Designation: D7272 – 06 (Reapproved 2011)

Standard Test Method for Determining the Integrity of Seams Used in Joining Geomembranes by Pre-manufactured Taped Methods[1]

This standard is issued under the fixed designation D7272; 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 and/or quality assurance tests to determine the integrity of seams produced using taped seaming methods. This test method presents the procedures used for determining the quality of taped seams subjected to both peel and shear tests. These test procedures are intended for non-reinforced and reinforced geomembranes.

1.2 The types of tape seaming techniques used to construct geomembrane seams include the following.

1.2.1 *Inseam Tape*—This technique requires the membrane to be overlapped a minimum distance. The top sheet is folded back and both the bottom sheet and the top sheet are primed with an adhesive primer. The primer is allowed to flash-off. The tape adhesive is applied to the bottom sheet so that a minimum of the tape will extend out from under the top sheet when laid over the tape. The top sheet is allowed to lay flat over the tape and the release paper is removed by pulling it at a 45 to 90 degree angle, keeping the release paper flat to the surface of the bottom sheet. The seam area is then rolled with a silicone sleeved roller.

1.2.2 *Cover Strip Tape*—This technique requires the membrane to be overlapped a minimum distance. An area either side of the seam edge is primed. The primer is allowed to flash-off. The cover strip is applied with the adhesive side down centered over the top sheet edge while removing the release paper as it proceeds along centered over the edge of the top sheet. The cover strip is then rolled with a silicone sleeved roller.

1.3 For nondestructive test methods, see Practice D4437.

1.4 This test method is applicable for seaming processes that use tape adhesive as a seaming mechanism.

1.5 Subsequent decisions as to seam acceptance criteria are made according to the site-specific contract plans, specifications, and contractor quality control/contractor quality assurance (CQC/CQA) documents.

1.6 In case of a material specific test method, this test method shall take precedence.

1.7 *Hazardous Materials*—Always consult the proper material safety data sheets for any hazardous material used for the proper ventilation and protection. The use of the oven in these test methods, in this practice, may accelerate fume production from the test specimen.

1.8 The values stated in both inch-pound and SI units are to be regarded separately as the standard. Values in parentheses are for information only.

1.9 *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]

D413 Test Methods for Rubber Property—Adhesion to Flexible Substrate

D638 Test Method for Tensile Properties of Plastics

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D882 Test Method for Tensile Properties of Thin Plastic Sheeting

D4437 Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes

D4439 Terminology for Geosynthetics

D5199 Test Method for Measuring the Nominal Thickness of Geosynthetics

D5994 Test Method for Measuring Core Thickness of Textured Geomembranes

3. Terminology

3.1 *Definitions*—For definitions of other geosynthetic terms used in this method, refer to Terminology D4439. For definitions of soil terms, refer to Terminology D653.

[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.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *tape adhesive, n*—solid strip of prefabricated or manufactured adhesive factory laminated to a release paper used to join two polymer sheets.

3.2.2 *tape adhesive seam, n*—adhesive-based tape placed between two polymer sheet materials forming a surface bond.

3.2.3 *cover strip adhesive, n*—solid strip of prefabricated or manufactured adhesive factory laminated to layer of polymer sheet material factory laminated to a release paper used to join two polymer sheets.

3.2.4 *cover strip adhesive seam, n*—adhesive-based laminated tape placed over two overlapping polymer sheet materials forming a surface bond.

4. Significance and Use

4.1 *Significance*—With the increased use of geomembranes as a barrier material to restrict liquid migration from one location to another, a need has been created for a standard test method to evaluate the quality of geomembrane seams produced by tape methods. In the case of geomembranes, it has become evident that geomembrane seams can exhibit separation in the field under certain conditions. This is an index type test method used for quality assurance and quality control purposes, it is also intended to provide the quality engineer with sufficient seam peel and shear data to evaluate seam quality.

4.2 *Use*—Recording and reporting data such as separation that occurs during the peel test and elongation during the shear test, will allow the quality assurance engineer to take measures necessary to ensure the repair of inferior seams during construction, and therefore, minimize the potential for seam separation while in service. The acceptable value of adhesion measured will, of course, vary from product to product as a result of different formulations and types of products. However, once a product is established, minimum values of separation force can be determined and agreed to by producer and consumer and both can monitor the installation to assure maintenance of the agreed-upon minimum value.

