Method D 624, a rate of grip separation of 500 mm (20 in.)/min and test five specimens in each direction. Report tear resistance in N/mm thickness (or pounds per inch thickness).

16.4 *Puncture Resistance*—Use Test Method D 4833 to test

ten specimens. Report puncture resistance in N/mm thickness (or pounds per inch thickness).

16.5 *Hardness*—Use Test Method D 2240, Type A Durometer and test five specimens.

16.6 *Extractables Content*—Use Appendix E of EPA/600/2-88/052 and test three specimens.

### **17. Recommended Testing, Group 3 Geomembranes (Non-Reinforced)**

17.1 *Seam Peel Adhesion*—Use Practices D 4437 or D 4545 and test five specimens.

17.2 *Bonded Seam Strength*—Use Practices D 4437 or D 4545 and test five specimens.

17.3 *Hydrostatic Resistance*—Use Method A, Procedure 1 of Test Method D 751 and test five specimens.

### **18. Flood Coating, Group 4 Geomembranes (Fabric Reinforced)**

18.1 Group 4 geomembranes (fabric reinforced) include but are not necessarily limited to: chlorinated polyethylene (CPE), chlorosulfonated polyethylene (CSPE), and ethylene interpolymer alloy (EIA).

18.2 Flood coating the edges of the immersed sheets is recommended for materials where the reinforcement is not designed to be in contact with the test fluid in an actual containment facility. Geomembranes containing a reinforcing fabric that is intended to be exposed in a containment facility must not be flood coated.

18.3 When flood coating is to be employed, an appropriate adhesive must be used. The adhesive used for field seaming or an adhesive with chemical resistance equal to the geomembrane would be considered appropriate. Use a solvent adhesive containing the same polymer as the geomembrane when possible.

18.4 After flood coating, allow the samples to cure in air for 24 h at standard laboratory conditions followed by curing in an air circulating oven at 30°C for 48 h. Then acclimate the geomembrane at standard laboratory conditions for at least 40 h prior to weighing and immersion.

### **19. Required Testing, Group 4 Geomembranes (Fabric Reinforced)**

19.1 *Tensile Properties*—Use Test Method D 751, a 25.4-mm (1.0-in.) wide strip tensile, a rate of grip separation of 305 mm (12 in.)/min to test five specimens in each direction. Report strain at fabric break, strain at polymer break, stress at fabric break, and stress at polymer break.

19.1.1 The orientation of the scrim fabric reinforcement is very important to the outcome of the strip tensile test. If the threads of the scrim fabric reinforcement are not parallel to the specimen or are not straight, the threads which run in the test direction will be cut and low tensile values may be obtained.

NOTE 9—Since straight rectangular specimens (as opposed to dumbbell specimens) are being used, caution must be used in the gripping of the

specimens to avoid failure at the grip faces.

19.2 *Bursting Strength*—Use Test Method D 751, a 25.4-mm (1.0-in.) diameter polished steel ball or FTMS 101C, Method 2031 and test five specimens.

19.3 *Hardness*—Use Test Method D 2240, Type A durometer and test five specimens.

19.4 *Extractables Content*—Use Appendix E of EPA/600/2-88/052.

19.5 *Ply Adhesion*—Use Test Method D 413, Type A, 180° peel tests. Test five specimens in each direction.

### **20. Recommended Testing, Group 4 Geomembranes (Fabric Reinforced)**

20.1 *Seam Peel Adhesion*—Use Practices D 4437 or D 4545 and test five specimens.

20.2 *Bonded Seam Strength*—Use Method A of Test Method D 751, as modified in Part 3 Annex, NSF Standard 54 and test five specimens.

20.3 *Tear Resistance*—Use Test Method D 751, Tongue Tear, as modified in Part 6 Annex, National Sanitation Foundation Standard 54 and test five specimens in each direction.

20.4 *Melting Point*—Use Test Method D 3418 or Test Method E 794 to obtain melting point if the polymer exhibits a crystalline melting point.

20.5 *Hydrostatic Resistance*—Use Method A, Procedure 1 of Test Method D 751 and test five specimens.

### **21. Report**

21.1 Report the following information:

21.1.1 State that the immersion was performed as directed in Practices D 5322 or D 5496,

21.1.2 Describe the material or product tested and the condition the material was in prior to the immersion (for example, any imperfections such as scratches),

21.1.3 Describe the method used to sample the product for the immersion procedure,

21.1.4 Report which test procedures, and any deviations from the procedures, that were used for evaluating the geomembrane,

21.1.5 Report all raw data, averages, and standard deviations,

21.1.6 Report the percent changes from the original unexposed test values for the exposed materials,

21.1.7 Plot the test results against the time of immersion, and

NOTE 10—It is suggested that error bars, range indicators, or similar means to illustrate observed experimental variability be used.

