Designation: D 1683 – 90a

Standard Test Method for Failure in Sewn Seams of Woven Fabrics[1]

This standard is issued under the fixed designation D 1683; 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 covers the measurement of the maximum sewn seam strength which can be achieved in woven fabrics when a force is applied perpendicular to the seam. The grab test procedure in Test Methods D 1682, which are used to measure breaking force and elongation of textile fabrics, will be used in conjunction with this test method for measuring sewn seam strength.

1.2 This test method is restricted to sewn seams which may either be obtained from a previously sewn article or prepared from fabric samples.

1.3 This test method is used when a breaking force to rupture, a minimum elongation, or both are required to determine the sewn seam strength, seam slippage, or seam integrity of a particular fabric for a specified end use.

1.4 This test method does not predict actual wear performance of a seam since wear life is dependent upon other factors in addition to seam stressing.

1.5 The grab test procedures in Test Methods D 1682 shall be used to determine any characteristic in fabric that can affect the measurement of sewn seam strength.

1.6 The values stated in either acceptable metric units (SI) or in other units shall be regarded separately as standard. The values expressed in each system may not be exact equivalents; therefore each system must be used independently of the other, without combining values in any way.

1.7 *This standard does not purport to address the safety problems 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:*

D 76 Specification for Tensile Testing Machines for Textiles[2]

D 123 Terminology Relating to Textiles[2]

D 1682 Test Methods for Breaking Load and Elongation of Textile Fabrics[2]

D 1776 Practice for Conditioning Textiles for Testing[2]

2.2 *Federal Standard:*

Fed. Std. No. 751a Stitches, Seams and Stitching[3]

3. Terminology

3.1 *Definitions:*

3.1.1 *needle damage, n—in sewn fabrics*, the partial or complete yarn severance or fiber fusing caused by a needle passing through a fabric during sewing.

3.1.2 *seam allowance, n—in sewn fabrics*, the distance from the edge of a fabric to the parallel stitch line furthest from the edge.

3.1.3 *seam assembly, n*—the composite structure obtained when fabric(s) are joined by means of a seam.

3.1.3.1 *Discussion*—A seam assembly may be described in terms of fabric orientation, seam direction, seam type, stitch type, seam allowance, sewing thread tex number(s) and type(s), stitch density, stitch gage, and rows of stitching.

3.1.4 *seam damage, n—in sewn fabrics*, a reduction in seam efficiency caused by a change in the physical condition of one or more of the components in a seam.

3.1.5 *seam efficiency, n—in sewn fabrics*, the ratio, expressed as a percentage, of the breaking force required to rupture a sewn seam to that required to rupture the fabric.

3.1.6 *seam engineering, n—in sewn fabrics*, the procedures used to select a specific combination of sewing thread, stitch type, seam type, and stitch density to achieve the maximum sewn seam strength for a particular fabric type.

3.1.7 *seam failure, n—in sewn fabrics*, that point at which an external force (1) ruptures the sewing thread, (2) ruptures the fabric, (3) causes excessive yarn slippage adjacent to the stitches, or (4) causes any combination of these unacceptable conditions.

3.1.7.1 *Discussion*—Despite the lack of rupture, excessive yarn slippage will significantly reduce seam efficiency, thus creating seam failure.

3.1.8 *seam interaction, n—in sewn fabrics*, the net effect of the relationship between the combination of fabric, seam type, stitch type, and stitch density on seam efficiency.

3.1.9 *seam slippage, n—in sewn fabrics*, the partial or complete loss of seam integrity manifested by yarn slippage parallel to, or adjacent to, the stitch line. (Syn. *yarn slippage, in sewn fabrics.*)

3.1.10 *seam type, n—in sewn fabrics*, an alphanumeric designation relating to the essential characteristics of fabric positioning and rows of stitching in a specified sewn fabric seam. (See Federal Standard 751a.)

3.1.10.1 *Discussion*—The first two letters of the designation show seam type; the third and subsequent letters specify

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

[3] Available from Government Printing Office, GSA, 7th and D Streets, S.W., Washington, DC 20407.

a particular mating alignment; the number designation indicates the number of rows of stitches.

3.1.11 *sewn seam, n—in sewn fabrics*, a juncture at which two or more planar structures such as textile fabrics, are joined by sewing, usually near the edge.

3.1.12 *sewn seam strength, n—in sewn fabrics*, the maximum resistance to rupture of the junction formed by stitching together two or more planar structures.

3.1.13 *stitch, n—in sewn seams*, the repeated unit formed by the sewing thread(s) in the production of seams.

3.1.14 *stitch density, n—in sewn fabrics*, the number of stitches per unit length in one row of stitching in the seam.

3.1.15 *stitch gage, n—in sewn fabrics*, the perpendicular distance between adjacent parallel rows of stitching.

