Designation: D7747/D7747M – 11 (Reapproved 2023)

Standard Test Method for Determining Integrity of Seams Produced Using Thermo-Fusion Methods for Reinforced Geomembranes by the Strip Tensile Method[1]

This standard is issued under the fixed designation D7747/D7747M; 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 describes destructive quality control tests used to determine the integrity of thermo-fusion seams made with reinforced geomembranes. Test procedures are described for seam tests for peel and shear properties using strip specimens.

1.2 The types of thermal field and factory seaming techniques used to construct geomembrane seams include the following:

1.2.1 *Hot Air*—This technique introduces high-temperature air between two geomembrane surfaces to facilitate melting. Pressure is applied to the top or bottom geomembrane, forcing together the two surfaces to form a continuous bond.

1.2.2 *Hot Wedge*—This technique melts the two geomembrane surfaces to be seamed by running a hot metal wedge between them. Pressure is applied to the top and bottom geomembrane to form a continuous bond. Some seams of this kind are made with dual tracks separated by a non-bonded gap. These seams are sometimes referred to as dual hot wedge seams or double-track seams.

1.2.3 *Extrusion*—This technique encompasses extruding molten resin between two geomembranes or at the edge of two overlapped geomembranes to effect a continuous bond.

1.2.4 *Radio Frequency (RF) or Dielectric*—High-frequency dielectric equipment is used to generate heat and pressure to form an overlap seam in factory fabrication.

1.2.5 *Impulse*—Clamping bars heated by wires or a ribbon melt the sheets clamped between them. A cooling period while still clamped allows the polymer to solidify before being released.

1.3 The types of materials covered by this test method include, but are not limited to, reinforced geomembranes made from the following polymers:

1.3.1 Very low-density polyethylene (VLDPE).

1.3.2 Linear low-density polyethylene (LLDPE).

1.3.3 Flexible polypropylene (fPP).

1.3.4 Polyvinyl chloride (PVC).

1.3.5 Chlorosulfonated polyethylene (CSPE).

1.3.6 Ethylene interpolymer alloy (EIA).

1.4 *Units*—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 nonconformance with the 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]

D76/D76M Specification for Tensile Testing Machines for Textiles
D4439 Terminology for Geosynthetics
D7003/D7003M Test Method for Strip Tensile Properties of Reinforced Geomembranes
D7004/D7004M Test Method for Grab Tensile Properties of Reinforced Geomembranes
D7749/D7749M Test Method for Determining Integrity of Seams Produced Using Thermo-Fusion Methods for Reinforced Geomembranes by the Grab Method

[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 November 2023. Originally approved in 2011. Last previous edition approved in 2018 as D7747/D7747M – 11 (2018). DOI: 10.1520/D7747_D7747M-11R23.

[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. Terminology

3.1 *Definitions*—Refer to Terminology D4439 for definitions of terms applying to this test method.

4. Significance and Use

4.1 The use of reinforced geomembranes as barrier materials has created a need for a standard test method to evaluate the quality of seams produced by thermo-fusion methods. This test method is used for quality control purposes and is intended to provide quality control and quality assurance personnel with data to evaluate seam quality.

4.2 This standard arose from the need for a destructive test method for evaluating seams of reinforced geomembranes. Standards written for destructive testing of nonreinforced geomembranes do not include all break codes (Fig. 1) applicable to reinforced geomembranes.

4.3 When reinforcement occurs in directions other than machine and cross-machine, scrim are cut at specimen edges, generally lowering results. To partially compensate for this, testing can be performed according to Test Method D7749/D7749M or the 2 in. wide strip specimen specified in this method can be utilized. Testing of 1 in. and 2 in. specimens is Method A and Method B, respectively.

4.4 The shear test outlined in this method correlates to strength of parent material measured according to Test Method D7003/D7003M only if reinforcement is parallel to TD. For other materials, seam strength and parent material strength can be compared through Test Methods D7749/D7749M and D7004/D7004M. Values obtained with the strip methods shall not be compared to values obtained with grab methods.