5. Apparatus

5.1 Tensile instrumentation shall meet the requirements outlined in Test Method D638 or D882.

5.2 A testing machine of the constant-rate-of-cross head movement type comprising essentially of the following:

5.2.1 *Fixed Member*—A fixed or essentially stationary member carrying one grip.

5.2.2 *Movable Member*—A movable member carrying a second grip.

5.2.3 *Grips*—Grips for holding the test specimen between the fixed member and the movable member and minimizes both slippage and uneven stress distribution. The grips shall be self-aligning so that they shall be attached to the fixed and movable member, respectively, in such a manner that they will move freely into alignment as soon as any load is applied, so that the long axis of the test specimen will coincide with the direction of the applied pull through the center line of the grip assembly. Grip faces shall be 25 mm (1 in.) wide and a minimum of 25 mm (1 in.) in length. Smooth surfaces, fine serrated or coarse serrated grip faces, use the grips that have all been found to be suitable for testing, depending on type of geomembrane seams that are being tested.

NOTE 1—Grips lined with thin rubber, crocus-cloth or pressure sensitive tape as well as file-faced or serrated grips have been successfully used for many materials. The choice of grip surface will depend on the material tested, thickness, etc.

5.2.4 *Drive Mechanism*—A drive mechanism for imparting to the movable member in uniform, controlled velocity with respect to the stationary member. Unless otherwise specified in the material specification, the mechanism shall be capable of and adjusted so that the movable member shall have a uniform speed of 50 mm/min, (2 in./min), 300 mm/min (12 in./min), and 500 mm/min (20 in./min).

5.2.5 *Load Indicator*—A suitable load-indicating mechanism capable of showing the total tensile load carried by the test specimen when held by the grips. This mechanism shall be essentially free of inertia lag at the specified rate of testing and shall indicate the load with an accuracy of ±1 % of the indicated value or better.

5.2.6 *Extension Indicator (Extensometer) (If Employed)*—A suitable instrument shall be used for determining the distance between two designated points within the gage length of the test specimen as the specimen is stretched and shall conform to requirements specified in Test Method D638.

6. Sampling and Specimen Preparation

6.1 *Trial Seam Sample*—A representative seam from each seaming crew, fabricated from the same sheet material, and using the seaming methods as those recommended by the geomembrane fabricator manufacturer, shall be used for this method.

6.1.1 *Destructive Seam Sample*—Alternatively, cut a portion of the fabricated seam from the installed liner or a daily test seam sample in accordance with the project specifications. It is recommended that the cutout sample be 0.3 m (1 ft) wide and 0.45 m (1.5 ft) in length with the seam centered in the middle of the seam.

6.1.2 *Specimen Preparation*—Five specimens shall be cut from the submittal sample for each the Peel and Shear test. The specimens for the Peel test shall be cut using a calibrated die, 25 ± 3 mm (nominal 1 ± 0.125 in.) wide by 150 ± 3 mm (nominal 6 ± 0.125 in.) long die. The Specimens for the Shear test shall be die cut using a calibrated die, 25 ± 3 mm (nominal 1 ± 0.125 in.) wide by 2 inches greater than the width of the seam. Specimens shall be such that the die is centered over the sample seam, perpendicular to the centerline of the seam. Peel and shear specimens shall be cut as shown in Fig. 1.

6.1.3 *Conditioning*—Samples should be conditioned for 24 hours in a standard laboratory environment that conforms to the requirements for testing geosynthetics as stated in Terminology D4439. Long sample conditioning times typically are not possible for most applications that require daily seam testing. Prior to testing, samples should be conditioned for a minimum of 1 h at 21 ± 2°C and a relative humidity between 50 and 70 %.