3.1.16 *stitch type, n*—a numerical designation relating to the essential characteristics of the interlacing of sewing thread(s) in a specified stitch.

3.1.16.1 *Discussion*—Stitch types are described in Federal Standard 751a.

3.1.17 *yarn slippage, n—in sewn fabrics*, the displacement of one or more yarns from the original position(s) so as to cause differences in alignment, spacing, or both in one or more fabric yarns.

3.1.18 For definitions of other textile terms used in this test method, refer to Terminology D 123.

4. Summary of Test Method

4.1 The breaking force required to effect rupture of sewn seams is measured using the grab test procedure in Test Methods D 1682. Specimens can be taken from previously sewn seams or from fabricated seams using either a like or a determined seam assembly as agreed to between purchaser and supplier.

4.1.1 The applied force is longitudinal and perpendicular to the seam.

4.2 This test method can be used to measure seam slippage by subtracting the elongation of the fabric from that of the fabric with a seam in it. The difference is indicated as seam slippage which can be considered one mode of failure of a seam assembly.

5. Significance and Use

5.1 This test method can be used for the determination of the sewn seam strength of textiles and may also be used for acceptance testing of commercial shipments to quantify sewn seam strength and seam efficiency. Because current information about laboratory precision is incomplete, comparative tests, as directed in 5.1.1, may be advisable.

5.1.1 In case of a dispute arising from differences in reported test results when using this test method for acceptance testing of commercial shipments, the purchaser and the supplier should perform comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens from the same lot of fabric to be evaluated, which utilize a like seam assembly (or standard seam assembly) to achieve seam interaction. The test specimens should then be randomly assigned in equal numbers to each laboratory for testing. If a bias is found, either its cause must be determined and corrected, or the purchaser and supplier must agree to interpret future test results in light of the known bias.

5.2 This test method determines the seam efficiency of a specified seam assembly with each fabric. Because seam efficiency varies with each fabric, one of the standard seam assemblies, as noted in Table 1, should be used when comparing the seam strength of different fabrics. If a determination cannot be made as to which seam is the best suited for a particular fabric, all should be evaluated.

5.3 Seams prepared for this test method should be made by either competent factory sewing operators or laboratory technicians familiar with the potential for damage to the integrity of the sewn seam when stitching is improperly done.

5.4 This test method is applicable whenever a determination of effective sewn seam strength, that is, the optimum seam interaction, is required. The breaking force of the seam and fabric will permit determination of seam efficiency.

5.4.1 Proper seam design engineering techniques for specific fabric types can also be determined by utilizing this test method.

5.5 This test method can be used to determine when the integrity of the junction is affected by seam slippage. While the ultimate consequence of this phenomenon is rupture, seam slippage greater than 6 mm (0.25 in.) may severely reduce the integrity such that the product cannot be used for its intended purpose.

6. Apparatus

6.1 *Tensile Testing Machine*, conforming to Specification D 76, and preferably a constant-rate-of extension (CRE) type of machine capable of jaw separation rate of 305 ± 10 mm/min (12.0 ± 0.5 in./min) and an adequate pen or interfaced computer response to record the force-extension curve. If a CRE type machine is not used, use a constant-rate-of-traverse (CRT) type of machine, or constant-rate-of-load (CRL) type of machine. In all cases, the same tensile testing machine used to perform the grab test procedures in Test Methods D 1682 should be used in this test method.

6.1.1 At least one clamp should be supported by a free swivel or universal joint to allow the clamp to rotate in the plane of the fabric (see Fig. 1).

NOTE 1—In cases of dispute a constant-rate-of-extension (CRE) type machine should be used for referee testing. Because of the biases between test results for these types of tensile testing machines, the section on reporting including the name, type, and date of calibration of the machine used.

6.1.2 *Back Jaws*, 25 mm (1 in.), parallel to direction of force application by not less than 50 mm (2 in.) perpendicular to direction of force application.

6.1.3 *Front Jaws*, 25 by 25 mm (1 by 1 in.).

6.2 *Sewing Machine*, with any necessary accessories capable of handling the test fabric and forming the required seam(s) and stitch types.

6.3 *Sewing Threads*, to be either of required type, materials, and tex size as determined by purchaser and supplier or of type, materials, and tex size specified for standard seams in Table 1.

6.4 *Dividers*, one pair.

6.5 *Metal Rule*, graduated in 1-mm (0.03125-in.) subdivisions.

