Designation: D7749 – 11

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

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. A test procedure is described that uses seam tests using grab specimens for seam shear strength.

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 melts 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 non-conformance 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D4439 Terminology for Geosynthetics

D7004 Test Method for Grab Tensile Properties of Reinforced Geomembranes

D7003 Test Method for Strip Tensile Properties of Reinforced Geomembranes

D76 Specification for Tensile Testing Machines for Textiles

3. Terminology

3.1 Definitions-Refer to Terminology for Geosynthetics, 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.

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[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.

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[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.

4.2 Values obtained with this method can be correlated toD7004. The purpose of correlating these methods was for the strength of parent material measured in to be comparable to seam strength measured by the test outlined here. The value obtained with this method cannot be compared to values for strip method D7003 for parent material or ASTM DXXXX strip method for reinforced seams.

5. Apparatus

5.1 *Tensile Testing Machine*—Constant Rate of Extension (CRE) equipment meeting the requirements of D76. 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 All clamp faces shall be square with sides 25.4 mm (1.00 in.). By aligning the grips, an area of approximately one square inch shall be held in each clamp.

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 *Specimens*—Five specimens. The locations from which the specimens are taken shall be spaced evenly along the length of the seam sample. Rectangular test specimens as shown in Fig. 2 shall be a minimum of 203 mm (8.00 in) plus the seam width in the direction perpendicular to the seam and 102 mm (4.00 in) in the dimension 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 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).

8.1.1 Place the specimen symmetrically in the clamps so the weld will experience shear force (Fig. 1). Center the seam vertically between the grips (Fig. 2).

8.1.2 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 in at least one location across the narrow dimension of the specimen. See Fig. 3 for explanation of separation in plane.

FIG. 1 Example of shear test

8.1.3 If a specimen slips in the grips or if scrim slip through the material held between the grips, discard the individual result and test another specimen. Slipping scrim may require increasing clamping pressure.

8.1.4 Record the load at peak. Record Break Code (Fig. 3 and Fig. 4). Only the 1 in.wide section of seam held directly between the grips during testing should be examined for Break Codes.

9. Calculations

9.1 *Seam Grab Strength:* Seam grab strength is equal to the average of the peak loads for the 5 specimens. Units should be in N or lbs.

NOTE 1—Because of the heterogonous nature of a reinforced geomembranes, calculating force per cross-sectional area is not relevant and should not be done.

10. Report

10.1 The report shall include the following information.

10.1.1 Peak load for individual specimens and average in N or lbs.

10.1.2 Individual location of break code for each specimen.

NOTE 2—"Locus-of-Failure" (Fig. 3 and Fig. 4) include only some of

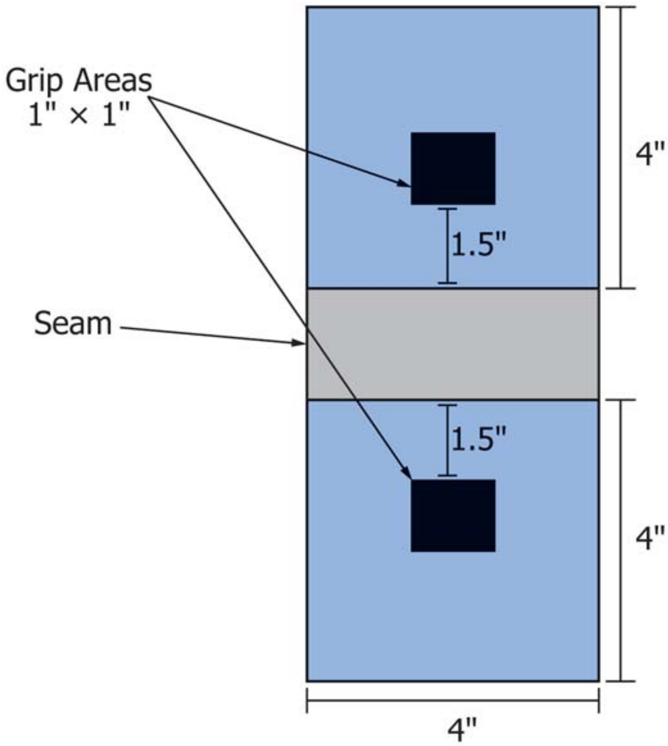


FIG. 2 Grab specimen test configuration

the typically found seam configurations found in the industry. When this test method is applied to seams bonded in configurations other than those identified in Fig. 3 or Fig. 4, the users of this test method must agree on applicable descriptions for modes of specimen rupture.