NOTE 2—Some adhesives may build up on the die. Dies need to be

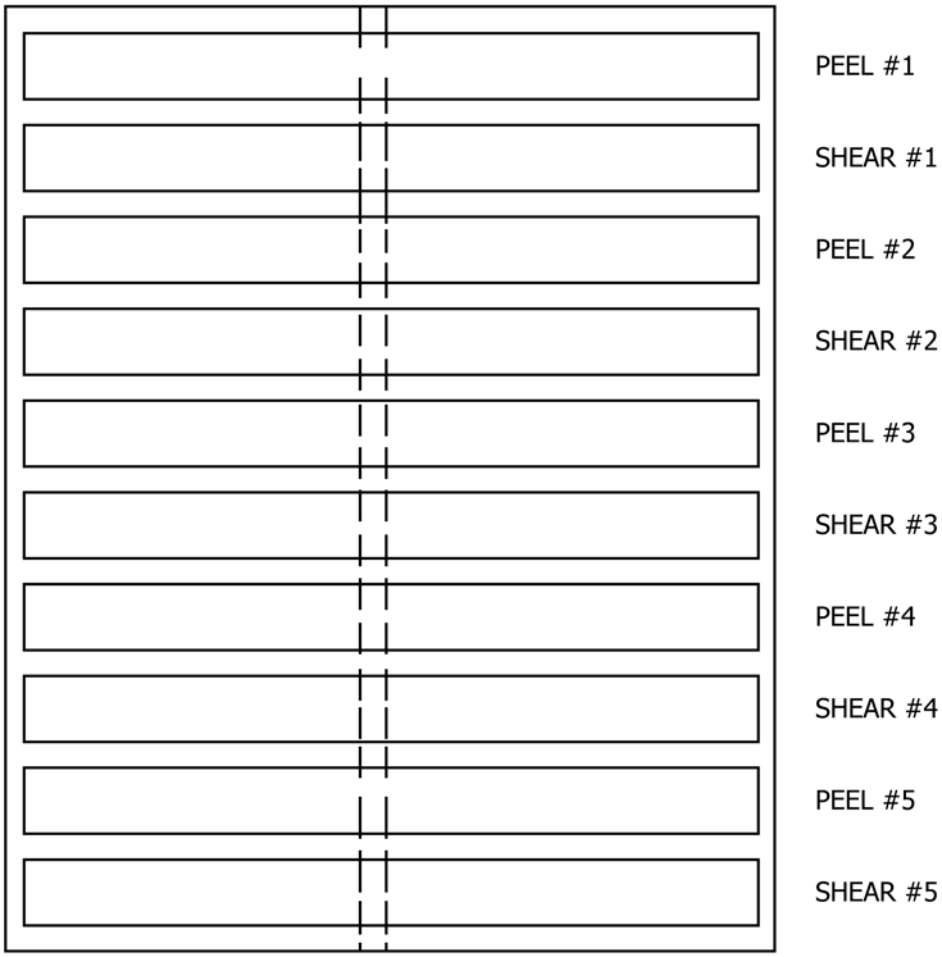


FIG. 1 Seam Sample

inspected and cleaned periodically. A non-reactive release agent may be used on the die to reduce adhesive buildup, but type and frequency of use must be documented in test report.

7. Destructive Test Methods

7.1 *Peel Testing*—Subject five specimens to the 180° "T-Peel" test (see Fig. 2). Maintaining the specimen in a horizontal position throughout the test is not required. Fully grip the test specimen across the width of the specimen. Grip the peel specimen by securing grips 13 mm (½ in.) on each side of the start of the seam bond. Apply a constant machine cross head speed of 500 mm (20 in.)/ min. The test is complete when the specimen ruptures. The seam samples shall be tested in accordance with Test Methods D413 Method A. The individual specimens shall be 25 ± 3 mm (1 ± 0.125 in.) wide and shall be cut with a standard calibrated die. The die shall be centered over the sample seam perpendicular to the centerline of the seam. The grips shall be positioned 25 mm (1 in.) apart with no more than 13.5 mm (0.5 in.) on either side of the start of the seam bond (seam bond centered between the grip edges). The grip surfaces shall be acceptable for the testing of the specific test material to prevent pullout. Grips shall be self aligning so that the axis of the test specimen will coincide with the direction of the applied load through the centerline of the grip assembly. The samples shall be inserted so that they are centered and under no initial stress and fully supported across the width of the seam. The seam overlap shall be as fabricated. The specimens shall be pulled to rupture.