5. Apparatus

5.1 *Tensile Testing Machine*—Constant rate of extension (CRE) equipment meeting the requirements of Specification D76/D76M. The load cell shall be accurate to within ±1 % of the applied force. The drive mechanism shall be able to control the rate of extension to within ±1 % of the targeted rate. The maximum allowable error in recorded grip displacement shall be ±1 % of the recorded values. The maximum allowable variation in nominal gage length on repeated return of the clamps to their starting position shall be less than 0.25 mm [0.01 in.].

5.2 *Grip Faces*—The clamping force and the clamp surfaces shall hold the specimen firmly without causing damage.

5.2.1 Clamp faces shall be a minimum of 25.4 mm [1.00 in.] in the dimension parallel to direction of test and wide enough to grip the full width of the specimen.

6. Sample and Specimen Preparation

6.1 *Seam Samples*—Approximately 1 m [36 in.] length of seam shall be cut out with a minimum of 12.5 cm [5 in.] of material on either side of the seam.

6.2 *Specimen Preparation*—Five specimens each for peel strength and shear strength. The locations from which the specimens are taken shall be spaced evenly along the length of the seam, with shear and peel specimens alternating along the sample length (Fig. 2).

6.2.1 *Specimens*—Rectangular test specimens shall be a minimum of 150 mm [6.0 in.] plus the seam width in the direction perpendicular to the seam. For Method A, the specimens shall be 25.4 mm [1.00 in.] in the direction parallel to the seam. For Method B, specimens shall be 50.8 mm [2.00 in.] in the direction parallel to the seam. The seam should be centered in the specimen.

7. Conditioning

7.1 *Conditioning*—Specimens may be tested once they have equilibrated at standard laboratory temperature. The time required to reach temperature equilibrium may vary according to the material type and thickness.

7.2 *Test Conditions*—Conduct tests at the standard atmosphere for testing geosynthetics, a temperature of 21 ± 2 °C [70 ± 4 °F] and a relative humidity between 50 to 70 %, unless otherwise specified.

8. Procedure

8.1 *Shear Test:*

8.1.1 Set the grip separation equal to the width of the seam plus 76.2 mm [3.00 in.]. Set the crosshead speed to 305 mm-/min [12 in./min].

8.1.2 Place the specimen symmetrically in the clamps so the weld will experience shear force (Fig. 3). Center the seam vertically between the grips.

8.1.3 Elongate the specimen until rupture of reinforcement and coating or until a separation of weld or separation in plane has occurred across the entire weld. (See Fig. 1 for explanation of separation in plane.)

8.1.4 Record the load at peak and break code (Fig. 4 and Fig. 1).

8.2 *Peel Test:*

8.2.1 Set the grip separation to 25.4 mm/min [1.00 in.]. Set the crosshead speed to 50.8 mm/min [2.00 in./min].

8.2.2 Place the specimen in the clamps in a "T" configuration (Fig. 4). If there is enough material, center the seam vertically between the grips.

8.2.3 Elongate the specimen until rupture of reinforcement and coating or until a separation of weld or separation in plane has occurred across the entire weld. (See Fig. 1 for explanation of separation in plane.)

8.2.4 If a specimen slips between the clamps, discard the individual result and test another specimen. If reinforcing strands slip through the material held between the grips, discard the individual result and test another specimen. Slipping scrim may require increasing clamping pressure.