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

### **22. Keywords**

22.1 chemical resistance; geomembrane; liquid wastes

**APPENDIXES**
**(Nonmandatory Information)**
**X1. TEST SUMMARY**

X1.1 Table X1.1 summarizes the testing program outlined in this practice.<sup>A</sup> indicates required testing.

**TABLE X1.1 Test Summary**

Material Property	Group 1	Group 2	Group 3	Group 4
Thickness	Test Method D 638 or Test Method D 5199 <sup>A</sup>	Test Method D 751 or Test Method D 5199 <sup>A</sup>	Test Method D 751 or Test Method D 5199 <sup>A</sup>	Test Method D 751 or Test Method D 5199 <sup>A</sup>
Weight	EPA/600/2-88/052 <sup>A</sup>	EPA/600/2-88/052 <sup>A</sup>	EPA/600/2-88/052 <sup>A</sup>	EPA/600/2-88/052 <sup>A</sup>
Length and Width	EPA/600/2-88/052 <sup>A</sup>	EPA/600/2-88/052 <sup>A</sup>	EPA/600/2-88/052 <sup>A</sup>	EPA/600/2-88/052 <sup>A</sup>
Volatile Loss	EPA/600/2-88/052 Appendix G <sup>A</sup>	EPA/600/2-88/052 Appendix G <sup>A</sup>	EPA/600/2-88/052 Appendix G <sup>A</sup>	EPA/600/2-88/052 Appendix G <sup>A</sup>
Tensile	Test Method D 638 <sup>A</sup>	Test Methods D 882 <sup>A</sup>	Test Method D 412 <sup>A</sup>	Test Method D 751 <sup>A</sup>
Tear	Test Method D 1004 <sup>A</sup>	Test Method D 1004 <sup>A</sup>	Test Method D 624 <sup>A</sup>	Test Method D 751 NSF Modified <sup>A</sup>
Puncture/Burst	Test Method D 4833 <sup>A</sup>	Test Method D 4833 <sup>A</sup>	Test Method D 4833 <sup>A</sup>	Test Method D 751 or FTMS 101C, 2031 <sup>A</sup>
2 % Secant Modulus	Practice D 5323 <sup>A</sup>	...	...	...
Hardness	Test Method D 2240	Test Method D 2240 <sup>A</sup>	Test Method D 2240 <sup>A</sup>	Test Method D 2240 <sup>A</sup>
Hydrostatic Resistance	Test Method D 751 Method A Procedure 1	Test Method D 751 Method A Procedure 1	Test Method D 751 Method A Procedure 1	Test Method D 751 Method A Procedure 1
Seam Peel Adhesion	Practice D 4437 or Practice D 4545	Practice D 4437 or Practice D 4545	Practice D 4437 or Practice D 4545	Practice D 4437 or Practice D 4545
Bonded Seam Strength	Practice D 4437 or Practice D 4545	Practice D 4437 or Practice D 4545	Practice D 4437 or Practice D 4545	Test Method D 751 NSF Modified
Notched Constant Tensile Load	Test Method D 5397 (single point)	...	...	...
Extractables Content	EPA/600/2-88/052 Appendix E <sup>A</sup>	EPA/600/2-88/052 Appendix E <sup>A</sup>	EPA/600/2-88/052 Appendix E <sup>A</sup>	EPA/600/2-88/052 Appendix E <sup>A</sup>
Melting Point	Test Method D 3418 or Test Method E 794	Test Method D 3418 or Test Method E 794	...	Test Method D 3418 or Test Method E 794
Percent Crystallinity	Test Method D 3417 or Test Method E 793	...	...	Test Method D 3417 or Test Method E 793
Oxidative Induction Time	Test Method D 3895	...	...	...
Ply Adhesion	...	...	...	Test Method D 413 Method A
Density	Test Method D 1505	...	...	...

<sup>A</sup> Indicated required testing (all other tests are recommended).

**X2. COMMENTARY**

X2.1 This practice is intended to provide a standardized procedure for conducting chemical resistance tests for geomembranes. The term “chemical compatibility” has also been used to describe such tests. The need for this practice was established by ASTM Subcommittee D35.02 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 waste fluids 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.

X2.2 EPA Method 9090 (EPA/600/2-88/052) has been

widely used as a reference describing procedures for chemical resistance testing of geomembranes. This practice addresses additional test methods applicable to geomembranes, and it should be used together with Practice D 5322 and Test Method D 5496 that defines immersion procedures for geosynthetics in waste fluids.

X2.3 Evaluation or interpretation is beyond the scope of this practice and should be conducted by the owner or his agent, 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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