7.2 *Shear Testing*—Subject five specimens to the shear test (see Fig. 2). Fully support the test specimen within the grips across the width of the specimen. The seam samples shall be tested in accordance with Test Method D882. The samples shall be 25 mm (1 in.) wide by 50 mm (2 in.) greater that the width of the seam. The cut shall be centered over the seam, perpendicular to the centerline of the seam. Grip separation shall be 50 mm (2 in.) plus the width of the seam. The samples shall be tested at a cross head speed of 500 mm (20 in.)/min. The grip surfaces shall be acceptable for the testing of the specific material to prevent pullout. Grips shall be self aligning so that the axis of the test specimen will coincide with the direction of the applied load through the centerline of the grip assembly. The seam overlap shall be as fabricated. Fully support the test specimen within the grips across the width of the specimen. The specimens shall be pulled to rupture or a specified percent strain (that is, 50 %, 100 %, 200 %).

NOTE 3—Both peel and shear tests for fPP, LLDPE, VLDPE, EPDM, and PVC geomembranes have been tested routinely at both 2 and 20 in./min. When conducting seam peel or shear testing for quality control, or quality assurance purposes, or both, it may be necessary to select the manufacturer's recommended testing speed. In the absence of explicit

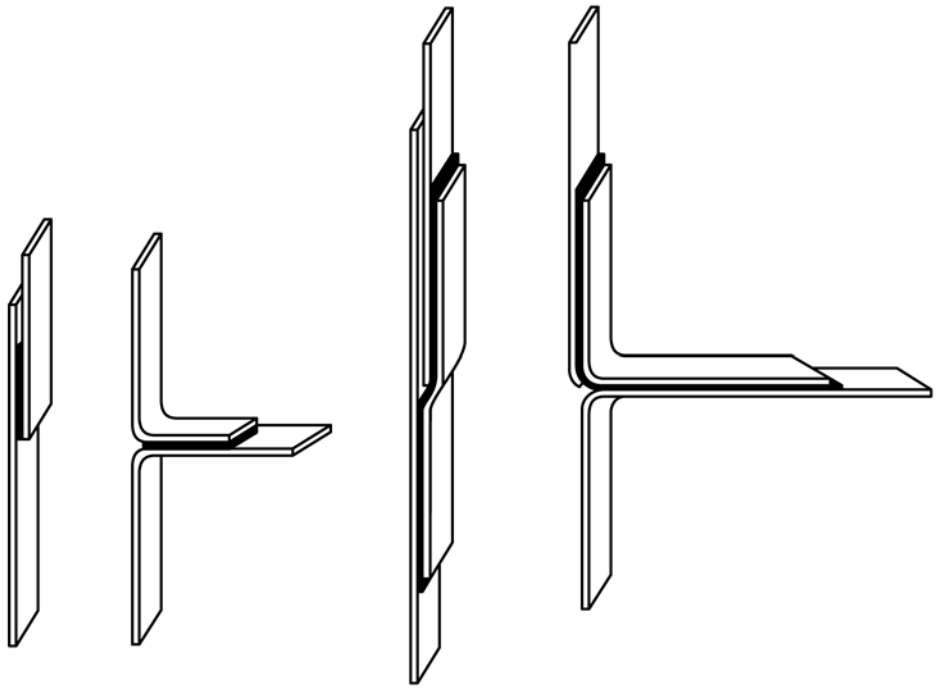


FIG. 2 Shear and T-Peel Specimens—In-Seam Tape (A), Cover Strip (B)

testing speed requirements, follow those recommended in 7.1 and 7.2.

8. Calculations and Observations

8.1 *Estimate of Seam Peel Separation*—Visually estimate the seam separation demonstrated prior to rupture for peel specimens. The estimate shall be based upon the proportion of linear length of separated bond in the direction of the test, to the length of original bonding to the nearest 25 %.

8.2 *Rupture Mode Selection*—Determine the locus of break for both the peel and shear specimens as shown in Figs. 3 and 4. The locus of break for shear specimens that do not rupture prior to test end shall be interpreted as occurring in the membrane that exhibits yielding.

8.3 *Shear Percent Elongation*—Calculate the percent elongation on shear specimens according to Eq 1. Divide the extension at test end by the original gage length of 25 mm and multiply by 100.

$$\text{Elongation} = L/L_0 \times 100 \quad (1)$$

where:

L = extension at test end, and
L_0 = original gauge length.