8.2.5 Record the load at peak and break code (see Fig. 1 and Fig. 5).

9. Calculation

9.1 *Seam Shear Strength:*

9.1.1 Divide the peak load by the width of the specimen to obtain results in N/mm or lb/in.

9.2 *Seam Peel Strength:*

9.2.1 Divide the peak load by the width of the specimen to obtain results in N/mm or lb/in.

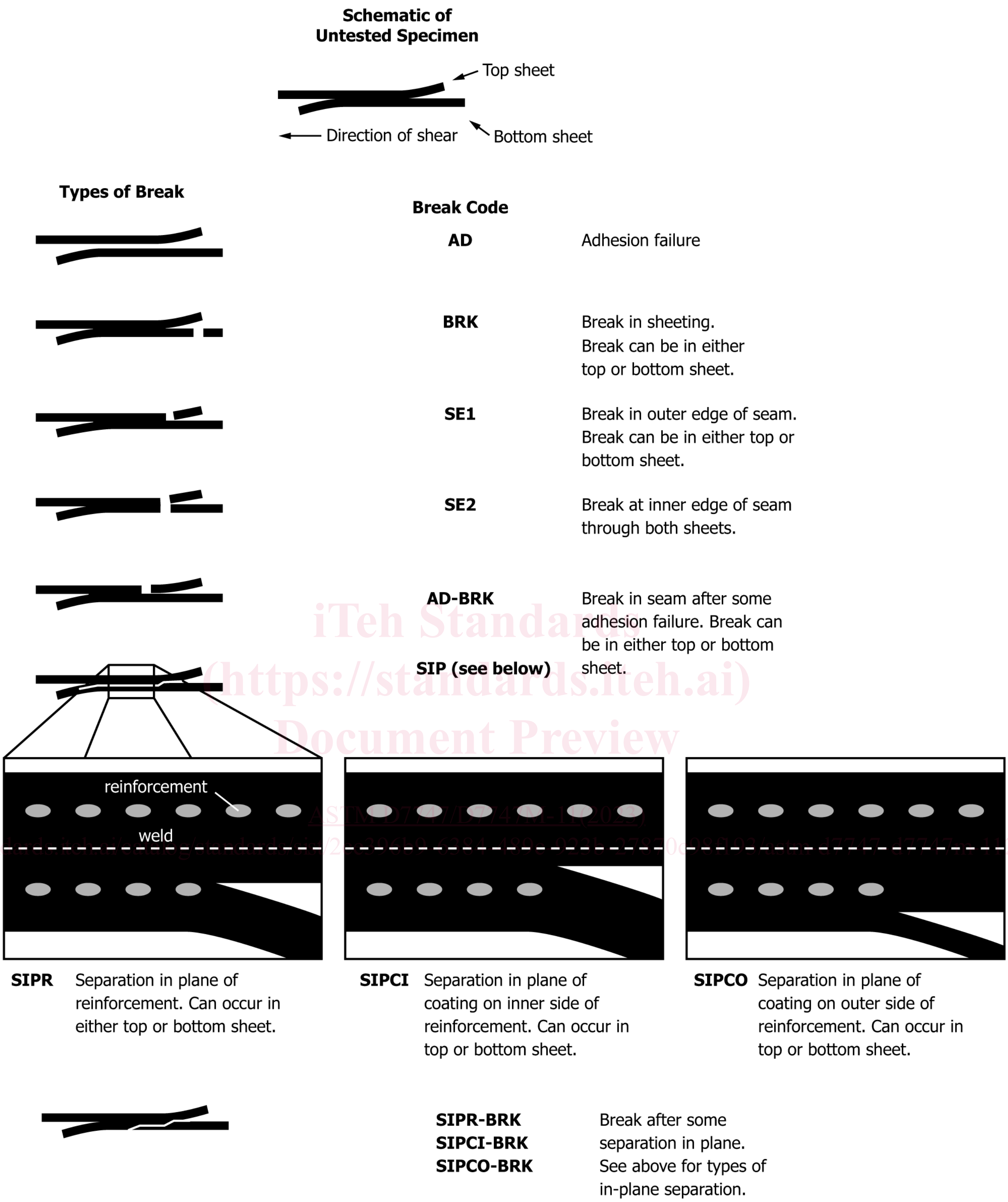

FIG. 1 Break Codes for Dual Hot Wedge and Hot Air Seams of Reinforced Geomembranes Tested for Seam Strength in Shear and Peel Modes