10.1.3 Type of specimen and test.

10.1.4 If the specimen does not rupture, report this and the maximum extension achieved during the test.

10.1.5 Report the grip separation and crosshead speed used in the testing.

11. Precision and Bias

11.1 No statement can be made at this time concerning precision or bias.

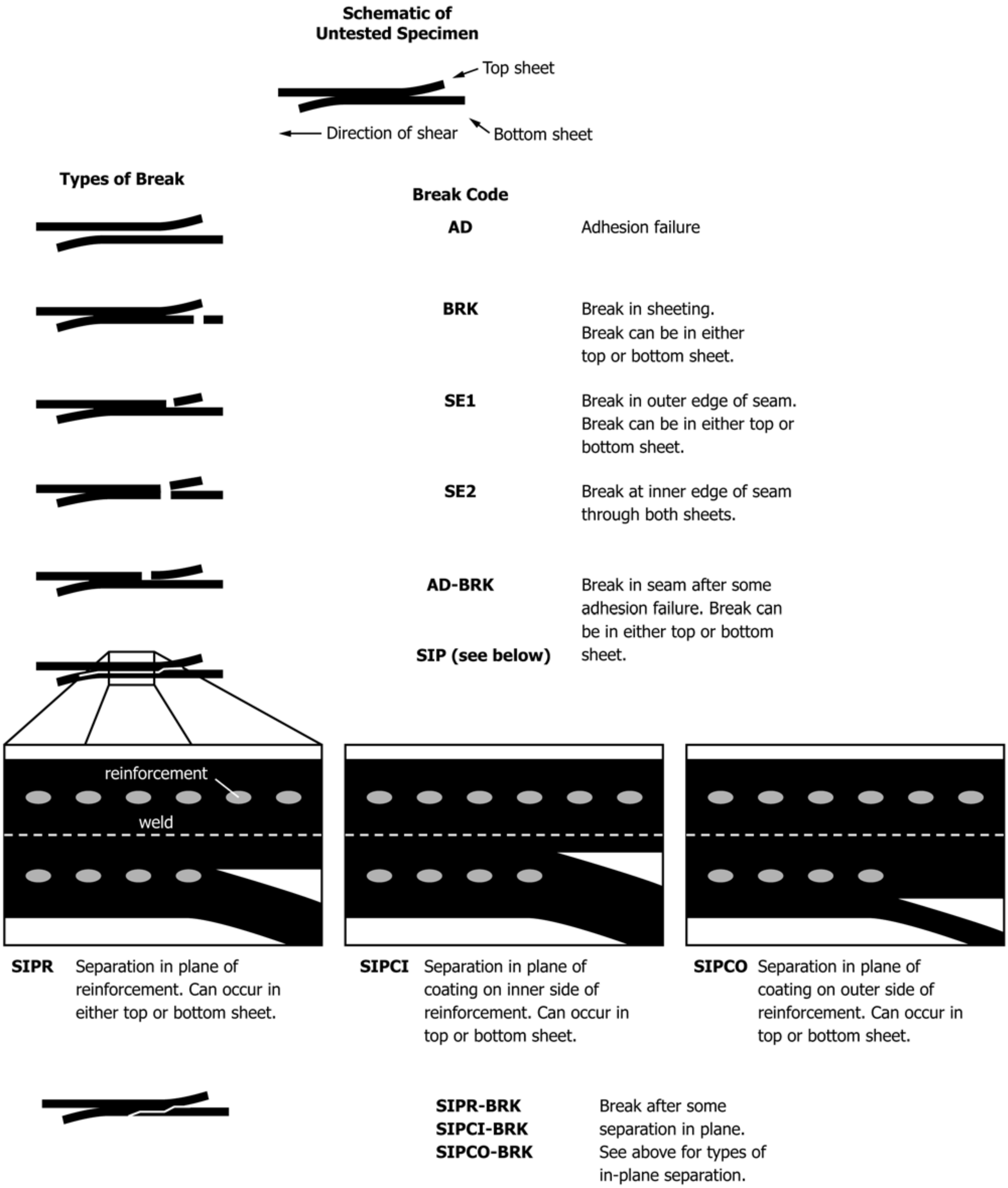
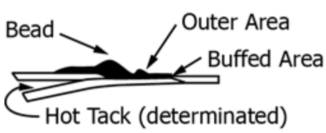


FIG. 3 Break Codes for dual hot wedge and hot air seams of reinforced geomembranes tested for seam grab strength.

Schematic of Untested Specimen



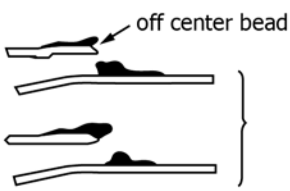
Schematic	Location of Break Code	Description
	**AD1**	Failure in adhesion. Specimens may also delaminate under the bead and break through the thin extruded material in the outer area.
	**AD2**	Failure in adhesion.
	**AD-WLD**	Break through the fillet.
	**SE1**	Break at seam edge in the bottom sheet
	**SE2**	Break at the seam edge in the top sheet
	**BRK1**	Break in the bottom sheet. A "B" in parentheses following the code means the specimen broke in the buffed area.
	**BRK2**	Break in the top sheet. A "B" in parentheses following the code means the specimen broke in the buffed area.
	**AD-BRK**	Break in the bottom sheeting after some adhesion failure between the fillet and the bottom sheet.
	**HT**	Break at the edge of the hot tack for specimens which could not be delaminated in the hot tack.
	**SIPR, SIPIC, SIPOC**	Separation in plane of the sheet. See figure 3 .

FIG. 4 Break codes for fillet extrusion weld seams in reinforced geomembranes tested for seam grab strength.