NOTE 4—The intent of measuring elongation using this test method is to identify relatively large reductions in typical break elongation values of seam samples. Length is defined as the distance from one grip to the seam edge. Using this definition implies that all strain experienced by the specimen during the shear test occurs on one side of the seam. Of course this assumption is inaccurate, since some strain will occur on each side of the seam, and in the seam area itself; however, it is difficult to make an accurate measurement of the strain distribution which occurs in the specimen during testing. Further, it is not critical to know the exact location of all the strain which occurs during testing but rather to simply identify when significant reductions in elongation (when compared with the typical elongation of a new material) have occurred.

9. Report

9.1 Report at a minimum the following information:

9.1.1 Complete identification of the geomembrane, including reinforced or non-reinforced sheet, sample location, seaming method (In-seam or Cover Strip), ambient temperature at time of test.

9.2 Suggested other parameters to be included in the report:

9.2.1 Complete identification of the sampling procedure and conditioning method (see Section 7 of this standard) but not limited to the sample type, sample location, sample identification, seaming technique, seam width, and date of fabrication of the seams, fabricator identification, and curing method used.

9.2.2 Type of tensile machine used, cross head speed, grip surface texture, grip dimensions, and grip pressure.

9.2.3 Method of preparing test specimens.

9.2.4 Type of test specimens and dimensions.

9.2.5 Conditioning procedures used.

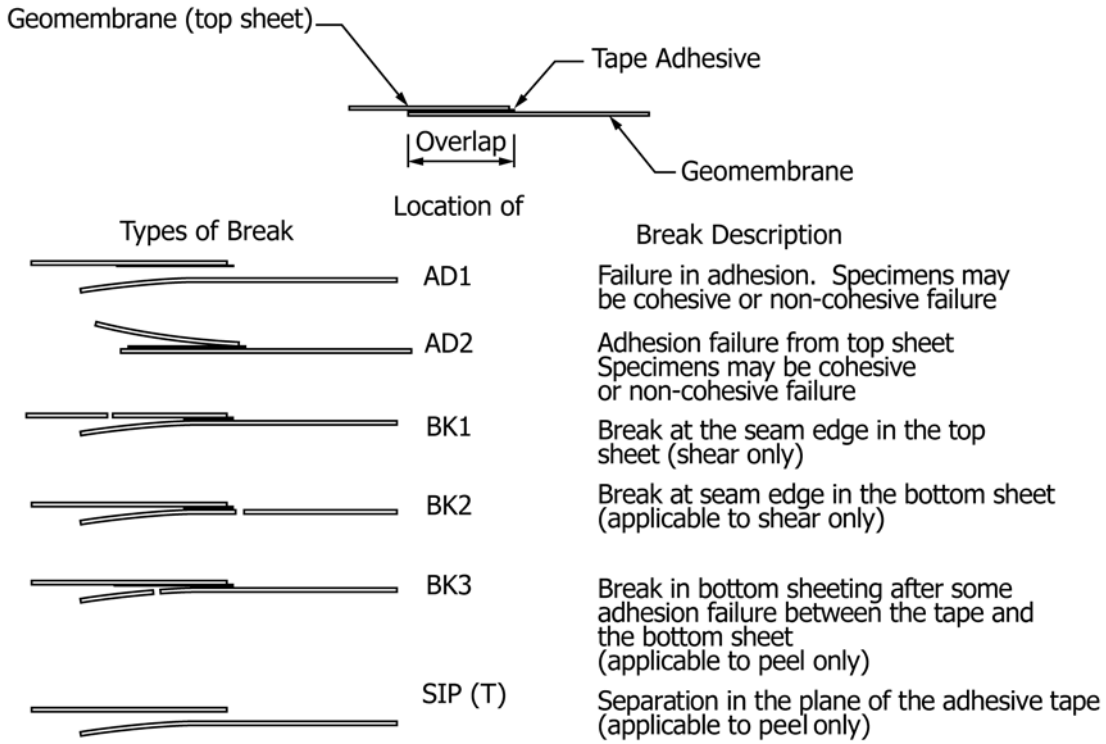
9.2.6 Report the maximum individual peel and shear specimen values in N/mm (lb/in.) of width.