TABLE 1 Standard Seam Assembly Specifications[A]

Fabric: High Density Warp and Fitting Yarn Construction of Fine Count Size Yarns		
Mass	up to 270 g/m² (8 oz/yd²)	over 270 g/m² (8 oz/yd²)
Seam allowance	13 mm (0.5 in.)	16 mm (0.625 in.)
Needle:		
Size	Metric 90 (0.036 in.)	Metric 110 (0.044 in.)
Finish	chrome	chrome
Point	thin ball (No. 1/No. 23)	medium ball (No. 23/No. 43)
Sewing thread size:		
Cotton	Tex 35	Tex 70
Polyester-core	Tex 40	Tex 60
Seam type	SSa-1	SSa-1
Stitch type	301	301
Stitch density	4.7 ± ½ stitches per centimetre (12 ± ½ stitches per inch)	3.1 ± ½ stitches per centimetre (8 ± ½ stitches per inch)
Fabric: Medium Density Warp and Filling Yarn Construction of Fine to Medium Count Size Yarns		
Mass	up to 270 g/m² (8 oz/yd²)	over 270 g/m² (8 oz/yd²)
Seam allowance	25 mm (1 in.)	25 mm (1 in.)
Needle:		
Size	Metric 110 (0.044 in.)	Metric 140 (0.054 in.)
Finish	chrome	chrome
Point	medium ball (No. 43/No. 44)	medium ball (No. 43/No. 44)
Sewing thread size:		
Cotton	Tex 70	Tex 105
Polyester-core	Tex 60	Tex 90
Seam type	SSn-2	SSn-2
Stitch type	301	301
Stitch density	4.7 ± ½ stitches per centimetre (12 ± ½ stitches per inch)	3.1 ± ½ stitches per centimetre (8 ± ½ stitches per inch)
Fabric: Low Density Warp and Filling Yarn Construction of Medium to Heavy Count Yarns		
Mass	up to 270 g/m² (8 oz/yd²)	over 270 g/m² (8 oz/yd²)
Seam allowance	40 mm (1.5 in.)	40 mm (1.5 in.)
Needle:		
Size	Metric 110 (0.044 in.)	Metric 140 (0.054 in.)
Finish	chrome	chrome
Point	medium ball (No. 44)	heavy ball (No. 45)
Sewing thread size:		
Cotton	Tex 70	Tex 105
Polyester-core	Tex 60	Tex 90
Seam type	SSd-2	SSd-2
Stitch type	401	401
Stitch density	4.7 ± ½ stitches per centimetre (12 ± ½ stitches per inch)	3.1 ± ½ stitches per centimetre (8 ± ½ stitches per inch)

[A] A complete description of seam types and stitch types can be found in Federal Standard 751a.

6.6 *Linear Variable Differential Transformer* (LVDT).[4]

7. Sampling Manufactured Items

7.1 *Lot Sample for Manufactured Items*—As a lot sample for acceptance testing, take, at random, the number of shipping units of manufactured items containing previously prepared seams as directed in an applicable material specification or other agreement between the purchaser and the supplier.

NOTE 2—An adequate specification or other agreement between the purchaser and supplier requires taking into account the variability between cartons of existing seams in previously manufactured items and rolls of fabric from which sewn seam will be prepared; and between specimens from a carton of manufactured items or prepared constructions to produce a sampling plan with a meaningful producer's risk and consumer's risk, while at the same time providing acceptable quality and limited quality levels.

7.2 *Laboratory Sample for Manufactured Items*—Take two manufactured items from each carton of a lot sample so as to provide adequate laboratory samples and adequate specimens for each assembly being evaluated. If more than one type of seam assembly exists in the laboratory samples, the choice of seam assembly to be evaluated must be agreed

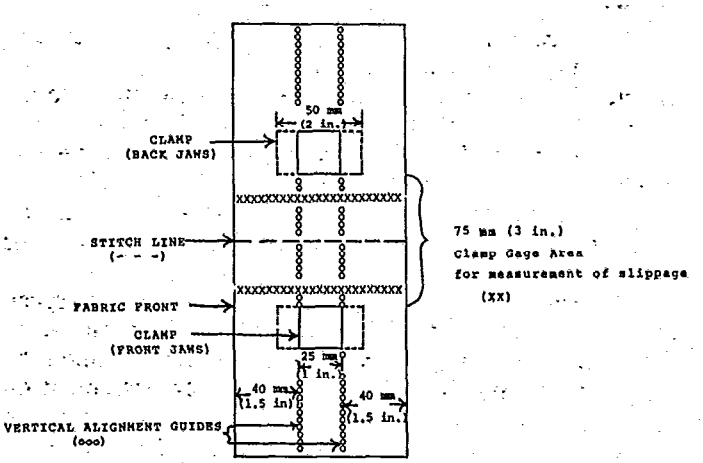

FIG. 1 Specimen Placement in Clamps (Clamp Gage Area, Vertical Alignment Guides)

[4] LVDT equipment, available from Schaevitz Engineering, Inc., P.O. Box 505, Camden, NJ 08110, or its equivalent, has been found suitable. Casings used to adapt LVDT's for textile applications, available from Westinghouse Environmental Engineering, 11785 Highway Drive, Suite 100, Cincinnati, OH 45241, have been found suitable.