9.2.7 Report the cross head speed used during peel and shear testing.

9.2.8 Report the average of the peel and shear values.

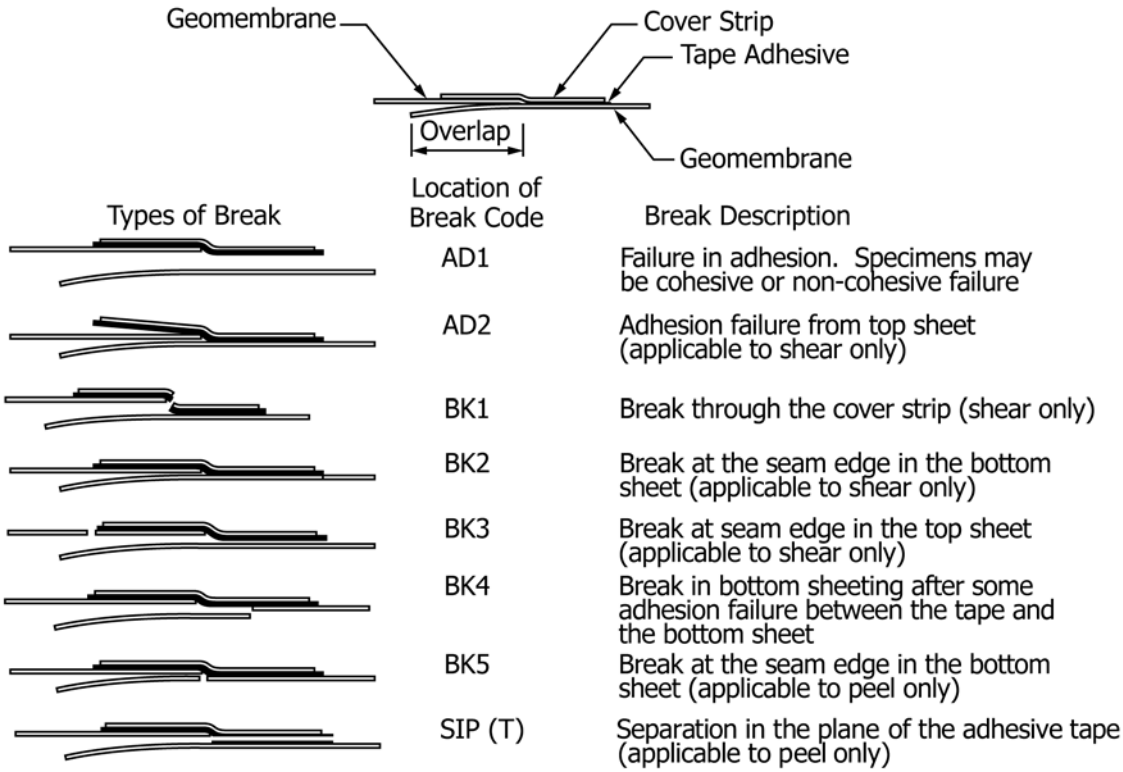
9.2.9 If the peel or shear specimen does not rupture, report the elongation at the maximum cross-head travel limitation. If the gage length is reduced to less that 25 mm (1 in.), this must be noted in the report.

9.2.10 Type of failure in the peel and shear tests, that is, within the tape material, within the sheet materials, within the bond between the tape and cover (if there is one), at clamp edge, or seam edge, for each individual specimen.



NOTE 1—Acceptance of any seam depends on whether the test values meet minimum specification values.

FIG. 3 Locus of Break Codes for In-Seam Tape Seams in Non-Reinforced and Reinforced Geomembranes Tested for Seam Strength in Shear and Peel Modes



NOTE 1—Acceptance of any seam depends on whether the test values meet minimum specification values.

FIG. 4 Locus of Break Codes for Cover Strip Tape Seams in Non-Reinforced and Reinforced Geomembranes Tested for Seam Strength in Shear and Peel Modes

9.2.11 Tensile stress at yield or break, if applicable, average value, and standard deviation.

9.2.12 Percent elongation at yield, or break, or strain at break, or all three as applicable, average value, and standard deviation.

9.2.13 Revision date of the test method.

NOTE 5—If requested, report the maximum peel or shear stress. This calculation will require an accurate measurement of thickness for each specimen. These measurements should be made in accordance with Test Method D5199 for smooth geomembranes and Test Method D5994 for textured geomembranes.

10. Precision and Bias

10.1 No statement is made about either the precision or bias of this method since it merely refers to available destructive and nondestructive methods that could be used in determining the quality of the bonded seams.

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